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

KANEKAL-4 (4D5B1P1d) 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

ICAR - NBSS & LUP

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.

Citation: Rajendra Hegde, Ramesh Kumar. S.C., K.V. Niranjana, S. Srinivas, B.A. Dhanorkar, R.S.Reddy and S.K. Singh (2019), "Land Resource Inventory and Socio-Economic Status of Farm Households for Watershed Planning and Development of Kanekal-4 (4D5B1P1d) Microwatershed, Balichakra Hobli, Yadgir Taluk & District, Karnataka", ICAR-NBSS&LUP Sujala MWS Publ. 173, ICAR – NBSS & LUP, RC, Bangalore. P.113 & 31.

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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-4 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-4 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 494 ha in Kanekal-4 microwatershed in Yadgir taluk and 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 17 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.*
- *Entire land area of the microwatershed is suitable for agriculture.*
- *Small area of less than 1 per cent are shallow (25-50 cm), 24 per cent soils are moderately shallow (50-75 cm), 18 per cent of the soils are moderately deep (75-100cm) and about 57 per cent soils are deep (100-150cm) to very deep (>150 cm) soils.*
- *About 58 per cent of the area has clayey soils, 39 per cent loamy soils and 2 per cent sandy soils at the surface.*
- *An area of about 77 per cent has non-gravelly and 22 per cent are gravelly.*
- *About 56 per cent of the area has soils that are very high (>200mm/m) in available water capacity, 6 per cent is medium (101-150 mm/m), 16 per cent low (51-100mm/m) and about 20 per cent very low (<50 mm/m).*

- *Maximum area of 82 per cent in the microwatershed has very gently sloping (1-3%) lands and 17 per cent gently sloping (3-5%) lands.*
- *Maximum area of about 82 per cent is soils that are moderately eroded (e2) and 17 per cent is severely eroded.*
- *An area of about 18 per cent has neutral (pH 6.5-7.3), 36 per cent is slightly alkaline (pH 7.3-7.8), 33 per cent soils that are moderately alkaline (pH 7.8 to 8.4) and about 12 per cent soils are strongly alkaline (pH 8.4 – 9.0) in soil reaction.*
- *The Electrical Conductivity (EC) of the soils are dominantly <2 dsm^{-1} indicating that the soils are non-saline.*
- *About <1 per cent is low (<0.5%), 8 per cent medium (0.5-0.75%) and 91 per cent high (>0.75%) in organic carbon.*
- *An area of 13 per cent has soils that are low (<23 kg/ha), 85 per cent medium (23-57 kg/ha) and 1 per cent high (>57 kg/ha) in available phosphorus.*
- *About 97 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 86 per cent area and medium (10-20 ppm) in 13 per cent area of the microwatershed.*
- *Available boron is low (<0.5 ppm) in 52 per cent, 44 per cent medium (0.5-1.0 ppm) and high (>1.0 ppm) in about 3 per cent area of the microwatershed.*
- *About 15 per cent area has soils that are deficient (<4.5 ppm) in available iron and 84 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-4 microwatershed

Crop	Suitability Area in ha (%)			Crop	Suitability Area in ha (%)	
	Highly suitable (S1)	Moderately suitable (S2)			Highly suitable (S1)	Moderately suitable (S2)
Sorghum	-	*385 (78)*		*Sapota*	-	*50 (10)*
Maize	-	*12 (2)*		*Guava*	-	*50 (10)*
Red gram	-	*370 (75)*		*Pomegranate*	-	*370 (75)*
Bajra	-	*381 (77)*		*Jackfruit*	-	*47 (9)*
Ground nut	-	*62 (12)*		*Jamun*	-	*301(61)*
Sunflower	-	*62 (12)*		*Musambi*	-	*370 (75)*
Cotton	*219 (44)*	*120 (24)*		*Lime*	-	*369 (75)*
Bengalgram	*238 (48)*	*100 (20)*		*Cashew*	-	-
Chilli	-	*216 (44)*		*Custard apple*	-	*385 (78)*
Tomato	-	*62 (12)*		*Amla*	-	*386 (78)*
Drumstick	-	*370 (75)*		*Tamarind*	-	*301 (61)*
Mulberry	-	*47 (9)*		*Marigold*	-	*389 (79)*
Mango	-	*53(11)*		*Chrysanthemum*	-	*389 (79)*

Apart from the individual crop suitability, a proposed crop plan has been prepared for the 7 identified LUCs by considering only the highly and moderately suitable lands for different crops and cropping systems with food, fodder, fibre and other horticulture crops 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 and produce lot of biomass that helps to restore the ecological balance in the microwatershed.*

Chapter 1

INTRODUCTION

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

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

In this critical juncture, the challenge before us is not only to increase the productivity per unit area which is steadily declining and showing a fatigue syndrome, but also to prevent or at least reduce the severity of degradation. If the situation is not reversed at the earliest, then the sustainability of the already fragile crop production system and the overall ecosystem will be badly affected in the state. The continued neglect and unscientific use of the resources for a long time has led to the situation observed at present in the state. It is a known fact and established beyond doubt by many studies in the past that the cause for all kinds of degradation is the neglect and irrational use of the land resources. Hence, there is an urgent need to generate a detailed site-specific farm level database on various land resources for all the villages/watersheds in a time bound manner that would help to protect the valuable soil and land resources and also to stabilize the farm production.

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

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

The Land Resource Inventory is basically done for identifying the 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 other states.

The land resource inventory aims to provide site specific database for Kanekal-4 microwatershed in Yadgir Taluk & District, Karnataka State for the Karnataka Watershed Development Department. The database was generated by using cadastral map of the village as a base along with high resolution IRS LISS IV and Cartosat-1 merged satellite imagery. Later, an attempt will be made to uplink this LRI data generated at 1:7920 scale under Sujala-III Project to the proposed Landscape Ecological Units (LEUs) map.

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

Chapter 2

GEOGRAPHICAL SETTING

2.1 Location and Extent

The Kanekal-4 micro-watershed is located in the northeastern part of Karnataka in Yadgir Taluk and District, Karnataka State (Fig.2.1). It comprises parts of Neelahalli, Sydhapura, Ramapura and Kanekal villages. It lies between 16^0 35' and 16^0 36' north latitudes and 77^0 15' and 77^0 16' east longitudes and covers an area of 494 ha. It is about 36 km from Yadgir town and is surrounded by Neelahalli on the north, Kanekal on the east, Rampura on the south, Sydhapura on the southwest and Kudlura village on the western side.

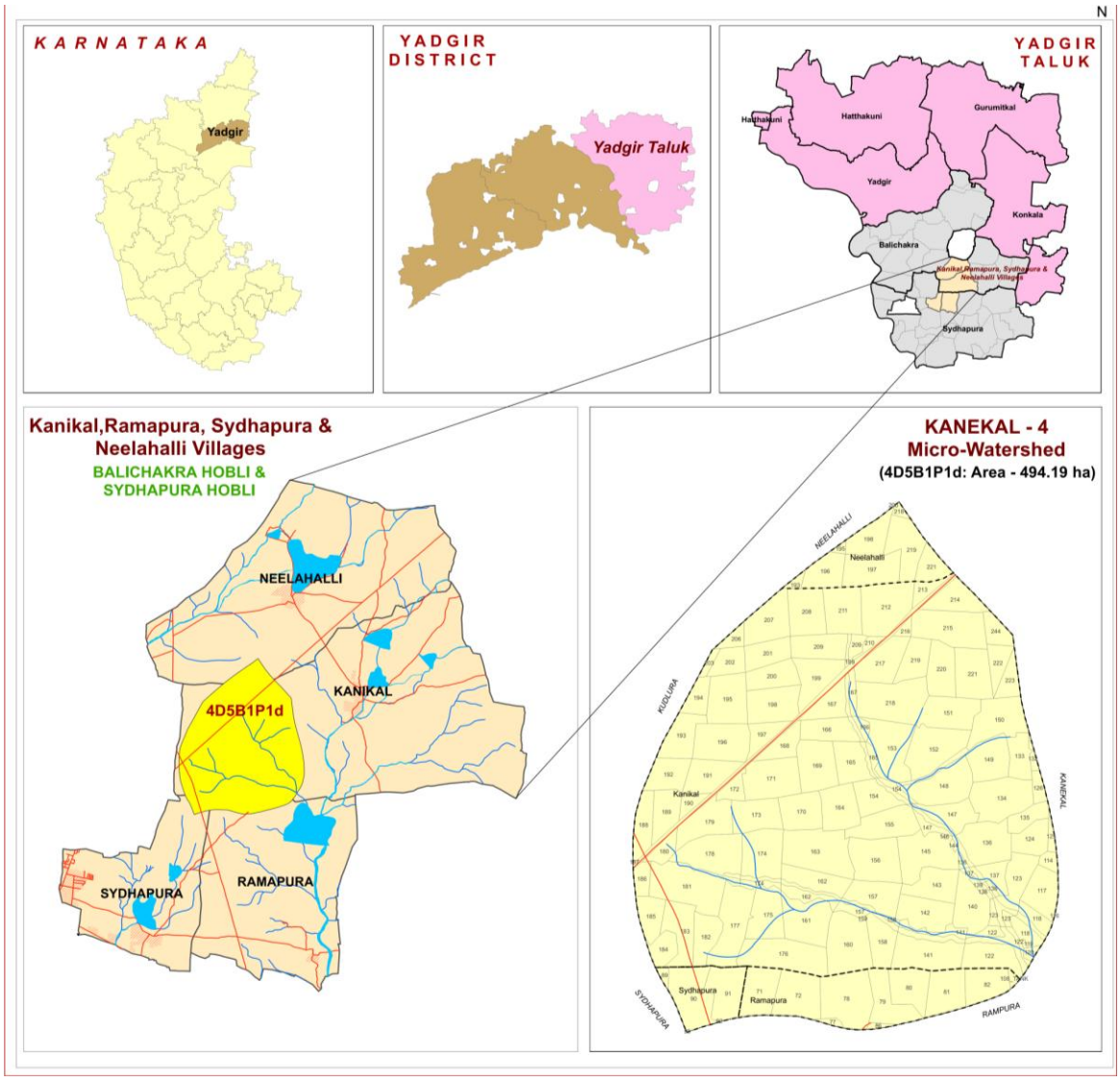


Fig.2.1 Location map of Kanekal-4 Microwatershed

2.2 Geology

Major rock formations observed in the microwatershed are granite gneiss and alluvium (Fig.2.2 a and b). Granite gneisses are essentially pink to gray and are coarse to medium grained. They consist primarily of quartz, feldspar, biotite and hornblende. The gray granite gneisses are highly weathered, fractured and fissured upto a depth of about 10 m. Dolerite dykes and quartz veins are common with variable width and found to occur in Kanelkal-4 microwatershed. The most widespread and characteristic development of alluvium in the watershed region lying between the rivers Krishna and Bhima is a wide belt, the underlying formation is gneiss and alluvial soils occur over gneiss, limestone and shale. The thickness of the alluvium generally is limited to less than a meter, except in river valleys where it is very deep extending to tens of meters. Such soils are transported and represent palaeo black soils originally formed at higher elevation, but now occupying river valleys.

Fig.2.2a Granite and granite gneiss rocks

Fig. 2.2b Alluvium

2.3 Physiography

Physiographically, the area has been identified as granite gneiss and alluvial landscapes 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 366-379 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 1^{st} week of June to 4^{th} 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**	

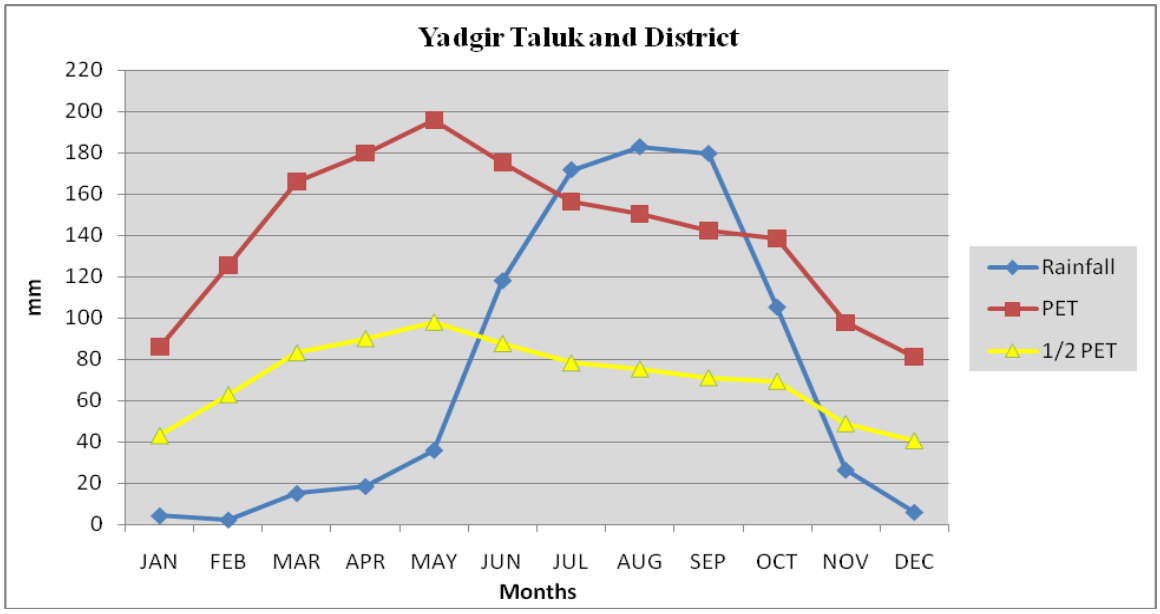


Fig 2.3 Rainfall distribution in Yadgir Taluk

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 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-4 microwatershed is presented in Fig.2.4. 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 and other water bodies in the Kanekal-4 microwatershed is given in Fig.2.5. The different crops and cropping systems adopted in the microwatershed is presented in the Figures 2.6 a & b.

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

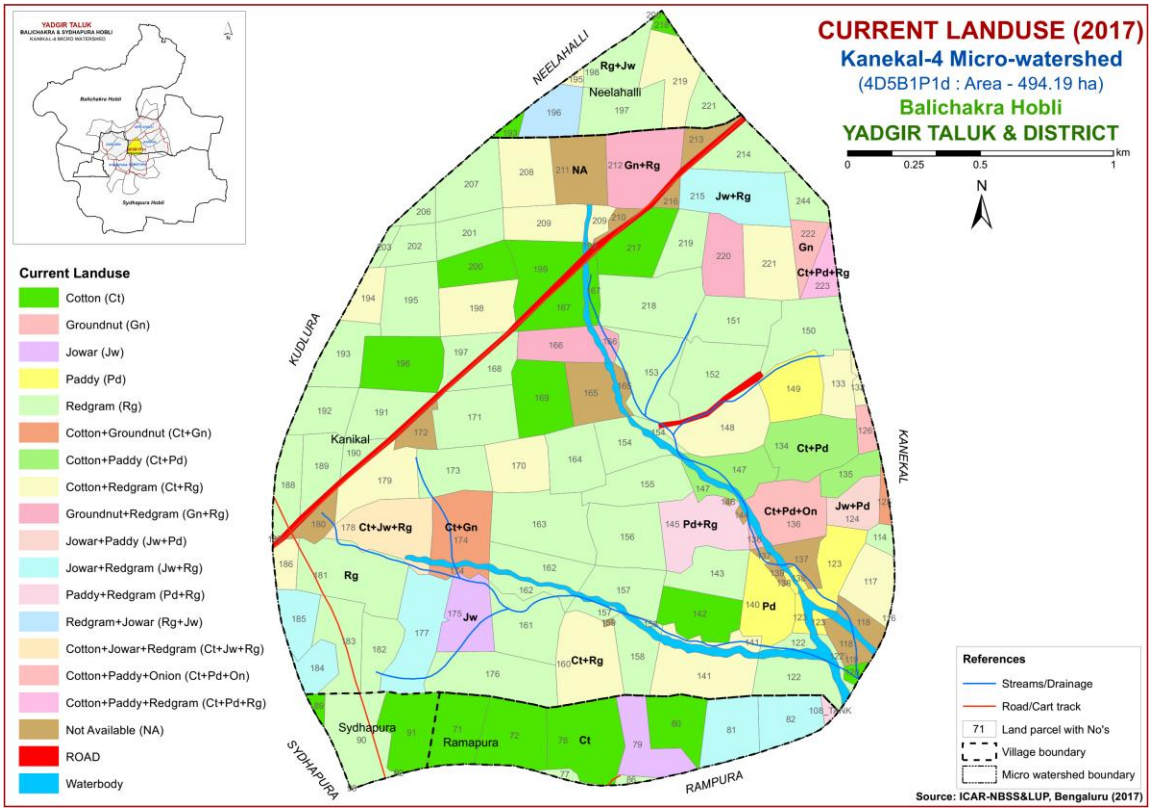


Fig.2.4 Current Land Use map of Kanekal-4 Microwatershed

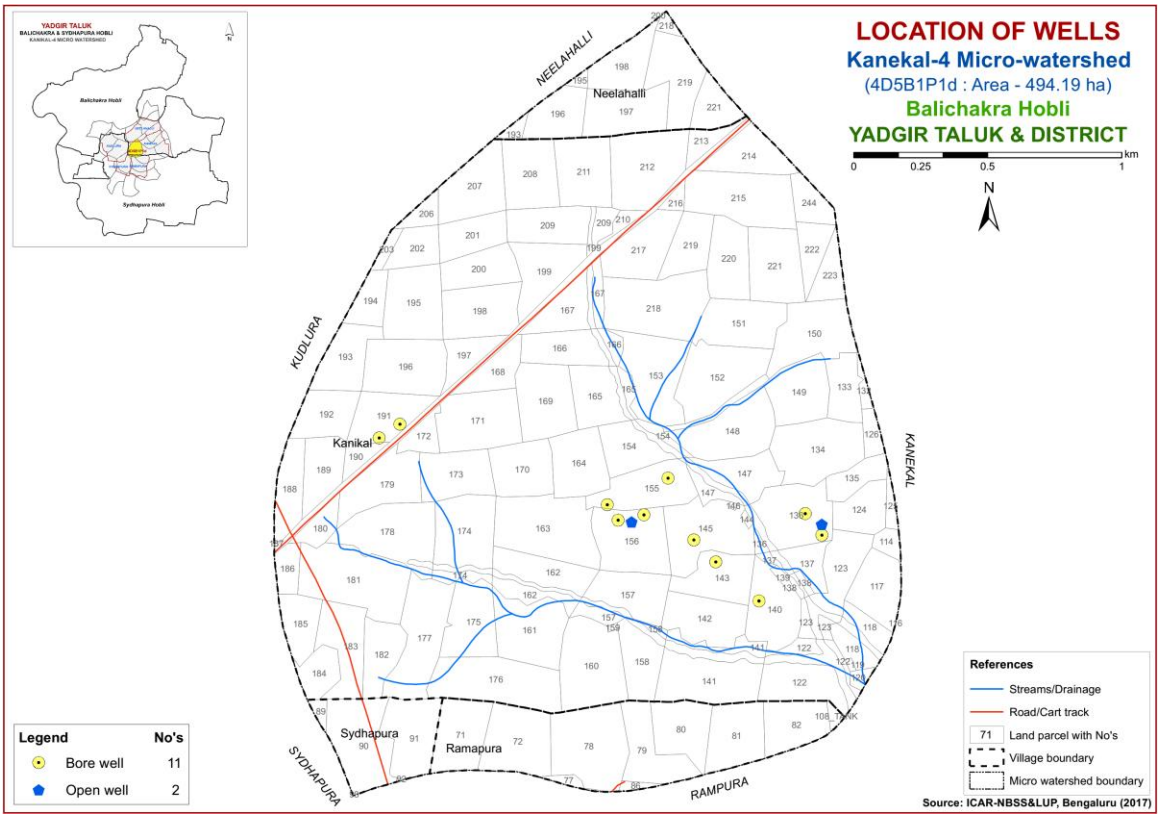


Fig.2.5 Location of wells map of Kanekal-4 Microwatershed

Fig.2.6 a. Different Crops and Cropping Systems in Kanekal-4 Microwatershed

Fig. 2.6 b. Different Crops and Cropping Systems in Kanekal-4 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-4 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 494 ha area. The methodology followed for carrying out land resource inventory was as per the guidelines given in Soil Survey Manual (IARI, 1971; Soil Survey Staff, 2006; Natarajan *et al.,* 2015) which is briefly described below.

3.1 Base Maps

The detailed survey of the land resources occurring in the microwatershed was carried out by using digitized cadastral map as and satellite imagery base supplied by the KSRSAC. The cadastral map shows field boundaries with their survey numbers, location of tanks, streams and other permanent features of the area (Fig. 3.1). Apart from the cadastral map, remote sensing data products from Cartosat-1 and LISS-IV merged at the scale of 1:7920 were used in conjunction with the cadastral map to identify the 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 and alluvial landscapes. 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

DSe – Alluvial Landscape

DSe 1 – Summit

- DSe 11 –
- DSe 12 –

DSe 2 – Very gently sloping

- DSe 21 – Very gently sloping, dark gray tone
- DSe 22 – Very gently sloping, medium gray tone
- DSe 23 – Very gently sloping, yellowish grey tone
- DSe 24 – Very gently sloping, whitish grey tone
- DSe 25 – Very gently sloping, whitish/ eroded/ calcareous tone
- DSe 26 – Very gently sloping, medium pink

DSe 3 – Valley/ Lowland

- DSe 31 – Whitish gray/Calcareous
- DSe 32 – Gray with pink patches
- DSe 33 – Medium gray tone
- DSe 34 – Lightish gray tone
- DSe 35 – Dark gray tone

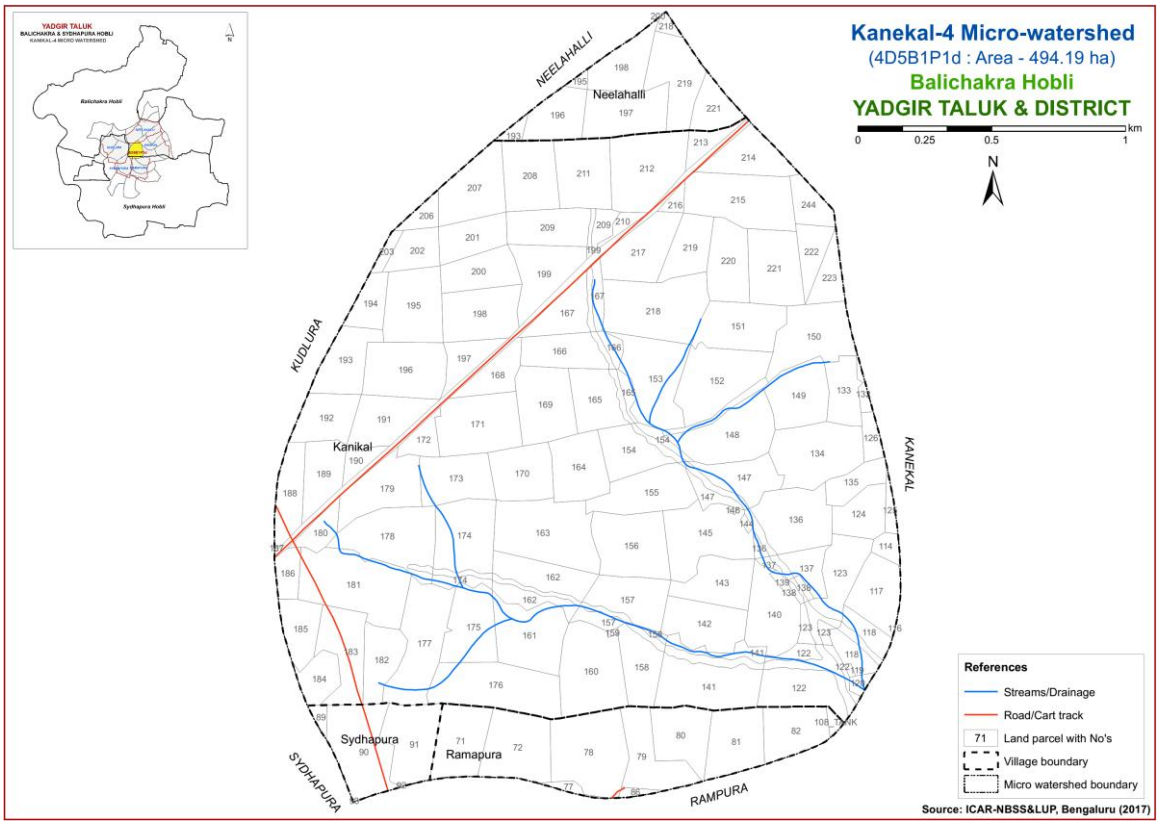


Fig 3.1 Scanned and Digitized Cadastral map of Kanekal-4 Microwatershed

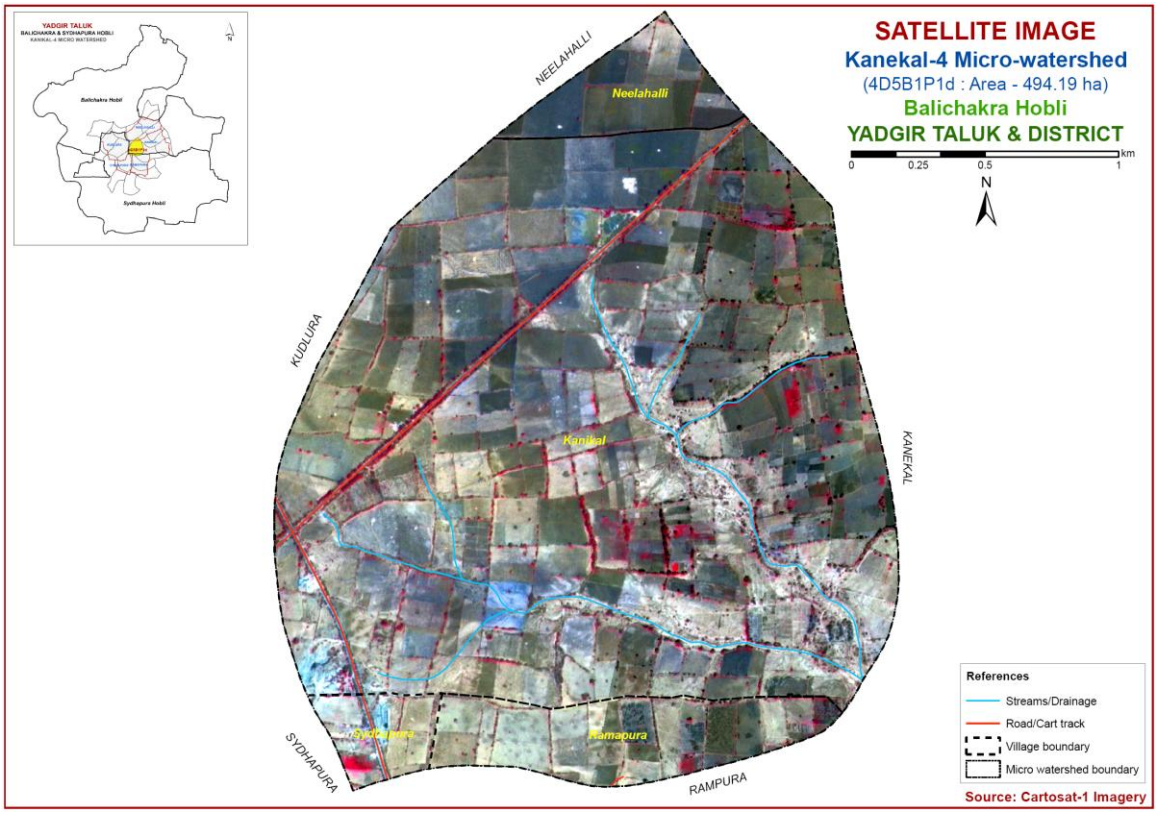


Fig.3.2 Satellite Image of Kanekal-4 Microwatershed

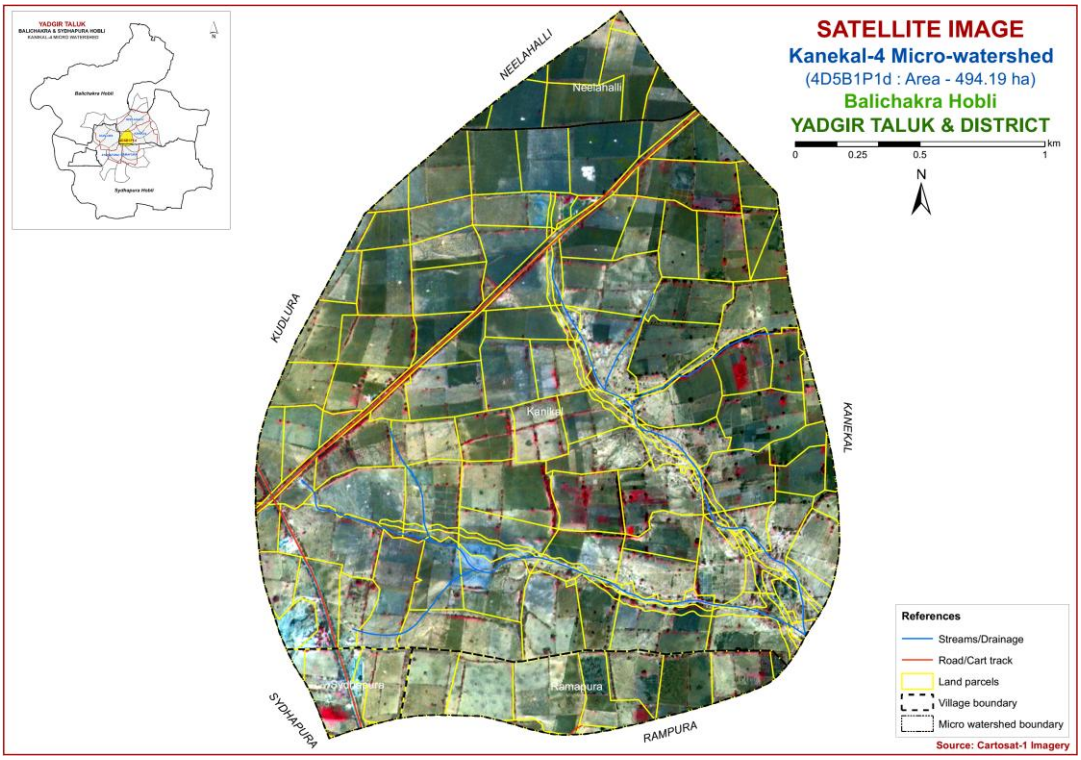


Fig.3.3 Cadastral map overlaid on IRS PAN+LISS IV merged imagery of Kanekal-4 Microwatershed

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).

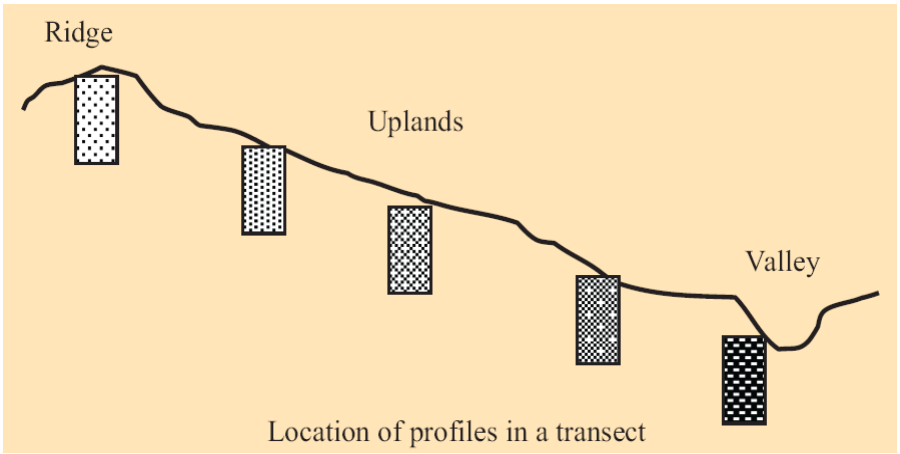


Fig: 3.4. Location of profiles in a transect

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-4 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	Badiyala (BDL)	25-50	7.5YR 2.5/3,2.5/2,3/3 10YR 3/4,4/3	sl	<15	Ap-Bw	e
2	Sambara (SBR)	50-75	10YR 7/1 7.5YR 7/4	ls	<15	Ap-AC	-
3	Yalleri (YLR)	50-75	2.5YR 3/4,4/4 5YR 3/4, 7.5YR 4/4	c	15-35	Ap-Bt	-
4	Hosalli (HSL)	75-100	10YR 5/4,4/4,4/6	sc	<15	Ap-Bw	e
5	Gowdagera (GWD)	75-100	10YR3/1,3/2,4/2	scl	<15	Ap-Bw	es
6	Yadgir (YDR)	100-150	10YR 4/3,4/4 2.5Y 4/3,5/3	sl	<15	Ap-AC	-
7	Nagapur (NGP)	100-150	10YR 3/2,3/1,2/1	c	<15	Ap-Bss	es
8	Mundargi (MDG)	100-150	10YR 4/4,3/3 7.5YR 4/4	scl	<15	Ap-Bw	-
9	Madhwara (MDR)	>150	10YR 3/1,3/2,2/1,2/2	scl	<15	Ap-Bw	e
10	Kadechoora (KDH)	75-100	10YR 3/2	sc	<15	Ap-Bw	e
SOILS OF ALLUVIAL LANDSCAPE							
11	Ramapur (RMP)	50-75	10YR 3/1,5/4	scl	<15	Ap-Bt	-

12	RHN (Rachanalli)	75-100	10YR 3/2,4/3	scl	<15	Ap-Bw	e
13	Mylapura (MYP)	>150	10YR 3/1,3/2,4/3	scl	<15	Ap-Bw	es

3.4 Soil Mapping

The area under each soil series was further separated into 17 soil phases and their boundaries delineated on the cadastral map based on the variations observed in the texture of the surface soil, slope, erosion, presence of gravel, stoniness etc. A soil phase is a subdivision of soil series based mostly on surface features that affect its use and management. The soil mapping units are shown on the 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 17 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 17 soil phases mapped in the microwatershed. Each mapping unit (soil phase) delineated on the map has similar soil and site characteristics. In other words, all the farms or survey numbers included in one phase will have similar management needs and have to be treated accordingly.

3.5 Land Use Classes (LUC's)

The 17 soil phases identified and mapped in the microwatershed were grouped into 7 Land Use Classes (LUC's) for the purpose of preparing a Proposed Crop Plan for sustained development of the microwatershed. The database (soil phases) generated under LRI was utilized for identifying Land Use Classes (LUC's) based on the management needs. One or more than one soil site characteristic having influence on the management have been chosen for identification and delineation of LUCs. For Kanekal-4 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 (48 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.

Table 3.2 Soil Map Unit description of Kanekal-4 microwatershed

Soil Map unit No.	Soil Series	Soil phase	Mapping Unit Description	Area in ha (%)
	Soil of Granite and Granite Gneiss Landscape			
	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 soils occurring on very gently to gently sloping uplands under cultivation		**3 (0.54)**
5		BDLiB2	Sandy clay surface, slope 1-3%, moderate erosion	3 (0.54)
	SBR	Sambra soils are moderately shallow (50-75 cm), somewhat excessively drained, have light gray to reddish yellow, loamy sand soils occurring on very gently to gently sloping uplands under cultivation		**98 (19.95)**
11		SBRcB2	Sandy loam surface, slope 1-3%, moderate erosion	14 (2.88)
12		SBRcC3g1	Sandy loam surface, slope 3-5%, severe erosion, gravelly (15-35%)	84 (17.07)
	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		**12 (2.38)**
27		YLRbB2	Loamy sand surface, slope 1-3%, moderate erosion	12 (2.38)
	HSL	Hosalli soils are moderately deep (75-100 cm), moderately well drained, have yellowish brown to dark yellowish brown, slightly calcareous sandy clay soils occurring on very gently sloping uplands under cultivation		**47 (9.45)**
33		HSLiB2	Sandy clay surface, slope 1-3%, moderate erosion	47 (9.45)
	GWD	Gowdagera soils are moderately deep (75-100 cm), moderately well drained, have dark grayish brown to very dark grayish brown, sodic calcareous sandy clay loam soils occurring on very gently sloping uplands under cultivation		**11 (2.23)**
35		GWDiB2	Sandy clay surface, slope 1-3%, moderate erosion	11 (2.23)
	YDR	Yadgir soils are deep (100-150 cm), well drained, have brown to dark yellowish brown and olive brown, sodic sandy loam soils occurring on very gently sloping uplands under cultivation		**3 (0.62)**
43		YDRiB2	Sandy clay surface, slope 1-3%, moderate erosion	3 (0.62)
	NGP	Nagalapur soils are deep (100-150 cm), moderately well drained, have very dark gray to very dark grayish brown, black calcareous cracking clay soils occurring on very gently sloping uplands under cultivation		**165 (33.45)**
49		NGPmB2	Clay surface, slope 1-3%, moderate erosion	165 (33.45)

	MDG	Mundargi soils are deep (100-150 cm), moderately well drained, have brown to dark yellowish brown, sodic sandy clay loam soils occurring on very gently sloping uplands under cultivation		**54 (10.82)**
57		MDGcB2	Sandy loam surface, slope 1-3%, moderate erosion	47 (9.41)
58		MDGiB2	Sandy clay surface, slope 1-3%, moderate erosion	7 (1.41)
	MDR	Madhwara soils are very deep (>150 cm), well drained, have very dark gray to very dark brown, sodic slightly calcareous sandy clay loam soils occurring on nearly level to very gently sloping uplands under cultivation		**16 (3.17)**
61		MDRmB2	Clay surface, slope 1-3%, moderate erosion	16 (3.17)
	KDH	Kadechoor soils are moderately deep (75-100 cm), moderately well drained, have very dark grayish brown, slightly calcareous sandy clay black soils occurring on very gently sloping lowlands under cultivation		**20 (3.97)**
99		KDHcB2	Sandy loam surface, slope 1-3%, moderate erosion	20 (3.97)
Soils of Alluvial Landscape				
	RMP	Ramapur soils are moderately shallow (50-75 cm), well drained, have yellowish brown to very dark gray, sandy clay loam alluvial soils occurring on very gently sloping plains under cultivation		**7 (1.42)**
71		RMPiB2	Sandy clay surface, slope 1-3%, moderate erosion	7 (1.42)
	RHN	Rachanalli soils are moderately deep (75-100 cm), well drained, have brown to very dark grayish brown, sodic slightly calcareous sandy clay loam alluvial soils occurring on very gently sloping plains under cultivation		**11.02 (2.214)**
77		RHNcB2	Sandy loam surface, slope 1-3%, moderate erosion	11 (2.21)
79		RHNmB2	Clay surface, slope 1-3%, moderate erosion	0.02 (0.004)
	MYP	Mylapura soils are very deep (>150 cm), well drained, have brown to very dark grayish brown, sodic calcareous sandy clay loam alluvial soils occurring on very gently sloping plains under cultivation		**43 (8.81)**
97		MYPhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	17 (3.47)
98		MYPiB2g1	Sandy clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	26 (5.34)
999	**Rock outcrops**	Rock lands both massive and bouldery		**5 (0.98)**

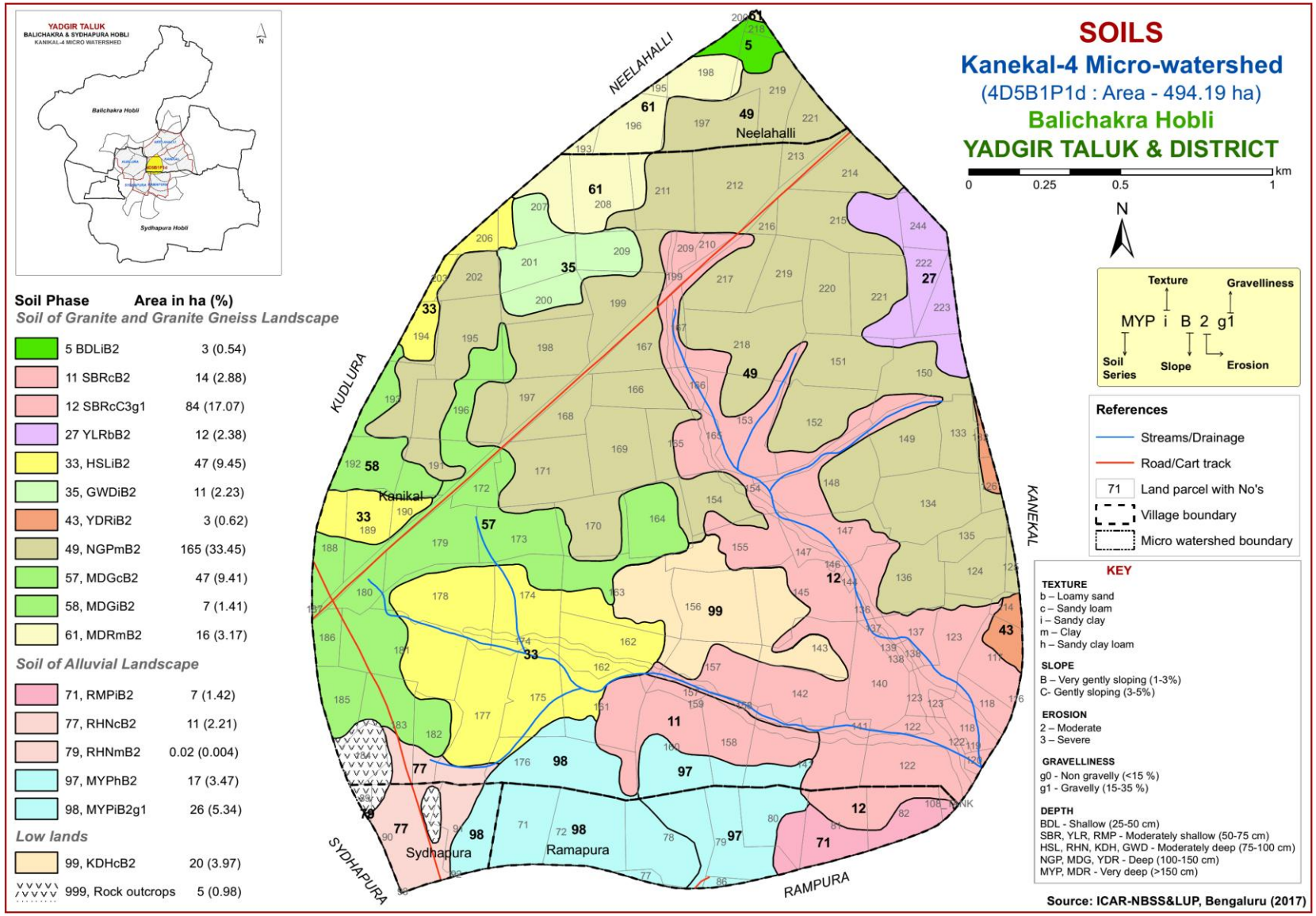


Fig 3.5 Soil phase or management units map of Kanekal-4 Microwatershed

Chapter 4

THE SOILS

Detailed information pertaining to the nature, extent and distribution of different kinds of soils occurring in Kanekal-4 microwatershed is provided in this chapter. The microwatershed area has been identified as granite gneiss and alluvial landscapes based on geology. In all, 13 soil series were identified in both the landscapes. 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 and in alluvial landscape; it is by parent material, climate and time.

A brief description of each of the 13 soil series identified followed by 18 soil phases (management units) mapped are furnished below. The physical and chemical characteristics of soil series identified in Kanekal-4 microwatershed are given in Table 4.1. The soils in any one map unit differ from place to place in their depth, texture, slope, gravelliness, erosion or any other site 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, 10 soil series are identified and mapped. Nagalapur (NGP) series occupies a maximum area of 165 ha (33%) followed by Sambara (SBR) 98 ha (20%), Mundargi (MDG) 54 ha (11%), Hosalli (HSL) 47 ha (9%), Kadechoor (KDH) 20 ha (4%), Madhwara (MDR) 16 ha (3%) 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 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 soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation. The Badiyala series has been classified as a member of the coarse-loamy, mixed, isohyperthermic family of Fluventic Haplustepts.

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

4.1.2 Sambara (SBR) Series: Sambara soils are moderately shallow (50-75 cm), somewhat excessively 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 Sambara series has been classified as a member of the sandy, mixed, isohyperthermic family of Typic Ustorthents.

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

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

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). Only one phase was identified and mapped.

Landscape and Soil Profile characteristics of Yalleri (YLR) Series

4.1.4 Hosalli (HSL) Series: Hosalli soils are moderately deep (75-100 cm), moderately well drained, have dark yellowish brown to yellowish brown, slightly calcareous sandy clay soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation. The Hosalli series has been classified as a member of the fine, mixed, isohyperthermic family of Typic Haplustepts.

The thickness of the solum ranges from 76 to 100 cm. The thickness of A horizon ranges from 6 to 15 cm. Its colour is in hue 10 YR and 7.5 YR with value 3 to 5 and chroma 2 to 4. Its texture varies from loamy sand to sandy loam and sandy clay loam. The thickness of B horizon ranges from 62 to 93 cm. Its colour is in hue 10 YR with value 3 to 4 and chroma 2 to 4. Its texture varies from sandy clay loam to sandy clay and 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 Hosalli (HSL) Series

4.1.5 Gowdagera (GWD) Series: Gowdagera soils are moderately deep (75-100 cm), moderately well drained, very dark gray to dark grayish brown, sodic calcareous sandy clay loam soils. They are developed from weathered granite gneiss and occur on very gently sloping uplands under cultivation. The Gowdagera series has been classified as a member of the fine-loamy, mixed, calcareous, isohyperthermic family of Typic Haplustepts.

The thickness of the solum ranges from 76 to 100 cm. The thickness of A horizon ranges from 8 to 16 cm. Its colour is in hue 10 YR with value 3 to 4 and chroma 2 to 4. Its texture varies from sandy loam to sandy clay loam. The thickness of B horizon ranges from 61 to 91 cm. Its colour is in hue 10 YR with value 2 to 4 and chroma 1 to 4. Its texture is sandy clay loam to sandy clay and is sodic calcareous soils. The available water capacity is medium (101-150 mm/m).Only one phase was identified and mapped.

Landscape and Soil Profile characteristics of Gowdagera (GWD) Series

4.1.6 Yadgir (YDR) Series: Yadgir soils are deep (100-150 cm), well drained, have very dark yellowish brown to light olive brown, sodic sandy loam soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation. The Yadgir series has been classified as a member of the coarse-loamy, mixed, isohyperthermic family of Typic Ustorthents.

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 range 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 is loamy sand to sandy loam and sandy clay loam and sodic soils. 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

4.1.7 Naglapur (NGP) Series: Naglapur soils are deep (100-150 cm), moderately well drained, have black to very dark grayish brown, calcareous cracking clay soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation. The Naglapur series has been classified as a member of the very fine, smectitic (calcareous), isohyperthermic family of Typic Haplusterts.

The thickness of the solum ranges from 110 to 150 cm. The thickness of A horizon ranges from 6 to 25 cm. Its colour is in 10 YR hue with value 3 to 5 and chroma 1 to 3. The texture varies from sandy loam to sandy clay and clay. The thickness of B horizon ranges from 110 to 141 cm. Its colour is in 10 YR hue with value 2 to 3 and chroma 1 to 2. 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 Naglapur (NGP) Series

4.1.8 Mundargi (MDG) Series: Mundargi soils are deep (100-150 cm), moderately well drained, dark brown to dark yellowish brown, sodic sandy clay loam soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation. The Mundargi series has been classified as a member of the fine-loamy, mixed, isohyperthermic family of Fluventic Haplustepts.

The thickness of the solum ranges from 100 to 149 cm. The thickness of A horizon ranges from 8 to 20 cm. Its colour is in 10 YR hue with value 3 and chroma 1 to 4. The texture ranges from sandy loam to sandy clay loam and sandy clay. The thickness of B horizon ranges from 105 to 140 cm. Its colour is in 10 YR hue with value 3 to 4 and chroma 2 to 4. The texture varies from sandy loam to sandy clay loam and is sodic soils. The available water capacity is very high (>200 mm/m). Two phases were identified and mapped.

Landscape and Soil Profile characteristics of Mundargi (MDG) Series

4.1.9 Madhwara (MDR) Series: Madhwara soils are very deep (>150 cm), well drained, have black to very dark brown and very dark gray to very dark grayish brown, sodic slightly calcareous sandy clay loam soils. They are developed from weathered granite gneiss and occur on nearly level to very gently sloping uplands under cultivation. The Madhwara series has been classified as a member of the fine-loamy, mixed, isohyperthermic family of Fluventic Haplustepts.

The thickness of the solum is more than150 cm. The thickness of A horizon ranges from 10 to 16 cm. Its colour is in 10 YR hue with value 3 to 5 and chroma 2 to 3. Texture varies from sandy clay and clay. The thickness of B horizon is >150 cm. Its colour is in 10 YR hue with value 3 to 5 and chroma 1 to 3. Texture varies from sandy clay loam to sandy clay and is slightly calcareous sodic soils. The available water capacity is very high (>200 mm/m). Only one phase was identified and mapped.

Landscape and Soil Profile characteristics of Madhwara (MDR) Series

4.1.10 Kadechoor (KDH) Series: Kadechoor soils are moderately deep (75-100 cm), moderately well drained, have very dark grayish brown to dark brown, slightly calcareous sandy clay soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping lowlands under cultivation. The Kadechoor series has been classified as a member of the fine, mixed, isohyperthermic family of Typic Haplustepts.

The thickness of the solum ranges from 75 to 98 cm. The thickness of A horizon ranges from 6 to 11 cm. Its colour is in hue 10 YR with value 3 to 4 and chroma 2. Its texture varies from sandy loam to sandy clay. The thickness of B horizon ranges from 73 to 90 cm. Its colour is in hue 10 YR with value 3 to 4 and chroma 2 to 3. The texture is sandy clay loam to sandy clay and is slightly calcareous. The available water capacity is low (51-100 mm/m). Only one phase was identified and mapped.

Landscape and Soil Profile characteristics of Kadechoor (KDH) Series

4.2 Soils of Alluvial plains`

In this landscape, 3 soil series are identified and mapped. Of these, Mylapura (MYP) series occupies maximum area of 43 ha (9%) followed by Rachanalli (RHN) 11 ha (2%) and Ramapura (RMP) 7 ha (1%). Brief description of each series identified and number of soil phases mapped is given below.

4.2.1 Ramapura (RMP) Series: Ramapura soils are moderately shallow (50-75 cm), well drained, have very dark to yellowish brown, sandy clay loam soils. They have developed from alluvium and occur on very gently sloping plains under cultivation. The Ramapura series has been classified as a member of the fine-loamy, mixed, isohyperthermic family of Typic Haplustalfs.

The thickness of the solum ranges from 53 to 75 cm. The thickness of A horizon ranges from 6 to 12 cm. Its colour is in 7. 5 YR and 10 YR hue with value 4 to 5 and chroma 3 to 6. The texture is sandy loam to sandy clay loam and sandy clay. The thickness of B horizon ranges from 48 to 65 cm. Its colour is in 10 YR and 7.5 YR hue with value 3 to 5 and chroma 1 to 6. Its texture is loamy sandy to sandy clay loam and sandy clay. The available water capacity is medium (101-150 mm/m). Only one phase was identified and mapped.

Landscape and Soil Profile characteristics of Rampura (RMP) Series

4.2.2 Rachanalli (RHN) Series: Rachanalli soils are moderately deep (75-100 cm), well drained, very dark grayish brown to dark brown, sodic, slightly calcareous sandy clay loam soils. They have developed from alluvium and occur on very gently sloping plains under cultivation. The Rachanalli series has been classified as a member of the fine-loamy, mixed, isohyperthermic family of Typic Haplustepts.

The thickness of the solum ranges from 76 to 100 cm. The thickness of A horizon ranges from 6 to 13 cm. Its colour is in hue 10 YR with value 3 to 4 and chroma 2 to 4. Its texture varies from sandy loam to sandy clay loam and sandy clay. The thickness of B horizon ranges from 66 to 92 cm. Its colour is in hue 10 YR with value 3 to 4 and chroma 1 to 3. Its texture varies from sandy loam to sandy clay loam and is slightly calcareous sodic soils. The available water capacity is medium (101-150 mm/m). Two phases were identified and mapped.

Landscape and Soil Profile characteristics of Rachanalli (RHN) Series

4.2.3 Mylapura (MYP) Series: Mylapura soils are very deep (>150 cm), well drained, have very dark gray to dark grayish brown and dark brown, sodic, calcareous clay loam to sandy clay loam soils. They have developed from alluvium and occur on nearly level to very gently sloping plains under cultivation. The Mylapura series has been classified as a member of the fine-loamy, mixed, calcareous, isohyperthermic family of Typic Haplustepts.

The thickness of the solum is more than150 cm. The thickness of A horizon ranges from 5 to 14 cm. Its colour is in 10 YR hue with value 3 to 5 and chroma 2. The texture is sandy clay. The thickness of B horizon is 155 to 179 cm. Its colour is in 10 YR hue with value 3 to 5 and chroma 1 to 3. Texture varies from clay loam to sandy clay loam and is calcareous sodic soils. The available water capacity is very high (>200 mm/m). Two phases were identified and mapped.

Landscape and Soil Profile characteristics of Mylapura (MYP) Series

Table: 4.1 Physical and Chemical Characteristics of Soil Series identified in Kanekal-4 microwatershed

Soil Series: Badiyala **(**BDL) **Pedon:** R-5

Location: $16^0$37'10.0"N $77^0$20'21.5", Gudalagunta village, Balichakra hobli, Yadgir taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Coarse-loamy, mixed, isohyperthermic Fluventic Haplustepts

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-12	Ap	87.13	7.04	5.83	10.03	24.32	23.61	23.51	5.67	<15	ls	6.27	2.44
12-28	Bw1	64.63	13.30	22.07	6.74	13.07	22.30	17.01	5.50	<15	scl	16.34	7.83
28-52	BC	73.11	12.02	14.87	3.93	16.03	26.89	18.41	7.86	<15	sl	12.94	5.47

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-12	6.20	-	-	0.074	1.00	0.00	2.80	0.98	0.14	0.01	3.92	4.20	0.72	93	0.20
12-28	9.04	-	-	0.253	0.80	3.20	-	-	0.16	0.69	-	16.90	0.77	100	4.09
28-52	9.41	-	-	0.364	1.10	3.60	-	-	0.16	1.39	-	11.10	0.75	100	12.52

Contd...

Soil Series: Sambara (SBR) **Pedon:** R-10

Location: $16^0$42'04.5"N $77^0$14'35.3"E, Jinatera village, Balichakra hobli, Yadgir taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Sandy, mixed, isohyperthermic Typic Ustorthents

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-9	Ap	81.90	8.22	9.88	23.76	14.05	23.76	10.62	9.71	-	ls	9.45	2.69
9-17	C1	84.08	6.59	9.33	21.30	20.69	17.65	17.65	6.80	-	ls	7.84	2.65
17-60	C2	86.86	6.17	6.98	11.53	21.54	25.08	23.46	5.26	-	ls	5.48	2.62
60-78	C3	87.27	6.92	5.81	15.05	20.91	26.36	19.29	5.66	-	ls	5.19	2.81

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-9	8.24	-	-	0.145	0.61	0.91	-	-	0.12	0.09	-	7.50	0.76	100	1.15
9-17	8.21	-	-	0.068	0.57	0.39	-	-	0.06	0.12	-	6.70	0.72	100	1.82
17-60	8.47	-	-	0.080	0.38	0.48	-	-	0.03	0.17	-	2.70	0.39	100	6.34
60-78	8.50	-	-	0.081	0.30	0.52	-	-	0.03	0.17	-	2.70	0.46	100	6.43

Contd...

Soil Series: Yalleri (YLR) **Pedon:** R-16

Location: $16^0$32'54.3"N $77^0$22'71.2"E, Duppalli village, Sydhapura hobli, Yadgir taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Fine, mixed, isohyperthermic Typic Haplustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-5	Ap	81.69	5.44	12.87	6.10	8.65	33.88	21.57	11.50	-	sl	8.60	3.37
5-34	Bt1	38.78	6.73	54.49	3.38	9.91	12.42	8.93	4.14	-	c	25.33	15.82
34-75	Bt2	40.35	2.90	56.75	12.91	6.83	10.30	7.48	2.82	35-60	c	24.49	16.20

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-5	6.91	-	-	0.069	0.70	0.00	5.29	1.37	0.28	0.03	6.96	6.90	0.54	100	0.45
5-34	7.05	-	-	0.053	0.62	0.00	16.43	3.89	0.26	0.09	20.67	21.60	0.40	96	0.42
34-75	7.25	-	-	0.058	0.59	0.00	15.22	3.46	0.25	0.14	19.06	19.90	0.35	96	0.69

Contd...

Soil Series: Hosalli (HSL) **Pedon:** R-3

Location: $16^0$46'60.3"N $77^0$05'47.6"E, Mudhanala village, Yadgir hobli, Yadgir taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Fine, mixed, isohyperthermic Typic Haplustepts

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-10	Ap	88.43	5.15	6.42	5.69	6.40	36.04	27.31	12.99	-	s	7.40	2.74
10-30	Bw1	58.47	7.24	34.29	4.26	9.37	19.91	19.28	5.64	-	scl	19.07	11.57
30-50	Bw2	51.43	12.67	35.90	3.49	8.89	16.72	15.87	6.46	<15	sc	21.64	12.44
50-90	Bw3	49.89	13.64	36.47	2.43	2.96	20.61	16.17	7.72	<15	sc	21.12	12.95

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-10	7.16	-	-	0.117	0.48	0.00	2.83	1.50	0.15	0.29	4.76	4.90	0.76	97	5.94
10-30	6.91	-	-	0.040	0.36	0.00	10.64	5.43	0.10	0.26	16.43	17.80	0.52	92	1.47
30-50	8.17	-	-	0.182	0.24	1.43	-	-	0.12	0.22	-	19.90	0.55	100	1.08
50-90	8.60	-	-	0.148	0.20	4.29	-	-	0.13	0.16	-	19.70	0.54	100	0.81

Contd...

Soil Series: Gowdagera (GWD) **Pedon:** R-13

Location: $16^0$38'24.4"N $77^0$21'24.0"E, Madhawara village, Balichakara hobli, Yadgir taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Fine-loamy, mixed (calcareous), isohyperthermic Typic Haplustepts

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-18	Ap	79.61	13.94	6.45	14.17	17.53	23.65	17.02	7.24	-	ls	11.36	3.86
18-42	BW1	69.09	10.58	21.06	10.54	16.58	22.01	14.43	5.53	-	scl	31.62	12.30
42-81	Bw2	51.37	13.51	35.60	7.59	10.55	16.24	11.60	5.38	-	sc	67.57	26.89

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-18	9.89	-	-	0.74	0.66	1.20	-	-	0.18	3.63	-	8.35	1.29	100	43.51
18-42	10.82	-	-	1.60	0.27	5.76	-	-	0.19	19.23	-	15.84	0.75	100	121.42
42-81	10.83	-	-	2.30	0.27	7.80	-	-	0.40	26.71	-	26.54	0.75	100	100.67

Contd...

Soil Series: Yadgir **(**YDR) **Pedon:** R-5

Location: $16^0$35'43.6"N $77^0$17'06.4"E, Kanikal village, Balichakra hobli, Yadgir taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Coarse-loamy, mixed, isohyperthermic Typic Ustorthents

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-14	Ap	86.59	8.77	4.64	23.19	26.92	14.11	15.22	7.16	-	ls	6.97	2.68
14-43	C1	73.39	11.31	15.30	6.76	20.27	24.87	15.66	5.83	-	sl	12.14	7.22
43-89	C2	80.41	3.75	15.84	8.06	13.47	36.73	15.71	6.43	-	sl	22.84	10.18
89-110	C3	63.55	5.40	31.05	8.10	23.05	19.00	9.87	3.53	15-35	scl	38.46	17.70

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-14	7.25	-	-	0.114	0.56	0.00	2.29	0.86	0.07	0.03	3.25	3.40	0.73	96	0.78
14-43	9.47	-	-	0.371	0.32	1.30	14.71	4.28	0.38	1.54	20.91	12.70	0.83	165	12.14
43-89	10.30	-	-	0.820	0.16	0.52	1.70	0.98	0.15	6.62	9.45	8.61	0.54	110	76.93
89-110	10.80	-	-	1.440	0.12	0.91	1.02	2.00	0.29	14.43	17.74	16.17	0.52	110	89.22

Contd...

Soil Series: Naglapur (NGP) **Pedon:** R-8

Location: $16^0$52'84.1"N $77^0$22'99.4"E, Gurumitkal village, Gurumitkal hobli, Yadgir taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Very fine, smectitic (calcareous), isohyperthermic Typic Haplusterts

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-10	Ap	7.53	19.88	72.59	1.00	0.78	0.89	2.10	2.77	-	c	44.31	32.79
10-35	Bss1	6.55	18.76	74.68	0.80	0.92	0.80	1.72	2.30	-	c	43.09	31.62
35-60	Bss2	6.58	21.05	72.37	0.69	0.46	1.04	1.50	2.89	-	c	46.52	32.52
60-102	Bss3	7.48	19.74	72.78	1.61	1.38	0.69	1.61	2.19	-	c	51.12	35.62

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-10	7.42	-	-	0.24	0.84	1.30	-	-	0.84	0.15	-	67.10	0.92	100	0.22
10-35	8.52	-	-	0.291	0.64	2.86	-	-	0.17	0.29	-	65.20	0.87	100	0.45
35-60	7.89	-	-	0.134	0.62	4.55	-	-	0.15	0.20	-	65.00	0.90	100	0.30
60-102	8.68	-	-	0.213	0.54	8.32	-	-	0.17	0.15	-	64.10	0.88	100	0.24

Contd...

Soil Series: Mundargi (MDG) **Pedon:** R-2

Location: $16^0$46'82.4"N $77^0$04'85.2"E, Thumakura village, Yadgir hobli, Yadgir taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Fine-Loamy, mixed, isohyperthermic Typic Haplustepts

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-9	Ap	81.23	12.97	5.80	4.84	10.19	14.83	37.94	13.42	<15	ls	11.75	3.31
9-20	Bw1	76.82	16.19	6.98	4.96	10.12	20.75	27.53	13.46	-	ls	14.52	3.99
20-46	Bw2	42.43	17.43	40.15	2.26	5.59	11.49	14.93	8.16	-	c	34.90	21.14
46-90	Bw3	54.51	16.56	28.93	4.72	5.03	19.92	16.67	8.18	-	scl	36.73	18.88
90-110	Bw4	53.69	11.00	35.30	9.57	9.89	16.23	13.01	4.99	-	sc	38.72	20.53

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-9	8.2	-	-	0.399	0.44	0.78	-	-	0.16	0.38	-	4.90	0.84	100	7.69
9-20	8.44	-	-	0.075	0.29	1.82	-	-	0.05	0.35	-	4.90	0.70	100	7.20
20-46	9.39	-	-	0.451	0.32	2.73	-	-	0.12	5.22	-	20.77	0.52	100	25.15
46-90	9.75	-	-	0.616	0.24	3.25	-	-	0.12	5.72	-	16.56	0.57	100	34.55
90-110	9.72	-	-	0.725	0.24	3.64	-	-	0.14	6.84	-	19.76	0.56	100	34.59

Contd...

Soil Series: Madhawara (MDR) **Pedon:** T_2 P_2

Location: $16^0$43'48.9"N $77^0$18'38.3"E, Yaleri village, Balichakra hobli, Yadgir taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Fine-Loamy, mixed, isohyperthermic Fluventic Haplustepts

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-11	Ap	58.94	20.74	20.32	5.41	7.28	13.31	20.89	12.06	-	scl	16.47	8.85
11-30	Bw1	55.52	19.32	25.16	5.00	7.19	13.12	19.69	10.52	-	scl	18.25	10.18
30-53	Bw2	53.95	19.15	26.90	4.68	7.48	12.58	19.65	9.56	-	scl	26.99	14.02
53-117	Bw3	52.68	19.51	27.81	2.84	5.47	14.72	20.82	8.83	-	scl	37.86	17.40
117-160	Bw4	49.95	17.27	32.79	2.11	5.07	14.15	20.49	8.13	-	scl	44.15	20.38

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-11	8.31	-	-	0.33	0.46	2.76	-	-	0.45	0.47	-	20.57	1.01	100	2.26
11-30	9.25	-	-	0.20	0.31	4.20	-	-	0.19	1.40	-	23.98	0.95	100	5.84
30-53	9.78	-	-	0.40	0.19	5.76	-	-	0.16	1.53	-	24.53	0.91	100	6.22
53-117	9.94	-	-	0.88	0.23	4.80	-	-	0.18	9.09	-	24.31	0.87	100	37.40
117-160	9.98	-	-	0.93	0.15	3.00	-	-	0.24	11.09	-	28.27	0.86	100	39.23

Contd...

Soil Series: Kadechoor (KDH) **Pedon:** T1/P3

Location: $16^0$31'15.0"N $77^0$20'52.2"E, Kadechoora village, Sydhapura hobli, Yadgir taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Fine, mixed, isohyperthermic Typic Haplustepts

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-18	Ap	75.81	4.05	20.14	7.09	16.85	24.77	19.10	8.01	-	scl	13.70	6.92
18-40	Bw1	57.82	7.95	34.23	2.38	13.52	21.68	14.97	5.27	-	scl	22.10	13.10
40-78	Bw2	50.54	10.54	38.92	1.99	4.51	24.19	12.91	6.95	<15	sc	24.00	14.54

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-18	8.22	-	-	0.198	0.84	0.91	-	-	0.41	0.33	-	12.26	0.61	100	2.71
18-40	8.71	-	-	0.163	0.64	1.56	-	-	0.18	0.26	-	20.31	0.59	100	1.27
40-78	8.92	-	-	0.17	0.40	2.90	-	-	0.16	0.37	-	21.41	0.55	100	1.71

Contd...

Soil Series: Rampura (RMP) **Pedon:** T1/P1

Location: $16^0$33'54.7"N $77^0$20'45.1"E, Sowrashtralli village, Sydhapura hobli, Yadgir taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Fine-loamy, mixed, isohyperthermic Typic Haplustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-7	Ap	93.37	4.32	2.31	18.39	21.91	24.62	19.90	8.54	-	s	3.89	1.01
7-28	Bt1	83.08	7.65	9.26	14.60	18.23	21.75	20.85	7.65	-	ls	6.25	1.94
28-70	Bt2	61.88	6.38	31.74	19.17	13.54	14.17	12.29	2.71	-	scl	15.95	8.69

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-7	5.97	-	-	0.04	0.34	0.00	0.70	0.18	0.06	0.01	0.95	1.70	0.74	56	0.77
7-28	6.06	-	-	0.03	0.26	0.00	1.83	0.53	0.07	0.05	2.48	3.30	0.36	75	1.58
28-70	6.65	-	-	0.20	0.26	0.00	7.05	3.19	0.15	0.95	11.34	13.00	0.41	87	7.31

Contd...

Soil Series: Rachanalli (RHN) **Pedon:** R-2

Location: 16^{0}44'40.9"N 77^{0}17'35.0"E, Gopalpura village, Gurumitkal hobli, Yadgir taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Fine-loamy, mixed, isohyperthermic Typic Haplustepts

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-8	Ap	77.72	14.09	8.19	6.31	13.12	18.82	27.16	12.31	-	sl	10.76	3.53
8-43	Bw1	76.00	10.38	13.62	13.29	17.92	16.99	20.60	7.21	-	sl	21.48	7.91
43-87	Bw2	52.64	19.95	27.41	2.69	4.66	16.79	16.89	11.61	-	scl	40.80	16.55

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-8	8.16	-	-	0.22	0.38	1.20	5.43	2.49	0.16	0.79	8.87	8.99	1.10	99	8.81
8-43	9.63	-	-	0.26	0.19	0.60	6.25	4.72	0.09	4.31	15.37	14.66	1.08	105	29.43
43-87	10.09	-	-	1.01	0.15	5.76	-	-	0.21	11.77	-	24.08	0.88	100	48.87

Contd...

Soil Series: Mylapura (MYP) **Pedon:** R-6

Location: $16^0$30'88.3"N $77^0$19'97.1"E, Kadechoora village, Sydhapura hobli, Yadgir taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Fine-loamy, mixed (calcareous), isohyperthermic Typic Haplustepts

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-18	Ap	54.46	22.28	23.26	6.02	8.61	12.86	15.66	11.31	-	scl	25.10	10.20
18-48	Bw1	52.88	21.23	25.89	5.13	4.19	17.49	14.87	11.20	-	scl	25.77	11.29
48-80	Bw2	47.20	24.81	27.99	3.28	6.35	12.28	15.45	9.84	-	scl	35.44	14.47
80-120	Bw3	46.88	22.15	30.97	2.53	6.97	12.67	15.95	8.76	-	scl	31.08	13.41
120-148	Bw4	40.97	20.70	38.33	0.75	1.18	12.47	12.69	13.87	-	cl	36.39	16.71
148-180	Bw5	41.71	18.93	39.36	0.86	3.96	12.62	17.75	6.52	-	cl	39.85	17.56

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-18	9.32	-	-	0.412	0.93	7.15	-	-	0.45	2.27	-	17.39	0.75	100	13.04
18-48	10.01	-	-	0.551	0.60	7.41	-	-	0.64	4.33	-	17.11	0.66	100	25.33
48-80	9.98	-	-	2.32	0.24	4.81	-	-	0.62	18.93	-	19.95	0.71	100	94.90
80-120	9.79	-	-	3.55	0.16	3.90	-	-	0.81	34.04	-	21.59	0.70	100	157.63
120-148	9.43	-	-	3.92	0.32	3.38	-	-	0.53	25.15	-	26.17	0.68	100	96.10
148-180	9.22	-	-	3.46	0.36	3.77	-	-	0.51	27.37	-	28.55	0.73	100	95.86

Chapter 5

INTERPRETATION FOR LAND RESOURCE MANAGEMENT

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

5.1 Land Capability Classification

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

Soil characteristics: 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 17 soil map units identified in the Kanekal-4 microwatershed are grouped under 2 land capability classes and 2 land capability subclasses. Entire area of the microwatershed is suitable for agriculture (Fig. 5.1).

Good cultivable lands (Class II) cover maximum area of 402 ha (81%) and are distributed in the major part of the microwatershed with minor problems of soil and erosion. Moderately good lands cover 87 ha (18%) and are distributed in the northern, central and southeastern part of the microwatershed with moderate problems of soil and erosion.

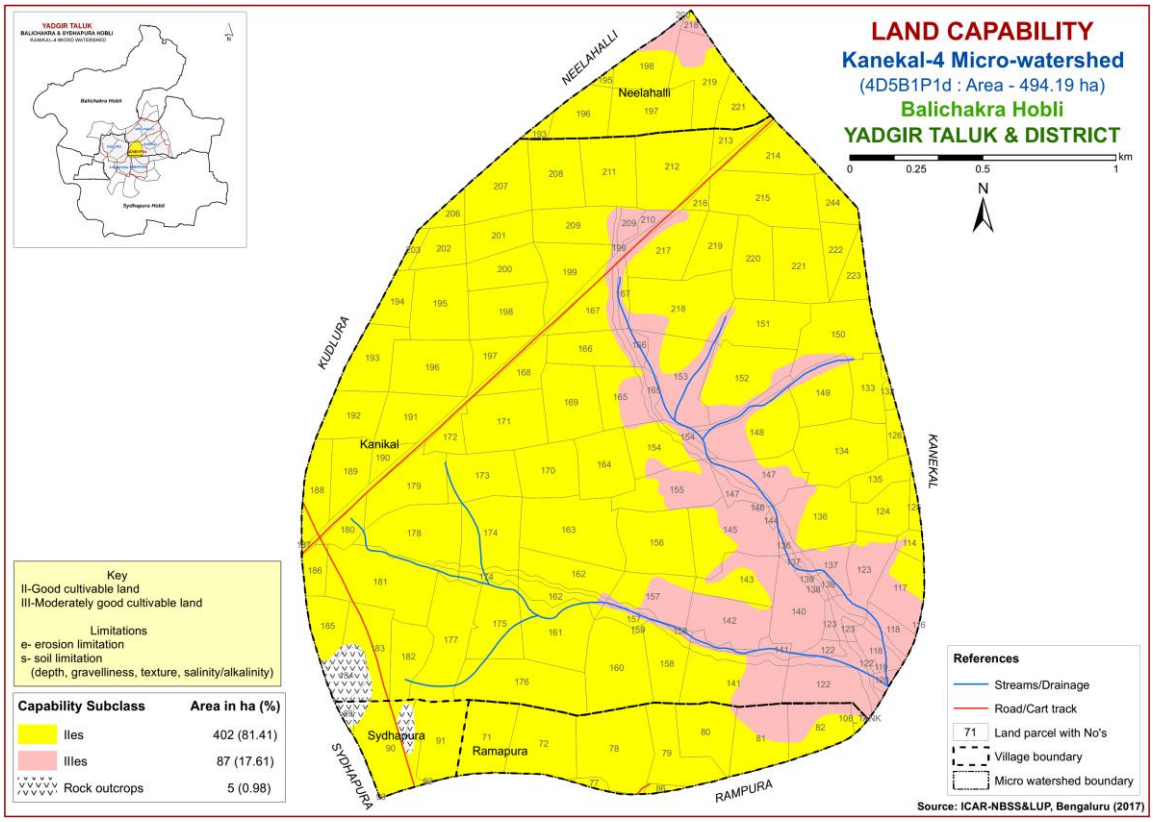


Fig. 5.1 Land Capability map of Kanekal-4 Microwatershed

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 59 ha (12%) and are distributed in the southern and northern part of the microwatershed. Deep soils (100-150 cm) occur in maximum area of 222 ha (45%) and are distributed in the major part of the microwatershed. Moderately deep soils (75-100 cm) occur in an area of about 88 ha (18%) and are distributed in the central, southern, western and northwestern part of the microwatershed. An area of about 117 ha (24%) is moderately shallow soils (50-75 cm) and are distributed in all parts of the microwatershed. Shallow soils (25-50 cm) occupy a small area of 3 ha (1%) and are distributed in the northern part of the microwatershed.

The most productive lands covering about 281 ha (57%) 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 the major part of the microwatershed.

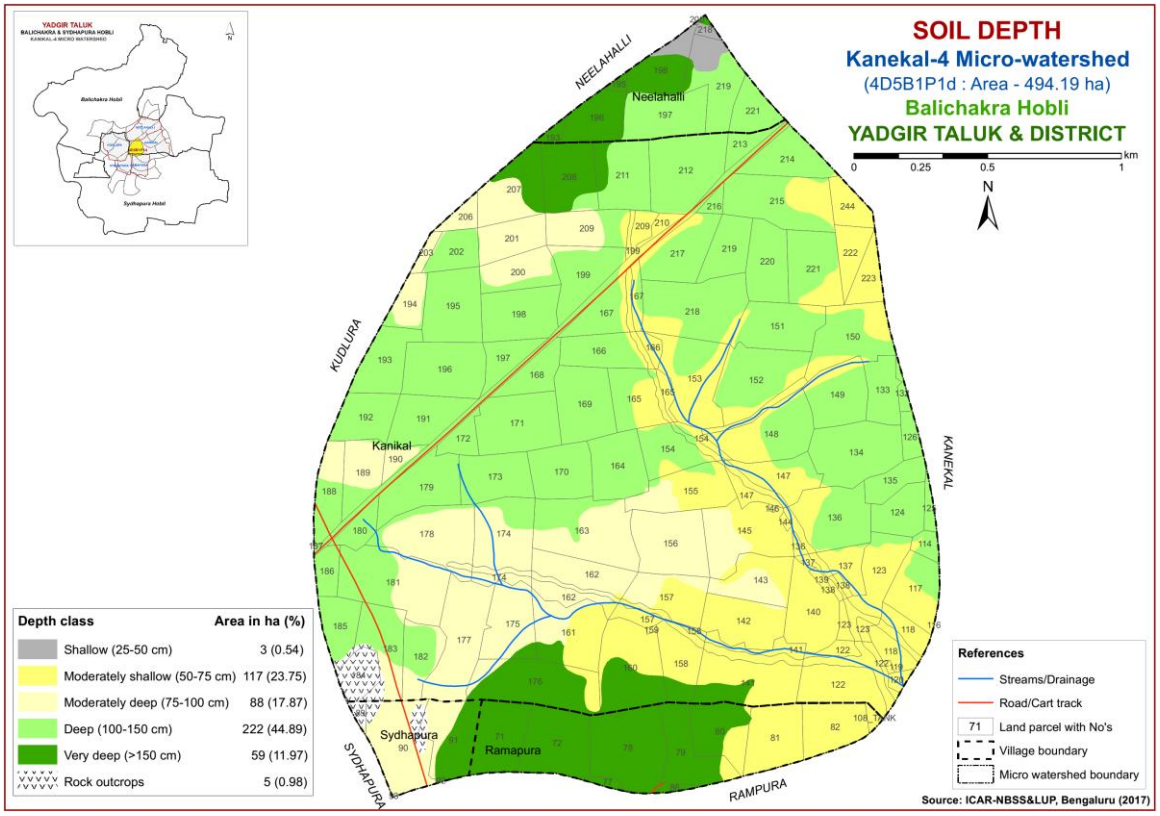


Fig. 5.2 Soil Depth map of Kanekal-4 Microwatershed

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 285 ha (58%) has clayey soils at the surface and are distributed in the major part of the microwatershed. Loamy soils occupy an area of about 193 ha (39%) and are distributed in all parts of the microwatershed. Sandy soils occupy a small area of about 12 ha (3%) and are distributed in the northeastern part of the microwatershed.

The most productive lands (58%) with respect to surface soil texture are the clay 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 (39%) 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 (3%) that have less run-off and low soil moisture retention, less capillary rise and less evaporation losses, but are amenable to good soil tilth and are ideal for root and tuber crops.

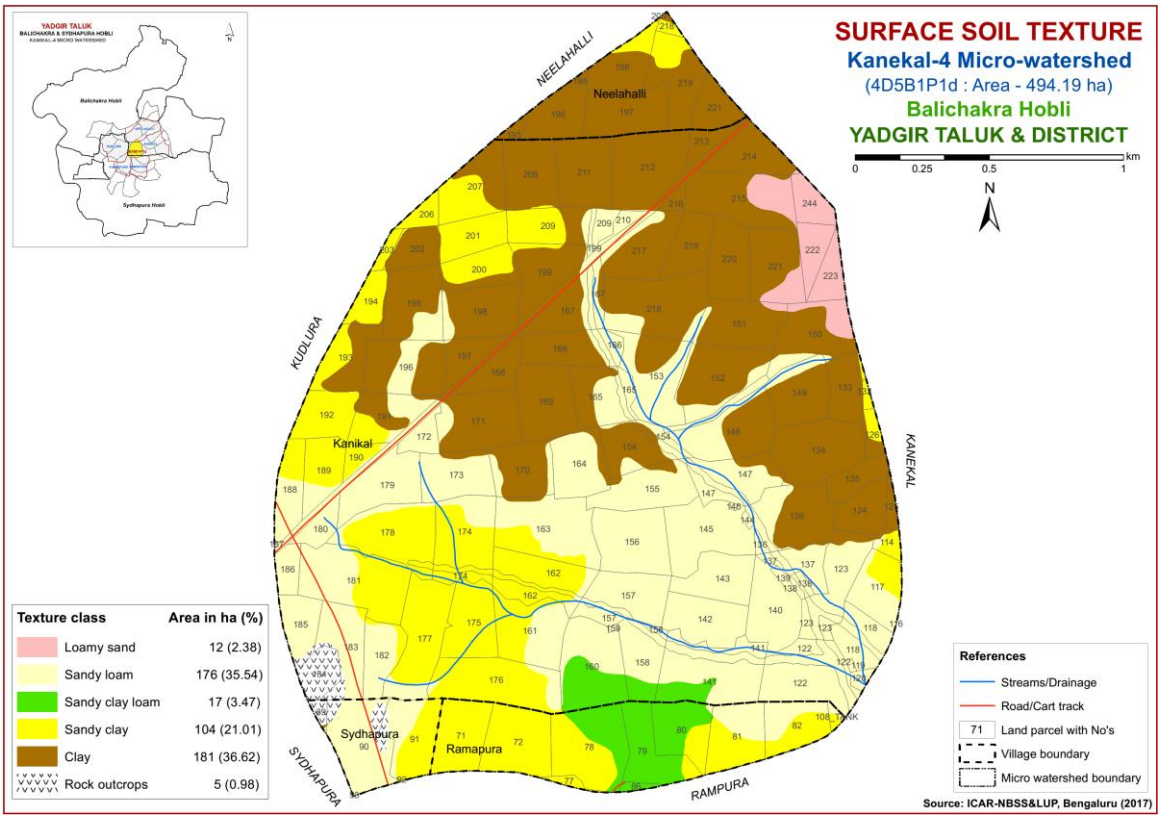


Fig. 5.3 Surface Soil Texture map of Kanekal-4 Microwatershed

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 379 ha (77%) has soils that are non gravelly (<15%) and are distributed in the major part of the microwatershed. An area of 111 ha (22%) is gravelly (15-35%) and is distributed in the southeastern, central and southern part of the microwatershed.

The most productive lands with respect to gravelliness are found to be 77 per cent. They are non gravelly (<15%) and have potential for growing all annual and perennial crops.

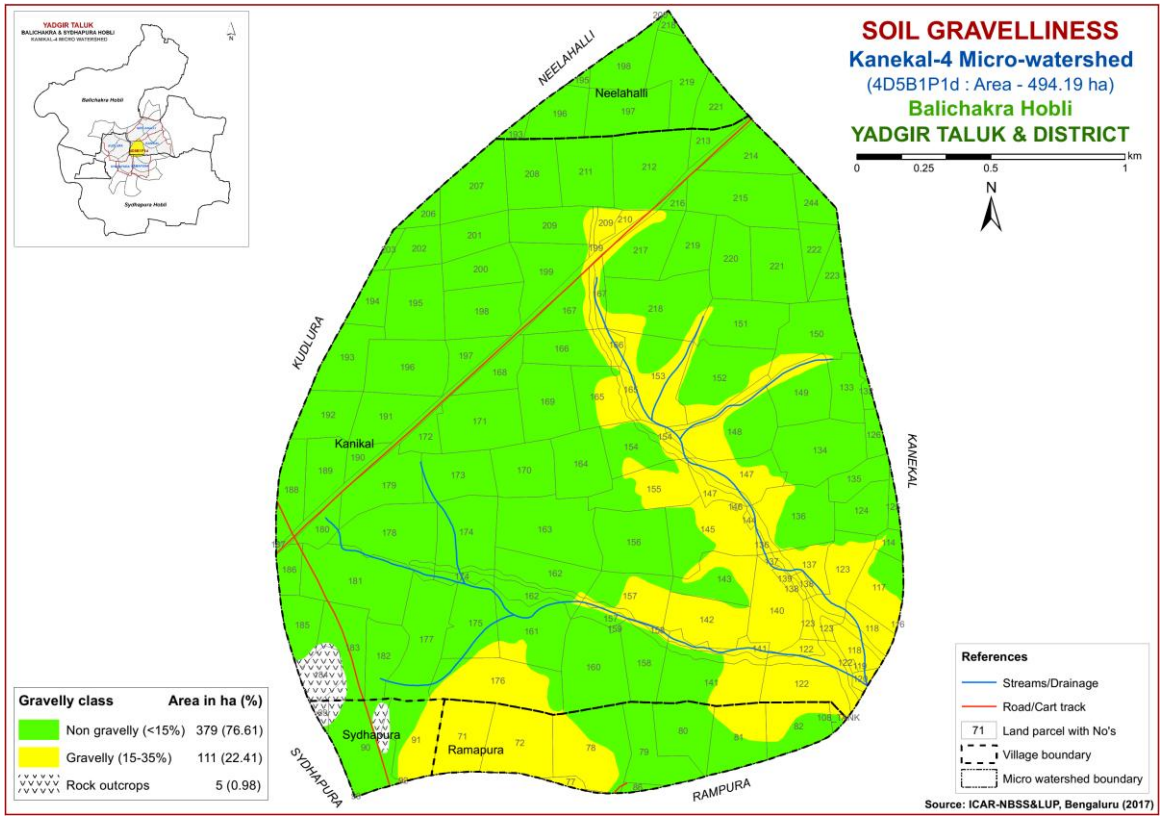


Fig. 5.4 Soil Gravelliness map of Kanekal-4 Microwatershed

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 101 ha (20%) has soils that are very low (<50 mm/m) in available water capacity and are distributed in the central and southeastern part of the microwatershed. An area of about 81 ha (16%) has soils that are low (51-100 mm/m) in available water capacity and are distributed in all parts of the microwatershed. An area of 29 ha (6%) is medium (101-150 mm/m) and are distributed in the northeastern, southwestern and southeastern part of the microwatershed. Maximum area of 278 ha (56%) in the microwatershed has soils that are very high (>200 mm/m) in available water capacity and are distributed in the major part of the microwatershed.

The most productive lands with very high available water capacity cover about 278 ha (56%), if the rainfall is normal and well distributed, all climatically adapted long duration annual and perennial crops can be grown. Maximum area of 182 ha (37%) 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 under other alternative uses.

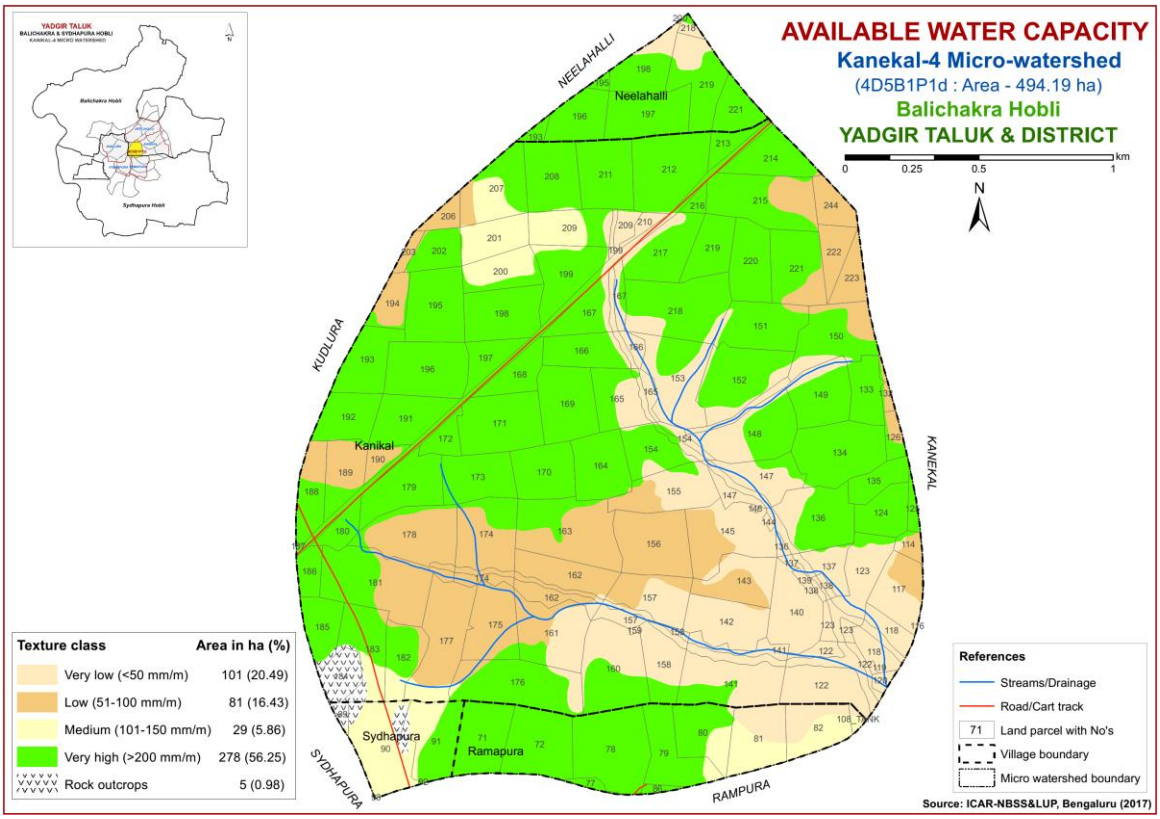


Fig. 5.5 Soil Available Water Capacity map of Kanekal-4 Microwatershed

5.6 Soil Slope

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

Maximum area of about 405 ha (82%) is under very gently sloping (1-3%) lands and they are distributed in the major part of the microwatershed. Gently sloping (3-5%) lands occupy an area of 84 ha (17%) and are distributed in the central and southeastern part of the microwatershed.

In areas of very gently sloping (1-3%) lands (82%), all climatically adapted annual and perennial crops can be grown without much soil and water conservation and other land development measures. In gently sloping (3-5%) lands (17%) the soil and water conservation measures should be adapted for better crop production.

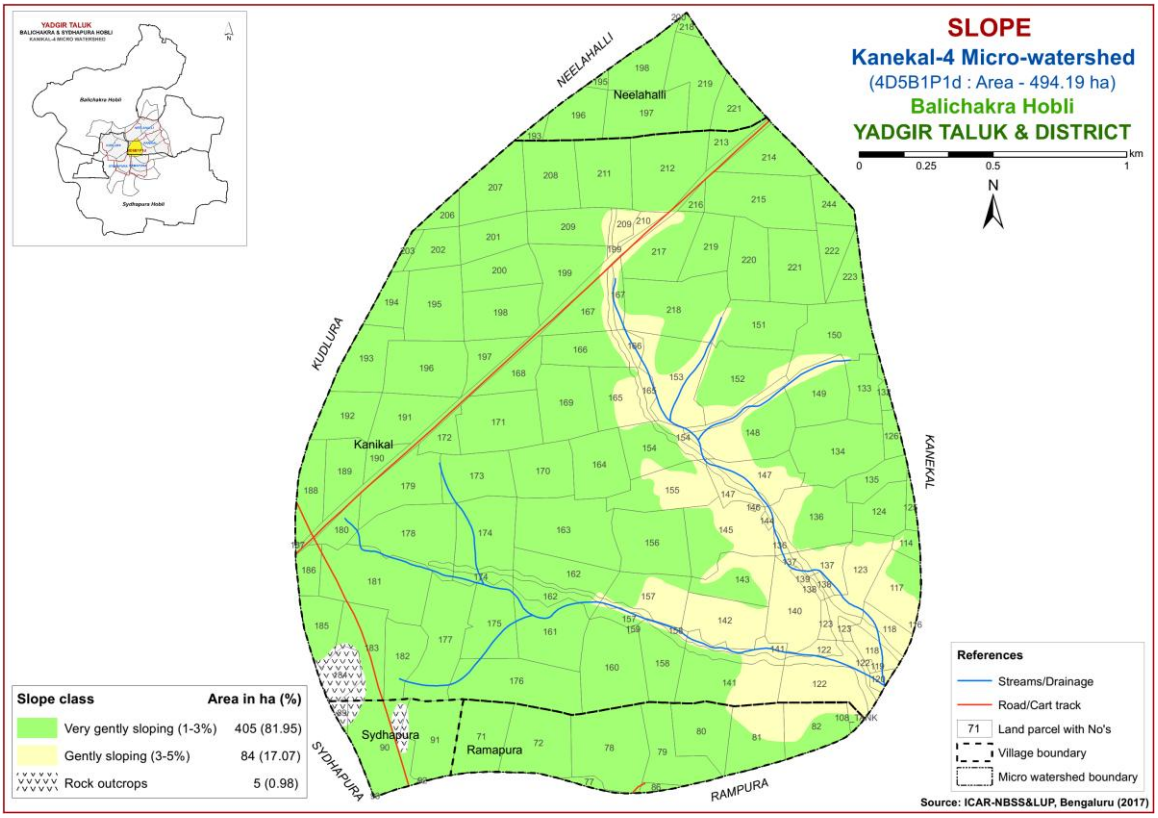


Fig. 5.6 Soil Slope map of Kanekal-4 Microwatershed

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 maximum area 405 ha (82%) and are distributed in the major part of the microwatershed. Severely eroded (e3 class) cover an area of 84 ha (17%) and are distributed in the central and southeastern part of the microwatershed.

In all these areas soil and water conservation and other land development measures be followed in order to control soil erosion.

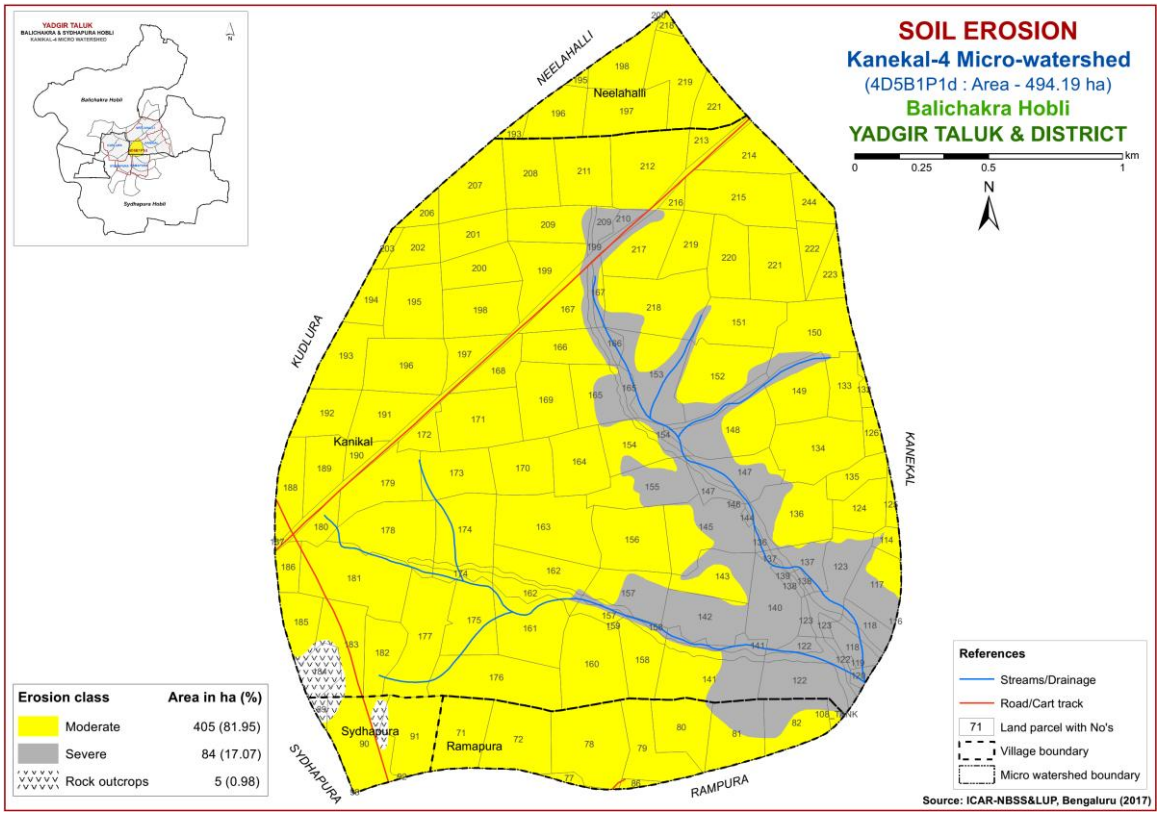


Fig. 5.7 Soil Erosion map of Kanekal-4 Microwatershed

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 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-4 microwatershed for soil reaction (pH) showed that an area of 59 ha (12%) is strongly alkaline (pH 8.4-9.0) and is distributed in the central and southeastern part of the microwatershed. An area of 164 ha (33%) is moderately alkaline (pH 7.8-8.4) in reaction and is distributed in the southeastern, central, southwestern and northern part of the microwatershed (Fig.6.1). Slightly alkaline (pH 7.3-7.8) is around 178 ha (36%) area and is distributed in the major part of the microwatershed. An area of about 89 ha (18%) is neutral (pH 6.5-7.3) and is distributed in the central, western and 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 447 ha (91%) and are distributed in the major part of the microwatershed. Medium (0.5-0.75%) organic carbon content accounts for an area of about 40 ha (8%) and is distributed in the western, northern and southeastern part of the microwatershed. Low in a small area of 2 ha (<1%) and are distributed in the southeastern part of the microwatershed.

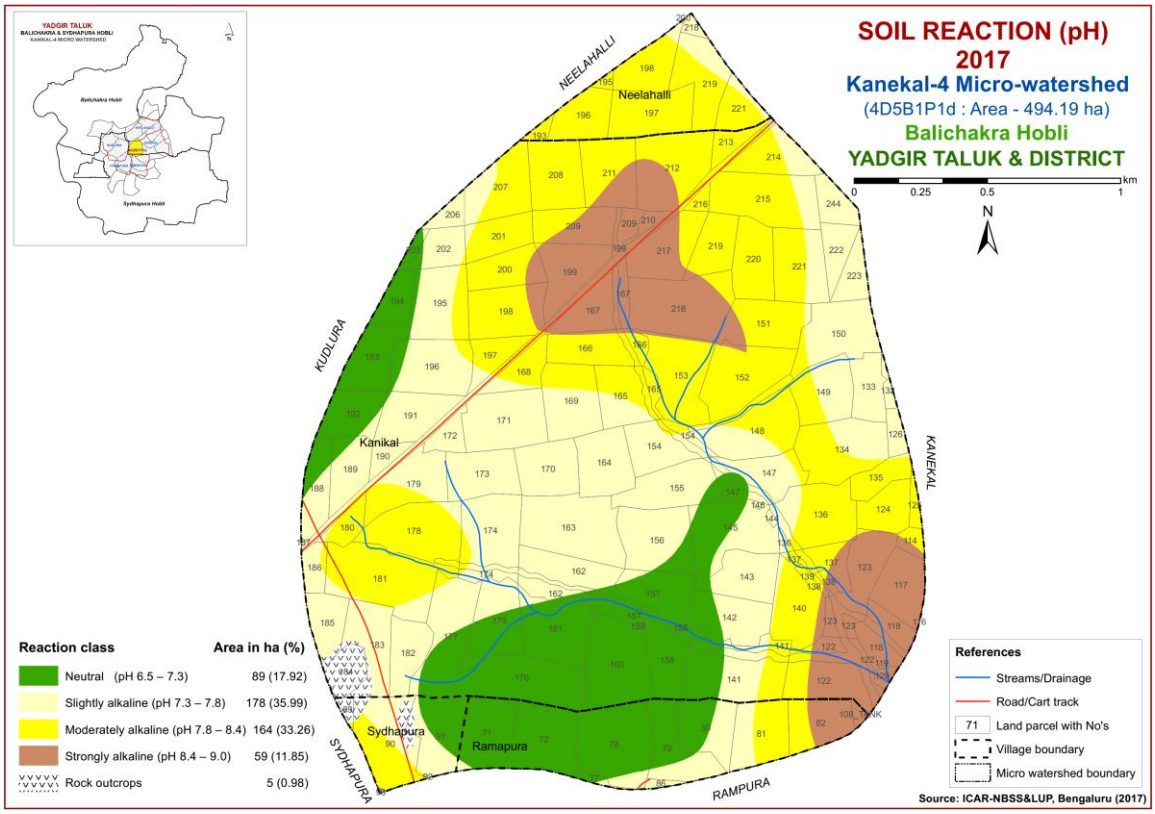


Fig.6.1 Soil Reaction (pH) map of Kanekal-4 Microwatershed

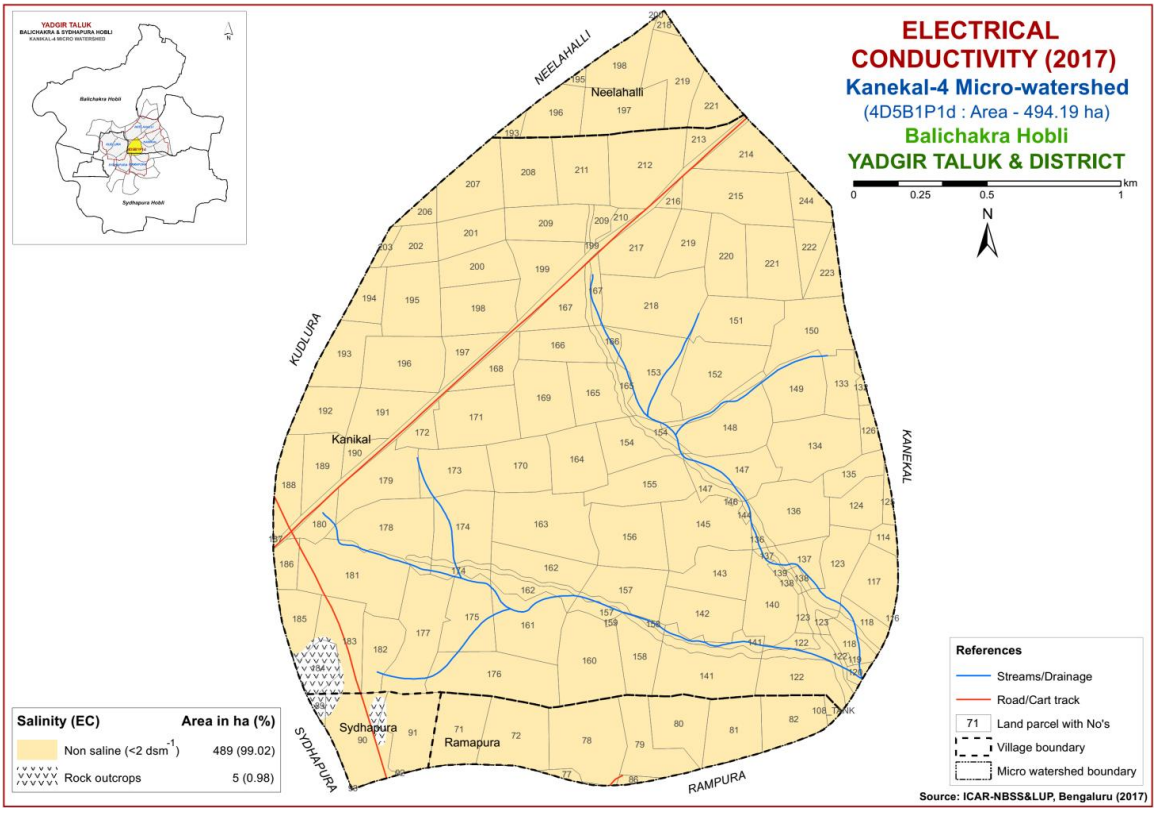


Fig.6.2 Electrical Conductivity (EC) map of Kanekal-4 Microwatershed

6.4 Available Phosphorus

The soil fertility analysis revealed that available phosphorus (Fig.6.4) is low (<23 kg/ha) in an area of 66 ha (13%) and is distributed in the southeastern and southern part of the microwatershed. Maximum area of about 418 ha (85%) is medium (23-57 kg/ha) in available phosphorus and is distributed in the major 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. The available phosphorous is high (>57 kg/ha) in a small area of 5 ha (1%) and is distributed in the western part of the microwatershed.

6.5 Available Potassium

Available potassium content (Fig.6.5) is medium (145-337 kg/ha) in a maximum area of 481 ha (97%) and is distributed in the major part of the microwatershed. High available potassium (>337 kg/ha) content accounts for a small area of 8 ha (2%) and is distributed in the northern part of the microwatershed.

6.6 Available Sulphur

Available sulphur content is medium (10-20 ppm) in an area of about 66 ha (13%) and is distributed in the northwestern, southern and central part of the microwatershed. Available sulphur is low (<10 ppm) in a maximum area of 424 ha (86%) and is distributed in the major part of the microwatershed (Fig.6.6).

6.7 Available Boron

Available boron content (Fig.6.7) is low (<0.5ppm) in a maximum area of 255 ha (52%) and is distributed in the major part of the microwatershed. An area of about 219 ha (44%) is medium in available boron (0.5-1.0 ppm) and is distributed in all parts of microwatershed. An area of about 15 ha (3%) is high (>1.0 ppm) in available boron and are distributed in the central part of microwatershed.

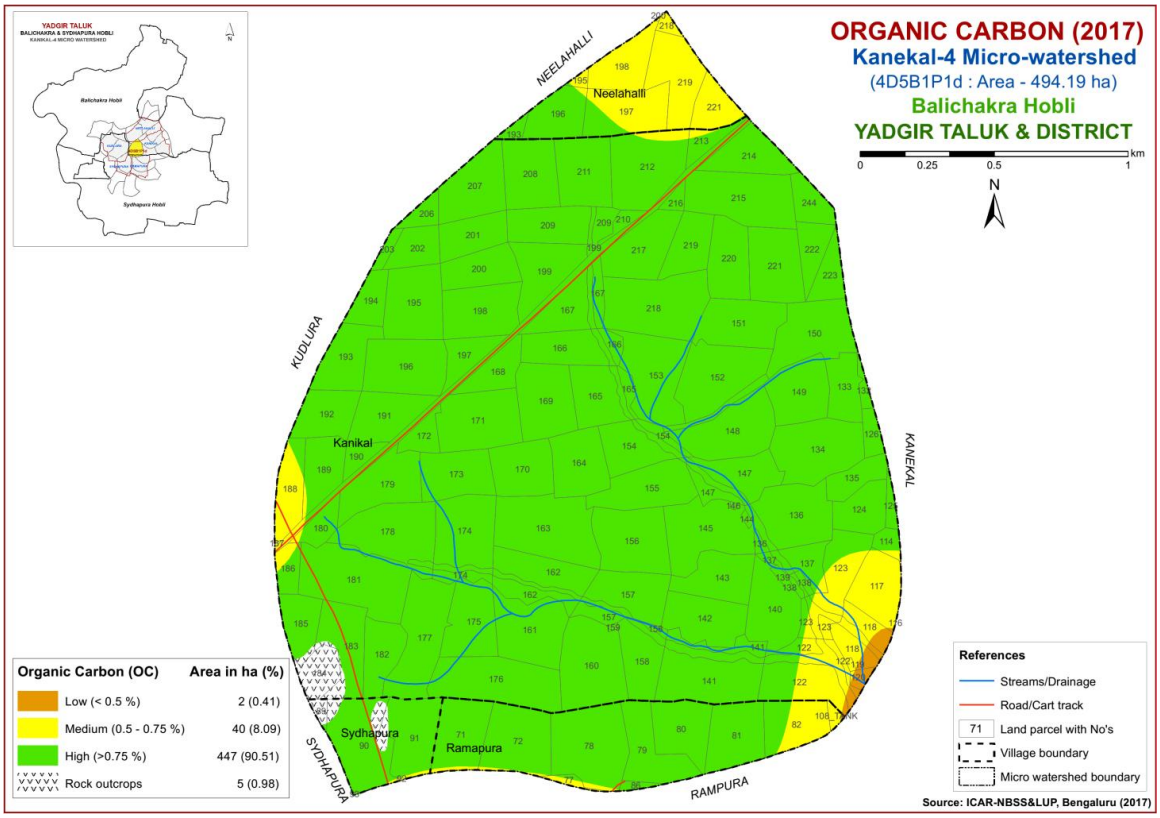


Fig.6.3 Soil Organic Carbon map of Kanekal-4 Microwatershed

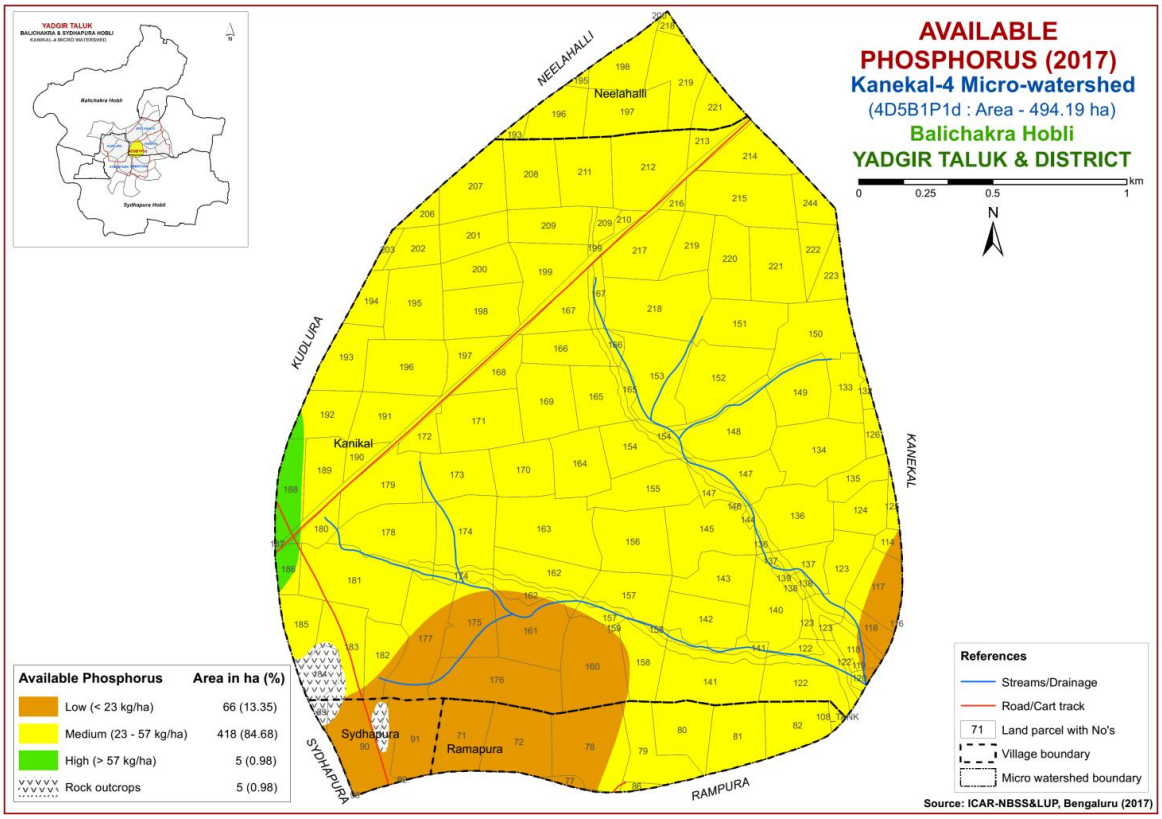


Fig.6.4 Soil available Phosphorus map of Kanekal-4 Microwatershed

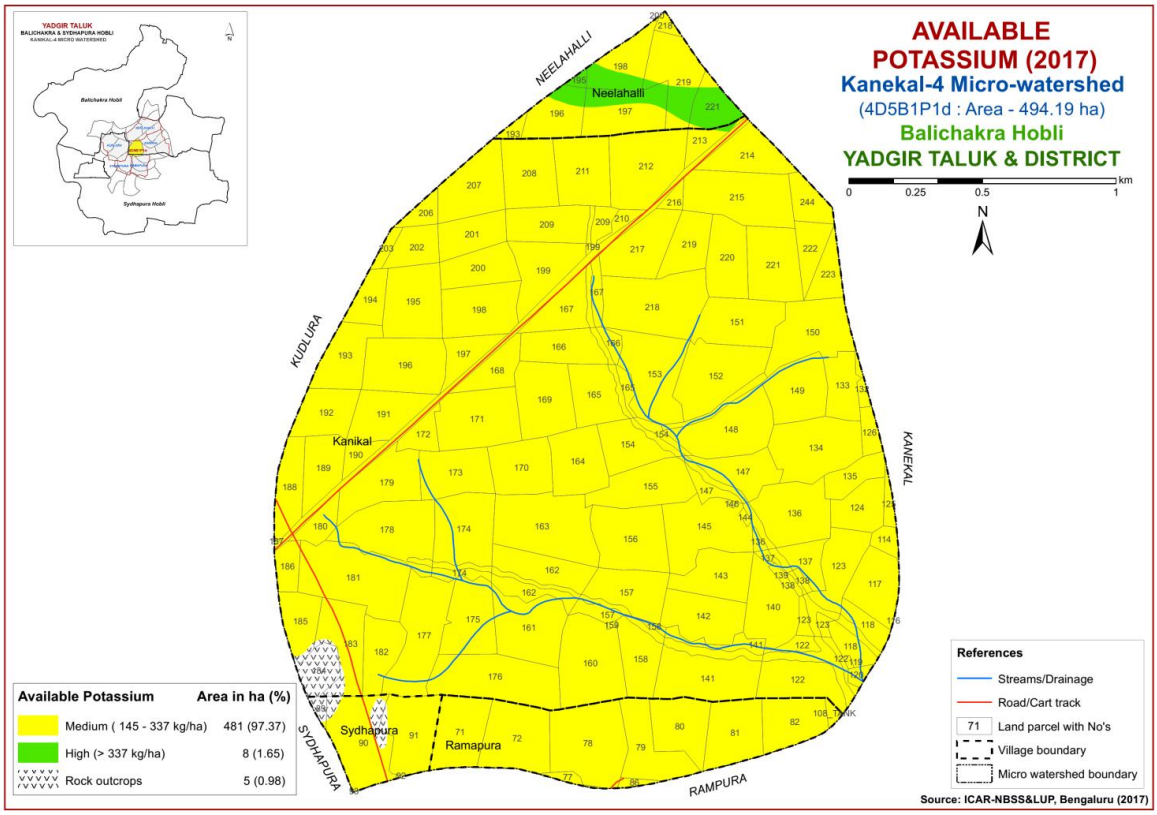


Fig.6.5 Soil available Potassium map of Kanekal-4 Microwatershed

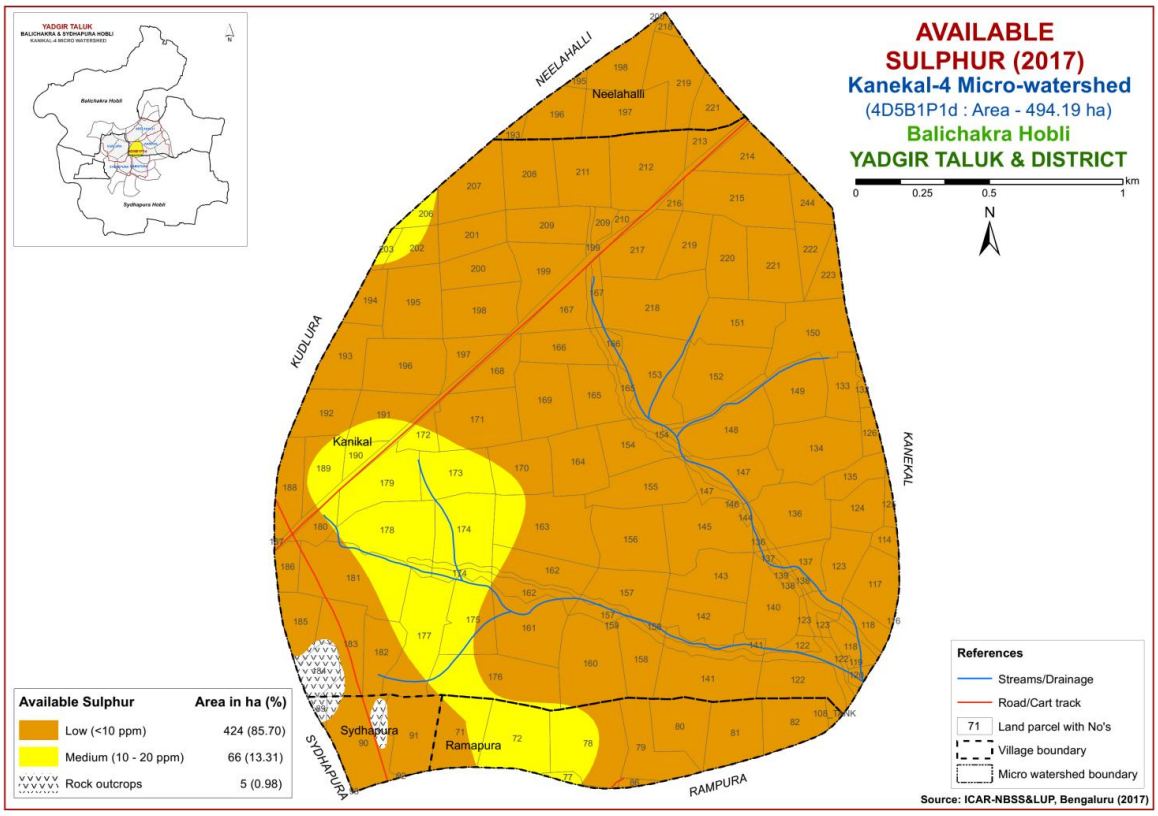


Fig.6.6 Soil available Sulphur map of Kanekal-4 Microwatershed

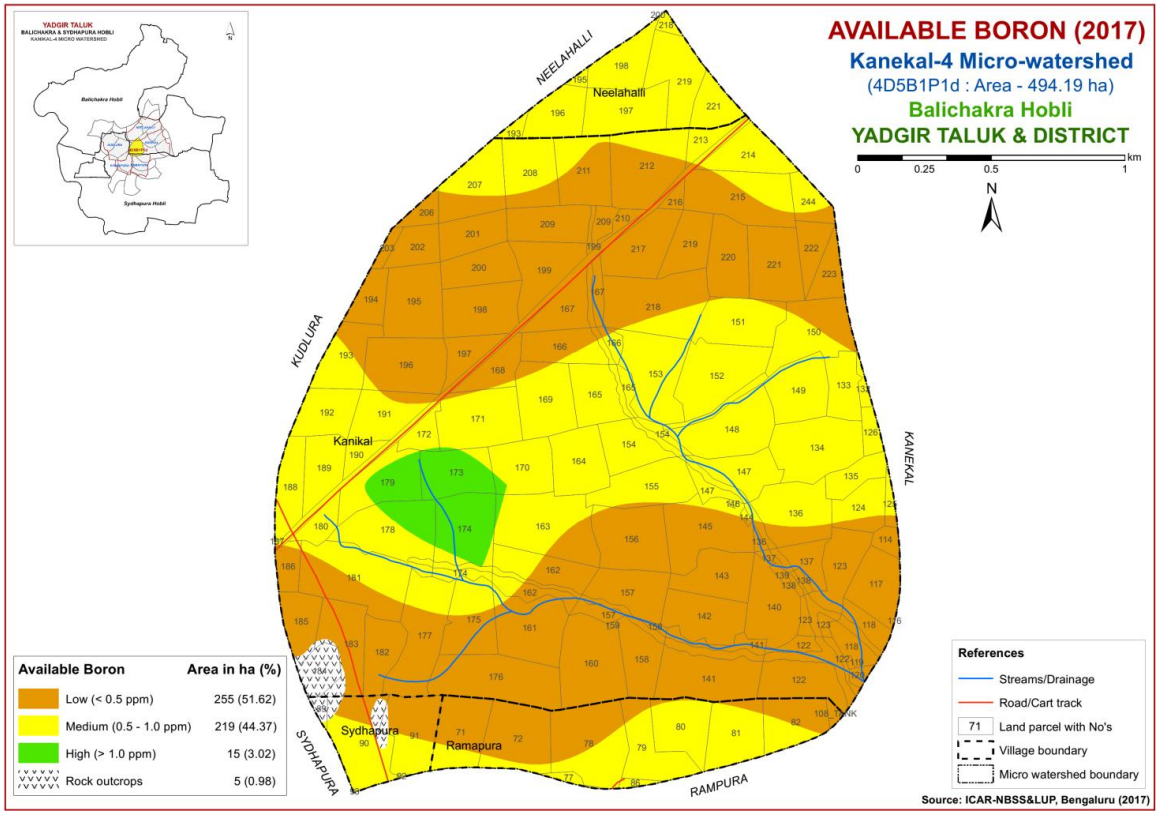


Fig.6.7 Soil available Boron map of Kanekal-4 Microwatershed

6.8 Available Iron

Available iron content is sufficient (>4.5 ppm) in a maximum area of about 415 ha (84%) and is distributed in the major part of the microwatershed. It is deficient (<4.5 ppm) in an area of about 75 ha (15%) and is distributed in the northern, central and southeastern 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 the microwatershed (Fig 6.11).

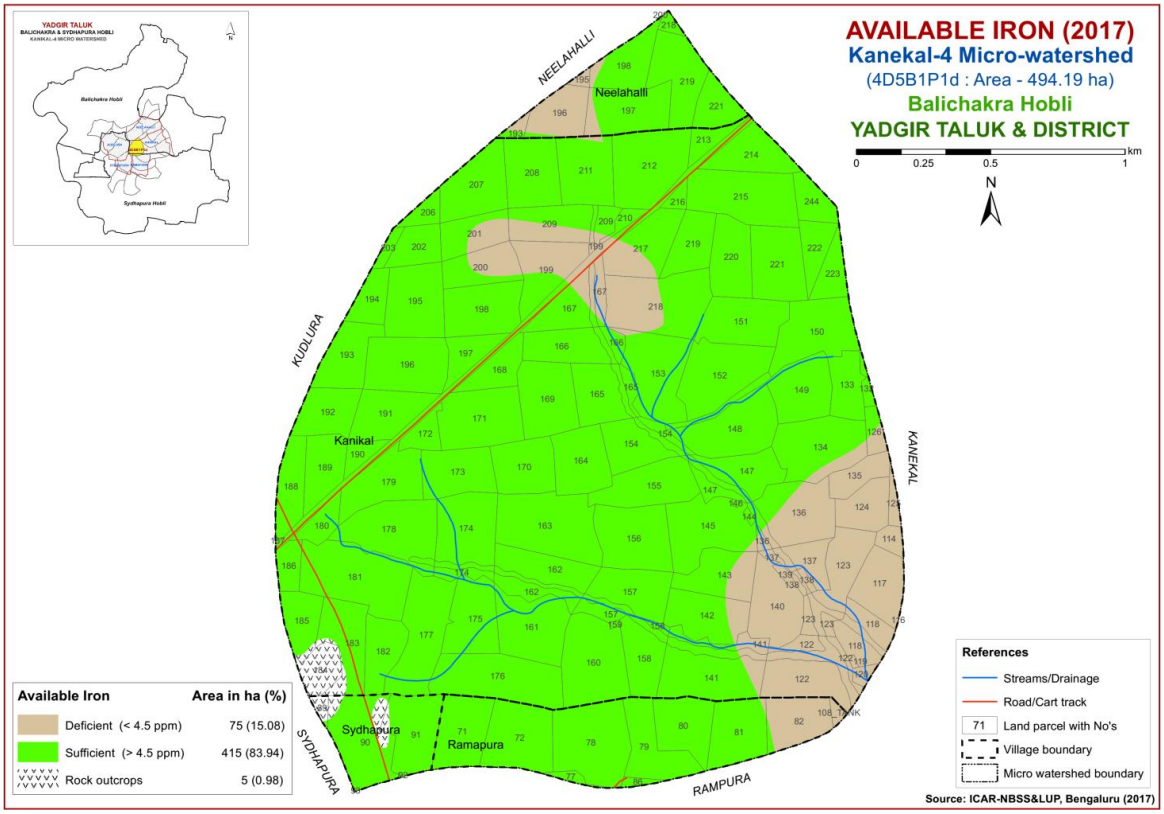


Fig.6.8 Soil available Iron map of Kanekal-4 Microwatershed

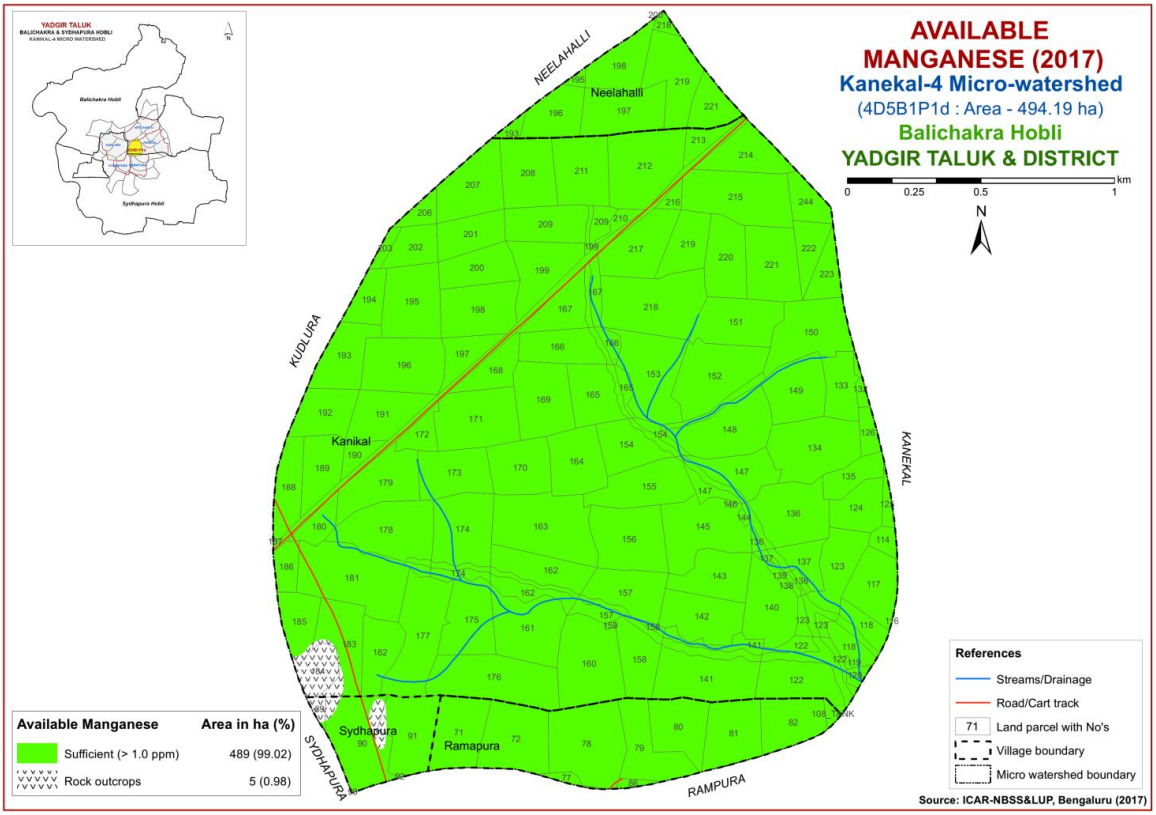


Fig.6.9 Soil available Manganese map of Kanekal-4 Microwatershed

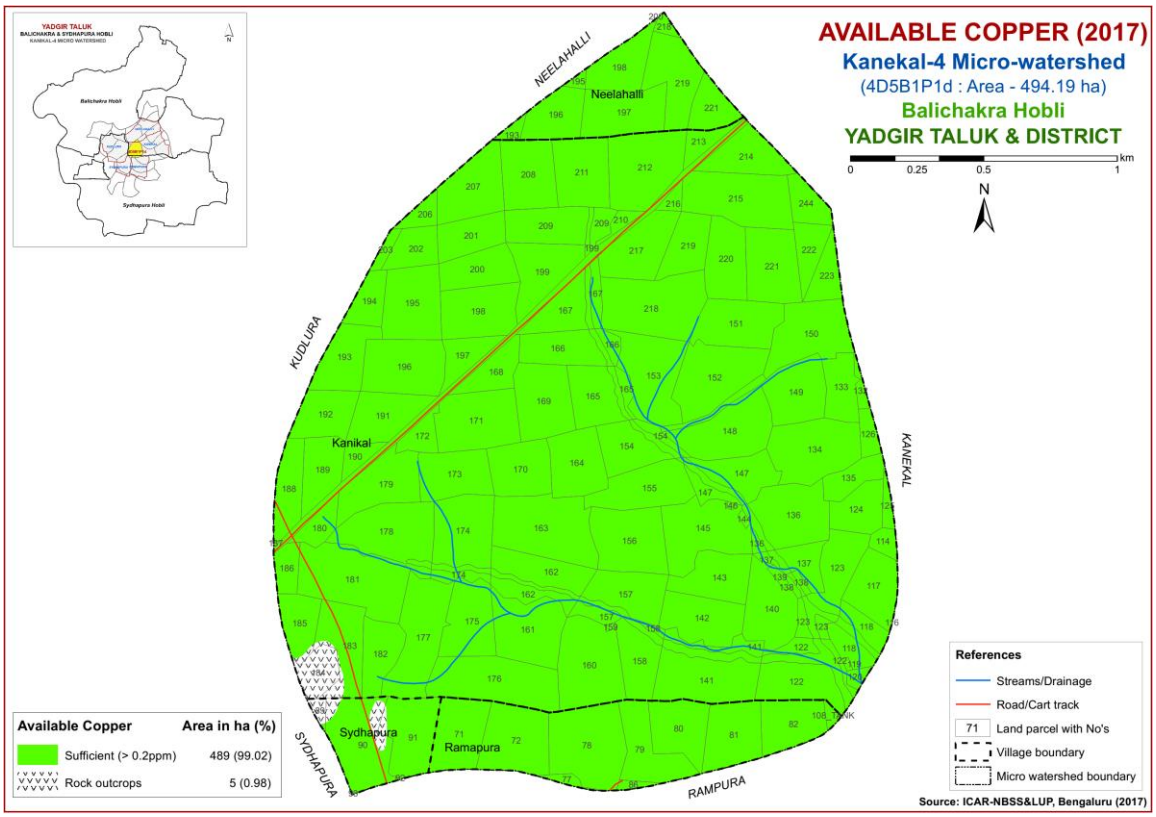


Fig.6.10 Soil available Copper map of Kanekal-4 Microwatershed

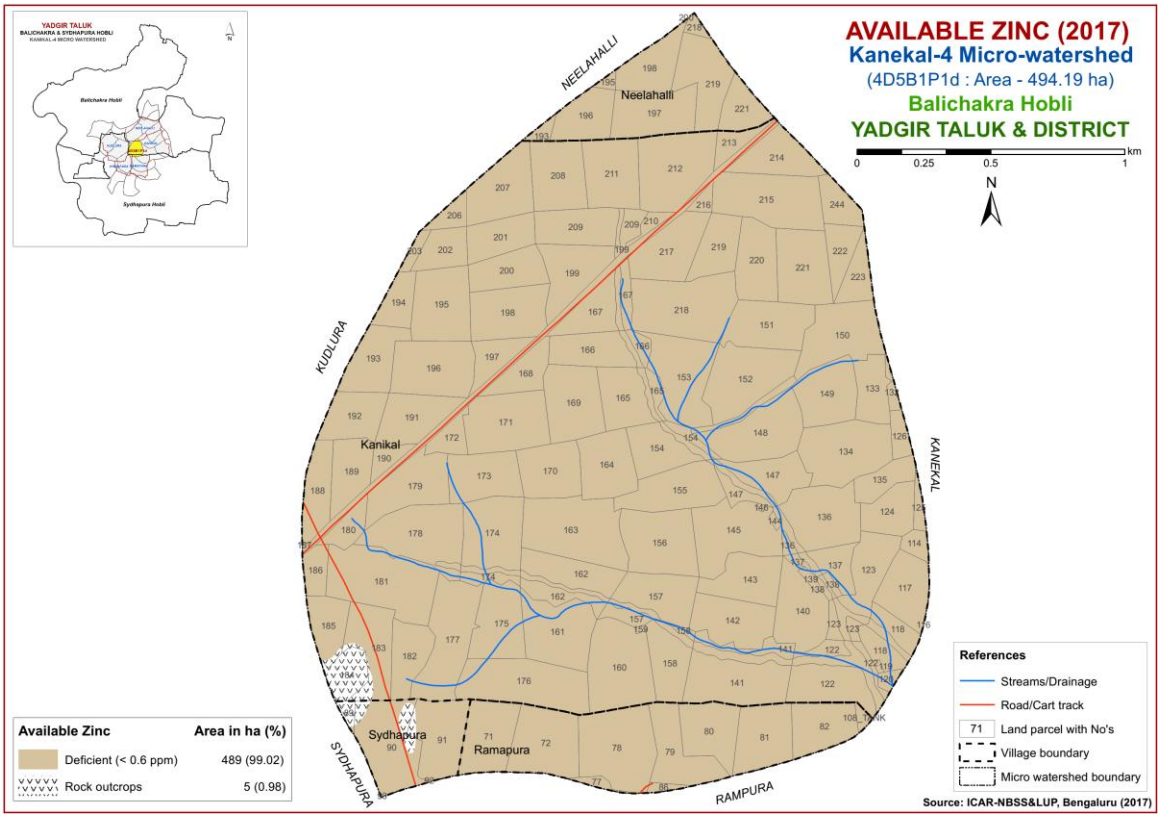


Fig.6.11 Soil available Zinc map of Kanekal-4 Microwatershed

Chapter 7

LAND SUITABILITY FOR MAJOR CROPS

The soil and land resource units (soil phases) of Kanekal-4 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 land with the limitations of soil depth and erosion is 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 in 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-4 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 (%)								
BDLiB2	866	150	WD	25-50	sc	sl	-	-	<50	1-3	moderate	6.20	0.074	0.20	4.20	93
SBRcB2	866	150	SED	50-75	sl	ls	-	-	<50	1-3	moderate	8.24	0.145	1.15	7.50	100
SBRcC3g1	866	150	SED	50-75	sl	ls	15-35	-	<50	3-5	severe	8.24	0.145	1.15	7.50	100
YLRbB2	866	150	WD	50-75	ls	c	-	15-35	51-100	1-3	moderate	6.91	0.069	0.45	6.90	100
HSLiB2	866	150	MW	75-100	sc	sc	-	-	101-150	1-3	moderate	7.16	0.117	5.94	4.90	97
GWDiB2	866	150	MW	75-100	sc	scl	-	-	101-150	1-3	moderate	9.89	0.74	43.51	8.35	100
YDRiB2	866	150	WD	100-150	sc	sl	-	-	51-100	1-3	moderate	9.47	0.371	12.14	12.70	100
NGPmB2	866	150	WD	100-150	c	c	-	-	>200	1-3	moderate	7.42	0.24	0.22	67.10	100
MDGcB2	866	150	MW	100-150	sl	scl	-	-	>200	1-3	moderate	8.20	0.39	7.69	4.90	100
MDGiB2	866	150	MW	100-150	sc	scl	-	-	>200	1-3	moderate	8.20	0.39	7.69	4.90	100
MDRmB2	866	150	WD	>150	c	scl	-	-	>200	1-3	moderate	8.31	0.33	2.26	20.57	100
RMPiB2	866	150	WD	50-75	sc	scl	-	-	101-150	1-3	moderate	5.97	0.04	0.77	1.70	56
RHNcB2	866	150	WD	75-100	sl	scl	-	-	101-150	1-3	moderate	8.16	0.22	8.81	8.99	99
RHNmB2	866	150	WD	75-100	c	scl	-	-	101-150	1-3	moderate	8.16	0.22	8.81	8.99	99
MYPhB2	866	150	WD	>150	scl	scl	-	-	>200	1-3	moderate	9.32	0.412	13.04	17.39	100
MYPiB2g1	866	150	WD	>150	sc	scl	15-35	-	>200	1-3	moderate	9.32	0.412	13.04	17.39	100
KDHcB2	866	150	MW	75-100	sl	sc	-	-	51-100	1-3	moderate	8.22	0.198	2.71	12.26	100

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

In Kanekal-4 microwatershed no highly (Class S1) suitable lands available for growing sorghum. Maximum area of about 385 ha (78%) 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 and rooting depth. Marginally suitable lands (Class S3) occupy an area of 105 ha (21%) and are distributed in the northern, central, eastern and southeastern part of the microwatershed. They have moderate limitations of texture, rooting depth and calcareousness.

Table 7.2 Crop suitability criteria for Sorghum

Crop requirement		Rating			
Soil –site characteristics	**Unit**	**Highly suitable(S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable(N)**
Slope	%	2-3	3-8	8-15	>15
LGP	Days	120-150	120-90	<90	
Soil drainage	class	Well to mod. 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

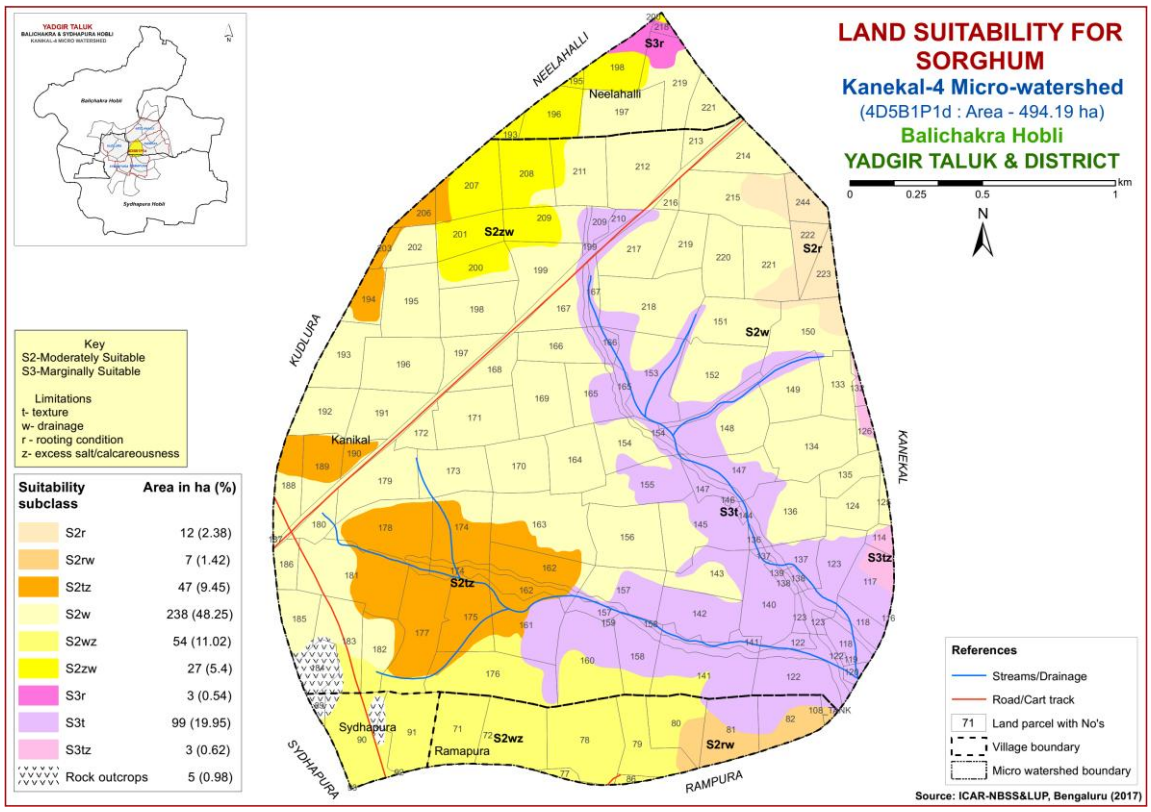


Fig. 7.1 Land Suitability map of Sorghum

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	

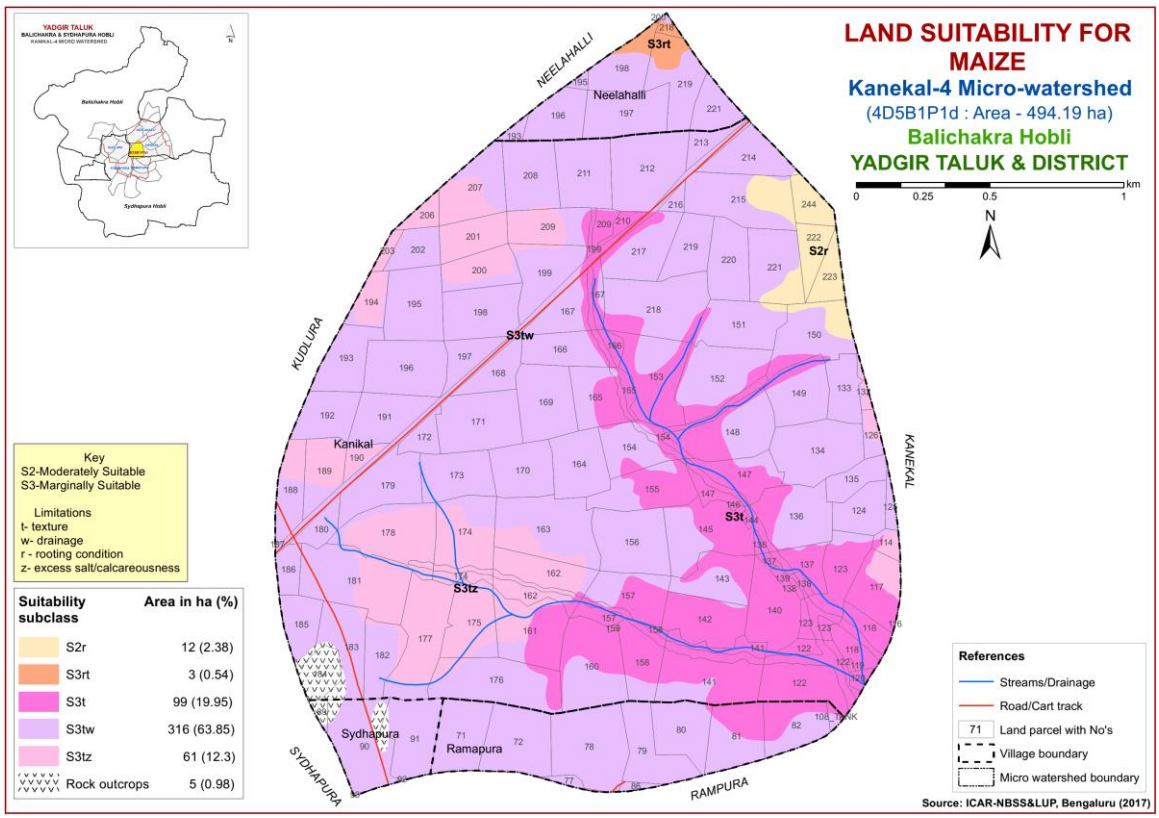


Fig. 7.2 Land Suitability map of Maize

In Kanekal-4 microwatershed no highly (Class S1) suitable lands available for growing maize. An area of about 12 ha (2%) is moderately suitable (Class S2) for

growing maize and are distributed in the northeastern part of the microwatershed with minor limitation of rooting depth. Marginally suitable lands (Class S3) occupy maximum area of 479 ha (97%) and are distributed in the major part of the microwatershed. They have moderate limitations of texture, rooting depth, drainage and calcareousness.

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-4 microwatershed, there are no lands that are highly (Class S1) suitable for growing redgram. Maximum area of about 370 ha (75%) is moderately suitable (Class S2) for red gram and is distributed in the major part of the microwatershed. They have minor limitations of texture, rooting depth, calcareousness and drainage. An area of about 121 ha (24%) is marginally suitable (Class S3) for growing red gram and are distributed in all parts of the microwatershed. They have moderate limitations of rooting depth, drainage and texture.

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.(	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	

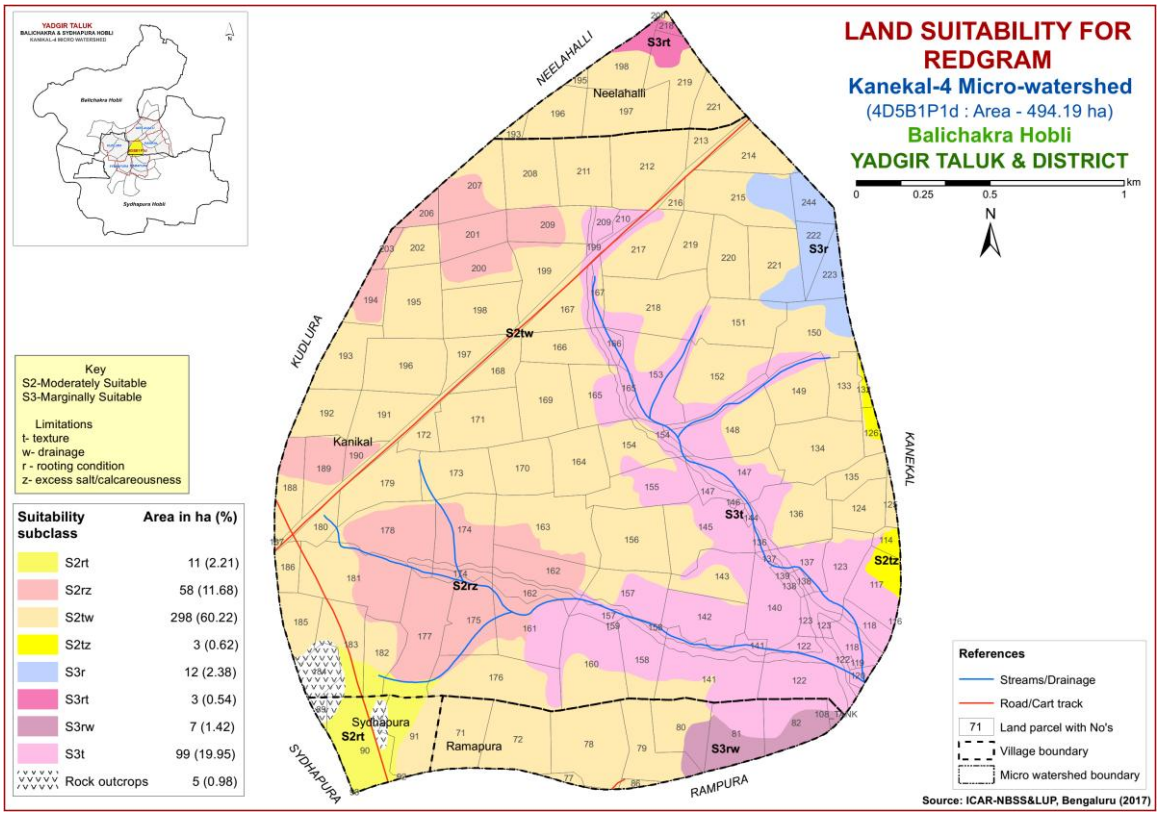


Fig. 7.3 Land Suitability map of Red gram

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.

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

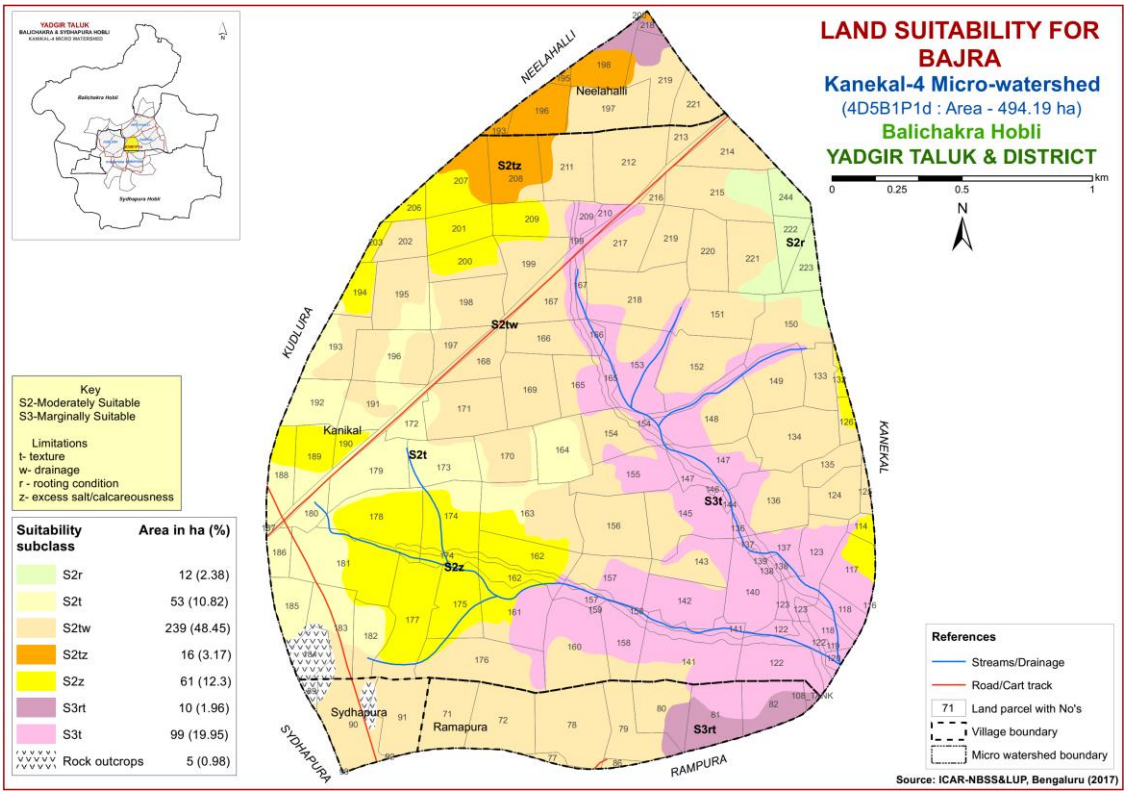


Fig. 7.4 Land Suitability map of Bajra

In Kanekal-4 microwatershed no lands that are highly (Class S1) suitable for growing bajra. Maximum area of about 381 ha (77%) is moderately suitable (Class S2) for growing bajra 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 109 ha (22%) and are distributed in the central and southeastern part of the microwatershed. They have moderate limitations of texture and rooting depth.

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.

In Kanekal-4 microwatershed, there are no highly suitable (Class S1) lands for growing groundnut. Moderately suitable (Class S2) lands cover an area of 62 ha (12%) and occur in all parts of the microwatershed. They have minor limitations of calcareousness, texture and rooting depth. The marginally suitable (Class S3) lands cover a maximum area of 429 ha (86%) and occur in the major part of the microwatershed. They have moderate limitations of texture, rooting depth, calcareousness and drainage.

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	

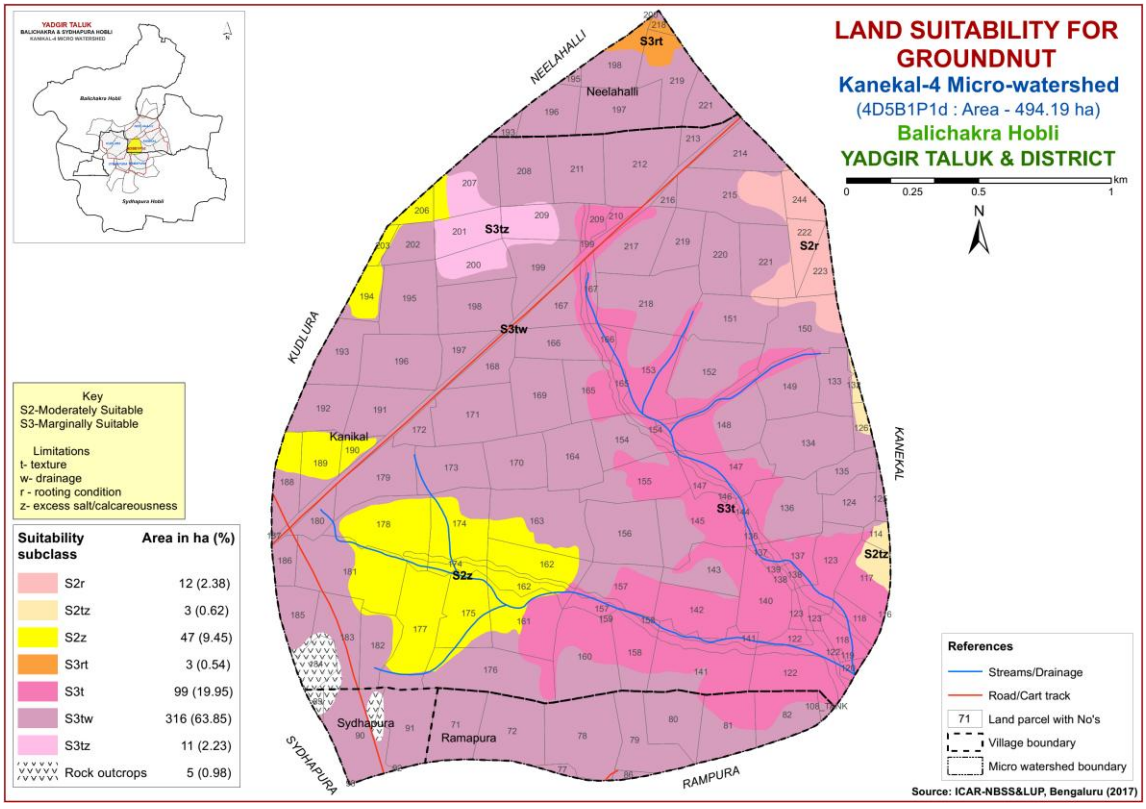


Fig. 7.5 Land Suitability map of Groundnut

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-4 microwatershed, there are no lands that are highly (Class S1) suitable for growing sunflower. An area of about 62 ha (12%) is moderately suitable (Class S2) for sunflower and is distributed in all parts of the microwatershed. They have minor limitations of rooting depth, calcareousness and texture. An area of about 429 ha (87%) is marginally suitable (Class S3) for growing sunflower and are distributed in the major part of the microwatershed. They have moderate limitations of rooting depth, drainage, texture and calcareousness.

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	

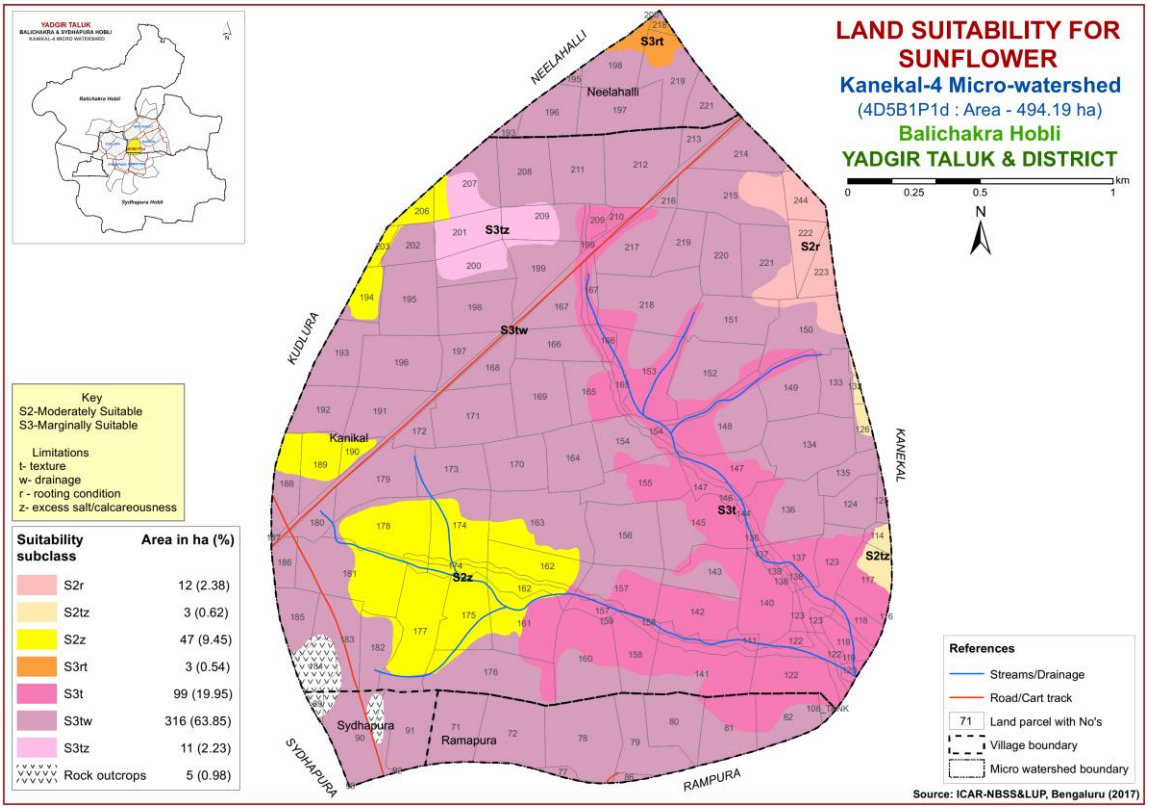


Fig. 7.6 Land Suitability map of Sunflower

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-4 microwatershed the highly (Class S1) suitable lands for growing cotton occur in maximum area of 219 ha (44%) and are distributed in the major part of the microwatershed. An area of about 120 ha (24%) is moderately suitable (Class S2) for growing cotton and are distributed in all parts of the microwatershed. They have minor limitations of drainage, calcareousness and rooting depth. Marginally suitable (Class S3) lands occupy an area of 50 ha (10%) and are distributed in the central, western, northwestern and northern part of the microwatershed. They have moderate limitations of rooting depth, texture and calcareousness. Not suitable (Class N1) lands occupy an area of 102 ha (21%) and are distributed in the central, eastern and southeastern part of the microwatershed with severe limitations of 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

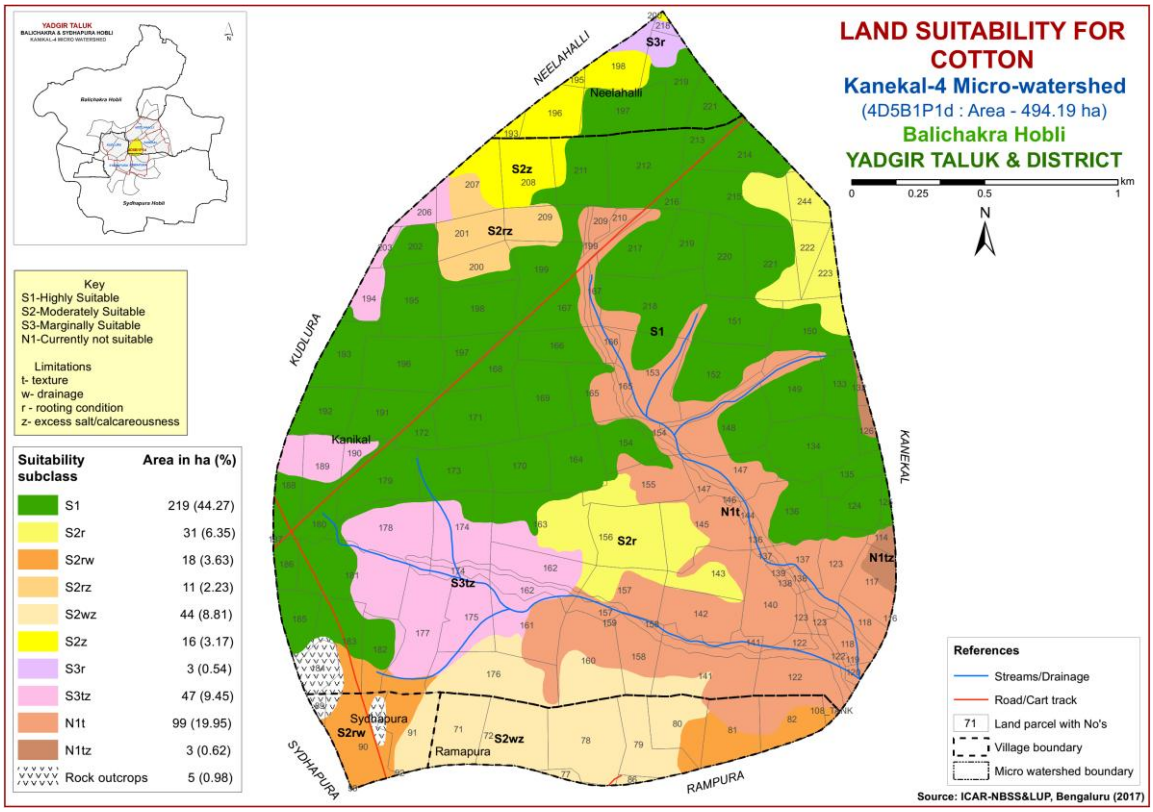


Fig. 7.7 Land Suitability map of Cotton

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.

Maximum area of about 238 ha (48%) is highly (Class S1) suitable for growing Bengal gram and are distributed in the major part of the microwatershed. An area of about 100 ha (20%) is moderately suitable (Class S2) for growing bengalgram and are distributed in all parts of the microwatershed. They have minor limitations of drainage, calcareousness and rooting depth. Marginally suitable (Class S3) lands occupy an area of 50 ha (10%) and are distributed in the central, western and northwestern part of the microwatershed. They have moderate limitations of rooting depth, calcareousness and texture. Not suitable (Class N1) lands occur in an area of 102 ha (21%) and are distributed in the southeastern, central, and eastern part of the microwatershed with severe limitations of texture and calcareousness.

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; imper. 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	

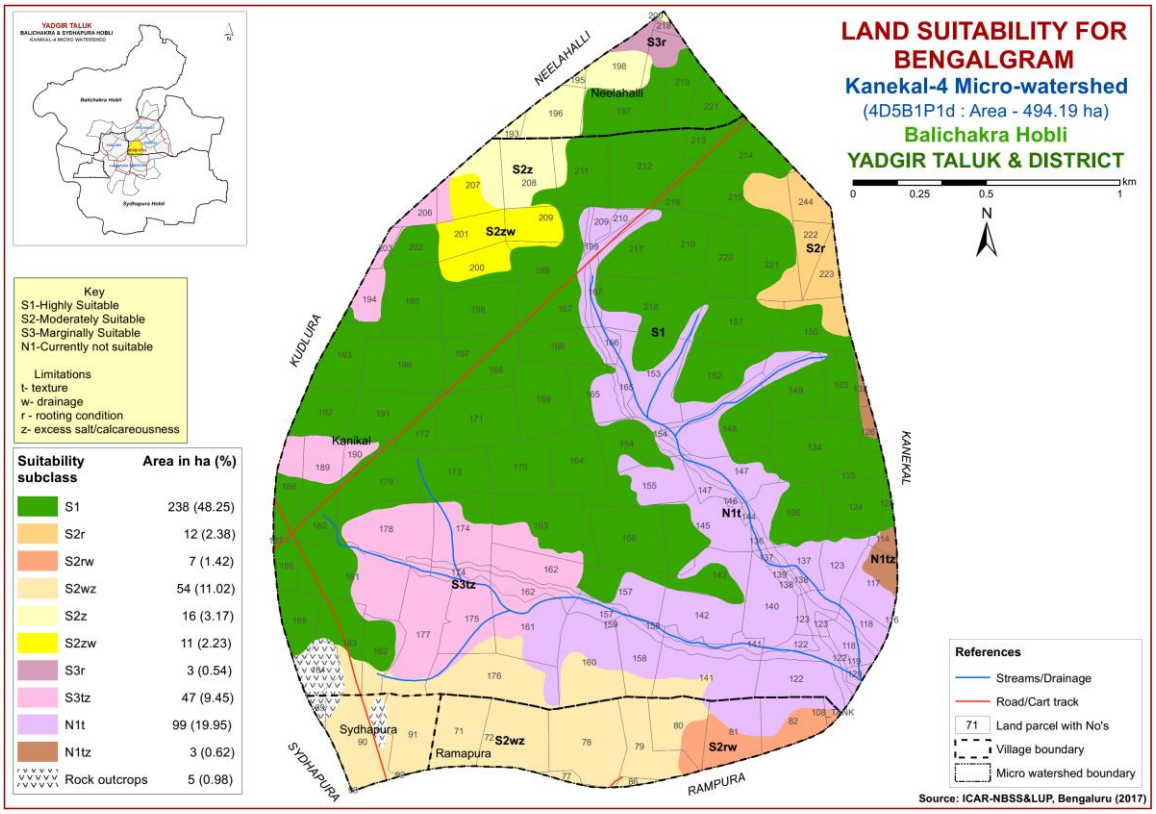


Fig. 7.8 Land Suitability map of Bengal gram

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-4 microwatershed, there are no highly (Class S1) suitable lands available for growing chilli. An area of about 216 ha (44%) 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 and rooting depth. Marginally suitable lands (Class S3) occupy an area of about 274 ha (55%) and are distributed in the major part of the microwatershed. They have moderate limitations of drainage, rooting depth and texture.

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 temperature 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	

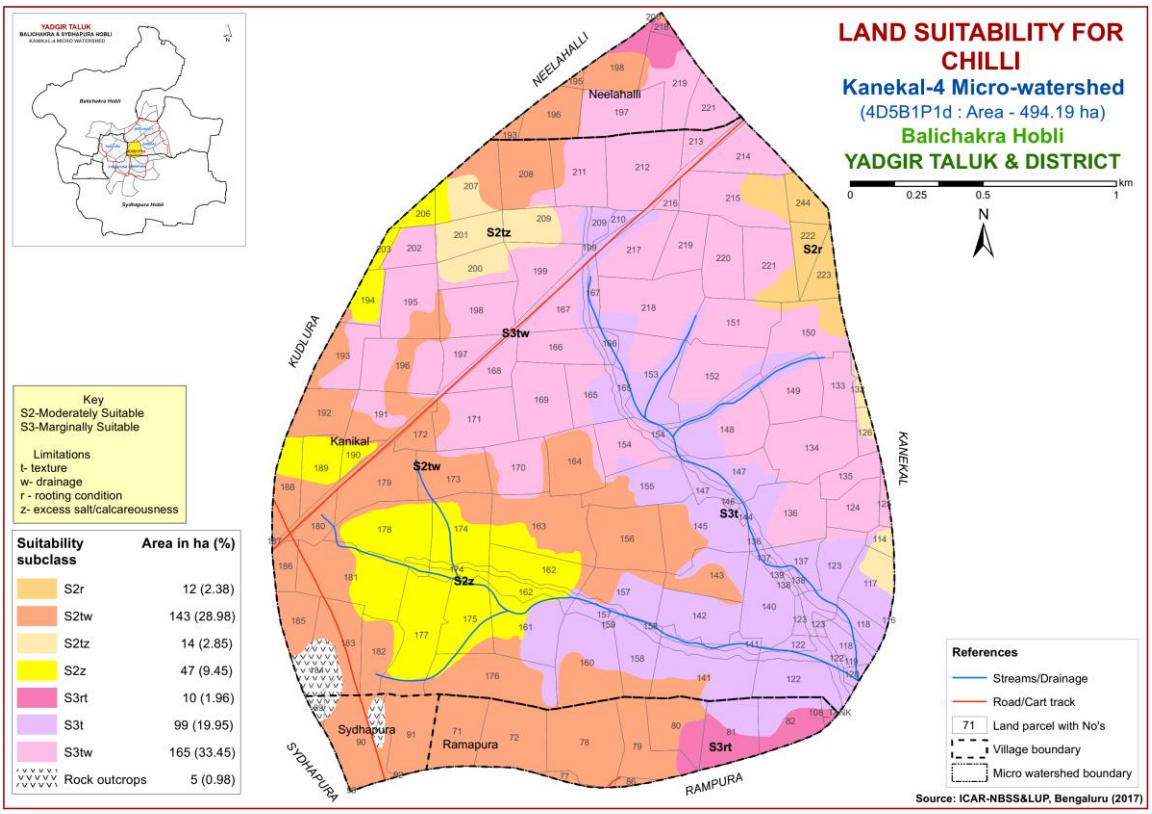


Fig 7.9 Land Suitability map of Chilli

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.

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

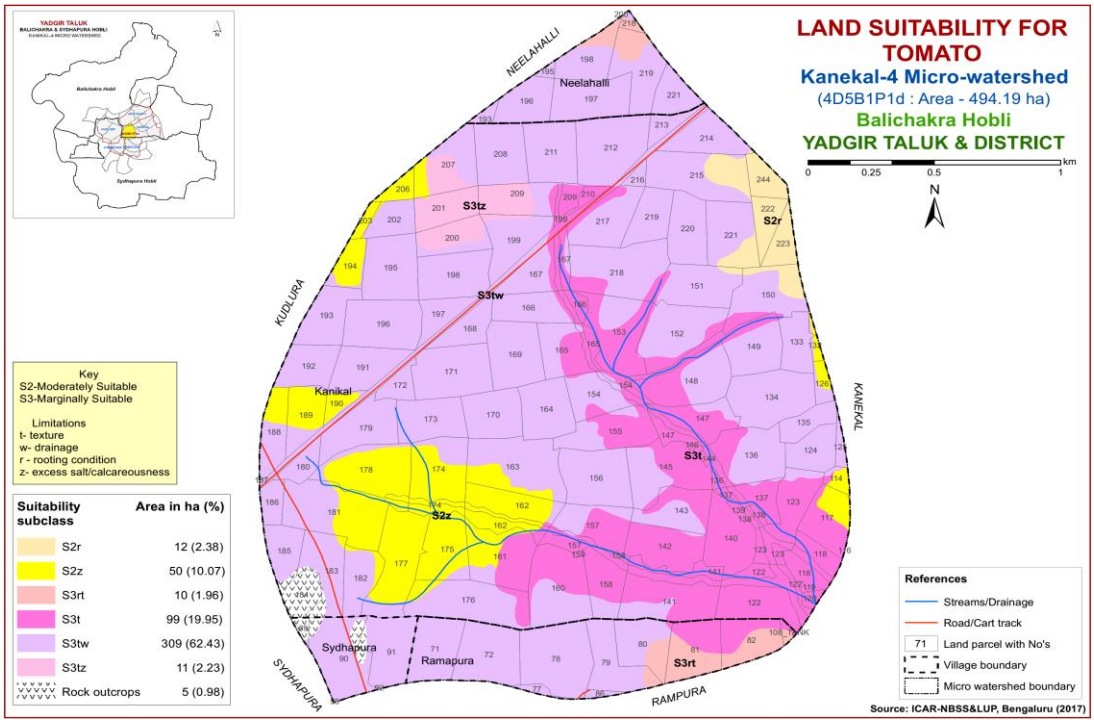


Fig 7.10 Land Suitability map of Tomato

In Kanekal-4 microwatershed, there are no highly (Class S1) suitable lands available for growing tomato. The moderately suitable (Class S2) lands cover an area of about 62 ha (12%) and occur in all parts of the microwatershed. They have minor limitations of calcareousness and rooting depth. The marginally suitable (Class S3) lands cover a maximum area of about 429 ha (87%) and occur in the major part of the microwatershed. They have moderate limitations of texture, rooting depth, calcareousness and drainage.

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.

In Kanekal-4 microwatershed, there are no highly (Class S1) suitable lands available for growing drumstick. Maximum area of about 370 ha (75%) 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 118 ha (24%) is marginally suitable (Class S3) for growing drumstick and are distributed in the central, northeastern and southeastern part of the microwatershed. They have moderate limitations of rooting depth, texture and drainage. Not suitable (Class N1) lands occur in a small area of 3 ha (1%) and are distributed in the northern part of the microwatershed with severe limitations of rooting depth and texture.

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

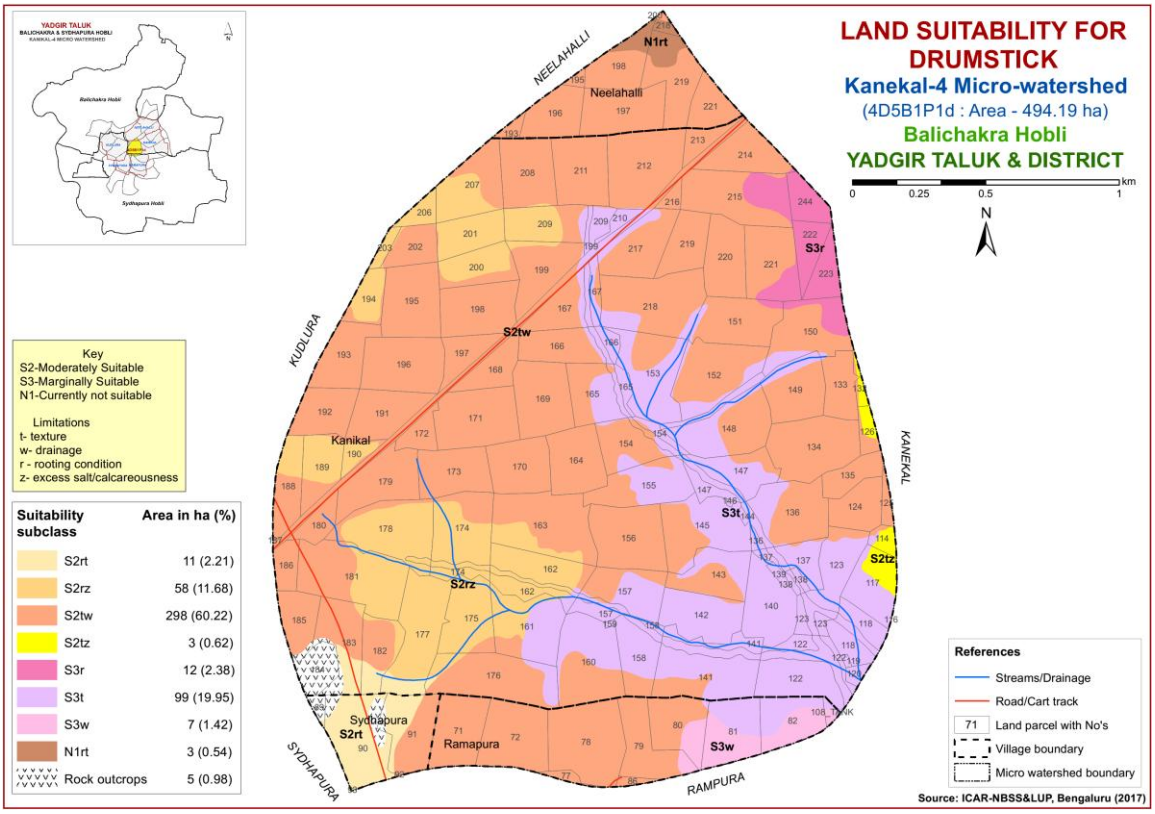


Fig 7.11 Land Suitability map of Drumstick

7.12 Land Suitability for Mulberry (*Morus nigra*)

Mulberry is one of the important leaf crop grown for rearing silk worm 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-4 microwatershed no highly (Class S1) suitable lands available for growing mulberry. An area of about 47 ha (9%) is moderately suitable (Class S2) for growing mulberry and are distributed in the central, northwestern and western part of the microwatershed. They have minor limitations of rooting depth and calcareousness. Marginally suitable lands (Class S3) occupy a maximum area of about 441 ha (89%) 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 a small area of 3 ha (1%) and are distributed in the northern 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

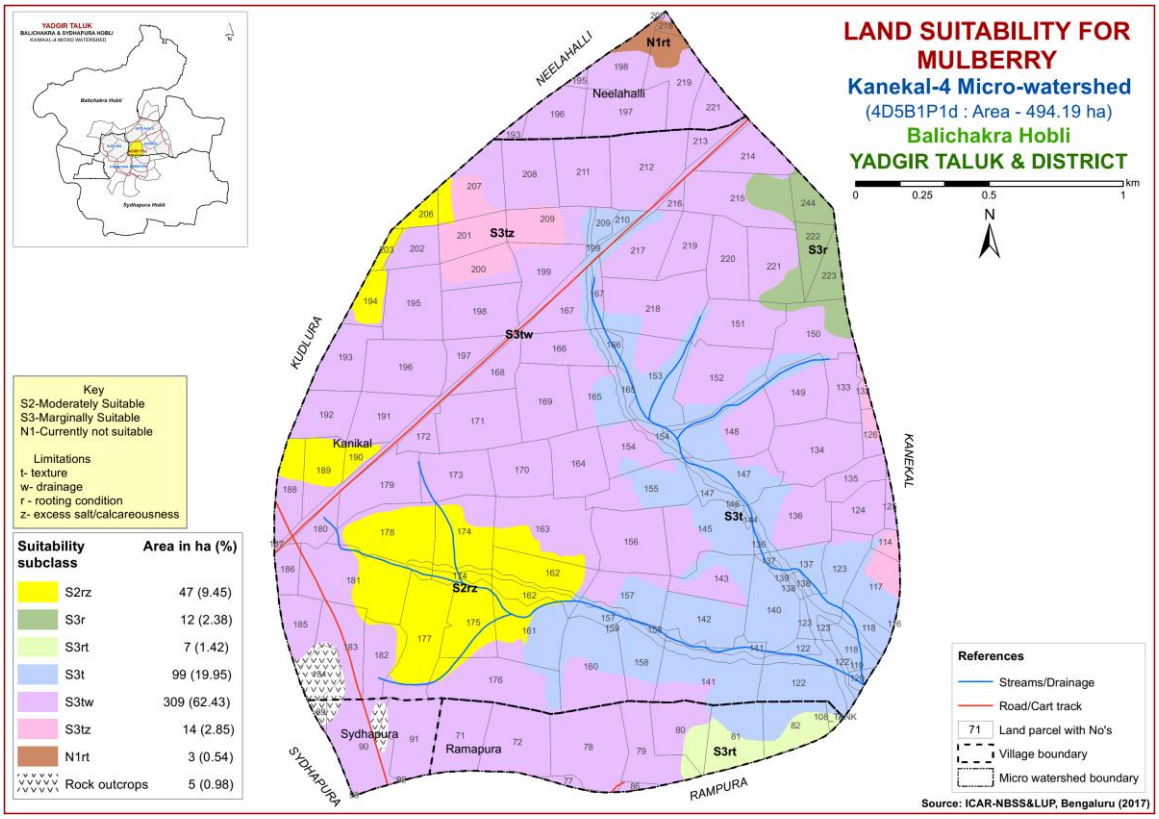


Fig 7.12 Land Suitability map of Mulberry

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.

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 imper.drained	Poor drained	Very 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	

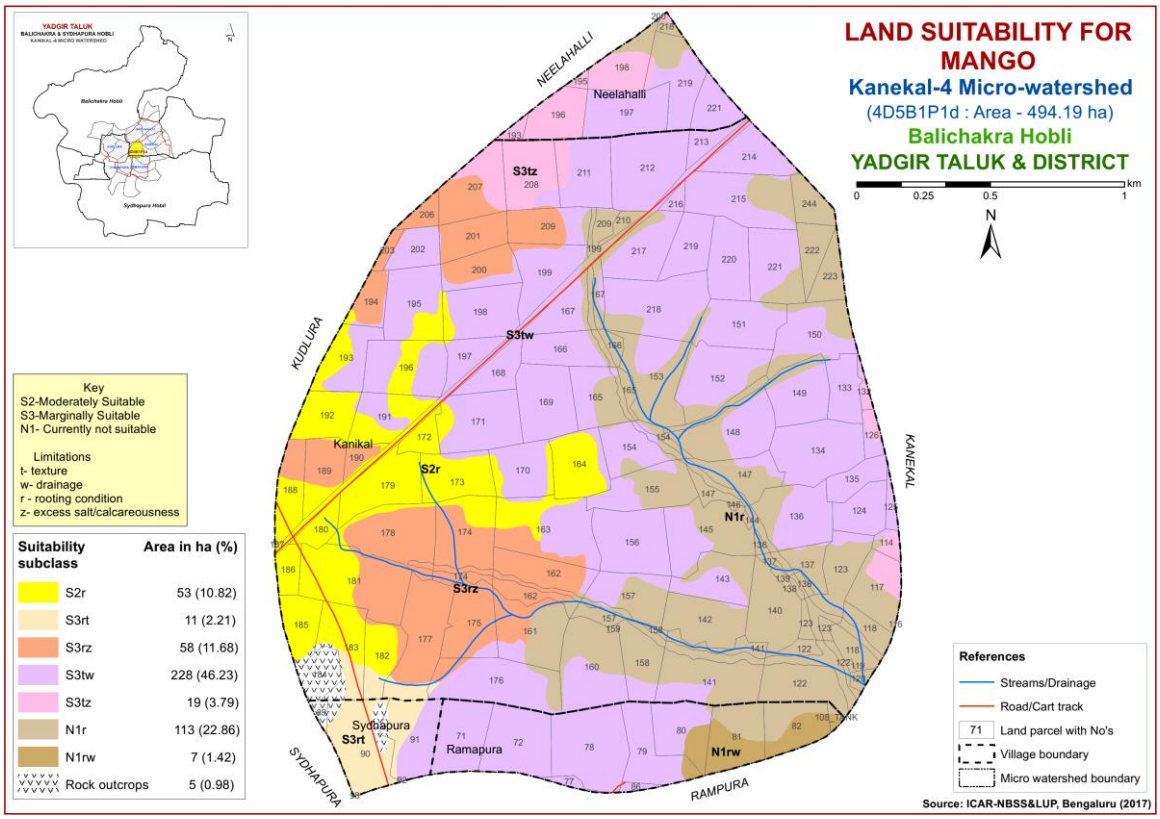


Fig. 7.13 Land Suitability map of Mango

No highly suitable (Class S1) lands available for growing mango in the microwatershed. Moderately suitable (Class S2) lands occupy 53 ha (11%) and are distributed in the southeastern and southern part of the microwatershed. Marginally suitable (Class S3) lands occupy a maximum area of 316 ha (64%) and are distributed in the major part of the microwatershed. They have moderate limitations of rooting depth, texture, calcareousness and drainage. Not suitable lands (Class N) occupy an area of about 120 ha (24%) and are distributed in the northern, northeastern, central and southeastern part of the microwatershed. They have severe limitations of rooting depth and drainage.

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.

No highly suitable (Class S1) lands available for growing sapota in the microwatershed. Moderately (Class S2) suitable lands occupy an area of 50 ha (10%) and are distributed in all parts of the microwatershed. They have minor limitations of rooting depth, texture and calcareousness. Maximum area of about 438 ha (88%) 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 (Class N1) lands occur in a small area of 3 ha (1%) and are distributed in the northern part of the microwatershed with 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 availabiliy	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

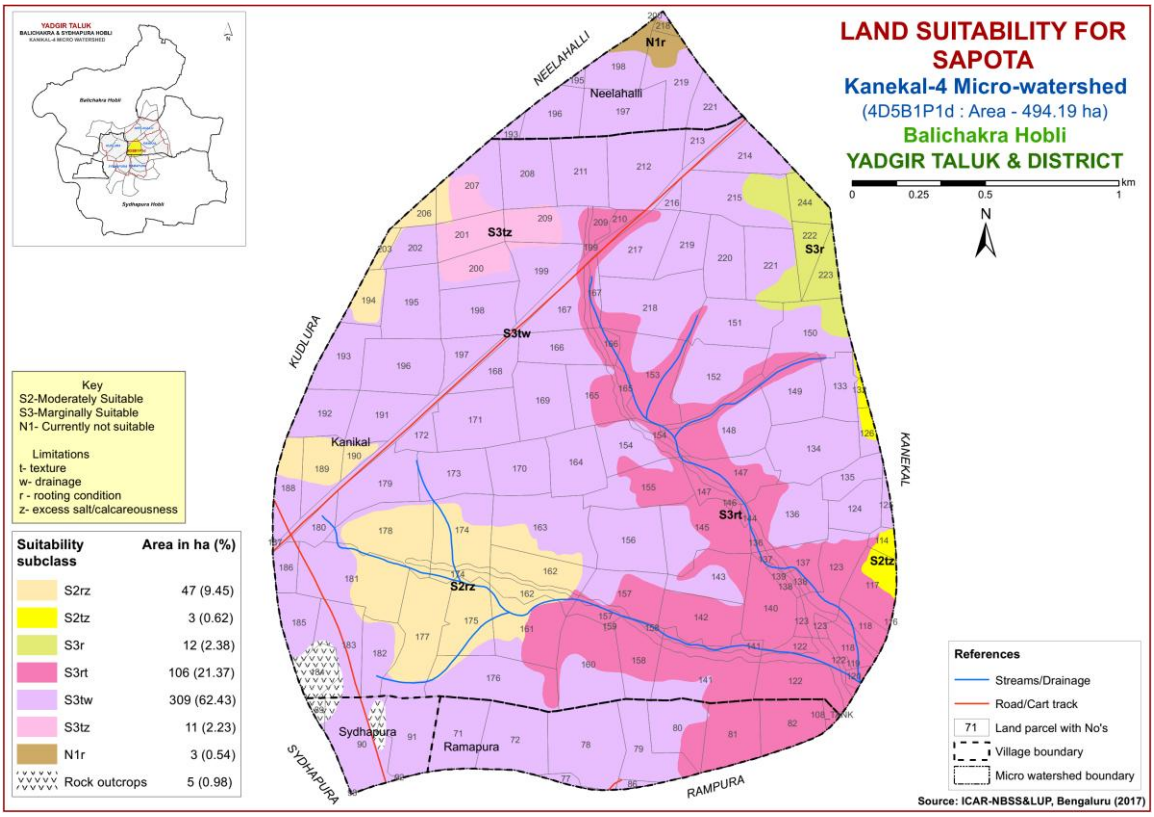


Fig. 7.14 Land Suitability map of Sapota

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.

No highly suitable (Class S1) lands available for growing guava in the microwatershed. Moderately suitable (Class S2) lands occupy 50 ha (10%) and are distributed in the western, central and northwestern part of the microwatershed. They have minor limitations of rooting depth, texture and calcareousness. Maximum area of about 438 ha (88%) 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 (Class N1) lands occupy a small area of 3 ha (1%) and are distributed in the northern part of the microwatershed with 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

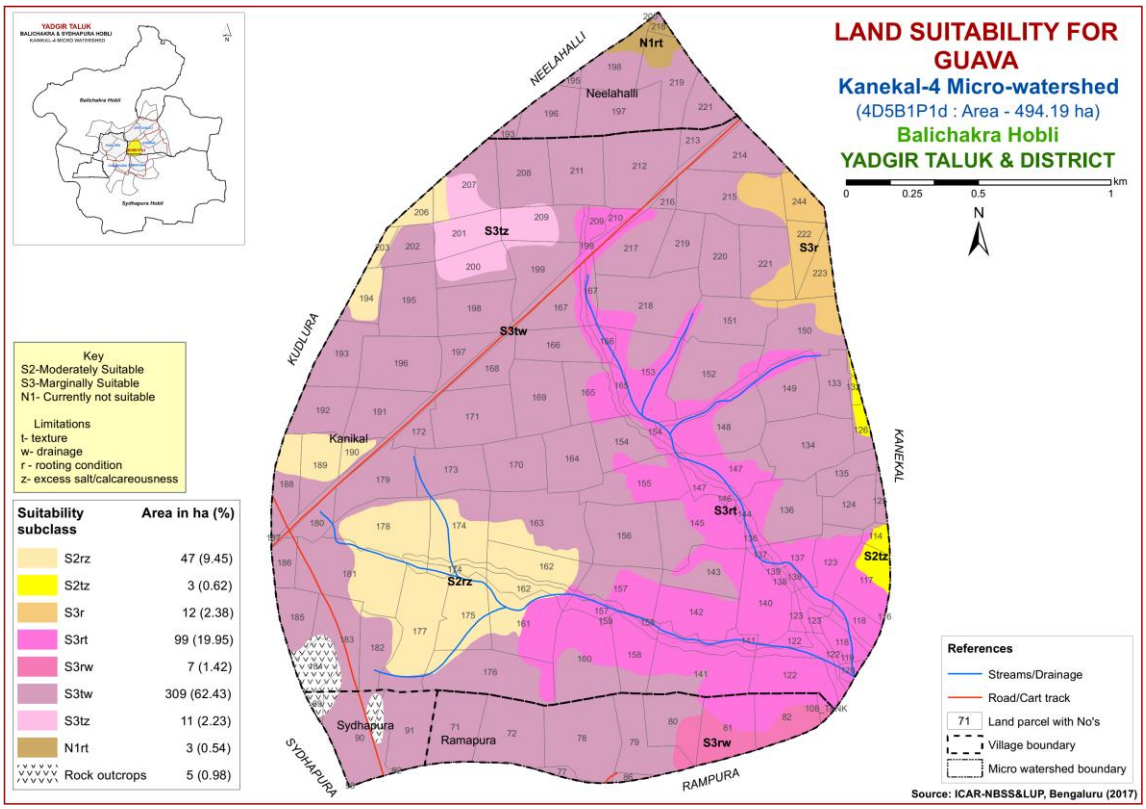


Fig 7.15 Land Suitability map of Guava

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.

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	

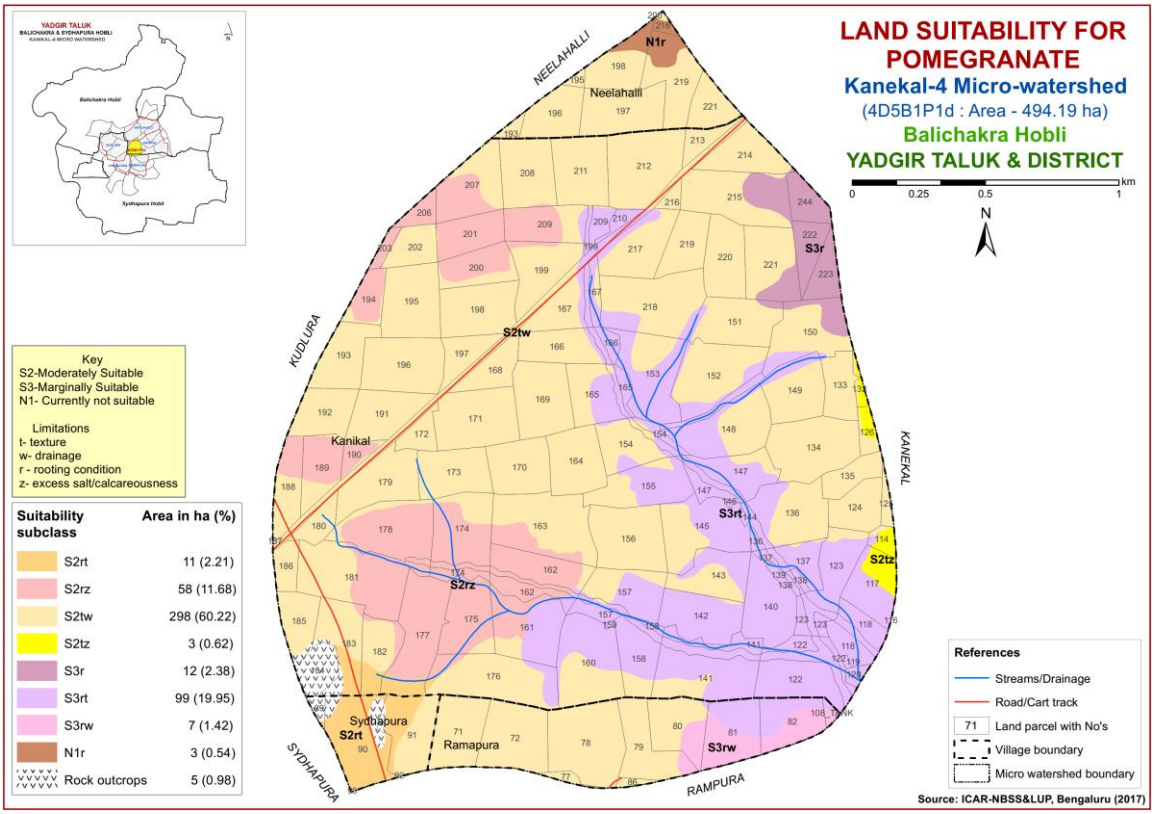


Fig 7.16 Land Suitability map of Pomegranate

In Kanekal-4 microwatershed no highly (Class S1) suitable lands available for growing pomegranate. Maximum area of about 370 ha (75%) 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 118 ha (24%) 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 drainage. Not suitable (Class N1) lands occupy an area of 3 ha (1%) and are distributed in the northern part of the microwatershed with severe limitation of rooting depth.

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.

No highly suitable (Class S1) lands available for growing jackfruit in the microwatershed. Moderately suitable (Class S2) lands occur in an area of 47 ha (9%) and are distributed in the western, central and northwestern part of the microwatershed. They have minor limitations of rooting depth and calcareousness. Maximum area of about 441 ha (89%) 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 (Class N1) lands occur in a small area of 3 ha (1%) and are distributed in the northern part of the microwatershed with 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	-

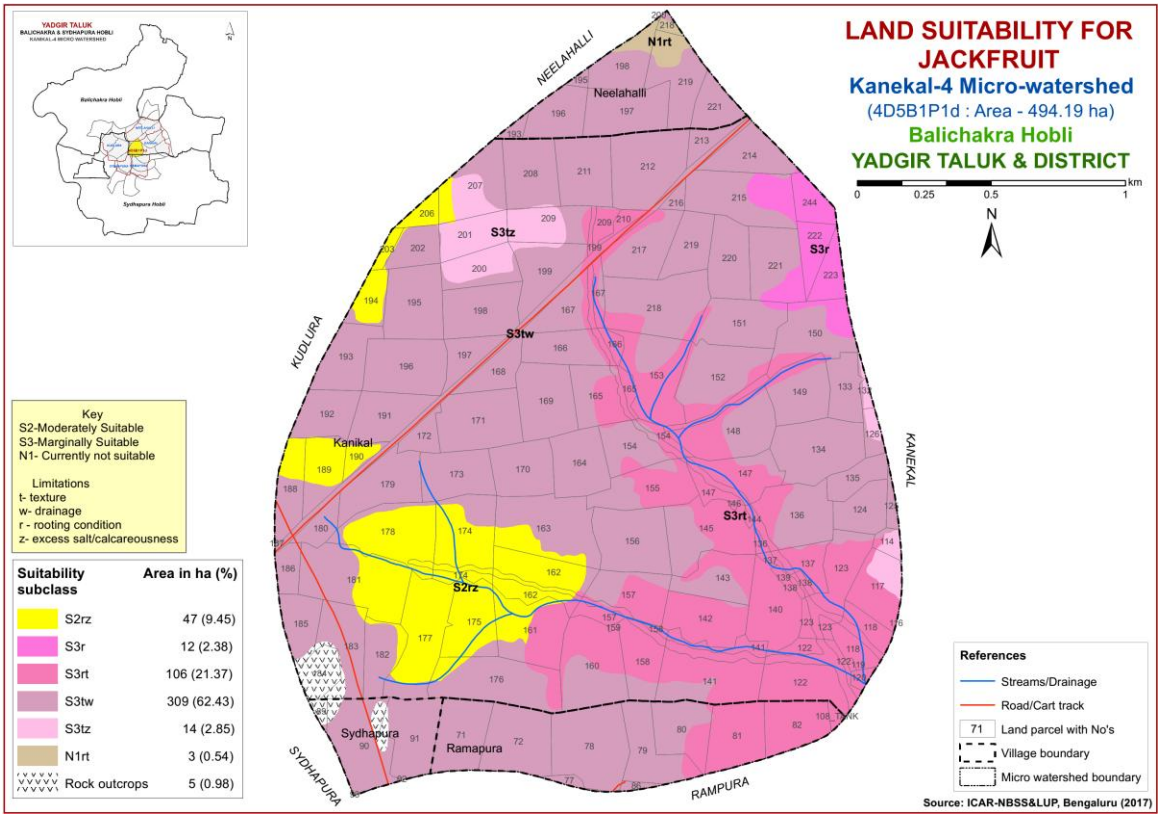


Fig 7.17 Land Suitability map of Jackfruit

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-4 microwatershed, no highly suitable (Class S1) lands available for growing jamun. Maximum area of about 301 ha (61%) is moderately suitable (Class S2) for jamun and is distributed in the major part of the microwatershed. They have minor limitations of texture, rooting depth, calcareousness and drainage. An area of about 187 ha (38%) is marginally suitable (Class S3) for growing jamun 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 northern part of the microwatershed with 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

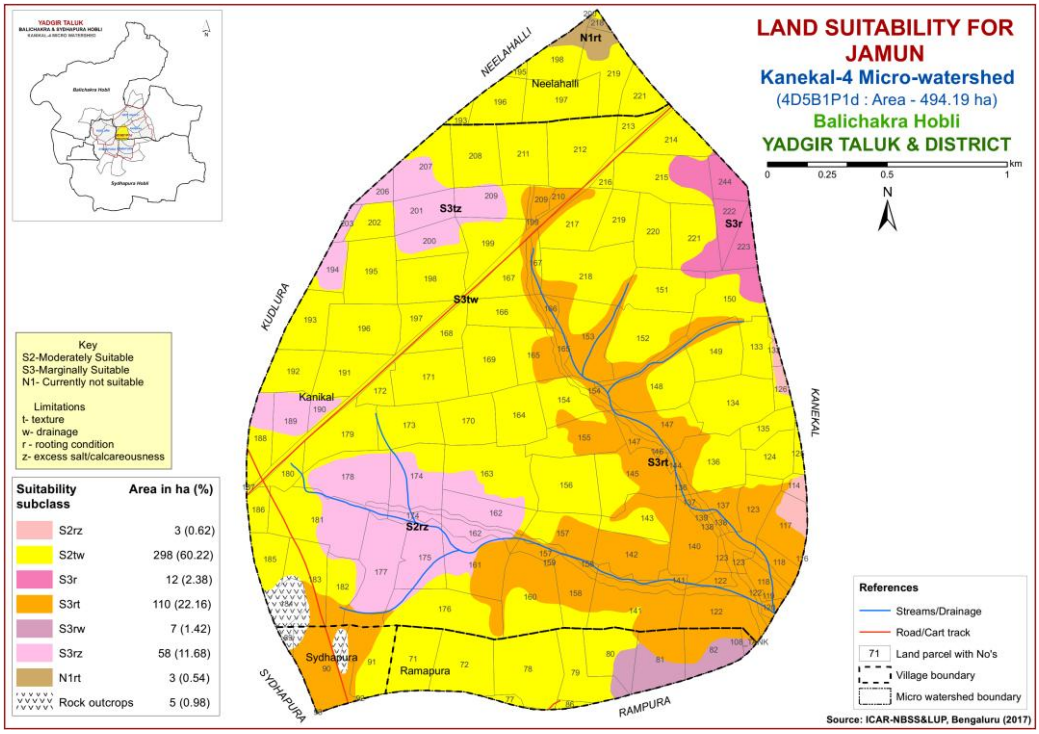


Fig 7.18 Land Suitability map of Jamun

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-4 microwatershed, there are no highly (Class S1) suitable lands available for growing musambi. Maximum area of about 370 ha (75%) 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 118 ha (24%) is marginally suitable (Class S3) for

growing musambi and are distributed in the eastern, central and southeastern part of the microwatershed. They have moderate limitations of rooting depth, texture and drainage. Not suitable lands occur in a small area of 3 ha (1%) and are distributed in the northern part of the microwatershed with severe limitation of rooting depth.

Table 7.20 Crop suitability criteria for Musambi

Crop requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable(S1)**	**Moderately suitable(S2)**	**Marginally suitable(S3)**	**Not suitable(N)**
Climate	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 imper. 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	

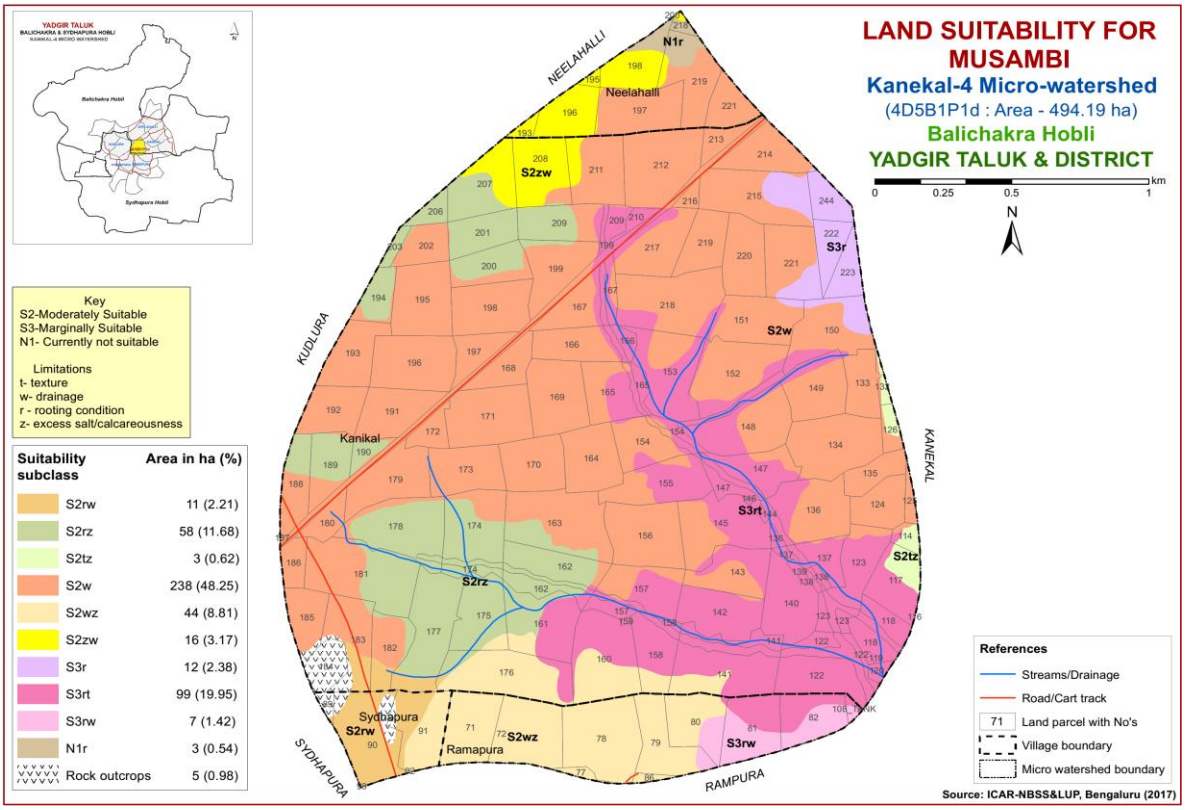


Fig 7.19 Land Suitability map of Musambi

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.

Table 7.21 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 imper. 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	

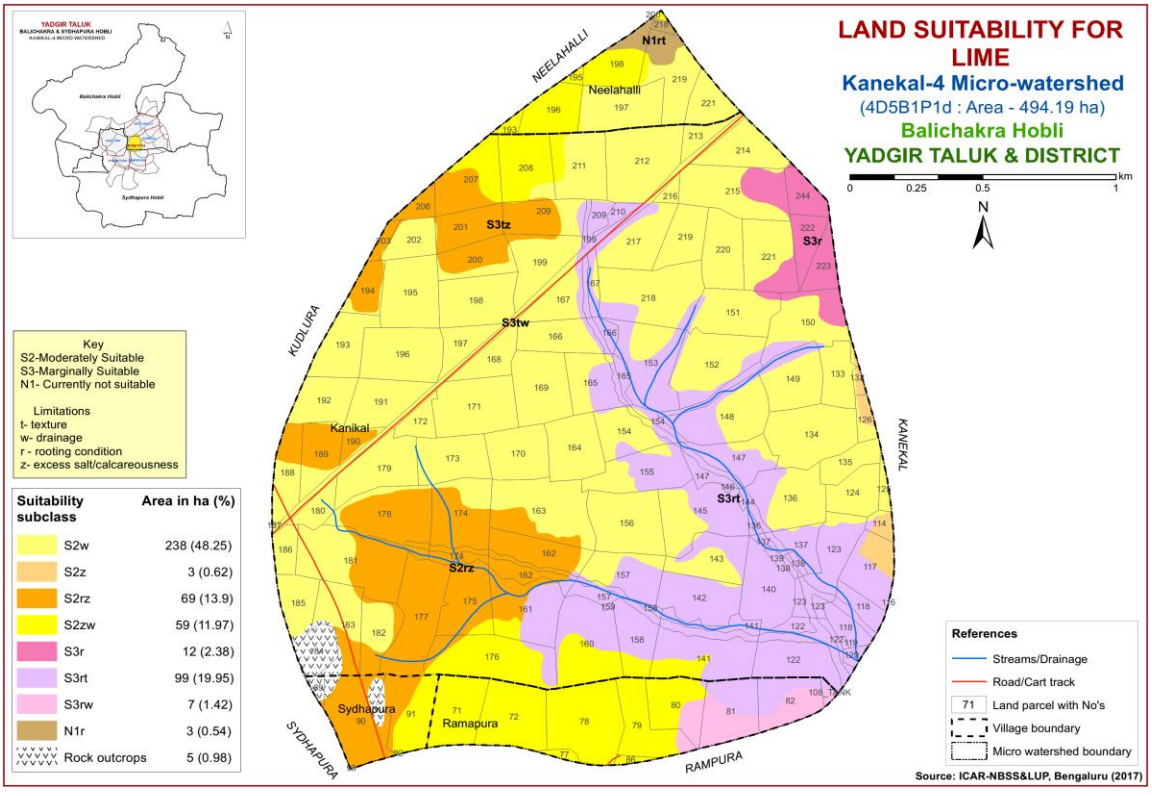


Fig 7.20 Land Suitability map of Lime

In Kanekal-4 microwatershed, no highly (Class S1) suitable lands available for growing lime. Maximum area of about 369 ha (75%) is moderately suitable (Class S2) and is distributed in the major part of the microwatershed. They have minor limitations of rooting depth, calcareousness and drainage. An area of about 118 ha (24%) is marginally suitable (Class S3) and are distributed in the eastern, central and southeastern part of the microwatershed. They have moderate limitations of rooting depth, texture and drainage. Not suitable (Class N1) lands occur in a small area of 3 ha (1%) and are distributed in the northern part of the microwatershed with severe limitation of rooting depth.

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.

There are no highly suitable (Class S1) and moderately suitable (Class S2) lands available for growing cashew in the microwatershed. An area of about 114 ha (23%) is marginally suitable for cashew and are distributed in the eastern, central and southeastern part of the microwatershed. They have moderate limitations of rooting depth, texture and calcareousness. Not suitable (Class N1) lands for growing cashew occur in maximum area of 376 ha (76%) in the major part of the microwatershed. They have severe limitations of rooting depth, texture, calcareousness and drainage.

Table 7.22 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	

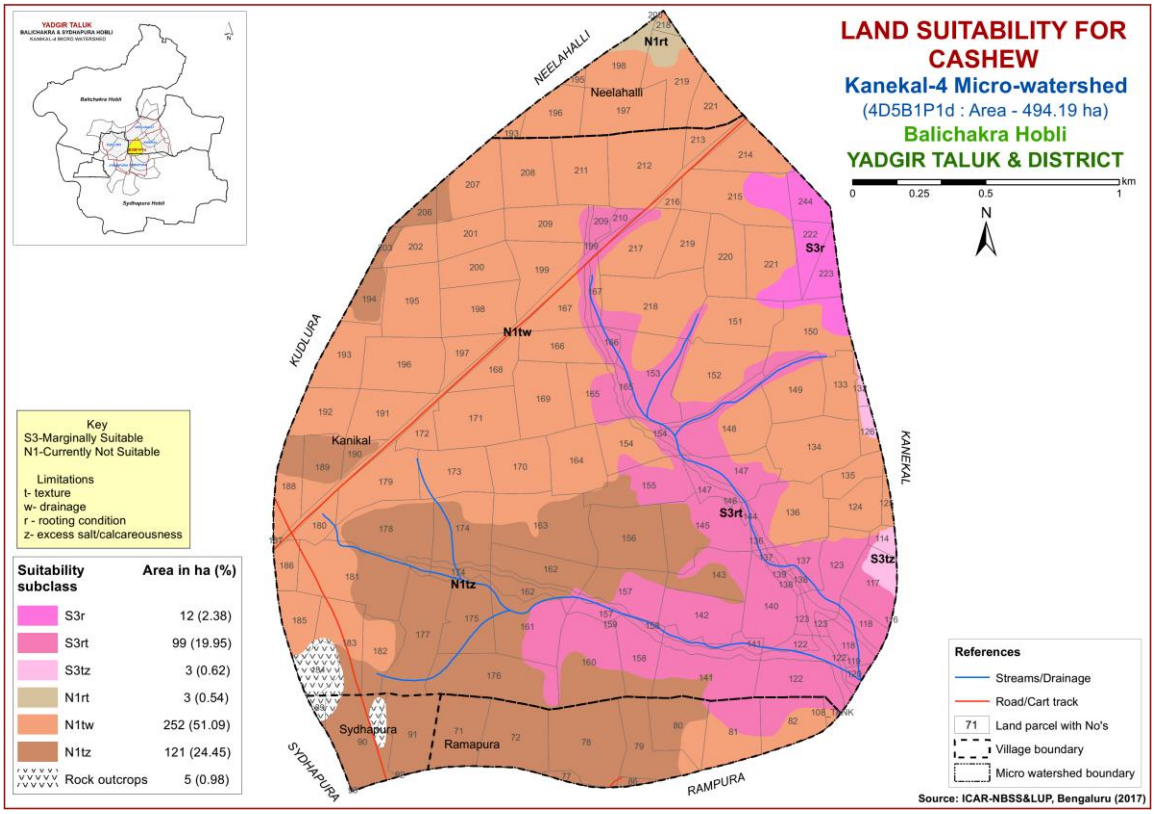


Fig 7.21 Land Suitability map of Cashew

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.

Table 7.23 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	

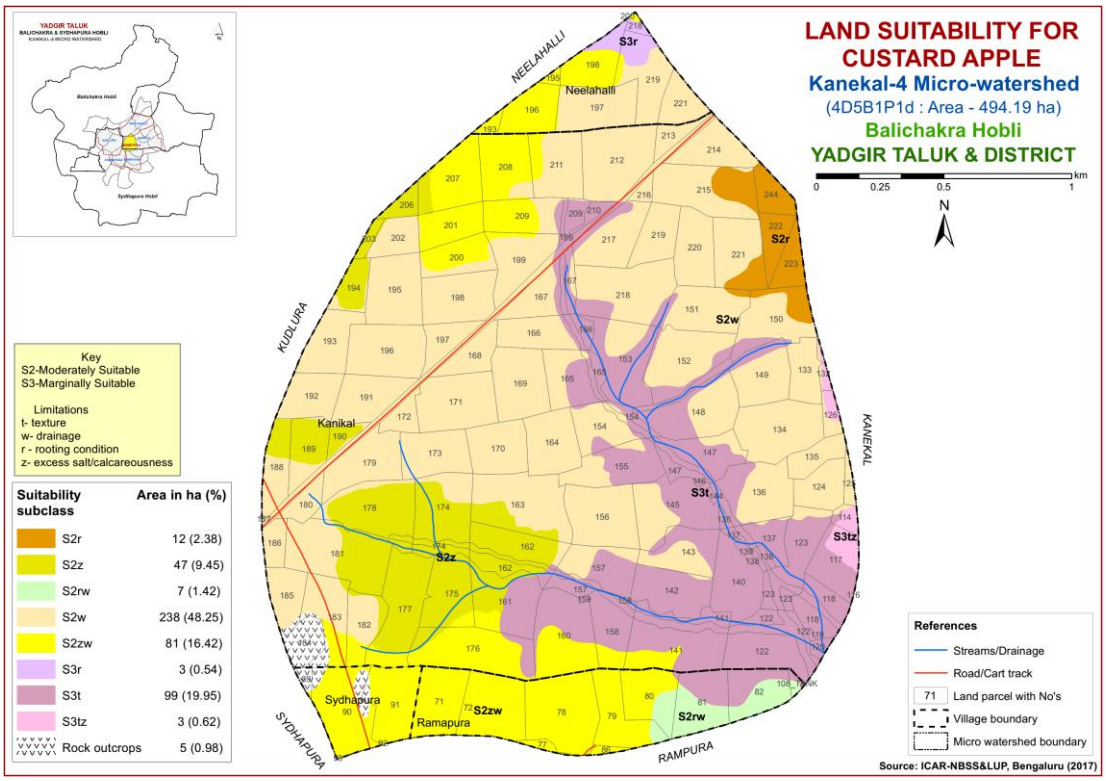


Fig 7.22 Land Suitability map of Custard Apple

In Kanekal-4 microwatershed, there are no highly (Class S1) suitable lands available for growing custard apple. Maximum area of about 385 ha (78%) 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 105 ha (21%) and are distributed in the central, eastern and southeastern part of the microwatershed. They have moderate limitations of texture, rooting depth and calcareousness.

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.

In Kanekal-4 microwatershed, there are no highly (Class S1) suitable lands available for growing amla. Maximum area of about 386 ha (78%) 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 105 ha (21%) and are distributed in the central, southeastern and eastern part of the microwatershed. They have moderate limitations of calcareousness, rooting depth and texture.

Table 7.24 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

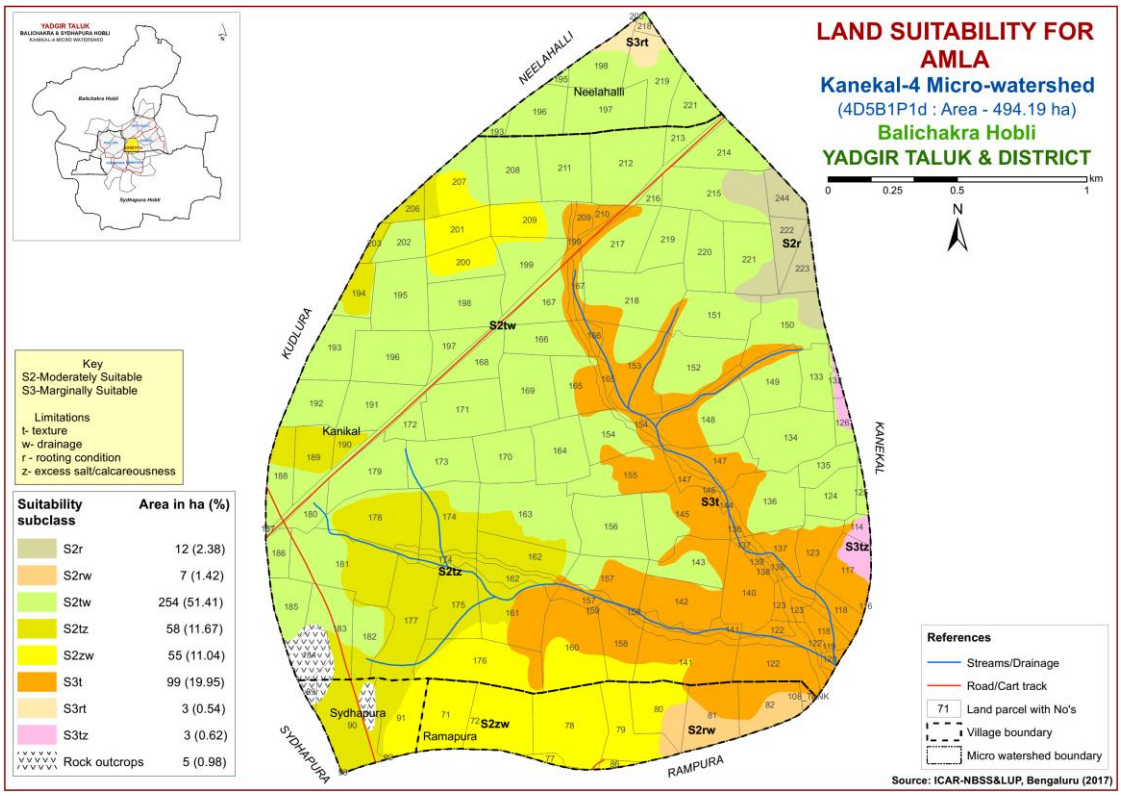


Fig 7.23 Land Suitability map of Amla

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.

No highly suitable (Class S1) lands available for growing tamarind in the microwatershed. Moderately suitable (Class S2) lands occur in a maximum area of 301 ha (61%) and are distributed in the major part of the microwatershed. They have minor limitations of texture, rooting depth and drainage. An area of about 69 ha (14%) is

marginally suitable (Class S3) for growing tamarind and are distributed in the western, northwestern and southwestern part of the microwatershed with moderate limitations of rooting depth, drainage and calcareousness. Not suitable lands (Class N1) occupy an area of about 120 ha (24%) and are distributed in the northeastern, central, northern and southeastern part of the microwatershed. They have severe limitations of rooting depth, texture and drainage.

Table 7.25 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

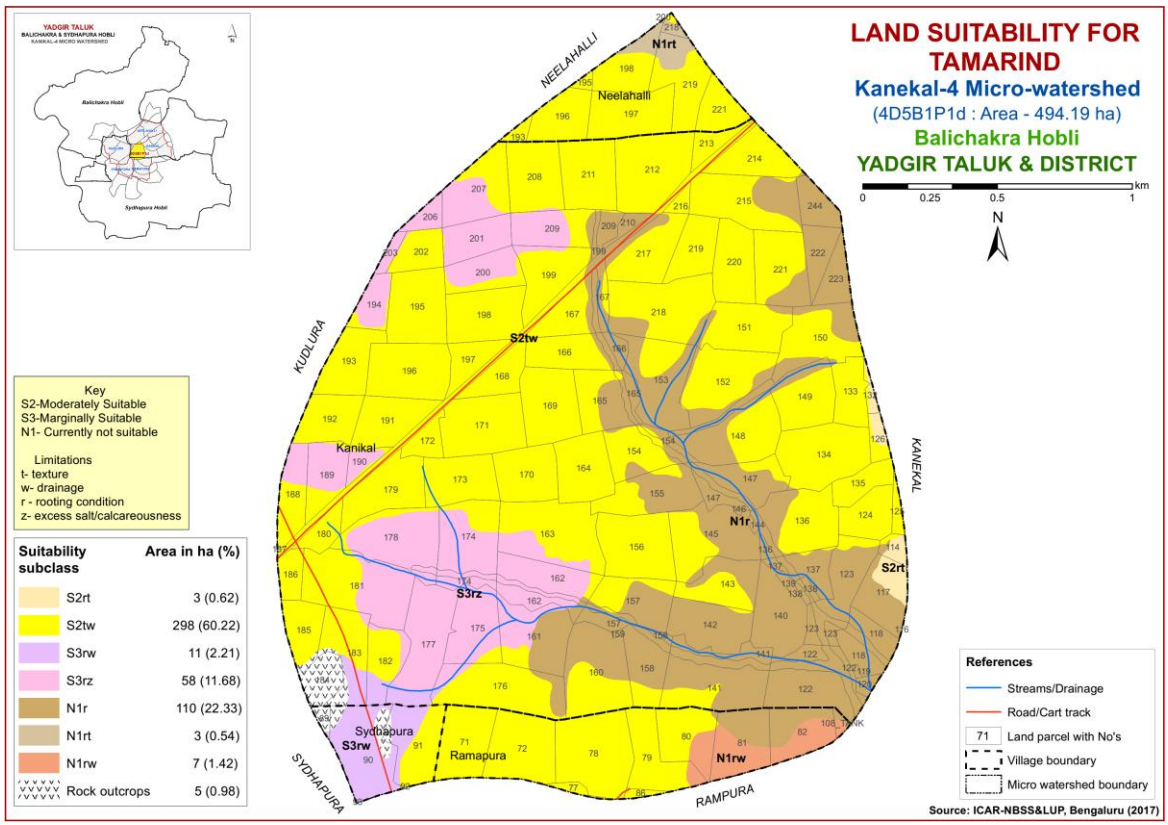


Fig 7.24 Land Suitability map of Tamarind

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.

Table 7.26 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	-

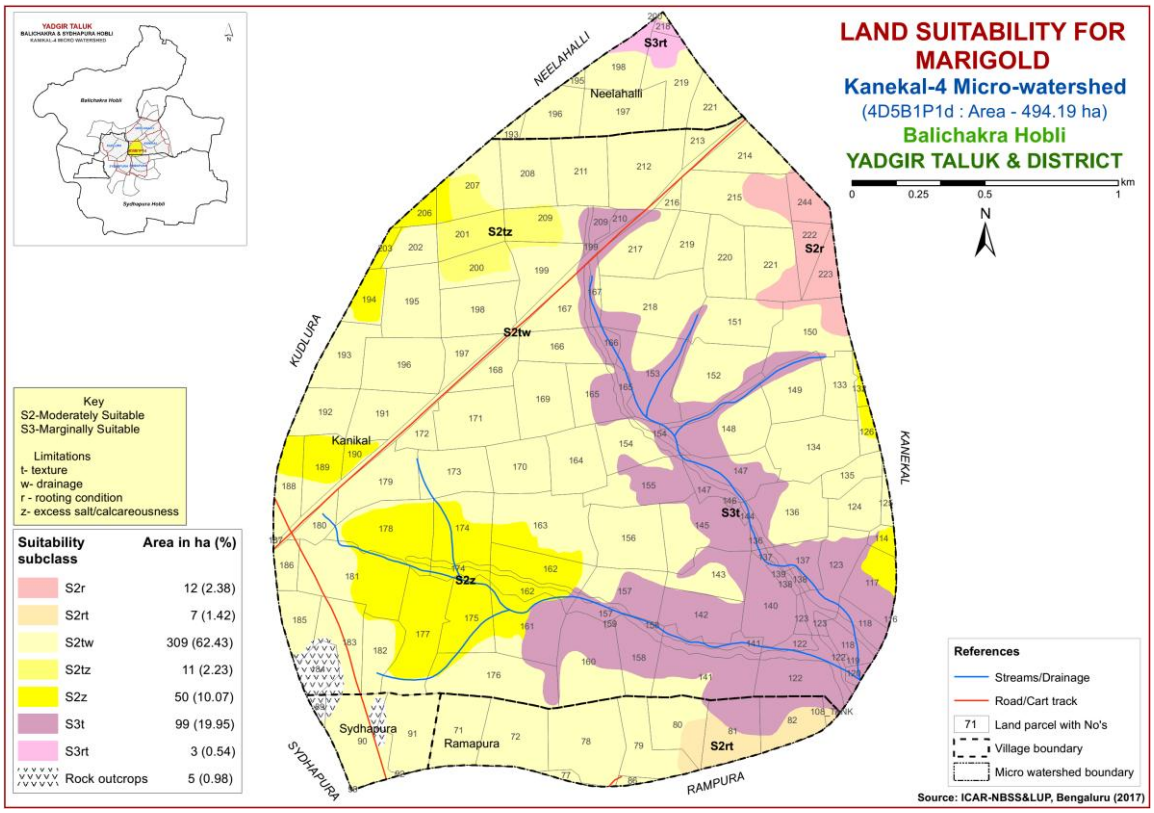


Fig. 7.25 Land Suitability map of Marigold

In Kanekal-4 microwatershed, there are no lands that are highly (Class S1) suitable for growing marigold. Maximum area of about 389 ha (79%) is moderately suitable (Class S2) for growing marigold 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 102 ha (20%) and are distributed in the northern, central, eastern and southeastern part of the microwatershed. They have moderate limitations of texture and rooting depth.

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.

In Kanekal-4 microwatershed, there are no lands that are highly (Class S1) suitable for growing chrysanthemum. Maximum area of about 389 ha (79%) is moderately suitable (Class S2) for growing chrysanthemum 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 about102 ha (20%) and are distributed in the northern, central, eastern and southeastern part of the microwatershed. They have moderate limitations of texture and rooting depth.

Table 7.27 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	

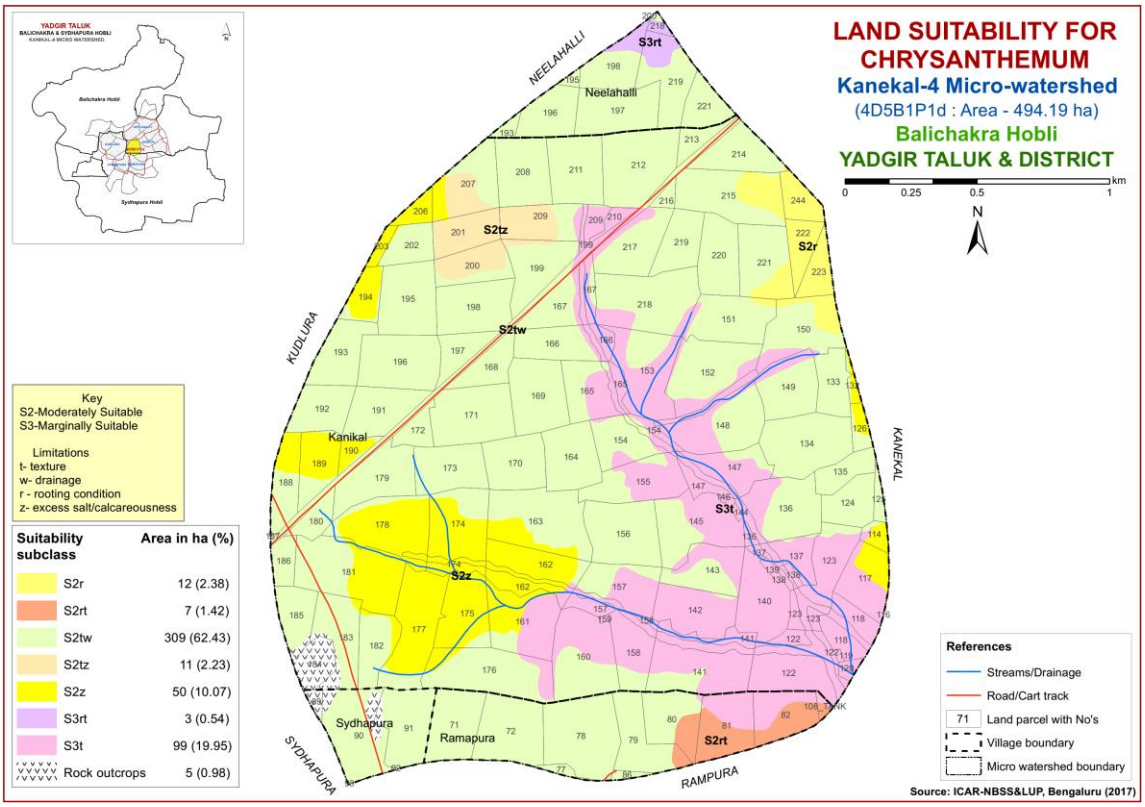


Fig. 7.26 Land Suitability map of Chrysanthemum

7.27 Land Management Units (LMU)

The 17 soil map units identified in Kanekal-4 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 17 soil map units that have been grouped into seven Land Management Units along with brief description of soil and site characteristics are given below.

LMU NO.	Soil Map Unit	Soil and site characteristics
1	99. KDHcB2	Moderately deep, lowland black clay soils, slopes 1-3%, moderate erosion, non gravelly (<15%)
2	33.HSLiB2 35.GWDiB2 57.MDGcB2 58.MDGiB2 61.MDRmB2 77.RHNcB2 79. RHNmB2 97. MYPhB2 98. MYPiB2g1	Moderately deep to very deep, black sandy clay to sandy clay loam soils, slopes 1-3%, moderate erosion and non gravelly to gravelly (<15-35%)
3	43.YDRiB2 49.NGPmB2	Deep black loamy sand to sandy loam soils, slopes 1-3%, moderate erosion, non gravelly (<15%)
4	71. RMPiB2	Moderately shallow, black clay soils, slopes 1-3%, moderate erosion, non gravelly (<15%)
5	11. SBRcB2 12.SBRcC3g1	Moderately shallow, black loamy sand soils, slopes 1-5%, moderate to severe erosion, non gravelly to gravelly (<15-35%)
6	27. YLRbB2	Moderately shallow, red sandy clay soils, slopes 1-3%, moderate erosion, non gravelly (<15%)
7	5. BDLiB2	Shallow, black clay soils, slopes 1-3%, moderate erosion, non gravelly

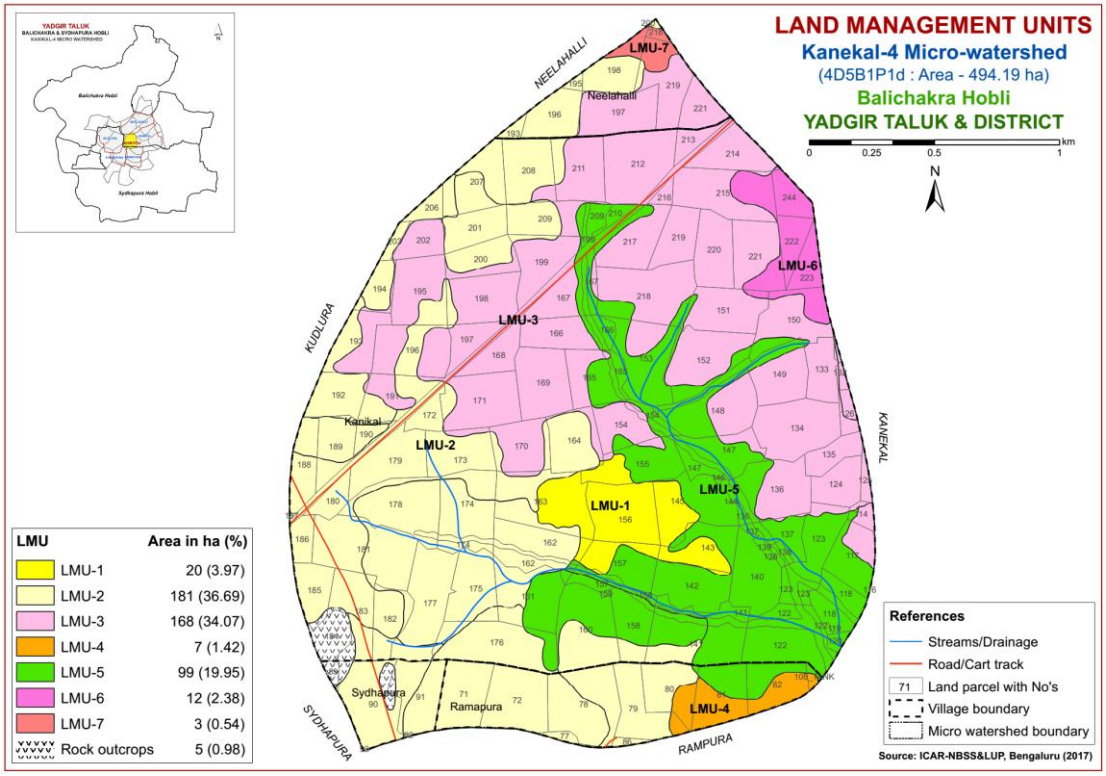


Fig. 7.27 Land Management Units (LMU) map of Kanekal-4 microwatershed

7.28 Proposed Crop Plan for Kanekal-4 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 7.28 Proposed Crop Plan for Kanekal-4 Micro watershed

Proposed LMU	Soil Map Units	Survey Number	Soil characters	Field Crops	Horticulture Crops	Suitable Interventions
1	99. KDHcB2	**Kanikal:** 143,156,163	(Moderately deep, lowland black clay soils, slopes 1-3%, moderate erosion, non gravelly (<15%)	Sunflower, Cotton, Bengal gram, Bajra	**Fruit crops:** Lime, Musambi Pomegranate, 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
2	33.HSLiB2 35.GWDiB2 57.MDGcB2 58.MDGiB2 61.MDRmB2 77.RHNcB2 79. RHNmB2 97. MYPhB2 98. MYPiB2g1	**Kanikal**:162,164,172,173,174,175,176,177,178,179,180,181,182,183,185,186,187,188,189,190,192,194,200,201,203,206,207, 208,209 **Neelahalli:**193,195,196,198 **Ramapura:**71,72,77,78,79,80,86 **Sydhapura:** 90,91,92,93	Moderately deep to very deep, black sandy clay to sandy clay loam soils, slopes 1-3%, moderate erosion and non gravelly to gravelly (<15-35%)	Sunflower, Sorghum, Cotton, Bengal gram, Safflower, Linseed, Bajra	**Fruit crops:** Lime, Musambi, Pomegranate, 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	43.YDRiB2 49.NGPmB2	**Kanikal:**114,124,125,126,132,133,134,135,136,148,149,150,151,152,154,166,167,168,169,170,171,191,193,195,196,197,198,199,202,211,212,213,214,215,216,217,218,219, 220,221	Deep black loamy sand to sandy loamy soils, slopes 1-3%, moderate erosion, 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

		Neelahalli: 197,219,221				
4	71. RMPiB2	**Ramapura:** 108,81,82	Moderately shallow, black clay soils, slopes 1-3%, moderate erosion, non gravelly (<15%)	Sorghum, Bengal gram, Safflower, Linseed, Bajra	**Fruit crops:** Amla, Custard apple **Vegetables:** Coriander **Flowers:** Marigold, Chrysanthemum	Application of FYM, Biofertilizers and micronutrients, drip irrigation, Mulching, suitable soil and water conservation practices
5	11. SBRcB2 12.SBRcC3g1	**Kanikal:**116,117,118,119,120,122,123,137,138,139,140,141,142,144,145, 146,147,153,155,157,158 ,159,160,161,165,210	Moderately shallow, black loamy sand soil, slopes 1-5%, moderate to severe erosion, non gravelly to gravelly (<15-35%)	Groundnut, Horsegram	**Vegetables:** Onion **Agri-Silvi-Pasture:** Custard apple, Amla**,** Hybrid Napier, *Styloxanthes hamata*, Glyricidia, *Styloxanthes scabra*	-do-
6	27. YLRbB2	**Kanikal:** 222,223,244	Moderately shallow, red sandy clay soils, slopes 1-3%, moderate erosion, non gravelly (<15%)	Maize, Sorghum, Groundnut, Bajra, Redgram , Horse gram	**Fruit crops:** Amla, Custard apple **Vegetables:** Tomato, Chilli **Flowers:** Marigold Chrysanthemum	Drip irrigation, mulching, suitable conservation practices (Crescent Bunding with Catch Pit etc)
7	5. BDLiB2	**Neelahalli:** 200,218	Shallow, black clay soils, slopes 1-3%, moderate erosion, non gravelly	Bengal gram, Horsegram	**Agri-Silvi-Pasture:** Hybrid Napier, *Styloxanthes hamata*, *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 health is basic to plant health and plant health is basic to human and bovine health. Soil is fundamental to crop production. Without soil, no food could be produced nor would livestock be fed on a large scale. Because it is finite and fragile, soil is a precious resource that requires special care from its users.

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

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

The most important characteristics of a healthy soil are

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

Characteristics of Kanekal-4 Microwatershed

- The soil phases with sizeable area identified in the microwatershed belonged to the soil series of NGP (165 ha), SBR (98 ha), MDG (54 ha), HSL (47 ha), MYP (43 ha), KDH (20 ha), MDR (16 ha), YLR (12 ha), GWD (11 ha), RHN (11 ha), RMP (7 ha), YDR (3 ha), and BDL (3 ha).
- As per land capability classification, entire area comes under arable land category (Class II and III). The major limitations identified in the arable lands were soil and erosion.

- On the basis of soil reaction, about 89 ha (18%) area is neutral (pH 6.5-7.3) and slightly alkaline (pH 7.3-7.8) soils 178 ha (36%). An area of about 164 ha (33%) is moderately alkaline (pH 7.8-8.4) and bout 59 ha (12%) is strongly alkaline (pH 8.4-9.0) in reaction. Thus, maximum of about 81 per cent of the soils in the microwatershed are alkaline in reaction.

Soil Health Management

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

Alkaline soils

(Slightly alkaline to 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 factors affecting the soil health in the microwatershed. Maximum area of 405 ha of the microwatershed is suffering from moderate erosion and about 84 ha is suffering from 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, radish, potato etc) but not ideal for crops that need stagnant water like lowland paddy. Heavy textured soils are poor in water infiltration and percolation. They are prone for sheet erosion; such soils can be improved by sand mulching. The technology that is developed by the AICRP-Dryland Agriculture, Vijayapura, Karnataka 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-4 microwatershed.
- **Organic Carbon:** In small area of about 2 ha (<1%) area the OC content is low (<0.5%), 40 ha (8%) is medium (0.5-0.75%) and about 447 ha (91%) area high (>0.75%). Low and medium in OC needs to be further improved by applying farmyard manure and rotating crops with cereals and legumes or mixed cropping.
- **Promoting green manuring:** Growing of green manuring crops 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 42 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 in these plots.

- **Available Phosphorus**: In 66 ha (13%) area, the available phosphorus is low and about 418 ha (85%) is medium. Hence for all the crops, 25% additional P-needs to be applied, where it is low or medium in available phosphorus. High in a small area of 5 ha (1%).
- **Available Potassium:** Available potassium is medium in 481 ha (97%) and high in 8 ha (2%) area of the microwatershed. In the medium plots, for all crops, additional 25 % potassium may be applied.
- **Available Sulphur:** Available sulphur is a very critical nutrient for oilseed crops. It is low in 424 ha (86%) area of the microwatershed and medium in 66 ha (13%).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 255 ha (52%) area of the microwatershed and medium in 219 ha (44%). For all these areas, application of borax @ 10 kg/ha as soil application or 0.2% sodium tetra borate as foliar spray on standing crop. High in area of about 15 ha (3%) in the microwatershed.
- **Available iron:** It is deficient in 75 ha (15%) area and it is sufficient in 415 ha (84%) 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 401 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.

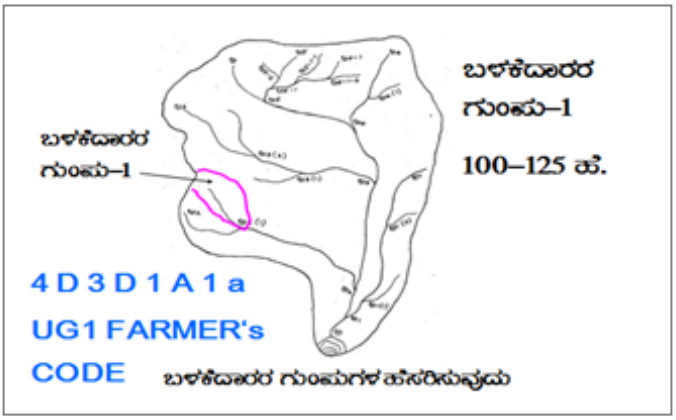
Land Suitability for various crops: Areas that are highly, moderately, marginally and not suitable for growing various crops are indicated. Along with the suitability, various constraints that are limiting the productivity are also indicated. For example, in case of cotton, gravel content, rooting depth 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-4 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.

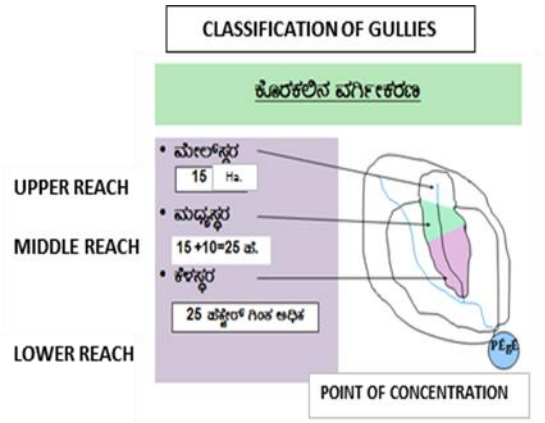
- Naming of user groups and farmers
- Identification of arable and non arable lands
- Identification of drainage lines and gullies
- Identification of non treatable areas
- Identification of priority areas in the arable lands
- Treatment plan for arable lands
- Location of water harvesting and recharge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

9.1 Treatment Plan

The treatment plan recommended for arable lands is briefly described below

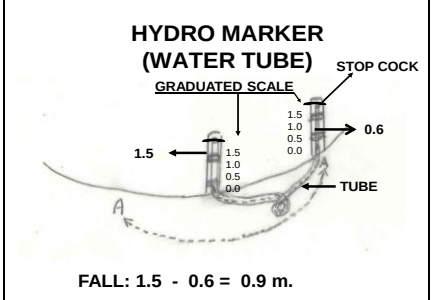
9.1.1 Arable Land Treatment

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.

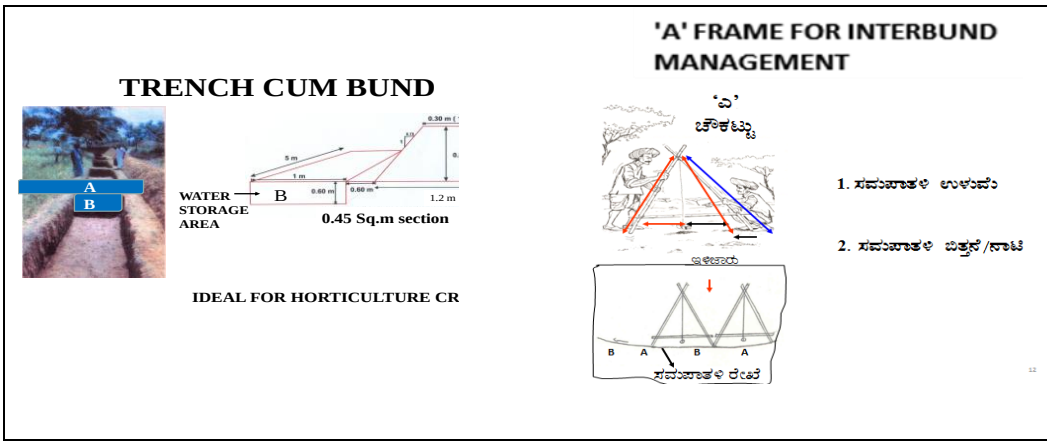
Recommended Bund Section

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.

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 the kind of conservation structures recommended has been prepared, which shows the spatial distribution and extent of area. Major area of about 478 ha (97%) requires Graded Bunding and small area of 12 ha (2%) requires Trench cum 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.

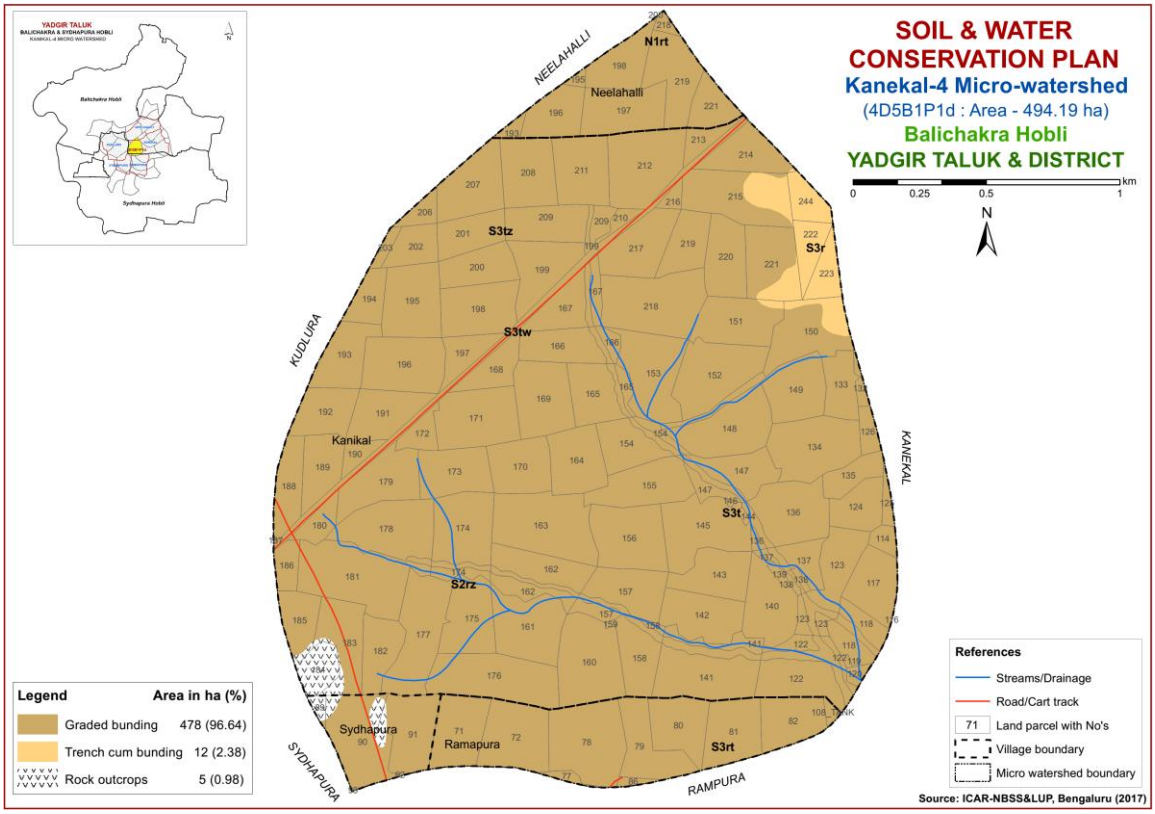


Fig. 9.1 Soil and Water Conservation Plan map of Kanekal-4 Microwatershed

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 Nerale (*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

Kanekal-4 Microwatershed

Soil phase Information

Village	Survey No	Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Kanikal	114	0.91	YDRiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	116	0	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Cotton+Redgram (Ct+Rg)	Not Available	IIIes	Graded bunding
Kanikal	117	4.16	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Cotton+Redgram (Ct+Rg)	Not Available	IIIes	Graded bunding
Kanikal	118	3.02	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Not Available (NA)	Not Available	IIIes	Graded bunding
Kanikal	119	0.12	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Not Available (NA)	Not Available	IIIes	Graded bunding
Kanikal	120	0.49	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Cotton (Ct)	Not Available	IIIes	Graded bunding
Kanikal	122	5.61	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Redgram (Rg)	Not Available	IIIes	Graded bunding
Kanikal	123	4.8	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Paddy (Pd)	Not Available	IIIes	Graded bunding
Kanikal	124	3.11	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Paddy (Jw+Pd)	Not Available	IIes	Graded bunding
Kanikal	125	0.66	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Groundnut (Ct+Gn)	Not Available	IIes	Graded bunding
Kanikal	126	1.11	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIes	Graded bunding
Kanikal	132	0.55	YDRiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Graded bunding
Kanikal	133	2.92	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Graded bunding
Kanikal	134	6.86	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Paddy (Ct+Pd)	Not Available	IIes	Graded bunding
Kanikal	135	2.24	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Paddy (Ct+Pd)	Not Available	IIes	Graded bunding
Kanikal	136	6.14	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Paddy+Onion (Ct+Pd+On)	2 Bore well,1 Open well	IIes	Graded bunding
Kanikal	137	2.24	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Not Available (NA)	Not Available	IIIes	Graded bunding
Kanikal	138	0.42	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Paddy (Pd)	Not Available	IIIes	Graded bunding
Kanikal	139	0.32	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Not Available (NA)	Not Available	IIIes	Graded bunding
Kanikal	140	4.98	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Paddy (Pd)	1 Bore well	IIIes	Graded bunding
Kanikal	141	7.61	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Cotton+Redgram (Ct+Rg)	Not Available	IIIes	Graded bunding
Kanikal	142	4.9	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Cotton (Ct)	Not Available	IIIes	Graded bunding

Village	Survey No	Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Kanikal	143	4.32	KDHcB2	LMU-1	Moderately deep (75-100 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	1 Bore well	IIes	Graded bunding
Kanikal	144	0.15	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Not Available (NA)	Not Available	IIIes	Graded bunding
Kanikal	145	6.69	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Paddy+Redgram (Pd+Rg)	1 Bore well	IIIes	Graded bunding
Kanikal	146	0.06	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Not Available (NA)	Not Available	IIIes	Graded bunding
Kanikal	147	4.41	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Cotton+Paddy (Ct+Pd)	Not Available	IIIes	Graded bunding
Kanikal	148	6.29	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Graded bunding
Kanikal	149	4.79	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Paddy (Pd)	Not Available	IIes	Graded bunding
Kanikal	150	6.04	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	151	5.22	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	152	6.75	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	153	6.65	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Redgram (Rg)	Not Available	IIIes	Graded bunding
Kanikal	154	4.12	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	155	5.19	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Redgram (Rg)	2 Bore well	IIIes	Graded bunding
Kanikal	156	6.31	KDHcB2	LMU-1	Moderately deep (75-100 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	1 Open well,2 Bore well	IIes	Graded bunding
Kanikal	157	5.27	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Redgram (Rg)	Not Available	IIIes	Graded bunding
Kanikal	158	3.84	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
Kanikal	159	0.08	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	160	7.28	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	161	6.1	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
Kanikal	162	5.41	HSLiB2	LMU-2	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	Graded bunding
Kanikal	163	8.39	KDHcB2	LMU-1	Moderately deep (75-100 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	164	4.76	MDGcB2	LMU-2	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	165	4.44	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Not Available (NA)	Not Available	IIIes	Graded bunding
Kanikal	166	4.34	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIes	Graded bunding

Village	Survey No	Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Kanikal	167	4.11	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Kanikal	168	2.65	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	169	5.62	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Kanikal	170	4.49	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Graded bunding
Kanikal	171	6.4	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	172	1.56	MDGcB2	LMU-2	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IIes	Graded bunding
Kanikal	173	4.59	MDGcB2	LMU-2	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	174	6.54	HSLiB2	LMU-2	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	Graded bunding
Kanikal	175	5	HSLiB2	LMU-2	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	Graded bunding
Kanikal	176	7.82	MYPiB2g1	LMU-2	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	177	7.12	HSLiB2	LMU-2	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Redgram (Jw+Rg)	Not Available	IIes	Graded bunding
Kanikal	178	6.97	HSLiB2	LMU-2	Moderately deep (75-100 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	Graded bunding
Kanikal	179	5.18	MDGcB2	LMU-2	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Graded bunding
Kanikal	180	1.68	MDGcB2	LMU-2	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IIes	Graded bunding
Kanikal	181	8.72	HSLiB2	LMU-2	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	Graded bunding
Kanikal	182	3.43	MDGcB2	LMU-2	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	183	4.82	MDGcB2	LMU-2	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	184	2.34	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	185	2.99	MDGcB2	LMU-2	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Redgram (Jw+Rg)	Not Available	IIes	Graded bunding
Kanikal	186	1.58	MDGcB2	LMU-2	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Graded bunding
Kanikal	187	0.03	MDGcB2	LMU-2	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IIes	Graded bunding
Kanikal	188	3.36	MDGcB2	LMU-2	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	189	3.51	HSLiB2	LMU-2	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	Graded bunding
Kanikal	190	1.14	HSLiB2	LMU-2	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	Graded bunding

Village	Survey No	Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Kanikal	191	4.32	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	2 Bore well	IIes	Graded bunding
Kanikal	192	3.71	MDGiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	193	4.14	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	194	2.28	HSLiB2	LMU-2	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Graded bunding
Kanikal	195	5.73	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	196	6.09	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Kanikal	197	2.31	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	198	5.33	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Graded bunding
Kanikal	199	4.67	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Kanikal	200	3.66	GWDiB2	LMU-2	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Kanikal	201	3.38	GWDiB2	LMU-2	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	202	2.54	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	203	0.66	HSLiB2	LMU-2	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	Graded bunding
Kanikal	206	1.19	HSLiB2	LMU-2	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	Graded bunding
Kanikal	207	5.27	MDRmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	208	5.09	MDRmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Graded bunding
Kanikal	209	5.04	GWDiB2	LMU-2	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Graded bunding
Kanikal	210	0.68	SBRcC3g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Severe	Not Available (NA)	Not Available	IIIes	Graded bunding
Kanikal	211	5.19	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IIes	Graded bunding
Kanikal	212	7.18	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIes	Graded bunding
Kanikal	213	1.39	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IIes	Graded bunding
Kanikal	214	3.9	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	215	7.3	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Redgram (Jw+Rg)	Not Available	IIes	Graded bunding
Kanikal	216	0.61	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IIes	Graded bunding

Village	Survey No	Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Kanikal	217	4.97	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Kanikal	218	8.2	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	219	3.35	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Kanikal	220	4.36	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIes	Graded bunding
Kanikal	221	5.37	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Graded bunding
Kanikal	222	2.23	YLRbB2	LMU-6	Moderately shallow (50-75 cm)	Loamy sand	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIes	Trench cum bunding
Kanikal	223	2.07	YLRbB2	LMU-6	Moderately shallow (50-75 cm)	Loamy sand	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Paddy+Redgram (Ct+Pd+Rg)	Not Available	IIes	Trench cum bunding
Kanikal	244	2.08	YLRbB2	LMU-6	Moderately shallow (50-75 cm)	Loamy sand	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding
Neelahalli	193	0.55	MDRmB2	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
Neelahalli	195	0.34	MDRmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Graded bunding
Neelahalli	196	3.63	MDRmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram+Jowar (Rg+Jw)	Not Available	IIes	Graded bunding
Neelahalli	197	5.25	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Neelahalli	198	3.77	MDRmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Neelahalli	200	0.02	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIIes	Graded bunding
Neelahalli	218	0.47	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIIes	Graded bunding
Neelahalli	219	5.1	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Graded bunding
Neelahalli	221	2.55	NGPmB2	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Ramapura	71	4.92	MYPiB2g1	LMU-2	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Ramapura	72	6.03	MYPiB2g1	LMU-2	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Ramapura	77	0.49	MYPiB2g1	LMU-2	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Ramapura	78	7.84	MYPiB2g1	LMU-2	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Ramapura	79	4.72	MYPhB2	LMU-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIes	Graded bunding
Ramapura	80	4.48	MYPhB2	LMU-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Ramapura	81	4.9	RMPiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Redgram (Jw+Rg)	Not Available	IIes	Graded bunding

Village	Survey No	Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Ramapura	82	4.16	RMPiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Redgram (Jw+Rg)	Not Available	IIes	Graded bunding
Ramapura	86	0.38	MYPhB2	LMU-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Ramapura	108	0.38	RMPiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Paddy+Redgram (Pd+Rg)	Not Available	IIes	Graded bunding
Sydhapura	89	0.5	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Not Available	Rock outcrops	Rock outcrops
Sydhapura	90	6.8	RHNcB2	LMU-2	Moderately deep (75-100 cm)	Sandy loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Sydhapura	91	5.21	MYPiB2g1	LMU-2	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Sydhapura	92	0.04	MYPiB2g1	LMU-2	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Sydhapura	93	0.01	RHNcB2	LMU-2	Moderately deep (75-100 cm)	Sandy loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding

Appendix II

Kanekal-4 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	114	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)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	116	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	117	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	118	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	119	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	120	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5 %)	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	122	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	123	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	124	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)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	125	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)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	126	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)	Medium (0.5 - 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	132	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	133	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	134	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	135	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)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	136	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)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	137	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)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	138	Strongly alkaline (pH 8.4 – 9.0)	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	139	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)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	140	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)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	141	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	142	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)

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	143	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	144	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	145	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	146	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	147	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	148	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	149	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	150	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	151	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	152	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	153	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	154	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	155	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	156	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	157	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	158	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	159	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	160	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	161	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	162	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	163	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	164	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	165	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	166	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)

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	167	Strongly alkaline (pH 8.4 – 9.0)	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	168	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	169	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	170	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	171	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	172	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	173	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)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	174	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)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	175	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)
Kanikal	176	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	177	Slightly alkaline (pH 7.3 – 7.8)	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)
Kanikal	178	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	179	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)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	180	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	181	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	182	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	183	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	184	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops
Kanikal	185	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	186	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (>0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	187	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)
Kanikal	188	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)
Kanikal	189	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	190	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	191	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)	Medium (0.5 - 1.0 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	192	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	193	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	194	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	195	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	196	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	197	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	198	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	199	Strongly alkaline (pH 8.4 – 9.0)	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	200	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)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	201	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	202	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	203	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)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	206	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	207	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	208	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	209	Strongly alkaline (pH 8.4 – 9.0)	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	210	Strongly alkaline (pH 8.4 – 9.0)	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	211	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	212	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	213	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	214	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	215	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	216	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	217	Strongly alkaline (pH 8.4 – 9.0)	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)

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	218	Strongly alkaline (pH 8.4 – 9.0)	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	219	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	220	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	221	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	222	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	223	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	244	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Neelahalli	193	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)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Neelahalli	195	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	High (> 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Neelahalli	196	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)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Neelahalli	197	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)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Neelahalli	198	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)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Neelahalli	200	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Neelahalli	218	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Neelahalli	219	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)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Neelahalli	221	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 - 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)
Ramapura	71	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)
Ramapura	72	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)
Ramapura	77	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 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)
Ramapura	78	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)
Ramapura	79	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)
Ramapura	80	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)
Ramapura	81	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)
Ramapura	82	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	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
Ramapura	86	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)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Ramapura	108	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sydhapura	89	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops
Sydhapura	90	Moderately alkaline (pH 7.8 – 8.4)	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)
Sydhapura	91	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)
Sydhapura	92	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 - 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)
Sydhapura	93	Strongly alkaline (pH 8.4 – 9.0)	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)

Appendix III

Kanekal-4 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	Mulberry
Kanikal	114	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
Kanikal	116	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	117	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	118	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	119	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	120	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	122	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	123	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	124	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	125	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	126	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	132	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
Kanikal	133	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	134	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	135	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	136	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	137	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	138	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	139	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	140	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

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	Mulberry
Kanikal	141	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	142	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	143	S3tw	S3tw	S3tw	S2w	S3tw	S2r	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tz	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	144	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	145	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	146	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	147	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	148	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	149	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	150	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	151	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	152	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	153	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	154	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	155	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	156	S3tw	S3tw	S3tw	S2w	S3tw	S2r	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tz	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	157	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	158	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	159	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	160	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	161	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	162	S3rz	S3tz	S2rz	S2tz	S2rz	S3tz	S3rz	S2rz	S3tz	S2rz	S2rz	S2tz	S2rz	S2z	N1tz	S3rz	S2rz	S2z	S2z	S2z	S2z	S2z	S2rz	S2z	S2rz	S2rz

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	Mulberry
Kanikal	163	S3tw	S3tw	S3tw	S2w	S3tw	S2r	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tz	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	164	S2r	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2t	S2tw	S3tw
Kanikal	165	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	166	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	167	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	168	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	169	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	170	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	171	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	172	S2r	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2t	S2tw	S3tw
Kanikal	173	S2r	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2t	S2tw	S3tw
Kanikal	174	S3rz	S3tz	S2rz	S2tz	S2rz	S3tz	S3rz	S2rz	S3tz	S2rz	S2rz	S2tz	S2rz	S2z	N1tz	S3rz	S2rz	S2z	S2z	S2z	S2z	S2z	S2rz	S2z	S2rz	S2rz
Kanikal	175	S3rz	S3tz	S2rz	S2tz	S2rz	S3tz	S3rz	S2rz	S3tz	S2rz	S2rz	S2tz	S2rz	S2z	N1tz	S3rz	S2rz	S2z	S2z	S2z	S2z	S2z	S2rz	S2z	S2rz	S2rz
Kanikal	176	S3tw	S3tw	S3tw	S2wz	S3tw	S2wz	S2tw	S2zw	S2wz	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2wz	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	177	S3rz	S3tz	S2rz	S2tz	S2rz	S3tz	S3rz	S2rz	S3tz	S2rz	S2rz	S2tz	S2rz	S2z	N1tz	S3rz	S2rz	S2z	S2z	S2z	S2z	S2z	S2rz	S2z	S2rz	S2rz
Kanikal	178	S3rz	S3tz	S2rz	S2tz	S2rz	S3tz	S3rz	S2rz	S3tz	S2rz	S2rz	S2tz	S2rz	S2z	N1tz	S3rz	S2rz	S2z	S2z	S2z	S2z	S2z	S2rz	S2z	S2rz	S2rz
Kanikal	179	S2r	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2t	S2tw	S3tw
Kanikal	180	S2r	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2t	S2tw	S3tw
Kanikal	181	S3rz	S3tz	S2rz	S2tz	S2rz	S3tz	S3rz	S2rz	S3tz	S2rz	S2rz	S2tz	S2rz	S2z	N1tz	S3rz	S2rz	S2z	S2z	S2z	S2z	S2z	S2rz	S2z	S2rz	S2rz
Kanikal	182	S2r	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2t	S2tw	S3tw
Kanikal	183	S2r	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2t	S2tw	S3tw
Kanikal	184	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

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	Mulberry
Kanikal	185	S2r	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2t	S2tw	S3tw
Kanikal	186	S2r	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2t	S2tw	S3tw
Kanikal	187	S2r	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2t	S2tw	S3tw
Kanikal	188	S2r	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2t	S2tw	S3tw
Kanikal	189	S3rz	S3tz	S2rz	S2tz	S2rz	S3tz	S3rz	S2rz	S3tz	S2rz	S2rz	S2tz	S2rz	S2z	N1tz	S3rz	S2rz	S2z	S2z	S2z	S2z	S2z	S2rz	S2z	S2rz	S2rz
Kanikal	190	S3rz	S3tz	S2rz	S2tz	S2rz	S3tz	S3rz	S2rz	S3tz	S2rz	S2rz	S2tz	S2rz	S2z	N1tz	S3rz	S2rz	S2z	S2z	S2z	S2z	S2z	S2rz	S2z	S2rz	S2rz
Kanikal	191	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	192	S2r	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2t	S2tw	S3tw
Kanikal	193	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	194	S3rz	S3tz	S2rz	S2tz	S2rz	S3tz	S3rz	S2rz	S3tz	S2rz	S2rz	S2tz	S2rz	S2z	N1tz	S3rz	S2rz	S2z	S2z	S2z	S2z	S2z	S2rz	S2z	S2rz	S2rz
Kanikal	195	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	196	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	197	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	198	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	199	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	200	S3rz	S3tz	S3tz	S2zw	S3tz	S2rz	S3rz	S2rz	S2zw	S2rz	S2rz	S2zw	S3tz	S2zw	N1tw	S3rz	S2rz	S3tz	S2tz	S3tz	S2tz	S2tz	S2rz	S2z	S2rz	S3tz
Kanikal	201	S3rz	S3tz	S3tz	S2zw	S3tz	S2rz	S3rz	S2rz	S2zw	S2rz	S2rz	S2zw	S3tz	S2zw	N1tw	S3rz	S2rz	S3tz	S2tz	S3tz	S2tz	S2tz	S2rz	S2z	S2rz	S3tz
Kanikal	202	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	203	S3rz	S3tz	S2rz	S2tz	S2rz	S3tz	S3rz	S2rz	S3tz	S2rz	S2rz	S2tz	S2rz	S2z	N1tz	S3rz	S2rz	S2z	S2z	S2z	S2z	S2z	S2rz	S2z	S2rz	S2rz
Kanikal	206	S3rz	S3tz	S2rz	S2tz	S2rz	S3tz	S3rz	S2rz	S3tz	S2rz	S2rz	S2tz	S2rz	S2z	N1tz	S3rz	S2rz	S2z	S2z	S2z	S2z	S2z	S2rz	S2z	S2rz	S2rz
Kanikal	207	S3tz	S3tw	S3tw	S2zw	S3tw	S2z	S2tw	S2zw	S2z	S2zw	S2tw	S2tw	S3tw	S2zw	N1tw	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tz	S2tw	S3tw
Kanikal	208	S3tz	S3tw	S3tw	S2zw	S3tw	S2z	S2tw	S2zw	S2z	S2zw	S2tw	S2tw	S3tw	S2zw	N1tw	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tz	S2tw	S3tw

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	Mulberry
Kanikal	209	S3rz	S3tz	S3tz	S2zw	S3tz	S2rz	S3rz	S2rz	S2zw	S2rz	S2rz	S2zw	S3tz	S2zw	N1tw	S3rz	S2rz	S3tz	S2tz	S3tz	S2tz	S2tz	S2rz	S2z	S2rz	S3tz
Kanikal	210	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	211	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	212	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	213	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	214	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	215	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	216	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	217	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	218	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	219	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	220	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	221	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Kanikal	222	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	223	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	244	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
Neelahalli	193	S3tz	S3tw	S3tw	S2zw	S3tw	S2z	S2tw	S2zw	S2z	S2zw	S2tw	S2tw	S3tw	S2zw	N1tw	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tz	S2tw	S3tw
Neelahalli	195	S3tz	S3tw	S3tw	S2zw	S3tw	S2z	S2tw	S2zw	S2z	S2zw	S2tw	S2tw	S3tw	S2zw	N1tw	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tz	S2tw	S3tw
Neelahalli	196	S3tz	S3tw	S3tw	S2zw	S3tw	S2z	S2tw	S2zw	S2z	S2zw	S2tw	S2tw	S3tw	S2zw	N1tw	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tz	S2tw	S3tw
Neelahalli	197	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Neelahalli	198	S3tz	S3tw	S3tw	S2zw	S3tw	S2z	S2tw	S2zw	S2z	S2zw	S2tw	S2tw	S3tw	S2zw	N1tw	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tz	S2tw	S3tw
Neelahalli	200	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

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	Mulberry
Neelahalli	218	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
Neelahalli	219	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Neelahalli	221	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Ramapura	71	S3tw	S3tw	S3tw	S2wz	S3tw	S2wz	S2tw	S2zw	S2wz	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2wz	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Ramapura	72	S3tw	S3tw	S3tw	S2wz	S3tw	S2wz	S2tw	S2zw	S2wz	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2wz	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Ramapura	77	S3tw	S3tw	S3tw	S2wz	S3tw	S2wz	S2tw	S2zw	S2wz	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2wz	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Ramapura	78	S3tw	S3tw	S3tw	S2wz	S3tw	S2wz	S2tw	S2zw	S2wz	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2wz	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Ramapura	79	S3tw	S3tw	S3tw	S2wz	S3tw	S2wz	S2tw	S2zw	S2wz	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2wz	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Ramapura	80	S3tw	S3tw	S3tw	S2wz	S3tw	S2wz	S2tw	S2zw	S2wz	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2wz	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Ramapura	81	N1rw	S3tw	S3rt	S2rw	S3rw	S2rw	N1rw	S3rw	S2rw	S3rw	S3rw	S2rw	S3rt	S2rw	N1tw	S3rw	S3rw	S3tw	S3rt	S3rt	S2rt	S2rt	S3rw	S3rt	S3w	S3rt
Ramapura	82	N1rw	S3tw	S3rt	S2rw	S3rw	S2rw	N1rw	S3rw	S2rw	S3rw	S3rw	S2rw	S3rt	S2rw	N1tw	S3rw	S3rw	S3tw	S3rt	S3rt	S2rt	S2rt	S3rw	S3rt	S3w	S3rt
Ramapura	86	S3tw	S3tw	S3tw	S2wz	S3tw	S2wz	S2tw	S2zw	S2wz	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2wz	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Ramapura	108	N1rw	S3tw	S3rt	S2rw	S3rw	S2rw	N1rw	S3rw	S2rw	S3rw	S3rw	S2rw	S3rt	S2rw	N1tw	S3rw	S3rw	S3tw	S3rt	S3rt	S2rt	S2rt	S3rw	S3rt	S3w	S3rt
Sydhapura	89	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
Sydhapura	90	S3rt	S3tw	S3tw	S2wz	S3tw	S2rw	S3rw	S2rz	S2wz	S2rw	S2rt	S2tz	S3tw	S2zw	N1tz	S3rt	S2rw	S3tw	S2tw	S3tw	S2tw	S2tw	S2rt	S2tw	S2rt	S3tw
Sydhapura	91	S3tw	S3tw	S3tw	S2wz	S3tw	S2wz	S2tw	S2zw	S2wz	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2wz	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Sydhapura	92	S3tw	S3tw	S3tw	S2wz	S3tw	S2wz	S2tw	S2zw	S2wz	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2wz	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Sydhapura	93	S3rt	S3tw	S3tw	S2wz	S3tw	S2rw	S3rw	S2rz	S2wz	S2rw	S2rt	S2tz	S3tw	S2zw	N1tz	S3rt	S2rw	S3tw	S2tw	S3tw	S2tw	S2tw	S2rt	S2tw	S2rt	S3tw

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: *Kanikal-4 micro-watershed (Yadgir taluk and district) is located in between $16^0$35' – $16^0$36' North latitudes and 77^0 15' – $76^0$16' East longitudes, covering an area of about 494.19 ha, bounded by Kanikal, Rampura, Sydhapura, Neelahalli and Kudlura villages with length of growing period (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.*

Results: *The socio-economic outputs for the Kanikal-4 micro-watershed in Yadgir taluk and district are presented here.*

Social Indicators;

- *Male and female ratio is 61.2 to 38.8 per cent to the total sample population.*
- *Younger age group 18 to 50 of population is around 51.8 per cent to the total population.*
- *Literacy population is around 61.2 per cent.*
- *Social groups belong to scheduled caste / scheduled tribes are around 47.1 per cent*
- *Wood is the source of energy for a cooking among 88.2 per cent.*
- *About 29.4 per cent of households have a yashaswini health card.*
- *About 11.8 per cent farm households having MGNREGA card for rural employments.*
- *Dependence on ration cards for food grains through public distribution system is around 94.1 per cent*
- *Swach bharath program providing closed toilet facilities around 31.2 per cent of sample households.*
- *Rural migration to unban centre for employment is prevalent among 23.5 per cent of farm households.*
- *Women participation in decisions making are around 47.1 per cent of households were found.*

Economic Indicators;

- *The average land holding is 2.4 ha indicates that majority of farm households are belong to marginal and small farmers. The account for 80.3 per cent of dry land*

and 19.7 per cent of irrigated land of total cultivated land among the sample households.

- *Agriculture is the main occupation among 17.6 per cent and agriculture is the main and non agriculture labour is subsidiary occupation for 51.8 per cent of sample households.*
- *The average value of domestic assets is around Rs.184954 per household. Mobile and television are mass popular mass communication media.*
- *The average farm assets a value is around Rs.115647 per household, about 28 per cent of sample farmers are owing plough.*
- *The average livestock value is around Rs.32666 per household; about 64 per cent of household are having livestock.*
- *The average per capita food consumption is around 1081.2 grams (2483.9 kilo calories) against national institute of nutrition recommendation at 827 gram. Around 23.5 per cent of sample households are consuming less than the NIN recommendation.*
- *The annual average income is around Rs. 37155 per household. About 29.4 per cent of farm households are below poverty line.*
- *The per capita monthly expenditure is around Rs. 2816.*

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 2236.2 per ha/year. The total cost of annual soil nutrients is around Rs 1093504 per year for the total area of 494.2 ha.*
- *The average value of ecosystem service for food grain production is around Rs. 8645/ ha/year. Per hector food production services is maximum in bajra (Rs. 25693) followed by maize (Rs. 5267), redgram (Rs. 5048), greengram (Rs. 5032), groundnut (Rs. 4863) and cotton (Rs. 3792).*
- *The average value of ecosystem service for fodder production is around Rs.1555/ ha/year. Per hector fodder production services is maximum in bajra (Rs 2717) followed by paddy (Rs 2083), groundnut (Rs.1049) and maize (Rs 370).*
- *The data on water requirement for producing one quintal of grain is considered for estimating the total value of water required for crop production. The per hectare value of water used and value of water was maximum in bajra (Rs. 110557) followed by greengram (Rs. 51173), red gram (Rs. 33808), cotton (Rs. 31928), maize (Rs. 20751) and groundnut (Rs.18037).*

Economic Land Evaluation;

- *The major cropping pattern is redgram (47.2 %) followed by cotton (17.6 %), groundnut (16.0 %), greengram (4.8 %), maize (4.8 %), paddy (8.0 %), and bajra (1.6 %)*

- *In Kanikal-4 micro watershed, major soils are soil of alluvial landscape of Sambara (SBR) series are having moderately shallow soil deep cover around 25.57 % of area. On this soil farmers are presently growing cotton (56.2 %), maize (25.0 %) paddy (6.2 %), and redgram (12.5 %). Soil of granite and granite gneiss landscape of Nagalapur (NGP) are also having deep soil deep cover around 0.97 % of area, the crops are paddy (11.1 %), and redgram (88.9 %). Madhwara (MDR) soil series having very deep soil depth cover around 23.42 % of areas, crops are redgram (100 %). Hosalli (HSL) soil series are having moderately deep soil depth cover around 15.53 per cent of area, respectively. The major crops grown are paddy (16.7 %) and redgram (83.3 %). Kadechoor (KDH) soil series are having moderately deep soil depth covers around 3.31 % of area, the major crop grown is bajra (8.3 %), cotton (12.5 %), greengram (16.7 %), groundnut (45.8 %) and redgram (16.7 %). Mylapura (MYP) and Rachanalli (RHN) soil series having very deep and moderately deep soil depth cover 1.54 % and 0.41 % of areas respectively; crops are cotton, greengram, maize, redgram, groundnut and paddy.*
- *The total cost of cultivation and benefit cost ratio (BCR) in study area for cotton ranges between Rs.35018/ha in MYP soil (with BCR of 1.18) and Rs.25702/ha in SBR soil (with BCR of 1.07).*
- *In maize the cost of cultivation range between Rs 35615/ha in MYP soil (with BCR of 1.14) and Rs.16683/ha in SBR soil (with BCR of 1.48).*
- *In paddy the cost of cultivation range between Rs. 74662/ha in SBR soil (with BCR of 1.51) and Rs. 20967/ha in RHN soil (with BCR of 1.06).*
- *In redgram cost of cultivation range between is Rs. 29997/ha in SBR soil (with BCR of 1.48) and Rs 8160 in NGP soil (with BCR of 1.02).*
- *In groundnut the cost of cultivation range between is Rs 23485/ha in KDH soil (with BCR of 1.22) and Rs.13831/ha in RHN soil (with BCR of 1.63).*
- *In greengram the cost of cultivation in MYP soil is Rs.33499/ha (with BCR of 1.24).*
- *In bajra the cost of cultivation in KDH soil is Rs.66931/ha (with BCR of 1.43).*
- *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. More fertilizer applications in deeper soils 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 cotton (46 to 64.6 %), maize (67.4 % to 72 %), paddy (34% to 78 %), red gram (27.3 % to 86.4 %), groundnut (26.6 % to 30.6 %).*

Chapter 2

INTRODUCTION

Watershed Development program aim to restore degraded watersheds in rainfed regions to increase their capacity to capture and store rain water, reduce soil erosion, and improved soil nutrients and carbon contents so they can produce greater agricultural yields and other benefits. As majority of rural poor live in these regions and dependent on natural resources for their livelihood and sustenance, improvements in agricultural yields improve human welfare and simultaneously improve national food security.

Sujala–III watershed development project conceptualised 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 objectives of Sujala-III is to demonstrate more effective watershed management through greater integration of programs related to rain fed 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 and socio-economic conditions. The project will be implemented over six years and linked with the centrally financed integrated watershed management programme.

Economic evaluations can better guide in watershed planning and implementation, as well as raise awareness of benefits of ecosystem restoration for food security and poverty alleviation program. 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, 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

Kanekal-4 micro-watershed is located in North-eastern Dry Zone of Karnataka (Figure 1). 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 soils with small pockets of shallow to medium black soils. The zone is cropped predominantly during Rabi due to insufficient rainfall (465-785 mm). The principal crops of the zone are jowar, bajra, oilseeds, pulses, cotton and sugarcane. It's represented Agro Ecological Sub Regional (AESR) 6.2 with LGP 120-150 days.

Kanekal-4 micro-watershed (Yadgir taluk and district) is located in between $16^0$35' – $16^0$36' North latitudes and 77^0 15' – $76^0$16' East longitudes, covering an area of about 494.19 ha, bounded by Kanikal, Rampura, Sydhapura, Neelahalli and Kudlura villages.

Sampling Procedure:

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

Sources of data and analysis:

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

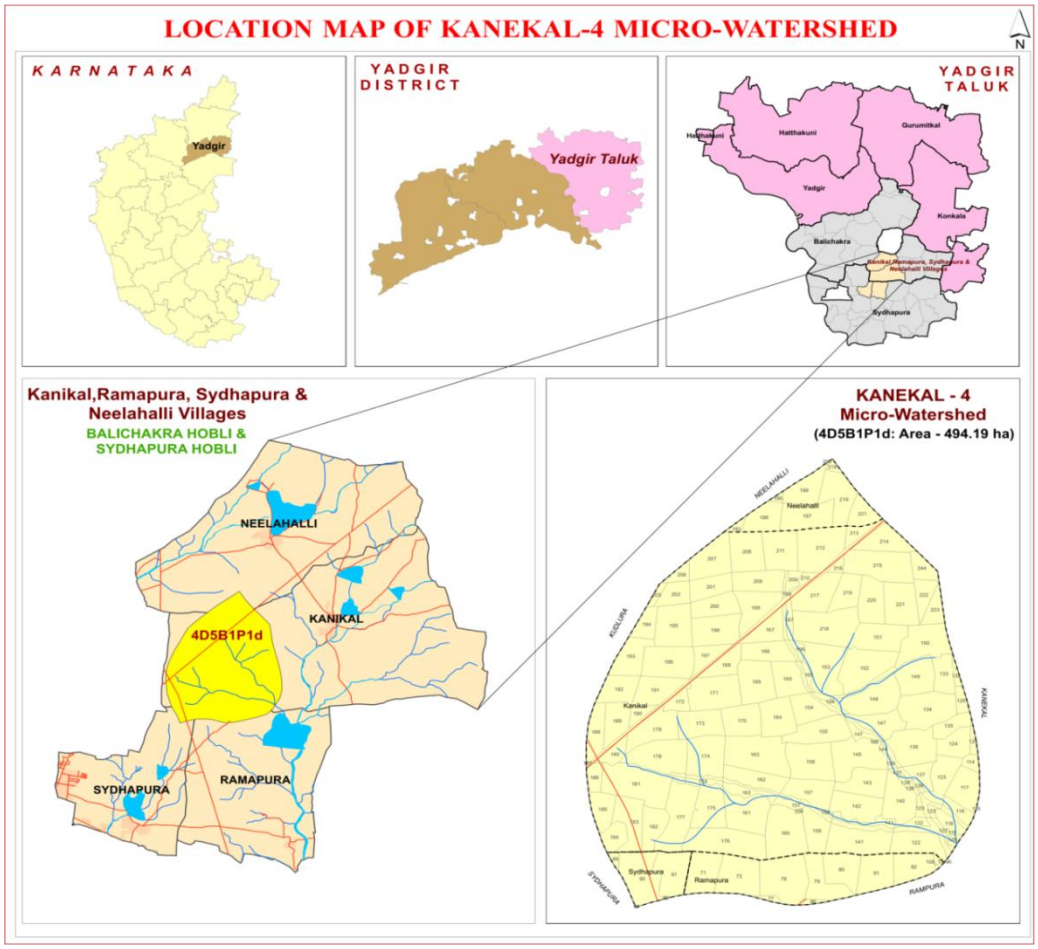
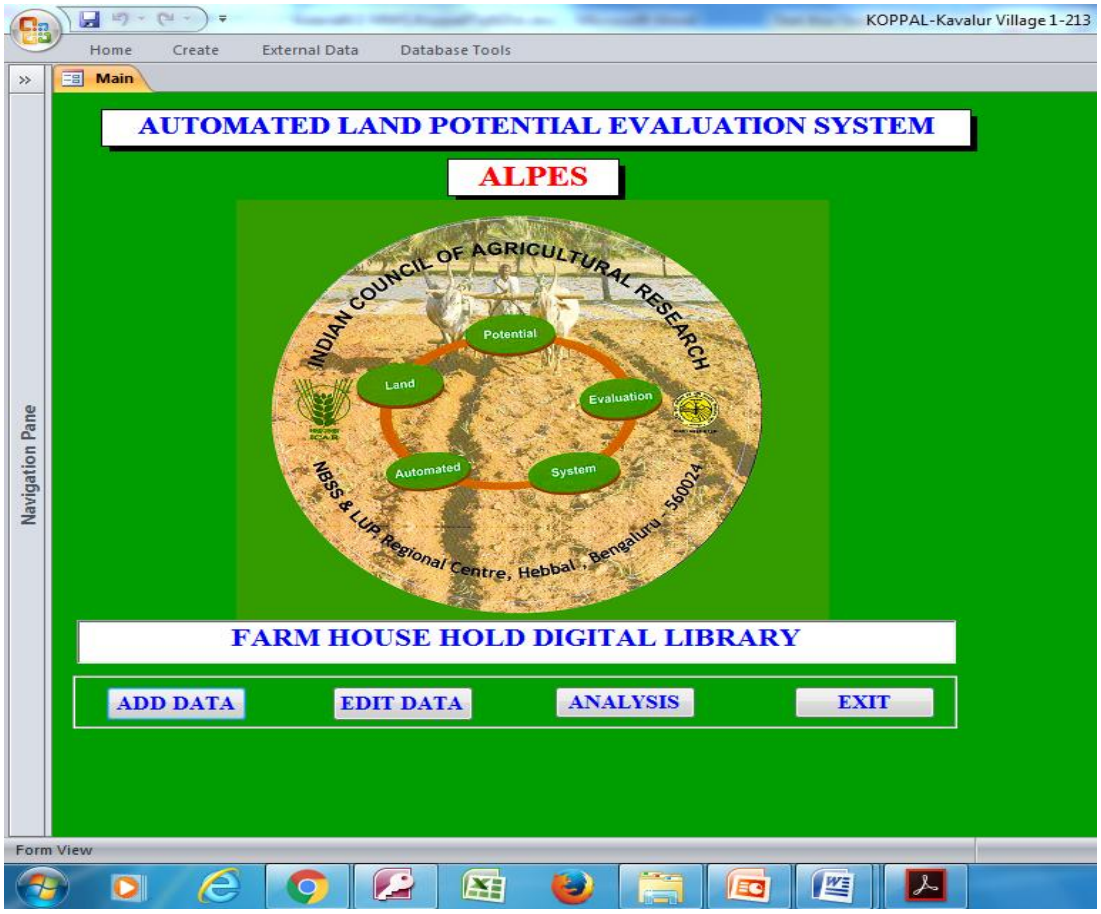


Figure 1: Location of study area

Steps followed in socio-economic assessment

1. •After the completion of soil profile study link the cadastral number to the soil profile in the micro watershed.
2. • Download the names of the farmers who are owning the land for each cadastral number in the Karnataka BHOOMI Website.
3. • Compiling the names of the farmers representing for all the soil profiles studied in the micro watershed for socio-economic Survey.
4. • Conducting the socioeconomic survey 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.



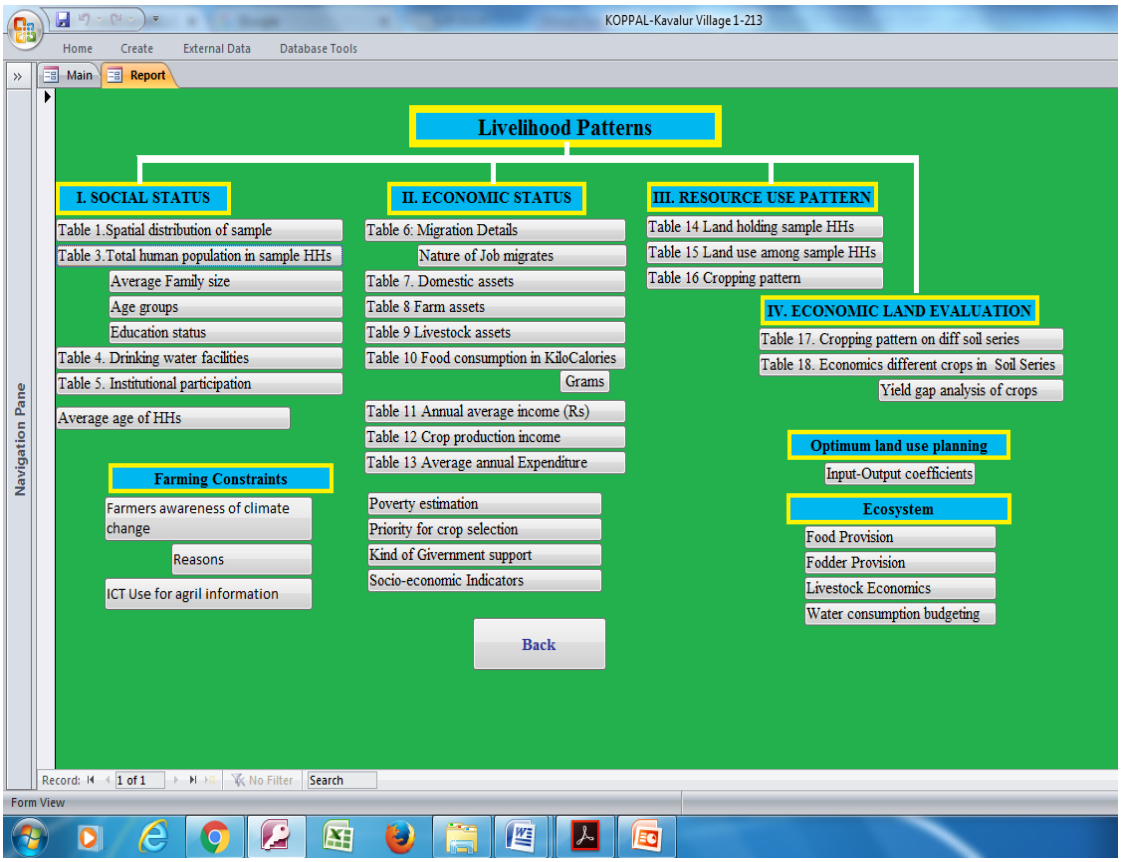


Figure 2: ALPES FRAMEWORK

The sample farmers were post classified in to marginal and small (0.0 to <=2 acres), medium and semi medium (>2 to <=10 acres) and large (>10 acres). The steps involved in estimation of soil potential involve estimation of total cost of cultivation, the yield/gross returns and net income per hectare. The cost of inputs such seed, manure and fertilizer, plant protection chemicals, payment towards human and bullock labour and interest on working capita are included under operational costs. In the case of perennial crops, the cost of establishment was estimated by using actual physical requirements and prevailing market prices. Estimation cost included maintenance cost up to bearing period. The value of main product and by product from the crop enterprise at the market rates were the gross returns of the crop. Net returns were worked out by deducting establishment and maintained cost from gross returns.

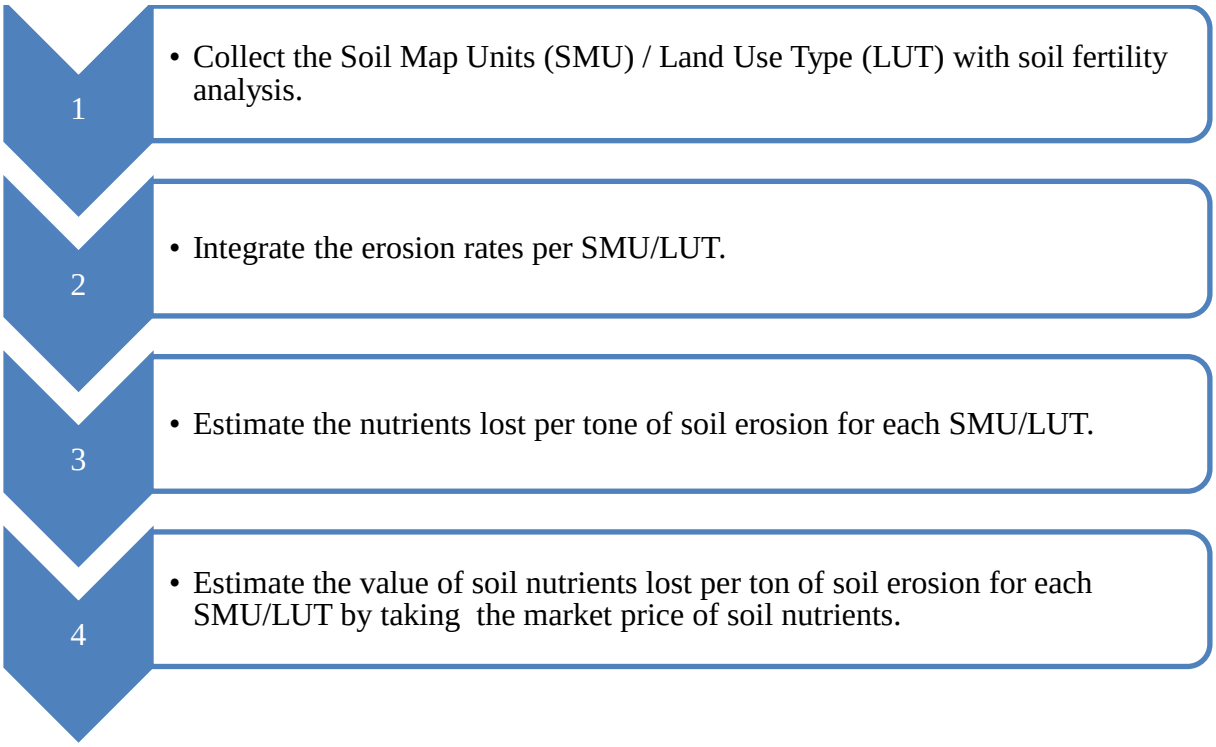
Operational Cost = cost of seeds, fertilizers, pesticides. Cost of human and bullock labour, cost of machinery, cost of irrigation water + interest on working capital.
Gross returns = Yield (Quintals/hectare)*Price (Rs/Quintal)
Net returns = Gross returns-Operational cost.
Benefit Cost Ratio = Net returns/Total cost.

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

Economic Valuation of Soil ecosystem services:

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

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



Chapter 4

RESULTS AND DISCUSSIONS

The 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 85, out of which 61.2 per cent were males and 38.8 per cent females. Average family size of the households is 5 of among sample population (Table 1).

Table 1: Human population among sample households in Kanikal-4 Microwatershed

Particulars	MF (9)		SF(27)		SMF (41)		MDF (8)		All(85)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Male	5	55.6	16	59.3	27	65.9	4	50.0	52	61.2
Female	4	44.4	11	40.7	14	34.1	4	50.0	33	38.8
Total human population in sample HHs	9	100	27	100	41	100	8	100	85	100
Average family size	4.50		3.86		5.86		8.00		5.00	

Age is an important factor, which affects the potential employment and mobility status of respondents. The data on age wise distribution of farmers in the sample households indicated that majority of the farmers are coming under the age group of 30 to 50 years (30.6 %) followed by 0 to18 years (34.1 %), 18 to 30 years (21.2 %) and more than 50 years (14.1 %). 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 (Table 2).

Table 2: Age group among sample households in Kanikal-4 Microwatershed

Particulars	MF (9)		SF(27)		SMF (41)		MDF (8)		All(85)	
	No.	%	No.	%	No.	No.	%	No.	%	No.
0 to 18 year	4	44.4	8	29.6	17	41.5		0	29	34.1
18 to 30 year	2	22.2	5	18.5	8	19.5	3	37.5	18	21.2
30 to 50 years	3	33.3	11	40.7	9	22.0	3	37.5	26	30.6
>50 years		0	3	11.1	7	17.1	2	25	12	14.1
Grand Total	9	100	27	100	41	100	8	100	85	100
Average of Age	22.67		32.93		29.39		40.75		30.87	

Data on literacy indicated that 38.8 per cent of respondents were illiterate and 61.2 per cent literate; with a highest is high school education (24.7 %) followed by middle school education (15.3%), primary school education (14.12 %) and graduate and post graduate (7.1 %) (Table 3).

The ethnic groups among the sample farm households found to be 35.3 per cent belonging to scheduled tribes (ST) followed by 35.3 per cent belonging to other backward castes (OBC), around 11.8 per cent belong to scheduled cast (SC) and 17.6 per cent belong to general castes (Table 4 and Figure 3).

Table 3: Education status among sample households in Kanikal-4 Microwatershed

Particulars	MF (9)		SF(27)		SMF (41)		MDF (8)		All(85)	
	No.	%	No.	%	No.	No.	%	No.	%	No.
Illiterates	2	22.2	14	51.9	15	36.6	2	25	33	38.8
Primary School (<5 class)	2	22.2	1	3.7	6	14.6	3	37.5	12	14.1
Middle School (6- 8 Class)	1	11.1	4	14.8	7	17.1	1	12.5	13	15.3
High School (9- 10 Class	2	22.2	8	29.6	10	24.4	1	12.5	21	24.7
Others	2	22.2	-	-	3	7.3	1	12.5	6	7.1
Grand Total	9	100	27	100	41	100	8	100	85	100.0

Table 4: Social status of sample households in Kanikal-4 Microwatershed

Particulars	MF (2)		SF (7)		SMF (7)		MDF (1)		All (17)	
	No.	%	No.	%	No.	%	No.	%	No.	%
SC	1	50	-	-	1	14.3	-	-	2	11.8
ST	-	-	5	71.4	1	14.3	-	-	6	35.3
OBC	-	-	2	28.6	4	57.1	-	-	6	35.3
General caste	1	50	-	-	1	14.3	1	100	3	17.6
Grand Total	2	100	7	100	7	100	1	100	17	100.0

About 88.2 per cent of sample households are using fire wood as source of fuel for cooking 5.9 per cent kerosene and 5.9 per cent of gas. All the sample farmers are having electricity connection. About 29.4 per cent are sample households having health cards. Only 11.8 per cent of having MNREGA job cards for employment generation. About 94.1 per cent of farm households are having ration cards for taking food grains from public distribution system. About 29.41 per cent of farm households are having toilet facilities.

Table 5: Basic needs of sample households in Kanikal-4 Microwatershed

Particulars	MF (2)		SF (7)		SMF (7)		MDF (1)		All (17)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Domestic Fuel Use										
Fire wood	2	100	6	85.7	6	85.7	1	100	15	88.2
Gas	-	-	1	14.3	-	-	-	-	1	5.9
Kerosene	-	-	-	-	1	14.3	-	-	1	5.9
Light										
Electricity	2	100	7	100	7	100	1	100	17	100
Health Card										
Yes	1	50	1	14.3	3	42.9	-	-	5	29.4
No	1	50	6	85.7	4	57.1	1	100	12	70.6
NREGA										
Yes	-	-	1	14.3	1	14.3	-	-	2	11.8
No	2	100	6	85.7	6	85.7	1	100	15	88.2
Ration Card										
Yes	2	100	7	100	6	85.7	1	100	16	94.1
No	-	-	-	-	1	14.3	-	-	1	5.9
Household with toilet										
Yes	1	50	1	14.29	2	28.571	1	100	5	29.41
No	1	50	6	85.71	5	71.429	-	-	12	70.59
Drinking Water										
Tube Well	2	100	7	100	7	100	1	100	17	100

The data collected on the source of drinking water in the study area is presented in Table 5. Majority of the sample respondents are having tube well source for water supply for domestic purpose (100 %).

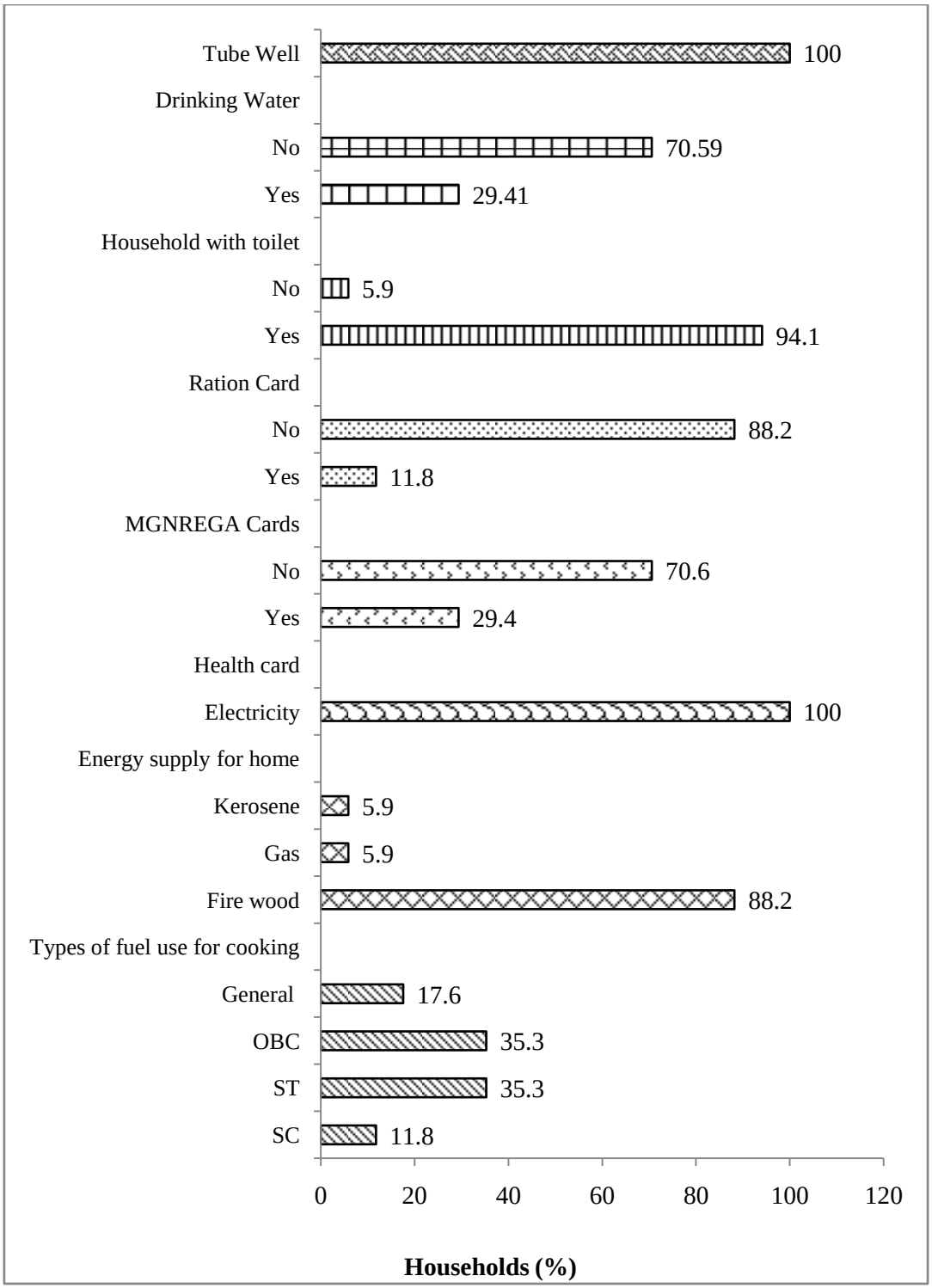


Figure 3: Basic needs of sample households in Kanikal-4 Microwatershed

The data on migration in Kanikal-4 Micro-watershed is given in Table 6. It indicated that around 23.5 per cent of samples households were migrated. The average distance travelled for seeking employment is 337 km.

Table 6: Migration details among the sample households in Kanikal-4 micro-watershed

Particulars	SF (7)	SMF (7)	All (17)
% of persons migrating	7.4	14.6	9.4
% of households showing migration	14.2	42.8	23.5
No. of month migrated in a year	10.0	10.0	10.0
Average Distance of migrating(Km)	600	250	337
Purpose Of Migration			
Education of the children's	0	33.3	25
Job/wage/work	100	66.7	75

The occupational pattern (Table 7) among sample households shows that agriculture is the main occupation around 5.4 per cent of farmers and agriculture is the main and non agriculture labour is around 51.8 per cent. Non agriculture labour is a main occupation is 11.8 per cent.

Table 7: Occupational pattern in sample households in Kanikal-4 Microwatershed

Occupation		MF (9)		SF(27)		SMF (41)		MDF (8)		All(85)	
Main	**Subsidiary**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	%
Agriculture	Agriculture	2	22.2	5	18.5	8	19.5		0.0	15	17.6
	Non Agriculture Labour	4	44.4	16	59.3	16	39.0	8	100.0	44	51.8
Non Agriculture Labour			0.0		0.0	10	24.4		0.0	10	11.8
Studying		3	33.3	6	22.2	7	17.1		0.0	16	18.8
Grand Total		9	100.0	27	100.0	41	100.0	8	100.0	85	100.0
Family Labour availability		**Man days/month**									
Male		25.0	55.6	66.9	64.8	77.8	70.8	100	55.6	76.3	64.1
Female		20.0	44.4	36.4	35.2	32.1	29.2	80.0	44.4	42.7	35.9
Total		45.0	100	103	100	109	100	180	100	119	100

The important assets especially with reference to domestic assets were analyzed and are given in Table 8 and Figure 4. The important domestic assets possessed by all categories of farmers are mobile phones (94.1 %) followed by television (70.6 %), motorcycle (64.7 %), mixer/grinder (17.6 %), refrigerator (11.8 %), radio (5.9 %), bicycle (5.9 %), auto (5.9 %), tempo (5.9 %) and four wheeler (5.9 %). The average value of domestic assets is around Rs. 184954 per households.

Table 8: Domestic assets among the sample households in Kanikal-4 Microwatershed

Particulars	MF (2)		SF (7)		SMF (7)		MDF (1)		All (17)	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	%
Radio	0	0.0	0	0.0	1	14.3	0	0.0	1	5.9
Tv	2	100.0	5	71.4	4	57.1	1	100.0	12	70.6
Bicycle	0	0.0	0	0.0	1	14.3	0	0.0	1	5.9
Motorcycle	1	50.0	5	71.4	4	57.1	1	100.0	11	64.7
Auto	0	0.0	1	14.3	0	0.0	0	0.0	1	5.9
Tempo	0	0.0	0	0.0	1	14.3	0	0.0	1	5.9
Four wheeler	1	50.0	0	0.0	0	0.0	0	0.0	1	5.9
Mixer/grinder	0	0.0	1	14.3	2	28.6	0	0.0	3	17.6
Refrigerator	0	0.0	1	14.3	1	14.3	0	0.0	2	11.8
Mobile Phone	2	100.0	7	100.0	6	85.7	1	100.0	16	94.1
Average value	*39000*		*36092*		*199357*		*16666*		*184954*	

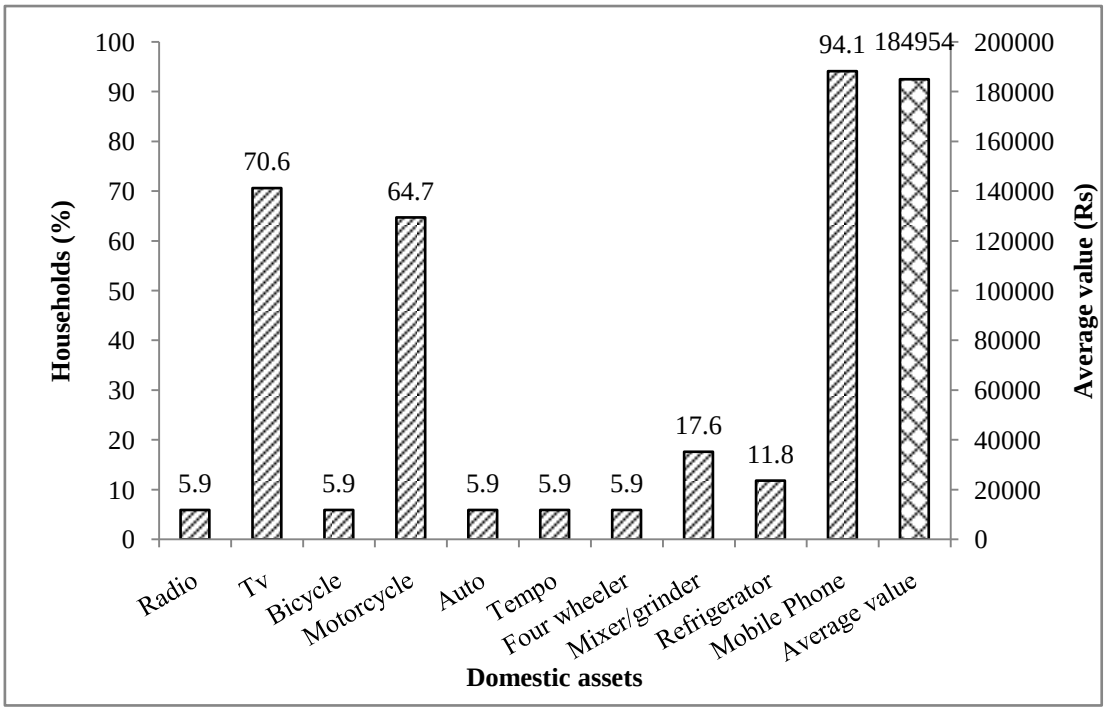


Figure 4: Domestic assets among the sample households in Kanikal-4 Microwatershed

The most popularly owned farm equipments were sickles, plough, cattle shed; pump sets, chaff cutter, bullock cart, sprayer and thresher. Plough and sickle were commonly present in all the sampled farmers; these were primary implements in agriculture. The per cent of households owned plough (28.0 %), bullock cart (24.0 %), tractor (8.0 %), sprayer (12.0 %), weeder (4.0 %), seed cum fertilizer drill (8.0 %), and harvester (4.0 %) was found highest among the sample farmers. The average value of farm assets is around Rs. 115647 per households (Table 9 and Figure 5).

Table 9: Farm assets among samples households in Kanikal-4 Microwatershed

Particulars	MF (2)		SF (7)		SMF (7)		MDF (1)		All (17)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Bullock cart	1	50	1	14.3	3	23.1	1	33.3	6	24.0
Plough	1	50	2	28.6	3	23.1	1	33.3	7	28.0
Seed Cum Fert Drill	0	0	1	14.3	1	7.7	0	0	2	8.0
Irrigation Pump	0	0	1	14.3	1	7.7	1	33.3	3	12.0
Tractor	0	0	1	14.3	1	7.7	0	0	2	8.0
Sprayer	0	0	1	14.3	2	15.4	0	0	3	12.0
Harvester	0	0	0	0	1	7.7	0	0	1	4.0
Weeder	0	0	0	0	1	7.7	0	0	1	4.0
Average value	***13000***		***185000***		***95666***		***8000***		***115647***	

Livestock is an integral component of the conventional farming systems (Table 10 and Figure 6). The highest livestock population is bullocks were around 31.3 per cent followed by local dry cow (18.8 %), local milching cow (18.8 %), milching buffalos (18.8 %), dry buffalos (6.3 %), and sheep's (6.3 %). The average livestock value was Rs. 32666 per livestock.

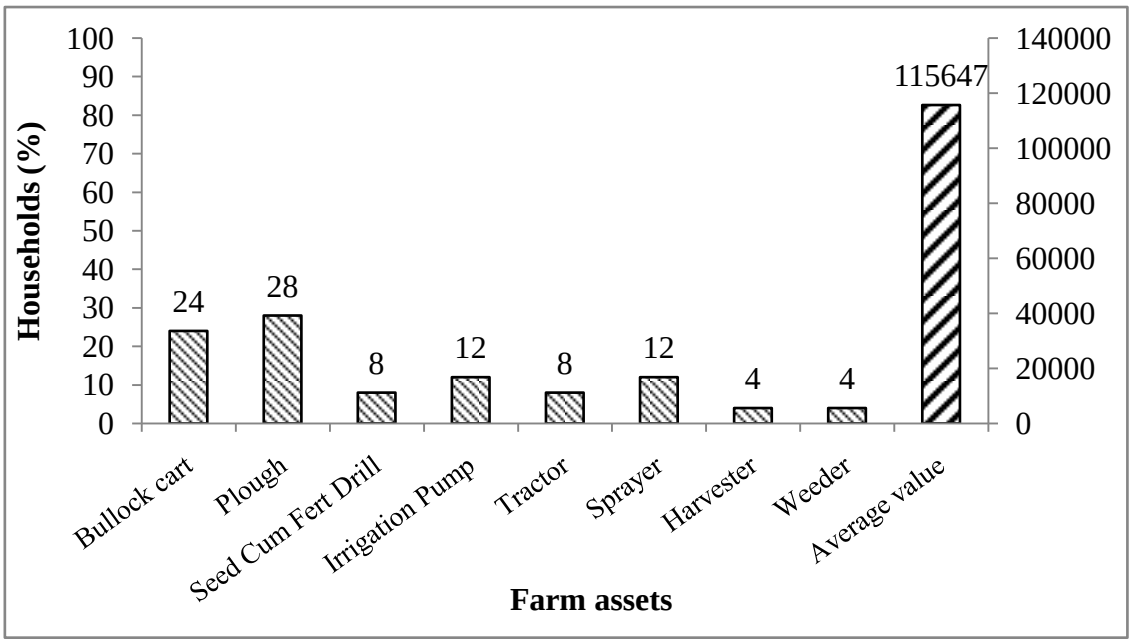


Figure 5: Farm assets among samples households in Kanikal-4 Microwatershed

Table 10: Livestock assets among sample households in Kanikal-4 micro-watershed

Particulars	MF (2)		SF (7)		SMF (7)		MDF (1)		All (17)	
	No.	%	No.	%	No.	%	No.	%	No.	%
No Livestock HHs	2	100	-	-	-	-	-	-	2	11.8
Local Dry Cow	-	-	-	-	2	29	1	100	3	18
Local Milching Cow	-	-	1	14.3	2	29	-	-	3	18
Dry Buffalos	-	-	1	14.3	-	-	-	-	1	5.9
Milching Buffalos	-	-	2	28.6	1	14	-	-	3	18
Bullocks	-	-	1	14.3	3	43	1	100	5	29
Sheeps	-	-	-	-	1	14	-	-	1	5.9
Average value (Rs)	-	-	*20000*		*35800*		*55000*		*32666*	

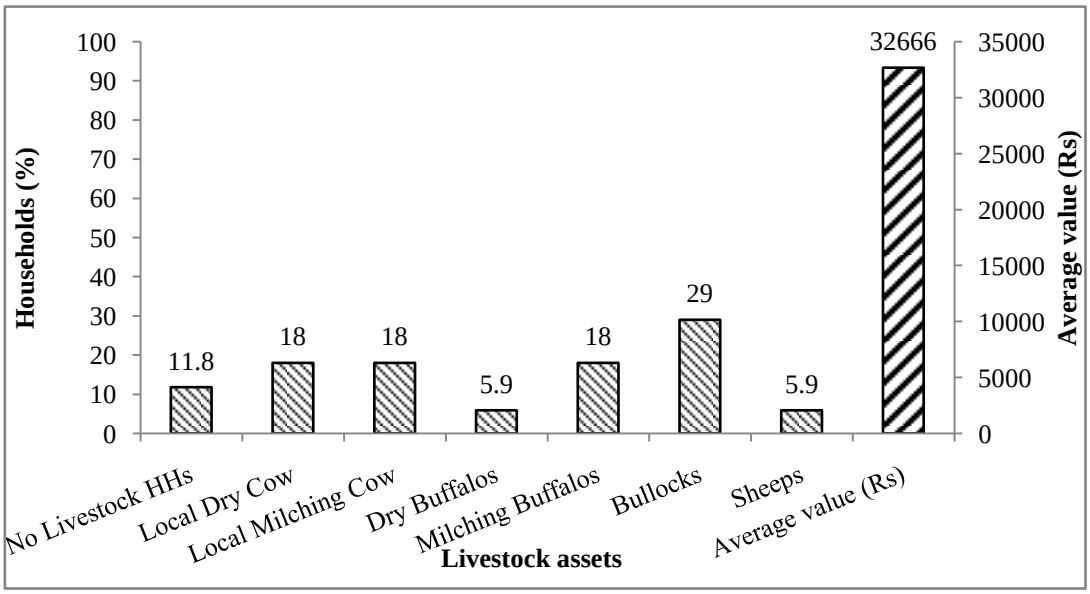


Figure 6: Livestock assets among sample households in Kanikal-4 micro-watershed

Average milk produced in sample households is 553 litters/ annum. Among the farm households, Paddy and Rice are the main crops for domestic food and fodder for animals. About 2222 kg /ha of average fodder is available per season for the livestock feeding (Table 11).

Table 11: Milk produced and fodder availability of sample households in Kanikal-4 Microwatershed

Particulars	MF (2)	SF (7)	SMF (7)	MDF (1)	All (17)
Livestock Name					**Ltr./Lactation/animal**
Local Milching Cow	0	0	630	624	626
Milching Buffalos	0	0	240	960	480
Average milk produced	**0**	**0**	**435**	**792**	**553**
Fodder produces					**Fodder yield (kg/ha.)**
Paddy	0	0	2222	0	2222
Livestock having households (%)	0	55.6	75	100	64.0
Livestock population (Numbers)	0	6	74	3	83

A woman participation in decision making is in this micro-watershed is presented in Table 12. About 5.9 per cent of women participation in local organisation activates, 70.6 per cent women earning for her family requirement and 47.1 per cent of women taking decision in her family and agriculture related activities.

Table 12: Women empowerment of sample households in Kanikal-4 Microwatershed

Particulars	MF (2)		SF (7)		SMF (7)		MDF (1)		All (17)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Women participation in local organization activities										
Yes		0	1	14.3		0.0		0.0	1	5.9
No	2	100	6	85.7	7	100.0	1	100.0	16	94.1
Women participation in Elected Penchant										
Yes		0	1	14.3		0.0		0.0	1	5.9
No	2	100	6	85.7	7	100.0	1	100.0	16	94.1
Women earning for her family requirement										
Yes	1	50.0	5	71.4	5	71.4	1	100.0	12	70.6
No	1	50.0	2	28.6	2	28.6		0.0	5	29.4
Women taking decision in her family and agriculture related activities										
Yes	1	50.0	2	28.6	4	57.1	1	100.0	8	47.1
No	1	50.0	5	71.4	3	42.9		0.0	9	52.9
Grand Total	***2***	***100.0***	***7***	***100.0***	***7***	***100.0***	***1***	***100.0***	***17***	***100.0***

The food intake in terms of kilo calorie (kcal) per person per day was calculated and presented in the Table 13 and Figure 7. More quantity of cereals is consumed by sample farmers which accounted for 1514.9 kcal per person. The other important food items consumed was pulses 174.1 kcal followed by cooking oil 253.9 kcal, milk 74.4 kcal, vegetables 41.3 kcal, egg 11.8 kcal and meat 92.4 kcal. In the sampled households, farmers were consuming more (2439 kcal) than NIN- recommended food requirement (2250 kcal).

Table 13: Per capita daily consumption of food among the sample farmers in Kanikal-4 Microwatershed

Particulars	NIN recommendation (gram/ per day/ person)	Present level of consumption (gram/ per day/ person)	Kilo Calories /day/person
Cereals	396.0	445.6	1514.9
Pulses	43.0	50.8	174.1
Milk	200.0	114.5	74.4
Vegetables	143.0	172.3	41.3
Cooking Oil	31.0	44.5	253.9
Egg	0.5	191.9	287.8
Meat	14.2	61.6	92.4
Total	**827.7**	**1081.2**	**2483.9**
Threshold of NIN recommendation		827 gram*	2250 Kcal*
% Below NIN		23.5	41.2
% Above NIN		76.47	58.8

Note: * day/person

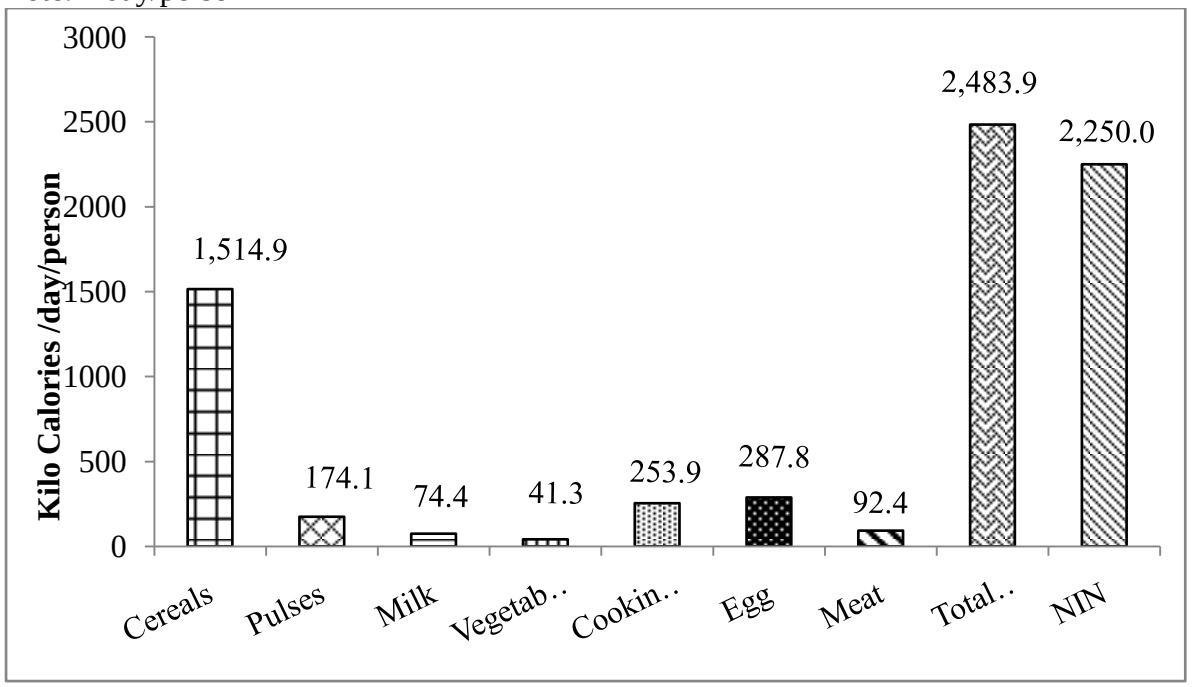


Figure 7: Per capita daily consumption of food among the sample farmers in Kanikal-4 Microwatershed

Annual income of the sample HHs: The average annual household income is around Rs 37155. Major source of income to the farmers in the study area is from crop production (Rs 12576) followed by livestock (Rs. 20095). The income from Non farm income was very low at Rs.4484. The monthly per capita income is Rs.619.3, 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 14).

Table 14: Annual average income of HHs from various sources in Kanikal-4 Microwatershed

Particulars	MF (2)	SF (7)	SMF (7)	MDF (1)	All (17)
Nonfarm income	0.0	4720 (14.3)	4405 (42.9)	0.0	4484 (23.5)
Livestock income	0.0	23205 (28.6)	18540 (57.1)	0.0	20095 (35.3)
Crop Production	8130 (100)	12287 (100)	15089 (100)	5896 (100)	12576 (100)
Total Income (Rs)	***8130***	***40212***	***38035***	***5896***	***37155***
Average monthly per capita income (Rs)	150.6	868.8	541.2	61.4	619.3
Threshold for Poverty level (Rs 975 per month/person)					
Above poverty line	50	100	42.9	100	70.6
Below poverty line	50	0	57.1	0	29.4
Grand Total	100	100	100.0	100	100.0

* Figure in the parenthesis indicates % of Households

The average annual expenditure of farm households indicated that farmers in the study area spend highest on food (Rs.61736) followed by education, clothing, social function and health. 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.2816 and about 29.4 per cent of farm households are below poverty line and 70.6 per of farm households are above poverty line (Table 15 and Figure 8).

Table 15: Average annual expenditure of sample HHs in Kanikal-4 Microwatershed

Particulars	MF (2)		SF (7)		SMF (7)		MDF (1)		All (17)	
	Rs	%	Rs	%	Rs	%	Rs	%	Rs	%
Food	62700	41	62683	47	62229	31	49740	22	61736	37
Education	7500	5	2571	2	10571	5	5000	2	6588	4
Clothing	6500	4	7429	6	23571	12	25000	11	15000	9
Social functions	50000	33	38000	28	78143	39	100000	44	59588	35
Health	25000	16	24000	18	25000	13	50000	22	26059	15
Total	151700	100	134683	100	199514	100	229740	100	168971	100
Monthly per capita expenditure (Rs)	2809		2910		2839		2393		2816	

Land holding: Total sample households are 17 and total area cultivated by them is 41.1 ha. The average land holding of sample HHs is 2.4 ha. Large number of sample households (7) is belong to small size group with an average holding size of 1.56 ha followed by semi-medium farmers (7) with an average holding size of 3.08 ha, marginal size (2) groups with an average land holding 0.84 ha and medium size groups with an average land holding 6.88 ha (Table 16).

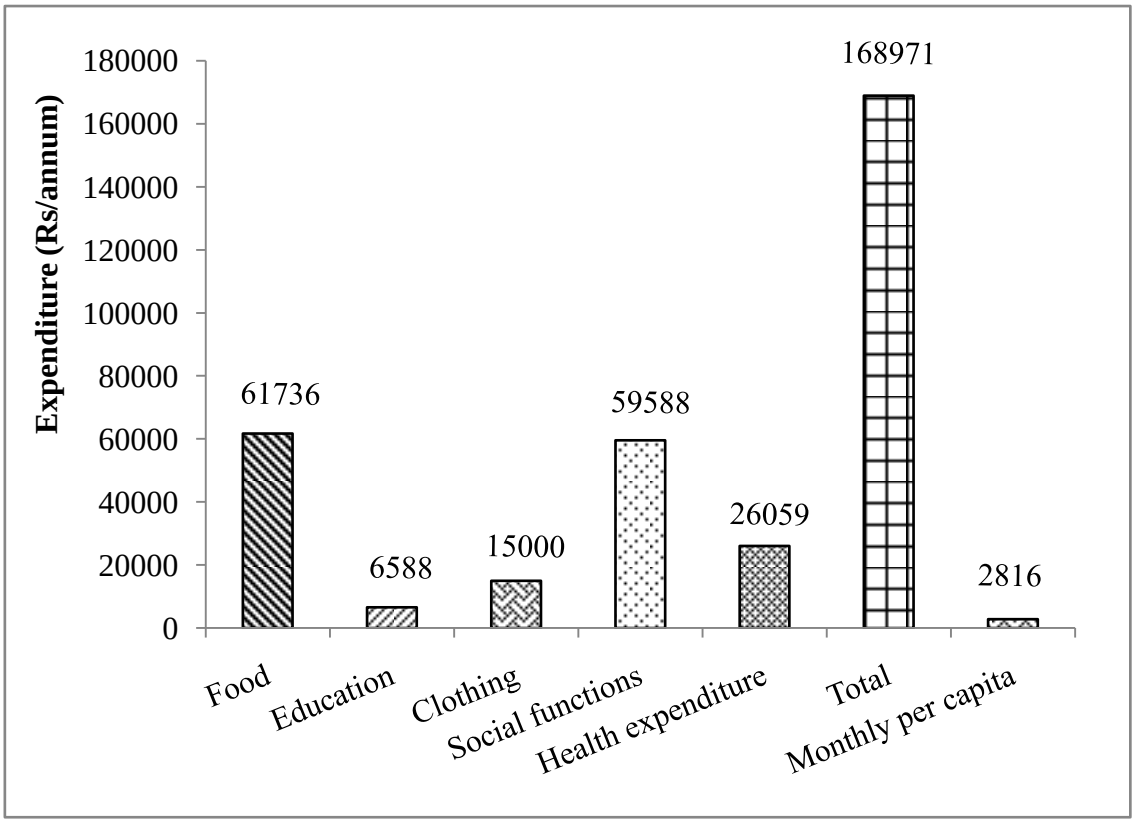


Figure 8: Average annual expenditure of sample HHs in Kanikal-4 Microwatershed

Table 16: Distribution of land holding among the sample households in Kanikal-4 micro-watershed

Size groups	Particulars	value
Marginal Farmers (MF) (2)	Total sample HHs in number	2
	Total land holding (ha)	1.69
	Average of Total land holding (ha)	0.84
Small farmers (SF) (7)	Total sample HHs in number	7
	Total land holding (ha)	10.93
	Average of Total land holding (ha)	1.56
Semi-medium farmers (SMF) (7)	Total sample HHs in number	7
	Total land holding (ha)	21.58
	Average of Total land holding (ha)	3.08
Medium farmers (MDF) (1)	Total sample HHs in number	1
	Total land holding (ha)	6.88
	Average of Total land holding (ha)	6.88
All farmers (17)	Total sample HHs in number	17
	Total land holding (ha)	41.08
	Average of Total land holding (ha)	2.42

Land use: The total land holding in the Kanikal-4 micro-watershed is 41.0 ha (Table 17). Of which 80.3 ha is dry land and 19.7 ha is irrigated land. The average land holding per household is worked out to be 2.4 ha.

Table 17: Land use among samples households in Kanikal-4 Microwatershed

Particulars	MF (2)		SF (7)		SMF (7)		MDF (1)		All (17)	
	ha	%	ha	%	ha	%	ha	%	ha	%
Irrigated land	0.0	0.0	3.2	29.6	4.5	20.6	0.4	5.9	8.1	19.7
Dry land	1.7	100	7.7	70.4	17.1	79.4	6.5	94.1	33.0	80.3
Fallow land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total land	1.7	100	10.9	100	21.6	100.0	6.9	100.0	41.1	100.0
Average of Total land	0.8		1.6		3.1		6.9		2.4	

In the micro-watershed, the prevalent present land uses under perennial plants are neem trees (53.3 %) followed by peeple tree (arali) (13.3 %), jalli (13.3), tamarind (8.0 %), mango (5.3 %), coconut (2.7 %) and banyan (1.33 %) (Table 18).

Table 18: Number of trees/plants covered in sample farm households in Kanikal-4 Microwatershed

Particulars	MF (2)		SF (7)		SMF (7)		MDF (1)		All (17)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Banyan tree(Alada)	-	-	-	-	1	5.3	-	-	1	1.3
Coconut	-	-	-	-	2	10.5	-	-	2	2.7
Jalli	-	-	10	30.3	-	-	-	-	10	13.3
Mango	-	-	3	9.1	1	5.3	-	-	4	5.3
Neem trees	5	100	14	42.4	13	68.4	8	44.4	40	53.3
Peeple tree(Arali)	-	-	-	-	-	-	10	55.6	10	13.3
Tamarind	-	-	6	18.2	-	-	-	-	6	8.0
Eucalyptus	-	-	-	-	2	10.5	-	-	2	2.7
Grand Total	5	100	33	100.0	19	100.0	18	100	75	100.0

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

The present dominant crops grown in dry lands in the study area were by redgram (47.2 %) followed by cotton (17.6 %), groundnut (16.0 %), paddy (3.20 %), maize (3.2 %), greengram (4.8 %) and bajra (1.6 %) which are taken during Kharif season respectively. maize (1.6 %) is taken during Rabi season. The cropping intensity was 101.6 per cent (Table 19 and Figure 9).

Table 19: Present cropping pattern and cropping intensity in Kanikal-4 Microwatershed

Particulars	MF (2)		SF (7)		SMF (7)		MDF (1)		All (17)	
	ha	%	ha	%	ha	%	ha	%	ha	%
Kharif	***2.43***	***100***	***14.17***	***100***	***26.32***	***97.01***	***6.88***	***100***	***49.80***	***98.40***
Red gram	0.81	33.33	4.86	34.29	11.74	43.28	6.48	94.12	23.89	47.20
Cotton	-	-	2.43	17.14	6.48	23.88	-	-	8.91	17.60
Groundnut	-	-	4.45	31.43	3.64	13.43	-	-	8.10	16.00
Green gram	-	-	1.62	11.43	0.81	2.99	-	-	2.43	4.80
Maize	1.62	66.67	-	-	-	-	-	-	1.62	3.20
Paddy	-	-	-	-	3.64	4.48	0.40	5.88	1.62	7.0
Bajra	-	-	0.81	5.71	-	-	-	-	3.24	1.60
Rabi	-	-	-	-	***0.81***	***2.99***	-	-	***0.81***	***1.60***
Maize	-	-	-	-	0.81	2.99	-	-	0.81	1.60
Grand Total	***2.43***	***100***	***14.17***	***100***	***27.13***	***100***	***6.88***	***100***	***50.61***	***100***

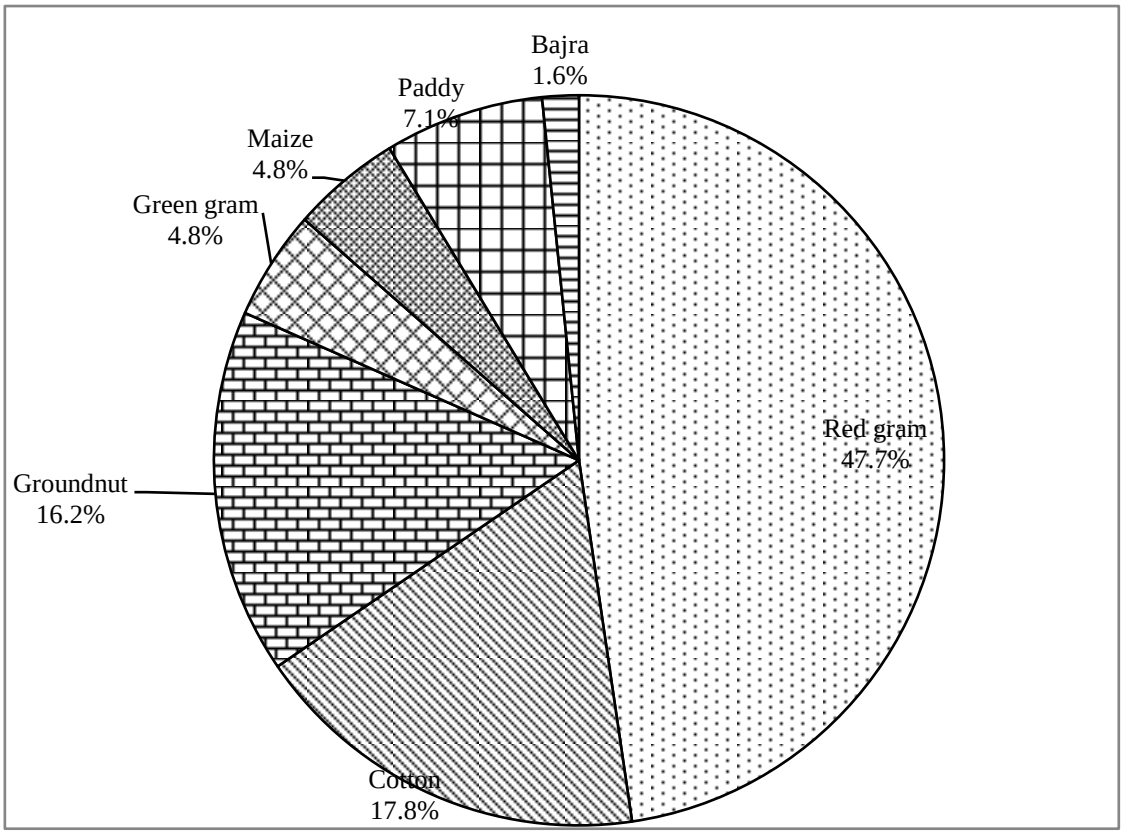


Figure 9: Present cropping pattern in Kanikal-4 Microwatershed

Economic land evaluation

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.

In Kanikal-4 micro-watershed, 13 soil series are identified and mapped (Table 20). The distribution of major soil series are Nagalapur covering an area around 165 ha (33.4 %) followed by Sambara 98 ha (19.9 %), Mundargi 54 ha (10.8 %), Mylapura 47 ha (8.8 %), Hosalli 47 ha (9.4 %), Kadechoor 20 ha (4.0 %), Madhwara16 ha (3.2 %), Yalleri 12 ha (2.3 %), Rachanalli 11.0 ha (2.2 %), Gowdagera 11 ha (2.2 %), Rampur 7 ha (1.4 %), Yadgir (0.6 %) and Badiyala 3 ha (0.5 %).

Table 20: Distribution of soil series in Kanikal-4 Microwatershed

Soil No*	Soil Series	Mapping Unit Description	Area in Ha (%)
Soil of Granite and Granite Gneiss Landscape			
1	BDL	Badiyala soils are shallow (25-50 cm), well drained, have dark brown to very dark brown and dark yellowish brown, sandy clay soils occurring on very gently to gently sloping uplands under cultivation	3 (0.54)
2	SBR	Sambra soils are moderately shallow (50-75 cm), well drained, have light gray to pink, loamy sand to sandy soils occurring on very gently to gently sloping uplands under cultivation	98 (19.95)
3	YLR	Yalleri soils are moderately shallow (50-75 cm), well drained, have brown to reddish brown and dark reddish brown, gravelly	12 (2.38)

		sandy clay red soils occurring on very gently to gently sloping uplands under cultivation	
4	HSL	Hosalli soils are moderately deep (75-100 cm), well drained, have yellowish brown to dark yellowish brown, calcareous sandy loam to sandy clay loam alluvial soils occurring on very gently sloping uplands under cultivation	47 (9.45)
5	GWD	Gowdagera soils are moderately deep (75-100 cm), moderately well drained, have dark grayish brown to very dark grayish brown, calcareous sandy clay to clay alluvial soils occurring on very gently sloping uplands under cultivation	11 (2.23)
6	YDR	Yadgir soils are deep (100-150 cm), well drained, have brown to dark yellowish brown and olive brown, calcareous loamy sand to sandy loam alluvial soils occurring on very gently sloping uplands under cultivation	3 (0.62)
7	NGP	Nagalapur soils are deep (100-150 cm), moderately well drained, have very dark gray to very dark grayish brown, black cracking clay soils occurring on very gently sloping uplands under cultivation	165 (33.45)
8	MDG	Mundargi soils are deep (100-150 cm), moderately well drained, have brown to dark yellowish brown, sandy clay to clay alluvial soils occurring on very gently sloping uplands under cultivation	54 (10.82)
9	MDR	Madhwara soils are very deep (>150 cm), moderately well drained, have very dark gray to very dark brown, calcareous sandy clay to clay alluvial soils occurring on nearly level to very gently sloping uplands under cultivation	16 (3.17)
Soil of Alluvial Landscape			
10	RMP	Rampur soils are moderately shallow (50-75 cm), moderately well drained, have yellowish brown to very dark gray, sandy clay to clay alluvial soils occurring on very gently sloping uplands under cultivation	7 (1.42)
11	RHN	Rachanalli soils are moderately deep (75-100 cm), moderately well drained, have brown to very dark grayish brown, sandy clay to calcareous alluvial clay soils occurring on very gently sloping uplands under cultivation	11.02 (2.214)
12	MYP	Mylapura soils are very deep (>150 cm), moderately well drained, have brown to very dark grayish brown, calcareous sandy clay to clay alluvial soils occurring on very gently sloping uplands under cultivation	47 (8.81)
Lowland Soils			
13	KDH	Kadechoor soils are moderately deep (75-100 cm), moderately well drained, have very dark grayish brown, sandy clay black soils occurring on very gently sloping lowlands under cultivation	20 (3.97)
	Rock outcrops		5(0.98)

Present cropping pattern on different soil series are given in Table 21. Crops grown on Sambara soils are cotton, maize, paddy, and redgram. Paddy and Redgram on Nagalapur soils are grown. Paddy and Redgram are grown on Hosalli soils. Bajra, Cotton, Greengram Groundnut and Redgram on Kadechoor soils are grow and redgram on Madhwara soils can grow. Cotton, greengram, maize and redgram are grown on Mylapura soil and groundnut and paddy are grown on Rachanalli.

Table 21: Cropping pattern on major soil series in Kanikal-4 micro-watershed

(Area in per cent)

Soil Series	Soil Depth	Crops	Dry	Irrigated		Grand Total
			Kharif	Kharif	Rabi	
SBR	Moderately shallow (50-75 cm)	Cotton	18.7	37.5	0	56.2
		Maize	25	0	0	25
		Paddy	0	0	6.25	6.2
		Redgram	12.5	0	0	12.5
HSL	Moderately deep (75-100 cm)	Paddy	0	16.7	0	16.7
		Redgram	83.3	0	0	83.3
KDH	Moderately deep (75-100 cm)	Bajra	8.3	0	0	8.3
		Cotton	0	12.5	0	12.5
		Greengram	0	16.7	0	16.7
		Groundnut	12.5	33.3	0	45.8
		Redgram	16.7	0	0	16.7
RHN	Moderately deep (75-100 cm)	Groundnut	0	66.7	0	66.7
		Paddy	0	33.7	0	33.7
NGP	Deep (100-150 cm)	Paddy	11.1	0	0	11.1
		Redgram	88.9	0	0	88.9
MYP	Very deep (>150 cm)	Cotton	12.5	0	0	12.5
		Greengram	12.5	0	0	12.5
		Maize	12.5	0	0	12.5
		Redgram	62.5	0	0	62.5
MDR	Very deep (>150 cm)	Redgram	100	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 22).

Table 22: Alternative land use options for different size group of farmers (Benefit Cost Ratio) in Kanikal-4 Microwatershed.

Soil Series	MF	SM	SMF	MDF
SBR	Maize (1.48)	Cotton (1.06)	Cotton (1.08) Paddy (1.51) Redgram (1.48)	
RHN			Groundnut (1.63) Paddy (1.06)	
HSL		Redgram (1.16)	Paddy (1.05) Redgram (1.28)	
KDH		Bajra (1.43) Cotton (1.2) Greengram (1.2) Groundnut (1.22) Redgram (1.53)		
NGP				Paddy (1.28) Redgram (1.02)
MDR			Redgram (1.12)	
MYP	Redgram (1.12)		Cotton (1.18) Greengram (1.24) Maize (1.14) Redgram (1.11)	

The productivity of different crops grown in Kanikal-4 micro-watershed under potential yield of the crops is given in Table 23 and 23b.

The data on cost of cultivation and benefit cost ratio (BCR) of different crops is given in Tables 21 and 21b. The total cost of cultivation in study area for cotton ranges between Rs.35018/ha in MYP soil (with BCR of 1.18) and Rs.25702/ha in SBR soil (with BCR of 1.07), maize range between Rs 35615/ha in MYP soil (with of 1.14) and Rs.16683/ha in SBR soil (with BCR of 1.48), paddy range between Rs. 74662/ha in SBR soil (with BCR of 1.51) and Rs. 20967/ha in RHN soil (with BCR of 1.06), redgram cost of cultivation range between is Rs.29997/ha in SBR soil (with BCR of 1.48) and Rs 8160 in NGP soil (with BCR of 1.02), groundnut range between is Rs 23485/ha in KDH soil (with BCR of 1.22) and Rs. 13831/ha in RHN soil (with BCR of 1.63), greengram cultivation in MYP soil is Rs.33499/ha (with BCR of 1.24) and bajra cultivation in KDH soil is Rs 66931/ha (with BCR of 1.43).

Table 23: Economic land evaluation and bridging yield gap for different crops in Kanikal-4 micro-watershed

Particulars	MDR(>150 cm)	MYP(>150 cm)			
	Redgram	Cotton	Greengram	Maize	Redgram
Total cost (Rs/ha)	20860	35018	33499	35613	23259
Gross Return (Rs/ha)	23289	41496	41496	40755	25935
Net returns (Rs/ha)	2429	6478	7997	5142	2676
B:C	1.12	1.18	1.24	1.14	1.11
Farmers Practices (FP)					
FYM (t/ha)	1.1	2.5	2.5	2.5	2.8
Nitrogen (kg/ha)	73.2	90.8	90.8	90.8	64.2
Phosphorus (kg/ha)	82.1	74.2	74.2	74.2	52.5
Potash (kg/ha)	0.0	7.1	7.1	7.1	5.3
Grain (Qtl/ha)	5.4	10.0	8.8	18.8	6.6
Price of Yield (Rs/Qtl)	4400	4200	4800	2200	4000
Soil test based fertilizer Recommendation (STBR)					
FYM (t/ha)	7.5	12.5	7.5	7.5	7.5
Nitrogen (kg/ha)	18.8	112.5	9.8	75.0	18.8
Phosphorus (kg/ha)	50.0	93.8	31.3	62.5	62.5
Potash (kg/ha)	25.0	75.0	25.0	25.0	25.0
Grain (Qtl/ha)	13.8	18.5	6.3	57.5	13.8
% of Adoption/yield gap (STBR-FP) / (STBR)					
FYM (%)	85.7	80.0	66.7	66.7	62.5
Nitrogen (%)	-290.5	19.3	-831.6	-21.1	-242.5
Phosphorus (%)	-64.3	20.9	-137.3	-18.7	16.0
Potash (%)	100.0	90.6	71.7	71.7	78.8
Grain (%)	61.0	46.0	-40.0	67.4	52.3
Value of yield and Fertilizer (Rs)					
Additional Cost (Rs/ha)	4861	12480	2497	4655	4976
Additional Benefits (Rs/ha)	36929	35784	-12000	85250	28750
Net change Income (Rs/ha)	32068	23304	-14497	80595	23774

To be continued…

Table 23a: Economic land evaluation and bridging yield gap for different crops in Kanikal-4 micro-watershed

Particulars	SBR(50-75 cm)				RHN (75-100 cm)		HSL(75-100 cm)	
	Cotton	Maize	Paddy	Redgram	Groundnut	Paddy	Paddy	Redgram
Total cost (Rs/ha)	25702	16683	74662	29997	13831	20967	24149	22741
Gross Return (Rs/ha)	27479	24638	112533	44460	22601	22230	25318	27479
Net returns (Rs/ha)	1777	7955	37871	14463	8769	1263	1168	4737
B:C	1.07	1.48	1.51	1.48	1.63	1.06	1.05	1.22
Farmers Practices (FP)								
FYM (t/ha)	1.0	2.5	0.0	0.0	0.8	1.7	1.9	0.8
Nitrogen (kg/ha)	77.1	31.3	81.4	81.4	65.4	65.4	45.6	44.5
Phosphorus (kg/ha)	62.3	43.1	44.7	44.7	51.5	51.5	43.1	40.3
Potash (kg/ha)	0.0	0.0	0.0	0.0	3.5	3.5	9.4	3.8
Grain (Qtl/ha)	6.6	15.6	37.5	10.0	6.3	16.7	12.5	6.8
Price of Yield (Rs/Qtl)	3750	1500	3000	4500	3500	1300	1800	4280
Soil test based fertilizer Recommendation (STBR)								
FYM (t/ha)	12.5	7.5	9.9	7.5	7.5	9.9	9.9	7.5
Nitrogen (kg/ha)	140.6	75.0	100.0	25.0	18.8	75.0	75.0	18.8
Phosphorus (kg/ha)	89.1	62.5	62.5	62.5	62.5	62.5	62.5	57.5
Potash (kg/ha)	75.0	25.0	50.0	25.0	25.0	50.0	50.0	25.0
Grain (Qtl/ha)	18.5	57.5	56.8	13.8	9.0	56.8	56.8	13.8
% of Adoption/yield gap (STBR-FP) / (STBR)								
FYM (%)	91.7	66.7	100.0	100.0	88.9	83.1	81.0	90.0
Nitrogen (%)	45.2	58.3	18.6	-225.6	-248.9	12.8	39.2	-137.3
Phosphorus (%)	30.1	31.0	28.4	28.4	17.7	17.7	31.0	30.0
Potash (%)	100.0	100.0	100.0	100.0	85.8	92.9	81.3	85.0
Grain (%)	64.6	72.8	34.0	27.3	30.6	70.7	78.0	50.9
Value of yield and Fertilizer (Rs)								
Additional Cost (Rs/ha)	14899	6878	11886	8106	7022	9743	10023	7625
Additional Benefits (Rs/ha)	44841	62813	57900	16875	9625	52173	79740	29960
Net change Income (Rs/ha)	29942	55935	46014	8769	2603	42430	69718	22335

To be continued...

Table 23b: Economic land evaluation and bridging yield gap for different crops in Kanikal-4 micro-watershed

Particulars	KDH(75-100 cm)					NGP(100-150 cm)	
	Bajra	Cotton	Greengram	Groundnut	Redgram	Paddy	Redgram
Total cost (Rs/ha)	66931	31539	17939	23485	16948	20681	8160
Gross Return (Rs/ha)	95342	37873	21613	28446	25935	26553	8336
Net returns (Rs/ha)	28411	6335	3674	4961	8987	5872	176
B:C	1.43	1.20	1.20	1.22	1.53	1.28	1.02
Farmers Practices (FP)							
FYM (t/ha)	6.5	3.3	2.5	1.2	0.0	2.5	1.3
Nitrogen (kg/ha)	83.3	71.5	42.8	71.7	80.0	38.8	38.8
Phosphorus (kg/ha)	80.5	76.7	35.9	67.8	57.5	39.5	39.5
Potash (kg/ha)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grain (Qtl/ha)	25.0	8.3	6.3	6.6	6.3	12.5	1.9
Price of Yield (Rs/Qtl)	3900	4600	3500	4214	4200	2000	4500
Soil test based fertilizer Recommendation (STBR)							
FYM (t/ha)	7.5	12.5	7.5	7.5	7.5	9.9	7.5
Nitrogen (kg/ha)	37.5	112.5	9.8	18.8	18.8	75.0	18.8
Phosphorus (kg/ha)	25.0	75.0	25.0	50.0	50.0	50.0	50.0
Potash (kg/ha)	0.0	75.0	25.0	25.0	25.0	50.0	25.0
Grain (Qtl/ha)	13.3	18.5	6.3	9.0	13.8	56.8	13.8
% of Adoption/yield gap (STBR-FP) / (STBR)							
FYM (%)	13.3	73.3	66.7	84.1	100.0	74.7	83.3
Nitrogen (%)	-122.0	36.4	-339.1	-282.4	-326.7	48.2	-107.1
Phosphorus (%)	-222.0	-2.2	-43.8	-35.5	-15.0	20.9	20.9
Potash (%)	0.0	100.0	100.0	100.0	100.0	100.0	100.0
Grain (%)	-87.5	55.0	0.0	26.6	54.5	78.0	86.4
Value of yield and Fertilizer (Rs)							
Additional Cost (Rs/ha)	-1991	11085	4622	5392	6935	9275	6970
Additional Benefits (Rs/ha)	-45513	46859	0	10084	31500	88600	53438
Net change Income (Rs/ha)	-43522	35774	-4622	4692	24565	79325	46468

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 23 and 23b. There is a huge gap between FYM application by farmers and recommended FYM in all the crops across the soils. There is a larger yield gap in crops grown across different soil series. Adequate knowledge about recommended package of practices is the pre-requisite for their use in cultivation of crops. It is a fact that, recommended practices are major contributing factors to yield. Inadequate knowledge about recommended practices leads to their improper adoption. Strengthening of extension services by concerned agency is required to increase adoption of recommended cultivation practices and ultimately reducing the gap. By adopting soil-test fertiliser recommendation, there is scope to increase yield and income to a maximum of Rs. 80595 in maize and a minimum of Rs. 2603 in groundnut cultivation.

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

The onsite cost of different soil nutrients lost due to soil erosion is given in Table 24 and Figure 10. The average value of soil nutrient loss is around Rs.2236.2 per ha/year. The total cost of annual soil nutrients is around Rs.1093504 per year for the total area of 494.2 ha.

Table 24: Estimation of onsite cost of soil erosion in Kanikal-4 micro-watershed

Particulars	Quantity(kg)		Value (Rs)	
	Per ha	Total	Per ha	Total
Organic matter	337.3	164945	2125.0	1039152
Phosphorus	0.2	115	10.4	5072
Potash	1.8	904	37.0	18085
Iron	0.1	60	5.9	2890
Manganese	0.2	81	45.7	22340
Cupper	0.0	5	5.9	2881
Zinc	0.0	2	0.1	64
Sulpher	0.1	71	5.8	2843
Boron	0.0	4	0.4	178
Total	**339.8**	**166188**	**2236.2**	**1093504**

The average value of ecosystem service for food grain production is around Rs. 8645/ ha/year (Table 25 and Figure 11). Per hector food grain production services is maximum in bajra (Rs. 25693) followed by maize (Rs. 5267), redgram (Rs. 5048), green gram (Rs. 5032), groundnut (Rs. 4863) and cotton (Rs. 3792).

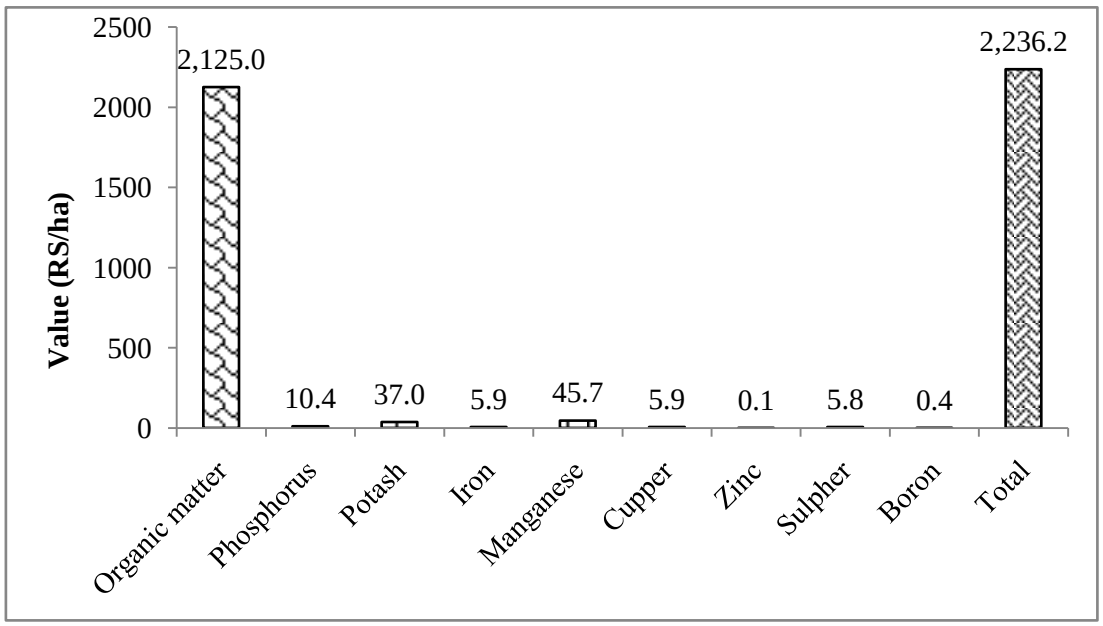


Figure 10: Estimation of onsite cost of soil erosion in Kanikal-4 micro-watershed

Table 25: Ecosystem services of food grain production in Kanikal-4 Microwatershed

Production items	Crops	Area in ha	Yield (Qtl/ha)	Price (Rs/Qtl)	Gross Returns (Rs/ha)	Cost of Cultivation (Rs/ha)	Net returns (Rs/ha)
Cereals	Bajra	0.81	24.70	3750	92625	66931	25693
	Maize	2.43	16.98	1850	31415	26148	5267
Pulses	Greengram	2.43	7.41	4150	30751	25718	5032
	Redgram	23.89	6.21	4250	26393	21344	5048
Oil seeds	Groundnut	6.88	6.48	4000	25935	21071	4863
Commercial crops	Cotton	5.67	7.92	4200	33283	29490	3792
Average value		42.1	9.1	3950	35865	27220	8645

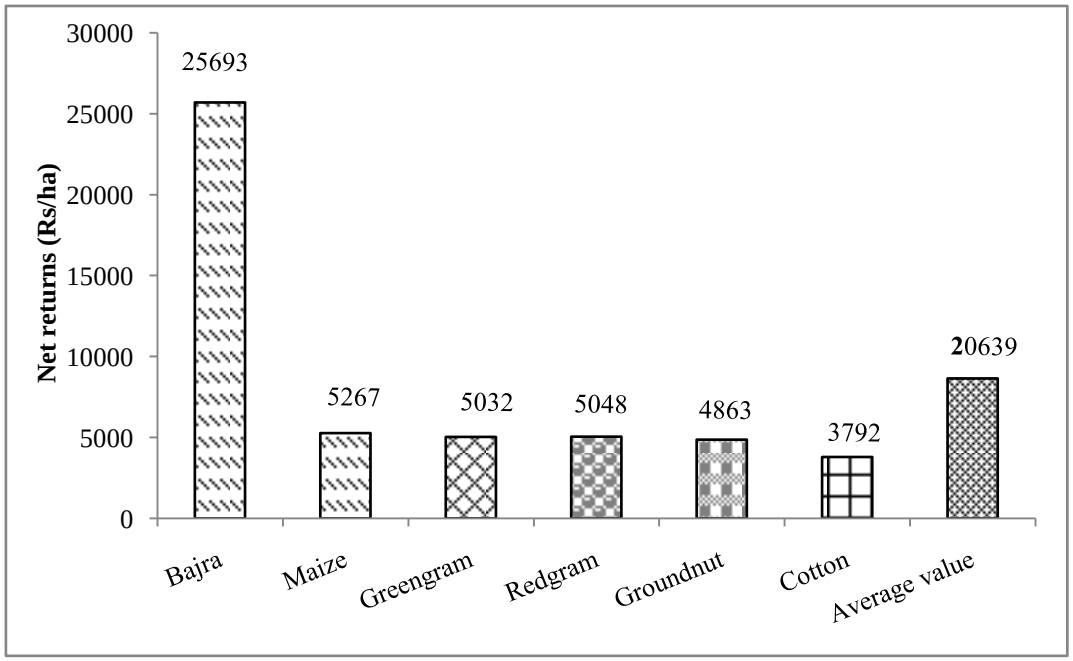


Figure 11: Ecosystem services of food production in Kanikal-4 Microwatershed

The average value of ecosystem service for fodder production is around Rs 12693/ ha/year (Table 26). Per hector fodder production services is maximum in bajra (Rs 2200) followed by paddy (Rs 8433), groundnut (Rs.7225) and maize (Rs 900).

Table 26: Ecosystem services of fodder production in Kanikal-4 Microwatershed

Production items	Crops	Area in ha	Yield (Qtl/ha)	Price (Rs/Qtl)	Net Returns (Rs/ha)
Cereals	Bajra	0.8	2.5	1100	2717
	Maize	2.4	0.6	600	370
	Paddy	4.1	1.7	1265	2083
Oil seeds	Groundnut	6.9	0.9	1200	1049
Grand Total		14.2	1.4	1041	1555

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 27 and Figure 12) in bajra (Rs110557) followed by greengram (Rs51173), redgram (Rs 33808), cotton (Rs.31928), maize (Rs 20751) and groundnut (Rs. 18037).

Table 27: Ecosystem services of water supply in Kanikal-4 Microwatershed

Crops	Yield (Qtl/ha)	Virtual water (cubic meter) per ha	Value of Water (Rs/ha)	Water consumption (Cubic meters/Qtl)
Bajra	24.7	11055	110557	447
Cotton	7.9	3192	31928	402
Greengram	7.4	5117	51173	690
Groundnut	6.5	1803	18037	278
Maize	16.9	2075	20751	122
Redgram	6.2	3380	33808	544
Average Value	9.1	3762	37621	414

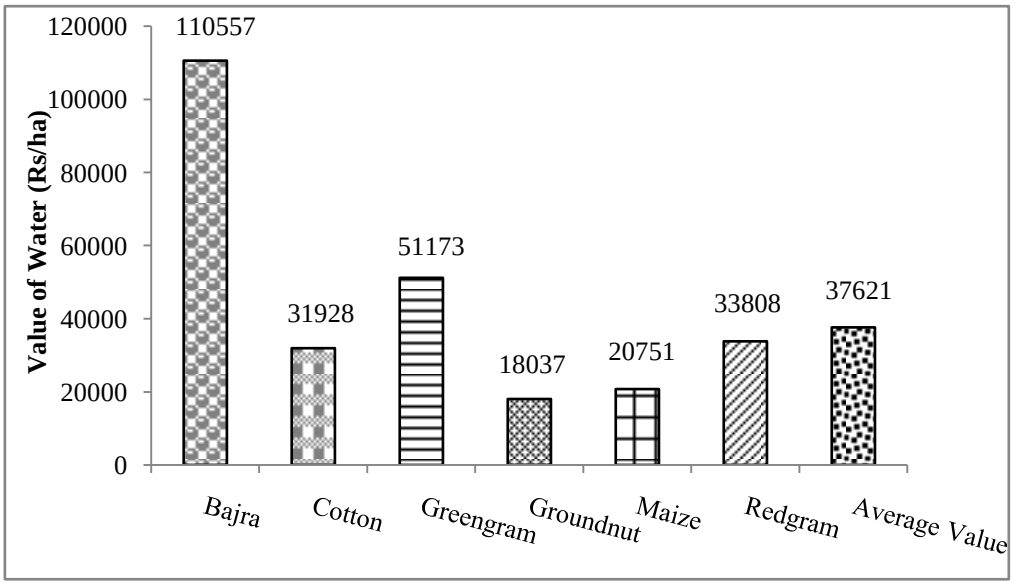


Figure 12: Ecosystem services of water supply in Kanikal-4 Microwatershed

The main constraints in farming is climate change particularly decline in rainfall and increasing temperature. Farmers reported that they are not getting timely support/extension services from the concerned development department (Table 28).

Table 28: Farming constraints related land resources of sample households in Kanikal-4 Microwatershed

Particulars	Per cent
Farmers awareness of climate change	
Yes	5.9
No	94.1
Perception on climate change	
Decrease in rainfall	100.0
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.