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

LAKKIPUR-1 (4B3E2E2b) MICRO WATERSHED

Gundlupet Taluk, Chamarajanagara District, Karnataka

Karnataka Watershed Development Project – II

SUJALA – III

World Bank funded Project

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.

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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 Lakkipur-1 Microwatershed, Gundlupet Taluk and Chamarajanagar 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 micowatershed. 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 Lakkipur-1 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 the 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 and use potentials of the soils in the microwatershed.

The present study covers an area of 342 ha in Gundlupet taluk of Chamarajanagar district, Karnataka. The climate is semiarid and categorized as drought-prone with an average annual rainfall of 734 mm, of which about 254 mm is received during south–west monsoon, 268 mm during the north-east and the remaining 212 mm during the rest of the year. An area of about 89 per cent is covered by soils, 26 per cent by forest and 3 per cent by others. The salient findings from the land resource inventory are summarized briefly below.

- *The soils belong to 11 soil series and 21 soil phases (management units) and 8 land management units.*
- *The length of crop growing period is about 150 days starting from the 3rd week of June to 3rd week of November.*
- *From the master soil map, several interpretative and thematic maps like land capability, soil depth, surface soil texture, soil gravelliness, available water capacity, soil slope and soil erosion were generated.*
- *Soil fertility status maps for macro and micronutrients were generated based on the surface soil samples collected at every 250 m grid interval.*
- *Land suitability for growing 27 major agricultural and horticultural crops were assessed and maps showing the degree of suitability along with constraints were generated.*
- *About 71 per cent area is suitable for agriculture.*
- *About 27 per cent of soils are shallow (25-50 cm), 26 per cent are moderately shallow (50-75 cm), 2 per cent of the soils are moderately deep (75-100 cm), 4 per cent of the soils are deep (100-150 cm) and 30 per cent are very deep (>150 cm).*
- *About 29 per cent of the area has clayey soils at the surface and 60 per cent area loamy soil.*
- *About 51 per cent of the area has non-gravelly soils and 38 per cent gravelly soils (15-35 % gravel) soils.*
- *About 27 per cent has soils that are very low (<50 mm/m), 32 per cent are low (51-100 mm/m) in available water capacity and an area of 30 per cent has very high (>200 mm/m) available water capacity.*

- *An area of about 59 per cent has very gently sloping (1-3% slope) lands, 12 per cent is gently sloping (3-5% slope), 9 per cent is moderately sloping (5-10%) and 9 per cent is strongly sloping (10-15% slope).*
- *An area of about 33 per cent has soils that are slightly eroded (e1) and 56 per cent soils are moderately eroded (e2).*
- *An area of about 14 per cent is strongly acid (pH 5.0-5.5), 16 per cent is moderately acid (pH 5.5-6.0), 23 per cent is slightly acid (pH 6.0-6.5), 32 per cent has soils that are neutral (pH 6.5-7.3) and an area of about 3 per cent has soils that are slightly alkaline (pH 7.3-7.8).*
- *The Electrical Conductivity (EC) of the soils are <2 dsm^{-1} indicating that the soils are non-saline.*
- *About 35 per cent of the soils are medium (0.5-0.75%) and 54 per cent soils are high (>0.75%) in organic carbon.*
- *About 17 per cent of soil are low (23 kg/ha), 36 per cent of the soils are medium (23-57 kg/ha) and 37 per cent are high (>57 kg/ha) in available phosphorus.*
- *About 29 per cent are medium (145-337 kg/ha) and 60 per cent are high (>337 kg/ha) in available potassium.*
- *About 3 per cent of the soils are low in available sulphur and 87 per cent are medium (10-20 ppm).*
- *Available boron is low (<0.5 ppm) in about 23 per cent, medium (0.5-1.0 ppm) in 56 per cent and 10 per cent high (>1.0 kg/ha).*
- *Available iron is sufficient (>4.5 ppm) in the entire area of the microwatershed.*
- *Available manganese and copper are sufficient in the entire area of the microwatershed.*
- *Available zinc is deficient (<0.6 ppm) in 38 per cent and sufficient (>0.6 ppm) in 52 per cent.*
- *The land suitability for 27 major crops grown in the microwatershed were assessed and the areas that are highly suitable (S1) and moderately suitable (S2) are given below. It is however to be noted that a given soil may be suitable for various crops but what specific crop to be grown may be decided by the farmer looking to his capacity to invest on various inputs, marketing infrastructure, price and finally the demand and supply position.*

Land suitability for various crops in the Microwatershed

Crop	Suitability Area in ha (%)			Crop	Suitability Area in ha (%)	
	Highly suitable(S1)	Moderately suitable(S2)			Highly suitable(S1)	Moderately suitable(S2)
Sorghum	*103 (30)*	*56 (16)*		*Sapota*	*46 (13)*	*20 (6)*
Maize	*53 (15)*	*48 (14)*		*Guava*	*60 (18)*	*-*
Redgram	*53 (15)*	*74 (22)*		*Banana*	*33 (10)*	*78 (23)*
Horsegram	*53 (15)*	*115 (34)*		*Jackfruit*	*46 (13)*	*14 (4)*
Field bean	*33 (10)*	*126 (37)*		*Jamun*	*46 (13)*	*14 (4)*
Groundnut	*20 (6)*	*81 (24)*		*Musambi*	*103 (30)*	*14 (4)*
Sunflower	*25 (7)*	*86 (25)*		*Lime*	*103 (30)*	*14 (4)*
Cotton	*83 (24)*	*68 (20)*		*Cashew*	*46 (13)*	*-*
Onion	*33 (10)*	*126 (37)*		*Custard apple*	*118 (34)*	*145 (42)*
Potato	*33 (10)*	*69 (20)*		*Amla*	*118 (34)*	*153 (45)*
French Beans	*33 (10)*	*126 (37)*		*Tamarind*	*46 (13)*	*14 (4)*
Beetroot	*33 (10)*	*68 (20)*		*Marigold*	*53 (15)*	*106 (31)*
Turmeric	*33 (10)*	*68 (20)*		*Chrysanthemum*	*33 (10)*	*126 (37)*
Mango	*46 (13)*	*14 (4)*		*-*	*-*	*-*

Apart from the individual crop suitability, a proposed crop plan has been prepared for the 8 identified LMUs by considering only the highly and moderately suitable lands for different crops and cropping systems with food, fodder, fibre and horticulture crops.

- *Maintaining soil-health is vital to crop production and conserve soil and land resource base for maintaining ecological balance and to mitigate climate change. For this, several ameliorative measures have been suggested to these problematic soils like saline/alkali, highly eroded, sandy soils etc.,*
- *Soil and water conservation treatment plan has been prepared that would help in identifying the sites to be treated and also the type of structures required.*
- *As part of the greening programme, several tree species have been suggested to be planted in marginal and submarginal lands and also in the hillocks, mounds and ridges.*

Chapter 1

INTRODUCTION

Soil is a finite natural resource that is central to sustainable agriculture and food security. Over the years, this precious resource is faced with the problems of erosion, salinity, alkalinity, degradation, depletion of nutrients and even decline in availability of jland for agriculture. It is a known fact, that it takes thousands of years to form a few centimetres of soil, thus, soil is a precious gift of nature. The area available for agriculture is about 51 per cent of the total geographical area and more than 60 per cent of the people are still dependant on agriculture for their livelihood. However, the capacity of a soil to produce is limited and the limits to the production are set by its intrinsic characteristics, agroclimatic setting, and use and management. There is therefore, tremendous pressure on land and water resources, which is causing decline in soil-health and stagnation in productivity. As much as 121 m ha of land is reportedly degraded which leads to impaired soil quality. It is imperative that steps are urgently taken to check and reverse land degradation without any further loss of time. The improvements in productivity will have to come from sustainable intensification measures that make the most effective use of land and water resources. Soil erosion alone has degraded about 35 lakh ha. Almost all the areas are facing various degrees of degradation, particularly soil erosion. Salinity and alkalinity has emerged as a major problem (>3.5 lakh ha) in the irrigated areas of the State. Nutrient depletion and declining factor productivity is common in both rainfed and irrigated areas. The degradation is continuing at an alarming rate and there appears to be no systematic effort among the stakeholders to contain this process. In recent times, an aberration of weather due to climate change phenomenon has added another dimension leading to unpredictable situations to be tackled by the farmers.

In this critical juncture, the challenge before us is not only to increase the productivity per unit area which is steadily declining and showing a fatigue syndrome, but also to prevent or at least reduce the severity of degradation. If the situation is not reversed at the earliest, then the sustainability of the already fragile crop production system and the overall ecosystem will be badly affected in the state. Added to this, every year there is a significant diversion of farm lands and water resources for non-agricultural purposes. Thus, developing strategies to slow down the degradation process or reclaim the soils to normal condition and ensure sustainability of production system are the major issues today. This demands a systematic appraisal of our soil and land resources with respect to their extent, geographic distribution, characteristics, behaviour and use potential, which is very important for developing an effective land use and cropping systems for augmenting agricultural production on a sustainable basis.

The soil and land resource inventories made so far in Karnataka had limited utility because the surveys were of different types, scales and intensities carried out at different times with specific objectives. Hence, there is an urgent need to generate detailed site-specific farm level database on various land resources for all the villages/watersheds in a

time bound manner that would help to protect the valuable soil and land resources and also to stabilize farm production. Therefore, the land resource inventory required for farm level planning is the one which investigates all the parameters which are critical for productivity *viz.*, soils, site characteristics (slope, erosion, gravelliness and stoniness) climate, water, topography, geology, hydrology, vegetation, crops, land use pattern, animal population, socio-economic conditions, infrastructure, marketing facilities and various schemes and developmental works of the government etc. From the data collected at farm level, the specific problems and potentials of the area can be identified and highlighted, conservation measures required for the area can be planned on a scientific footing, suitability of the area for various uses can be worked out and finally viable and sustainable land use options suitable for each and every land holding can be prescribed.

The Land Resource Inventory is basically done for identifying potential and problem areas, developing sustainable land use plans, estimation of surface run off and water harvesting potential, preparation of soil and water conservation plans, land degradation/desertification etc. The Bureau is presently engaged in developing an LRI methodology using high resolution satellite remote sensing data and Digital Elevation Model (DEM) data to prepare Landscape Ecological Units (LEU) map representing agro-ecosystem as a whole. The LEU is preferred over landform as the base for LRI. LEU is the assemblage of landform, slope and land use. An attempt has 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 data and maps presented here aims to provide site-specific database for Lakkipur-1 Microwatershed in Gundlupet Taluk, Chamarajanagar 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 Lakkipur-1 Microwatershed (Gopalpur subwatershed) is located in the southern part of Karnataka in Gundlupet Taluk, Chamarajanagara District, Karnataka State (Fig. 2.1). It comprises of Berambadi, Lakkipur and Kannigala villages. It lies between $11^0$44' to 11^0 45' North latitudes and 76^0 33' to 76^0 35' East longitudes and covers an area of 342 ha. It is about 51 km southwest of Gundlupet and is surrounded by Bachanahalli on the west, Channamallipura on the north, Maddinahalli on the northeast, Gopalpur and Kannigala villages on the east and Berambadi district forest on the southern side.

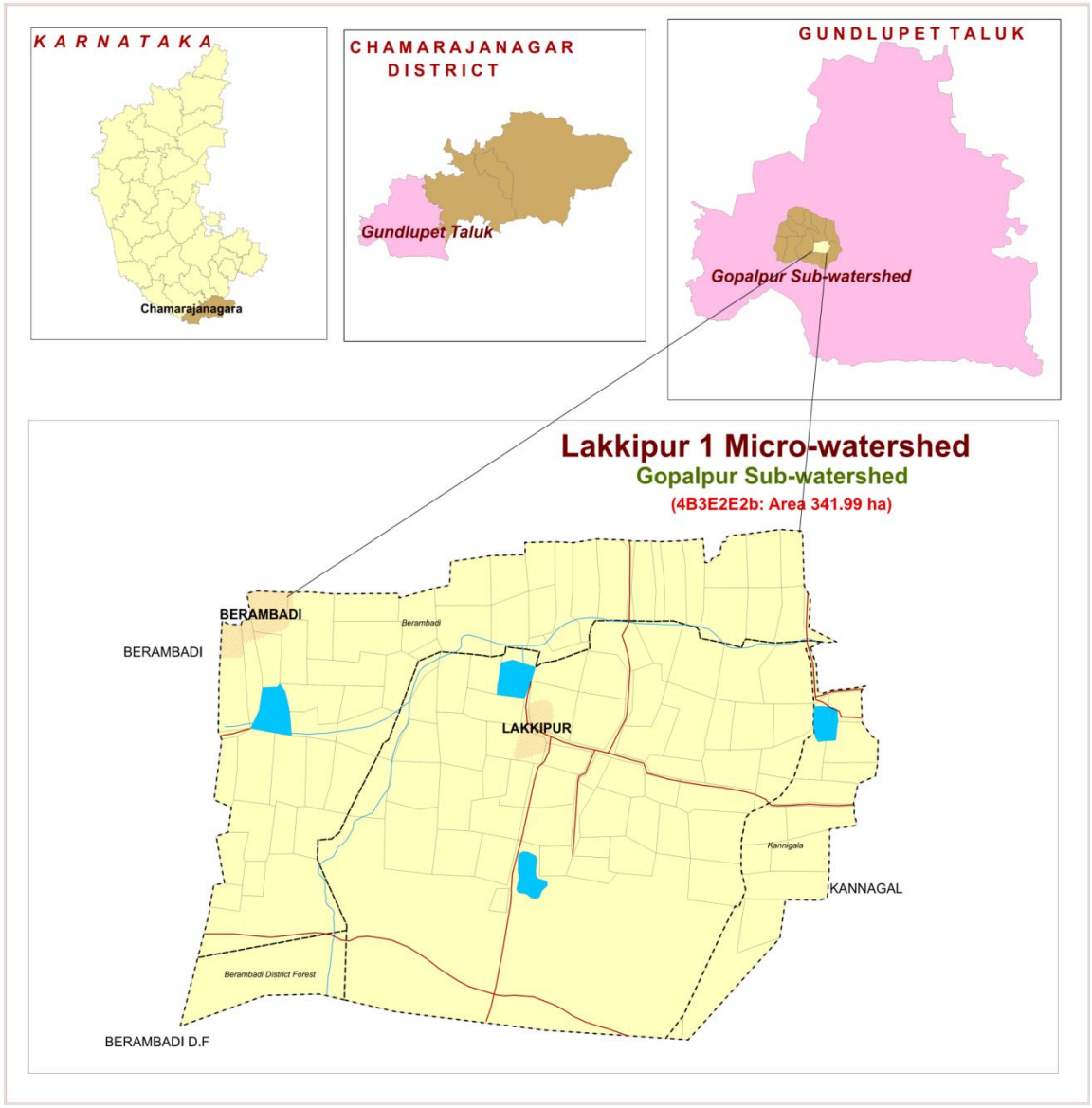


Fig. 2.1 Location map of Lakkipur-1 Microwatershed

2.2 Geology

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

Fig. 2.2 a Granite and granite gneiss rocks

Fig. 2.2 b Granite rocks

2.3 Physiography

Physiographically, the area has been identified as granite gneiss landscape based on the geology. The microwatershed area has been further divided into mounds/ ridges, summits, side slopes and very gently sloping uplands based on slope and relief features. The mounds and ridges are mostly covered by rock outcrops.

2.4 Drainage

There are no perennial rivers flowing in Gundlupet taluk. However, the area is drained by several small seasonal streams like Gundluhole along its course. Though, it is not a perennial one, during rainy season, it carries large quantities of rain water. The microwatershed has only a few small tanks which are not capable of storing water that flows during the rainy season. Due to this, the ground water recharge is very much affected in the villages. This is reflected in the failure of many bore wells in the villages. If the available rain water is properly harnessed by constructing tanks and recharge structures at appropriate places in the villages, then the drinking and irrigation needs of the entire area can be easily met. The drainage network is dendritic to sub parallel.

2.5 Climate

The district falls under semiarid tract and is categorized as drought-prone with average annual rainfall of 734 mm (Table 2.1). Of the total rainfall, a maximum of 254 mm is received during the south–west monsoon period from June to September, north-east monsoon from October to early December contributes maximum about 268 mm and the remaining 212 mm is received during the rest of the year. The winter season is from December to February. During April and May, the temperatures reach up to 42 °C and in December and January, the temperatures will go down to 16 °C. Rainfall distribution is shown in Figure 2.3. The average Potential Evapotranspiration (PET) is 128 mm and varies from a low of 106 mm in November to 165 mm in the month of March. The PET is always higher than precipitation in all the months except in the month of October. Generally, the length of crop growing period (LGP) is 150 days and starts from 3rd week of June to third week of November.

Table 2.1 Mean Monthly Rainfall, PET, 1/2 PET in Gundlupet Taluk, Chamarajanagara District

Sl. no.	Months	Rainfall	PET	1/2 PET
1	JAN	0.80	129.10	64.55
2	FEB	6.80	133.80	66.90
3	MAR	26.90	164.90	82.45
4	APR	73.60	153.80	76.90
5	MAY	103.90	147.20	73.60
6	JUN	56.00	124.60	62.30
7	JUL	50.40	116.40	58.20
8	AUG	55.80	117.10	58.55
9	SEP	92.00	116.80	58.40
10	OCT	164.10	111.10	55.55
11	NOV	80.50	106.20	53.10
12	DEC	23.50	109.90	54.95
Total		**734.30**	**127.57**	

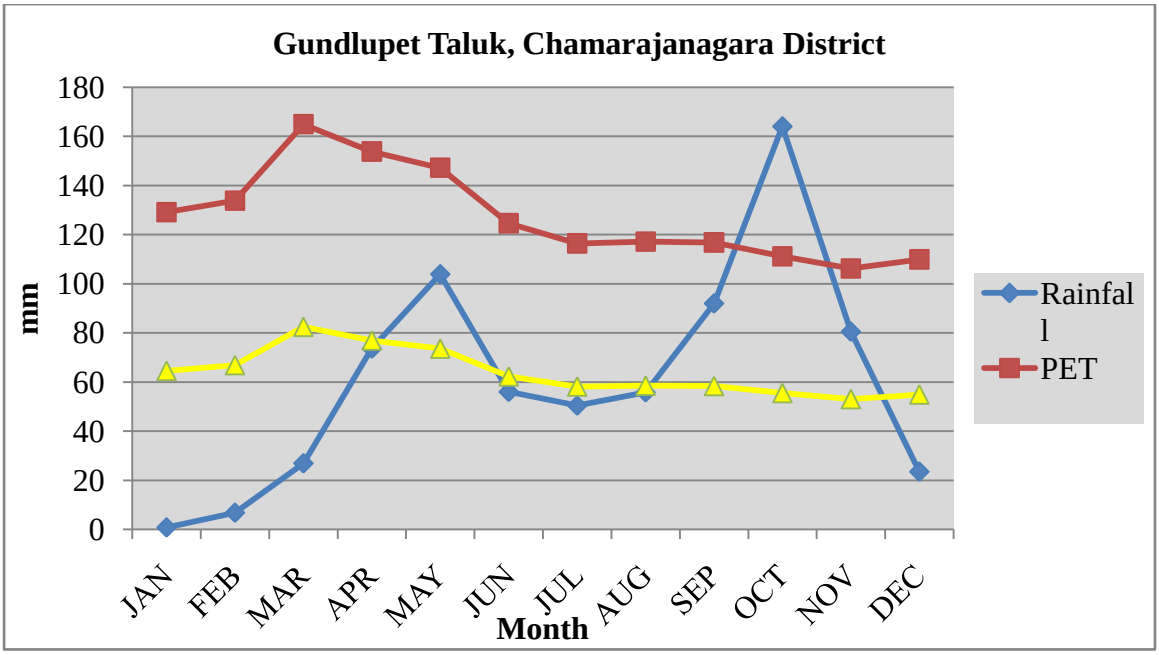


Fig 2.3 Rainfall distribution in Gundlupet Taluk, Chamarajanagara District

2.6 Natural Vegetation

Forests occupy about 32 per cent area in Gundlupet taluk. The major area of these forests are found in Bandipur National Park and Himavad Gopalaswamy Betta. The rest of the area in the taluk has sparse natural vegetation comprising few tree species, shrubs and herbs. The mounds, ridges and boulders occupy very sizeable areas which are under thin to moderately thick forest vegetation. Still, there are some remnants of the past forest cover which can be seen in patches in some ridges and hillocks in the microwatershed.

Fig. 2.4 Natural vegetation of Lakkipur-1 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 is left in the area. The uncontrolled grazing has left no time for the regeneration of the vegetative cover. This leads to the accelerated rate of erosion on the hill slopes, resulting in the formation of deep gullies in the foot slopes and eventually resulting in the heavy siltation of few tanks and reservoirs in the microwatershed.

2.7 Land Utilization

About 48 per cent area (Table 2.2) in Gundlupet taluk is cultivated at present. An area of about 6 per cent is currently barren. Forests occupy an area of about 32 per cent and the tree cover is in a very poor state except in Bandipura National Park and Gopalaswamy Betta. Most of the mounds, ridges and bouldery areas have very poor vegetative cover. Major crops grown in the area are sorghum, maize, cotton, onion, sugarcane, groundnut, red gram, horse gram, banana, sapota, chilly, tomato, brinjal and marigold and (Fig. 2.5 a & b). 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 generated. The current land use map generated shows the arable and non-arable lands, other land uses and different types of crops grown in the area (Fig. 2.6). Simultaneously, enumeration of wells (bore wells and open wells) and existing conservation structures in the microwatershed are made and their location in different survey numbers is located on the cadastral map. Map showing the location of wells, conservation structures and other water bodies in Lakkipur-1 Microwatershed is given in Figure 2.7.

Table 2.2 Land Utilization in Gundlupet Taluk

Sl. No.	Agricultural land use	Area (ha)	Per cent
1.	Total geographical area	140607	
2.	Total cultivated area	67339	47.84
3.	Area sown more than once	13532	
4.	Cropping intensity	-	120.09
5.	Trees and grooves	3485	2.47
6.	Forest	44859	31.98
7.	Cultivable wasteland	3265	2.32
8.	Permanent Pasture land	10287	7.31
9.	Barren land	7988	5.68
10.	Non- Agriculture land	3384	2.40

Fig. 2.5.a. Different crops and cropping systems in Lakkipur-1 Microwatershed

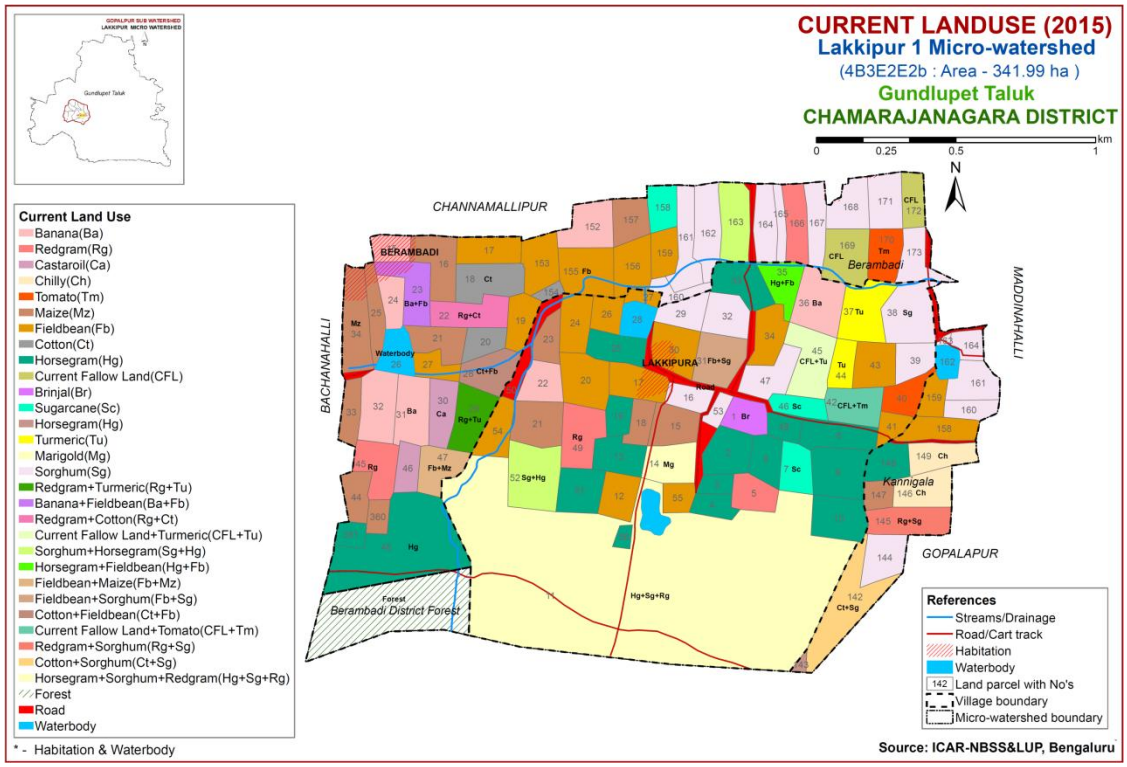


Fig. 2.6 Current Land Use map of Lakkipur-1 Microwatershed

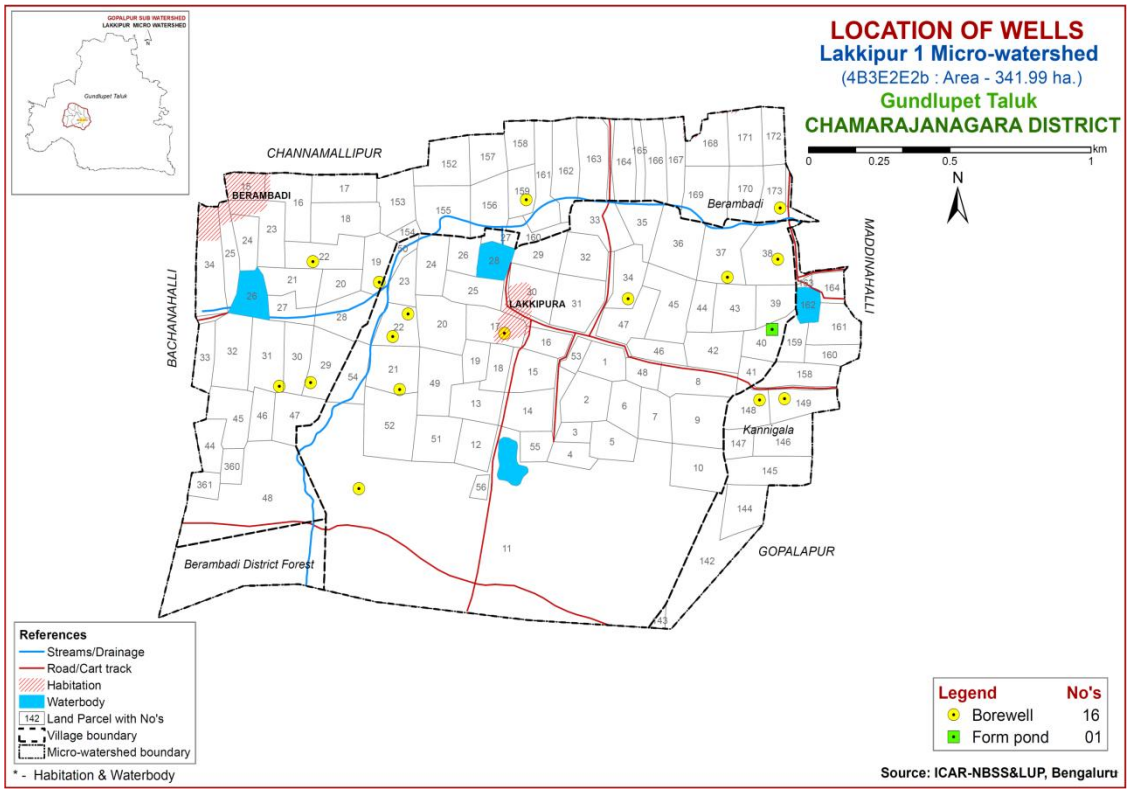


Fig. 2.7 Location of Wells and Conservation Structures map of Lakkipur-1 Microwatershed

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 Lakkipur-1 Microwatershed by the detailed study of all the soil characteristics (depth, texture, colour, structure, consistence, coarse fragments, porosity, soil reaction, soil horizons etc.), and site characteristics (slope, erosion, drainage, occurrence of rock fragments etc.) followed by grouping of similar areas based on soil-site characteristics into homogeneous (management units) units, and showing their extent and geographic distribution on the microwatershed cadastral map. The detailed soil survey at 1:7920 scale was carried out in an area of 342 ha. The methodology followed for carrying out land resource inventory was as per the guidelines given in Soil Survey Manual (IARI, 1971; Soil Survey Staff, 2006; Natarajan *et al.,* 2015) which is briefly described below.

3.1 Base Maps

The detailed survey of the land resources occurring in the microwatershed was carried out by using digitized cadastral map and satellite imagery as a base supplied by the KSRSAC. The cadastral map shows field boundaries with their survey numbers, location of tanks, streams and other permanent features of the area (Fig. 3.1). Apart from the cadastral map, remote sensing data products from Cartosat-1 and LISS IV merged at the scale of 1:7920 were used in conjunction with the cadastral map to identify the 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 also 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 (FCC) of Cartosat-I and LISS-IV merged satellite data covering the microwatershed area was visually interpreted using image interpretation elements and all the available collateral data with local knowledge. The delineated physiographic boundaries were transferred on to a cadastral map overlaid on satellite imagery. Physiographically, the area has been identified as granite gneiss landscape. They were divided into landforms such as ridges, mounds and uplands based on slope and other relief features. 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)
	G24		Valleys/ lowlands
		G241	Valleys, pink tones
		G242	Valleys gray mixed with pink tones

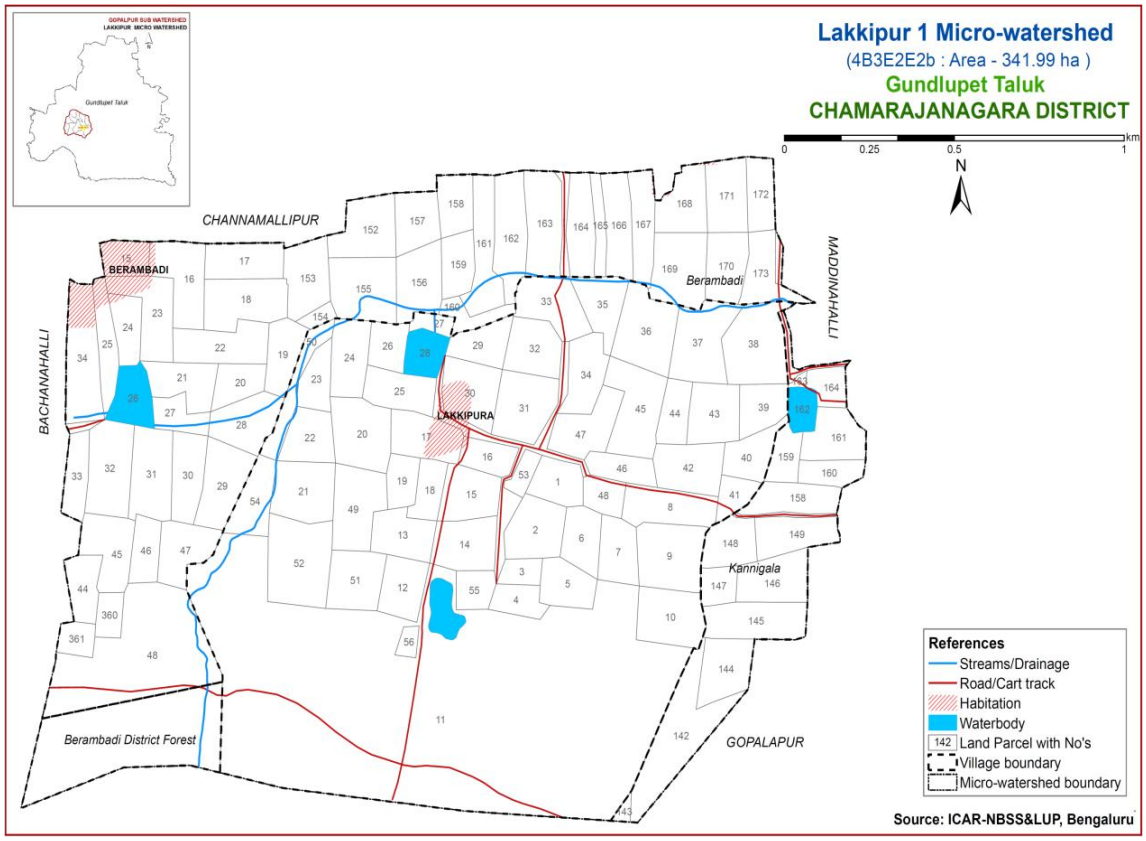


Fig 3.1 Scanned and Digitized Cadastral map of Lakkipur-1 Microwatershed

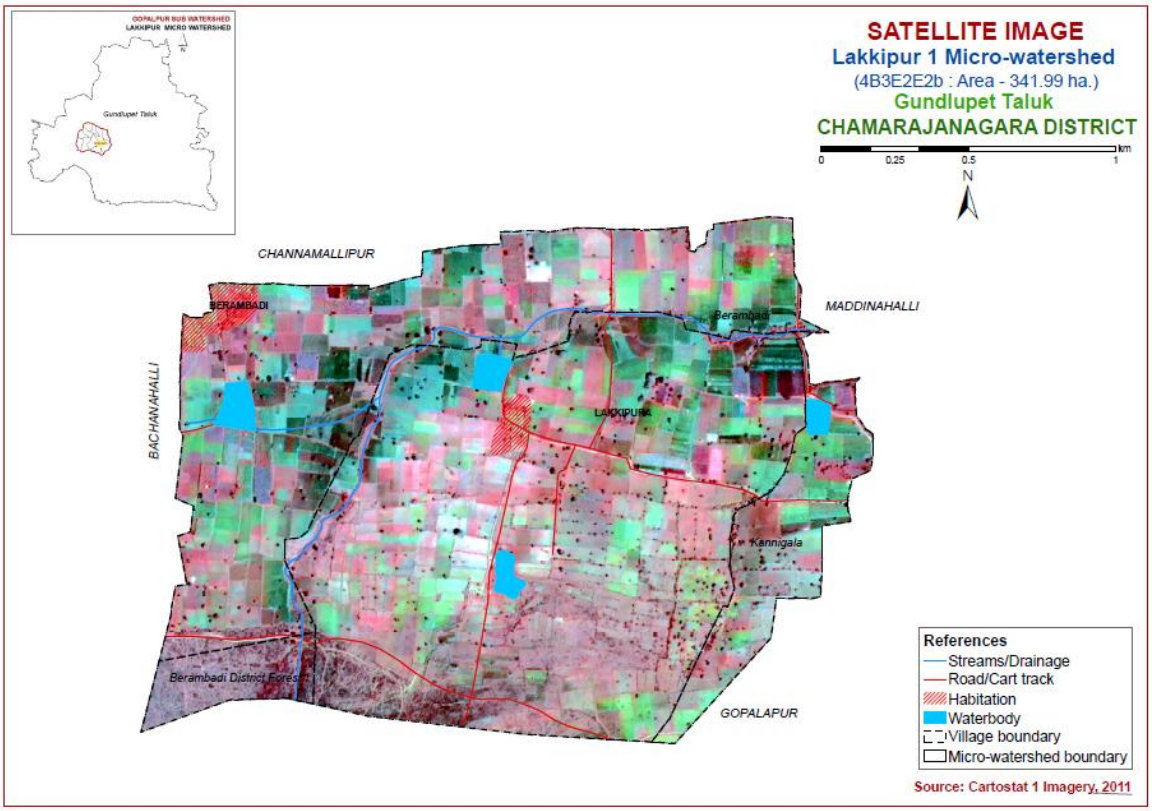


Fig. 3.2 Satellite Image of Lakkipur-1 Microwatershed

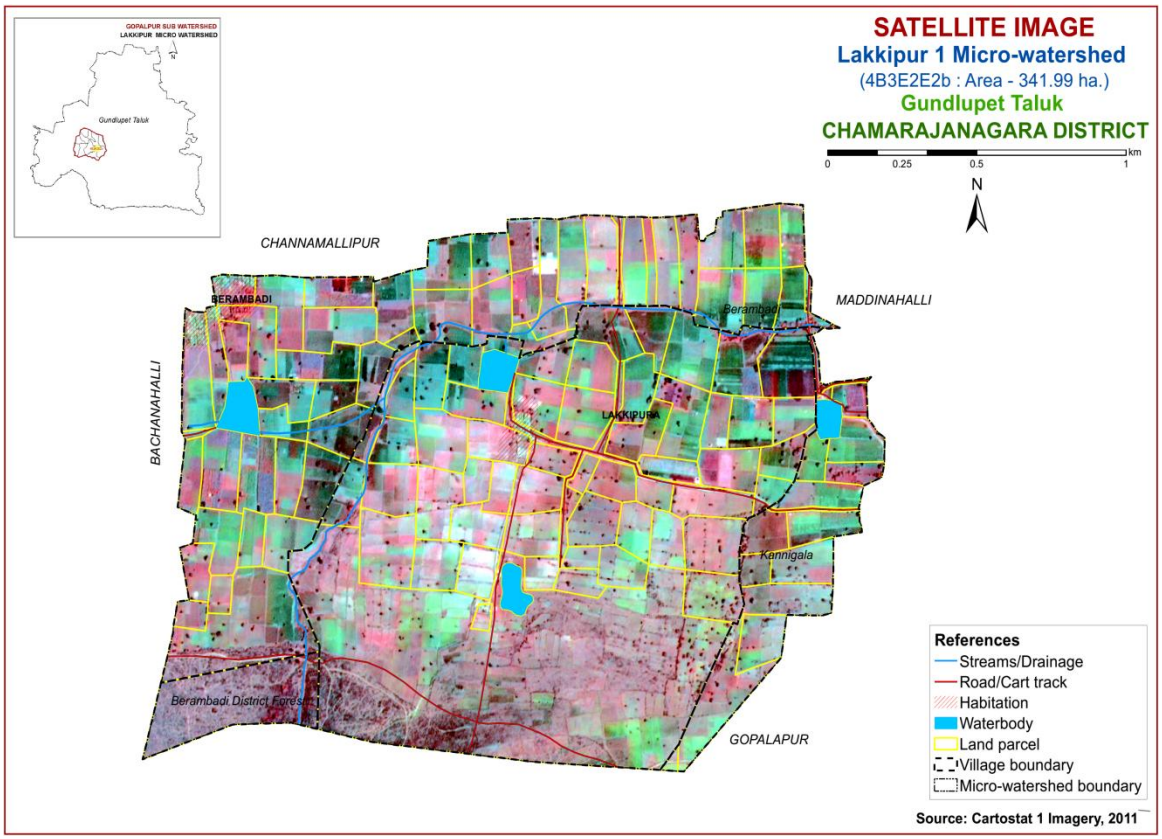


Fig. 3.3 Cadastral map overlaid on IRS PAN+LISS IV merged imagery of Lakkipur-1 Microwatershed

3.3 Field Investigation

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

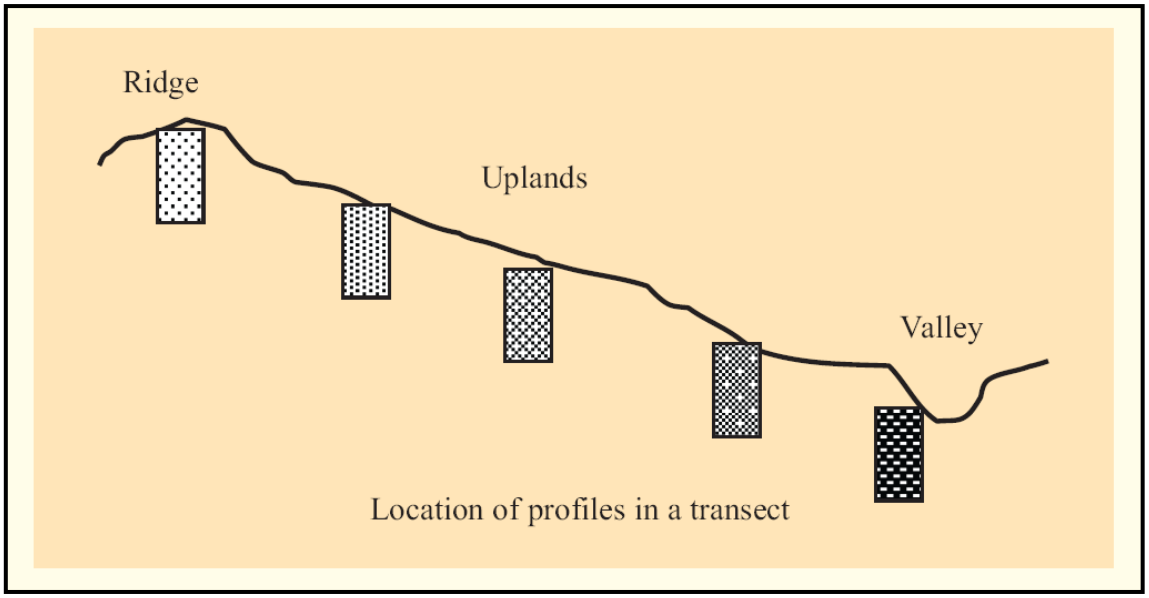


Fig. 3.4 Location of profiles in a transect

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

Based on the soil characteristics, the soils were grouped into different soil series. Soil series is the most homogeneous unit having similar horizons and properties and behaves similarly for a given level of management. Soil depth, texture, colour, kind of horizon and horizon sequence, amount and nature of gravel present, nature of substratum etc, were used as the major differentiating characteristics for identifying soil series occurring in the area. The differentiating characteristics used for identifying the soil series are given in Table 3.1. Based on the above characteristics, 11 soil series were identified in the Lakkipur-1 Microwatershed.

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

Soils of Granite gneiss Landscape						
Sl. no	**Soil Series**	**Depth (cm)**	**Colour (Moist)**	**Texture**	**Gravel (%)**	**Horizon sequence**
1	Annurkeri (ARK)	>150	2.5YR 2.5/2,3/2,2.5/3,3/3,2.5/4,3/4	sc	<15	Ap-Bt
2	Beemanabeedu	>150	10YR 2/1,3/1,3/2,4/1	c	<15	Ap-Bw

	(BMB)					
3	Berambadi (BMD)	25-50	10YR 3/3,4/2 7.5YR 3/2,3/3	scl	<15	Ap-Bw-Cr
4	Devarahall (DRH)	50-75	2.5YR 5/4,3/2,3/6	gscl	15-35	Ap-Bt-Cr
5	Gopalapura (GPR)	75-100	2.5YR 3/2,3/3 5YR 3/3,4/3	gscl	15-35	Ap-Bt-Cr
6	Hundipur (HDR)	25-50	2.5YR 2.5/4 5YR 3/2	sl	<15	Ap-A2-Cr
7	Honnegaudanahalli (HGH)	>150	7.5YR 2.5/2,2.5/3,3/3,2.5/4,3/4	scl	<15	Ap-Bw
8	Hullipura (HPR)	50-75	7.5YR 2.5/2,3/2	gscl	15-35	Ap-Bw-Cr
9	Kallipura (KLP)	100-150	2.5YR 2.5/3,2.5/4,3/4	sc	<15	Ap-Bt-Cr
10	Magoonahalli (MGH)	50-75	2.5YR 2.5/4,3/4	gscl	35-60	Ap-Bt-Cr
11	Shivapura (SPR)	25-50	2.5YR 2.5/4,3/4	gscl	35-60	Ap-Bt-Cr

3.4 Soil Mapping

The area under each soil series was further separated into 21 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 20 soil profile pits, few minipits and a few auger bores representing different landforms occurring in the microwatershed were studied. In addition to the profile study, spot observations in the form of minipits, road cuts, terrace cuts etc., were studied to validate the soil boundaries on the soil map. The soil map shows the geographic distribution of 21 mapping units representing 11 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 21 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 they have to be treated accordingly.

3.5 Laboratory Characterization

Soil samples were collected from representative master profiles for laboratory characterization by following the methods outlined in the Laboratory Manual (Sarma *et al*, 1987). Surface soil samples collected from farmer's fields (52 samples) for fertility status (major and micronutrients) at 250 m grid interval were analyzed in the laboratory (Katyal and Rattan, 2003). By linking the soil fertility data to the survey numbers through GIS, soil fertility maps were generated using Kriging method for the microwatershed.

Table 3.2 Soil map unit description of Honagahalli-2Microwatershed

Soil No	Soil Series	Soil Phase	Mapping Unit Description	Area in ha (%)
	ARK	Annurkeri soils are very deep (>150 cm), well drained, have dark reddish brown to very dusky red sandy clay soils occurring on very gently sloping uplands under cultivation		**24.99 (7.31)**
1		ARKiB2	Sandy clay surface, slope 1-3%, moderate erosion	24.99 (7.31)
	BMB	Beemanabeedu soils are very deep (>150 cm), moderately well drained, have very dark grayish brown to dark grey and very dark brown clayey soils occurring on very gently sloping lowlands under cultivation		**57.65 (17.22)**
2		BMBhB1	Sandy clay loam surface, slope 1-3%, slight erosion	26.37 (7.71)
3		BMBmB2	Clay surface, slope 1-3%, moderate erosion	31.28 (9.15)
	BMD	Berambadi soils are shallow (25-50 cm), well drained, have dark brown to dark greyish brown sandy clay loam soils occurring on gently to moderately sloping uplands under cultivation		**34.19 (10.00)**
4		BMDcC2g1	Sandy loam surface, slope 3-5%, moderate erosion, gravelly (15-35%)	15.43 (4.51)
5		BMDcD2g1	Sandy loam surface, slope 5-10%, moderate erosion, gravelly (15-35%)	13.53 (3.96)
6		BMDhC2g1	Sandy clay loam surface, slope 3-5%, moderate erosion, gravelly (15-35%)	5.23 (1.53)
	DRH	Devarahalli soils are moderately shallow (50-75 cm), well drained, have dark red to reddish brown and dusky red gravelly sandy clay loam soils occurring on very gently sloping uplands under cultivation		**6.88 (2.10)**
7		DRHiB2	Sandy clay surface, slope 1-3% , moderate erosion	6.88 (2.10)
	GPR	Gopalapura soils are moderately deep (75-100 cm), well drained, have dark brown to dark reddish brown and reddish brown gravelly sandy clay loam soils occurring on very gently sloping uplands under cultivation		**5.63 (1.01)**
8		GPRhB1g1	Sandy clay loam surface, slope 1-3%, slight erosion, gravelly (15-35%)	2.85 (0.83)
9		GPRiB1	Sandy clay surface, slope 1-3%, slight erosion	2.78 (0.18)
	HDR	Hundipur soils are shallow (25-50 cm), well drained, have dark reddish brown to dusky red sandy loam soils occurring on very gently sloping uplands under cultivation		**8.66 (2.53)**
10		HDRhB1	Sandy clay loam surface, slope 1-3%, slight erosion	8.66 (2.53)
	HGH	Honnegaudanahalli soils are very deep (>150 cm), well drained, have very dark brown to brown and dark reddish brown sandy clay loam soils occurring on very gently sloping uplands under cultivation		**20.54 (6.01)**
11		HGHhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	12.76 (3.73)
12		HGHmB1	Clay surface, slope 1-3%, slight erosion	7.78 (2.28)

	HPR	Hullipura soils are moderately shallow (50-75 cm), well drained, have dark brown to very dark brown gravelly sandy clay loam soils occurring on very gently to gently sloping uplands under cultivation		**41.25 (12.05)**
13		HPRcB1g1	Sandy loam surface, slope 1-3%, slight erosion, gravelly (15-35%)	11.64 (3.40)
14		HPRhB1	Sandy clay loam surface, slope 1-3%, slight erosion	12.98 (3.79)
15		HPRiB1	Sandy clay surface, slope 1-3%, slight erosion	16.63 (4.86)
	KLP	Kallipura soils are deep (100-150 cm), well drained, have dark reddish brown to dark red sandy clay soils occurring on very gently sloping uplands under cultivation		**14.31 (4.18)**
16		KLPhB1	Sandy clay loam surface, slope 1-3%, slight erosion	14.31 (4.18)
	MGH	Magoonahalli soils are moderately shallow (50-75 cm), well drained, have very dark brown to dark brown gravelly sandy clay loam soils occurring on very gently to strongly sloping mounds and ridges		**40.77 (11.92)**
17		MGHhE2g1	Sandy clay loam surface, slope 10-15%, moderate erosion, gravelly (15-35%)	31.61 (9.24)
18		MGHiB1	Sandy clay surface, slope 1-3%, slight erosion	9.16 (2.68)
	SPR	Shivapura soils are shallow (25-50 cm), well drained, have dark reddish brown gravelly sandy clay loam soils occurring on very gently to moderately sloping uplands under cultivation		**50.37 (14.73)**
19		SPRcC2g1	Sandy loam surface, 3-5% slope, moderate erosion, gravelly (15-35%)	19.86 (5.81)
20		SPRcD2g1	Sandy loam surface, slope 5-10 %, moderate erosion, gravelly (15-35%)	18.27 (5.34)
21		SPRhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	12.24 (3.58)
22		Forest		26.01 (7.60)
23		Others		10.73 (3.14)

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

3.6 Land management Units

The 21 soil phases identified and mapped in the microwatershed were regrouped into 8 Land Management Units (LMU's) for the purpose of preparing a proposed crop plan for sustained development of the microwatershed. The database (soil phases) generated under LRI was utilized for identifying Land Management Units (LMUs) based on the management needs. One or more than one soil site characteristic having influence on the management have been choosen for identification and delineation of LMUs. For Lakkipur-1 Microwatershed, five soil and site characteristics, namely soil depth, soil texture, slope, erosion and gravel content have been considered for defining LMUs. The land management units are expected to behave similarly for a given level of management.

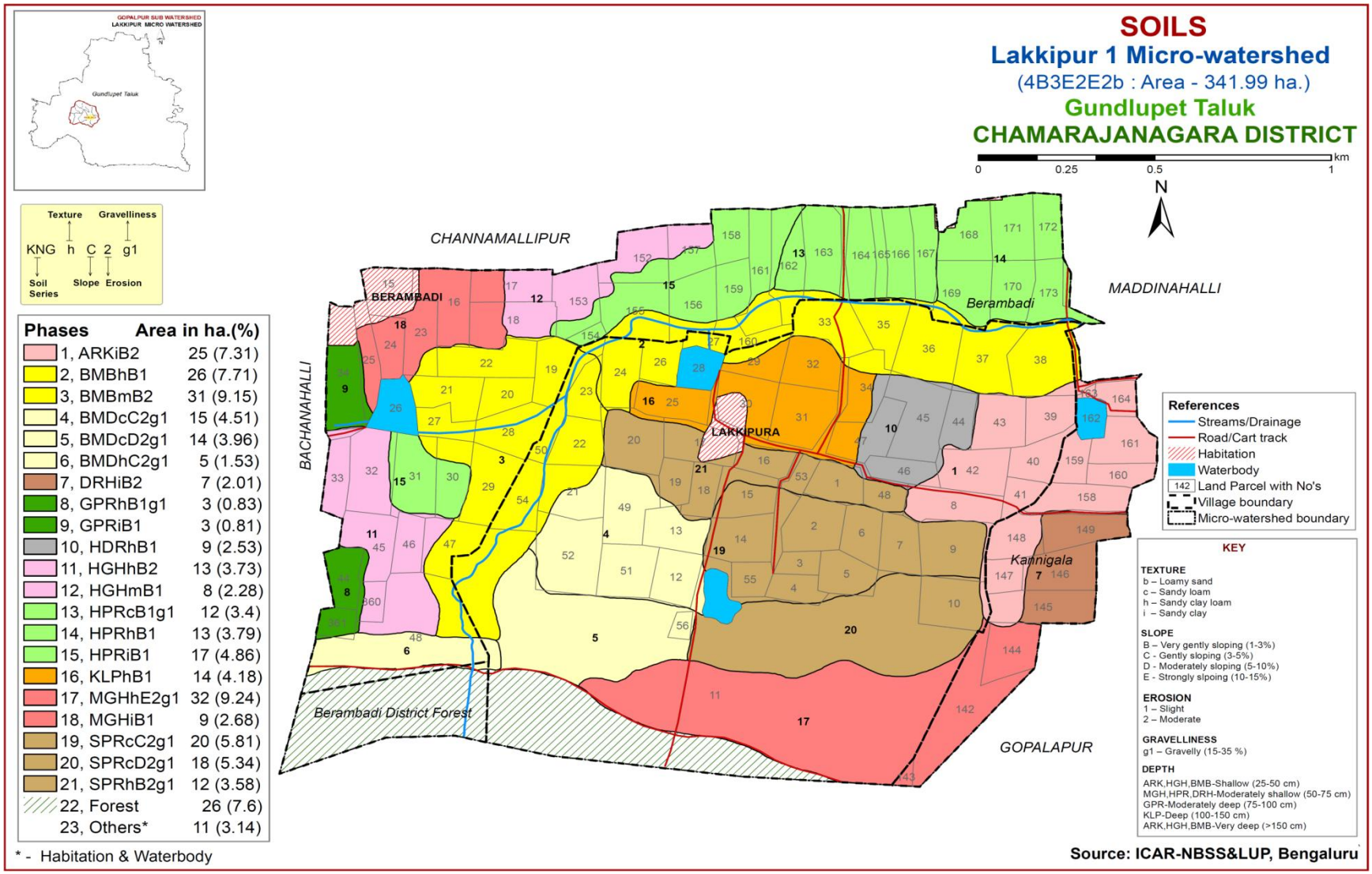


Fig 3.5 Soil Phase or Management Units Map of Lakkipur-1 Microwatershed

Chapter 4

THE SOILS

Detailed information pertaining to the nature, extent and distribution of different kinds of soils occurring in Lakkipur-1 Microwatershed is provided in this chapter. The microwatershed area has been identified as granite gneiss landscape based on geology. In all, 11 soil series were identified in different landforms. Soil formation is the result of the combined effect of environmental and terrain factors that are reflected in soil morphology. In the Granite gneiss landform, it is by parent material, relief and climate.

A brief description of each of the 11 soil series identified followed by 21 soil phases (management units) mapped (Fig. 3.5) are furnished below. The physical and chemical characteristics of soil series identified in Lakkipur-1 Microwatershed along with soil classification 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 gneiss Landscape

In this landscape, 11 soil series are identified and mapped. Of these, Beemanabeedu (BMB) soil series occupies maximum area of about 58 ha (17 %) followed by Shivapura (SPR) soil series 50 ha (15%), Magoonahalli (MGH) series 41 ha (12%), Hullipura (HPR) series 41 ha (12%), Berambadi (BMD) 34 ha (10%) and other series cover a small area of the microwatershed. The brief description of each soil series along with the soil phases identified and mapped is given below.

4.1.1 Annurkeri (ARK) Series: Annurkeri soils are very deep (>150 cm), well drained, have dark reddish brown to very dusky red sandy clay soils. They are developed from weathered granite gneiss and occur on very gently sloping uplands. The Annurkeri series has been classified as a member of the fine, mixed, isohyperthermic family of Rhodic Paleustalfs.

The thickness of the solum is more than 150 cm. The thickness of A horizon ranges from 11 to 18 cm. Its colour is in 5YR and 2.5 YR hue with value 3 and chroma 3 to 4. The texture varies from sandy clay to clay with 10 to 15 per cent gravel. The thickness of B horizon is more than 150 cm. Its colour is in 2.5 YR hue with value 2.5 to 3 and chroma 2 to 4. Texture is dominantly sandy clay to clay with less than 15 per cent gravel. The available water capacity is very high (200 mm/m). Only one phase was identified and mapped.

Landscape and Soil Profile characteristics of Annurkeri (ARK) Series

4.1.2 Beemanabeedu (BMB) Series: Beemanabeedu soils are very deep (>150 cm), moderately well drained, have very dark greyish brown to dark grey and very dark brown clay soils. They are developed from weathered granite gneiss and occur on very gently sloping lowlands. The Beemanabeedu series has been classified as a member of the fine, mixed, isohyperthermic family of Typic Haplustepts.

The thickness of the solum is more than 150 cm. The thickness of A horizon ranges from 12 to 17 cm. Its colour is in 10 YR and 7.5 YR hue with value 2.5 to 4 and chroma 2 to 4. The texture varies from sandy clay to clay with 10 to 12 per cent gravel. The thickness of B horizon is more than 150 cm. Its colour is in 10 YR hue with value 2 to 4 and chroma 1to 2. Texture is sandy clay to clay. The available water capacity is very high (200 mm/m). Two phases were identified and mapped.

Landscape and soil profile characteristics of Beemanabeedu (BMB) series

4.1.3 Berambadi (BMD) Series: Berambadi soils are shallow (25-50 cm), well drained, very dark gray to dark brown sandy clay loam soils. They have developed from weathered granite gneiss and occur on very gently to moderately sloping uplands under cultivation. The Berambadi series has been classified as member of the fine-loamy, mixed, isohyperthermic family of Typic Haplustepts.

The thickness of the solum ranges from 30 to 50 cm. The thickness of A-horizon ranges from 10 to 17 cm. Its colour is in 10 YR hue with value 3 to 4 and chroma 3. The texture varies from sandy loam to sandy clay with 15 to 25 per cent gravel. The thickness of B horizon ranges from 30 to 40 cm. Its colour is in 10YR and 7.5YR hue with value 3 to 4 and chroma 2 to 4. Its texture is sandy clay loam with gravel content of 10 to 15 per cent. The available water capacity is low (50-100 mm/m). Three phases were identified and mapped.

4.1.4 Devarahalli (DRH) Series: Devarahalli soils are moderately shallow (50-75 cm), well drained, have dark red to reddish brown and dusky red gravelly sandy clay loam soils. They have developed from weathered granite gneiss and occur on very gently to gently sloping uplands. The Devarahalli series has been classified as a member of the fine-loamy, mixed, isohyperthermic family of Typic Rhodustalfs.

The thickness of the solum ranges from 52 to 73 cm. The thickness of A horizon ranges from 7 to 15 cm. Its colour is in 7.5 YR and 5YR hue with value 3 to 4 and chroma 2 to 6. The texture varies from loamy sand to clay with 10 to 25 per cent gravel. The thickness of B horizon ranges from 45 to 58 cm. Its colour is in 2.5 YR hue with value 2.5 to 3 and chroma 4 to 6. Its texture is gravelly sandy clay loam with gravel content of 15 to 35 per cent. The available water capacity is low (75 mm/m). Only one phase was identified and mapped.

Landscape and Soil Profile characteristics of Devarahalli (DRH) Series

4.1.5 Gopalapura (GPR) Series: Gopalapura soils are moderately deep (75-100 cm), well drained, have dark brown to dark reddish brown and reddish brown gravelly sandy clay loam soils. They have developed from weathered granite gneiss and occur on very gently to gently sloping uplands.

The thickness of the solum ranges from 73 to 97 cm. The thickness of A horizon ranges from12 to 18 cm. Its colour is in 2.5 YR and 7.5 YR hue with value 3 and chroma 2. The texture varies from gravelly sandy clay to sandy clay loam with 12-25 per cent gravel. The thickness of B horizon ranges from 66 to79 cm. Its colour is in 2.5 YR and 5 YR hue with value 3 to 4 and chroma 2 to 3. Its texture is gravelly sandy clay with gravel content of 15-35 per cent. The available water capacity is low (75 mm/m). Two phases were identified and mapped.

Landscape and Soil Profile characteristics of Gopalapura (GPR) Series

4.1.6 Hundipura (HDR) Series: Hundipura soils are shallow (25-50 cm), well drained, have dark reddish brown to dusky red sandy loam soils. They have developed from weathered granite gneiss and occur on very gently to moderately sloping uplands. The Hundipura series has been classified as a member the sandy, mixed, isohyperthermic family of Paralithic Ustorthents.

The thickness of the soil ranges from 35 to 46 cm. The thickness of A horizon ranges from 7 to 18 cm. Its colour is in 7.5 YR and 5 YR hue with value 3 and chroma 3 to 4. The texture varies from loamy sand to clay with 10 to 20 per cent gravel. The thickness of subsurface horizon ranges from 19 to 31 cm. Its colour is in 2.5 YR and 5 YR hue with value 2.5 to 3 and chroma 2 to 4. Its texture is sandy loam with gravel content of < 15 per cent. The available water capacity is very low (50 mm/m). Only one phase was identified and mapped.

Landscape and soil profile characteristics of Hundipura (HDR) Series

4.1.5 Honnegaudanahalli (HGH) Series: Honnegaudanahalli soils are very deep (>150 cm), well drained, have very dark brown to brown and dark reddish brown sandy clay loam soils. They are developed from weathered granite gneiss and occur on very gently sloping uplands under cultivation. The Honnegaudanahalli series has been classified as a member of the fine-loamy over clayey, mixed, isohyperthermic family of Typic Haplustepts.

The thickness of the solum is more than 150 cm. The thickness of a horizon ranges from 14 to 19 cm. Its colour is in 7.5 YR hue with value 2.5 to 4 and chroma 2 to 6. The texture varies from sandy loam to clay with 10 to 15 per cent gravel. The thickness of B horizon is more than 150 cm. Its colour is in 7.5 YR hue with value 2.5 to 3 and chroma 2 to 4. Texture is sandy clay loam. The available water capacity is high (200 mm/m). Two phases were identified and mapped.

Landscape and soil profile characteristics of Honnegaudanahalli (HGH) Series

4.1.6 Hullipura (HPR) Series: Hullipura soils are moderately shallow (50-75 cm), well drained, have dark brown to very dark brown gravelly sandy clay loam soils. They have developed from granite gneiss and occur on very gently to gently sloping uplands. The Hullipura series has been classified as a member of the fine-loamy, mixed, isohyperthermic family of Typic Haplustepts.

The thickness of the solum ranges from 51 to 71 cm. The thickness of A horizon ranges from 13 to 18 cm. Its colour is in 7.5YR and 10 YR hue with value 2.5 to 3 and chroma 2 to 4. The texture varies from gravelly sandy loam to gravelly clay with 15 to 25 per cent gravel. The thickness of B horizon ranges from 38 to 52 cm. Its colour is in 7.5 YR hue with value 2.5 to 3 and chroma 2. Its texture is gravelly sandy clay loam with gravel content of 15 to 35 per cent. The available water capacity is low (75 mm/m). Three phases were identified and mapped.

Landscape and soil profile characteristics of Hullipura (HPR) series

4.1.7 Kallipura (KLP) Series: Kallipura soils are deep (100-150 cm), well drained, have brown to very dark red and dark reddish brown sandy clay soils. They have developed from weathered granite gneiss and occur on gently sloping uplands. The Kallipura series has been classified as a member of the fine, mixed, isohyperthermic family of Typic Rhodustalfs.

The thickness of the solum ranges from 110 to 140 cm. The thickness of A horizon ranges from 11 to 19 cm. Its colour is in 7.5 YR, 5YR and 2.5 YR hue with value 2.5 to 4 and chroma 2 to 6. The texture varies from gravelly sandy loam to gravelly clay loam with 10 to 20 per cent gravel. The thickness of B horizon ranges from 120 to 90 cm. Its colour is in 2.5 YR hue with value 3 and chroma 4 to 6. Its texture is sandy clay. The available water capacity is medium (100 mm/m). Only one phase was identified and mapped.

Landscape and soil profile characteristics of Kallipura (KLP) Series

Magoonahalli (MGH) Series: Magoonahalli soils are moderately shallow (50-75 cm), well drained, have very dark brown to dark brown gravelly sandy clay loam soils. They have developed from weathered granite gneiss and occur on very gently to moderately sloping uplands. The Magoonahalli series has been classified as a member of the loamy-skeletal, mixed, isohyperthermic family of Typic Rhodustalfs.

The thickness of the solum ranges from 53 to 74 cm. The thickness of A horizon ranges from 15 to 18 cm. Its colour is in 7.5 YR and 5 YR hue with value 3 to 4 and chroma 2 to 6. The texture varies from gravelly sandy loam to gravelly clay with 15 to 25 per cent gravel. The thickness of B horizon ranges from 44 to 52 cm. Its colour is in 2.5 YR hue with value 2.5 to 3 and chroma 4. Its texture is gravelly sandy clay loam with gravel content of >35 per cent. The available water capacity is very low (50 mm/m). Two phases were identified and mapped.

Landscape and Soil Profile characteristics of Magoonahalli (MGH) Series

Shivapura (SPR) Series: Shivapura soils are shallow (25-50 cm), well drained, have dark reddish brown gravelly sandy clay loam soils. They have developed from weathered granite gneiss and occur on very gently to very strongly sloping uplands. The Shivapura series has been classified as a member of the Loamy-skeletal, mixed, isohyperthermic family of (Paralithic) Rhodustalfs.

The thickness of the solum ranges from 26 to 46 cm. The thickness of A horizon ranges from 9 to 17 cm. Its colour is in 7.5 YR and 2.5 YR hue with value 3 to 4 and chroma 3 to 6. The texture varies from sandy loam to sandy clay with 15 to 25 per cent gravel. The thickness of B horizon ranges from 18 to 30 cm. Its colour is in 2.5 YR hue with value 2.5 to 3 and chroma 4. Its texture is gravelly sandy clay loam soils with gravel content of >35 per cent. The available water capacity is very low (25 mm/m). Three phases were identified and mapped.

Landscape and Soil Profile characteristics of Shivapura (SPR) Series

Table: 4.1 Physical and Chemical Characteristics of Soil Series identified in Lakkipur-1 microwatershed

Soil Series: Annurkeri (ARK), **Pedon**: RM-83

Location: $11^0$43'17.6"N, $76^0$38'74" (**4B3E2G2c**) Siddhapura village, Gundlupet Taluk and Chamarajanagara District

Analysis at: NBSS&LUP, Regional Centre, Bangalore. **Classification:** Fine, mixed, isohyperthermic, Rhodic Paleustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-25	Ap	79.05	5.82	15.13	3.64	15.38	21.46	25.61	12.96	<5	sl	-	-
25-46	A2	78.83	7.26	13.91	2.42	6.35	25.60	29.84	14.62	<5	sl	-	-
46-77	Bt1	55.15	5.36	39.49	2.60	16.34	14.36	13.94	7.91	<5	sc	-	-
77-102	Bt2	52.89	8.50	38.61	3.00	10.54	18.90	12.71	7.75	<5	sc	-	-
102-126	Bt3	48.90	7.24	43.86	1.15	3.97	18.18	15.26	10.34	<5	sc	-	-
126-156	Bt4	47.75	10.71	41.54	3.25	10.16	12.36	13.93	8.06	<5	sc	-	-
156-180	Bt5	45.27	11.65	43.08	3.82	9.68	12.07	11.97	7.70	<5	sc	-	-

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-25	7.17	-	-	0.16	0.51	0.00	-	-	0.74	0.13	-	4.79	0.32	100	2.71
25-46	7.09	-	-	0.11	0.47	0.00	-	-	0.37	0.06	-	5.81	0.42	100	1.03
46-77	7.33	-	-	0.06	0.47	0.00	-	-	0.27	0.07	-	15.96	0.40	100	0.44
77-102	7.21	-	-	0.07	0.55	0.00	-	-	0.21	0.09	-	15.62	0.40	100	0.58
102-126	7.22	-	-	0.07	0.47	0.00	-	-	0.23	0.22	-	15.39	0.35	100	1.43
126-156	7.27	-	-	0.07	0.43	0.00	-	-	0.56	0.51	-	14.93	0.36	100	3.42
156-180	7.33	-	-	0.09	0.39	0.00	-	-	0.42	0.51	-	14.82	0.34	100	3.44

Contd…

Soil Series: Bheemanabeedu (BMB), **Pedon**: RM-34

Location: $11^0$43'45.9"N, $76^0$37'18.6"E, (4B3E2F1c) Honnegaudanahalli village, Gundlupet Taluk**,** Chamarajanagara District

Analysis at: NBSS&LUP, Regional Centre, Bangalore. **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
0-13	Ap	63.25	17.32	19.42	3.89	9.31	13.61	19.14	17.30	5	sc	-	-
13-32	Bw1	61.95	18.00	20.05	3.18	12.21	13.54	18.56	14.46	-	sc	-	-
32-53	Bw2	54.42	20.16	25.42	3.89	9.79	12.63	14.95	13.16	-	sc	-	-
53-76	Bw3	40.54	20.40	39.05	2.40	8.25	9.82	11.91	8.15	-	c	-	-
76-114	Bw4	35.54	17.90	46.56	2.00	7.36	8.94	9.88	7.36	-	c	-	-
114-146	Bw5	28.31	19.25	52.44	2.55	5.73	6.68	6.89	6.47	-	c	-	-
146-180	Bw6	19.43	27.91	52.66	1.61	2.35	3.84	6.06	5.57	-	c	-	-

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-13	7.59	-	-	0.48	0.78	0.59	-	-	1.04	0.17	-	10.83	0.56	100	1.57
13-32	7.94	-	-	0.18	0.66	0.35	-	-	0.62	0.26	-	11.74	0.59	100	2.21
32-53	8.11	-	-	0.13	0.58	0.76	-	-	0.41	0.59	-	14.71	0.58	100	4.01
53-76	8.34	-	-	0.12	0.54	0.71	-	-	0.49	0.92	-	25.31	0.65	100	3.63
76-114	8.21	-	-	0.20	0.50	1.59	-	-	0.64	0.82	-	28.39	0.61	100	2.89
114-146	8.37	-	-	0.27	0.46	2.47	-	-	0.51	0.65	-	30.55	0.58	100	2.13
146-180	8.46	-	-	0.27	0.35	5.28	-	-	0.57	0.94	-	35.34	0.67	100	2.66

Contd…

Soil Series: Berambadi (BMD), **Pedon:** RM-125

Location: $11^0$43'17"N, $76^0$41' 41.4"E, (4B3E2J2a) Hundipur village, Gundlupet Taluk, Chamarajanagara District

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

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-12	Ap	64.81	10.27	24.92	5.78	13.11	18.99	17.54	9.39	15	scl	-	-
12-30	A1	63.68	11.19	25.13	5.52	12.59	16.86	19.98	8.74	<10	scl	-	-
30-43	Bw	55.49	10.87	33.65	17.55	10.76	11.29	10.14	5.75	<10	scl	-	-

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	8.28	-	-	0.23	0.74	1.02	-	-	0.73	0.15	-	18.13	0.73	100	0.83
12-30	8.61	-	-	0.18	0.70	1.14	-	-	0.98	0.54	-	19.61	0.78	100	2.75
30-43	8.68	-	-	0.20	0.51	2.28	-	-	0.48	0.58	-	19.15	0.57	1003	3.03

Contd…

Soil Series: Devarahalli (DRH), **Pedon:** TR-17/P1

Location: $11^0$42'57.4"N, $76^0$40'41.4"E, (4B3E2J2a) Shivapura village, Gundlupet Taluk, Chamarajanagara District

Analysis at: NBSS&LUP, Regional Centre, Bangalore. **Classification:** Fine-loamy, mixed, isohyperthermic Typic Rhodustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-14	Ap	77.94	12.17	9.89	5.47	9.31	16.50	25.11	20.55	30	sl	-	-
14-29	Bt1	58.64	15.33	26.03	7.41	11.01	12.45	16.67	11.11	15	scl	-	-
29-55	Bt2	58.99	14.28	26.73	11.36	12.40	11.88	13.95	9.40	40	scl	-	-

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	5.43	-	-	0.13	0.46	0.00	3.05	1.04	0.21	0.01	4.31	11.40	1.15	38	0.09
14-29	6.64	-	-	0.08	0.43	0.00	9.33	2.90	0.21	0.08	12.52	13.45	0.52	93	0.59
29-55	6.81	-	-	0.06	0.39	0.00	10.13	2.76	0.17	0.12	13.18	13.22	0.49	100	0.91

Contd…

Soil Series: Hundipura (HDR), (Pedon: TR15/P1)

Location: $11^0$42'25.8"N, $76^0$41'26"E, (4B3E2J2a) Hundipura village, Gundlupet Taluk and Chamarajanagara District

Analysis at: NBSS&LUP, Regional Centre, Bangalore **Classification:** Sandy, mixed, isohyperthermic Paralithic 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
0-17	Ap	76.89	9.00	14.11	11.25	13.60	19.12	22.39	10.53	15	sl	-	-
17-37	A2	75.31	11.73	12.96	9.02	11.27	18.24	23.36	13.42	10	sl	-	-

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-17	8.28	-	-	0.18	0.50	1.06	-	-	0.63	0.08	-	12.54	0.89	100	0.64
17-37	8.53	-	-	0.10	0.43	0.65	-	-	0.38	0.04	-	10.03	0.77	100	0.40

Contd…

Soil Series: Honnegaudanahalli (HGH) (Pedon: RM33)

Location: $11^0$45'42.5"N, $76^0$36'46.2"E, (4B3E2F1c) Honnegaudanahalli village, Gundlupet Taluk and Chamarajanagara District

Analysis at: NBSS&LUP, Regional Centre, Bangalore. **Classification:** Fine-loamy over clayey, 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
Ap	0-18	66.23	11.55	22.23	2.95	10.89	18.41	21.36	12.61	10	scl	-	-
Bw1	18-30	62.83	16.68	20.49	3.77	10.90	15.99	21.59	10.59	-	scl	-	-
Bw2	30-52	59.33	16.64	24.03	2.14	10.91	13.56	18.76	13.97	-	scl	-	-
Bw3	52-78	65.74	11.85	22.41	3.69	13.13	16.00	19.49	13.44	-	scl	-	-
Bw4	78-100	68.91	10.58	20.51	3.16	6.73	25.08	21.61	12.33	-	scl	-	-
Bw5	100-148	30.06	14.12	55.82	1.57	9.81	6.78	6.58	5.32	-	c	-	-
Bw6	148-160	22.82	29.70	47.48	1.49	4.13	6.54	5.39	5.28	-	c	-	-
Bw7	160-190	24.83	28.46	46.71	0.80	2.86	8.47	6.18	6.52	-	c	-	-

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-18	7.37	-	-	0.18	0.5	0.00	-	-	0.74	0.13	-	8.66	0.39	100	1.50
18-30	7.55	-	-	0.11	0.46	0.00	-	-	0.37	0.06	-	8.66	0.42	100	0.69
30-52	7.78	-	-	0.08	0.39	0.00	-	-	0.27	0.07	-	10.03	0.42	100	0.70
52-78	7.98	-	-	0.08	0.39	0.00	-	-	0.21	0.09	-	8.55	0.38	100	1.05
78-100	8.01	-	-	0.05	0.31	0.00	-	-	0.23	0.22	-	8.32	0.41	100	2.64
100-148	7.86	-	-	0.09	0.43	7.20	-	-	0.56	0.51	-	25.65	0.46	100	1.99
148-160	8.47	-	-	0.18	0.35	5.88	-	-	0.42	0.51	-	23.37	0.49	100	2.18
160-190	8.55	-	-	0.17	0.27	6.48	-	-	0.45	0.56	-	23.57	0.50	100	2.38

Contd…

Soil Series: Hullipura (HPR), **Pedon:** RM-126

Location: $11^0$43'21.8"N, $76^0$41' 28.1"E, (4B3E2J2a) Hundipur village, Gundlupet Taluk, Chamarajanagara District

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

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-15	Ap	47.38	17.57	35.05	7.38	9.95	8.98	10.80	10.27	15	sc	-	-
15-28	Bw1	49.95	18.96	31.10	7.21	10.29	9.97	12.51	9.97	15	scl	-	-
28-55	Bc	70.38	11.41	18.21	6.23	13.18	14.20	21.45	15.32	20	sl	-	-

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-15	8.36	-	-	0.36	0.60	2.34	-	-	0.93	0.43	-	24.17	0.69	100	1.78
15-28	8.36	-	-	0.37	0.72	3.30	-	-	1.10	0.61	-	6.16	0.20	100	9.90
28-55	8.73	-	-	0.23	0.24	0.84	-	-	0.41	0.85	-	16.30	0.90	100	5.21

Contd…

Soil Series: Kallipura (KLP) (**Pedon:** RM52)

Location: $11^0$43'45.9"N, $76^0$37'18.6"E, (4B3E2F2c) Kallipura village, Gundlupet Taluk and Chamarajanagara District

Analysis at: NBSS&LUP, Regional Centre, Bangalore. **Classification:** Fine, mixed, isohyperthermic Typic Rhodustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-28	Ap	65.05	10.57	24.38	5.17	13.86	17.79	18.20	10.03	10	scl	-	-
28-48	Bt1	61.05	10.50	28.45	2.53	9.37	19.47	20.74	8.95	-	scl	-	-
48-75	Bt2	58.11	10.79	31.10	2.01	12.51	18.45	18.88	6.26	-	scl	-	-
75-97	Bt3	47.69	6.51	45.80	4.74	11.73	12.92	13.02	5.27	-	sc	-	-
97-120	Bt4	37.80	10.25	51.95	4.57	9.45	9.14	9.66	4.98	-	c	-	-
120-136	Bc	53.11	5.08	41.81	20.55	6.95	11.49	9.48	4.64	40	sc	-	-

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-28	6.07	-	-	0.14	0.70	0.00	-	-	0.59	0.26	-	9.23	0.38	100	2.82
28-48	6.45	-	-	0.04	0.58	0.00	-	-	0.25	0.19	-	9.92	0.35	100	1.92
48-75	6.47	-	-	0.04	0.54	0.00	-	-	0.24	0.13	-	9.80	0.32	100	1.33
75-97	6.50	-	-	0.06	0.58	0.00	-	-	0.26	0.17	-	13.22	0.29	100	1.29
97-120	6.51	-	-	0.05	0.50	0.00	-	-	0.36	0.32	-	15.50	0.30	100	2.06
120-136	6.88	-	-	0.04	0.46	0.00	-	-	0.24	0.17	-	14.82	0.35	100	1.15

Contd…

Soil Series: Magoonahalli (MGH), **Pedon:** RM-80

Location: $11^0$42'59"N, $76^0$38'36.5"E, (4B3E2H1b) Magoonahalli village, Gundlupet Taluk, Chamarajanagara District

Analysis at: NBSS&LUP, Regional Centre, Bangalore. **Classification:** Loamy-skeletal, mixed, isohyperthermic Typic Rhodustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-12	Ap	74.82	11.17	14.01	7.31	9.95	14.92	24.97	17.66	35	sl	-	-
12-32	Bt1	63.65	11.76	25.59	14.77	12.02	12.83	14.66	9.37	30	scl	-	-
32-50	Bt2	59.88	14.94	25.18	13.44	12.83	12.42	14.15	7.03	45	scl	-	-
50-60	Bc	67.38	11.65	20.97	10.94	17.22	14.49	16.01	8.92	40	scl	-	-

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	6.42	-	-	0.13	0.74	0.00	-	-	0.35	0.12	-	14.02	1.00	100	0.86
12-32	6.44	-	-	0.07	0.70	0.00	-	-	0.14	0.08	-	9.35	0.37	100	0.86
32-50	6.83	-	-	0.05	0.62	0.00	-	-	0.12	0.12	-	7.87	0.31	100	1.52
50-60	6.92	-	-	0.04	0.51	0.00	-	-	0.11	0.14	-	7.75	0.37	100	1.81

Contd…

Soil Series: Shivapura (SPR), **Pedon:** TR-17/P3

Location: $11^0$43'33"N, $76^0$40'58.6"E, (4B3E2J2a) Shivapura village, Gundlupet Taluk, Chamarajanagara District

Analysis at: NBSS&LUP, Regional Centre, Bangalore **Classification:** Loamy-skeletal, mixed, isohyperthermic (paralithic) Rhodustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-18	Ap	68.60	12.70	18.70	2.44	11.38	20.43	24.90	9.45	30	sl	-	-
18-30	Bt1	52.69	12.78	34.52	8.28	10.46	11.70	14.60	7.66	40	scl	-	-

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	7.83	-	-	0.33	0.36	0.41	-	-	0.39	0.08	-	9.80	0.52	100	0.82
18-30	8.00	-	-	0.26	0.28	0.41	-	-	0.31	0.22	-	19.38	0.56	100	1.14

Chapter 5

INTERPRETATION FOR LAND RESOURCE MANAGEMENT

The most important soil and site characteristics that affect land use and conservation needs of an area are land capability, land irrigability, soil depth, 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 conservation structures needed thus helping to maintain good soil health for sustained crop production. The various thematic maps generated are described below.

5.1 Land Capability Classification

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

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

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

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

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

Class I: The soil map units have few or very few limitations that restrict their use.

Class II: The soil map units have moderate limitations that reduce the choice of crops or that require moderate conservations practices.

Class III: The soil map units have severe limitations that reduce the choice of crops or that require special conservation practices.

Class IV: The soil map units have severe limitations that reduce the choice of crops or that require very careful management.

Class V: Soils in the mapping units are not likely to erode, but have other limitations that are impractical to remove and as such not suitable for agriculture.

Class VI: The lands have severe limitations that make them generally unsuitable for cultivation.

Class VII: The lands have very severe limitations that make them unsuitable for cultivation.

Class VIII: Soil and other miscellaneous areas that have very severe limitations that nearly preclude their use for any crop production.

The land capability subclasses are recognised based on the dominant limitations observed within the given 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/alkaline 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 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 21 soil map units identified in Lakkipur-1 Microwatershed are grouped under 4 land capability classes and 7 land capability subclasses (Fig. 5.1).

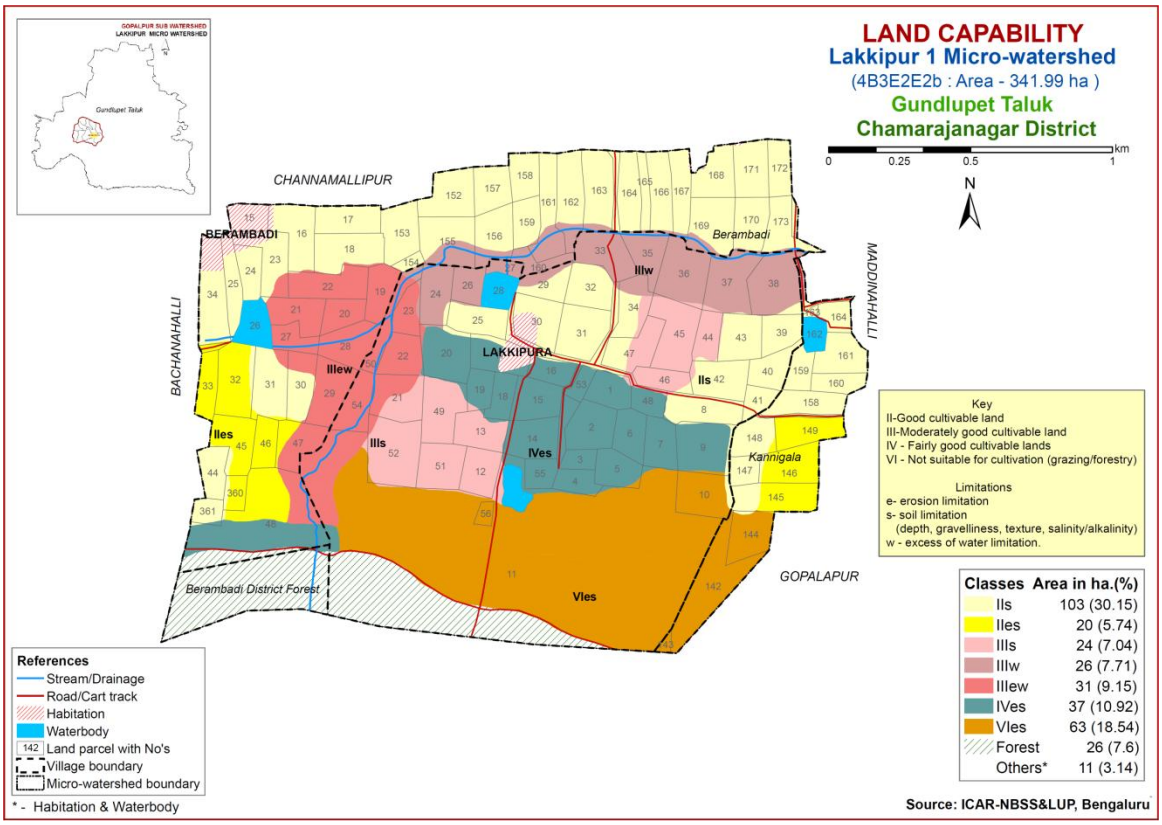


Fig. 5.1 Land Capability map of Lakkipur-1 Microwatershed

Of the lands suitable for agriculture, about 36 per cent are good cultivable lands (Class II) with minor limitations of soil and erosion and are distributed in the major part of the

microwatershed. About 24 per cent are moderately good cultivable lands (Class III) with moderate limitations of wetness, soil and erosion and are distributed in the northern, eastern, central and western part of the microwatershed. About 11 per cent is fairly good cultivable lands (Class IV) with severe limitations of soil and erosion and are distributed in the central and southwestern part of the microwatershed. About 19 per cent area is not suitable for cultivation (Class VI) with severe limitations of soil and erosion and is distributed in the central and southern part of the microwatershed. About 8 per cent area is under State forest and 3 per cent under habitation and water bodies.

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.

Shallow (25-50 cm) soils cover an area of 93 ha (27%) and are distributed in the central and southwestern part of the microwatershed. Moderately shallow (50-75 cm) soils occupy about 89 ha (26%) and are distributed in all parts of the microwatershed. Moderately deep (75-100 cm) soils occupy about 6 ha (2%) and are distributed in the western and northwestern part of the microwatershed. Deep (100-150 cm) soils occur in an area of 14 ha (4%) and are distributed in the central part of the microwatershed. An area of about 103 ha (30%) that are very deep (>150 cm) occur in the major part of the microwatershed.

The problematic lands cover 93 ha (27%) that have shallow (25-50 cm) rooting depth. They are suitable for growing short duration agricultural crops but well suited for pasture, forestry or other recreational purposes. The most productive lands cover about 117 ha (34%) where all climatically adapted long duration crops be grown.

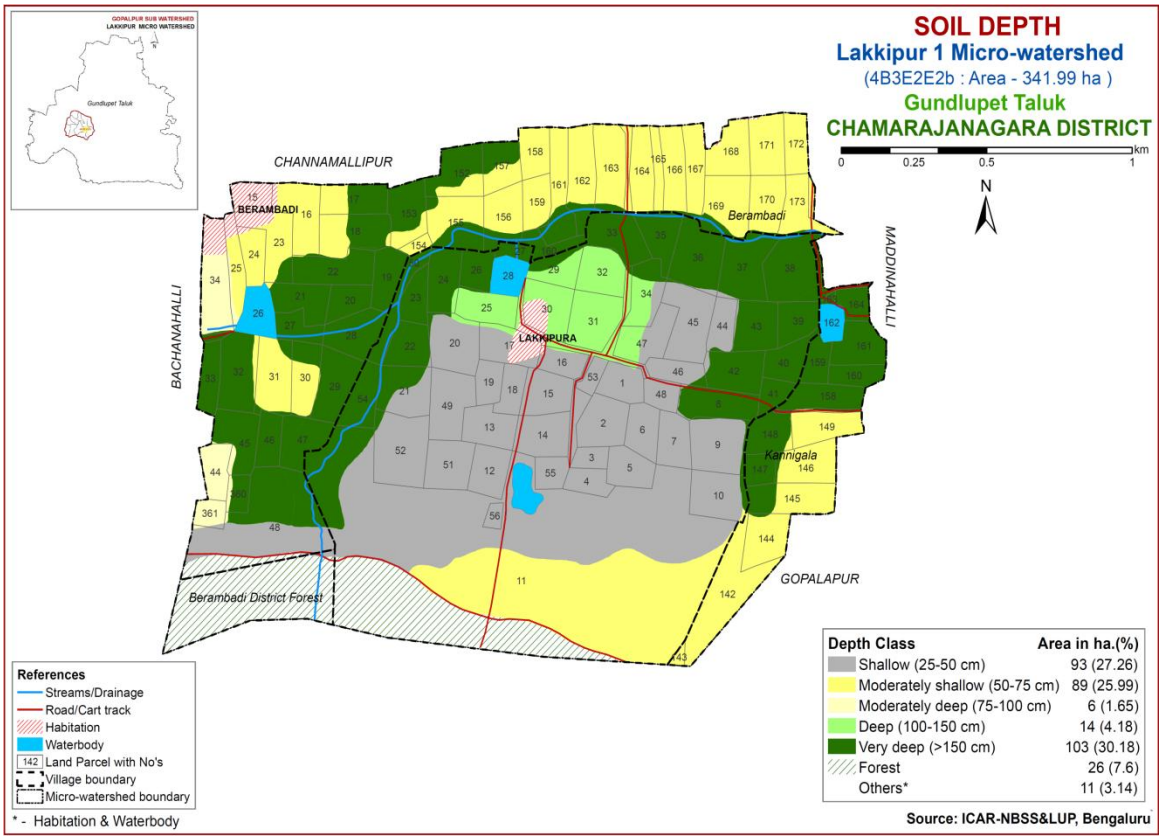


Fig. 5.2 Soil Depth map of Lakkipur-1 Microwatershed

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 the soils 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 206 ha (60%) has loamy soils and are distributed in the major part of the microwatershed. An area of about 99 ha (29%) are clay soils and are distributed in the northwestern, western, northern and eastern part of the microwatershed (Fig. 5.3).

The productive lands 305 ha (89%) with respect to surface soil texture are the clayey and loamy 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 in the clayey soils.

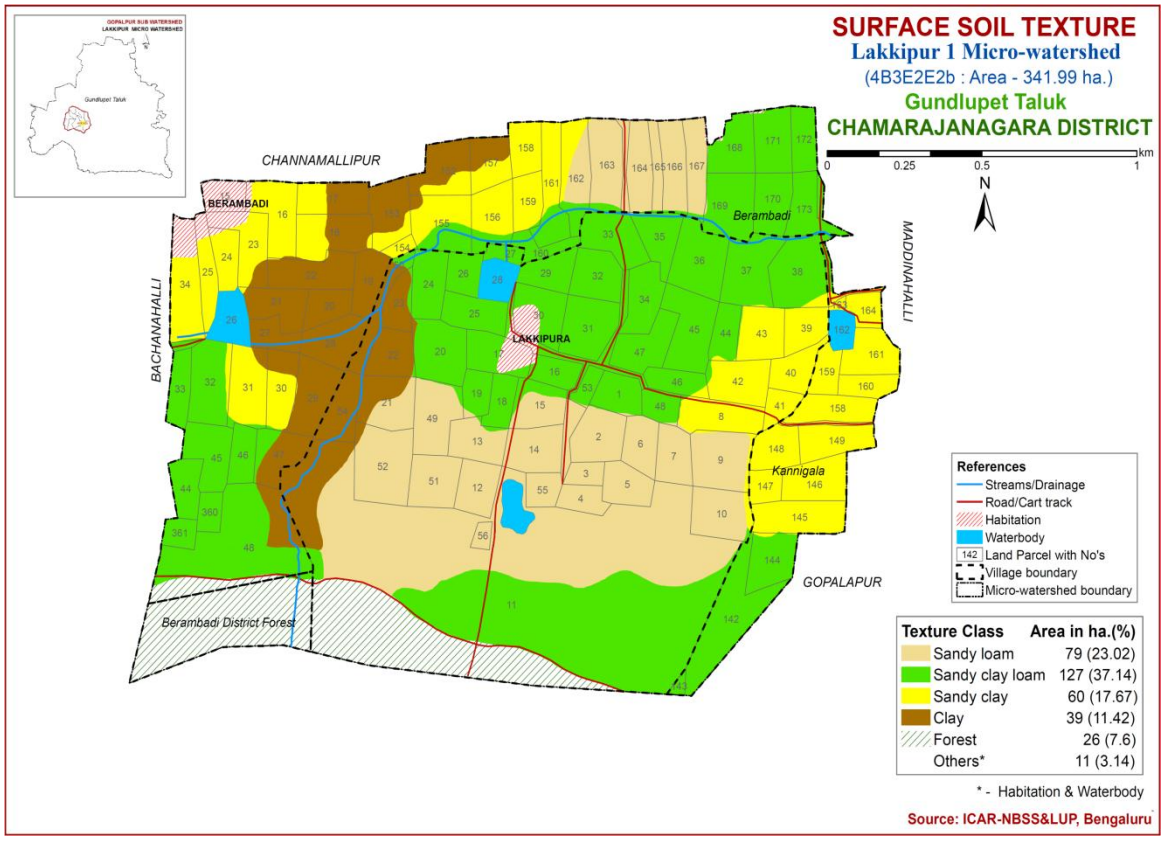


Fig. 5.3 Surface Soil Texture map of Lakkipur-1 Microwatershed

5.4 Soil Gravelliness

Gravel is the term used for describing coarse fragments between 2 mm and 7.5 cm diameter and stones for those between 7.5 cm and 25 cm. The presence of gravel and stones in soil reduces the volume of soil responsible for moisture and nutrient storage, drainage, infiltration and runoff and hinders plant growth by impeding root growth and seedling emergence, intercultural operations and farm mechanization. The gravelliness classes used in LRI were used to classify the soils and using these classes a gravelliness map was generated. The area extent and their geographic distribution in the microwatershed is shown in Figure 5.4.

The soils that are gravelly (15-35%) cover an area of about 131 ha (38%) and is distributed in the western, northern, central and southern part of the microwatershed. The soils that are non-gravelly (<15%) cover maximum area of about 175 ha (51%) and are distributed in the major part of the microwatershed.

The most productive lands with respect to gravelliness are found to be 51 per cent. They are non-gravelly with less than 15 per cent gravel and have potential for growing both annual and perennial crops. The problem soils cover about 131 ha (15%) that are gravelly (15-35%) where medium and short duration crops can be grown.

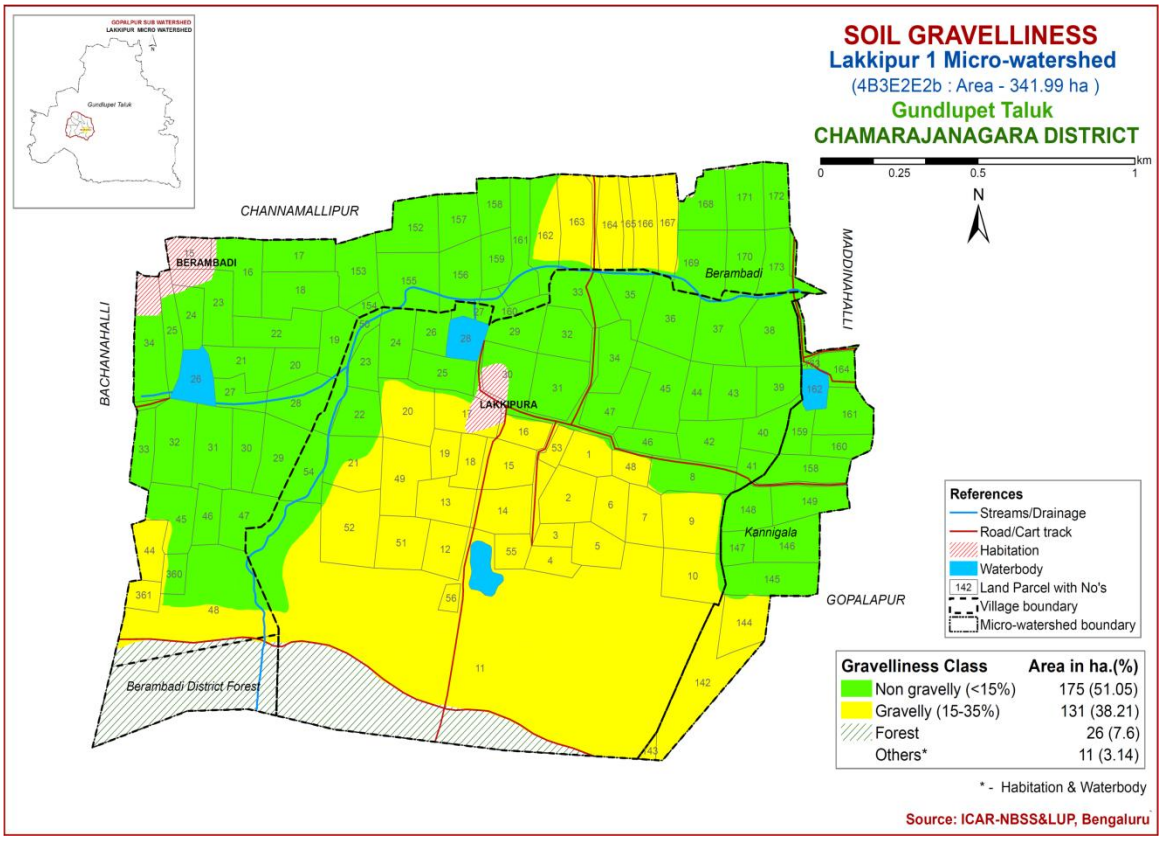


Fig. 5.4 Soil Gravelliness map of Lakkipur-1 Microwatershed

5.5 Available Water Capacity

The soil available water capacity (AWC) is estimated based on the ability of the soil column to retain water between the tensions of 0.33 and 15 bar in a depth of 100 cm or the entire solum if the soil is shallower. The AWC of the soils (soil series) as estimated by considering the soil texture, mineralogy, soil depth and gravel content (Sehgal *et al.*, 1990) and accordingly the soil map units were grouped into five AWC classes *viz*, very low (<50 mm/m), low (50-100 mm/m), medium (100-150 mm/m), high (150-200 mm/m) and very high (>200 mm/m) and using these values, an AWC map was generated. The area extent and their geographic distribution of different AWC classes in the microwatershed is given in Figure 5.5.

An area of about 93 ha (27%) has soils that are very low (<50 mm/m) in available water capacity and are distributed in the central and western part of the microwatershed. An area of 109 ha (32%) has soils that are low (51-100 mm/m) in available water capacity and are distributed in the major part of the microwatershed. An area of about 103 ha (30%) are very high in available water capacity (>200 mm/m) and are distributed in the central, western, northern and eastern part of the microwatershed.

About 93 ha (27%) area in the microwatershed has soils that are problematic (<50 mm/m) with regard to available water capacity. Here, only short duration crops can be grown and the probability of crop failure is very high. These areas are best put to other alternative uses. The potential soils with respect to AWC cover about 103 ha (30%) that have very high AWC, where all climatically adapted long duration crops can be grown.

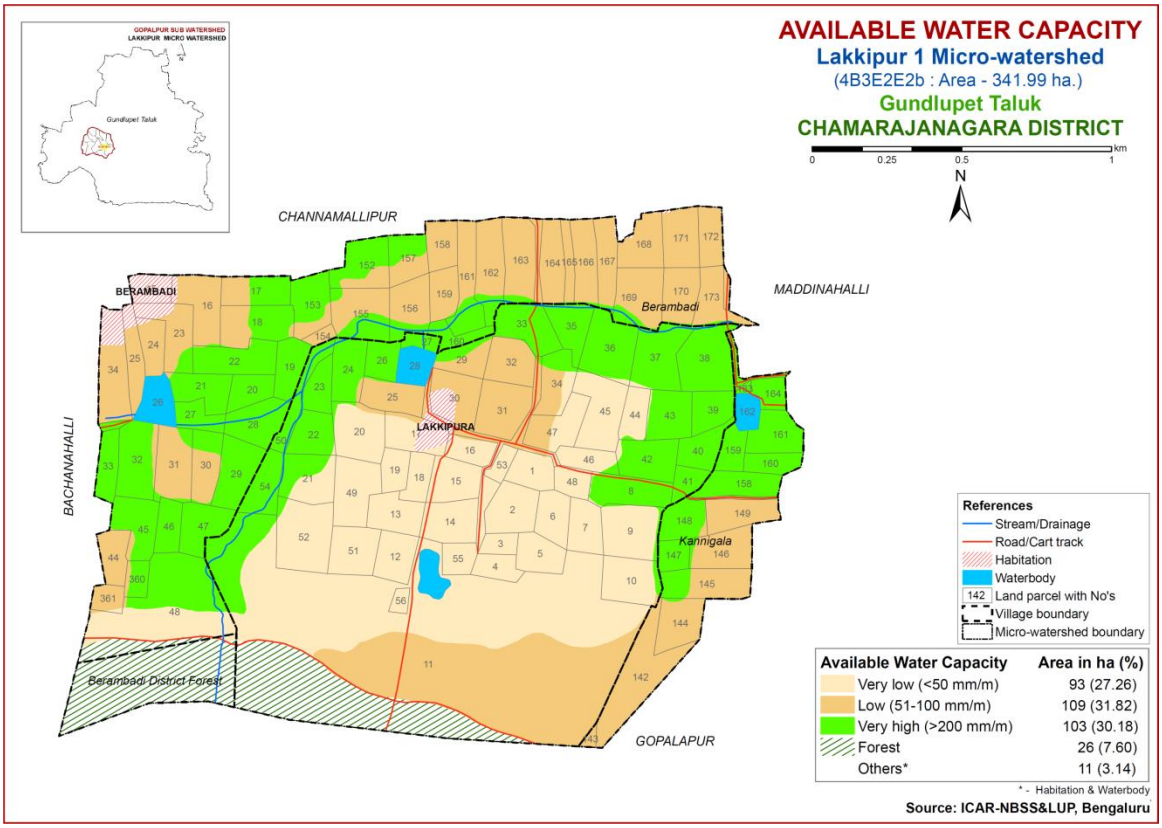


Fig. 5.5 Soil Available Water Capacity map of Lakkipur-1 Microwatershed

5.6 Soil Slope

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

Maximum area of 201 ha (59%) of the microwatershed falls under very gently sloping (1-3% slope) class and are distributed in all parts of the microwatershed. About 41 ha (12%) is having gently sloping lands (3-5% slope) and are distributed in the central and western part of the microwatershed. Moderately sloping lands (5-10% slope) occupy 32 ha (9%) and are distributed in the southern part of the microwatershed. About 32 ha (9%) area has strongly sloping (10-15% slope) lands and are distributed in the southern part of the microwatershed.

An area of about 201 ha (59%) in the microwatershed has soils that have high potential in respect of soil slopes. In these areas, all climatically adapted annual and perennial crops can be grown without much soil and water conservation and other land development measures. About 105 ha (30%) area in the microwatershed has gently to

strongly sloping lands. In these areas suitable soil and water conservation structures and other land developmental activities should be carried out for production of crops.

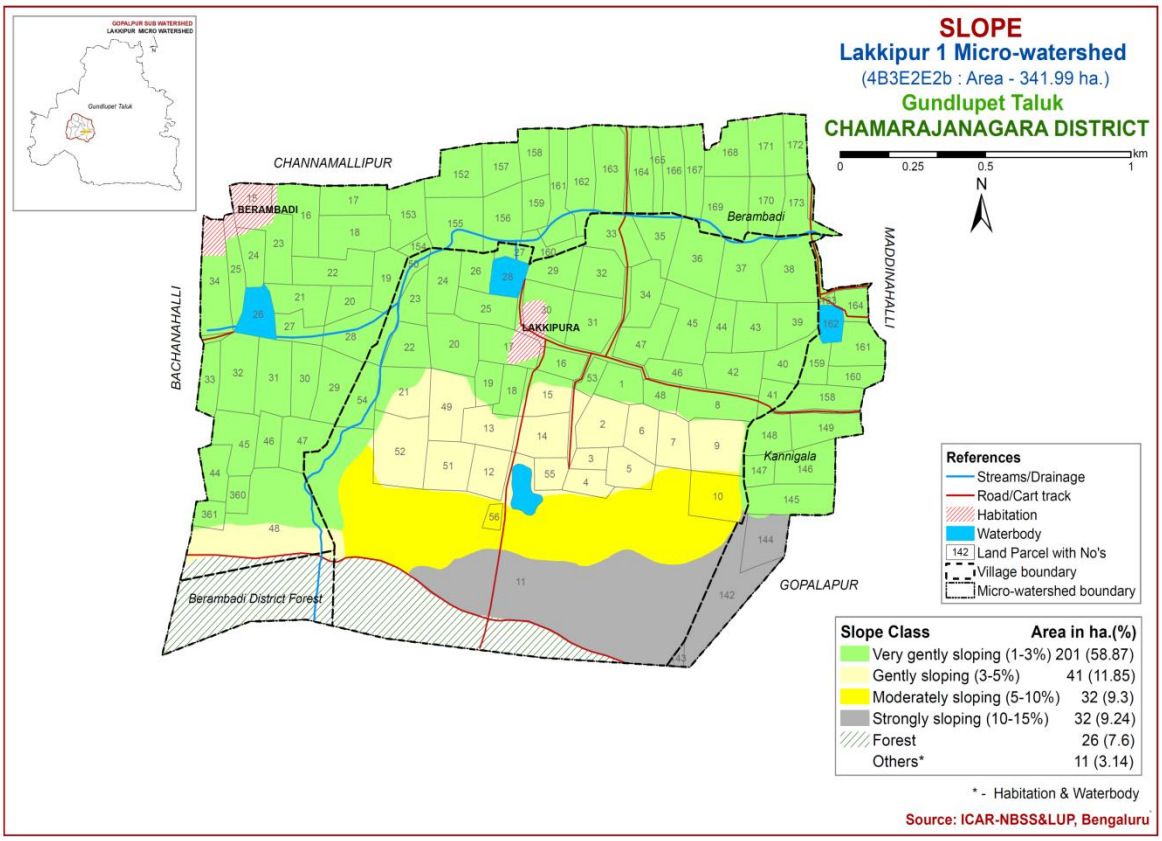


Fig. 5.6 Soil Slope map of Lakkipur-1 Microwatershed

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

Soils that are slightly eroded (e1 class) cover an area of about 113 ha (33%) in the microwatershed. They are distributed in the northern, western and central part of the microwatershed. Moderately eroded (e2 class) soils cover a maximum area of about 192 ha (56%) and are distributed in the major part of the microwatershed.

An area of about 192 ha (56%) in the microwatershed is problematic because of moderate erosion. These areas need soil and water conservation and other land development measures for restoring the soil health.

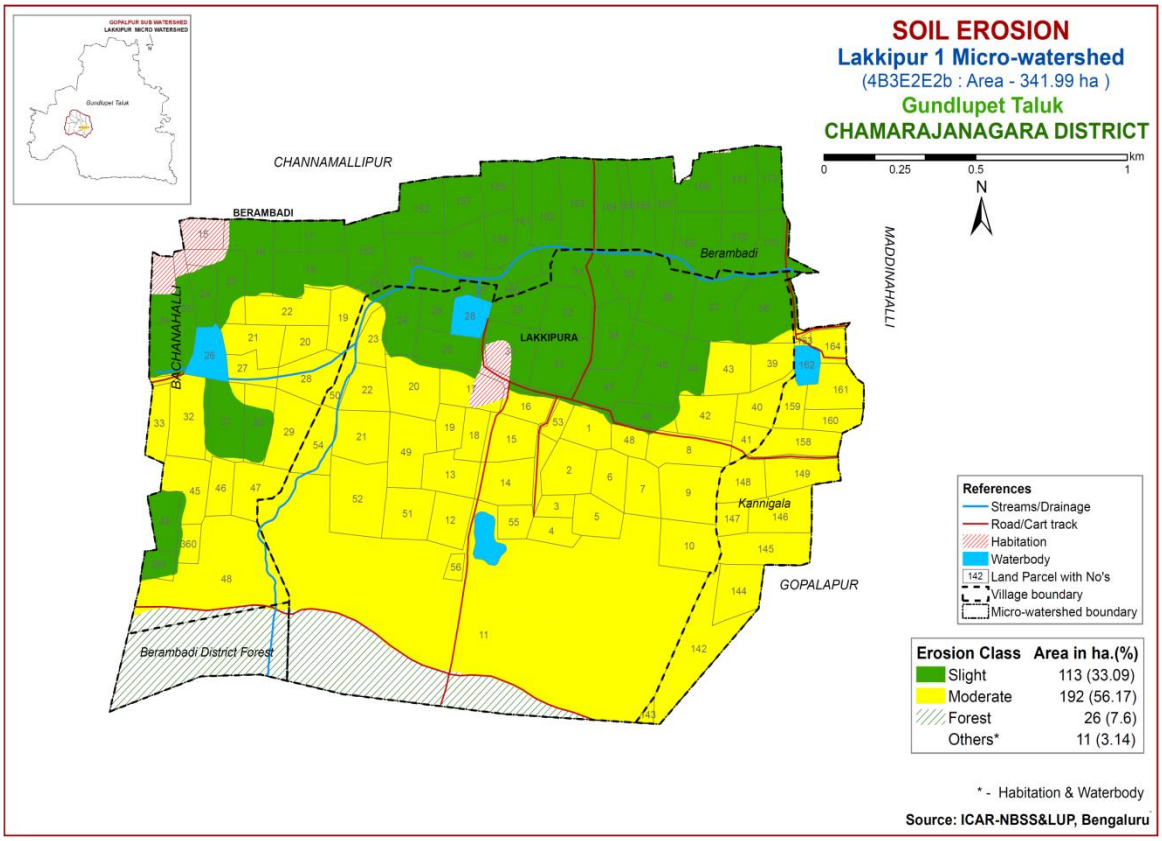


Fig. 5.7 Soil Erosion map of Lakkipur-1 Microwatershed

Chapter 6

FERTILITY STATUS

Soil fertility plays an important role in increasing crop yield. The adoption of high yielding varieties that require high amounts of nutrients has resulted in deficiency symptoms in crops and plants due to imbalanced fertilization and poor inherent fertility status as these areas characterised by low rainfall and high temperatures. Hence, it is necessary to know the fertility (macro and micro nutrients) status of the soils of the watersheds for assessing the kind and amount of fertilizers required for each of the crop intended to be grown. For this purpose, the surface soil samples collected from the grid points (one soil sample at every 250 m grid interval) all over the microwatershed through land resource inventory in the year 2015 were analysed for pH, EC, organic carbon, available phosphorus and potassium, and for micronutrients like zinc, boron, copper, iron and manganese, and secondary nutrient sulphur.

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

6.1 Soil Reaction (pH)

The soil analysis of the Lakkipur-1 Microwatershed for soil reaction (pH) showed that an area of about 49 ha (14%) is strongly acid (5.0-5.5) and is distributed in the southern part of the microwatershed. About 56 ha (16%) area is moderately acid (pH 5.5-6.0) and is distributed in the southern and central part of the microwatershed. An area of 80 ha (23%) is slightly acid (pH 6.0-6.5) in reaction and is distributed in the western, northern, eastern and central part of the microwatershed. About 112 ha (33%) is neutral (pH 6.5-7.3) in reaction and distributed in all parts. Slightly alkaline (pH 7.3-8.4) soils cover a small area of 9 ha (3%) and are distributed in the northeastern 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 are non saline.

6.3 Organic Carbon

The soil organic carbon content of the microwatershed area is medium (0.5-0.75%) in 121 ha (35%) and is distributed in the northern, northeastern, central and eastern part of the microwatershed. High (>0.75%) in organic carbon occur in a maximum area of 185 ha (54%) and is distributed in the major part of the microwatershed (Fig. 6.3).

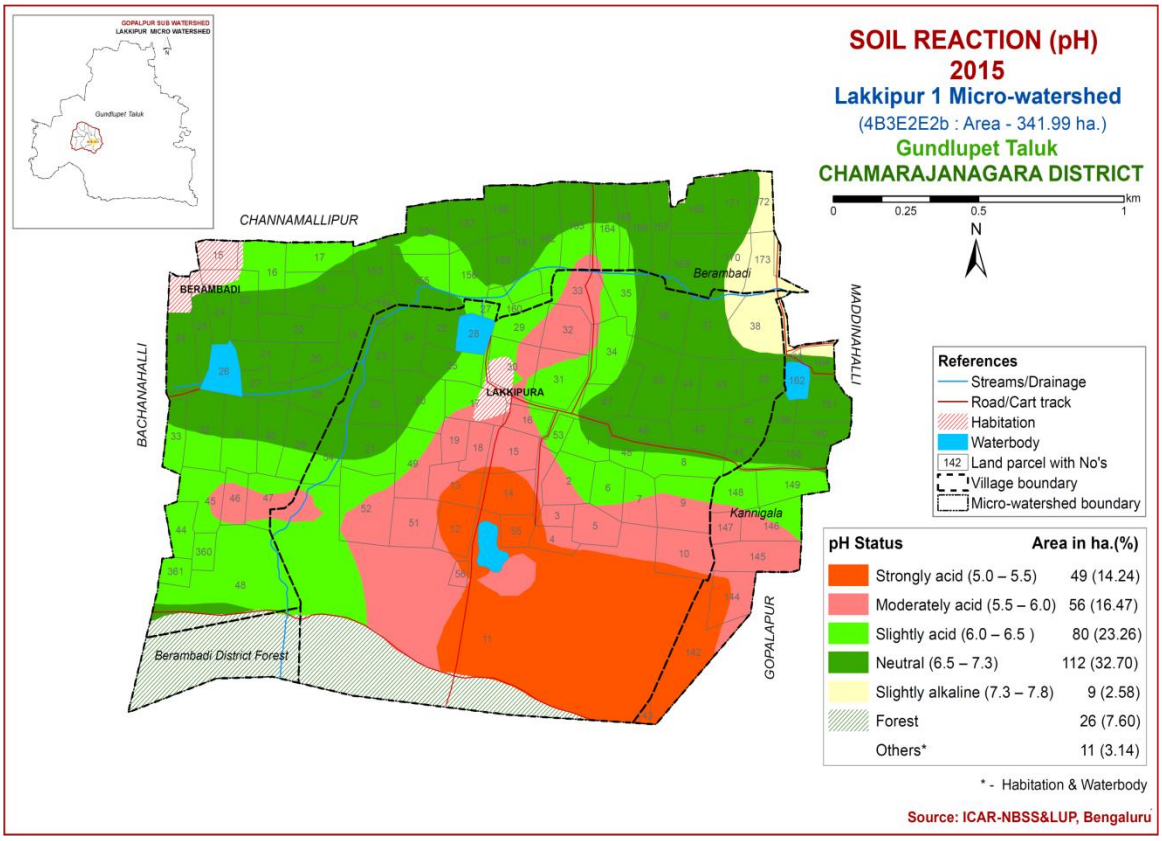


Fig. 6.1 Soil Reaction (pH) map of Lakkipur-1 Microwatershed

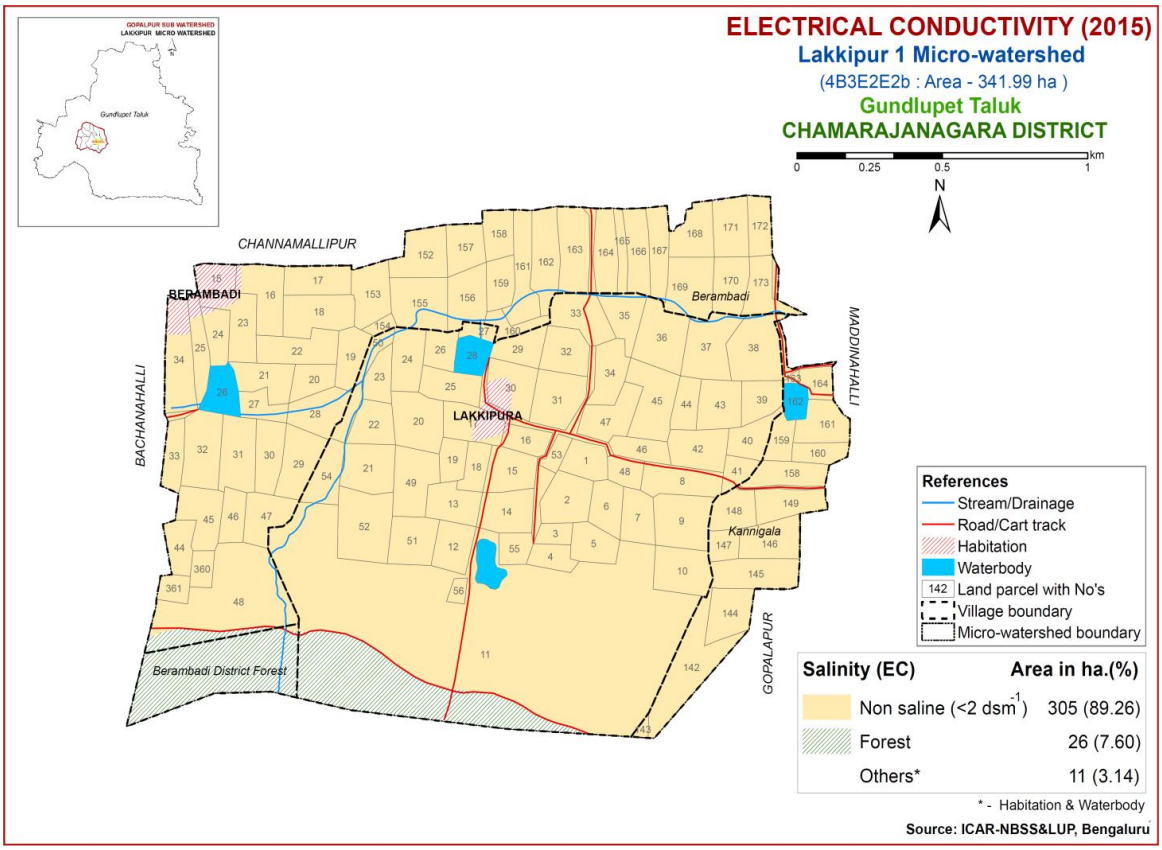


Fig. 6.2 Electrical Conductivity (EC) map of Lakkipur-1 Microwatershed

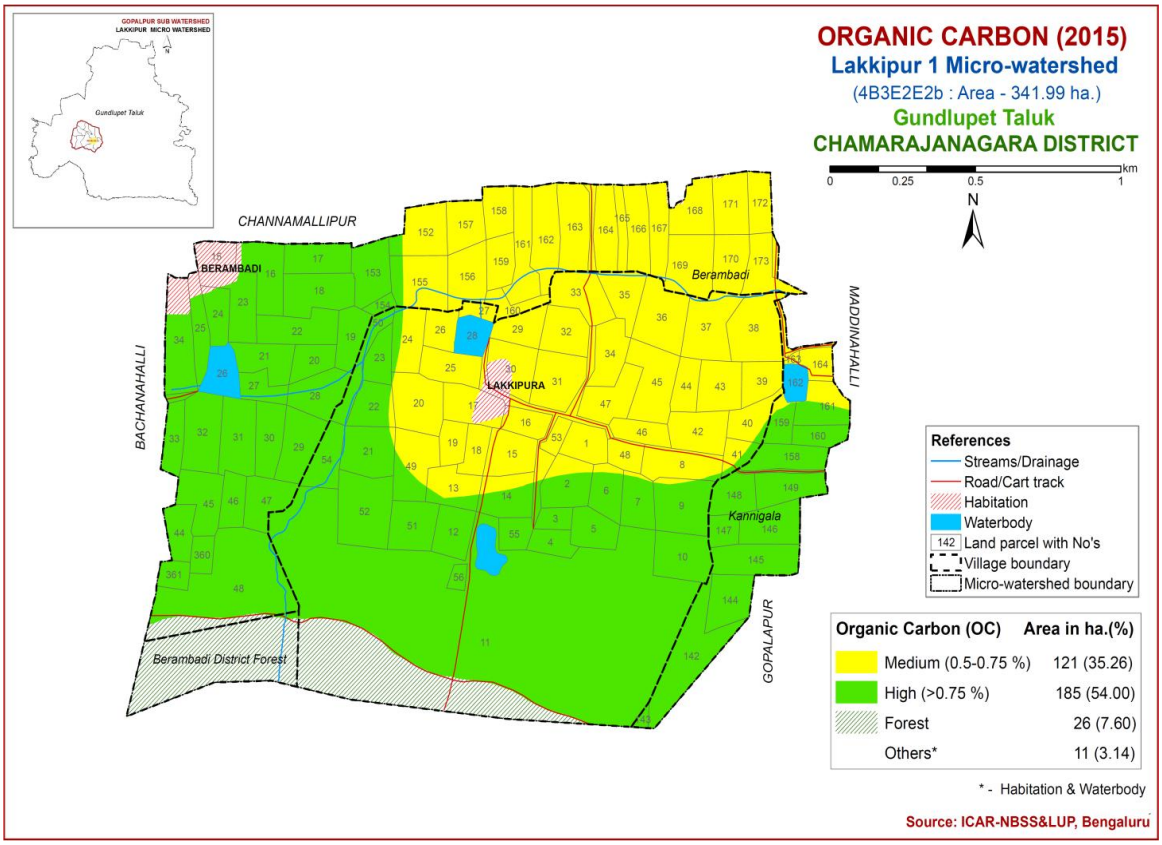


Fig. 6.3 Soil Organic Carbon map of Lakkipur-1 Microwatershed

6.4 Available Phosphorus

The soil analysis revealed that the available phosphorus is low in an area of 57 ha (17%) and are distributed in the southern and southwestern part of the microwatershed. Medium (23-57 kg/ha) in an area of about 122 ha (36%) and is distributed in all parts of the microwatershed. An area of about126 ha (37%) is high (>57 kg/ha) and is distributed in the major part of the microwatershed (Fig 6.4). There is an urgent need to increase the dose of phosphorus for all the crops by 25 per cent over the recommended dose to realize better crop performance in low and medium areas.

6.5 Available Potassium

Available potassium content is medium (145-337 kg/ha) in an area of 101 ha (29%) and is distributed in the central, southern and southeastern part of the microwatershed. High in available potassium (>337 kg/ha) cover maximum area of 205 ha (60%) and are distributed in the major part of the microwatershed (Fig 6.5).

6.6 Available Sulphur

Available sulphur content is low (<10 ppm) in a small area of 9 ha (3%) and is distributed in the northwestern and northeastern part of the microwatershed. Maximum area of 296 ha (87%) is medium (10-20 ppm) and is distributed in the major part of the microwatershed. (Fig. 6.6).

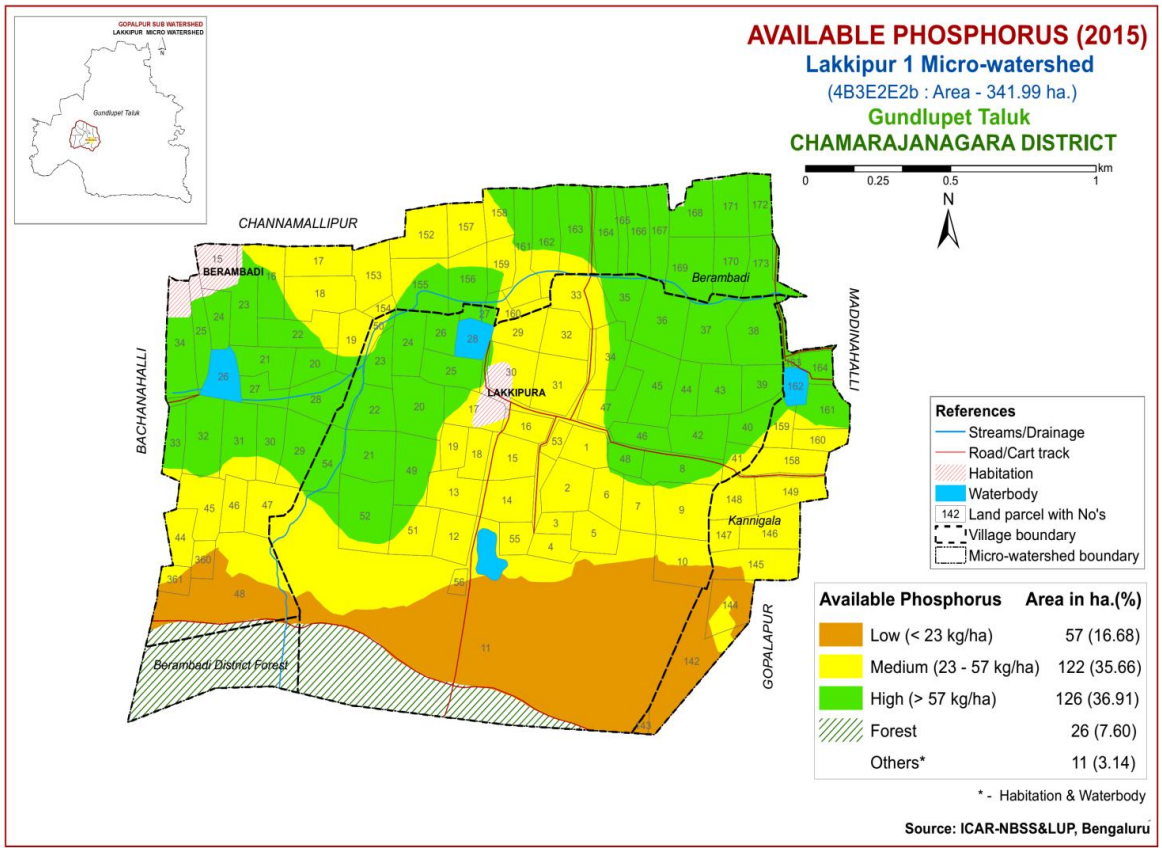


Fig. 6.4 Soil available Phosphorus map of Lakkipur-1 Microwatershed

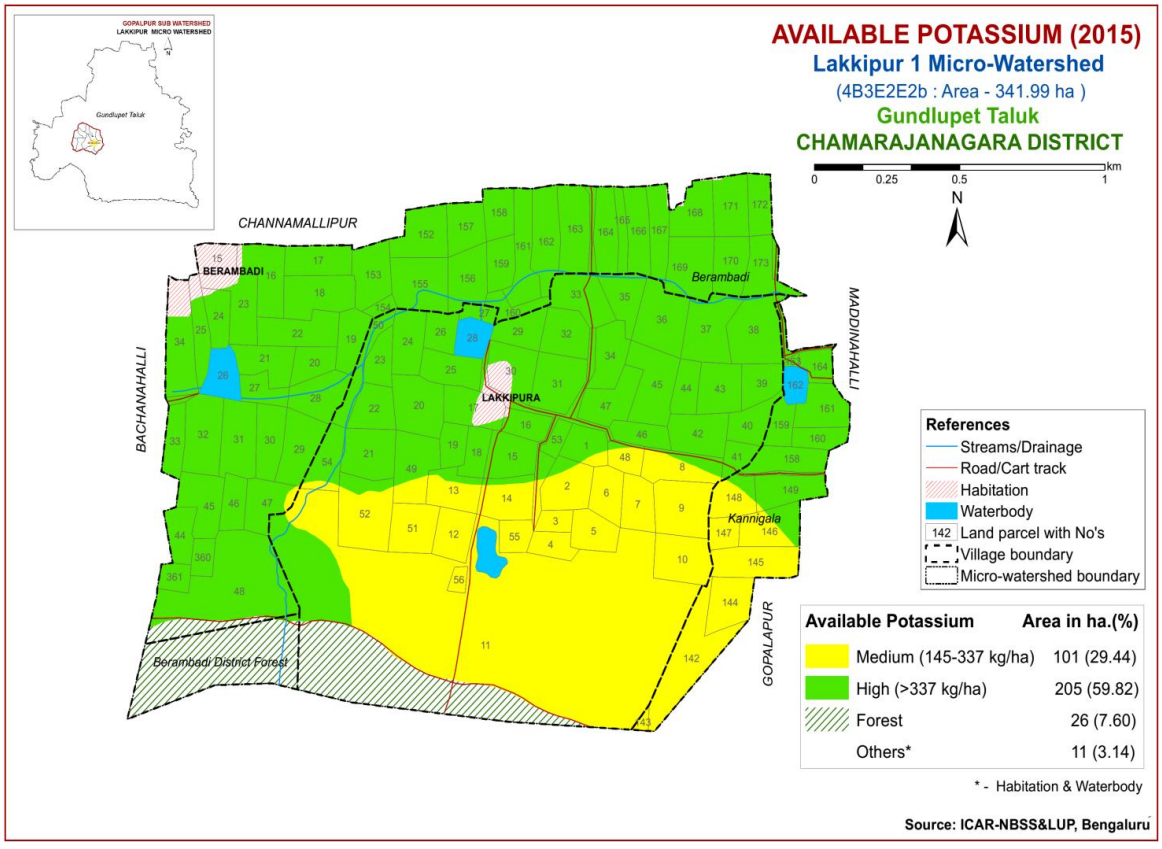


Fig. 6.5 Soil available Potassium map of Lakkipur-1 Microwatershed

6.7 Available Boron

Available boron content is low (<0.5 ppm) in an area of about 80 ha (23%) and is distributed in all parts of the microwatershed. Maximum area of 190 ha (56%) is medium (0.5-1.0 ppm) and is distributed in the major part of the microwatershed. High (>1.0 ppm) in available boron occur in an area of 35 ha (10%) and is distributed in the central, eastern and southern part of the microwatershed (Fig. 6.7).

6.8 Available Iron

Available iron content is sufficient (>4.5 ppm) in the entire area of the microwatershed (Fig 6.8).

6.9 Available Manganese

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

6.10 Available Copper

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

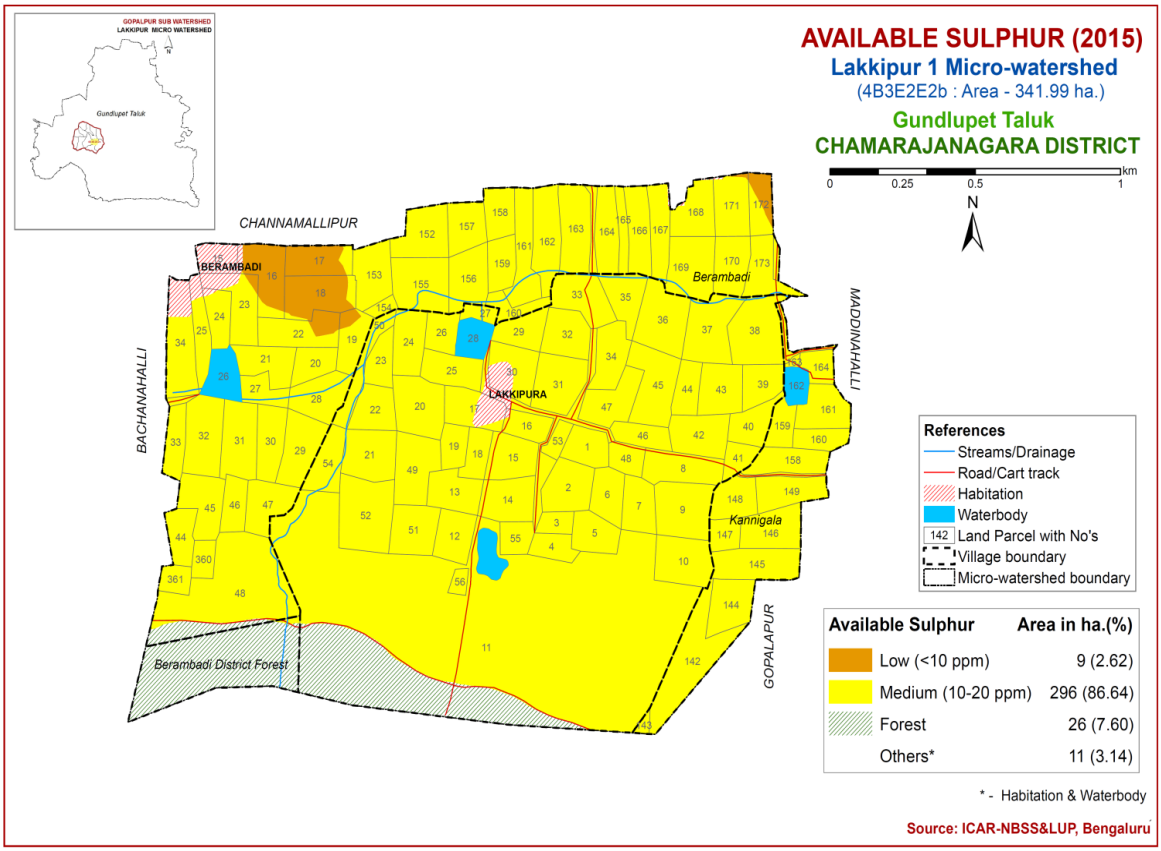


Fig. 6.6 Soil available Sulphur map of Lakkipur-1 Microwatershed

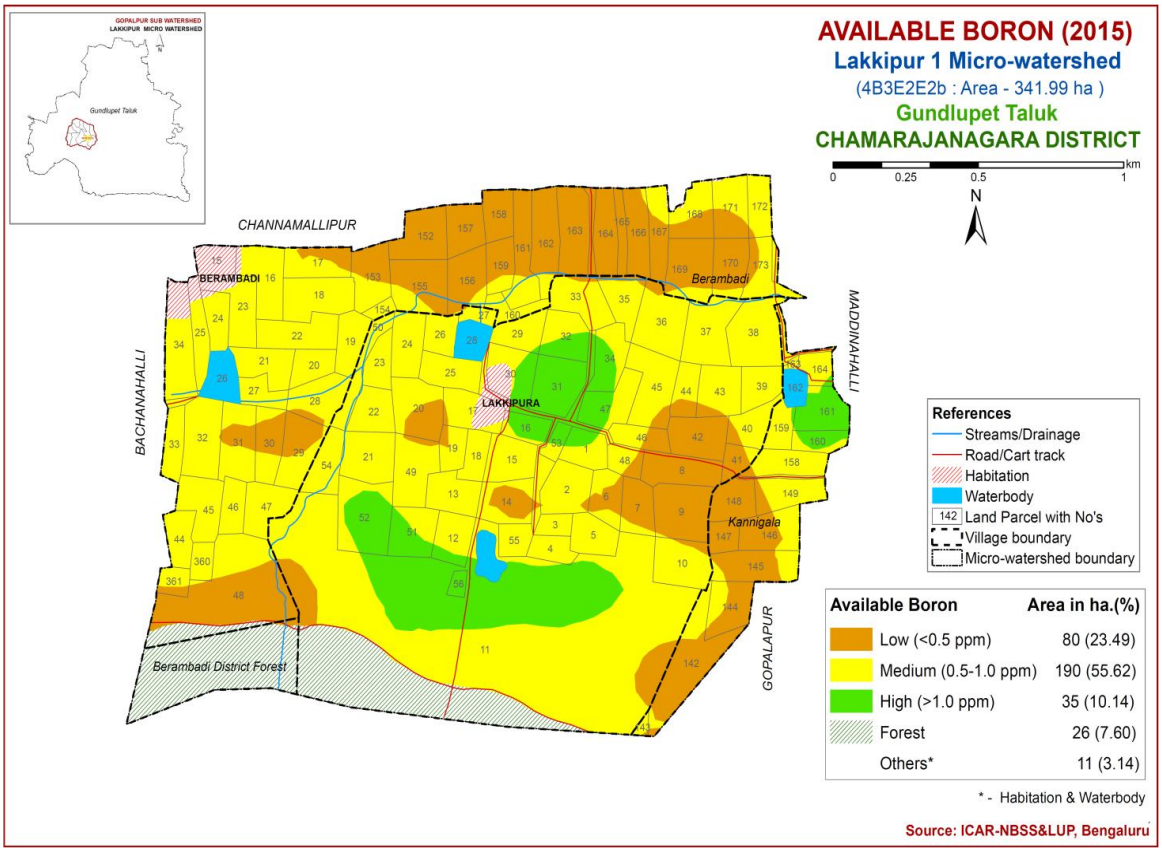


Fig. 6.7 Soil available Boron map of Lakkipur-1 Microwatershed

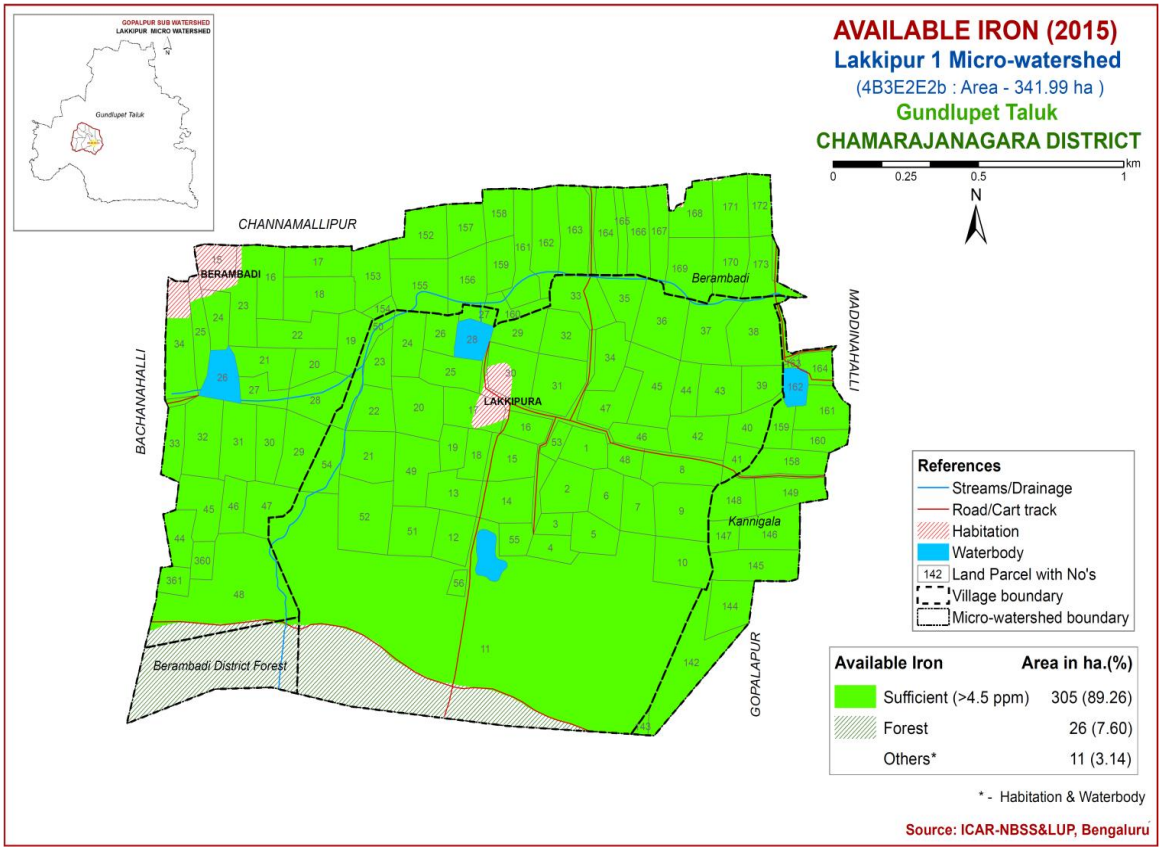


Fig. 6.8 Soil available Iron map of Lakkipur-1 Microwatershed

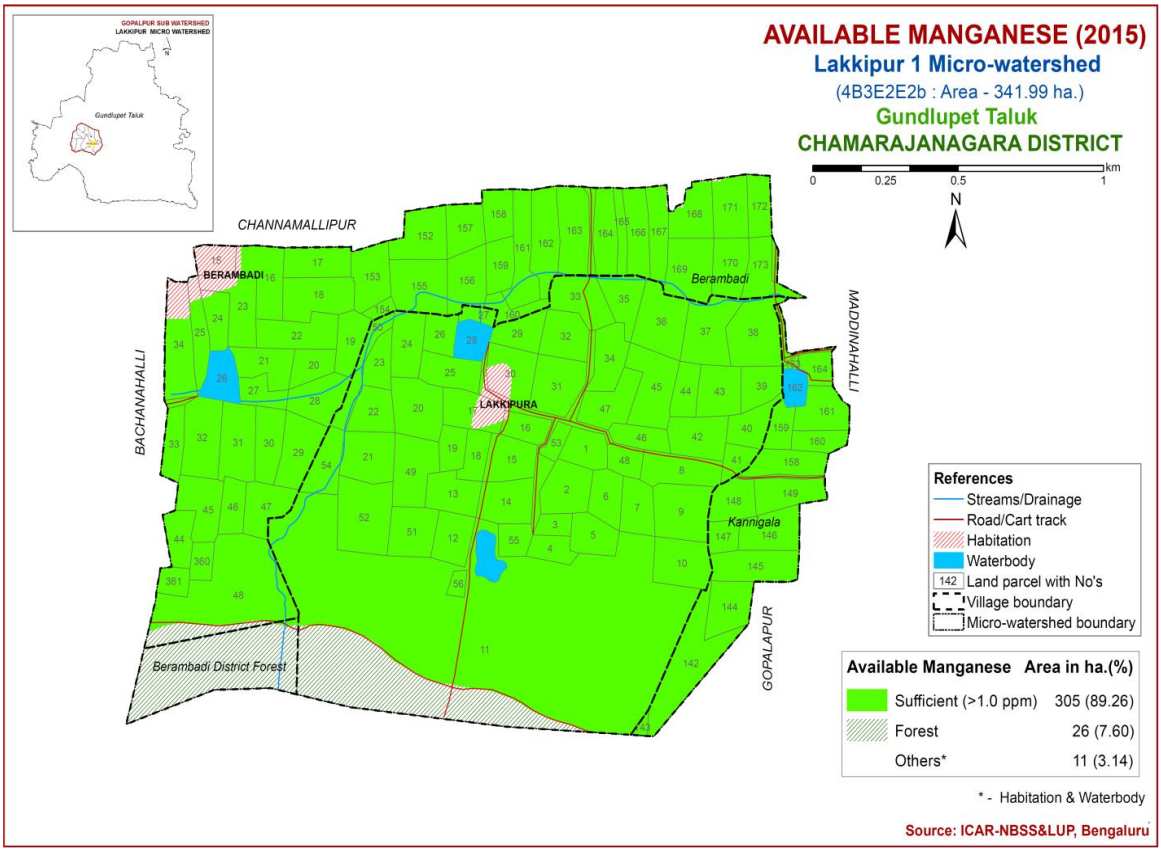


Fig. 6.9 Soil available Manganese map of Lakkipur-1 Microwatershed

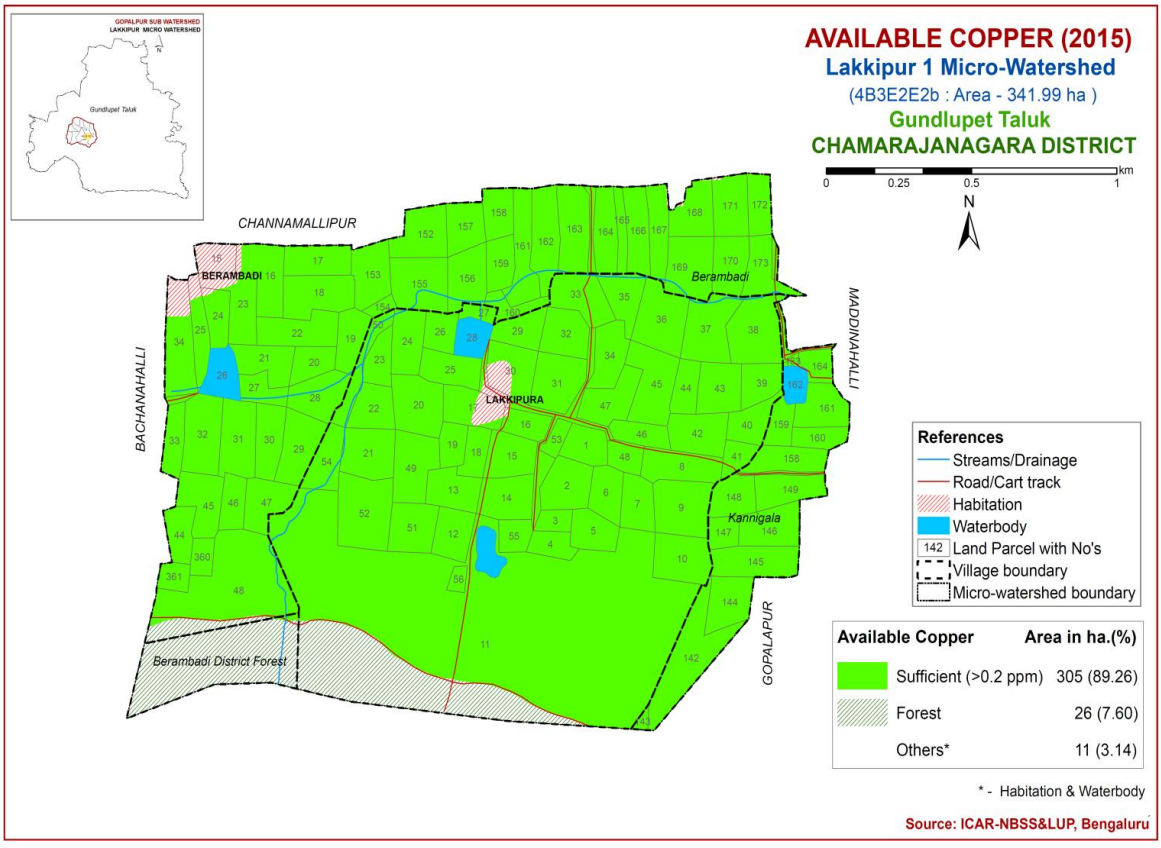


Fig. 6.10 Soil available Copper map of Lakkipur-1 Microwatershed

6.11 Available Zinc

Available zinc content is deficient (<0.6 ppm) in an area of 128 ha (38%) and are distributed in all parts of the microwatershed. Sufficient (>0.6 ppm) in available zinc content cover maximum area of about 177 ha (52%) and are distributed in the major part of the microwatershed (Fig 6.11).

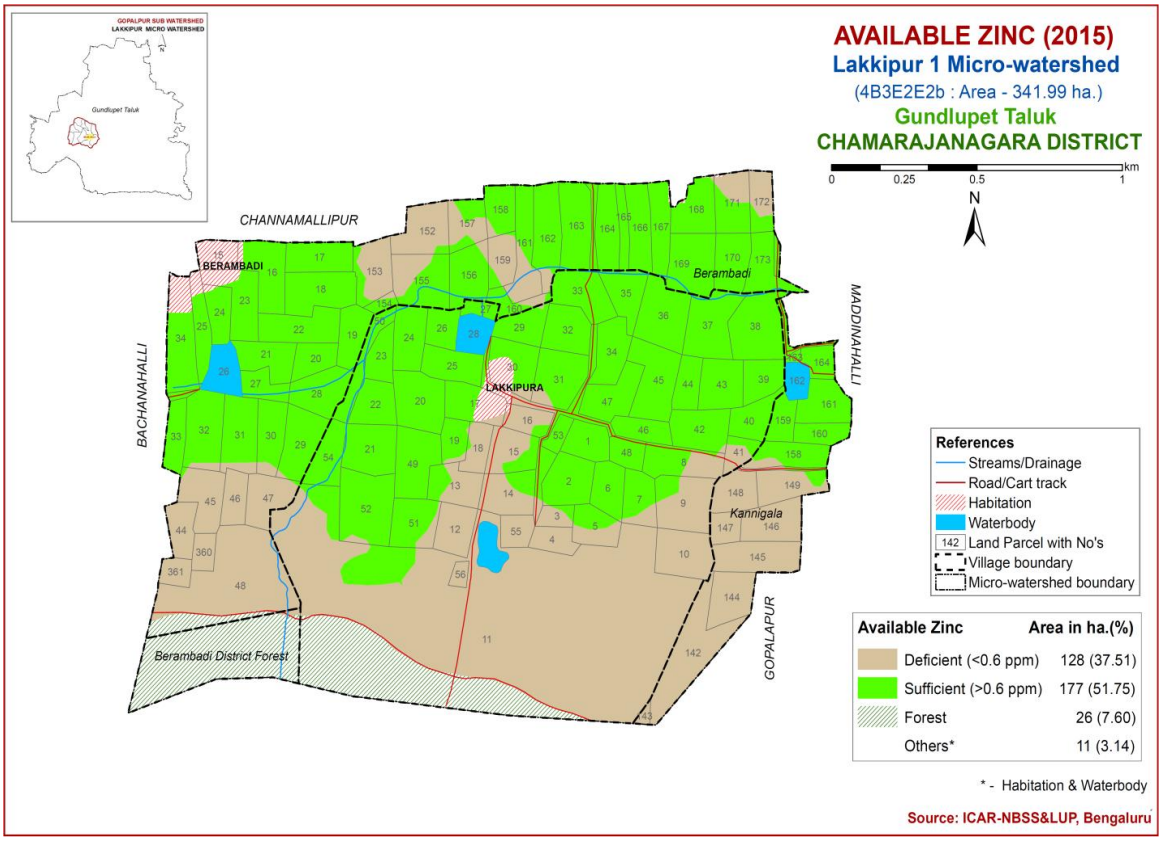


Fig. 6.11 Soil available Zinc map of Lakkipur-1 Microwatershed

Chapter 7

LAND SUITABILITY FOR MAJOR CROPS

The soil and land resource units (soil phases) of Lakkipur-1 microwatershed were assessed for their suitability for growing food, fodder, fibre and 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, 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, 's' for sodium 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 27 major agricultural and horticultural crops were generated. The detailed information on the kind of suitability of each of the soil phase for the crops assessed are given village/ survey number wise for the microwatershed in Appendix-III.

7.1 Land Suitability for Sorghum (*Sorghum bicolor*)

Sorghum is one of the major crop grown in Karnataka in an area of 10.47 lakh ha in 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 is given in Figure 7.1.

An area of about 103 ha (30%) is highly suitable (Class S1) for growing sorghum and are distributed in all parts of the microwatershed. About 56 ha (16%) has soils that are moderately suitable (Class S2) and are distributed in the northern, northeastern, eastern and central part of the microwatershed. They have minor

Table 7.1 Soil-Site Characteristics of Lakkipur-1 Microwatershed

Soil Map Units	Climate (P) (mm)	Growing period (Days)	Drai-nage 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	Surf-ace (%)	Sub surface (%)								
ARKiB2	734	150	WD	>150	sc	sc	<15	<15	101-150	1-3	Moderate	7.17	0.16	2.71	4.79	100
BMBhB1	734	150	MWD	>150	scl	c	<15	<15	>200	1-3	Slight	7.59	0.48	1.57	10.83	100
BMBmB2	734	150	MWD	>150	c	c	<15	<15	>200	1-3	Moderate	7.59	0.48	1.57	10.83	100
BMDcC2g1	734	150	WD	25-50	sl	scl	15-35	<15	<50	3-5	Moderate	8.28	0.23	083	18.13	100
BMDcD2g1	734	150	WD	25-50	sl	scl	15-35	<15	<50	5-10	Moderate	8.28	0.23	083	18.13	100
BMDhC2g1	734	150	WD	25-50	scl	scl	15-35	<15	<50	3-5	Moderate	8.28	0.23	083	18.13	100
DRHiB2	734	150	WD	50-75	sc	scl	<15	15-35	51-100	1-3	Moderate	5.43	0.13	0.09	11.40	38
GPRhB1g1	734	150	WD	75-100	scl	scl	15-35	15-35	51-100	1-3	Slight	-	-	-	-	-
GPRiB1	734	150	WD	75-100	sc	scl	<15	15-35	51-100	1-3	Slight	-	-	-	-	-
HDRhB1	734	150	WD	25-50	scl	sl	<15	<15	<50	1-3	Slight	8.288	0.18	0.64	12.54	100
HGHhB2	734	150	WD	>150	scl	scl	<15	<15	101-150	1-3	Moderate	7.37	0.185	1.505	8.66	100
HGHmB1	734	150	WD	>150	c	scl	<15	<15	101-150	1-3	Slight	7.37	0.185	1.505	8.66	100
HPRcB1g1	734	150	WD	50-75	sl	scl	15-35	15-35	51-100	1-3	Slight	8.36	0.36	1.78	24.17	100
HPRhB1	734	150	WD	50-75	scl	scl	<15	15-35	51-100	1-3	Slight	8.36	0.36	1.78	24.17	100
HPRiB1	734	150	WD	50-75	sc	scl	<15	15-35	51-100	1-3	Slight	8.36	0.36	1.78	24.17	100
KLPhB1	734	150	WD	100-150	scl	sc	<15	<15	101-150	1-3	Slight	6.07	0.14	2.82	9.23	100
MGHhE2g1	734	150	WD	50-75	scl	scl	15-35	35-60	<50	10-15	Moderate	6.42	0.13	0.86	14.02	100
MGHiB1	734	150	WD	50-75	sc	scl	<15	35-60	<50	1-3	Slight	6.42	0.13	0.86	14.02	100
SPRcC2g1	734	150	WD	25-50	sl	scl	15-35	35-60	<50	3-5	Moderate	7.83	0.33	0.82	9.80	100
SPRcD2g1	734	150	WD	25-50	sl	scl	15-35	35-60	<50	5-10	Moderate	7.83	0.33	0.82	9.80	100
SPRhB2g1	734	150	WD	25-50	scl	scl	15-35	35-60	<50	1-3	Moderate	7.83	0.33	0.82	9.80	100

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

limitations of rooting depth and texture. Marginally suitable (Class S3) lands cover an area of 115 ha (34%) and are distributed in the major part of the microwatershed with moderate limitations of gravelliness, topography, texture and rooting condition. Currently not suitable (Class N1) lands occur in an area of about 32 ha (9%) and distributed in the southern and southeastern part. They have severe limitations of slopes and gravelliness.

Table 7.2 Land suitability criteria for Sorghum

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

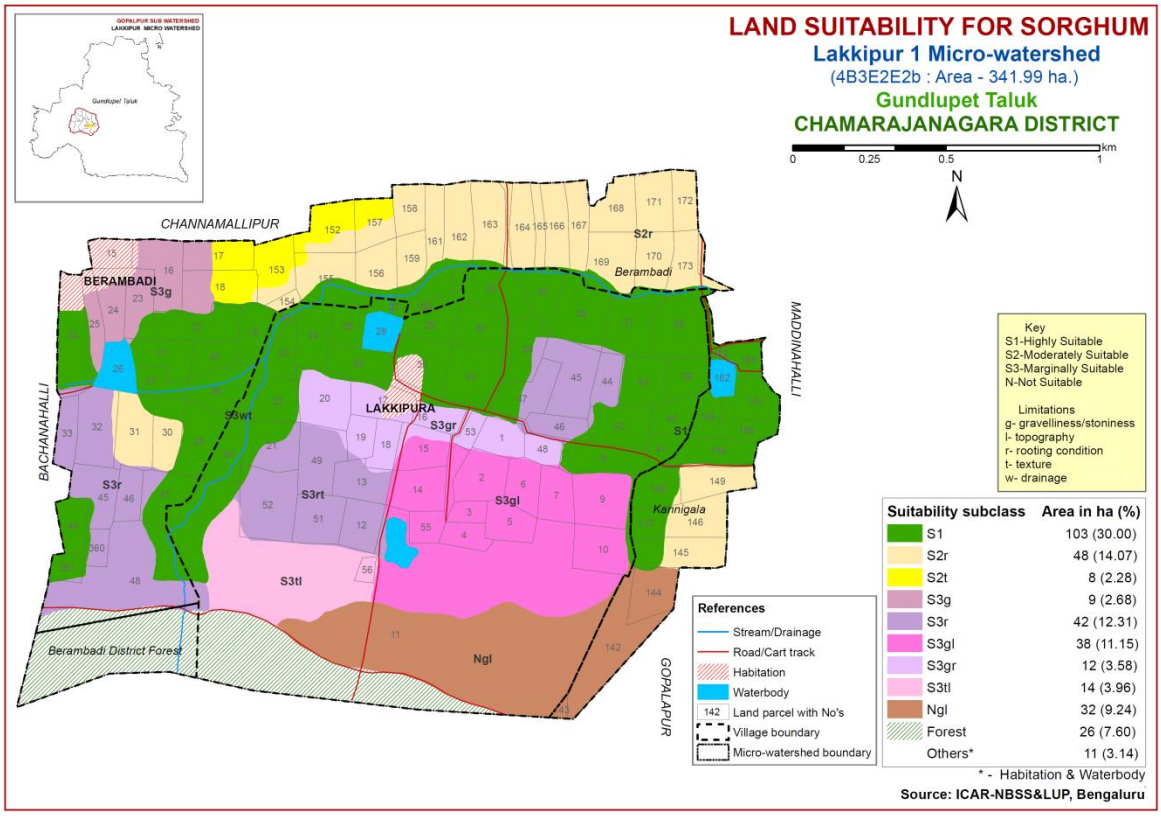


Fig. 7.1 Land Suitability map of Sorghum

7.2 Land Suitability for Maize (*Zea mays*)

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

An area of about 53 ha (15%) in the microwatershed has soils that are highly suitable (Class S1) for growing maize and are distributed in all parts of the microwatershed. About 48 ha (14%) has soils that are moderately suitable (Class S2) and are distributed in the northeastern, northern, western and eastern part of the microwatershed. They have minor limitation of rooting depth. The marginally suitable (Class S3) lands cover a maximum area of about 173 ha (51%) and occur in the major part of the microwatershed. They have moderate limitations of texture, rooting depth, topography, drainage and gravelliness. Currently not suitable (Class N1) lands occupy 32 ha (9%) and are distributed in the southern part of the microwatershed. They have severe limitations of topography and gravelliness

Table 7.3 Land suitability criteria for Maize

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

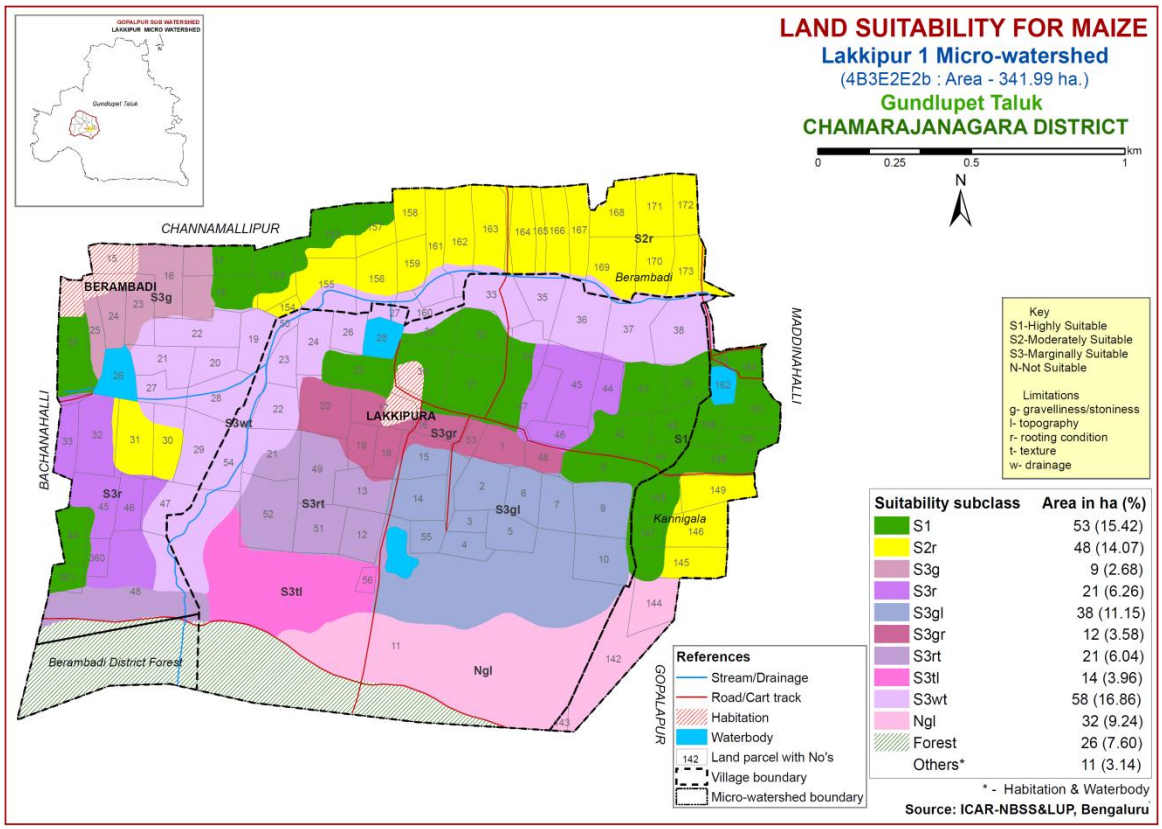


Fig. 7.2 Land Suitability map of Maize

7.3 Land Suitability for 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.

The highly suitable (Class S1) lands for growing red gram occupy about 53 ha (15%) and are distributed in all parts of the microwatershed. An area of about 74 ha (22%) is moderately suitable (Class S2) for red gram and are distributed in the northeastern, western, central and southeastern part of the microwatershed. They have minor limitations of gravelliness, rooting depth and drainage. Marginally suitable lands (Class S3) for growing red gram occupy an area of about 41 ha (12%) and occur in the northwestern, northern and western part of the microwatershed. They have moderate limitation of root depth. Currently not suitable (Class N1) lands occur in an area of 138 ha (40%) and are distributed in the major part of the microwatershed with severe limitations of rooting depth, gravelliness, topography, and texture.

Table 7.4 Land suitability criteria for Red gram

Crop requirement		Rating			
Soil –site characteristics	**Unit**	**Highly suitable(S1)**	**Moderately suitable(S2)**	**Marginally suitable(S3)**	**Not suitable(N)**
Slope	%	<3	3-5	5-10	>10
LGP	Days	>210	180-210	150-180	<150
Soil drainage	class	Well drained	Mod. to well drained	Imperfectly drained	Poorly drained
Soil reaction	pH	6.5-7.5	5.0-6.5 7.6-8.0	8.0-9.0	>9.0
Surface soil texture	Class	l, scl, sil, cl, sl	sicl, sic, c(m)	ls	s, fragmental
Soil depth	cm	>100	85-100	40-85	<40
Gravel content	% vol.	<20	20-35	35-60	>60
Salinity (EC)	dSm^{-1}	<1.0	1.0-2.0	>2.0	
Sodicity (ESP)	%	<10	10-15	>15	

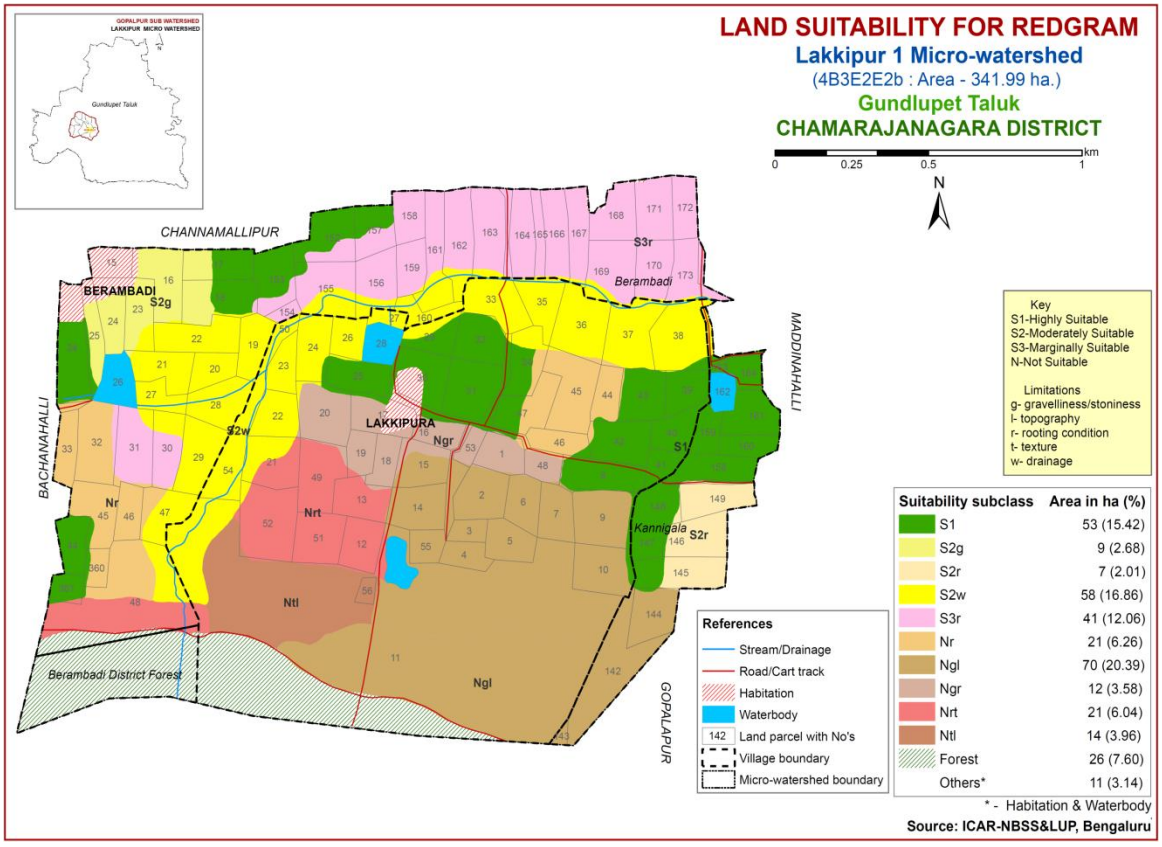


Fig. 7.3 Land Suitability map of Red gram

7.4 Land Suitability for Horse gram (*Macrotyloma uniflorum*)

Horsegram is one of the most important pulse crop grown in an area of 1.8 lakh ha in almost all the districts of the State. The crop requirements for growing horsegram (Table 7.5) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing horsegram was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.4.

The highly suitable (Class S1) lands for growing horse gram occupy about 53 ha (15%) and are distributed in all parts of the microwatershed. A major area of about 115 ha (34%) is moderately suitable (Class S2) for horse gram and are distributed in the major part of the microwatershed. They have minor limitations of rooting depth, gravelliness and drainage. An area of 106 ha (31%) is marginally suitable (Class S3) and are distributed in the northeastern, northwestern, central, southeastern and eastern part of the microwatershed with moderate limitations of rooting depth, gravelliness, topography and texture. Currently not suitable (Class N1) lands occupy an area of 32 ha (9%) and are distributed in the southern part of the microwatershed with severe limitations of gravelliness and topography.

Table 7.5 Land suitability criteria for Horse 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				
Soil drainage	Class	Well drained/mod. well drained	imperfectly drained	Poorly drained	Very Poorly drained
Soil reaction	pH	6.0-8.5	8.5-9.0 5.5-5.9	9.1-9.5 5.0-5.4	>9.5
Surface soil texture	Class	l, sl, scl, cl, sc	ls, sic, sicl, c, ls	Heavy clays (>60%)	-
Soil depth	cm	50-75	25-50	<25	-
$CaCO_3$ in root zone	% vol.	<15	15-25	25-30	>30
Salinity (ECe)	dsm^{-1}	<1.0	1.0-2.0	>2.0	
Sodicity (ESP)	%	<10	10-15	>15	-

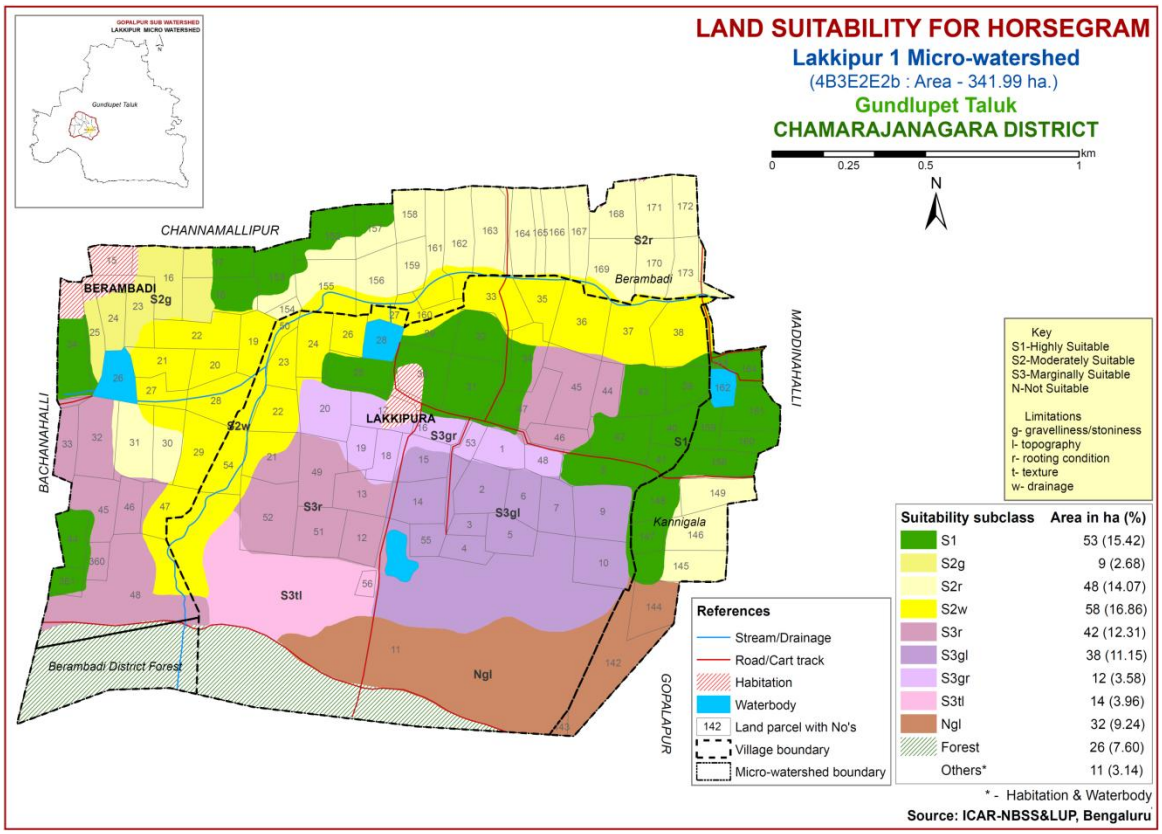


Fig. 7.4 Land Suitability map of Horse gram

7.5 Land Suitability for Field bean (*Dolichos lablab*)

Field Bean is one of the most important pulse crop grown in an area of 0.68 lakh ha in almost all the districts of the State. The crop requirements (Table 7.4) for growing field bean were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing field bean was generated. The area extent and their geographical distribution of different suitability subclasses in different microwatersheds is given in Figure 7.5.

The highly suitable (Class S1) lands for growing field bean occupy an area of about 33 ha (10%) and are distributed in the western and northern part of the microwatershed. Maximum area of about 126 ha (38%) is moderately suitable (Class S2) for field bean and are distributed in the major part of the microwatershed. They have minor limitations of gravelliness, rooting depth and drainage. An area of about 115 ha (34%) is marginally suitable (Class S3) and are distributed in the northeastern, eastern, central and southern part of the microwatershed with moderate limitations of gravelliness, topography, texture and rooting depth. Currently not suitable (Class N1) lands occupy 26 ha (8%) and are distributed in the southern part of the microwatershed with severe limitations of gravelliness and topography.

Table 7.6 Land suitability criteria for Field Bean

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	>120	90-120	70-90	<70
Soil drainage	Class	Well drained/mod. well drained	imperfectly drained	Poorly drained	Very Poorly drained
Soil reaction	pH	6.0-8.5	8.5-9.0 5.5-5.9	9.1-9.5 5.0-5.4	>9.5
Sub Surface soil texture	Class	l, sl, scl, cl,sc	sic, sicl, c	Heavy clays (>60%), ls	s
Soil depth	cm	>75	50-75	25-50	<25
$CaCO_3$ in root zone	% vol.	<15	15-35	35-50	>50
Salinity (EC)	dsm^{-1}	<1.0	1.0-2.0	>2.0	
Sodicity (ESP)	%	<10	10-15	15-20	>20

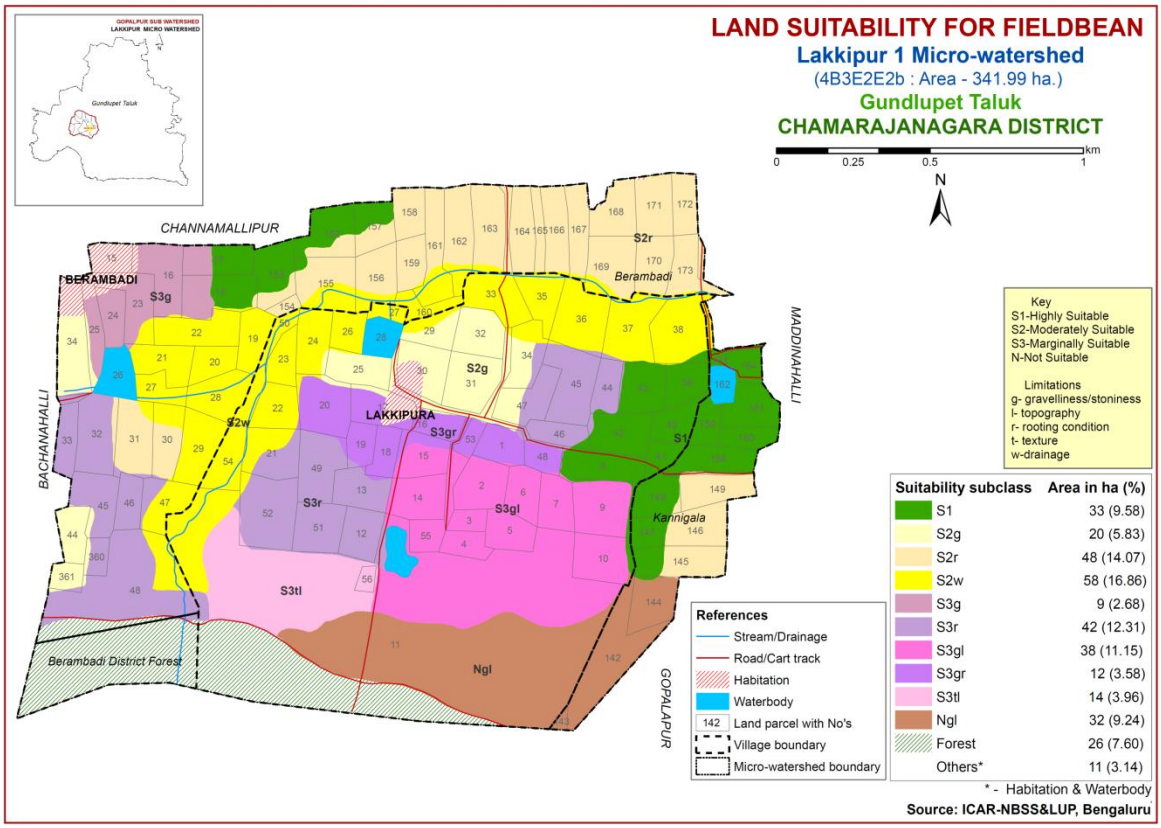


Fig. 7.5 Land Suitability map of Field Bean

7.6 Land Suitability for Groundnut (*Arachis hypogaea*)

Groundnut is one of the major oilseed crop grown in an area of 6.5 lakh ha in Karnataka in most of the districts either as rainfed or irrigated crop. The crop requirements for growing groundnut (Table 7.7) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map

for growing groundnut was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.6.

An area of 20 ha (6%) is highly suitable (Class S1) for growing groundnut and are distributed in the central, southwestern and western part of the microwatershed. An area of about 81 ha (24%) is moderately suitable (Class S2) for growing groundnut and are distributed in the northern, northeastern, central, eastern and western part of the microwatershed. They have minor limitations of rooting depth and texture. Marginally suitable lands (Class S3) for growing groundnut occupy maximum area of about 173 ha (51%) and are distributed in the major part of the microwatershed. They have moderate limitations of drainage, rooting depth, gravelliness, topography and texture. Currently not suitable (Class N1) lands occupy an area of 32 ha (9%) and are distributed in the southern part of the microwatershed with severe limitations of gravelliness and topography.

Table 7.7 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	
Surface soil texture	Class	l, cl, sil, sc, sicl	sc, sic, c,	s, ls, sl c (>60%)	s, fragmental
Soil depth	cm	>75	50-75	25-50	<25
Gravel content	% vol.	<35	35-50	>50	
$CaCO_3$ in root zone	%	high	medium	low	
Salinity (EC)	dSm^{-1}	<2.0	2.0-4.0	4.0-8.0	
Sodicity (ESP)	%	<5	5-10	>10	

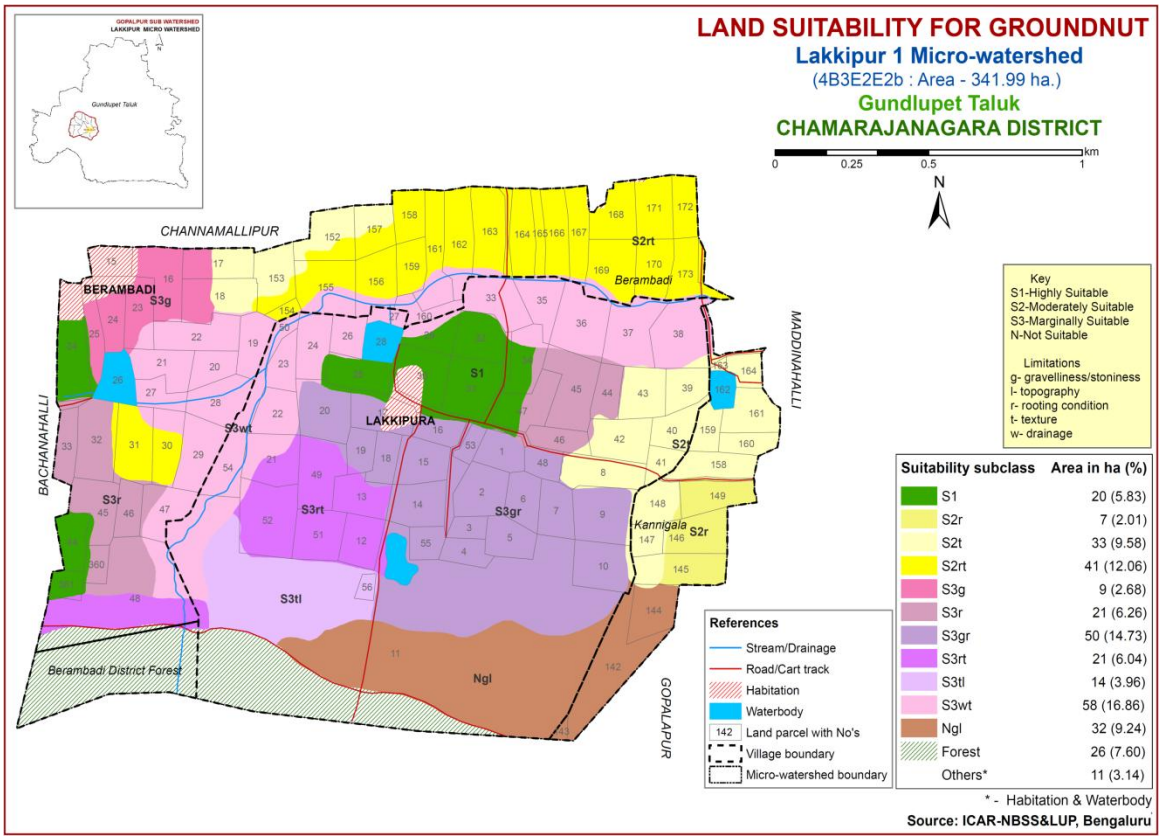


Fig. 7.6 Land Suitability map of Ground nut

7.7 Land Suitability for Sunflower (*Helianthus annus*)

Sunflower is one of the most important oilseed crop grown in an area of 4.1 lakh ha in the State in all the districts. The crop requirements for growing sunflower (Table 7.8) 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 7.7.

An area of 25 ha (7%) is highly suitable (Class S1) for growing sunflower and are distributed in the eastern part of the microwatershed. Moderately suitable (Class S2) lands are found to occur in an area of about 86 ha (25%) and are distributed in all parts of the microwatershed. They have minor limitations of drainage, texture and gravelliness. Marginally suitable (Class S3) lands cover about 57 ha (17%) and occur in the northern, northeastern, eastern and western part of the microwatershed. They have moderate limitations of rooting depth and gravelliness. Currently not suitable (Class N1) lands cover a maximum area of about 138 ha (40%) and are distributed in the major part of the microwatershed with severe limitations of rooting depth, gravelliness, topography and texture.

Table 7.8 Land 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	

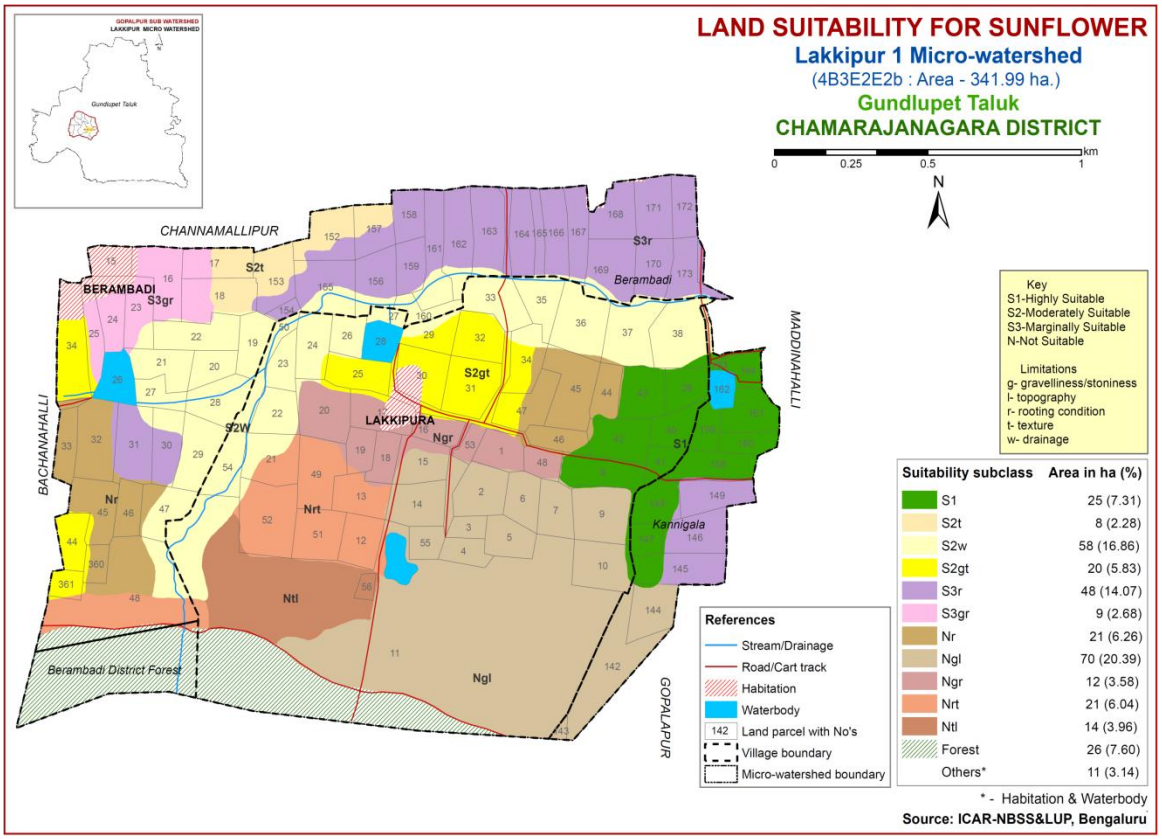


Fig. 7.7 Land Suitability map of Sunflower

7.8 Land Suitability for Cotton (*Gossypium hirsutum*)

Cotton is one of the most important fibre crop grown in the State in about 6.6 lakh ha area in Raichur, Dharwad, Belgaum, Kalaburgi, Bijapur, Bidar, Bellary, Chitradurga and Chamarajnagar districts. The crop requirements for growing cotton (Table 7.9) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for

growing cotton was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.8.

The highly suitable (Class S1) lands for growing cotton cover about 83 ha (24%) and are distributed in the western, central and eastern part of the microwatershed. An area of about 68 ha (20%) has soils that are moderately suitable (Class S2) for growing cotton and are distributed in all parts of the microwatershed with minor limitations of rooting depth and texture. The marginally suitable (Class S3) lands cover an area of about 123 ha (36%) and are distributed in the major part of the microwatershed with moderate limitations of gravelliness, texture, topography and rooting depth. Currently not suitable (Class N1) lands occupy 32 ha (9) and are distributed in the southern part of the microwatershed with severe limitations of gravelliness and topography.

Table 7.9 Land suitability criteria for Cotton

Crop requirement		**Rating**			
Soil–site characteristic	**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 moderately 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

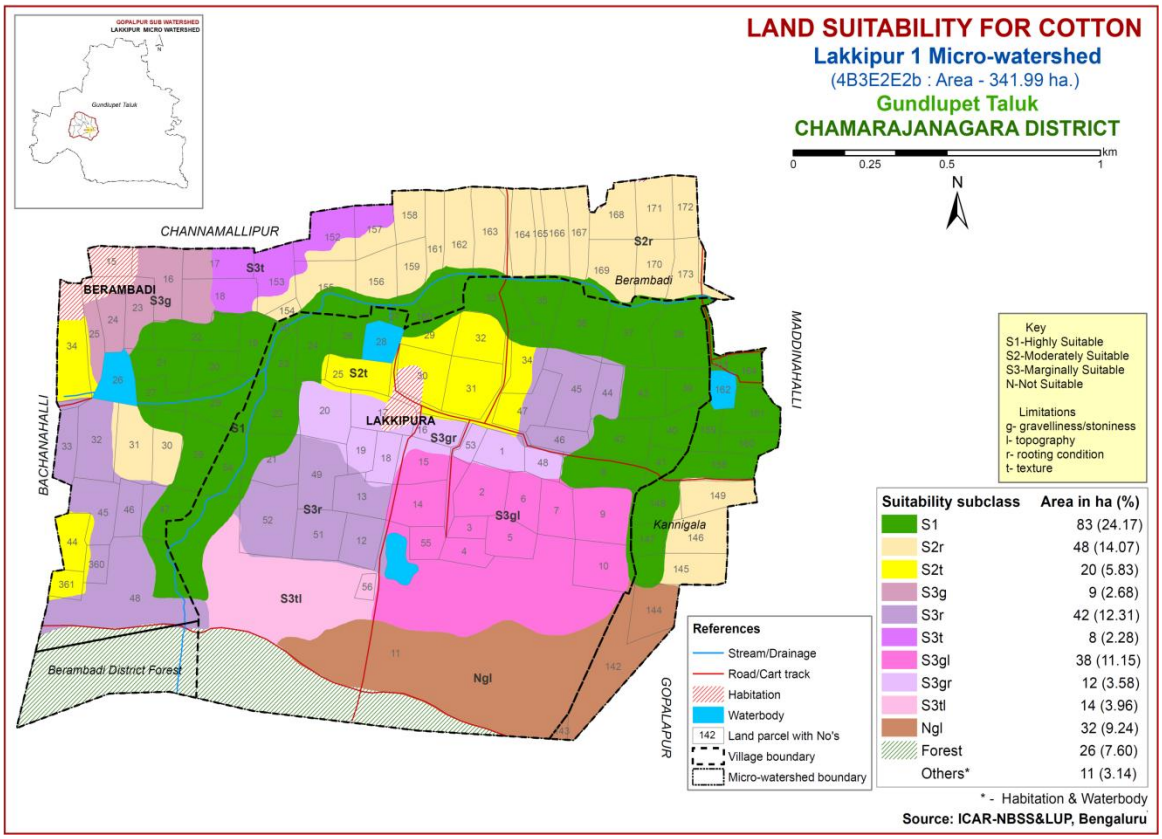


Fig. 7.8 Land Suitability map of Cotton

7.9 Land Suitability for Onion (*Allium cepa*)

Onion is one of the most important vegetable crop grown in an area in Raichur, Dharwad, Belgaum, Gulbarga, Bijapur, Bidar, Bellary, Chitradurga and Chamarajnagar districts. The crop requirements for growing Onion (Table 7.10) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing Onion was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.9.

The highly suitable (Class S1) lands for growing onion cover about 33 ha (10%) and are distributed in the eastern and northern part of the microwatershed. Maximum area of about 126 ha (37%) has soils that are moderately suitable (Class S2) for growing onion and are distributed in the major part of the microwatershed with minor limitations of gravelliness, rooting depth, drainage and texture. An area of about 115 ha (34%) is marginally suitable (Class S3) and are distributed in all parts of the microwatershed with moderate limitations of gravelliness, rooting depth, topography and texture. Currently not suitable (Class N1) lands occur in an area of 32 ha (9%) and are distributed in the southern part of the microwatershed.

Table 7.10 Land suitability criteria for Onion

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	35-40	>40
Slope	%	<3	3-5	5-10	>10
Soil drainage	Class	Well drained	Moderately /imperfectly	Poor drained	Very poorly drained
Soil reaction	pH	6.5-7.3	7.3-7.8 5.0-5.4	7.8-8.4 <5.0	>8.4
Surface soil texture	Class	scl, sil, sl	sc, sicl, c (red soil)	sc, c (black soil)	ls
Soil depth	cm	>75	50-75	25-50	<25
Gravel content	% vol.	<15	15-35	35-60	60-80
Salinity (ECe)	dsm^{-1}	<1.0	1.0-2.0	2.0-4.0	<4
Sodicity (ESP)	%	<5	5-10	10-15	>15

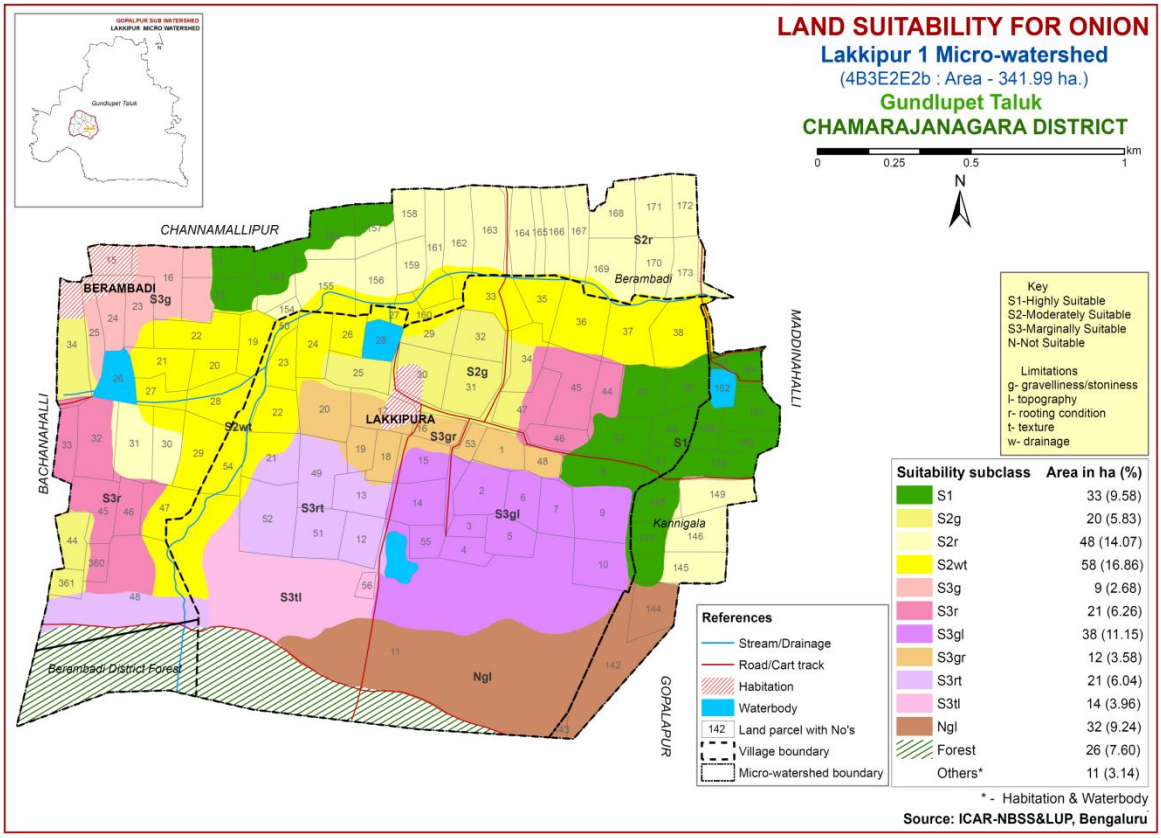


Fig. 7.9 Land Suitability map of Onion

7.10 Land Suitability for Potato (*Solanum tuberosum*)

Potato is one of the most important vegetable crop grown in Raichur, Dharwad, Belgaum, Chikkaballapur, Kolar, Gulbarga, Bijapur, Bidar, Bellary, Chitradurga and Chamarajnagar districts. The crop requirements for growing Potato (Table 7.11) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for

growing Potato was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.10.

The highly suitable (Class S1) lands for growing potato occupy an area of about 33 ha (10%) and are distributed in the northern and eastern part of the microwatershed. An area of about 69 ha (20%) is moderately suitable (Class S2) and are distributed in all parts of the microwatershed. They have minor limitations of rooting depth and gravelliness. Marginally suitable lands (Class S3) for growing potato occupy a maximum of about 173 ha (51%) and occur in the major part of the microwatershed. They have moderate limitations of texture, gravelliness, rooting depth, topography and drainage. Currently not suitable (Class N1) lands cover 32. Ha (9%) and are distributed in the southern and southeastern part with severe limitations of topography and gravelliness.

Table 7.11 Land suitability criteria for Potato

Crop requirement			**Rating**			
Soil –site characteristics		**Unit**	**Highly suitable(S1)**	**Moderately suitable(S2)**	**Marginally suitable(S3)**	**Not suitable (N)**
Slope	Hills	%	<5	5-10	10-15	>15
	Plains	%	<3	3-5	5-8	>8
Mean temperature in growing season		^{0}C	16-25	26-30 13-15	31-32 10-12	>32 <10
Soil drainage		Class	Well drained	Moderately /imperfectly	Poor drained	Very poorly drained
Soil reaction		pH	5.5-6.5	6.6-8.2 5.0-5.4	>8.2 <5.0	-
Surface soil texture		Class	scl, sil	s, sil	s	
Soil depth		cm	75-100	50-75	25-50	<25
Stoniness		%	0-10	10-15	15-35	>35
Salinity (ECe)		dsm^{-1}	<1.0	1.0-2.0	2.0-4.0	>4.0
Sodicity (ESP)		%	<10	10-15	>15	-

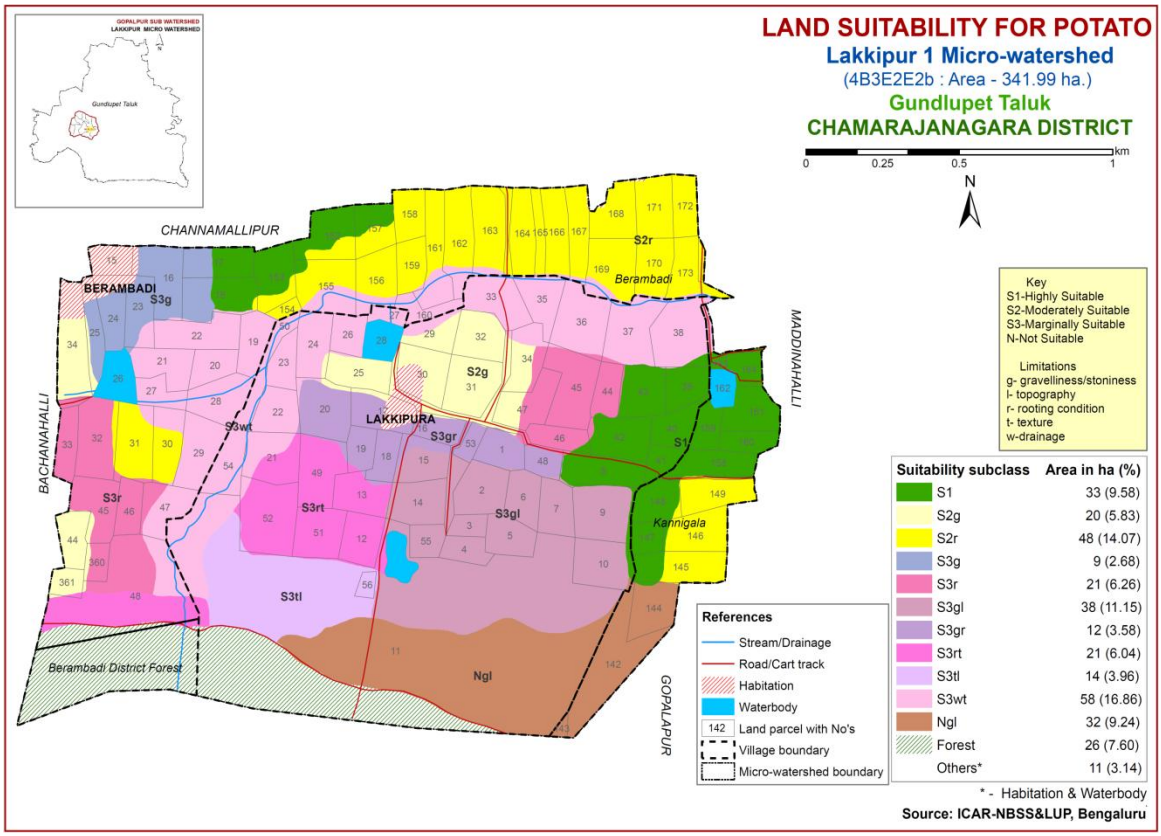


Fig. 7.10 Land Suitability map of Potato

7.11 Land Suitability for French Beans (*Phaseolus vulgaris*)

French Beans are one of the most important vegetable crop grown in almost all the districts of Karnataka. The crop requirements for growing beans were matched with the soil–site characteristics and a land suitability map for growing beans was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.11.

The highly suitable (Class S1) lands for growing French beans cover an area of about 33 ha (10%) and are distributed in the northern and eastern part of the microwatershed. Moderately suitable (Class S2) lands are found to occur in an area of about 126 ha (37%) and are distributed in the major part of the microwatershed. They have minor limitations of gravelliness, texture, rooting depth and drainage. An area of about 115 ha (34%) is marginally suitable (Class S3) and are distributed in the major part of the microwatershed with severe limitations of gravelliness, rooting depth, topography and texture. Currently not suitable (Class N1) lands occur in an area of 32 ha (9%) and are distributed in the southern part of the microwatershed with severe limitations of gravelliness and topography.

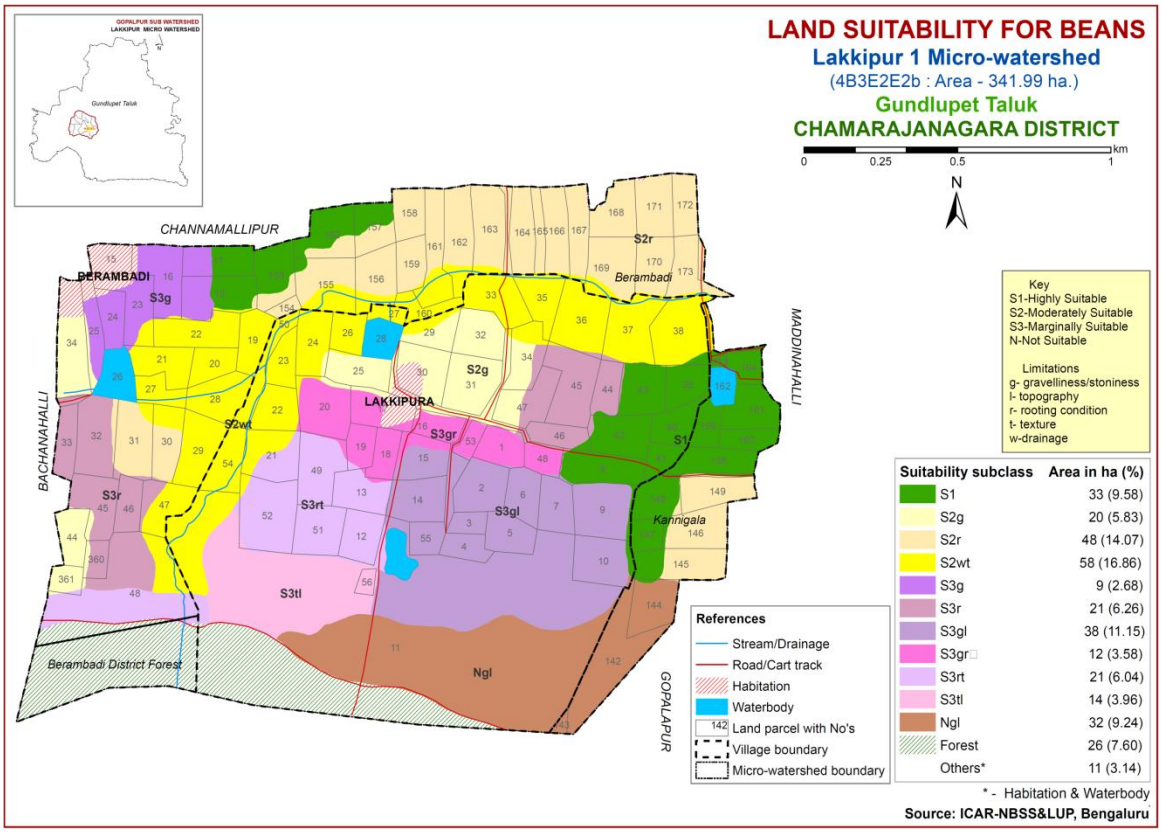


Fig. 7.11 Land Suitability map of Beans

7.12 Land Suitability for Beetroot (*Beta vulgaris*)

Beetroot is one of the most important vegetable crop grown in almost all the districts of Karnataka. The crop requirement for growing beetroot were matched with the soil site characteristics and a land suitability map for growing beetroot was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.12.

The highly suitable (Class S1) lands for growing beetroot cover an area of about 33 ha (10%) and are distributed in the northern and eastern part of the microwatershed. The moderately suitable (Class S2) lands are found to occur in an area of about 68 ha (20%) and are distributed in all parts of the microwatershed. They have minor limitations of gravelliness and rooting depth. The marginally suitable (Class S3) lands cover a maximum area of about 173 ha (51%) and occur in the major part of the microwatershed. They have moderate limitations of texture, gravelliness, rooting depth, topography and drainage. Currently not suitable (Class N1) lands occur in an area of 32 ha (9%) and are distributed in the southern part of the microwatershed with severe limitations of gravelliness and topography.

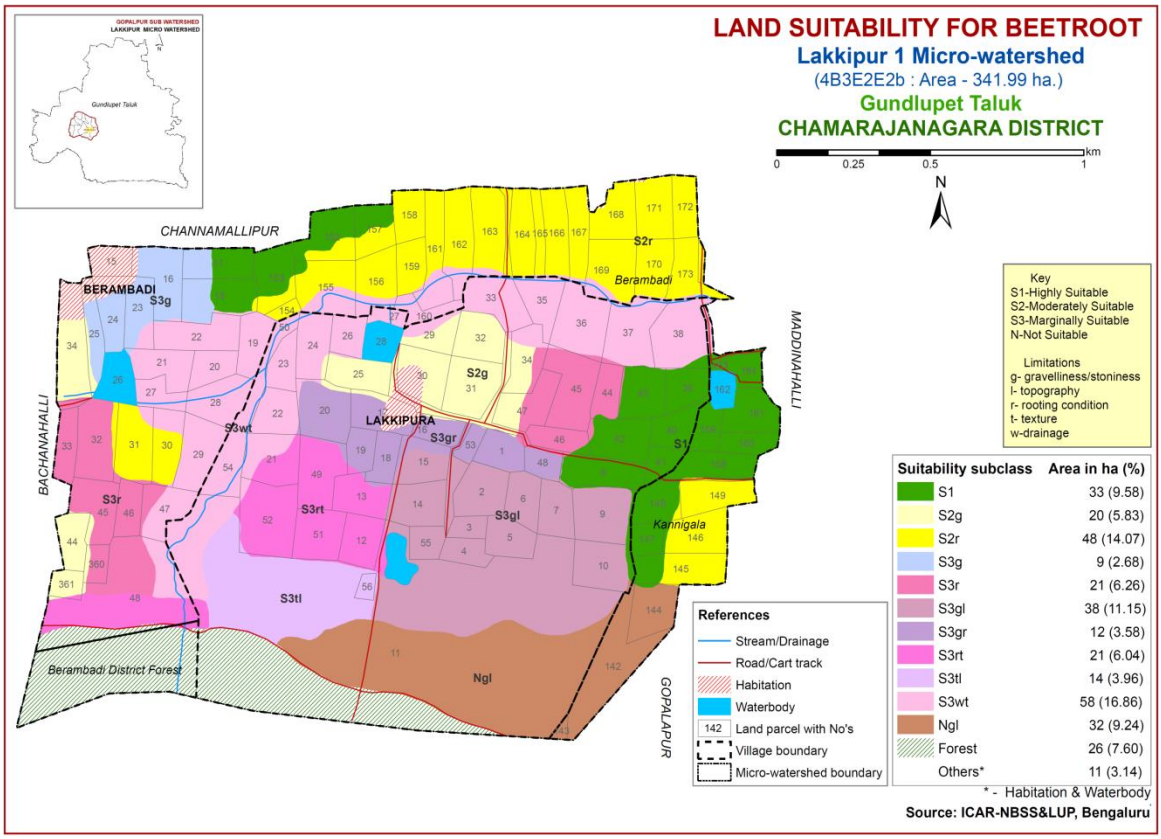


Fig. 7.12 Land Suitability map of Beetroot

7.13 Land suitability for Mango (*Mangifera indica*)

Mango is one of the most important fruit crop grown in almost all the districts of the State. The crop requirements (Table 7.13) for growing mango were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing mango was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.13.

The highly suitable (Class S1) lands for growing mango cover an area of about 46 ha (13%) and are distributed in the western, northern and eastern part of the microwatershed. An area of 14 ha (4%) is moderately suitable (Class S2) and are distributed in the central part of the microwatershed with minor limitation of rooting depth. The marginally suitable (Class S3) lands cover a very small area of about 6 ha (2%) and occur in the western and southeastern part of the microwatershed. They have moderate limitation of rooting depth. Maximum area of about 240 ha (70%) is currently not suitable (Class N1) for growing mango and are distributed in the major part of the microwatershed.

Table 7.12 Land suitability criteria for Mango

Crop requirement			Rating			
Soil-site characteristics		**Unit**	**Highly suitable(S1)**	**Moderately Suitable(S2)**	**Marginally suitable(S3)**	**Not suitable(N)**
Climate	Temp. in growing season	^{0}C	28-32	24-27 33-35	36-40	20-24
	Min. temp. before flowering	^{0}C	10-15	15-22	>22	
Soil moisture	Growing period	Days	>180	150-180	120-150	<120
Soil aeration	Soil drainage	Class	Well drained	Mod. To imp. drained	Poor drained	V.poorly drained
	Water table	M	>3	2.50-3.0	2.5-1.5	<1.5
Nutrient availability	Texture	Class	sc, l, sil, cl	sl, sc, sic, l, c	c (<60%)	c(>60%),
	pH	1:2.5	5.5-7.5	7.6-8.55.0-5.4	8.6-9.04.0-4.9	>9.0<4.0
	OC	%	High	medium	low	
	$CaCO_3$ in root zone	%	Non calcareous	<5	5-10	>10
Rooting conditions	Soil depth	cm	>200	125-200	75-125	<75
	Gravel content	% vol	Non gravelly	<15	15-35	>35
Soil toxicity	Salinity	dS/m	Non saline	<2.0	2.0-3.0	>3.0
	Sodicity	%	Non sodic	<10	10-15	>15
Erosion	Slope	%	<3	3-5	5-10	

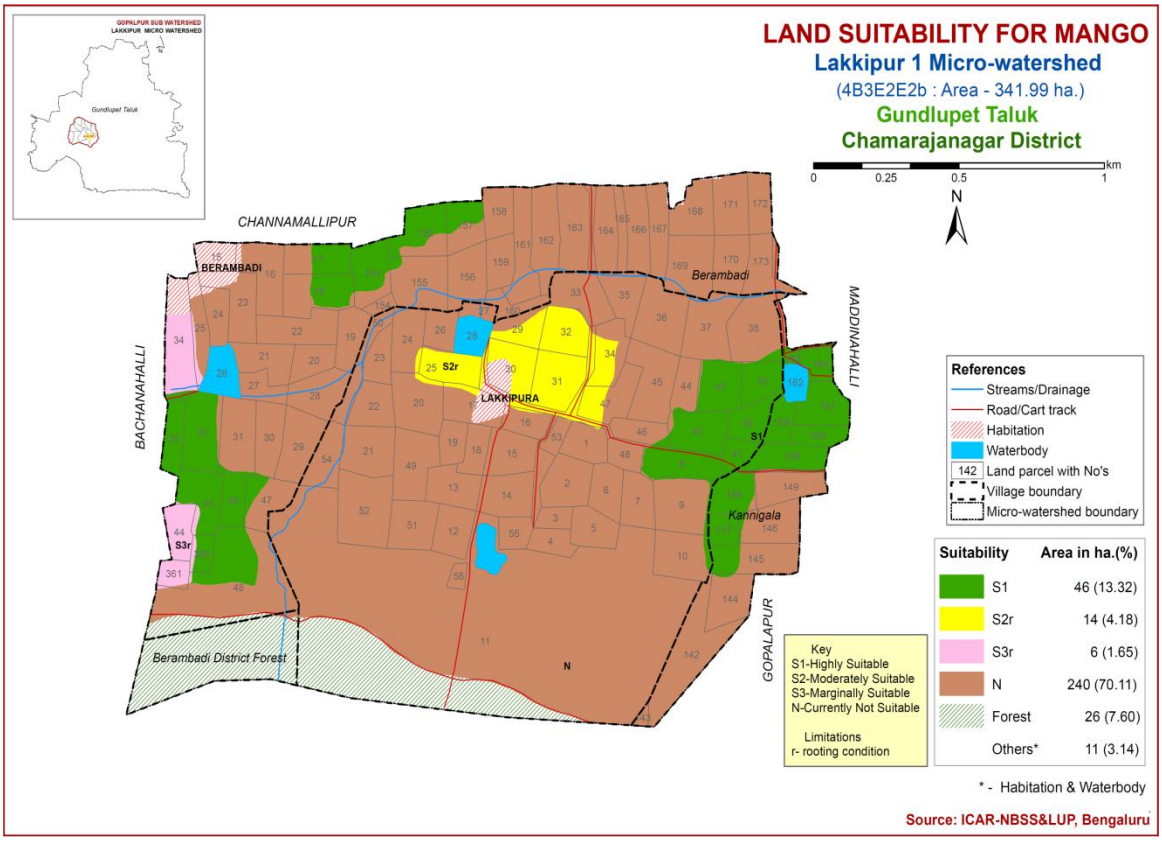


Fig. 7.13 Land Suitability map of Mango

7.14 Land suitability for Sapota (*Manilkara zapota*)

Sapota is one of the most important fruit crop grown in an area of 3.11 lakh ha in almost all the districts of the State. The crop requirements (Table 7.14) for growing sapota were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing sapota was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.14.

The highly suitable (Class S1) lands for growing sapota cover about 46 ha (13%) area and are distributed in the western, northern and eastern part of the microwatershed. Moderately suitable (Class S2) lands are found to occur in an area of about 20 ha (6%) and are distributed in the western and central part of the microwatershed. They have minor limitations of rooting depth. The marginally suitable (Class S3) lands cover a maximum area of about 147 ha (43%) and are distributed in the major part of the microwatershed. They have moderate limitations of texture and rooting depth. An area of 93 ha (27%) is currently not suitable (Class N1) and are distributed in the central, southwestern and southern part of the microwatershed.

Table 7.13 Land suitability criteria for Sapota

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	33-36 24-27	37-42 20-23	>42 <18
Soil moisture	Growing period	Days	>150	120-150	90-120	<120
Soil aeration	Soil drainage	class	Well drained	Moderately well drained	Imperfectly drained	Poorly drained
Nutrient availability	Texture	Class	scl, l, cl, sil	sl, sicl, sc	c (<60%)	ls, s, c (>60%)
	pH	1:2.5	6.0-7.5	7.6-8.0 5.0-5.9	8.1-9.0 4.5-4.9	>9.0 <4.5
	$CaCO_3$ in root zone	%	Non calcareous	<10	10-15	>15
Rooting conditions	Soil depth	cm	>150	75-150	50-75	<50
	Gravel content	% vol.	Non gravelly	<15	15-35	<35
Soil toxicity	Salinity	dS/m	Non saline	Up to 1.0	1.0-2.0	2.0-4.0
	Sodicity	%	Non sodic	10-15	15-25	>25
Erosion	Slope	%	<3	3-5	5-10	>10

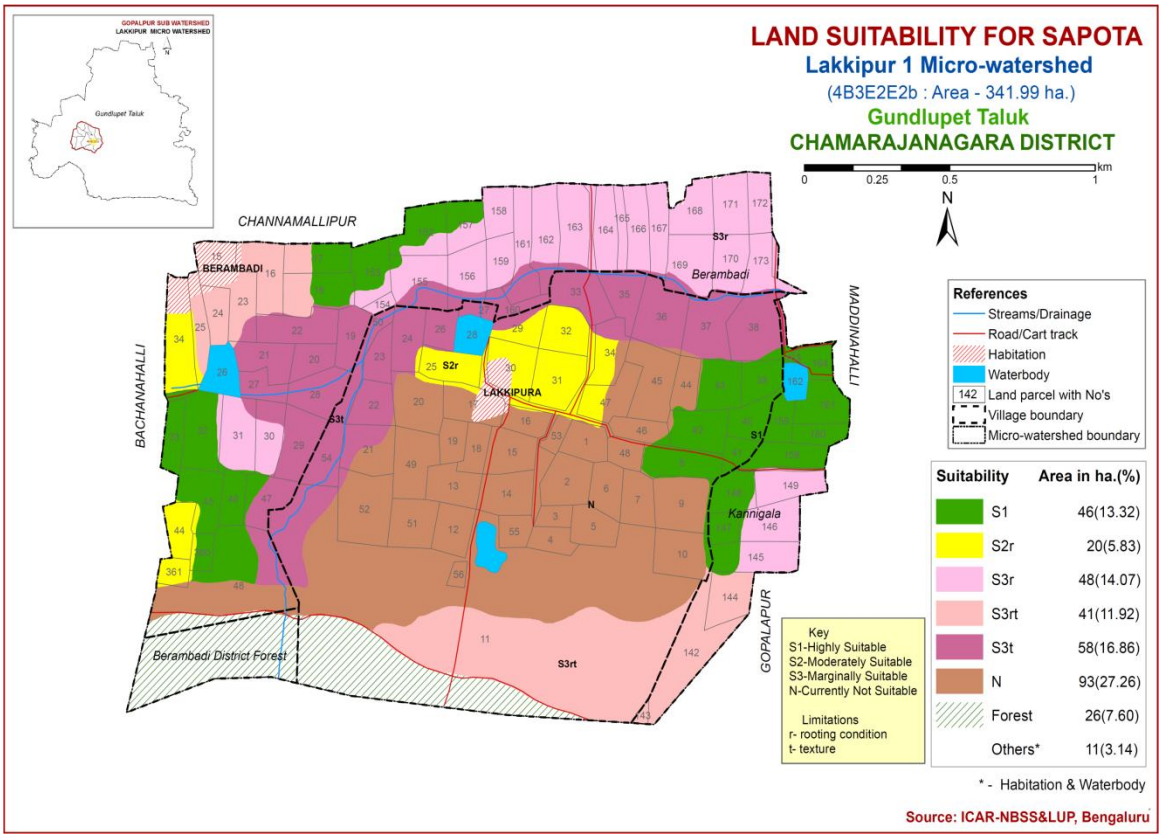


Fig. 7.14 Land Suitability map of Sapota

7.15 Land suitability for Guava (*Psidium guajava*)

Guava is one of the most important fruit crop grown in an area of 0.64 lakh ha in almost all the districts of the State. The crop requirements (Table 7.15) for growing guava were matched with the soil-site characteristics (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 are given in Figure 7.15.

The highly suitable (Class S1) lands for growing guava cover about 60 ha (18%) area and are distributed in all parts of the microwatershed. Marginally suitable (Class S3) lands cover a major area of about 153 ha (45%) and are distributed in the major part of the microwatershed. They have moderate limitations of rooting depth and texture. About 93 ha (27%) area is currently not suitable (Class N1) for growing guava and is distributed in the central, southwestern and southern part of the microwatershed.

Table 7.14 Land 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

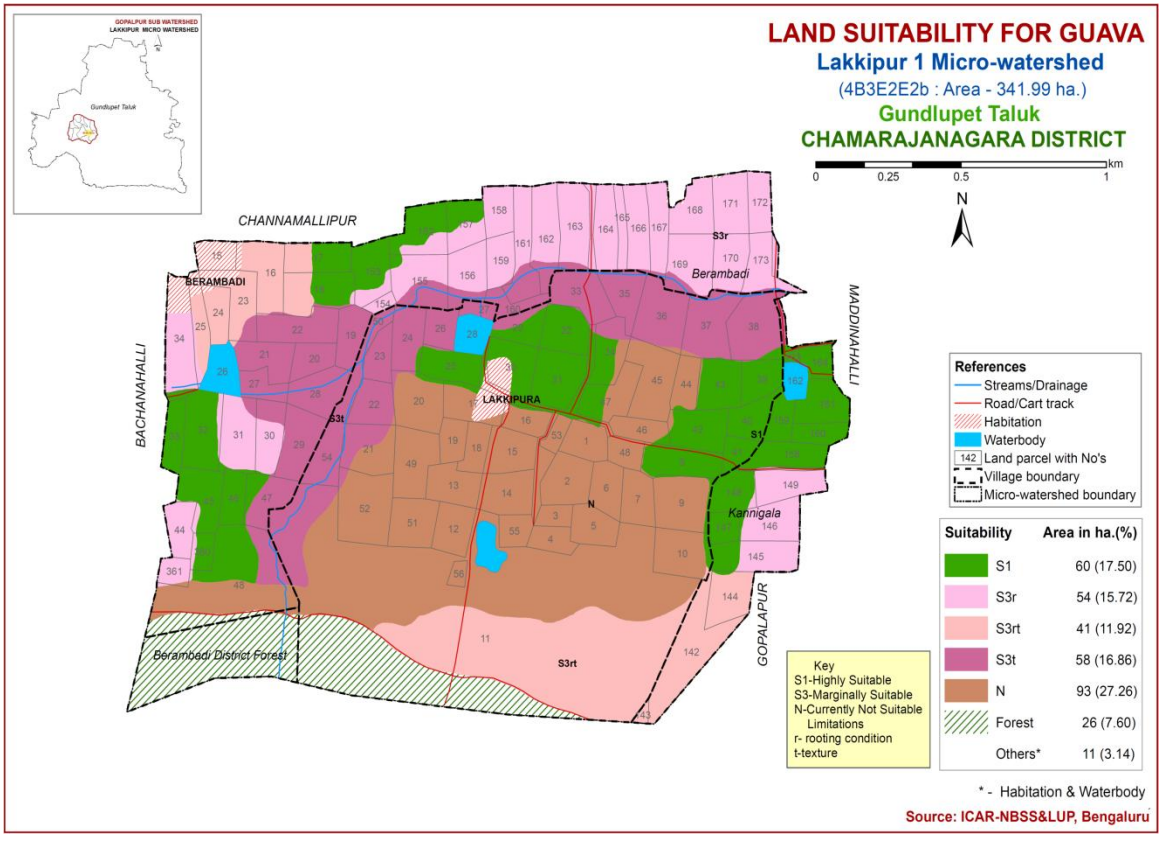


Fig. 7.15 Land Suitability map of Guava

7.16 Land Suitability for Banana (*Musa paradisiaca*)

Banana is one of the major fruit crop grown in an area of 1.02 lakh ha in Karnataka State. The crop requirements for growing banana (Table 7.16) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map for growing banana was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.16.

The highly suitable (Class S1) lands for growing banana cover about 33 ha (10%) area and are distributed in the western and northern part of the microwatershed. Moderately suitable (Class S2) lands are found to occur in an area of about 78 ha (23%) and are distributed in the western, central and eastern part of the microwatershed. They have minor limitations of gravelliness, texture and drainage. The marginally suitable (Class S3) lands cover an area of about 57 ha (17%) and are distributed in the northern, northwestern, western and eastern part of the microwatershed. They have moderate limitations of rooting depth and gravelliness. Currently not suitable (Class N1) lands cover a maximum area of 139 ha (40%) and are distributed in the major part of the microwatershed with severe limitations of rooting depth, gravelliness, topography and texture.

Table 7.15 Land suitability criteria for Banana

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	26-33	34-36 24-25	37-38	>38
Soil aeration	Soil drainage	Class	Well drained	Moderately to imperfectly drained	Poorly drained	Very poorly drained
Nutrient availability	Texture	Class	l,cl, scl,sil	sicl, sc, c(<45%)	c (>45%), sic, sl	ls, s
	pH	1:2.5	6.5-7.0	7.1-8.5 5.5-6.4	>8.5 <5.5	
Rooting conditions	Soil depth	cm	>125	76-125	50-75	<50
	Stoniness	%	<10	10-15	15-35	>35
Soil toxicity	Salinity	dS/m	<1.0	1-2	>2	
	Sodicity	%	<5	5-10	10-15	>15
Erosion	Slope	%	<3	3-5	5-15	>15

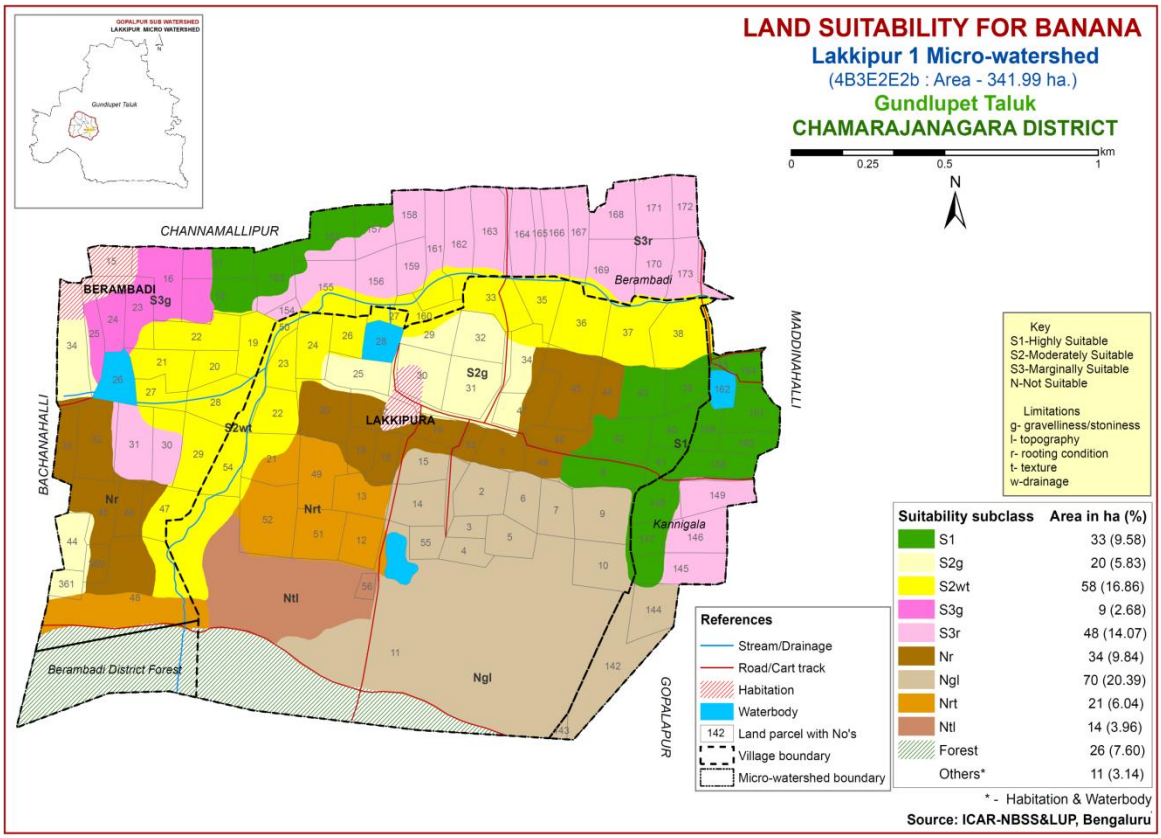


Fig. 7.16 Land Suitability map of Banana

7.17 Land Suitability for Jackfruit (*Artocarpus heterophyllus*)

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

The highly suitable (Class S1) lands for growing jackfruit cover about 46 ha (13%) and are distributed in the western, northern and eastern part of the microwatershed. An area of 14 ha (4%) is moderately suitable (Class S2) for jackfruit and are distributed in the central part of the microwatershed with minor limitations of rooting depth. Marginally suitable (Class S3) lands cover a maximum area of about 153 ha (45%) and are distributed in the major part of the microwatershed. They have moderate limitations of texture and rooting depth. About 93 ha (27%) is currently not suitable (Class N1) for growing jackfruit and are distributed in the southwestern and central part of the microwatershed.

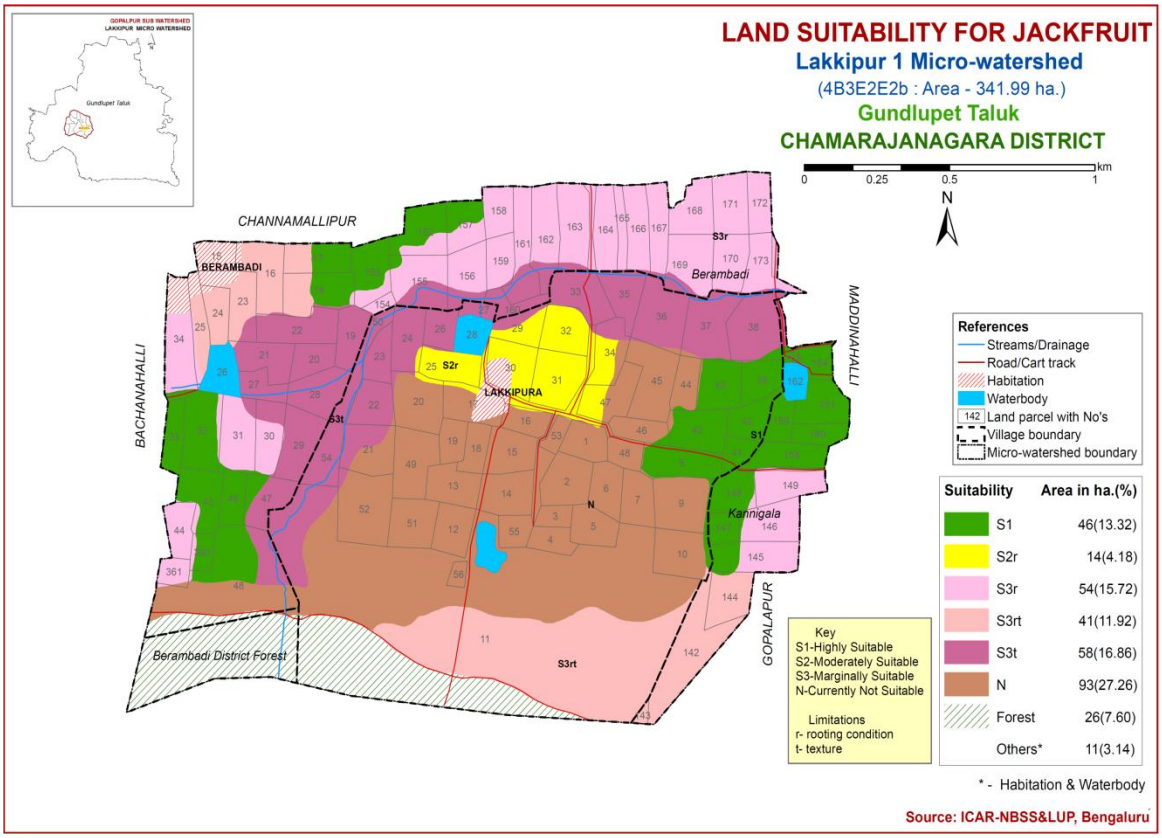


Fig. 7.17 Land Suitability map of Jackfruit

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 were matched with the soil-site characteristics 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.

The highly suitable (Class S1) lands for growing jamun cover about 46 ha (13%) and are distributed in the western, northern and eastern part of the microwatershed. An area of 14 ha (4%) is moderately suitable (Class S2) and are distributed in the central part of the microwatershed. They have minor limitation of rooting depth. Marginally suitable (Class S3) lands cover a major area of about 153 ha (45%) and are distributed in the major part of the microwatershed. They have moderate limitations of texture and rooting depth. An area of about 93 ha (27%) is currently not suitable (Class N1) and are distributed in the western and central part of the microwatershed.

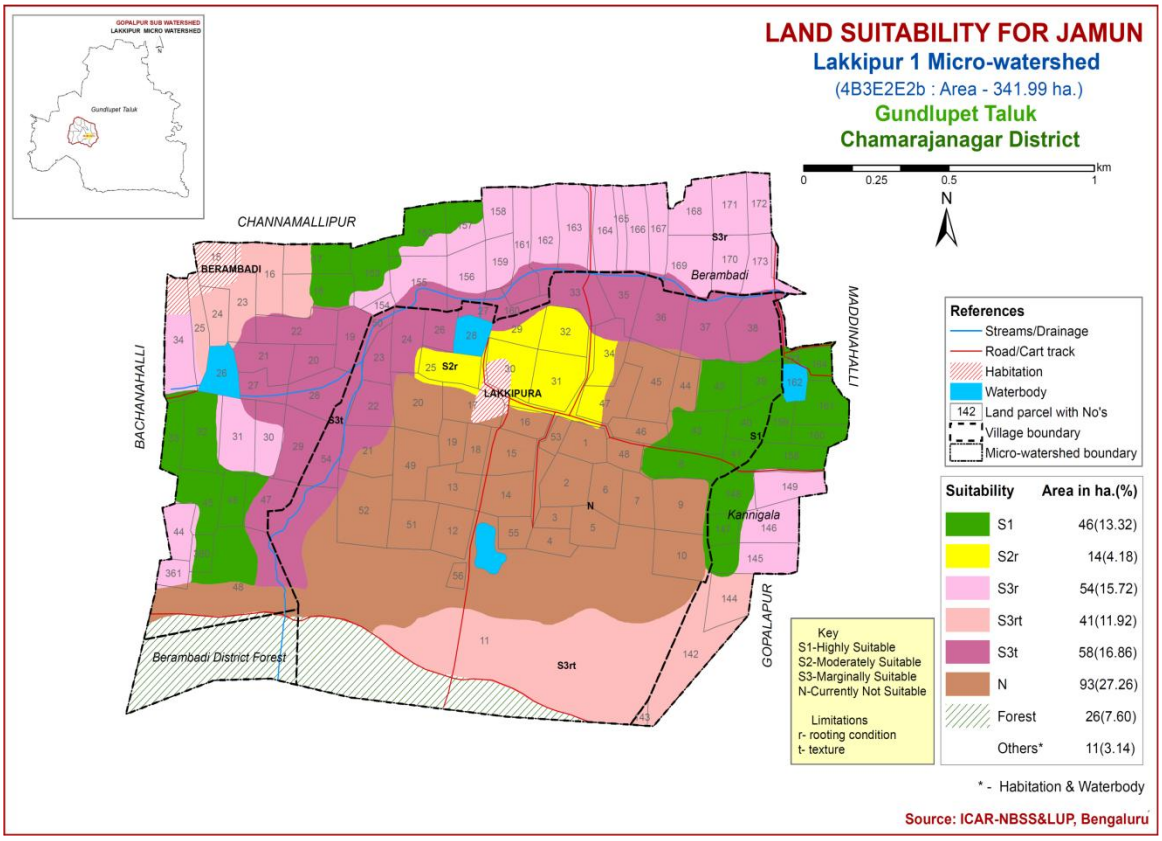


Fig. 7.18 Land Suitability map of Jamun

7.19 Land Suitability for Musambi (*Citrus limetta*)

Musambi is one of the most important fruit crop grown in 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.

The highly suitable (Class S1) lands for growing Musambi cover a maximum of about 103 ha (30%) and are distributed in the major part of the microwatershed. An area of 14 ha (4%) is moderately suitable (Class S2) and are distributed in the central part of the microwatershed with minor limitation of rooting depth. Marginally suitable (Class S3) lands cover an area of about 95 ha (28%) and are distributed in all parts of the microwatershed. They have moderate limitations of texture and rooting depth. An area of about 93 ha (27%) is currently not suitable (Class N1) and are distributed in the southwestern and central part of the microwatershed.

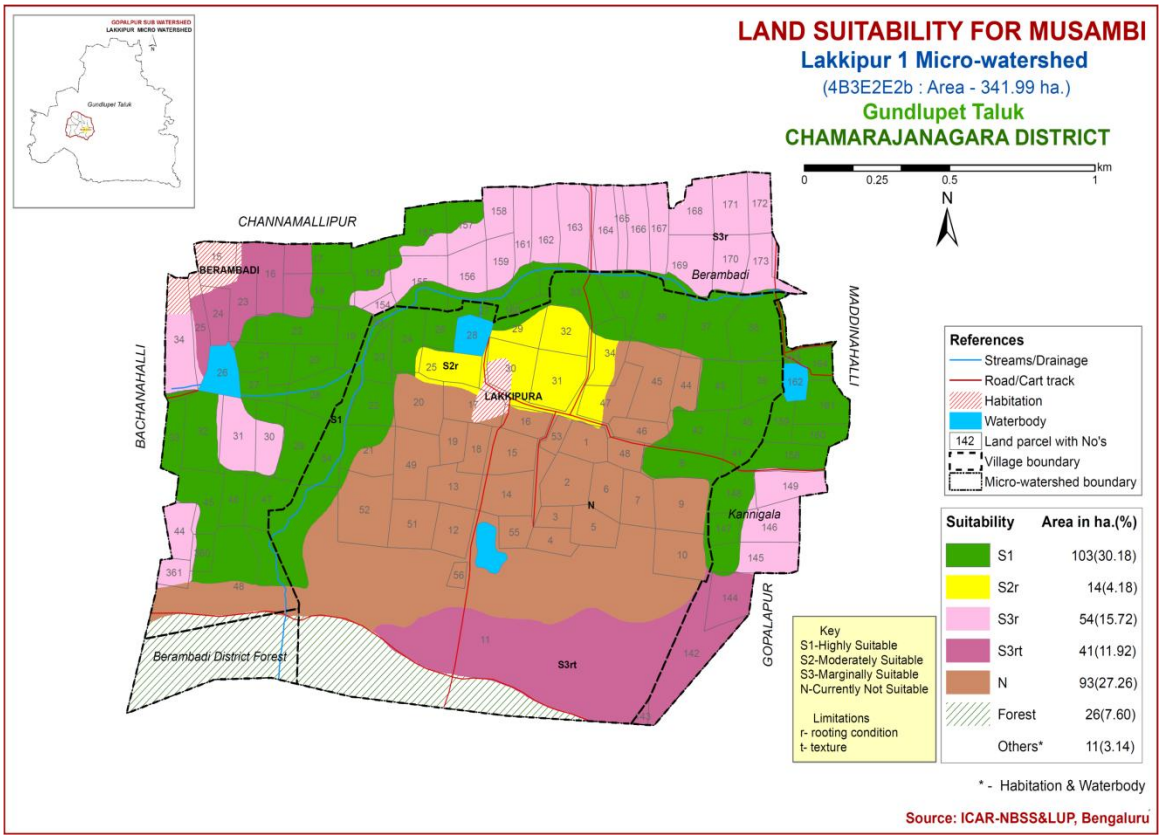


Fig. 7.19 Land Suitability map of Musambi

7.20 Land Suitability for Lime (*Citrus sp*)

Lime is one of the most important fruit crop grown in an area of 0.11 lakh ha in almost all the districts of the state. The crop requirements for growing lime (Table 7.17) 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.

The highly suitable (Class S1) lands for growing lime cover a maximum area of about 103 ha (30%) and are distributed in the major part of the microwatershed. An area of 14 ha (4%) is moderately suitable (Class S2) and are distributed in the central part of the microwatershed with minor limitation of rooting depth. The marginally suitable (Class S3) lands cover an area of about 95 ha (28%) and are distributed all parts of the microwatershed. They have moderate limitations of texture and rooting depth. An area of about 93 ha (28%) is currently not suitable (Class N1) and are distributed in the southwestern and central part of the microwatershed.

Table 7.16 Land suitability criteria for Lime

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

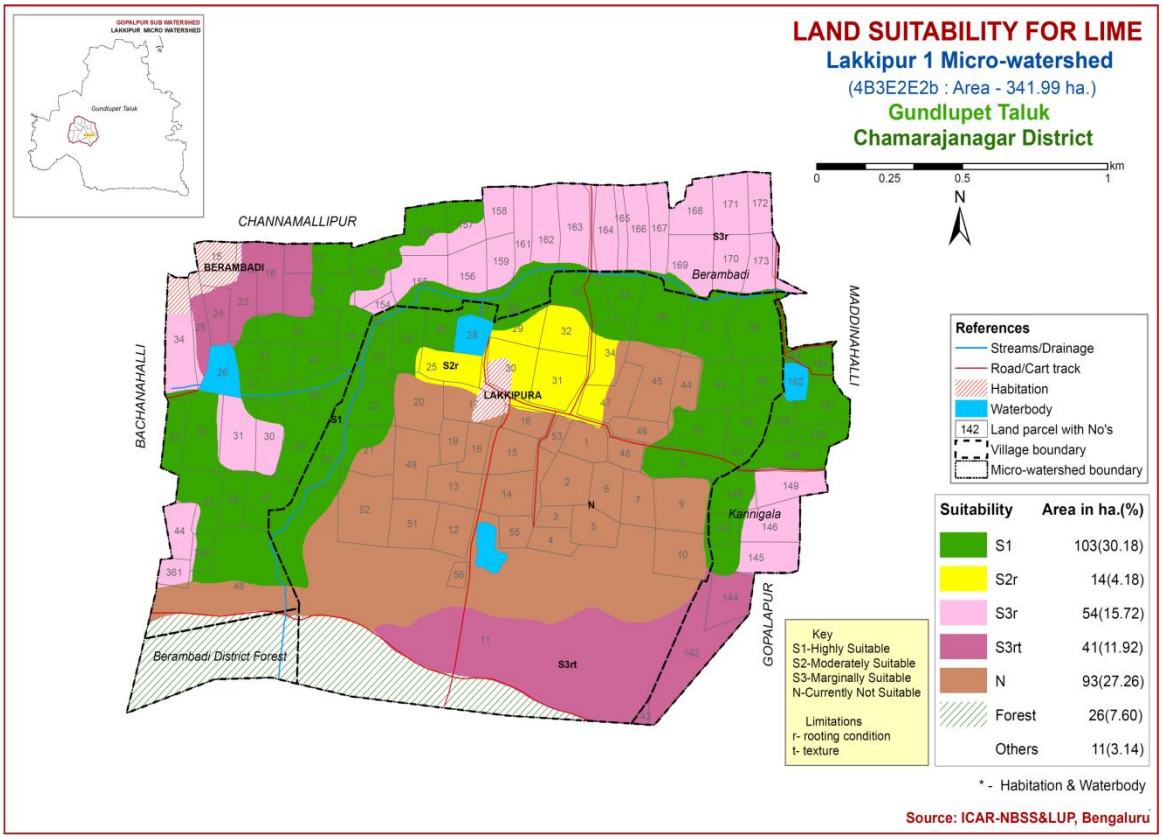


Fig. 7.20 Land Suitability map of Lime

7.21 Land Suitability for Cashew (*Anacardium occidentale)*

Cashew is one of the most important plantation nut crop grown in an area of 1.24 lakh ha in almost all the districts. The crop requirements for growing Cashew were matched with the soil-site characteristics 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.

The highly suitable (Class S1) lands for growing cashew cover about 46 ha (13%) area and are distributed in the western, northern and eastern part of the microwatershed. Marginally suitable (Class S3) lands cover an area of about 109 ha (32%) and are distributed in all parts of the microwatershed. They have moderate limitations of texture and rooting depth. Maximum area of 151 ha (44%) is currently not suitable (Class N1) for growing cashew and are distributed in the major part of the microwatershed.

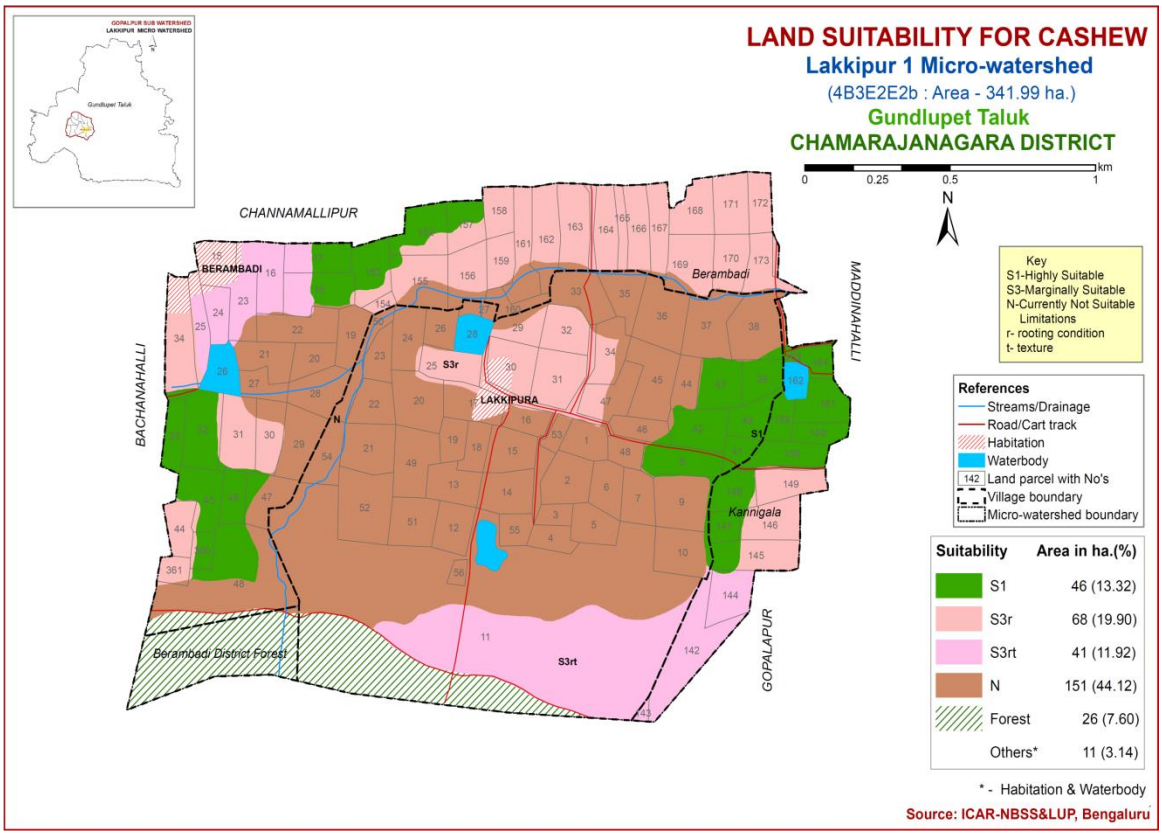


Fig. 7.21 Land Suitability map of Cashew

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

Custard apple is one of the most important fruit crop grown in almost all the districts of the state. The crop requirements for growing custard apple were matched with the soil-site characteristics 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 7.21.

The highly suitable (Class S1) lands for growing custard apple cover about 118 ha (34%) area and are distributed in all parts of the microwatershed. Moderately suitable

(Class S2) lands occur in a maximum area of about 145 ha (42%) and are distributed in the major part of the microwatershed. They have minor limitations of rooting depth and gravelliness. An area of 43 ha (13%) is marginally suitable (Class S3) and are distributed in the northwestern, southwestern and central part of the microwatershed with moderate limitation of rooting depth.

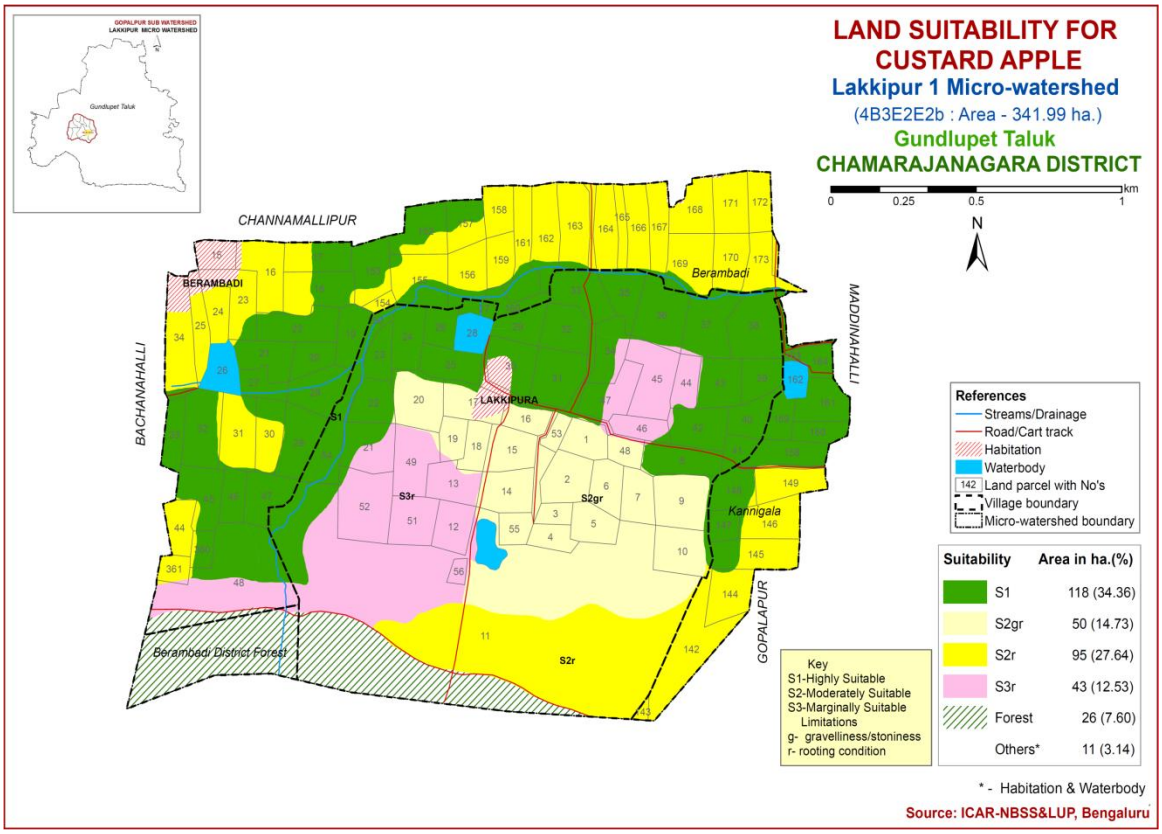


Fig. 7.22 Land Suitability map of Custard Apple

7.23 Land Suitability for Amla (*Phyllanthus emblica*)

Amla is one of the most important medicinal fruit crop grown in almost all the districts of the state. The crop requirements for growing amla were matched with the soil-site characteristics 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.

The highly suitable (Class S1) lands for growing amla cover about 118 ha (34%) and are distributed in all parts of the microwatershed. The moderately suitable (Class S2) lands are found to occur in a maximum area of about 153 ha (45%) and are distributed in the major part of the microwatershed. They have minor limitations of rooting depth and gravelliness. An area of 34 ha (10%) is marginally suitable (Class S3) and are distributed in the northwestern, central and southwestern part of the microwatershed with moderate limitation of rooting depth.

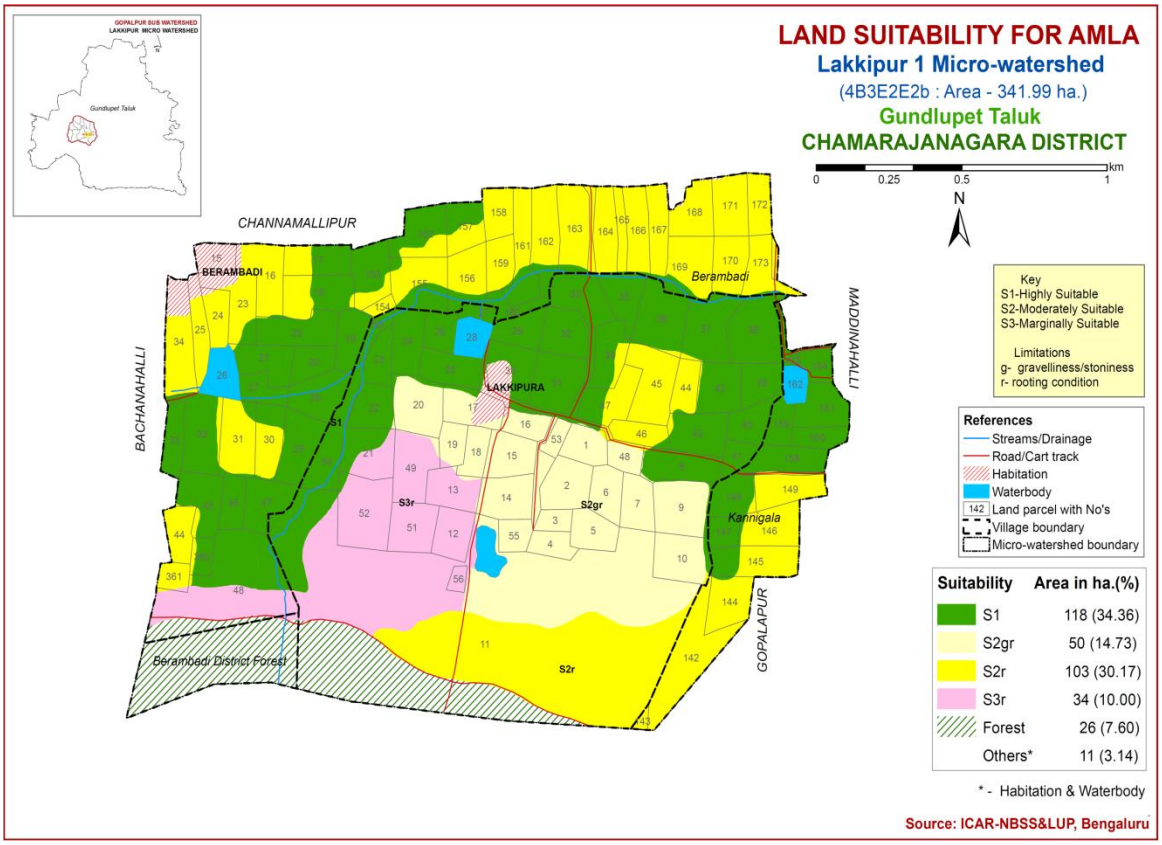


Fig. 7.23 Land Suitability map of Amla

7.24 Land Suitability for Tamarind (*Tamarindus indica*)

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

The highly suitable (Class S1) lands for growing tamarind cover about 46 ha (13%) area and are distributed in the western, northern and eastern part of the microwatershed. Small area of 14 ha (4%) is moderately suitable (Class S2) and are distributed in the central part of the microwatershed. They have minor limitation of rooting depth. Marginally suitable (Class S3) lands cover a maximum area of about 153 ha (45%) and are distributed in the major part of the microwatershed. They have moderate limitations of texture and rooting depth. An area of 93 ha (27%) is currently not suitable (Class N1) and are distributed in the southwestern and central part of the microwatershed.

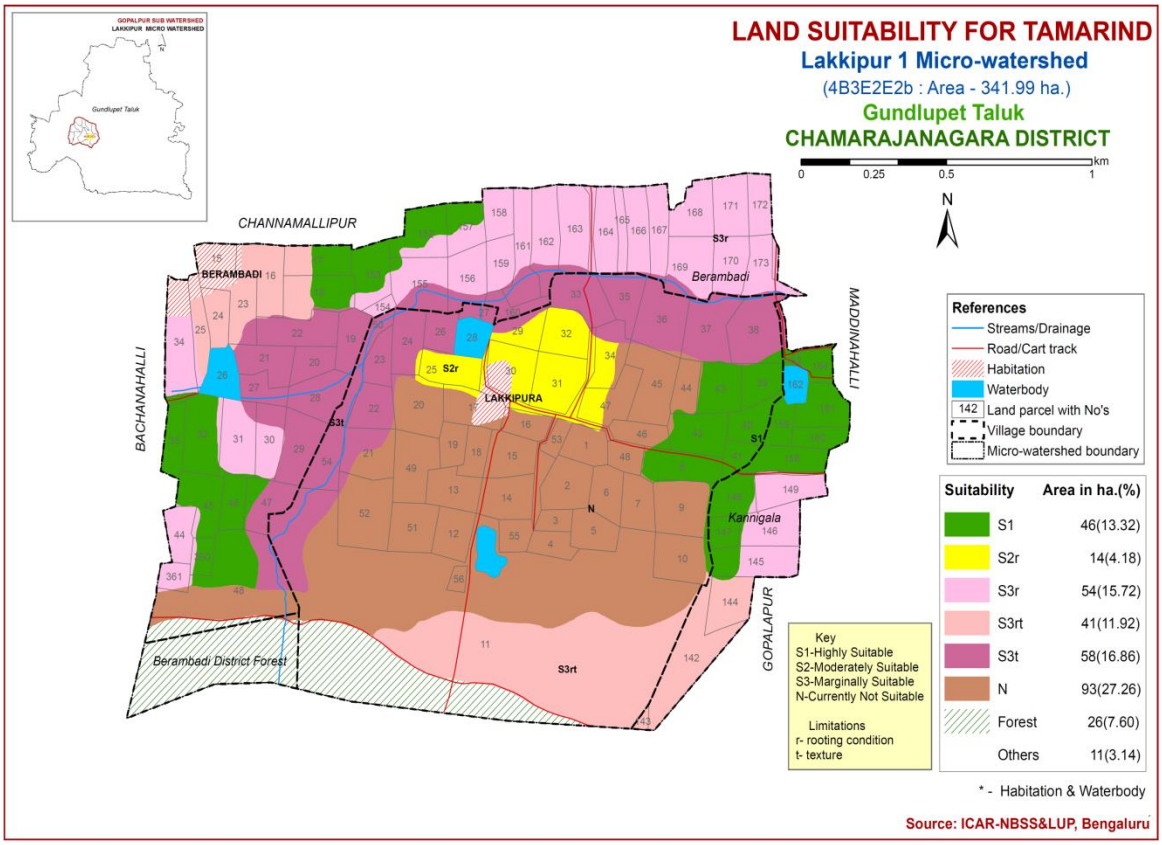


Fig. 7.24 Land Suitability map of Tamarind

7.25 Land Suitability for Marigold (*Tagetes erecta*)

Marigold is one of the most important flower crop grown in an area of 1858 ha in almost all the districts of the State. The crop requirements (Table 7.18) for growing marigold were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing marigold was prepared. The area extent and their geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.25.

The highly suitable (Class S1) lands for growing marigold cover about 53 ha (15%) area and are distributed in the western, central, northern and eastern part of the microwatershed. Moderately suitable (Class S2) lands are found to occur in an area of about 106 ha (31%) and are distributed in all parts of the microwatershed. They have minor limitations of rooting depth, texture and drainage. Maximum area of 115 ha (34%) is under marginally suitable (Class S3) and are distributed in the major part of the microwatershed with moderate limitations of rooting depth, gravelliness, topography and texture. Currently not suitable (Class N1) lands occur in an area of 32 ha (9%) and are distributed in the southern part of the microwatershed with severe limitations of gravelliness and topography.

Table 7.17 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	^{0}C	18-23	17-15 24-35	35-40 10-14	>40 <10
Soil aeration	Soil drainage	Class	Well drained	Moderately well drained	Imperfectly drained	Poorly drained
Nutrient availability	Texture	Class	l ,sl, scl, cl, sil	sicl, sc, sic, c	c	ls, s
	pH	1:2.5	7.0-7.5	5.5-5.9 7.6-8.5	<5 >8.5	-
	$CaCO_3$ in root zone	%	Non calcareous	Slightly calcareous	Strongly calcareous	-
Rooting conditions	Soil depth	cm	>75	50-75	25-50	<25
	Gravel content	% vol.	<15	15-35	>35	-
Soil toxicity	Salinity	ds/m	Non saline	Slightly	Strongly	-
	Sodicity (ESP)	%	<10	10-15	>15	-
Erosion	Slope	%	1-3	3-5	5-10	-

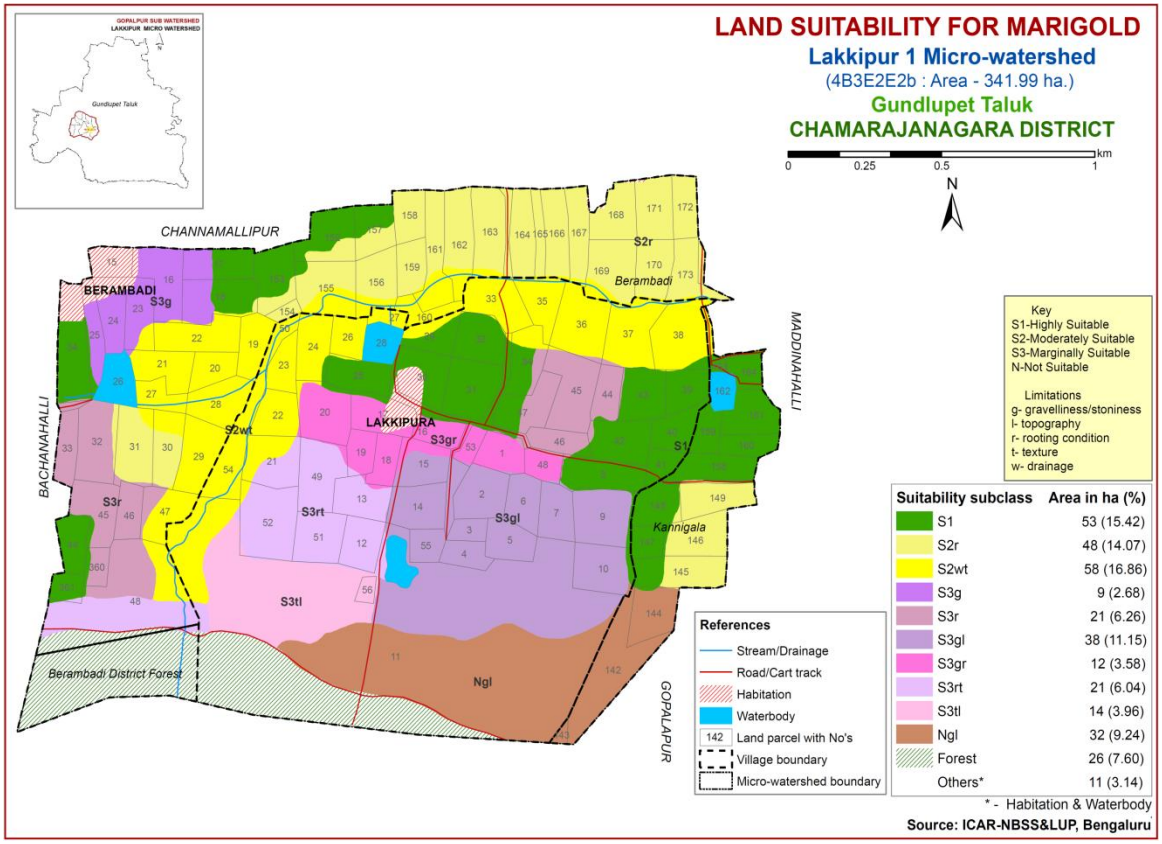


Fig. 7.25 Land Suitability map of Marigold

7.26 Land Suitability for Chrysanthemum (*Chrysanthemum indicum*)

Chrysanthemum is one of the most important flower crop grown in an area of 803 ha in almost all the districts of the State. The crop requirements (7.19) for growing chrysanthemum 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.

The highly suitable (Class S1) lands for growing chrysanthemum covers an area of about 33 ha (10%) and are distributed in the northern and eastern part of the microwatershed. Moderately suitable (Class S2) lands are found to occur in a major area of about 126 ha (37%) and are distributed in the major part of the microwatershed. They have minor limitations of gravelliness, rooting depth, texture and drainage. An area of 115 ha (34%) is marginally suitable (Class S3) and are distributed in all parts of the microwatershed with moderate limitations of gravelliness, rooting depth, topography and texture. Currently not suitable (Class N1) lands occupy an area of 32 ha (9%) and are distributed in the southern part of the microwatershed with severe limitations of gravelliness and topography.

Table 7.18 Land suitability criteria for Chrysanthemum

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

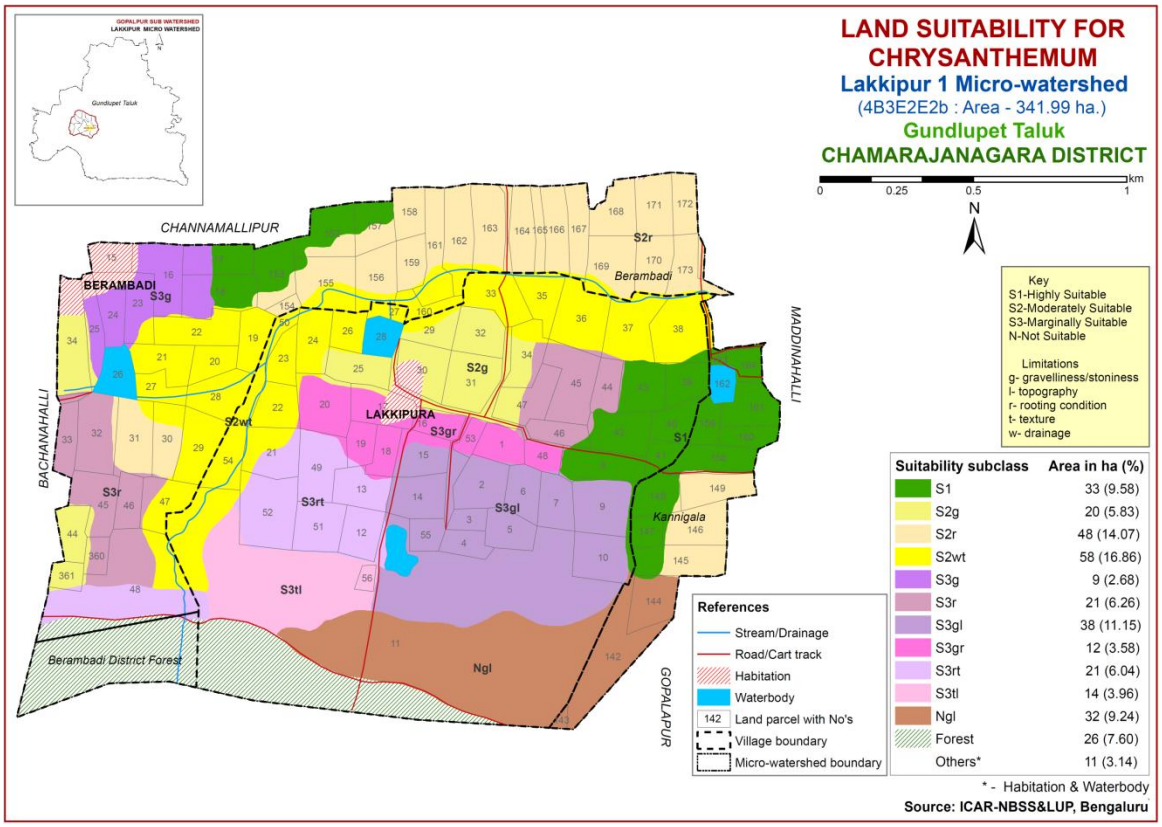


Fig. 7. 26 Land suitability map of Chrysanthemum

7.27 Land Suitability for Turmeric (*Curcuma longa*)

Turmeric is one of the most important spice crop grown in an area of 1.39 lakh ha in almost all the districts of the State. The crop requirements for growing turmeric (Table 7.12) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map for growing turmeric was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.27.

The highly suitable (Class S1) lands for growing turmeric cover an area about 33 ha (10%) and are distributed in the northern and eastern part of the microwatershed. The moderately suitable (Class S2) lands are found to occur in an area of about 68 ha (20%) and are distributed in the northern, western and eastern part of the microwatershed. They have minor limitations of gravelliness and rooting depth. The marginally suitable (Class S3) lands cover maximum area of about 173 ha (51%) and occur in the major part of the microwatershed. They have moderate limitations of gravelliness, drainage, rooting depth, topography and texture. Currently not suitable (Class N1) lands occur in an area of 32 ha (9%) and are distributed in the southern part of the microwatershed with gravelliness and topography.

Table 7.19 Land suitability criteria for Turmeric

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	20-27 33-37	10-19 38-40	<10 >40
Soil aeration	Soil drainage	class	Well drained	Mod. well drained	Imperfectly drained	Poorly drained
Nutrient availability	Texture	class	l, cl, scl, sl	Sc, sic, sicl	c(40-60%), ls	Stony heavy clay>60%
	pH	1:2.5				
	Available nutrient status (NPK)	Fertility rating class	high	medium	low	
Rooting conditions	Soil depth	cm	>75	50-75	25-50	<25
Erosion	Slope	%	<3	3-8	8-15	>15mm

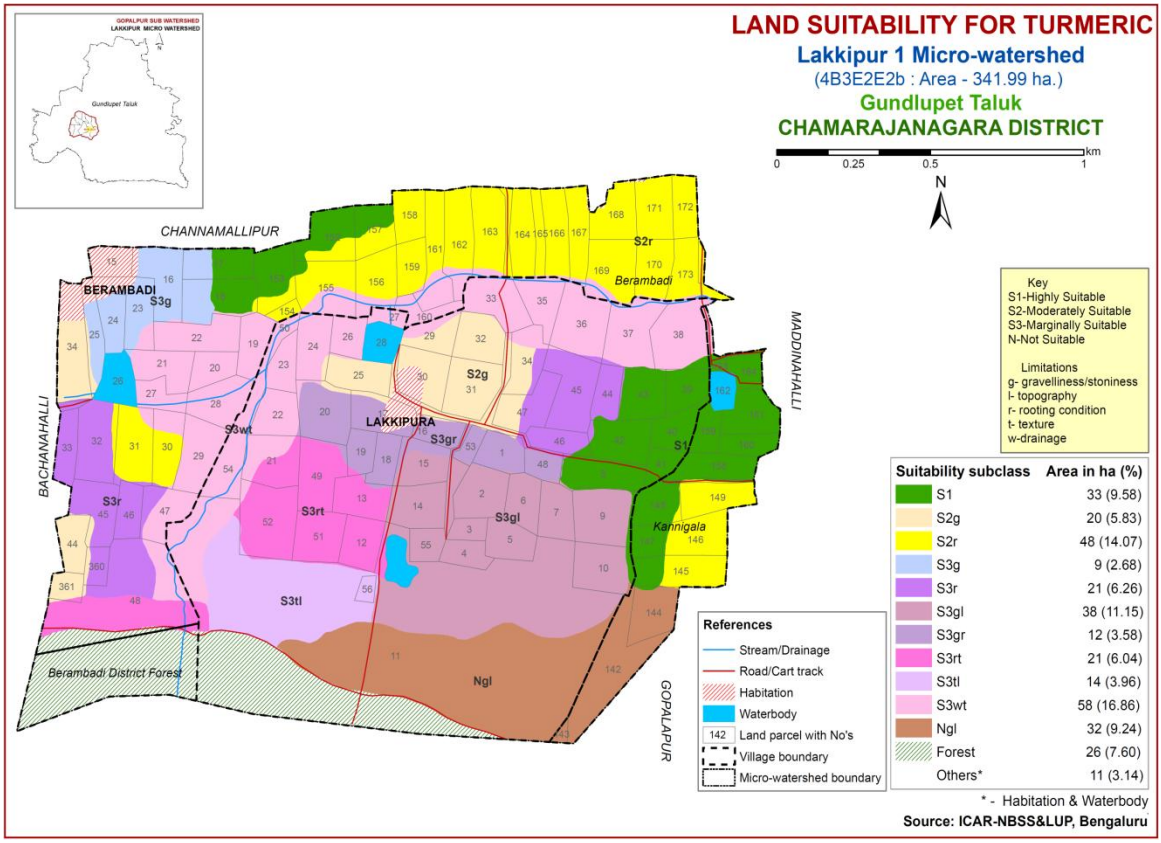


Fig. 7.27 Land Suitability map of Turmeric

7.28 Land Management Units (LMUs)

The 21 soil map units identified in Lakkipur-1 Microwatershed have been regrouped into 8 Land Management Units (LMU's) 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. 7.28) has been generated. These Land Management Units are expected to behave similarly for a given level of management.

The map units that have been grouped into 8 land management units along with brief description of soil and site characteristics are given below.

LMUs	Soil map units number	Mapping unit	Soil and site characteristics
1	1, 11, 12	ARKiB2, HGHhB2, HGHmB1	Very deep (>150 cm), 1-3% slopes, slight to moderate erosion, non gravelly soils.
2	2, 3	BMBhB1, BMBmB2	Very deep (>150 cm), 1-3% slopes, slight to moderate erosion, non gravelly soils.
3	16	KLPhB1	Deep (100-150 cm), 1-3% slopes, slight erosion, non gravelly soils.
4	8, 9	GPRhB1g1, GPRiB1	Moderately deep (75-100 cm), 1-3% slopes, slight erosion, non gravelly to gravelly soils.
5	7, 13, 14, 15, 18	DRHiB2, HPRcB1g1, HPRhB1, HPRiB1, MGHiB1	Moderately shallow (50-75 cm), 1-3% slopes, slight to moderate erosion, non gravelly to gravelly soils.
6	4, 5, 6	BMDcC2g1, BMDcD2g1, BMDhC2g1	Shallow (25-50 cm), 3-10 slopes, moderate erosion, gravelly soils.
7	10	HDRhB1	Shallow (25-50 cm), 1-3 slopes, slight erosion, non gravelly soils.
8	19, 20, 21, 17	SPRcC2g1, SPRcD2g1, SPRhB2g1, MGHhE2g1	Shallow to moderately shallow (25-75 cm), 3-15 slopes, moderately eroded, gravelly soils.

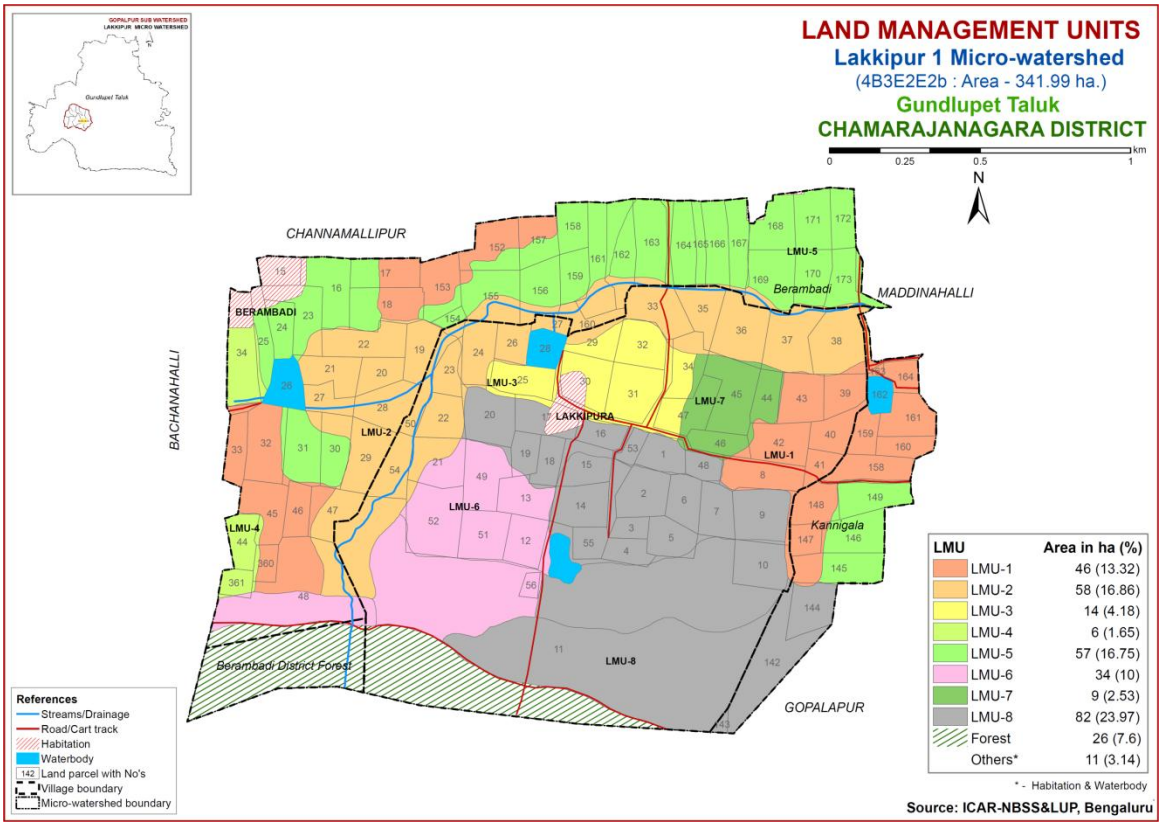


Fig. 7.28 Land Management Units Map- Lakkipur-1 Microwatershed

After assessing the land suitability for the 27 major crops, the proposed crop plan has been generated for the 8 identified LMUs by considering only the highly (Class S1) and moderately (Class S2) suitable lands for each of the 27 crops. The resultant proposed crop plan is presented below in Table 7.20.

Table 7.20 Proposed Crop Plan for Lakkipur-1 Microwatershed

LMU	Mapping Units	Survey Number	Field Crops/Forestry	Suitable Horticulture Crops under Irrigation	Horticulture Crops with suitable Interventions	Suitable Interventions
1	ARKiB2, HGHhB2, HGHmB1	**Berambadi**:152,153,157,17,18,32,33, 360,45,46 **Kannigala:**147,148,158,159,160,161,163,164 **Lakkipura:**8,39,40,41,42,43,	Maize, Sorghum, Redgram, Cotton, Sugarcane, Sunflower, **Multiple crop rotation:** Redgram+Maize Redgram+Groundnut Pulses+Ragi Pulses+Sorghum	Mango, Sapota, Guava, Turmeric, Banana, Lime, Tomato, Beans, Bhendi	**Flower crops:** Marigold, Chrysanthemum **Perennial components:** Mango, Sapota, Custard apple, Amla, Lime, Musambi. **Vegetables:** Chilli, Bhendi	Drip irrigation, Mulching, crop suitable conservation practices
2	BMBhB1, BMBmB2	**Berambadi:**160,19,20,21,22,27,28,29,47 **Lakkipura:**22,23,24,26, 27,33,35,36,37,38,50,54	Sorghum, Redgram, Cotton, Sunflower, Sugarcane **Multiple crop rotation:** Redgram+Fodder sorghum Pulses+Sorghum	**Vegetables:** Beetroot, Banana, Lime, Tomato, Beans, Bhendi	**Flower crops:** Marigold, Chrysanthemum **Perennial components:** Custard apple, Amla, Lime, **Vegetables:** Chilli, Bhendi	Drip irrigation, Mulching, crop suitable conservation practices
3	KLPhB1	**Lakkipura:**25,29,30,31, 32,34	Maize, Sorghum, Redgram, Cotton, Sugarcane, Sunflower **Multiple crop rotation:** Redgram+Maize Redgram+Groundnut Pulses+Sorghum	**Vegetables:** Tomato, Beetroot, Potato, Beans, Bhendi, Turmeric	**Perennial components:** Sapota, lime **Flower crops:** Marigold, Chrysanthemum **Vegetables:** Chilli, Bhendi	Drip irrigation, Mulching, Crop suitable conservation practices
4	GPRhB1g1, GPRiB1	**Berambadi:**34,361,44	Maize, Sorghum, Cotton, Ragi, Sunflower, Pulses+Sorghum	Fieldbean, Beetroot, Onion, Turmeric, Tomato	**Perennial components:** Sapota, Guava **Flower crops:** Marigold, Chrysanthemum	Drip irrigation, Mulching, Crop suitable conservation

					Vegetables: Bhendi, Chilli	practices
5	DRHiB2, HPRcB1g1, HPRhB1, HPRiB1, MGHiB1	**Berambadi:**23,24,25,30,31,154,155,156,158,159,16,161,162,163,164,165,166,167,168,169,170,171,172,173 **Kannigala:**145,146,149	Ragi, Groundnut, Maize, Sorghum, Cotton, Pulses+Sorghum	Fieldbean, Beetroot, Onion, Turmeric, Tomato, Banana	Custard apple, Ber, Aonla **Flower crops:** Marigold, Chrysanthemum, Gaillardia **Vegetables:** Bhendi, Cluster bean	Drip irrigation, Mulching, Crop suitable conservation practices
6	BMDcC2g1, BMDcD2g1, BMDhC2g1	**Berambadi:**48 **Lakkipura:**12,13,21,49,51,52,56	Bengal gram, Horsegram	Custard apple, Amla	Custard apple, Ber	Drip irrigation, Mulching, Crop suitable conservation practices
7	HDRhB1	**Lakkipura:** 44,45,46,47	Groundnut, Horsegram	Custard apple, Amla	Custard apple, Ber	Drip irrigation, Mulching, Crop suitable conservation practices
8	SPRcC2g1, SPRcD2g1, SPRhB2g1, MGHhE2g1	**Kannigala:**142,143,144 **Lakkipura:**1,2,6,7,9,10,11,14,15,16,17,18,19,20,3,4,48,5,53,55	Groundnut, Horsegram **Silviculture:** *Acasia auriculiformis, Glycirdia, Simaruba, Agave, Cassia* **Grasses**: *Styloxanthes hamata, Styloxanthes scabra, Styloxanthus hamata, Khus grass*	Custard apple, Amla	Custard apple, Ber	Drip irrigation, Mulching, Crop suitable conservation practices

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 Lakkipur-1 Microwatershed

- The soil phases identified in the microwatershed belonged to the soil series of BMB (58 ha), SPR (50 ha), MGH (41 ha), HPR (41 ha), BMD (34 ha), ARK (25 ha), HGH (21 ha), KLP (14 ha), HDR (9 ha), DRH (7 ha) and GPR (6 ha).
- As per land capability classification, about 71 per cent area in the microwatershed falls under arable land category (Class II, III and IV). The major limitations identified in the arable lands were soil, wetness and erosion. Non arable lands occupy in 19 per cent area of the microwatershed with major limitations of soil and erosion.

- ❖ On the basis of soil reaction, an area of about 49 ha (14%) is strongly acid (pH 5.0-5.5), 56 ha (16%) is moderately acid (pH 5.5-6.0), 80 ha (23%) is slightly acid (pH 6.0-6.5), 112 ha (33%) is neutral (pH 6.5-7.3) and 9 ha (3%) is slightly alkaline (pH 6.0-6.5).

Soil Health Management

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

Acid soils

Acid soils occupy an area of about 185 ha in the microwatershed. The following measures recommended for reclaiming acid soils

1. Growing of crops suitable for a particular soil pH.
2. Ameliorating the soils through the application of amendments (liming materials).

Liming materials:

1. $CaCO_3$ (Calcium Carbonate). More than 90% use in India.
2. Dolomite [Ca Mg $(Co_3)_2$]
3. Quick lime (Cao)
4. Slaked lime [Ca $(OH)_2$]

For normal pH and pH-4.8 (35 t/ha) and pH 6 .0-7.0 (4 t/ha) lime is required

Alkaline soils

Slightly alkaline soils cover about 9 ha in the microwatershed.

1. Regular addition of organic manure, green manuring, green leaf manuring, crop residue incorporation and mulching needs to be taken up to improve the soil organic matter status.
2. Application of biofertilizers (Azospirullum, 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

Neutral soils cover 112 ha area in the microwatershed.

1. Regular addition of organic manure, green manuring, green leaf manuring, crop residue incorporation and mulching needs to be taken up to improve the soil organic matter status.
2. Application of biofertilizers, (Azospirullum, Azotobacter, Rhizobium).
3. Application of 100 per cent RDF.
4. Need based micronutrient applications.

Besides the above recommendations, the best transfer of technology options are also to be adopted.

Soil Degradation

Soil erosion is one of the major factor affecting the soil health in the microwatershed. Out of total 342 ha area in the microwatershed, about 113 ha is suffering from slight erosion. About 192 ha are suffering from moderate erosion. These areas need immediate soil and water conservation and, other land development and land husbandry practices for restoring soil health.

Dissemination of Information and Communication of Benefits

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

Inputs for Net Planning and Interventions needed

Net planning in IWMP is focusing on preparation of

1. Soil and Water Conservation Plans for each plot or farm.
2. Productivity enhancement measures/ interventions for existing crops/livestock/other farm enterprises.
3. Diversification of farming mainly with perennial horticultural crops and livestock.
4. Improving livelihood opportunities and income generating activities.

In this connection, how various outputs of Sujala-III are of use in addressing these objectives of Net Planning are briefly presented below.

- **Soil Depth:** The depth of a soil decides the amount of moisture and nutrients it can hold, what crops can be taken up or not, depending on the rooting depth and the length of growing period available for raising any crop. Deeper the soil, better for a wide variety of crops. If sufficient depth is not available for growing deep rooted crops, either choose medium or short duration crops or deeper planting pits need to be opened and additional good quality soil brought from outside has to be filled into the planting pits.
- **Surface Soil Texture:** Lighter soil texture in the top soil means, better rain water infiltration, less run-off and soil moisture conservation, less capillary rise and less evaporation losses. Lighter surface textured soils are amenable to good soil tilth and are highly suitable for crops like groundnut, root vegetables (carrot, raddish, potato etc) but not ideal for crops that need stagnant water like lowland paddy. Heavy textured soils are poor in water infiltration and percolation. They are prone for sheet erosion; such soils can

be improved by sand mulching. The technology that is developed by the AICRP-Dryland Agriculture, Vijayapura, Karnataka can be adopted.

- **Gravelliness:** More gravel content is favorable for run-off harvesting but poor in soil moisture storage and nutrient availability. It is a significant parameter that decides the kind of crop to be raised.
- **Land Capability Classification:** The land capability map shows the areas suitable and not suitable for agriculture and the major constraints in each of the plot/survey number. Hence, one can decide what kind of enterprise is possible in each of these units. In general, erosion and soil are the major constraints in Lakkipur-1 microwatershed.
- **Organic Carbon:** The OC content is medium (0.5-0.75%) in 121 ha (35%). The areas that are medium in OC needs to be further improved by applying farmyard manure and rotating crops with cereals and legumes or mixed cropping. It is high (>0.75%) in an area of 185 ha (54%).
- **Promoting green manuring:** Growing of green manuring crops costs Rs. 1250/ha (green manuring seeds) and about Rs. 2000/ha towards cultivation that totals to Rs. 3250/- per ha. On the other hand, application of organic manure @ 10 tons/ha costs Rs. 5000/ha. The practice needs to be continued for 2-3 years or more. Nitrogen fertilizer needs to be supplemented by 25% in addition to the recommended level in 121 ha area where OC is medium (0.5-0.75%). For example, for rainfed maize, recommended level is 50 kg N per ha and an additional 12 kg /ha needs to be applied for all the crops grown in these plots.
- **Available Phosphorus**: In 57 ha (17%) area, the available phosphorus is low, medium (23-57 kg/ha) in 122 ha (36%) and 126 ha (37%) is high (>57 kg/ha). Hence for all the crops, 25% additional P-needs to be applied, where it is low and medium.
- **Available Potassium:** Available potassium is medium (145-337 kg/ha) in 101 ha (29%) of the microwatershed. Hence, in all the plots where available potassium is medium, for all the crops, additional 25% potassium may be applied. It is high (>337 kg/ha) in 205 ha (60%) area of the microwatershed.
- **Available Sulphur:** Available sulphur is a very critical nutrient for oilseed crops. It is low in an area of 9 ha (3%) and is medium (10-20 ppm) in about 296 ha (87%) area of the microwatershed. 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:** An area of about 80 ha (23%) is low (<0.5 ppm) and about 190 ha (56%) is medium (0.5-1.0 ppm) in available boron content. The areas with low and medium in boron content need to be applied with sodium borate @ 10 kg/ha as soil application or 0.2% borax as foliar spray to correct the deficiency. It is high (>1.0 ppm) in 35 ha (10%) area of the microwatershed.
- **Available Iron:** Available iron is sufficient (>4.5 ppm) in the entire area of the microwatershed.
- **Available manganese**: It is sufficient in the entire area of the microwatershe**d.**
- **Available copper:** It is sufficient in the entire area of the microwatershed**.**

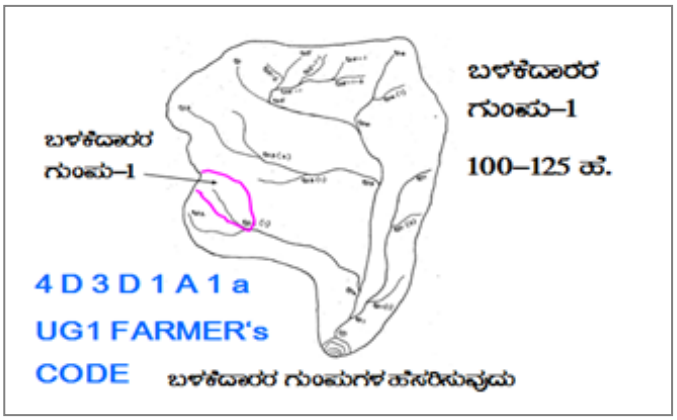
- **Available Zinc:** It is deficient (<0.6 ppm) in 128 ha (38%) and about 177 ha (52%) is sufficient (>0.6 ppm) in the microwatershed. Application of zinc sulphate @ 25 kg/ha is recommended for the deficient areas.

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

SOIL AND WATER CONSERVATION TREATMENT PLAN

For preparing soil and water conservation treatment plan for Lakkipur-1 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
- Soil gravelliness
- Available water capacity
- Soil slope
- Soil erosion
- Land capability
- Present land use /land cover
- Crop suitability
- Rainfall
- Hydrology
- Water Resources
- Socio-economic data



- Contour plan with existing features- Network of waterways, pothissa boundaries, cut up/ minor terraces etc.
- Cadastral map (1:7920 scale)
- Satellite imagery (1:7920 scale)

Apart from these, Hand Level/ Hydro Marker/ Dumpy Level/ Total Station and Kathedars' List has to be collected.

Steps for Survey and Preparation of Treatment Plan

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

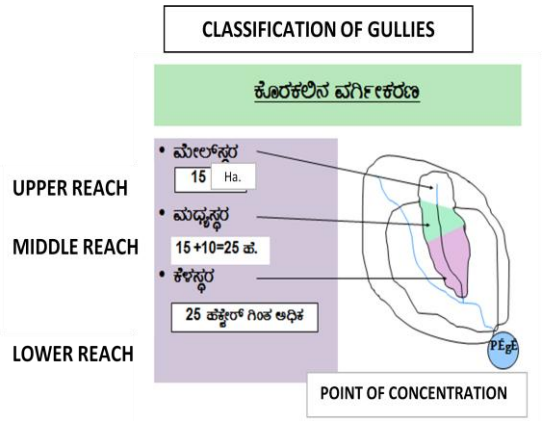
- Naming of user groups and farmers
- Identification of arable and non arable lands
- Identification of drainage lines and gullies
- Identification of non treatable areas
- Identification of priority areas in the arable lands
- Treatment plan for arable lands
- Location of water harvesting and recharge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

9.1 Treatment Plan

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

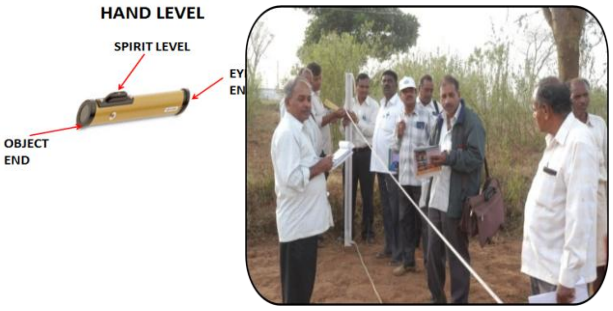
9.1.1 Arable Land Treatment

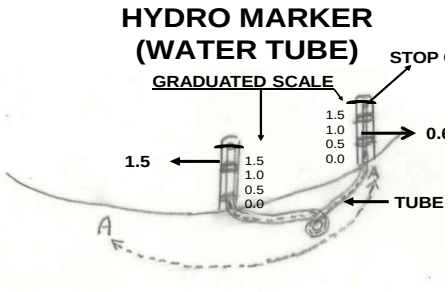
A. BUNDING

Steps for Survey and Preparation of Treatment Plan		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 25 ha 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.





FALL: 1.5 - 0.6 = 0.9 m.

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%, 1= slight erosion) the intervals have to be decided.

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

Section of the Bund

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

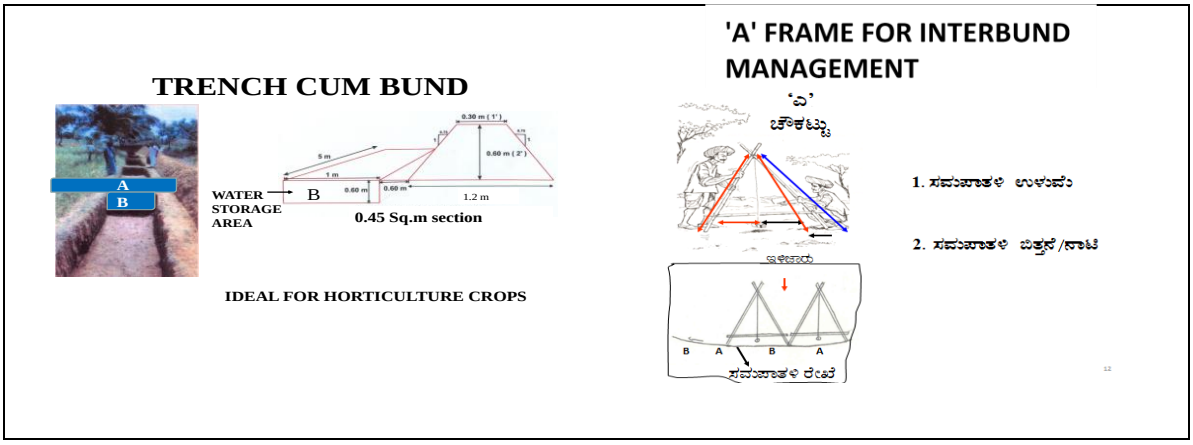
Recommended Bund Section

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

Formation of Trench cum Bund

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

Details of Borrow Pit dimensions are given below



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

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

B. Waterways

1. Existing waterways are marked on the cadastral map (1:7920 scale) and their dimensions are recorded.
2. Considering the contour plan of the MWS, additional waterways/ modernization of the existing ones can be thought of.
3. The design details are given in the Manual.

C. Farm Ponds

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

D. Diversion Channel

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

9.1.2 Non-Arable Land Treatment

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

9.1.3 Treatment of Natural Water Course/ Drainage Lines

a) The cadastral map has to be updated as regards the network of drainage lines (gullies/ *nalas/ hallas*) and existing structures are marked to the scale and storage capacity of the existing water bodies are documented.
b) The drainage line will be demarcated into Upper Reach, Middle Reach and Lower Reach.
c) Considering the Catchment, *Nala* bed and bank conditions, suitable structures are decided.
d) Number of storage structures (Check dam/ *Nala* bund/ Percolation tank) will be decided considering the commitments and available runoff in water budgeting and quality of water in the wells and site suitability.
e) Detailed Leveling Survey using Dumpy Level / Total Station has to be carried out to arrive at the site-specific designs as shown in the Manual.
f) The location of ground water recharge structures are decided by examining the lineaments and fracture zones from geological maps.
g) Rainfall intensity data of the nearest Rain Gauge Station is considered for Hydrologic Designs.
h) Silt load to the Storage/Recharge Structures is reduced by providing vegetative, boulder and earthen checks in the natural water course. Location and design details are given in the Manual.

9.2 Recommended Soil and Water Conservation Measures

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

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

A map (Fig. 9.1) showing soil and water conservation plan with different kinds of structures recommended has been generated which shows the spatial distribution and extent of area. Maximum area of about 184 ha (54%) requires Trench cum bunding, 58 ha (17%) area needs Graded Bunds or strengthening of existing bunds and 63 ha (19%) requires terracing. The conservation plan generated may be presented to all the stakeholders including farmers and after considering their suggestions, the conservation plan for the microwatershed may be finalised in a participatory approach.

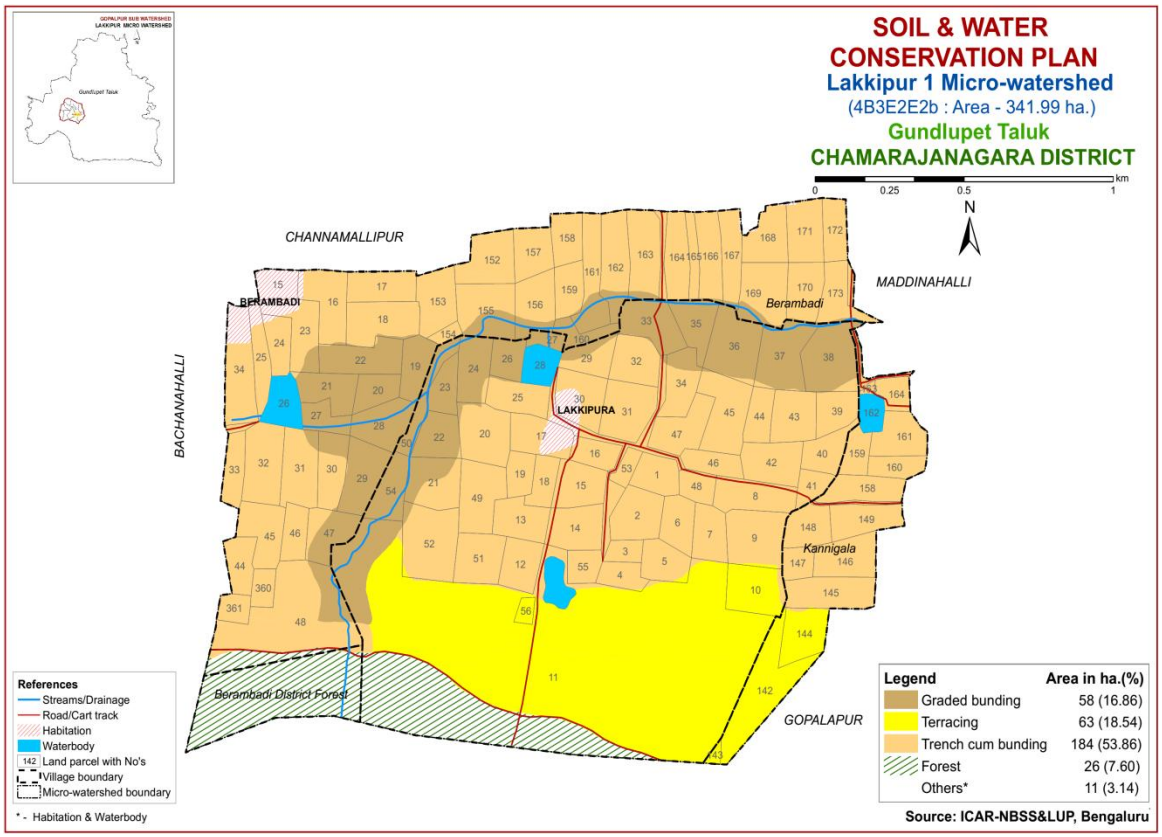


Fig. 9.1 Soil and Water Conservation Plan map of Lakkipur-1 Microwatershed

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 and VII) and also the lands that are not suitable or marginally suitable for growing annual and perennial crops. The method of planting these trees is given below.

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

The tree species suitable for the area considering rainfall, temperature and adaptability is listed below; waterlogged areas are recommended to be planted with species like Neral (*Sizyziumcumini*) 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				
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

Lakkipur1 2E2b APPENDIX

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
Lakkipura	TANK	1.14	Waterbody	Others	Others	Others	Others	Others	Others	Others	Others	Not Available	Others	Others
Lakkipura	1	1.69	SPRhB2g1	LMU-8	Shallow (25-50 cm)	Sandy clay loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Brinjal(Br)	Not Available	IVes	TCB
Lakkipura	2	2.53	SPRcC2g1	LMU-8	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Moderate	Horsegram(Hg)	Not Available	IVes	TCB
Lakkipura	3	0.83	SPRcC2g1	LMU-8	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Moderate	Horsegram(Hg)	Not Available	IVes	TCB
Lakkipura	4	1.21	SPRcC2g1	LMU-8	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Moderate	Horsegram(Hg)	Not Available	IVes	TCB
Lakkipura	5	1.84	SPRcC2g1	LMU-8	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Moderate	Redgram(Rg)	Not Available	IVes	TCB
Lakkipura	6	1.79	SPRcC2g1	LMU-8	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Moderate	Horsegram(Hg)	Not Available	IVes	TCB
Lakkipura	7	1.91	SPRcC2g1	LMU-8	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Moderate	Sugarcane(Sc)	Not Available	IVes	TCB
Lakkipura	8	2.57	ARKiB2	LMU-1	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Horsegram(Hg)	Not Available	IIs	TCB
Lakkipura	9	3.36	SPRcC2g1	LMU-8	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Moderate	Horsegram(Hg)	Not Available	IVes	TCB
Lakkipura	10	2.84	SPRcD2g1	LMU-8	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Moderately sloping (5-10%)	Moderate	Horsegram(Hg)	Not Available	VIes	Terracing
Lakkipura	11	71.56	MGHhE2g1	LMU-8	Moderately shallow (50-75 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Strongly sloping (10-15%)	Moderate	Horsegram+Sorghum+ Redgram(Hg+Sg+Rg)	1 Borewell	VIes	Terracing
Lakkipura	12	1.98	BMDcC2g1	LMU-6	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Moderate	Fieldbean(Fb)	Not Available	IIIs	TCB
Lakkipura	13	2.15	BMDcC2g1	LMU-6	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Moderate	Horsegram(Hg)	Not Available	IIIs	TCB
Lakkipura	14	2.47	SPRcC2g1	LMU-8	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Moderate	Marigold(Mg)	Not Available	IVes	TCB
Lakkipura	15	2.26	SPRcC2g1	LMU-8	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Moderate	Maize(Mz)	Not Available	IVes	TCB
Lakkipura	16	1.32	SPRhB2g1	LMU-8	Shallow (25-50 cm)	Sandy clay loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Sorghum(Sg)	Not Available	IVes	TCB
Lakkipura	17	2.35	SPRhB2g1	LMU-8	Shallow (25-50 cm)	Sandy clay loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Fieldbean(Fb)	1 Borewell	IVes	TCB
Lakkipura	18	1.31	SPRhB2g1	LMU-8	Shallow (25-50 cm)	Sandy clay loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Maize(Mz)	Not Available	IVes	TCB
Lakkipura	19	1.24	SPRhB2g1	LMU-8	Shallow (25-50 cm)	Sandy clay loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Horsegram(Hg)	Not Available	IVes	TCB
Lakkipura	20	3.08	SPRhB2g1	LMU-8	Shallow (25-50 cm)	Sandy clay loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Fieldbean(Fb)	Not Available	IVes	TCB
Lakkipura	21	2.81	BMDcC2g1	LMU-6	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Moderate	Maize(Mz)	1 Borewell	IIIs	TCB
Lakkipura	22	1.97	BMBmB2	LMU-2	Very deep (>150	Clay	Non gravelly	Very high	Very gently	Moderate	Banana(Ba)	2 Borewell	IIIew	Graded

Village	Survey No.	Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
					cm)		(<15%)	(>200 mm/m)	sloping (1-3%)					bunding
Lakkipura	23	1.42	BMBmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize(Mz)	Not Available	IIIew	Graded bunding
Lakkipura	24	2.22	BMBhB1	LMU-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Fieldbean(Fb)	Not Available	IIIw	Graded bunding
Lakkipura	25	2.07	KLPhB1	LMU-3	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Horsegram(Hg)	Not Available	IIs	TCB
Lakkipura	26	1.36	BMBhB1	LMU-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Fieldbean(Fb)	Not Available	IIIw	Graded bunding
Lakkipura	27	0.61	BMBhB1	LMU-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Fieldbean(Fb)	Not Available	IIIw	Graded bunding
Lakkipura	28_tank	1.38	waterbody	others	Others	Others	Others	Others	Others	Others	Others	Not Available	Others	Others
Lakkipura	29	1.72	KLPhB1	LMU-3	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Sorghum(Sg)	Not Available	IIs	TCB
Lakkipura	30	2.63	KLPhB1	LMU-3	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Fieldbean(Fb)	Not Available	IIs	TCB
Lakkipura	31	2.93	KLPhB1	LMU-3	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Fieldbean+Sorghum (Fb+Sg)	Not Available	IIs	TCB
Lakkipura	32	2.26	KLPhB1	LMU-3	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Sorghum(Sg)	Not Available	IIs	TCB
Lakkipura	33	2.62	BMBhB1	LMU-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Horsegram(Hg)	Not Available	IIIw	Graded bunding
Lakkipura	34	2.19	KLPhB1	LMU-3	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Fieldbean(Fb)	1 Borewell	IIs	TCB
Lakkipura	35	2	BMBhB1	LMU-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Horsegram+Fieldbean(Hg+Fb)	Not Available	IIIw	Graded bunding
Lakkipura	36	3.38	BMBhB1	LMU-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Banana(Ba)	Not Available	IIIw	Graded bunding
Lakkipura	37	3.34	BMBhB1	LMU-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Turmeric(Tu)	1 Borewell	IIIw	Graded bunding
Lakkipura	38	3.67	BMBhB1	LMU-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Sorghum(Sg)	1 Borewell	IIIw	Graded bunding
Lakkipura	39	1.72	ARKiB2	LMU-1	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Sorghum(Sg)	Not Available	IIs	TCB
Lakkipura	40	1.72	ARKiB2	LMU-1	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Tomato(Tm)	1 Form pond	IIs	TCB
Lakkipura	41	1.01	ARKiB2	LMU-1	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Fieldbean(Fb)	Not Available	IIs	TCB
Lakkipura	42	2.56	ARKiB2	LMU-1	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current Fallow Land+ Tomato(CFL+Tm)	Not Available	IIs	TCB
Lakkipura	43	2.37	ARKiB2	LMU-1	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Fieldbean(Fb)	Not Available	IIs	TCB
Lakkipura	44	1.45	HDRhB1	LMU-7	Shallow (25-50 cm)	Sandy clay loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Turmeric(Tu)	Not Available	IIIs	TCB
Lakkipura	45	3.43	HDRhB1	LMU-7	Shallow (25-50 cm)	Sandy clay loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Current Fallow Land+ Turmeric(CFL+Tu)	Not Available	IIIs	TCB
Lakkipura	46	1.41	HDRhB1	LMU-7	Shallow (25-50 cm)	Sandy clay loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Sugarcane(Sc)	Not Available	IIIs	TCB

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
Lakkipura	47	2.41	HDRhB1	LMU-7	Shallow (25-50 cm)	Sandy clay loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Sorghum(Sg)	Not Available	IIIs	TCB
Lakkipura	48	1.13	SPRhB2g1	LMU-8	Shallow (25-50 cm)	Sandy clay loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Horsegram(Hg)	Not Available	IVes	TCB
Lakkipura	49	3.02	BMDcC2g1	LMU-6	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Moderate	Redgram(Rg)	Not Available	IIIs	TCB
Lakkipura	50	1.62	BMBmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Road	Not Available	IIIew	Graded bunding
Lakkipura	51	2.47	BMDcC2g1	LMU-6	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Moderate	Horsegram(Hg)	Not Available	IIIs	TCB
Lakkipura	52	4.19	BMDcC2g1	LMU-6	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Moderate	Sorghum+Horsegram(Sg+Hg)	Not Available	IIIs	TCB
Lakkipura	53	0.69	SPRhB2g1	LMU-8	Shallow (25-50 cm)	Sandy clay loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Sorghum(Sg)	Not Available	IVes	TCB
Lakkipura	54	2	BMBmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Fieldbean(Fb)	Not Available	IIIew	Graded bunding
Lakkipura	55	1.14	SPRcC2g1	LMU-8	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Moderate	Fieldbean(Fb)	Not Available	IVes	TCB
Lakkipura	56	0.44	BMDcD2g1	LMU-6	Shallow (25-50 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Moderately sloping (5-10%)	Moderate	Horsegram(Hg)	Not Available	VIes	Terracing
Kannigala	142	4.95	MGHhE2g1	LMU-8	Moderately shallow (50-75 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Strongly sloping (10-15%)	Moderate	Cotton+Sorghum(Ct+Sg)	Not Available	VIes	Terracing
Kannigala	143	0.25	MGHhE2g1	LMU-8	Moderately shallow (50-75 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Strongly sloping (10-15%)	Moderate	Horsegram(Hg)	Not Available	VIes	Terracing
Kannigala	144	2.35	MGHhE2g1	LMU-8	Moderately shallow (50-75 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Strongly sloping (10-15%)	Moderate	Sorghum(Sg)	Not Available	VIes	Terracing
Kannigala	145	2.91	DRHiB2	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram+Sorghum(Rg+Sg)	Not Available	IIes	TCB
Kannigala	146	2.54	DRHiB2	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Chilly(Ch)	Not Available	IIes	TCB
Kannigala	147	1.06	ARKiB2	LMU-1	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize(Mz)	Not Available	IIs	TCB
Kannigala	148	1.88	ARKiB2	LMU-1	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Horsegram(Hg)	1 Borewell	IIs	TCB
Kannigala	149	2.21	DRHiB2	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Chilly(Ch)	1 Borewell	IIes	TCB
Kannigala	158	2.1	ARKiB2	LMU-1	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Fieldbean(Fb)	Not Available	IIs	TCB
Kannigala	159	1.23	ARKiB2	LMU-1	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Fieldbean(Fb)	Not Available	IIs	TCB
Kannigala	160	1.25	ARKiB2	LMU-1	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Sorghum(Sg)	Not Available	IIs	TCB
Kannigala	161	2.21	ARKiB2	LMU-1	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Sorghum(Sg)	Not Available	IIs	TCB
Kannigala	162_TANK	0.97	Waterbody	Others	Others	Others	Others	Others	Others	Others	Sorghum(Sg)	Not Available	Others	Others
Kannigala	163	0.14	ARKiB2	LMU-1	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Sorghum(Sg)	Not Available	IIs	TCB
Kannigala	164	1.08	ARKiB2	LMU-1	Very deep (>150	Sandy clay	Non gravelly	Very high	Very gently	Moderate	Sorghum(Sg)	Not	IIs	TCB

Village	Survey No.	Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
					cm)		(<15%)	(>200 mm/m)	sloping (1-3%)			Available		
Berambadi	15	1.31	Habitation	Others	Others	Others	Others	Others	Others	Others	Banana(Ba)	Not Available	Others	Others
Berambadi	16	2.84	MGHiB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Maize(Mz)	Not Available	IIs	TCB
Berambadi	17	2.22	HGHmB1	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Fieldbean(Fb)	Not Available	IIs	TCB
Berambadi	18	3.04	HGHmB1	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Cotton(Ct)	Not Available	IIs	TCB
Berambadi	19	1.82	BMBmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Fieldbean(Fb)	1 Borewell	IIIew	Graded bunding
Berambadi	20	1.48	BMBmB2	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	IIIew	Graded bunding
Berambadi	21	2.15	BMBmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize(Mz)	Not Available	IIIew	Graded bunding
Berambadi	22	2.73	BMBmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram+Cotton(Rg+Ct)	1 Borewell	IIIew	Graded bunding
Berambadi	23	2.68	MGHiB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Banana+Fieldbean(Ba+Fb)	Not Available	IIs	TCB
Berambadi	24	1.47	MGHiB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Banana(Ba)	Not Available	IIs	TCB
Berambadi	25	1.69	MGHiB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Maize(Mz)	Not Available	IIs	TCB
Berambadi	26_TANK	1.75	Waterbody	Others	Others	Others	Others	Others	Others	Others	Others	Not Available	Others	Others
Berambadi	27	1.28	BMBmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Fieldbean(Fb)	Not Available	IIIew	Graded bunding
Berambadi	28	2.43	BMBmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Fieldbean(Ct+Fb)	Not Available	IIIew	Graded bunding
Berambadi	29	2.71	BMBmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram+Turmeric (Rg+Tu)	1 Borewell	IIIew	Graded bunding
Berambadi	30	2.18	HPRiB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Castaroil(Ca)	Not Available	IIs	TCB
Berambadi	31	2.93	HPRiB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Banana(Ba)	1 Borewell	IIs	TCB
Berambadi	32	3.18	HGHhB2	LMU-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Banana(Ba)	Not Available	IIes	TCB
Berambadi	33	1.52	HGHhB2	LMU-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize(Mz)	Not Available	IIes	TCB
Berambadi	34	3.46	GPRiB1	LMU-4	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Maize(Mz)	Not Available	IIs	TCB
Berambadi	44	1.58	GPRhB1g1	LMU-4	Moderately deep (75-100 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Maize(Mz)	Not Available	IIs	TCB
Berambadi	45	2.51	HGHhB2	LMU-1	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	TCB
Berambadi	46	1.42	HGHhB2	LMU-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Castaroil(Ca)	Not Available	IIes	TCB
Berambadi	47	2.25	BMBmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Fieldbean+Maize (Fb+Mz)	Not Available	IIIew	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
Berambadi	48	10.67	BMDhC2g1	LMU-6	Shallow (25-50 cm)	Sandy clay loam	Gravelly (15-35%)	Very low (<50 mm/m)	Gently sloping (3-5%)	Moderate	Horsegram(Hg)	Not Available	IVes	TCB
Berambadi	152	2.73	HGHmB1	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Banana(Ba)	Not Available	IIs	TCB
Berambadi	153	2.45	HGHmB1	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Fieldbean(Fb)	Not Available	IIs	TCB
Berambadi	154	0.44	HPRiB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Cotton(Ct)	Not Available	IIs	TCB
Berambadi	155	3.27	HPRiB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Fieldbean(Fb)	Not Available	IIs	TCB
Berambadi	156	2.47	HPRiB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Fieldbean(Fb)	Not Available	IIs	TCB
Berambadi	157	1.96	HGHmB1	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Maize(Mz)	Not Available	IIs	TCB
Berambadi	158	1.63	HPRiB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Sugarcane(Sc)	Not Available	IIs	TCB
Berambadi	159	1.57	HPRiB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Fieldbean(Fb)	1 Borewell	IIs	TCB
Berambadi	160	1.02	BMBhB1	LMU-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Sorghum(Sg)	Not Available	IIIw	Graded bunding
Berambadi	161	2.67	HPRiB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Sorghum(Sg)	Not Available	IIs	TCB
Berambadi	162	2.88	HPRcB1g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Sorghum(Sg)	Not Available	IIs	TCB
Berambadi	163	2.95	HPRcB1g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Sorghum+Horsegram(Sg+Hg)	Not Available	IIs	TCB
Berambadi	164	2.12	HPRcB1g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Sorghum(Sg)	Not Available	IIs	TCB
Berambadi	165	0.9	HPRcB1g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Sorghum(Sg)	Not Available	IIs	TCB
Berambadi	166	2.22	HPRcB1g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Redgram(Rg)	Not Available	IIs	TCB
Berambadi	167	2.01	HPRcB1g1	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Sorghum(Sg)	Not Available	IIs	TCB
Berambadi	168	2.25	HPRhB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Sorghum(Sg)	Not Available	IIs	TCB
Berambadi	169	3.08	HPRhB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Current Fallow Land(CFL)	Not Available	IIs	TCB
Berambadi	170	2.17	HPRhB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Tomato(Tm)	Not Available	IIs	TCB
Berambadi	171	2.35	HPRhB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Sorghum(Sg)	Not Available	IIs	TCB
Berambadi	172	1.58	HPRhB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Current Fallow Land(CFL)	Not Available	IIs	TCB
Berambadi	173	2.02	HPRhB1	LMU-5	Moderately shallow (50-75 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Sorghum(Sg)	1 Borewell	IIs	TCB
Berambadi	360	0.92	HGHhB2	LMU-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize(Mz)	Not Available	IIes	TCB
Berambadi	361	0.92	GPRhB1g1	LMU-4	Moderately deep	Sandy clay	Gravelly (15-	Low (51-100	Very gently	Slight	Horsegram(Hg)	Not	IIs	TCB

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
					(75-100 cm)	loam	35%)	mm/m)	sloping (1-3%)			Available		
Berambadi District Forest	XX	11.21	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Not Available	Forest	Forest

Appendix II

Lakkipur1 2E2b APPENDIX

Soil Fertility Information

Village	Survey Number	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Lakkipura	TANK	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Lakkipura	1	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	2	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	3	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Lakkipura	4	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Lakkipura	5	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Lakkipura	6	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	7	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	8	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	9	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Lakkipura	10	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Lakkipura	11	Strongly acid (pH 5.0-5.5)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Lakkipura	12	Strongly acid (pH 5.0-5.5)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Lakkipura	13	Strongly acid (pH 5.0-5.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Lakkipura	14	Strongly acid (pH 5.0-5.5)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Lakkipura	15	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Lakkipura	16	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	High (>1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Lakkipura	17	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Others	Others	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	18	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Lakkipura	19	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	20	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	21	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	22	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)

Village	Survey Number	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Lakkipura	23	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	24	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	25	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	26	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	27	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	28_TANK	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Lakkipura	29	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	30	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	High (>1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	31	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	High (>1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	32	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	33	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	34	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	High (>1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	35	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	36	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (>56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	37	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (>56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	38	Slightly alkaline (pH 7.3-7.8)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	39	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	40	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	41	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Lakkipura	42	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	43	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	44	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (>56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	45	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (>56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	46	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	47	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)

Village	Survey Number	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Lakkipura	48	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	49	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	50	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	51	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	High (>1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	52	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	High (>1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	53	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	High (>1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	54	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Lakkipura	55	Strongly acid (pH 5.0-5.5)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Lakkipura	56	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	High (>1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Kannigala	142	Strongly acid (pH 5.0-5.5)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Kannigala	143	Strongly acid (pH 5.0-5.5)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Kannigala	144	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Kannigala	145	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Kannigala	146	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Kannigala	147	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Kannigala	148	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Kannigala	149	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Kannigala	158	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Kannigala	159	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Kannigala	160	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	High (>1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Kannigala	161	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	High (>1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Kannigala	162_TANK	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Kannigala	163	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Kannigala	164	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	15	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Berambadi	16	Slightly acid (pH	Non saline	High (>0.75	Low (<23	High (>330	Low (<10	Medium (0.5-	Sufficient	Sufficient	Sufficient	Sufficient

Village	Survey Number	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
		6.0-6.5)	(<2 dsm)	%)	kg/ha)	kg/ha)	ppm)	1.0 ppm)	(>4.5 ppm)	(>1.0 ppm)	(>0.2 ppm)	(>0.6 ppm)
Berambadi	17	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Low (<10 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	18	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Low (<10 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	19	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	20	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	21	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	High (>56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	22	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	23	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	24	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	25	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	26_TANK	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Berambadi	27	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	28	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	29	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	30	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	31	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	32	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	33	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	34	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	High (>56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	44	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Berambadi	45	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Berambadi	46	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Berambadi	47	Moderately acid (pH 5.5-6.0)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Berambadi	48	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	Medium (140-330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Berambadi	152	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Berambadi	153	Neutral (pH 6.5-	Non saline	High (>0.75	Low (<23	High (>330	Medium (10-	Low (<0.5	Sufficient	Sufficient	Sufficient	Deficient

Village	Survey Number	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
		7.3)	(<2 dsm)	%)	kg/ha)	kg/ha)	20 ppm)	ppm)	(>4.5 ppm)	(>1.0 ppm)	(>0.2 ppm)	(<0.6 ppm)
Berambadi	154	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	155	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	156	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	157	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Berambadi	158	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	159	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Berambadi	160	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	161	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	162	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	163	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	164	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	165	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	166	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	167	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	168	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	169	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	170	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	171	Neutral (pH 6.5-7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	172	Slightly alkaline (pH 7.3-7.8)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Low (<10 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Berambadi	173	Slightly alkaline (pH 7.3-7.8)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	Medium (23-56 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Berambadi	360	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Berambadi	361	Slightly acid (pH 6.0-6.5)	Non saline (<2 dsm)	High (>0.75 %)	Low (<23 kg/ha)	High (>330 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Berambadi District Forest	XX	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest

Appendix III

Lakkipur1 2E2b APPENDIX

Soil Suitability Information

Village	Survey Number	Mango	Maize	Sapota	Sorghum	Guava	Cotton	Tamarind	Lime	Sunflower	Red gram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Onion	Marigold	Chrysanthemum	Banana	Horse gram	Field-bean	Turmeric	Beetroot	Potato	Beans
Lakkipura	TANK	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Lakkipura	1	N	S3gr	N	S3gr	N	S3gr	N	N	Ngr	Ngr	S2gr	N	S2gr	N	N	N	S3gr	S3gr	S3gr	S3gr	Nr	S3gr	S3gr	S3gr	S3gr	S3gr	S3gr
Lakkipura	2	N	S3gl	N	S3gl	N	S3gl	N	N	Ngl	Ngl	S2gr	N	S2gr	N	N	N	S3gr	S3gl	S3gl	S3gl	Ngl	S3gl	S3gl	S3gl	S3gl	S3gl	S3gl
Lakkipura	3	N	S3gl	N	S3gl	N	S3gl	N	N	Ngl	Ngl	S2gr	N	S2gr	N	N	N	S3gr	S3gl	S3gl	S3gl	Ngl	S3gl	S3gl	S3gl	S3gl	S3gl	S3gl
Lakkipura	4	N	S3gl	N	S3gl	N	S3gl	N	N	Ngl	Ngl	S2gr	N	S2gr	N	N	N	S3gr	S3gl	S3gl	S3gl	Ngl	S3gl	S3gl	S3gl	S3gl	S3gl	S3gl
Lakkipura	5	N	S3gl	N	S3gl	N	S3gl	N	N	Ngl	Ngl	S2gr	N	S2gr	N	N	N	S3gr	S3gl	S3gl	S3gl	Ngl	S3gl	S3gl	S3gl	S3gl	S3gl	S3gl
Lakkipura	6	N	S3gl	N	S3gl	N	S3gl	N	N	Ngl	Ngl	S2gr	N	S2gr	N	N	N	S3gr	S3gl	S3gl	S3gl	Ngl	S3gl	S3gl	S3gl	S3gl	S3gl	S3gl
Lakkipura	7	N	S3gl	N	S3gl	N	S3gl	N	N	Ngl	Ngl	S2gr	N	S2gr	N	N	N	S3gr	S3gl	S3gl	S3gl	Ngl	S3gl	S3gl	S3gl	S3gl	S3gl	S3gl
Lakkipura	8	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Lakkipura	9	N	S3gl	N	S3gl	N	S3gl	N	N	Ngl	Ngl	S2gr	N	S2gr	N	N	N	S3gr	S3gl	S3gl	S3gl	Ngl	S3gl	S3gl	S3gl	S3gl	S3gl	S3gl
Lakkipura	10	N	S3gl	N	S3gl	N	S3gl	N	N	Ngl	Ngl	S2gr	N	S2gr	N	N	N	S3gr	S3gl	S3gl	S3gl	Ngl	S3gl	S3gl	S3gl	S3gl	S3gl	S3gl
Lakkipura	11	N	Ngl	S3rt	Ngl	S3rt	Ngl	S3rt	S3rt	Ngl	Ngl	S2r	S3rt	S2r	S3rt	S3rt	S3rt	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl
Lakkipura	12	N	S3rt	N	S3r	N	S3r	N	N	Nrt	Nrt	S3r	N	S3r	N	N	N	S3rt	S3rt	S3rt	S3rt	Nrt	S3r	S3r	S3rt	S3rt	S3rt	S3rt
Lakkipura	13	N	S3rt	N	S3r	N	S3r	N	N	Nrt	Nrt	S3r	N	S3r	N	N	N	S3rt	S3rt	S3rt	S3rt	Nrt	S3r	S3r	S3rt	S3rt	S3rt	S3rt
Lakkipura	14	N	S3gl	N	S3gl	N	S3gl	N	N	Ngl	Ngl	S2gr	N	S2gr	N	N	N	S3gr	S3gl	S3gl	S3gl	Ngl	S3gl	S3gl	S3gl	S3gl	S3gl	S3gl
Lakkipura	15	N	S3gl	N	S3gl	N	S3gl	N	N	Ngl	Ngl	S2gr	N	S2gr	N	N	N	S3gr	S3gl	S3gl	S3gl	Ngl	S3gl	S3gl	S3gl	S3gl	S3gl	S3gl
Lakkipura	16	N	S3gr	N	S3gr	N	S3gr	N	N	Ngr	Ngr	S2gr	N	S2gr	N	N	N	S3gr	S3gr	S3gr	S3gr	Nr	S3gr	S3gr	S3gr	S3gr	S3gr	S3gr
Lakkipura	17	N	S3gr	N	S3gr	N	S3gr	N	N	Ngr	Ngr	S2gr	N	S2gr	N	N	N	S3gr	S3gr	S3gr	S3gr	Nr	S3gr	S3gr	S3gr	S3gr	S3gr	S3gr
Lakkipura	18	N	S3gr	N	S3gr	N	S3gr	N	N	Ngr	Ngr	S2gr	N	S2gr	N	N	N	S3gr	S3gr	S3gr	S3gr	Nr	S3gr	S3gr	S3gr	S3gr	S3gr	S3gr
Lakkipura	19	N	S3gr	N	S3gr	N	S3gr	N	N	Ngr	Ngr	S2gr	N	S2gr	N	N	N	S3gr	S3gr	S3gr	S3gr	Nr	S3gr	S3gr	S3gr	S3gr	S3gr	S3gr
Lakkipura	20	N	S3gr	N	S3gr	N	S3gr	N	N	Ngr	Ngr	S2gr	N	S2gr	N	N	N	S3gr	S3gr	S3gr	S3gr	Nr	S3gr	S3gr	S3gr	S3gr	S3gr	S3gr
Lakkipura	21	N	S3rt	N	S3r	N	S3r	N	N	Nrt	Nrt	S3r	N	S3r	N	N	N	S3rt	S3rt	S3rt	S3rt	Nrt	S3r	S3r	S3rt	S3rt	S3rt	S3rt
Lakkipura	22	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Lakkipura	23	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Lakkipura	24	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Lakkipura	25	S2r	S1	S2r	S1	S1	S2t	S2r	S2r	S2gt	S1	S1	S2r	S1	S3r	S2r	S2r	S1	S2g	S1	S2g	S2g	S1	S2g	S2g	S2g	S2g	S2g
Lakkipura	26	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Lakkipura	27	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Lakkipura	28_TANK	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Lakkipura	29	S2r	S1	S2r	S1	S1	S2t	S2r	S2r	S2gt	S1	S1	S2r	S1	S3r	S2r	S2r	S1	S2g	S1	S2g	S2g	S1	S2g	S2g	S2g	S2g	S2g
Lakkipura	30	S2r	S1	S2r	S1	S1	S2t	S2r	S2r	S2gt	S1	S1	S2r	S1	S3r	S2r	S2r	S1	S2g	S1	S2g	S2g	S1	S2g	S2g	S2g	S2g	S2g
Lakkipura	31	S2r	S1	S2r	S1	S1	S2t	S2r	S2r	S2gt	S1	S1	S2r	S1	S3r	S2r	S2r	S1	S2g	S1	S2g	S2g	S1	S2g	S2g	S2g	S2g	S2g
Lakkipura	32	S2r	S1	S2r	S1	S1	S2t	S2r	S2r	S2gt	S1	S1	S2r	S1	S3r	S2r	S2r	S1	S2g	S1	S2g	S2g	S1	S2g	S2g	S2g	S2g	S2g
Lakkipura	33	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Lakkipura	34	S2r	S1	S2r	S1	S1	S2t	S2r	S2r	S2gt	S1	S1	S2r	S1	S3r	S2r	S2r	S1	S2g	S1	S2g	S2g	S1	S2g	S2g	S2g	S2g	S2g
Lakkipura	35	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Lakkipura	36	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Lakkipura	37	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt

Village	Survey Number	Mango	Maize	Sapota	Sorghum	Guava	Cotton	Tamarind	Lime	Sunflower	Red gram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Onion	Marigold	Chrysanthemum	Banana	Horse gram	Field-bean	Turmeric	Beetroot	Potato	Beans
Lakkipura	38	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Lakkipura	39	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Lakkipura	40	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Lakkipura	41	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Lakkipura	42	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Lakkipura	43	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Lakkipura	44	N	S3r	N	S3r	N	S3r	N	N	Nr	Nr	S2r	N	S3r	N	N	N	S3r	S3r	S3r	S3r	Nr	S3r	S3r	S3r	S3r	S3r	S3r
Lakkipura	45	N	S3r	N	S3r	N	S3r	N	N	Nr	Nr	S2r	N	S3r	N	N	N	S3r	S3r	S3r	S3r	Nr	S3r	S3r	S3r	S3r	S3r	S3r
Lakkipura	46	N	S3r	N	S3r	N	S3r	N	N	Nr	Nr	S2r	N	S3r	N	N	N	S3r	S3r	S3r	S3r	Nr	S3r	S3r	S3r	S3r	S3r	S3r
Lakkipura	47	N	S3r	N	S3r	N	S3r	N	N	Nr	Nr	S2r	N	S3r	N	N	N	S3r	S3r	S3r	S3r	Nr	S3r	S3r	S3r	S3r	S3r	S3r
Lakkipura	48	N	S3gr	N	S3gr	N	S3gr	N	N	Ngr	Ngr	S2gr	N	S2gr	N	N	N	S3gr	S3gr	S3gr	S3gr	Nr	S3gr	S3gr	S3gr	S3gr	S3gr	S3gr
Lakkipura	49	N	S3rt	N	S3r	N	S3r	N	N	Nrt	Nrt	S3r	N	S3r	N	N	N	S3rt	S3rt	S3rt	S3rt	Nrt	S3r	S3r	S3rt	S3rt	S3rt	S3rt
Lakkipura	50	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Lakkipura	51	N	S3rt	N	S3r	N	S3r	N	N	Nrt	Nrt	S3r	N	S3r	N	N	N	S3rt	S3rt	S3rt	S3rt	Nrt	S3r	S3r	S3rt	S3rt	S3rt	S3rt
Lakkipura	52	N	S3rt	N	S3r	N	S3r	N	N	Nrt	Nrt	S3r	N	S3r	N	N	N	S3rt	S3rt	S3rt	S3rt	Nrt	S3r	S3r	S3rt	S3rt	S3rt	S3rt
Lakkipura	53	N	S3gr	N	S3gr	N	S3gr	N	N	Ngr	Ngr	S2gr	N	S2gr	N	N	N	S3gr	S3gr	S3gr	S3gr	Nr	S3gr	S3gr	S3gr	S3gr	S3gr	S3gr
Lakkipura	54	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Lakkipura	55	N	S3gl	N	S3gl	N	S3gl	N	N	Ngl	Ngl	S2gr	N	S2gr	N	N	N	S3gr	S3gl	S3gl	S3gl	Ngl	S3gl	S3gl	S3gl	S3gl	S3gl	S3gl
Lakkipura	56	N	S3tl	N	S3tl	N	S3tl	N	N	Ntl	Ntl	S3r	N	S3r	N	N	N	S3tl	S3tl	S3tl	S3tl	Ntl	S3tl	S3tl	S3tl	S3tl	S3tl	S3tl
Kannigala	142	N	Ngl	S3rt	Ngl	S3rt	Ngl	S3rt	S3rt	Ngl	Ngl	S2r	S3rt	S2r	S3rt	S3rt	S3rt	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl
Kannigala	143	N	Ngl	S3rt	Ngl	S3rt	Ngl	S3rt	S3rt	Ngl	Ngl	S2r	S3rt	S2r	S3rt	S3rt	S3rt	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl
Kannigala	144	N	Ngl	S3rt	Ngl	S3rt	Ngl	S3rt	S3rt	Ngl	Ngl	S2r	S3rt	S2r	S3rt	S3rt	S3rt	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl	Ngl
Kannigala	145	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Kannigala	146	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Kannigala	147	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Kannigala	148	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Kannigala	149	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Kannigala	158	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Kannigala	159	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Kannigala	160	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Kannigala	161	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Kannigala	162_TANK	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Kannigala	163	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Kannigala	164	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Berambadi	15	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Berambadi	16	N	S3g	S3rt	S3g	S3rt	S3g	S3rt	S3rt	S3gr	S2g	S2r	S3rt	S2r	S3rt	S3rt	S3rt	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g
Berambadi	17	S1	S1	S1	S2t	S1	S3t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Berambadi	18	S1	S1	S1	S2t	S1	S3t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Berambadi	19	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Berambadi	20	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Berambadi	21	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Berambadi	22	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Berambadi	23	N	S3g	S3rt	S3g	S3rt	S3g	S3rt	S3rt	S3gr	S2g	S2r	S3rt	S2r	S3rt	S3rt	S3rt	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g

Village	Survey Number	Mango	Maize	Sapota	Sorghum	Guava	Cotton	Tamarind	Lime	Sunflower	Red gram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Onion	Marigold	Chrysanthemum	Banana	Horse gram	Field-bean	Turmeric	Beetroot	Potato	Beans
Berambadi	24	N	S3g	S3rt	S3g	S3rt	S3g	S3rt	S3rt	S3gr	S2g	S2r	S3rt	S2r	S3rt	S3rt	S3rt	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g
Berambadi	25	N	S3g	S3rt	S3g	S3rt	S3g	S3rt	S3rt	S3gr	S2g	S2r	S3rt	S2r	S3rt	S3rt	S3rt	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g
Berambadi	26_TANK	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Berambadi	27	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Berambadi	28	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Berambadi	29	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Berambadi	30	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	31	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	32	S1	S3r	S1	S3r	S1	S3r	S1	S1	Nr	Nr	S1	S1	S1	S1	S1	S1	S3r	S3r	S3r	S3r	Nr	S3r	S3r	S3r	S3r	S3r	S3r
Berambadi	33	S1	S3r	S1	S3r	S1	S3r	S1	S1	Nr	Nr	S1	S1	S1	S1	S1	S1	S3r	S3r	S3r	S3r	Nr	S3r	S3r	S3r	S3r	S3r	S3r
Berambadi	34	S3r	S1	S2r	S1	S3r	S2t	S3r	S3r	S2gt	S1	S2r	S3r	S2r	S3r	S3r	S3r	S1	S2g	S1	S2g	S2g	S1	S2g	S2g	S2g	S2g	S2g
Berambadi	44	S3r	S1	S2r	S1	S3r	S2t	S3r	S3r	S2gt	S1	S2r	S3r	S2r	S3r	S3r	S3r	S1	S2g	S1	S2g	S2g	S1	S2g	S2g	S2g	S2g	S2g
Berambadi	45	S1	S3r	S1	S3r	S1	S3r	S1	S1	Nr	Nr	S1	S1	S1	S1	S1	S1	S3r	S3r	S3r	S3r	Nr	S3r	S3r	S3r	S3r	S3r	S3r
Berambadi	46	S1	S3r	S1	S3r	S1	S3r	S1	S1	Nr	Nr	S1	S1	S1	S1	S1	S1	S3r	S3r	S3r	S3r	Nr	S3r	S3r	S3r	S3r	S3r	S3r
Berambadi	47	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Berambadi	48	N	S3rt	N	S3r	N	S3r	N	N	Nrt	Nrt	S3r	N	S3r	N	N	N	S3rt	S3rt	S3rt	S3rt	Nrt	S3r	S3r	S3rt	S3rt	S3rt	S3rt
Berambadi	152	S1	S1	S1	S2t	S1	S3t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Berambadi	153	S1	S1	S1	S2t	S1	S3t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Berambadi	154	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	155	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	156	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	157	S1	S1	S1	S2t	S1	S3t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Berambadi	158	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	159	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	160	N	S3wt	S3t	S1	S3t	S1	S3t	S1	S2W	S2w	S1	S3t	S1	N	S3t	S1	S3wt	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S3wt	S3wt	S3wt	S2wt
Berambadi	161	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	162	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	163	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	164	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	165	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	166	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	167	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	168	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	169	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	170	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	171	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	172	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	173	N	S2r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2rt	S2r	S2r	S2r	S3r	S2r	S2r	S2r	S2r	S2r	S2r
Berambadi	360	S1	S3r	S1	S3r	S1	S3r	S1	S1	Nr	Nr	S1	S1	S1	S1	S1	S1	S3r	S3r	S3r	S3r	Nr	S3r	S3r	S3r	S3r	S3r	S3r
Berambadi	361	S3r	S1	S2r	S1	S3r	S2t	S3r	S3r	S2gt	S1	S2r	S3r	S2r	S3r	S3r	S3r	S1	S2g	S1	S2g	S2g	S1	S2g	S2g	S2g	S2g	S2g
Berambadi District Forest	XX	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest	Forest

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**: Lakkipur 1 micro-watershed (Gopalapur sub-watershed, Gundlupet taluk, Chamarajanagar district) is located in between $11^0$44' – $11^0$45' North latitudes and $76^0$33' – $76^0$35' East longitudes, covering an area of about 342 ha, bounded by Channamallipur, Maddinahalli and Lakkipur villages with a length of growing period LGP of 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 eco system services were quantified.*

***Results:** The socio-economic outputs for the Lakkipur 1 micro-watershed (Gopalapur sub-watershed, Gundlupet taluk, Chamarajanagar district) are presented here.*

Social Indicators;

- *Male and female ratio is 47.1 to 52.9 per cent to the total sample population.*
- *Younger age 18 to 50 years group of population is around 50.0 per cent to the total population.*
- *Literacy population is around 44.1 per cent.*
- *Social groups belong to scheduled caste (SC)/scheduled tribes (ST) were around 20.0 per cent.*
- *Liquefied petroleum gas (LPG) is the source of energy for a cooking among 80.0 per cent.*
- *About 40.0 per cent of households have a yashaswini health card.*
- *Majority of farm households (70.0 %) are having MGNREGA card for rural employments.*
- *Dependence on ration cards for food grains through public distribution system of having all sample households.*
- *Swach bharath program providing closed toilet facilities around 40.0 per cent of sample households.*
- *Institutional participation is only 8.8 per cent of sample households.*
- *Women participation in decisions making are around 47.2 per cent of households were found.*

Economic Indicators;

- *The average land holding is 1.3 ha indicates that majority of farm households are belong to small and medium farmers. The dry land account for 67.7 % and irrigated land 32.3 % of total cultivated land area among the sample farmers.*
- *Agriculture is the main occupation among 6.3 per cent and agriculture is the main and non agriculture labour is subsidiary occupation for 87.5 per cent of sample households.*
- *The average value of domestic assets is around Rs. 11970 per household. Mobile and television are popular media mass communication.*
- *The average value of farm assets is around Rs. 30383 per household, about 50 per cent of sample farmers own plough and sprayer (10 %).*
- *The average value of livestock is around Rs.19625 per household; about 50 per cent of household are having livestock.*
- *The average per capita food consumption is around 690.8 grams (1494.1 kilo calories) against national institute of nutrition (NIN) recommendation at 827 gram. Around 60 per cent of sample households are consuming less than the NIN recommendation.*
- *The annual average income is around Rs.54221 per household. Thirty per cent of sample households on above poverty line.*
- *The per capita monthly average expenditure is around Rs.1269.*

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.1078 per ha/year. The total cost of annual soil nutrients is around Rs.328649 per year for the total area of 342.0 ha.*
- *The average value of ecosystem service for food grain production is around Rs. 50726/ ha/year. Per hectare food grain production services is maximum in turmeric (Rs.132852) followed by cotton (Rs. 124561), garlic (Rs. 101751), onion (Rs. 63229), maize (Rs. 36649), cowpea (Rs. 35235), sunflower (Rs. 31093), horse gram (Rs. 18747), ragi (Rs. 14441), marigold (Rs.3179) and groundnut is negative returns.*
- *The average value of ecosystem service for fodder production is around Rs. 2286/ha/year. Per hectare fodder production services is maximum in groundnut (Rs.3952) followed by maize (Rs. 2653), cowpea (Rs.2506), ragi (Rs.1300) and horse gram (Rs. 1300).*
- *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 cotton (Rs.*

274528) followed by turmeric (Rs. 54978), maize (Rs. 54775), sunflower (Rs. 49884), horse gram (Rs. 31878), groundnut (Rs. 27486), onion (Rs. 16796), garlic (Rs. 15587), ragi (Rs. 13238) and cowpea (Rs. 12042).

Economic Land Evaluation;

- *The major cropping pattern is maize (27.5 %) followed by maize (27.5 %), horse gram (18.0 %), cowpea (8.4%), groundnut (8.4 %), onion (8.4 %), sunflower (8.4 %), turmeric (5.5 %), ragi (4.8 %), garlic (4.7 %), marigold (4.7 %) and cotton (1.2 %).*
- *In Lakkipur 1 micro-watershed, major soils are soil of alluvial landscape of Kallipura (KLP) series is having deep soil depth cover around 4.2% of area. On this soil farmers are presently growing garlic. Honnegaudanahalli (HGH) are also having very deep soil depth cover 6.0 % of area, the crops are cotton (7.4 %), maize (7.4 %), onion (51.0 %) and turmeric (34.2 %). Beemanabeedu (BMB) soil series having very deep soil depth cover around 17.2 % of areas, crops are maize. Hullipura (HPR) soil series having moderately shallow soil depth cover around 12.1 % of area, crops are cowpea (18.2 %), horse gram (31.8 %), maize (18.2 %) and sunflower (31.8 %). Magoonahalli (MGH) soil series are having moderately shallow soil depth cover around 11.9 % of area; the major crops grown are cowpea (37.9 %), groundnut (18.9 %) and horse gram (21.6 %). Shivapura (SPR) soil series are having very shallow soil depth covers around 14.7 % of area, the major crop grown is maize (64.1%) and marigold (35.9 %).*
- *The total cost of cultivation and benefit cost ratio (BCR) in study area for maize ranges between Rs.78831/ha in HGH soil (with BCR of 1.07) and Rs. 27873/ha in BMB soil (with BCR of 1.61).*
- *In horse gram the cost of cultivation range between Rs 27542/ha in MGH soil (with of 1.51) and Rs. 14192/ha in HPR soil (with BCR of 2.65).*
- *In cowpea the cost of cultivation ranges between Rs. 33083/ha in HPR soil (with BCR of 1.57) and Rs. 11497/ha in MGH soil (with BCR of 4.3).*
- *In cotton the cost of cultivation in MLR soil is Rs.202501/ha (with BCR of 1.62).*
- *In onion the cost of cultivation in HGH soil is Rs 60271/ha (with BCR of 2.05).*
- *In sunflower the cost of cultivation in HPR soil is Rs 28187/ha (with BCR of 2.1).*
- *In ragi the cost of cultivation in MGH soil is Rs 29976/ha (with BCR of 1.53).*
- *In garlic the cultivation in KLP soil is Rs.57035/ha (with BCR of 2.78) and turmeric cultivation in HGH soil is Rs.115992/ha (with BCR of 2.15).*
- *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 are deeper soil to maximize returns.*

Suggestions;

- *Involving farmers is watershed planning helps in strengthing institutional participation.*
- *The per capita food consumption and monthly income is very low. Diversifying income generation activities from crop and livestock production in order to reduce risk related to drought and market prices.*
- *Majority of farmers reported that they are not getting timely support/extension services from the concerned development departments.*
- *By strengthing agricultural extension for providing timely advice improved technology there is scope to increase in net income of farm households.*
- *By adopting recommended package of practices by following the soil test fertiliser recommendation, there is scope to increase yield in maize (42.9 to76 %), cowpea (0 to 53.7%), cotton (26.5 %), ragi (90 %), garlic (71.1%) and turmeric (36.7%).*

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:

Lakkipur 1 micro-watershed is located in Southern Dry Zone of Karnataka (Figure1). It has a total geographical area of 1.56 M ha with 0.74 M ha under cultivation of which 0.22 M ha is irrigated. The mean elevation ranges from 450 to 900 m MSL; most part of the zone is situated at 800-900 m. The major soils are red loams with pockets of black soils in Kollegal, Yalandur and T.N. Pura taluks of Mysore district. The average annual rainfall ranges from 670 to 890 mm, of which about 55 to 75 per cent is received during the Kharif season. The major crops grown are rice, ragi, sugarcane, pulses and minor millets. It's represented Agro Ecological Region (AER) –3 having LGP 120-150 days.

Lakkipur1 micro-watershed (Gopalapur sub-watershed, Gundlupet taluk, Chamarajanagar district) is located in between $11^0$44' – $11^0$45' North latitudes and $76^0$33' – $76^0$35' East longitudes, covering an area of about 342 ha, bounded by Channamallipur, Maddinahalli and Lakkipur 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).

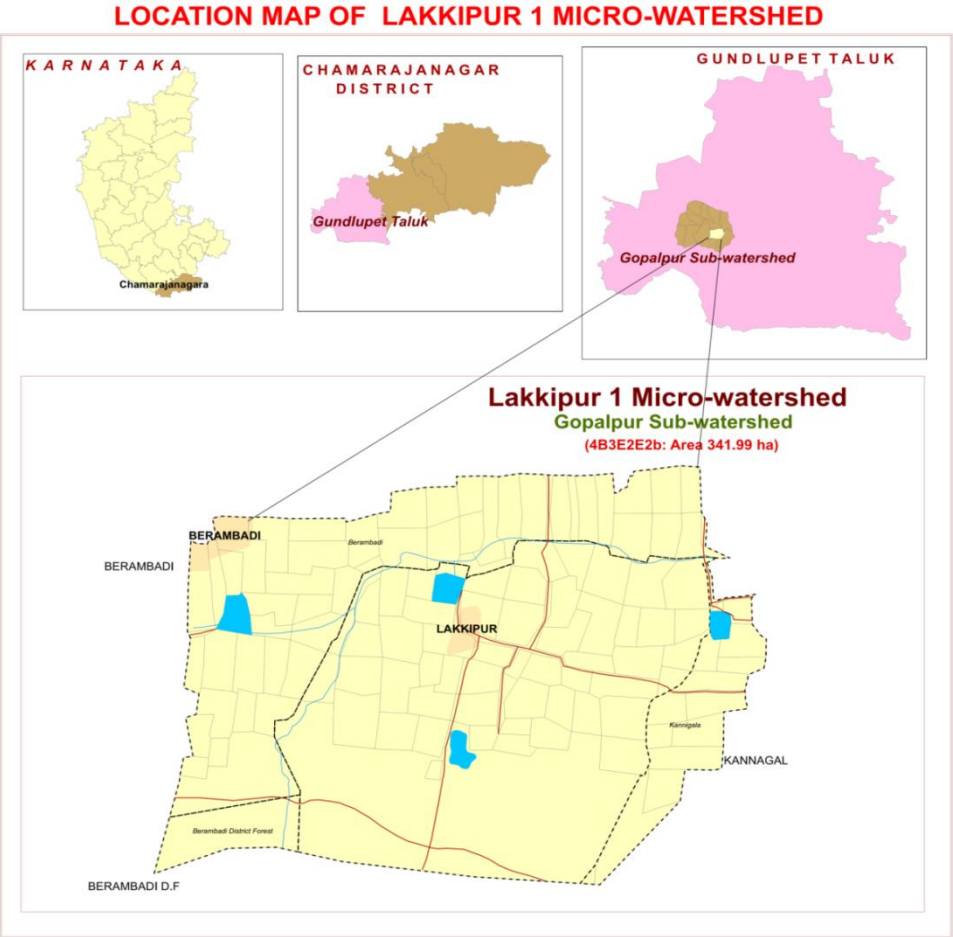

Figure 1: Location of study area

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 .

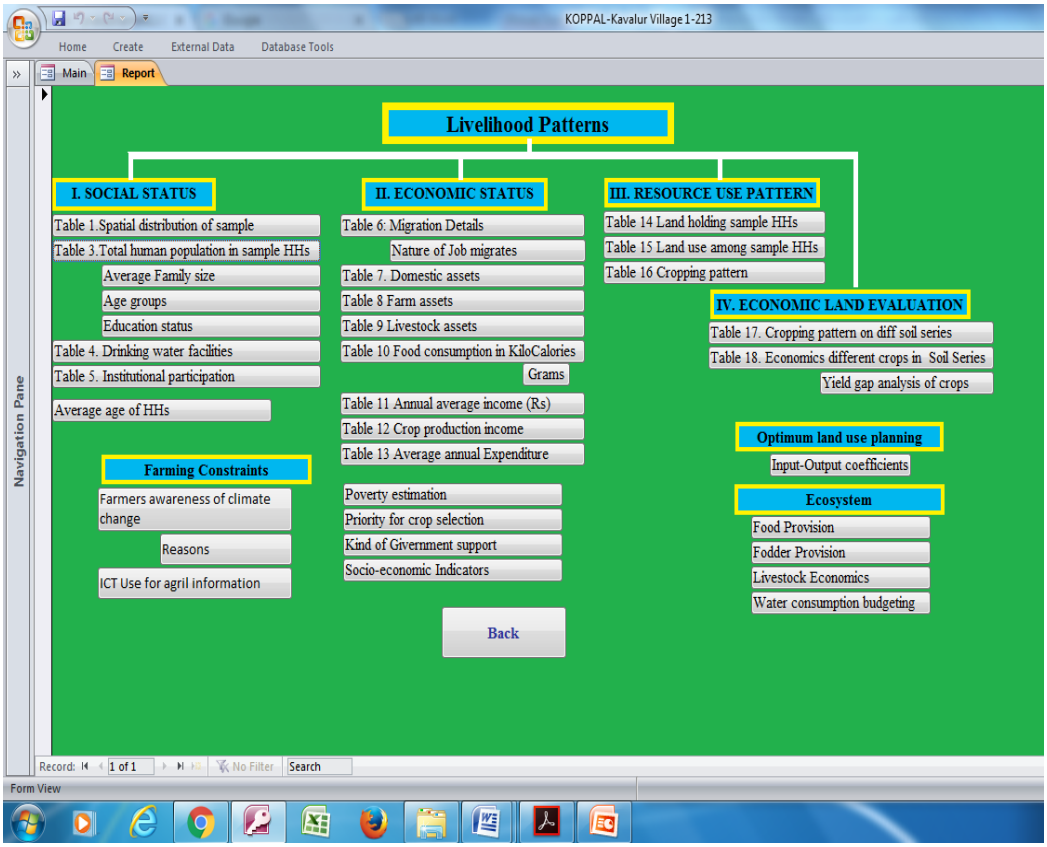

Figure 2: ALPES FRAMEWORK

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

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

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

Economic Valuation of Soil ecosystem services:

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

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

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

Chapter 4

RESULTS AND DISCUSSIONS

The 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 34, out of which 47.1per cent were males and 52.9 per cent females. Average family size of the households is 3.4. Age is an important factor, which affects the potential employment and mobility status of respondents. The data on age wise distribution of farmers in the sample households indicated that majority of the farmers are coming under the age group of more than 50 years (44.1 %) followed by 30 to 50 years (29.4 %),18 to 30 years (20.6 %) and 0 to 18 years (5.9 %). Hence, in the study area in general, the respondents were of young and middle age, indicating thereby that the households had almost settled with whatever livelihood options they were practicing and sample respondents were young by age who could venture into various options of livelihood sources. Data on literacy indicated that 55.9 per cent of respondents were illiterate and 44.1 per cent literate (Table 1).

Table 1: Human population among sample households in Lakkipur 1 Microwatershed

Particulars	**Units**	**Value**
Total human population in sample HHs	Number	34.0
Male	% to total Population	47.1
Female	% to total Population	52.9
Average family size	Number	3.4
Age group		
0 to 18 years	% to total Population	5.9
18 to 30 years	% to total Population	20.6
30 to 50 years	% to total Population	29.4
>50 years	% to total Population	44.1
Average age	Age in years	47.8
Education Status		
Illiterates	% to total Population	55.9
Literates	% to total Population	44.1
Primary School (<5 class)	% to total Population	11.8
Middle School (6- 8 class)	% to total Population	17.6
High School (9- 10 class)	% to total Population	14.7

The ethnic groups among the sample farm households found to be 40.0 per cent belonging to general castes followed by 40.0 per cent belonging to other backward caste (OBC), scheduled casts (SC) and scheduled tribes (ST) is around 20 per cent (Table 2 and Figure 3). About 80 per cent of sample households are using gas as source of fuel for

cooking and only 20.0 per cent of fire wood. All the sample farmers are having electricity connection. About 40.0 per cent are sample households having health cards. Only 70.0 percent are having MNREGA job cards for employment generation. Among all farm households are having ration cards for taking food grains from public distribution system. About 40.0 per cent of farm households are having toilet facilities.

Table 2: Basic needs of sample households in Lakkipur Microwatershed

Particulars	Units	Value
Social groups		
SC	% of Households	10.0
ST	% of Households	10.0
OBC	% of Households	40.0
Others	% of Households	40.0
Types of fuel use for cooking		
Fire wood	% of Households	20.0
Gas	% of Households	80.0
Energy supply for home		
Electricity	% of Households	100
Number of households having Health card		
Yes	% of Households	40.0
No	% of Households	60.0
MGNREGA Card		
Yes	% of Households	70.0
No	% of Households	30.0
Ration Card		
Yes	% of Households	100
No	% of Households	0.0
Households with toilet		
Yes	% of Households	40.0
No	% of Households	60.0
Drinking water facilities		
Tube well	% of Households	100

The data collected on the source of drinking water in the study area is presented in Table 2. Majority of the sample respondents are having tube well source for water supply for domestic purpose (100 %).

Only 8.8 per cent of the farmers are participating in community based organizations (Table 3). Among them majority were participating in user groups (3.0 %) followed by marketing co-operative societies (2.9 %) and Self help groups (2.9 %) like Sri Dharmasthala Swasahaya Sangha, Stri Shakhti Sangha.

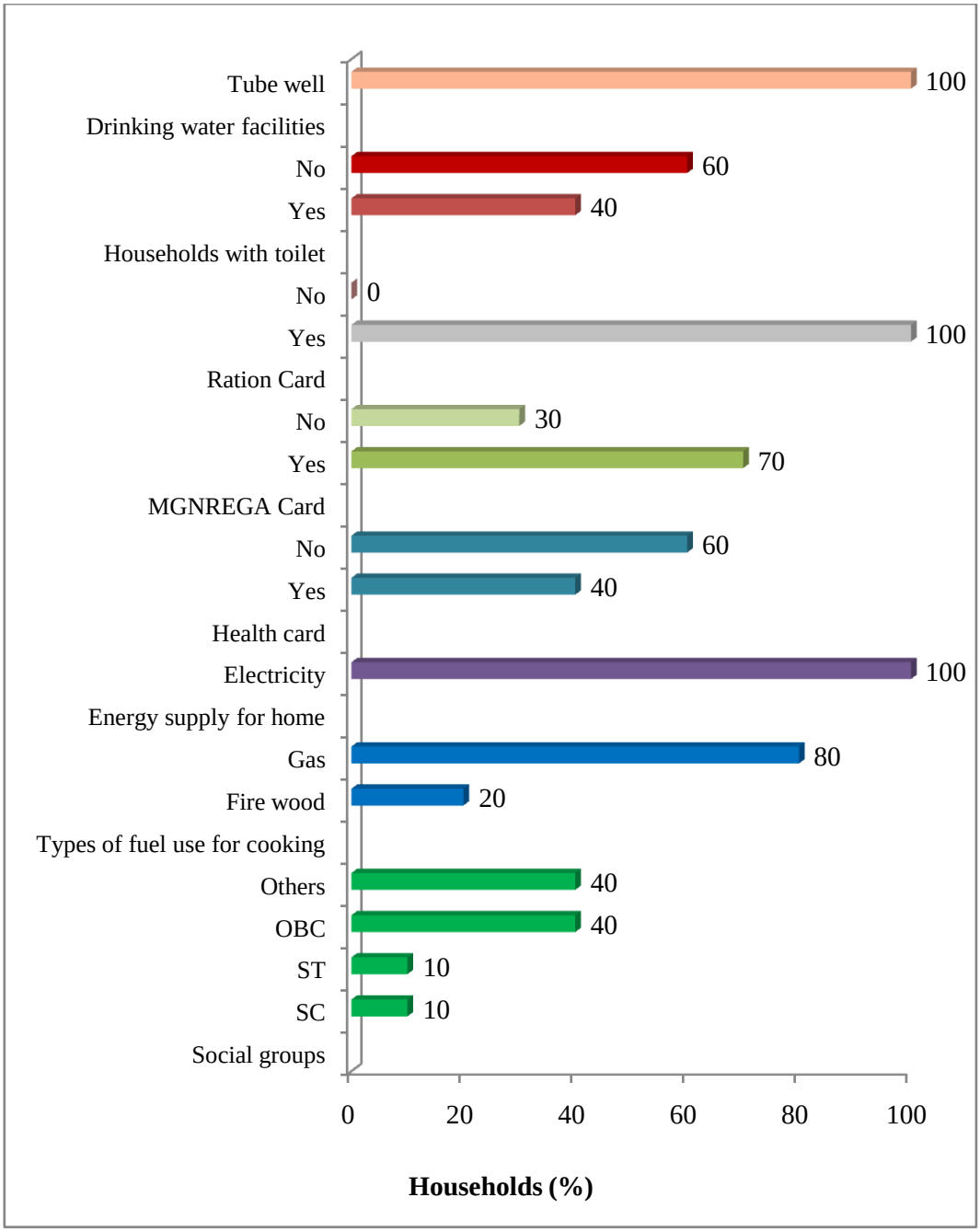

Figure 3: Basic needs of sample households in Lakkipur 1 Microwatershed

Table 3: Institutional participation among the sample population in Lakkipur Microwatershed

Particulars	Units	Value
No. Of people participating	% to total	8.8
Users groups	% to total	3.0
Self help groups (SHG's)	% to total	2.9
Co-operative Societies - marketing	% to total	2.9
No. Of people not participating	% to total	91.2

The occupational pattern (Table 4) among sample households shows that agriculture is the main occupation around 6.3 per cent of farmers followed by subsidiary occupations like agricultural labour (87.5 %) and non agriculture labour (6.2 %).

Table 4: Occupational pattern in sample population in Lakkipur 1 Microwatershed

Occupation		% to total
Main	**Subsidiary**	
Agriculture	Agriculture	6.3
	Agriculture Labour	87.5
	Non Agriculture Labour	6.2
Grand Total		100.0
Family Labour Availability		**Man days/month**
Male		40.0
Female		22.9
Total		62.9

The important assets especially with reference to domestic assets were analyzed and are given in Table 5 and Figure 4. The important domestic assets possessed by all categories of farmers are television (80.0 %) followed by mobile phone (80.0 %), mixer/grinder (50.0 %), motor cycle (20.0 %) and dvd/cvd (10.0 %) and radio (10.0). The average value of domestic assets is around Rs. 11970 per households.

Table 5: Domestic assets among the sample households in Lakkipur 1 Microwatershed

Particulars	% of households	Average value in Rs
Television	80.0	8517
Mobile Phone	80.0	5924
Mixer/grinder	50.0	2250
Motor cycle	20.0	50209
Dvd/Cvd	10.0	3393
Radio	10.0	1525
Average value in Rs	11970	

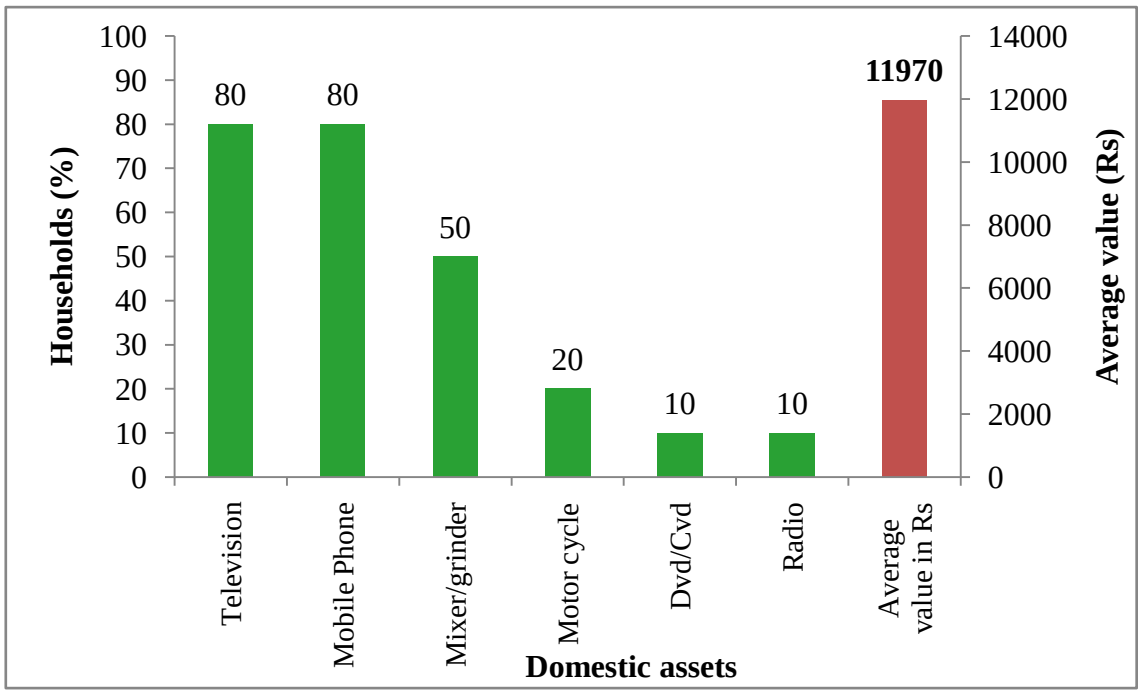

Figure 4: Domestic assets among the sample households in Lakkipur 1 Microwatershed

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 (50 %), drip/sprinkler (10.0 %), sprayer (10.0 %) and irrigation pump (10.0 %) was found highest among the sample farmers. The average value of farm assets is around Rs.7153 per households (Table 6 and Figure 5).

Table 6: Farm assets among samples households in Lakkipur 1 Microwatershed

Particulars	% of households	Average value in Rs
Plough	50.0	1533
Drip/sprinkler	10.0	30000
Sprayer	10.0	30000
Irrigation pump	10.0	60000
Average value	30383	

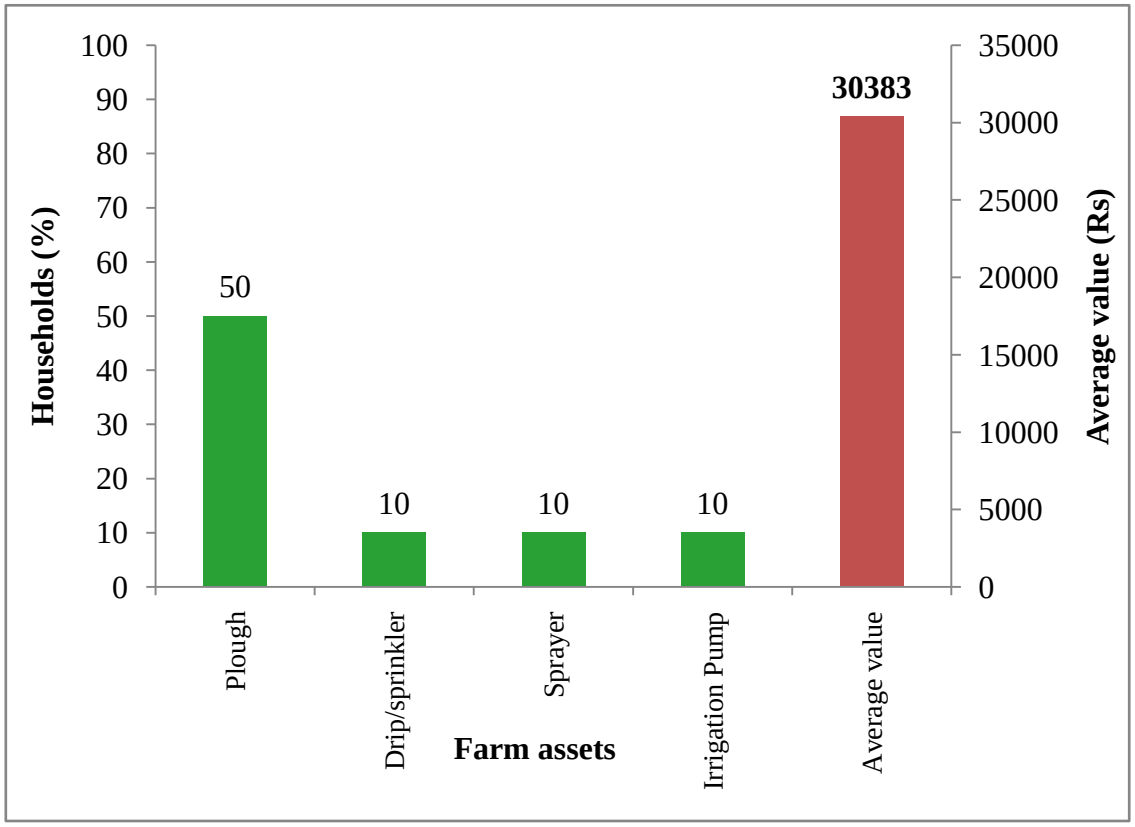

Figure 5: Farm assets among samples households in Lakkipur 1 Microwatershed

Livestock is an integral component of the conventional farming systems (Table 7 and Figure 6). The highest livestock population is crossbred milching cow were around 28.6 per cent followed by local dry cow (28.6 %), bullocks (14.3 %) and crossbred dry cow (28.6 %).The average livestock value was Rs.16714 per household.

Table 7: Livestock assets among sample households in Lakkipur 1micro-watershed

Particulars	% of livestock population	Average value in Rs
Crossbred Milching Cow	28.6	27000
Local Dry Cow	28.6	5000
Bullocks	14.3	40000
Crossbred Dry Cow	28.6	6500
Average value	19625	

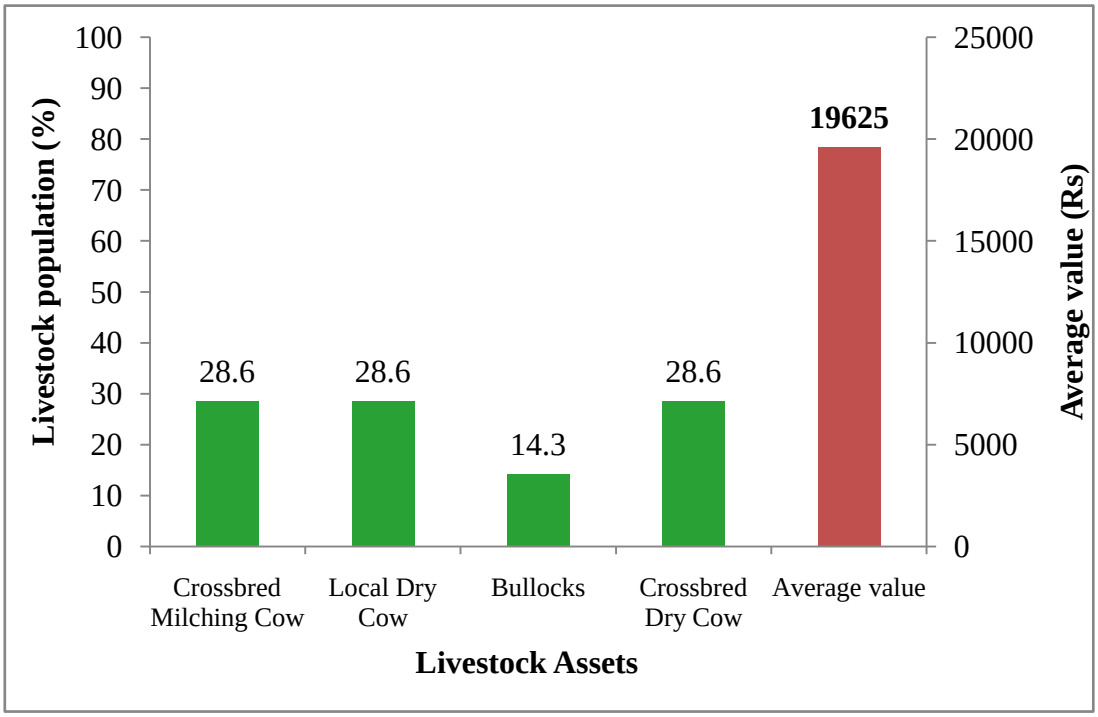

Figure 6: Livestock assets among sample households in Lakkipur 1 micro-watershed

Average milk produced in sample households is 1080 litters/ annum. Among the farm households, ragi, maize, sorghum, horse gram and groundnut are the main crops for domestic food and fodder for animals. About 1500kg /ha of average fodder is available per season for the livestock feeding (Table 8).

Table 8: Milk produced and fodder availability of sample households in Lakkipur 1 Microwatershed

Particulars	
Name of the Livestock	**Ltr./Lactation/animal**
Crossbred Milching Cow	1080
Fodder produces	**Fodder yield (kg/ha.)**
Ragi	1250
Horsegram	1666
Groundnut	1250
Average fodder availability	1500
Livestock having households (%)	50.0
Livestock population (Numbers)	8

A woman participation in decision making is in this micro-watershed is presented in Table 9. About 40.0 per cent of women participation in local organisation activates, twenty per cent of women elected as panchayat member and about 82.2 per cent of women taking decision in her family and agriculture related activities.

Table 9: Women empowerment of sample households in Lakkipur 1 Microwatershed % to Grand Total

Particulars	**Yes**	**No**
Women participation in local organization activities	40.0	60.0
Women elected as panchayat member	20.0	80.0
Women earning for her family requirement	0.0	100
Women taking decision in her family and agriculture related activities	82.2	17.8

The food intake in terms of kilo calorie (kcal) per person per day was calculated and presented in the Table 10 and Figure 7. More quantity of cereals is consumed by sample farmers which accounted for 896.3 kcal per person. The other important food items consumed was cooking oil 182.7 kcal followed by pulses 126.5 kcal, milk 122.2 kcal, egg 123.7 kcal, meat 25.7 kcal and vegetables 16.93 kcal. In the sampled households, farmers were consuming less (1494.1kcal) than NIN- recommended food requirement (2250 kcal).

Table 10: Per capita daily consumption of food among the sample households in Lakkipur 1 Microwatershed

Particulars	**NIN recommendation (gram/ per day/ person)**	**Present level of consumption (gram/ per day/ person)**	**Kilo Calories /day/person**
Cereals	396.0	263.6	896.3
Cooking Oil	31.0	32.1	182.7
Pulses	43.0	36.9	126.5
Milk	200.0	188.1	122.2
Egg	0.5	82.5	123.7
Meat	14.2	17.1	25.7
Vegetables	143.0	70.6	16.93
Total	**827.7**	**690.8**	**1494.1**
Threshold of NIN recommendation		827 gram*	2250 Kcal*
% Below NIN		60	100
% Above NIN		40	0

Note: * day/person

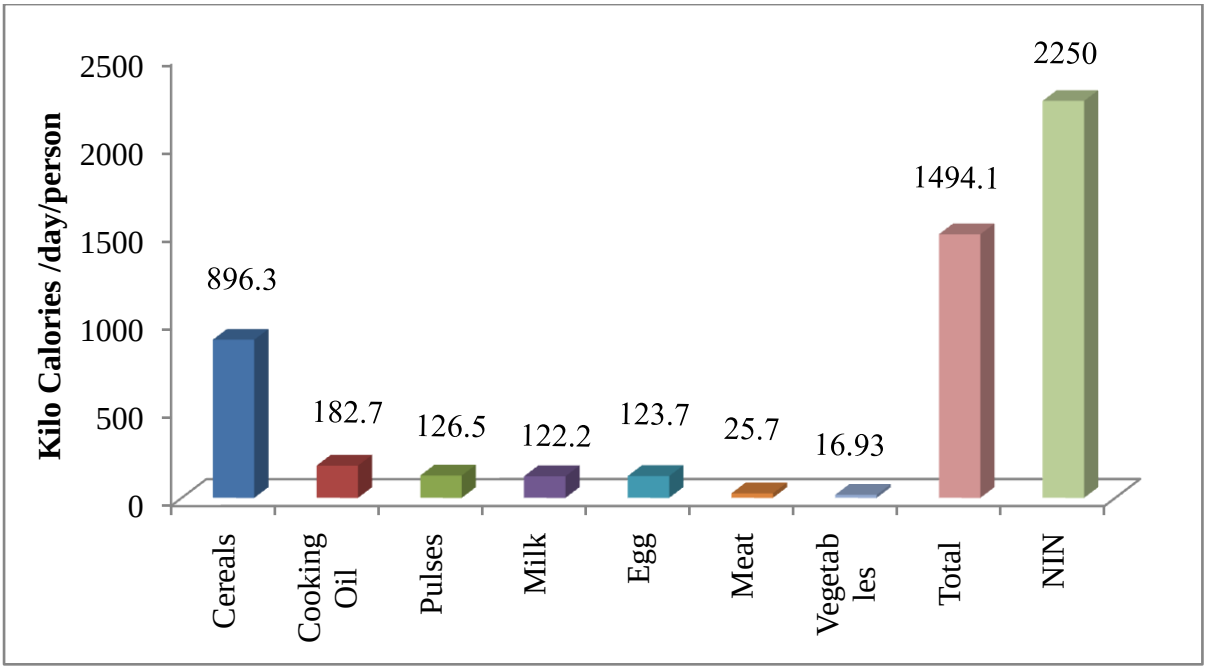

Figure 7: Per capita daily consumption of food among the sample households in Lakkipur 1 Microwatershed

Annual income of the sample HHs: The average annual household income is around Rs 54221. Major source of income to the farmers in the study area is from crop production (Rs 31141) followed by livestock (Rs. 23080). The monthly per capita income is Rs.1328, which is more than the threshold monthly income of Rs 975 for considering above poverty line. Due to the fact that erratic rainfall and shortage of water, farmers are diverting from crop production activities to enable the household for a comfortable livelihood. The incomes from the other aforesaid sources are very meagre (Table 11).

Table 11: Annual average income of HHs from various sources in Lakkipur 1 Microwatershed

Particulars	**Income ***
Nonfarm Income	0 (0)
Livestock income (Rs)	23080 (20.0)
Crop Production (Rs)	31141 (100)
Total Annual Income (Rs)	***54221***
Average monthly per capita income (Rs)	1328
Threshold for Poverty level (Rs 975 per month/person)	
% of households below poverty line	70.0
% of households above poverty line	30.0

* 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.29386) 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.1269 and all sample farm households are comes above poverty line (Table 12 and Figure 8).

Table 12: Average annual expenditure of sample HHs in Lakkipur 1Microwatershed

Particulars	Value in Rupees	Per cent
Food	29386	56.7
Education	5000	9.7
Clothing	4100	7.9
Social functions	5200	10.0
Health	8100	15.6
Total Expenditure (Rs/year)	51787	100.0
Monthly per capita expenditure (Rs)	1269	

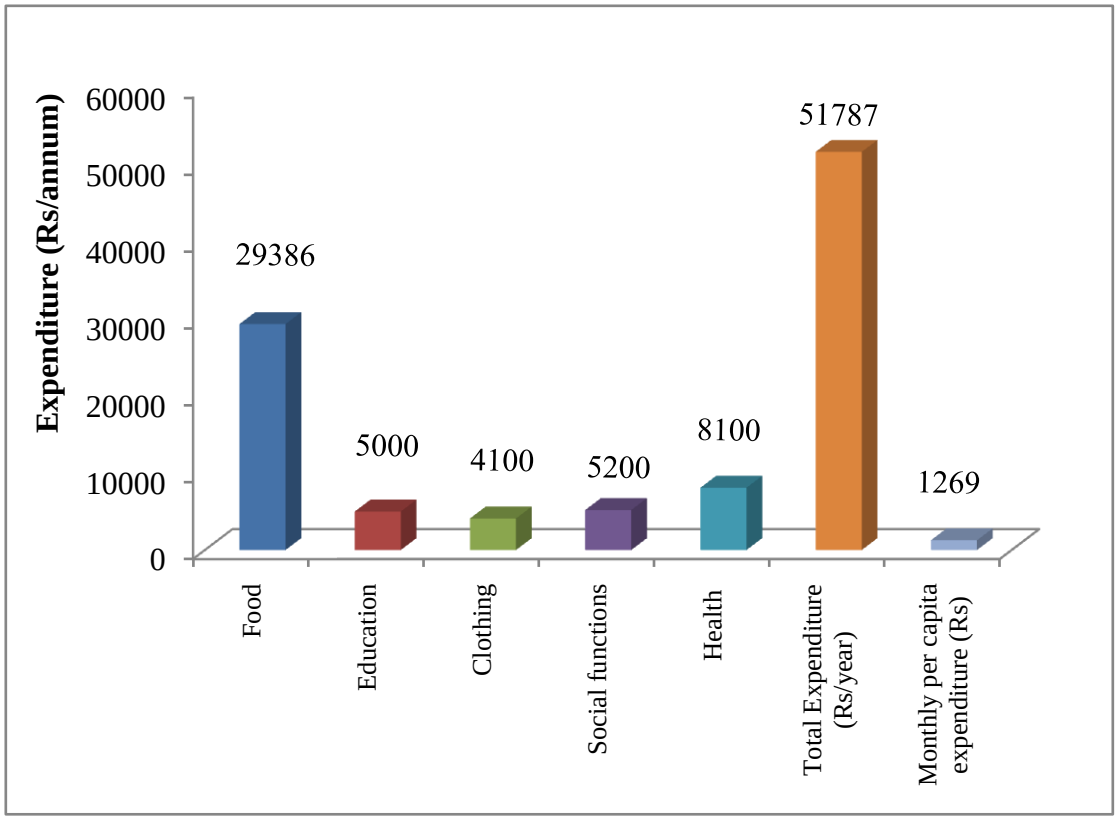

Figure 8: Average annual expenditure of sample HHs in Lakkipur 1 Microwatershed

Land use: The total land holding in the Lakkipur 1 micro-watershed is 7.0 ha (Table 13). Of which 4.7 ha is dry land and 2.3 ha is irrigated land. The average land holding per household is worked out to be 1.3 ha.

Table 13: Land use among samples households in Lakkipur 1 Microwatershed

Particulars	Per cent	Area in ha
Irrigated land	32.3	2.3
dry Land	67.7	4.7
Fallow land	0.0	0.0
Total land holding	100.0	7.0
Average land holding	1.3	

In the micro-watershed, the prevalent present land uses under perennial plants are coconut (44.4 %) followed by teak (22.2 %), neem trees (16.7 %), acacia (11.1 %) and peeple tree (5.6 %) (Table 14).

Table 14: Number of trees/plants covered in sample farm households in Lakkipur 1 Microwatershed

Particulars	Number of Plants/trees	Per cent
Coconut	8	44.4
Neem trees	3	16.7
Teak	4	22.2
Acacia	2	11.1
Peeple tree(Arali)	1	5.6
Grand Total	18	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 maize (26.3 %) followed by groundnut (8.4 %), onion (8.4%), sunflower (8.4%), turmeric (5.5%), ragi (4.8 %), garlic (4.7%), marigold (4.7%) and cotton (1.2%) which are taken during kharif and horse gram (18.0 %), cow pea (8.4 %) and maize (1.2 %) during rabi season respectively. The cropping intensity was 138 per cent (Table 15 and Figure 9).

Table 15: Present cropping pattern and cropping intensity in Lakkipur 1 Microwatershed % to Grand Total

Crops	Kharif	Rabi	Grand Total
Maize	26.3	1.2	27.5
Horsegram		18.0	18.0
Cowpea		8.4	8.4
Groundnut	8.4		8.4
Onion	8.4		8.4
Sunflower	8.4		8.4
Turmeric	5.5		5.5
Ragi	4.8		4.8
Garlic	4.7		4.7
Marigold	4.7		4.7
Cotton	1.2		1.2
Grand Total	72.4	27.6	100
Cropping intensity (%)	138.1		

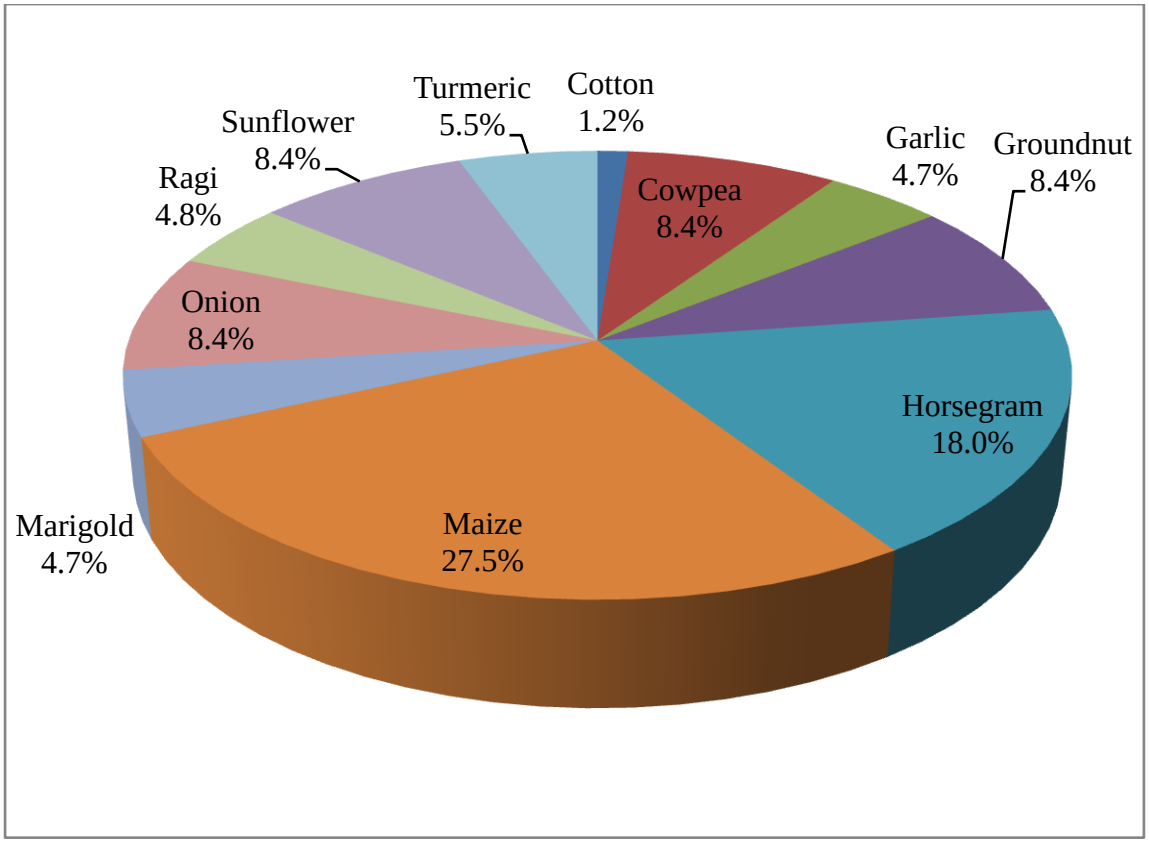

Figure 9: Present cropping pattern in Lakkipur 1 Microwatershed

Economic land evaluation

The main purpose of economic land evaluation 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 Lakkipur micro-watershed, 11 soil series are identified and mapped (Table 16). The distribution of major soil series are Beemanabeedu covering an area around 57.6 ha (17.2%) followed by Shivapura 50.4 ha (14.7%), Hullipura 41.2 ha (12.0%), Magoonahalli 40.8ha (11.9%), Berambadi 34.2 ha (10.0%), Annurkeri 25.0ha (7.3 %), Honnegaudanahalli 20.5 ha (6.0 %), Kallipura 14.3 ha (4.2 %), Hindupur 8.7 ha (2.5 %), Devarahalli 6.9 ha (2.1%) and Gopalapura 5.6 ha (1.0 %).

Table 16: Distribution of soil series in Lakkipur 1 Microwatershed

Soil No	Soil Series	Mapping Unit Description	Area in ha (%)
1	ARK	Annurkeri soils are very deep (>150 cm), well drained, have dark reddish brown to very dusky red sandy clay to clay soils occurring on very gently sloping uplands under cultivation	25.0 (7.3)
2	BMB	Beemanabeedu soils are very deep (>150 cm), moderately well	57.6

		drained, have very dark grayish brown to dark grey and very dark brown clayey soils occurring on very gently sloping lowlands under cultivation	(17.2)
3	BMD	Berambadi soils are shallow (25-50 cm), well drained, dark brown to dark greyish brown clayey soils occurring on gently to moderately sloping uplands under cultivation	34.2 (10.0)
4	DRH	Devarahalli soils are moderately shallow (50-75 cm), well drained, have dark red to reddish brown and dusky red gravelly sandy clay loam to sandy clay soils occurring on very gently sloping uplands under cultivation	6.9 (2.1)
5	GPR	Gopalapura soils are moderately deep (75-100 cm), well drained, have dark brown to dark reddish brown and reddish brown gravelly sandy clay loam to sandy clay soils occurring on very gently sloping uplands under cultivation	5.6 (1.0)
6	HDR	Hindupur soils are shallow (25-50 cm), well drained, have dark reddish brown to dusky red sandy clay loam to sandy clay soils occurring on very gently sloping uplands under cultivation	8.7 (2.5)
7	HGH	Honnegaudanahalli soils are very deep (>150 cm), well drained, have very dark brown to brown and dark reddish brown sandy clay loam soils occurring on very gently sloping uplands under cultivation	20.5 (6.0)
8	HPR	Hullipura soils are moderately shallow (50-75 cm), well drained, have dark brown to very dark brown gravelly sandy clay loam to sandy clay soils occurring on very gently to gently sloping uplands under cultivation	41.2 (12.0)
9	KLP	Kallipura soils are deep (100-150 cm), well drained, have dark reddish brown to dark red gravelly sandy clay loam to sandy clay soils occurring on very gently sloping uplands under cultivation	14.3 (4.2)
10	MGH	Magoonahalli soils are moderately shallow (50-75 cm), well drained, have very dark brown to dark brown gravelly sandy clay loam soils occurring on very gently to strongly sloping mounds and ridges	40.8 (11.9)
11	SPR	Shivapura soils are shallow (25-50 cm), well drained, have dark reddish brown gravelly sandy clay loam to sandy clay soils occurring on very gently to moderately sloping uplands under cultivation	50.4 (14.7)
12		Forest	26 (7.6)
13		Others	10.7 (3.1)

Present cropping pattern on different soil series are given in Table 17. Crops grown on Kallipura soils are garlic. Cotton, maize, onion and turmeric on Honnegaudanahalli soils is grown. Maize is grown on Beemanabeedu soils. Cowpea,

horsegram, maize and sunflower on Hullipura soils are grow. Cowpea, groundnut, horsegram and ragi on Magoonahalli soils are grow. Maize and marigold on Shivapura soils can grow.

Table 17: Cropping pattern on major soil series in Lakkipur 1 micro-watershed

(Area in per cent)

Soil Series	Soil Depth	Crops	Dry		Irrigated	Grand Total
			Kharif	Rabi	Kharif	
SPR	Shallow (25-50 cm)	Maize	64.1	0.0	0.0	64.1
		Marigold	35.9	0.0	0.0	35.9
MGH	Moderately shallow (50-75 cm)	Cowpea	0.0	37.9	0.0	37.9
		Groundnut	18.9	0.0	0.0	18.9
		Horse gram	0.0	21.6	0.0	21.6
		Ragi	21.6	0.0	0.0	21.6
HPR	Moderately shallow (50-75 cm)	Cowpea	0.0	18.2	0.0	18.2
		Horse gram	0.0	31.8	0.0	31.8
		Maize	18.2	0.0	0.0	18.2
		Sunflower	31.8	0.0	0.0	31.8
KLP	Deep (100-150 cm)	Garlic	0.0	0.0	100.0	100.0
HGH	Very deep (>150cm)	Cotton	7.4	0.0	0.0	7.4
		Maize	0.0	7.4	0.0	7.4
		Onion	0.0	0.0	51.0	51.0
		Turmeric	0.0	0.0	34.2	34.2
BMB	Very deep (>150 cm)	Maize	100.0	0.0	0.0	100.0

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

Table 18: Alternative land use options for different size group of farmers (Benefit Cost Ratio) in Lakkipur 1 Microwatershed.

Soil Series	Small Farmers
SPR	Maize (1.86), Marigold (1.13)
HPR	Cowpea (1.19), Horsegram (2.2), Maize (2.29), Sunflower (1.02)
MGH	Cowpea (4.43), Groundnut (1.14), Horsegram (1.26), Ragi (1.63)
KLP	Garlic (2.88)
BMB	Maize (1.66)
HGH	Cotton (1.32), Maize (1.13), Onion (2.09), Turmeric (2.17)

The productivity of different crops grown in Lakkipur 1 micro-watershed under potential yield of the crops is given in Table 19.

Table 19: Economic land evaluation and bridging yield gap for different crops in Lakkipur 1 micro-watershed

Particulars	SPR (25-50 cm)		HPR (50-75 cm)				MGH (50-75 cm)				KLP (100-150 cm)	BMB (>150 cm)	HGH (>150 cm)			
	Maize	Marigold	Cow pea	Horse gram	Maize	Sun flower	Cow pea	Ground nut	Horse gram	Ragi	Garlic	Maize	Cotton	Maize	Onion	Turmeric
Total cost (Rs/ha)	27354	48021	31228	13135	48523	14496	11497	36343	27542	28121	55147	26522	66423	78831	59214	114414
Gross Return (Rs/ha)	50882	54031	37267	28899	110933	14820	50882	41496	34667	45717	158786	44034	87710	89431	123500	248843
Net returns (Rs/ha)	23528	6011	6039	15764	62411	324	39385	5153	7125	17595	103639	17512	21287	10600	64286	134429
BCR	1.86	1.13	1.19	2.20	2.29	1.02	4.43	1.14	1.26	1.63	2.88	1.66	1.32	1.13	2.09	2.17
Farmers Practices (FP)																
FYM (t/ha)	2.5	6.7	4.4	2.5	8.8	1.3	0.0	2.5	0.0	4.4	4.5	3.2	5.1	0.0	2.5	3.7
Nitrogen (kg/ha)	57.5	37.9	116.8	39.7	116.8	39.7	4.3	4.3	18.6	18.6	75.9	39.9	70.5	70.5	77.1	77.1
Phosphorus (kg/ha)	98.8	80.4	108.0	19.7	108.0	19.7	9.0	9.0	39.5	39.5	160.7	78.3	143.2	143.2	84.9	84.9
Potash (kg/ha)	25.0	0.0	29.1	5.3	29.1	5.3	0.0	0.0	0.0	0.0	133.9	0.0	0.0	0.0	60.0	60.0
Grain (Qtl/ha)	25.0	78.1	8.8	7.5	54.8	3.8	6.3	7.5	8.8	11.0	26.8	24.0	15.3	51.7	62.5	33.6
Price of Yield (Rs/Qtl)	2000	700	4000	3800	2000	4000	8000	5400	3850	4100	6000	1800	5800	1650	2000	7500
Soil test based fertilizer Recommendation (STBR)																
FYM (t/ha)	8.6	19.8	7.4	0.0	8.6	6.6	7.4	8.6	0.0	8.6	24.7	8.6	12.4	8.6	29.6	24.7
Nitrogen (kg/ha)	123.5	166.7	18.5	24.7	92.6	55.2	18.5	18.5	18.5	55.6	123.5	123.5	111.2	92.6	92.6	111.2
Phosphorus (kg/ha)	77.2	74.1	49.4	46.3	61.8	74.1	61.8	77.2	46.3	54.0	61.8	61.8	92.6	77.2	74.1	123.5
Potash (kg/ha)	32.1	59.3	18.5	18.5	24.1	27.8	24.7	30.9	24.7	44.5	46.3	24.1	55.6	24.1	92.6	185.3
Grain (Qtl/ha)	84.0	98.8	12.4	9.9	84.0	16.5	12.4	17.3	9.9	30.9	79.0	84.0	17.3	84.0	247.0	24.7
% of Adoption/yield gap (STBR-FP) / (STBR)																
FYM (%)	71.1	66.1	40.8	0.0	-1.5	81.0	100.0	71.1	0.0	49.3	81.9	63.0	58.7	100.0	91.6	84.9
Nitrogen (%)	53.4	77.2	-530.4	-60.7	-26.1	28.1	77.1	77.1	-0.6	66.5	38.5	67.7	36.6	23.9	16.7	30.6
Phosphorus (%)	-27.9	-8.4	-118.6	57.5	-74.9	73.4	85.4	88.3	14.8	26.9	-160.3	-26.8	-54.6	-85.6	-14.6	31.3
Potash (%)	22.1	100.0	-56.9	71.3	-20.7	80.9	100.0	100.0	0.0	100.0	-189.2	100.0	0.0	100.0	35.2	67.6
Grain (%)	70.2	20.9	29.0	24.1	34.7	77.2	49.4	56.6	11.2	64.5	66.1	71.5	11.5	38.4	74.7	-36.0
Value of yield and Fertilizer (Rs)																
Additional Cost (Rs/ha)	6130	15519	-944	-1244	-2551	8366	10396	9934	794	6232	14700	6207	6621	6487	27504	25581
Additional Benefits (Rs/ha)	117960	14473	14312	9044	58311	50867	48800	52866	4266	81631	313526	108033	11506	53222	369000	-66616
Net change Income (Rs/ha)	111830	-1047	15256	10288	60862	42501	38404	42932	3473	75399	298825	101826	4885	46735	341496	-92197

The data on cost of cultivation and benefit cost ratio (BCR) of different crops is given in Table 19. The total cost of cultivation in study area for maize ranges between Rs. 78831/ha in HGH soil (with BCR of1.07) and Rs. 27873/ha in BMB soil (with BCR of 1.61), horse gram range between Rs 27542/ha in MGH soil (with of 1.51) and Rs. 14192/ha in HPR soil (with BCR of 2.65), cowpea range between Rs. 33083/ha in HPR soil (with BCR of 1.57) and Rs. 11497/ha in MGH soil (with BCR of 4.3), cotton cost of cultivation range between is Rs. 202501/ha in HGH soil (with BCR of 1.62), onion cultivation in HGH soil is Rs.60271/ha (with BCR of 2.05), sunflower cultivation in HGH soil is Rs 28187/ha (with BCR of 2.05), ragi cultivation in HGH soil is Rs.29976/ha (with BCR of 1.53), garlic cultivation in KPL soil is Rs 57035/ha (with BCR of 2.78) and turmeric cultivation in HGH soil is Rs 115992/ha (with BCR of 2.78).

The data on FYM, Nitrogen, Phosphorus and Potash application by the farmers to different crops and recommended FYM for different crops is given in Table 19. There is a huge gap between FYM application by farmers and recommended FYM in all the crops across the soils. There is a larger yield gap in crops grown across different soil series. Adequate knowledge about recommended package of practices is the pre-requisite for their use in cultivation of crops. It is a fact that, recommended practices are major contributing factors to yield. Inadequate knowledge about recommended practices leads to their improper adoption. Strengthening of extension services by concerned agency is required to increase adoption of recommended cultivation practices and ultimately reducing the gap. By adopting soil-test fertiliser recommendation, there is scope to increase yield and income to a maximum of Rs. 341496 in onion and a minimum of Rs. 4885 in cotton cultivation.

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

The onsite cost of different soil nutrients lost due to soil erosion is given in Table 20 and Figure 10. The average value of soil nutrient loss is around Rs.1078 per ha/year. The total cost of annual soil nutrients is around Rs.328649 per year for the total area of 342.0 ha.

Table 20: Estimation of onsite cost of soil erosion in Lakkipur 1 micro-watershed

Particulars	Quantity(kg)		Value (Rs)	
	Per ha	Total	Per ha	Total
Organic matter	156.29	47669	984.6	300316
Phosphorus	0.20	62	8.9	2724
Potash	1.76	537	35.2	10738
Iron	0.26	80	12.5	3818
Manganese	0.01	2	2.0	617
Cupper	0.02	6	11.7	3565
Zinc	0.40	122	16.0	4892
Sulpher	0.15	47	6.2	1882
Boron	0.01	2	0.3	97
Total	129.41	48528	1077.5	328649

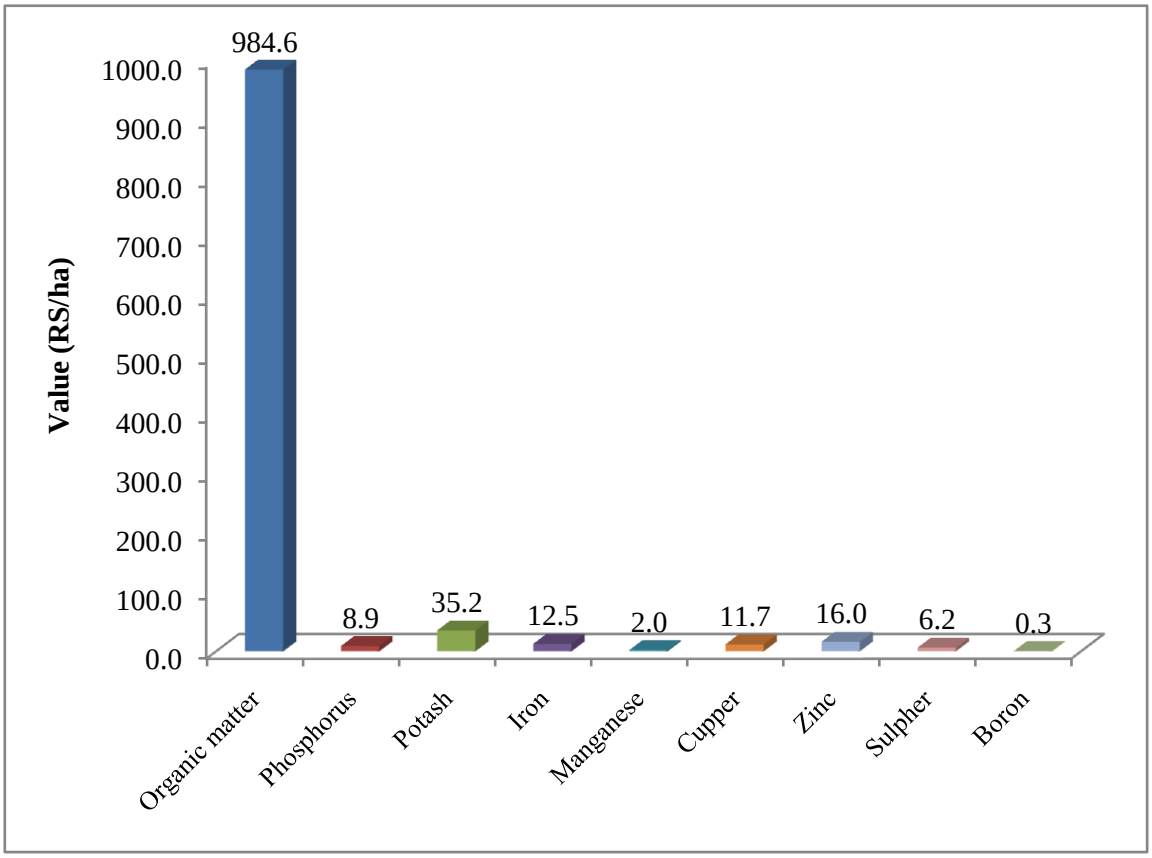

Figure 10: Estimation of onsite cost of soil erosion in Lakkipur 1 micro-watershed

The average value of ecosystem service for food grain production is around Rs 50726/ ha/year (Table 21 and Figure 11). Per hectare food grain production services is maximum in turmeric (Rs.132852) followed by cotton (Rs.124561), garlic (Rs.101751), onion (Rs.63229), maize (Rs. 36649), cowpea (Rs.35235) sunflower (Rs.31093), horse gram (Rs.18747) ragi (Rs.14441), marigold (Rs.3179) and groundnut is negative returns.

Table 21: Ecosystem services of food grain production in Lakkipur 1 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	Maize	2.7	44.8	1863	83485	46837	36649
	Ragi	0.5	10.8	4100	44417	29976	14441
Pulses	Cowpea	1.3	9.6	6000	57525	22290	35235
	Horsegram	1.3	10.4	3825	39614	20867	18747
Oil seeds	Groundnut	0.4	9.9	5400	53352	57100	-3748
	Sunflower	0.8	14.8	4000	59280	28187	31093
Vegetables	Onion	0.8	61.8	2000	123500	60271	63229
Commercial Crops	Cotton	0.1	68.1	4800	327062	202501	124561
	Marigold	0.5	77.2	700	54031	50852	3179
Spice crops	Garlic	0.5	26.5	6000	158786	57035	101751
	Turmeric	0.5	33.2	7500	248843	115992	132852
Average value		9.4	33.4	4199	113627	62901	50726

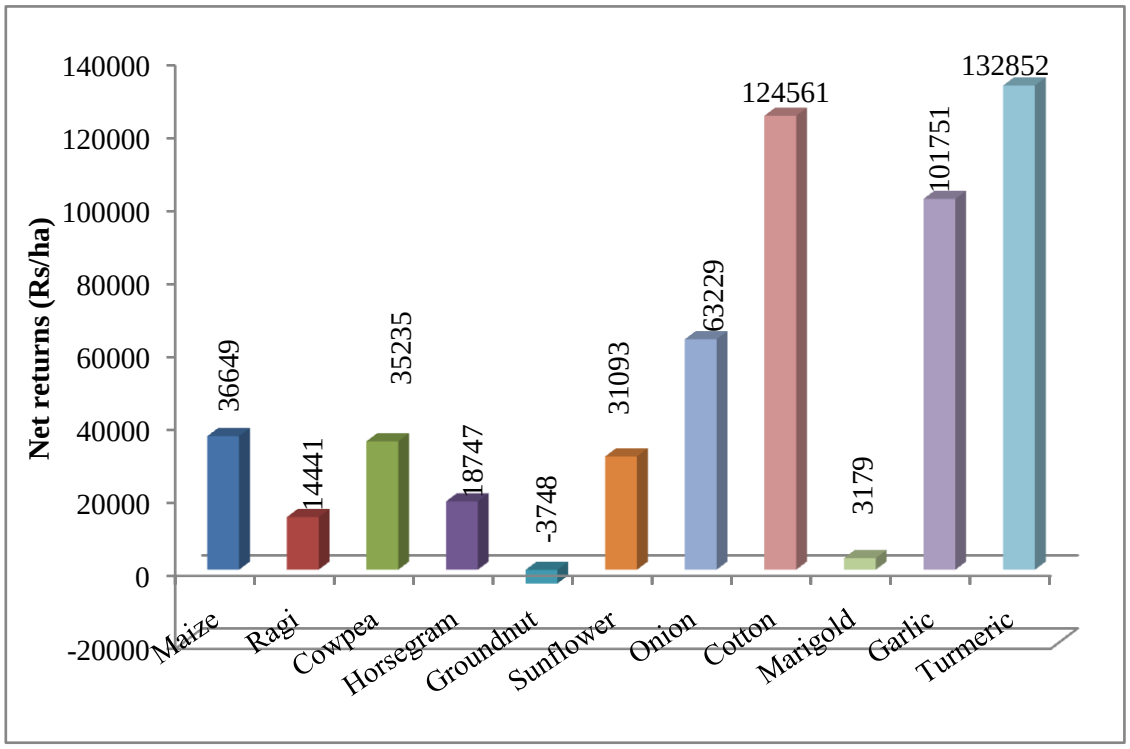

Figure 11: Ecosystem services of food grain production in Lakkipur-1 Microwatershed

The average value of ecosystem service for fodder production is around Rs. 2286/ha/year (Table 22). Per hectare fodder production services is maximum in groundnut (Rs. 3952) followed by maize (Rs. 2653), cowpea (Rs.2506), ragi (Rs.1300) and horse gram (Rs.1300).

Table 22: Ecosystem services of fodder production in Lakkipur-1 Microwatershed

Production items	Crops	Area in ha	Yield (Qtl/ha)	Price (Rs/Qtl)	Net Returns (Rs)
Cereals	Maize	2.66	4.42	600	2653
	Ragi	0.46	2.17	600	1300
Pulses	Cowpea	1.27	2.78	900	2506
	Horsegram	1.27	1.70	600	1021
Oil seeds	Groundnut	0.40	2.47	1600	3952
Grand Total		6.06	2.71	860	2286

The water demand for production of different crops was worked out in arriving at the ecosystem services of water support to crop growth. The data on water requirement for producing one quintal of grain is considered for estimating the total value of water required for crop production. The per hectare value of water used and value of water was maximum (Table 23 and Figure 12) in cotton (Rs.274528) followed by turmeric (Rs.54978), maize (Rs.54775), sunflower (Rs. 49884), horse gram (Rs.31878), groundnut (Rs.27486), onion (Rs.16796), garlic (Rs.15587), ragi (Rs.13238) and cowpea (Rs.12042).

Table 23: Ecosystem services of water supply in Lakkipur 1 Microwatershed

Crops	Yield (Qtl/ha)	Virtual water (cubic meter) per ha	Value of Water(Rs/ha)	Water consumption (Cubic meters/Qtl)
Cotton	68.1	27453	274528	403
Cowpea	9.6	1204	12042	126
Garlic	26.5	1559	15587	59
Groundnut	9.9	2749	27486	278
Horsegram	10.4	3188	31878	308
Maize	44.8	5478	54775	122
Onion	61.8	1680	16796	27
Ragi	10.8	1324	13238	122
Sunflower	14.8	4988	49884	337
Turmeric	33.2	5498	54978	166
Average	29.0	5512	55119	195

The main farming constraints in Lakkipur 1 micro-watershed to be found are less rainfall, lack of good quality seeds, lack of transportation and damage of crops by wild animals. Majority of farmers depend up on money lender of the sources of loan for purpose of crop production. Farmers to sell the agriculture produce through village market and the farmers getting the agriculture related information on newspaper and television. Farmers reported that they are not getting timely support/extension services from the concerned development department (Table 24).

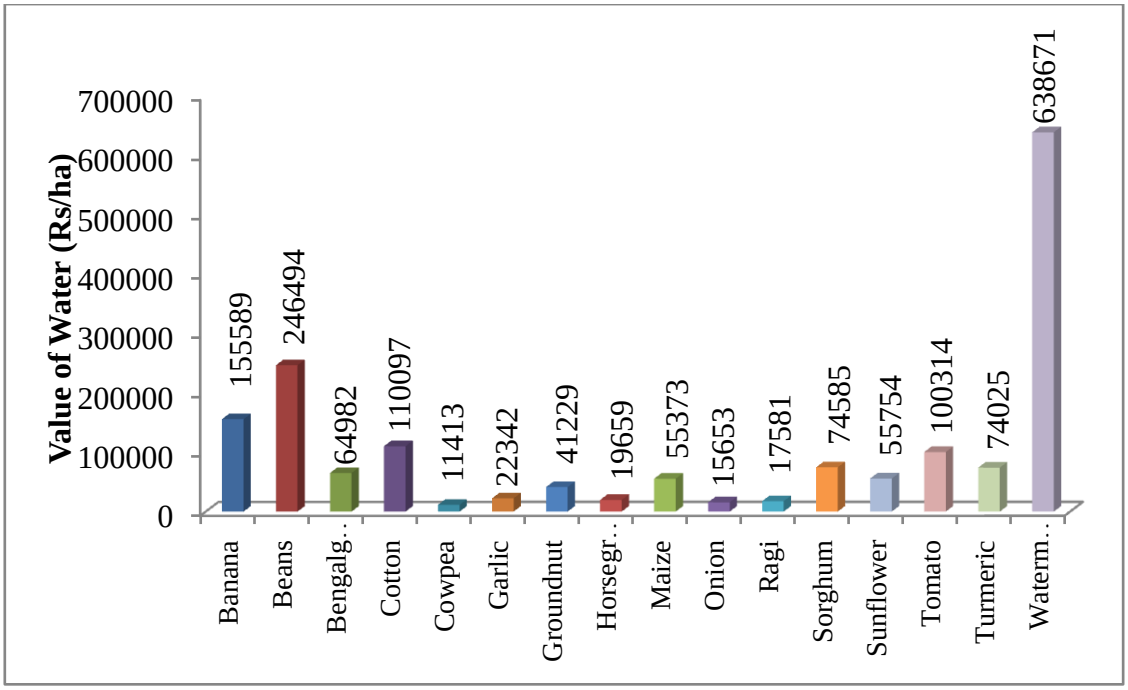

Figure 12: Ecosystem services of water supply in Lakkipur 1 Microwatershed

Table 24: Farming constraints related land resources of sample household's in Lakkipur 1 Microwatershed

Sl. No	Particulars	Per cent
1	Less Rainfall	100.0
2	Lack of good quality seeds	10.0
3	Lack of transportation	30.0
4	Damage of crops by Wild Animals	100.0
5	**Source of loan**	
	Money Leander	100.0
6	**Market for selling**	
	Village market	100.0
7	**Sources of Agri-Technology information**	
	Newspaper	100.0

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.