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**LAND RESOURCE INVENTORY FOR WATERSHED PLANNING AND
DEVELOPMENT**

BHAGYANAGAR-2 (4D4A1X1e) MICROWATERSHED

Koppal Taluk and District, Karnataka

Karnataka Watershed Development Project – II

SUJALA – III

World Bank funded Project



THE WORLD BANK



ICAR – NATIONAL BUREAU OF SOIL SURVEY AND LAND USE PLANNING



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. The challenges 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 Inventory. 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 for Watershed Planning and Development of for Bhagyanagar-2 microwatershed in Koppal Taluk, and District, Karnataka” for integrated development was taken up in collaboration with the State Agricultural Universities, IISC, KRSRAC, KSNDMC as Consortia partners. The project provides detailed land resource information at cadastral level (1:7920 scale) for all the plots in the micro-watershed. The project report with the accompanying maps for the microwatershed will provide required detailed database for evolving effective land use plan, alternative land use options and conservation plans for the planners, administrators, agricultural extension personnel, KVK officials, developmental departments and other land users to manage the land resources in a sustainable manner.

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

Nagpur

Date: 17-10-2019

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EXECUTIVE SUMMARY

The land resource inventory of Bhagyanagar-2 microwatershed was conducted using village cadastral maps and IRS satellite imagery on 1:7920 scale. The false colour composites of IRS imagery were interpreted for physiography and these physiographic delineations were used as base for mapping soils. The soils were studied in several transects and a soil map was prepared with phases of soil series as mapping units. Random checks were made all over the area outside the transects to confirm and validate the soil map unit boundaries. The soil map shows the geographic distribution and extent, characteristics, classification, behavior and use potentials of the soils in the Microwatershed.

The present study covers an area of 553 ha in Koppal taluk and district, Karnataka. The climate is semiarid and categorized as drought - prone with an average annual rainfall of 662 mm, of which about 424 mm is received during south –west monsoon, 161 mm during north-east and the remaining 77 mm during the rest of the year. An area of about 29 per cent is covered by soil, <1 per cent by railways and 70 per cent by settlements. The salient findings from the land resource inventory are summarized briefly below

- ❖ *The soils belong to 8 soil series and 10 soil phases (management units) and 5 land management units.*
- ❖ *The length of crop growing period is <90 days and starts from 2nd week of August to 2nd 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 320 m grid interval.*
- ❖ *Land suitability for growing 31 major agricultural and horticultural crops were assessed and maps showing the degree of suitability along with constraints were generated.*
- ❖ *Entire area is suitable for agriculture.*
- ❖ *About 14 per cent moderately shallow (50-75 cm), 3 per cent moderately deep (75-100 cm), 12 per cent is deep to very deep (100->150cm) soils.*
- ❖ *About 6 per cent loamy (sandy loam) and 24 per cent has clayey (sandy clay and clay) soils at the surface.*
- ❖ *Entire area in the microwatershed has non-gravelly (<15%)soils.*
- ❖ *With respect to available water capacity 14 per cent of the area has very low (<50mm/m), 11 per cent of the area has low (51-100 mm/m) and 5 per cent area is high to very high (151->200mm/m) in available water capacity.*
- ❖ *Entire area in the microwatershed has very gently sloping (1-3%) lands.*

- ❖ *An area of about 3 per cent is slightly eroded (e1) and 27 per cent is moderately eroded (e2).*
- ❖ *An area of about 15 per cent is slightly alkaline (pH 7.3 to 7.8), 10 per cent moderately alkaline (pH 7.8 to 8.4), 4 per cent strongly alkaline (pH 8.4 to 9.0) and <1 per cent very strongly alkaline (pH >9.0).*
- ❖ *The Electrical Conductivity (EC) of the soils are <2 dsm⁻¹ indicating that soils are non saline.*
- ❖ *Organic carbon is medium (0.5-0.75%) in 26 per cent and high (>0.75%) in 4 per cent area of the microwatershed.*
- ❖ *Entire area in the microwatershed is medium (23-57 kg/ha) in available phosphorus.*
- ❖ *Entire area in the microwatershed is medium (145-337 kg/ha) in available potassium.*
- ❖ *Available sulphur is low (<10 ppm) in 30 per cent and medium (10-20 ppm) in <1 per cent area of the soils.*
- ❖ *Available boron is low (<0.5 ppm) in 16 per cent and medium (0.5-1.0 ppm) in 14 per cent area of the microwatershed.*
- ❖ *Available iron is deficient (<4.5ppm) in 27 per cent and sufficient (>4.5 ppm) in 3 per cent of the area.*
- ❖ *Available zinc is deficient (<0.6 ppm) in 10 per cent and sufficient (>0.6 ppm) in 20 per cent of the microwatershed.*
- ❖ *Available manganese and copper are sufficient in the entire area.*
- ❖ *The land suitability for 31 major agricultural and horticultural crops grown in the microwatershed was assessed and the areas that are highly suitable (class S1) and moderately suitable (class S2) are given below. It is however to be noted that a given soil may be suitable for various crops but what specific crop to be grown may be decided by the farmer looking to his capacity to invest on various inputs, marketing infrastructure, market price, and finally the demand and supply position.*

Land suitability for various crops in the microwatershed

Crop	Suitability Area in ha (%)		Crop	Suitability Area in ha (%)	
	Highly suitable (S1)	Moderately suitable (S2)		Highly suitable (S1)	Moderately suitable (S2)
Sorghum	52(9)	14 (2)	Sapota	37(7)	16(3)
Maize	37(7)	30 (5)	Pomegranate	37(7)	46(8)
Bajra	37(7)	125(23)	Guava	-	52(10)
Redgram	37(7)	30(5)	Jackfruit	37(7)	16(3)
Bengal gram	16(3)	130(23)	Jamun	36(7)	46(8)
Groundnut	-	76(14)	Musambi	52(9)	30(5)
Sunflower	52 (9)	14 (2)	Lime	52(9)	30(5)
Cotton	52(9)	14(2)	Cashew	-	55(10)
Chilli	37(7)	-	Custard apple	52(9)	112(20)
Tomato	37(7)	-	Amla	37(7)	128(23)
Brinjal	-	92(17)	Tamarind	36(7)	30(5)
Onion	-	62(11)	Marigold	37(7)	30(5)
Bhendi	-	92(17)	Chrysanthemum	37(7)	30(5)
Drumstick	37(7)	30(5)	Jasmine	37(7)	-
Mulberry	37(7)	49(9)	Crossandra	37(7)	-
Mango	36(7)	49(9)	-	-	-

Apart from the individual crop suitability, a proposed crop plan has been prepared for the 5 identified LMUs by considering only the highly and moderately suitable lands for different crops and cropping systems with food, fodder, fibre and other horticulture crops.

- ❖ Maintaining soil-health is vital for 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 and drainage line treatment plans have been prepared that would help in identifying the sites to be treated and also the type of structures required.
- ❖ As part of the greening programme, several tree species have been suggested to be planted in marginal and submarginal lands, field bunds and also in the hillocks, mounds and ridges. That would help in supplementing the farm income, provide fodder and fuel, and generate lot of biomass which in turn would help in maintaining the ecological balance and contribute to mitigating the climate change.

INTRODUCTION

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

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

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

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

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

The Land Resource Inventory is basically done for identifying potential and problem areas, developing sustainable land use plans, estimation of surface run off and water harvesting potential, preparation of soil and water conservation plans, land degradation/desertification etc. The Bureau is presently engaged in developing an LRI methodology using high resolution satellite remote sensing data and Digital Elevation Model (DEM) data to prepare Landscape Ecological Units (LEU) map representing agro-ecosystem as a whole. The LEU is preferred over landform as the base map for LRI. LEU is the assemblage of landform, slope and land use. An attempt was made to upscale the soil resource information from 1:250000 and 1:50000 scale to the LEU map in Goa and other states.

The land resource inventory aims to provide site-specific database for Bhagyanagar-2 Microwatershed in Koppal Taluk, Koppal District, Karnataka State for the Karnataka Watershed Development Department. The database was generated by using cadastral map of the village as a base along with high resolution IRS LISS IV and Cartosat-1 merged satellite imagery. Later, an attempt will be made to uplink this LRI data generated at 1:7920 scale under Sujala-III Project to the proposed Landscape Ecological Units (LEUs) map.

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

GEOGRAPHICAL SETTING

2.1 Location and Extent

The Bhagyanagar-2 micro-watershed is located in the central part of Karnataka in Koppal taluk and district (Fig 2.1). It lies between 15⁰20' and 15⁰22' North latitudes and 76⁰8' and 76⁰10' East longitudes and covers an area of about 553 ha. It comprises parts of Koppal and Ojanahalli villages. It is about 2 km from Koppal town and is bounded by Ojanahalli on the north and Koppal on the south, west and eastern side of the microwatershed.

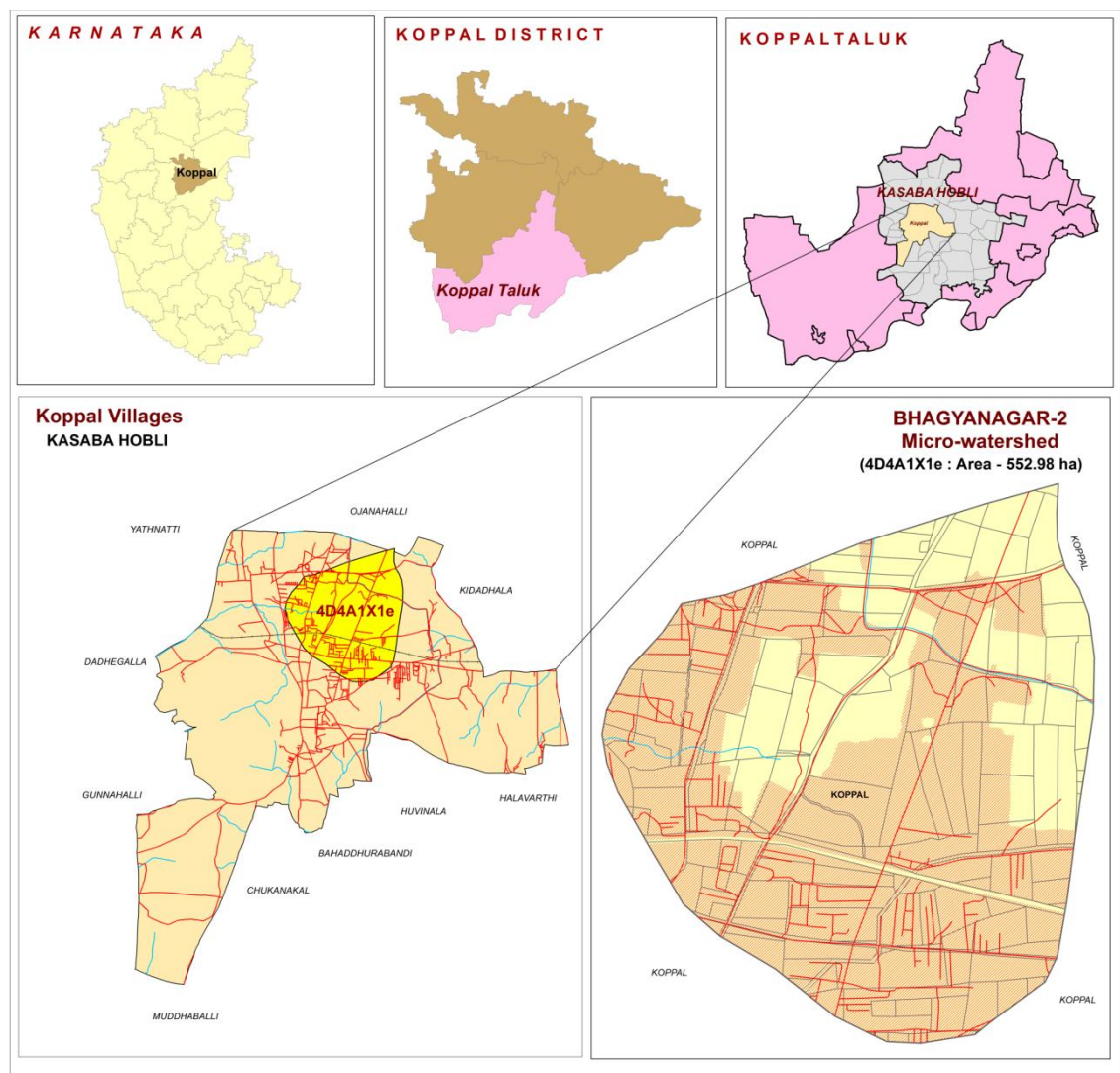


Fig.2.1 Location map of Bhagyanagar-2 Microwatershed

2.2 Geology

Major rock formations observed in the microwatershed are granite gneiss and alluvium (Fig.2.2 a and b). Granite gneisses are essentially pink to gray and are coarse to medium grained. They consist primarily of quartz, feldspar, biotite and hornblende. The

gray granite gneisses are highly weathered, fractured and fissured upto a depth of about 10 m. Dolerite dykes and quartz veins are common with variable width and found to occur in Bhagyanagar-2village. The thickness of the alluvium generally is limited to less than a meter, except in river valleys where it is very deep extending to tens of meters. Such soils are transported and represent paleo black soils originally formed at higher elevation, but now occupying river valleys.



Fig.2.2 a Granite and granite gneiss rocks



Fig.2.2 b Alluvium

2.3 Physiography

Physiographically, the area has been identified as Granite gneiss and Alluvial landscapes based on geology. The microwatershed area has been further divided into mounds/ridges, summits, side slopes and very gently sloping uplands and nearly level

plains based on slope and its relief features. The elevation ranges from 526 to 542m in the gently sloping uplands. The mounds and ridges are mostly covered by rock outcrops.

2.4 Drainage

The area is drained by several small seasonal streams that join Hire *halla* and Chenna *halla* along its course. Though, the streams are not perennial, during rainy season they carry large quantities of rain water. The microwatershed has only few small tanks which are not able to store the water flowing during the rainy season. Due to this, the ground water recharge is very much affected in the villages. This is reflected in the failure of many bore wells in the villages. If the available rain water is properly harnessed by constructing tanks and recharge structures at appropriate places in the villages, then the drinking and irrigation needs of the area can be easily met. The drainage network is dendritic to sub parallel.

2.5 Climate

The district falls under semiarid tract of the state and is categorized as drought - prone with total annual rainfall of 662 mm (Table 2.1). Of this, a maximum of 424 mm precipitation is received during south–west monsoon period from June to September, north-east monsoon contributes about 161 mm and prevails from October to early December and the remaining 77 mm is received during the rest of the year. The winter season is from December to February. During April and May, the temperatures reach up to 45°C and in December and January, the temperatures will go down to 16°C. Rainfall distribution is shown in Figure 2.3. The average Potential Evapo Transpiration (PET) is 145 mm and varies from a low of 101 mm in December to 193 mm in the month of May. The PET is always higher than precipitation in all the months except in the month of September. Generally, the Length of crop Growing Period (LGP) is <90 days and starts from 2nd week of August to 2nd week of November.

Table 2.1 Mean Monthly Rainfall, PET, 1/2 PET at Koppal Taluk and District

Sl. no.	Months	Rainfall	PET	1/2 PET
1	January	1.60	116.70	58.35
2	February	1.50	129.20	64.60
3	March	14.10	169.80	84.90
4	April	18.10	180.60	90.30
5	May	41.60	193.50	96.75
6	June	85.80	167.90	83.95
7	July	72.10	156.20	78.10
8	August	110.50	152.50	76.25
9	September	155.60	138.50	69.25
10	October	116.30	122.30	61.15
11	November	36.00	106.40	53.20
12	December	9.10	101.00	50.50
TOTAL		662.30	144.55	

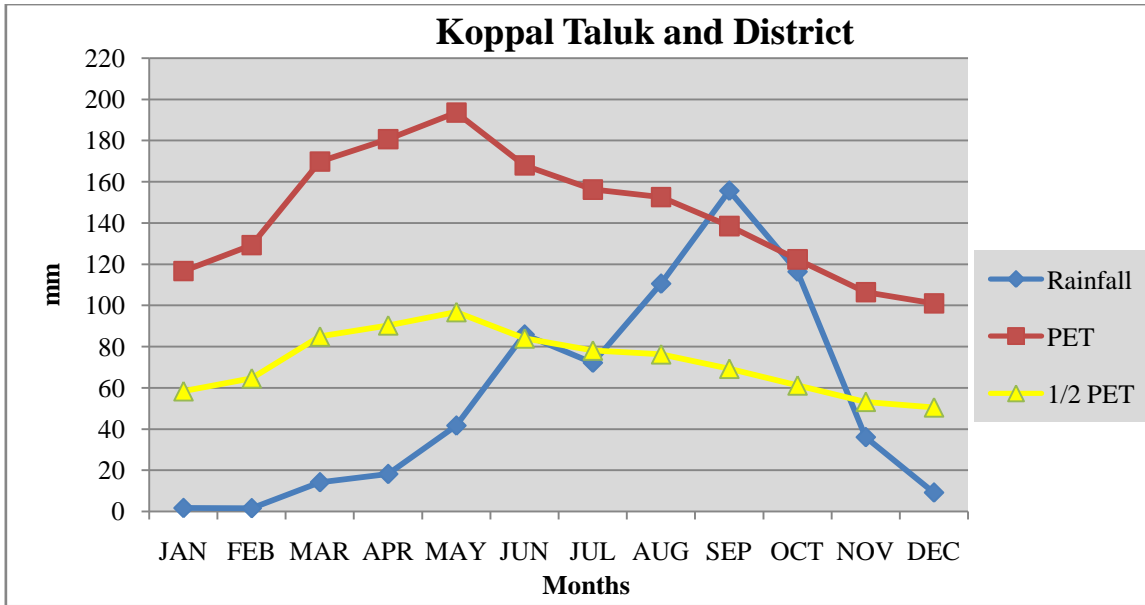


Fig. 2.3 Rainfall distribution in Koppal Taluk and District

2.6 Natural Vegetation

The natural vegetation is sparse comprising few tree species, shrubs and herbs. The mounds, ridges and boulders occupy sizeable areas which are under thin to moderately thick forest vegetation. Still, there are some remnants of the past forest cover which can be seen in patches in some ridges and hillocks in the microwatershed (Fig 2.4).

Apart from the continuing deforestation, the presence of large population of goats, sheep and other cattle in the microwatershed is causing vegetative degradation of whatever little vegetation left in the area. The uncontrolled grazing has left no time for the regeneration of the vegetative cover. This leads to the accelerated rate of erosion on the hill slopes, resulting in the formation of deep gullies in the foot slopes and eventually resulting in the heavy siltation of few tanks and reservoirs in the microwatershed.



Fig 2.4 Natural vegetation of Bhagyanagar-2 Microwatershed

2.7 Land Utilization

About 91 per cent area (Table 2.2) in Koppal district is cultivated at present and about 17 per cent of the area is sown more than once. An area of about 3 per cent is currently barren. Forests occupy a small area of about 5 per cent and the tree cover is in a very poor state. Most of the mounds, ridges and boulder areas have very poor vegetative cover. Major crops grown in the area are sorghum, maize, bajra, cotton, safflower, sunflower, red gram, horse gram, onion, mulberry, pomegranate, sugarcane, bengalgram and groundnut (Fig 2.5 a and 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 prepared. The current land use map prepared shows the arable and non-arable lands, other land uses and different types of crops grown in the area. The current land use map of Bhagyanagar-2Microwatershed is presented in Fig.2.6. Simultaneously, enumeration of existing wells (bore wells) is made and their location in different survey numbers is marked on the cadastral map. Map showing the location of wells in Bhagyanagar-2Microwatershed is given in Fig 2.7.

Table 2.2 Land Utilization in Koppal District

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



Fig.2.5 (a) Different crops and cropping systems in Bhagyanagar-2 Microwatershed

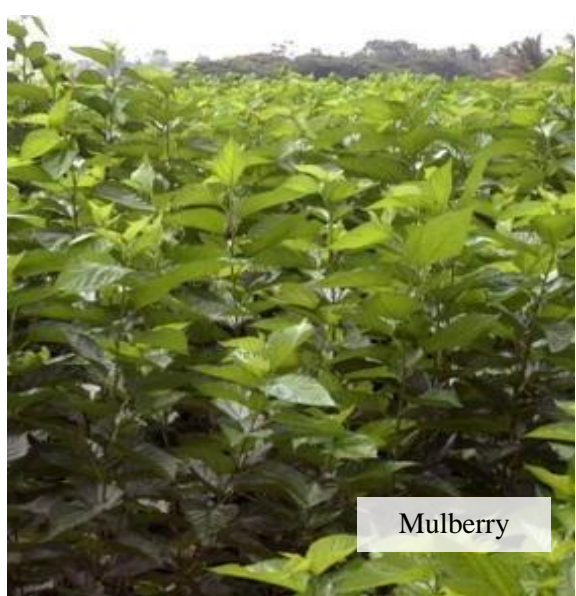


Fig.2.5 (b) Different crops and cropping systems in Bhagyanagar-2 Microwatershed

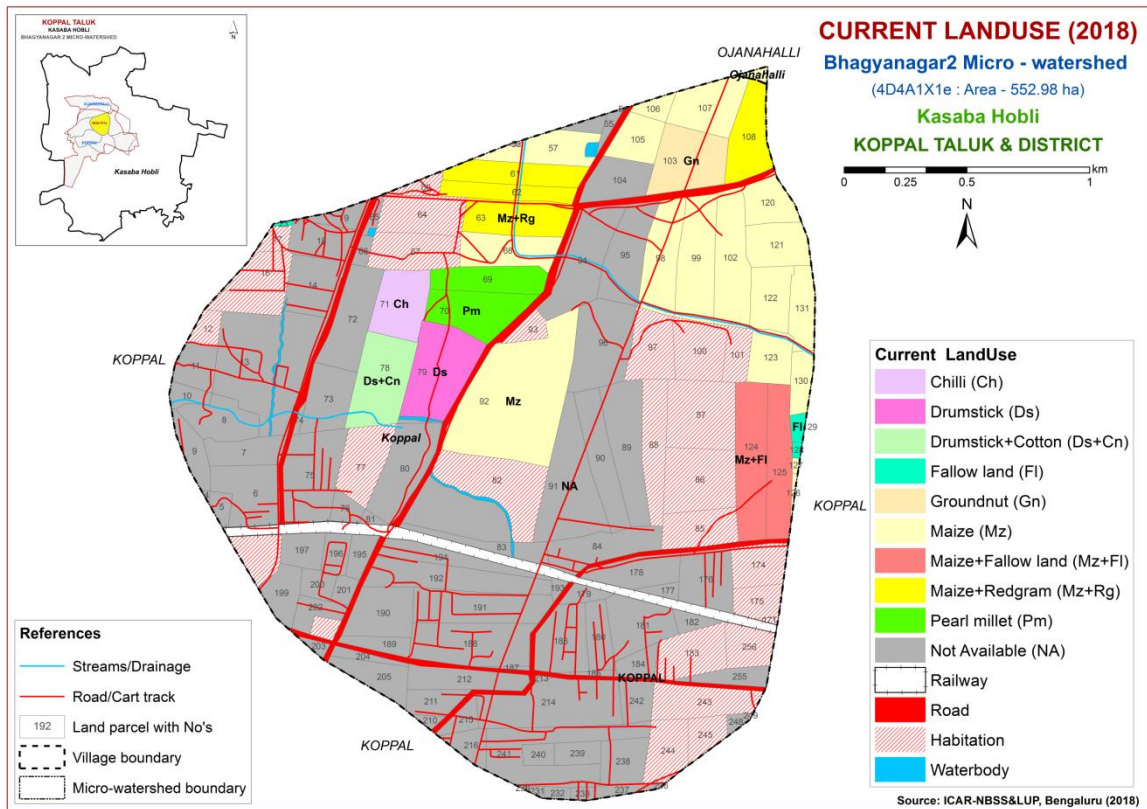


Fig.2.6 Current Land Use – Bhagyanagar-2 Microwatershed

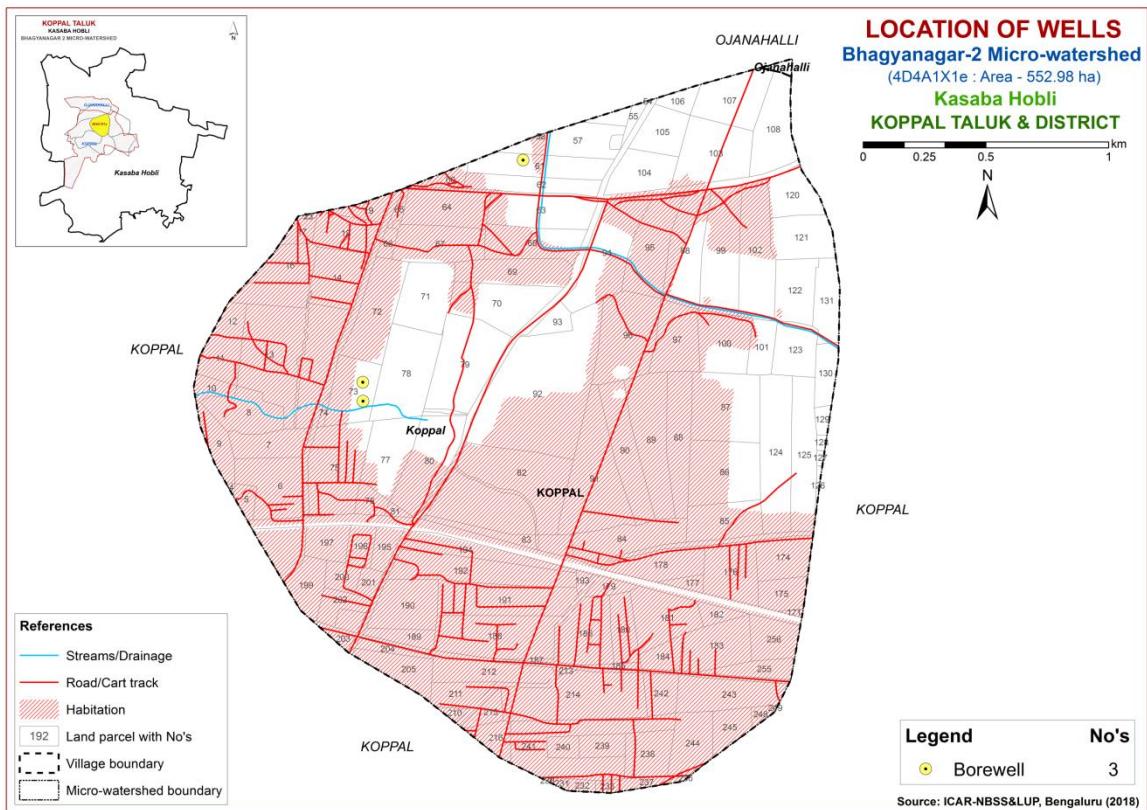


Fig.2.7 Location of wells– Bhagyanagar-2 Microwatershed

SURVEY METHODOLOGY

The purpose of land resource inventory is to delineate similar areas (soil series and phases), which respond or expected to respond similarly for a given level of management. This was achieved in Bhagyanagar-2 microwatershed by the detailed study of all the soil characteristics (depth, texture, colour, structure, consistence, coarse fragments, porosity, soil reaction, soil horizons etc.) and site 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 553 ha area. The methodology followed for carrying out land resource inventory was as per the guidelines given in Soil Survey Manual (IARI, 1971; Soil Survey Staff, 2006; Natarajan *et al.*, 2015) which is briefly described below.

3.1 Base Maps

The detailed survey of the land resources occurring in the microwatershed was carried out by using digitized cadastral map and satellite imagery as base supplied by the KRSRAC. The cadastral map shows field boundaries with their survey numbers, location of tanks, streams and other permanent features of the area (Fig. 3.1). Apart from the cadastral map, remote sensing data products from Cartosat-1 and LISS IV merged at the scale of 1:7920 were used in conjunction with the cadastral map to identify the geology, landscapes, landforms and other surface features. The imagery helped in the identification and delineation of boundaries between hills, uplands and lowlands, water bodies, forest and vegetated areas, roads, habitations and other cultural features of the area (Fig.3.2). The cadastral map was overlaid on the satellite imagery (Fig.3.3) that helps to identify the parcel boundaries and other permanent features. Apart from cadastral maps and images, toposheets of the area (1:50,000 scale) were used for initial traversing, identification of geology, landscapes and landforms, drainage features, present land use and also for selection of transects in the microwatershed.

3.2 Image Interpretation for Physiography

False Colour Composites (FCC) of Cartosat-I and LISS-IV merged satellite data covering the microwatershed area was visually interpreted using image interpretation elements and all the available collateral data with local knowledge. The delineated physiographic boundaries were transferred on to a cadastral map overlaid on satellite imagery. Physiographically, the area has been identified as granite gneiss and alluvial landscapes and is divided into landforms such as ridges, mounds and uplands based on slope. They were further subdivided into physiographic/ image interpretation units based on image characteristics. The image interpretation legend for physiography is given below.

Image Interpretation Legend for Physiography

G- Granite gneiss landscape

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

DSe -Alluvial landscape

DSe 1 Summit

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

DSe 2 Very genetly sloping

- DSe 21 Very gently sloping, whitish tone
- DSe 22 Very gently sloping, greyish pink tone
- DSe 23 Very gently sloping, whitish grey tone
- DSe 24 Very gently sloping, medium grey tone
- DSe 25 Very gently sloping, medium pink tone
- DSe 26 Very gently sloping, dark grey tone
- DSe 27 Very gently sloping, bluish grey tone
- DSe 28 Very gently sloping, greenish grey tone
- DSe 29 Very gently sloping, Pinkish grey

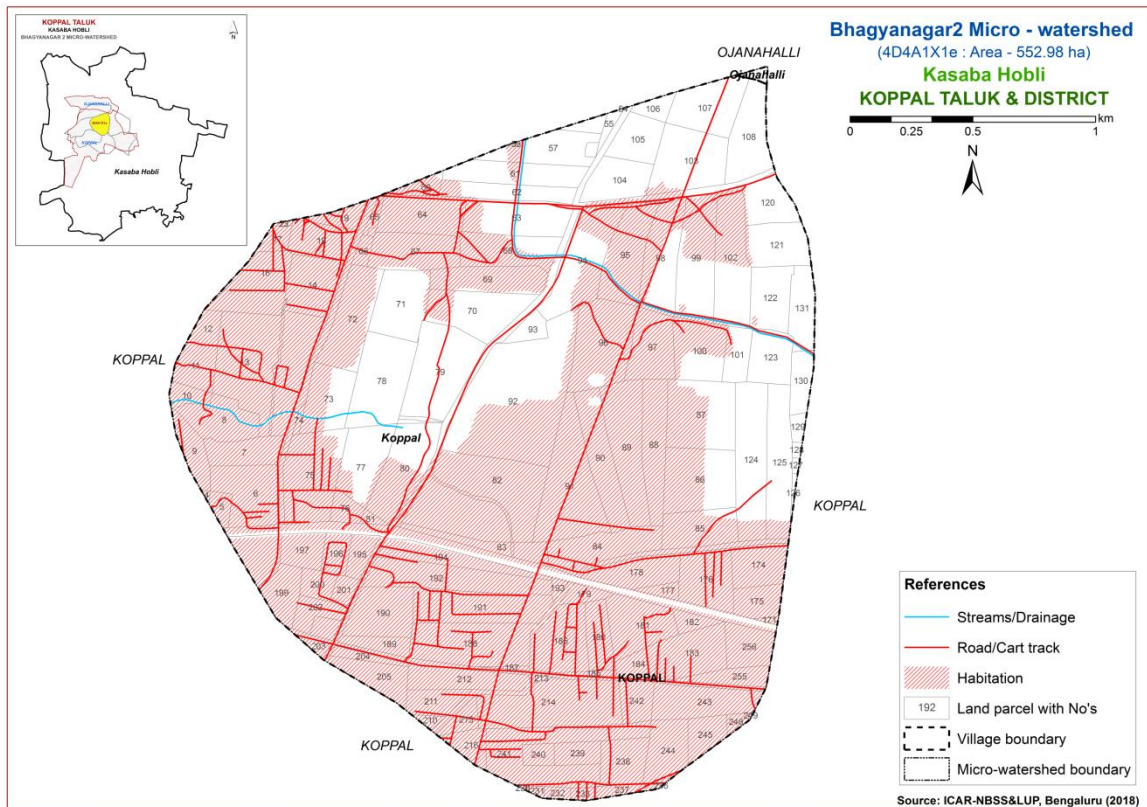


Fig 3.1 Scanned and Digitized Cadastral map of Bhagyanagar-2Microwatershed

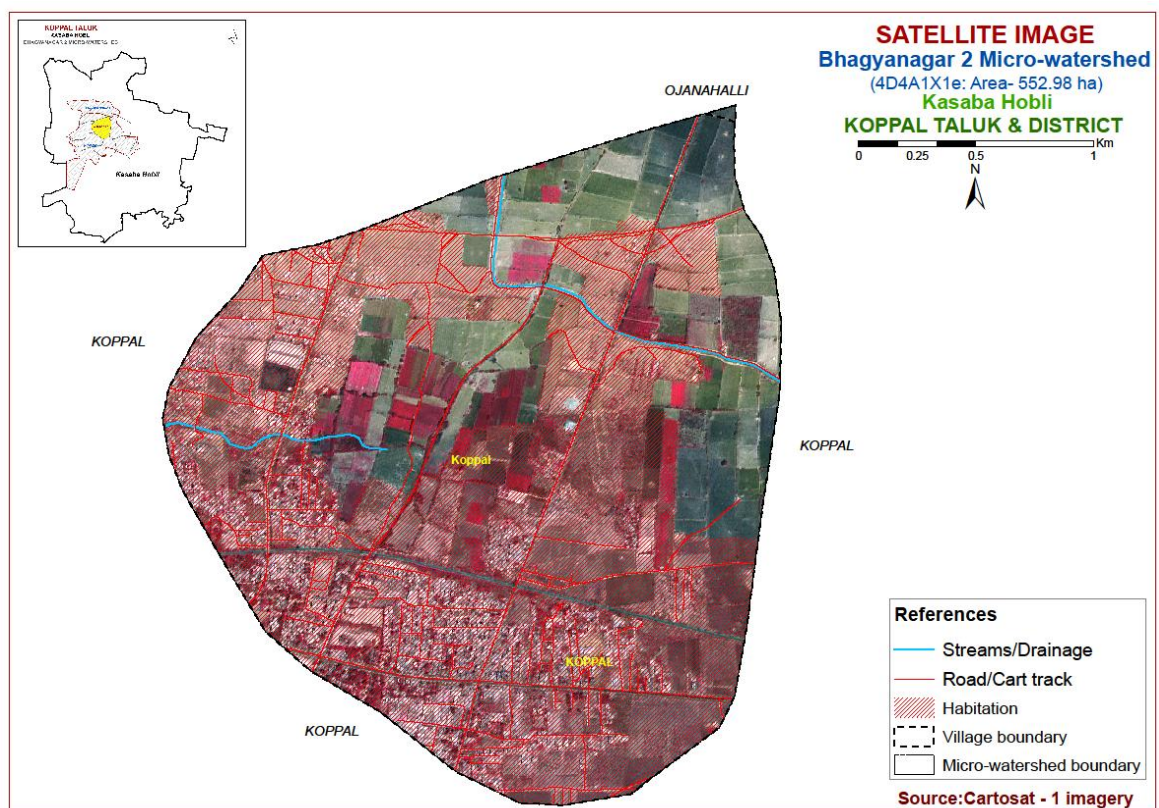


Fig.3.2 Satellite Image of Bhagyanagar-2Microwatershed

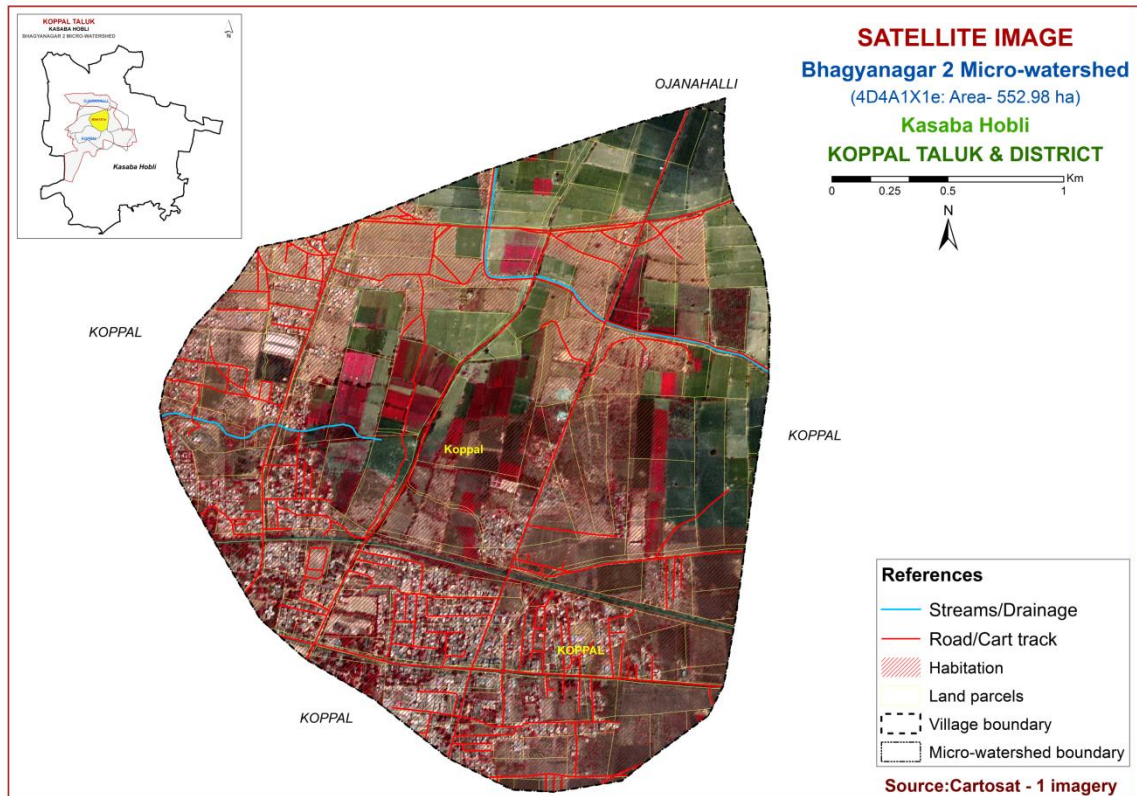


Fig.3.3 Cadastral map overlaid on IRS PAN+LISS IV merged imagery of Bhagyanagar-2 Microwatershed

3.3 Field Investigation

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

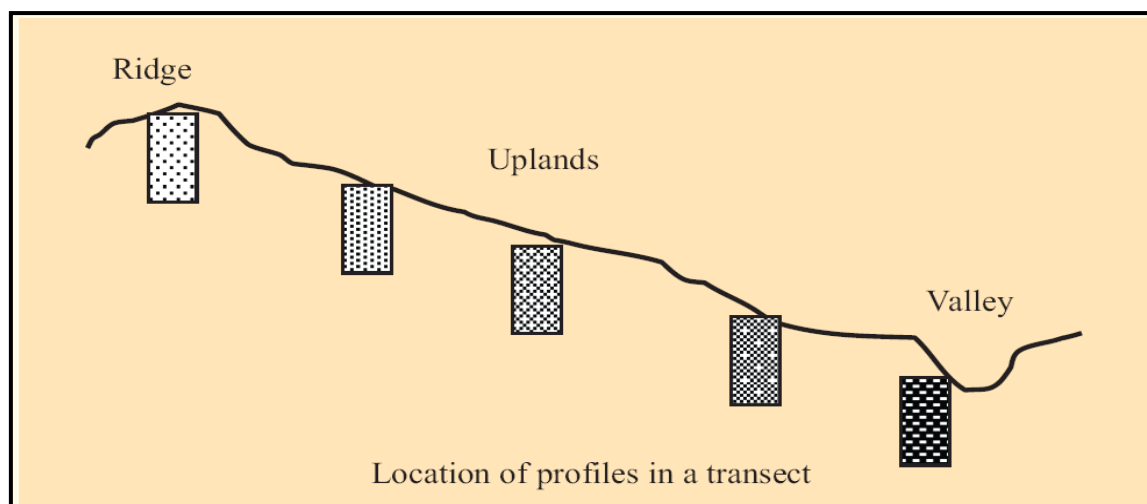


Fig: 3.4. Location of profiles in a transect

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

Based on the soil characteristics, the soils were grouped into different soil series. Soil series is the most homogeneous unit having similar horizons and properties and behaves similarly for a given level of management. Soil depth, texture, colour, kind of horizon and horizon sequence, amount and nature of gravel present, calcareousness, nature of substratum etc, were used as the major differentiating characteristics for identifying soil series occurring in the area. The differentiating characteristics used for identifying the soil series are given in Table 3.1. Based on the above characteristics, 10 soil series were identified in Bhagyanagar-2microwatershed.

**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	Calcareousness
1	Lakkur (LKR)	50-75	2.5YR 2.5/3, 2.5/4, 3/4, 3/6	gsc	40-60	Ap-Bt-Bc-Cr	-
2	Kethanapura (KTP)	50-75	2.5YR3/4, 3/6	gsc	15-35	Ap-Bt-Cr	-
3	Hooradhahalli (HDH)	75-100	2.5YR2.5/4,3/4, 3/6	gsc-gc	>35	Ap-Bt-Cr	-
4	Bidanagere	75-100	5YR3/3,3/4,4/3,5/4	gc	35-60	Ap-Bt-Cr	-

	(BDG)		2.5YR3/4				
5	Kumchahalli (KMH)	100-150	2.5YR3/4, 3/6	sc	<15	Bt-Cr	-
6	Giddadapalya (GDP)	100-150	2.5YR3/4, 3/6	gsc-gc	30-60 after 60 cm	Ap-Bt-Cr	-
Soils of Alluvial Landscape							
7	Gatareddihal (GRH)	100-150	10YR 2/1, 3/1, 2.5Y 4/3, 5/4	c	<15	Ap-Bss- BC-C	es
8	Budagumpa (BGP)	>.150	7.5YR3/2,5/1 10YR4/1,4/4	c	<15	Ap-Bw	es

3.4 Soil Mapping

The area under each soil series was further separated into soil phases and their boundaries delineated on the cadastral map based on the variations observed in the texture of the surface soil, slope, erosion, presence of gravel, stoniness etc. A soil phase is a subdivision of soil series based mostly on surface features that affect its use and management. The soil mapping units are shown on the map (Fig.3.5) in the form of symbols. During the survey many soil profile pits, few mini pits 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 mini pits, road cuts, terrace cuts etc., were studied to validate the soil boundaries on the soil map.

The soil map shows the geographic distribution of 10 mapping units representing 8 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 10 phases mapped in the microwatershed. Each mapping unit (soil phase) delineated on the map has similar soil and site characteristics. In other words, all the farms or survey numbers included in one soil phase will have similar management needs and have to be treated accordingly.

3.5 Land Management Units

The 10 soil phases identified and mapped in the microwatershed were regrouped into five 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 (LMU's) based on the management needs. One or more than one soil site characteristic having influence on the management have been chosen for identification and delineation of LMUs. For Bhagyanagar-2microwatershed, five soil and site characteristics, namely the 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.

3.6 Laboratory Characterization

Soil samples for each soil series soil were collected from representative master profiles for laboratory characterization by following the methods outlined in the Laboratory Manual (Sarma *et al*, 1987). Surface soil samples collected in the year 2018 from farmer's fields in Bhagyanagar-2 microwatershed (54 samples) for fertility status (major and micronutrients) at 320 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 Bhagyanagar-2 Microwatershed

Soil map unit No*	Soil Series	Soil Phase Symbol	Mapping Unit Description	Area in ha (%)
Soils of Granite and Granite gneiss Landscape				
	LKR		Lakkur soils are moderately shallow (50-75 cm), well drained, have dark reddish brown to dark red, red gravelly sandy clay soils occurring on very gently to moderately sloping uplands under cultivation	56 (10.19)
53		LKRiB2	Sandy clay surface, slope 1-3%, moderate erosion	56 (10.19)
	KTP		Kethanapura soils are moderately shallow (50-75 cm), well drained, have dark reddish brown red gravelly sandy clay soils occurring on very gently sloping uplands under cultivation	23 (4.11)
454		KTPPhB2	Sandy clay loam surface, slope 1-3 %, moderate erosion	23 (4.11)
	HDH		Hooradhahalli soils are moderately deep (75-100 cm), well drained, have dark red to dark reddish brown, red gravelly sandy clay to clay soils occurring on nearly level to moderately sloping uplands under cultivation	16(2.94)
122		HDHhB2	Sandy clay loam surface, slope 1-3 %, moderate erosion	9 (1.61)
127		HDHiB2	Sandy clay surface, slope 1-3%, moderate erosion	7 (1.33)
	BDG		Bidanagere soils are moderately deep (75-100 cm), well drained, have dark reddish brown red gravelly clay soils occurring on nearly level to gently sloping uplands under cultivation	3 (0.53)
191		BDGiB1	Sandy clay surface, slope 1-3%, slight erosion	3 (0.53)
	KMH		Kumchahalli soils are deep (100-150cm), well drained, have dark reddish brown to dark red sandy clay soils occurring on nearly level to very gently sloping uplands under cultivation	0.10 (0.02)
201		KMHiB2	Sandy clay surface, slope 1-3%, moderate erosion	0.10 (0.02)
	GDP		Giddadapalya soils are deep (100-150 cm), well drained,	36 (6.59)

Soil map unit No*	Soil Series	Soil Phase Symbol	Mapping Unit Description	Area in ha (%)
			have dark reddish brown to dark red gravelly sandy clay to clay soils occurring on very gently sloping uplands under cultivation	
269		GDPiB2	Sandy clay surface, slope 1-3%, moderate erosion	36 (6.59)
Soils of Alluvial Landscape				
	GRH		Gatareddihal soils are deep (100-150 cm), moderately well drained, have light olive brown to very dark gray, calcareous, sodic black cracking clay soils occurring on nearly level to very gently sloping plains under cultivation	16 (2.81)
373		GRHmB2	Clay surface, slope 1-3%, moderate erosion	16 (2.81)
	BGP		Budagumpa soils are very deep (>150 cm), moderately well drained, have dark yellowish brown to dark brown and dark gray, calcareous, sodic black clay soils occurring on nearly level to very gently sloping plains under cultivation	14 (2.47)
396		BGPmB1	Clay surface, slope 1-3%, slight erosion	14 (2.47)
992		Railway	Railway line	4 (0.74)
999		Rock outcrops	Rock lands both massive and bouldery with little or no soil	0.46 (0.08)
1000		Others	Habitation	384(69.52)

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

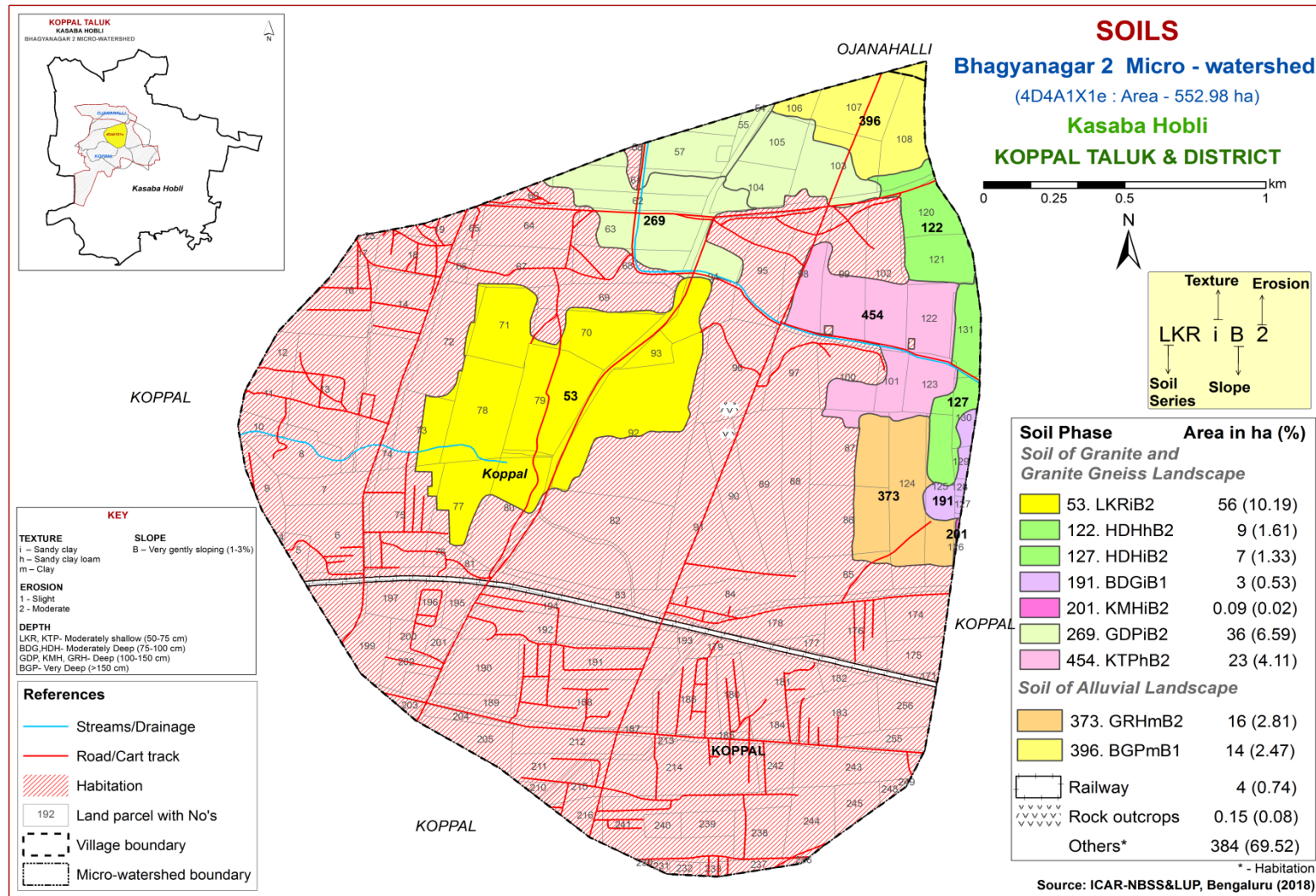


Fig 3.5 Soil Phase or Management Units- Bhaganagar-2 Microwatershed

THE SOILS

Detailed information pertaining to the nature, extent and distribution of different kinds of soils occurring in Bhagyanagar-2 microwatershed is provided in this chapter. The microwatershed area has been identified as granite gneiss and alluvial landscapes based on geology. In all, 8 soil series were identified. Soil formation is the result of the combined effect of environmental and terrain factors that are reflected in soil morphology. The soil formation is dominantly influenced by the parent material, climate, time and relief.

A brief description of each of the 8 soil series identified followed by 10 soil phases (management units) mapped (Fig. 3.5) are furnished below. The physical and chemical characteristics of soil series identified in Bhagyanagar-2 microwatershed are given in Table 4.1 along with soil classification. The soils in any one map unit differ from place to place in their depth, texture, slope, gravelliness, erosion or any other site characteristic that affect management. The soil phase map can be used for identifying the suitability of areas for growing specific crops or for other alternative uses and also for deciding the type of conservation structures needed. The detailed information on soil and site-characteristics like soil depth, surface soil texture, slope, erosion, gravelliness, AWC, LCC etc, with respect to each of the soil phase identified is given village/survey number wise for the microwatershed in Appendix-I.

4.1 Soils of Granite gneiss Landscape

In this landscape, 6 soil series were identified and mapped. Of these series, Lakkur (LKR) series occupies maximum area of 56 ha (10 %) followed by Giddadapalya (GDP) 36 ha (7 %) and others occupy minor area. The brief description of the soil series along with the soil phases identified and mapped is given below.

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

The thickness of the solum ranges from 51 to 74 cm. The thickness of A horizon ranges from 12 to 18 cm. Its colour is in 5YR and 2.5 YR hue with value 3 to 4 and chroma 4 to 6. The texture varies from loamy sand to sandy clay loam with 15 to 50 per cent gravel. The thickness of B horizon ranges from 39 to 58 cm. Its colour is in 2.5 YR hue with value 3 to 4 and chroma 4 to 6. Texture is sandy clay with 40 to 60 per cent gravel. The available water capacity is low (50-100 mm/m). One soil phase was identified and mapped.



Landscape and soil profile characteristics of Lakkur (LKR) Series

4.1.2 Kethanapura (KTP) Series: Kethanapura soils are moderately shallow (50-75cm), well drained, have dark reddish brown gravelly sandy clay soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands. The Kethanapura series has been classified as a member of the fine, mixed, isohyperthermic family of Rhodic Paleustalfs .

The thickness of the solum ranges from 53 to 72 cm. The thickness of A-horizon ranges from 11 to 16 cm. Its colour is in 5YR and 2.5 YR hue with value 3 to 4 and chroma 3 to 6. The texture varies from loamy sand to sandy clay loam with 15 to 40 per cent gravel. The thickness of B-horizon varies from 41 to 56 cm. Its colour is in 2.5 YR hue with value 3 to 4 and chroma 4 to 6. Texture is dominantly sandy clay loam with 15 to 35 per cent gravel. The available water capacity is medium (101-150 mm/m). One soil phase was identified and mapped.



Landscape and soil profile characteristics of Kethanapura (KTP) Series

4.1.3 Hooradhahalli (HDH) Series: Hooradhahalli soils are moderately deep (75-100 cm), well drained, have red to dark red and reddish brown gravelly sandy clay to clay soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands. The Hooradhahalli series has been classified as a member of the clayey-skeletal, mixed isohyperthermic family of Rhodic Paleustalfs.

The thickness of the solum ranges from 76 to 100 cm. The thickness of A horizon ranges from 11 to 19 cm. Its colour is in 5 YR and 2.5 YR hue with value 3 to 4 and chroma 3 to 6. The texture varies from loamy sand to sandy clay with 15 to 50 per cent gravel. The thickness of B horizon varies from 65 to 83 cm. Its colour is in 2.5 YR hue with value 2.5 to 3 and chroma 4 to 6. Texture is sandy clay to clay with 35 to 50 per cent gravel. The available water capacity is low (50-100mm/m). Two soil phases were identified and mapped.



Landscape and soil profile characteristics of Hooradhahalli (HDH) Series

4.1.4 Bidanagere (BDG) Series: Bidanagere soils are moderately deep (75-100 cm), well drained, have dark reddish brown gravelly clay soils. They have developed from weathered granite gneiss and occur on very gently sloping uplands under cultivation. The Bidanagere series has been classified as a member of the clayey-skeletal, mixed, isohyperthermic family of Rhodic Paleustalfs.

The thickness of the solum ranges from 78 to 99 cm. The thickness of A-horizon ranges from 12 to 19 cm. Its colour is in 2.5 YR and 5 YR hue with value 2 to 3 and chroma 3 to 4. The texture varies from sandy clay loam to sandy clay with 10 to 20 per cent gravel. The thickness of B-horizon ranges from 68 to 85 cm. Its colour is in 5 YR and 2.5 YR hue with value 3 to 5 and chroma 3 to 4. Its texture is gravelly clay with gravel content of 35-60 per cent. The available water capacity is very low (<50 mm/m). One soil phase was identified and mapped.



Landscape Soil Profile Characteristics of Bidanagere (BDG) Series

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

The thickness of the solum ranges from 102 to 150 cm. The thickness of A horizon ranges from 11 to 23 cm. Its colour is in 5 YR and 2.5 YR hue with value 2.5 to 3 and chroma 3 to 6. The texture is dominantly sandy clay. The thickness of B horizon ranges from 95 to 132 cm. Its colour is in 2.5 YR hue with value 3 and chroma 4 to 6. Its texture is dominantly sandy clay loam to sandy clay. The available water capacity is high (150-200 mm/m). One soil phase was identified and mapped.



Landscape and soil profile characteristics of Kumchahalli (KMH) Series

4.1.6 Giddadapalya (GDP) Series: Giddadapalya soils are deep (100-150 cm), well drained, have dark reddish brown to dark red, gravelly sandy clay to clay soils. They are developed from weathered granite gneiss and occur on very gently sloping uplands under cultivation. The Giddadapalya soil series has been classified as a member of the fine, mixed, isohyperthermic family of Rhodic Paleustalfs.

The thickness of the solum ranges from 106 to 145 cm. The thickness of A-horizon ranges from 12 to 13 cm. Its colour is in 5 YR hue with value and chroma 3 to 4. The texture ranges from sandy loam with 10 to 15 per cent gravel. The thickness of B-horizon ranges from 106 to 123 cm. Its colour is in 2.5 YR hue with value 3 to 4 and chroma 3 to 6. Texture is sandy clay to clay with 35 to 75 per cent gravel. The available water capacity is low (51-100 mm/m). One soil phase was identified and mapped.



Landscape and soil profile characteristics of Giddadapalya (GDP) Series

4.2 Soils of Alluvial Landscape

In this landscape, two soil series were identified and mapped. The brief description of the soil series along with the soil phases identified and mapped is given below.

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

The thickness of the solum ranges from 102 to 149 cm. The thickness of A-horizon ranges from 12 to 19 cm. Its colour is in 7.5 YR, 10 YR hue with value 3 to 4 and chroma 1 to 6. The texture is sandy clay loam to clay. The thickness of B-horizon ranges from 86 to 117 cm. Its colour is in 10 YR and 7.5 YR hue with value 3 and chroma

2 to 6. Texture is clay with less than 15 per cent gravel. The available water capacity is very high (>200 mm/m). One soil phase was identified and mapped.



Landscape and soil profile characteristics of Gatareddihal (GRH) Series

4.2.2 Budagumpa (BGP) Series: Budagumpa soils are very deep (>150 cm), well drained, black calcareous sodic clay soils. They have developed from alluvium and occur on very gently sloping plains under cultivation. The Budagumpa series has been classified as a member of the fine, mixed (calc), isohyperthermic family of Typic Haplustepts.

The thickness of the solum is more than 150 cm. The thickness of A horizon ranges from 16 to 26 cm. Its colour is in 7.5 YR and 10 YR hue with value 2 to 3 and chroma 2 to 4. The texture varies from sandy clay to clay with 5 to 10 per cent gravel. The thickness of B horizon ranges from 130 to 160 cm. Its colour is in 10 YR and 7.5 YR hue with value 3 to 5 and chroma 1 to 4. Its texture is clay with gravel content of <15 per cent. These soils are calcareous that increase with depth. The available water capacity is very high (>200 mm/m). One soil phase was identified and mapped.



Landscape and Soil Profile Characteristics of Budagumpa (BGP) Series

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

Soil Series: Lakkur (LKR), **Pedon:** RM-8.

Location: 15°04'26.3"N, 75°37'84.1"E, (4D4A3I1f), Belhatti village, Shirahatti taluk, Gadag district

Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Clayey-skeletal, mixed, isohyperthermic Typic Rhodustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand							1/3 Bar	15 Bar
		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)				
0-21	Ap	74.00	8.34	17.66	9.62	11.57	15.76	23.13	13.92	20	sl	-	-
21-35	Bt	54.37	10.48	35.14	16.33	8.64	9.69	11.59	8.11	40	sc	-	-
35-56	Bc	48.37	13.46	38.17	10.96	7.69	9.17	11.28	9.27	60	sc	-	-

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	CaCO ₃	Exchangeable bases					CEC	CEC/Clay	Base saturation	ESP						
	Water	CaCl ₂	M KCl				dS m ⁻¹	%	%	Ca	Mg					K	Na	Total	cmol kg ⁻¹	%	%
0-21	8.18	-	-	0.30	0.56	0.94	-	-	0.31	0.55	0.86	12.19	0.69	100.00	4.51						
21-35	8.17	-	-	0.30	0.52	1.29	-	-	0.19	0.84	1.03	22.18	0.63	100.00	3.79						
35-56	7.95	-	-	0.46	0.48	1.99	-	-	0.24	0.58	0.82	22.94	0.60	100.00	2.53						

Contd...

Series Name: Kethanapura (KTP), **Pedon:** R-9

Location: 15°25'28.81"N, 76°22'00.76" E Jabbaragudda village, Koppal taluk and 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							1/3 Bar	15 Bar
		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)				
0-18	Ap	83.64	10.52	5.84	25.61	22.36	15.24	13.52	6.91	10	ls	7.92	2.58
18-38	Bt1	46.06	5.63	48.31	21.58	9.54	3.53	4.15	7.26	30	sc	19.62	14.48
38-73	Bt2	52.31	6.91	40.78	24.56	12.74	5.96	5.55	3.49	30	sc	17.73	11.95

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	CaCO ₃	Exchangeable bases					CEC	CEC/Clay	Base saturation	ESP
	Water	CaCl ₂	M KCl	dS m ⁻¹	%	%	Ca	Mg	K	Na	Total				
							cmol kg ⁻¹								
0-18	6.42	-		0.07	1.24	-	2.95	0.93	0.57	0.02	4.48	4.41	0.75	100.00	0.05
18-38	6.63	-	-	0.09	0.70	-	11.71	3.53	0.98	0.08	16.31	16.59	0.34	98.30	0.50
38-73	6.88	-	-	0.15	0.48	-	11.36	3.30	0.72	0.13	15.50	15.75	0.39	98.42	0.80

Contd...

Soil Series: Hooradhahalli (HDH), **Pedon:** RM-69

Location: 13°24'31"N, 76°33'41"E, (4D3D8G2d), Hesarahalli village, Chikkanayakanahalli taluk, Tumukura district

Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Clayey-skeletal, mixed, isohyperthermic Rhodic Paleustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand							1/3 Bar	15 Bar
		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)				
0-18	Ap	72.56	15.17	12.27	4.57	8.33	17.38	23.88	18.39	35	sl	-	-
18-33	Bt1	56.29	10.75	32.96	7.88	10.24	13.41	14.43	10.34	55	scl	-	-
33-58	Bt2	46.66	10.79	42.55	10.79	9.87	8.43	9.04	8.53	55	sc	-	-
58-90	Bt3	43.09	13.63	43.27	9.90	8.25	7.32	8.76	8.87	45	c	-	-

Depth (cm)	pH (1:2.5)			E.C. (1:2.5) dS m ⁻¹	O.C. %	CaCO ₃ %	Exchangeable bases					CEC	CEC/Clay	Base saturation %	ESP %
	Water	CaCl ₂	M KCl				Ca	Mg	K	Na	Total				
0-18	6.54	-	-	0.07	0.60	0.00	2.68	1.38	0.44	0.42	4.91	5.84	0.48	84.07	7.11
18-33	5.90	-	-	0.07	0.52	0.00	3.99	1.27	0.09	0.37	5.71	8.61	0.26	66.32	4.29
33-58	6.16	-	-	0.07	0.44	0.00	4.92	1.67	0.08	0.55	7.22	10.00	0.24	72.23	5.50
58-90	6.39	-	-	0.06	0.40	0.00	4.30	2.02	0.08	0.46	6.87	9.21	0.21	74.61	5.05

Contd...

Series: Bidanagere (BDG), **Pedon:** RM-3

Location: 13°22'11"N, 76°38'03"E, (4D3D8G1a), Tharabenahalli village, Chikkanayakanahalli taluk, Tumakuru district.

Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Clayey-skeletal, mixed, isohyperthermic Rhodic Paleustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand							1/3 Bar	15 Bar
		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)				
0-20	Ap	81.19	11.25	7.56	12.54	15.07	17.90	21.94	13.75	50	ls	-	-
20-35	Bt1	57.45	11.45	31.10	12.76	11.02	10.92	12.45	10.31	50	scl	-	-
35-92	Bt2	44.63	7.85	47.52	12.40	9.61	8.37	7.75	6.51	60	c	-	-

Depth (cm)	pH (1:2.5)			E.C. (1:2.5) dS m ⁻¹	O.C. %	CaCO ₃ %	Exchangeable bases					CEC	CEC/Clay	Base saturation %	ESP %
	Water	CaCl ₂	M KCl				Ca	Mg	K	Na	Total				
0-20	6.24	-	-	0.06	0.60	0.00	1.61	0.26	0.10	0.01	1.98	3.76	0.50	52.56	0.35
20-35	5.99	-	-	0.02	0.40	0.00	4.25	0.46	0.08	0.28	5.07	8.02	0.26	63.18	3.46
35-92	6.70	-	-	0.03	0.20	0.00	5.45	0.31	0.10	0.22	6.09	9.90	0.21	61.48	2.24

Contd...

Series Name: Kumchahalli (KMH), **Pedon:** RM-9

Location: 15°20'05"N, 76°13'21"E, Basapura village, Koppal taluk and 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							1/3 Bar	15 Bar
		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)				
0-13	Ap	51.76	9.05	39.19	7.99	8.84	13.42	14.38	7.14	-	sc	20.08	13.69
13-27	A21	53.50	8.12	38.38	7.00	11.05	15.21	14.33	5.91	-	sc	17.05	12.32
27-43	A22	63.60	5.01	31.40	3.85	11.56	24.52	18.52	5.14	-	scl	11.76	9.09
43-64	Bt1	48.74	5.91	45.35	8.87	9.31	12.49	12.27	5.81	10	sc	16.68	13.35
64-84	Bt2	45.13	8.90	45.97	9.86	7.12	10.95	10.62	6.57	20	sc	17.45	13.42
84-114	BC	65.04	6.94	28.02	10.49	16.21	17.80	13.88	6.67	40	scl	13.20	9.75

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	CaCO ₃	Exchangeable bases					CEC	CEC/Clay	Base saturation	ESP
	Water	CaCl ₂	M KCl				Ca	Mg	K	Na	Total				
				dS m ⁻¹	%	%								%	%
0-13	7.2	-	-	0.193	0.81	3.00	9.69	3.93	1.41	0.08	15.10	15.07	0.38	100	0.54
13-27	7.13	-	-	0.161	0.7	3.00	8.69	3.57	1.29	0.16	13.70	13.75	0.36	100	1.14
27-43	7.31	-	-	0.096	0.89	2.64	5.19	2.36	1.07	0.24	8.86	9.46	0.30	94	2.51
43-64	7.65	-	-	0.089	1.16	2.52	8.25	2.88	0.72	0.35	12.20	12.65	0.28	96	2.79
64-84	7.98	-	-	0.1	0.38	3.12	10.49	2.88	0.26	0.41	14.04	14.63	0.32	96	2.78
84-114	8.23	-	-	0.121	0.58	2.88	8.02	1.87	0.09	0.43	10.41	10.67	0.38	98	4.02

Contd...

Series Name: Giddadapalya (GDP), **Pedon:** R-8

Location: 15°25'26"N, 76°10'59"E, Kalakeri village, Koppal taluk and 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							1/3 Bar	15 Bar
		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)				
0-16	Ap	74.95	9.24	15.81	18.43	18.94	13.85	14.97	8.76	-	sl	11.88	5.09
16-43	Bt1	41.69	13.89	44.42	9.84	10.90	7.41	7.62	5.93	-	c	23.13	14.53
43-61	Bt2	47.67	6.13	46.19	21.14	10.15	5.29	6.45	4.65	-	sc	21.60	11.87
61-83	Bt3	52.52	7.10	40.38	24.42	10.59	5.66	7.55	4.30	40	sc	19.51	11.35
83-119	Bt4	43.76	11.59	44.65	20.15	7.56	5.77	5.46	4.83	60	c	20.80	12.06
119-139	Bt5	54.93	9.84	35.23	29.70	10.49	5.50	5.92	3.32	50	sc	15.24	11.97

Depth (cm)	pH (1:2.5)			E.C. (1:2.5) dS m ⁻¹	O.C. %	CaCO ₃ %	Exchangeable bases					CEC	CEC/Clay	Base saturation %	ESP %
	Water	CaCl ₂	M KCl				Ca	Mg	K	Na	Total				
0-16	7.88	-	-	0.103	0.79	-	5.98	1.35	0.05	0.22	7.60	7.8	0.49	97	2.87
16-43	7.81	-	-	0.117	0.66	-	13.99	1.97	0.08	0.46	16.50	16.9	0.38	98	2.74
43-61	7.74	-	-	0.132	0.51	-	12.70	2.18	0.08	0.69	15.64	15.9	0.34	98	4.36
61-83	7.72	-	-	0.142	0.39	-	11.46	2.22	0.08	0.66	14.41	14.6	0.36	99	4.53
83-119	7.58	-	-	0.115	0.22	-	11.30	2.70	0.09	0.73	14.82	15.3	0.34	97	4.79
119-139	7.50	-	-	0.113	0.22	-	10.03	2.19	0.07	0.65	12.95	13.2	0.37	98	4.89

Contd...

Series Name: Gatareddihal (GRH) Pedon: R-7

Location: 15°14'20.8"N, 76°04'28.4" E Gudlanur village, Koppal taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bangalore. **Classification:** Very fine, smectitic(calc), isohyperthermic Sodic Haplusterts

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand							1/3 Bar	15 Bar
		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)				
0-18	Ap	20.07	19.71	60.23	1.76	3.75	3.64	3.42	7.50	-	c	41.70	29.56
18-51	Bss1	15.11	17.47	67.42	3.16	3.04	2.25	3.38	3.27	-	c	59.43	38.52
51-80	Bss2	13.19	18.74	68.07	1.80	2.93	2.37	3.04	3.04	-	c	60.69	40.91
80-107	Bss3	17.54	19.50	62.96	2.46	4.13	3.24	4.25	3.46	-	c	57.25	37.31
107-131	BC	9.42	17.48	73.10	1.48	1.82	1.36	1.93	2.84	-	c	64.62	43.98

Depth (cm)	pH (1:2.5)			E.C. (1:2.5) dS m ⁻¹	O.C. %	CaCO ₃ %	Exchangeable bases					CEC	CEC/Clay	Base saturation %	ESP %
	Water	CaCl ₂	M KCl				Ca	Mg	K	Na	Total				
0-18	9.08	-	-	0.23	0.33	6.89	-	-	0.70	6.36	-	63.21	1.05	100.00	7.11
18-51	9.19	-	-	0.61	0.49	9.10	-	-	0.54	14.20	-	66.05	0.98	100.00	15.98
51-80	9.27	-	-	0.56	0.29	9.36	-	-	0.49	14.75	-	65.63	0.96	100.00	17.07
80-107	9.28	-	-	0.57	0.39	9.62	-	-	0.44	14.64	-	63.95	1.02	100.00	17.49
107-131	9.04	-	-	1.08	0.31	8.32	-	-	0.52	16.40	-	68.36	0.94	100.00	17.30

Contd...

Series Name: Budagumpa (BGP), **Pedon:** R-21

Location: 15°23'45"N, 76°08'52"E Neregalla village, Koppal taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bangalore.

Classification: Fine, mixed (calc), isohyperthermic Typic Haplustepts

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand							1/3 Bar	15 Bar
		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)				
0-16	Ap	58.30	18.10	23.60	6.34	11.75	11.66	17.44	11.10	-	scl	18.24	10.29
16-38	Bw1	44.26	18.39	37.36	4.71	9.79	9.32	12.24	8.19	-	cl	32.99	18.12
38-68	Bw2	37.84	24.91	37.25	3.66	7.51	8.45	10.89	7.32	-	cl	39.50	22.32
68-83	Bw3	19.17	19.89	60.93	0.87	3.47	3.85	6.07	4.91	-	c	47.27	28.52
83-107	Bw4	14.76	23.22	62.02	0.63	2.41	3.25	4.61	3.87	-	c	46.10	29.36
107-131	Bw5	11.86	17.75	70.39	0.85	2.73	2.45	3.20	2.64	-	c	50.52	28.09
131-160	Bw6	14.48	18.21	67.31	2.23	2.50	2.59	3.84	3.31	-	c	59.14	28.35

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	CaCO ₃	Exchangeable bases					CEC	CEC/Clay	Base saturation	ESP			
	Water	CaCl ₂	M KCl				dS m ⁻¹	%	%	Ca	Mg					K	Na	Total
										cmol kg ⁻¹						%	%	
0-16	9.20	-	-	0.27	0.51	6.24	-	-	0.42	3.11	-	19.60	0.83	100.00	3.84			
16-38	9.29	-	-	0.88	0.35	5.98	-	-	0.17	9.36	-	28.40	0.76	100.00	15.38			
38-68	8.95	-	-	2.37	0.31	4.81	-	-	0.31	24.10	-	34.90	0.94	100.00	42.65			
68-83	8.65	-	-	4.28	0.33	4.42	-	-	0.39	27.95	-	45.10	0.74	100.00	25.94			
83-107	8.10	-	-	9.50	0.30	3.38	-	-	0.44	31.29	-	44.10	0.71	100.00	12.82			
107-131	8.16	-	-	9.32	0.22	2.73	-	-	0.63	37.86	-	47.20	0.67	100.00	20.37			
131-160	8.49	-	-	5.29	0.19	3.51	-	-	0.60	34.82	-	43.70	0.65	100.00	48.66			

INTERPRETATION FOR LAND RESOURCE MANAGEMENT

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

5.1 Land Capability Classification

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The 10 soil map units identified in the Bhagyanagar-2 Microwatershed are grouped under two land capability classes and five land capability subclasses (Fig. 5.1).

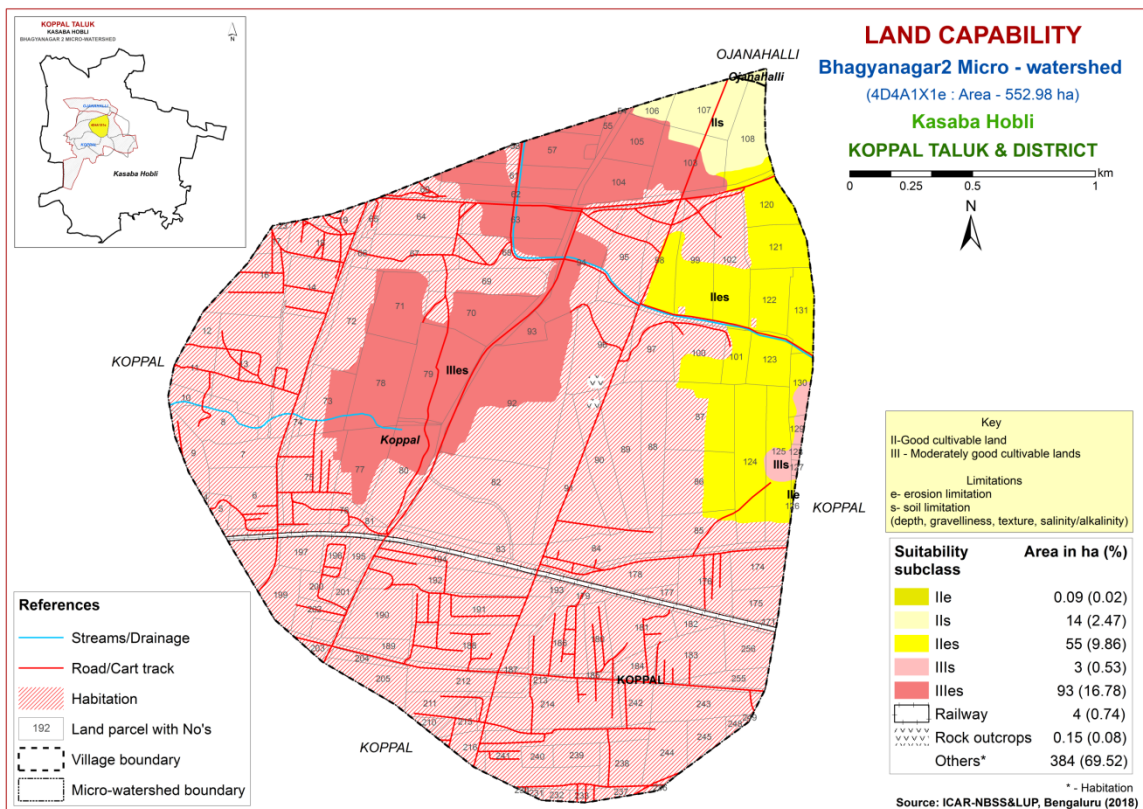


Fig. 5.1 Land Capability map of Bhagyanagar-2 Microwatershed

Entire cultivated area in the microwatershed is suitable for agriculture. Good lands (Class II) cover an area of about 69 ha (12%) and distributed in the eastern and northern part of the microwatershed with minor problems of soil and erosion. Moderately good lands (Class III) occupy an area of about 96 ha (17%) and distributed in the major part of the microwatershed with severe limitations of soil and erosion. An area of about 4 ha (<1%) is covered by railways, <1 ha (<1 %) by rock out crops, and 384 ha (70%) is under habitation.

5.2 Soil Depth

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

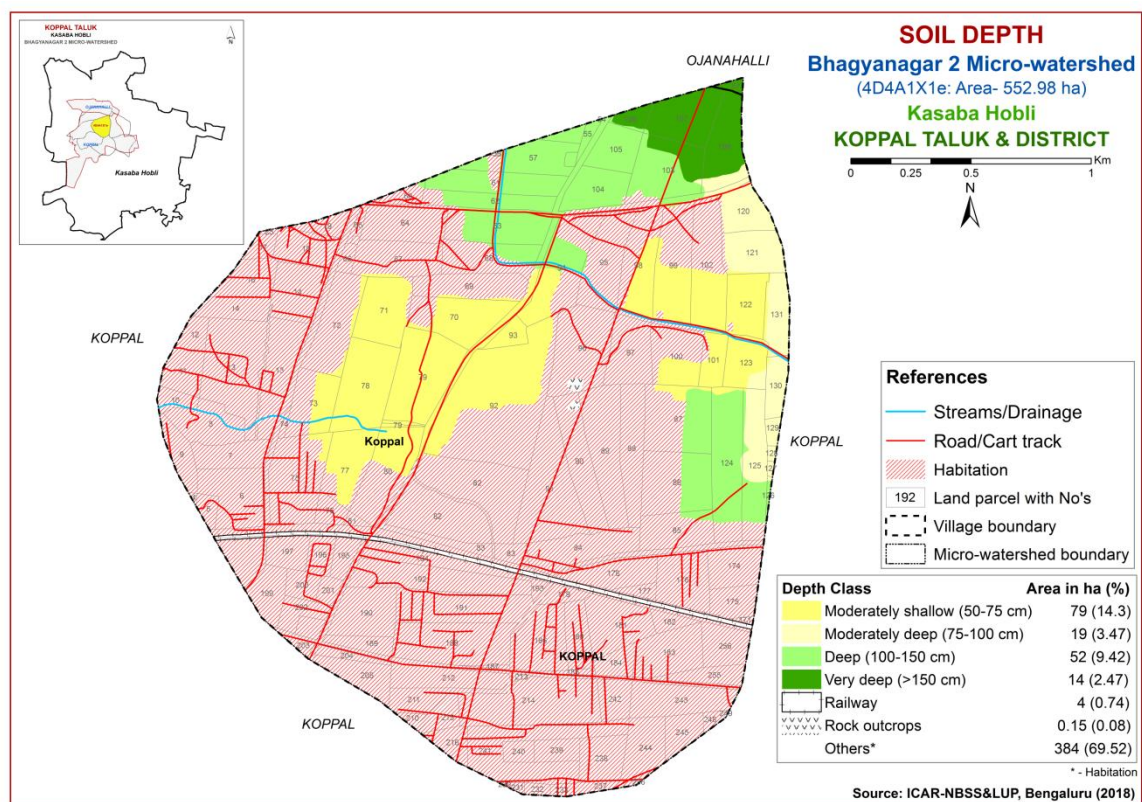


Fig. 5.2 Soil Depth map of Bhagyanagar-2 Microwatershed

Moderately shallow (50-75 cm) soils cover an area of about 79 ha (14%) and distributed in the eastern and central part of the microwatershed. An area of about 19 ha

(3%) is moderately deep soils (75-100 cm) and distributed in the eastern part of the microwatershed. Deep to very deep (100- >150 cm) soils occupy an area of about 66 ha (12%) and distributed in the northern part of the microwatershed.

The most productive lands cover about 66 ha (12%) where all climatically adopted long duration crops be grown.

5.3 Surface Soil Texture

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

An area of about 32 ha (6%) is loamy (sandy clay loam) at the surface and distributed in the northeastern part of the microwatershed. Clayey (sandy clay and clay) soils cover about 132 ha (24%) and are distributed in the major part of the microwatershed.

The most productive lands with respect to surface soil texture are clayey soils that (24%) have high potential for soil-water retention and availability and nutrient retention and availability, but have more problems of drainage, infiltration, workability and other physical problems. The other productive lands are loamy (6%) soils which also have high potential for soil- water retention and nutrient availability but have no drainage or other physical problems.

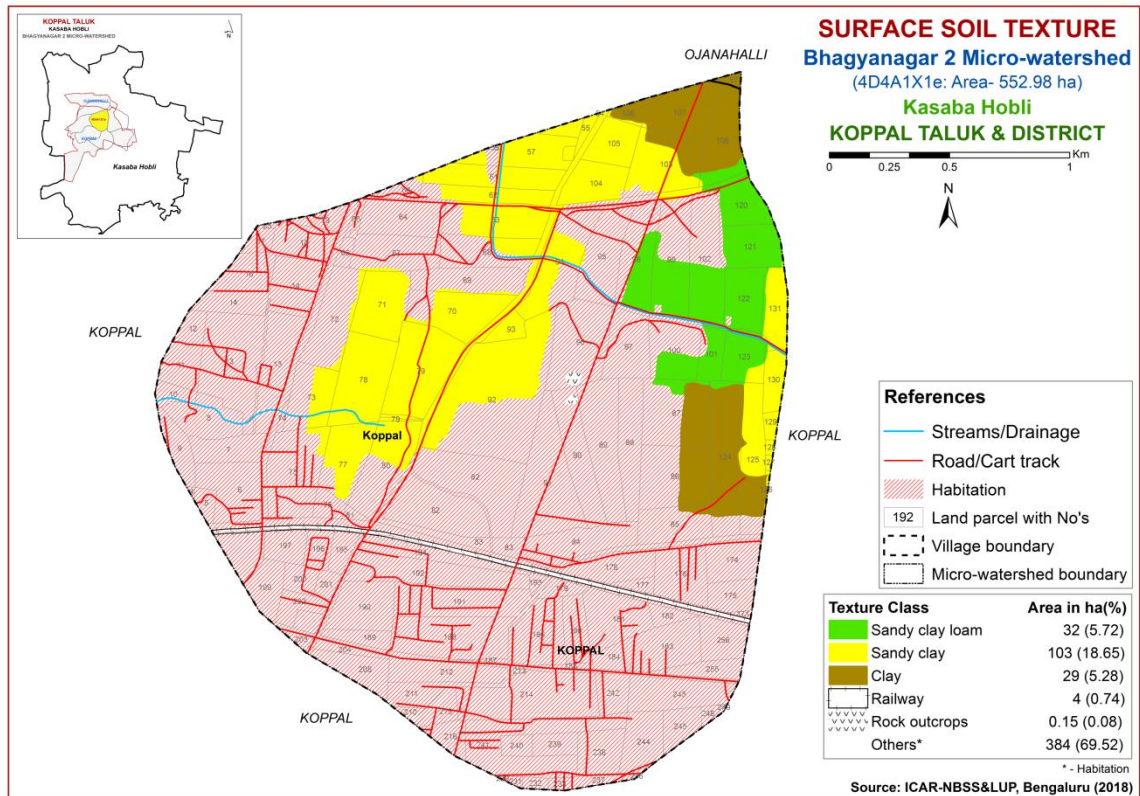


Fig. 5.3 Surface Soil Texture map of Bhagyanagar-2 Microwatershed

5.4 Soil Gravelliness

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

Entire area in the microwatershed is non-gravelly (<15% gravel) and have potential for growing both annual and perennial crops (Fig. 5.4).

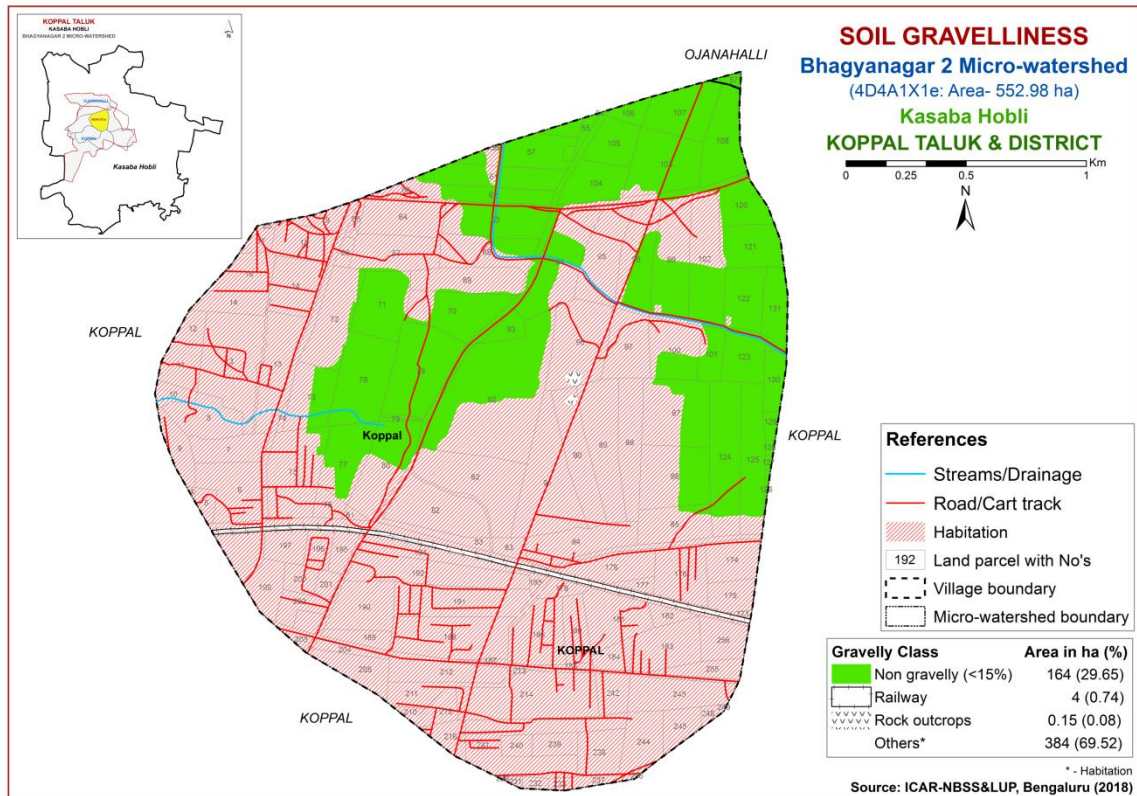


Fig. 5.4 Soil Gravelliness map of Bhagyanagar-2 Microwatershed

5.5 Available Water Capacity

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

An area of about 76 ha (14%) in the microwatershed has soils that are very low (<50 mm/m) in available water capacity and are distributed in the central part of the microwatershed. An area of about 59 ha (11%) has soils that are low (51 to 100 mm/m) in available water capacity and are distributed in the northern part of the microwatershed. An area of about 30 ha (5%) is high to very high (151->200 mm/min) in available water capacity and distributed in the northern and eastern part of the microwatershed.

An area of about 135 ha (24%) in the microwatershed has soils that are problematic with regard to available water capacity. Here, only short duration crops can be grown and the probability of crop failure is very high. These areas are best put to other alternative uses. An area of about 30 ha (5%) has soils that have high potential (>200

mm/m) with regard to available water capacity where all climatically adapted long duration crops can be grown successfully.

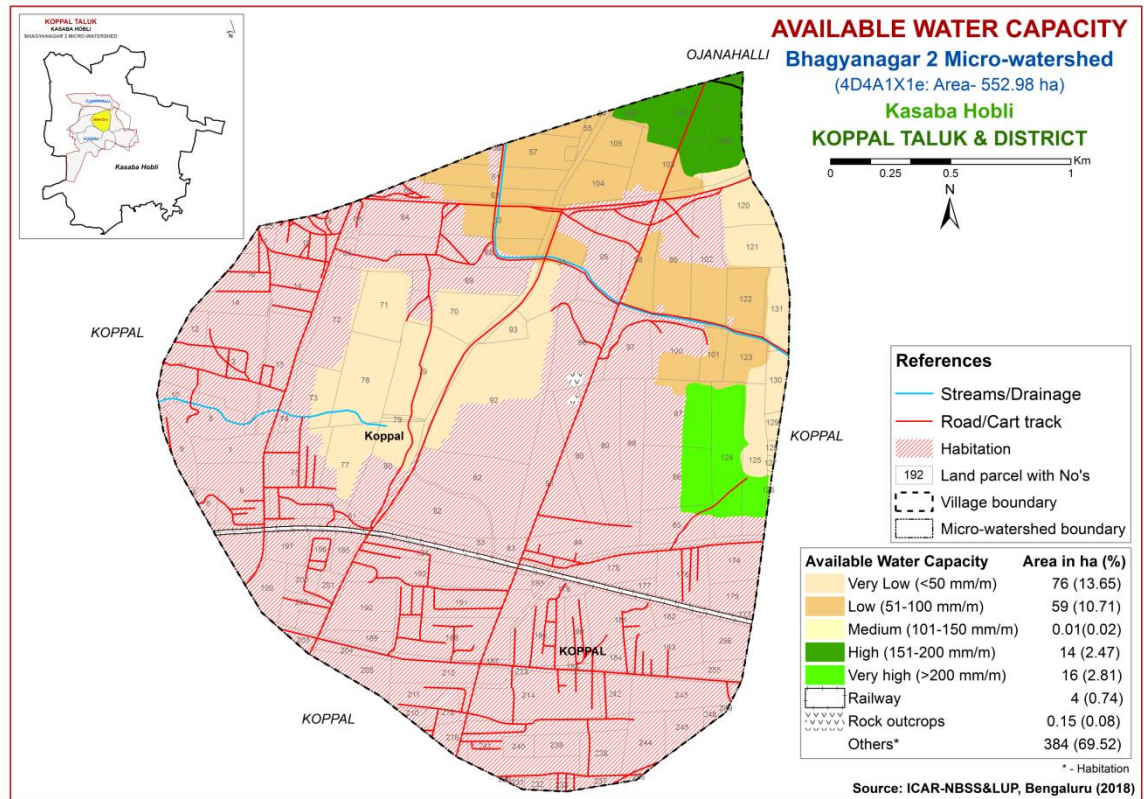


Fig. 5.5 Soil Available Water Capacity map of Bhagyanagar-2 Microwatershed

5.6 Soil Slope

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

Entire area in the microwatershed is very gently sloping (1-3%) lands. In all these areas, all climatically adapted annual and perennial crops can be grown without much soil and water conservation and other land development measures.

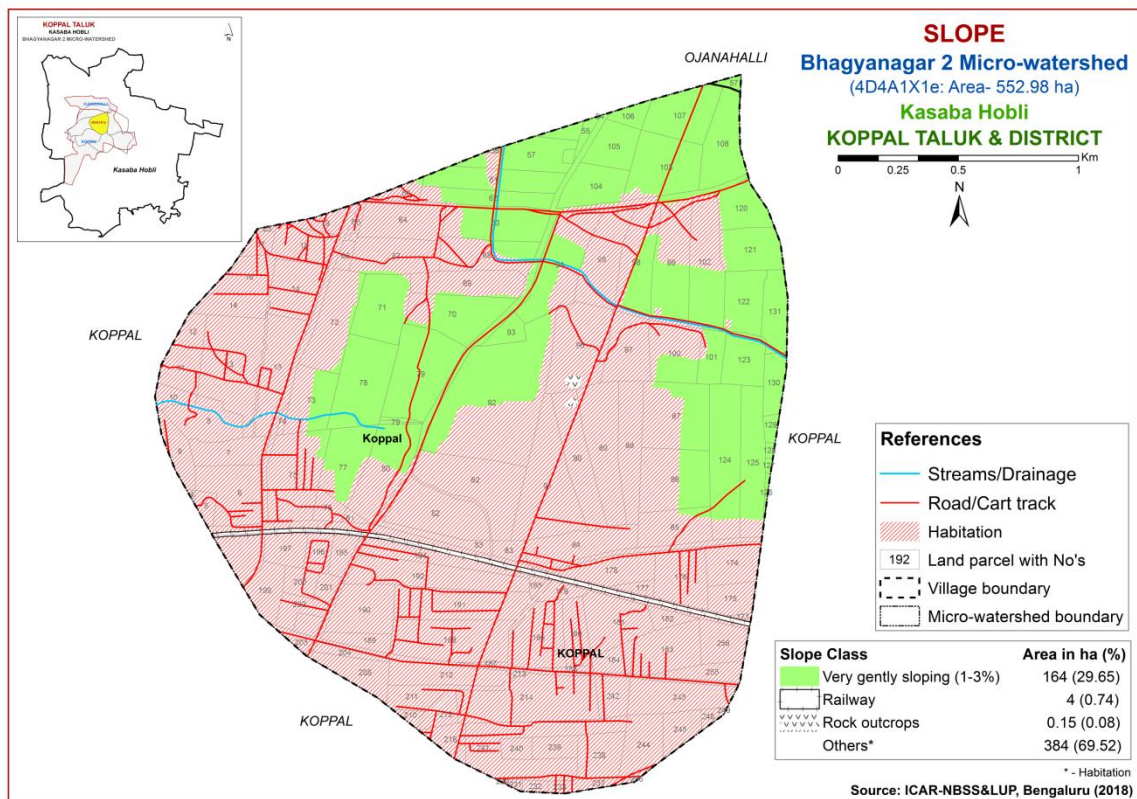


Fig. 5.6 Soil Slope map of Bhagyanagar-2 Microwatershed

5.7 Soil Erosion

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

Slightly eroded lands cover an area of about 17 ha (3%) and distributed in the northern part of the microwatershed. Maximum area of about 147 ha (27 %) is moderately eroded (e2 class) and distributed in the major part of the microwatershed. Moderately eroded lands are problematic and need appropriate soil and water conservation and other land development measures.

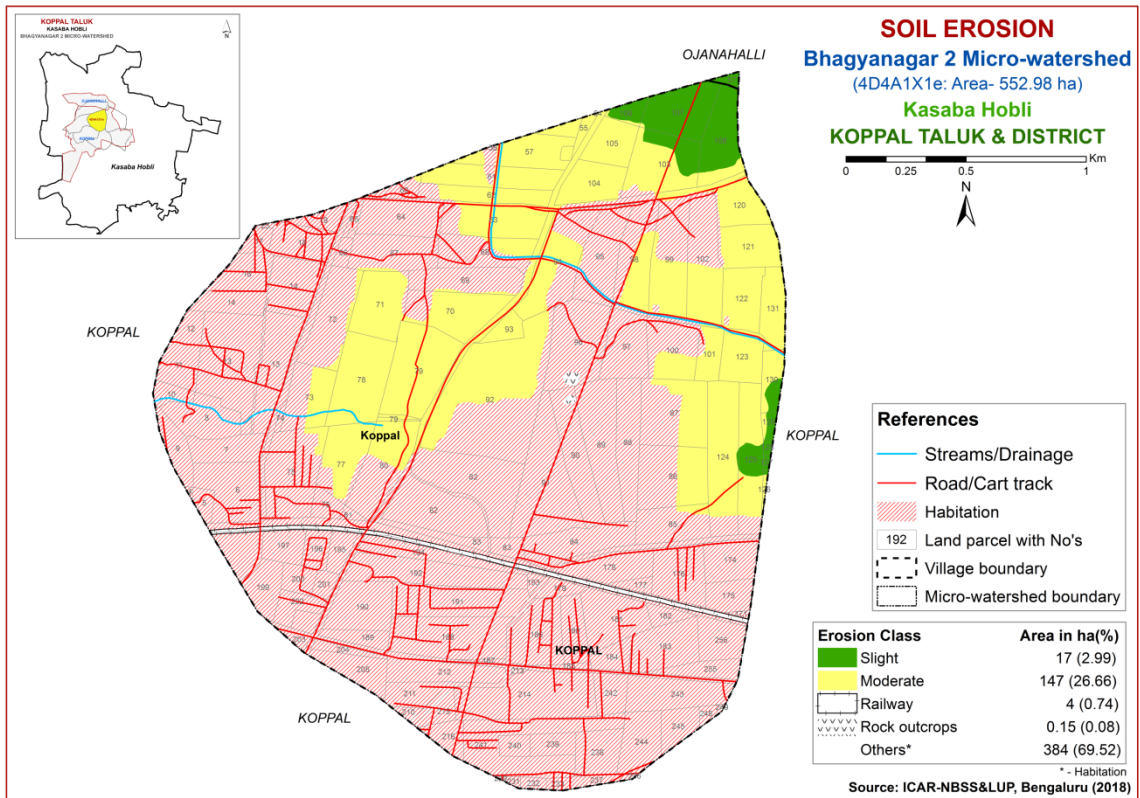


Fig. 5.7 Soil Erosion map of Bhagyanagar-2 Microwatershed

FERTILITY STATUS

Soil fertility plays an important role in increasing crop yield. The adoption of high yielding varieties that require high amounts of nutrients has resulted in deficiency symptoms in crops and plants due to imbalanced fertilization and poor inherent fertility status, as these areas are characterized 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 320 m grid interval) all over the microwatershed through land resource inventory in the year 2017 were analyzed for pH, EC, organic carbon, available phosphorus and potassium, and for micronutrients like zinc, boron, copper, iron and manganese, and secondary nutrient sulphur.

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

6.1 Soil Reaction (pH)

The soil analysis of the Bhagyanagar-2 microwatershed for soil reaction (pH) showed that slightly to moderately alkaline (pH 7.3-8.4) soils cover a maximum area of about 140 ha (25%) and distributed in the major part of the microwatershed. An area of about 24 ha (4%) is strongly to very strongly alkaline (pH 8.4->9.0) and is distributed in the southern part of the microwatershed. (Fig.6.1). Thus, entire area in the microwatershed is alkaline in reaction.

6.2 Electrical Conductivity (EC)

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

6.3 Organic Carbon

An area of about 143 ha (26%) is medium (0.5-0.75%) in OC and distributed in the major part of the microwatershed. An area of about 21 ha (4%) is high ($>0.75\%$) and distributed in the eastern part of the microwatershed (Fig.6.3).

6.4 Available Phosphorus

Entire area in the microwatershed is medium (23-57 kg/ha) in available phosphorus. Apply additional 25% phosphorus in areas where it is medium (Fig 6.4).

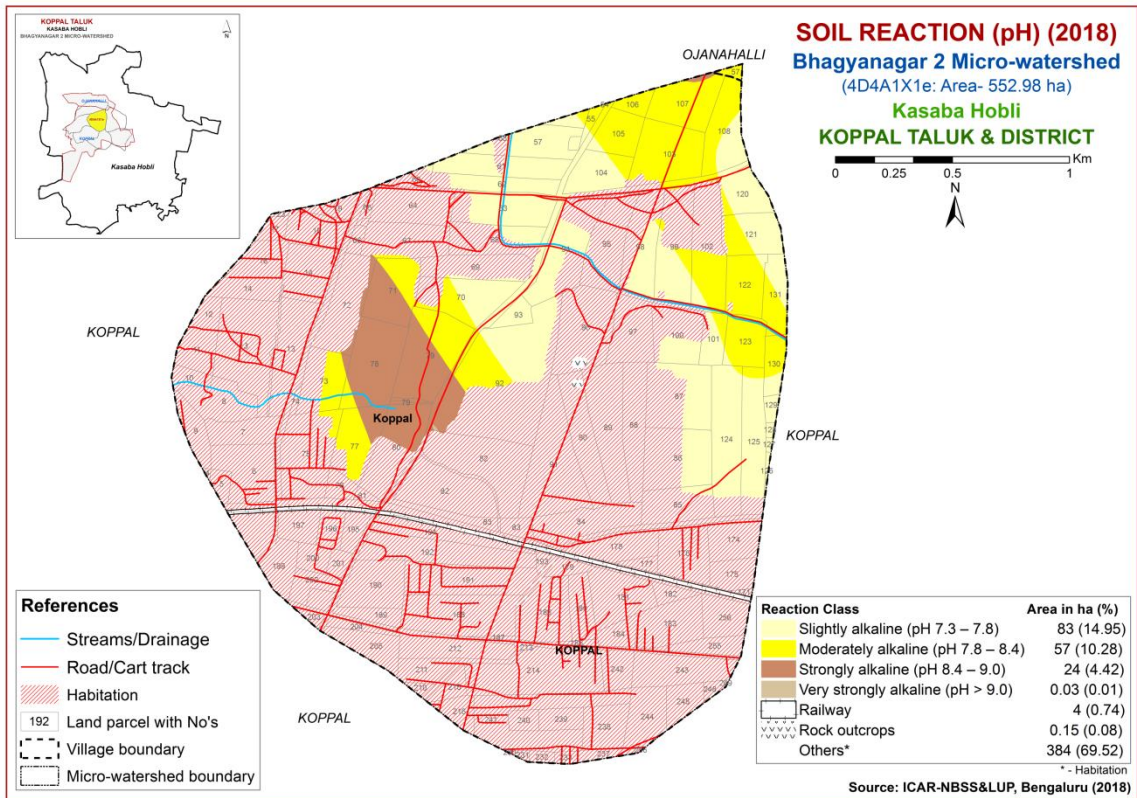


Fig.6.1 Soil Reaction (pH) map of Bhagyanagar-2Microwatershed

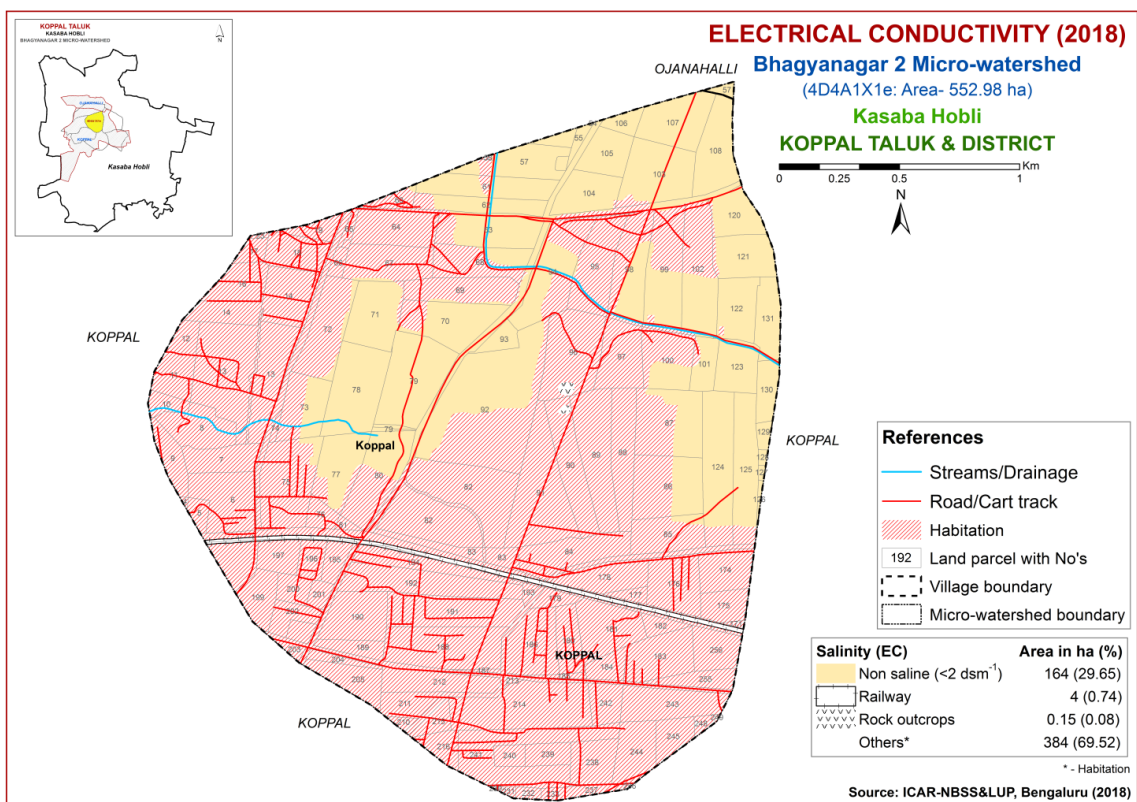


Fig.6.2 Electrical Conductivity (EC) map of Bhagyanagar-2Microwatershed

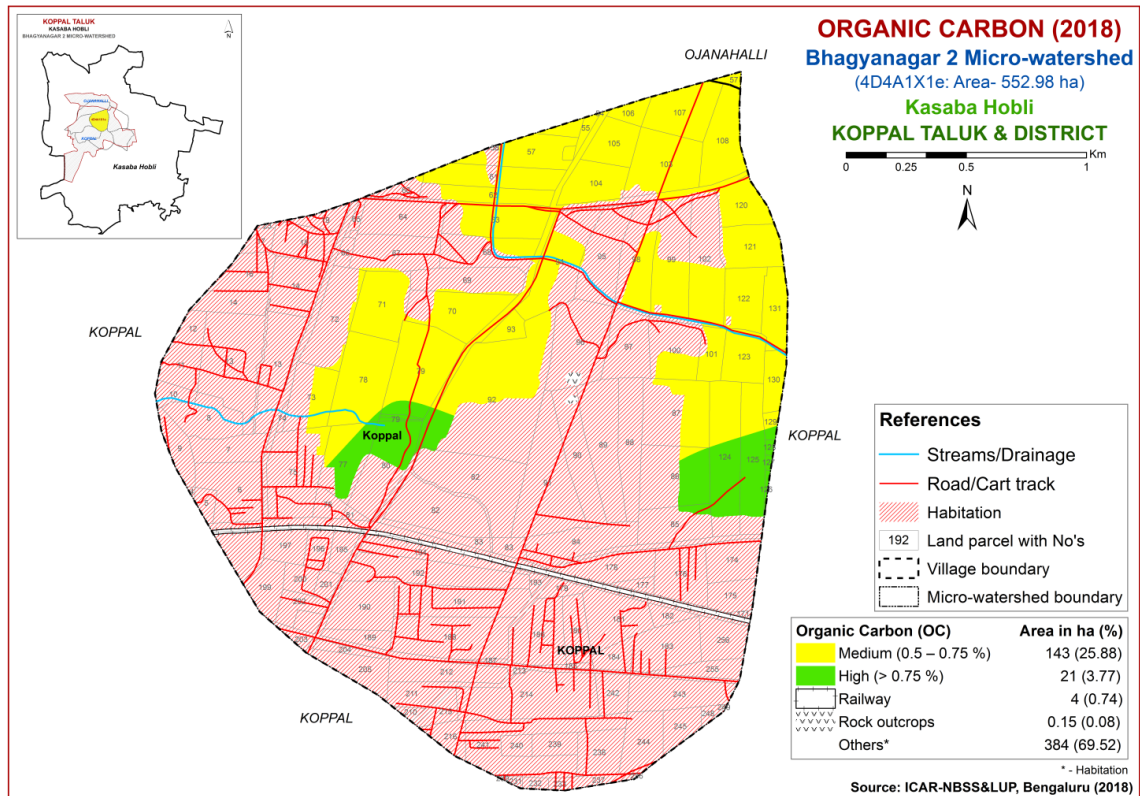


Fig.6.3 Soil Organic Carbon map of Bhagyanagar-2Microwatershed

6.5 Available Potassium

Available potassium is medium (145-337 kg/ha) in the entire area of the microwatershed. Apply additional 25% potassium in areas where it is medium (Fig 6.5).

6.6 Available Sulphur

Soil analysis of available sulphur content in Bhagyanagar-2 microwatershed showed that an area of about 164 ha (30%) is low and distributed in the major part of the microwatershed. An area of about <1 ha (<1%) is medium (10-20 ppm) in available sulphur content and distributed in the northern part of the microwatershed. (Fig.6.6). The areas that are low and medium in available sulphur need to be applied with magnesium sulphate or gypsum or factomphos (p) fertilizer (13% sulphur) for 2-3 years for the deficiency to be corrected.

6.7 Available Boron

An area of about 88 ha (16%) is low (< 0.5ppm) in available boron and distributed in the northern and northeastern part of the microwatershed. An area of about 76 ha (14%) is medium (0.5-1.0 ppm) and distributed in the central and northern part of the microwatershed (Fig.6.7).

6.8 Available Iron

Available iron content in the soils of the Bhagyanagar-2 microwatershed is deficient (<4.5 ppm) in a maximum area of about 150 ha (27%) and distributed in the

major part of the microwatershed. An area of about 14 ha (3 %) showed sufficiency (>4.5 ppm) with respect to iron content and distributed in the northeastern part of the microwatershed (Fig 6.8).

6.9 Available Manganese

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

6.10 Available Copper

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

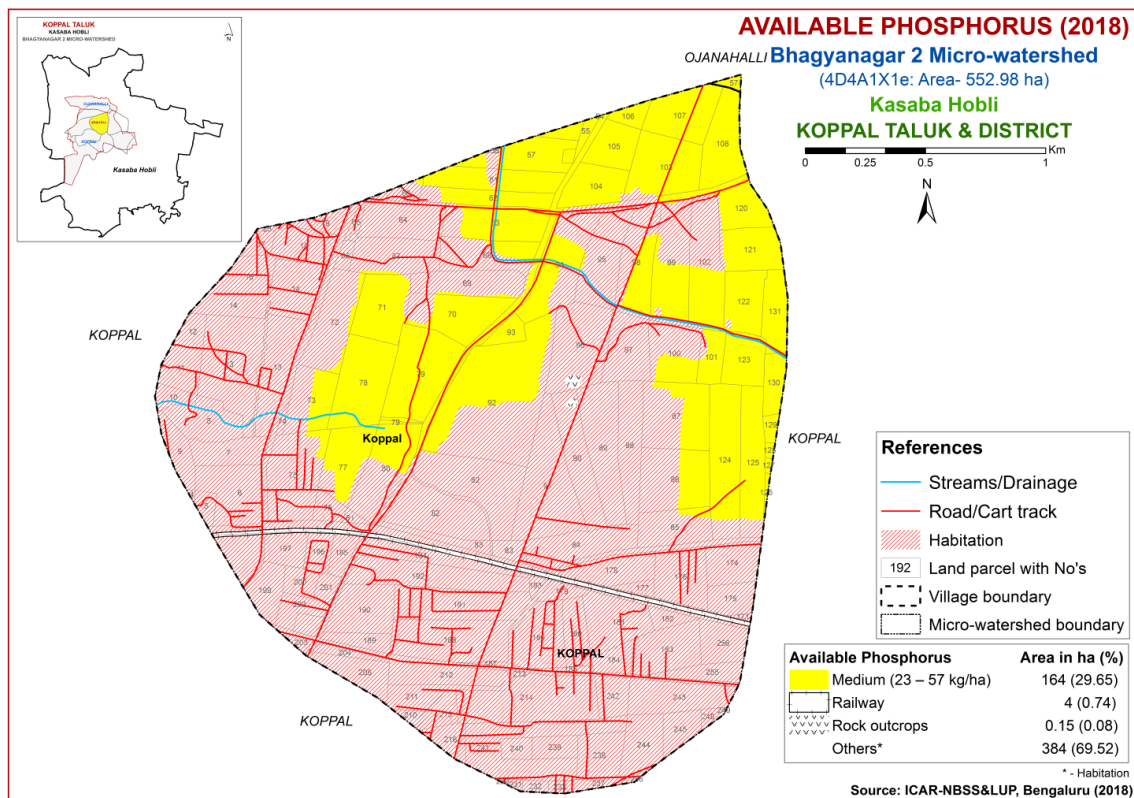


Fig.6.4 Soil Available Phosphorus map of Bhagyanagar-2Microwatershed

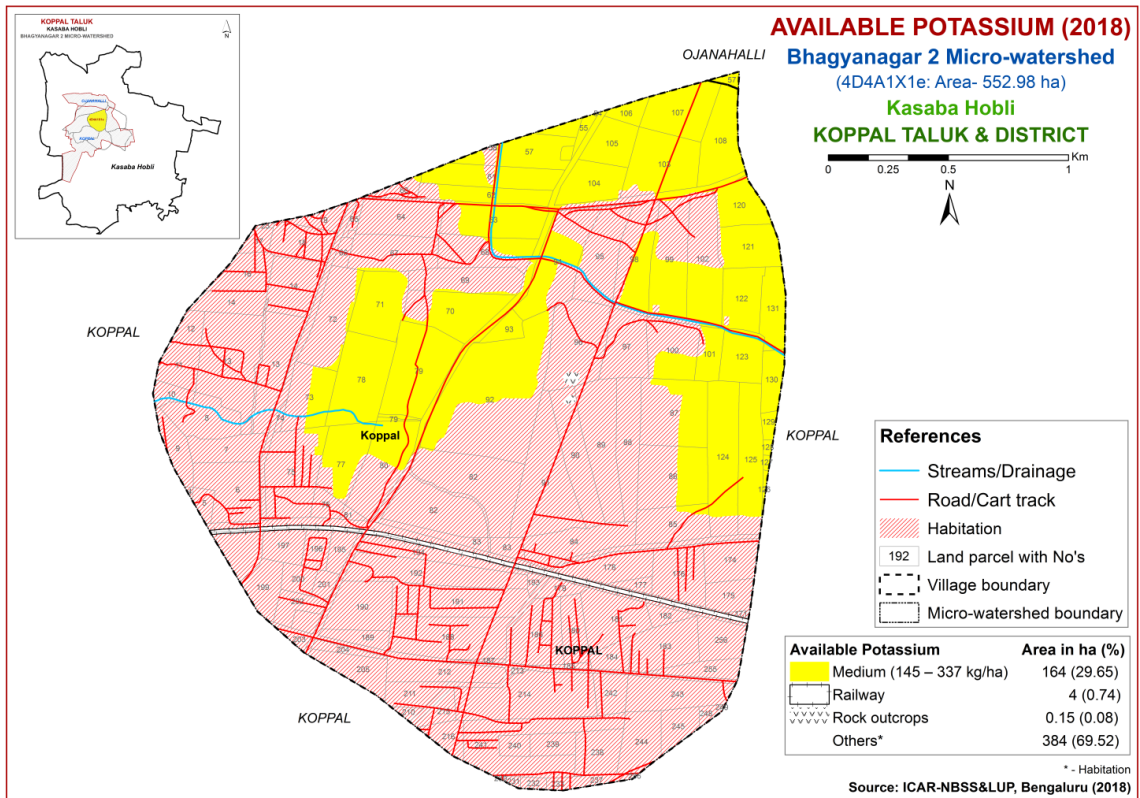


Fig.6.5 Soil Available Potassium map of Bhagyanagar-2Microwatershed

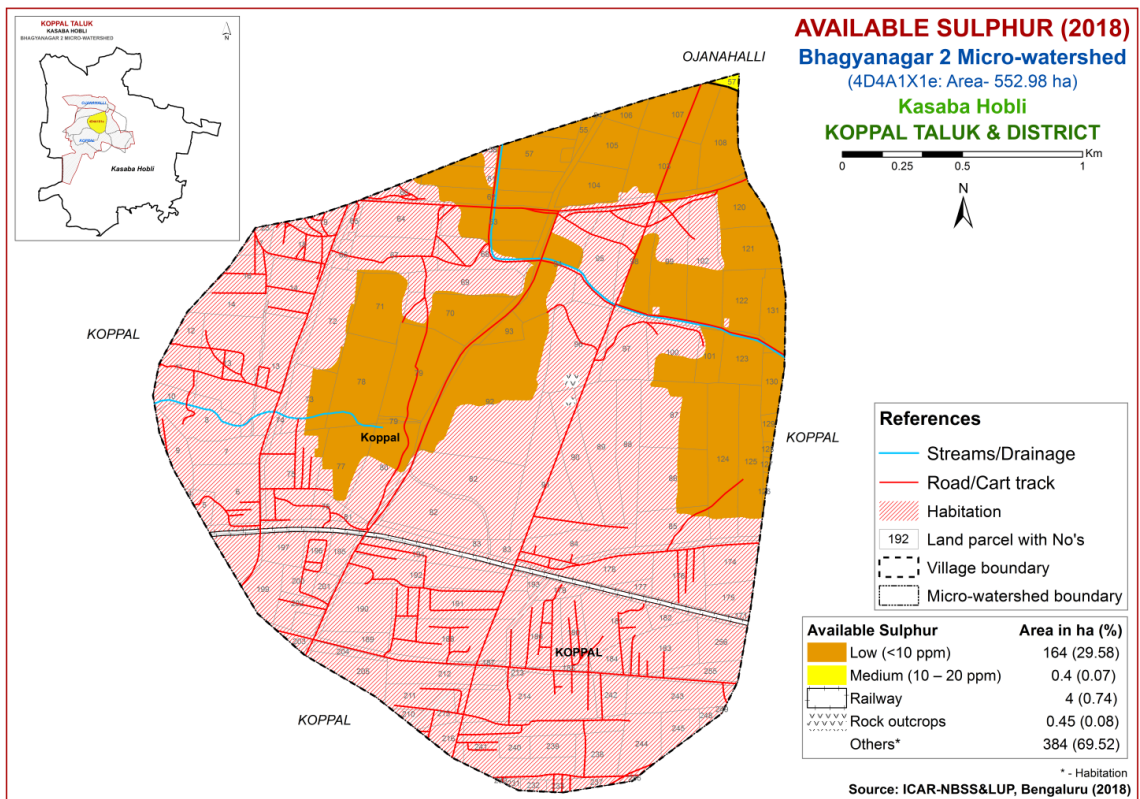


Fig.6.6 Soil Available Sulphur map of Bhagyanagar-2Microwatershed

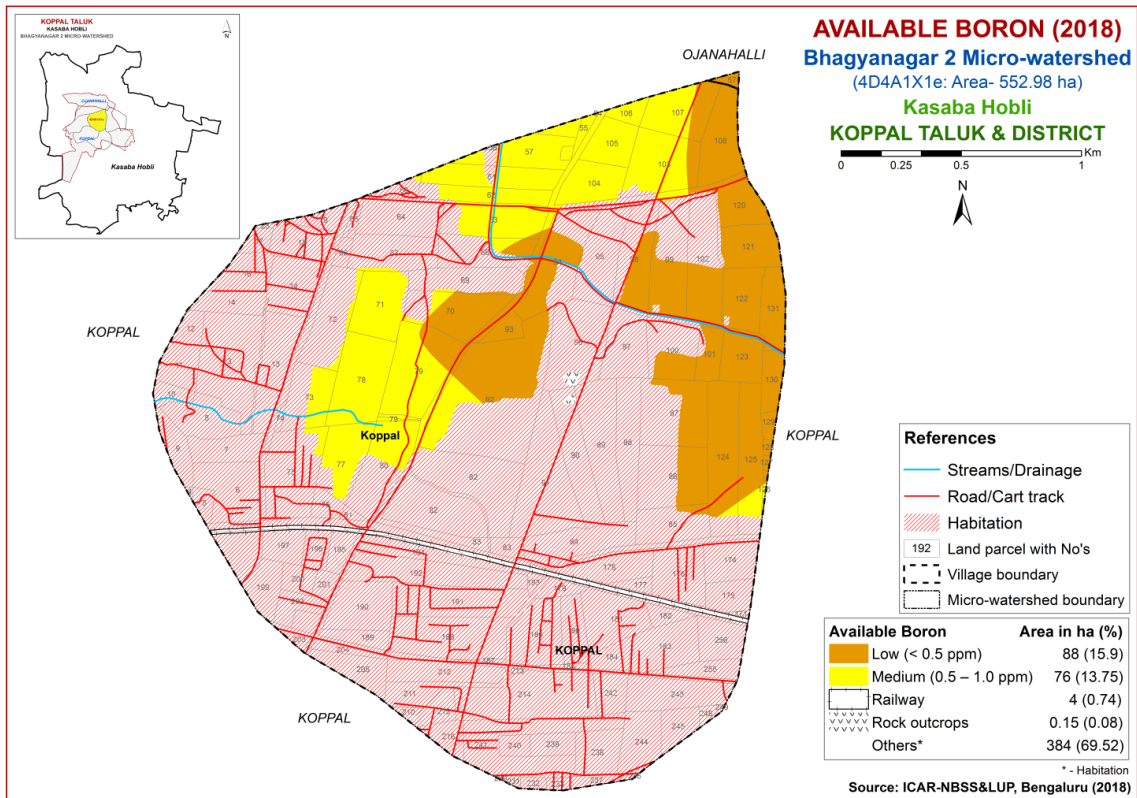


Fig.6.7 Soil Available Boron map of Bhagyanagar-2Microwatershed

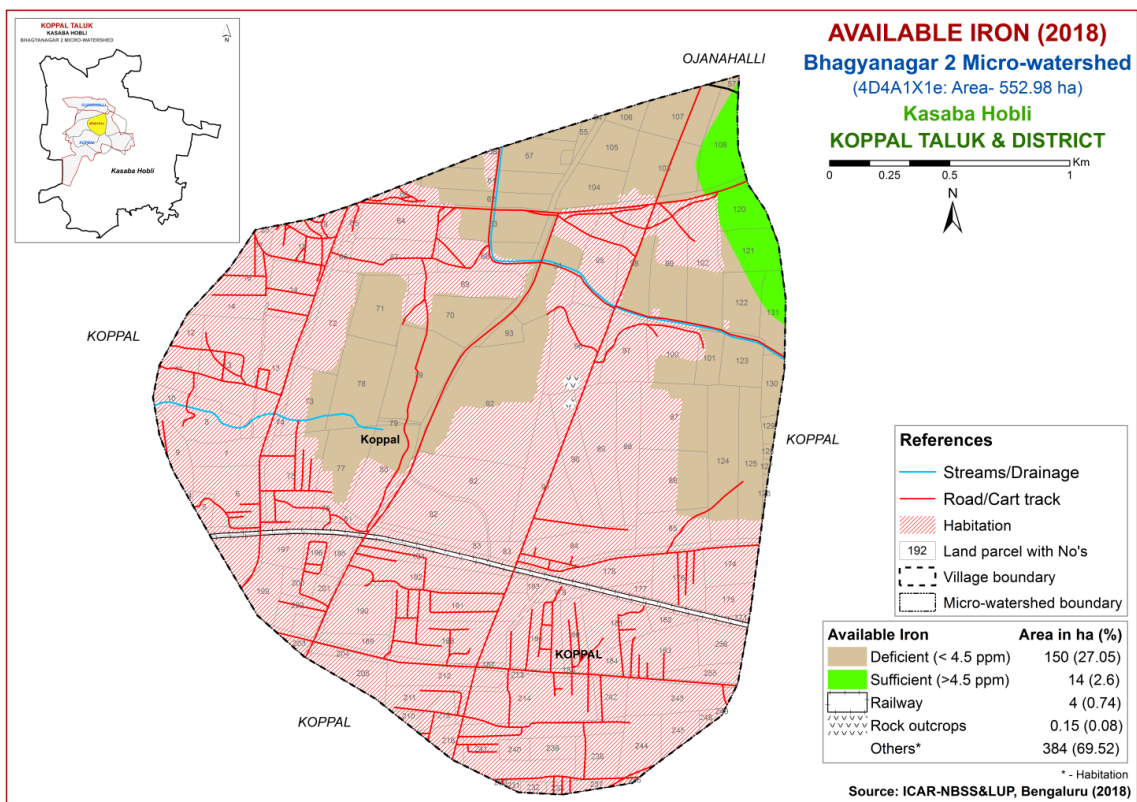


Fig.6.8 Soil Available Iron map of Bhagyanagar-2Microwatershed

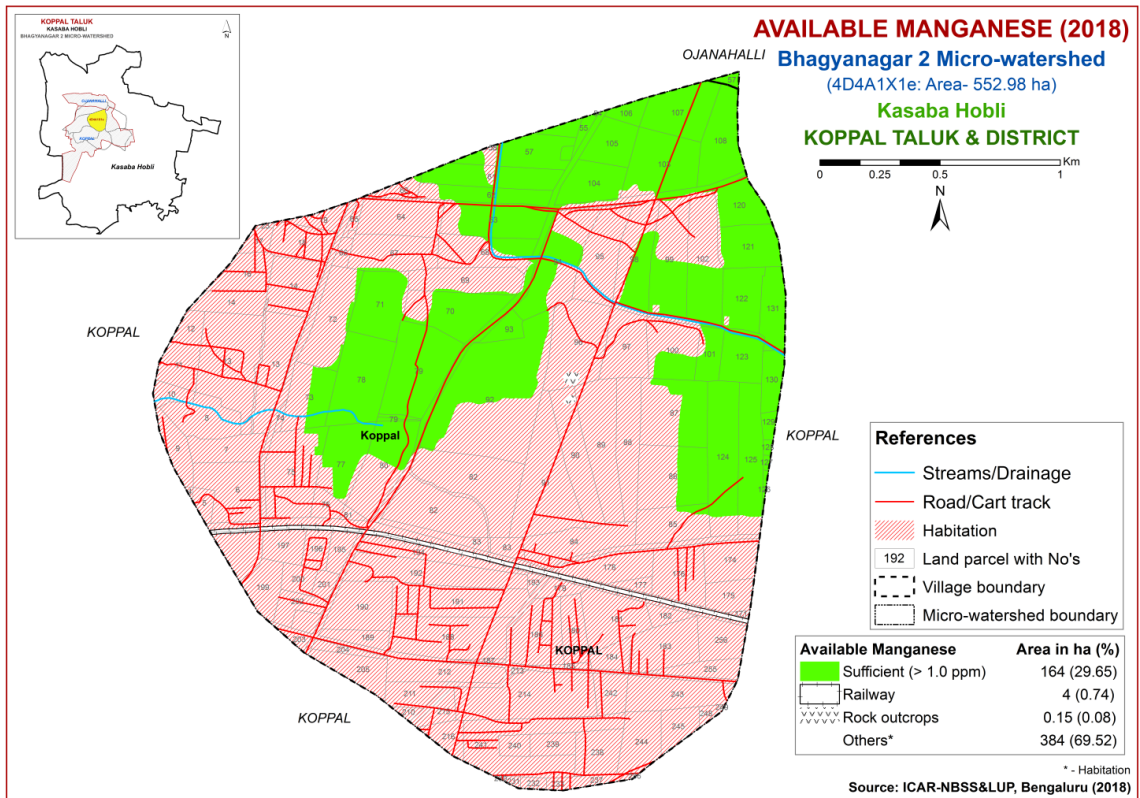


Fig.6.9 Soil Available Manganese map of Bhagyanagar-2Microwatershed

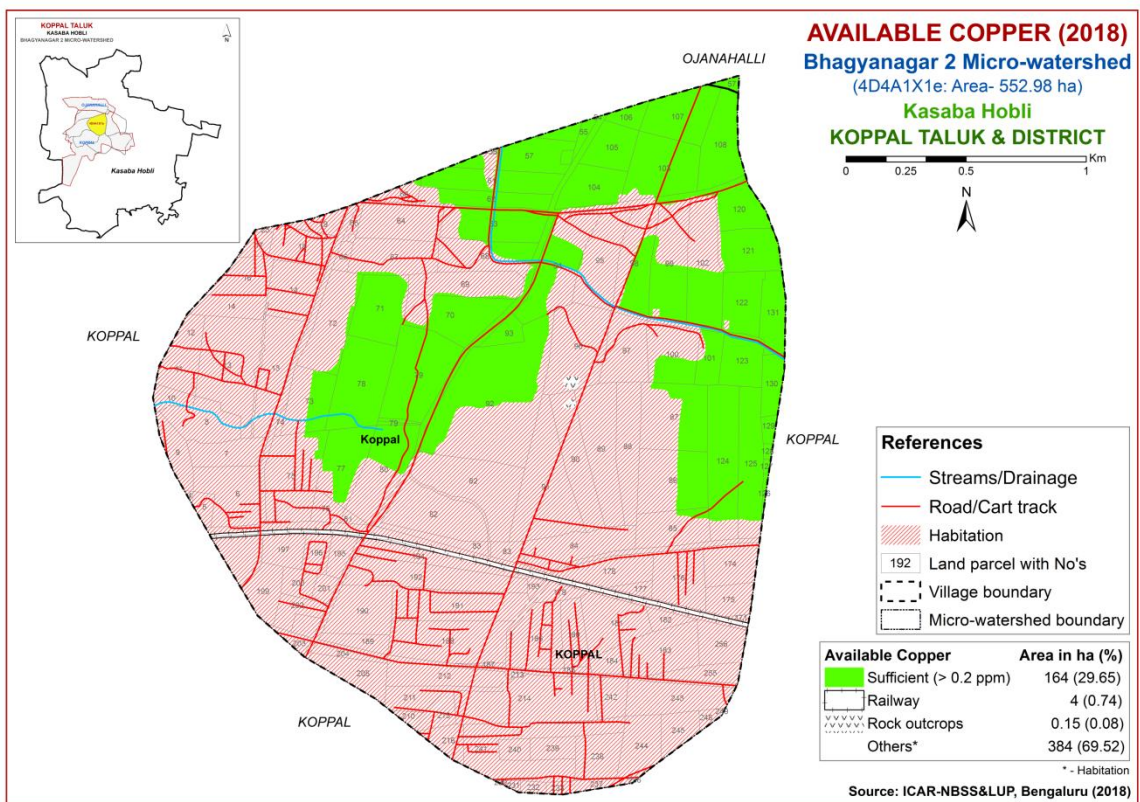


Fig.6.10 Soil Available Copper map of Bhagyanagar-2 Microwatershed

6.11 Available Zinc

Available zinc content is deficient (<0.6 ppm) in an area of about 54 ha (10 %) and distributed in the central part of the microwatershed. An area of about 110 ha (20%) is sufficient (>0.6 ppm) and distributed in the major part of the microwatershed (Fig 6.11).

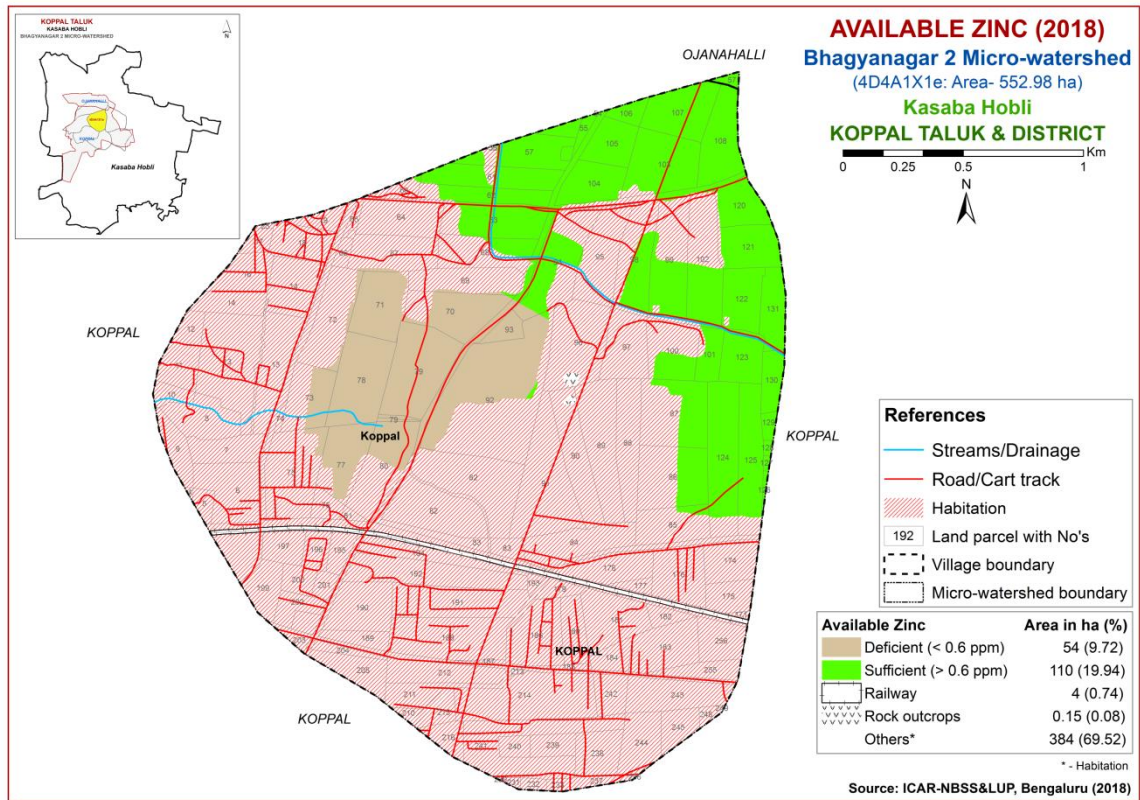


Fig.6.11 Soil Available Zinc map of Bhagyanagar-2Microwatershed

LAND SUITABILITY FOR MAJOR CROPS

The soil and land resource units (soil phases) of Bhagyanagar-2 Microwatershed were assessed for their suitability for growing food, fodder, fibre and other horticulture crops by following the procedure as outlined in FAO, 1976 and 1983. Crop requirements were developed for each of the crop from the available research data and also by referring to Naidu *et. al.* (2006) and Natarajan *et. al.* (2015). The soil and land characteristics were matched with the crop requirements to arrive at the crop suitability. The soil and land characteristics table (Table 7.1) were matched with the crop requirements (Tables 7.2-7.32) to arrive at the crop suitability and the crop requirement tables are given at the end of the chapter. In FAO land suitability classification, two orders are recognized. Order S- Suitable and Order N- Not suitable. The orders have classes, subclasses and units. Order S has three classes, Class S1- Highly Suitable, Class S2- Moderately Suitable and Class S3- Marginally Suitable. Order N has two Classes, N1- Currently not Suitable and N2- Permanently not Suitable. There are no subclasses within the Class S1 as they will have very minor or no limitations for crop growth. Classes S2, S3 and N1 are divided into subclasses based on the kinds of limitations encountered. The limitations that affect crop production are 'c' for erratic rainfall and its distribution and length of growing period (LGP), 'e' for erosion hazard, 'r' for rooting condition, 't' for lighter or heavy texture, 'g' for gravelliness or stoniness, 'n' for nutrient availability, 'l' for topography, 'm' for moisture availability, 's' for sodium 'z' for calcareousness and 'w' for drainage. These limitations are indicated as lower case letters to the class symbol. For example, moderately suitable lands with the limitations of soil depth and erosion are designated as S2re. For the microwatershed, the soil mapping units were evaluated and classified up to subclass level.

Using the above criteria, the soil map units of the microwatershed were evaluated and land suitability maps for 31 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 food crop grown in Karnataka in an area of 10.47 lakh ha in Bijapur, Gulbarga, Raichur, Bidar, Belgaum, Dharwad, Bellary, Chitradurga, Mysore and Chamarajnar district. The crop requirements for growing sorghum (Table 7.2) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map for growing sorghum was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.1.

Highly suitable (Class S1) lands occupy an area of about 52 ha (9%) for growing sorghum and occur in the eastern and northern part of the microwatershed. An area of about 14 ha (2%) is moderately suitable (Class S2) for growing sorghum and distributed in the northern part of the microwatershed with minor limitation of calcareousness. Maximum area of about 98 ha (18%) is marginally suitable for growing sorghum and distributed in the major part of the microwatershed. They have moderate limitations of and gravelliness.

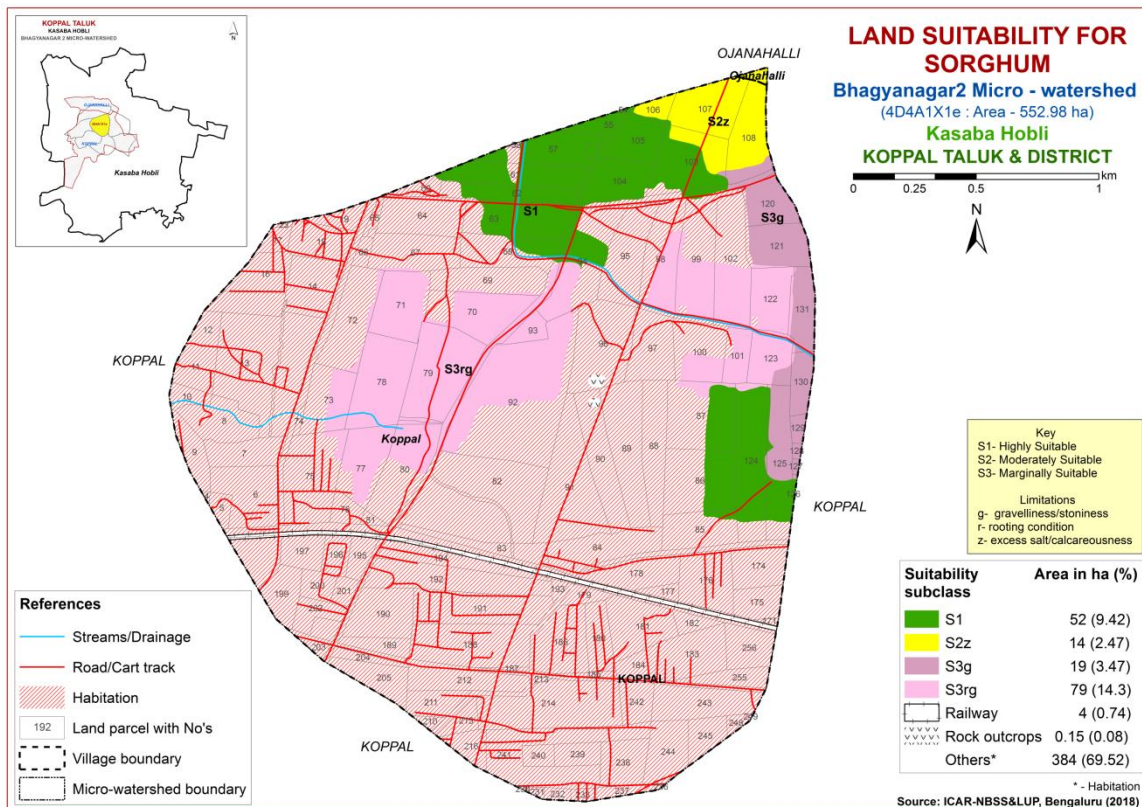


Fig. 7.1 Land Suitability map of Sorghum

7.2 Land Suitability for Maize (*Zea mays*)

Maize is one of the most important food crop grown in an area of 13.37 lakh ha in almost all the districts of the State. The crop requirements for growing maize (Table 7.3) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing maize was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.2.

An area of about 37 ha (7 %) is highly suitable (Class S1) and distributed in the northern part of the microwatershed. Moderately suitable (Class S2) lands cover an area of about 30 ha (5%) and distributed in the northern and eastern part of the microwatershed with minor limitations of texture and calcareousness. Marginally suitable (Class S3) lands cover an area of about 98 ha (18%) and occur in the major part of the microwatershed. They have moderate limitations of gravelliness and rooting depth.

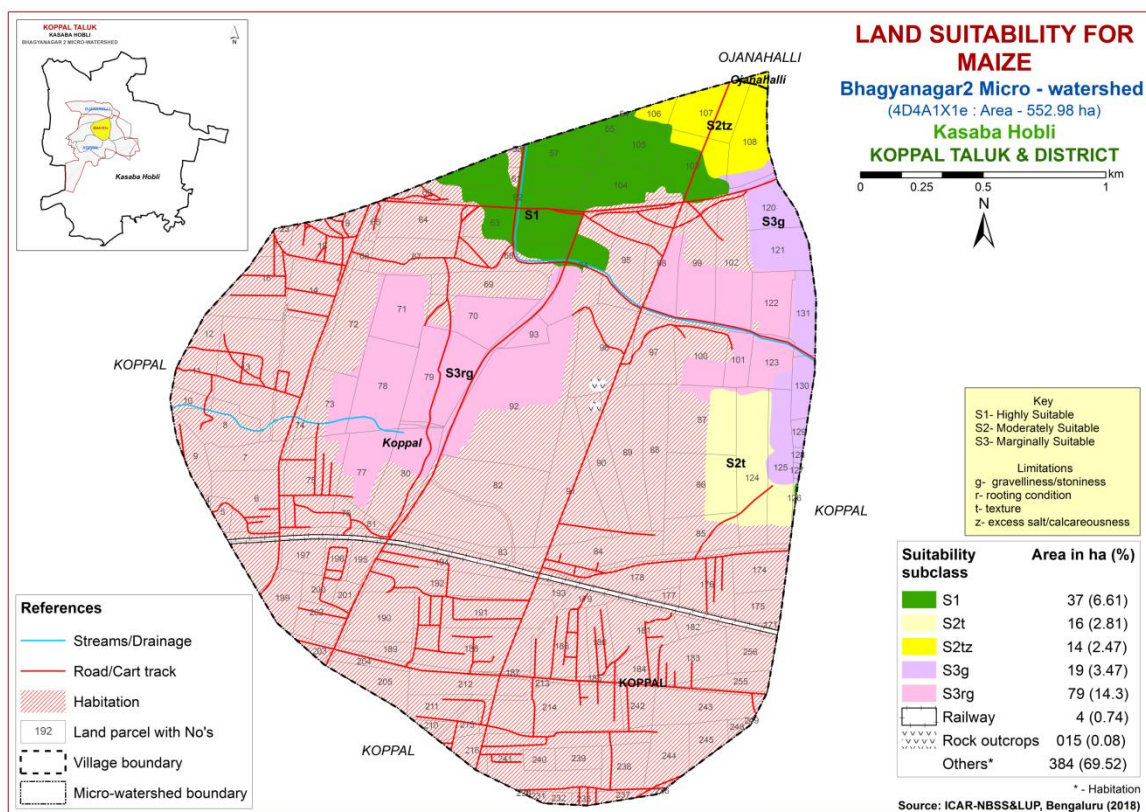


Fig. 7.2 Land Suitability map of Maize

7.3 Land Suitability for Bajra (*Pennisetum glaucum*)

Bajra is one of the major food crop grown in an area of 2.34 lakh ha in Karnataka in the northern districts. The crop requirements (Table 7.4) for growing bajra were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map for growing bajra was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.3.

Highly suitable (Class S1) lands occupy an area of about 37 ha (7 %) for growing bajra and occur in the northern part of the microwatershed. Maximum area of about 125 ha (23%) is moderately suitable (Class S2) for growing bajra and distributed in the major part of the microwatershed with minor limitations of texture, calcareousness, rooting depth and gravelliness. Marginally suitable (Class S3) lands cover an area of about 3 ha (<1%) and occur in the eastern part of the microwatershed. They have moderate limitation of gravelliness.

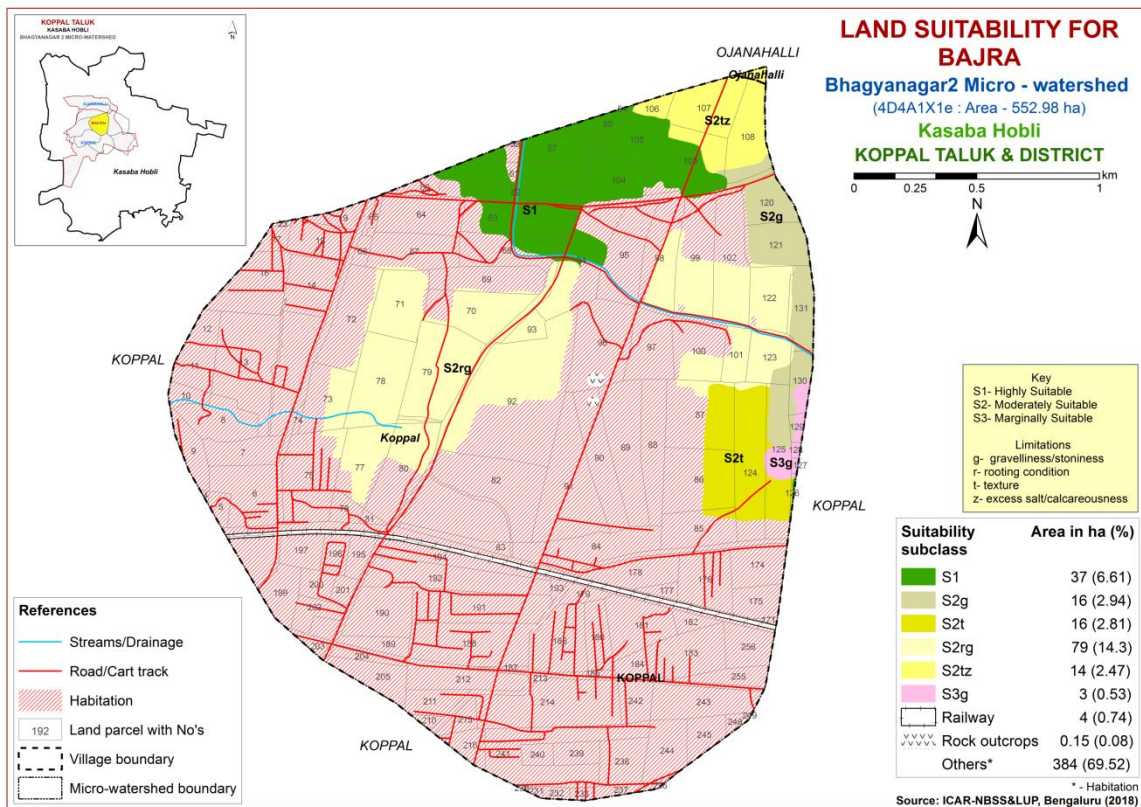


Fig. 7.3 Land Suitability map of Bajra

7.4 Land Suitability for Redgram (*Cajanus cajan*)

Redgram is one of the most important pulse crop grown in an area of 7.28 lakh ha in almost all the districts of the State. The crop requirements for growing redgram (Table 7.5) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing redgram was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.4.

Highly suitable (Class S1) lands occupy an area of about 37 ha (7%) for growing redgram and occur in the northern part of the microwatershed. An area of about 30 ha (5%) is moderately suitable (Class S2) for growing redgram and distributed in the northern and eastern part of the microwatershed. They have minor limitations of texture and calcareousness. Marginally suitable lands (Class S3) occupy a maximum area of about 98 ha (18%) and occur in the major part of the microwatershed. They have moderate limitations of rooting depth and gravelliness.

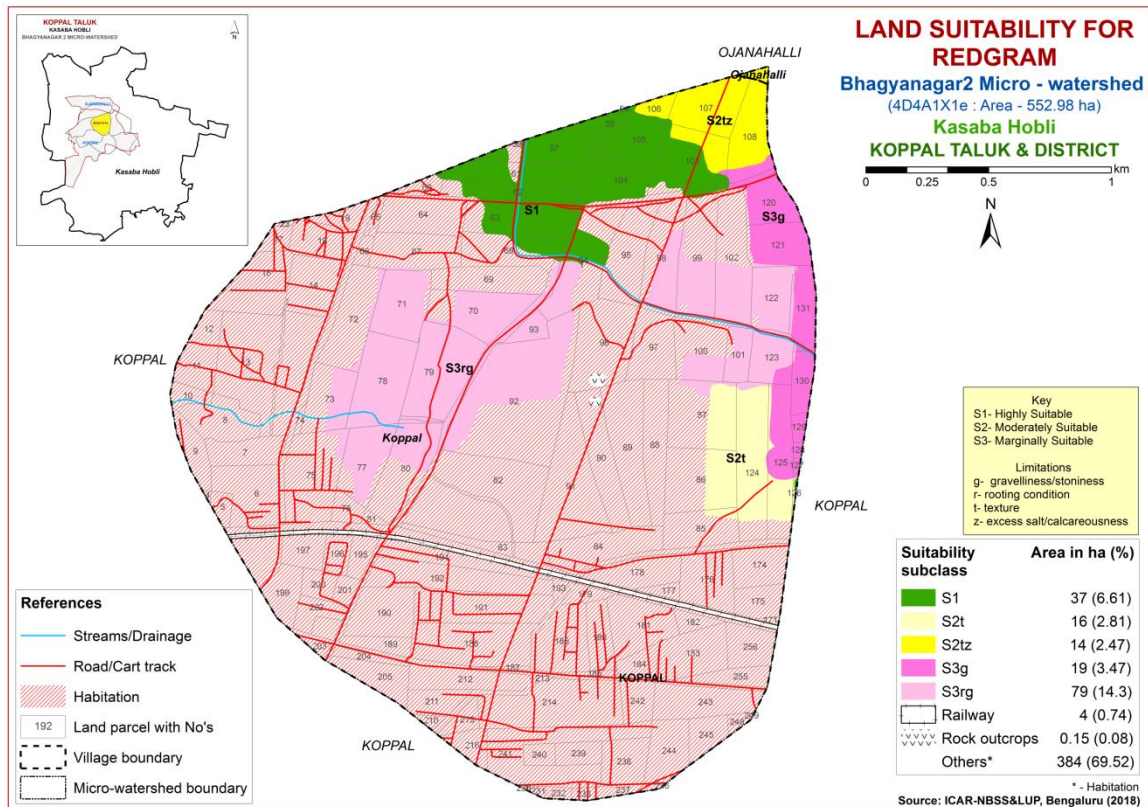


Fig. 7.4 Land Suitability map of Redgram

7.5 Land Suitability for Bengal gram (*Cicer arietinum*)

Bengal gram is one of the major pulse crop grown in an area of 9.39 lakh ha in northern Karnataka in Bijapur, Gulbarga, Raichur, Bidar, Belgaum, Dharwad and Bellary districts. The crop requirements for growing Bengal gram (Table 7.6) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map for growing Bengal gram was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.5.

Highly suitable (Class S1) lands occupy an area of about 16 ha (3%) for growing bengal gram and occur in the eastern part of the microwatershed. Maximum area of about 130 ha (23%) is moderately suitable (Class S2) for growing bengalgram and are distributed in the major part of the microwatershed. They have minor limitations of texture, calcareousness and rooting depth. Marginally suitable (Class S3) lands cover an area of about 19 ha (3%) and are distributed in the eastern part of the microwatershed. They have moderate limitation of gravelliness.

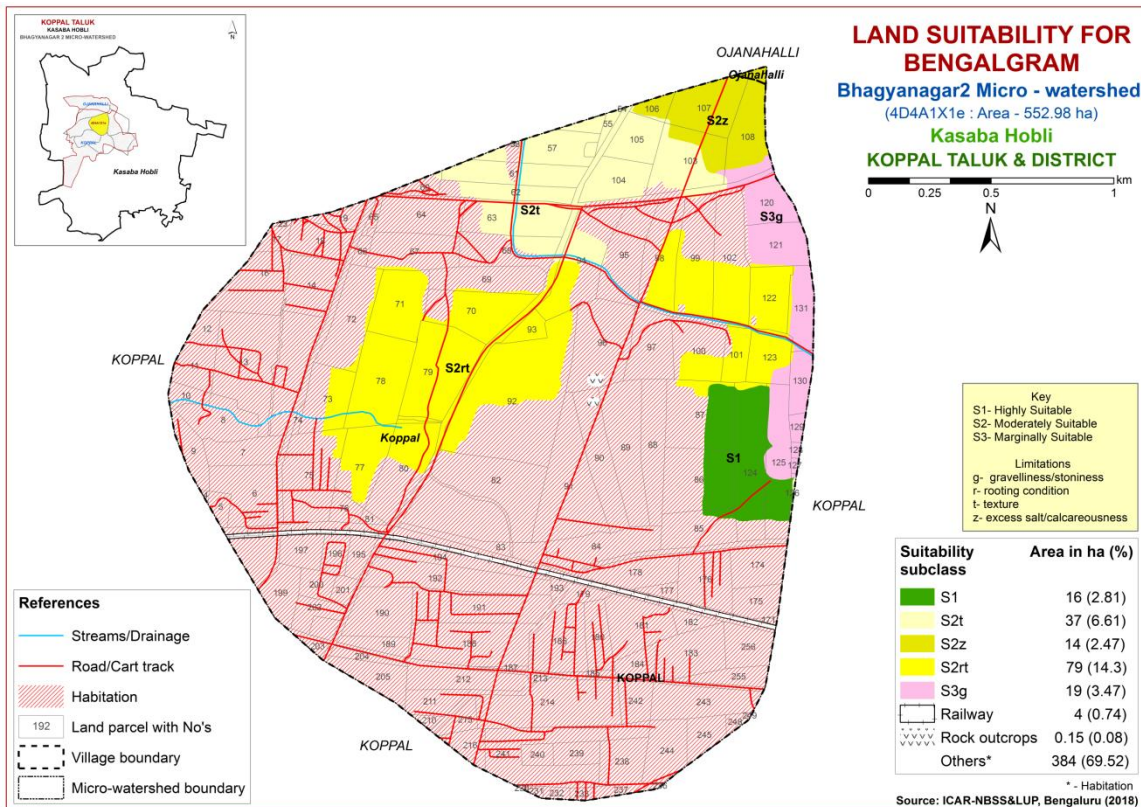


Fig. 7.5 Land Suitability map of Bengal gram

7.6 Land Suitability for Groundnut (*Arachis hypogaea*)

Groundnut is one of the major oilseed crop grown in an area of 6.54 lakh ha in Karnataka in most of the districts either as rainfed or irrigated crop. The crop requirements for growing groundnut (Table 7.7) 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 about 76 ha (14%) is moderately suitable (Class S2) for growing groundnut and distributed in the northern and eastern part of the microwatershed. They have minor limitations of gravelliness, and rooting depth and texture. An area of about 89 ha (16%) is marginally suitable (Class S3) for growing groundnut and are distributed in the major part of the microwatershed with moderate limitations of texture, rooting depth, gravelliness and calcareousness.

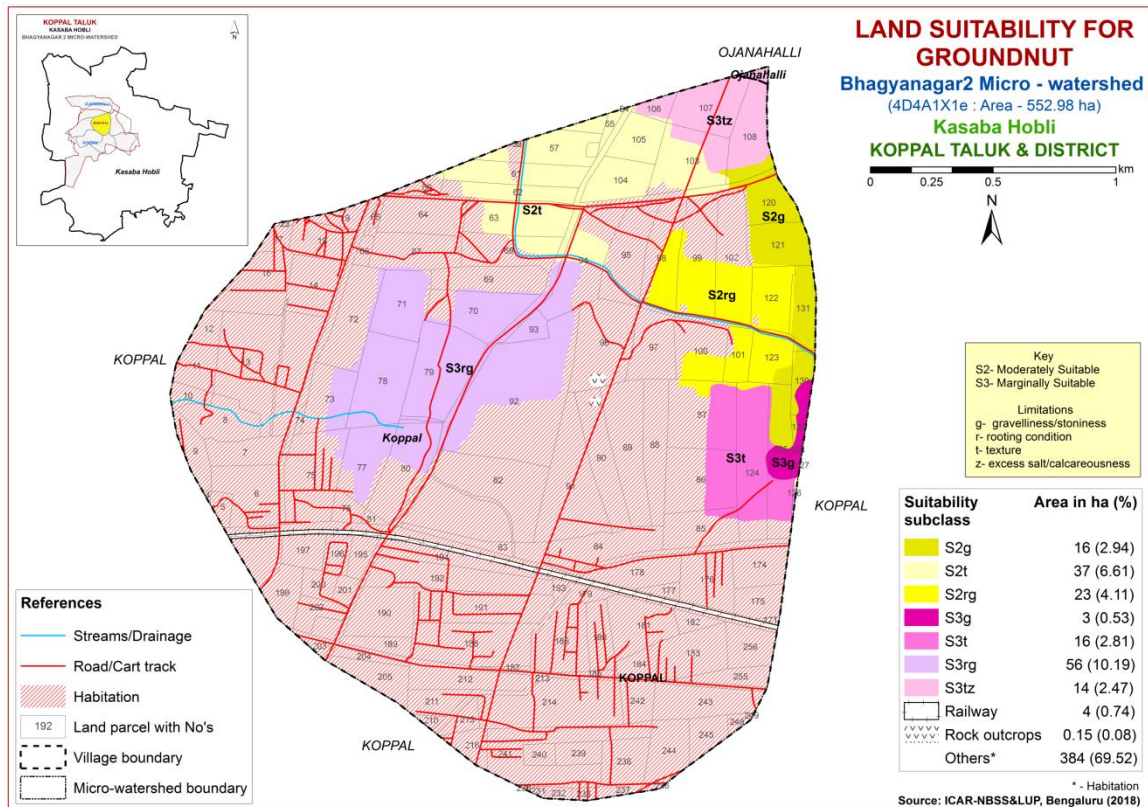


Fig. 7.6 Land Suitability map of Groundnut

7.7 Land Suitability for Sunflower (*Helianthus annus*)

Sunflower is one of the most important oilseed crop grown in an area of 3.56 lakh ha in the State in all the districts. The crop requirements for growing sunflower (Table 7.8) 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 about 52 ha (9%) is highly suitable (Class S1) for growing sunflower and are distributed in the northern and eastern part of the microwatershed. An area of about 14 ha (2%) is moderately suitable (Class S2) and are distributed in the northern part of the microwatershed. They have minor limitation of calcareousness. Marginally suitable (Class S3) lands occupy an area of about 98 ha (18%) and are distributed in the major part of the microwatershed with moderate limitations of rooting depth and gravelliness.

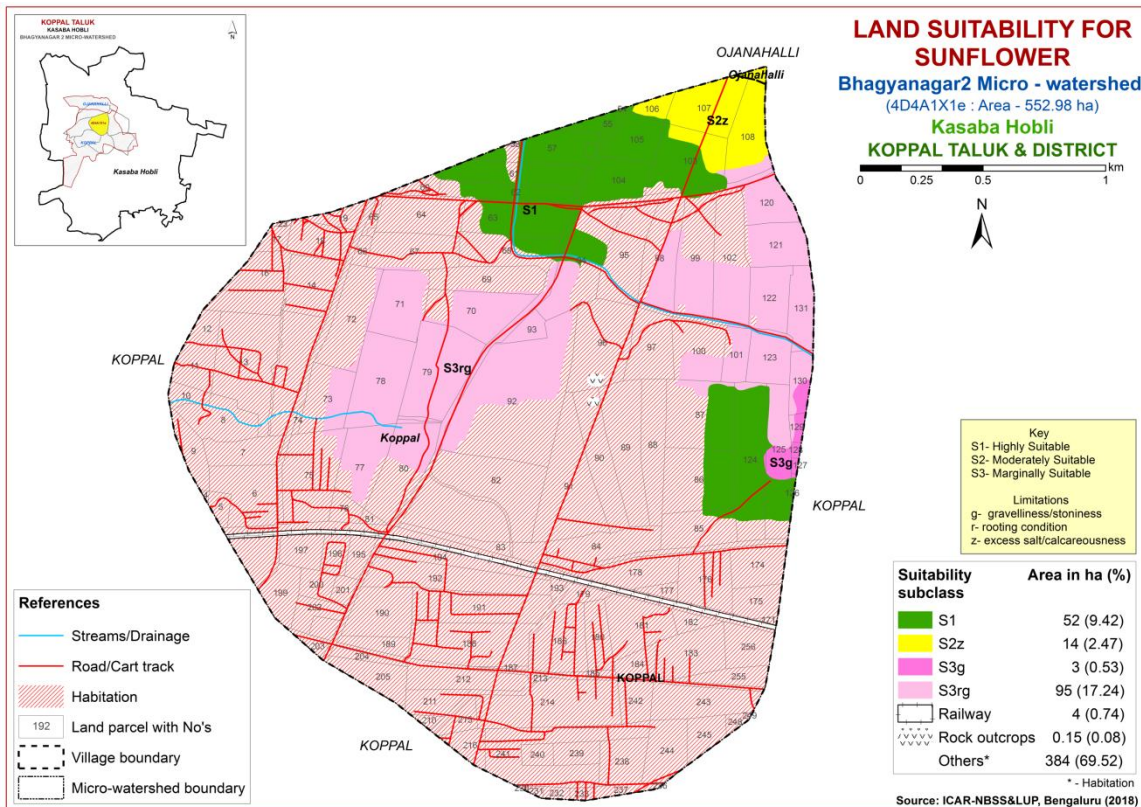


Fig. 7.7 Land Suitability map of Sunflower

7.8 Land Suitability for Cotton (*Gossypium hirsutum*)

Cotton is one of the most important fibre crop grown in the State in about 8.75 lakh ha area in Raichur, Dharwad, Belgaum, Gulbarga, 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.

An area of about 52 ha (9%) is highly suitable (Class S1) for growing cotton and are distributed in the northern and eastern part of the microwatershed. An area of about 14 ha (2%) is moderately suitable (Class S2) and are distributed in the northern part of the microwatershed. They have minor limitations of texture and calcareousness. Marginally suitable (Class S3) lands occupy an area of about 98 ha (18%) and are distributed in the major part of the microwatershed with moderate limitations of rooting depth and gravelliness.

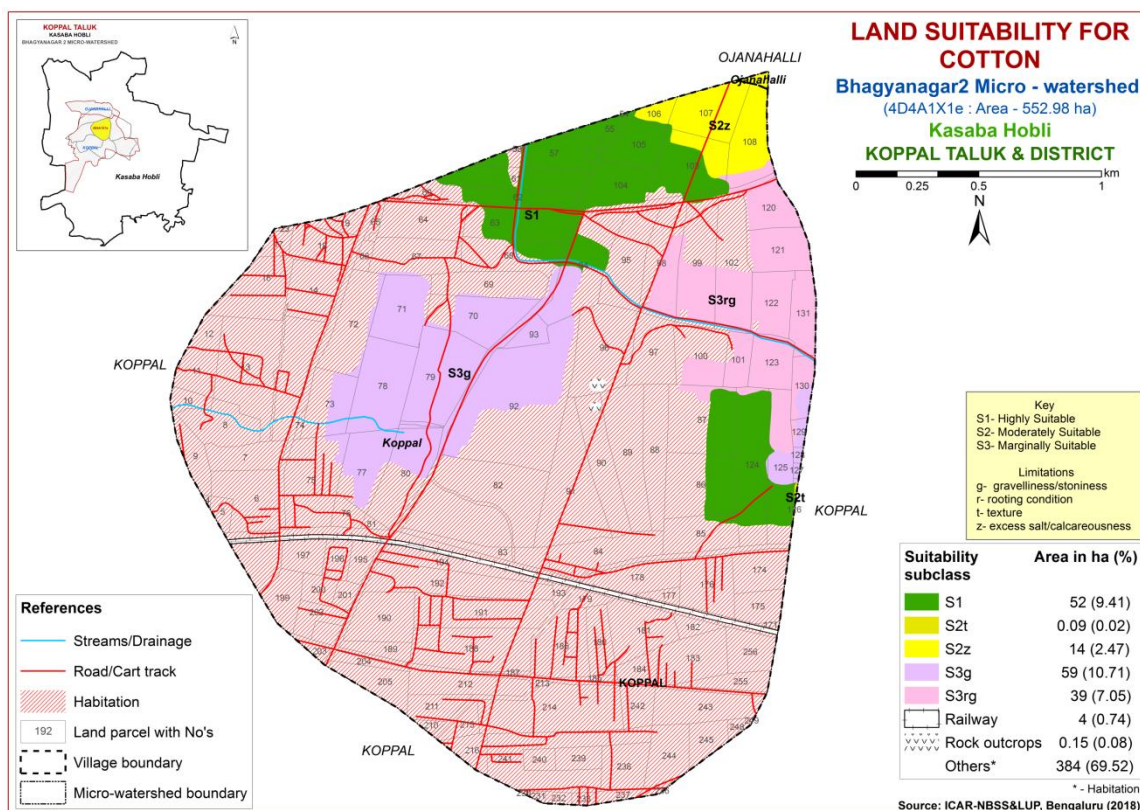


Fig. 7.8 Land Suitability map of Cotton

7.9 Land Suitability for Chilli (*Capsicum annum L*)

Chilli is one of the most important spice crop grown in an area of 0.42 lakh ha in Karnataka State. The crop requirements for growing chilli (Table 7.10) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map for growing chilli was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.9.

An area of about 37 ha (7%) is highly suitable (Class S1) for growing chilli and are distributed in the northern part of the microwatershed. Marginally suitable (Class S3) lands cover an area of about 129 ha (23%) and distributed in the major part of the microwatershed. They have moderate limitations of gravelliness, texture, rooting depth and calcareousness.

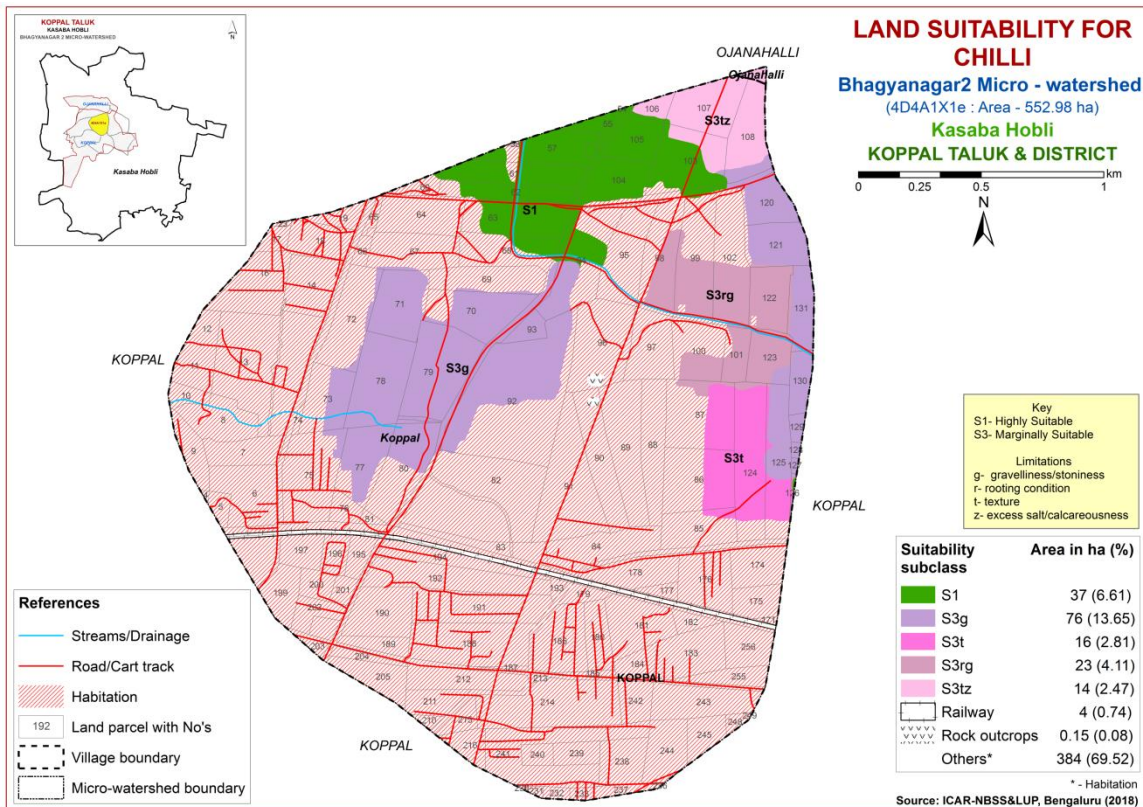


Fig. 7.9 Land Suitability map of Chilli

7.10 Land Suitability for Tomato (*Solanum lycopersicum*)

Tomato is one of the most important vegetable crop grown in an area of 0.65 lakh ha in almost all the districts of the State. The crop requirements (Table 7.11) for growing tomato were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing tomato was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.10.

An area of about 37 ha (7%) is highly suitable (Class S1) for growing tomato and are distributed in the northern part of the microwatershed. Marginally suitable (Class S3) lands cover a maximum area of about 129 ha (23%) and distributed in the major part of the microwatershed. They have moderate limitations of gravelliness, rooting depth, texture and calcareousness.

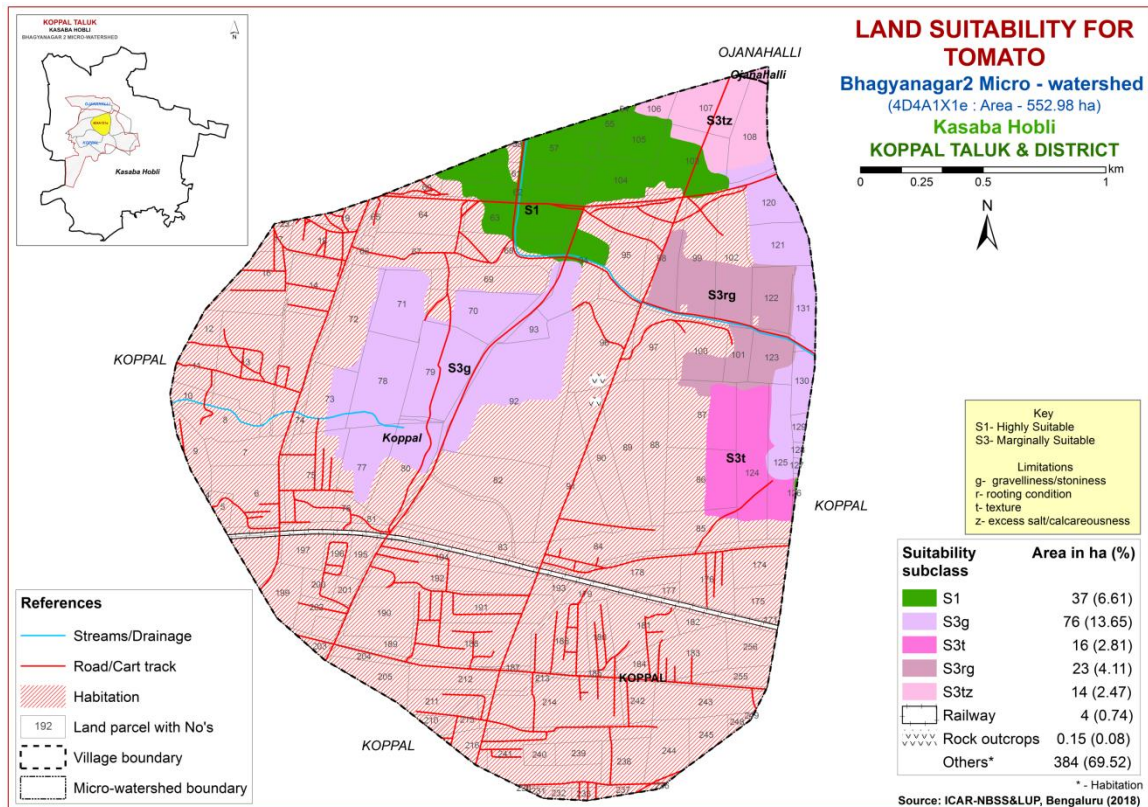


Fig. 7.10 Land Suitability map of Tomato

7.11 Land Suitability for Brinjal (*Solanum melongena*)

Brinjal is one of the most important vegetable crop grown in the state. The crop requirements for growing brinjal (Table 7.12) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing brinjal was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.11.

Maximum area of about 92 ha (17%) is moderately suitable (Class S2) for growing Brinjal and distributed in the major part of the microwatershed with minor limitations of texture, rooting depth, calcareousness and gravelliness. Marginally suitable (Class S3) lands cover an area of about 73 ha (13%) and occur in the northeastern and central part of the microwatershed with moderate limitation of gravelliness.

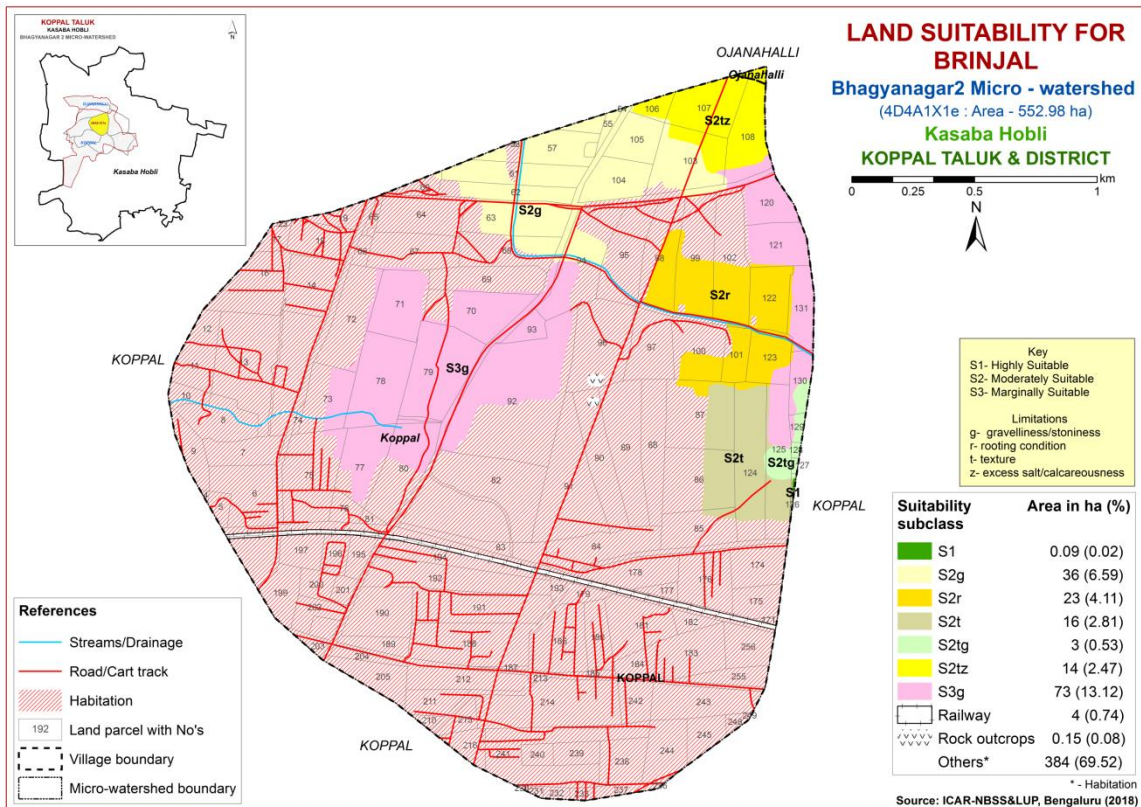


Fig 7.11 Land Suitability map of Brinjal

7.12 Land Suitability for Onion (*Allium cepa L.*)

Onion is one of the most important vegetable crop grown in the state. The crop requirements for growing onion (Table 7.13) 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 7.12.

An area of about 62 ha (11%) is moderately suitable (Class S2) for growing Onion and distributed in the northern part of the microwatershed with minor limitations of texture, rooting depth and gravelliness. Marginally suitable (Class S3) lands cover a maximum area of about 103 ha (18%) and occur in the major part of the microwatershed with moderate limitations of texture, gravelliness and calcareousness.

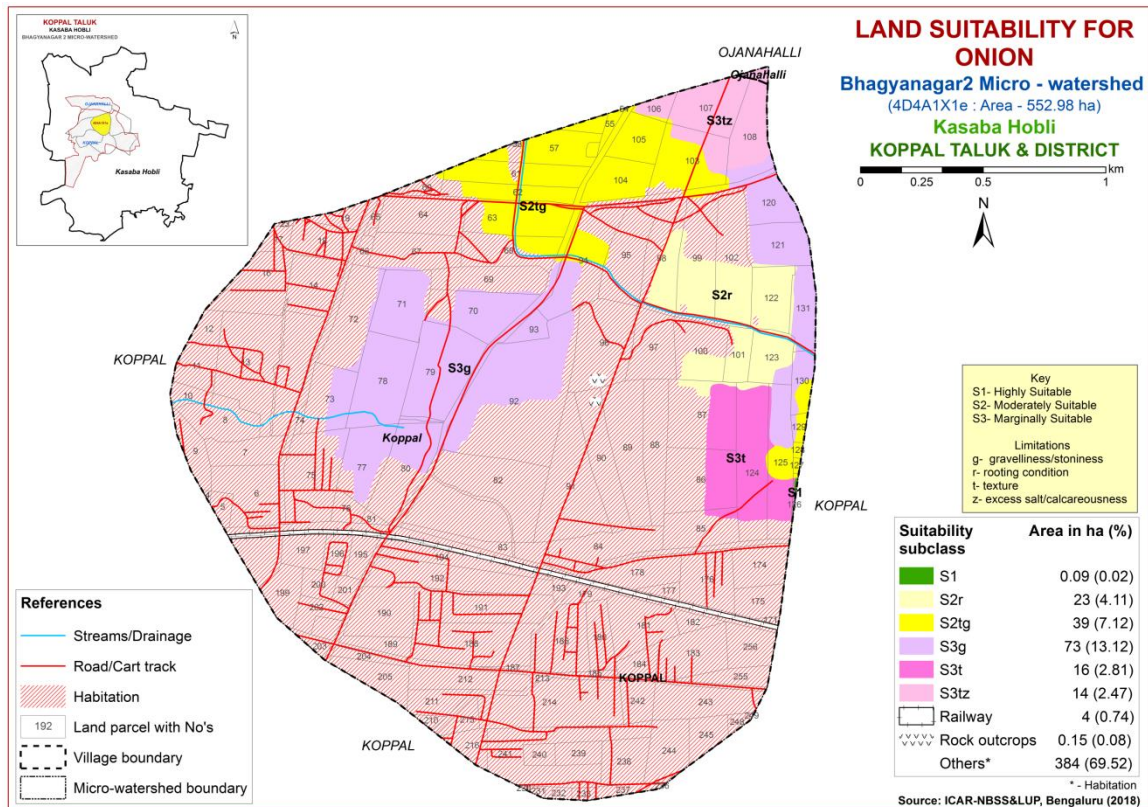


Fig 7.12 Land Suitability map of Onion

7.13 Land Suitability for Bhendi (*Abelmoschus esculentus*)

Bhendi is one of the most important vegetable crop grown in the state. The crop requirements for growing bhendi (Table 7.14) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing bhendi was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.13.

Moderately suitable (Class S1) lands occupy a maximum area of about 92 ha (17%) for growing Bhendi and occur in the major part of the microwatershed with minor limitations of rooting depth, texture, gravelliness and calcareousness. An area of 73 ha (13%) is moderately suitable (Class S2) for growing Bhendi and distributed in the central and eastern part of the microwatershed with minor limitation of gravelliness.

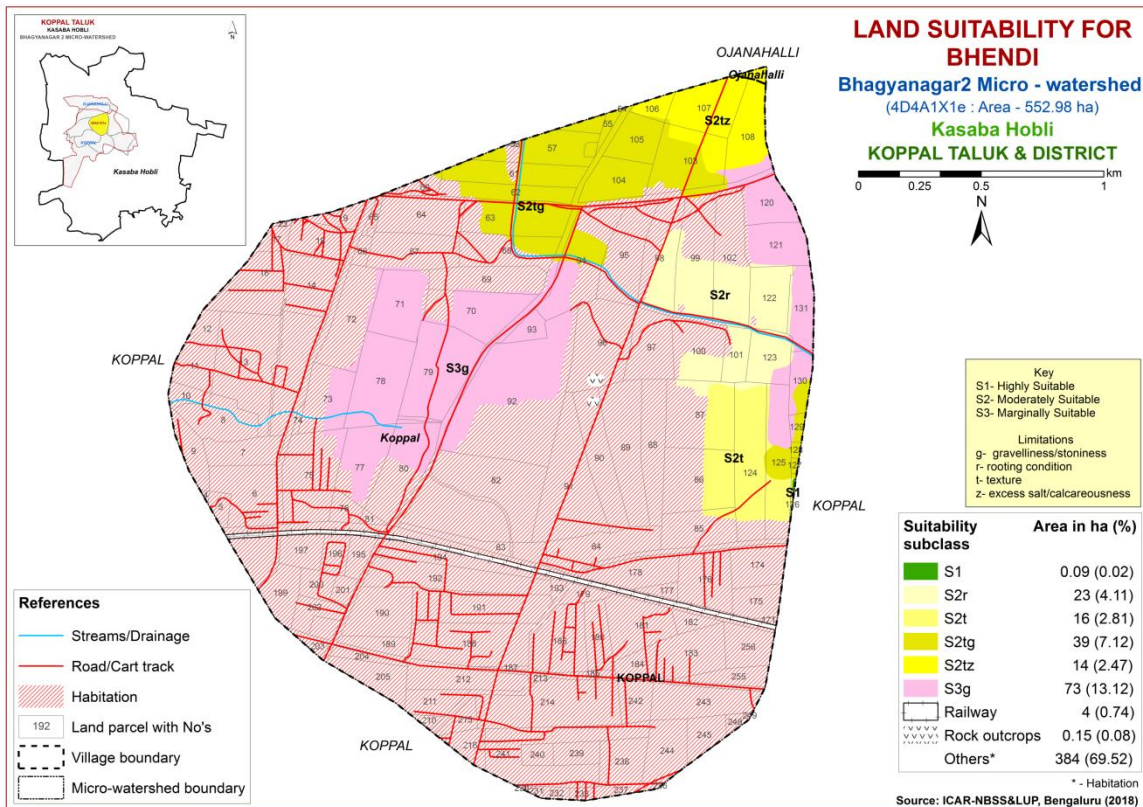


Fig 7.13 Land Suitability map of Bhendi

7.14 Land Suitability for Drumstick (*Moringa oleifera*)

Drumstick is one of the most important vegetable crop grown in 2403 ha area in the state. The crop requirements for growing drumstick (Table 7.15) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing drumstick was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.14.

An area of about 37 ha (7%) is highly suitable (Class S1) for growing drumstick and are distributed in the northern part of the microwatershed. Moderately suitable (Class S2) lands cover an area of about 30 ha (5%) and are distributed in the northern and eastern part of the microwatershed. They have minor limitations of texture and calcareousness. Marginally suitable (Class S3) lands cover an area of about 98 ha (18%) and occur in the major part of the microwatershed. They have moderate limitations of gravelliness, calcareousness and rooting depth.

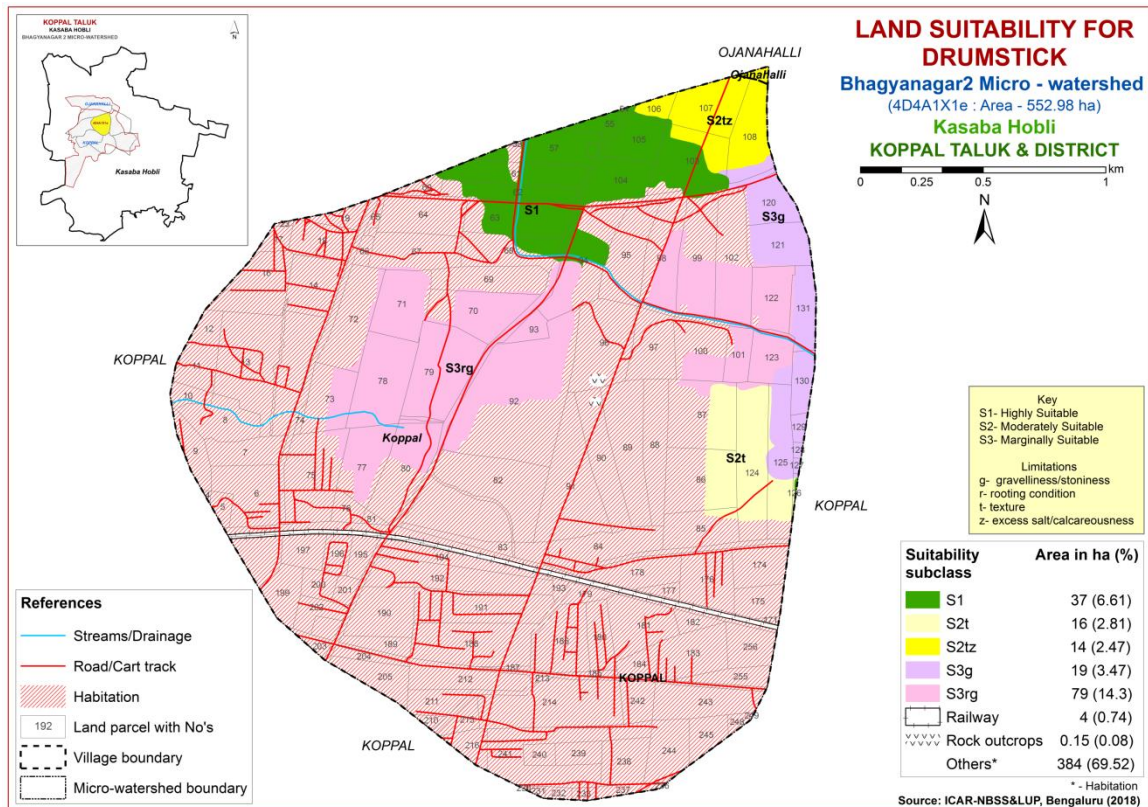


Fig. 7.14 Land Suitability map of Drumstick

7.15 Land Suitability for Mulberry (*Morus nigra*)

Mulberry is the most important leaf crop grown for rearing silkworms in about 1.66 lakh ha in all the districts of the state. The crop requirements for growing mulberry (Table 7.16) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing mulberry was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.15.

An area of about 37 ha (7%) is highly suitable (Class S1) for growing mulberry and are distributed in the northern part of the microwatershed. An area of about 49 ha (9%) is moderately suitable (Class S2) for growing mulberry and distributed in the northern and eastern part of the microwatershed. They have minor limitations of texture, gravelliness and calcareousness. Marginally suitable (Class S3) lands cover an area of about 79 ha (14%) and occur in the major part of the microwatershed. They have moderate limitations of rooting depth and gravelliness.

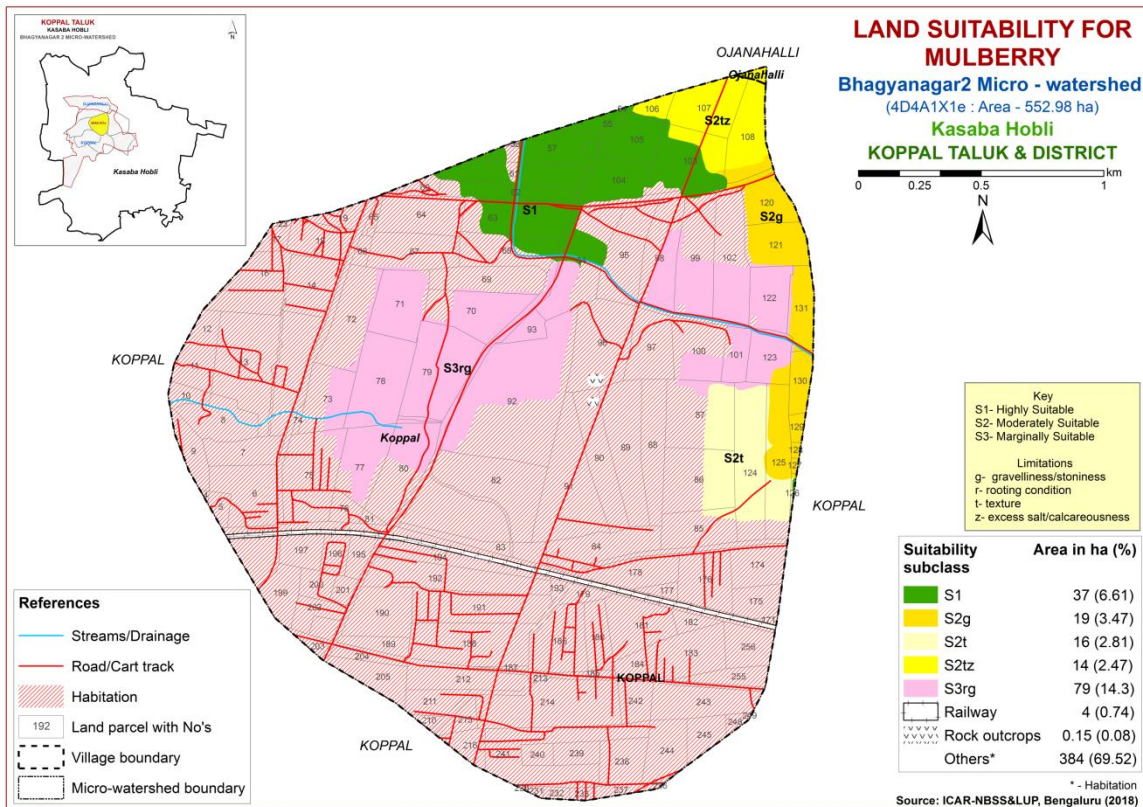


Fig. 7.15 Land Suitability map of Mulberry

7.16 Land Suitability for Mango (*Mangifera indica*)

Mango is one of the most important fruit crop grown in about 1.73 lakh ha in almost all the districts of the State. The crop requirements (Table 7.17) for growing mango were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing mango was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.16.

An area of about 36 ha (7%) is highly suitable (Class S1) for growing mango and are distributed in the northern part of the microwatershed. Marginally suitable (Class S3) lands cover an area of about 49 ha (9%) and occur in the eastern part of the microwatershed. They have moderate limitations of rooting depth, gravelliness, texture and calcareousness. Area currently not suitable (Class N1) for growing mango cover about 79 ha (14%) and distributed in the major part of the microwatershed with severe limitations of rooting depth and gravelliness.

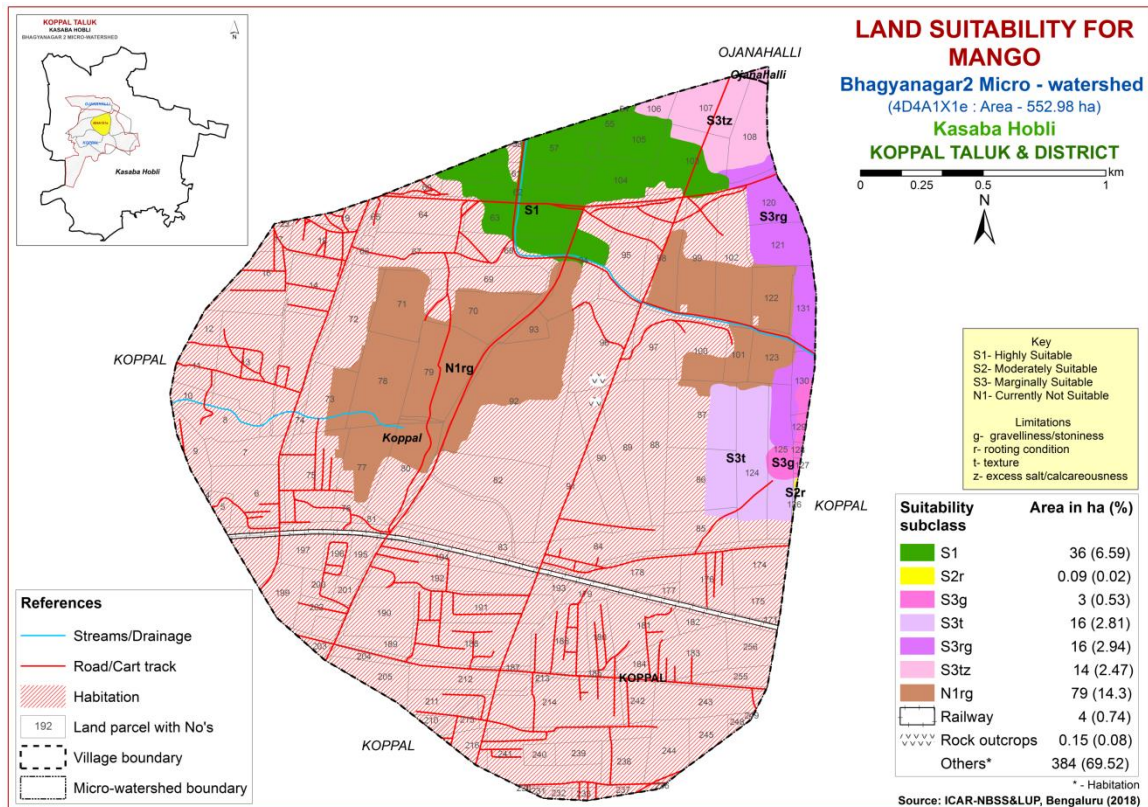


Fig. 7.16 Land Suitability map of Mango

7.17 Land Suitability for Sapota (*Manilkara zapota*)

Sapota is one of the most important fruit crop grown in an area of about 29373 ha in almost all the districts of the state. The crop requirements (Table 7.18) for growing sapota were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing sapota was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.17.

An area of about 37 ha (7%) is highly suitable (Class S1) for growing sapota and are distributed in the northern part of the microwatershed. Moderately suitable (S2) lands cover an area of about 16 ha (3%) and are distributed in the northeastern part of the microwatershed. They have minor limitations of rooting depth and gravelliness. Marginally suitable (Class S3) lands cover a maximum area of about 112 ha (20%) and occur in the major part of the microwatershed. They have moderate limitations of rooting depth, calcareousness, gravelliness and texture.

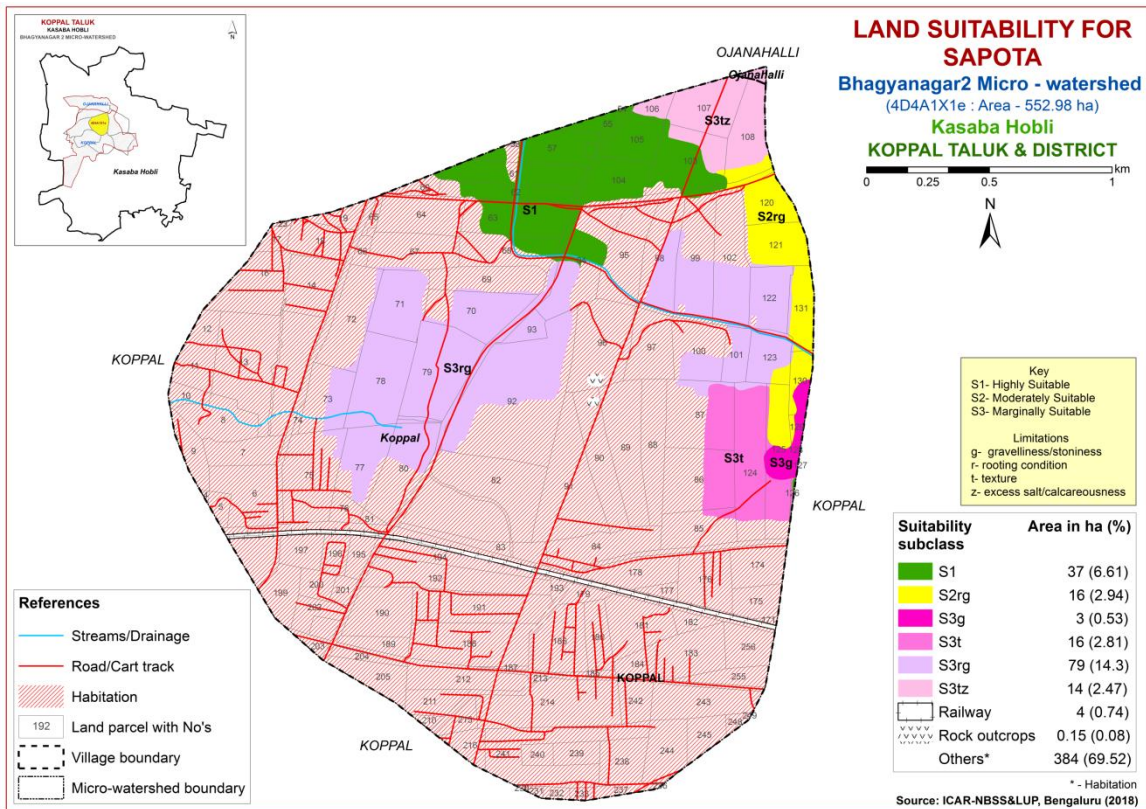


Fig. 7.17 Land Suitability map of Sapota

7.18 Land Suitability for Pomegranate (*Punica granatum*)

Pomegranate is one of the commercially grown fruit crop in about 18488 ha in Karnataka mainly in Bijapur, Bagalkot, Koppal, Gadag and Chitradurga districts. The crop requirements for growing pomegranate (Table 7.19) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map for growing pomegranate was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.18.

An area of about 37 ha (7%) is highly suitable (Class S1) for growing pomegranate and are distributed in the northern part of the microwatershed. Moderately suitable (Class S2) lands occupy an area of about 46 ha (8%) and are distributed in the northern and eastern part of the microwatershed. They have minor limitations of rooting depth, gravelliness, calcareousness and texture. Marginally suitable (Class S3) lands for growing pomegranate occupy an area of about 82 ha (15%) and are distributed in the major part of the microwatershed with moderate limitations of gravelliness and rooting depth.

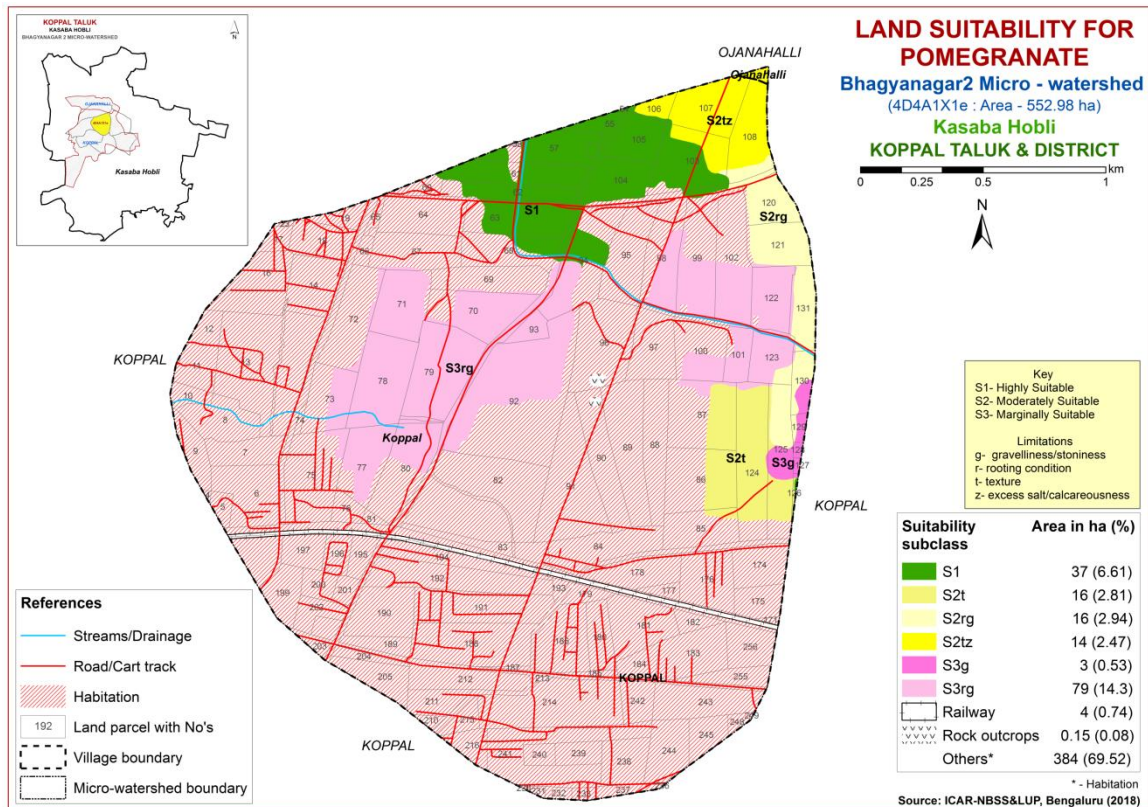


Fig. 7.18 Land Suitability map of Pomegranate

7.19 Land Suitability for Guava (*Psidium guajava*)

Guava is one of the most important fruit crop grown in an area of about 6558 ha in almost all the districts of the state. The crop requirements (Table 7.20) for growing guava were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing guava was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.19.

Moderately suitable (Class S2) lands occupy an area of about 52 ha (10 %) and are distributed in the northern and northeastern part of the microwatershed. They have minor limitations of rooting depth, gravelliness and texture. Marginally suitable (Class S3) lands for growing guava occupy a maximum area of about 112 ha (20%) and are distributed in the major part of the microwatershed with moderate limitations of calcareousness, gravelliness, rooting depth and texture.

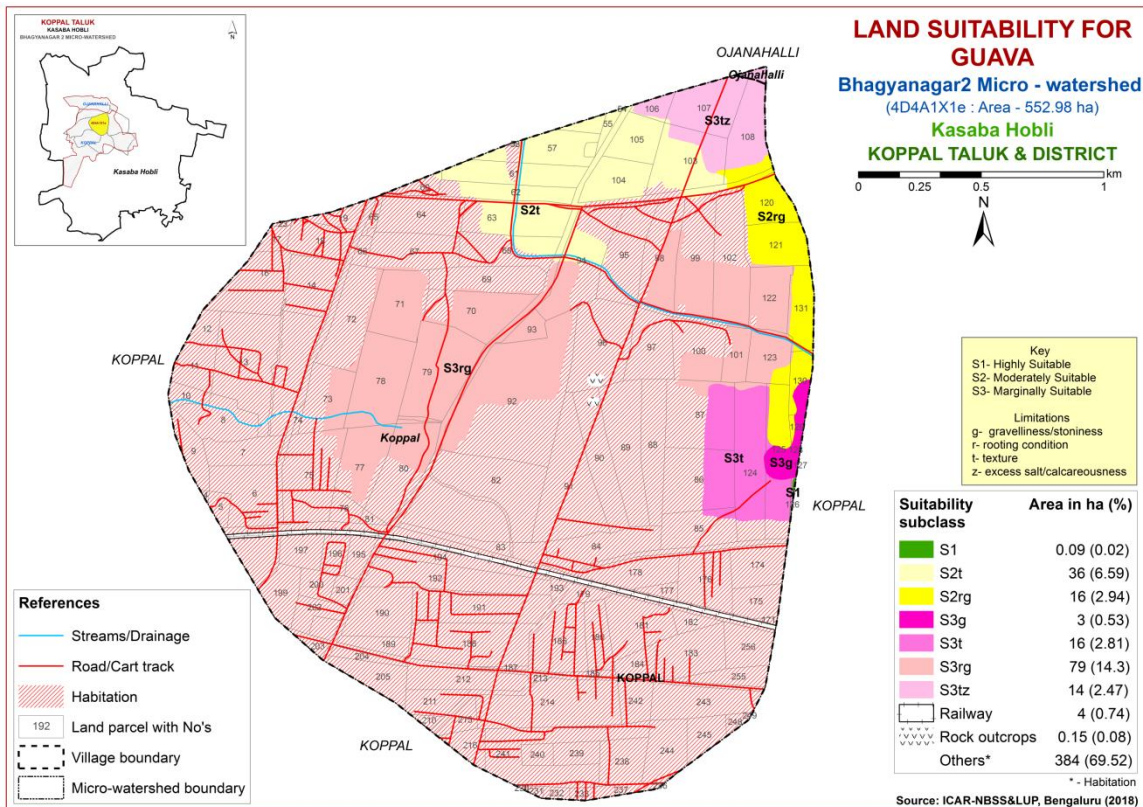


Fig. 7.19 Land Suitability map of Guava

7.20 Land Suitability for Jackfruit (*Artocarpus heterophyllus*)

Jackfruit is one of the most important fruit crop grown in 5368 ha in all the districts of the state. The crop requirements (Table.7.21) for growing jackfruit were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing jackfruit was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in figure 7.20.

An area of about 37 ha (7%) is highly suitable (Class S1) for growing jackfruit and are distributed in the northern part of the microwatershed. Moderately suitable (Class S2) lands cover an area of about 16 ha (3%) and are distributed in the eastern part of the microwatershed. They have minor limitations of rooting depth and gravelliness. Marginally suitable (Class S3) lands cover a maximum area of about 112 ha (20%) and occur in the major part of the microwatershed. They have moderate limitations of calcareousness, rooting depth, gravelliness and texture.

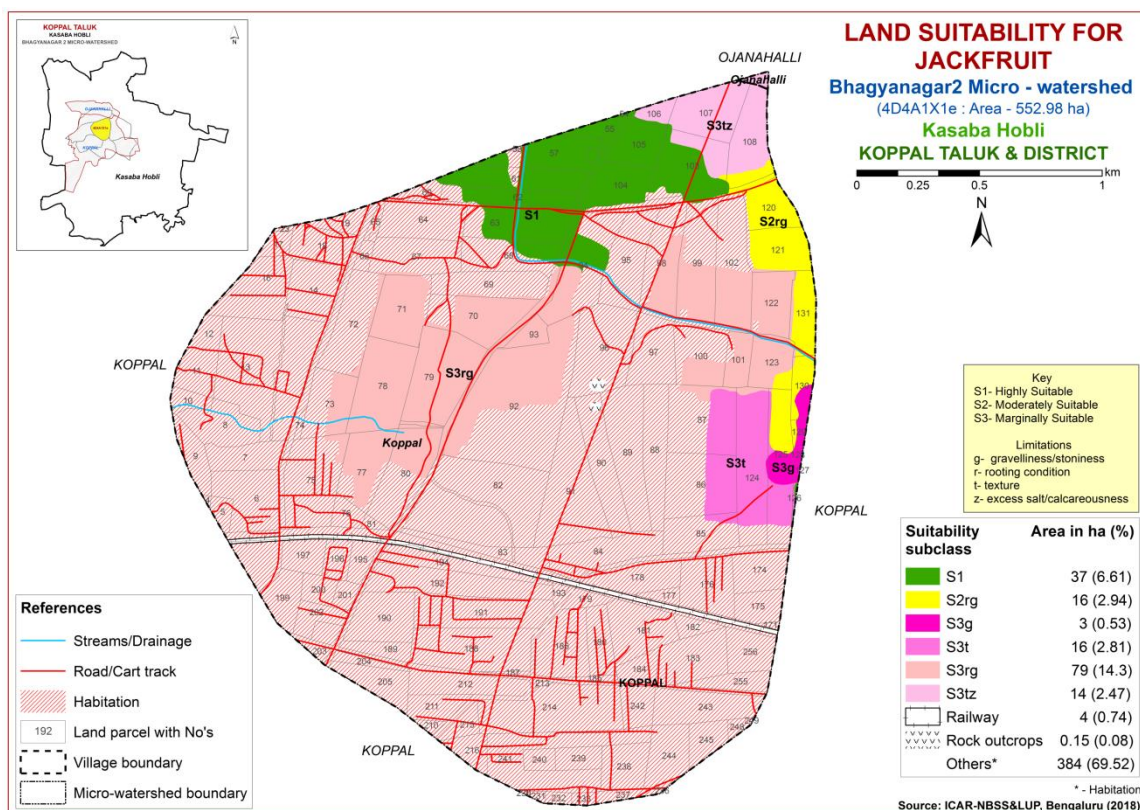


Fig. 7.20 Land Suitability map of Jackfruit

7.21 Land Suitability for Jamun (*Syzygium cumini*)

Jamun is an important fruit crop grown in almost all the districts of the state. The crop requirements (Table 7.22) for growing jamun were matched with the soil-site characteristics and a land suitability map for growing jamun was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.21.

An area of about 36 ha (7%) is highly suitable (Class S1) for growing jamun and are distributed in the northern part of the microwatershed. Moderately suitable (Class S2) lands occupy an area of about 46 ha (8%) and distributed in the northern and eastern part of the microwatershed. They have minor limitations of rooting depth, texture, calcareousness and gravelliness. Marginally suitable (Class S3) lands cover a maximum area of about 82 ha (15%) and are distributed in the major part of the microwatershed with moderate limitations of rooting depth and gravelliness.

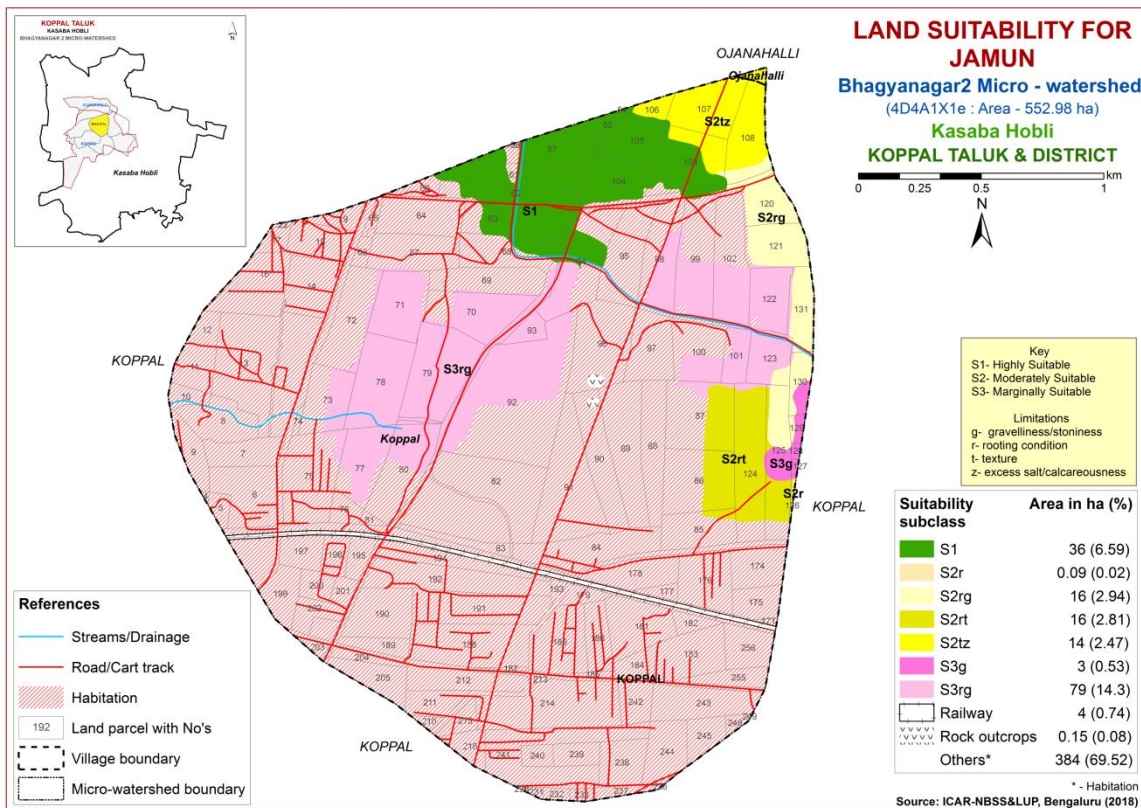


Fig. 7.21 Land Suitability map of Jamun

7.22 Land Suitability for Musambi (*Citrus limetta*)

Musambi is one of the most important fruit crop grown in an area of 5446 ha in almost all the districts of the state. The crop requirements (Table 7.23) for growing musambi were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing musambi was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.22.

An area of about 52 ha (9%) is highly suitable (Class S1) for growing musambi and are distributed in the northern and eastern part of the microwatershed. An area of about 30 ha (5%) is moderately suitable (Class S2) and occur in the northern and eastern part of the microwatershed. They have minor limitations of calcareousness, gravelliness and rooting depth. An area of about 82 ha (15%) is marginally suitable (Class S3) for growing musambi and are distributed in major part of the microwatershed with moderate limitations of calcareousness, gravelliness and rooting depth.

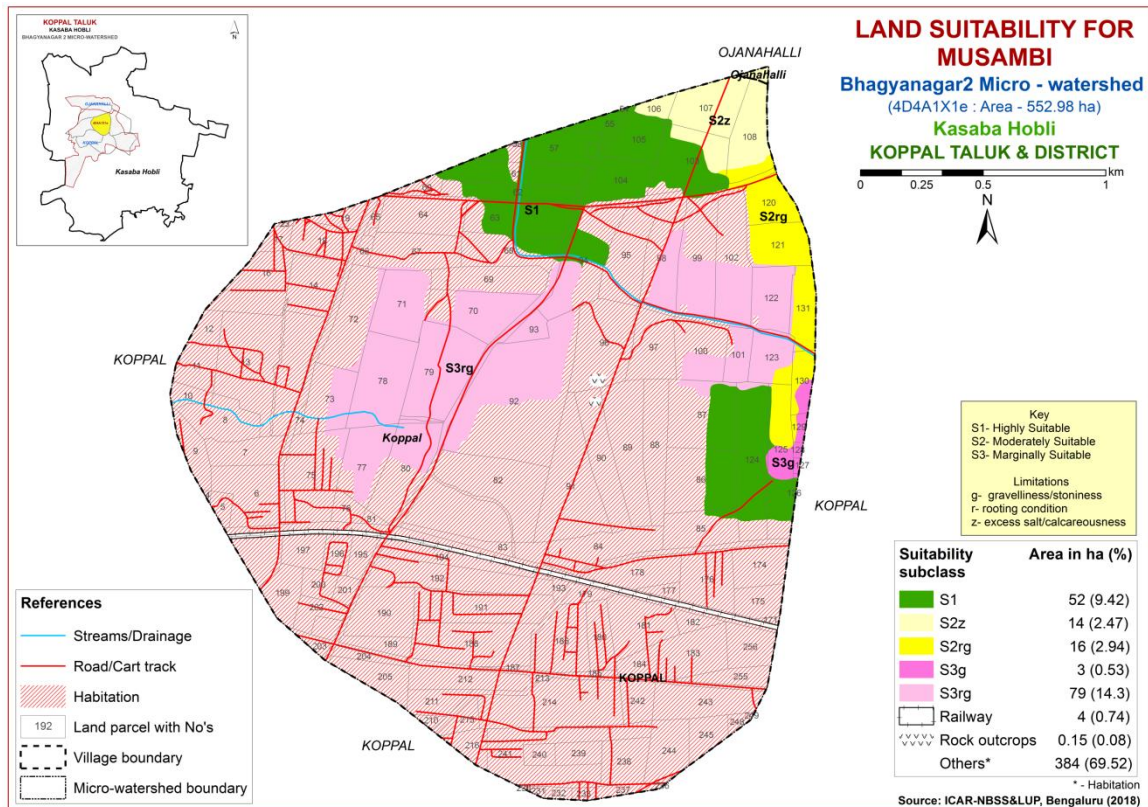


Fig. 7.22 Land Suitability map of Musambi

7.23 Land Suitability for Lime (*Citrus sp*)

Lime is one of the most important fruit crop grown in an area of 11752 ha in almost all the districts of the State. The crop requirements for growing lime (Table 7.24) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing lime was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.23.

An area of about 52 ha (9%) is highly suitable (Class S1) for growing lime and are distributed in the northern and eastern part of the microwatershed. An area of about 30 ha (5%) is moderately suitable (Class S2) and occur in the northern and eastern part of the microwatershed. They have minor limitations of calcareousness, gravelliness and rooting depth. Maximum area of about 82 ha (15%) is marginally suitable (Class S3) for growing lime and are distributed in the major part of the microwatershed with moderate limitations of gravelliness and rooting depth.

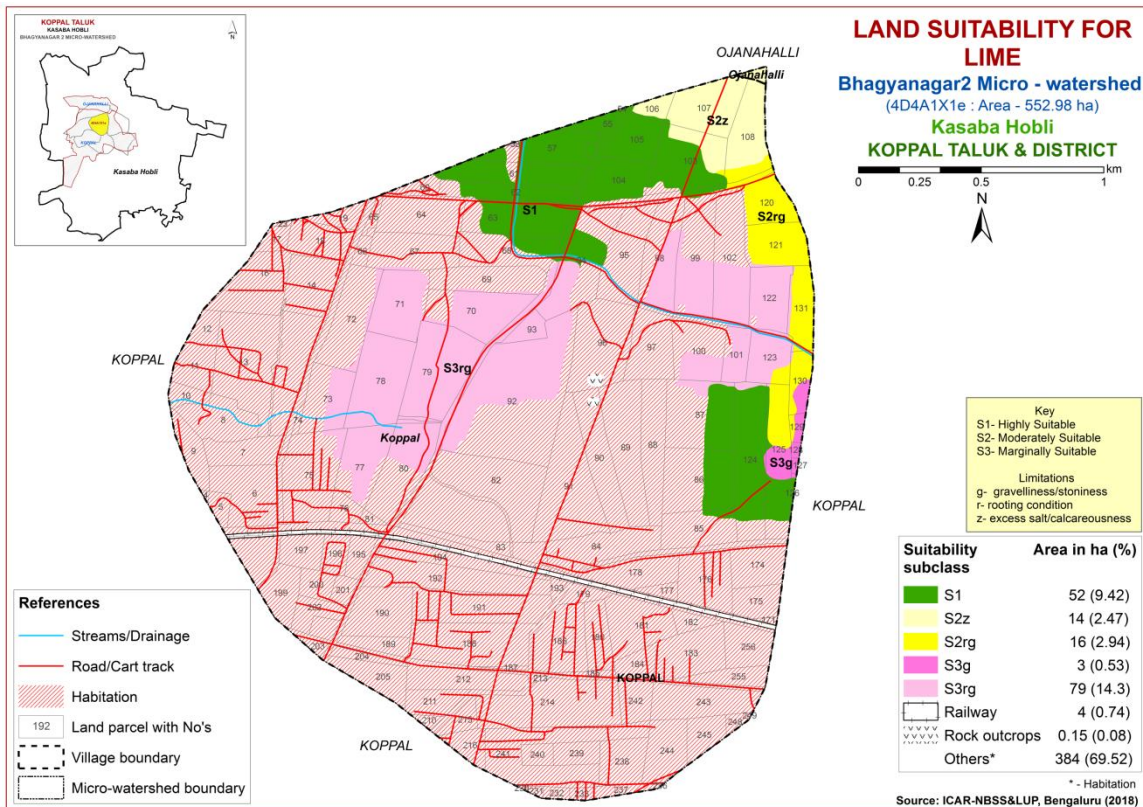


Fig. 7.23 Land Suitability map of Lime

7.24 Land Suitability for Cashew (*Anacardium occidentale*)

Cashew is one of the most important nut crop grown in an area of 7052 ha in almost all the districts of the State. The crop requirements for growing cashew (Table 7.25) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing cashew was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.24.

An area of about 55 ha (10 %) is moderately suitable (Class S2) and occur in the northern and eastern part of the microwatershed. They have minor limitations of gravelliness, texture and rooting depth. An area of about 79 ha (14%) is marginally suitable (Class S3) for growing cashew and are distributed in the major part of the microwatershed with moderate limitations of gravelliness and rooting depth. An area of about 30 ha (5%) is currently not suitable (Class N1) for growing cashew and distributed in the northern and eastern part of the microwatershed with severe limitations of texture and calcareousness.

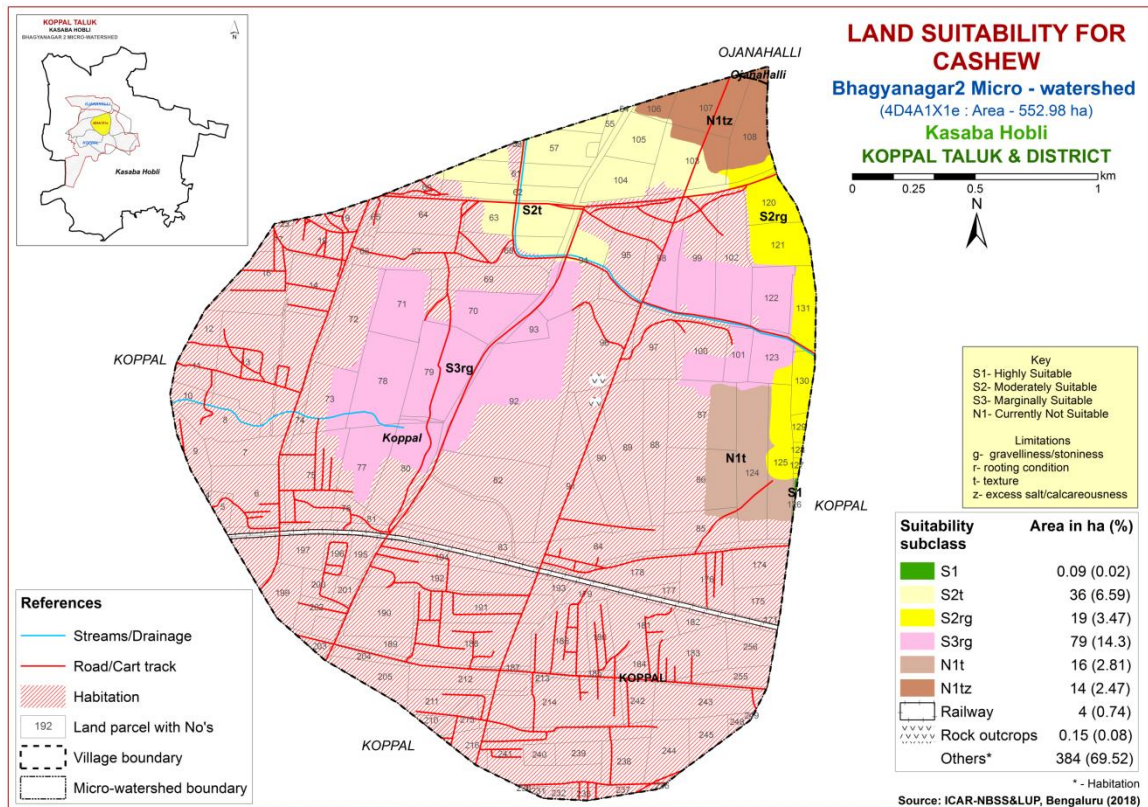


Fig. 7.24 Land Suitability map of Cashew

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

Custard apple is one of the most important fruit crop grown in 1426 ha in almost all the districts of the State. The crop requirements(Table 7.26) for growing custard apple were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing custard apple was generated .The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.25.

An area of about 52 ha (9%) is highly suitable (Class S1) for growing custard apple and are distributed in the northern and eastern part of the microwatershed. Moderately suitable (Class S2) lands cover an area of about 112 ha (20%) and occur in the major part of the microwatershed. They have minor limitations of rooting depth, calcareousness and gravelliness.

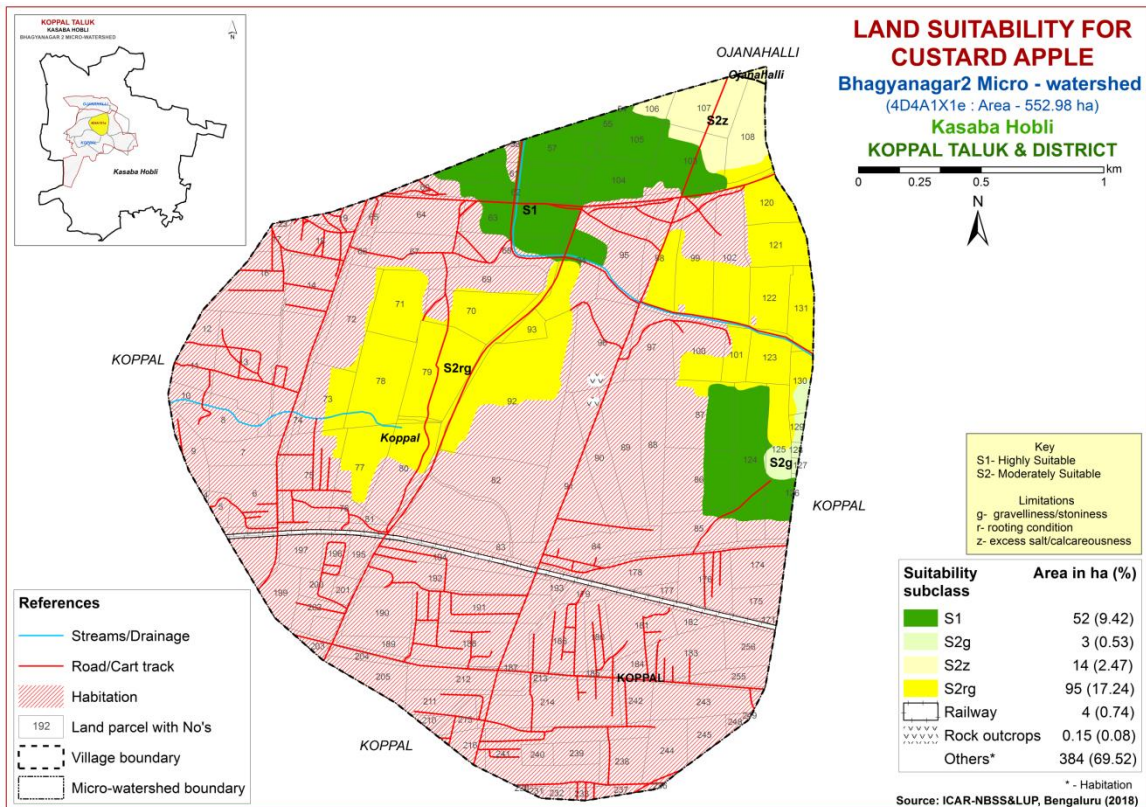


Fig. 7.25 Land Suitability map of Custard Apple

7.26 Land Suitability for Amla (*Phyllanthus emblica*)

Amla is one of the most important fruit and medicinal crop grown in an area of 151 ha and distributed in almost all the districts of the state. The crop requirements (Table 7.27) for growing amla were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing amla was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.26.

An area of about 37 ha (7%) is highly suitable (Class S1) for growing amla and are distributed in the northern part of the microwatershed. Moderately suitable (Class S2) lands cover a maximum area of about 128 ha (23%) and occur in the major part of the microwatershed. They have minor limitations of rooting depth, gravelliness, calcareousness and texture.

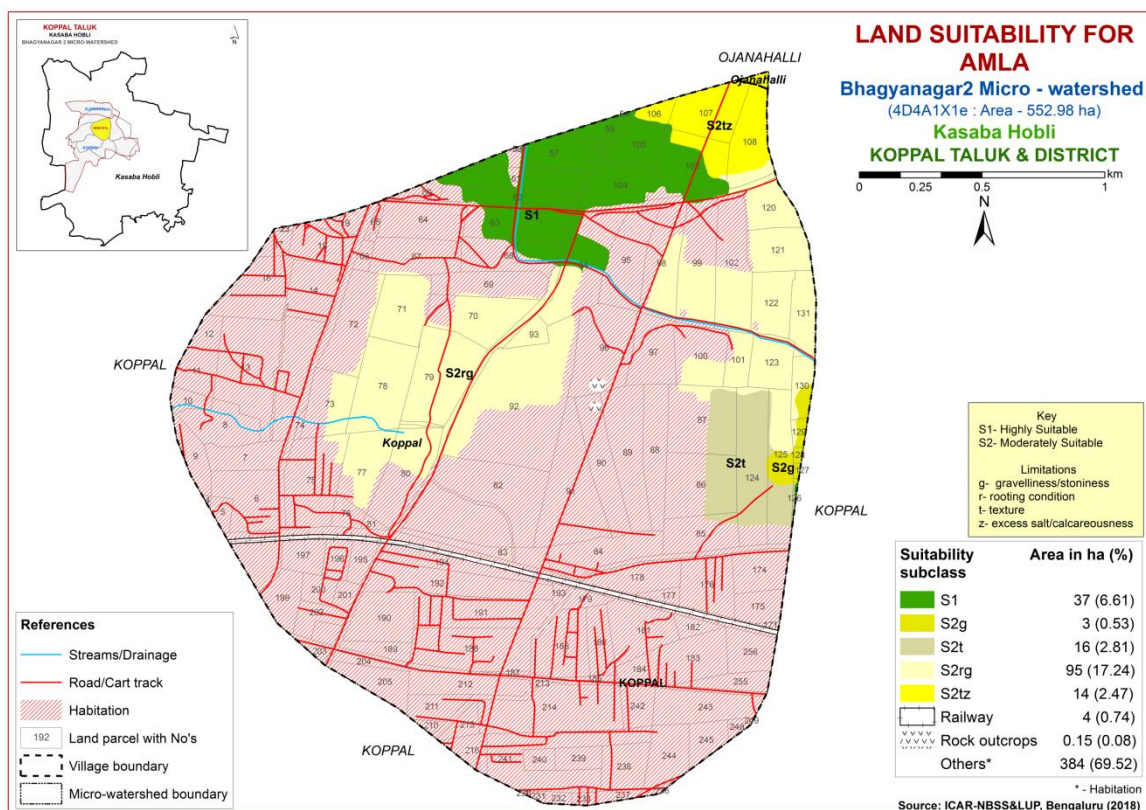


Fig. 7.26 Land Suitability map of Amla

7.27 Land Suitability for Tamarind (*Tamarindus indica*)

Tamarind is one of the most important spice crop grown in 14897 ha in all the districts of the state. The crop requirements (Table 7.28) for growing tamarind were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing tamarind was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.27.

An area of about 36 ha (7%) is highly suitable (Class S1) for growing tamarind and are distributed in the northern part of the microwatershed. An area of about 30 ha (5%) is moderately suitable (Class S2) and occur in the eastern and northern part of the microwatershed. They have minor limitations of rooting depth, texture and calcareousness. An area of about 19 ha (3%) is marginally suitable (Class S3) for growing tamarind and are distributed in the eastern part of the microwatershed with moderate limitations of rooting depth and gravelliness. An area of about 79 ha (14%) is currently not suitable (Class N1) for growing tamarind and distributed in the major part of the microwatershed with severe limitations of rooting depth and gravelliness.

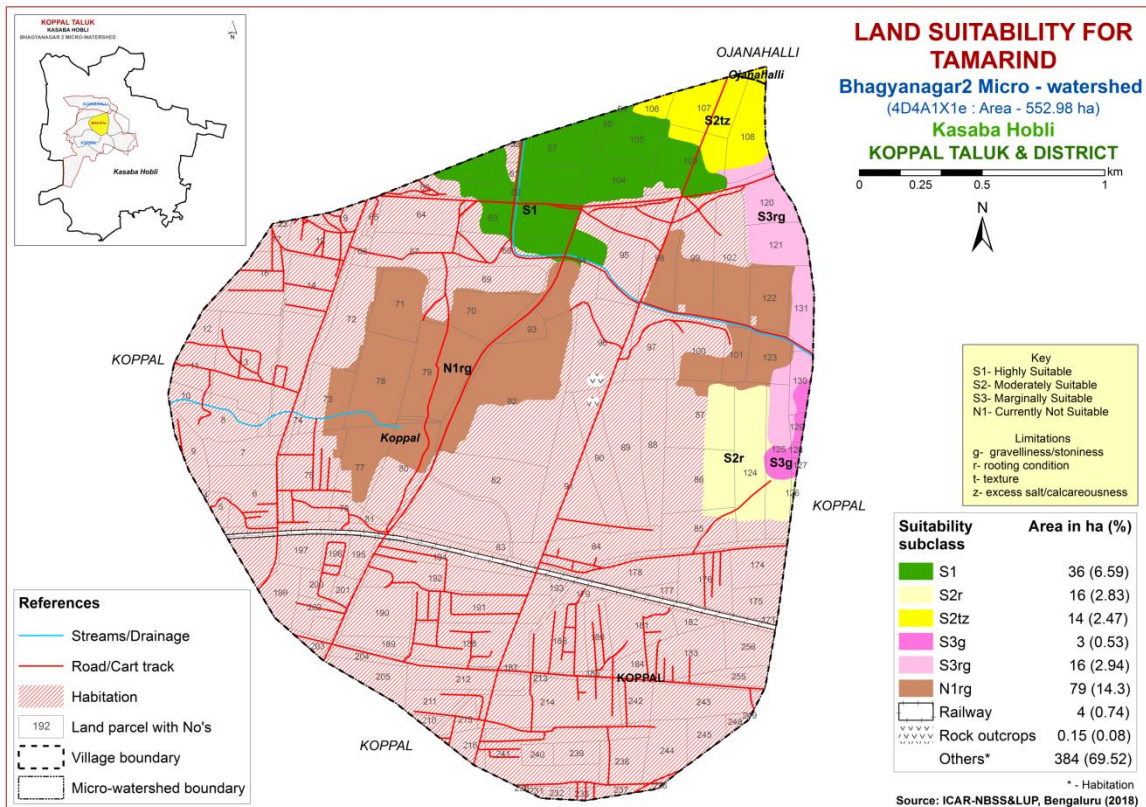


Fig. 7.27 Land Suitability map of Tamarind

7.28 Land Suitability for Marigold (*Tagetes erecta*)

Marigold is one of the most important flower crop grown in an area of 9108 ha in almost all the districts of the state. The crop requirements (Table 7.29) for growing marigold were matched with the soil-site characteristics and a land suitability map for growing marigold was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.28.

An area of about 37 ha (7%) is highly suitable (Class S1) for growing marigold and are distributed in the northern part of the microwatershed. An area of about 30 ha (5%) is moderately suitable (Class S2) and occur in the northern and eastern part of the microwatershed. They have minor limitations of calcareousness and texture. Maximum area of about 99 ha (18%) is marginally suitable (Class S3) for growing marigold and are distributed in the major part of the microwatershed with moderate limitations of graveliness and rooting depth.

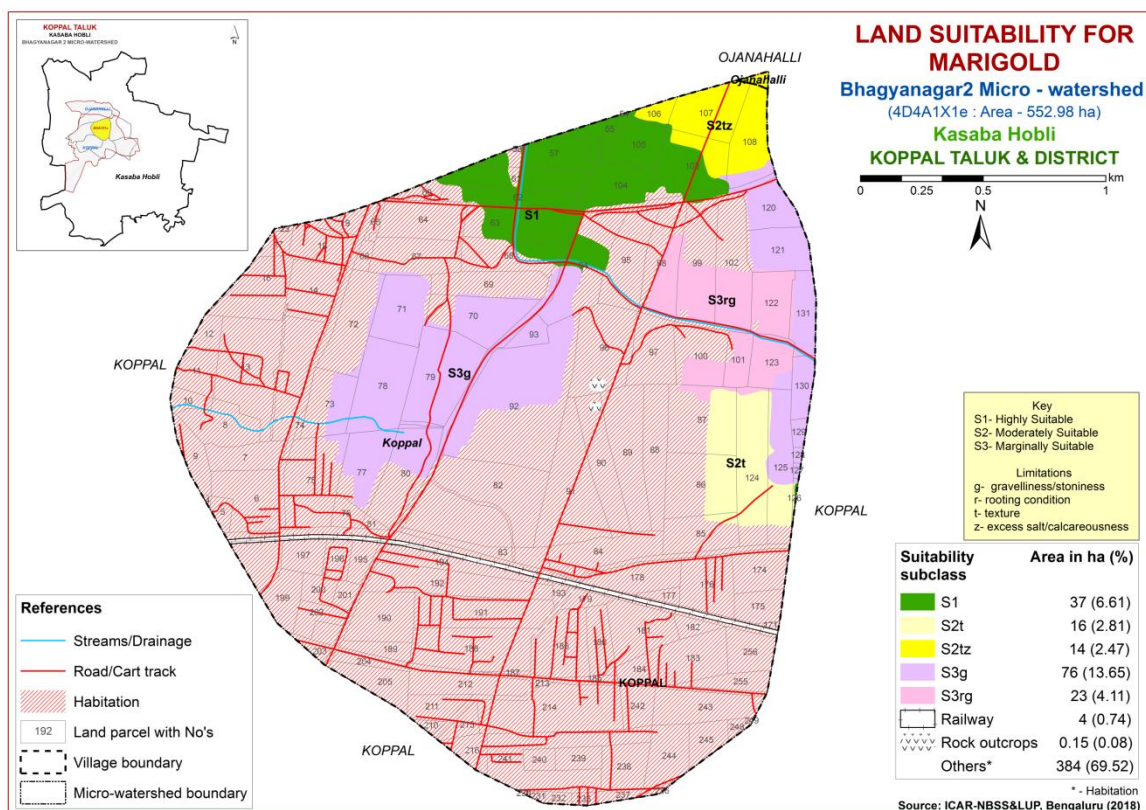


Fig. 7.28 Land Suitability map of Marigold

7.29 Land Suitability for Chrysanthemum (*Chrysanthemum indicum*)

Chrysanthemum is one of the most important flower crop grown in an area of 4978 ha in almost all the districts of the State. The crop requirements (Table 7.30) 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 geographic distribution of different suitability subclasses in the microwatershed is given in Figure 7.29.

An area of about 37 ha (7%) is highly suitable (Class S1) for growing chrysanthemum and distributed in the northern part of the microwatershed. An area of about 30 ha (5%) is moderately suitable (Class S2) and occur in the northern and eastern part of the microwatershed. They have minor limitations of texture and calcareousness. Maximum area of about 99 ha (18%) is marginally suitable (Class S3) for growing chrysanthemum and are distributed in the major part of the microwatershed with moderate limitations of gravelliness and rooting depth.

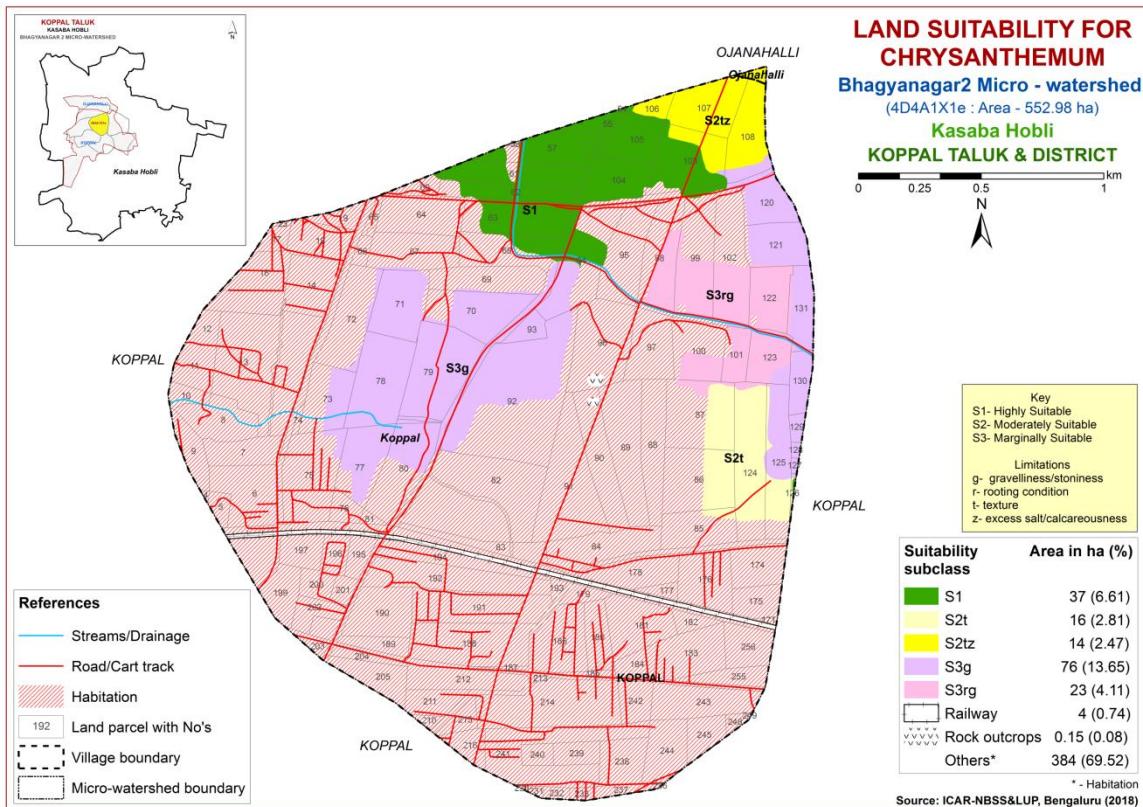


Fig. 7.29 Land Suitability map of Chrysanthemum

7. 30 Land Suitability for Jasmine (*Jasminum sp.*)

Jasmine is one of the most important flower crop grown in an area of 803 ha in almost all the districts of the State. The crop requirements (Table 7.31) for growing jasmine were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing jasmine was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.30.

An area of about 37 ha (7%) is highly suitable (Class S1) for growing jasmine and distributed in the northern part of the microwatershed. Maximum area of about 129 ha (23%) is marginally suitable (Class S3) for growing jasmine and are distributed in the major part of the microwatershed with moderate limitations of gravelliness, rooting depth, texture and calcareousness.

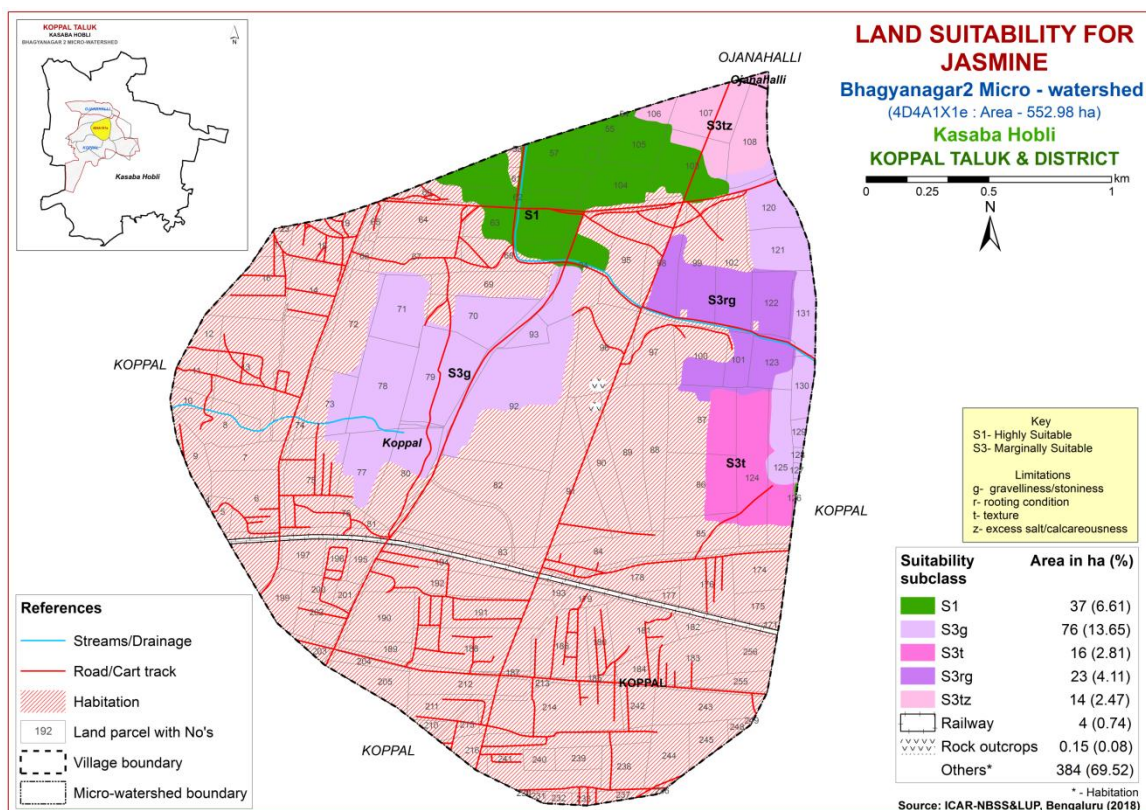


Fig. 7.30 Land Suitability map of Jasmine

7. 31 Land Suitability for Crossandra (*Crossandra infundibuliformis*)

Crossandra is one of the most important flower crop grown in almost all the districts of the State. The crop requirements (Table 7.32) for growing crossandra were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing crossandra was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.31.

An area of about 37 ha (7%) is highly suitable (Class S1) for growing crossandra and are distributed in the northern part of the microwatershed. Maximum area of about 129 ha (23%) is marginally suitable (Class S3) for growing crossandra and are distributed in the major part of the microwatershed with moderate limitations of gravelliness, rooting depth, calcareousness and texture.

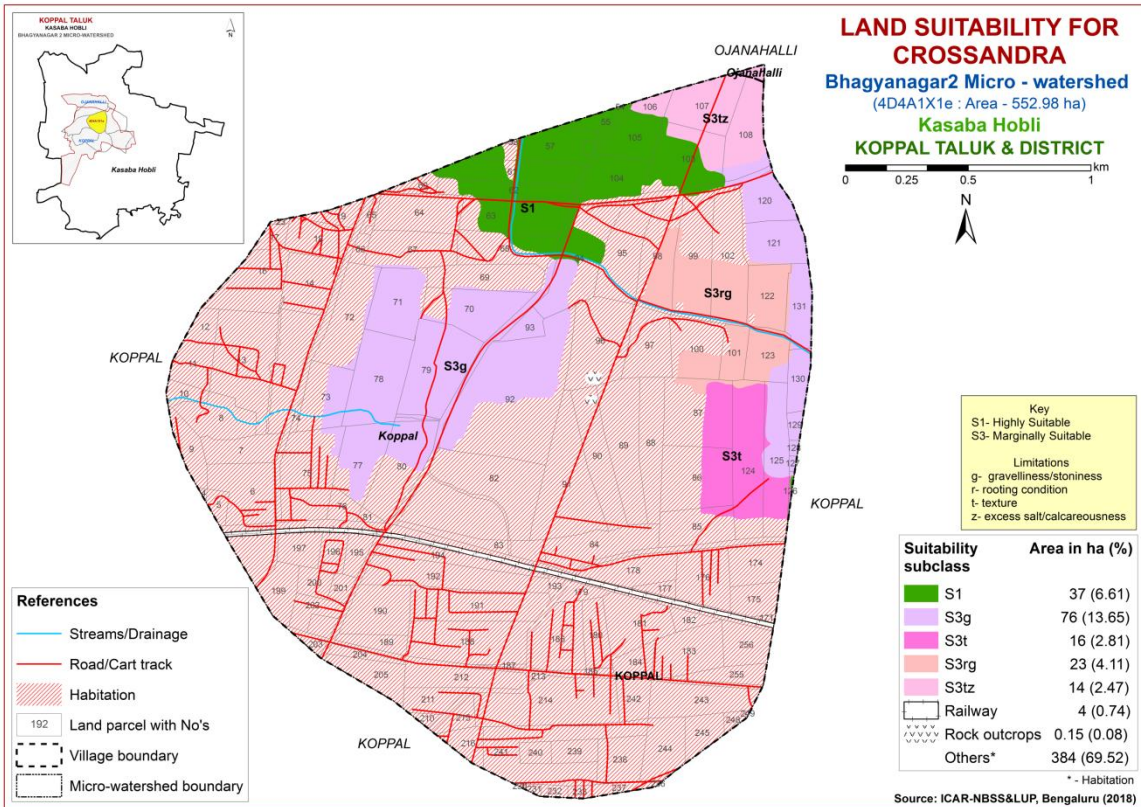


Fig. 7.31 Land Suitability map of Crossandra

Table 7.1 Soil-Site Characteristics of Bhagyanagar-2 Microwatershed

Soil Map Units	Climate (P) (mm)	Growing period (Days)	Drainage Class	Soil depth (cm)	Soil texture		Gravelliness		AWC (mm/m)	Slope (%)	Erosion	pH	EC (dSm ⁻¹)	ESP	CEC [Cmol (p ⁺)kg ⁻¹]	BS (%)
					Surf-ace	Sub-surface	Sur-face	Sub-surface								
LKRiB2	662	<90	WD	50-75	sc	gsc	-	40-60	51-100	1-3	moderate	8.18	0.30	4.51	12.19	100
KTPPhB2	662	<90	WD	50-75	scl	sc	-	15-35	101-150	1-3	moderate	6.42	0.07	0.05	4.41	100
HDHhB2	662	<90	WD	75-100	scl	gsc-gc	-	>35	51-100	1-3	moderate	6.54	0.07	7.11	5.84	84.7
HDHiB2	662	<90	WD	75-100	sc	gsc-gc	-	>35	51-100	1-3	moderate	6.54	0.07	7.11	5.84	84.7
BDGiB1	662	<90	WD	75-100	sc	gc	-	35-60	35-60	1-3	slight	6.24	0.06	0.35	3.76	52.56
KMHiB2	662	<90	WD	100-150	sc	sc	-	<15	151-200	1-3	moderate	7.2	0.19	0.54	15.07	100
GDPiB2	662	<90	WD	100-150	sc	gsc-gc	-	30-60	51-100	1-3	moderate	6.24	0.06	0.35	3.76	52.56
GRHmB2	662	<90	MWD	100-150	c	c	-	<15	>200	1-3	moderate	9.08	0.23	7.11	63.21	100
BGPmB1	662	<90	MWD	>150	c	c	-	<15	>200	1-3	slight	9.20	0.27	3.84	19.60	100

Table 7.2 Land suitability criteria for Sorghum

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime 1	Mean temperature in growing season	°C	26–30	30–34; 24–26	34–40; 20–24	>40; <20
	Mean max. temp. in growing season	°C				
	Mean min. temp. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristics					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V. poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sc, c (red), c (black)	scl, cl	ls, sl	-
	pH	1:2.5	5.5-7.8	5.0-5.5 7.8-9.0	>9.0	-
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO ₃ in root zone	%		<5	5-10	10-15
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	5-10	10-15	>15	
Erosion hazard	Slope	%	0-3	3-5	5-10	>10

Table 7.3 Land suitability criteria for Maize

Land use requirement		Rating				
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	30-34	35-38 26-30	38-40 26-20	
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	Very poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc	c (red), c (black)	ls, sl	-
	pH	1:2.5	5.5-7.8	5.0-5.5 7.8-9.0	>9.0	-
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO ₃ in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	ds/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	5-10	10-15	>15	-
Erosion hazard	Slope	%	0-3	3-5	5-10	>10

Table 7.4 Land suitability criteria for Bajra

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	28-32	33-38 24-27	39-40 20-23	<20
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm	500-750	400-500	200-400	<200
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	Very poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	Sl, scl, cl,sc,c (red)	C (black)	ls	-
	pH	1:2.5	6.0-7.8	5.0-5.5 7.8-9.0	5.5-6.0 >9.0	
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	15-35	35-60	>60	
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	5-10	10-15	>15	
Erosion hazard	Slope	%	1-3	3-5	5-10	>10

Table 7.5 Land suitability criteria for Red gram

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	30-35(G) 20-25(AV) 15-18 (F&PS) 35-40(M)	25-30(G) 20-25 (AV) 12-15 (F&PS) 30-35(M)	20-25(G) 15-20(AV) 10-12 (F&PS) 25-30(M)	< 20 <15 <10 <25
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Mod. Well drained	Poorly drained	Very Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sc, c (red)	c (black),sl, scl, cl	ls	-
	pH	1:2.5	6.0-7.8	5.5-6.0 7.8-9.0	5.0-5.5 >9.0	-
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO ₃ in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-50	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<1.0	1.0-2.0	>2.0	
	Sodicity (ESP)	%	5-10	10-15	>15	
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.6 Land suitability criteria for Bengal gram

Land use requirement			Rating			
Soil –site characteristics	Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)	
Climatic regime	Mean temperature in growing season	°C	20–25	25–30; 15–20	30–35; 10–15	>35; <10
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Mod. Well drained	Poorly drained	Very Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	C (black)	-	c (red), scl, cl, sc	ls, sl
	pH	1:2.5	6.0-7.8	5.0-6.0 7.8-9.0	>9.0	-
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO ₃ in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	5-10	10-15	>15	-
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.7 Land suitability criteria for Groundnut

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	24–33	22–24; 33–35	20–22; 35–40	<20; >40
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Mod. Well drained	Poorly drained	Very Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl	sl,cl, sc	c (red), c (black), ls	-
	pH	1:2.5	6.0-7.8	5.5-6.0 7.8-8.4	5.0-5.5 8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<35	35-60	>60	
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.8 Land suitability criteria for Sunflower

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	24–30	30–34; 20–24	34–38; 16–20	>38; <16
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	mod. Well drained	-	Poorly to very drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	cl, sc,c (red), c (black)	scl	ls, sl	-
	pH	1:2.5	6.5-7.8	7.8-8.4 5.5-6.5	8.4-9.0; 5.0-5.5	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.9 Land suitability criteria for Cotton

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	22-32	>32	<19	-
	Mean max. temp. in growing season	°C				
	Mean min. temp. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well to moderately well	Poorly drained/Some what excessively drained	-	very poorly/excessively drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sc, c (red,black)	cl	scl	ls, sl
	pH	1:2.5	6.5-7.8	7.8-8.4	5.5-6.5 8.4->9.0	<5.5
	CEC	C mol (p+)Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	50-100	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	5-10	10-15	>15	
Erosion hazard	Slope	%	<3	3-5	-	>5

Table 7.10 Land suitability criteria for Chili

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	25-32	33-35 20-25	35-38 <20	>38
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	Very poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc	c (black), sl	ls	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.11 Land suitability criteria for Tomato

Land use requirement		Rating				
Soil –site characteristics	Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)	
Climatic regime	Mean temperature in growing season	°C	25-28	29-32 20-24	15-19 33-36	<15 >36
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V.poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sl, scl, cl, sc, c (red)	-	ls, c(black)	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO ₃ in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.12 Land suitability criteria for Brinjal

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	Well drained	Moderately well drained	Poorly drained	V. Poorly drained
	Mean max. temp. in growing season	°C				
	Mean min. temp. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class				
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sl, scl, cl, sc c (red)	-	ls, c (black)	-
	pH	1:2.5	6.0-7.3	7.3-8.4 5.0-6.0	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO ₃ in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	>60
Soil toxicity	Salinity (EC saturation extract)	ds/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.13 Land suitability criteria for Onion

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	20-30	30-35	35-40	>40
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately /imperfectly	-	Poorly to V poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sl,scl,cl,sc,c (red)	-	c (Black),ls	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-7.8	7.8-8.4	>8.4
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	ds/m	<1.0	1.0-2.0	2.0-4.0	<4
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.14 Land suitability criteria for Bhendi

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	25-28	29-32 20-24	15-19 33-36	<15 >36
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Imperfectly drained	Poorly to very poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl,sc, c (red)	c (black)	ls	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO ₃ in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	ds/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.15 Land suitability criteria for Drumstick

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C				
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sc, scl, cl, c (red)	sl, c (black)	ls	s
	pH	1:2.5	6.0-7.3	5.0-5.5 7.3-7.8	5.5-6.0 7.8-8.4	>8.4
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<35	35-60	60-80	>80
Soil toxicity	Salinity (EC saturation extract)	dS/m				
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-10	-	>10

Table 7.16 Land suitability criteria for Mulberry

Land use requirement			Rating			
Soil –site characteristics	Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)	
Climatic regime	Mean temperature in growing season	°C	24–28	22–24; 28–32	32–38; 22–18	>38; <18
	Mean max. temp. in growing season	°C				
	Mean min. temp. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V. Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sc, cl, scl	c (red)	c (black), sl, ls	-
	pH	1:2.5	5.5-7.3	5.0-5.5 7.8-8.4	7.3-8.4	>8.4
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	0-35	35-60	60-80	>80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	0-3	3-5	5-10	>10

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

Table 7.17 Land suitability criteria for Mango

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	28-32	24-27 33-35	36-40	20-24
	Min temp. before flowering	°C	10-15	15-22	>22	-
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration	Days				
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c (red)	-	ls, sl, c (black)	-
	pH	1:2.5	5.5-7.3	5.0-5.5 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>150	100-150	75-100	<75
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.18 Land suitability criteria for Sapota

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	28-32	33-36 24-27	37-42 20-23	>42 <18
	Mean max. temp. in growing season	°C				
	Mean min. temp. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	-	Poorly to very drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c (red)	sl	ls, c (black)	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO ₃ in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.19 Land suitability criteria for Pomegranate

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	30-34	35-38 25-29	39-40 15-24	
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl,cl, sc, c (red)	c (black),sl	ls	-
	pH	1:2.5	5.5-7.8	7.8-8.4	5.0-5.5 8.4-9.0	>9.0
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO ₃ in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.20 Land suitability criteria for Guava

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	28-32	33-36 24-27	37-42 20-23	
	Mean max. temp. in growing season	°C				
	Mean min. temp. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c (red)	sl	c (black), ls	-
	pH	1:2.5	6.0-7.8	5.0-6.0	7.8-8.4	>8.4
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.21 Land suitability criteria for Jackfruit

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C				
	Mean max. temp. in growing season	°C				
	Mean min. temp. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Mod. well	Poorly	V. Poorly
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c (red)	-	sl, ls, c (black)	-
	pH	1:2.5	5.5-7.3	5.0-5.5 7.3-7.8	7.8-8.4	>8.4
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	>60
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	0-3	3-5	5-10	>10-

Table 7.22 Land suitability criteria for Jamun

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C				
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well	Mod. well	Poorly	V.Poorly
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c(red)	sl, c (black)	ls	-
	pH	1:2.5	6.0-7.8	5.0-6.0	7.8-8.4	>8.4
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO ₃ in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>150	100-150	50-100	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	>60
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	0-3	3-5	5-10	>10

Table 7.23 Land suitability criteria for Musambi

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	28-30	31-35 24-27	36-40 20-23	>40 <20
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately drained	poorly	Very poorly
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c	sl	ls	-
	pH	1:2.5	6.0-7.8	5.5-6.0 7.8-8.4	5.0-5.5 8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.24 Land suitability criteria for Lime

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	28-30	31-35 24-27	36-40 20-23	>40 <20
	Mean max. temp. in growing season	°C				
	Mean min. temp. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately drained	poorly	Very poorly
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c	sl	ls	-
	pH	1:2.5	6.0-7.8	5.5-6.0 7.8-8.4	5.0-5.5 8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO ₃ in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.25 Land suitability criteria for Cashew

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	32 to 34	28 to 32; 34 to 38	24 to 28; 38 to 40	<20; >40
	Mean max. temp. in growing season	°C				
	Mean min. temp. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	moderately well drained	Poorly drained	Very poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c (red)	-	sl, ls	c (black)
	pH	1:2.5	5.5-6.5	5.0-5.5 6.5-7.3	7.3-7.8	>7.8
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO ₃ in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-10	>10	-

Table 7.26 Land suitability criteria for Custard apple

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C				
	Mean max. temp. in growing season	°C				
	Mean min. temp. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Mod. well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	Scl, cl, sc, c (red), c (black)	-	Sl, ls	-
	pH	1:2.5	6.0-7.3	5.5-6.0 7.3-8.4	5.0-5.5 8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO ₃ in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15-35	35-60	60-80	-
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	0-3	3-5	>5	-

Table 7.27 Land suitability criteria for Amla

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C				
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Mod.well drained	Poorly drained	V. Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c (red)	c (black)	ls, sl	-
	pH	1:2.5	5.5-7.3	5.0-5.5 7.3-7.8	7.8-8.4	>8.4
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15-35	35-60	60-80	-
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	0-3	3-5	5-10	>10

Table 7.28 Land suitability criteria for Tamarind

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C				
	Mean max. temp. in growing season	°C				
	Mean min. temp. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Mod.well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl,sc, c (red)	sl, c (black)	ls	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-7.8	7.8-8.4	>8.4
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>150	100-150	75-100	<75
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	0-3	3-5	5-10	>10

Table 7.29 Land suitability criteria for Marigold

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	18-23	17-15 24-35	35-40 10-14	>40 <10
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sl,scl, cl, sc, c (red)	c (black)	ls	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%				
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.30 Land suitability criteria for Chrysanthemum

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	18-23	17-15 24-35	35-40 10-14	>40 <10
	Mean max. temp. in growing season	°C				
	Mean min. temp. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sl,scl, cl, sc, c (red)	c (black)	ls	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%				
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.31 Land suitability criteria for Jasmine (irrigated)

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	18-23	17-15 24-35	35-40 10-14	-
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c (red)	sl	ls, c (black)	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%				
Erosion hazard	Slope	%	<3	3-5	5-10	>10

7.32 Land suitability criteria for Crossandra

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C				
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	-	Poorly to very poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c(red)	sl,	c (black),ls	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%				
Erosion hazard	Slope	%	<3	3-5	5-10	>10

7.31 Land Management Units (LMUs)

The 10 soil map units identified in Bhagyanagar-2 Microwatershed have been grouped into five Land Management Units (LMUs) 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.7.32) 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 five Land Management Units along with brief description of soil and site characteristics are given below.

LMU	Mapping unit	Soil and site characteristics
1	BGPmB1, GRHmB2	Deep to very deep, black calcareous clay soils with slopes of 1-3%, slight to moderate erosion
2	GDPiB2, BDGiB1, HDHhB2 ,HDHiB2	Moderately deep to deep, red gravelly sandy clay to clay soils with slopes of 1-3%, slight to moderate erosion
3	KMHiB2	Deep, red sandy clay soils with slopes of 1-3%, moderate erosion
4	KTPhB2	Moderately shallow, red loamy soils with slopes of 1-3%, moderate erosion
5	LKRiB2	Moderately shallow, red gravelly sandy clay soils with slopes of 1-3%, moderate erosion

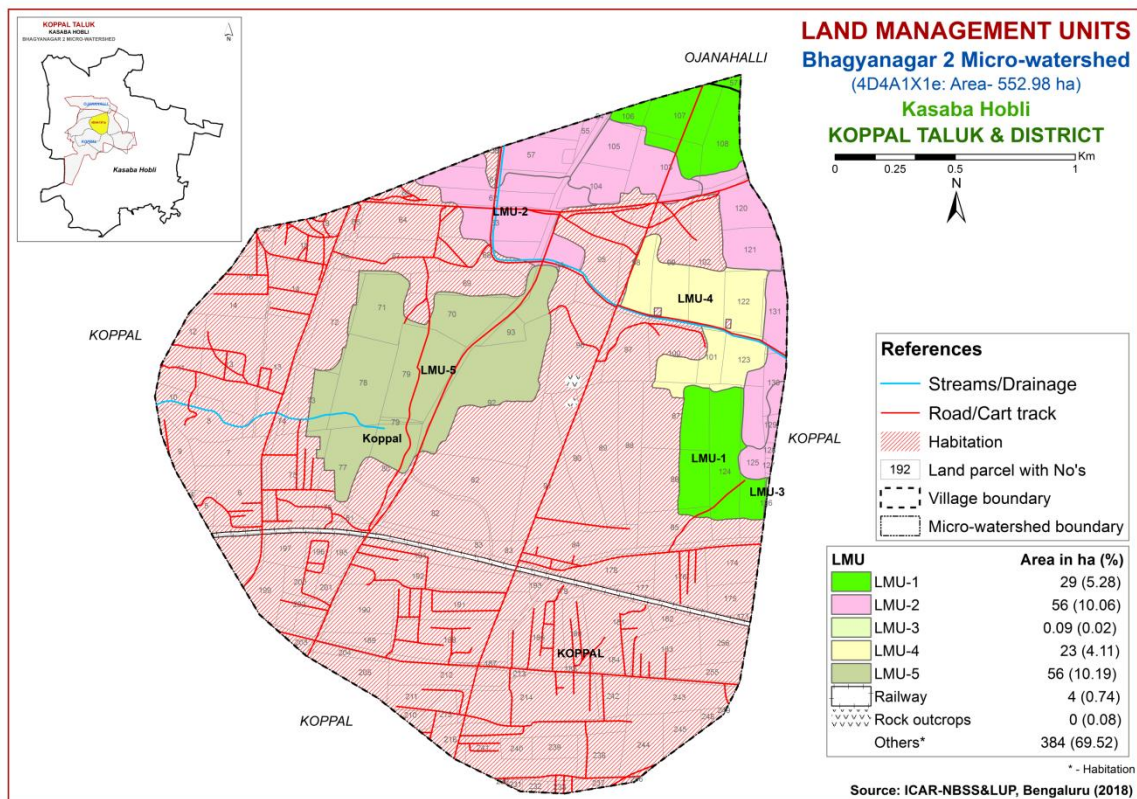


Fig 7.32 Land Management Units map of Bhagyanagar-2 microwatershed

7.31 Proposed Crop Plan for Bhagyanagar-2 Microwatershed

After assessing the land suitability for the 31 crops, the proposed crop plan has been prepared for the five identified LMUs by considering only the highly (Class S1) and moderately (Class S2) suitable lands for each of the 31 crops. The resultant proposed crop plan is presented in Table 7.33.

Table 7.33 Proposed Crop Plan for Bhagyanagar-2 Microwatershed

LMU	Soil Map Units	Survey Number	Field Crops/ Commercial crops	Horticulture Crops (Rainfed/Irrigated)	Suitable Interventions
1	396.BGPmB1 373.GRHmB2 (Deep to very deep, black calcareous clay soils)	Koppal: 106,107,108,124, 126 Ojanahalli: 57	Maize, Sorghum, Sunflower, Cotton, Bengal gram, Safflower, Linseed, Bajra , Soybean	Fruit crops: Sapota, Pomegranate, Jamun, Lime, Musambi, Tamarind, Amla, Custard apple Vegetables: Drumstick, Chilli, Coriander, Tomato, Bhendi Flowers: Marigold, Chrysanthemum, Crossandra, Jasmine	Application of FYM, Biofertilizers and micronutrients, drip irrigation, mulching, suitable soil and water conservation practices
2	269.GDPiB2 191.BDGiB1 122.HDHhB2 127.HDHiB2 (Moderately deep to deep, red gravelly sandy clay to clay soils)	Koppal: 54,55,57,61,62,63,103, 104,105,120, 121,125,127,128, 129,130,131	Groundnut, Bajra, Horse gram, Castor, Mulberry	Fruit crops: Musambi, Lime, Jamun, Jackfruit Amla, Custard apple, Tamarind Vegetable crops: Drumstick, Curry leaves	Drip irrigation, mulching, suitable soil and water conservation practices (Crescent Bunding with Catch Pit etc)
3	201.KMHiB2 (Deep, red sandy clay soils)	Koppal : 126	Maize, Sorghum, Sunflower, Bajra, Finger millet, Groundnut, Red gram, Cowpea, Field bean, Castor, Mulberry	Fruit crops: Mango, Pomegranate, Guava, Sapota, Jackfruit, Jamun, Tamarind, Lime, Musambi, Amla, Custard apple, Cashew Vegetable crops: Drumstick, Tomato, Bhendi, Chilli, Brinjal, Onion, Curry leaves Flower crops: Marigold, Chrysanthemum, Jasmine,	Drip irrigation, mulching, suitable soil and water conservation practices (Crescent Bunding with Catch Pit etc)

LMU	Soil Map Units	Survey Number	Field Crops/ Commercial crops	Horticulture Crops (Rainfed/Irrigated)	Suitable Interventions
				Crossandra	
4	454.KTPhB2 (Moderately shallow, red loamy soils)	Koppal :101,122,123	Sorghum, Groundnut, Bajra, Green gram, Black gram, Cowpea, Horse gram, Castor,	Fruit crops: Lime, Musambi, Amla, Custard apple, Cashew Flower crops: Marigold, Chrysanthemum, Crossandra, Jasmine	Drip irrigation, Mulching, suitable soil and water conservation practices (Crescent Bunding with Catch Pit etc)
5	53.LKRiB2 (Moderately shallow, red gravelly sandy clay soils)	Koppal :70,71,77,78,79,92,93	Groundnut, Bajra, Castor	Fruit crops: Lime, Musambi, Amla, Cashew, Custard apple,	Drip irrigation, mulching, suitable soil and water conservation practices (Crescent Bunding with Catch Pit etc)

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 Bhagyanagar-2Microwatershed

- ❖ The soil phases with sizeable area identified in the microwatershed belonged to the soil series of LKR (56 ha), GDP (36 ha), KTP (23 ha), HDH (16 ha), GRH(16 ha), BDG(3 ha), KMH(<1 ha) and BGP (18 ha).
- ❖ As per land capability classification, entire area in the microwatershed falls under arable land category (Class II and III). The major limitations identified in the arable lands were soil and erosion.

- ❖ On the basis of soil reaction, an area of about 83 ha (15%) is slightly alkaline (pH 7.3-7.8), 57 (10%) is moderately alkaline, 24 ha (4%) is strongly alkaline (pH 8.4-9.0) and <1 ha (<1%) is very strongly alkaline (pH >9.0) in reaction.

Soil Health Management

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

Alkaline soils

An area of about 164 ha (30%) is under alkaline soils. The following actions are recommended.

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 (Azospirillum, Azotobacter, Rhizobium).
3. Application of 25% extra N and P (125 % RDN&P).
4. Application of ZnSO₄ – 12.5 kg/ha (once in three years).
5. Application of Boron – 5 kg/ha (once in three years).

Soil Degradation

Soil erosion is one of the major factors affecting the soil health in the microwatershed. An area of about 147 ha (27%) is under moderate. The areas with moderate erosion need immediate soil and water conservation and, other land development and land husbandry practices for restoring soil health.

Dissemination of Information and Communication of Benefits

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

Inputs for Net Planning (Saturation Plan) and Interventions needed

Net planning in IWMP is focusing on preparation of

1. Soil and Water Conservation Treatment Plans for each plot or farm.
2. Productivity enhancement measures/ interventions for existing crops/livestock/other farm enterprises.
3. Diversification of farming mainly with perennial horticultural crops and livestock.

4. Improving livelihood opportunities and income generating activities.

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

- ❖ **Soil Depth:** The depth of a soil decides the amount of moisture and nutrients it can hold, what crops can be taken up or not, depending on the rooting depth and the length of growing period available for raising any crop. Deeper the soil, better for a wide variety of crops. If sufficient depth is not available for growing deep rooted crops, either choose medium or short duration crops or deeper planting pits need to be opened and additional good quality soil brought from outside has to be filled into the planting pits.
- ❖ **Surface Soil Texture:** Lighter soil texture in the top soil means, better rain water infiltration, less run-off and soil moisture conservation, less capillary rise and less evaporation losses. Lighter surface textured soils are amenable to good soil tilth and are highly suitable for crops like groundnut, root vegetables (carrot, radish, potato etc) but not ideal for crops that need stagnant water like lowland paddy. Heavy textured soils are poor in water infiltration and percolation. They are prone for sheet erosion; such soils can be improved by sand mulching. The technology that is developed by the AICRP-Dryland Agriculture, Vijayapura, Karnataka can be adopted.
- ❖ **Gravelliness:** More gravel content is favorable for run-off harvesting but poor in soil moisture storage and nutrient availability. It is a significant parameter that decides the kind of crop to be raised.
- ❖ **Land Capability Classification:** The land capability map shows the areas suitable and not suitable for agriculture and the major constraints in each of the plot/survey number. Hence, one can decide what kind of enterprise is possible in each of these units. In general, erosion and soil are the major constraints in Bhagyanagar-2 Microwatershed.
- ❖ **Organic Carbon:** An area of about 143 ha (26%) is medium (0.5-0.75%) in OC and 21 ha (4%) is high (>0.75%). The areas that are low and medium in OC needs to be further improved by applying farmyard manure and rotating crops with cereals and legumes or mixed cropping.
- ❖ **Promoting green manuring:** Growing of green manuring crops costs Rs. 1250/ha (green manuring seeds) and about Rs. 2000/ha towards cultivation that totals to Rs. 3250/- per ha. On the other hand, application of organic manure @ 10 tons/ha costs Rs. 5000/ha. The practice needs to be continued for 2-3 years or more. Nitrogen fertilizer needs to be supplemented by 25% in addition to the recommended level in 143 ha area where OC is less than 0.75 per cent. For example, for rainfed maize, recommended level is 50 kg N per ha and an additional 12 kg /ha needs to be applied for all the crops grown in these plots.
- ❖ **Available Phosphorus:** Available phosphorus is medium in (23-57 kg/ha) in entire area of the soils. The areas with high phosphorus content reduce 25% from the RDF

to avoid the excess application of fertilizer and apply additional 25% phosphorus in areas where it is low and medium.

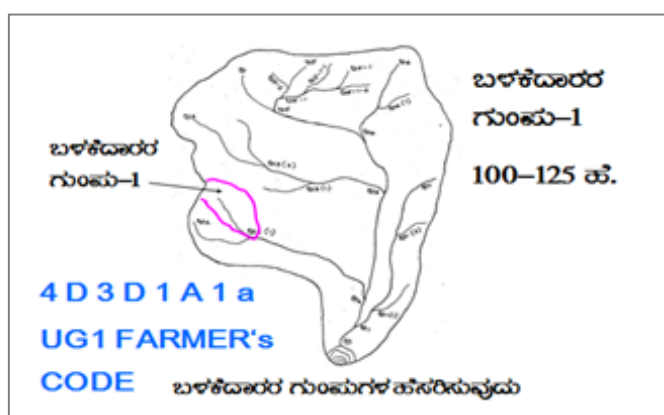
- ❖ **Available Potassium:** Available potassium is medium (145-337 kg/ha) in entire area of the microwatershed. The areas with high potassium content reduce 25% from the RDF to avoid the excess application of fertilizer and apply additional 25% potassium in areas where it is medium.
- ❖ **Available Sulphur:** Available sulphur is a very critical nutrient for oilseed crops. Available sulphur is low (<10 ppm) in 164 ha (30%) and medium in <1 ha (<1%) area of the microwatershed. Areas with low and medium in available sulphur 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 Iron:** It is deficient (<4.5 ppm) in 150 ha (27%) and sufficient (>4.5 ppm) in 14 ha (3 %) area of the microwatershed. To manage iron deficiency iron sulphate @ 25 kg/ha needs to be applied for 2-3 years.
- ❖ **Available Zinc:** It is deficient (<0.6 ppm) in the 54 ha (10%) and sufficient (>0.6 ppm) in 110 ha (20 %) area of the microwatershed. Application of zinc sulphate @ 25kg/ha is to be followed in areas that are deficient in available zinc.
- ❖ **Available Boron:** Available boron is low in (<0.5ppm) 88 ha (16%) and medium (0.5-1.0 ppm) in 76 ha (14%) area of the microwatershed. The areas with low and medium in boron content need to be applied with sodium borate @ 10kg/ha as soil application or 0.2% borax as foliar spray to correct the deficiency.
- ❖ **Available Manganese:** It is sufficient in the entire area of the microwatershed.
- ❖ **Available Copper:** It is sufficient in the entire area of the microwatershed.
- ❖ **Soil Alkalinity:** An area of about 164 ha (30%) in the microwatershed has soils that are slightly to very strongly alkaline. These areas need application of gypsum and wherever calcium is in excess, iron pyrites and element sulphur can be recommended. Management practices like treating repeatedly with good quality water to drain out the excess salts and provision of subsurface drainage and growing of salt tolerant crops like Casuarina, Acasia, Neem, Ber etc, are recommended.

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

SOIL AND WATER CONSERVATION TREATMENT PLAN

For preparing soil and water conservation treatment plan for Bhagyanagar-2 Microwatershed, the land resource inventory database generated under Sujala-III project has been transformed as information through series of interpretative (thematic) maps using soil phase map as a base. The various thematic maps (1:7920 scale) generated were

- Soil depth
- Surface soil texture
- Available water capacity
- Soil slope
- Soil gravelliness
- Land capability
- Present land use and land cover
- Crop suitability maps
- Rainfall map
- Hydrology
- Water Resources
- Socio-economic data
- Contour plan with existing features- network of waterways, pottissa boundaries, cut up/ minor terraces etc.
- Cadastral map (1:7920 scale)
- Satellite imagery (1:7920 scale)



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

Steps for Survey and Preparation of Treatment Plan

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

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

9.1 Treatment Plan

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

9.1.1 Arable Land Treatment

A. BUNDING

Steps for Survey and Preparation of Treatment Plan		USER GROUP-1 CLASSIFICATION OF GULLIES
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	
<i>Halla/Nala</i>	(more than 25ha catchment)	

Measurement of Land Slope

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



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

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

Note: i) The above intervals are maximum.

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

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

Section of the Bund

Bund section is decided considering the soil texture class and gravelliness class (bg₀b = loamy sand, g₀ = <15% gravel). The recommended sections for different soils are given below.

Recommended Bund Section

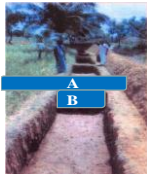
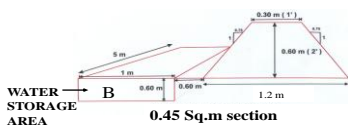
Top width (m)	Base width (m)	Height (m)	Side slope (Z:1;H:V)	Cross section (sq m)	Soil Texture	Remarks
0.3	0.9	0.3	01:01	0.18	Sandy loam	Vegetative bund
0.3	1.2	0.3	1.5:1	0.225	Sandy clay	
0.3	1.2	0.5	0.9:1	0.375	Red gravelly soils	
0.3	1.2	0.6	0.75:1	0.45		
0.3	1.5	0.6	01:01	0.54	Red sandy loam	
0.3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

Formation of Trench cum Bund

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

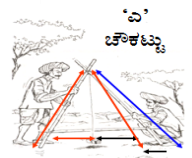
Details of Borrow Pit dimensions are given below

TRENCH CUM BUND

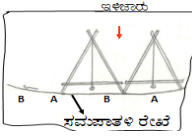



IDEAL FOR HORTICULTURE CROPS

'A' FRAME FOR INTERBUND MANAGEMENT



1. ಸಮಾನಾಕಲ ಉಳುವು
2. ಸಮಾನಾಕಲ ಬಿತ್ತನೆ/ನಾಟಿ



ಸಮಾನಾಕಲ ರೇಖೆ

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
			L(m)	W(m)	D(m)	Quantity (m ³)		
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

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

C. Farm Ponds

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

D. Diversion Channel

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

9.1.2 Non-Arable Land Treatment

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

9.1.3 Treatment of Natural Water Course/ Drainage Lines

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

9.2 Recommended Soil and Water Conservation Measures

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

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

A map (Fig. 9.1) showing soil and water conservation plan with different kinds of structures recommended has been prepared which shows the spatial distribution and extent of area. A maximum area of about 135 ha (24 %) needs trench cum bunding and area of about 29 ha (5%) needs graded bunding. The conservation plan prepared may be presented to all the stakeholders including farmers and after considering their suggestions, the conservation plan for the microwatershed may be finalized in a participatory approach.

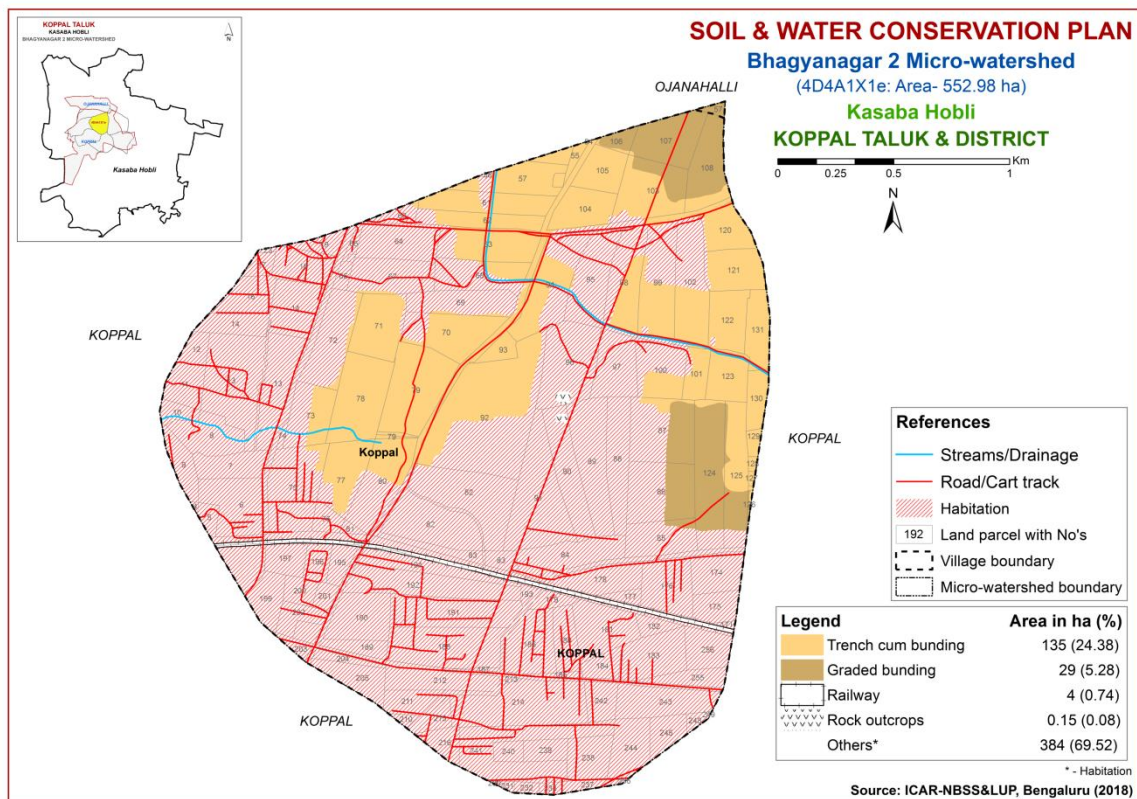


Fig. 9.1 Soil and Water Conservation Plan map of Bhagyanagar-2 Microwatershed

9.3 Greening of Microwatershed

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

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

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

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

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Appendix I
Bhagyanagar-2 (1X1e) Microwatershed
Soil Phase Information

Village	Survey No	Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	Wells	Land Capability	Conservation Plan
Koppal	4	0.1	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	5	0.97	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	6	5.83	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	7	3.37	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	8	4.32	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	9	2.43	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	10	1.25	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	11	2.82	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	12	1.42	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	13	15.49	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	14	7.47	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	16	3.3	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	17	1.08	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	18	3.56	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	19	1.56	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	23	0.13	Habitation	Others	Others	Others	Others	Others	Others	Others	Fallow land (Fl)	Not Available	Others	Others
Koppal	54	0.001	GDPiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	Illes	Trench cum bunding
Koppal	55	0.59	GDPiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	Illes	Trench cum bunding
Koppal	57	4.61	GDPiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	Illes	Trench cum bunding
Koppal	58	0.08	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	60	1.23	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	61	4.9	GDPiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Redgram (Mz+Rg)	1 Borewell	Illes	Trench cum 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
Koppal	62	3.54	GDPiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Redgram (Mz+Rg)	Not Available	Illes	Trench cum bunding
Koppal	63	6.04	GDPiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Redgram (Mz+Rg)	Not Available	Illes	Trench cum bunding
Koppal	64	5.28	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	65	0.53	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	66	0.71	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	67	5.29	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	68	5.12	Habitation	Others	Others	Others	Others	Others	Others	Others	Maize (Mz)	Not Available	Others	Others
Koppal	69	4.83	Habitation	Others	Others	Others	Others	Others	Others	Others	Pearl millet (Pm)	Not Available	Others	Others
Koppal	70	6.32	LKRiB2	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Pearl millet (Pm)	Not Available	Illes	Trench cum bunding
Koppal	71	5.64	LKRiB2	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Chilli (Ch)	Not Available	Illes	Trench cum bunding
Koppal	72	6.33	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	73	4.75	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	2 Borewell	Others	Others
Koppal	74	0.28	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	75	7.99	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	76	1.32	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	77	5.23	LKRiB2	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Habitation (Hb)	Not Available	Illes	Trench cum bunding
Koppal	78	7.85	LKRiB2	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Drumstick+Cotton (Ds+Cn)	Not Available	Illes	Trench cum bunding
Koppal	79	8.95	LKRiB2	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Drumstick (Ds)	Not Available	Illes	Trench cum bunding
Koppal	80	6.72	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	81	0.38	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	82	15.57	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	83	2.55	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	84	5.4	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	85	4.44	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others

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
Koppal	86	7.29	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	87	7.71	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	88	5.24	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	89	7.47	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	90	5.66	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	91	10.07	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	92	20.98	LKRiB2	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIes	Trench cum bunding
Koppal	93	1.34	LKRiB2	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Habitation (Hb)	Not Available	IIes	Trench cum bunding
Koppal	94	7.93	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	95	6.16	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	96	8	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	97	4.84	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	98	6.25	Habitation	Others	Others	Others	Others	Others	Others	Others	Maize (Mz)	Not Available	Others	Others
Koppal	99	7.52	Habitation	Others	Others	Others	Others	Others	Others	Others	Maize (Mz)	Not Available	Others	Others
Koppal	100	5.04	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	101	2.25	KTPbB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Habitation (Hb)	Not Available	Iies	Trench cum bunding
Koppal	102	7.38	Habitation	Others	Others	Others	Others	Others	Others	Others	Maize (Mz)	Not Available	Others	Others
Koppal	103	7.05	GDPiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIes	Trench cum bunding
Koppal	104	4	GDPiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IIes	Trench cum bunding
Koppal	105	3.4	GDPiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIes	Trench cum bunding
Koppal	106	1.2	BGPmB1	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Slight	Maize (Mz)	Not Available	Iis	Graded bunding
Koppal	107	5.53	BGPmB1	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Slight	Maize (Mz)	Not Available	Iis	Graded bunding
Koppal	108	5.47	BGPmB1	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Redgram (Mz+Rg)	Not Available	Iis	Graded bunding
Koppal	120	3.48	HDHhB2	LMU-2	Moderately deep (75-100 cm)	Sandy clay loam	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	Iies	Trench cum bunding

Village	Survey No	Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Graveliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	Wells	Land Capability	Conservation Plan
Koppal	121	4.41	HDHhB2	LMU-2	Moderately deep (75-100 cm)	Sandy clay loam	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	Iles	Trench cum bunding
Koppal	122	4.21	KTPPhB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	Iles	Trench cum bunding
Koppal	123	3.7	KTPPhB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	Iles	Trench cum bunding
Koppal	124	8.14	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Fallow land (Mz+Fl)	Not Available	Iles	Graded bunding
Koppal	125	6.22	HDHiB2	LMU-2	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Fallow land (Mz+Fl)	Not Available	Iles	Trench cum bunding
Koppal	126	0.25	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	Iles	Graded bunding
Koppal	127	0.17	BDGiB1	LMU-2	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Maize (Mz)	Not Available	IIIs	Trench cum bunding
Koppal	128	0.23	BDGiB1	LMU-2	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Fallow land (Fl)	Not Available	IIIs	Trench cum bunding
Koppal	129	0.64	BDGiB1	LMU-2	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Fallow land (Fl)	Not Available	IIIs	Trench cum bunding
Koppal	130	2.15	HDHiB2	LMU-2	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	Iles	Trench cum bunding
Koppal	131	3.32	HDHiB2	LMU-2	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	Iles	Trench cum bunding
Koppal	171	0.18	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	174	3.68	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	175	2.42	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	176	4.99	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	177	0.73	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	178	4.02	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	179	1.08	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	180	2.81	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	181	5.26	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	182	1.08	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	183	5.06	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	184	1.7	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	185	0.39	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others

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
Koppal	186	5.28	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	187	0.19	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	188	8.24	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	189	1.62	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	190	5.07	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	191	7.03	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	192	6.98	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	193	0.38	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	194	3.62	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	195	1.55	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	196	1.75	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	197	2.39	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	199	2.89	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	200	1.55	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	201	0.95	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	202	1.93	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	203	0.48	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	204	0.87	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	205	3.27	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	210	0.41	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	211	2.26	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	212	4.05	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	213	0.12	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	214	9.89	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others

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
Koppal	215	1.34	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	216	1.84	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	230	0.04	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	231	0.24	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	232	0.52	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	233	0.49	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	236	0.01	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	237	0.97	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	238	3.47	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	239	1.75	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	240	1.13	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	241	9.28	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	242	2.2	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	243	5.2	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	244	4	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	245	2.23	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	248	0.54	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	249	0.04	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Koppal	255	2.06	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Koppal	256	3.11	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation (Hb)	Not Available	Others	Others
Ojanahalli	57	0.44	BGPmB1	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Slight	Maize (Mz)	Not Available	IIs	Graded bunding

Appendix II
Bhayanagar-2 (1X1e) Microwatershed
Soil Fertility Information

Village	Survey Number	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Koppal	4	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	5	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	6	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	7	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	8	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	9	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	10	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	11	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	12	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	13	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	14	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	16	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	17	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	18	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	19	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	23	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	54	Moderately alkaline (pH 7.8 - 8.4)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Koppal	55	Moderately alkaline (pH 7.8 - 8.4)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Koppal	57	Slightly alkaline (pH 7.3 - 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Koppal	58	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	60	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	61	Slightly alkaline (pH 7.3 - 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Koppal	62	Slightly alkaline (pH 7.3 - 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Koppal	63	Slightly alkaline (pH 7.3 - 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Koppal	64	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	65	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others

Village	Survey Number	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Koppal	66	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	67	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	68	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	69	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	70	Slightly alkaline (pH 7.3 - 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Koppal	71	Strongly alkaline (pH 8.4 - 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Koppal	72	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	73	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	74	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	75	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	76	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	77	Moderately alkaline (pH 7.8 - 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Koppal	78	Strongly alkaline (pH 8.4 - 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Koppal	79	Strongly alkaline (pH 8.4 - 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Koppal	80	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	81	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	82	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	83	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	84	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	85	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	86	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	87	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	88	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	89	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	90	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	91	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	92	Slightly alkaline (pH 7.3 - 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Koppal	93	Slightly alkaline (pH 7.3 - 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)

Village	Survey Number	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Koppal	131	Moderately alkaline (pH 7.8 - 8.4)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Koppal	171	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	174	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	175	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	176	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	177	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	178	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	179	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	180	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	181	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	182	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	183	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	184	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	185	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	186	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	187	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	188	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	189	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	190	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	191	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	192	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	193	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	194	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	195	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	196	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	197	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	199	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	200	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	201	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	202	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others

Village	Survey Number	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Koppal	203	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	204	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	205	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	210	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	211	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	212	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	213	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	214	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	215	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	216	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	230	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	231	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	232	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	233	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	236	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	237	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	238	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	239	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	240	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	241	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	242	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	243	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	244	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	245	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	248	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	249	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	255	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Koppal	256	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Ojanahalli	57	Moderately alkaline (pH 7.8 - 8.4)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)

Village	Survey Number	Mango	Maize	Sapota	Sorghum	Guava	Cotton	Tamarind	Lime	Bengal gram	Sunflower	Red gram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Bajra	Jasmine	Bhendi	Brinjal	Crossandra	Drumstick	Mulberry	Onion		
Koppal	89	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	Others	Others	Others	Others	Others	
Koppal	90	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	Others	Others	Others	Others	Others	
Koppal	91	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	Others	Others	Others	Others	Others	
Koppal	92	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	Others	Others	Others	Others	Others	
Koppal	93	N1rg	S3rg	S3rg	S3rg	S3rg	S3g	N1rg	S3rg	S2rt	S3rg	S3rg	S2rg	S3rg	S2rg	S3rg	S3rg	S3rg	S3rg	S3g	S3g	S3g	S3g	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S3rg	S3g
Koppal	94	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	Others	Others	Others	Others	Others	
Koppal	95	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	Others	Others	Others	Others	Others	
Koppal	96	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	Others	Others	Others	Others	Others	
Koppal	97	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	Others	Others	Others	Others	Others	
Koppal	98	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	Others	Others	Others	Others	Others	
Koppal	99	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	Others	Others	Others	Others	Others	
Koppal	100	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	Others	Others	Others	Others	Others	
Koppal	101	N1rg	S3rg	S3rg	S3rg	S3rg	S3rg	N1rg	S3rg	S2rt	S3rg	S3rg	S2rg	S3rg	S2rg	S3rg	S3rg	S3rg	S2rg	S3rg	S3rg	S3rg	S3rg	S3rg	S2rg	S3rg	S2r	S2r	S3rg	S3rg	S3rg	S2r		
Koppal	102	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	Others	Others	Others	Others	Others	
Koppal	103	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg		
Koppal	104	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg		
Koppal	105	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg		
Koppal	106	S3tz	S2tz	S3tz	S2z	S3tz	S2z	S2tz	S2z	S2z	S2z	S2tz	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S2tz	S3tz	S2tz	S2tz	S3tz	S2tz	S2tz	S3tz		
Koppal	107	S3tz	S2tz	S3tz	S2z	S3tz	S2z	S2tz	S2z	S2z	S2z	S2tz	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S2tz	S3tz	S2tz	S2tz	S3tz	S2tz	S2tz	S3tz		
Koppal	108	S3tz	S2tz	S3tz	S2z	S3tz	S2z	S2tz	S2z	S2z	S2z	S2tz	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S2tz	S3tz	S2tz	S2tz	S3tz	S2tz	S2tz	S3tz		
Koppal	120	S3rg	S3g	S2rg	S3g	S2rg	S3rg	S3rg	S2rg	S3g	S3rg	S3g	S2rg	S2rg	S2rg	S2rg	S2rg	S2rg	S2g	S3g	S3g	S3g	S3g	S2rg	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	
Koppal	121	S3rg	S3g	S2rg	S3g	S2rg	S3rg	S3rg	S2rg	S3g	S3rg	S3g	S2rg	S2rg	S2rg	S2rg	S2rg	S2rg	S2g	S3g	S3g	S3g	S3g	S2rg	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	
Koppal	122	N1rg	S3rg	S3rg	S3rg	S3rg	S3rg	N1rg	S3rg	S2rt	S3rg	S3rg	S2rg	S3rg	S2rg	S3rg	S3rg	S3rg	S2rg	S3rg	S3rg	S3rg	S3rg	S3rg	S2rg	S3rg	S2r	S2r	S3rg	S3rg	S3rg	S2r		
Koppal	123	N1rg	S3rg	S3rg	S3rg	S3rg	S3rg	N1rg	S3rg	S2rt	S3rg	S3rg	S2rg	S3rg	S2rg	S3rg	S3rg	S3rg	S2rg	S3rg	S3rg	S3rg	S3rg	S3rg	S2rg	S3rg	S2r	S2r	S3rg	S3rg	S3rg	S2r		
Koppal	124	S3t	S2t	S3t	S1	S3t	S1	S2r	S1	S1	S1	S2t	S2t	S3t	S1	N1t	S2rt	S1	S3t	S3t	S3t	S2t	S2t	S2t	S2t	S3t	S2t	S2t	S3t	S2t	S2t	S3t		
Koppal	125	S3rg	S3g	S2rg	S3g	S2rg	S3rg	S3rg	S2rg	S3g	S3rg	S3g	S2rg	S2rg	S2rg	S2rg	S2rg	S2rg	S2g	S3g	S3g	S3g	S3g	S2rg	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	

Village	Survey Number	Mango	Maize	Sapota	Sorghum	Guava	Cotton	Tamarind	Lime	Bengal gram	Sunflower	Red gram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Bajra	Jasmine	Bhendi	Brinjal	Crossandra	Drumstick	Mulberry	Onion	
Koppal	239	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	Others	Others	Others	Others	Others
Koppal	240	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	Others	Others	Others	Others	Others
Koppal	241	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	Others	Others	Others	Others	Others
Koppal	242	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	Others	Others	Others	Others	Others
Koppal	243	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	Others	Others	Others	Others	Others
Koppal	244	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	Others	Others	Others	Others	Others
Koppal	245	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	Others	Others	Others	Others	Others
Koppal	248	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	Others	Others	Others	Others	Others
Koppal	249	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	Others	Others	Others	Others	Others
Koppal	255	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	Others	Others	Others	Others	Others
Koppal	256	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	Others	Others	Others	Others	Others
Ojanah alli	57	S3tz	S2tz	S3tz	S2z	S3tz	S2z	S2tz	S2z	S2z	S2z	S2tz	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S2tz	S3tz	S2tz	S2tz	S3tz	S2tz	S2tz	S3tz	