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

MADDENAHALLI (4B3D3N1a) MICROWATERSHED

Gubbi Taluk, Tumkur District, Karnataka

Karnataka Watershed Development Project – II

SUJALA – III

World Bank funded Project

The World Bank

ICAR – NATIONAL BUREAU OF SOIL SURVEY AND LAND USE PLANNING

ICAR - NBSS & LUP

WATERSHED DEVELOPMENT DEPARTMENT
GOVT. OF KARNATAKA, BANGALORE

About ICAR - NBSS&LUP

The ICAR-National Bureau of Soil Survey and Land Use Planning (ICAR-NBSS&LUP), Nagpur, a premier Institute of the Indian Council of Agricultural Research (ICAR), was set up during 1976 with the objective to prepare soil resource maps at national, state and district levels and to provide research inputs in soil resource mapping and its applications, land evaluation, land use planning, land resource management, and database management using GIS for optimising land use on different kinds of soils in the country.

The Bureau has been engaged in carrying out soil resource survey, agro-ecological and soil degradation mapping at the country, state and district levels for qualitative assessment and monitoring the soil health towards viable land use planning. The research activities have resulted in identifying the soil potentials and problems, and the various applications of the soil surveys with the ultimate objective of sustainable agricultural development. The Bureau has the mandate to correlate and classify soils of the country and maintain a National Register of all the established soil series. The Institute is also imparting in-service training to staff of the soil survey agencies in the area of soil survey, land evaluation and soil survey interpretations for land use planning. The Bureau in collaboration with Panjabrao Krishi Vidyapeeth, Akola is running post-graduate teaching and research programme in land resource management, leading to M.Sc. and Ph.D. degrees.

Citation: Rajendra Hegde, Ramesh Kumar, S.C., K.V. Niranjana, S. Srinivas, M.Lalitha, B.A. Dhanorkar, R.S. Reddy and S.K. Singh (2019). “Land Resource Inventory and Socio-Economic Status of Farm Households for Watershed Planning and Development of Maddenahalli (4B3D3N1a) Microwatershed, Gubbi Taluk, Tumkur District, Karnataka”, ICAR-NBSS&LUP Sujala MWS Publ.106, ICAR – NBSS & LUP, RC, Bangalore. p.101& 32.

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PREFACE

In Karnataka, as in other Indian States, the livelihoods of rural people are intertwined with farming pursuits. Thechallenges in agriculture are seriously threatening the livelihood of a large number of farmers as they have been practicing farming in contextual factors beyond their control. Climatic factors are the most important ones and have become much more significant in recent times due to rapid climate changes induced by intensive anthropogenic activities affecting our ecosystem in multiple ways. Climate change has become the reality, it is happening and efforts to evolve and demonstrate climate resilient technologies have become essential. Due to the already over stressed scenario of agrarian sector, the climate change is resulting in manifold increase in the complexities, pushing the rural mass to face more and more unpredictable situations. The rising temperatures and unpredictable rainfall patterns are going to test seriously the informed decisions farmers have to make in order to survive in farming and sustain their livelihood.

It is generally recognized that impacts of climate change shall not be uniform across the globe. It is said that impact of climate change is more severe in South Asia. Based on the analysis of meteorological data, it is predicted that in India, there will be upward trend in mean temperature, downward trend in relative humidity, annual rainfall and number of wet days in a year. Also, in general, phenomena like erratic monsoon, spread of tropical diseases, rise in sea levels, changes in availability of fresh water, frequent floods, droughts, heat waves, storms and hurricanes are predicted. Each one of these adverse situations are already being experienced in various parts of India and also at the global level. Decline in agricultural productivity of small and marginal farmers becoming more vulnerable is already witnessed.

In Karnataka, more than 60 per cent of the population live in rural areas and depend on agriculture and allied activities for their livelihood. Though the state has achieved significant progress in increasing the yield of many crops, there is tremendous pressure on the land resources due to the growing and competing demands of various land uses. This is reflected in the alarming rate of land degradation observed. Already more than 50 per cent of the area is affected by various forms of degradation. If this trend continues, the sustainability of the fragile ecosystem will be badly affected. The adverse effects of change in the climatic factors are putting additional stress on the land resources and the farmers dependent on this.

The natural resources (land, water and vegetation) of the state need adequate and constant care and management, backed by site-specific technological interventions and investments particularly by the government. Detailed database pertaining to the nature of

the land resources, their constraints, inherent potentials and suitability for various land based rural enterprises, crops and other uses is a prerequisite for preparing location-specific action plans, which are in tune with the inherent capability of the resources. Any effort to evolve climate resilient technologies has to be based on the baseline scientific database. Then only one can expect effective implementation of climate resilient technologies, monitor the progress, make essential review of the strategy, and finally evaluate the effectiveness of the implemented programs. The information available at present on the land resources of the state are of general nature and useful only for general purpose planning. Since the need of the hour is to have site-specific information suitable for farm level planning and detailed characterization and delineation of the existing land resources of an area into similar management units is the only option.

ICAR-NBSS&LUP, Regional Centre, Bangalore has taken up a project sponsored by the Karnataka Watershed Development Project-II, (Sujala-III), Government of Karnataka funded by the World Bank under Component -1 Land Resource Inventry. This study was taken up to demonstrate the utility of such a database in reviewing, monitoring and evaluating all the land based watershed development programs on a scientific footing. To meet the requirements of various land use planners at grassroots level, the present study on "Land Resource Inventory and Socio-Economic Status of Farm Households for Watershed Planning and Development of Maddenahalli Microwatershed, Gubbi Taluk and Tumakuru District, Karnataka" for integrated development was taken up in collaboration with the State Agricutural Universities, IISC, KSRSAC, KSNDMC as Consortia partners. The project provides detailed land resource information at cadastral level (1:7920 scale) for all the plots and socio-economic status of farm households covering thirty per cent farmers randomely selected representing landed and landless class of farmers in the micowatershed. The project report with the accompanying maps for the Microwatershed will provide required detailed database for evolving effective land use plan, alternative land use options and conservation plans for the planners, administrators, agricutural extention personnel, KVK officials, developmental departments and other land users to manage the land resources in a sustainable manner.

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

Nagpur
Date: 05.01.2018

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PART-A

LAND RESOURCE INVENTORY

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EXECUTIVE SUMMARY

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

The present study covers an area of 588 ha in Gubbi taluk of Tumakuru district, Karnataka. The climate is semiarid and categorized as drought- prone with an average annual rainfall of 813 mm, of which about 466 mm is received during south –west monsoon, 196 mm during north-east and the remaining 151 mm during the rest of the year. An area of about 95 per cent is covered by soils, five per cent by others. The salient findings from the land resource inventory are summarized briefly below.

- *The soils belong to 6 soil series and 18 soil phases (management units) and 5 land management units.*
- *The length of crop growing period is about 150 days starting from 3rd week of June to third week of November.*
- *From the master soil map, several interpretative and thematic maps like land capability, soil depth, surface soil texture, soil gravelliness, available water capacity, soil slope and soil erosion were generated.*
- *Soil fertility status maps for macro and micronutrients were generated based on the surface soil samples collected at every 250 m grid interval.*
- *Land suitability for growing 34 major agricultural and horticultural crops were assessed and maps showing the degree of suitability along with constraints were generated.*
- *About 95 per cent area is suitable for agriculture.*
- *About 95 per cent of the soils are moderately deep (75-100 cm) to very deep (>150 cm).*
- *About 17 per cent of the area has clayey soils at the surface and 78 per cent loamy soils.*
- *About 56 per cent of the area has non-gravelly soils, 34 per cent gravelly soils (15-35 % gravel) and 6 per cent has very gravelly (35- 60% gravel) soils.*
- *About 55 per cent has soils that are very low (<50mm/m) to low (51-100 mm/m) in available water capacity, 23 per cent medium (101-150 mm/m) and 18 per cent has very high (>200 mm/m) available water capacity.*
- *About 83 per cent of the area has very gently sloping (1-3% slope) lands and 12 per cent area has nearly level (0-1%).*
- *An area of about 74 per cent has soils that are slightly eroded (e1) and 22 per cent moderately eroded (e2).*

- *An area of about 28 per cent has soils that are slightly acidic (pH 6.0-6.5),40 per cent area moderately acid (pH 5.5-6.0), 28 per cent strongly acid (pH 5.0-5.5) and 6 per cent area has neutral (pH 6.5-7.3).*
- *The Electrical Conductivity (EC) of the soils are dominantly <2 dsm^{-1}indicating that the soils are non-saline.*
- *About 63 per cent of the soils are low (<0.5%) in organic carbon and 32 per cent soils are medium (0.5-0.75%).*
- *Entire area is high (>57 kg/ha) in available phosphorus.*
- *About 19 per cent of the soils are low (<145 kg/ha), medium (145-337 kg/ha) in 73 per cent area and 3 per cent of the soils are high (>337 kg/ha) in available potassium.*
- *Available sulphur is high (>10 ppm) in about 1 per cent area and medium (10-20 ppm) in about 94 per cent area.*
- *Available boron is low (0.5 ppm) in about 95 per cent area and medium (0.5-1.0 ppm) in <1 per cent area.*
- *Available iron is sufficient (>4.5 ppm) in the entire microwatershed area.*
- *Available manganese and copper are sufficient in all the soils of the microwatershed.*
- *Available zinc is deficient (<0.6 ppm) in 43 per cent and sufficient (>0.6 ppm) in 52 per cent of soils of the microwatershed.*
- *The land suitability for 34 major 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	219 (37)	18 (3)		Guava	86 (15)	423 (72)
Fodder Sorghum	219 (37)	18 (3)		Pomegranate	219 (37)	18 (3)
Maize	-	237 (40)		Banana	219 (37)	18 (3)
Upland paddy	219 (37)	68 (12)		Jackfruit	219 (37)	18 (3)
Finger millet	219 (37)	68 (12)		Jamun	219 (37)	18 (3)
Red gram	219 (37)	18 (3)		Musambi	219 (37)	18 (3)
Horse gram	219 (37)	340 (58)		Lime	219 (37)	18 (3)
Field bean	219 (37)	18 (3)		Cashew	86 (15)	405 (69)
Cowpea	219 (37)	18 (3)		Custard apple	219 (37)	340 (58)
Groundnut	86 (15)	322 (55)		Amla	219 (37)	340 (58)
Sunflower	219 (37)	18 (3)		Tamarind	219 (37)	18 (3)
Onion	133 (23)	104 (18)		Marigold	219 (37)	18 (3)
Chilli	219 (37)	18 (3)		Chrysanthemum	219 (37)	18 (3)
Brinjal	219 (37)	18 (3)		Jasmine	219 (37)	18 (3)
Tomato	219 (37)	18 (3)		Coconut	86 (15)	151 (26)
Mango	219 (37)	18 (3)		Arecanut	86 (15)	151 (26)
Sapota	219 (37)	18 (3)		Mulbery	25 (5)	4557)

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 horticulture crops.

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

Chapter 1

INTRODUCTION

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

Further, land degradation has emerged as a serious problem which has already affected about 38 lakh ha of cultivated area in the state. Soil erosion alone has degraded about 35 lakh ha. Almost all the uncultivated areas are facing various degrees of degradation, particularly soil erosion. Salinity and alkalinity has emerged as a major problem affecting 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 the potential and problem areas, developing sustainable land use plans, estimation of surface run off and water harvesting potential, preparation of soil and water conservation plans, land degradation/desertification etc. The Bureau is presently engaged in developing an LRI methodology using high resolution satellite remote sensing data and Digital Elevation Model (DEM) data to prepare Landscape Ecological Units (LEU) map representing agro-ecosystem as a whole. The LEU is preferred over landform as the base map for LRI. LEU is the assemblage of landform, slope and land use. An attempt 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 Maddenahalli microwatershed in Gubbi Taluk, Tumakuru 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.

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

Chapter 2

GEOGRAPHICAL SETTING

2.1 Location and Extent

Tumakuru District popularly known as *Kalpataru Nadu* (famous for production of Coconuts) is located in the southeastern part of Karnataka state. The Maddenahalli microwatershed (Bangihalli subwatershed) is located in the southeastern part of Karnataka in Gubbi Taluk, Tumakuru District, Karnataka State (Fig.2.1). It comprises parts of Gadi Ankanahalli, Jogihalli, Karegondanahalli, Sanabanahalli, Maranahalli, Madhenahalli and Pinnenahalli villages. It lies between 13^0 27' and 13^0 28' North latitudes and 76^0 51' to $76^0$53' East longitudes and covers an area of 588 ha. It is about 71 km south of Tumakuru and is surrounded by Sanabanahalli on the northeast, Pinnenahalli on northwest, Gadi Ankanahalli on the south and Maranahalli on the eastern side.

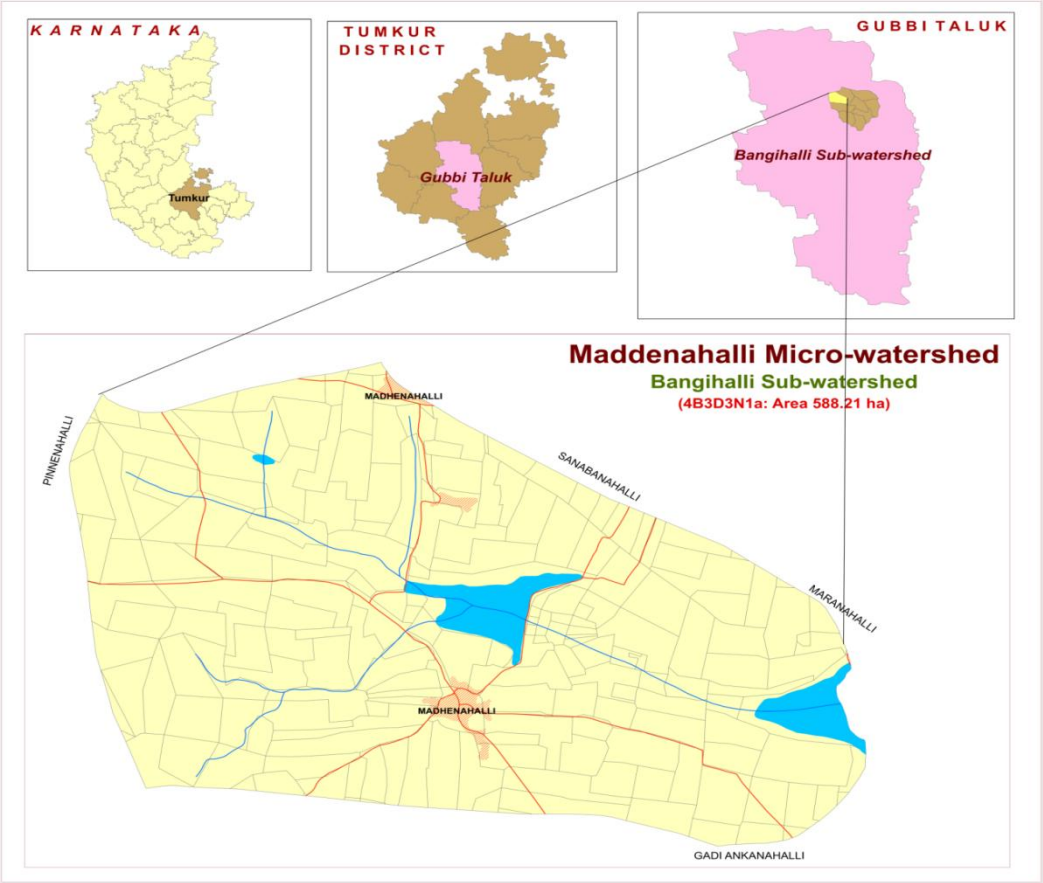


Fig.2.1 Location map of Maddenahalli Microwatershed

2.2 Geology

Major rock formation observed in the microwatershed are of Archaean age and comprise of (Figs.2.2 and 2.3) granite and granite gneiss. They are essentially pink to gray granite gneisses. The rocks are coarse to medium grained. They consist primarily of

quartz, feldspar, biotite and hornblende. The gray granite gneisses are highly weathered, fractured and fissured upto a depth of about 10 m.

Fig.2.2 Granite and granite gneiss rocks

Fig. 2.3 Granite rocks

2.3 Physiography

Physiographically, the area has been identified as granite gneiss landscape based on geology. It has been further divided into three landforms *viz*; mounds/ ridges, uplands and lowlands based on slope and other relief features. They have been further subdivided into four physiographic units, *viz;* summits, side slopes, very gently sloping uplands and lowlands/valleys. The elevation ranges from 832-856 m. The mounds and ridges are mostly covered by rock outcrops.

2.4 Drainage

There are no perennial rivers flowing in Gubbi taluk. However, the area is drained by several small seasonal streams like Hosa kaluve which joins the river Shimsha along its course. Though, they are not perennial, during rainy season, it carries large quantities of rain water. The microwatershed area has only few small tanks which are not capable of storing water that flows during the rainy season. Due to this, the ground water recharge is

very much affected in the villages. This is reflected in the failure of many bore wells in the villages. If the available rain water is properly harnessed by constructing new tanks and recharge structures at appropriate places in the villages, then the drinking and irrigation needs of the area can be easily met. The drainage network is dendritic to sub parallel.

2.5 Climate

The district falls under semiarid tract and is categorized as drought-prone with average annual rainfall of 813 mm (Table 2.1). Of the total rainfall, a maximum of 466 mm is received during south–west monsoon period from June to September, north-east monsoon from October to early December contributes about 196 mm and the remaining 151 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 35°C and in December and January, the temperatures will go down to 20°C. Rainfall distribution is shown in Figure 2.4. The average Potential Evapo-Transpiration (PET) is 110 mm and varies from a low of 73 mm in December to 152 mm in the month of April. The PET is always higher than precipitation in all the months except in the last week of August to first week of October. Generally, the Length of crop Growing Period (LGP) is 150 days and starts from 3rd week of June to third week of November.

Table 2.1 Mean Monthly Rainfall, PET, 1/2 PET in Gubbi Taluk, Tumakuru District

Sl. no.	Months	Rainfall	PET	1/2 PET
1	JAN	6.50	78.30	39.15
2	FEB	7.00	102.70	51.35
3	MAR	24.40	142.60	71.30
4	APR	40.50	151.60	75.80
5	MAY	72.50	149.70	74.85
6	JUN	78.50	121.10	60.55
7	JUL	99.20	107.60	53.80
8	AUG	119.70	105.80	52.90
9	SEP	168.30	101.20	50.60
10	OCT	141.90	100.20	50.10
11	NOV	47.00	85.00	42.50
12	DEC	7.30	73.00	36.50
	Total	812.80	109.90	

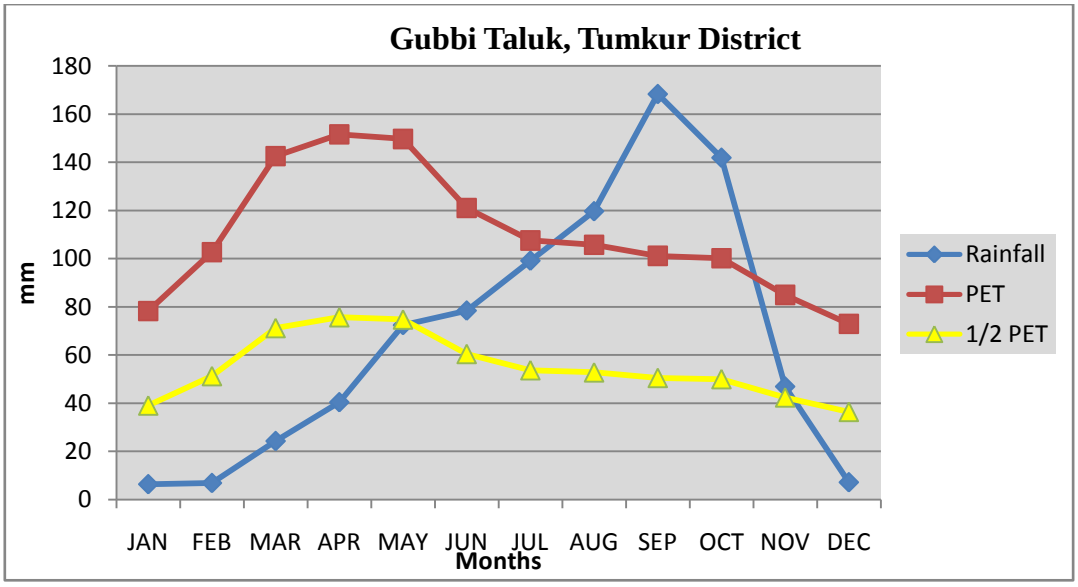


Fig 2.4 Rainfall distribution in Gubbi Taluk, Chamarajanagara District

2.6 Natural Vegetation

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

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

Fig. 2.5 Natural vegetation of Maddenahalli Microwatershed

2.7 Land Utilization

About 64 per cent area (Table 2.2) in Gubbi taluk is cultivated at present. An area of about 4 per cent is currently barren. Forests occupy an area of about 8 per cent. Most of the mounds, ridges and bouldery areas have very poor vegetative cover. Major crops grown in the area are Ragi, Groundnut, Maize, Sorghum, Redgram, Horse gram, Sunflower, Field bean, Cowpea, Mango, Banana, Mulberry and Plantation crops like Coconut, Banana and Arecanut. The cropping intensity is 116 per cent in the taluk. 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 Maddenahalli microwatershed is prepared. The current land use map generated shows the arable and non-arable lands, other land uses and different types of crops grown in the area (Fig 2.6). The different crops and cropping systems adopted in the microwatershed is presented in Figures 2.8.a &b. Simultaneously, enumeration of wells (bore wells and open wells) and existing conservation structures in the microwatershed are made and their location in different survey numbers is located on the cadastral map. Map showing the location of wells and other water bodies and conservation structures in Maddenahalli microwatershed is given in Fig.2.7.

Table 2.2 Land Utilization in Gubbi Taluk

Sl. No.	Agricultural land use	Area (ha)	Per cent
1	Total geographical area	122057	-
2	Total cultivated area	78418	64.24
3	Area sown more than once	12934	-
4	Cropping intensity	-	116.49
5	Trees and grooves	2811	2.30
6	Forest	10090	8.26
7	Cultivable wasteland	2731	2.23
8	Permanent Pasture land	3850	3.15
9	Barren land	4971	4.07
10	Non- Agriculture land	17390	14.24

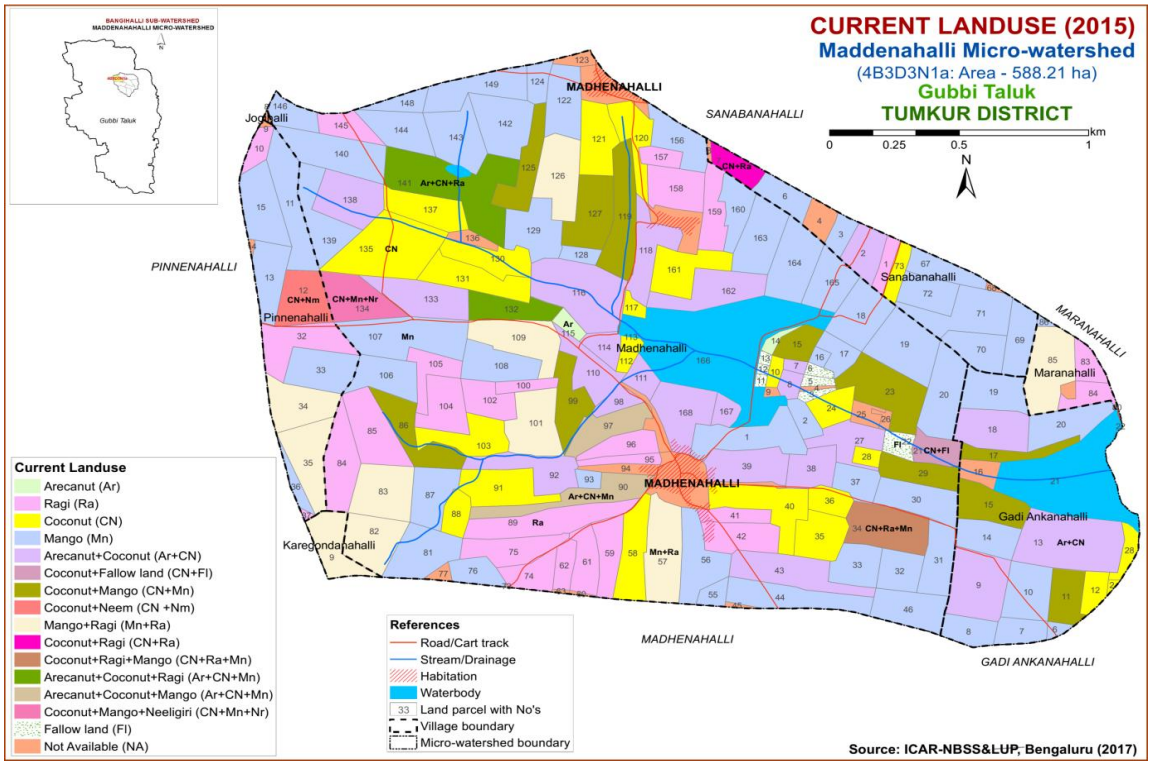


Fig.2.6 Current Land Use – Maddenahalli Microwatershed

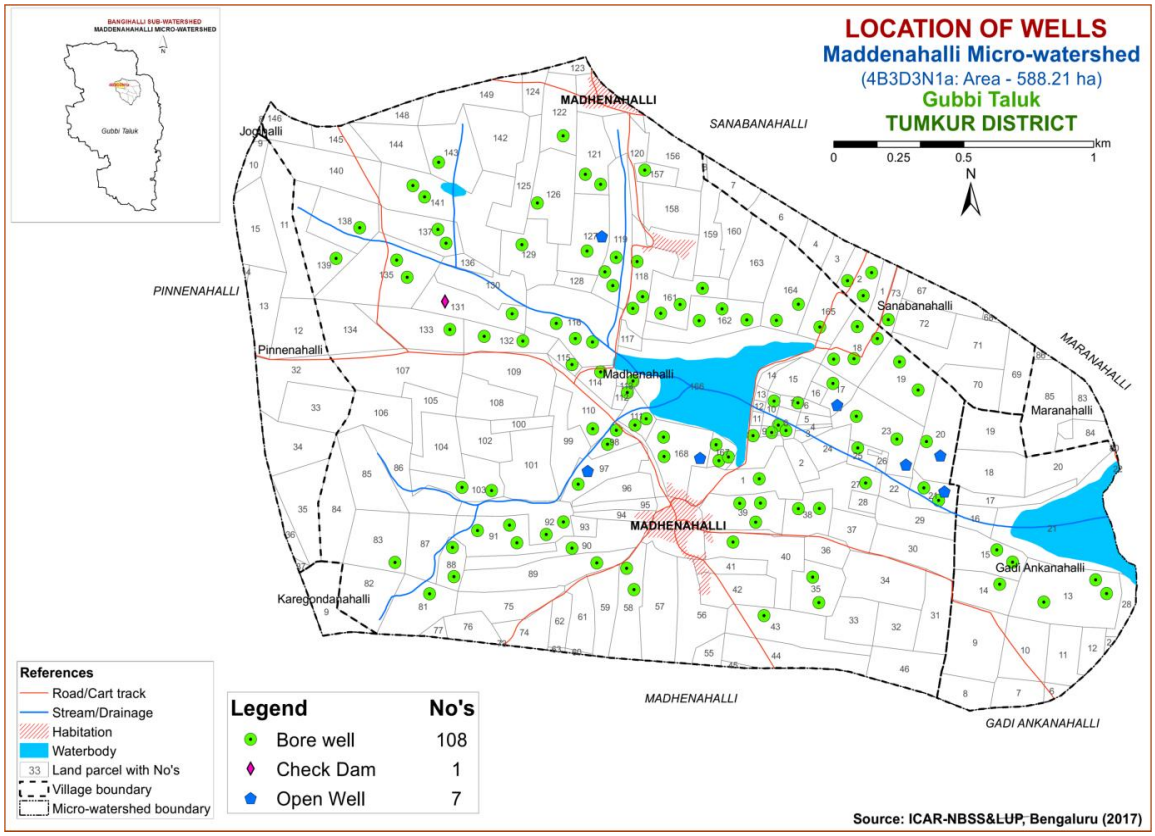


Fig.2.7 Location of Wells and Conservation Structures - Maddenahalli Microwatershed

Fig.2.8.a Different crops and cropping systems in Maddenahalli Microwatershed

Fig.2.8.b Different crops and cropping systems in Maddenahalli Microwatershed

Chapter 3

SURVEY METHODOLOGY

The purpose of land resource inventory is to delineate similar areas (soil series and phases), which respond or expected to respond similarly to a given level of management. This was achieved in Maddenahalli 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 of the land, erosion, drainage, occurrence of rock fragments etc.). This is followed by grouping of similar areas based on soil-site characteristics into homogeneous (management units) units, and showing their extent and their geographic distribution on the microwatershed cadastral map. The detailed survey at 1:7920 scale was carried out in an area of 588 ha. The methodology followed for carrying out land resource inventory was as per the guidelines given in Soil Survey Manual (IARI, 1971; Soil Survey Staff, 2006; Natarajan *et al.*, 2015) which is briefly described below.

3.1 Base Maps

The detailed survey of the land resources occurring in the microwatershed was carried out by using digitized cadastral map as a base. The cadastral map shows field boundaries with their survey numbers, location of tanks, streams and other permanent features of the area (Fig. 3.1). Apart from the cadastral map, remote sensing data products from Cartosat-1 and LISS IV merged at the scale of 1:7920 were used in conjunction with the cadastral map to identify the 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 in the field. Apart from cadastral maps and images, toposheets of the area (1:50,000 scale) were also used for initial traversing, identification of geology, landscape, landforms, drainage features, present land use and also for selection of transects in the microwatershed.

3.2 Image Interpretation for Physiography

False Colour Composites (FCCs) of Cartosat-I and LISS-IV merged satellite data covering the microwatershed area was visually interpreted using image interpretation elements along with the geology map and all the available collateral data with local knowledge. The delineated physiographic boundaries were transferred on to a cadastral map overlaid on satellite imagery. Physiographically, the area has been identified as granite gneiss landscape and is divided into land forms such as ridges, mounds, uplands and valleys based on slope and other relief features. They were further subdivided into

physiographic/ image interpretation units based on image characteristics. The image interpretation legend for physiography is given below.

Image Interpretation Legend for Physiography

G- Granite gneiss landscape

G1			Hills/ Ridges/ Mounds
	G11		Summits
	G12		Side slopes
		G121	Side slopes with dark grey tones
G2			Uplands
	G21		Summits
	G22		Gently sloping uplands
		G221	Gently sloping uplands, yellowish green (eroded)
		G222	Gently sloping uplands, yellowish white (severely eroded)
	G23		Very gently sloping uplands
		G231	Very gently sloping uplands, yellowish green
		G232	Very gently sloping uplands, medium green and pink
		G233	Very gently sloping uplands, pink and green (scrub land)
		G234	Very gently sloping uplands, medium greenish grey
		G235	Very gently sloping uplands, yellowish white (eroded)
		G236	Very gently sloping uplands, dark green
		G237	Very gently sloping uplands, medium pink (coconut garden)
		G238	Very gently sloping uplands, pink and bluish white (eroded)
	G24		Valleys/ lowlands
		G241	Valleys, pink tones
		G242	Valleys gray mixed with pink tones

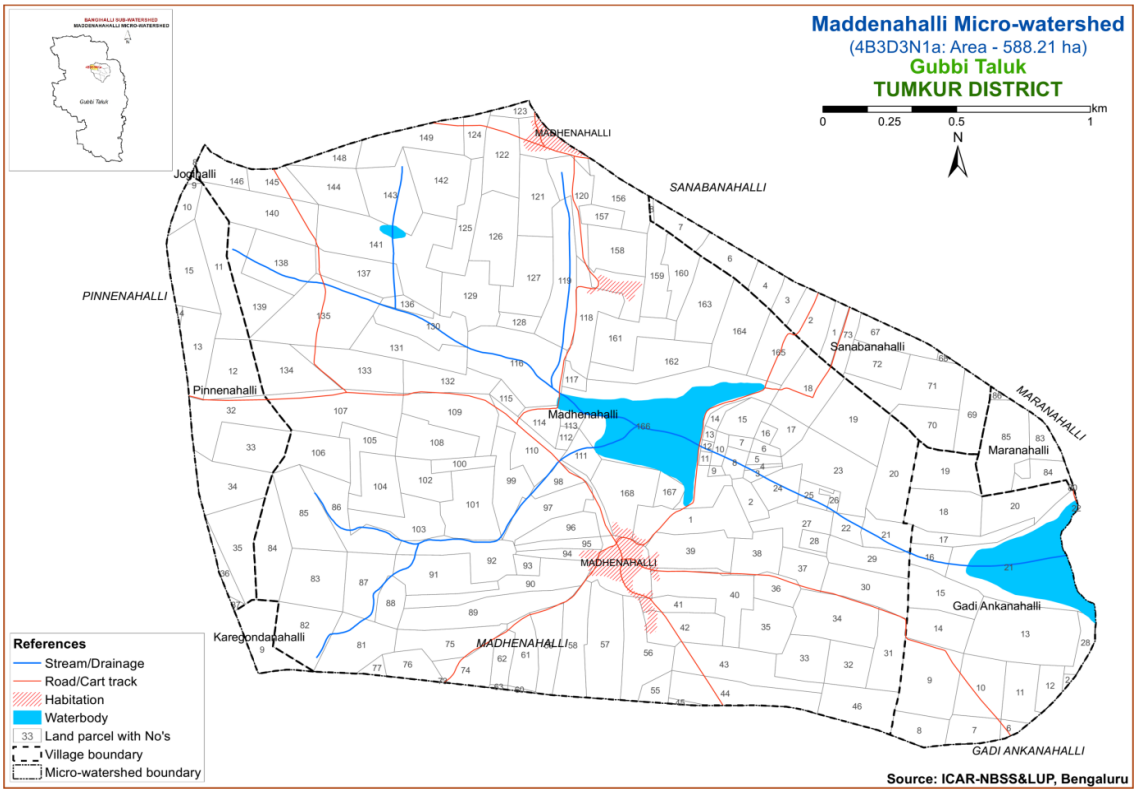


Fig 3.1 Scanned and Digitized Cadastral map of Maddenahalli Microwatershed

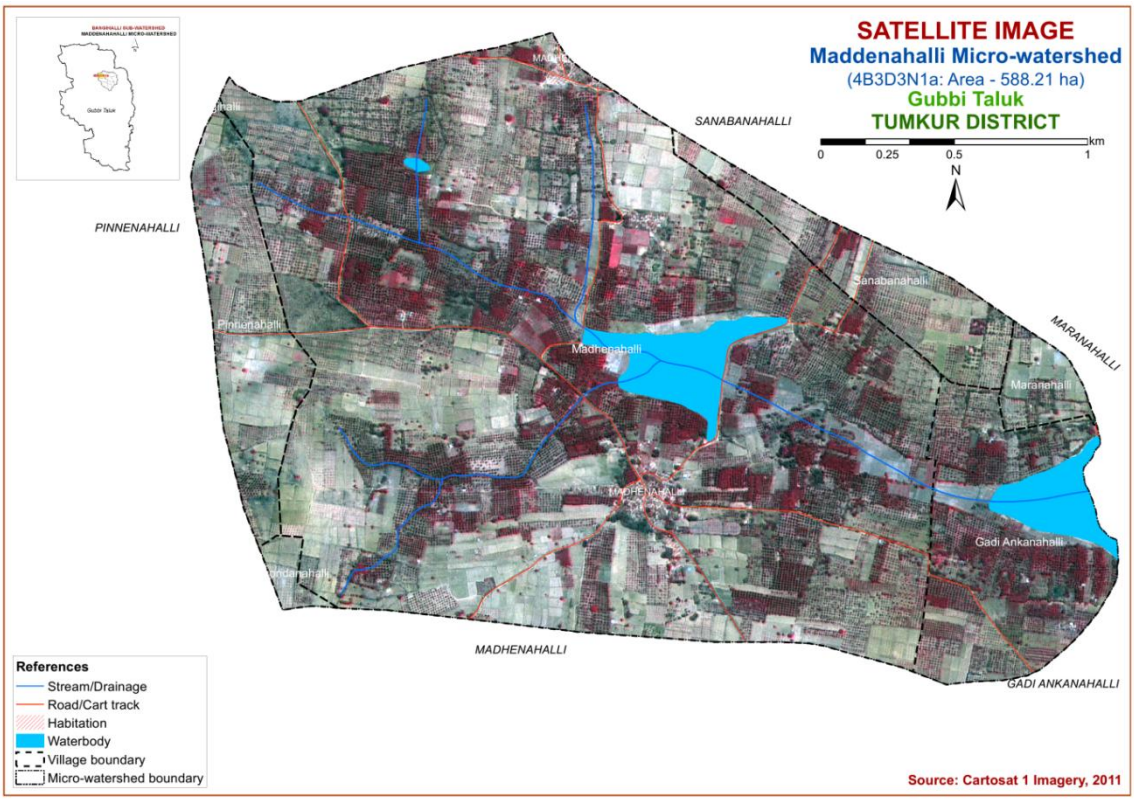


Fig.3.2 Satellite Image of Maddenahalli Microwatershed

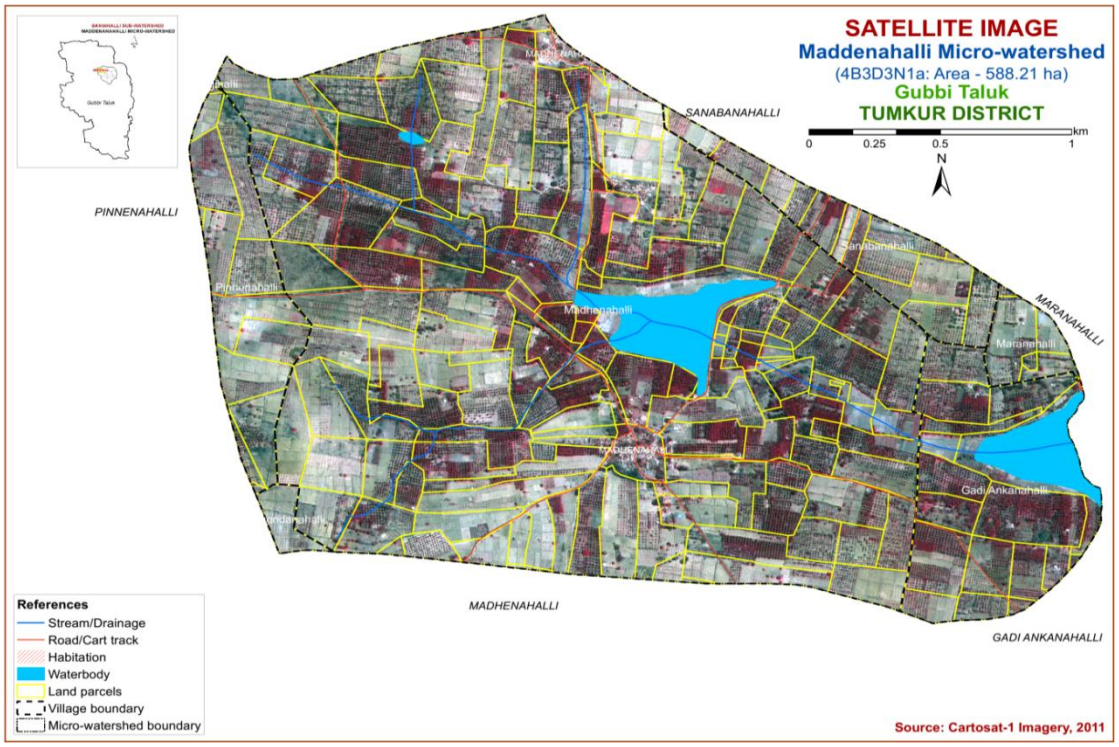


Fig.3.3 Cadastral map overlaid on IRS PAN+LISS IV merged imagery of Maddenahalli Microwatershed

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 valleys was carried out. Based on the variability observed on the surface, transects (Fig. 3.4) were selected across the slope covering all the landform units in the microwatershed (Natarajan and Dipak Sarkar, 2010).

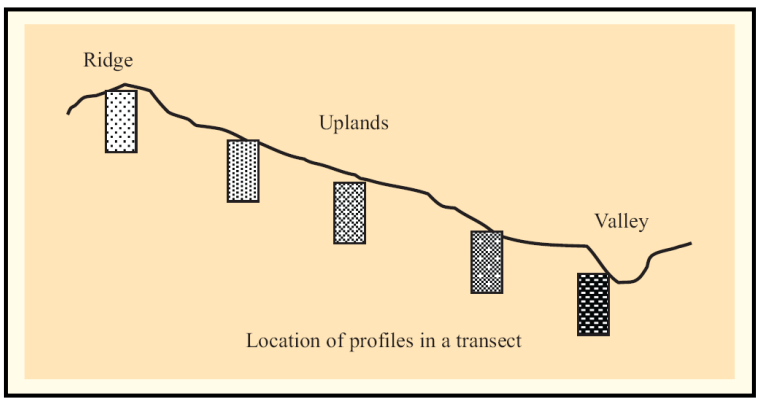


Fig: 3.4. Location of profiles in a transect

In the selected transect, soil profiles (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 up to 200 cm or to the depth limited by rock or hard substratum and studied in detail for all their morphological and physical characteristics. The soil and site characteristics were recorded for all profile sites on a standard proforma as per the guidelines given in USDA Soil Survey Manual (Soil Survey Staff, 2012). Apart from the transect study, profiles were also studied at random, almost like in a grid pattern, outside the transect areas.

Based on the soil characteristics, the soils were grouped into different soil series. Soil series is the most homogeneous unit having similar horizons and properties and behaves similarly for a given level of management. Soil depth, texture, colour, kind of horizon and horizon sequence, amount and nature of gravel present, nature of substratum etc, were used as the major differentiating characteristics for identifying soil series occurring in the area. The differentiating characteristics used for identifying the soil series are given in Table 3.1. Based on the above characteristics, 6 soil series were identified in the Maddenahalli microwatershed.

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

Soils of Granite gneiss Landscape							
Sl.No	**Soil Series**	**Depth (cm)**	**Colour (moist)**	**Texture (control section)**	**Gravel (%) (control section)**	**Horizon sequence**	**Calcareo-usness**
1	**Bidanagere (BDG)**	75-100	5YR3/3,3/4,4/3,5/4 2.5YR3/4	scl-sc	35-60	Ap-Bt-Cr	-
2	**Balapur (BPR)**	100-150	2.5YR2.5/4,3/4	sc-c	>35	Ap-Bt-Cr	-
3	**Muradi (MRD)**	>150	2.5YR3/6,4/6,5/6, 5/8	scl-sc	-	Ap-Bt	-
4	**Ranatur (RTR)**	>150	2.5YR2.5/3,2.5/4, 3/3,4/6	c	-	Ap-Bt	-
5	**Kadagathur (KDT)**	>150	10 YR 3/1, 3/2, 3/3, 7.5YR 3/3, 3/4	sc-c	-	Ap-Bw	-
Low land Series							
1	**Thimmasandra (TSD)**	>150	10YR2/12/2,3/1, 3/2,4/1, 4/2,4/3	sc-c	-	Ap-Bw	-

3.4 Soil Mapping

The area under each soil series was further separated into 18 soil phases and their boundaries delineated on the cadastral map based on the variations observed in the texture of the surface soil, slope, erosion, presence of gravel, stoniness etc. A soil phase is a subdivision of soil series based mostly on surface features that affect its use and management. The soil mapping units are shown on the map (Fig.3.5) in the form of symbols. During the survey about 8 profile pits, few minipits and a few auger bores representing different landforms occurring in the microwatershed were studied. In addition to the profile study, spot observations in the form of minipits, road cuts, terrace cuts etc., were studied to validate the soil boundaries on the soil map. The soil map shows the geographic distribution of 18 mapping units representing 6 soil series occurring in the microwatershed. The soil map unit (soil legend) description is presented in Table 3.2. The soil phase map (management units) shows the distribution of 18 soil phases mapped in the microwatershed. Each mapping unit (soil phase) delineated on the map has similar soil and site characteristics. In other words, all the farms or survey numbers included in one phase will have similar management needs and have to be treated accordingly.

The 18 soil phases identified and mapped in the microwatershed were regrouped into 5 Land Use Classes (LUC's) for the purpose of preparing a Proposed Crop Plan for sustained development of the microwatershed. The database (soil phases) generated under LRI was utilized for identifying Land Use Classes (LUCs) based on the management needs. One or more than one soil site characteristic having influence on the management have been choosen for identification and delineation of LUCs. For Maddenahalli microwatershed, five soil and site characteristics, namely soil depth, soil texture, slope, erosion and gravel content have been considered for defining LUCs. The land use classes are expected to behave similarly for a given level of management.

3.5 Laboratory Characterization

Soil samples were collected from representative master profiles for each soil series for laboratory characterization by following the methods outlined in the Laboratory Manual (Sarma *et al*, 1987). Surface soil samples collected from farmer's fields (88 samples) for fertility status (major and micronutrients) at 250 m grid interval were analyzed in the laboratory (Katyal and Rattan, 2003). By linking the soil fertility data to the survey numbers through GIS, soil fertility maps were generated using krigging method for the microwatershed.

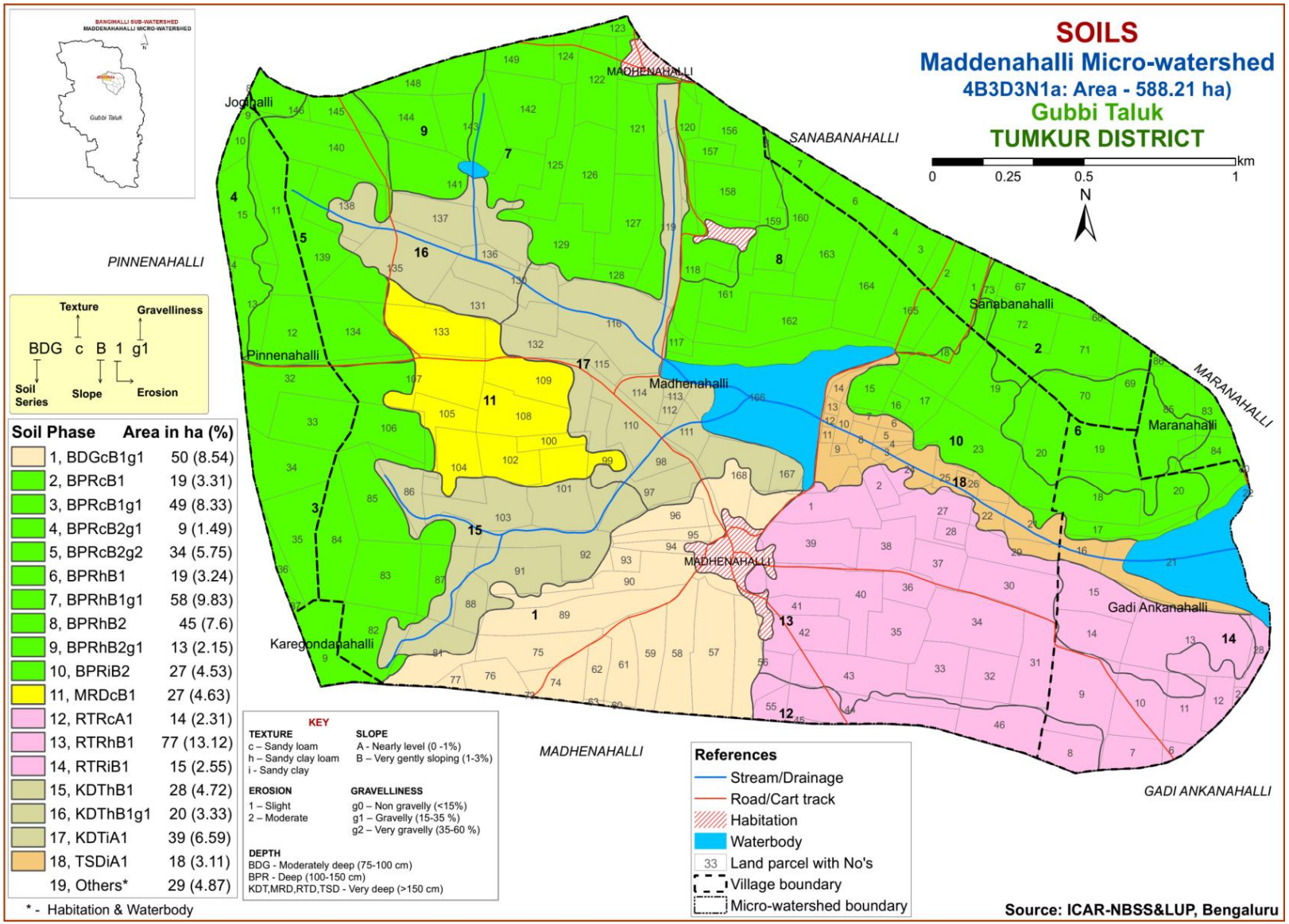


Fig 3.5 Soil Phase or Management Units Map - Maddenahalli Microwatershed

Table 3.2 Soil map unit description of Maddenahalli Microwatershed

Soil No	Soil Series	Soil Phase	Mapping Unit Description	Area in ha (%)
SOILS OF GRANITE GNEISS LANDSCAPE				
	BDG	Bidanagere soils are moderately deep (75-100 cm), well drained, have dark reddish brown gravelly sandy clay loam to sandy clay soils occurring on very gently sloping uplands under cultivation		**50 (8.54)**
1		BDGcB1g1	Sandy loam surface, slope 1-3%, slight erosion, gravelly (15-35%)	50 (8.54)
	BPR	Balapur soils are deep (100-150 cm), well drained, have dark reddish brown to dark red gravelly sandy clay to clay soils occurring on very gently sloping uplands under cultivation		**273 (46.23)**
2		BPRcB1	Sandy loam surface, slope 1-3%, slight erosion	19 (3.31)
3		BPRcB1g1	Sandy loam surface, slope 1-3%, slight erosion, gravelly (15-35%)	49 (8.33)
4		BPRcB2g1	Sandy loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	9 (1.49)
5		BPRcB2g2	Sandy loam surface, slope 1-3%, moderate erosion, very gravelly (35-60%)	34 (5.75
6		BPRhB1	Sandy clay loam surface, slope 1-3%, slight erosion	19 (3.24)
7		BPRhB1g1	Sandy clay loam surface, slope 1-3%, slight erosion, gravelly (15-35%)	58 (9.83)
8		BPRhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	45 (7.60)
9		BPRhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	13 (2.15)
10		BPRiB2	Sandy clay surface, slope 1-3%, moderate erosion	27 (4.53)
	MRD	Muradi soils are very deep (>150 cm), well drained, have red to dark red sandy clay loam to sandy clay soils occurring on very gently sloping uplands under cultivation		**27 (4.63)**
11		MRDcB1	Sandy loam surface, slope 1-3%, slight erosion	27 (4.63)
	RTR	Ranatur soils are very deep (>150 cm), well drained, have dark reddish brown to dark red clay soils occurring on very gently sloping uplands under cultivation		**106 (17.98)**
12		RTRcA1	Sandy loam surface, slope 0-1%, slight erosion	14 (2.31)
13		RTRhB1	Sandy clay loam surface, slope 1-3%, slight erosion	77 (13.12)

14		RTRiB1	Sandy clay surface, slope 1-3%, slight erosion	15 (2.55)
	KDT	Kadagathur soils are very deep (>150 cm), moderately well drained, have dark brown to very dark grayish brown sandy clay to clay soils occurring on nearly level to very gently sloping uplands under cultivation		**87 (14.64)**
15		KDThB1	Sandy clay loam surface, slope 1-3%, slight erosion	28 (4.72)
16		KDThB1g1	Sandy clay loam surface, slope 1-3%, slight erosion, gravelly (15-35%)	20 (3.33)
17		KDTiA1	Sandy clay surface, slope 0-1%, slight erosion	39 (6.59)
	TSD	Thimmasandra soils are very deep (>150 cm), moderately well drained, have very dark brown to very dark grayish brown sandy clay to clay soils occurring on nearly level to very gently sloping lowlands under cultivation		**18 (3.11)**
18		TSDiA1	Sandy clay surface, slope 0-1%, slight erosion	18 (3.11)
19		Others	Habitation and waterbody	29 (4.87)

Chapter 4

THE SOILS

Detailed information pertaining to the nature, extent and their distribution of different kinds of soils occurring in Maddenahalli microwatershed is provided in this chapter. The microwatershed area has been identified as granite gneiss landscape based on geology. In all, 6 soil series are identified. Soil formation is the result of the combined effect of environmental and terrain factors that are reflected in soil morphology. In the granite gneiss landscape it is by parent material, relief and climate.

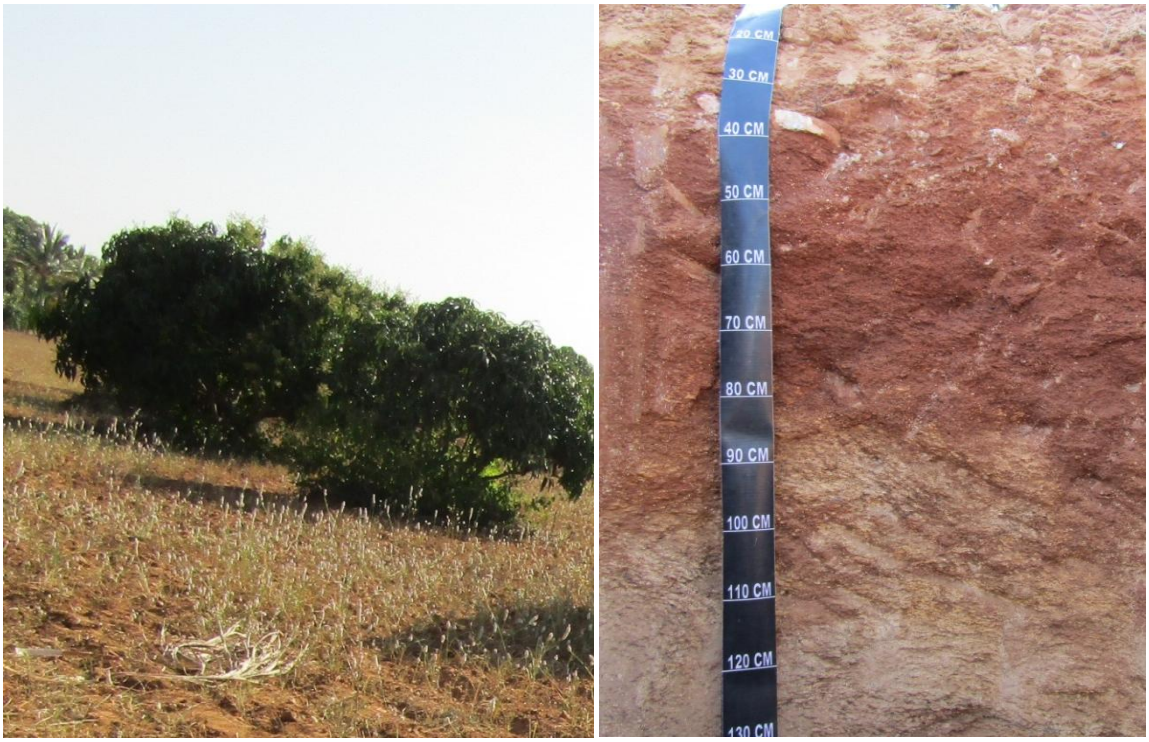
A brief description of each of the 6 soil series identified followed by 18 soil phases (management units) mapped under each series (Fig. 3.5) are furnished below. The soils in any one map unit differ from place to place in their depth, texture, slope, gravelliness, erosion or any other site characteristic 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 are identified and mapped. Brief description of each series identified is given below. Of these, Balapur (BPR) series occupy a major area of about 273 ha (46%) followed by Ranatur (RTR) 106 ha (18%). The brief description of each soil series and number of phases identified in the microwatershed are given below. The mapping unit description (Soil Legend) of the soil phases identified and mapped under each series is given in Table 3.2.

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

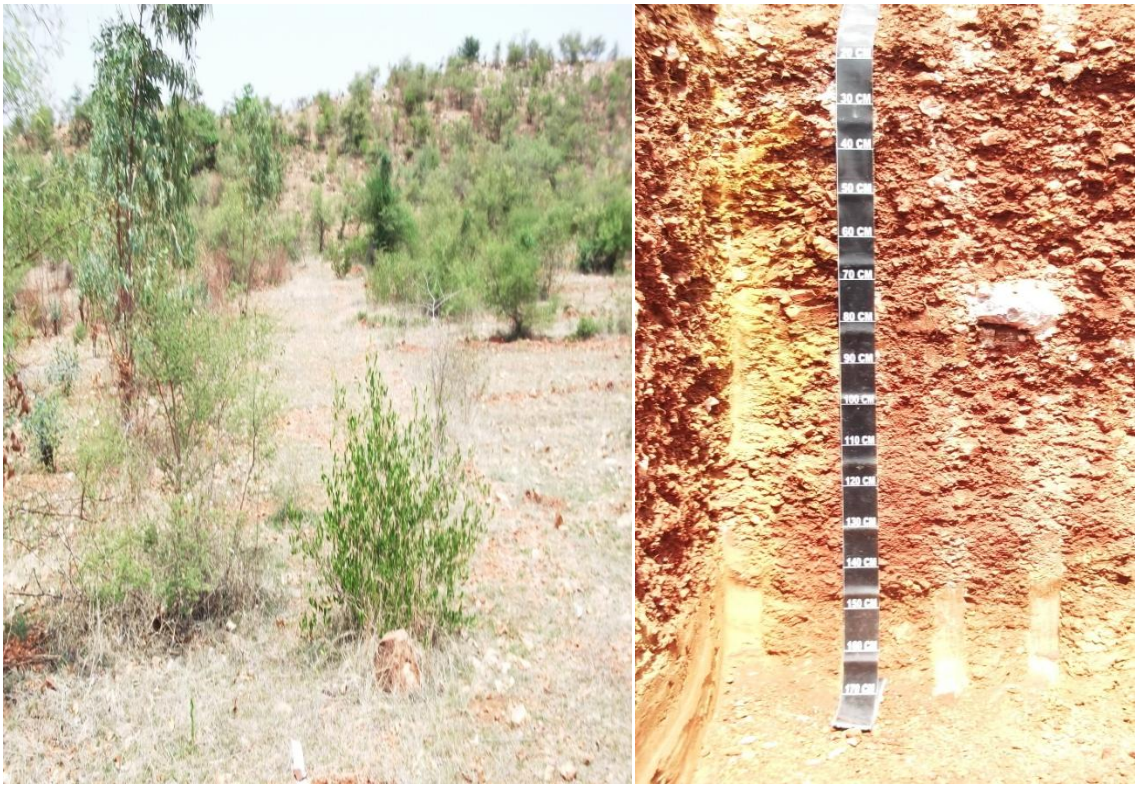
The thickness of the solum ranges from 78 to 99 cm. The thickness of A horizon ranges from 12 to 19 cm. Its colour is in 2.5 YR and 5 YR hue with value 2 to 3 and chroma 3 to 4. The texture varies from sandy clay loam to sandy clay with 10 to 20 per cent gravel. The thickness of B horizon ranges from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



Landscape Soil Profile Characteristics of Bidanagere (BDG) Series

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

The thickness of the solum ranges from 102 to 147 cm. The thickness of A horizon ranges from 12 to 17 cm. Its colour is in 5 YR and 2.5 YR hue with value and chroma 3 to 4. The texture ranges from loamy sand to sandy clay with 15 to 50 per cent gravel. The thickness of B horizon ranges from 90 to 132 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 (51-100 mm/m). Nine phases were identified and mapped.



Landscape and Soil Profile Characteristics of Balapur (BPR) Series

4.1.3 Muradi (MRD) Series: Muradi soils are very deep (>150 cm), well drained, have red to dark red sandy clay loam to sandy clay soils. They have developed from weathered granite gneiss and occur on very gently sloping uplands under cultivation.

The thickness of the solum ranges from 120 to 180 cm. The thickness of A horizon ranges from 16 to 26 cm. Its colour is in 2.5 YR hue with value 3 and chroma 4. The texture is sandy loam. The thickness of B horizon ranges from 112 to 160 cm. Its colour is in 2.5 YR hue with value 3 to 5 and chroma 6 to 8. Its texture is sand clay loam to sandy clay. The available water capacity is medium (101-150 mm/m). Only one phase was identified and mapped.

Landscape Soil Profile Characteristics of Muradi (MRD) Series

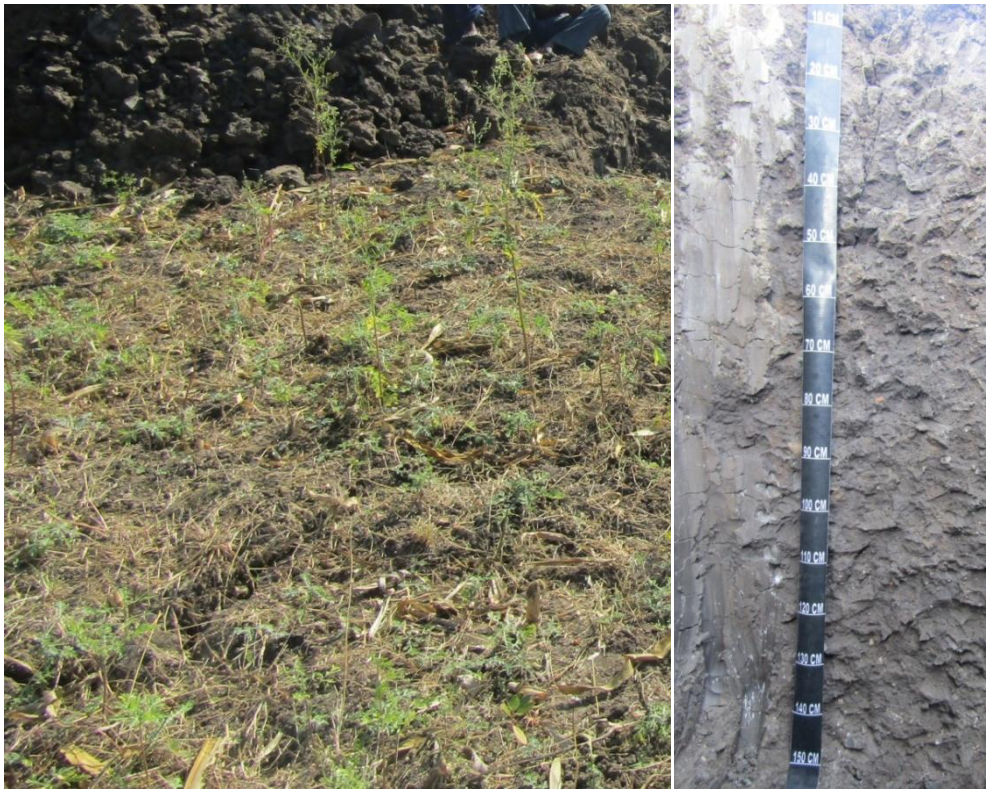
4.1.4 Ranatur (RTR) Series: Ranatur soils are very deep (> 150 cm), well drained, have dark reddish brown to dark red clayey soils. They have developed from weathered granite gneiss and occur on very gently sloping uplands. The Ranatur series has been tentatively classified as a member of the fine, mixed, isohyperthermic family of Rhodic Paleaustalfs.

The thickness of the solum is more than 150 cm. The thickness of A horizon ranges from 8 to 14 cm. Its colour is in 5 YR and 2.5 YR hue with value 2.5 to 4 and chroma 3 to 6. The texture varies from sandy loam to sand clay. The thickness of B horizon is more than 150 cm. Its colour is in 2.5 YR hue with value 2.5 to 3 and chroma 3 to 6. Its texture is clay. The available water capacity is medium (101-150 mm/m). Three phases were identified and mapped.

Landscape and soil profile characteristics of Ranatur (RTR) Series

4.1.5 Kadagathur (KDT) Series: Kadagathur soils are very deep (>150 cm), moderately well drained, have dark brown to very dark grayish brown sandy clay to clay soils. They have developed from weathered granite gneiss and occur on nearly level to very gently sloping uplands under cultivation.

The thickness of the solum is more than 150 cm. The thickness of A horizon ranges from 8 to 14 cm. Its colour is in 10 YR hue with value 3 and chroma 4. The texture varies from sandy loam to sandy clay loam. The thickness of B horizon is more than 150 cm. Its colour is in 10 YR and 7.5 YR hue with value 3 and chroma 1 to 4. Its texture is sandy clay to clay. The available water capacity is very high (>200 mm/m). Three phases were identified and mapped.



Landscape and soil profile characteristics of Kadagathur (KDT) Series

4.1.6 Thimmasandra (TSD) Series: Thimmasandra soils are very deep (>150 cm), moderately well drained, have very dark brown to very dark grayish brown sandy clay to clay soils. They have developed from weathered granite gneiss and occur on nearly level to very gently sloping lowlands under cultivation.

The thickness of the solum ranges from 150-200 cm. The thickness of A horizon ranges from 11 to 17 cm. Its colour is in 10 YR hue with value 3 and chroma 3. The texture is sandy clay. The thickness of B horizon is more than 150 cm. Its colour is in 10 YR hue with value 2 to 4 and chroma 1 to 3. Its texture is sandy clay to clay. The available water capacity is very high (>200 mm/m). Only one phase was identified and mapped.

Chapter 5

INTERPRETATION FOR LAND RESOURCE MANAGEMENT

The most important soil and site characteristics that affect the land use and conservation needs of an area are land capability, soil depth, soil texture, coarse fragments, available water capacity, soil slope, soil erosion, soil reaction etc. These are interpreted from the data base generated through land resource inventory and several interpretative and 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 interpretative and thematic maps generated are described below.

5.1 Land Capability Classification

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

Soil characteristics: Depth, texture, gravelliness, calcareousness.

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

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

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

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

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

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

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

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

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

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

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

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

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

The 18 soil map units identified in the Maddenahalli microwatershed are grouped under 2 land capability classes and 4 land capability subclasses. About 560 ha (95%) in the microwatershed is suitable for agriculture and 29 ha (5 %) is not suitable for agriculture (Fig. 5.1).

Good cultivable lands (Class II) cover an area of about 40 per cent and are distributed in the central, southern and southeastern part of the micowatershed with minor problems of soil and wetness. Moderately good cultivable lands (Class III) cover an area of about 55 per cent and are distributed in the northern, southern, southwestern and northwestern part of the microwatershed with moderate problems of erosion and soil.

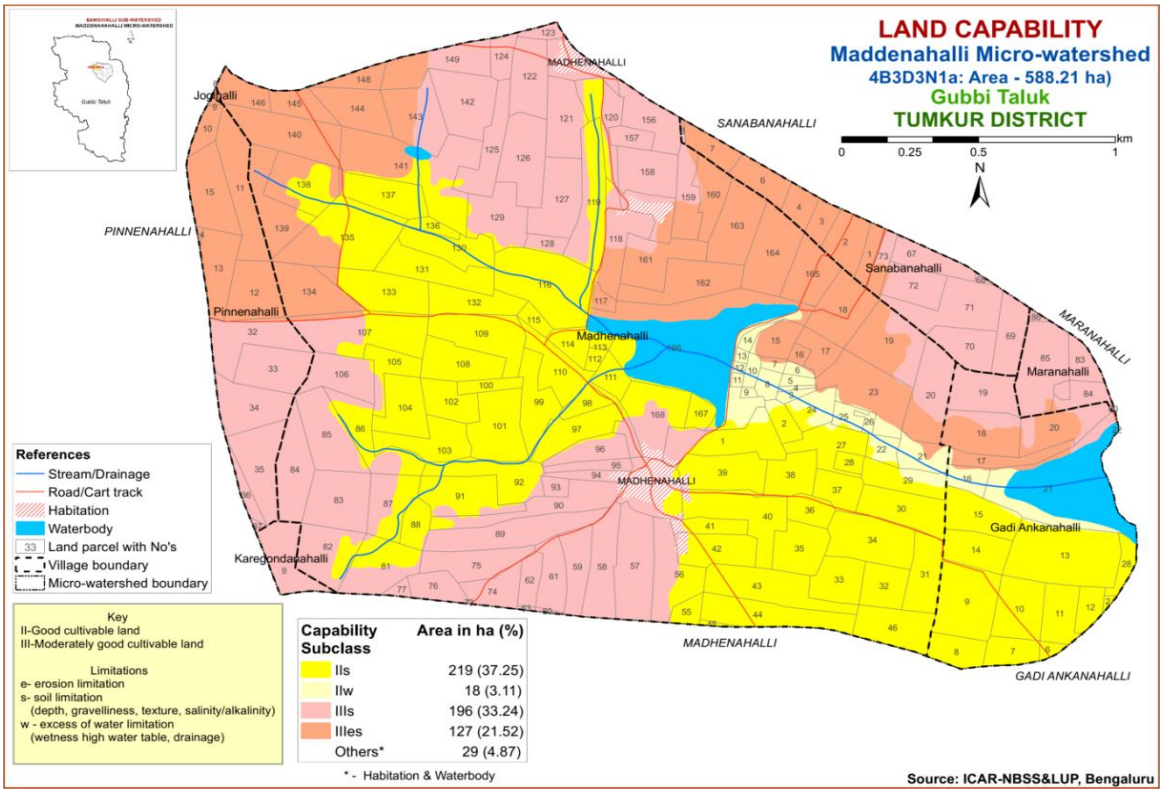


Fig. 5.1 Land Capability map of Maddenahalli Microwatershed

5.2 Soil Depth

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

Moderately deep (75-100 cm) soils occupy a small area of about 50 ha (9%) and are distributed in the southern part of the microwatershed. Deep (100-150 cm) soils occupy a maximum area of 272 ha (46%) and are distributed in the northern, northeastern and western part of the microwatershed. Very deep (>150 cm) soils cover an area of 237 ha (40%) and are distributed in the central and southern part of the microwatershed.

The most productive lands 509 ha (86%) with respect to soil rooting depth where all climatically adapted annual and perennial crops can be grown are very deep (>150 cm depth) and deep (100-150 cm) occurring in major part of the microwatershed.

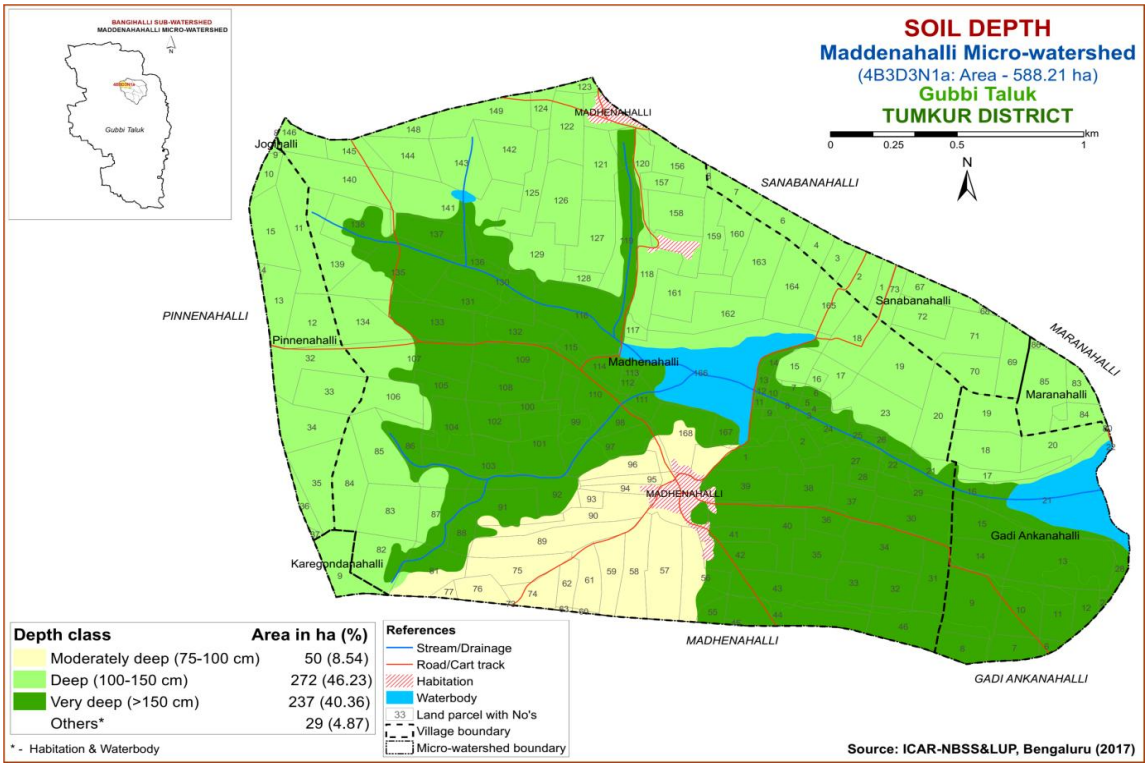


Fig. 5.2 Soil Depth map of Maddenahalli Microwatershed

5.3 Surface Soil Texture

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

Maximum area of about 461 ha (78%) has soils that are loamy at the surface. They are distributed in the major part of the microwatershed and an area of 99 ha (17%) has soils that are clayey at the surface and are distributed in the central and eastern part of the microwatershed (Fig. 5.3).

The productive lands (17%) with respect to surface soil texture are the clayey soils that have high potential for soil-water retention and availability, and nutrient retention and availability, but more have problems of drainage, infiltration, workability and other physical problems. The other most productive lands (78%) are loamy soils which also have high potential for AWC, nutrient availability but have no drainage or other physical problems.

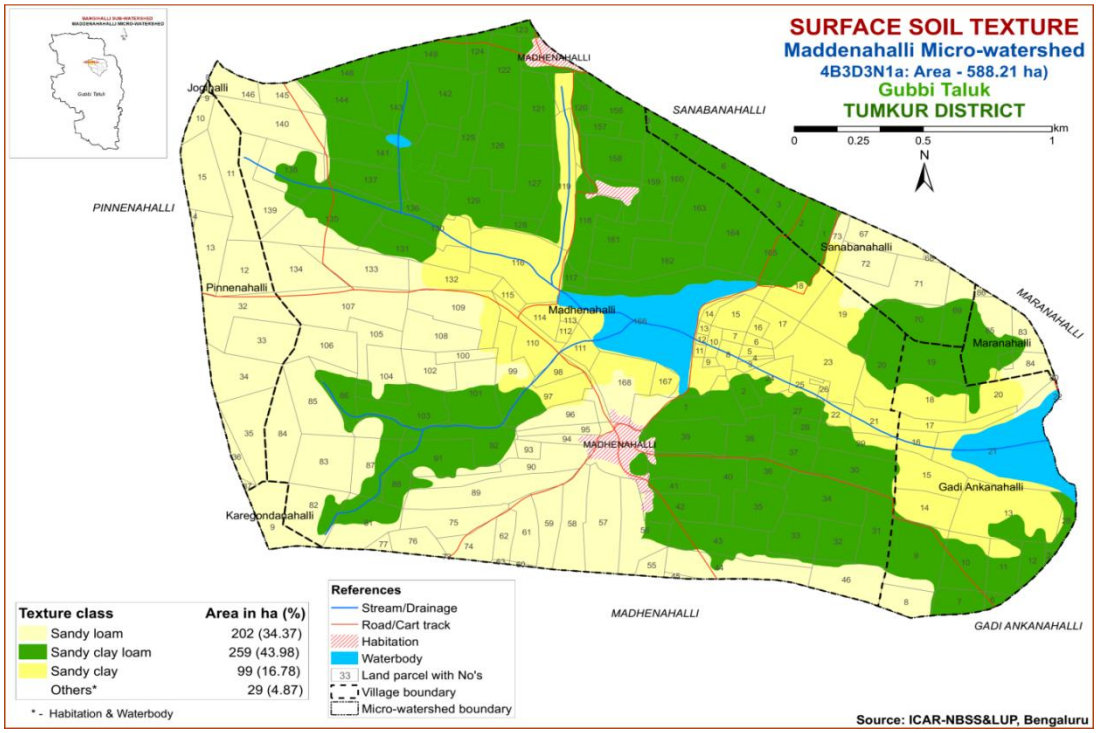


Fig. 5.3 Surface Soil Texture map of Maddenahalli Microwatershed

5.4 Soil Gravelliness

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

An area in the microwatershed has soils that are very gravelly (35-60%) covering a very small area of about 34 ha (6%) and are distributed in the northeastern part of the microwatershed. Maximum area of about 328 ha (56%) is non gravelly (<15%) and distributed in the central, southeastern and northeastern part of the microwatershed. Gravelly (15-35%) soils covering an area of about 198 ha (34%) are distributed in the northwestern and southwestern part of the microwatershed (Fig 5.4).

The problem soils (6%) that are very gravelly (35-60%) where only short duration crops can be grown and are distributed in the northwestern part of the microwatershed.
The most productive soils (56%) that are non gravelly (<15%) and are distributed in the central, southeastern and northeastern part of the microwatershed where all climatically adopted crops can be grown.

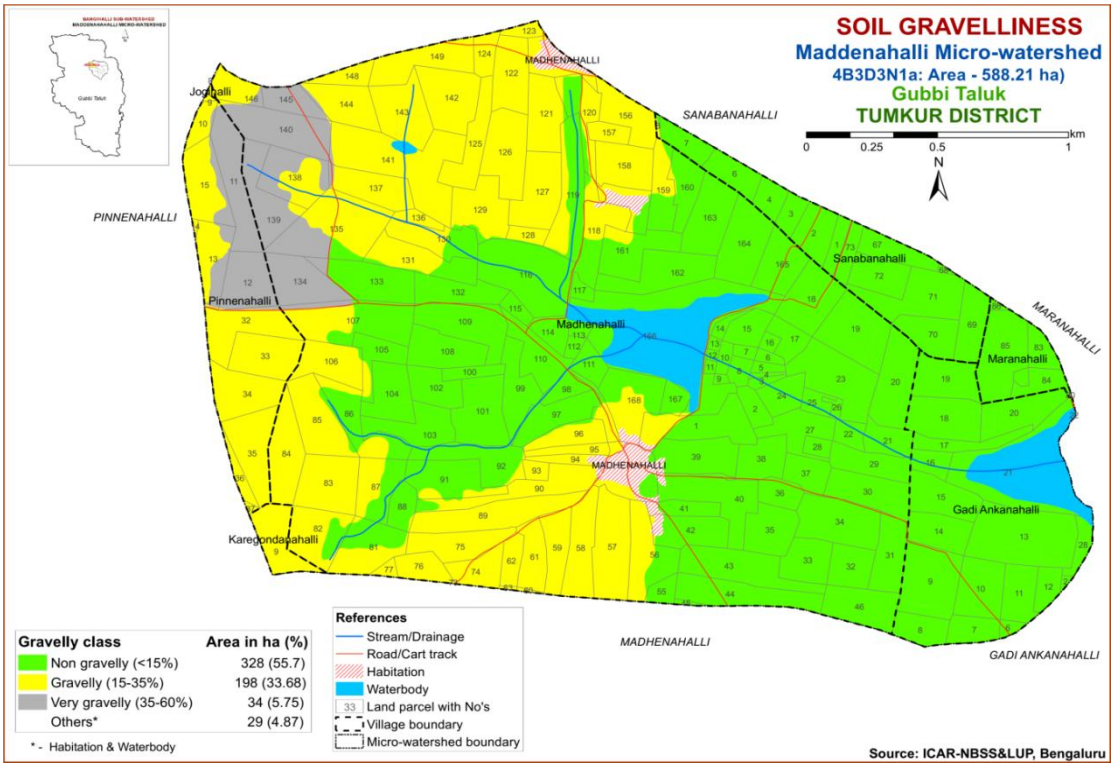


Fig. 5.4 Soil Gravelliness map of Maddenahalli Microwatershed

5.5 Available Water Capacity

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

An area of about 50 ha (9%) in the microwatershed has soils that are very low (<50 mm/m) in available water capacity and are distributed in the southern part of the microwatershed. Maximum area of about 272 ha (46%) are low (51-100 mm/m) in available water capacity and are distributed in major part of the microwatershed. An area of about 133 ha (23%) is medium (101-150 mm/m) in available water capacity and are distributed in the southern part of the microwateshed followed by an area of 104 ha (18%) very high (>200 mm/m) and are distributed in the central part of the microwatershed.

About 322 ha (55%) area in the microwatershed has soils that are problematic with regard to available water capacity. Here, only short or medium duration crops can be grown and the probability of crop failure is very high. These areas are best put to other alternative uses. The most productive lands cover about 18 per cent area where all climatically adopted long duration crops can be grown successfully.

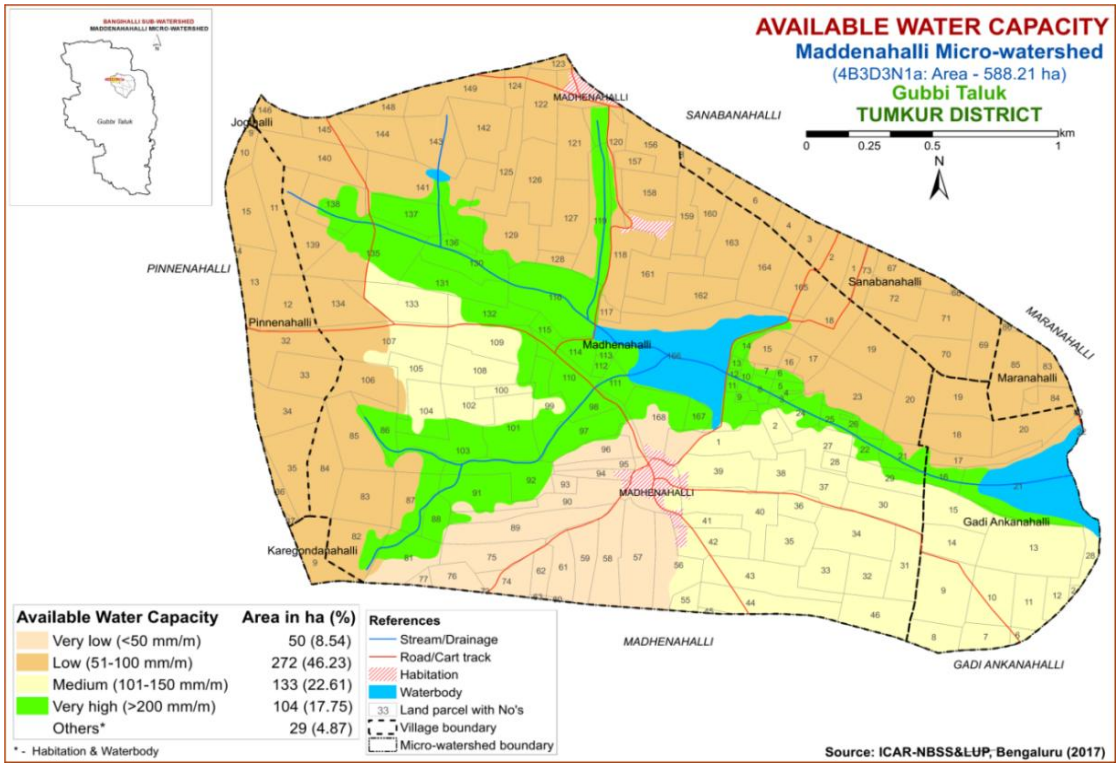


Fig. 5.5 Soil Available Water Capacity map of Maddenahalli Microwatershed

5.6 Soil Slope

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

Major area of about 489 ha (83%) falls under very gently sloping (1-3% slope) lands and is distributed in the major part of the microwatershed and an area of about 71 ha (12%) is under nearly level (0-1% slope) and distributed in the central part of the microwatershed.

Entire area in the microwatershed has soils that have high potential in respect of soil slopes. In these areas, all climatically adapted annual and perennial crops can be grown without much soil and water conservation and other land development measures.

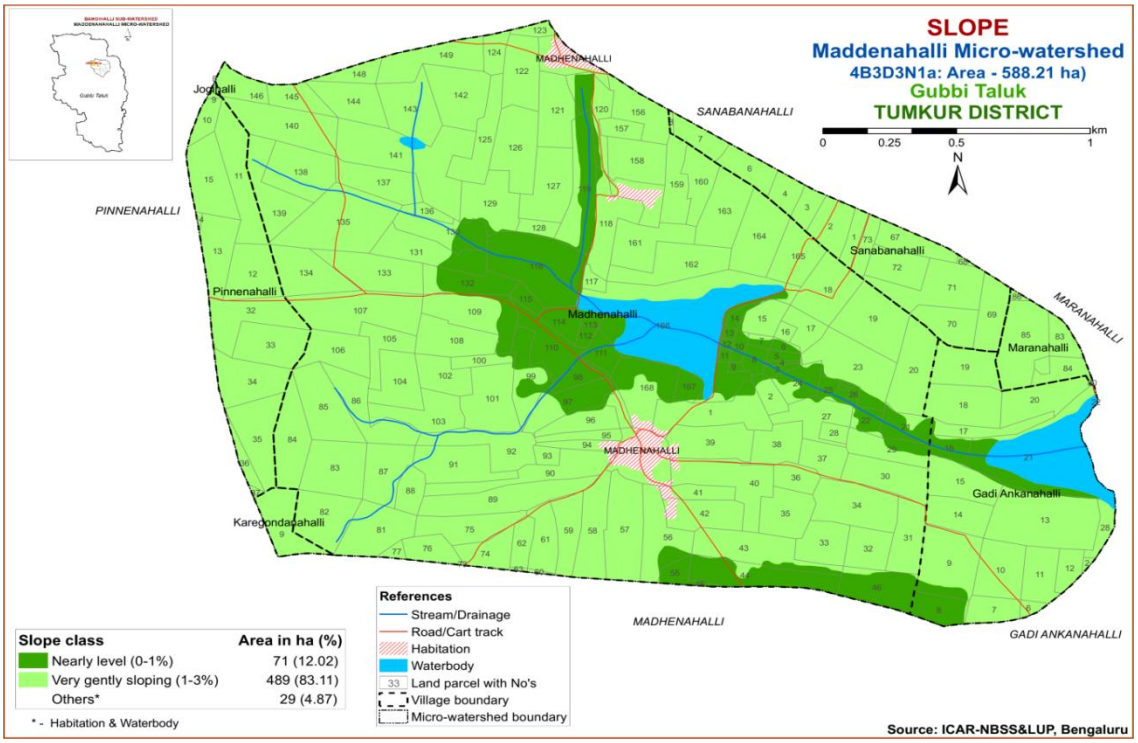


Fig. 5.6 Soil Slope map of Maddenahalli Microwatershed

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.

Soils that are moderately eroded (e2 Class) cover an area of about 127 ha (22%) in the microwatershed. They are distributed in the northern part of the microwatershed. Slightly eroded (e1 Class) soils cover a maximum area of about 433 ha (74%) and are distributed in the major part of the microwatershed.

An area of about 127 ha (22%) in the microwatershed is problematic because of moderate erosion. For these areas taking up soil and water conservation and other land development measures are needed.

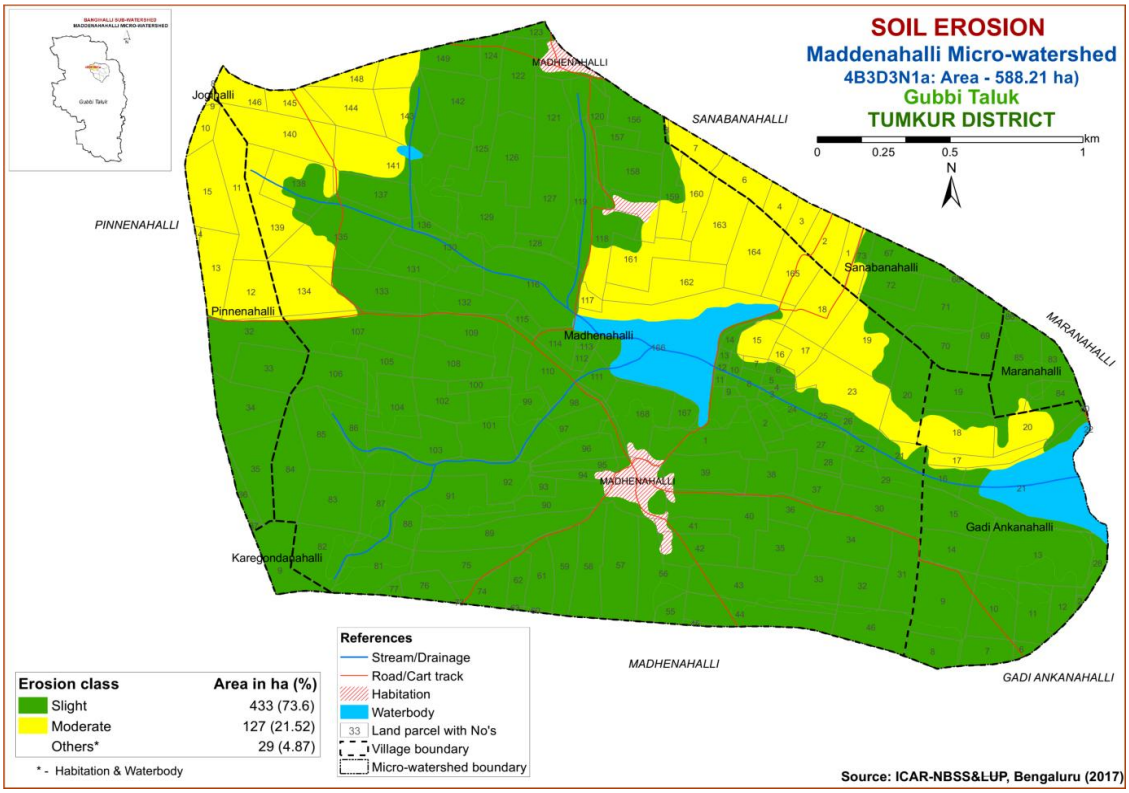


Fig. 5.7 Soil Erosion map of Maddenahalli Microwatershed

Chapter 6

FERTILITY STATUS

Soil fertility plays an important role in increasing crop yield. The adoption of high yielding varieties that require high amounts of nutrients has resulted in deficiency symptoms in crops and plants due to imbalanced fertilization and poor inherent fertility status as the area is characterised by low rainfall and high temperatures. Hence, it is necessary to know the fertility (macro and micro nutrients) status of the soils of the watersheds for assessing the kind and amount of fertilizers required for each of the crop intended to be grown. For this purpose, the surface soil samples collected from the grid points (one soil sample at every 250 m interval) all over the microwatershed through land resource inventory in the year 2014 were analysed for pH, EC, organic carbon, available phosphorus and potassium, and for micronutrients like zinc, boron, copper, iron and manganese, and secondary nutrient sulphur.

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

6.1 Soil Reaction (pH)

The soil analysis of the Maddenahalli microwatershed for soil reaction (pH) showed that an area of about 37 ha (6%) is neutral (pH 6.5-7.3) and are distributed in the central part of the microwatershed. An area of 168 ha (28%) is slightly acid (pH 6.0-6.5) and are distributed in the eastern, central and northern part of the microwatershed, a maximum area of 237 ha (40%) is moderately acid (pH 5.5-6.0) and are distributed in the major part of the microwatershed. An area of about 168 ha (28%) is strongly acid (pH 5.0-5.5) and are distributed in the southern and northeastern part of the microwatershed (Fig.6.1).

6.2 Electrical Conductivity (EC)

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

6.3 Organic Carbon

The soil organic carbon (An index of available Nitrogen) content in the microwatershed is medium (0.5-0.75%) covering a maximum area of about 186 ha (32%) and is distributed in the northern and eastern part of the microwatershed. It is low (<0.5%) in a maximum area of about 373 ha (63%) area and distributed in the major part of the microwatershed (Fig.6.3).

6.4 Available Phosphorus

Available phosphorus content is high (>57 kg/ha) in the entire microwatershed (Fig 6.4).

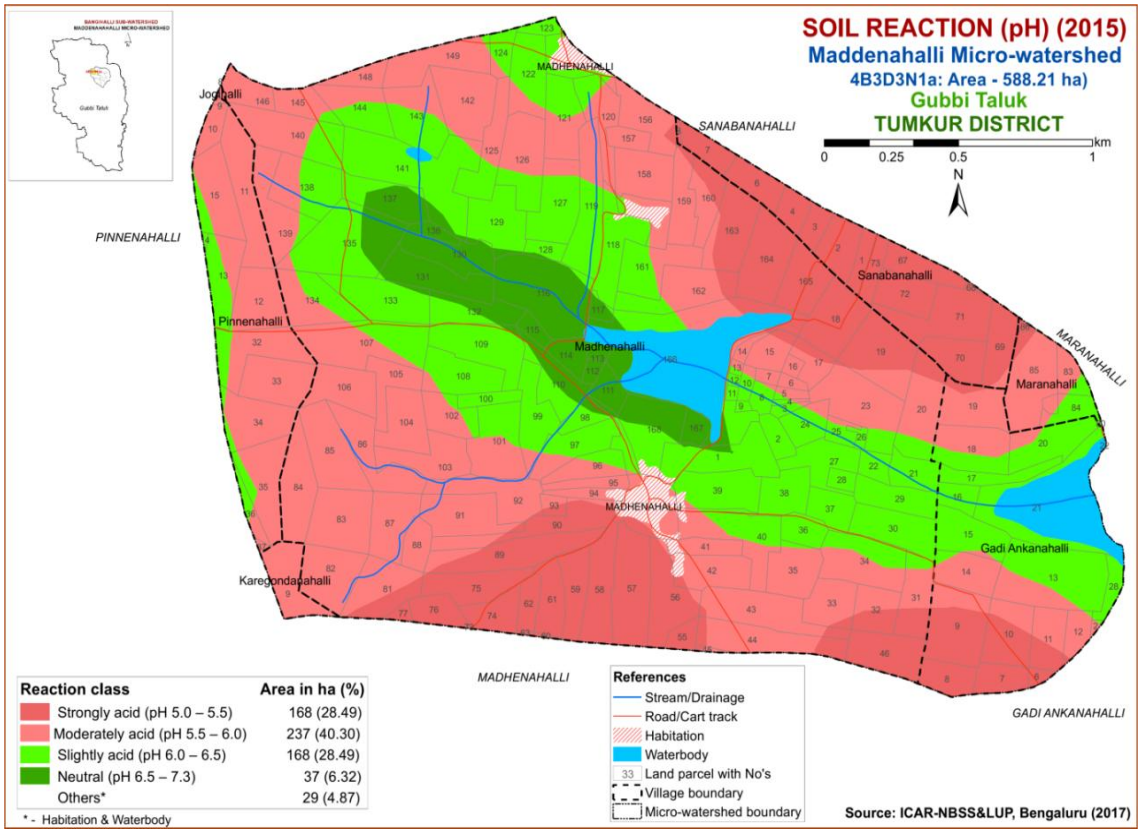


Fig.6.1 Soil Reaction (pH) map of Maddenahalli Microwatershed

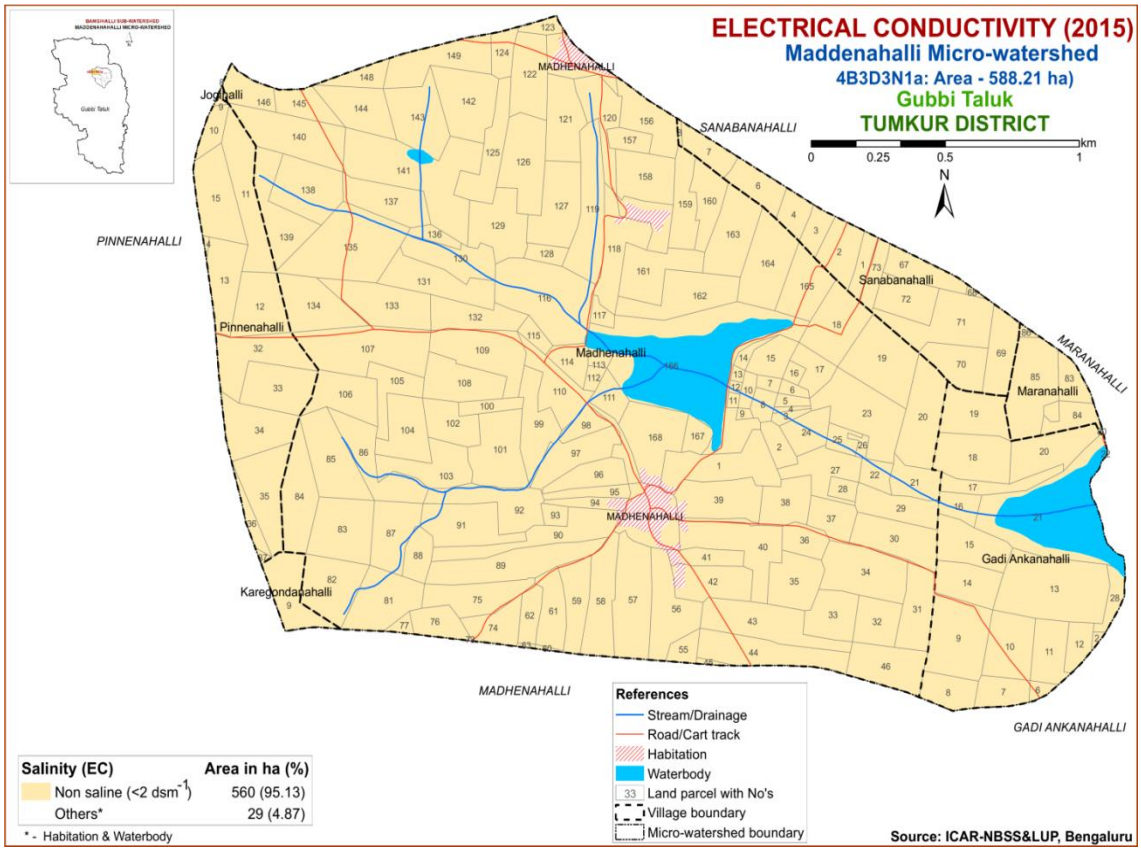


Fig.6.2 Electrical Conductivity (EC) map of Maddenahalli Microwatershed

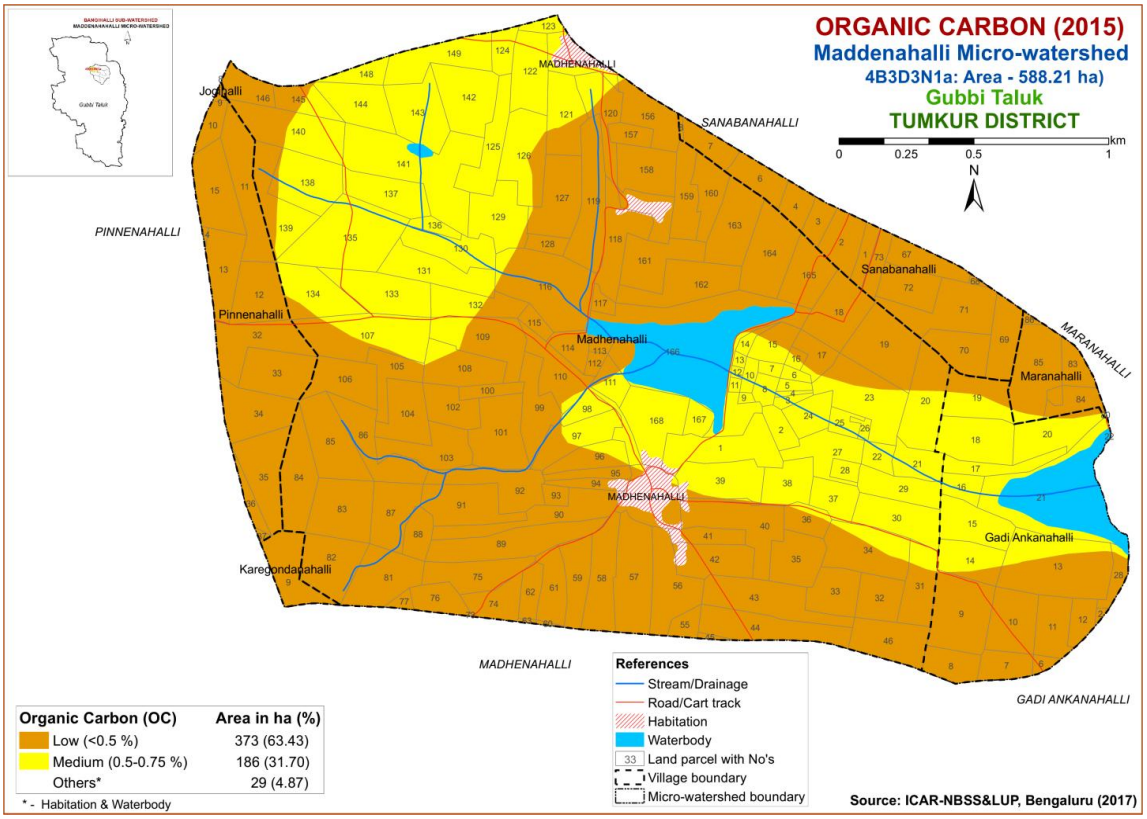


Fig.6.3 Soil Organic Carbon map of Maddenahalli Microwatershed

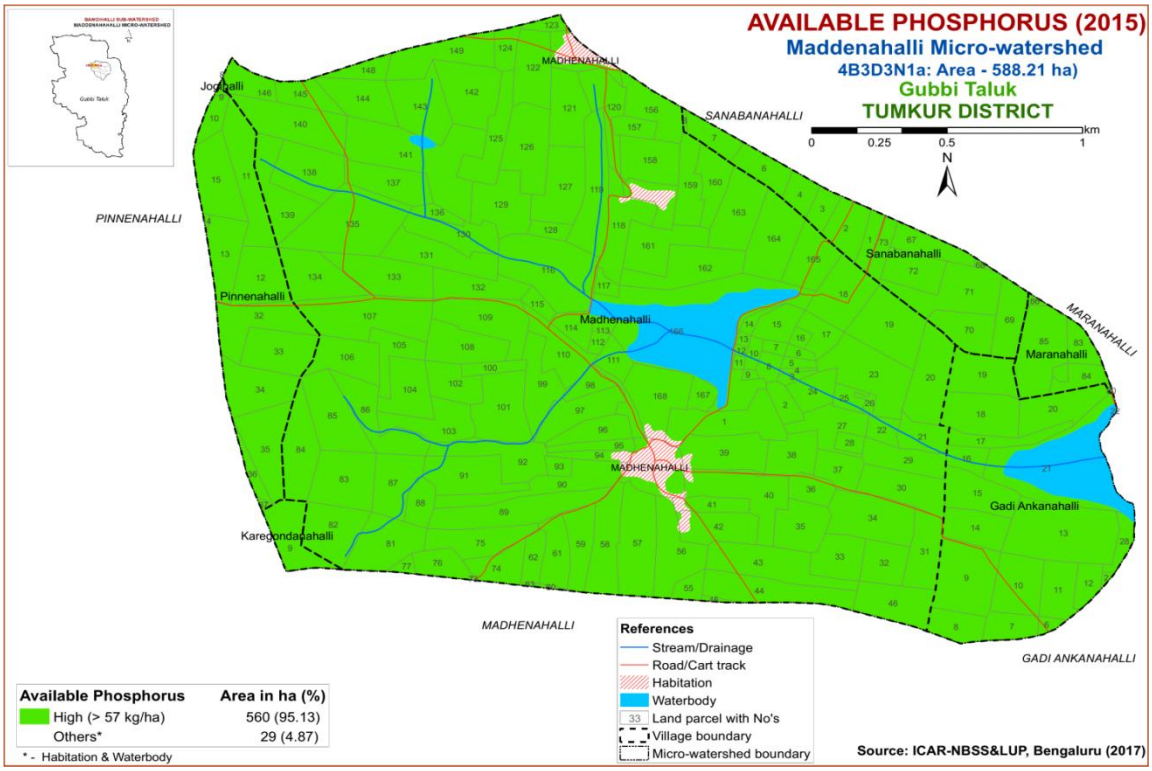


Fig.6.4 Soil Available Phosphorus map of Maddenahalli Microwatershed

6.5 Available Potassium

Available potassium content is medium (145-337 kg/ha) in maximum area of about 428 ha (73%) and is distributed in the major part of the microwatershed (Fig.6.5). High available potassium (>337 kg/ ha) is in an area of 20 ha (3%) and is distributed in the central part of the microwatershed. It is low in an area of 111 ha (19%) and is distributed in the southern and northern part of the microwatershed.

6.6 Available Sulphur

Major area of about 552 ha (94%) is medium (10-20 ppm) in available sulphur and is distributed in the major part of the microwatershed and high (>20 ppm) in a very minor area of 8 ha (1%) (Fig. 6.6).

6.7 Available Boron

Available boron content is medium (0.5-1.0 ppm) in very minor area of 1 ha (<1%) and maximum area of about 559 ha (95%) is low (<0.5 ppm) in available boron and is distributed in the major part of the microwatershed (Fig. 6.7).

6.8 Available Iron

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

6.9 Available Manganese

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

6.10 Available Copper

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

6.11 Available Zinc

Available zinc content is deficient (<0.6 ppm) in an area of 255 ha (43%) and are distributed in the northeastern, southern and eastern part of the microwatershed and major area of 304 ha (52%) is sufficient (>0.6 ppm) and are distributed in the central and northwestern part of the microwatershed (Fig 6.11).

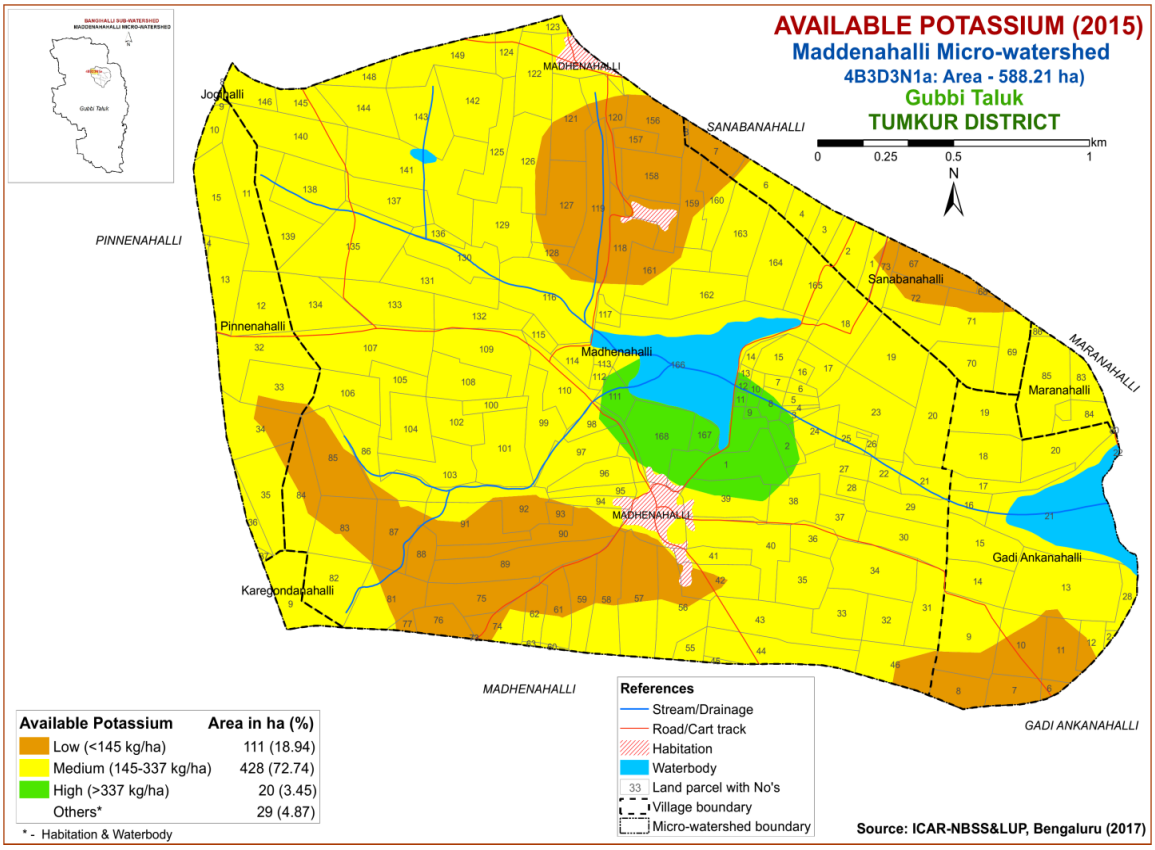


Fig.6.5 Soil Available Potassium map of Maddenahalli Microwatershed

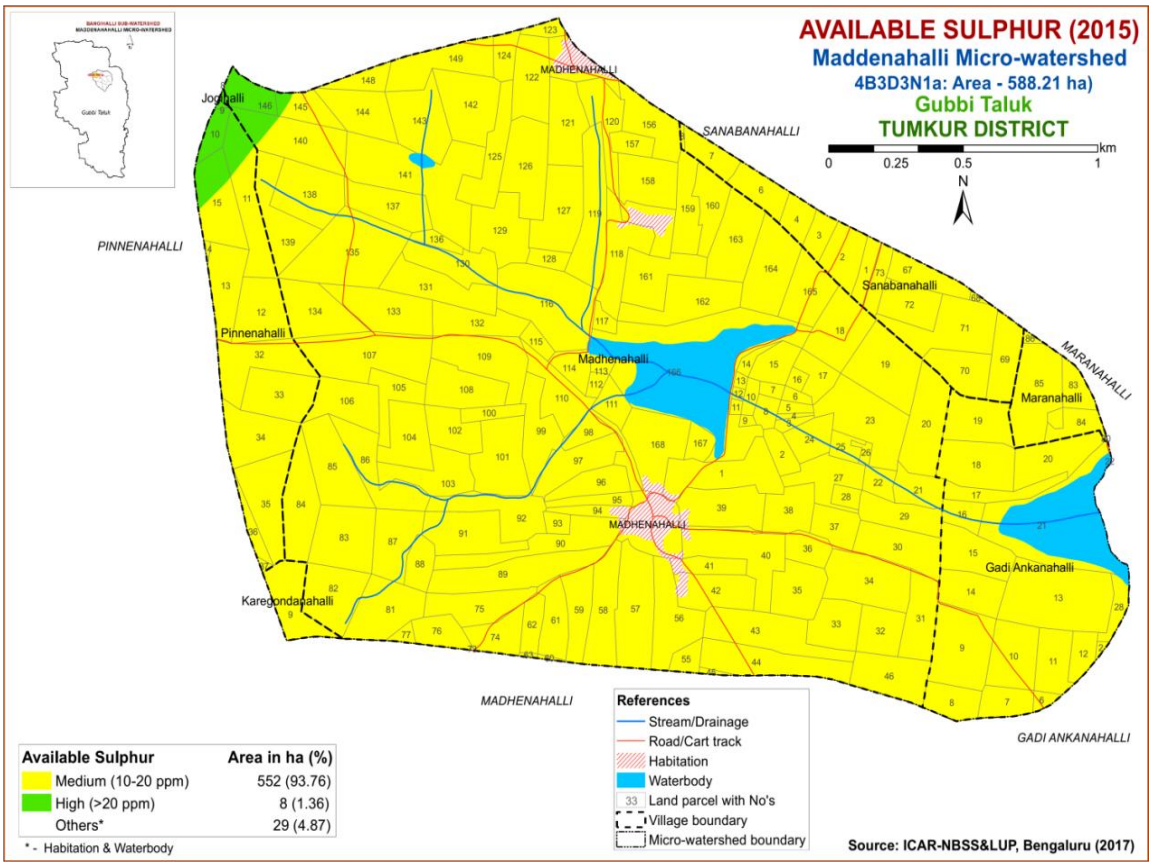


Fig.6.6 Soil Available Sulphur map of Maddenahalli Microwatershed

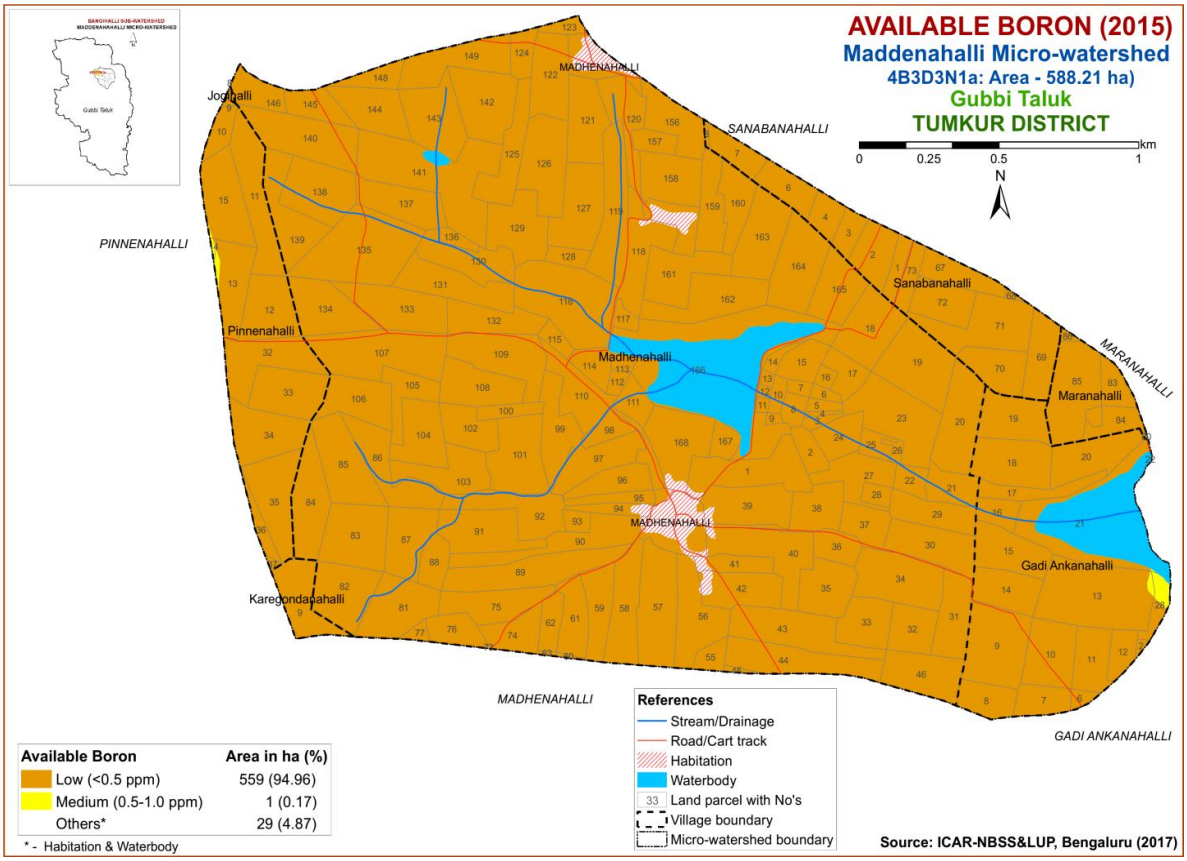


Fig.6.7 Soil Available Boron map of Maddenahalli Microwatershed

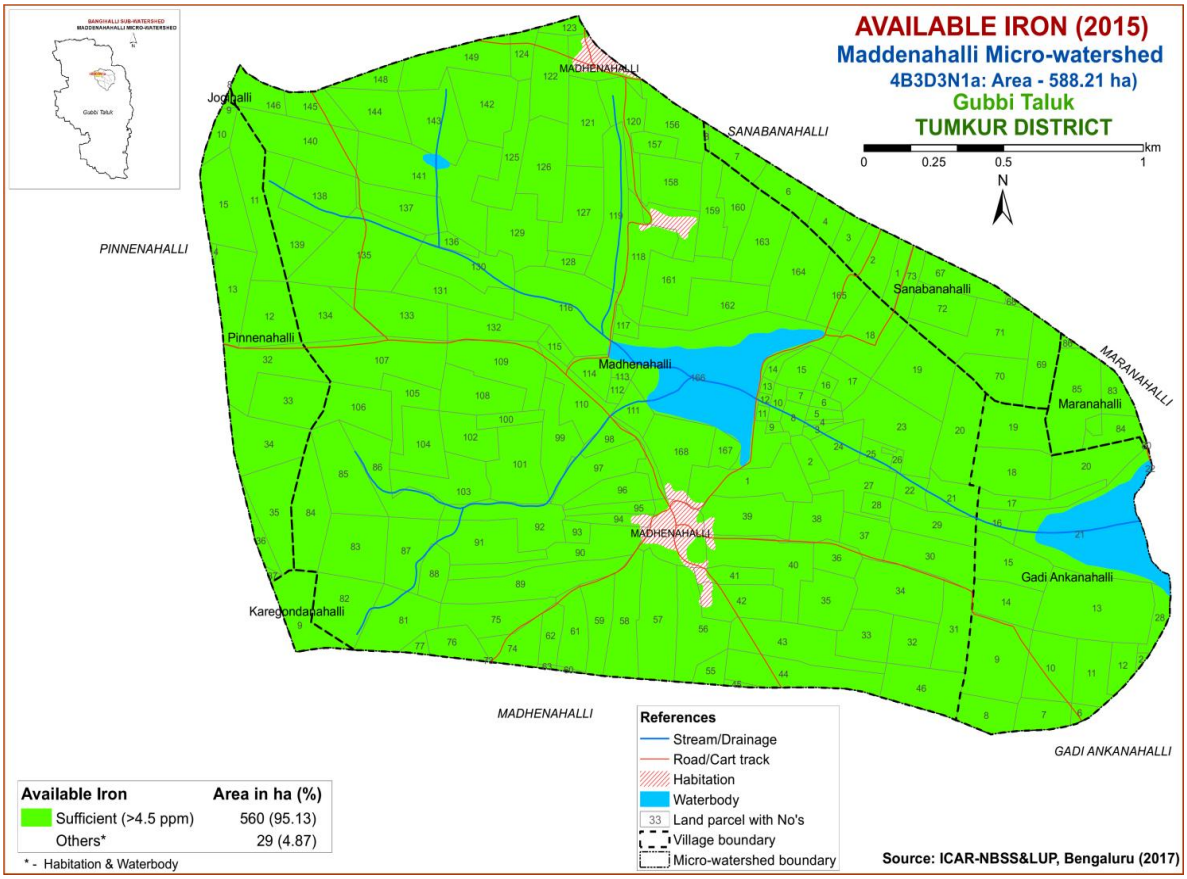


Fig.6.8 Soil Available Iron map of Maddenahalli Microwatershed

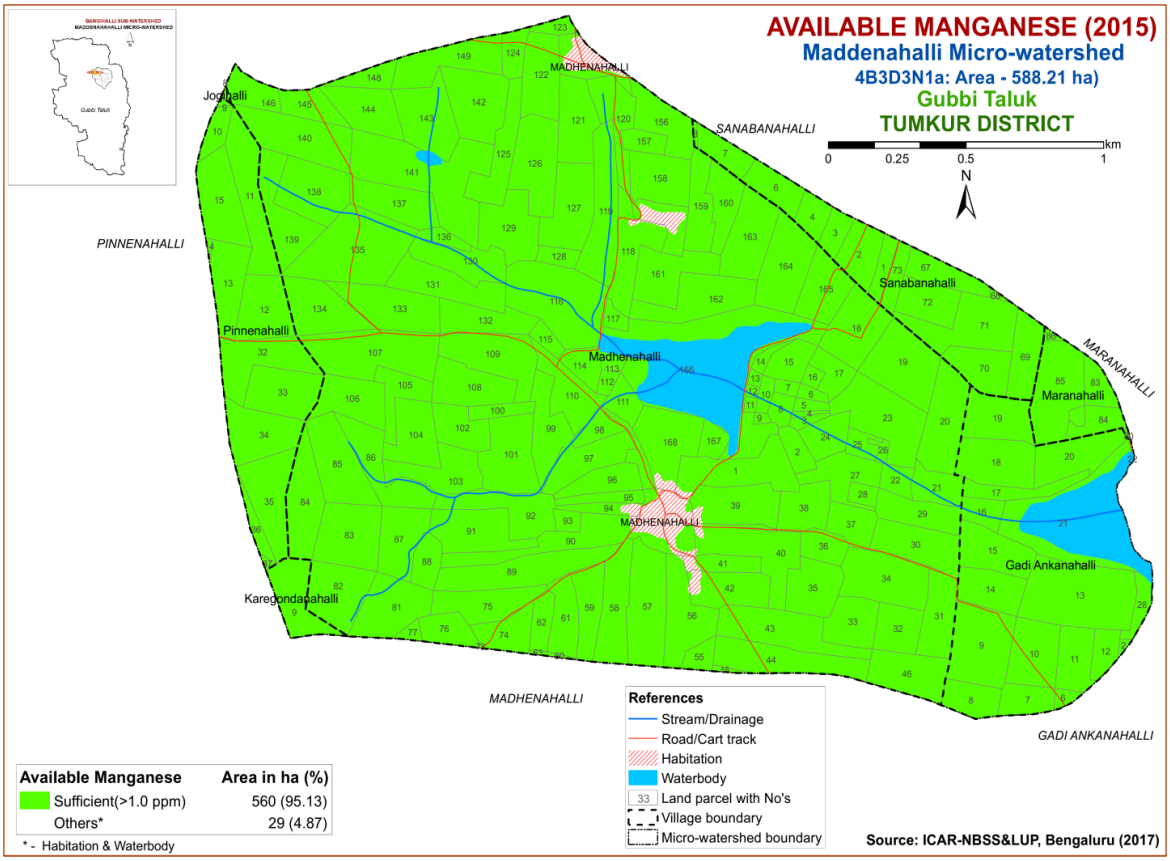


Fig.6.9 Soil Available Manganese map of Maddenahalli Microwatershed

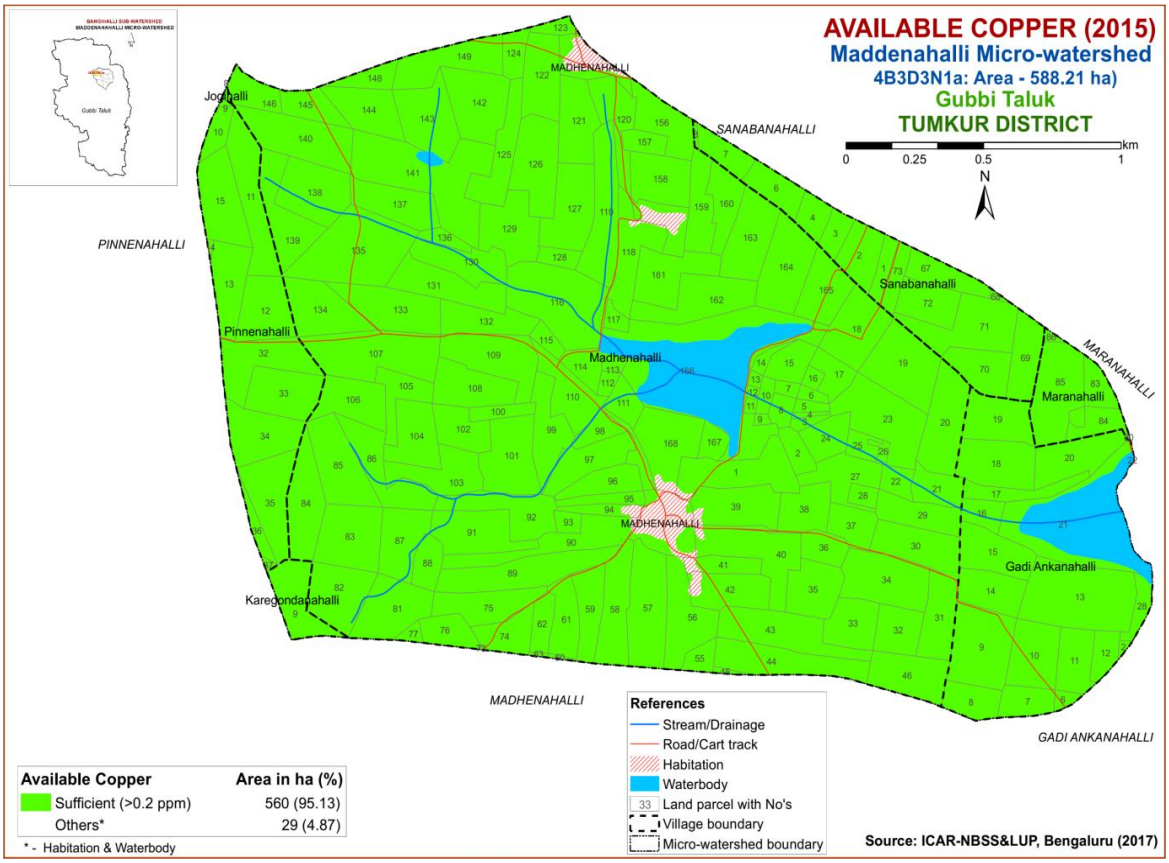


Fig.6.10 Soil Available Copper map of Maddenahalli Microwatershed

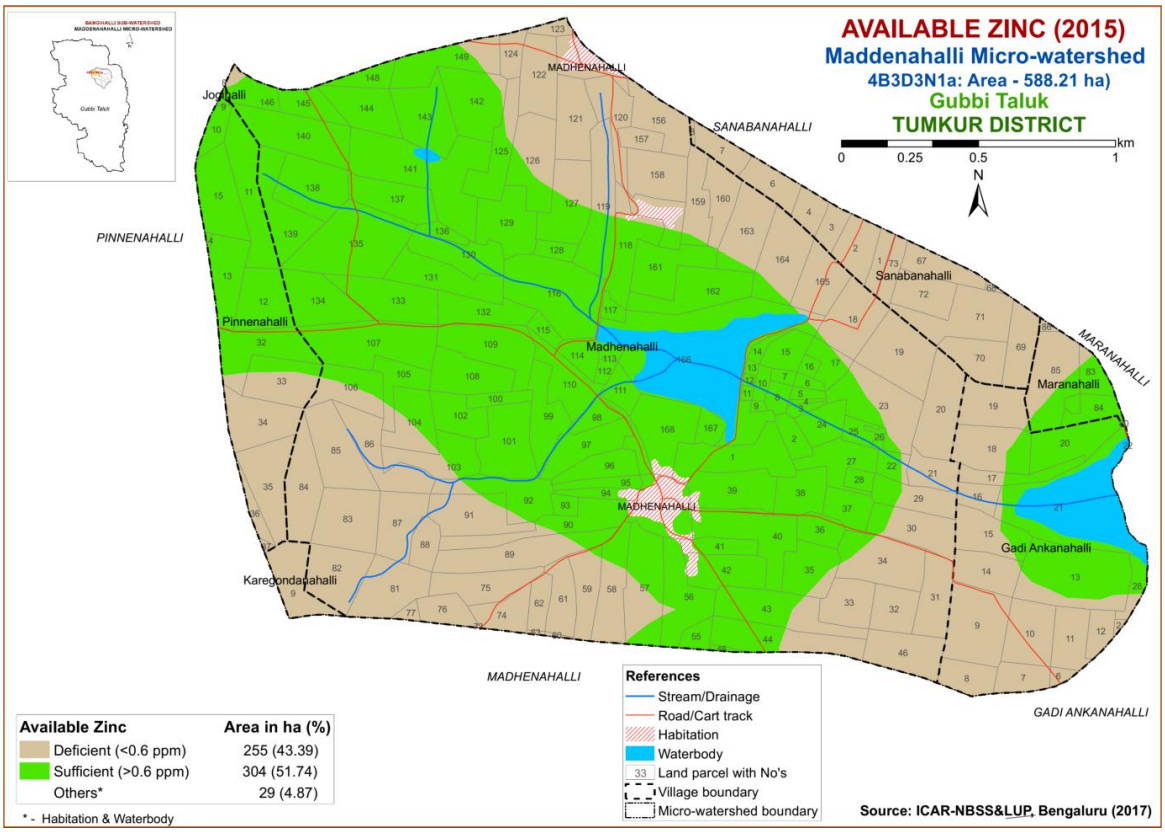


Fig.6.11 Soil Available Zinc map of Maddenahalli Microwatershed

Chapter 7

LAND SUITABILITY FOR MAJOR CROPS

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

Using the above criteria, the soil map units of the microwatershed were evaluated and land suitability maps for 34 major annual and perennial crops were generated. The detailed information on the kind of suitability of each of the soil phase for the crops assessed are given village/ survey number wise for the microwatershed in Appendix-III.

7.1 Land Suitability for Sorghum (*Sorghum bicolor*)

Sorghum is one of the major crops grown in Karnataka in an area of 10.47 lakh ha in Bijapur, Gulbarga, Raichur, Bidar, Belgaum, Dharwad, Bellary, Chitradurga, Mysore and Tumakuru districts. The crop requirements for growing sorghum (Table 7.2) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map for growing sorghum was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.1.

An area of about 219 ha (37%) is highly suitable (Class S1) for growing sorghum and are distributed in the central, southern and southeastern part the microwatershed. A very small area of about 18 ha (3%) is moderately suitable (Class S2) for growing sorghum and are distributed in the eastern part the microwatershed.

Table 7.1 Soil-Site Characteristics of Maddenahalli Microwatershed

Soil Map Units	Climate (P) (mm)	Growing period (Days)	Drai-nage Class	Soil depth (cm)	Soil texture		Gravelliness		AWC (mm/m)	Slope (%)	Erosion	p H	E C	ESP	CEC [Cmol (p^+) kg^{-1}]	BS (%)
					Surf-ace	Sub-surface	Surface (%)	Sub-surface (%)								
BDGcB1g1	813	150	WD	75-100	sl	scl-sc	15-35	35-60	<50	1-3	slight					
BPRCB1	813	150	WD	100-150	sl	sc-c	-	>35	51-100	1-3	slight					
BPRCB1g1	813	150	WD	100-150	sl	sc-c	15-35	>35	51-100	1-3	slight					
BPRCB2g1	813	150	WD	100-150	sl	sc-c	15-35	>35	51-100	1-3	moderate					
BPRcB2g2	813	150	WD	100-150	sl	sc-c	35-60	>35	51-100	1-3	moderate					
BPRhB1	813	150	WD	100-150	scl	sc-c	-	>35	51-100	1-3	slight					
BPRhB1g1	813	150	WD	100-150	scl	sc-c	15-35	>35	51-100	1-3	slight					
BPRhB2	813	150	WD	100-150	scl	sc-c	-	>35	51-100	1-3	moderate					
BPRhB2g1	813	150	WD	100-150	scl	sc-c	15-35	>35	51-100	1-3	moderate					
BPRiB2	813	150	WD	100-100	scl	sc-c	-	>35	51-100	1-3	moderate					
MRDcB1	813	150	WD	>150	sl	scl-sc	-	-	101-150	1-3	slight					
RTRcA1	813	150	WD	>150	sl	c	-	-	101-150	0-1	slight					
RTRhB1	813	150	WD	>150	scl	c	-	-	101-150	1-3	slight					
RTRiB1	813	150	WD	>150	sc	c	-	-	101-150	1-3	slight					
KDThB1	813	150	MWD	>150	scl	sc-c	-	-	>200	1-3	slight					
KDThB1g1	813	150	MWD	>150	scl	sc-c	15-35	-	>200	1-3	slight					
KDTiA1	813	150	MWD	>150	sc	sc-c	-	-	>200	0-1	slight					
TSDiA1	813	150	WD	>150	sc	sc-c	-	-	>200	0-1	slight					

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

They have minor limitations of wetness. Marginally suitable lands (Class S3) for growing sorghum occupy major area of about 322 ha (55%) and occur in the major part of the microwatershed. They have moderate limitations of rooting depth and gravelliness.

Table 7.2 Crop suitability criteria for Sorghum

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

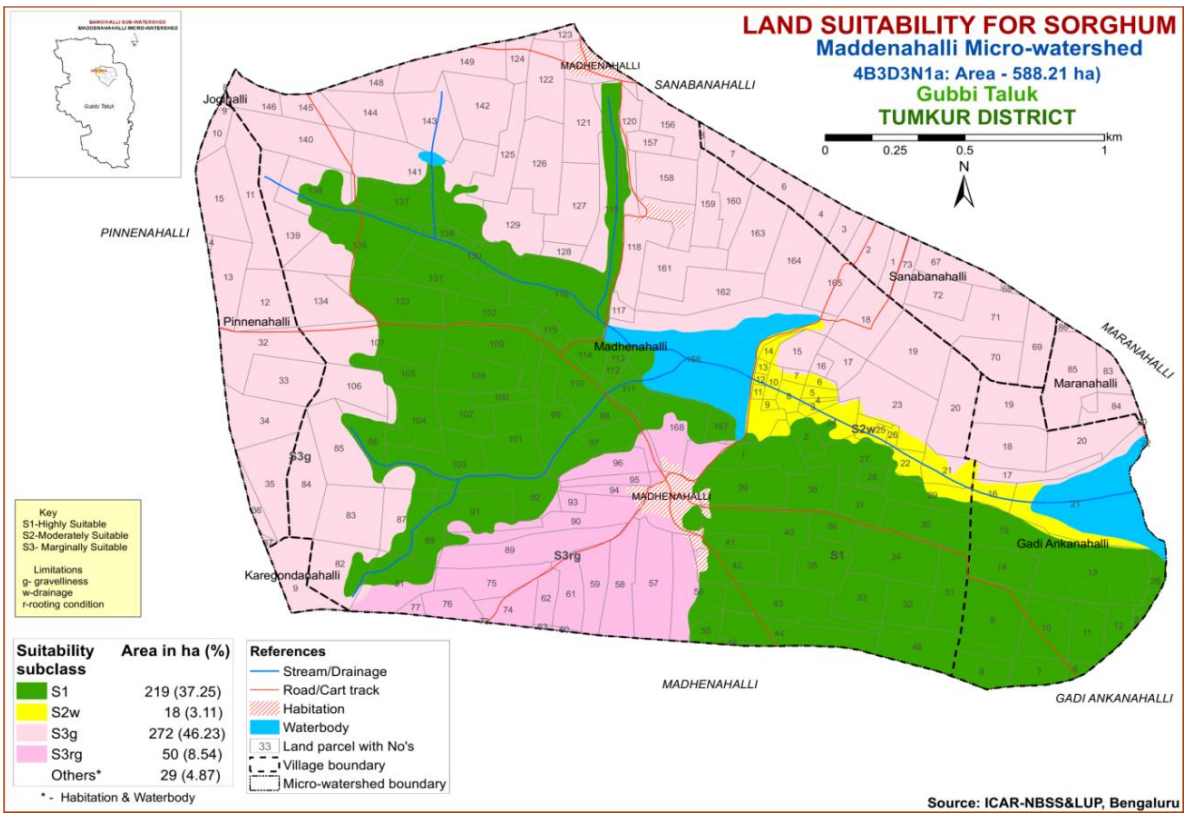


Fig. 7.1 Land Suitability map of Sorghum

7.2 Land Suitability for Fodder Sorghum (*Sorghum bicolor*)

Fodder Sorghum is one of the major fodder crops grown in South Karnataka in Tumakuru, Chikkaballapur, Mysore, Mandya, Bengaluru Rural and Kolar districts. The crop requirements for growing Fodder sorghum (Table 7.3) 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 7.2.

An area of about 219 ha (37%) is highly suitable (Class S1) for growing Fodder sorghum and are distributed in the central, southern and southeastern part the microwatershed. A very small area of about 18 ha (3%) is moderately suitable (Class S2) for growing Fodder sorghum and are distributed in the eastern part the microwatershed. They have minor limitation of wetness. Marginally suitable lands (Class S3) for growing Fodder sorghum occupy major area of about 322 ha (55%) and occur in the major part of the microwatershed. They have moderate limitations of rooting depth and gravelliness.

Table 7.3 Crop suitability criteria for Fodder Sorghum

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

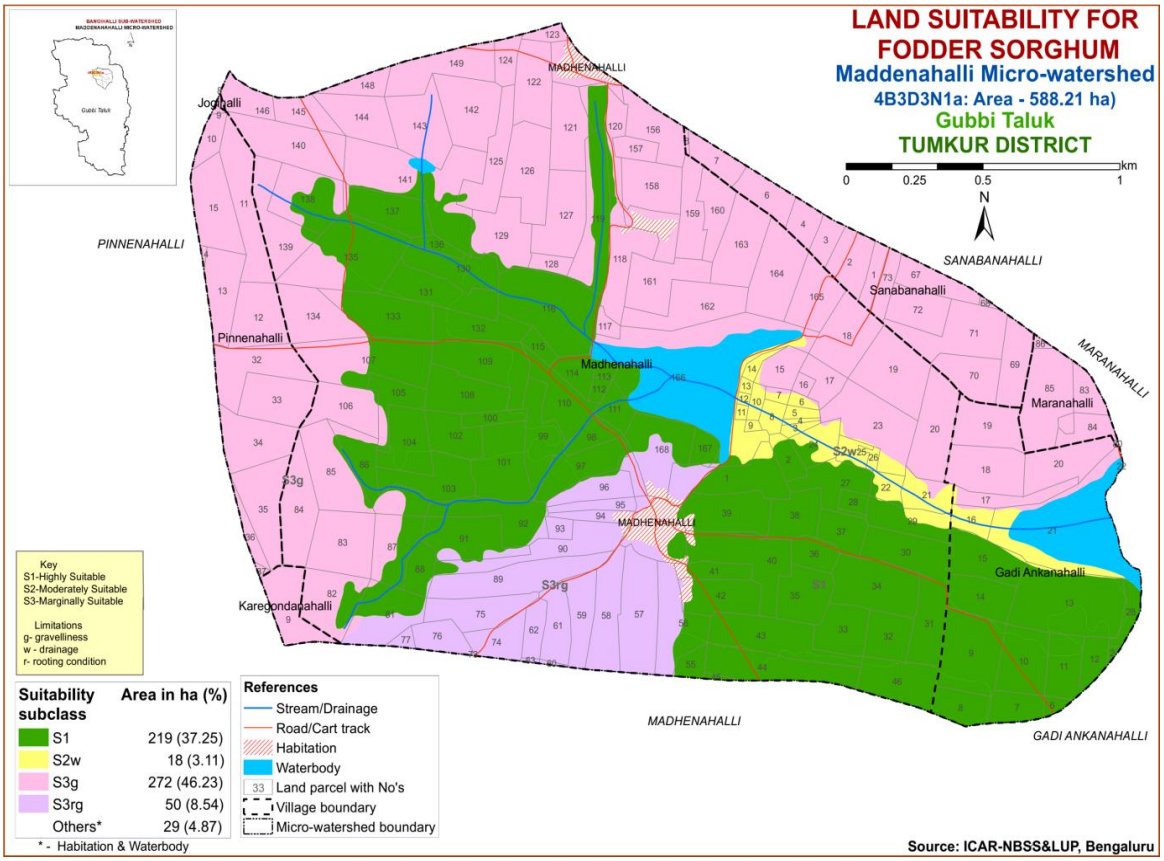


Fig. 7.2 Land Suitability map of Fodder Sorghum

7.3 Land Suitability for Maize (*Zea mays*)

Maize is 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 7.4) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing maize was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.3.

An area of about 237 ha (40%) is moderately suitable (Class S2) for growing maize and are distributed in the central, southern and southeastern part the microwatershed. They have minor limitations texture and wetness. Marginally suitable lands (Class S3) for growing maize occupy major area of about 322 ha (55%) and occur in the major part of the microwatershed and have moderate limitations of rooting depth and gravelliness.

Table 7.4 Crop suitability criteria for Maize

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

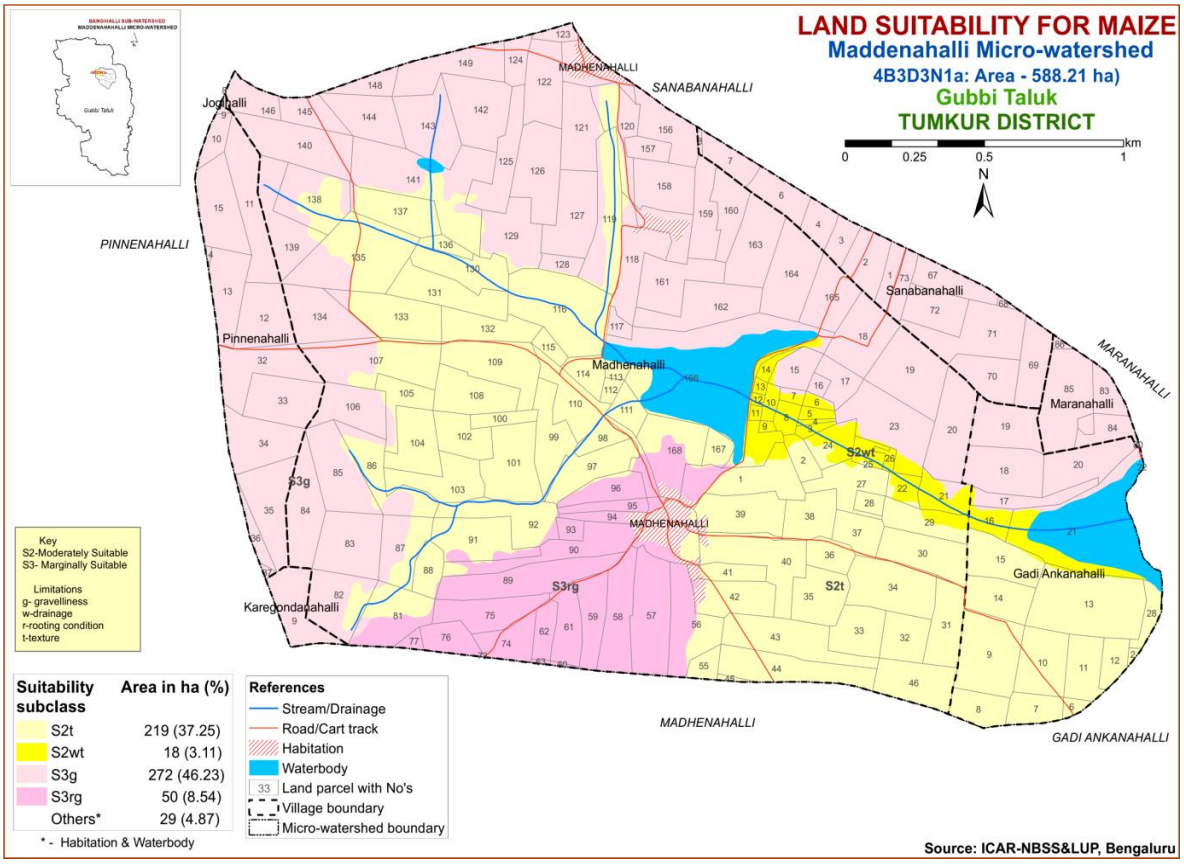


Fig. 7.3 Land Suitability map of Maize

7.4 Land Suitability for Upland Paddy (*Oryaza Sativa*)

Upland paddy is the most important food crop grown in an area of 13.26 lakh ha in major parts of the district of the State under rainfed condition. The crop requirements for growing Upland paddy (Table 7.5) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing Upland paddy was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.4.

An area of about 219 ha (37%) is highly suitable (Class S1) for growing Upland paddy and are distributed in the central, southern and southeastern part the microwatershed. A small area of about 68 ha (12%) is moderately suitable (Class S2) for growing Upland paddy and are distributed in the southern and eastern part the microwatershed. They have minor limitations gravelliness and wetness. Marginally suitable lands (Class S3) for growing Upland paddy occupy major area of about 272 ha (46%) and occur in the southern, southeastern, western and northwestern part of the microwatershed. They have moderate limitation of gravelliness.

Table 7.5 Land suitability criteria for Upland paddy

Crop requirement		Rating			
Soil –site characteristics	**Unit**	**Highly suitable S1**	**Moderately suitable S2**	**Marginally suitable S3**	**Not suitable N**
Slope	%	1-3	1-3	3-5	>5
Soil drainage	class	Well to mod.	poorly	Very poorly	
Soil reaction	pH	5.5-6.5	6.5-7.3 4.5-5.4	7.3-8.4	>8.4
Surface soil texture	Class	C, sic, cl, sicl, sc	Scl, sil, l	Sl, ls	S
Soil depth	Cm	>75	50-75	25-50	<25
Gravel content	% vol.	<15	15-35	35-60	60-80

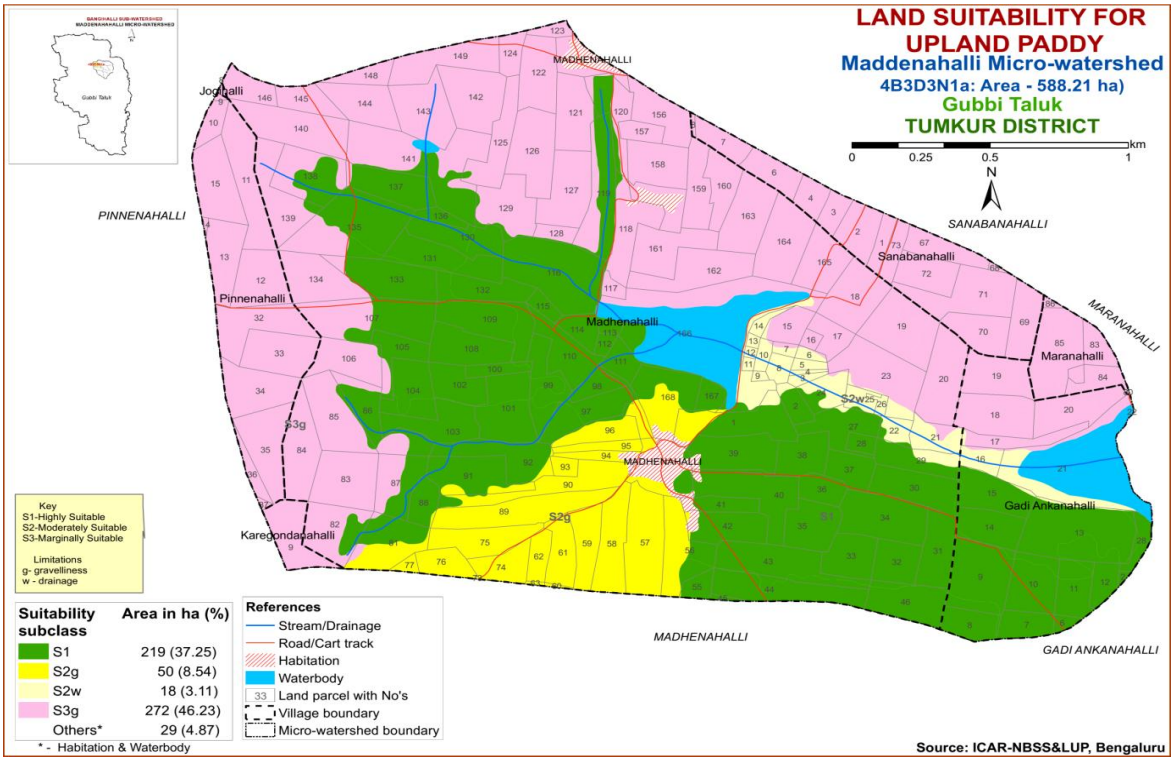


Fig. 7.4 Land Suitability map of Upland paddy

7.5 Land Suitability for Finger millet (*Eleusine Coracana*)

Finger millet is the most important food crop grown in an area of 7.08 lakh ha in almost all the districts of south Karnataka. The crop requirements for growing Finger millet (Table 7.6) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing Finger millet was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.5.

An area of about 219 ha (37%) is highly suitable (Class S1) for growing Finger millet and are distributed in the central, southern and southeastern part the microwatershed. A small area of about 68 ha (12%) is moderately suitable (Class S2) for growing Finger millet and are distributed in the southern and eastern part the microwatershed. They have minor limitations of gravelliness and wetness. Marginally suitable lands (Class S3) for growing Finger millet occupy a maximum area of about 272 ha (46%) and occur in the northern and northeastern part of the microwatershed. They have moderate limitation of gravelliness.

Table 7.6 Land suitability criteria for Finger millet

Crop requirement		**Rating**			
Soil –site characteristics	**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Slope	%	<3	3-5	5-10	>10
LGP	Days	>110	90-110	60-90	<60
Soil drainage	class	Well to mod. drained	Imperfectly drained	Poorly/excessively	V. poorly
Soil reaction	pH	5.5-7.3	7.3-8.4	8.4-9.0	>9.0
Surface soil texture	Class	l, sil, sl, cl, sicl, scl	sic, c, sc	ls, s,c >60%	
Soil depth	Cm	>75	50-75	25-50	<25
Gravel content	% vol.	<15	15-35	35-60	>60
Salinity (ECe)	dsm^{-1}	<1.0	1.0-2.0	2.0-4.0	
Sodicity (ESP)	%	<10	10-15	15-25	>25

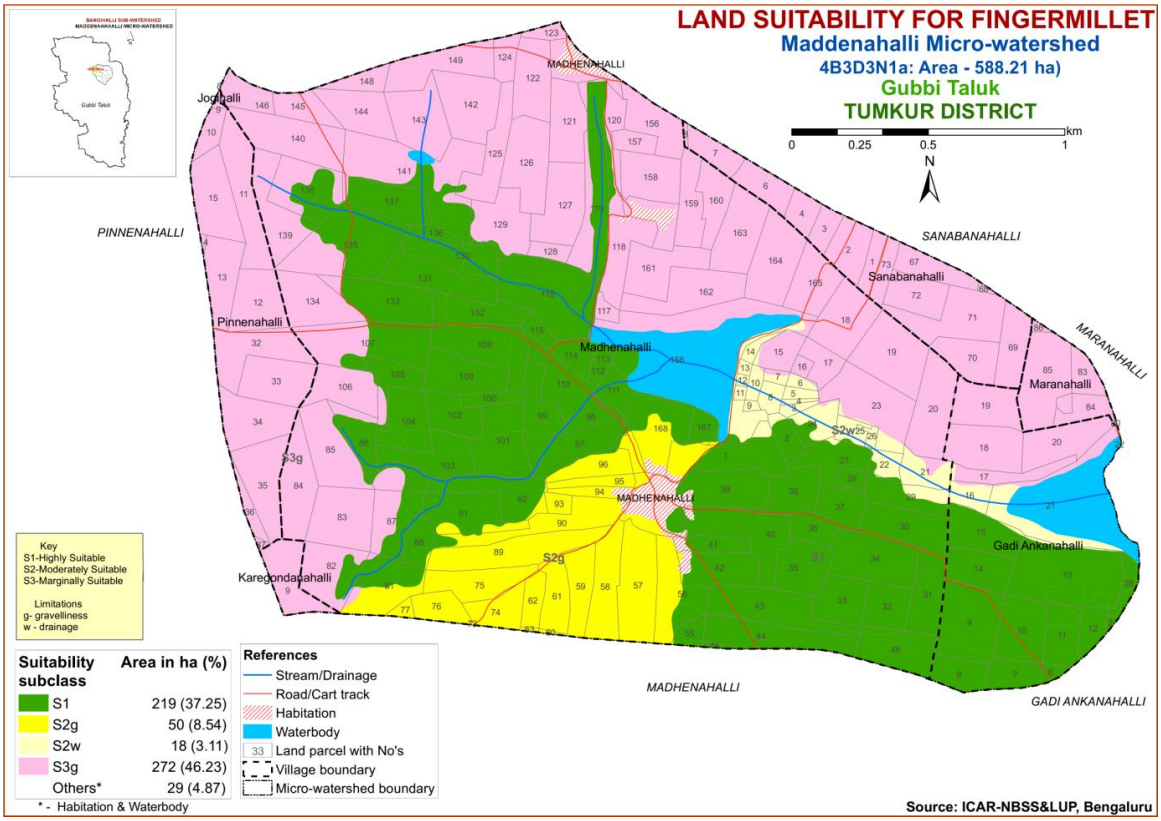


Fig. 7.5 Land Suitability map of Finger millet

7.6 Land suitability criteria for Red gram (*Cajanus Cajan)*

Red gram is 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 Red gram (Table 7.7) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing red gram was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.6.

An area of about 219 ha (37%) is highly suitable (Class S1) for growing red gram and are distributed in the central, southern and southeastern part the microwatershed. A very small area of about 18 ha (3%) is moderately suitable (Class S2) for growing red gram and are distributed in the eastern part the microwatershed. They have minor limitation of wetness. Marginally suitable lands (Class S3) for growing red gram occupy a maximum area of about 322 ha (55%) and occur in the major part of the microwatershed. They have moderate limitation of gravelliness.

Table 7.7 Land suitability criteria for Red gram

Crop requirement		Rating			
Soil –site characteristics	**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Slope	%	<3	3-5	5-10	>10
LGP	Days	>210	180-210	150-180	<150
Soil drainage	Class	Well drained	Mod. well drained	Imperfectly drained	Poorly drained
Soil reaction	pH	6.5-7.5	5.0-6.5 7.6-8.0	8.0-9.0	>9.0
Sub Surface soil texture	Class	l, scl, sil, cl, sl	sicl, sic, c(m)	ls	
Soil depth	Cm	>100	75-100	50-75	<50
Gravel content	% vol.	<15	15-35	3-60	>60
Salinity (EC)	dsm^{-1}	<1.0	1.0-2.0	>2.0	
Sodicity (ESP)	%	<10	10-15	>15	

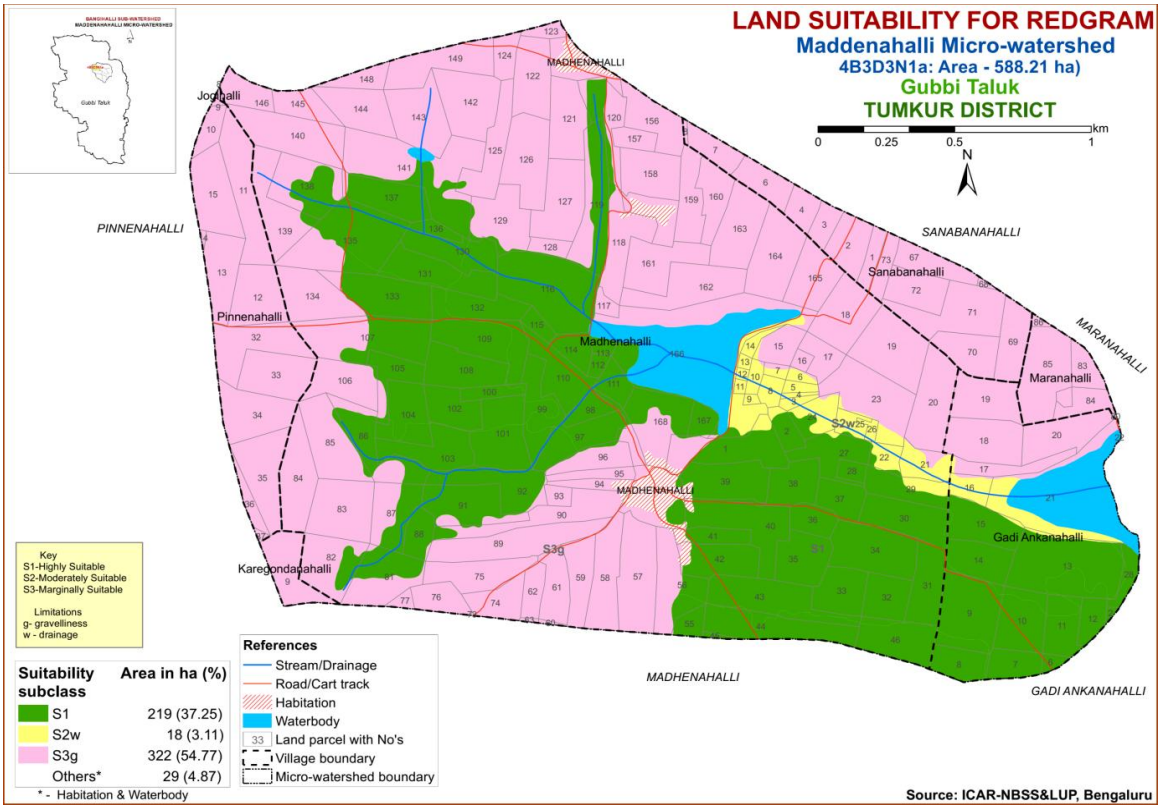


Fig. 7.6 Land Suitability map of Redgram

7.7 Land suitability for Horse gram (*Macrotyloma uniflorum*)

Horse gram is the most important pulse crop grown in an area of 1.8 lakh ha in almost all the districts of the State. The crop requirements for growing horse gram were matched with the soil-site characteristics (Table 7.1) and a land suitability map for

growing horse gram (Table 7.8) 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 219 ha (37%) is highly suitable (Class S1) for growing horse gram and are distributed in the central, southern and southeastern part the microwatershed. Maximum area of about 340 ha (58%) is moderately suitable (Class S2) for growing horse gram and are distributed in the major part of the microwatershed. They have minor limitations of gravelliness and wetness.

Table 7.8 Land suitability criteria for Horse gram

Crop requirement		**Rating**			
Soil –site characteristics	**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Slope	%	<3	3-5	5-10	>10
LGP	Days				
Soil drainage	Class	Well drained/mod. well drained	imperfectly drained	Poorly drained	Very Poorly drained
Soil reaction	pH	6.0-8.5	8.5-9.0 5.5-5.9	9.1-9.5 5.0-5.4	>9.5
Surface soil texture	Class	l, sl, scl, cl, sc	Ls, sic, sicl, c, ls	Heavy clays (>60%)	-
Soil depth	Cm	50-75	25-50	<25	-
$CaCO_3$ in root zone	% vol.	<15	15-25	25-30	>30
Salinity (ECe)	dsm^{-1}	<1.0	1.0-2.0	>2.0	
Sodicity (ESP)	%	<10	10-15	>15	-

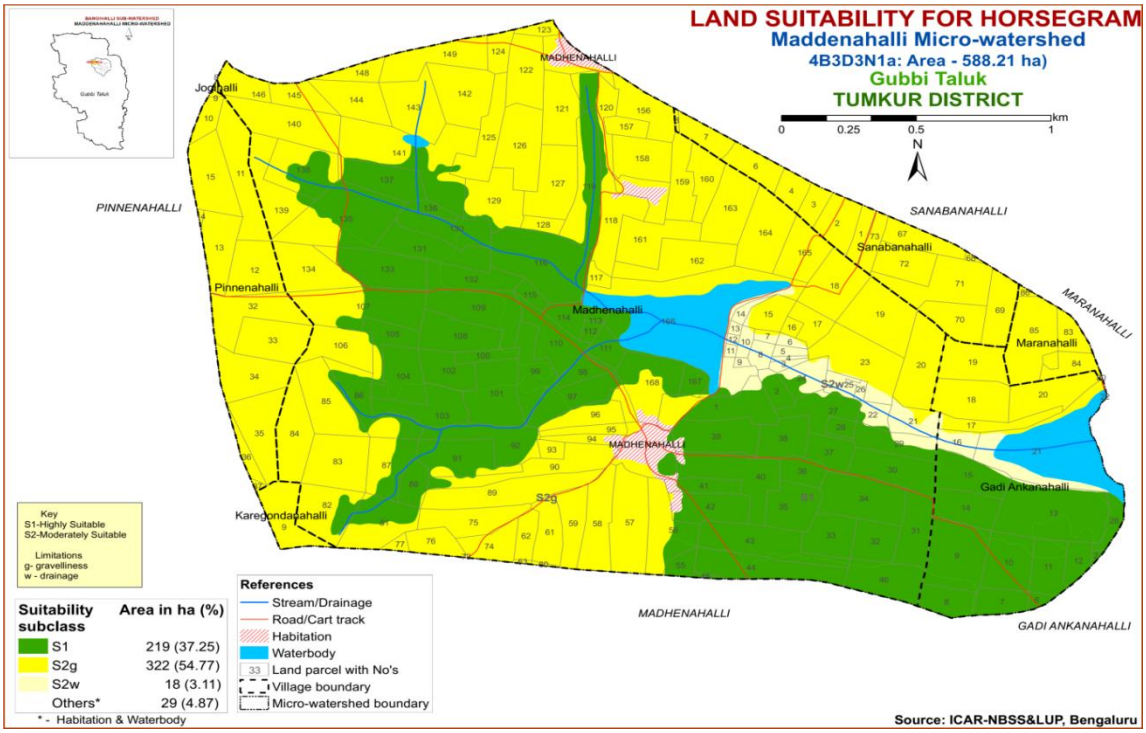


Fig. 7.7 Land Suitability map of Horsegram

7.8 Land suitability for Field Bean (*Dolichos lablab*)

Field Bean is the most important pulse crop grown in an area of 0.59 lakh ha in almost all the districts of the State. The crop requirements (Table 7.9) for growing field bean were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing field bean was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Fig. 7.8.

An area of about 219 ha (37%) is highly suitable (Class S1) for growing field bean and are distributed in the central, southern and southeastern part the microwatershed. A very small area of about 18 ha (3%) is moderately suitable (Class S2) for growing field bean and are distributed in the eastern part the microwatershed. They have minor limitation of wetness. Marginally suitable lands (Class S3) for growing field bean occupy major area of about 322 ha (55%) and occur in the major part of the microwatershed and have moderate limitation of gravelliness.

Table 7.9 Land suitability criteria for Field Bean

Crop requirement		Rating			
Soil –site characteristics	**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Slope	%	<3	3-5	5-10	>10
LGP	Days	>120	90-120	70-90	<70
Soil drainage	Class	Well drained/mod. well drained	imperfectly drained	Poorly drained	Very Poorly drained
Soil reaction	pH	6.0-8.5	8.5-9.0 5.5-5.9	9.1-9.5 5.0-5.4	>9.5
Sub Surface soil texture	Class	l, sl, scl, cl, sc	sic, sicl, c	Heavy clays (>60%), ls	s
Soil depth	Cm	>75	50-75	25-50	<25
CaCO3 in root zone	% vol.	<15	15-35	35-50	>50
Salinity (EC)	dsm-1	<1.0	1.0-2.0	>2.0	
Sodicity (ESP)	%	<10	10-15	15-20	>20

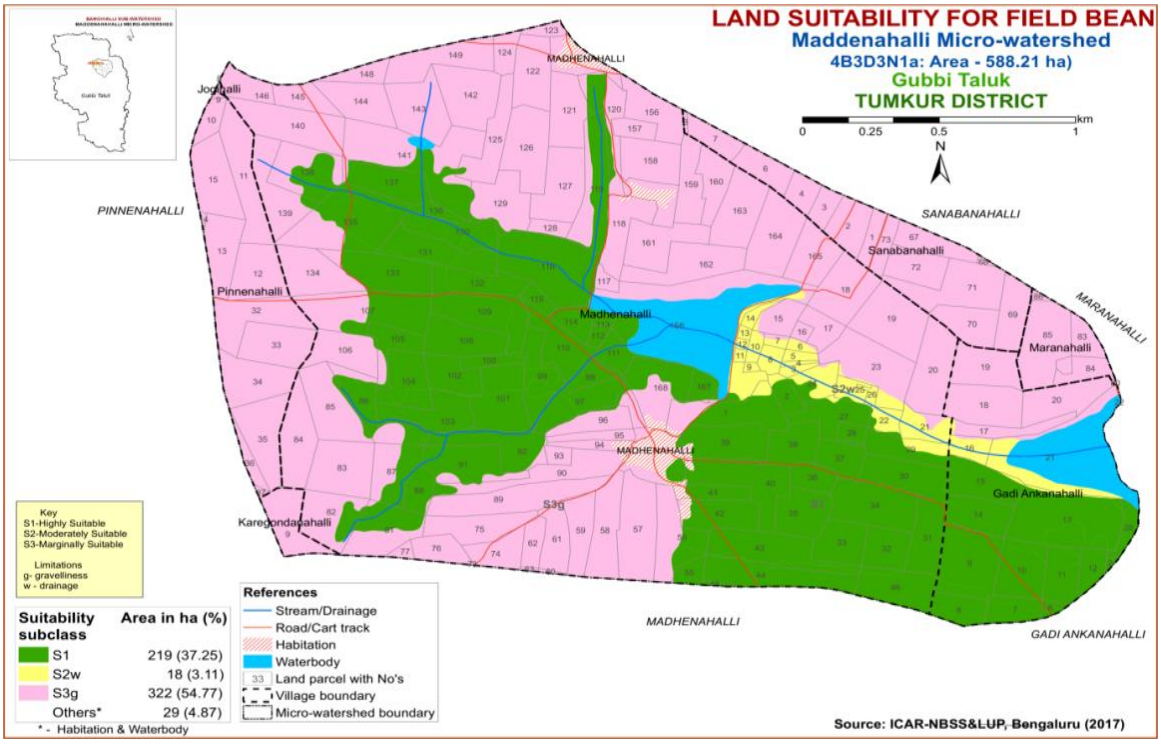


Fig. 7.8 Land Suitability map of Field bean

7. 9 Land Suitability for Cowpea (*Vigna radiata*)

Cowpea is the most important pulse crop grown in an area of 0.80 lakh ha in almost all the districts of the State. The crop requirements for growing cowpea were

matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing cowpea was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Fig. 7.9.

An area of about 219 ha (37%) is highly suitable (Class S1) for growing Cowpea and are distributed in the central, southern and southeastern part the microwatershed. A very small area of about 18 ha (3%) is moderately suitable (Class S2) for growing Cowpea and are distributed in the eastern part the microwatershed. They have minor limitation of wetness. Marginally suitable lands (Class S3) for growing Cowpea occupy major area of about 322 ha (55%) and occur in the major part of the microwatershed. They have moderate limitation of gravelliness.

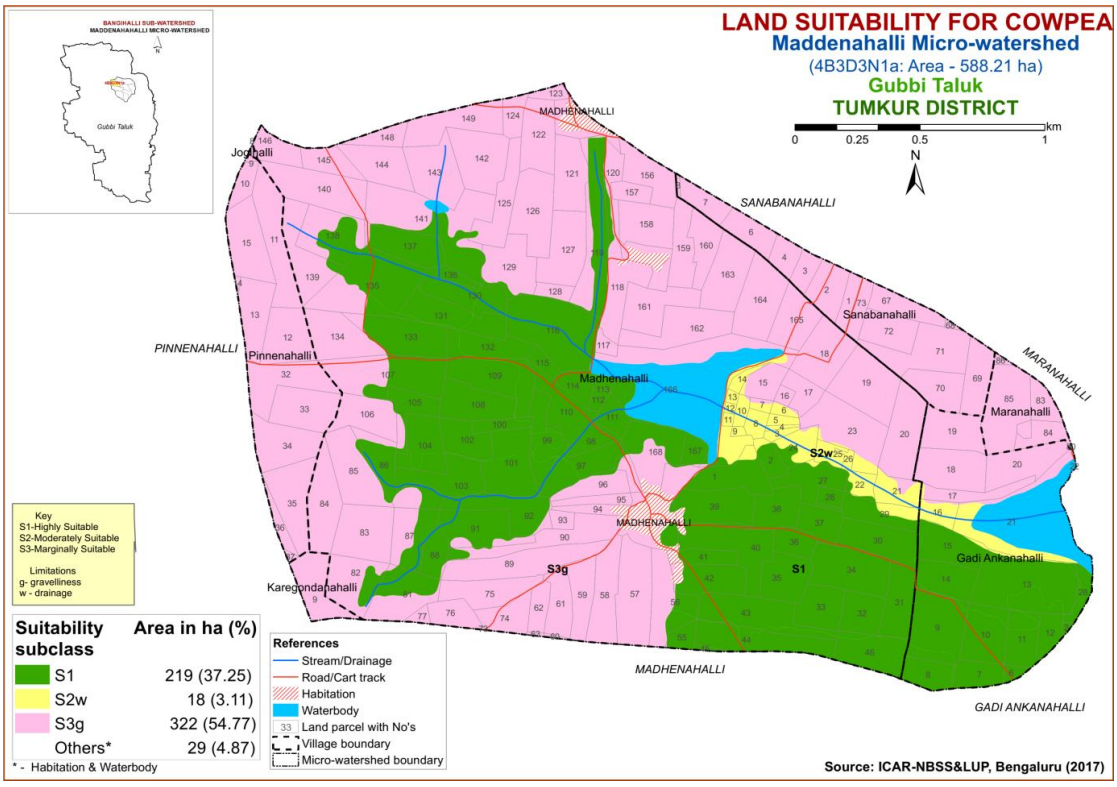


Fig. 7.9 Land Suitability map of Cowpea

7.10 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 rain fed or irrigated crop. The crop requirements for growing groundnut (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 groundnut 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 86 ha (15%) is highly suitable (Class S1) for growing Groundnut and are distributed in the central part the microwatershed. Major area of about 322 ha (55%) is moderately suitable (Class S2) for groundnut and are distributed in the major part of the microwatershed. They have minor limitations of rooting depth, gravelliness

and texture. Marginally suitable lands (Class S3) for growing groundnut occupy an area of about 151 ha (26%) and are distributed in the central and southern part of the microwatershed. They have moderate limitations of texture and wetness.

Table 7.10 Crop suitability criteria for Groundnut

Crop requirement		Rating			
Soil–site characteristics	**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Slope	%	<3	3-5	5-10	>10
LGP	Days	100-125	90-105	75-90	
Soil drainage	Class	Well drained	Mod. Well drained	Imperfectly drained	Poorly drained
Soil reaction	pH	6.0-8.0	8.1-8.5 5.5-5.9	>8.5 <5.5	
Surface soil texture	Class	l, cl, sil, sc, sicl	Sc, sic, c,	S, ls, sl c (>60%)	S, fragmental
Soil depth	Cm	>75	50-75	25-50	<25
Gravel content	% vol.	<35	35-50	>50	
$CaCO_3$ in root zone	%	high	Medium	low	
Salinity (EC)	dSm^{-1}	<2.0	2.0-4.0	4.0-8.0	
Sodicity (ESP)	%	<5	5-10	>10	

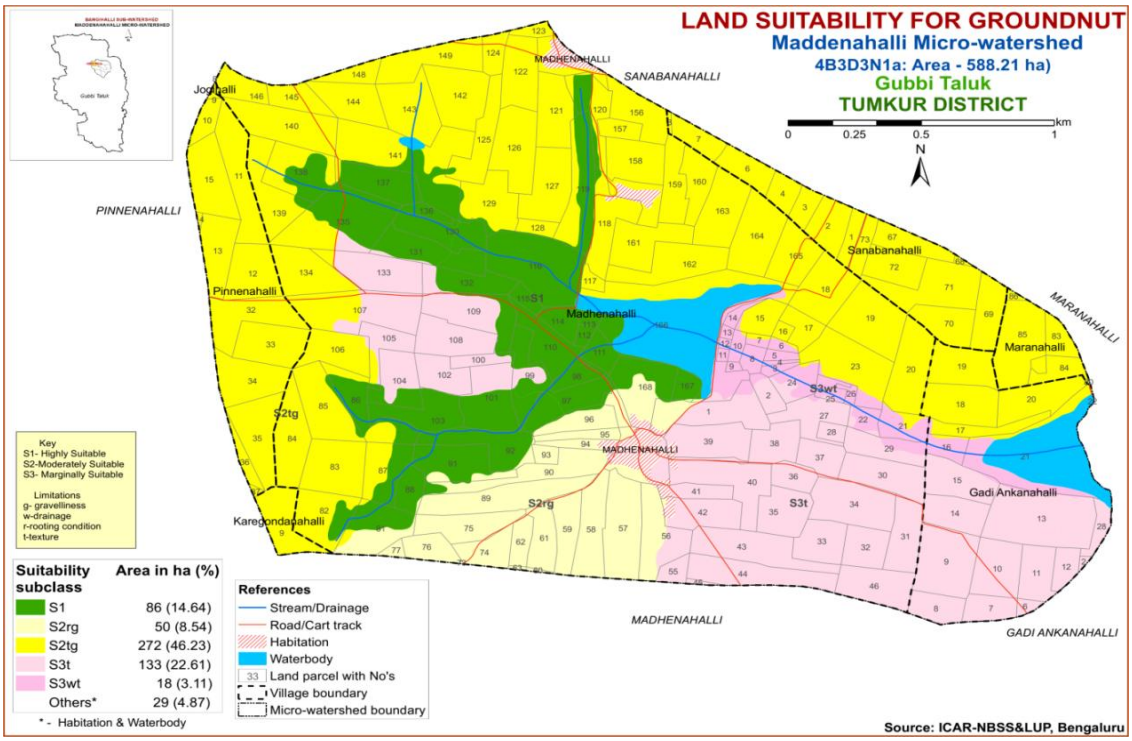


Fig. 7.10 Land Suitability map of Groundnut

7.11 Land Suitability for Sunflower (*Helianthus annus*)

Sunflower is 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 7.11) 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 7.11.

About 219 ha (37%) area is highly suitable (Class S1) for growing sunflower and is distributed in the central, southern and southeastern part of the microwatershed. Moderately suitable (Class S2) lands for growing sunflower are found to occur in a very small area of about 18 ha (3%). They have minor limitation of wetness and are distributed in the eastern part of the microwatershed. The marginally suitable (Class S3) lands cover a maximum area of about 322 ha (55%) and occur in the major part of the microwatershed. They have moderate limitations of gravelliness and rooting depth.

Table 7.11 Crop suitability criteria for Sunflower

Crop requirement		**Rating**			
Soil–site characteristics	**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Slope	%	<3	3-5	5-10	>10
LGP	Days	>90	80-90	70-80	<70
Soil drainage	Class	Well drained	Mod. well rained	Imperfectly drained	Poorly drained
Soil reaction	pH	6.5-8.0	8.1-8.55.5-6.4	8.6-9.0;4.5-5.4	>9.0<4.5
Surface soil texture	Class	l, cl, sil, sc	Scl, sic, c,	c (>60%), sl	ls, s
Soil depth	Cm	>100	75-100	50-75	<50
Gravel content	% vol.	<15	15-35	35-60	>60
Salinity (EC)	dSm^{-1}	<1.0	1.0-2.0	>2.0	
Sodicity (ESP)	%	<10	10-15	>15	

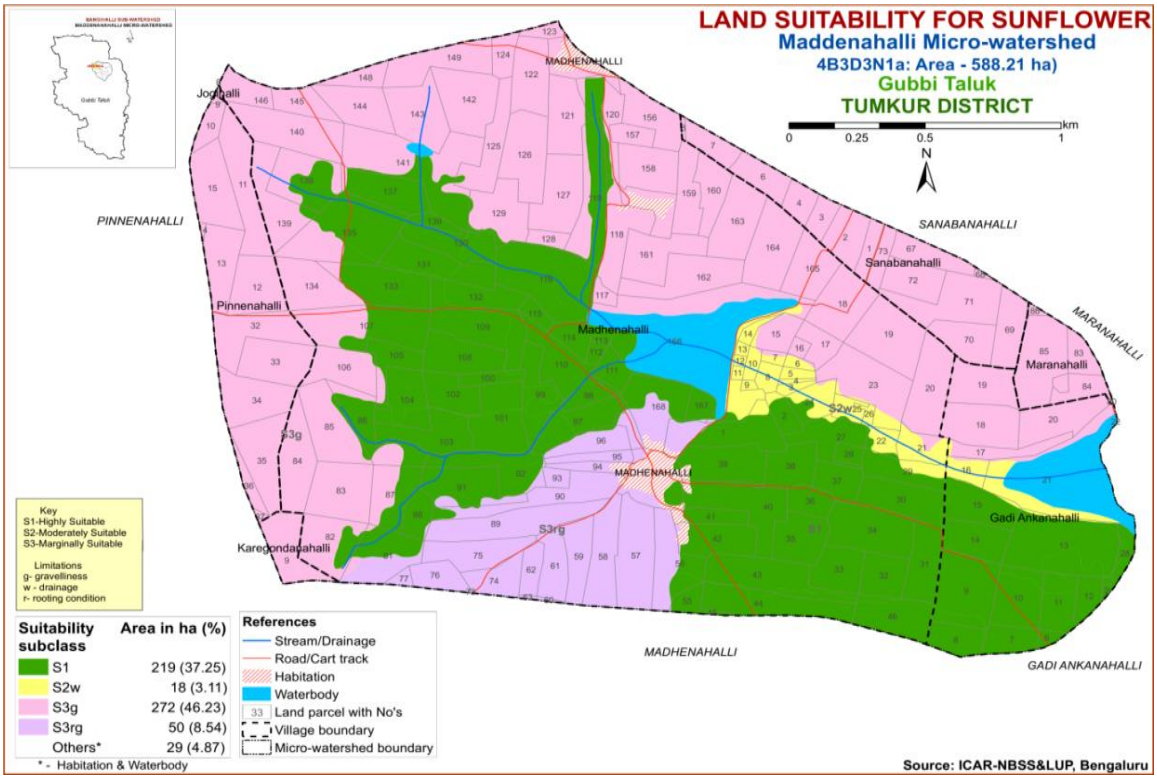


Fig. 7.11 Land Suitability map of Sunflower

7.12 Land Suitability for Onion (*Allium cepa*)

Onion is the most important vegetable crop grown in Raichur, Dharwad, Belgaum, Gulbarga, Bijapur, Bidar, Bellary, Chitradurga and Tumakuru districts. The crop requirements for growing onion (Table 7.12) 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 are given in Figure 7.12.

An area of about 133 ha (23%) has soils that are highly suitable (Class S1) and are distributed in the central part of the microwatershed. An area of about 104 ha (18%) has soils that are moderately suitable (Class S2) for growing onion with minor limitations of gravelliness and rooting depth. They are distributed in the northern, northeastern and western part of the microwatershed. The marginally suitable (Class S3) lands cover a maximum area of about 322 ha (55%) and occur in the northern and central part of the microwatershed. They have moderate limitations of rooting depth, gravelliness and slope.

Table 7.12 Land suitability criteria for Onion

Crop requirement		Rating			
Soil –site characteristics	**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Mean temperature in growing season	^{0}c	20-30	30-35	35-40	>40
Slope	%	<3	3-5	5-10	>10
Soil drainage	Class	Well drained	Moderately /imperfectly	Poor drained	Very poorly drained
Soil reaction	pH	6.5-7.3	7.3-7.8 5.0-5.4	7.8-8.4 <5.0	>8.4
Surface soil texture	Class	Scl, sil, sl	sc, sicl, c (red soil)	sc, c (black soil)	ls
Soil depth	Cm	>75	50-75	25-50	<25
Gravel content	% vol.	<15	15-35	35-60	60-80
Salinity (ECe)	dsm^{-1}	<1.0	1.0-2.0	2.0-4.0	<4
Sodicity (ESP)	%	<5	5-10	10-15	>15

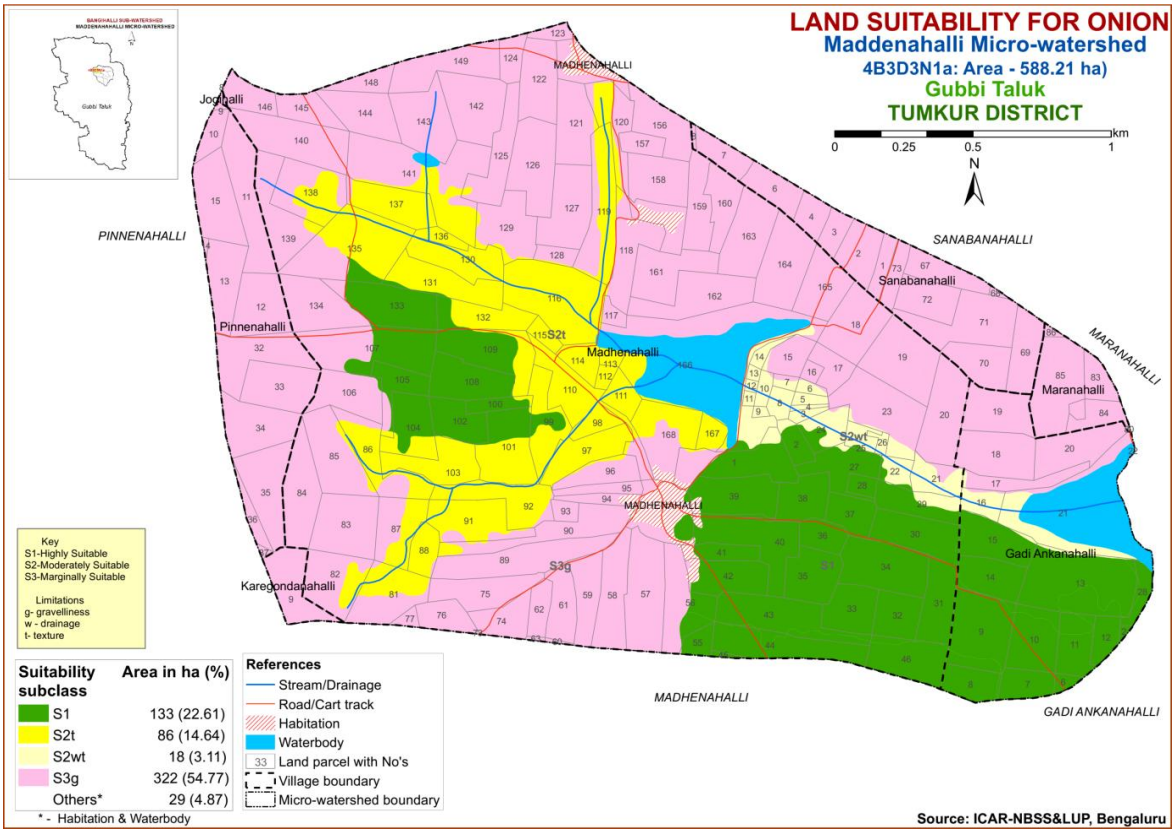


Fig. 7.12 Land Suitability map of Onion

7.13 Land Suitability for Chilli (*Capscicum annuum L.*)

Chilli is the most important commercial crop grown in an area of 0.42 lakh ha in the State in all the districts. The crop requirements for growing Chilli (Table 7.13) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing Chilli was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.13.

An area of about 219 ha (37%) has soils that are highly suitable (Class S1) and are distributed in the central, southern and southeastern part of the microwatershed. A very small area of about 18 ha (3%) has soils that are moderately suitable (Class S2) for growing Chilli with minor limitation of wetness. They are distributed in the eastern part of the microwatershed. The marginally suitable (Class S3) lands cover a maximum area of about 322 ha (55%) and occur in the major part of the microwatershed and have moderate limitation of gravelliness.

Table 7.13 Land suitability criteria for Chillies

Crop requirement		**Rating**			
Soil –site characteristics	**Unit**	**Highly suitable (S1)**	**Moderately Suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Slope	%	<3	3-5	5-10	
LGP	Days	>150	120-150	90-120	<90
Soil drainage	class	Well drained	Mod. to imperfectly drained	Poor drained/excessively	Very poorly drained
Soil reaction	pH	6.0-7.0	7.1-8.0	8.1-9.0 5.0-5.9	>9.0
Surface soil texture	Class	L, scl, cl, sil	sl, sc, sic,c(m/k)	C(ss), ls, s	
Soil depth	Cm	>75	50-75	25-50	<25
Gravel content	% vol.	<15	15-35	>35	
Salinity (ECe)	dsm^{-1}	<1.0	1.0-2.0	2.0-4.0	<4
Sodicity (ESP)	%	<5	5-10	10-15	

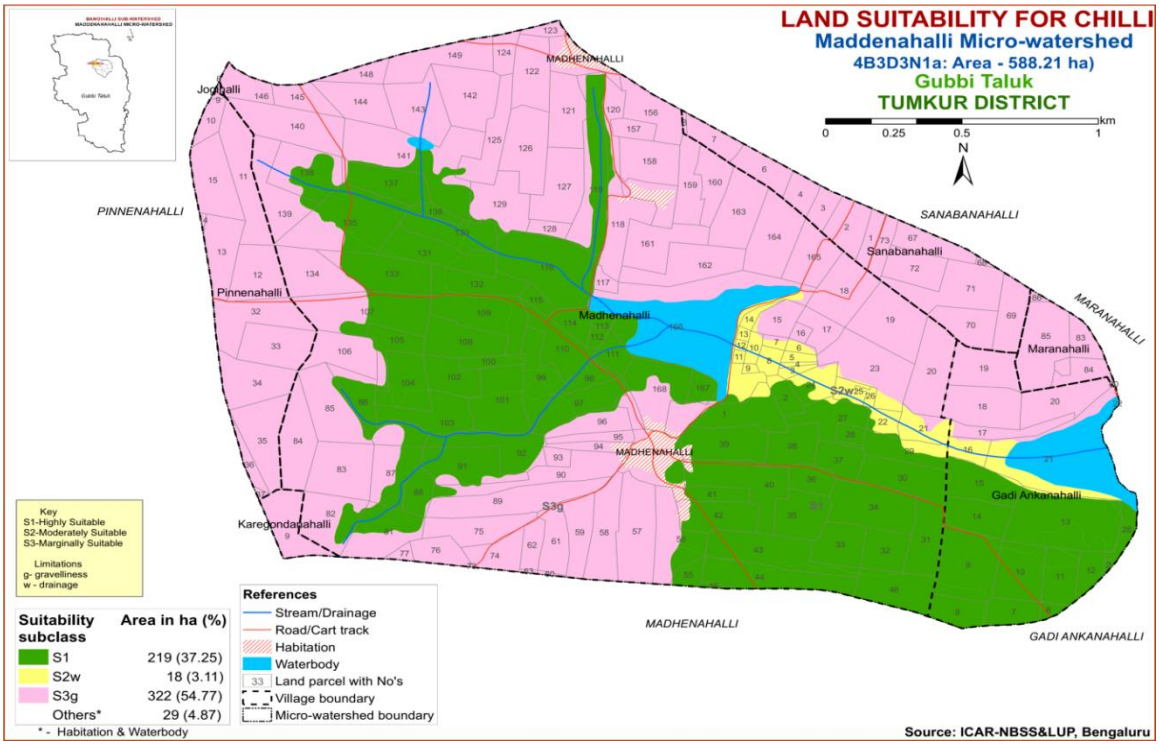


Fig. 7.13 Land Suitability map of Chilli

7.14 Land suitability for Brinjal (*Solanum melongena*)

Brinjal is the most important vegetable crop grown in all the districts. The crop requirements for growing Brinjal (Table 7.14) 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 7.14.

An area of about 219 ha (37%) has soils that are highly suitable (Class S1) and are distributed in the central, southern and southeastern part of the microwatershed. A very small area of about 18 ha (3%) has soils that are moderately suitable (Class S2) for growing Brinjal with minor limitations of wetness. They are distributed in the eastern part of the microwatershed. The marginally suitable (Class S3) lands cover a maximum area of about 322 ha (55%) and occur in the major part of the microwatershed. They have moderate limitation of gravelliness.

Table 7.14 Land suitability criteria for Brinjal

Crop requirement			Rating			
Soil-site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N)
Soil aeration	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V. Poorly drained
Nutrient availability	Texture	Class	Sl, scl, cl, sc	C (red)	Ls, c (black)	-
	pH	1:2.5	6.0-7.3	7.3-8.4 5.5-6.0	8.4-9.0	>9.0
Rooting conditions	Soil depth	Cm	>75	50-75	25-50	<25
	Gravel content	% vol.	<15	15-35	35-60	>60
Erosion	Slope	%	0-3	3-5	5-10	>10

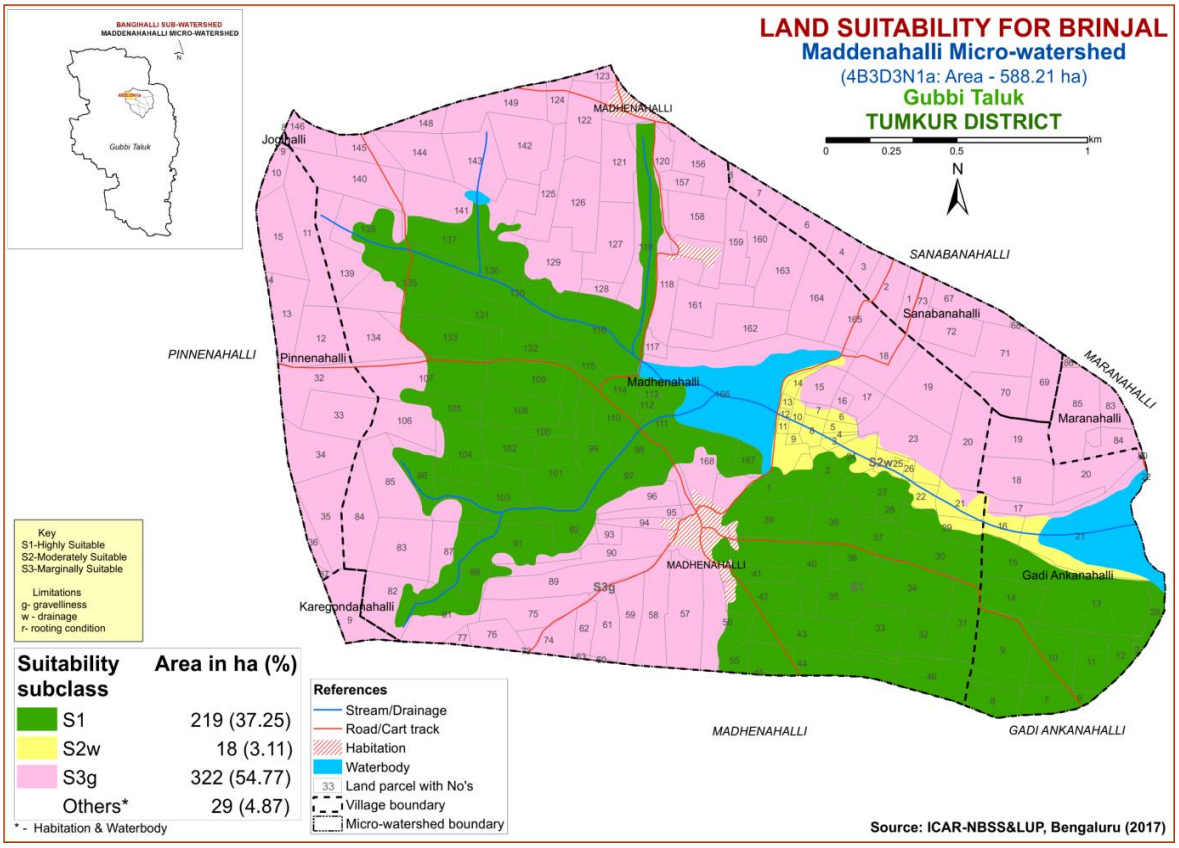


Fig. 7.15 Land Suitability map of Brinjal

7.15 Land suitability for Tomato (*Lycopersicon esculentum*)

Tomato is 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 for growing Tomato (Table 7.15) were matched with the soil-site characteristics (Table 7.1) and a land suitability map

for growing Tomato was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.15.

An area of about 219 ha (37%) has soils that are highly suitable (Class S1) and are distributed in the central, southern and southeastern part of the microwatershed. A very small area of about 18 ha (3%) has soils that are moderately suitable (Class S2) for growing Tomato with minor limitation of wetness. They are distributed in the eastern part of the microwatershed. The marginally suitable (Class S3) lands cover a maximum area of about 322 ha (55%) and occur in the major part of the microwatershed. They have moderate limitation of gravelliness.

Table 7.15 Land suitability criteria for Tomato

Crop requirement			**Rating**			
Soil-site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately Suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
climate	Temperature in growing season	^{0}c	25-28	29-32 20-24	15-19 33-36	<15 >36
Soil moisture	Growing period	Days	>150	120-150	90-120	
Soil aeration	Soil drainage	class	Well drained	Moderately well drained	Poorly drained	V. poorly drained
Nutrient availability	Texture	Class	l, sl, cl, scl	Sic, sicl, sc, c(m/k)	C (ss), ls	s
	pH	1:2.5	6.0-7.3	5.5-6.0 7.3-8.4	8.4-9.0	>9.0
	$CaCO_3$ in root zone	%	Non calcareous	Slightly calcareous	Strongly calcareous	
Rooting conditions	Soil depth	Cm	>75	50-75	25-50	<25
	Gravel content	% vol.	<15	15-35	>35	
Soil toxicity	Salinity	ds/m	Non saline	slight	strongly	
	Sodicity (ESP)	%	<10	10-15	>15	-
Erosion	Slope	%	1-3	3-5	5-10	>10

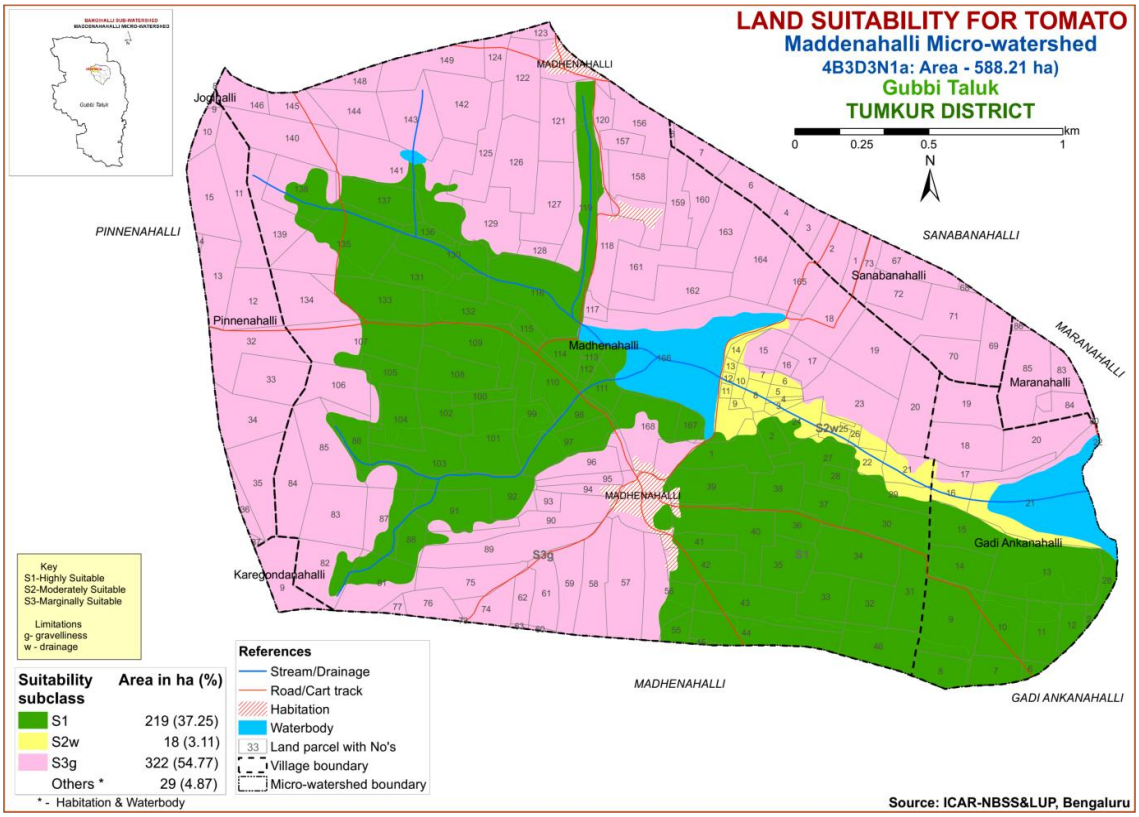


Fig. 7.15 Land Suitability map of Tomato

7.16 Land suitability for Mango (*Mangifera indica*)

Mango is the most important fruit crop grown in about 1.73 lakh ha area in almost all the districts of the State. The crop requirements (Table 7.16) 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 is given in Figure 7.16.

An area of about 219 ha (37%) in the microwatershed is highly suitable (Class S1) for growing mango and are distributed in the central, southeastern and southern part of the microwatershed. A very small area of about 18 ha (3%) is moderately suitable (Class S2) for growing mango and are distributed in the eastern part the microwatershed. They have minor limitations of wetness and texture. The marginally suitable (Class S3) lands cover a maximum area of about 322 ha (55%) and are distributed in the major part of the microwatershed. They have moderate limitations of rooting depth and gravelliness.

Table 7.16 Crop suitability criteria for Mango

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

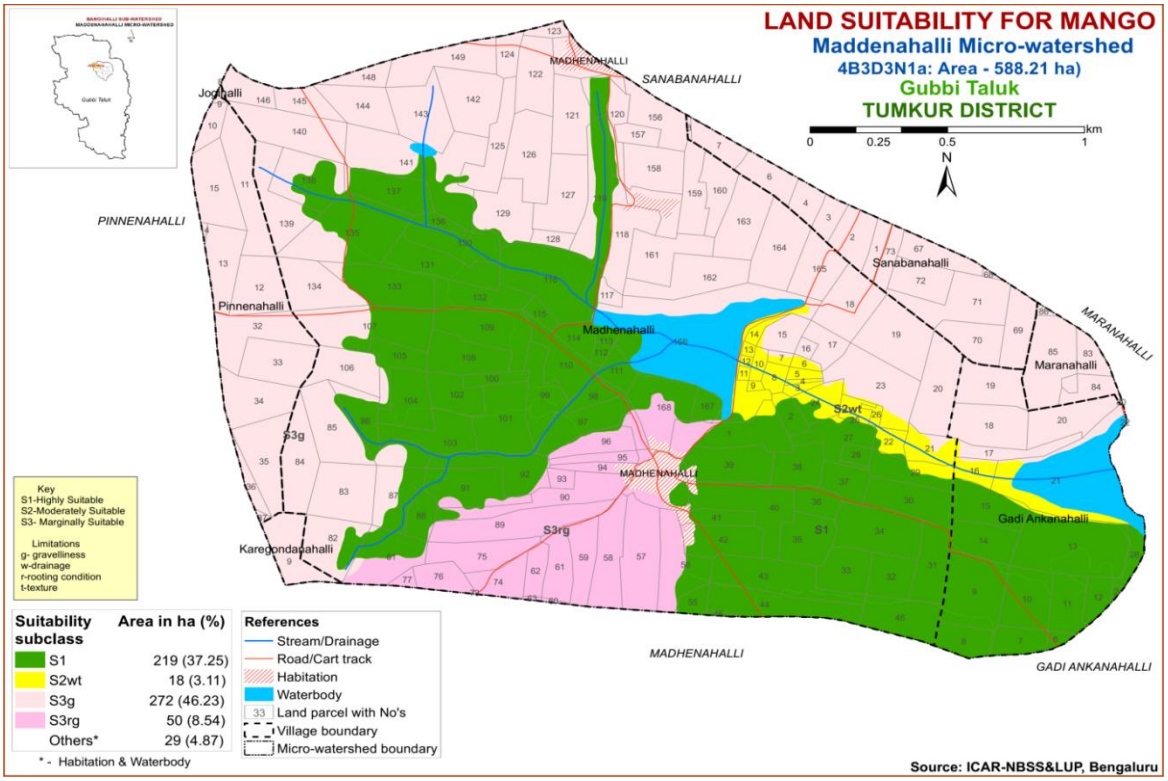


Fig. 7.16 Land Suitability map of Mango

7.17 Land suitability for Sapota (*Manilkara zapota*)

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

An area of about 219 ha (37%) in the microwatershed is highly suitable (Class S1) for growing Sapota and are distributed in the central, southeastern and southern part of the microwatershed. A very small area of about 18 ha (3%) is moderately suitable (Class S2) for growing Sapota and are distributed in the eastern part the microwatershed and have minor limitations of wetness and texture. The marginally suitable (Class S3) lands cover a maximum area of about 322 ha (55%) and are distributed in the major part of the microwatershed. They have moderate limitations of rooting depth and gravelliness.

Table 7.17 Crop suitability criteria for Sapota

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

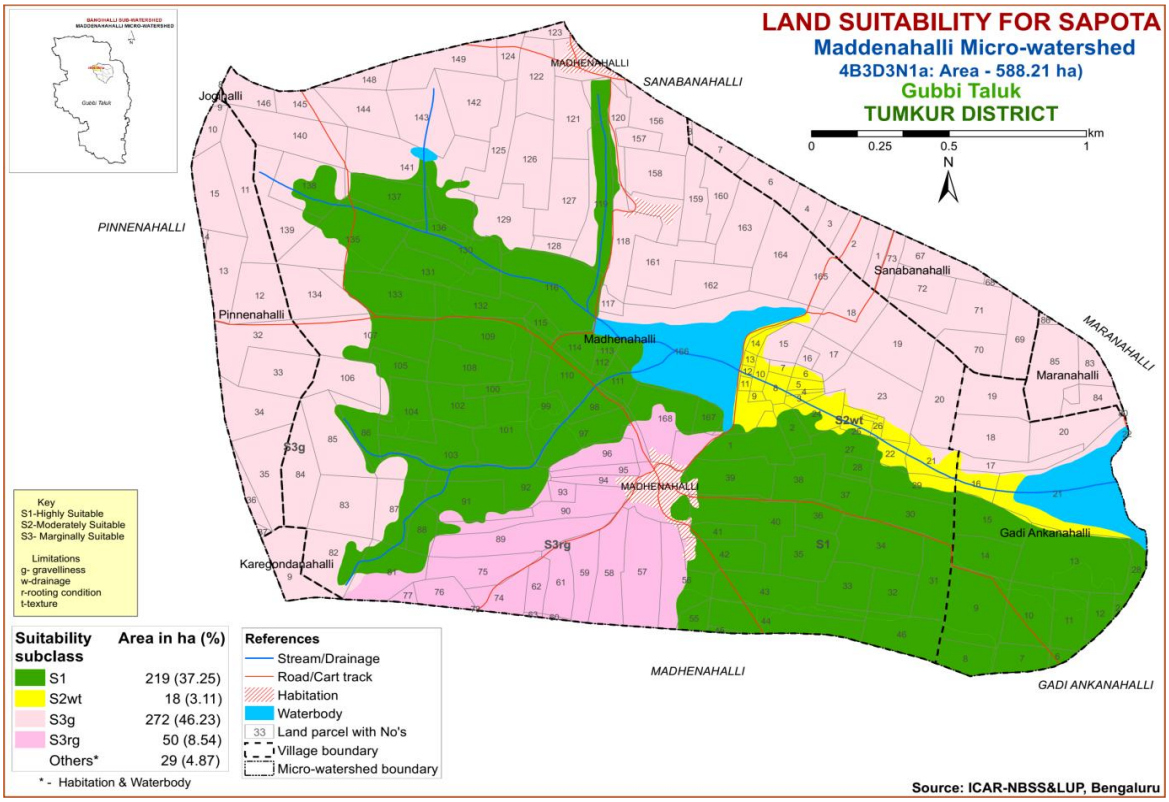


Fig. 7.18 Land Suitability map of Sapota

7.18 Land suitability for Guava (*Psidium guajava*)

Guava is the most important fruit crop grown in an area of 6558 ha in almost all the districts of the State. The crop requirements (Table 7.18) for growing guava were matched with the soil-site characteristics (7.1) and a land suitability map for growing guava was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.18.

An area of about 86 ha (15%) in the microwatershed is highly suitable (Class S1) for growing guava and are distributed in the central part of the microwatershed. A maximum area of about 423 ha (72%) is moderately suitable (Class S2) for growing guava and are distributed in the major part and have minor limitations of gravelliness, texture and wetness. The marginally suitable (Class S3) lands cover an area of about 50 ha (9%) and are distributed in the southern part of the microwatershed. They have moderate limitations of rooting depth and gravelliness.

Table 7.18 Crop suitability criteria for Guava

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

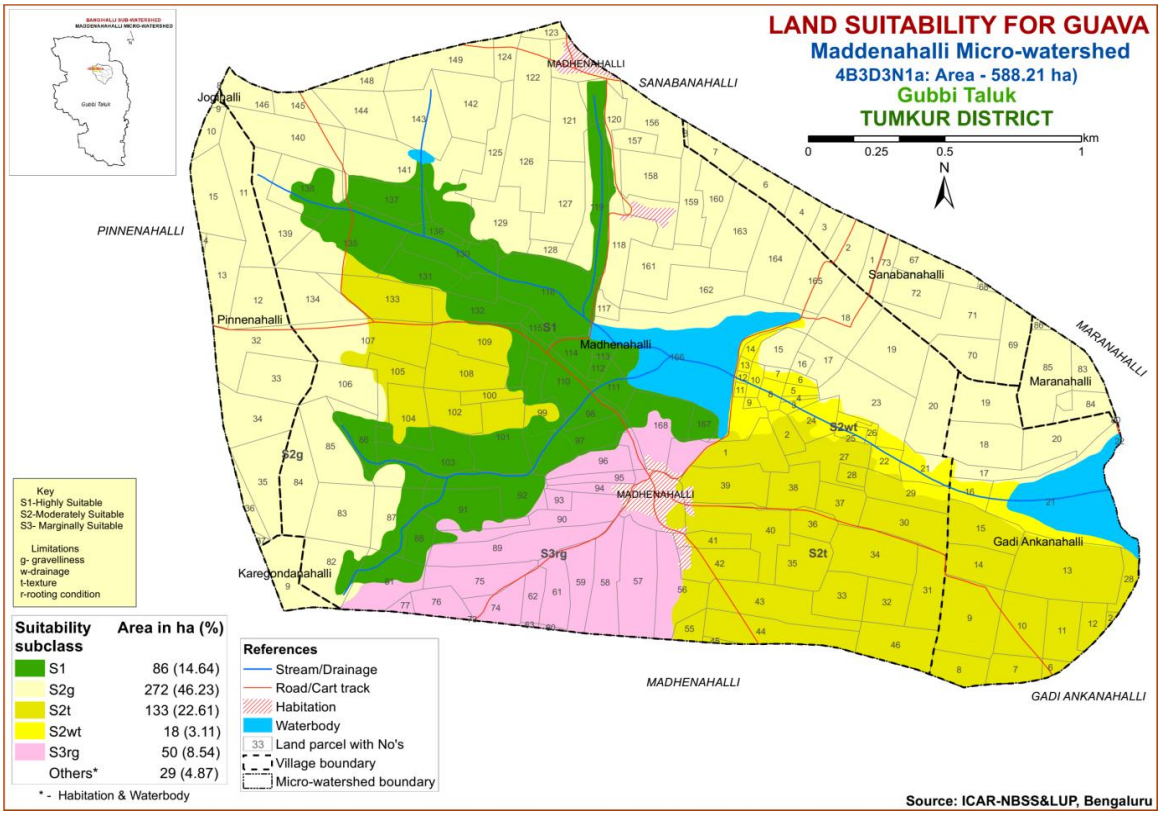


Fig. 7.18 Land Suitability map of Guava

7.19 Land Suitability for Pomegranate (*Punica granatum*)

Pomegranate is one of the commercially grown fruit crop in Karnataka in an area of 0.18 lakh ha 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 7.19.

An area of about 219 ha (37%) is highly suitable (Class S1) for growing pomegranate and are distributed in the central, southern and southeastern part of the microwatershed. A very small area of about 18 ha (3%) is moderately suitable (Class S2) for growing pomegranate and are distributed in the eastern part of the microwatershed. They have minor limitations of wetness and texture. Marginally suitable (Class S3) lands for growing pomegranate occupy a maximum area of about 322 ha (55%) and are distributed in the major part of the microwatershed. They have minor limitations of rooting depth and gravelliness.

Table 7.19 Crop suitability criteria for Pomegranate

Crop requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Climate	Temperature in growing season	^{0}C	30-34	35-38 25-29	39-40 15-24	
Soil moisture	Growing period	Days	>150	120-150	90-120	<90
Soil aeration	Soil drainage	class	Well drained	imperfectly drained		
Nutrient availability	Texture	Class	Sl, scl, l, cl	C, sic, sicl	Cl, s, ls	S, fragmental
Rooting conditions	pH	1:2.5	5.5-7.5	7.6-8.5	8.6-9.0	
	Soil depth	Cm	>100	75-100	50-75	<50
	Gravel content	% vol.	nil	15-35	35-60	>60
Soil toxicity	Salinity	dS/m	Nil	<9	>9	<50
	Sodicity	%	nil			
Erosion	Slope	%	<3	3-5	5-10	

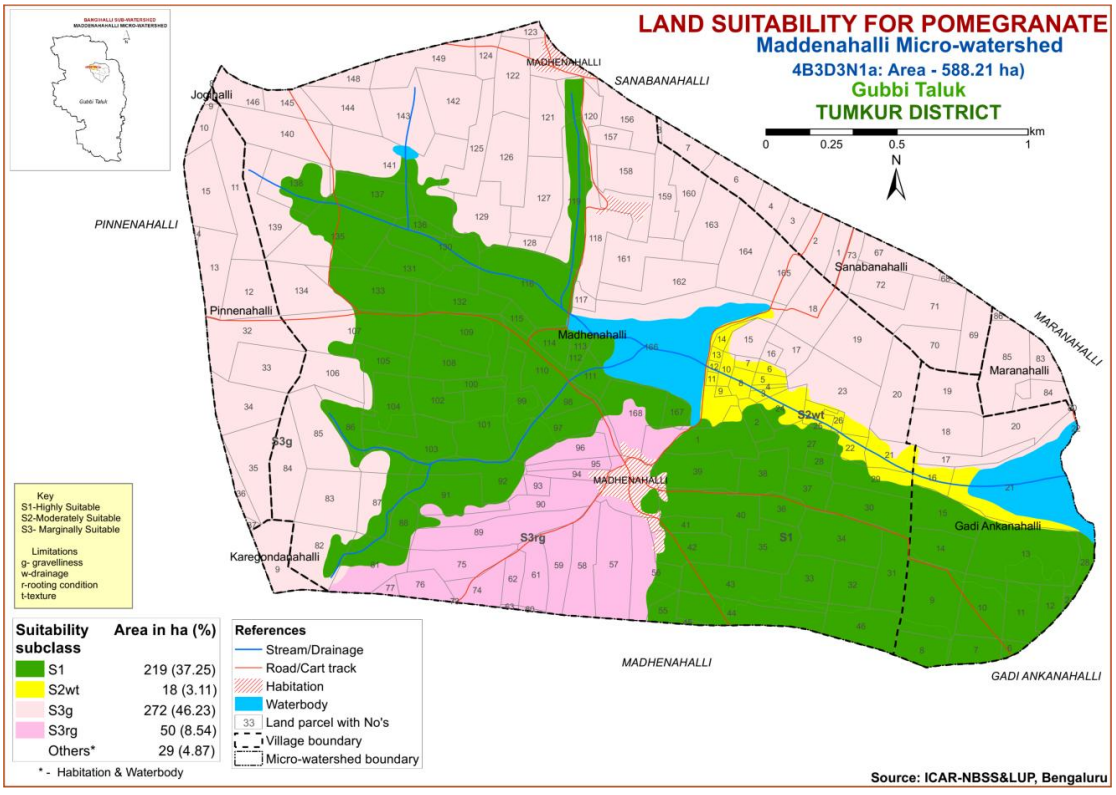


Fig. 7.19 Land Suitability map of Pomegranate

7.20 Land Suitability for Banana (*Musa paradisiaca*)

Banana is one of the major fruit crop grown in an area of 1.02 lakh ha in Karnataka State. The crop requirements for growing banana (Table 7.20) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map for growing banana was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.20.

An area of about 219 ha (37%) is highly suitable (Class S1) for growing banana and are distributed in the central, southern and southeastern part of the microwatershed. A very small area of about 18 ha (3%) is moderately suitable (Class S2) for growing banana and are distributed in the eastern part of the microwatershed. They have minor limitations of wetness and texture. Marginally suitable (Class S3) lands for growing banana occupy a maximum area of about 322 ha (55%) and are distributed in the major part of the microwatershed. They have minor limitations of rooting depth and gravelliness.

Table 7.20 Crop suitability criteria for Banana

Crop requirement			**Rating**			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Climate	Temperature in growing season	^{0}C	26-33	34-36 24-25	37-38	>38
Soil aeration	Soil drainage	Class	Well drained	Moderately to imperfectly drained	Poorly drained	Very poorly drained
Nutrient availability	Texture	Class	l,cl, scl,sil	Sicl, sc, c(<45%)	C (>45%), sic, sl	ls, s
	pH	1:2.5	6.5-7.0	7.1-8.5 5.5-6.4	>8.5 <5.5	
Rooting conditions	Soil depth	Cm	>125	76-125	50-75	<50
	Stoniness	%	<10	10-15	15-35	>35
Soil toxicity	Salinity	dS/m	<1.0	1-2	>2	
	Sodicity	%	<5	5-10	10-15	>15
Erosion	Slope	%	<3	3-5	5-15	>15

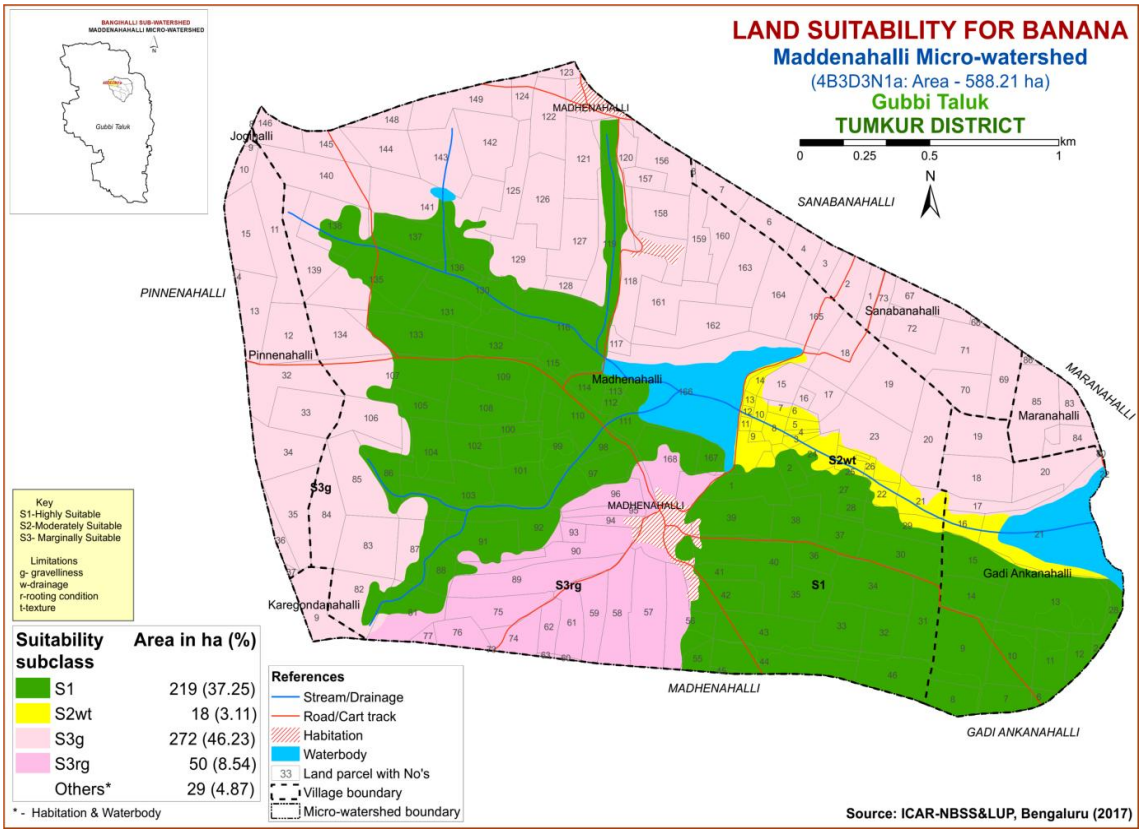


Fig. 7.20 Land Suitability map of Banana

7.21 Land Suitability for Jackfruit (*Artocarpus heterophyllus*)

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

An area of about 219 ha (37%) is highly suitable (Class S1) for growing Jackfruit and are distributed in the central, southern and southeastern part of the microwatershed. A very small area of about 18 ha (3%) is moderately suitable (Class S2) for growing Jackfruit and are distributed in the eastern part of the microwatershed. They have minor limitation of wetness. Marginally suitable (Class S3) lands for growing Jackfruit occupy a maximum area of about 322 ha (55%) and are distributed in the major part of the microwatershed. They have minor limitations of rooting depth and gravelliness.

Table 7.21 Land suitability criteria for Jackfruit

Crop requirement			Rating			
Soil site characteristics		**unit**	**Highly suitable (S1)**	**Moderately Suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Soil aeration	Soil drainage	class	well	Mod. well	Poorly	V. Poorly
Nutrient availability	Texture	Class	Scl, cl, sc, c (red)	-	Sl, ls, c (black)	-
	pH	1:2.5	5.5-7.3	5.0-5.5 7.3-7.8	7.8-8.4	>8.4
Rooting conditions	Soil depth	Cm	>100	75-100	50-75	<50
	Gravel content	% vol.	<15	15-35	35-60	>60
Erosion	Slope	%	0-3	3-5	>5	-

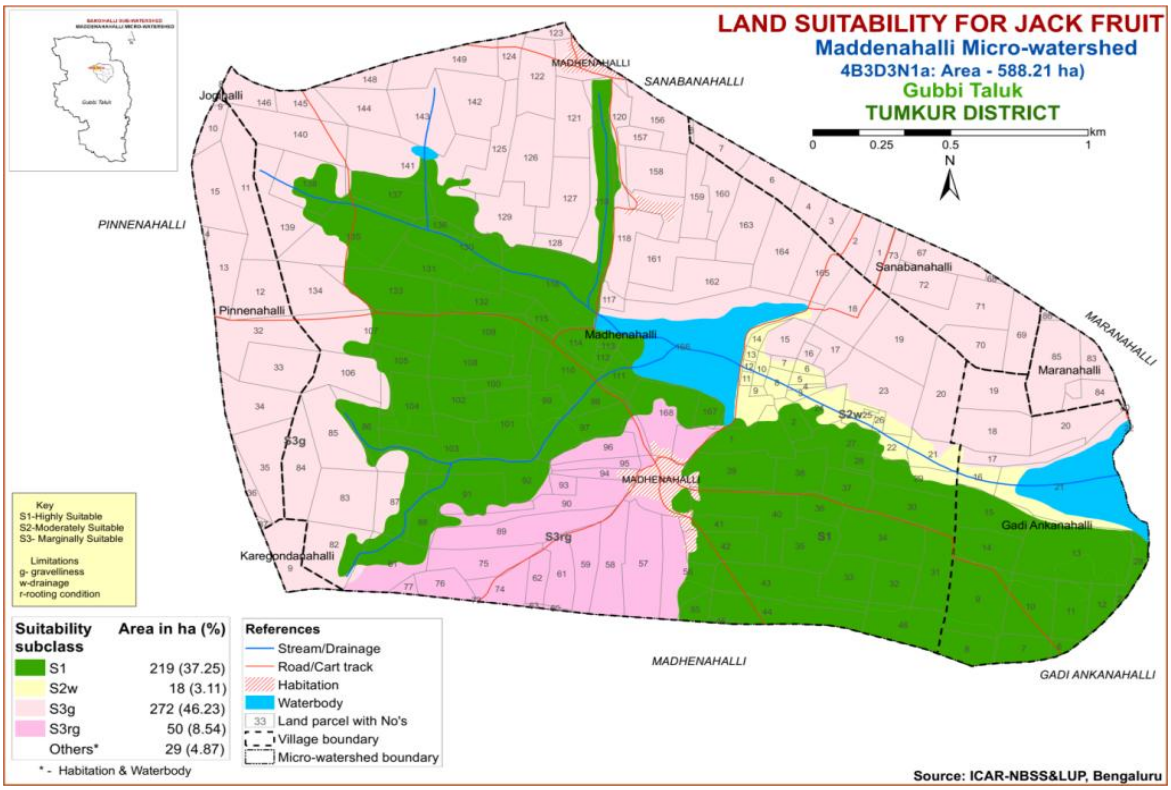


Fig. 7.21 Land Suitability map of Jackfruit

7.22 Land Suitability for Jamun (*Syzygium cumini*)

Jamun is an important fruit crop grown in almost all the districts of the State. The crop requirements for growing jamun were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing jamun (Table .22) was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.22.

An area of about 219 ha (37%) is highly suitable (Class S1) for growing Jamun and are distributed in the central, southern and southeastern part of the microwatershed. A very small area of about 18 ha (3%) is moderately suitable (Class S2) for growing Jamun and are distributed in the eastern part of the microwatershed. They have minor limitations of wetness and texture. Marginally suitable (Class S3) lands for growing Jamun occupy a maximum area of about 322 ha (55%) and are distributed in the major part of the microwatershed. They have minor limitations of rooting depth and gravelliness.

Table .22 Land suitability criteria for Jamun

Crop requirement			Rating			
Soil –site characteristics		**unit**	**Highly suitable (S1)**	**Moderately Suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Soil aeration	Soil drainage	Class	Well	Mod. well	Poorly	V.Poorly
Nutrient availability	Texture	Class	Scl, cl, sc, C (red)	Sl, C (black)	ls	-
	pH	1:2.5	6.0-7.8	5.0-6.0	7.8-8.4	>8.4
Rooting conditions	Soil depth	Cm	>150	100-150	50-100	<50
	Gravel content	% vol.	<15	15-35	35-60	>60
Erosion	Slope	%	0-3	3-5	5-10	>10

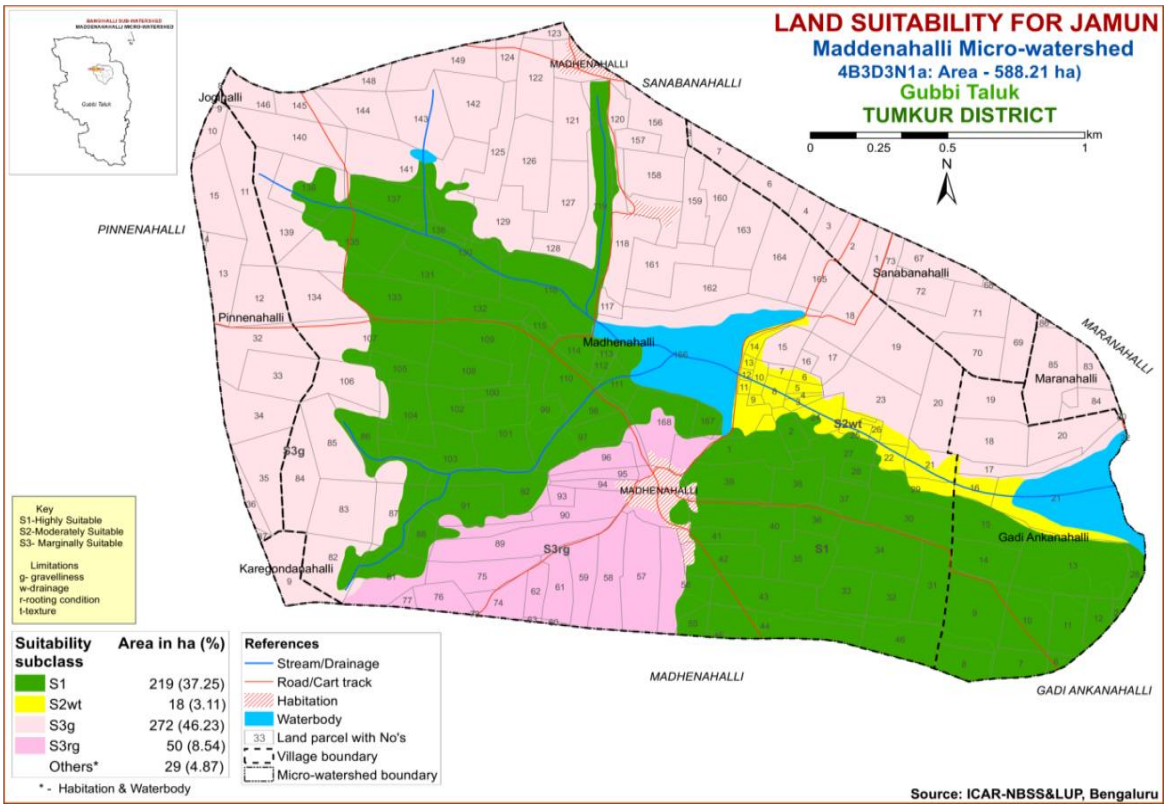


Fig. 7.22 Land Suitability map of Jamun

7.23 Land Suitability for Musambi (*Citrus limetta*)

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

An area of about 219 ha (37%) is highly suitable (Class S1) for growing Musambi and are distributed in the central, southern and southeastern part of the microwatershed. A very small area of about 18 ha (3%) is moderately suitable (Class S2) and are distributed in the eastern part of the microwatershed. They have minor limitation of wetness. Marginally suitable (Class S3) lands occupy a maximum area of about 322 ha (55%) and are distributed in the major part of the microwatershed and have minor limitations of rooting depth and gravelliness.

Table 7.23 Crop suitability criteria for Musambi

Crop requirement			**Rating**			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable(N)**
Soil aeration	Soil drainage	Class	Well drained	Mod. to imperfectly drained	poorly	Very poorly
Nutrient availability	Texture	Class	Scl, l, sicl, cl, s	Sc, sc, c	C(>70%)	S, ls
	pH	1:2.5	6.0-7.5	5.5-6.47.6-8.0	4.0-5.4 8.1-8.5	<4.0 >8.5
Rooting conditions	Soil depth	Cm	>150	100-150	50-100	<50
	Gravel content	% vol.	Non gravelly	15-35	35-55	>55
Erosion	Slope	%	<3	3-5	5-10	

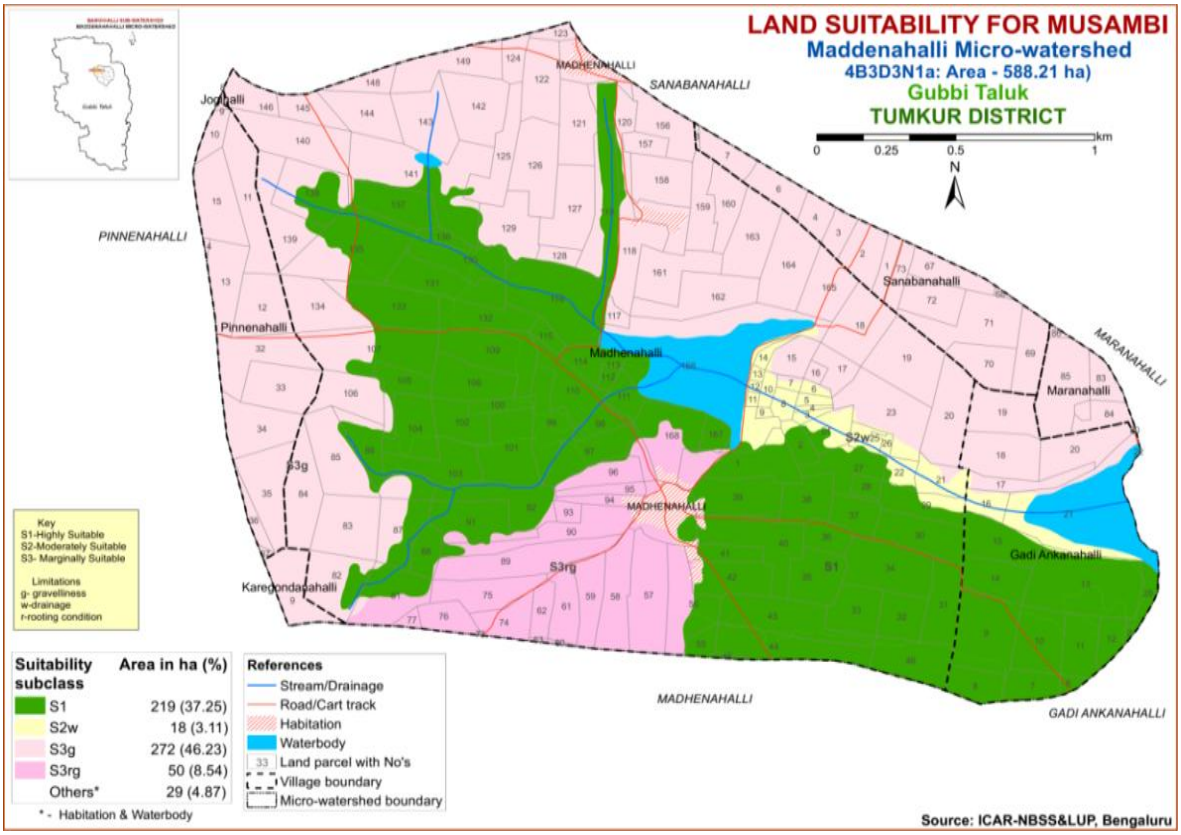


Fig. 7.23 Land Suitability map of Musambi

7.24 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 geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7. 24.

An area of about 219 ha (37%) is highly suitable (Class S1) for growing Lime and are distributed in the central, southern and southeastern part of the microwatershed. A very small area of about 18 ha (3%) is moderately suitable (Class S2) for growing lime and are distributed in the eastern part of the microwatershed. They have minor limitations of wetness and texture. Marginally suitable (Class S3) lands for growing lime occupy a maximum area of about 322 ha (55%) and are distributed in the major part of the microwatershed. They have minor limitations of rooting depth and gravelliness.

Table 7.24 Crop suitability criteria for Lime

Crop requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable(N)**
Climate	Temperature in growing season	^{0}C	28-30	31-35 24-27	36-40 20-23	>40 <20
Soil moisture	Growing period	Days	240-265	180-240	150-180	<150
Soil aeration	Soil drainage	Class	Well drained	Mod. to imperfectly drained	poorly	Very poorly
Nutrient availability	Texture	Class	Scl, l, sicl, cl, s	Sc, sc, c	C(>70%)	S, ls
	pH	1:2.5	6.0-7.5	5.5-6.47.6-8.0	4.0-5.4 8.1-8.5	<4.0 >8.5
	$CaCO_3$ in root zone	%	Non 34calcareous	Upto 5	5-10	>10
Rooting conditions	Soil depth	Cm	>150	100-150	50-100	<50
	Gravel content	% vol.	Non gravelly	15-35	35-55	>55
Soil toxicity	Salinity	dS/m	Non saline	Upto 1.0	1.0-2.5	>2.5
	Sodicity	%	Non sodic	5-10	10-15	>15
Erosion	Slope	%	<3	3-5	5-10	

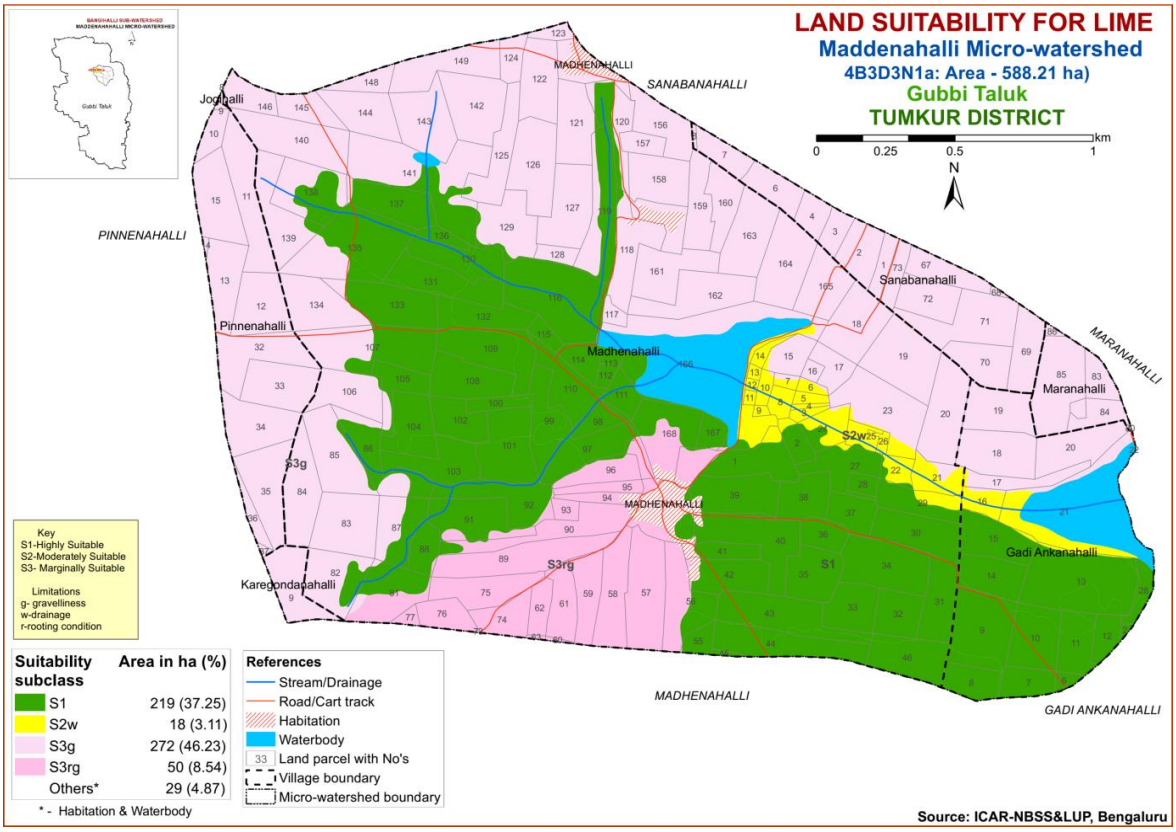


Fig. 7.24 Land Suitability map of Lime

7.25 Land Suitability for Cashew (*Anacardium occidentale)*

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

An area of about 86 ha (15%) is highly suitable (Class S1) for growing cashew and are distributed in the central part of the microwatershed. A major area of 405 ha (69%) is moderately suitable for growing cashew and are distributed in major part of the microwatershed. They have minor limitations of texture and gravelliness. The marginally suitable (Class S3) lands cover an area of about 50 ha (9%) and occur in the southern part of the microwatershed. They have moderate limitations of gravelliness and rooting depth. A very small area of about 18 ha (3%) is not suitable for growing cashew and occur in the eastern part of the microwatershed and have very severe limitation of wetness.

Table 7.25 Land suitability criteria for Cashew

Crop requirement			Rating			
Soil –site characteristics		**unit**	**Highly suitable (S1)**	**Moderately Suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Soil aeration	Soil drainage	Class	Well drained	Mod. well drained	Poorly drained	V.Poorly drainage
Nutrient availability	Texture	Class				
	pH	1:2.5	5.5-6.5	5.0-5.5 6.5-7.3	7.3-7.8	>7.8
Rooting conditions	Soil depth	Cm	>100	75-100	50-75	<50
	Gravel content	% vol.	<15	15-35	35-60	>60
Erosion	Slope	%	0-3	3-10	>10	

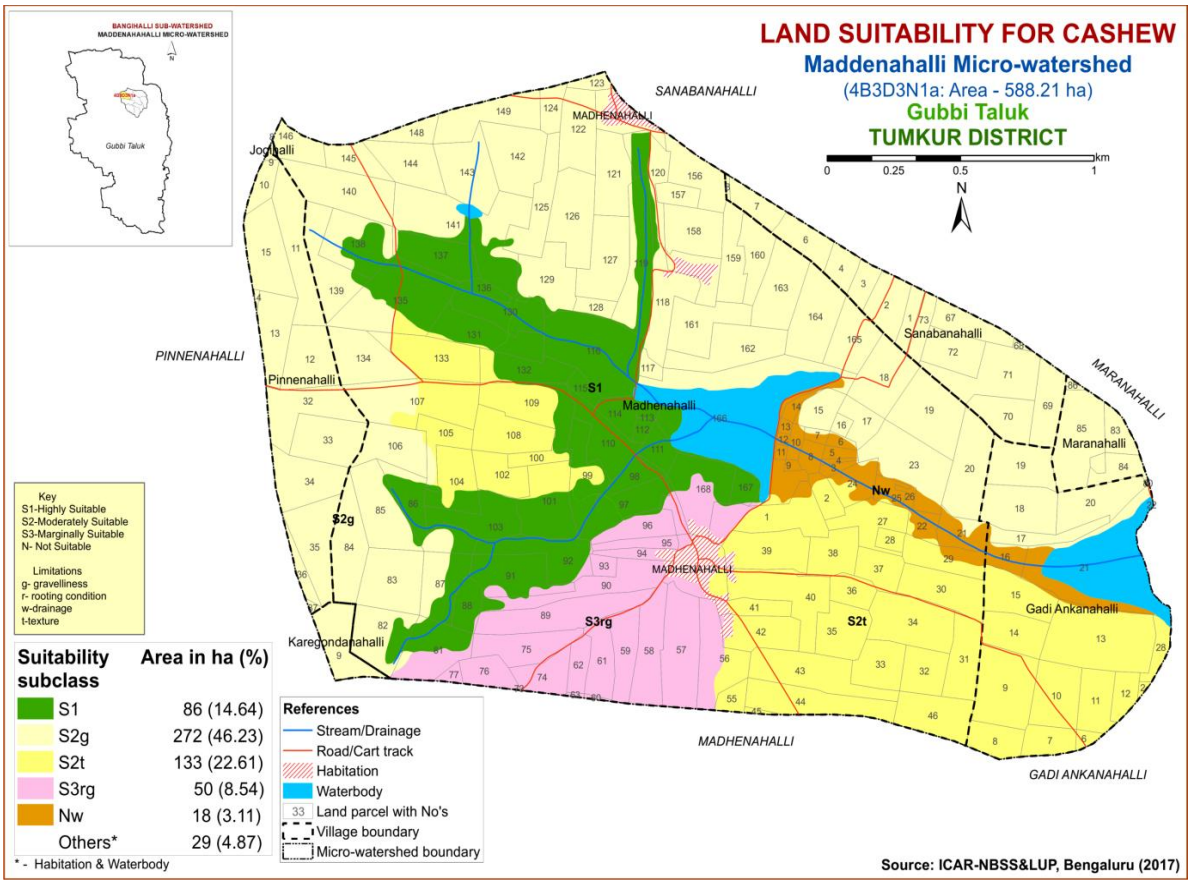


Fig. 7.25 Land Suitability map of Cashew

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

Custard apple is one of the most important fruit crop grown in almost all the districts of the State. The crop requirements for growing custard apple were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing custard

apple (Table 26) was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.26.

An area of 219 ha (37%) is highly suitable (Class S1) for growing custard apple and are distributed in the central, southern and southeastern part of the microwatershed. A maximum area of about 340 ha (58%) has soils that are moderately suitable (Class S2) for growing custard apple with minor limitations of wetness and gravelliness and are distributed in the major part of the microwatershed.

Table 7.26 Land suitability criteria for Custard apple

Crop requirement			**Rating**			
Soil –site characteristics		**unit**	**Highly suitable (S1)**	**Moderately Suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Soil aeration	Soil drainage	Class	Well drained	Mod. well drained	Poorly drained	V. Poorly drained
Nutrient availability	Texture	Class	Scl, cl, sc, c (red), c (black)	-	Sl, ls	-
	pH	1:2.5	6.0-7.3	7.3-8.4	5.0-5.5 8.4-9.0	>9.0
Rooting conditions	Soil depth	Cm	>75	50-75	25-50	<25
	Gravel content	% vol.	<15-35	35-60	60-80	-
Erosion	Slope	%	0-3	3-5	>5	

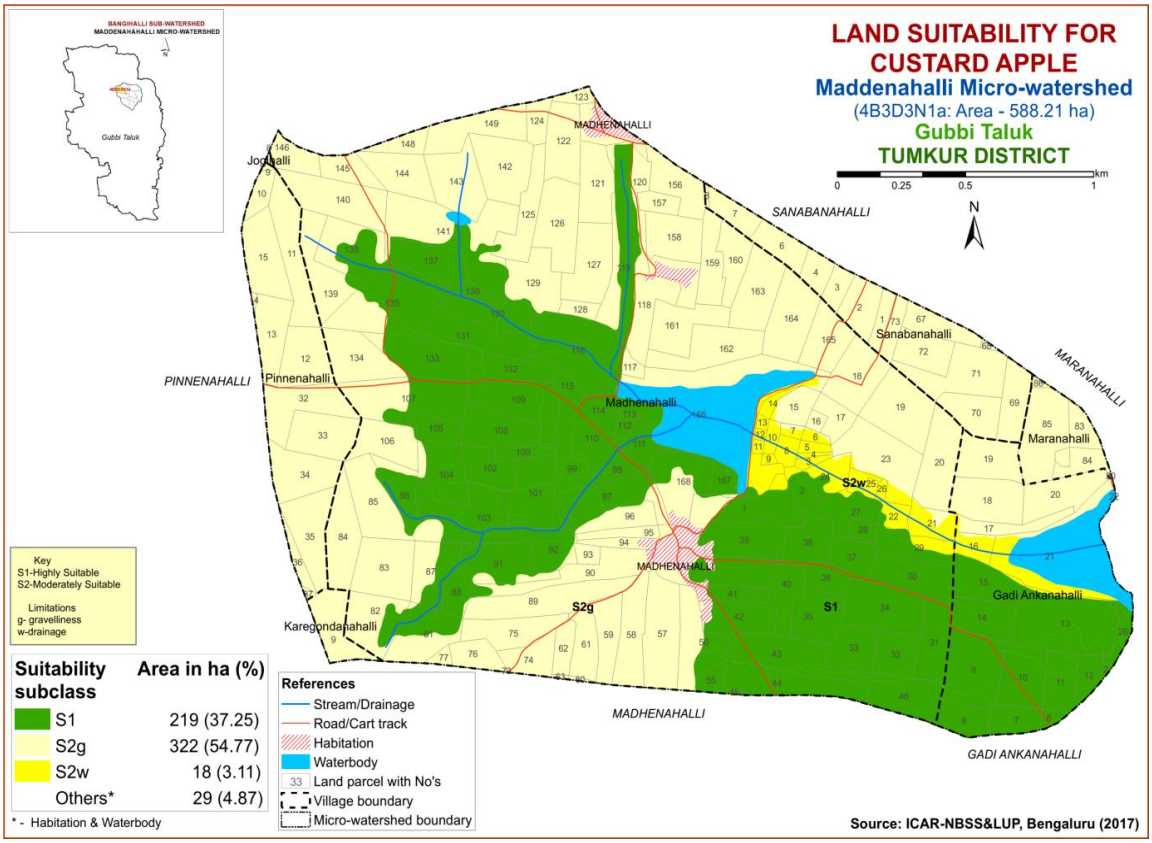


Fig. 7.26 Land Suitability map of Custard Apple

7.27 Land Suitability for Amla (*Phyllanthus emblica*)

Amla is one of the fruit crop grown in almost all the districts of the State. The crop requirements for growing amla were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing amla (Table 7.27) was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.27.

An area of 219 ha (37%) is highly suitable (Class S1) for growing Amla and are distributed in the central, southern and southeastern part of the microwatershed. A maximum area of about 340 ha (58%) has soils that are moderately suitable (Class S2) for growing Amla with minor limitations of wetness and gravelliness and are distributed in the major part of the microwatershed.

Table 7. 27 Land suitability criteria for Amla

Crop requirement			Rating			
Soil –site characteristics		unit	Highly suitable (S1)	Moderately Suitable (S2)	Marginally suitable (S3)	Not suitable (N)
Soil aeration	Soil drainage	Class	Well drained	Mod.well drained	Poorly drained	V. Poorly drained
Nutrient availability	Texture	Class	Scl, cl, sc, c (red)	C (black)	ls, sl	-
	pH	1:2.5	5.5-7.3	5.0-5.5	7.8-8.4	>8.4
Rooting conditions	Soil depth	Cm	>75	50-75	25-50	<25
	Gravel content	% vol.	<15-35	35-60	60-80	
Erosion	Slope	%	0-3	3-5	5-10	>10

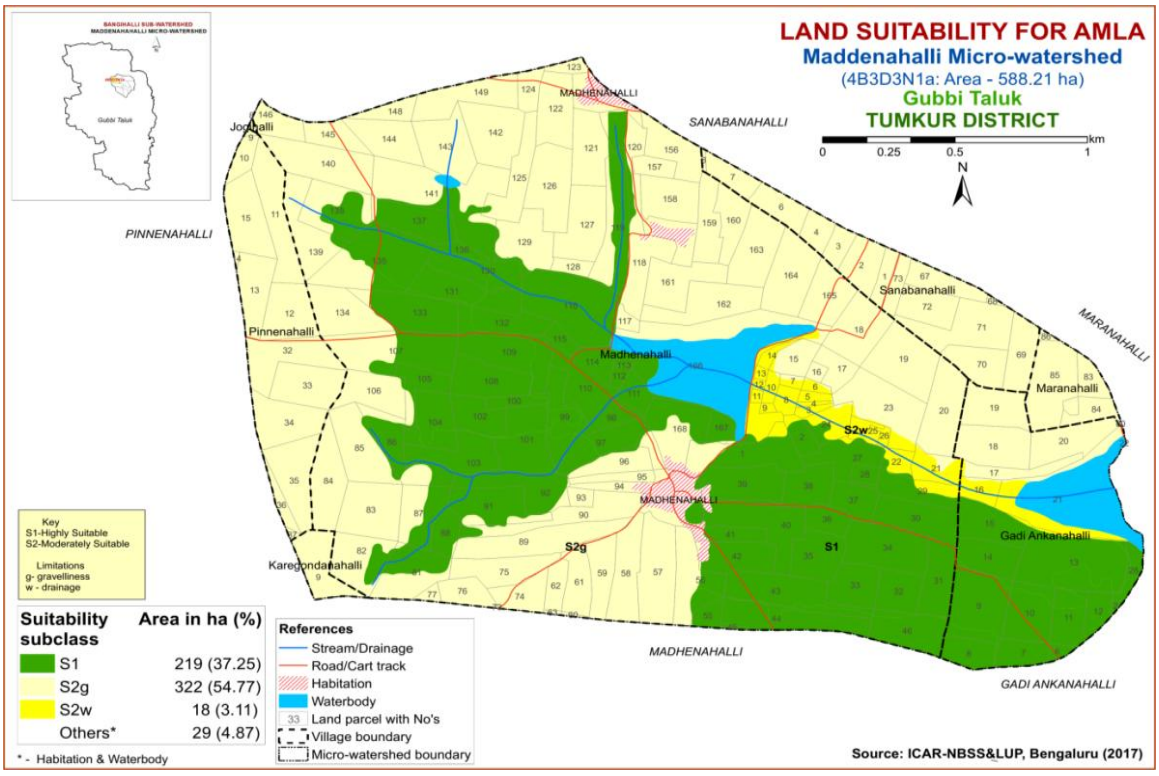


Fig. 7.27 Land Suitability map of Amla

7.28 Land Suitability for Tamarind (*Tamarindus indica*)

Tamarind is the most important spice crop grown in 14897 ha in all the districts of the state. The crop requirements for growing tamarind were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing tamarind (Table 7.28) 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 219 ha (37%) is highly suitable (Class S1) for growing Tamarind and are distributed in the central, southern and southeastern part of the microwatershed. A very small area of about 18 ha (3%) is moderately suitable (Class S2) for growing Tamarind and are distributed in the eastern part of the microwatershed and have minor limitations of wetness and texture. Marginally suitable (Class S3) lands for growing Tamarind occupy a maximum area of about 322 ha (55%) and are distributed in the major part of the microwatershed. They have minor limitations of rooting depth and gravelliness.

Table 7.28 Land suitability criteria for Tamarind

Crop requirement			Rating			
Soil –site characteristics		**unit**	**Highly suitable S1**	**Moderately Suitable S2**	**Marginally suitable S3**	**Not suitable N**
Soil aeration	Soil drainage	Class	Well drained	Mod.well drained	Poorly drained	V.Poorly drained
Nutrient availability	Texture	Class	Scl, cl,sc, c (red)	Sl, c (black)	ls	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-7.8	7.8-8.4	>8.4
Rooting conditions	Soil depth	Cm	>150	100-150	75-100	<50
	Gravel content	% vol.	<15	15-35	35-60	60-80
Erosion	Slope	%	0-3	3-5	5-10	>10

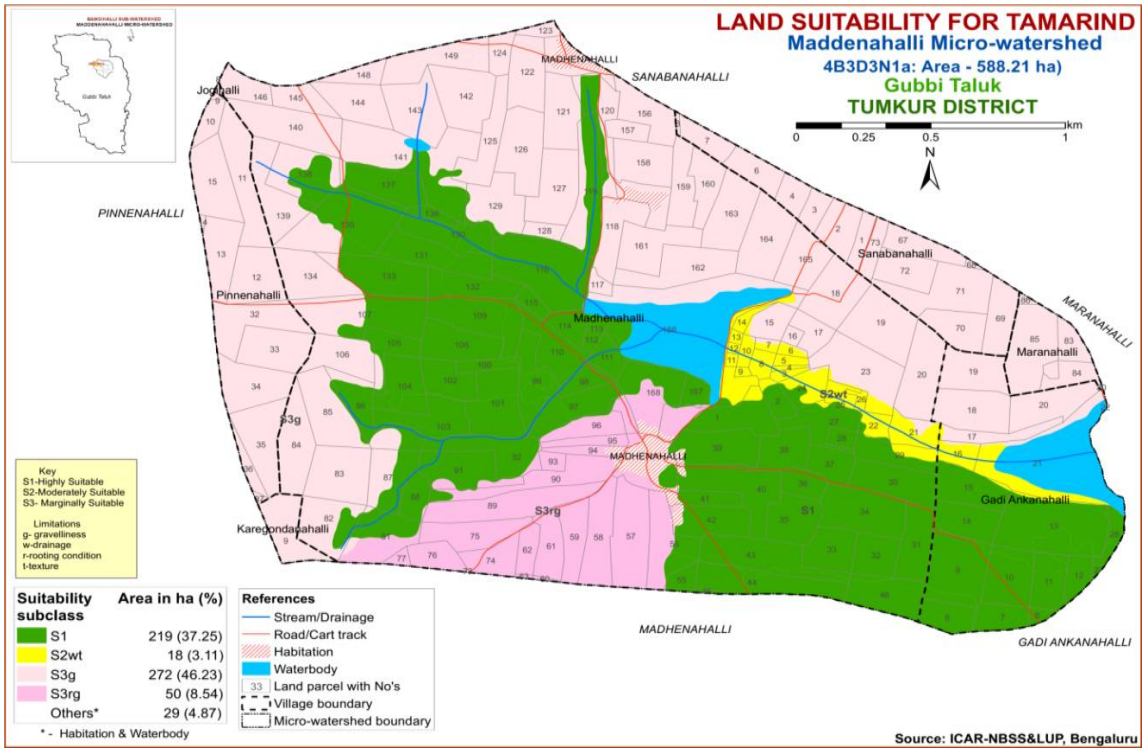


Fig. 7.28 Land Suitability map of Tamarind

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

Marigold is 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 (Table 7.1) and a land suitability map for growing marigold was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.29.

An area of about 219 ha (37%) is highly suitable (Class S1) for growing Marigold and are distributed in the central, southern and southeastern part of the microwatershed. A very small area of about 18 ha (3%) is moderately suitable (Class S2) for growing Marigold and are distributed in the eastern part of the microwatershed and have minor limitations of wetness and texture. Marginally suitable (Class S3) lands for growing Marigold occupy a maximum area of about 322 ha (55%) and are distributed in the major part of the microwatershed. They have minor limitation of gravelliness.

Table 7.29 Land suitability criteria for Marigold

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

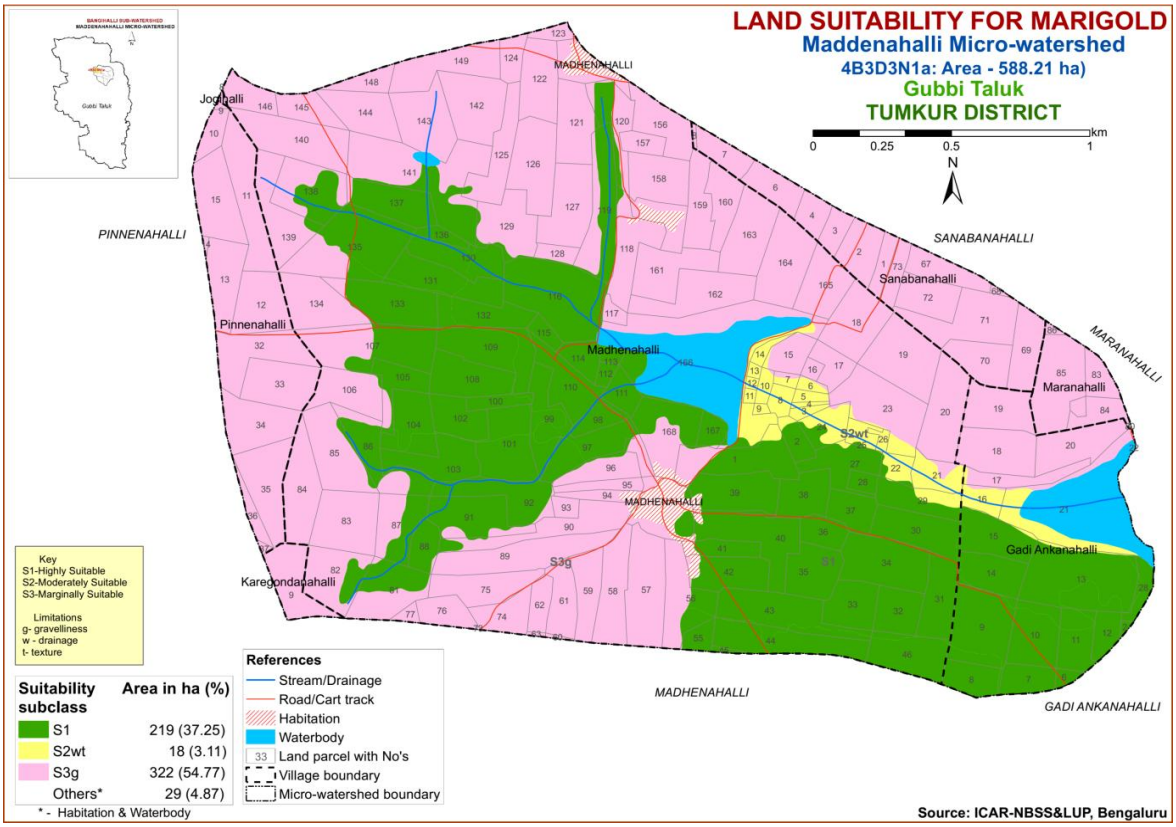


Fig. 7.29 Land Suitability map of Marigold

7.30 Land Suitability for Chrysanthemum (*Dendranthema grandiflora*)

Chrysanthemum is the most important flower crop grown in an area of 803 ha in almost all the districts of the State. The crop requirements (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 geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.30.

An area of about 219 ha (37%) is highly suitable (Class S1) for growing chrysanthemum and are distributed in the central, southern and southeastern part of the microwatershed. A very small area of about 18 ha (3%) is moderately suitable (Class S2) for growing chrysanthemum and are distributed in the eastern part of the microwatershed. They have minor limitations of wetness and texture. Marginally suitable (Class S3) lands for growing chrysanthemum occupy a maximum area of about 322 ha (55%) and are distributed in the major part of the microwatershed. They have minor limitation of gravelliness.

Table 7.30 Land suitability criteria for Chrysanthemum

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

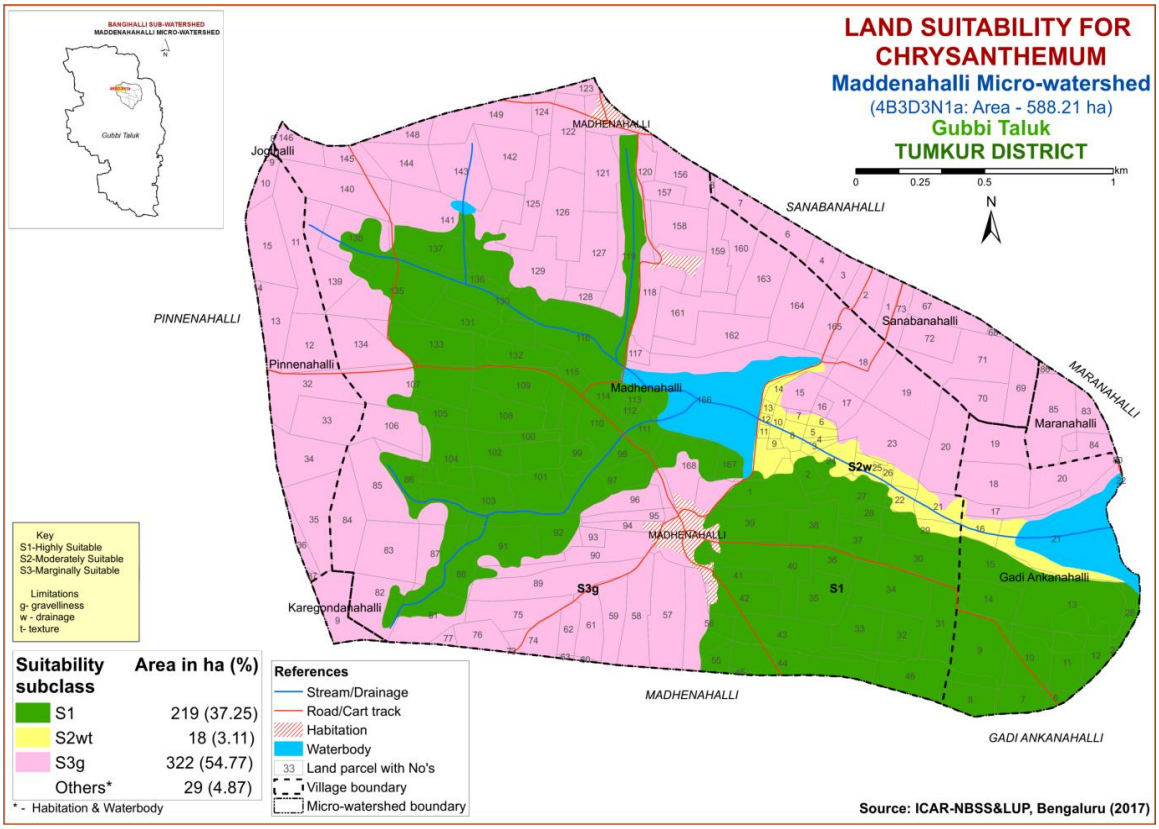


Fig. 7.30 Land Suitability map of Chrysanthemum

7. 31 Land Suitability for Jasmine *(Jasminum sp.)*

Jasmine is 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 chrysanthemum were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing chrysanthemum was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.31.

An area of about 219 ha (37%) is highly suitable (Class S1) for growing Jasmine and are distributed in the central, southern and southeastern part of the microwatershed. A very small area of about 18 ha (3%) is moderately suitable (Class S2) for growing Jasmine and are distributed in the eastern part of the microwatershed. They have minor limitations of wetness and texture. Marginally suitable (Class S3) lands for growing Jasmine occupy a maximum area of about 322 ha (55%) and are distributed in the major part of the microwatershed. They have minor limitation of gravelliness.

Table 7.31 Land suitability criteria for jasmine (irrigated)

Crop requirement			**Rating**			
		Unit	**Highly suitable (S1)**	**Moderately Suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Climate	Temperature in growing season		18-23	17-15 24-35	35-40 10-14	
Soil aeration	Soil drainage	Class	Well drained	Moderately drained	Imperfectly drained	Poorly drained
Nutrient availability	Texture	Class	Scl, l, scl, cl, sil	sicl, sc, sic, c (m/k)	C(ss),	ls, s
	pH	1:2.5	6.0-7.5	5.5-5.9 7.6-8.5	<5 >8.5	
	$CaCO_3$ in root zone	%	Non calcareous	Slightly calcareous	Strong calcareous	
Rooting conditions	Soil depth	Cm	>75	50-75	25-50	<25
	Gravel content	% vol.	<15	15-35	>35	
Soil toxicity	Salinity	ds/m	Non saline	Slight	Strongly	
	Sodicity	%	Non sodic	Slight	Strongly	
Erosion	Slope	%	1-3	3-5	5-10	

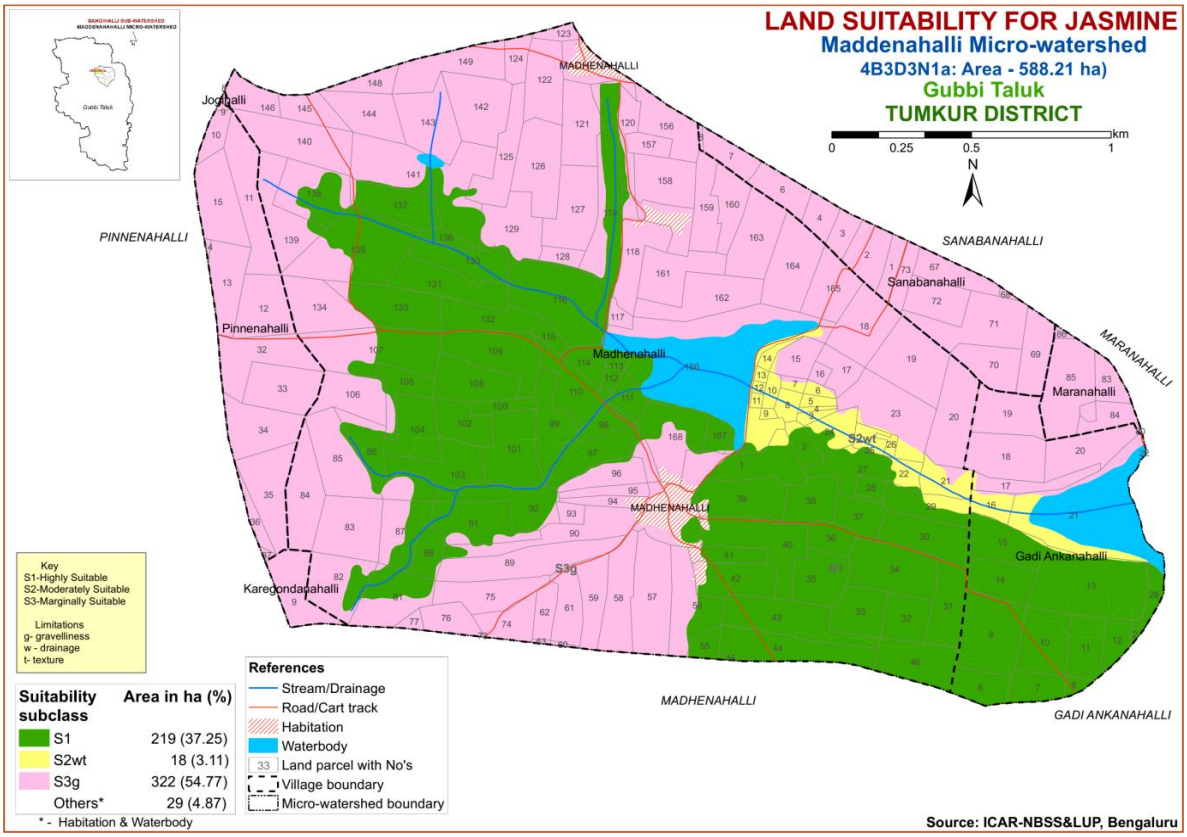


Fig. 7.31 Land Suitability map of Jasmine

7.32 Land Suitability for Coconut (*Cocos nucifera*)

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

An area of about 86 ha (15%) is highly suitable (Class S1) for growing coconut and are distributed in the central part of the microwatershed. An area of about 151 ha (26%) is moderately suitable (Class S2) for growing coconut and are distributed in the central, southern and southeastern part of the microwatershed. They have minor limitations of wetness and texture. Marginally suitable (Class S3) lands for growing coconut occupy a maximum area of about 322 ha (55%) and are distributed in the major part of the microwatershed. They have minor limitation of gravelliness.

Table 7. 32 Land suitability criteria for Coconut

Crop requirement		Rating			
Soil –site characteristics	**Unit**	**Highly suitable (S1)**	**Moderately Suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Slope	%	0-3	3-5	5-10	>10
Soil drainage	class	Well drained	Mod. drained	Poorly	Very poorly
Soil reaction	pH	5.1-6.5	6.6-7.5	7.6-8.5	-
Surface soil texture	Class	Sc, cl, scl	C (red), sl	C (black), ls	-
Soil depth	Cm	>100	75-100	50-75	<50
Gravel content	% vol.	<15	15-35	35-60	>60

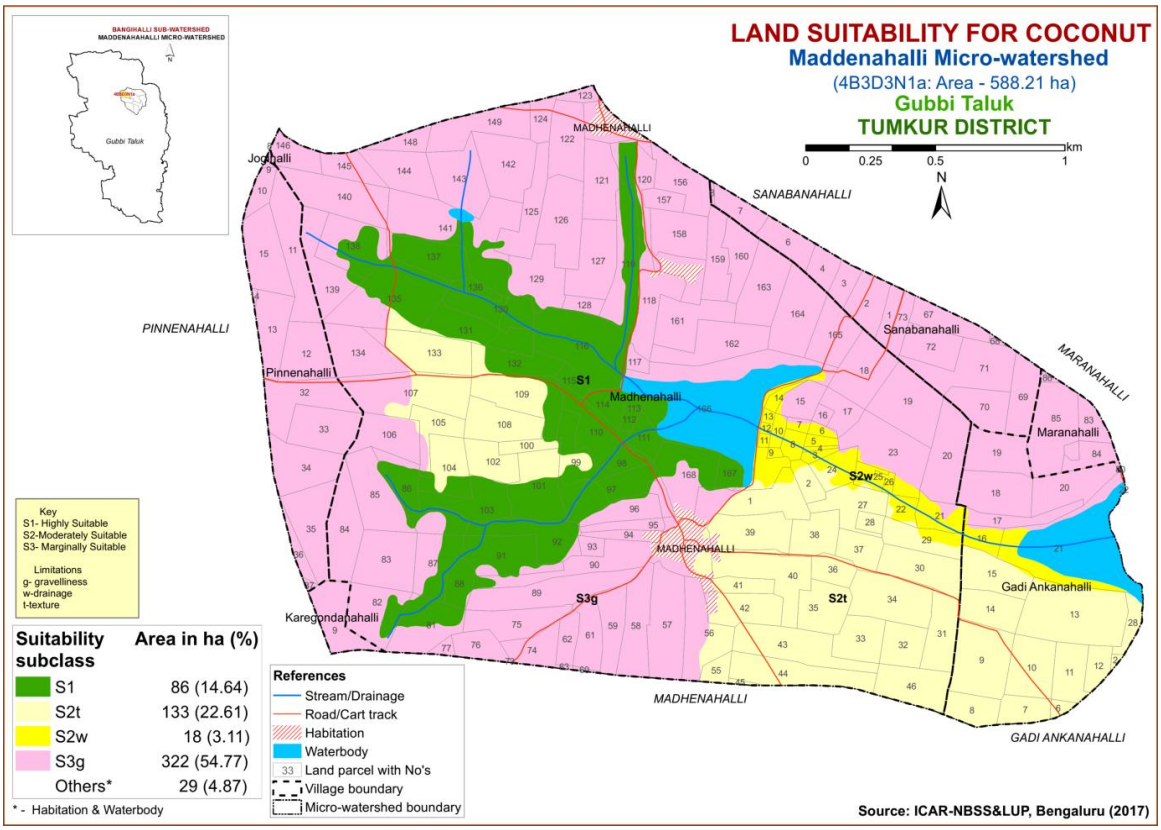


Fig. 7.32 Land Suitability map of Coconut

7.33 Land Suitability for Areca nut (*Areca catechu*)

Areca nut is the most important nut crop grown in few districts of the State. The crop requirements (7.33) for growing Areca nut were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing Areca nut was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.33.

An area of about 86 ha (15%) is highly suitable (Class S1) for growing areca nut and are distributed in the central part of the microwatershed. An area of about 151 ha (26%) is moderately suitable (Class S2) for growing areca nut and are distributed in the

central, southern and southeastern part of the microwatershed. They have minor limitations of wetness and texture. Marginally suitable (Class S3) lands for growing areca nut occupy a maximum area of about 322 ha (55%) and are distributed in major part of the microwatershed. They have minor limitation of gravelliness.

Table 7.33 Land suitability criteria for Areca nut

Crop requirement		Rating			
Soil –site characteristics	**unit**	**Highly suitable S1**	**Moderately Suitable S2**	**Marginally suitable S3**	**Not suitable N**
Slope	%	0-3	3-5	5-10	>10
Soil drainage	class	Well drained	Mod. to poorly drained	-	Very poorly
Soil reaction	pH	5.0-6.5	6.6-7.5	7.6-8.5	
Surface soil texture	Class	Sc, cl, scl	C (red), sl	C (black), ls	-
Soil depth	Cm	>100	75-100	50-75	<50
Gravel content	% vol.	<15	15-35	35-60	>60

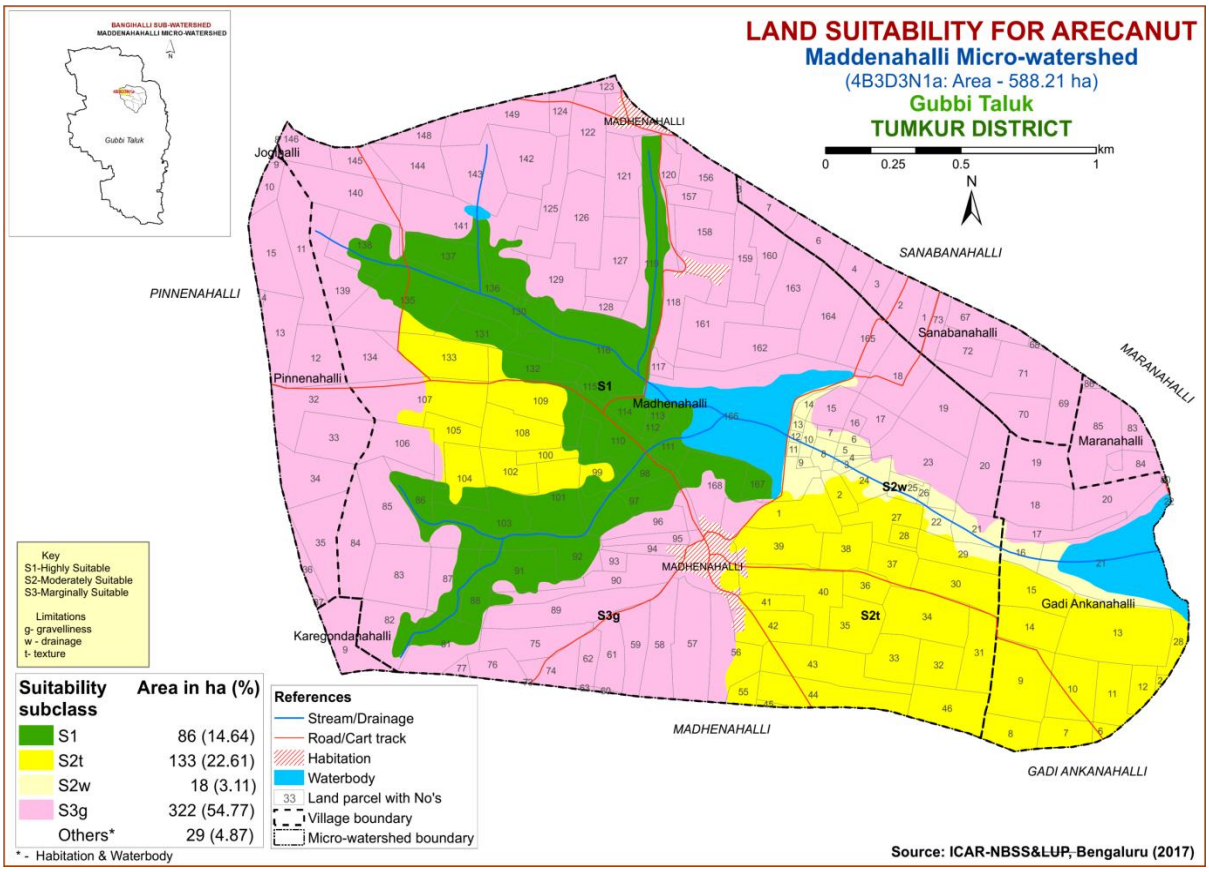


Fig. 7.33 Land Suitability map of Arecanut

7.34 Land Suitability for Mulbery (*Morus nigra*)

Mulbery is the most important leaf crop grown in about 1.66 lakh ha in all the districts of the state for feeding silk worms. The crop requirements for growing mulbery

(Table 7.34) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing mulbery was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.11.

Highly suitable (Class S1) lands occupy an area of about 27 ha (5%) for growing mulbery and occur in the central part of the microwatershed. Moderately suitable (Class S2) lands occupy maximum area of about 455 ha (77%) and occur in all parts of the microwatershed. They have minor limitations of gravelliness and texture. Marginally suitable lands cover an area of about 77 ha (13%) and occur in the northern and central part of the microwatershed. They have moderate limitation of texture.

Table 34 Land suitability criteria for Mulberry

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

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

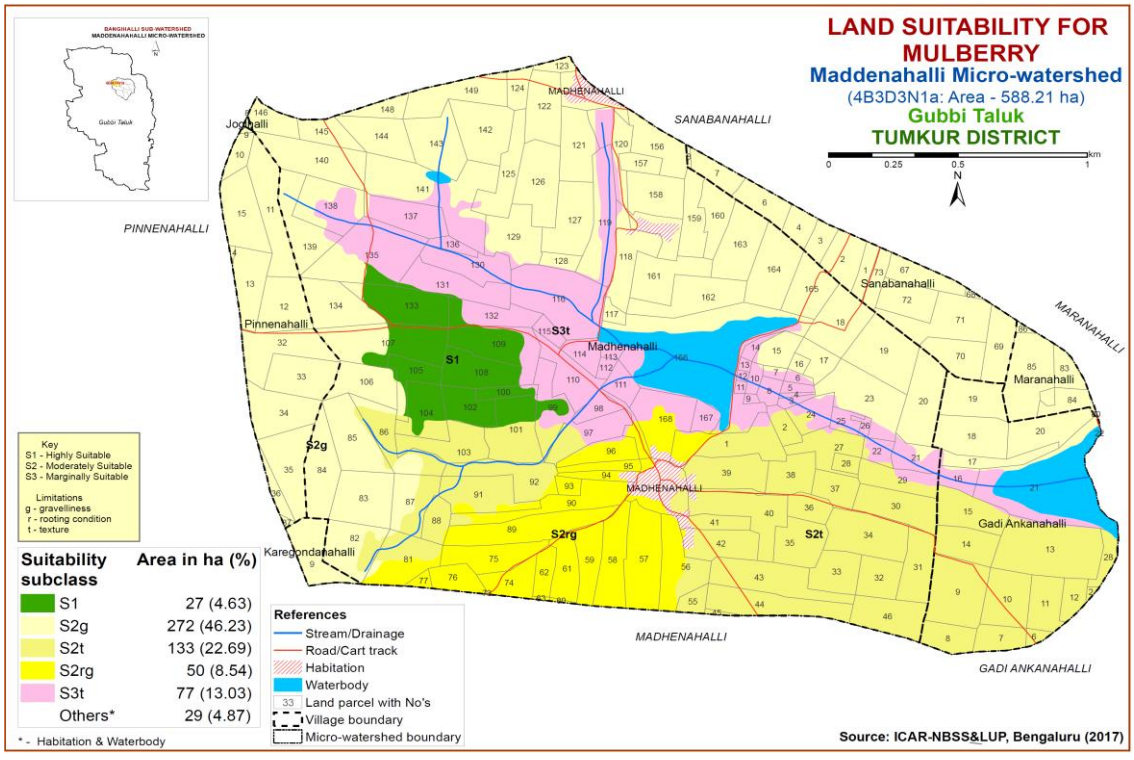


Fig. 7.34 Land Suitability map of Mulberry

7.35 Land Use Classes (LUCs)

The 18 soil map units identified in Maddenahalli microwatershed have been regrouped into 5 Land Use Classes (LUC's) for the purpose of preparing a Proposed Crop Plan. Land Use Classes 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 Use Classes map (Fig.7.28) has been generated. These land use classes are expected to behave similarly for a given level of management.

The map units that have been grouped into 5 land use classes along with brief description of soil and site characteristics are given below.

LUC NO.	Soil map unit number	Soil map units	Soil and site characteristics
1	11,12,13,14	MRDcB1 RTRcA1 RTRhB1 RTRiB1	Very deep, red clay to sandy clay loam soils with slopes of 0-3% and slight erosion
2	15,16,17,	KDThB1 KDThB1g1 KDTiA1	Very deep, sandy clay loam soils with slopes of 0-3%, gravelly (15-35%) and slight erosion
3	18	TSDiA1	Very deep, black clayey soils and low land soils with slopes of 0-1% and slight erosion
4	2, 3, 4, 5, 6, 7, 8, 9, 10	BPRcB1 BPRcB1g1 BPRcB2g1 BPRcB2g2 BPRhB1 BPRhB1g1 BPRhB2 BPRhB2g1 BPRiB2	Deep, red gravelly sandy clay loam to sandy clay soils with slopes of 1-3%, gravelly to very gravelly (15-60%) and slight to moderate erosion
5	1	BDGcB1g1	Moderately deep gravelly red sandy loam soils with slopes of 1-3%, gravelly (15-35%) and slight erosion

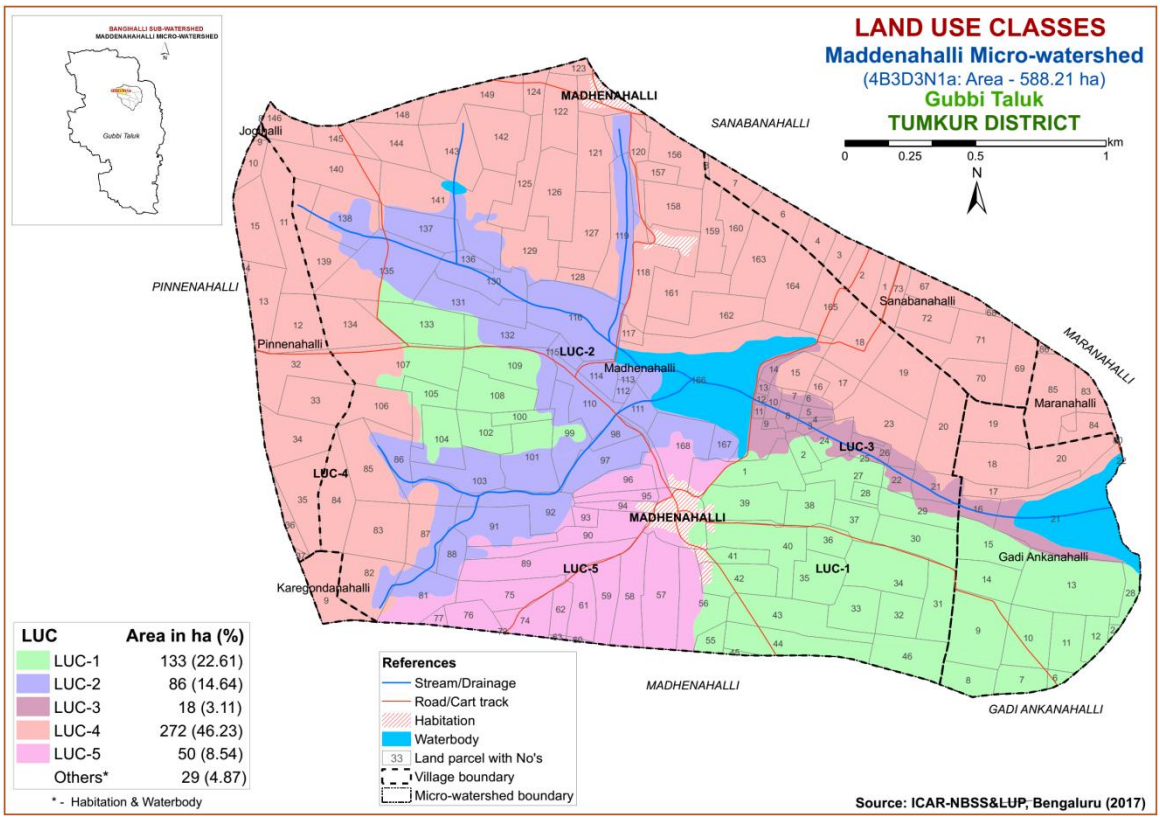


Fig. 7.36 Land Use Classes Map - Maddenahalli Microwatershed

7.36 Proposed Crop Plan for Maddenahalli Microwatershed

After assessing the land suitability for the 34 crops, a proposed crop plan has been prepared for the 5 identified LUCs by considering only the highly (Class S1) and moderately (Class S2) suitable lands for each of the 34 crops. The resultant proposed crop plan is presented below in Table 7.35.

Table 7.35 Proposed Crop Plan for Maddenahalli Microwatershed

LUC No	Mapping Units	Survey Number	Soil Characteristics	Field Crops	Forestry/ Grasses	Horticulture Crops with suitable interventions	Suitable Interventions
LUC1 133 ha (23%)	MRDcB1 RTRcA1 RTRhB1 RTRiB1	Gadi Ankanahalli: 2,6,7,8,9,10,11,12,13,14, 15,28 Madhenahalli: 1,2,27,28,29,30,31,32,33, 34,35,36,37,38,39,40,41, 42,43,44,45,46,55,100,102 ,104,105,107,108,109,133	Very deep, red clay to sandy clay loam soils with slopes of 0-3% and slight erosion	**Sole Crops:** Ragi, Upland paddy, Maize, Sorghum, Fodder sorghum, Sunflower, Groundnut, Redgram, Fieldbean, Cowpea **Intercropping:** Redgram+Fodder sorghum Ragi+Cowpea Ragi+Redgram Ragi+Fieldbean	Neem, Silver Oak **Grasses** *Styloxanthes hamata*, *Styloxanthes Scabra*, Hybrid Napier, Sesbania,	**Vegetables**: Onion, Tomato, Brinjal Chillies, Coriander, Drumstick **Flower crops:** Chrysanthemum, Jasmine, China aster, Marigold, Crossandra **Fruit crops/ Plantation crops:** Mango, Sapota, Guava, Cashew, Pomegranate Jackfruit, Musambi, Arecanut, Coconut	Summer ploughing, cultivation on raised beds with mulches, Drip irrigation and suitable conservation practices (Crescent Bunding with Catch Pit etc)
LUC 2 86 ha (15%)	KDThB1 KDThB1g1 KDTiA1	Madhenahalli: 81,86,87,88,91,92,97,98, 99,101,103,110,111,112, 113,114,115,116,119,130, 131,132,135,136,137,167, 168	Very deep, sandy clay loam soils with slopes of 0-3%, gravelly (15-35%) and slight erosion	**Sole crops**: Sorghum, Sunflower, Fodder sorghum, Redgram, Field bean, Horse gram **Intercropping:** Redgram+Fodder sorghum	Hebbevu, Silveroak **Grasses:** *Styloxanthes hamata, Styloxanthes scabra*, Hybrid napier	**Vegetables:** Brinjal, Tomato, chillies, Cucurbits **Flower crops:** Marigold, Chrysanthemum **Fruit crops:** Pomegranate, Tamarind, Custard Apple, Amla, Lime, Musambi Arecanut, Coconut	Application of FYM and micronutrients, drip irrigation, Mulching, suitable conservation practises

LUC 3 18 ha (3%)	TSDiA1	Gadi Ankanahalli: 16 Madhenahalli: 3,4,5,6,7,8,9,10,11,12,13, 14,21,22,24,25,26	Very deep, black clayey soils and low land soils with slopes of 0-1% and slight erosion	**Sole crop**: Paddy	Hebbevu, Silveroak **Grasses:** *Styloxanthes hamata*, *Styloxanthes scabra*, Hybrid napier	**Fruit crops/ plantation crops:** Tamarind, Custard Apple, Amla, Arecanut, Coconut	Providing proper drainage, addition of organic manures, green leaf manuring, suitable conservation practices
LUC 4 272 ha (46%)	BPRcB1 BPRcB1g1 BPRcB2g1 BPRcB2g2 BPRhB1 BPRhB1g1 BPRhB2 BPRhB2g1 BPRiB2	Gadi Ankanahalli: 17,18,19,20 Jogihalli: 8 Karegondanahalli: 9 Madhenahalli: 15,16,17,18,19,20,23,82, 83,84,85,106,117,118,120, 121,122,123,124,125,126, 127,128,129,134,138,139, 140,141,142,143,144,145, 146,148,149,156,157,158, 159,160,161,162,163,164, 165 Maranahalli: 80,83,84,85,86 Pinnenahalli: 9,10,11,12,13,14,15,32,33, 34,35,36,37 Sanabanahalli: 1,2,3,4,6,7,8,67,68,69,70,7 1,72,73	Deep, red gravelly sandy clay loam to sandy clay soils with slopes of 1-3%, gravelly to very gravelly (15-60%) and slight to moderate erosion	**Sole crops**: Upland paddy, Ragi, Maize, Sorghum, Groundnut, Fieldbean, Cowpea, Fodder sorghum, Horse gram	Glyricidia, **Grasses:** *Styloxanthes hamata*, *Styloxanthes scabra*, Hybrid Napier	**Vegetables:** Tomato, Brinjal, Drumstick, Chillies, Curry leaf **Flower crops:** Chrysanthemum, Marigold, Crossandra, **Fruit crops/ Plantation crops:** Tamarind, Custard Apple, Amla, Lime, Musambi, Arecanut, Coconut	Drip irrigation, Mulching, suitable conservation practices (Crescent Bunding with Catch Pit etc)

LUC 5 50 ha (9%)	BDGcB1g1	Madhenahalli: 56,57,58,59,60,61,62,63,73,74,75,76,77,89,90,93,94,95,96	Moderately deep gravelly red sandy loam soils with slopes of 1-3%, gravelly (15-35%) and slight erosion	**Sole crops**: Upland paddy, Ragi, Maize, Sorghum, Groundnut, Field bean, Cowpea, Fodder sorghum, Horse gram	Glyricidia, **Grasses:** *Styloxanthes hamata, Styloxanthes scabra*, Hybrid Napier	**Vegetables:** Tomato, Brinjal, Drumstick, Chillies, Curry leaf **Flower crops:** Chrysanthemum, Marigold, Crossandra, **Fruit crops:** Banana, Custard Apple, Amla, Lime, Musambi	Drip irrigation, Mulching, suitable conservation practices (Crescent Bunding with Catch Pit etc)

Chapter 8

SOIL HEALTH MANAGEMENT

8.1 Soil Health

Soil is fundamental to crop production. Without soil, no food could be produced nor would livestock be fed on a large scale. Because it is finite and fragile, soil is a precious resource that requires special care from its users.

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

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

The most important characterististics of a healthy soil are

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

Characteristics of Maddenahalli Microwatershed

- The soil phases identified in the microwatershed belonged to the soil series of BPR 273 ha (46%), RTR 106 ha (18%), KDT 87 ha (15%), BDG 50 ha (9%), MRD 27 ha (5%) and TSD 18 ha (3%).
- As per land capability classification, entire area in the microwatershed falls under arable land category (Class II & III). The major limitations identified in the arable lands were soil, wetness and erosion.
- On the basis of soil reaction, maximum area of about 573 ha (97%) is slightly acid to strongly acid (pH 5.0 -6.5) and about 37 ha (34%) is under neutral (pH 6.5-7.3).

Soil Health Management

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

Acid soils

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

Liming materials:

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

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

Alkaline soils

(Slightly alkaline to moderately alkaline soils)

1. Regular addition of organic manure, green manuring, green leaf manuring, crop residue incorporation and mulching needs to be taken up to improve the soil organic matter status.
2. Application of biofertilizers (Azospirullum, Azatobacter, Rhizobium).
3. Application of 25% extra N and P (125 % RDN&P).
4. Application of $ZnSO_4$ – 12.5 kg/ha (once in three years).
5. Application of Boron – 5kg/ha (once in three years).

Neutral soils

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

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

Soil Degradation

Soil erosion is not a major factor affecting the soil health in the microwatershed. Out of total 588 ha area in the microwatershed, a very small area of about 127 ha is suffering from moderate erosion. These areas need immediate soil and water conservation and, other land development and land husbandry practices for restoring soil health.

Dissemination of information and communication of benefits

Any large scale implementation of soil health management requires that supporting information is made available widely, particularly through channels familiar to farmers and extension workers. Given the very high priority attached to soil health

especially by the Central Government on issuing Soil-Health Cards to all the farmers, media outlets like Regional, State and National Newspapers, Radio and Dooradarshan programs in local languages but also modern information and communication technologies such as Cellular phones and the Internet, which can be much more effective in reaching the younger farmers.

Inputs for Net Planning (Saturation Plan) and Interventions needed

Net planning in IWMP is focusing on preparation of

1. Soil and Water Conservation 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 (Saturation Plan) are briefly presented below.

- **Soil Depth:** The depth of a soil decides the amount of moisture and nutrients it can hold, what crops can be taken up or not, depending on the rooting depth and the length of growing period available for raising any crop. Deeper the soil, better for a wide variety of crops. If sufficient depth is not available for growing deep rooted crops, either choose medium or short duration crops or deeper planting pits need to be opened and additional good quality soil brought from outside has to be filled into the planting pits.
- **Surface soil texture:** Lighter soil texture in the top soil means, better rain water infiltration, less run-off and soil moisture conservation, less capillary rise and less evaporation losses. Lighter surface textured soils are amenable to good soil tilth and are highly suitable for crops like groundnut and root vegetables (carrot, raddish, potato etc) but not ideal for crops that need stagnant water like lowland paddy. Heavy textured soils are poor in water infiltration and percolation. They are prone for sheet erosion; such soils can be improved by sand mulching. The technology that is developed by the AICRP-Dryland Agriculture, Vijayapura, Karnataka can be adopted.
- **Gravelliness:** More gravel content is favorable for run-off harvesting but poor in soil moisture storage and nutrient availability. It is a significant parameter that decides the kind of crop to be raised.
- **Land Capability Classification:** The land capability map shows the areas suitable and not suitable for agriculture and the major constraints in each of the plot/survey number. Hence, one can decide what kind of enterprise is possible in each of these units. In general, erosion and soil are the major constraints in Maddenahalli microwatershed.
- **Organic Carbon:** The OC content is medium (0.5-0.75%) in about 186 ha (32%) area and low (<0.5%) in about 373 ha (63%). The areas that are low and medium in

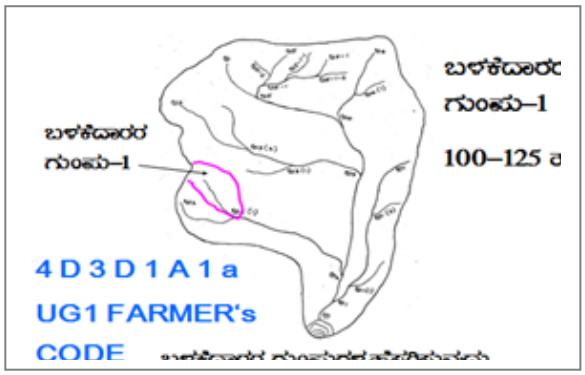
OC needs to be further improved by applying farmyard manure and rotating crops with cereals and legumes or mixed cropping.

- **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 559 ha area where OC is medium (0.5-0.75%) and low (<0.5%). 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**: The available phosphorus is high (>57 kg/ha) in the entire area.
- **Available Potassium:** Available potassium is medium in maximum area of 428 ha (73%) in the microwatershed, about 111 ha (19%) area is low (<145 kg/ha) in available potassium and an area of about 20 ha (3%) is high (>337 kg/ha) in available potassium. Hence, in all these plots, where available potassium is low and medium, for all the crops, additional 25 % potassium may be applied.
- **Available Sulphur:** Available sulphur is a very critical nutrient for oilseed crops. It is medium in 552 ha (94%). These areas need to be applied with magnesium sulphate or gypsum or Factamphos (p) fertitilizer (13% sulphur) for 2-3 years for the deficiency to be corrected.
- **Available Boron:** Available boron is low in the entire 559 ha (95%) in the microwatershed. These areas need to be applied with sodium borate @ 10 kg/ha as soil application or 0.2% borax as foliar application to correct the boron deficiency.
- **Available Iron:** Entire area is sufficient in available iron in the microwatershed.
- **Available Zinc:** It is deficient (<0.6 ppm) in 255 ha (43%) area of the microwatershed. Application of zinc sulphate @25kg/ha is to be recommended and about 304 ha (52%) area is sufficient (>0.6 ppm) in available Zinc.
- **Soil acidity:** The microwatershed has 573 ha (97%) area with soils that are slightly to strongly acid. These areas need application of lime (Calcium Carbonate).
- **Land Suitability for various crops:** Areas that are highly, moderately and marginally suitable for growing various crops are indicated. Along with the suitability, various constraints that are limiting the productivity are also indicated. For example, in case of cotton, gravel content, rooting depth and salinity/alkalinity are the major constraints in various plots. With suitable management interventions, the productivity can be enhanced. In order to increase water holding capacity of light textured soils, growing of green manure crops and application of organic manure is recommended.

Chapter 9

SOIL AND WATER CONSERVATION TREATMENT PLAN

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



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

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

Steps for Survey and Preparation of Treatment Plan

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

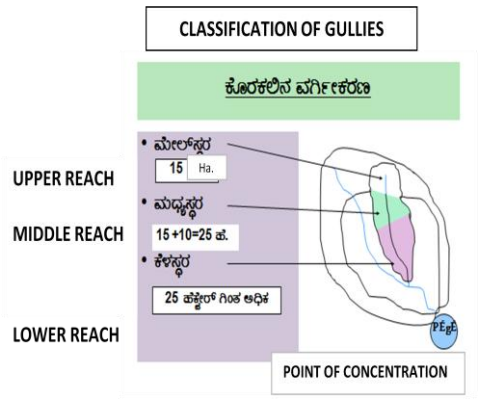
- Naming of user groups and farmers
- Identification of arable and non arable lands
- Identification of drainage lines and gullies
- Identification of non treatable areas
- Identification of priority areas in the arable lands
- Treatment plan for arable lands
- Location of water harvesting and recharge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

9.1 Treatment Plan

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

9.1.1 Arable Land Treatment

A. BUNDING

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

Measurement of Land Slope

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

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

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

Note: (i) The above intervals are maximum.

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

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

Section of the Bund

Bund section is decided considering the soil texture class and gravelliness class (bg_{0}.... $b_{=}$ loamy sand, g_{o}=<15% gravel). The recommended Sections for different soils are given below.

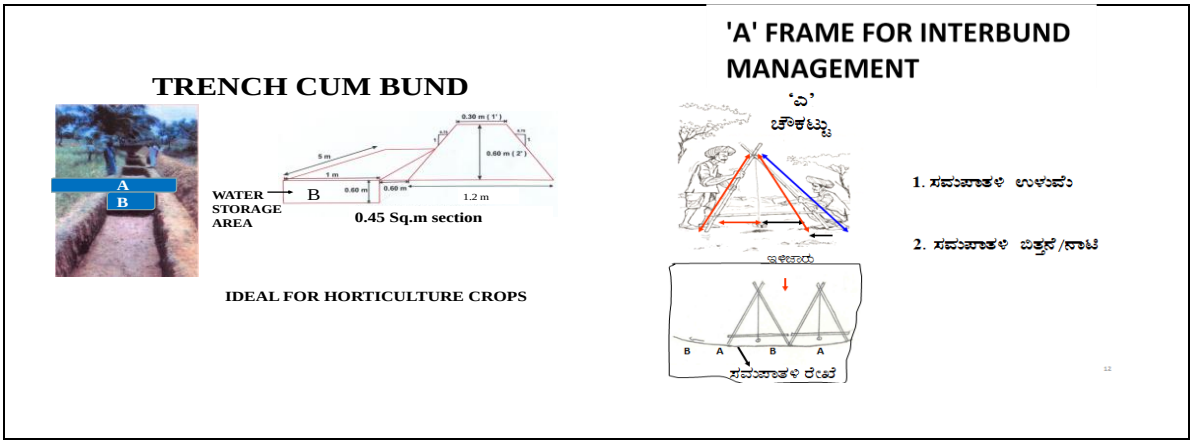
Recommended Bund Section

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

Formation of Trench cum Bund

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

Details of Borrow Pit dimensions are given below



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

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

B. Waterways

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

C. Farm Ponds

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

D. Diversion channel

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

9.1.2 Non-Arable Land Treatment

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

9.1.3 Treatment of Natural Water Course/ Drainage Lines

a) The cadastral map has to be updated as regards the network of drainge lines (gullies/ nalas/ hallas) and existing structures are marked to the scale and storage capacity of the existing water bodies are documented.

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

9.2 Recommended Soil and Water Conservation Measures

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

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

A map (Fig. 9.1) showing soil and water conservation plan with different kinds of structures recommended has been generated which shows the spatial distribution and extent of area. A maximum area of about 442 ha (75%) requires trench cum bunding, about 71 ha (12%) area requires Bunding/ Strengthening of existing bunds and small area of about 47 ha (8%) area requires graded bunding. The conservation plan generated may be presented to all the stakeholders including farmers and after including their suggestions, the conservation plan for the microwatershed may be finalised in a participatory approach.

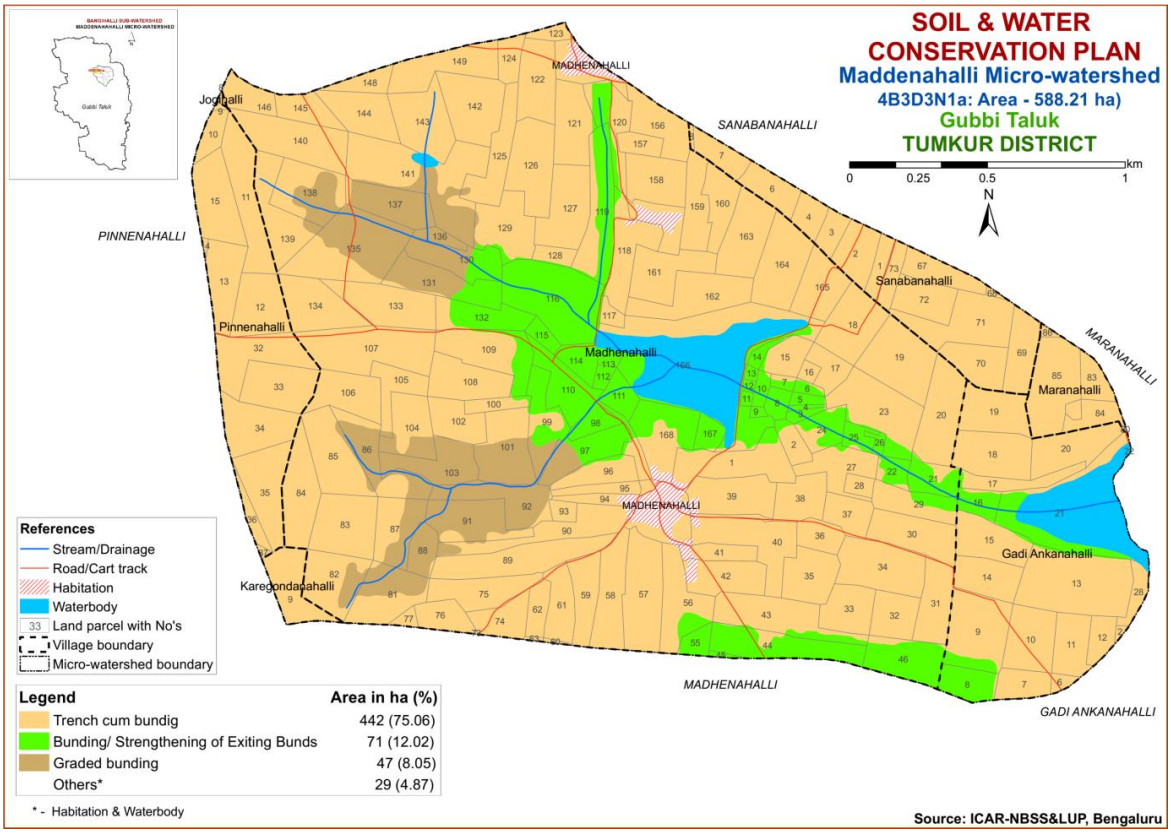


Fig. 9.1 Soil and Water Conservation Plan map of Maddenahalli Microwatershed

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

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

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

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Appendix I

Maddenahalli Microwatershed

Soil Phase Information

Village	Survey No	Total Area (ha)	Soil Phase	LUC	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Madhenahalli	1	5.12	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clayloam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	1 Bore well	IIs	Trench cum bundig
Madhenahalli	2	1.29	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clayloam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIs	Trench cum bundig
Madhenahalli	3	0.45	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Fallow land (Fl)	Not Available	IIw	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	4	0.21	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Not Available (NA)	Not Available	IIw	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	5	0.48	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Fallow land (Fl)	Not Available	IIw	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	6	0.45	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Fallow land (Fl)	Not Available	IIw	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	7	0.43	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Arecanut+Coconut (Ar+CN)	1 Bore well	IIw	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	8	0.89	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Arecanut+Coconut (Ar+CN)	2 Bore well	IIw	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	9	0.21	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Not Available (NA)	1 Bore well	IIw	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	10	0.63	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Coconut (CN)	1 Bore well	IIw	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	11	0.22	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Fallow land (Fl)	Not Available	IIw	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	12	0.19	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Fallow land (Fl)	Not Available	IIw	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	13	0.23	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Fallow land (Fl)	Not Available	IIw	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	14	0.51	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Arecanut (Ar)	Not Available	IIw	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	15	1.88	BPRiB2	LUC-4	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Coconut+Mango (CN+Mn)	Not Available	IIIes	Trench cum bundig
Madhenahalli	16	0.45	BPRiB2	LUC-4	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	Not Available	IIIes	Trench cum bundig
Madhenahalli	17	1.67	BPRiB2	LUC-4	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	1 Open Well, 1 Bore well	IIIes	Trench cum bundig

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Madhenahalli	18	4.31	BPRiB2	LUC-4	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	4 Bore well	IIIes	Trench cum bundig
Madhenahalli	19	5.42	BPRiB2	LUC-4	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	2 Bore well	IIIes	Trench cum bundig
Madhenahalli	20	4.86	BPRhB1	LUC-4	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	1 Open Well,1 Bore well	IIIs	Trench cum bundig
Madhenahalli	21	2.07	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Coconut+Fallow land (CN+Fl)	2 Bore well,1 Open Well	IIw	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	22	1.14	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Fallow land (Fl)	Not Available	IIw	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	23	5.93	BPRiB2	LUC-4	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Coconut+Mango (CN+Mn)	1 Open Well,2 Bore well	IIIes	Trench cum bundig
Madhenahalli	24	2.07	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Coconut (CN)	Not Available	IIw	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	25	0.96	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Not Available (NA)	1 Bore well	IIw	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	26	0.36	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Not Available (NA)	Not Available	IIw	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	27	3.07	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Arecanut+Coconut (Ar+CN)	1 Bore well	IIs	Trench cum bundig
Madhenahalli	28	0.72	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	Not Available	IIs	Trench cum bundig
Madhenahalli	29	2.92	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Coconut+Mango (CN+Mn)	Not Available	IIs	Trench cum bundig
Madhenahalli	30	4	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIs	Trench cum bundig
Madhenahalli	31	3.35	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIs	Trench cum bundig
Madhenahalli	32	2.6	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIs	Trench cum bundig
Madhenahalli	33	2.98	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIs	Trench cum bundig
Madhenahalli	34	5.25	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Coconut+Ragi+Mango (CN+Ra+Mn)	Not Available	IIs	Trench cum bundig
Madhenahalli	35	3.41	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	2 Bore well	IIs	Trench cum bundig
Madhenahalli	36	1.72	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	Not Available	IIs	Trench cum bundig
Madhenahalli	37	2.16	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIs	Trench cum bundig
Madhenahalli	38	2.82	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Arecanut+Coconut (Ar+CN)	2 Bore well	IIs	Trench cum bundig
Madhenahalli	39	4.2	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Arecanut+Coconut (Ar+CN)	3 Bore well	IIs	Trench cum bundig

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Madhenahalli	40	5.15	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	1 Bore well	IIs	Trench cum bundig
Madhenahalli	41	1.59	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIs	Trench cum bundig
Madhenahalli	42	3.47	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIs	Trench cum bundig
Madhenahalli	43	5.41	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Arecanut+Coconut (Ar+CN)	1 Bore well	IIs	Trench cum bundig
Madhenahalli	44	4.87	RTRcA1	LUC-1	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Nearly level (0-1%)	Slight	Mango (Mn)	Not Available	IIs	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	45	0.18	RTRcA1	LUC-1	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Nearly level (0-1%)	Slight	Not Available (NA)	Not Available	IIs	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	46	3.92	RTRcA1	LUC-1	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Nearly level (0-1%)	Slight	Mango (Mn)	Not Available	IIs	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	55	1	RTRcA1	LUC-1	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Nearly level (0-1%)	Slight	Mango (Mn)	Not Available	IIs	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	56	4.44	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Madhenahalli	57	5.59	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Mango+Ragi (Mn+Ra)	Not Available	IIIs	Trench cum bundig
Madhenahalli	58	4.06	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	2 Bore well	IIIs	Trench cum bundig
Madhenahalli	59	2.83	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIIs	Trench cum bundig
Madhenahalli	60	0.11	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Not Available (NA)	Not Available	IIIs	Trench cum bundig
Madhenahalli	61	2.57	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIIs	Trench cum bundig
Madhenahalli	62	1.43	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIIs	Trench cum bundig
Madhenahalli	63	0.1	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Not Available (NA)	Not Available	IIIs	Trench cum bundig
Madhenahalli	73	0.01	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Not Available (NA)	Not Available	IIIs	Trench cum bundig
Madhenahalli	74	2.36	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIIs	Trench cum bundig

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Madhenahalli	75	3.59	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIIs	Trench cum bundig
Madhenahalli	76	1.96	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Madhenahalli	77	0.45	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Not Available (NA)	Not Available	IIIs	Trench cum bundig
Madhenahalli	81	4.51	KDThB1	LUC-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	1 Bore well	IIs	Graded bunding
Madhenahalli	82	4.29	BPRcB1g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango+Ragi (Mn+Ra)	Not Available	IIIs	Trench cum bundig
Madhenahalli	83	4.85	BPRcB1g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango+Ragi (Mn+Ra)	1 Bore well	IIIs	Trench cum bundig
Madhenahalli	84	4.4	BPRcB1g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIIs	Trench cum bundig
Madhenahalli	85	4.83	BPRcB1g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIIs	Trench cum bundig
Madhenahalli	86	4.17	KDThB1	LUC-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Coconut+Mango (CN+Mn)	Not Available	IIs	Graded bunding
Madhenahalli	87	3.62	KDThB1	LUC-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIs	Graded bunding
Madhenahalli	88	1.68	KDThB1	LUC-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	2 Bore well	IIs	Graded bunding
Madhenahalli	89	5.61	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	1 Bore well	IIIs	Trench cum bundig
Madhenahalli	90	4.43	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Arecanut+Coconut+ Mango (Ar+CN+Mn)	1 Bore well	IIIs	Trench cum bundig
Madhenahalli	91	4.39	KDThB1	LUC-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	3 Bore well	IIs	Graded bunding
Madhenahalli	92	4.11	KDThB1	LUC-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Arecanut+Coconut (Ar+CN)	2 Bore well	IIs	Graded bunding
Madhenahalli	93	0.69	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Madhenahalli	94	1.06	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Not Available (NA)	Not Available	IIIs	Trench cum bundig
Madhenahalli	95	1.14	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIIs	Trench cum bundig
Madhenahalli	96	2.28	BDGcB1g1	LUC-5	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIIs	Trench cum bundig
Madhenahalli	97	3.34	KDTiA1	LUC-2	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Arecanut+Coconut+ Mango (Ar+CN+Mn)	1 Bore well,1 Open Well	IIs	Bunding/ Strengthening of Exiting Bunds

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Madhenahalli	98	1.26	KDTiA1	LUC-2	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Arecanut+Coconut (Ar+CN)	2 Bore well	IIs	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	99	3.46	KDTiA1	LUC-2	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Coconut+Mango (CN+Mn)	Not Available	IIs	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	100	1.09	MRDcB1	LUC-1	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIs	Trench cum bundig
Madhenahalli	101	4.83	KDThB1	LUC-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Mango+Ragi (Mn+Ra)	Not Available	IIs	Graded bunding
Madhenahalli	102	2.63	MRDcB1	LUC-1	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIs	Trench cum bundig
Madhenahalli	103	3.65	KDThB1	LUC-2	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	2 Bore well	IIs	Graded bunding
Madhenahalli	104	3.57	MRDcB1	LUC-1	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIs	Trench cum bundig
Madhenahalli	105	2.32	MRDcB1	LUC-1	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIs	Trench cum bundig
Madhenahalli	106	3.53	BPRcB1g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Madhenahalli	107	7.02	MRDcB1	LUC-1	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIs	Trench cum bundig
Madhenahalli	108	3.75	MRDcB1	LUC-1	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIs	Trench cum bundig
Madhenahalli	109	4.97	MRDcB1	LUC-1	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Mango+Ragi (Mn+Ra)	Not Available	IIs	Trench cum bundig
Madhenahalli	110	3.4	KDTiA1	LUC-2	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Arecanut+Coconut (Ar+CN)	1 Bore well	IIs	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	111	1.46	KDTiA1	LUC-2	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Arecanut+Coconut (Ar+CN)	2 Bore well	IIs	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	112	0.5	KDTiA1	LUC-2	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Coconut (CN)	1 Bore well	IIs	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	113	0.61	KDTiA1	LUC-2	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Coconut (CN)	1 Bore well	IIs	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	114	1.55	KDTiA1	LUC-2	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Arecanut+Coconut (Ar+CN)	1 Bore well	IIs	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	115	0.79	KDTiA1	LUC-2	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Arecanut (Ar)	1 Bore well	IIs	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	116	8.01	KDTiA1	LUC-2	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Arecanut+Coconut (Ar+CN)	3 Bore well	IIs	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	117	0.62	BPRhB2	LUC-4	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Coconut (CN)	Not Available	IIIes	Trench cum bundig

Village	Survey No	Total Area (ha)	Soil Phase	LUC	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Madhenahalli	118	3.94	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Arecanut+Coconut (Ar+CN)	3 Bore well	IIIs	Trench cum bundig
Madhenahalli	119	5.31	KDTiA1	LUC-2	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Coconut+Mango (CN+Mn)	3 Bore well	IIs	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	120	3.18	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	Not Available	IIIs	Trench cum bundig
Madhenahalli	121	3.78	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	2 Bore well	IIIs	Trench cum bundig
Madhenahalli	122	3.83	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	1 Bore well	IIIs	Trench cum bundig
Madhenahalli	123	0.71	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Not Available (NA)	Not Available	IIIs	Trench cum bundig
Madhenahalli	124	1.37	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Madhenahalli	125	3.56	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Coconut+Mango (CN+Mn)	Not Available	IIIs	Trench cum bundig
Madhenahalli	126	4.89	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango+Ragi (Mn+Ra)	1 Bore well	IIIs	Trench cum bundig
Madhenahalli	127	4.61	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Coconut+Mango (CN+Mn)	1 Bore well,1 Open Well	IIIs	Trench cum bundig
Madhenahalli	128	0.92	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Madhenahalli	129	4.22	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	1 Bore well	IIIs	Trench cum bundig
Madhenahalli	130	3.37	KDThB1g1	LUC-2	Very deep (>150 cm)	Sandy clay loam	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	Not Available	IIs	Graded bunding
Madhenahalli	131	4.16	KDThB1g1	LUC-2	Very deep (>150 cm)	Sandy clay loam	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	1 Bore well,1 Check Dam	IIs	Graded bunding
Madhenahalli	132	3.15	KDTiA1	LUC-2	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Arecanut+Coconut+ Ragi (Ar+CN+Mn)	2 Bore well	IIs	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	133	4.72	MRDcB1	LUC-1	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Arecanut+Coconut (Ar+CN)	1 Bore well	IIs	Trench cum bundig
Madhenahalli	134	4.24	BPRcB2g2	LUC-4	Deep (100-150 cm)	Sandy loam	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Coconut+Mango+Neeligiri (CN+Mn+Nr)	Not Available	IIIes	Trench cum bundig
Madhenahalli	135	8.3	KDThB1g1	LUC-2	Very deep (>150 cm)	Sandy clayloam	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	2 Bore well	IIs	Graded bunding
Madhenahalli	136	0.81	KDThB1g1	LUC-2	Very deep (>150 cm)	Sandy clayloam	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Not Available (NA)	Not Available	IIs	Graded bunding
Madhenahalli	137	3.67	KDThB1g1	LUC-2	Very deep (>150 cm)	Sandy clayloam	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	2 Bore well	IIs	Graded bunding
Madhenahalli	138	4.67	BPRcB2g2	LUC-4	Deep (100-150 cm)	Sandy loam	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Arecanut+Coconut (Ar+CN)	1 Bore well	IIIes	Trench cum bundig
Madhenahalli	139	4.19	BPRcB2g2	LUC-4	Deep (100-150 cm)	Sandy loam	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	1 Bore well	IIIes	Trench cum bundig
Madhenahalli	140	5.48	BPRcB2g2	LUC-4	Deep (100-150 cm)	Sandy loam	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	Not Available	IIIes	Trench cum bundig
Madhenahalli	141	9.88	BPRhB2g1	LUC-4	Deep (100-150 cm)	Sandy clayloam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Arecanut+Coconut+ Ragi (Ar+CN+Mn)	2 Bore well	IIIes	Trench cum bundig

Village	Survey No	Total Area (ha)	Soil Phase	LUC	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Madhenahalli	142	4.77	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clayloam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Madhenahalli	143	4.64	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clayloam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	1 Bore well	IIIs	Trench cum bundig
Madhenahalli	144	3.55	BPRhB2g1	LUC-4	Deep (100-150 cm)	Sandy clayloam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	Not Available	IIIes	Trench cum bundig
Madhenahalli	145	2.08	BPRcB2g2	LUC-4	Deep (100-150 cm)	Sandy loam	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Ragi (Ra)	Not Available	IIIes	Trench cum bundig
Madhenahalli	146	1.94	BPRcB2g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	Not Available	IIIes	Trench cum bundig
Madhenahalli	148	1.42	BPRhB2g1	LUC-4	Deep (100-150 cm)	Sandy clayloam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	Not Available	IIIes	Trench cum bundig
Madhenahalli	149	4.31	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clayloam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Madhenahalli	156	3.29	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clayloam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Madhenahalli	157	1.17	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clayloam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	1 Bore well	IIIs	Trench cum bundig
Madhenahalli	158	3.63	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clayloam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIIs	Trench cum bundig
Madhenahalli	159	2.9	BPRhB2	LUC-4	Deep (100-150 cm)	Sandy clayloam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Ragi (Ra)	Not Available	IIIes	Trench cum bundig
Madhenahalli	160	2.6	BPRhB2	LUC-4	Deep (100-150 cm)	Sandy clayloam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	Not Available	IIIes	Trench cum bundig
Madhenahalli	161	4.02	BPRhB2	LUC-4	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Coconut (CN)	3 Bore well	IIIes	Trench cum bundig
Madhenahalli	162	4.77	BPRhB2	LUC-4	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Arecanut+Coconut (Ar+CN)	3 Bore well	IIIes	Trench cum bundig
Madhenahalli	163	4.4	BPRhB2	LUC-4	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	Not Available	IIIes	Trench cum bundig
Madhenahalli	164	4.95	BPRhB2	LUC-4	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	2 Bore well	IIIes	Trench cum bundig
Madhenahalli	165	3.44	BPRhB2	LUC-4	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	1 Bore well	IIIes	Trench cum bundig
Madhenahalli	166	20.57	Water body	Others	Others	Others	Others	Others	Others	Others	Coconut+Mango (CN+Mn)	1 Bore well	Others	Others
Madhenahalli	167	1.09	KDTiA1	LUC-2	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Arecanut+Coconut (Ar+CN)	3 Bore well	IIs	Bunding/ Strengthening of Exiting Bunds
Madhenahalli	168	4.73	KDTiA1	LUC-2	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Arecanut+Coconut (Ar+CN)	1 Open Well,2 Bore well	IIs	Bunding/ Strengthening of Exiting Bunds
Gadi Ankanahalli	2	0.17	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	Not Available	IIs	Trench cum bundig
Gadi Ankanahalli	6	0.48	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIs	Trench cum bundig
Gadi Ankanahalli	7	1.96	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIs	Trench cum bundig

Village	Survey No	Total Area (ha)	Soil Phase	LUC	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Gadi Ankanahalli	8	2.23	RTRcA1	LUC-1	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Nearly level (0-1%)	Slight	Mango (Mn)	Not Available	IIs	Bunding/ Strengthening of Exiting Bunds
Gadi Ankanahalli	9	5.79	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Arecanut+Coconut (Ar+CN)	Not Available	IIs	Trench cum bundig
Gadi Ankanahalli	10	3.91	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIs	Trench cum bundig
Gadi Ankanahalli	11	2.78	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Coconut+Mango (CN+Mn)	Not Available	IIs	Trench cum bundig
Gadi Ankanahalli	12	1.43	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	Not Available	IIs	Trench cum bundig
Gadi Ankanahalli	13	8.61	RTRiB1	LUC-1	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Arecanut+Coconut (Ar+CN)	3 Bore well	IIs	Trench cum bundig
Gadi Ankanahalli	14	3.08	RTRiB1	LUC-1	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	1 Bore well	IIs	Trench cum bundig
Gadi Ankanahalli	15	3.64	RTRiB1	LUC-1	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Coconut+Mango (CN+Mn)	2 Bore well	IIs	Trench cum bundig
Gadi Ankanahalli	16	1.4	TSDiA1	LUC-3	Very deep (>150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Not Available (NA)	Not Available	IIw	Bunding/ Strengthening of Exiting Bunds
Gadi Ankanahalli	17	1.96	BPRiB2	LUC-4	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Coconut+Mango (CN+Mn)	Not Available	IIIes	Trench cum bundig
Gadi Ankanahalli	18	4.39	BPRiB2	LUC-4	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Arecanut+Coconut (Ar+CN)	Not Available	IIIes	Trench cum bundig
Gadi Ankanahalli	19	3.7	BPRhB1	LUC-4	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Gadi Ankanahalli	20	3.84	BPRiB2	LUC-4	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	Not Available	IIIes	Trench cum bundig
Gadi Ankanahalli	21	12.4	Water body	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Gadi Ankanahalli	22	0.03	Water body	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Gadi Ankanahalli	28	1.22	RTRhB1	LUC-1	Very deep (>150 cm)	Sandy clay loam	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	Not Available	IIs	Trench cum bundig
Pinnenahalli	9	0.1	BPRcB2g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IIIes	Trench cum bundig
Pinnenahalli	10	1.26	BPRcB2g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Ragi (Ra)	Not Available	IIIes	Trench cum bundig
Pinnenahalli	11	5.07	BPRcB2g2	LUC-4	Deep (100-150 cm)	Sandy loam	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	Not Available	IIIes	Trench cum bundig
Pinnenahalli	12	3.96	BPRcB2g2	LUC-4	Deep (100-150 cm)	Sandy loam	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Coconut+Neem (CN +Nm)	Not Available	IIIes	Trench cum bundig
Pinnenahalli	13	3.5	BPRcB2g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	Not Available	IIIes	Trench cum bundig
Pinnenahalli	14	0.11	BPRcB2g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IIIes	Trench cum bundig
Pinnenahalli	15	4.45	BPRcB2g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	Not Available	IIIes	Trench cum bundig
Pinnenahalli	32	4.53	BPRcB1g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIIs	Trench cum bundig

Village	Survey No	Total Area (ha)	Soil Phase	LUC	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Pinnenahalli	33	4.07	BPRcB1g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Pinnenahalli	34	4.19	BPRcB1g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango+Ragi (Mn+Ra)	Not Available	IIIs	Trench cum bundig
Pinnenahalli	35	4.52	BPRcB1g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango+Ragi (Mn+Ra)	Not Available	IIIs	Trench cum bundig
Pinnenahalli	36	0.95	BPRcB1g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Pinnenahalli	37	0.14	BPRcB1g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIIs	Trench cum bundig
Sanabanahalli	1	1.14	BPRhB2	LUC-4	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Ragi (Ra)	Not Available	IIIes	Trench cum bundig
Sanabanahalli	2	2.71	BPRhB2	LUC-4	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Arecanut+Coconut (Ar+CN)	3 Bore well	IIIes	Trench cum bundig
Sanabanahalli	3	1.26	BPRhB2	LUC-4	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	Not Available	IIIes	Trench cum bundig
Sanabanahalli	4	1.46	BPRhB2	LUC-4	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IIIes	Trench cum bundig
Sanabanahalli	6	2.26	BPRhB2	LUC-4	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	Not Available	IIIes	Trench cum bundig
Sanabanahalli	7	1.84	BPRhB2	LUC-4	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Coconut+Ragi (CN+Ra)	Not Available	IIIes	Trench cum bundig
Sanabanahalli	8	0.14	BPRhB1g1	LUC-4	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Not Available (NA)	Not Available	IIIs	Trench cum bundig
Sanabanahalli	67	2.4	BPRcB1	LUC-4	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Sanabanahalli	68	0.15	BPRcB1	LUC-4	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Not Available (NA)	Not Available	IIIs	Trench cum bundig
Sanabanahalli	69	2.98	BPRhB1	LUC-4	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Sanabanahalli	70	2.98	BPRhB1	LUC-4	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Sanabanahalli	71	5.34	BPRcB1	LUC-4	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Sanabanahalli	72	2.88	BPRcB1	LUC-4	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Sanabanahalli	73	1.34	BPRcB1	LUC-4	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Coconut (CN)	1 Bore well	IIIs	Trench cum bundig
Maranahalli	80	0.01	BPRcB1	LUC-4	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Not Available (NA)	Not Available	IIIs	Trench cum bundig
Maranahalli	83	1.5	BPRcB1	LUC-4	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIIs	Trench cum bundig
Maranahalli	84	1.61	BPRcB1	LUC-4	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Ragi (Ra)	Not Available	IIIs	Trench cum bundig
Maranahalli	85	5.46	BPRhB1	LUC-4	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango+Ragi (Mn+Ra)	Not Available	IIIs	Trench cum bundig
Maranahalli	86	0.2	BPRcB1	LUC-4	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango (Mn)	Not Available	IIIs	Trench cum bundig
Jogihalli	8	0.09	BPRcB2g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IIIes	Trench cum bundig
Karegondana halli	9	3.63	BPRcB1g1	LUC-4	Deep (100-150 cm)	Sandy loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Mango+Ragi (Mn+Ra)	Not Available	IIIs	Trench cum bundig

Appendix II

Maddenahalli Microwaterhed

Soil Fertility Information

Village	Survey No	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Madhenahalli	1	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	High (>337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	2	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	High (>337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	3	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	4	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	5	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	6	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	7	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	8	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	High (>337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	9	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	High (>337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	10	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	High (>337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	11	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	High (>337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	12	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	High (>337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	13	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	14	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	15	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	16	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	17	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	18	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	19	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	20	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	21	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	22	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)

Village	Survey No	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Madhenahalli	23	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	24	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	25	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	26	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	27	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	28	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	29	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	30	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	31	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	32	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	33	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	34	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	35	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	36	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	37	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	38	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	39	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	40	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	41	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	42	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	43	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	44	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	45	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	46	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)

Village	Survey No	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Madhenahalli	55	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	56	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	57	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	58	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	59	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	60	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	61	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	62	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	63	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	73	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	74	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	75	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	76	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	77	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	81	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	82	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	83	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	84	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	85	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	86	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	87	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	88	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	89	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	90	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	91	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)

Village	Survey No	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Madhenahalli	92	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	93	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	94	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	95	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	96	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	97	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	98	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	99	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	100	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	101	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	102	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	103	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	104	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	105	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	106	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	107	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	108	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	109	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	110	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	111	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	High (>337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	112	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	113	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	114	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	115	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	116	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)

Village	Survey No	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Madhenahalli	117	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	118	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	119	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	120	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	121	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	122	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	123	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	124	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	125	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	126	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	127	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	128	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	129	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	130	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	131	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	132	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	133	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	134	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	135	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	136	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	137	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	138	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	139	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	140	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	141	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)

Village	Survey No	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Madhenahalli	142	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	143	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	144	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	145	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	146	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	High (>20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	148	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	149	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	156	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	157	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	158	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	159	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	160	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	161	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	162	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	163	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	164	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	165	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Madhenahalli	166	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Madhenahalli	167	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	High (>337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Madhenahalli	168	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	High (>337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Gadi Ankanahalli	2	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Gadi Ankanahalli	6	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Gadi Ankanahalli	7	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Gadi Ankanahalli	8	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Gadi Ankanahalli	9	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)

Village	Survey No	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Gadi Ankanahalli	10	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Gadi Ankanahalli	11	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Gadi Ankanahalli	12	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Gadi Ankanahalli	13	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Gadi Ankanahalli	14	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Gadi Ankanahalli	15	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Gadi Ankanahalli	16	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Gadi Ankanahalli	17	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Gadi Ankanahalli	18	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Gadi Ankanahalli	19	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Gadi Ankanahalli	20	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Gadi Ankanahalli	21	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Gadi Ankanahalli	22	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Gadi Ankanahalli	28	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Pinnenahalli	9	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	High (>20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Pinnenahalli	10	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	High (>20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Pinnenahalli	11	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Pinnenahalli	12	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Pinnenahalli	13	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Pinnenahalli	14	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Medium (0.5-1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Pinnenahalli	15	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Pinnenahalli	32	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Pinnenahalli	33	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Pinnenahalli	34	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Pinnenahalli	35	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)

Village	Survey No	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Pinnenahalli	36	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Pinnenahalli	37	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Sanabanahalli	1	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Sanabanahalli	2	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Sanabanahalli	3	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Sanabanahalli	4	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Sanabanahalli	6	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Sanabanahalli	7	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Sanabanahalli	8	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Sanabanahalli	67	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Sanabanahalli	68	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Sanabanahalli	69	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Sanabanahalli	70	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Sanabanahalli	71	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Sanabanahalli	72	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Sanabanahalli	73	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Maranahalli	80	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5-0.75 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Maranahalli	83	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Maranahalli	84	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Maranahalli	85	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Maranahalli	86	Strongly acid (pH 5.0 – 5.5)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)
Jogihalli	8	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	High (>20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Sufficient (>0.6 ppm)
Karegondanahalli	9	Moderately acid (pH 5.5 – 6.0)	Non saline (<2 dsm)	Low (<0.5 %)	High (> 57 kg/ha)	Medium (145-337 kg/ha)	Medium (10-20 ppm)	Low (<0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient(>1.0 ppm)	Sufficient (>0.2 ppm)	Deficient (<0.6 ppm)

Appendix III

Maddenahalli Microwaterhed

Soil Suitability Information

Village	Survey No	Mango	Maize	Sapota	Sorgham	Coconut	Guava	Tamarind	Lime	Sunflower	Redgram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Onion	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Banana	Horsegram	Field-bean	Arecanut	Finger-Millet	Brinjal	FodderSorghum	Upland-Paddy	Jasmine	Cowpea
Madhenahalli	1	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	2	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	3	S2wt	S2wt	S2wt	S2w	S2w	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	Nw	S2wt	S2w	S3wt	S2wt	S2w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w
Madhenahalli	4	S2wt	S2wt	S2wt	S2w	S2w	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	Nw	S2wt	S2w	S3wt	S2wt	S2w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w
Madhenahalli	5	S2wt	S2wt	S2wt	S2w	S2w	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	Nw	S2wt	S2w	S3wt	S2wt	S2w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w
Madhenahalli	6	S2wt	S2wt	S2wt	S2w	S2w	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	Nw	S2wt	S2w	S3wt	S2wt	S2w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w
Madhenahalli	7	S2wt	S2wt	S2wt	S2w	S2w	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	Nw	S2wt	S2w	S3wt	S2wt	S2w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w
Madhenahalli	8	S2wt	S2wt	S2wt	S2w	S2w	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	Nw	S2wt	S2w	S3wt	S2wt	S2w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w
Madhenahalli	9	S2wt	S2wt	S2wt	S2w	S2w	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	Nw	S2wt	S2w	S3wt	S2wt	S2w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w
Madhenahalli	10	S2wt	S2wt	S2wt	S2w	S2w	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	Nw	S2wt	S2w	S3wt	S2wt	S2w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w
Madhenahalli	11	S2wt	S2wt	S2wt	S2w	S2w	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	Nw	S2wt	S2w	S3wt	S2wt	S2w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w
Madhenahalli	12	S2wt	S2wt	S2wt	S2w	S2w	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	Nw	S2wt	S2w	S3wt	S2wt	S2w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w
Madhenahalli	13	S2wt	S2wt	S2wt	S2w	S2w	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	Nw	S2wt	S2w	S3wt	S2wt	S2w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w
Madhenahalli	14	S2wt	S2wt	S2wt	S2w	S2w	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	Nw	S2wt	S2w	S3wt	S2wt	S2w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w
Madhenahalli	15	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	16	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	17	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	18	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	19	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	20	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	21	S2wt	S2wt	S2wt	S2w	S2w	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	Nw	S2wt	S2w	S3wt	S2wt	S2w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w
Madhenahalli	22	S2wt	S2wt	S2wt	S2w	S2w	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	Nw	S2wt	S2w	S3wt	S2wt	S2w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w

Village	Survey No	Mango	Maize	Sapota	Sorgham	Coconut	Guava	Tamarind	Lime	Sunflower	Redgram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Onion	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Banana	Horsegram	Field-bean	Arecanut	Finger-Millet	Brinjal	FodderSorghum	Upland-Paddy	Jasmine	Cowpea
Madhenahalli	23	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	24	S2wt	S2wt	S2wt	S2w	S2w	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	Nw	S2wt	S2w	S3wt	S2wt	S2w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w
Madhenahalli	25	S2wt	S2wt	S2wt	S2w	S2w	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	Nw	S2wt	S2w	S3wt	S2wt	S2w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w
Madhenahalli	26	S2wt	S2wt	S2wt	S2w	S2w	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	Nw	S2wt	S2w	S3wt	S2wt	S2w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w
Madhenahalli	27	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	28	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	29	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	30	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	31	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	32	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	33	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	34	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	35	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	36	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	37	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	38	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	39	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	40	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	41	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	42	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	43	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	44	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	45	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	46	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	55	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	56	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g
Madhenahalli	57	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g
Madhenahalli	58	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g

Village	Survey No	Mango	Maize	Sapota	Sorgham	Coconut	Guava	Tamarind	Lime	Sunflower	Redgram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Onion	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Banana	Horsegram	Field-bean	Arecanut	Finger-Millet	Brinjal	FodderSorghum	Upland-Paddy	Jasmine	Cowpea
Madhenahalli	59	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g
Madhenahalli	60	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g
Madhenahalli	61	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g
Madhenahalli	62	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g
Madhenahalli	63	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g
Madhenahalli	73	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g
Madhenahalli	74	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g
Madhenahalli	75	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g
Madhenahalli	76	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g
Madhenahalli	77	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g
Madhenahalli	81	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	82	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	83	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	84	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	85	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	86	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	87	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	88	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	89	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g
Madhenahalli	90	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g
Madhenahalli	91	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	92	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	93	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g
Madhenahalli	94	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g
Madhenahalli	95	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g

Village	Survey No	Mango	Maize	Sapota	Sorgham	Coconut	Guava	Tamarind	Lime	Sunflower	Redgram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Onion	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Banana	Horsegram	Field-bean	Arecanut	Finger-Millet	Brinjal	FodderSorghum	Upland-Paddy	Jasmine	Cowpea
Madhenahalli	96	S3rg	S3rg	S3rg	S3rg	S3g	S3rg	S3rg	S3rg	S3rg	S3g	S2g	S3rg	S2g	S3rg	S3rg	S3rg	S2rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3rg	S2g	S3g	S3g	S2g	S3g	S3rg	S2g	S3g	S3g
Madhenahalli	97	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	98	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	99	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	100	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1
Madhenahalli	101	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	102	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1
Madhenahalli	103	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	104	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1
Madhenahalli	105	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1
Madhenahalli	106	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	107	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1
Madhenahalli	108	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1
Madhenahalli	109	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1
Madhenahalli	110	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	111	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	112	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	113	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	114	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	115	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	116	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	117	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	118	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	119	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	120	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	121	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	122	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	123	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g

Village	Survey No	Mango	Maize	Sapota	Sorgham	Coconut	Guava	Tamarind	Lime	Sunflower	Redgram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Onion	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Banana	Horsegram	Field-bean	Arecanut	Finger-Millet	Brinjal	FodderSorghum	Upland-Paddy	Jasmine	Cowpea
Madhenahalli	124	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	125	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	126	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	127	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	128	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	129	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	130	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	131	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	132	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	133	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Madhenahalli	134	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	135	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	136	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	137	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	138	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	139	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	140	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	141	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	142	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	143	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	144	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	145	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	146	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	148	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	149	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g

Village	Survey No	Mango	Maize	Sapota	Sorgham	Coconut	Guava	Tamarind	Lime	Sunflower	Redgram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Onion	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Banana	Horsegram	Field-bean	Arecanut	Finger-Millet	Brinjal	FodderSorghum	Upland-Paddy	Jasmine	Cowpea
Madhenahalli	156	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	157	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	158	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	159	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	160	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	161	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	162	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	163	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	164	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	165	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Madhenahalli	166	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	Others
Madhenahalli	167	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Madhenahalli	168	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Gadi Ankanahalli	2	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Gadi Ankanahalli	6	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Gadi Ankanahalli	7	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Gadi Ankanahalli	8	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Gadi Ankanahalli	9	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Gadi Ankanahalli	10	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Gadi Ankanahalli	11	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Gadi Ankanahalli	12	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Gadi Ankanahalli	13	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Gadi Ankanahalli	14	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Gadi Ankanahalli	15	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1

Village	Survey No	Mango	Maize	Sapota	Sorgham	Coconut	Guava	Tamarind	Lime	Sunflower	Redgram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Onion	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Banana	Horsegram	Field-bean	Arecanut	Finger-Millet	Brinjal	FodderSorghum	Upland-Paddy	Jasmine	Cowpea
Gadi Ankanahalli	16	S2 wt	S2 wt	S2 wt	S2w	S2w	S2 wt	S2wt	S2 w	S2w	S2w	S2 w	S2w	S2w	Nw	S2 wt	S2 w	S3wt	S2 wt	S2 w	S2w	S2wt	S2wt	S2wt	S2wt	S2w	S2 w	S2w	S2w	S2w	S2w	S2w	S2wt	S2w
Gadi Ankanahalli	17	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Gadi Ankanahalli	18	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Gadi Ankanahalli	19	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Gadi Ankanahalli	20	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Gadi Ankanahalli	21	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	Others
Gadi Ankanahalli	22	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	Others
Gadi Ankanahalli	28	S1	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S3t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1
Pinnenahalli	9	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Pinnenahalli	10	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Pinnenahalli	11	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Pinnenahalli	12	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Pinnenahalli	13	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Pinnenahalli	14	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Pinnenahalli	15	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Pinnenahalli	32	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Pinnenahalli	33	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Pinnenahalli	34	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Pinnenahalli	35	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Pinnenahalli	36	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Pinnenahalli	37	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Sanabanahalli	1	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Sanabanahalli	2	S3 g	S3 g	S3 g	S3g	S3g	S2 g	S3g	S3 g	S3g	S3g	S2 g	S3g	S2g	S2g	S3 g	S3 g	S2tg	S3 g	S3 g	S3g	S3g	S3g	S3g	S3g	S2g	S3 g	S3g	S3g	S3g	S3g	S3g	S3g	S3g

Village	Survey No	Mango	Maize	Sapota	Sorgham	Coconut	Guava	Tamarind	Lime	Sunflower	Redgram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Onion	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Banana	Horsegram	Field-bean	Arecanut	Finger-Millet	Brinjal	FodderSorghum	Upland-Paddy	Jasmine	Cowpea
Sanabanahalli	3	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Sanabanahalli	4	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Sanabanahalli	6	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Sanabanahalli	7	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Sanabanahalli	8	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Sanabanahalli	67	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Sanabanahalli	68	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Sanabanahalli	69	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Sanabanahalli	70	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Sanabanahalli	71	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Sanabanahalli	72	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Sanabanahalli	73	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Maranahalli	80	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Maranahalli	83	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Maranahalli	84	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Maranahalli	85	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Maranahalli	86	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Jogihalli	8	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g
Karegondanahalli	9	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S2g	S3g	S3g	S2tg	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g

PART-B

SOCIO-ECONOMIC STATUS OF FARM HOUSEHOLDS

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Chapter 1

EXECUTIVE SUMMARY

Baseline socioeconomic characterisation is prerequisite to prepare action plan for program implementation and to assess the project performance before making any changes in the watershed development program. The baseline provides appropriate policy direction for enhancing productivity and sustainability in agriculture.

Methodology: *Maddenahalli micro-watershed (Bangihalli sub-watershed, Gubbi taluk, Tumkur district) is located in between $13^0$27' – $13^0$28' North latitudes and $76^0$51' – $76^0$53' East longitudes, covering an area of about 588.21 ha, bounded by Sanabanahalli, Maranahalli, Madhenahalli and Pinnenahalli villages with length of growing period (LGP) 120-150 days. We used soil resource map as basis for sampling farm households to test the hypothesis that soil quality influence crop selection, and conservation investment of farm households. The level of technology adoption and productivity gaps and livelihood patterns were analyses. The cost of soil degradation and eco system services were quantified.*

Results: *The socio-economic outputs for the Maddenahalli micro-watershed (Bangihalli sub-watershed, Gubbi taluk, Tumkur district) are presented here.*

Social Indicators;

- *Male and female ratio is 59.2 to 40.8 Per cent to the total sample population.*
- *Younger age 18 to 50 years group of population is 57.1 around per cent to the total population.*
- *Literacy population is around 87.8 per cent.*
- *Social groups among all are general caste.*
- *Among all farm households having liquefied petroleum gas is the source of energy for a cooking.*
- *About 50 per cent of households have a yashaswini health card.*
- *Farm households are having MGNREGA card only 20 per cent for rural employment.*
- *Dependence on ration cards for food grains through public distribution system is around 70 percent of farm households.*
- *Swach bharath program providing closed toilet facilities around 80 per cent of sample households.*
- *Women participation in decisions making is around 77.8 per cent of households were found.*

Economic Indicators;

- *The average land holding is 0.72 ha indicates that majority of farm households are belong to marginal and small farmers. The rainfed land is 91 per cent and 9 per cent of irrigated land is cultivated land area among the sample farmers.*
- *Agriculture is the main occupation among 53.1 per cent and agriculture is the main and agriculture labour is subsidiary occupation for 14.3 per cent of the sample households.*
- *The average value of domestic assets is around Rs.16772 per household. Mobile and television are popular media mass communication.*
- *The average value of farm assets is around Rs. 104460 per household; about 70 per cent of sample farmers having plough and bullock cart.*
- *The average value of livestock is around Rs.17271 per household; about 81.25 per cent of household are having livestock.*
- *The average per capita food consumption is around 455.7 grams (1138.2 kilo calories) against national institute of nutrition (NIN) recommendation at 827 gram. Among all sample households are consuming less than the NIN recommendation.*
- *The annual average income is around Rs.102052 per household. About 50 per cent of farm households are below poverty line.*
- *The per capita average monthly expenditure is around Rs.818.*

Environmental Indicators-Ecosystem Services;

- *The value of ecosystem service helps to support investment to decision on soil and water conservation and in promoting sustainable land use.*
- *The onsite cost of different soil nutrients lost due to soil erosion is around Rs. 442 per ha/year. The total cost of annual soil nutrients is around Rs. 247521per year for the total area of 588.21 ha.*
- *The average value of ecosystem service for food grain production is around Rs. 70428/ ha/year. Per hectare food grain production services is maximum in Mango (Rs. 227566) followed by areca nut (Rs. 105087), coconut (Rs. 84360), ragi (Rs.7727), sorghum (Rs. 600) and paddy is negative return.*
- *The average value of ecosystem service for fodder production is around Rs. 3356/ ha/year. Per hectare fodder production services is maximum in paddy (Rs. 4693), sorghum (Rs. 3356) and ragi (Rs. 2020).*
- *The data on water requirement for producing one quintal of grain is considered for estimating the total value of water required for crop production. The per hectare value of water used and value of water was maximum in coconut (Rs. 277513) followed by mango (Rs. 65867), sorghum (Rs. 31043), paddy (Rs. 14463), ragi (Rs.12515) and areca nut (Rs.4284).*

Economic Land Evaluation;

- *The major cropping pattern is ragi (28.4 %) followed by areca nut (28.4 %), sorghum (23.5 %), coconut (12.9 %), mango (5.9 %) and paddy (1.1 %).*
- *In Maddenahalli micro-watershed, major soil series are Balapur series having very deep soil depth covered around 46.23 % of area; major crops are areca nut (82.5 %), and ragi (17.5 %). Kadagathur soils series are having very deep soil depth covered around 14.64 % of area on this soil farmers are presently growing areca nut (20.6 %), coconut (16.1 %), ragi (31.6%) and sorghum (31.6 %). Ranatur soils series are having very deep soil depth covers around 17.98 % of area. On this soil farmers are presently growing coconut (13.4 %), mango (18.0 %), ragi (27.5%) and sorghum (41.1 %). Thimmasandra soils series are having very deep soil depth covers around 3.11 % of area. On this soil farmers are presently growing paddy (50 %) and sorghum (50 %).*
- *The total cost of cultivation and benefit cost ratio (BCR) in study area for coconut range between Rs 97036/ha in KDT soil (with of 2.01) and Rs. 69905/ha in RTR soil (with BCR of 1.11).*
- *In areca nut the cost of cultivation ranges between Rs.69122/ha in KDT soil (with BCR of 1.92) and Rs.8499/ha in BPR soil (with BCR of 18.24).*
- *In sorghum the cost of cultivation range between Rs. 25729/ha KDT soil (with BCR of 0.98) and Rs.16497/ha RTR soil (with BCR of 1.62).*
- *In ragi the cost of cultivation range between Rs. 37931/ha BPR soil (with BCR of 1.18) and Rs.15857/ha KDT soil (with BCR of 1.51).*
- *In mango the cost of cultivation in RTR soil Rs.28582/ha (with BCR of 8.96) and*
- *In paddy the cost of cultivation in RTR soil Rs.32164/ha (with BCR of 1.62).*
- *The land management practices reported by the farmers are crop rotation, tillage practices, fertilizer application and use of farm yard manure (FYM). Due to higher wages farmer are following labour saving strategies is not prating soil and water conservation measures. Less ownership of livestock limiting application of FYM.*
- *It was observed soil quality influences on the type and intensity of land use. More fertilizer applications in deeper soil to maximize returns.*

Suggestions;

- *Involving farmers is watershed planning helps in strengthing institutional participation.*
- *The per capita food consumption and monthly income is very low. Diversifying income generation activities from crop and livestock production in order to reduce risk related to drought and market prices.*

- *Majority of farmers reported that they are not getting timely support/extension services from the concerned development departments.*
- *By strengthing agricultural extension for providing timely advice improved technology there is scope to increase in net income of farm households.*
- *By adopting recommended package of practices by following the soil test fertiliser recommendation, there is scope to increase yield in areca nut (91.4 to 91.6 %), coconut (8.1 to 79.9 %), sorghum (57.7to 73.9 %) and ragi (68.9 to 76.0 %), mango (63.0 %) and paddy (85.4 %).*

Chapter 2

INTRODUCTION

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

Sujala–III watershed development project conceptualised and implemented by the Watershed Development Department of Government of Karnataka with tripartite cost-sharing arrangements. The World Bank through International Development Association provided major portion of plan outlay as a loan to Government of India and in turn loan to Government of Karnataka.

The objectives of Sujala-III is to demonstrate more effective watershed management through greater integration of programs related to rain fed agriculture, innovative and science based approaches and strengthened institutions and capacities. The project is implemented in 11 districts of Bidar, Vijayapura, Gulbarga, Yadgir, Koppal, Gadag, Raichur, Davanagere, Tumkur, Chikkamangalur and Chamarajanagar which have been identified by the Watershed Development Department based on rainfall and socio-economic conditions. The project will be implemented over six years and linked with the centrally financed integrated watershed management programme.

Economic evaluations can better guide in watershed planning and implementation, as well as raise awareness of benefits of ecosystem restoration for food security and poverty alleviation program. The present study aims to characterize socio-economic status of farm households, assess the land and water use status, evaluate the economic viability of land use, prioritize farming constraints and suggest the measures for soil and water conservation for sustainable agriculture.

Objectives of the study

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

Chapter 3

METHODOLOGY

Study area

Maddenahalli micro-watershed is located in Eastern Dry Zone of Karnataka (figure 1)**.** The zone covers entire Bangalore and Kolar districts and 2 taluks of Tumkur. It has an area of 1.80 M ha with 0.85 M ha under cultivation. About 0.23 M ha are irrigated mainly from tanks and wells. Elevation ranges from 800 to 1500m MSL with major area falling between 800 and 900m. The major soil type is non-gravelly red loam with a narrow belt of lateritic soil. Average annual rainfall ranges between 680 and 890mm. The principal crops of the zone are ragi, rice, pulses, maize, oil seeds and mulberry. A sizeable area is also under vegetables and flowering plants. It represents Agro Ecological Sub Region (AESR) 8.2 having LGP 120-150 days.

Maddenahalli micro-watershed (Bangihalli sub-watershed, Gubbi taluk, Tumkur district) is located in between $13^0$27' – $13^0$28' North latitudes and $76^0$51' – $76^0$53' East longitudes, covering an area of about 588.21 ha, bounded by Sanabanahalli, Maranahalli, Madhenahalli and Pinnenahalli villages.

Sampling Procedure:

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

Sources of data and analysis:

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

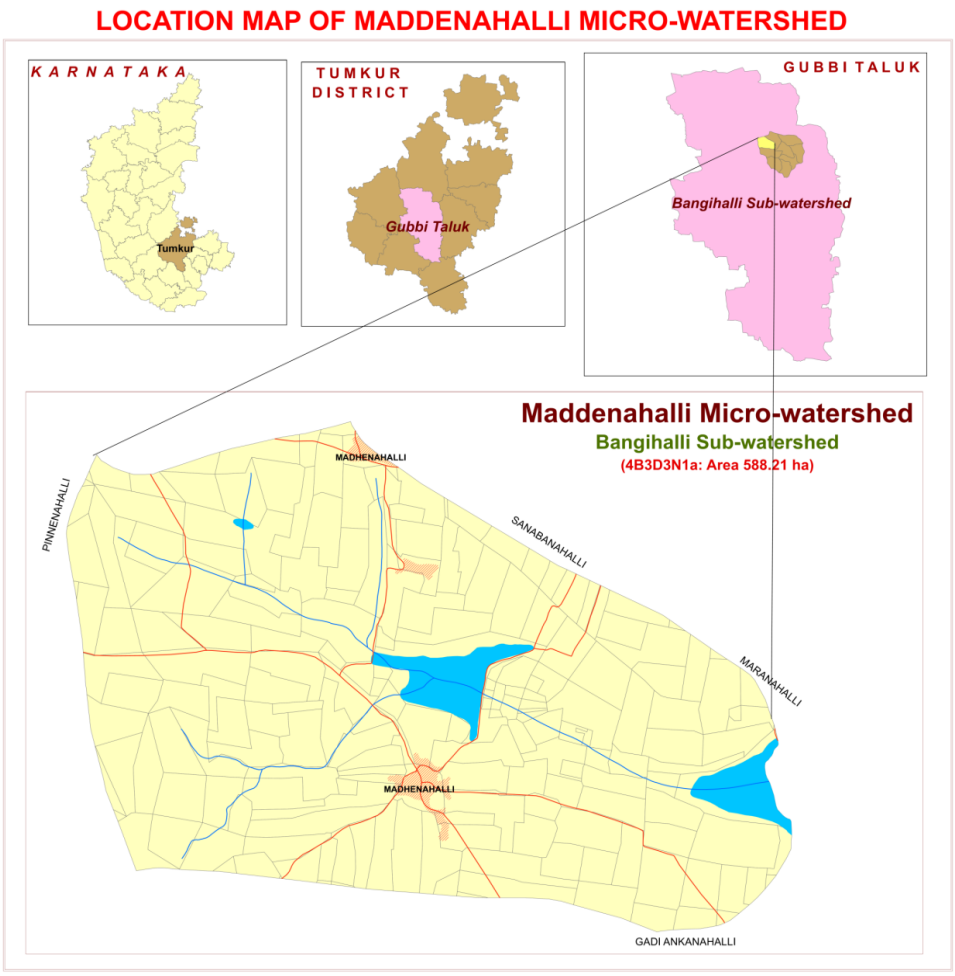


Figure 1: Location of study area

Steps followed in socio-economic assessment

1. •After the completion of soil profile study link the cadastral number to the soil profile in the micro watershed.
2. • Download the names of the farmers who are owning the land for each cadastral number in the Karnataka BHOOMI Website.
3. • Compiling the names of the farmers representing for all the soil profiles studied in the micro watershed for socio-economic Survey.
4. • Conducting the socioeconomic survey of selected farm households in the micro watershed .
5. • Farm households database created using the Automated Land Potential Evaluation System (ALPES) for analysis of socio economic status for each micro watershed .
6. • Synthesis of tables and preparation of report for each micro watershed .

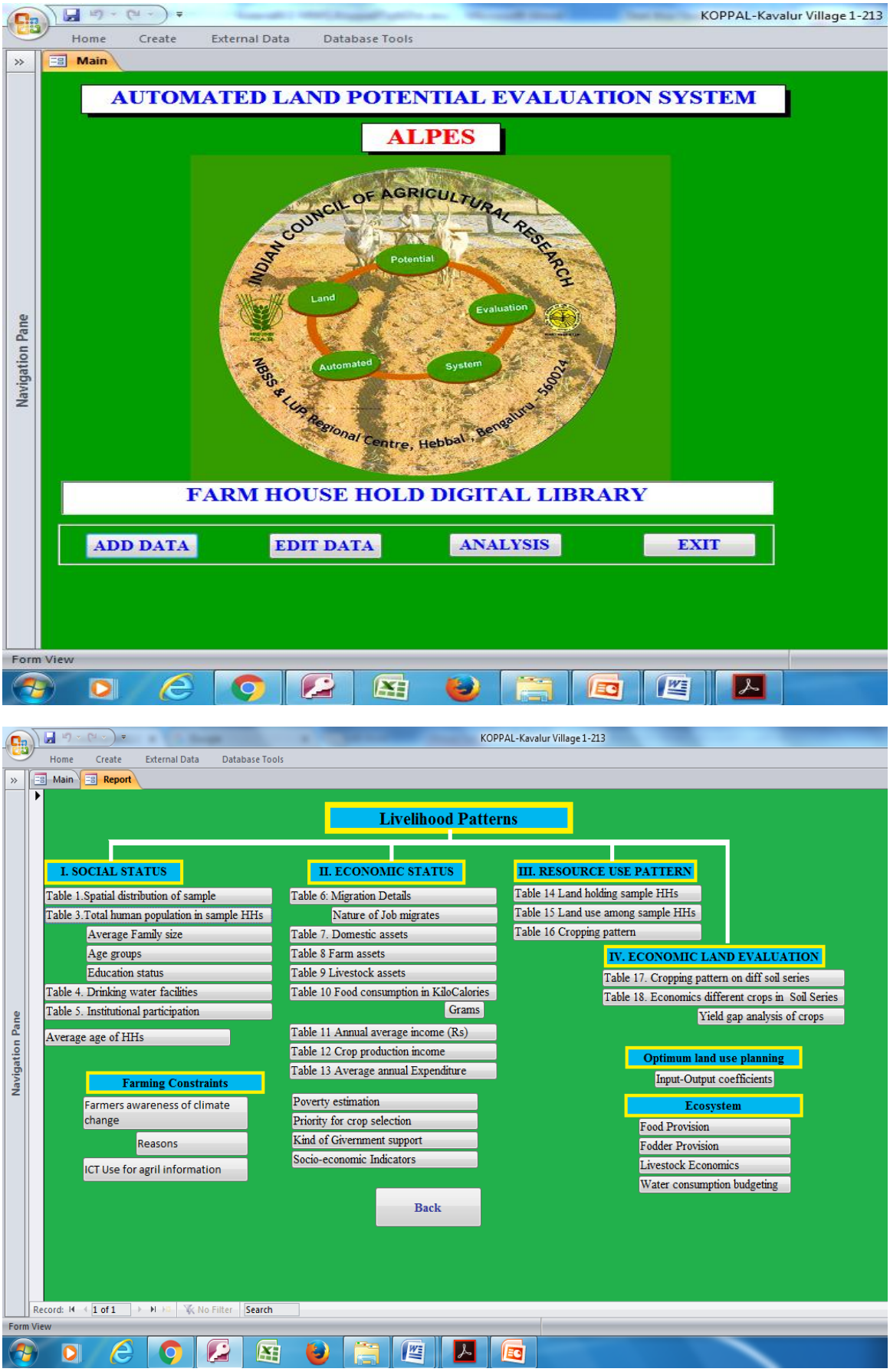


Figure 2: ALPES FRAMEWORK

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

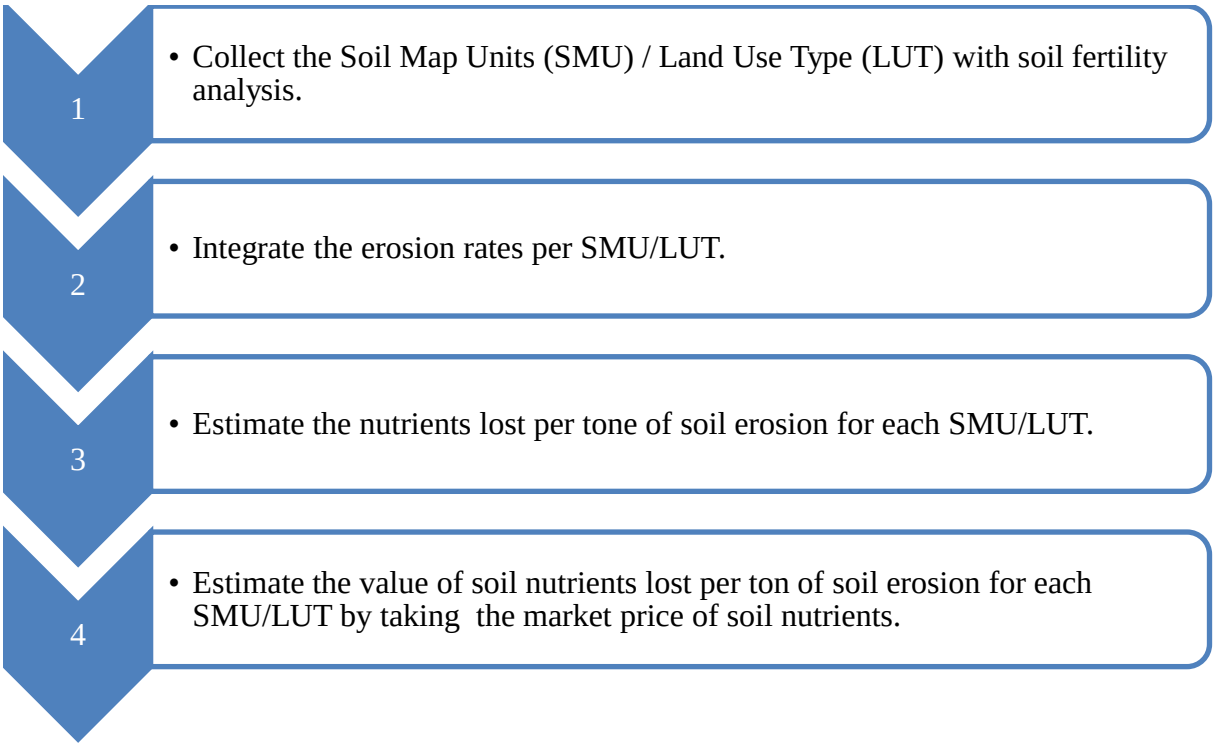
Operational Cost = cost of seeds, fertilizers, pesticides. Cost of human and bullock labour, cost of machinery, cost of irrigation water + interest on working capital.
Gross returns = Yield (Quintals/hectare)*Price (Rs/Quintal)
Net returns = Gross returns-Operational cost.
Benefit Cost Ratio = Net returns/Total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

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

Economic Valuation of Soil ecosystem services:

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

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



Chapter 4

RESULTS AND DISCUSSIONS

The demographic information shows that the household population dynamics encompasses the socioeconomic status of the farmer. For a rural family, the household size should be optimal to earn a comfortable livelihood through farm and non-farm wage earning. The total number of population in watershed area was 49, out of which 59.2 per cent were males and 40.8 per cent females. Average family size of the households is 4.9. Age is an important factor, which affects the potential employment and mobility status of respondents. The data on age wise distribution of farmers in the sample households indicated that majority of the farmers are coming under the age group of 30 to 50 years (36.7 %) followed by more than 50 years (30.6 %), 18 to 30 years (20.4%) and 0 to18 years (12.2 %). Hence, in the study area in general, the respondents were of young and middle age, indicating thereby that the households had almost settled with whatever livelihood options they were practicing and sample respondents were young by age who could venture into various options of livelihood sources. Data on literacy indicated that 12.2 per cent of respondents were illiterate and 87.8 per cent literate (Table 1).

Table 1: Human population among sample households in Maddenahalli Microwatershed

Particulars	**Units**	**Value**
Total human population in sample HHs	Number	49
Male	% to total Population	59.2
Female	% to total Population	40.8
Average family size	Number	4.9
Age group		
0 to 18 years	% to total Population	12.2
18 to 30 years	% to total Population	20.4
30 to 50 years	% to total Population	36.7
>50 years	% to total Population	30.6
Average age	Age in years	41.5
Education Status		
Illiterates	% to total Population	12.2
Literates	% to total Population	87.8
Primary School (<5 class)	% to total Population	16.3
Middle School (6- 8 class)	% to total Population	10.2
High School (9- 10 class)	% to total Population	26.5
Others	% to total Population	34.7

The ethnic groups among the sample farm households found to be among all sample households are general caste (Table 2 and Figure 3). Among all sample households are using liquefied petroleum gas (LPG) as source of fuel for cooking. All the

sample farmers are having electricity connection. About 40.0 per cent are sample households having health cards. About 20 percent of households are having MNREGA job cards for employment generation. About 70 per cent of farm households are having ration cards for taking food grains from public distribution system. About 80 per cent of farm households are having toilet facilities.

Table 2: Basic needs of sample households in Maddenahalli Microwatershed

Particulars	**Units**	**Value**
Social groups		
General	% of Households	100.0
Types of fuel use for cooking		
Gas	% of Households	100.0
Energy supply for home		
Electricity	% of Households	100.0
Number of households having Health card		
Yes	% of Households	50.0
No	% of Households	50.0
MGNREGA Card		
Yes	% of Households	20.0
No	% of Households	80.0
Ration Card		
Yes	% of Households	70.0
No	% of Households	30.0
Households with toilet		
Yes	% of Households	80.0
No	% of Households	20.0
Drinking water facilities		
Tube Well	% of Households	100.0

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

About 24.5per cent of the farmers are participating in community based organizations (Table 3). Among them majority were participating in diary co-operatives societies (16.3%) followed by village panchayat (4.1 %) and self help group organization (4.1%) like Sri Dharmasthala Swasahaya Sangha, Stri Shakhti Sangha.

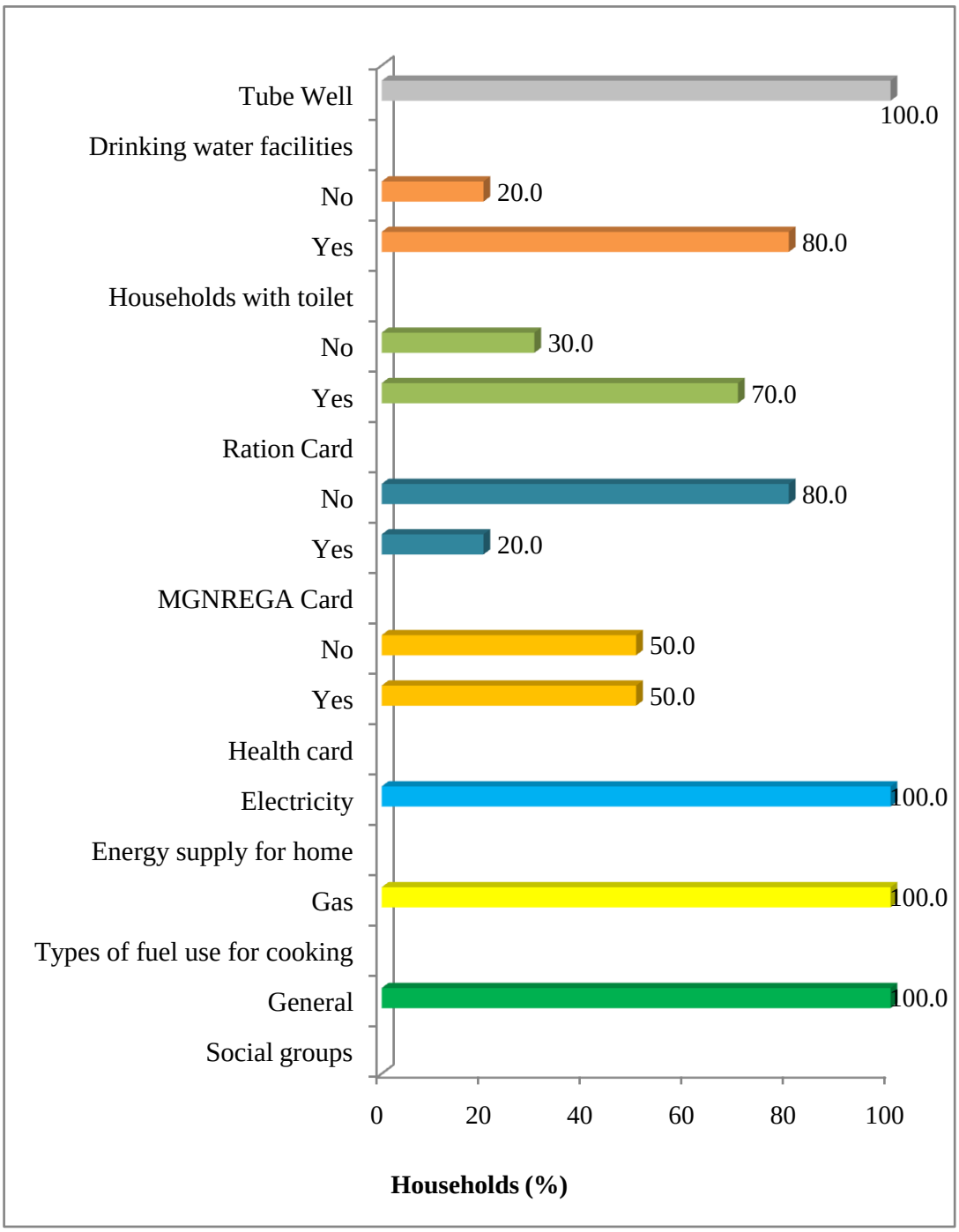


Figure 3: Basic needs of sample households in Maddenahalli Microwatershed

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

Particulars	Units	Value
No. of people participating	% to total	24.5
Co-operative Societies-Dairy	% of total	16.3
Village Panchayath	% of total	4.1
Self help groups(SHG's)	% of total	4.1
No. Of people not participating	% to total	75.5

The occupational pattern (Table 4) among sample households shows that agriculture is the main occupation around 53.1 per cent of farmers followed by agriculture is the main occupation and subsidiary occupations like agricultural labour (14.3 %) and govt service (2.0 %) and student (16.3 %) as a main occupation of sample household.

Table 4: Occupational pattern in sample population in Maddenahalli Microwatershed

Occupation		**% to total**
Main	**Subsidiary**	
Agriculture	Agriculture	53.1
	Agriculture labour	14.3
	Private service	4.1
	Non Agriculture Labour	10.2
Govt. service		2.0
Student		16.3
Grand Total		100.0
Family labour availability		**Man days/month**
Male		42.50
Female		30.00
Total		72.50

The important assets especially with reference to domestic assets were analyzed and are given in Table 5 and Figure 4. The important domestic assets possessed by all categories of farmers are television (100 %) followed by mobile phone (90 %), mixer/grinder (90 %), motor cycle (60 %), bicycle (30 %), refrigerator (20 %) and dvd/cvd (10 %). The average value of domestic assets is around Rs 16772 per households.

Table 5: Domestic assets among the sample households in Maddenahalli Microwatershed

Particulars	**% of households**	**Average value in Rs**
Bicycle	30.0	1600
Dvd/Cvd	10.0	60000
Mixer/grinder	90.0	2689
Mobile Phone	90.0	3278
Motorcycle	60.0	34000
Refrigerator	20.0	13000
Television	100.0	2840
Average Value	16772	

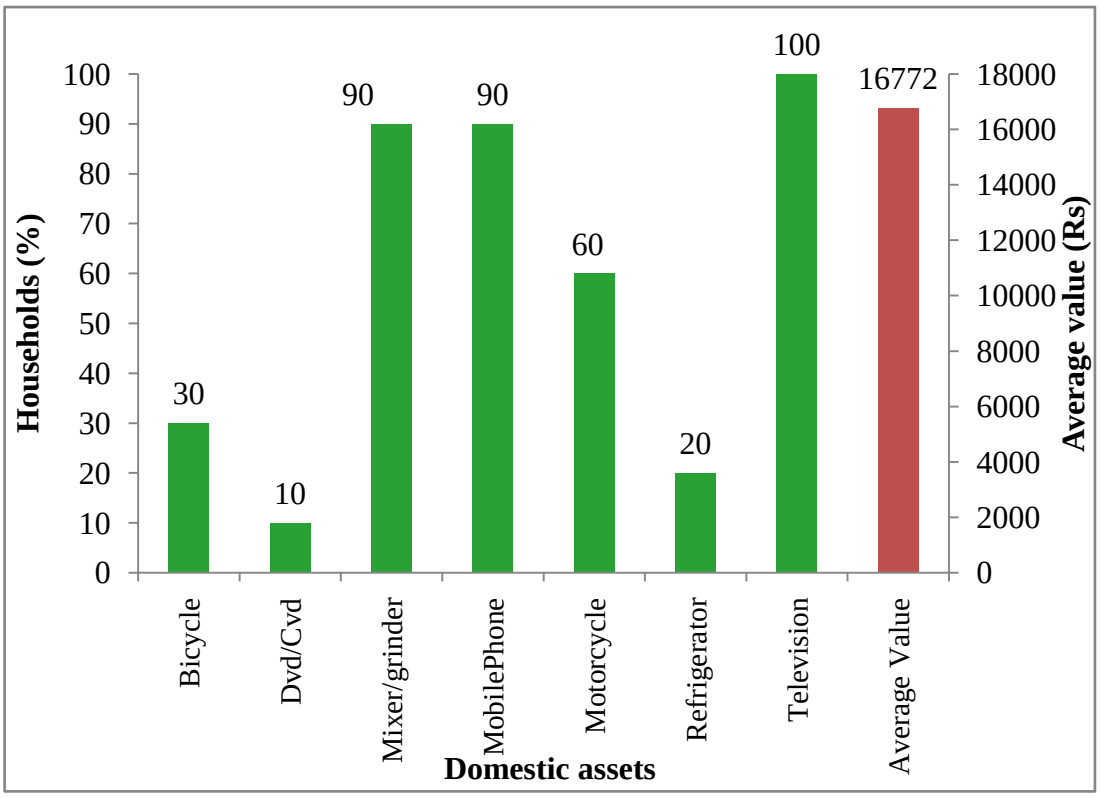


Figure 4: Domestic assets among the sample households in Maddenahalli Microwatershed

The most popularly owned farm equipments were sickles, plough, cattle shed; pump sets, chaff cutter, bullock cart, sprayer and thresher. Plough and sickle were commonly present in all the sampled farmers; these were primary implements in agriculture. The per cent of households owned plough (70 %), weeder (60 %), sprayer (40 %), tractor (20 %), chaff cutter (20 %), bullock cart (20 %) and tractor (10 %). The average value of farm assets is around Rs.104460 per households (Table 6 and Figure 5).

Table 6: Farm assets among samples households in Maddenahalli Microwatershed

Particulars	% of households	Average value in Rs
Bullock cart	20.0	14000
Chaff Cutter	20.0	2100
Plough	70.0	2529
Sprayer	40.0	8075
Tractor	20.0	600000
Weeder	60.0	58
Average Value	104460	

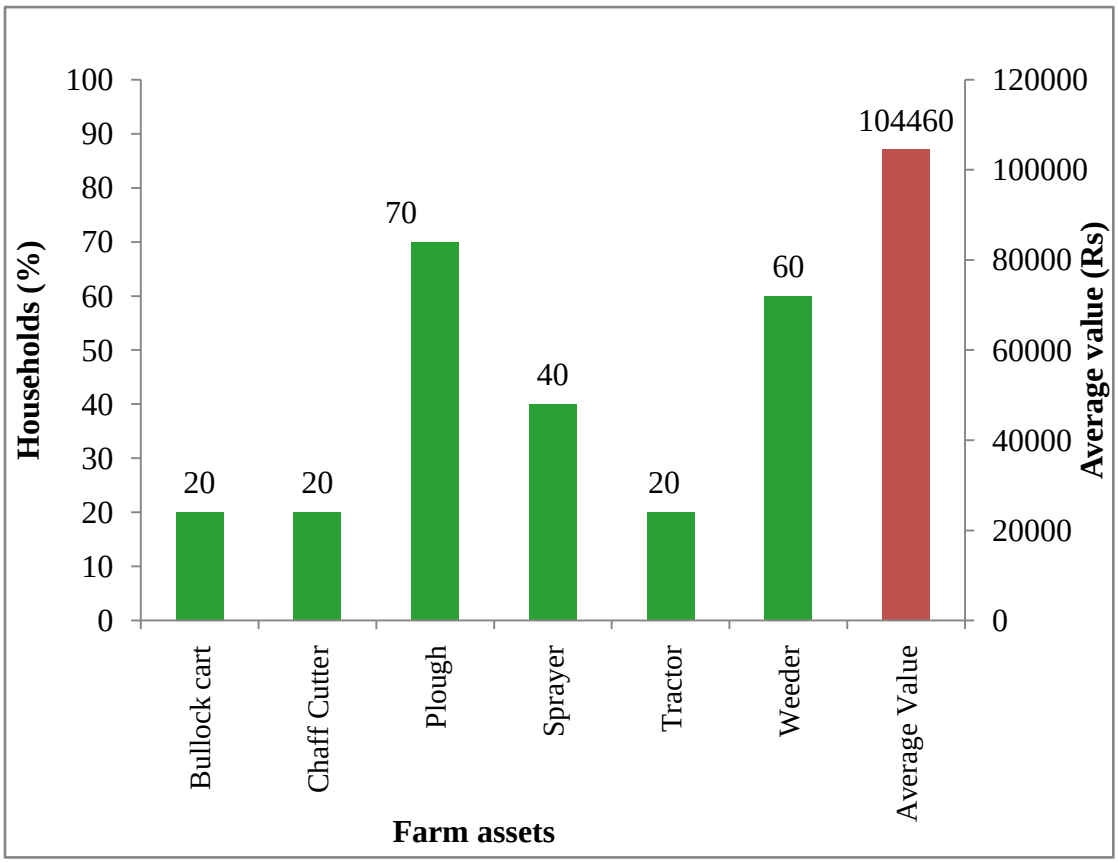


Figure 5: Farm assets among the sample households in Maddenahalli Microwatershed

Livestock is an integral component of the conventional farming systems (Table 7 and Figure 6). The highest livestock population is crossbred milching cow were around 46.2 per cent followed milching buffalos (30.8 %), crossbred dry cow (15.4 %) and goats (7.7 %). The average livestock value was Rs. 17271 per household.

Table 7: Livestock assets among sample households in Maddenahalli Microwatershed

Particulars	% of livestock population	Average value in Rs
Crossbred Dry Cow	15.4	8000
Crossbred Milching Cow	46.2	32833
Milching Buffalos	30.8	25750
Goats	7.7	2500
Average value	17271	

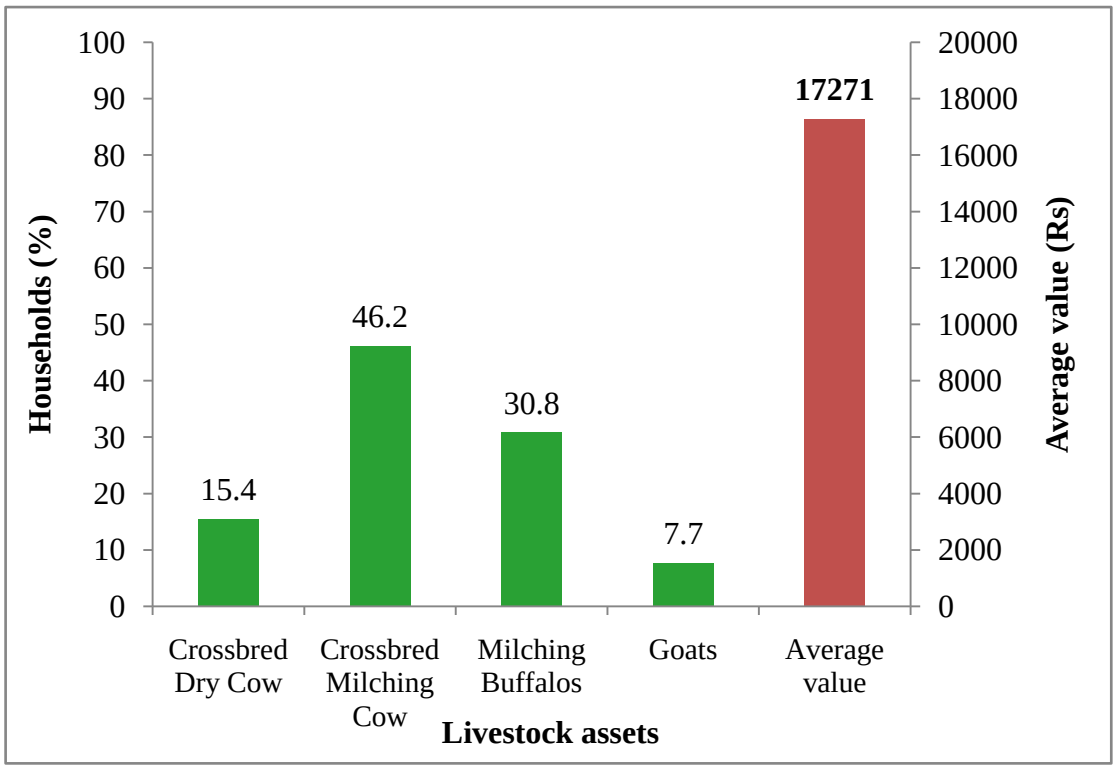


Figure 6: Livestock assets among sample households in Maddenahalli Microwatershed

Average milk produced in sample households is 2573 litter/annum. Among the farm households, sorghum paddy and ragi are the main crops for domestic food and fodder for animals. About 3065 kg /ha of average fodder is available per season for the livestock feeding (Table 8).

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

Particulars	
Name of the Livestock	**Ltr./Lactation/animal**
Crossbred Milching Cow	3500
Milching Buffalos	1645
Average Milk Produced	2573
Fodder produces	**Fodder yield (kg/ha.)**
Sorghum	4708
Paddy	2500
Ragi	1988
Average fodder availability	3065
Livestock having households (%)	81.25
Livestock population (Numbers)	24

A woman participation in decision making is in this micro-watershed is presented in Table 9. About 50 per cent of Women participation in local organization activities, about 20 per cent of Women earning for her family requirement and among 77.8 per cent of women taking decision in her family and agriculture related activities in these study area.

Table 9: Women empowerment of sample households in Maddenahalli Microwatershed

% to Grand Total

Particulars	**Yes**	**No**
Women participation in local organization activities	50.0	50.0
Women elected as panchayat member	10.0	90.0
Women earning for her family requirement	20.0	80.0
Women taking decision in her family and agriculture related activities	77.8	22.2

The food intake in terms of kilo calorie (kcal) per person per day was calculated and presented in the Table 10 and Figure 7. More quantity of cereals is consumed by sample farmers which accounted for 767.5 kcal per person. The other important food items consumed was pulses 93.8 kcal followed by milk 76.8 kcal, vegetables 12.4 kcal and cooking oil 187.7 kcal. In the sampled households, farmers were consuming less (1138.2kcal) than NIN- recommended food requirement (2250 kcal).

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

Particulars	**NIN recommendation (gram/ per day/ person)**	**Present level of consumption (gram/ per day/ person)**	**Kilo Calories /day/person**
Cereals	396	225.7	767.5
Pulses	43	27.4	93.8
Milk	200	118.2	76.8
Vegetables	143	51.5	12.4
Cooking Oil	31	32.9	187.7
Egg	0.5	0.0	0.0
Meat	14.2	0.0	0.0
Total	**827.7**	**455.7**	**1138.2**
Threshold of NIN recommendation		827 gram*	2250 Kcal*
% Below NIN		100.0	100.0
% Above NIN		0.0	0.0

Note: * day/person

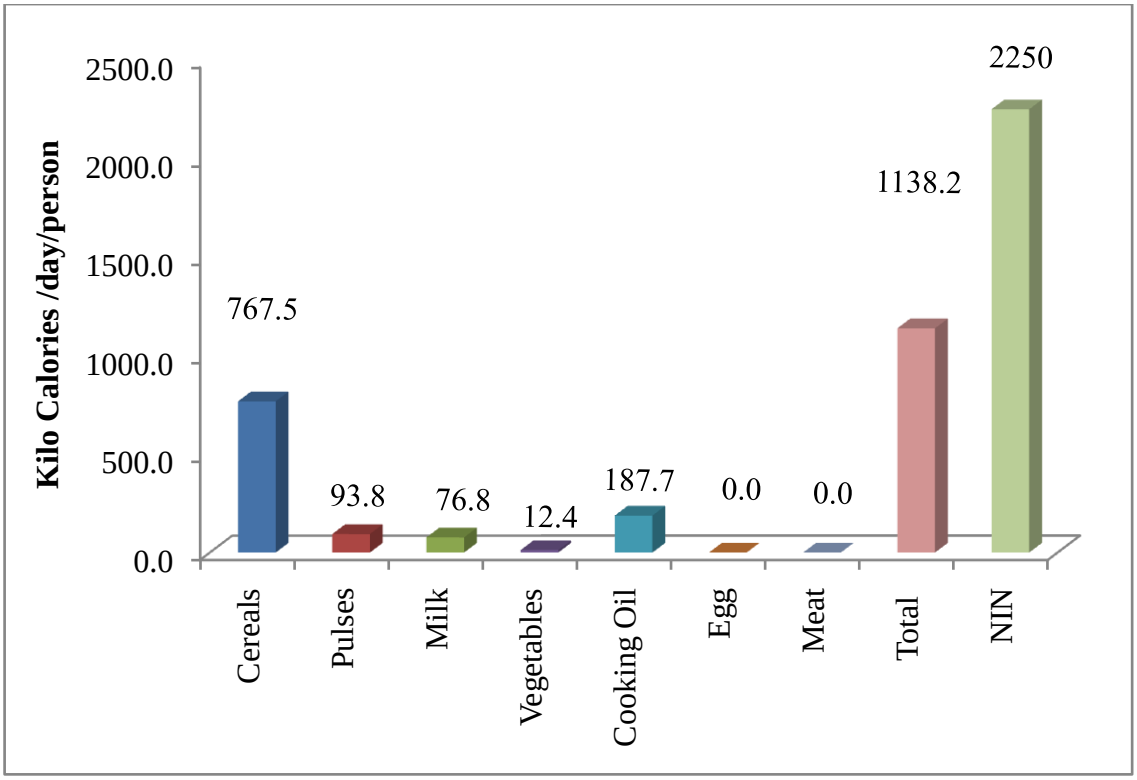


Figure 7: Per capita daily consumption of food among the sample households in Maddenahalli Microwatershed

Annual income of the sample HHs: The average annual household income is around Rs 102052. Major source of income to the farmers in the study area is from crop production (Rs 53879) followed by livestock (Rs. 48173). The monthly per capita income is Rs.1736, which is above than the threshold monthly income of Rs 975 for considering above poverty line. Due to the fact that erratic rainfall and shortage of water, farmers are diverting from crop production activities to enable the household for a comfortable livelihood. The incomes from the other aforesaid sources are very meagre (Table 11).

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

Particulars	**Income ***
Nonfarm income (Rs)	0 (0)
Livestock income (Rs)	48173 (60)
Crop Production (Rs)	53879 (100)
Total Annual Income (Rs)	***102052***
Average monthly per capita income (Rs)	1736
Threshold for Poverty level (Rs 975 per month/person)	
% of households below poverty line	50.0
% of households above poverty line	50.0

* Figure in the parenthesis indicates % of Households

The average annual expenditure of farm households indicated that farmers in the study area spend highest on food (Rs.25620) followed by education, clothing, social function and health. Now a day's education is most important among all of us. In today's competitive world, education is a necessity for man after food, clothing, and shelter. It is the only fundamental way by which a desired change in the society can happen. The average per capita monthly expenditure is around Rs 818 and about 50 per cent of farm households are below poverty line (Table 12 and Figure 8).

Table 12: Average annual expenditure of sample HHs in Maddenahalli Microwatershed

Particulars	Value in Rupees	Per cent
Food	25620	53.2
Education	5300	11.0
Clothing	4100	8.5
Social functions	7300	15.2
Health	5800	12.1
Total Expenditure (Rs/year)	48120	100.0
Monthly per capita expenditure (Rs)	818	

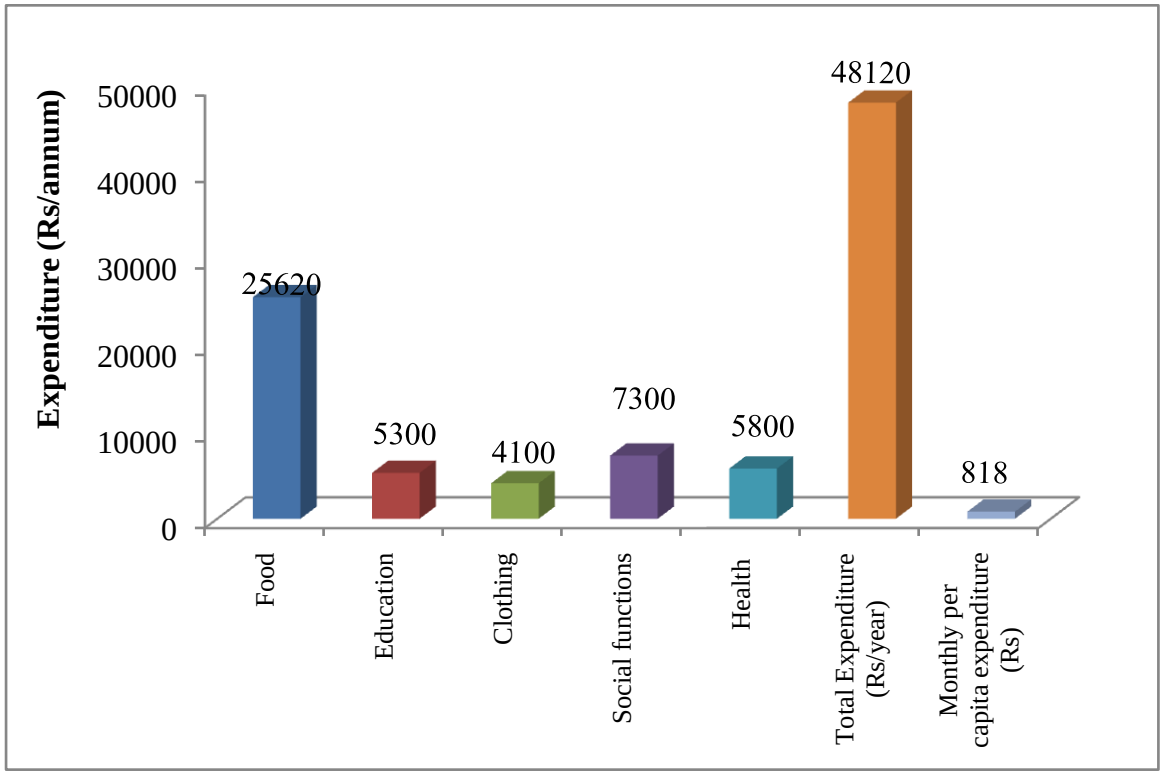


Figure 8: Average annual expenditure of sample HHs in Maddenahalli Microwatershed

Land holding: Total sample households are total area cultivated by them is 7.2 ha. The average land holding of sample HHs is 0.7 ha. Large number of sample HHs (90 %) belong to small size group with an average holding size of 0.6 ha and medium farmers (10 %) with an average holding size of 2.1 ha (Table 13).

Table 13: Distribution of land holding among the sample households in Maddenahalli micro-watershed

Particulars	Units	Values
Small farmers		
Total land	ha	5.1
Sample size	Per cent	90.0
Average land holding	ha	0.6
Medium farmers		
Total land	ha	2.1
Sample size	Per cent	10.0
Average land holding	ha	2.1
Total sample households		
Total land	ha	7.2
Sample size	Per cent	100.0
Average land holding	ha	0.7

Land use: The total land holding in the Maddenahalli micro-watershed is 7.2 ha (Table 14). Of which 6.6 ha is rainfed land and 0.6 ha is irrigated land. The average land holding per household is worked out to be 0.72 ha.

Table 14: Land use among samples households in Maddenahalli Microwatershed

Particulars	Per cent	Area in ha
Irrigated land	9.0	0.6
Rainfed Land	91.0	6.6
Fallow Land	0.0	0.0
Total land holding	100.0	7.2
Average land holding	0.72	

In the micro-watershed, the prevalent present land uses under perennial plants are mango (58.3%) followed by neem trees (24.2 %), tamarind (6.8%), teak (3%) other (3%), lime (3%) and custard apple (1.5%) (Table 15).

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

Particulars	Number of Plants/trees	Per cent
Lime	4	3.0
Mango	77	58.3
Neem trees	32	24.2
Tamarind	9	6.8
Custard Apple	2	1.5
other	4	3.0
Teak	4	3.0
Grand Total	132	100.0

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

The present dominant crops grown in dry lands in the study area were by areca nut (28.2 %), sorghum (22.4 %), ragi (19.6 %), coconut (12.9 %) and paddy (1.1 %), which is taken during kharif and mango (5.9 %) during rabi season respectively. The cropping intensity was 119 per cent (Table 16 and Figure 9).

Table 16: Present cropping pattern and cropping intensity in Maddenahalli Microwatershed

% to Grand Total

Crops	**Kharif**	**Rabi**	**Summer**	**Grand Total**
Ragi	19.6	8.81	0.0	28.4
Arecanut	28.2	0.0	0.0	28.2
Sorghum	22.4	1.1	0.0	23.5
Coconut	12.9	0.0	0.0	12.9
Mango	0.0	0.0	5.9	5.9
Paddy	1.1	0.0	0.0	1.1
Grand Total	***84.1***	***9.9***	***5.9***	***100.0***
Cropping intensity (%)	119			

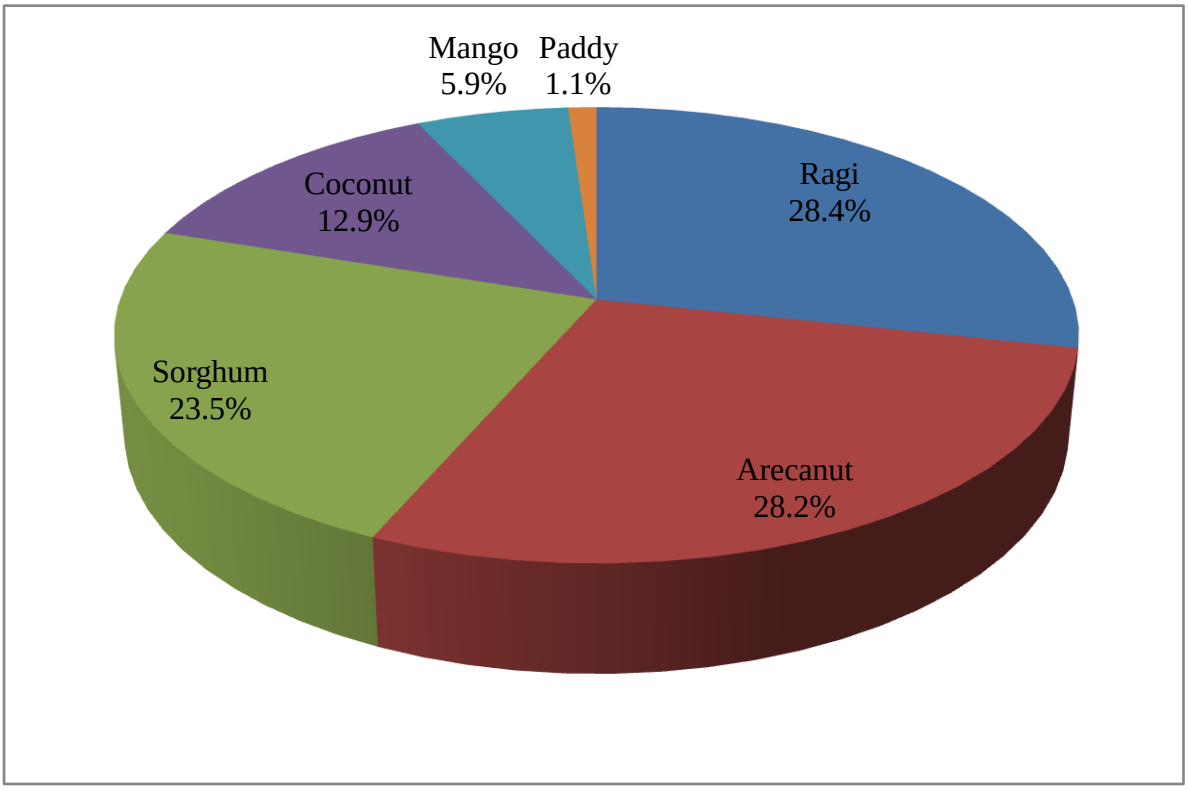


Figure 9: Present cropping pattern in Maddenahalli Microwatershed

Economic land evaluation

The main purpose to characterise the socio-economic systems in the watershed is to identify the existing production constraints and propose the potential/alternate options for agro-technology transfer and for bridging the adoption and yield gap.

In Maddenahalli micro-watershed, 3 soil series are identified and mapped (Table 17). The distribution of major soil series are Balapur covering an area around 273 ha (46.23 %) followed by Ranatur106 ha (17.98 %), Kadagathur 87 ha (14.64%), Bidanagere 50ha (8.54%), Muradi 27ha (4.63%) and Thimmasandra 18 ha (3.11%).

Table 17: Distribution of soil series in Maddenahalli Microwatershed

Soil No	Soil Series	Mapping Unit Description	Area in ha (%)
SOILS OF GRANITE GNEISS LANDSCAPE			
1	BDG	Bidanagere soils are moderately deep (75-100 cm), well drained, have dark reddish brown gravelly sandy clay loam to sandy clay soils occurring on very gently sloping uplands under cultivation	50 (8.54)
2	BPR	Balapur soils are deep (100-150 cm), well drained, have dark reddish brown to dark red gravelly sandy clay to clay soils occurring on very gently sloping uplands under cultivation	273 (46.23)
3	MRD	Muradi soils are very deep (>150 cm), well drained, have red to dark red sandy clay loam to sandy clay soils occurring on very gently sloping uplands under cultivation	27 (4.63)
4	RTR	Ranatur soils are very deep (>150 cm), well drained, have dark reddish brown to dark red clay soils occurring on very gently sloping uplands under cultivation	106 (17.98)
5	KDT	Kadagathur soils are very deep (>150 cm), moderately well drained, have dark brown to very dark grayish brown sandy clay to clay soils occurring on nearly level to very gently sloping uplands under cultivation	87 (14.64)
6	TSD	Thimmasandra soils are very deep (>150 cm), moderately well drained, have very dark brown to very dark grayish brown sandy clay to clay soils occurring on nearly level to very gently sloping lowlands under cultivation	18 (3.11)
7		Others	29 (4.87)

Present cropping pattern on different soil series are given in Table 18. Crops grown on Balapur soils are areca nut and ragi. Areca nut, Cotton, ragi and sorghum on Kadagathur soils is grown. Coconut, mango ragi and sorghum on Ranatur soil are grown and Thimmasandra is paddy and sorghum.

Table 18: Cropping pattern on major soil series in Maddenahalli Microwatershed

(Area in per cent)

Soil Series	Soil Depth	Crops	Dry			Irrigated		Grand Total
			Kharif	Rabi	Summer	Kharif	Rabi	
BPR	Deep (100-150 cm)	Arecanut	82.5	0.0	0.0	0.0	0.0	82.5
		Ragi	17.5	0.0	0.0	0.0	0.0	17.5
KDT	Very deep (>150 cm)	Arecanut	20.6	0.0	0.0	0.0	0.0	20.6
		Coconut	0.0	0.0	0.0	16.1	0.0	16.1
		Ragi	0.0	31.6	0.0	0.0	0.0	31.6
		Sorghum	31.6	0.0	0.0	0.0	0.0	31.6
RTR	Very deep (>150 cm)	Coconut	13.4	0.0	0.0	0.0	0.0	13.4
		Mango	0.0	0.0	18.0	0.0	0.0	18.0
		Ragi	27.5	0.0	0.0	0.0	0.0	27.5
		Sorghum	41.1	0.0	0.0	0.0	0.0	41.1
TSD	Very deep (>150 cm)	paddy	0.0	0.0	0.0	50.0	0.0	50.0
		Sorghum	0.0	0.0	0.0	0.0	50.0	50.0

Land is used for agricultural use for growing cereals, pulse, oilseeds and commercial crops. The soil/ land potential are measures in terms of physical yield and net income. The alternative land use options for each micro-watershed are given below (Table 19).

Table 19: Alternative land use options for different size group of farmers (Benefit Cost Ratio) in Maddenahalli Microwatershed.

Soil Series	Small Farmers	Medium Farmers
BPR	Ragi (1.18)	Arecanut (18.24)
RTR	Coconut (1.11), Mango (8.96), Ragi (1.89) & Sorghum (1.62)	
KDT	Arecanut (1.92), Coconut (2.01), Ragi (1.51)& Sorghum (0.98)	
TSD	Paddy (1.06) & Sorghum (1.02)	

The productivity of different crops grown in Maddenahalli Microwatershed under potential yield of the crops is given in Table 20.

The data on cost of cultivation and benefit cost ratio (BCR) of different crops is given in Table 20. The total cost of cultivation in study area for areca nut ranges between Rs.69122/ha in KDT soil (with BCR of 1.92) and Rs.8499/ha in BPR soil (with BCR of 18.24), coconut range between Rs 97036/ha in KDT soil (with of 2.01) and Rs.69905/ha in RTR soil (with BCR of 1.11), sorghum range between Rs. 25729/ha KDT soil (with BCR of 0.98) and Rs.16497/ha RTR soil (with BCR of 1.62), ragi range between Rs. 37931/ha BPR soil (with BCR of 1.18) and Rs.15857/ha KDT soil (with BCR of 1.51), mango cost of cultivation in RTR soil Rs.28582/ha (with BCR of 8.96) and paddy cost of cultivation in RTR soil Rs.32164/ha (with BCR of 1.62).

Table 20: Economic land evaluation and bridging yield gap for different crops in Maddenahalli Microwatershed

Particulars	BPR(100-150 cm)		KDT (>150 cm)				RTR(>150 cm)				TSD(>150 cm)	
	Areca nut	Ragi	Areca nut	Coco nut	Ragi	Sor ghum	Coco nut	Mango	Ragi	Sor ghum	Paddy	Sor ghum
Total cost (Rs/ha)	8499	37931	69122	97036	15857	25729	69905	28582	16229	16497	32164	20139
Gross Return (Rs/ha)	154980	44597	133000	194936	23897	25194	77805	256148	30695	26705	34086	20501
Net returns (Rs/ha)	146482	6667	63878	97900	8040	-535	7900	227566	14466	10208	1922	362
BCR	18.24	1.18	1.92	2.01	1.51	0.98	1.11	8.96	1.89	1.62	1.06	1.02
Farmers Practices (FP)												
FYM (t/ha)	2.0	4.6	1.9	7.4	0.0	2.5	2.5	7.4	2.4	3.2	2.5	2.5
Nitrogen (kg/ha)	0.0	20.8	17.3	154.4	11.3	11.3	0.0	0.0	0.0	21.9	0.0	0.0
Phosphorus (kg/ha)	0.0	53.2	44.2	394.6	28.8	28.8	0.0	0.0	0.0	56.0	0.0	0.0
Potash (kg/ha)	0.0	0.0	0.0	294.1	18.8	18.8	0.0	0.0	0.0	0.0	0.0	0.0
Grain (Qtl/ha)	3.9	13.7	3.8	169.5	7.4	11.1	37.1	36.6	9.6	12.0	8.6	7.4
Price of Yield (Rs/Qtl)	40000	3000	35000	1150	3100	2100	2100	7000	3000	2100	3400	2100
Soil test based fertilizer Recommendation (STBR)												
FYM (t/ha)	6.8	8.6	6.8	10.0	8.6	7.4	10.0	61.8	8.6	7.4	9.9	7.4
Nitrogen (kg/ha)	100.0	92.6	100.0	102.5	92.6	101.9	128.1	231.6	74.1	101.9	98.8	81.5
Phosphorus (kg/ha)	56.3	32.4	56.3	48.8	32.4	42.6	48.8	37.1	32.4	42.6	37.1	42.6
Potash (kg/ha)	40.0	44.5	30.0	245.0	44.5	39.5	245.0	172.9	44.5	39.5	49.4	39.5
Grain (Qtl/ha)	45.0	30.9	45.0	184.5	30.9	28.4	184.5	98.8	30.9	28.4	59.3	28.4
% of Adoption/yield gap (STBR-FP) / (STBR)												
FYM (%)	71.0	46.4	71.5	26.5	100.0	66.3	75.0	88.0	71.9	56.2	74.7	66.3
Nitrogen (%)	100.0	77.5	82.7	-50.6	87.9	89.0	100.0	100.0	100.0	78.5	100.0	100.0
Phosphorus (%)	100.0	-64.2	21.4	-709.5	11.3	32.5	100.0	100.0	100.0	-31.4	100.0	100.0
Potash (%)	100.0	100.0	100.0	-20.0	57.8	52.6	100.0	100.0	0.0	100.0	100.0	100.0
Grain (%)	91.4	55.6	91.6	8.1	76.0	60.9	79.9	63.0	68.9	57.7	85.4	73.9
Value of yield and Fertilizer (Rs)												
Additional Cost (Rs/ha)	9264	4850	6948	-14176	10297	7023	16083	62210	9423	5324	11184	8553
Additional Benefits (Rs/ha)	1645020	51458	1442000	17239	72742	36309	309645	435452	63848	34389	172159	44090
Net change Income (Rs/ha)	1635755	46608	1435052	31415	62444	29286	293563	373242	54426	29065	160975	35536

The data on FYM, Nitrogen, Phosphorus and Potash application by the farmers to different crops and recommended FYM for different crops is given in Table 20. There is a huge gap between FYM application by farmers and recommended FYM in all the crops across the soils. There is a larger yield gap in crops grown across different soil series. Adequate knowledge about recommended package of practices is the pre-requisite for their use in cultivation of crops. It is a fact that, recommended practices are major contributing factors to yield. Inadequate knowledge about recommended practices leads to their improper adoption. Strengthening of extension services by concerned agency is required to increase adoption of recommended cultivation practices and ultimately reducing the gap. By adopting soil-test fertiliser recommendation, there is scope to increase yield and income to a maximum of Rs 1635755 in areca nut and a minimum of Rs 29065 in sorghum cultivation.

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

The onsite cost of different soil nutrients lost due to soil erosion is given in Table 21 and Figure 10. The average value of soil nutrient loss is around Rs 442 per ha/year. The total cost of annual soil nutrients is around Rs 247521 per year for the total area of 588.21 ha.

Table 21: Estimation of onsite cost of soil erosion in Maddenahalli Microwatershed

Particulars	**Quantity(kg)**		**Value (Rs)**	
	Per ha	**Total**	**Per ha**	**Total**
Organic matter	58.72	32881	369.91	207149
Phosphorus	0.19	107	8.37	4687
Potash	0.67	376	13.43	7521
Iron	0.11	64	5.48	3068
Manganese	0.13	73	36.05	20186
Cupper	0.01	3	3.02	1691
Zinc	0.00	2	0.17	96
Sulphur	0.14	76	5.46	3059
Boron	0.00	2	0.11	64
Total	59.97	33584	442.00	247521

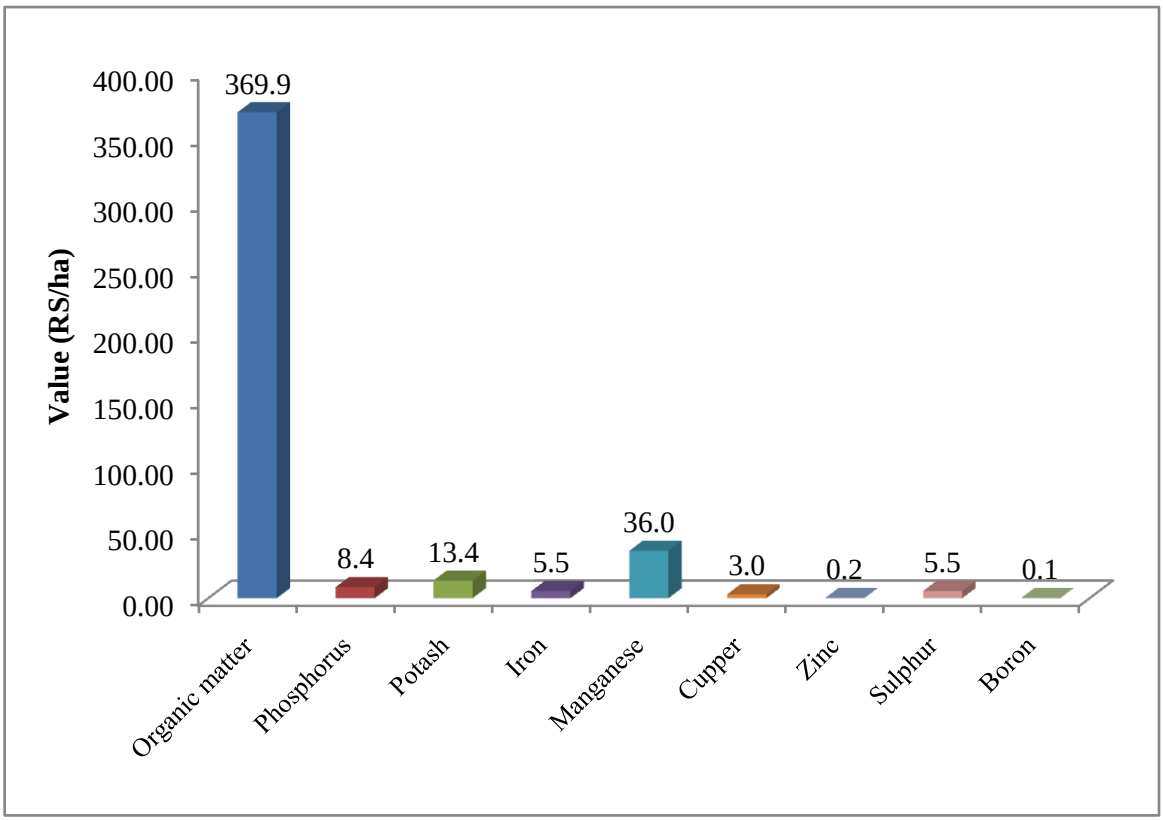


Figure 10: Estimation of onsite cost of soil erosion in Maddenahalli Microwatershed

The average value of ecosystem service for food grain production is around Rs 70428/ ha/year (Table 22 and Figure 11). Per hectare food grain production service is maximum in mango (Rs 227566) followed by areca nut (Rs 105087), coconut (Rs 84360) ragi (7727) sorghum (Rs 600) and paddy is negative return.

Table 22: Ecosystem services of food grain production in Maddenahalli Microwatershed

Production items	**Crops**	**Area in ha**	**Yield (Qtl/ha)**	**Price (Rs/Qtl)**	**Gross Returns (Rs/ha)**	**Cost of Cultivation (Rs/ha)**	**Net Returns (Rs/ha)**
Cereals	Paddy	0.4	8.6	3400	29393	32164	-2771
	Ragi	2.1	10.2	3033	31066	23339	7727
	Sorghum	2.5	10.2	2100	21388	20788	600
Oil seeds	Coconut	0.8	103.3	1625	167830	83470	84360
Commercial Crops	Arecanut	2.6	3.8	37500	143897	38810	105087
Fruits	Mango	0.5	36.6	7000	256148	28582	227566
Average value		8.9	28.8	9110	108287	37859	70428

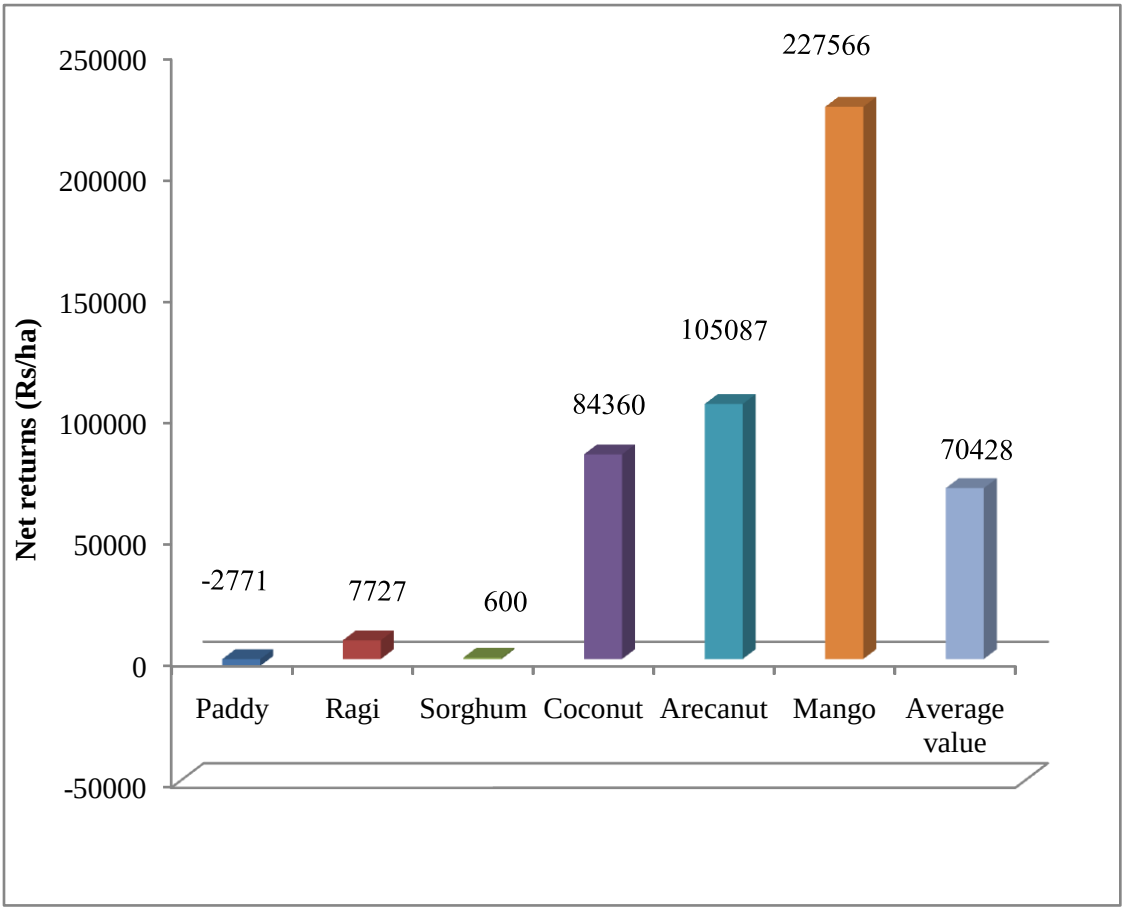


Figure 11: Ecosystem services of food grain production in Maddenahalli Microwatershed

The average value of ecosystem service for fodder production is around Rs. 3356/ ha/year (Table 23). Per hectare fodder production service is maximum in paddy (Rs. 4693), sorghum (Rs. 3356) and ragi (Rs. 2020).

Table 23: Ecosystem services of fodder production in Maddenahalli Microwatershed

Production items	Crops	Area in ha	Yield (Qtl/ha)	Price (Rs/Qtl)	Net Returns (Rs/ha)
Cereals	Paddy	0.4	2.5	1900	4693
	Ragi	2.1	1.6	1283	2020
	Sorghum	2.5	2.0	1592	3356
Average value		5.0	2.0	1592	3356

The water demand for production of different crops was worked out in arriving at the ecosystem services of water support to crop growth. The data on water requirement for producing one quintal of grain is considered for estimating the total value of water required for crop production. The per hectare value of water used and value of water was maximum (Table 24 and Figure 12) in coconut (Rs. 277513) followed by mango (Rs 65867) sorghum (Rs. 31043), paddy (Rs14463), ragi (Rs 12515) and areca nut (Rs.4284).

Table 24: Ecosystem services of water supply in Maddenahalli Microwatershed

Crops	Yield (Qtl/ha)	Virtual water (cubic meter) per ha	Value of Water (Rs/ha)	Water consumption (Cubic meters/Qtl)
Arecanut	3.8	428	4284	112
Coconut	103.3	27751	277513	269
Mango	36.6	6587	65867	180
Paddy	8.6	1446	14463	167
Ragi	10.2	1252	12515	122
Sorghum	10.2	3104	31043	305
Average value	28.8	6761	67614	192

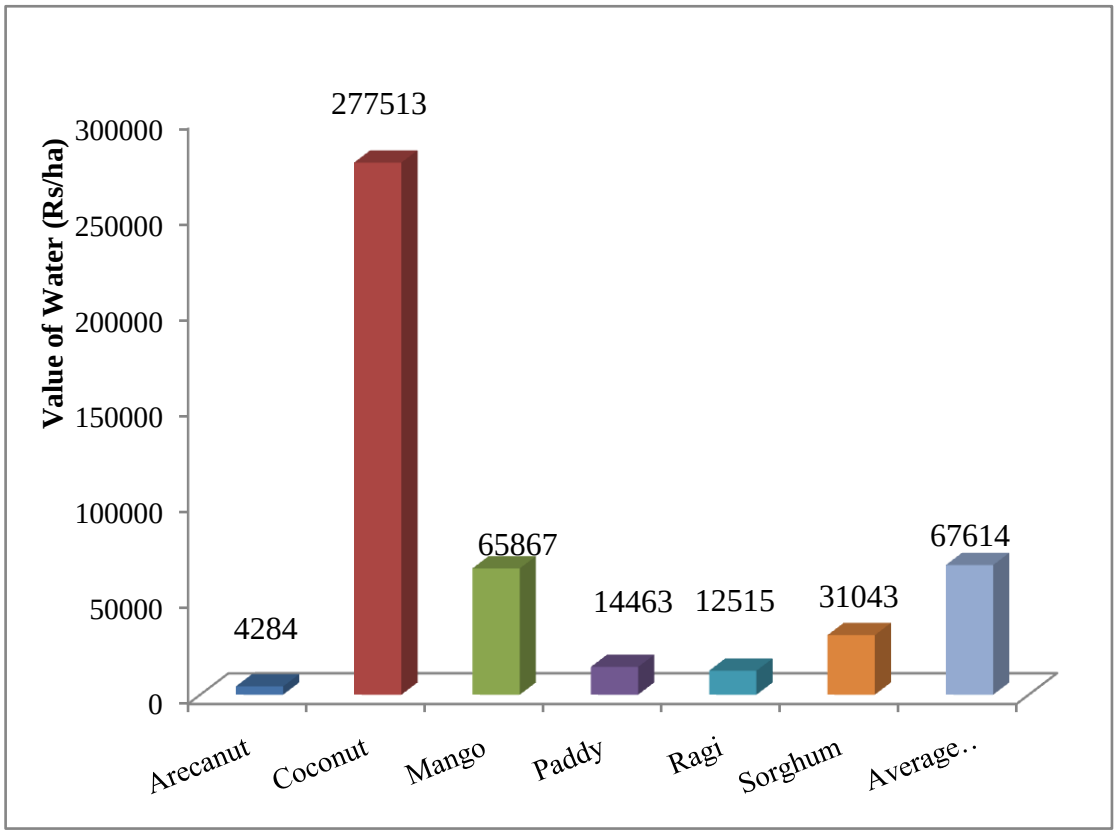


Figure 12: Ecosystem services of water supply in Maddenahalli Microwatershed

The main farming constraints in Maddenahalli micro-watershed to be found are less rainfall, and damage of crops by wild animals, Majority of farmers depend up on money lender of the sources of loan for purpose of crop production. Farmers to sell the agriculture produce through village market and the farmers getting the agriculture related information on newspaper and television. Farmers reported that they are not getting timely support/extension services from the concerned development department (Table 25).

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

Sl.No	Particulars	Per cent
1	Less Rainfall	100.0
2	Lack of good quality seeds	50.0
3	Lack of transportation	20.0
4	Lack of storage	50.0
5	Damage of crops by Wild Animals	80.0
6	Non availability of Plant Protection Chemicals	80.0
7	**Source of loan**	
	Money Leander	100.0
8	**Market for selling**	
	Village market	100.0
9	**Sources of Agri-Technology information**	
	Newspaper	20.0
	Television	80.0

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