हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

ICAR

Agri search with a *human touch*

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

BELHATTI-6 (4D4A3I1f) MICROWATERSHED

Shirhatti Taluk, Gadag 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.

TO OBTAIN COPIES,

Please write to:
Director, ICAR - NBSS & LUP,

Amaravati Road, NAGPUR - 440 033, India

Phone   :   (0712) 2500386, 2500664, 2500545 (O)

Telefax   :   0712-2522534

E-Mail   :   director@nbsslup.ernet.in

Website URL   :   nbsslup.in

Or

Head, Regional Centre, ICAR - NBSS&LUP, Hebbal, Bangalore - 560 024

Phone   :   (080) 23412242, 23510350 (O)

Telefax   :   080-23510350

E-Mail   :   nbssrcb@gmail.com

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

BELHATTI-6 (4D4A3I1f) MICROWATERSHED

Shirahatti Taluk, Gadag District, Karnataka

Karnataka Watershed Development Project – II

Sujala-III

World Bank funded Project

ICAR – NATIONAL BUREAU OF SOIL SURVEY AND LAND USE PLANNING

WATERSHED DEVELOPMENT DEPARTMENT, GOVT. OF KARNATAKA, BANGALORE

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 Belhatti-6 Microwatershed, Gadag Taluk and District, Karnataka" for integrated development was taken up in collaboration with the State Agricutural Universities, IISC, KSRSAC, KSNDMC as Consortia partners. The project provides detailed land resource information at cadastral level (1:7920 scale) for all the plots and socio-economic status of farm households covering thirty per cent farmers randomely selected representing landed and landless class of farmers in the micowatershed. The project report with the accompanying maps for the microwatershed will provide required detailed database for evolving effective land use plan, alternative land use options and conservation plans for the planners, administrators, agricutural extention personnel, KVK officials, developmental departments and other land users to manage the land resources in a sustainable manner.

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

Nagpur   **S.K. SINGH**

Date: `   Director, ICAR NBSS&LUP, Nagpur

Contributors

Dr. Rajendra Hegde	Dr. S.K.Singh
Principal Scientist, Head &	Director, ICAR-NBSS&LUP
Project Leader, Sujala-III Project	Coordinator, Sujala-III Project
ICAR-NBSS&LUP, Regional Centre,	Nagpur
Bangalore	
Soil Survey, Mapping & Report Preparation	
Dr. K.V. Niranjana	Sh. R.S. Reddy
Dr. B.A. Dhanorkar	Sh. Nagendra, B.R.
	Smt. Chaitra, S.P.
Field Work	
Sh. C.Bache Gowda	Sh. Sandesh Shastri
Sh. Somashekar	Sh. Rajeev, G.S.
Sh. Venkata Giriyappa	Sh. Balasubramanyam, M.G.
Sh. M. Jayaramaiah	Sh. Vijaya Kumar
Sh. Paramesha, K.	Sh. Mayur Patil
	Sh. Kamalesh K. Avate
GIS Work	
Dr. S.Srinivas	Sh. A.G.Devendra Prasad
Sh. D.H.Venkatesh	Sh. Prakashanaik, M.K.
Smt.K.Sujatha	Sh. Abhijith Sastry, N.S.
Smt. K.V.Archana	Sh. Nagendra Babu Kolukondu
Sh. N.Maddileti	Sh. Sudip Kumar Suklabaidya
	Sh. Avinash, K.N.
	Smt. K.Karunya Lakshmi
	Ms. Seema, K.V.
	Ms. A. Rajab Nisha
	Ms. Ramireddy Lakshmi Silpa
	Sh. Amar Suputhra, S
	Sh. Deepak, M.J.
	Ms. Bhanu Rekha, T.
	Ms.Rajata Bhat

Laboratory Analysis	
Dr. K.M.Nair	Smt. Savitha, H.R.
Smt. Arti Koyal	Smt. Steffi Peter
Smt. Parvathy, S.	Smt. Thara, V.R.
	Smt. Roopa, G.
	Ms. Shwetha, N.K.
	Smt. Ishrat Haji
	Ms. Pavana Kumari, P.
	Sh. Shanthaveeraswamy, H.M.
	Sh. Ramesh, K.
	Ms. Padmaja, S.
	Ms. Veena, M.
Socio-Economic Analysis	
Dr. S.C. Ramesh Kumar	Sh. M. K. Prakashanaik
	Ms. Sowmya K.B
	Sh.Manjunath M
	Sh.Veerabhadraswamy R
	Sh.Lankesh RS
	Sh.Kalaveerachari R Kammar
	Sh.Pradyumma U
	Sh.Yogesha HN
	Sh.Vijay kumar lamani
	Sh.Arun N Kambar
	Sh.Vinay
	Sh.Basavaraj.Biradar
	Sh.Vinod R
	Sh.Praveenkumar P Achalkar
	Sh.Rajendra D
Watershed Development Department, GoK, Bangalore	
Sh. Rajeev Ranjan IFS Project Director & Commissioner, WDD	Dr. A. Natarajan NRM Consultant, Sujala-III Project
Dr. S.D. Pathak IFS Executive Director & Chief Conservator of Forests, WDD	

PART-A

LAND RESOURCE INVENTORY

Contents

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

The land resource inventory of Belhatti-6 Microwatershed was conducted using village cadastral maps and IRS satellite imagery on 1:7920 scale. The false colour composites of IRS imagery were interpreted for physiography and these physiographic delineations were used as base for mapping soils. The soils were studied in several transects and a soil map was prepared with phases of soil series as mapping units. Random checks were made all over the area outside the transects to confirm and validate the soil map unit boundaries. The soil map shows the geographic distribution and extent, characteristics, classification and use potentials of the soils in the microwartershed.

The present study covers an area of 468 ha in Shirahatti taluk of Gadag district, Karnataka. The climate is semiarid and categorized as drought prone with an average annual rainfall of 633 mm of which about 363 mm is received during south –west monsoon, 165 mm during north-east and the remaining 105 mm during the rest of the year. An area of about 98 per cent is covered by soils, two per cent by rock lands, waterbodies, settlements and others. The salient findings from the land resource inventory are summarized briefly below.

❖ The soils belong to 13 soil series and 30 soil phases (management units) and 8 land management units.

❖ The length of crop growing period is about 150 days starting from the 3rd week of June to 1rd week of October.

❖ From the master soil map, several interpretative and thematic maps like land capability, soil depth, surface soil texture, soil gravelliness, available water capacity, soil slope and soil erosion were generated.

❖ Soil fertility status maps for macro and micronutrients were generated based on the surface soil samples collected at every 250 m grid interval.

❖ Land suitability for growing major agricultural and horticultural crops were assessed and maps showing the degree of suitability along with constraints were generated.

❖ About 98 per cent area is suitable for agriculture and <1 per cent is not suitable for agriculture but well suited for forestry, pasture, agroforestry, silvi-pasture, installation of wind mills and as habitat for wildlife.

❖ About 39 per cent of the soils are very deep (>150 cm) to deep (100 - 150 cm), 41 per cent are moderately shallow to shallow (25-75 cm) and about 18 per cent are moderately deep (75-100 cm) soils.

❖ About 78 per cent of the area has clayey soils at the surface and 20 per cent loamy soils.

❖ About 15 per cent of the area has non-gravelly soils, 47 per cent gravelly soils (15-35 % gravel) and 37 per cent very gravelly (35- 60% gravel) and extremely gravelly (60-80%) soils.

❖ About 22 per cent of the area has soils that are very high (>200mm/m) in available water capacity, 3 per cent medium (101-150 mm/m) and about 72 per cent low (51-100 mm/m) and very low (<50mm/m).

- *About 93 per cent of the area has nearly level (0-1%) to very gently sloping (1-3% slope) lands and 6 per cent is under gently sloping (3-5%) lands.*
- *An area of about 53 per cent has soils that are slight eroded (e1), 38 per cent moderately eroded (e2) and 7 per cent soils are severely eroded (e3).*
- *An area of about 38 per cent has soils that are moderately alkaline (pH 7.8 to 8.4) to slightly alkaline (pH 7.3 to 7.8), 51 per cent strongly to very strongly alkaline (pH 8.4 to >9.0) and 10 percent has soils that area neutral (pH 6.5-7.3).*
- *The Electrical Conductivity (EC) of the soils are dominantly <2 dsm^{-1}indicating that of the soils are non-saline.*
- *About 63 per cent of the soils are medium (0.5-0.75%) in organic carbon and 35 per cent of the soils are low in organic carbon.*
- *Major area of 76 per cent has soils that are low (<23 kg/ha) in available phosphorus, medium in 19 per cent area and high in 7 per cent area.*
- *About 71 per cent medium (145-337 kg/ha), 25 per cent high (>337 kg/ha) in available potassium and low in about 1 per cent area.*
- *Available sulphur is low (<10 ppm) in about 23 per cent area, medium (10-20 ppm) in about 23 per cent area and about 53 per cent area is high (>20 ppm).*
- *Available boron is low (0.5 ppm) in about 98 per cent area.*
- *Available iron is deficient in about 16 per cent area and sufficient in 82 per cent area.*
- *Available manganese and copper are sufficient in all the soils.*
- *Available zinc is sufficient (>0.6 ppm) in entire area of the microwatershed.*
- *The land suitability for 21 major crops grown in the microwatershed were assessed and the areas that are highly suitable (S1) and moderately suitable (S2) are given below. It is however to be noted that a given soil may be suitable for various crops but what specific crop to be grown may be decided by the farmer looking to his capacity to invest on various inputs, marketing infrastructure, price and finally the demand and supply position.*

Land suitability for various crops in the Microwatershed

Crop	Suitability Area in ha (%)		Crop	Suitability Area in ha (%)	
	Highly suitable (S1)	Moderately suitable (S2)		Highly suitable (S1)	Moderately suitable (S2)
Sorghum	46 (10)	246 (53)	Jackfruit	-	78 (17)
Maize	46 (10)	220 (47)	Jamun	-	183 (39)
Bengalgram	4 (<1)	428 (92)	Musambi	11 (2)	231 (49)
Groundnut	11 (2)	176 (38)	Lime	11 (2)	240 (51)
Sunflower	11 (2)	173 (37)	Cashew	11 (2)	236 (50)
Cotton	15 (3)	336 (72)	Custard Apple	46 (10)	327 (70)
Banana	11 (2)	301 (64)	Amla	46 (10)	266 (57)
Pomegranat	11 (2)	301 (64)	Tamarind	-	183 (39)

e						
Mango	*-*	*11 (2)*		*Marigold*	*42 (9)*	*272 (58)*
Sapota	*11 (2)*	*135(29)*		*Chrysanthemum*	*42 (9)*	*272 (58)*
Guava	*11 (2)*	*131 (28)*				

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

❖ *Maintaining soil-health is vital to crop production and conserve soil and land resource base for maintaining ecological balance and to mitigate climate change. For this, several ameliorative measures have been suggested to these problematic soils like saline/alkali, highly eroded, sandy soils etc.,*

❖ *Soil and water conservation treatment plan has been prepared that would help in identifying the sites to be treated and also the type of structures required.*

❖ *As part of the greening programme, several tree species have been suggested to be planted in marginal and submarginal lands and also in the hillocks, mounds and ridges.*

INTRODUCTION

Soil being a vital natural resource on whose proper use depends the life supporting systems of a country and the socioeconomic development of its people. Soils provide food, fodder, fibre and fuel for meeting the basic human and animal needs. With the ever increasing growth in human and animal population, the demand on soil for more food and fodder production is on the increase. The area available for agriculture is about 51 per cent of the total geographical area and more than 60 per cent of the people are still dependant on agriculture for their livelihood. However, the capacity of a soil to produce is limited and the limits to the production are set by its intrinsic characteristics, agro-climatic setting, and use and management. There is therefore, tremendous pressure on land and water resources, which is causing decline in soil-health and stagnation in productivity. The soils have been degrading at an estimated rate of one million hectares per year and ground water levels have been receding at an alarming rate resulting in decline in the ground water resource. Further, land degradation has emerged as a serious problem which has already affected about 38 lakh ha of cultivated area in the State. Soil erosion alone has degraded about 35 lakh ha. Almost all the uncultivated areas are facing various degrees of degradation, particularly soil erosion; salinity and alkalinity has emerged as a major problem (>3.5 lakh ha) in the irrigated areas of the State. Nutrient depletion and declining factor productivity is common in both rainfed and irrigated areas. The degradation is continuing at an alarming rate and there appears to be no systematic effort among the stakeholders to contain this process. In recent times, an aberration of weather due to climate change phenomenon has added another dimension leading to unpredictable situations to be tackled by the farmers.

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

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

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

The Land Resource Inventory is basically done for identifying potential and problem areas, developing sustainable land use plans, estimation of surface run off and water harvesting potential, preparation of soil and water conservation plans, land degradation/desertification etc. The Bureau is presently engaged in developing an LRI methodology using high resolution satellite remote sensing data and Digital Elevation Model (DEM) data to prepare Landscape Ecological Units (LEU) map representing agro-ecosystem as a whole. The LEU is preferred over landform as the base map for LRI. LEU is the assemblage of landform, slope and land use. An attempt has already been made to upscale the soil resource information from 1:250000 and 1:50000 scale to the LEU map in Goa and other states. Here, an attempt is being made to uplink the LRI data generated under Sujala-III Project to the Landscape Ecological Units (LEUs) map. For this, the major physiographic region*, i.e.*, South Deccan Plateau is taken as an example.

The land resource inventory aims to provide site specific database for Belhatti-6 microwatershed in Shirahatti Taluk, Gadag District, Karnataka State for the Karnataka Watershed Development Department. The database was generated by using cadastral map of the village as a base along with high resolution IRS LISS IV and Cartosat-1 merged satellite imagery. Later, an attempt will be made to uplink this LRI data generated at 1:7920 scale under Sujala-III Project to the proposed Landscape Ecological units (LEUs) map.

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

GEOGRAPHICAL SETTING

2.1 Location and Extent

The Belhatti-6 microwatershed (Belhatti subwatershed) is located in the central part of northern Karnataka in Shirahatti Taluk, Gadag District, Karnataka State (Fig.2.1). It comprises parts of Belhatti, Chikkasavanur and Konchigeri villages. It lies between $15^03'$ to $15^05'$ North latitudes and $75^036'$ to $75^039'$ East longitudes and covers an area of 468 ha. It is about 60 km south of Gadag and is surrounded by Devihal village on the north, Bijjur village in the south, Kurubgatta village on the east and Nilogal village on the west.

LOCATION MAP OF BELHATTI 6 MICRO-WATERSHED
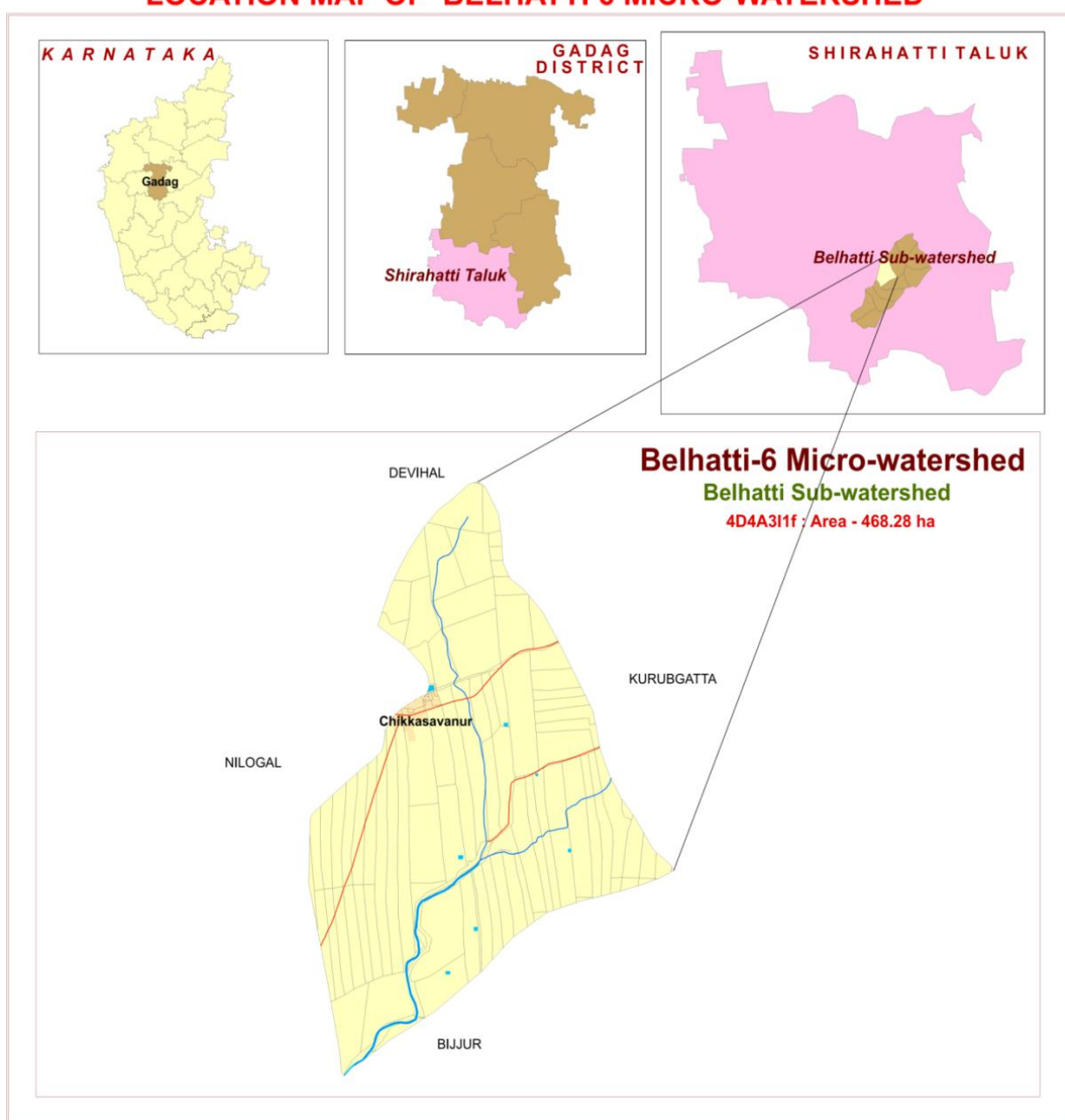
Fig.2.1 Location map of Belhatti-6 Microwatershed

2.2 Geology

Major rock formations observed in the microwatershed is Peninsular Gneiss (Fig.2.2) with thick coating of iron oxides. The granite gneiss consists primarily of quartz, feldspar, biotite and hornblende.

Fig.2.2 Granite gneiss

2.3 Physiography

Physiographically, the area has been identified as Granite gneiss landscape based on geology. The microwatershed area has been further divided into mounds/ridges, summits, side slopes and very gently sloping uplands. Based on slope and its relief features. The elevation ranges from 562 to 596 m in the gently sloping uplands. The mounds and ridges are mostly covered by rock outcrops.

2.4 Drainage

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

2.5 Climate

The district falls under semiarid tract of the state and is categorized as drought prone with average annual rainfall of 633 mm (Table 2.1). The north-east monsoon contributes about 165 mm and prevails from October to early December, maximum of 363 mm precipitation takes place during south–west monsoon period from June to September and the remaining 105 mm takes place during the rest of the year. The winter season is from December to February. During April and May, the temperatures reach up to 42°C and in December and January, the temperatures will go down to 16°C. Rainfall distribution is shown in Figure 2.3. The average Potential Evapotranspiration (PET) is 137 mm and varies from a low of 109 mm in December to 182 mm in the month of May. 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 at Shirahatti Taluk, Gadag District

Sl.No.	Months	Rainfall	PET	1/2 PET
1	January	0.80	122.20	61.10
2	February	1.50	131.40	65.70
3	March	15.20	172.00	86.00
4	April	30.10	178.80	89.40
5	May	57.60	182.00	91.00
6	June	87.10	146.20	73.10
7	July	79.90	130.80	65.40
8	August	87.80	130.80	65.40
9	September	108.70	123.20	61.60
10	October	121.00	113.10	56.55
11	November	36.00	112.70	56.35
12	December	7.80	108.70	54.35
TOTAL		633.50	137.65	
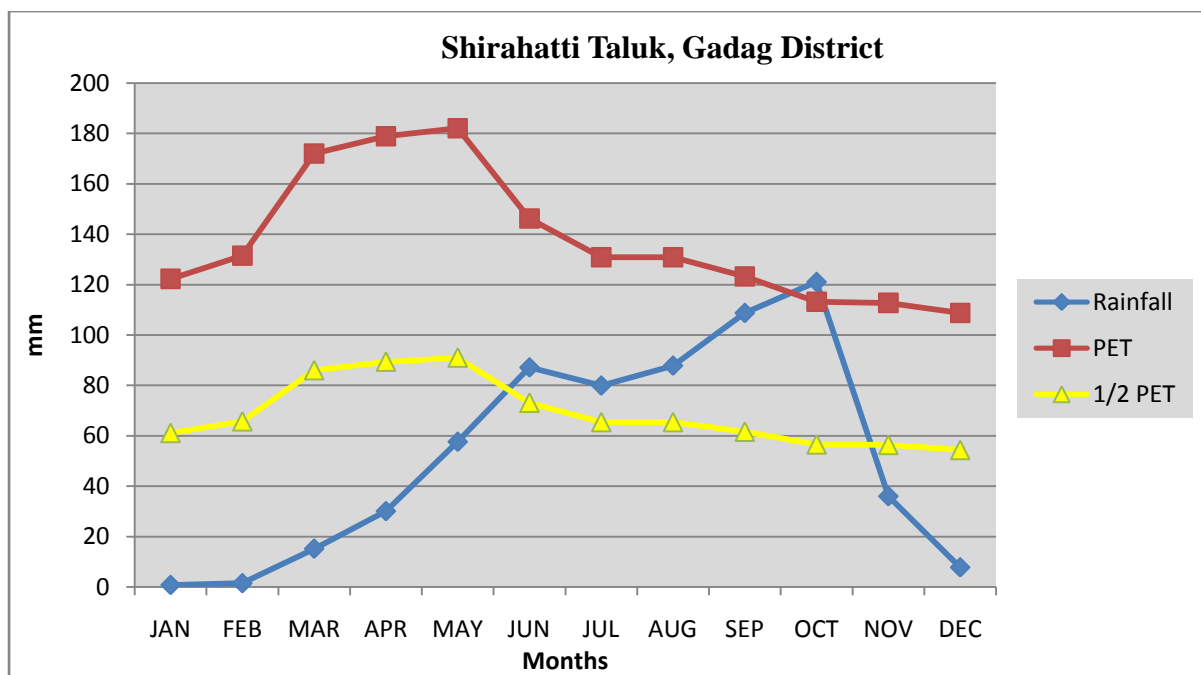
Fig. 2.3 Rainfall distribution in Shirahatti Taluk, Gadag District

2.6 Natural Vegetation

The natural vegetation is sparse comprising few tree species, shrubs and herbs. The mounds, ridges and bouldery areas 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 micowatershed is causing vegetative degradation of whatever little vegetation left in the area. The uncontrolled grazing has left no time for the regeneration of the vegetative cover. This leads to the accelerated rate of erosion on the hill slopes, resulting in the formation of deep gullies in the foot slopes and eventually resulting in the heavy siltation of few tanks and reservoirs in the microwatershed.

2.7 Land Utilization

About 77 per cent area (Table 2.2) in the Shirahatti taluk is cultivated at present and about 14 per cent of the area is sown more than once. An area of about 17 per cent is currently barren. Forests occupy a small area of about 1.6 per cent and the tree cover is in a very poor state. Most of the mounds, ridges and bouldery areas have very poor vegetative cover. Major crops grown in the area are sorghum, maize, cotton, safflower, sunflower, red gram, horse gram, onion, mulberry, sugarcane, bengal gram and groundnut. While carrying out land resource inventory, the land use/land cover particulars are collected from all the survey numbers and a current land use map of the microwatershed is prepared. The current land use map prepared shows the arable and non-arable lands, other land uses and different

types of crops grown in the area. The current land use map of Belhatti-6 microwatershed is presented in Fig.2.4.
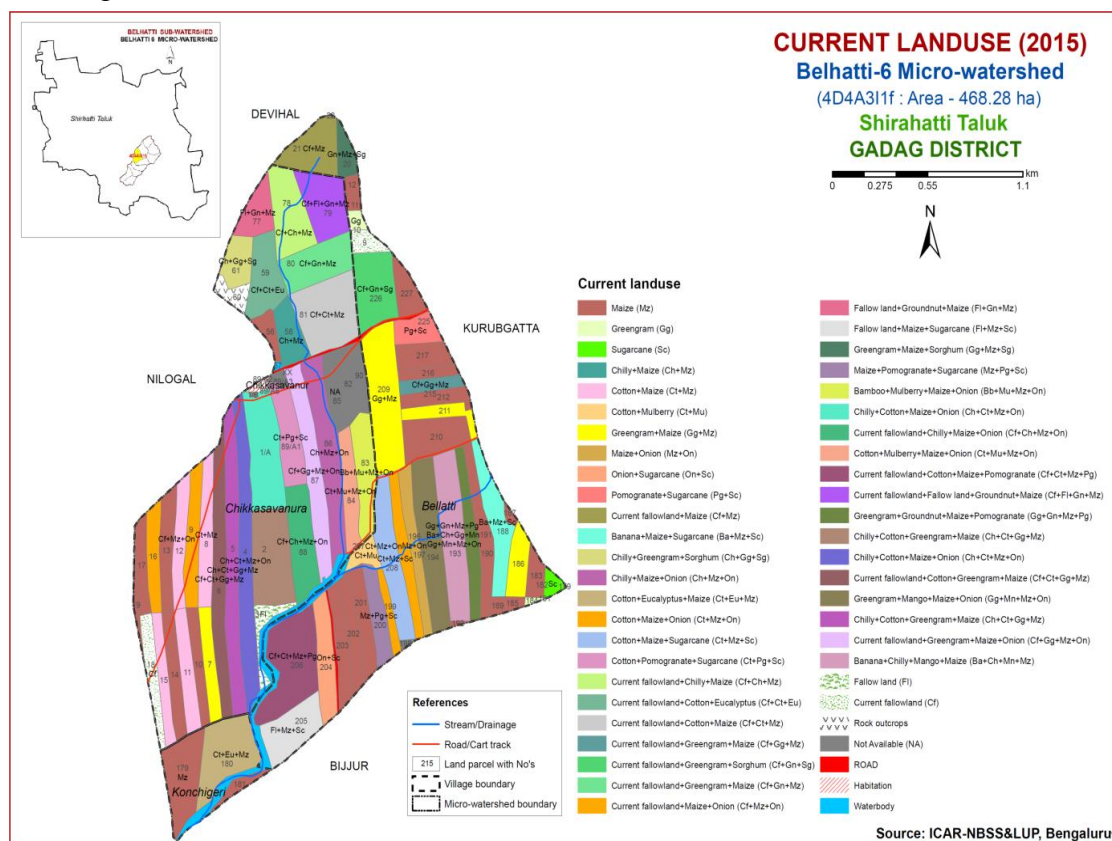
Fig.2.4 Current Land Use – Belhatti-6 Microwatershed

Simultaneously, enumeration of wells (bore wells and open wells) and other soil and water conservation structures in the microwatershed is made and their location in different survey numbers is located on the cadastral map. Map showing the location of wells, soil conservation structures and other water bodies in the Belhatti-6 microwatershed is given Fig.2.5.

Table 2.2 Land Utilization in Shirahatti Taluk

Sl.No.	Agricultural land use	Area (ha)	Per cent
1	Total cultivated area	85004	77.0
2	Cultivable wasteland	291	0.26
3	Pasture land	1054	1.0
4	Forest area	1749	1.6
5	Area sown more than once	15366	14.0
6	Current Barren	18302	16.7
7	Total geographical area	109751	
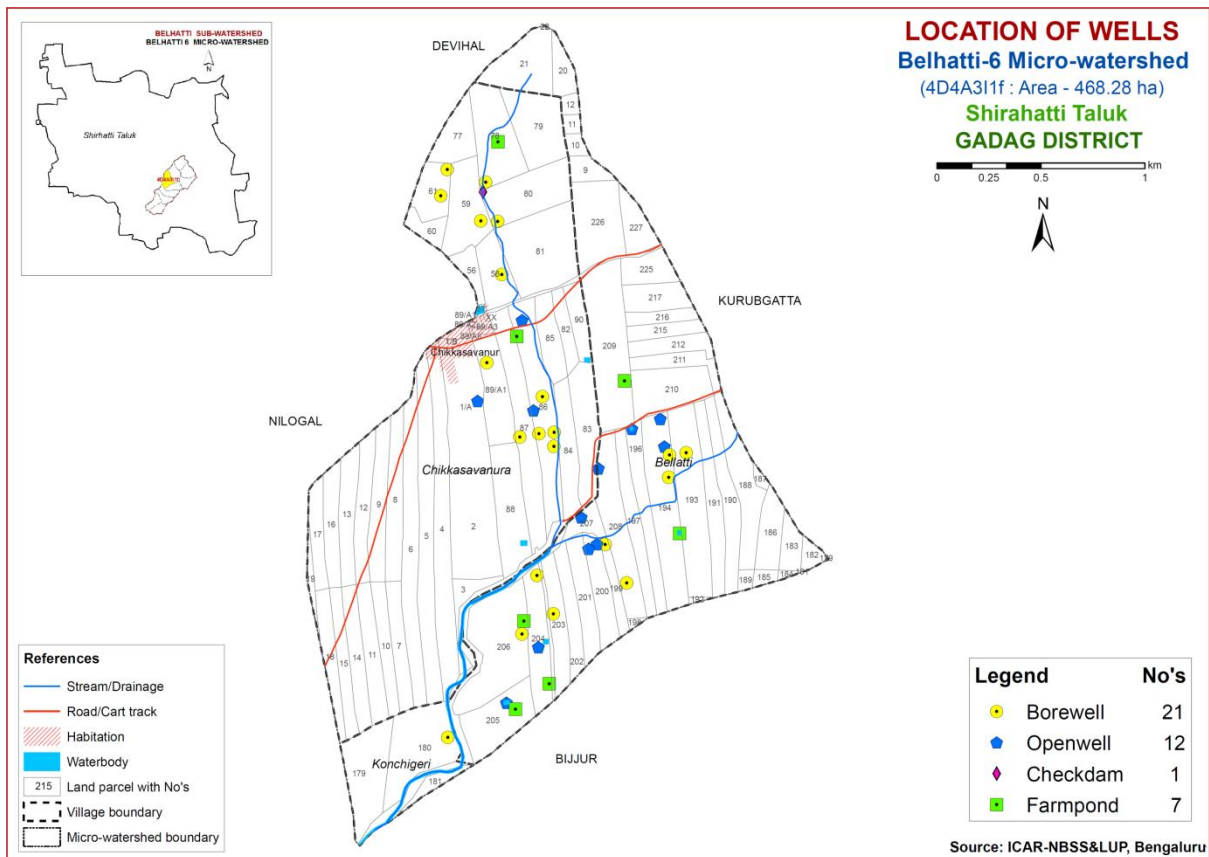
Fig.2.5 Location of Wells and conservation structures- Belhatti-6 Microwatershed

Sunflower

Pomegranate
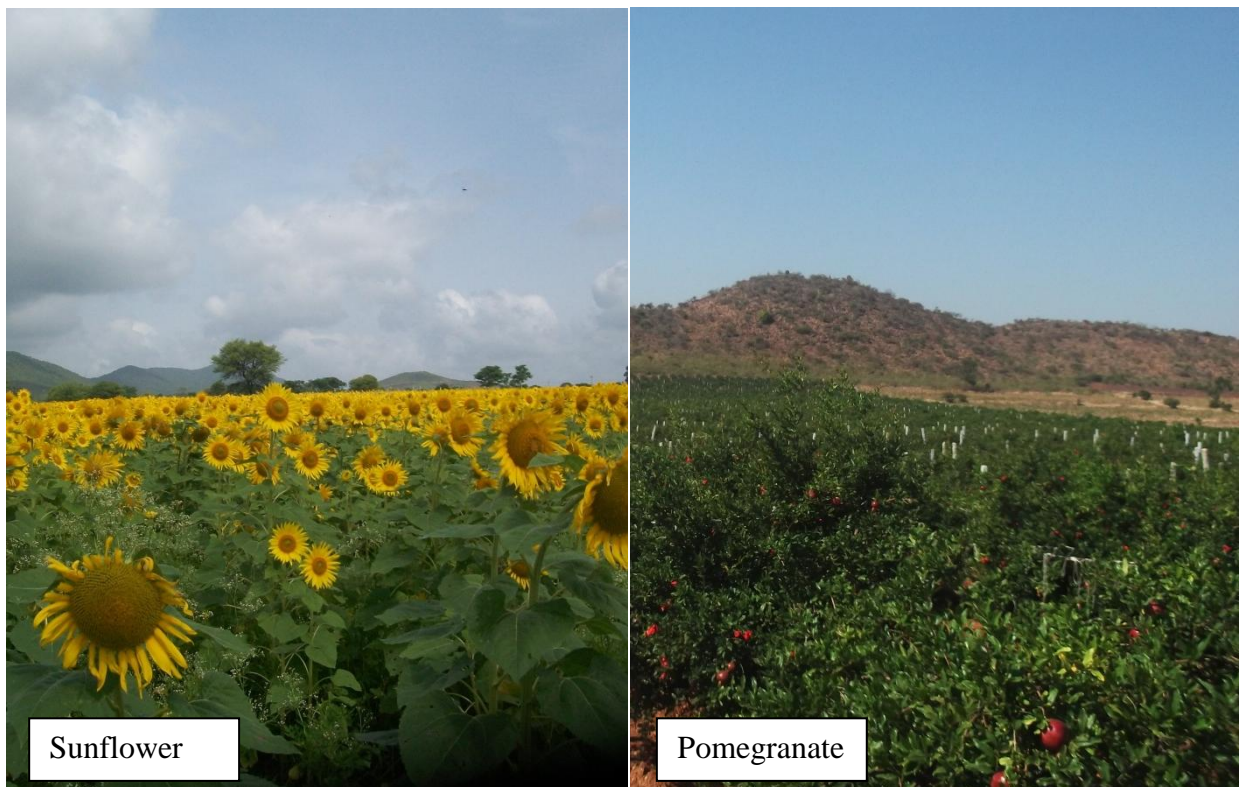
Different crops and cropping systems in Belhatti-6 Microwatershed

Sorghum

Cotton

Different crops and cropping systems in Belhatti-6 Microwatershed

SURVEY METHODOLOGY

The purpose of land resource inventory is to delineate similar areas (soil series and phases), which respond or expected to respond similarly to a given level of management. This was achieved in Belhatti-6 microwatershed by the detailed study of all the soil characteristics (depth, texture, colour, structure, consistence, coarse fragments, porosity, soil reaction, soil horizons etc.) and site (slope of the land, erosion, drainage, occurrence of rock fragments etc.) and followed by grouping of similar areas based on soil-site characteristics into homogeneous (management units) units and showing their extent and geographic distribution on the microwatershed cadastral map. The detailed survey at 1:7920 scale was carried out in 468 ha area. The methodology followed for carrying out land resource inventory was as per the guidelines given in Soil Survey Manual (IARI, 1971; Soil Survey Staff, 2006; Natarajan *et al.,* 2015) which is briefly described below.

3.1 Base Maps

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

3.2 Image Interpretation for Physiography

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

Image Interpretation Legend for Physiography

G- Granite gneiss landscape

G1		Hills/ Ridges/ Mounds
	G11	Summits
	G12	Side slopes
	G121	Side slopes with dark grey tones
G2		Uplands
	G21	Summits
	G22	Gently sloping uplands
	G221	Gently sloping uplands, yellowish green (eroded)
	G222	Gently sloping uplands, yellowish white (severely eroded)
	G23	Very gently sloping uplands
	G231	Very gently sloping uplands, yellowish green
	G232	Very gently sloping uplands, medium green and pink
	G233	Very gently sloping uplands, pink and green (scrub land)
	G234	Very gently sloping uplands, medium greenish grey
	G235	Very gently sloping uplands, yellowish white (eroded)
	G236	Very gently sloping uplands, dark green
	G237	Very gently sloping uplands, medium pink (coconut garden)
	G238	Very gently sloping uplands, pink and bluish white (eroded)
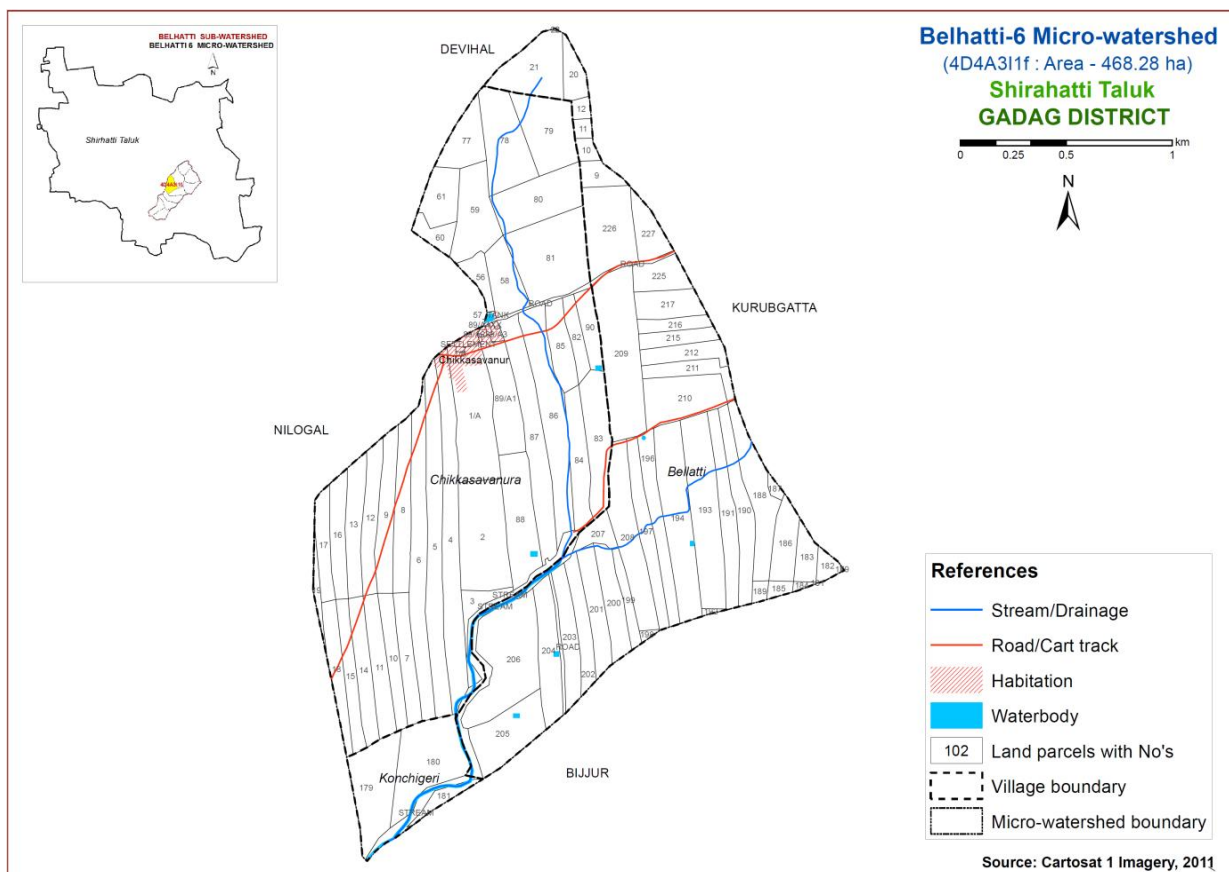
Fig 3.1 Scanned and Digitized Cadastral map of Belhatti-6 microwatershed
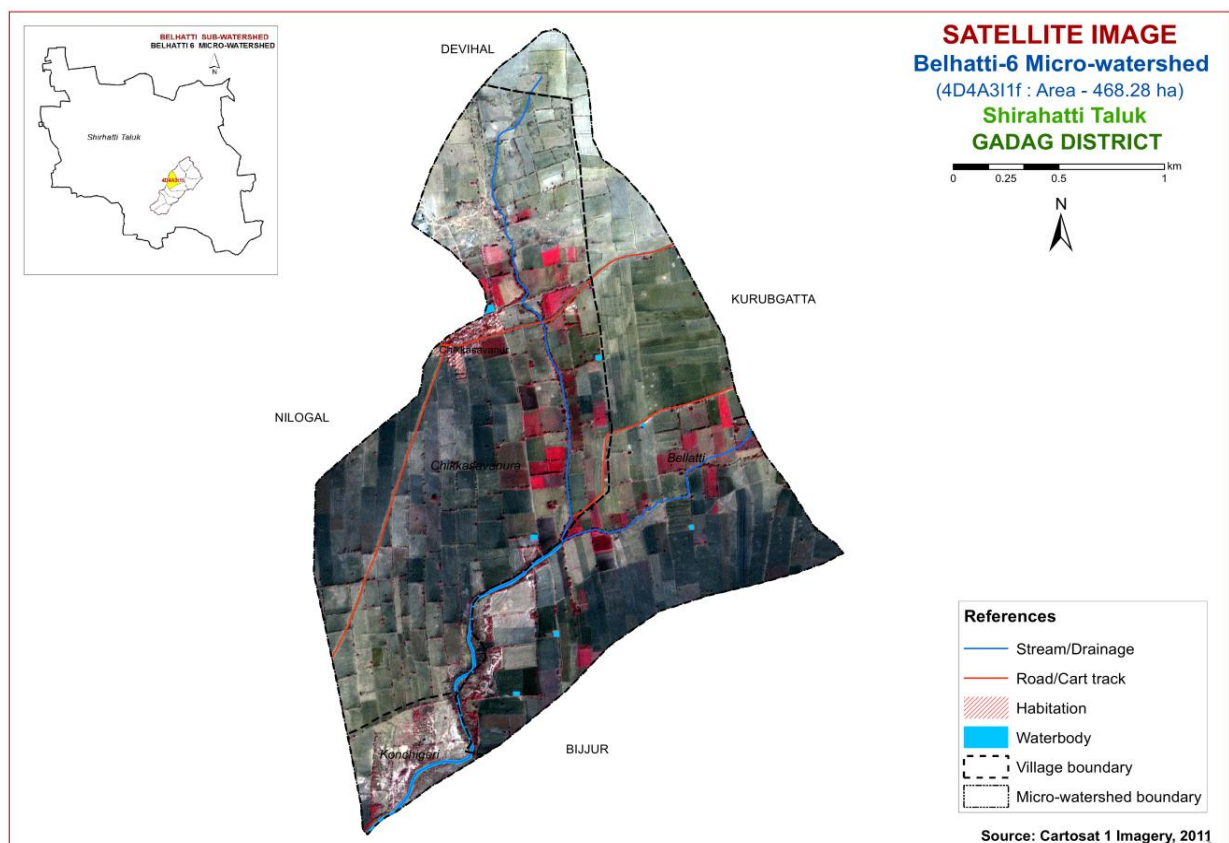
Fig.3.2 Satellite Image of Belhatti-6 microwatershed

13
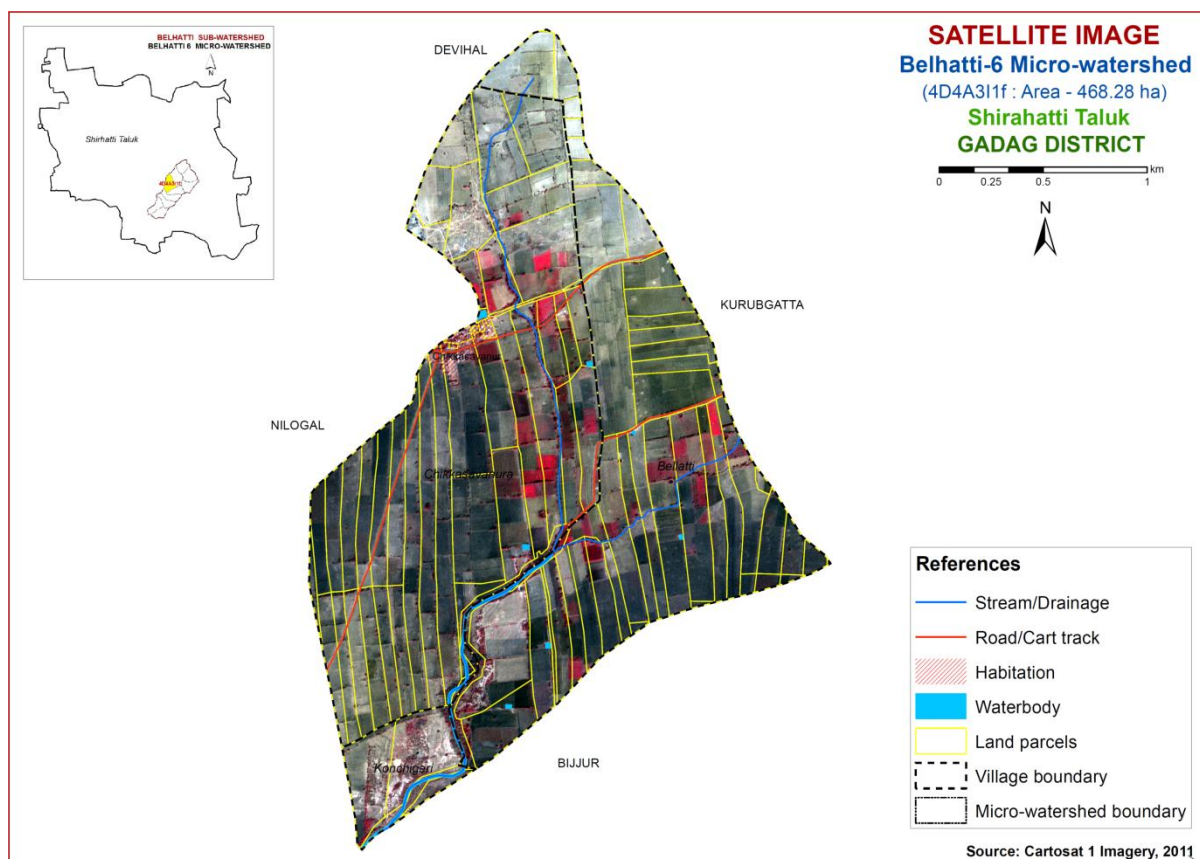
Fig.3.3 Cadastral map overlaid on IRS PAN+LISS IV merged imagery of Belhatti-6 Microwatershed

3.3 Field Investigation

The field boundaries and survey numbers given on the cadastral sheet were located on the ground by following permanent features like roads, cart tracks, nallas, streams, tanks etc., and wherever changes were noticed, they were incorporated on the microwatershed cadastral map.

Preliminary traverse of the microwatershed was carried out with the help of cadastral map, imagery and toposheets. While traversing, landforms and physiographic units identified were checked and preliminary soil legend was prepared by studying soils at few selected places.

Then, intensive traversing of each physiographic unit like hills, ridges and uplands was carried out. Based on the variability observed on the surface, transects were selected across the slope covering all the landform units in the microwatershed (Natarajan and Dipak Sarkar, 2010).

In the selected transect, soil profiles 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

14

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, 13 soil series were identified in the Belhatti-6 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	Texture	Gravel (%)	Horizon sequence	Calcareo-usness
1.	Kanchanahalli (Knh)	25-50	2.5YR3/4	sc	<15	Ap—Bt-Cr	
2.	Harve (Hrv)	25-50	2.5YR3/6 5YR4/4	scl	>35	Ap-Bt-Cr-	
3.	Muttal (Mtl)	25-50	10YR3/2,3/3,4/2 7.5YR3/2,3/3,6/4	sc-c	15-35	Ap-Bw-Ck	e-ev
4.	Lakkur (Lkr)	50-75	2.5YR3/4, 3/6	scl-sc	40-60	Ap-Bt-Bc-Cr	
5.	Kutegoudanahundi (Kgh)	50-75	7.5YR3/2	scl	15-35	Ap-Bt-Cr	
6.	Ravanaki (Rnk)	50-75	7.5YR3/2,3/3,5/2,5/3 10YR3/1,3/2,4/1,4/2, 5/1,6/1	sc-c	15-35	Ap-Bw-Cr	e-ev
7.	Gollarahatti (Ght)	75-100	2.5YR3/4,4/6	scl	15-35	Ap-Bt-Cr	
8.	Kanchikere (Kkr)	75-100	10YR3/3,4/2,5/2 7.5YR3/1,3/2,5/2	cl-sc	-	Ap-Bw-BC-Cr	
9.	Chikkamegheri (Ckm)	75-100	2.5YR2.5/3,3/4, 3/6	sc	-	Ap-Bt-Cr	
10.	Balapur (Bpr)	100-150	2.5YR2.5/4,3/4	sc-c	>35	Ap-Bt-Cr	
11.	Vaddarahalli (Vdh)	100-150	7.5YR3/2,3/3,3/4	sc-c	-	Ap-Bt-Cr	
12.	Lakshmangudda (Lgd)	100-150	10YR3/1,3/2,4/1, 4/2,7.5YR3/1,3/2, 5/1,2.5Y5/2,5/3,6/3	sc-c	<15	Ap-Bss-Ck	e-es
13.	Budagumpa (Bgp)	.>150	7.5YR3/2,5/1 10YR4/1,4/4	c	10-20	Ap-Bw	es

3.4 Laboratory Characterization

Soil samples were collected from representative master profiles for laboratory characterization by following the methods outlined in the Laboratory Manual (Sarma *et al*, 1987). Surface soil samples collected from farmer's fields (75 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 for the microwatershed.

3.5 Finalization of Soil Map

The area under each soil series was further separated into soil phases and their boundaries delineated on the cadastral map based on the variations observed in the texture of the surface soil, slope, erosion, presence of gravel, stoniness etc. A soil phase is a subdivision of soil series based mostly on surface features that affect its use and management.

The soil mapping units are shown on the map (Fig.3.4) in the form of symbols. During the survey about 14 profile pits, few minipits and a few auger bores representing different landforms occurring in the microwatershed were studied. All the profile locations are indicated on the village cadastral map in the form of a triangle. 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 30 mapping units representing 13 soil series occurring in the microwatershed. The soil map unit (soil legend) description is presented in Table 3.2.

The soil phase map (management units) shows the distribution of 30 phases mapped in the microwatershed. Each mapping unit (soil phase) delineated on the map has similar soil and site characteristics. In other words, all the farms or survey numbers included in one phase will have similar management needs and they have to be treated accordingly.

The 30 soil phases identified and mapped in the microwatershed were regrouped into 8 Land Management Units (LMU's) for the purpose of preparing a proposed land use plan for sustained development of the microwatershed. The database (soil phases) generated under LRI was utilized for identifying Land Management Units (LMUs) based on the management needs. One or more than one soil site characteristic having influence on the management have been choosen for identification and delineation of LMUs. For Belhatti-6 microwatershed, five soil and site characteristics, namely soil depth, soil texture, slope, erosion and gravel content have been considered for defining LMUs. The land management units are expected to behave similarly for a given level of management.
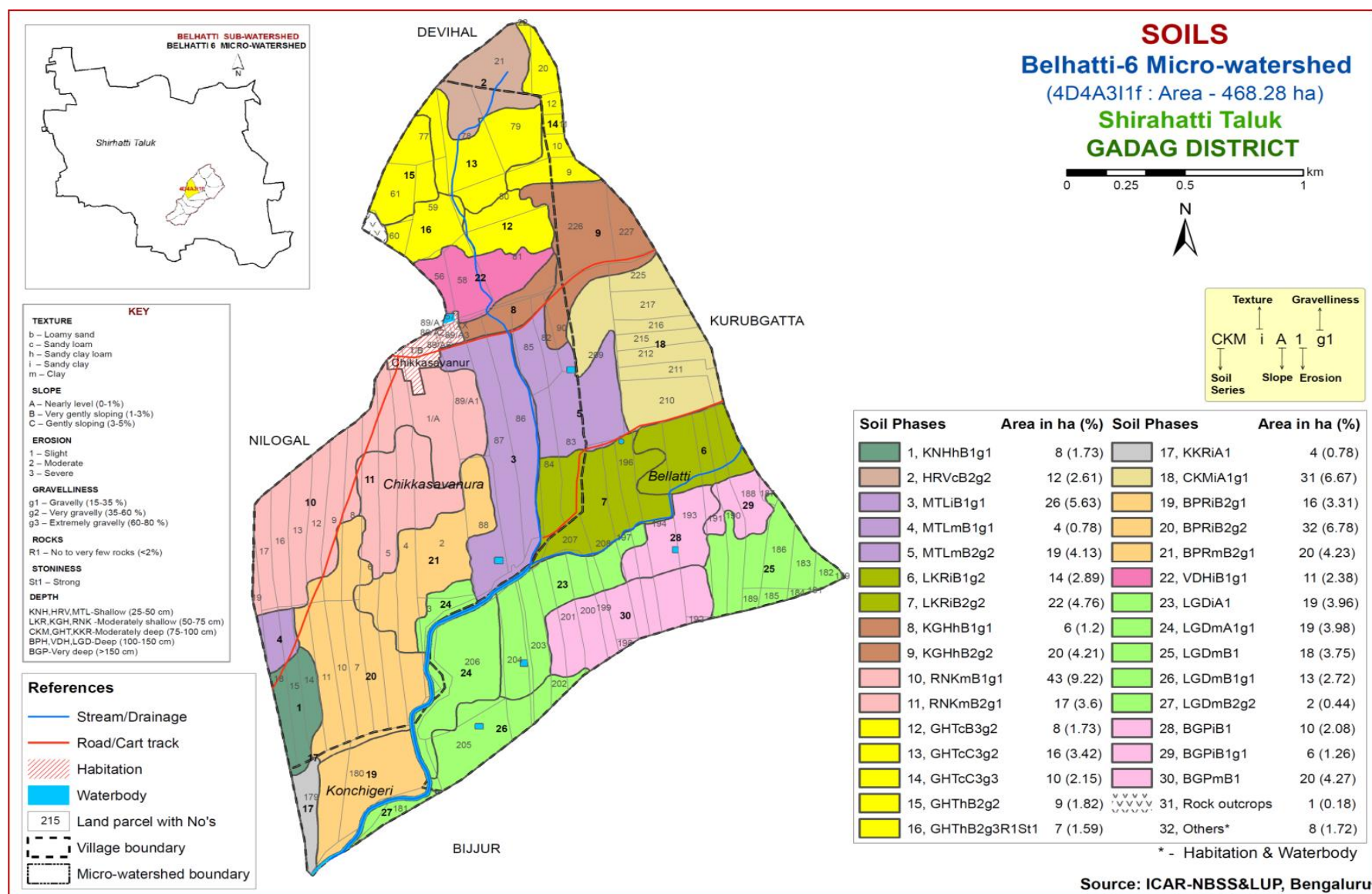
Fig 3.4 Soil Phase or Management Units- Belhatti-6 microwatershed

17

Table 3.2 Soil map unit description of Belhatt-6 Microwatershed

Soil No	Soil Series	Soil Phases	Mapping Unit Description	Area in ha (%)
			SOILS OF GRANITE GNEISS LANDSCAPE	
	KNH		Kanchanahalli soils are shallow (25-50 cm), well drained, have dark reddish brown sandy clay soils occurring on very gently sloping uplands under cultivation	**8.10 (1.73)**
1		KNHhB1g1	Sandy clay loam surface, slope 1-3 %, slight erosion, gravelly (15-35 %)	8.10 (1.73)
	HRV		Harve soils are shallow (25-50 cm), well drained, have reddish brown to dark red sandy clay loam soils occurring on very gently sloping uplands under cultivation	**12.24 (2.61)**
2		HRVcB2g2	Sandy loam surface, slope 1-3%, moderate erosion, very gravelly (35-60 %)	12.24 (2.61)
	MTL		Muttal soils are shallow (25 - 50 cm), well drained, have dark brown to very dark grayish brown calcareous sandy clay to clay soils occurring on very gently sloping uplands under cultivation	**49.34 (10.52)**
3		MTLiB1g1	Sandy clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)	26.35 (5.62)
4		MTLmB1g1	Clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)	3.63 (0.77)
5		MTLmB2g2	Clay surface, slope 1-3 %, moderate erosion, very gravelly (35-60 %)	19.36 (4.13)
	LKR		Lakkur soils are moderately shallow (50-75 cm), well drained, have reddish brown to dark red gravelly sandy clay loam to sandy clay red soils occurring on very gently sloping uplands under cultivation	**35.75 (7.65)**
6		LKRiB1g2	Sandy clay surface, slope 1-3 %, slight erosion, very gravelly (35-60%)	13.55 (2.89)
7		LKRiB2g2	Sandy clay surface, slope 1-3 %, moderate erosion, very gravelly (35-60%)	22.29 (4.76)
	KGH		Kutegoudanahundi soils are moderately shallow (50 - 75 cm), well drained, have brown to dark brown sandy clay loam soils occurring on very gently sloping uplands under cultivation	**25.33 (4.4)**
8		KGHhB1g1	Sandy clay loam surface, slope 1-3 %, slight erosion, gravelly (15-35 %)	5.63 (1.20)
9		KGHhB2g2	Sandy clay loam surface, slope 1-3 %, moderate erosion, very gravelly (35-60 %)	19.70 (4.20)

	RNK		Ravanaki soils are moderately shallow (50-75 cm), well drained, black calcareous sandy clay to clay soils occurring on very gently sloping uplands under cultivation	**60.04 (12.81)**
10		RNKmB1g1	Clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)	43.17 (9.21)
11		RNKmB2g1	Clay surface, slope 1-3 %, moderate erosion, gravelly (15-35 %)	16.87 (3.60)
	GHT		Gollarahatti soils are moderately deep (75-100 cm), well drained, have dark reddish brown to dark red sandy clay loam to clay soils occurring on very gently to gently sloping uplands under cultivation	**50.14 (10.68)**
12		GHTcB3g2	Sandy loam surface, slope 1-3%, severe erosion, very gravelly (35-60 %)	8.12 (1.73)
13		GHTcC3g2	Sandy loam surface, slope 3-5%, severe erosion, very gravelly (35-60 %)	16.00 (3.41)
14		GHTcC3g3	Sandy loam surface, slope 3-5%, severe erosion, extremely gravelly (60-80 %)	10.05 (2.14)
15		GHThB2g2	Sandy clay loam surface, slope 1-3 %, moderate erosion, very gravelly (35-60 %)	8.53 (1.82)
16		GHThB2g3R1St1	Sandy clay loam surface, slope 1-3 %, moderate erosion, extremely gravelly (60-80 %), few to fairly rocky (<2-10%), stony (0.01-0.1%)	7.44 (1.58)
	KKR		Kanchikere soils are moderately deep (75-100 cm), well drained, have dark brown to very dark brown clay loam to sandy clay soils occurring on nearly level uplands under cultivation	**3.65 (0.78)**
17		KKRiA1	Sandy clay surface, slope 0-1 %, slight erosion	3.65 (0.78)
	CKM		Chikkamegheri soils are moderately deep (75-100 cm), well drained, have dark brown to dark reddish brown sandy clay soils occurring on nearly level uplands under cultivation	**31.22 (6.66)**
18		CKMiA1g1	Sandy clay surface, slope 0-1 %, slight erosion, gravelly (15-35%)	31.22 (6.66)
	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 to gently sloping uplands under cultivation	**67.1 (14.32)**
19		BPRiB2g1	Sandy clay surface, slope 1-3 %, moderate erosion, gravelly (15-35 %)	15.51 (3.31)
20		BPRiB2g2	Sandy clay surface, slope 1-3 %, moderate erosion, very gravelly (35-60 %)	31.76 (6.78)

21		BPRmB2g1	Clay surface, slope 1-3 %, moderate erosion, gravelly (15-35 %)	19.83 (4.23)
	VDH		Vaddarahalli soils are deep (100 - 150 cm), well drained, have dark reddish brown to dark brown clayey soils occurring on very gently sloping uplands under cultivation	**11.14 (2.37)**
22		VDHiB1g1	Sandy clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)	11.14 (2.37)
	LGD		Lakshmangudda soils are deep (100 - 150 cm), well drained, have light olive brown to very dark gray calcareous clay soils occurring on nearly level to very gently sloping uplands under cultivation	**69.60 (14.84)**
23		LGDiA1	Sandy clay surface, slope 0-1 %, slight erosion	18.56 (3.96)
24		LGDmA1g1	Clay surface, slope 0-1 %, slight erosion, gravelly (15-35 %)	18.66 (3.98)
25		LGDmB1	Clay surface, slope 1-3 %, slight erosion	17.58 (3.75)
26		LGDmB1g1	Clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)	12.73 (2.71)
27		LGDmB2g2	Clay surface, slope 1-3 %, moderate erosion, very gravelly (35-60 %)	2.07 (0.44)
	BGP		Budagumpa soils are very deep (>150 cm), well drained, black calcareous gravelly clay soils occurring on nearly level to very gently sloping uplands under cultivation	**35.63 (7.60)**
28		BGPiB1	Sandy clay surface, slope 1-3 %, slight erosion	9.75 (2.08)
29		BGPiB1g1	Sandy clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)	5.88 (1.25)
30		BGPmB1	Clay surface, slope 1-3 %, slight erosion	20.00 (4.27)
MISCELLANEOUS LANDS				
31		Rock outcrops		0.84 (0.18)
32		Habitation		4.44 (0.94)
33		Waterbody		3.60 (0.76)

THE SOILS

Detailed information pertaining to the nature, extent and distribution of different kinds of soils occurring in Belhatti-6 Microwatershed is provided in this chapter. The microwatershed area has been identified as Granite gneiss landscape based on geology. In all, 13 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 granite gneiss landscape, soil formation is dominantly influenced by the parent material, climate and relief.

A brief description of each of the 13 soil series identified followed by 30 soil phases (management units) mapped under each series (Fig. 3.4) are furnished below. The soils in any one map unit differ from place to place in their depth, texture, slope, gravelliness, erosion or any other site characteristics that affect management. The soil phase map can be used for identifying the suitability of areas for growing specific crops or for other alternative uses and also for deciding the type of conservation structures needed. The detailed information on soil and site-characteristics like soil depth, surface soil texture, slope, erosion, gravelliness, AWC, LCC etc, with respect to each of the soil phase identified is given village/survey number wise for the microwatershed in Appendix-I.

4.1 Soils of Granite gneiss Landscape

In this landscape, 13 soil series are identified and mapped. Of these, Lakshmangudda (LGD) soil series occupies maximum area of about 70 ha (15%) followed by Balapur (BPR) 67 ha (14%) area. The brief description of each soil series and their phases identified in the microwatershed are given below.

4.1.1 Kanchanahalli (KNH) Series: Kanchanahalli soils are shallow (25 -50 cm), well drained, have dark reddish brown sandy clay soils. They have developed from granite gneiss and occur on very gently sloping uplands.

The thickness of the solum ranges from 28 to 48 cm. The thickness of A horizon ranges from 12 to 18 cm. Its colour is in 5YR and 2.5 YR hue with value 3 and chroma 4 to 6. The texture varies from sandy clay loam to sandy clay with 10 to 15 per cent gravel. The thickness of B horizon ranges from 16 to 38 cm. Its colour is in 2.5 YR hue with value 3 to 4 and chroma 4 to 6. Its texture is sandy clay with gravel content of < 15 per cent. The available water capacity is low (50-100 mm/m).

Only one phase was identified:

KNHhB1g1	Sandy clay loam surface, slope 1-3 %, slight erosion, gravelly (15-35 %)

Landscape and Soil Profile Characteristics of Kanchanahalli (KNH) Series

4.1.2 Harve (HRV) Series: Harve soils are shallow (25-50 cm), well drained, have reddish brown to dark red sandy clay loam soils. They have developed from granite gneiss and occur on very gently to moderately sloping uplands.

The thickness of the solum ranges from 28 to 48 cm. The thickness of A horizon ranges from 12 to 17 cm. Its colour is in 5YR and 2.5 YR hue with value 3 to 4 and chroma 4 to 6. The texture varies from loamy sand to sandy loam with 20 to 60 per cent gravel. The thickness of B horizon ranges from 16 to 32 cm. Its colour is in 2.5 YR and 5 YR hue with value 3 to 4 and chroma 4 to 6. Its texture is sandy clay loam with gravel content of 35 to 50 per cent. The available water capacity is very low (<50mm/m).

Only one phase was identified:

| HRVcB2g2 | Sandy loam surface, slope 1-3%, moderate erosion, very gravelly (35-60 %) |

Landscape and Soil Profile Characteristics of Harve (HRV) Series

4.1.3 Muttal (MTL) Series: Muttal soils are shallow (25-50 cm), well drained, have dark brown to very dark grayish brown, calcareous sandy clay to clay soils. They have developed from granite gneiss and occur on nearly level to very gently sloping uplands.

The thickness of the solum ranges from 30 to 50 cm. The thickness of A horizon ranges from 15 to 18 cm. Its colour is in 7.5 YR and 10 YR hue with value 2 to 3 and chroma 2.5 to 4. The texture varies from sandy clay to clay with 10 to 15 per cent gravel. The thickness of B horizon ranges from 18 to 32 cm. Its colour is in 10 YR and 7.5 YR hue with value 2 to 6 and chroma 2 to 4. Its texture is sandy clay to clay with gravel content of 15 to 35 per cent. The available water capacity is very low (<50 mm/m).

Three phases were identified:

MTLiB1g1	Sandy clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)
MTLmB1g1	Clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)
MTLmB2g2	Clay surface, slope 1-3 %, moderate erosion, very gravelly (35-60 %)
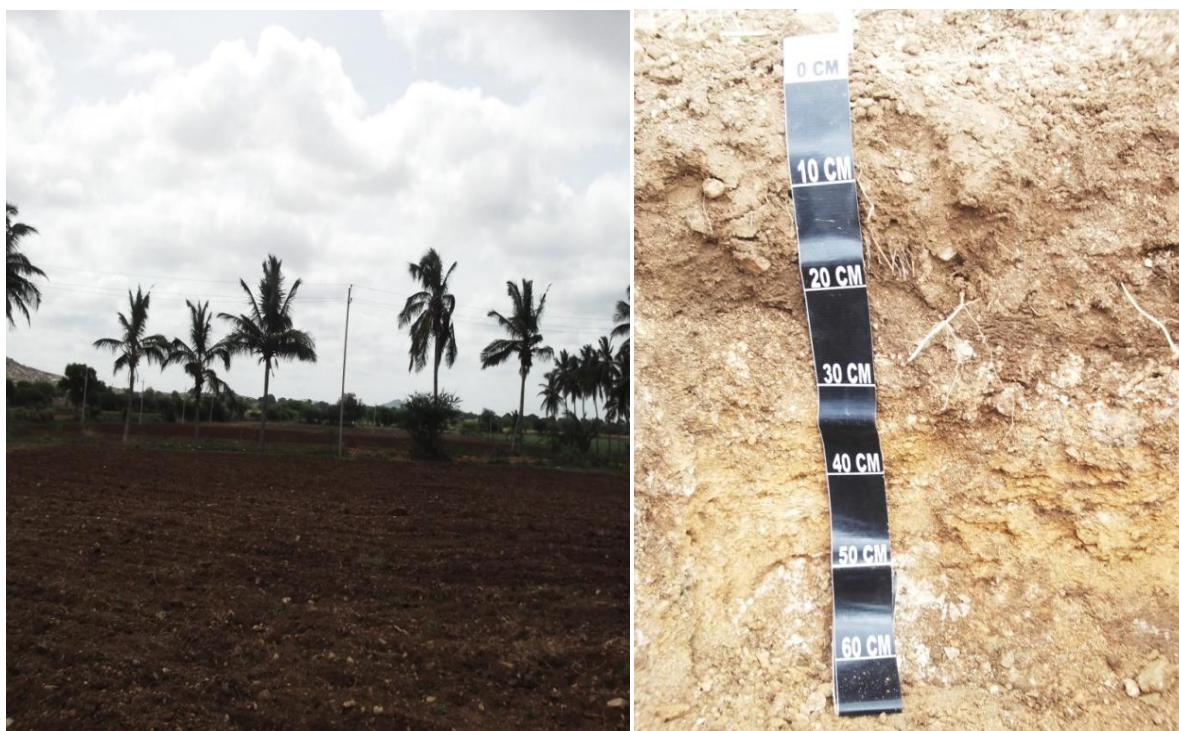
Landscape and Soil Profile Characteristics of Muttal (MTL) Series

4.1.4 Lakkur (LKR) Series: Lakkur soils are moderately shallow (50-75 cm), well drained, have reddish brown to dark red gravelly sandy clay loam to sandy clay red soils. They have developed from granite gneiss and occur on nearly level to very gently and gently sloping uplands.

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

Two phases were identified:

LKRiB1g2	Sandy clay surface, slope 1-3 %, slight erosion, very gravelly (35-60%)
LKRiB2g2	Sandy clay surface, slope 1-3 %, moderate erosion, very gravelly (35-60%)

Landscape and Soil Profile Characteristics of Lakkur (LKR) Series

4.1.5 Kutegoudanahundi (KGH) Series: Kutegoudanahundi soils are moderatly shallow (50-75 cm), well drained, have brown to dark brown sandy clay loam soils. They have developed from granite gneiss and occur on very gently to gently sloping uplands.

The thickness of the solum ranges from 50 to 74 cm. The thickness of A horizon ranges from 12 to 22 cm. Its colour is in 7.5 YR and 10 YR hue with value and chroma 3 to 4. The texture varies from loamy sand to sandy loam and sandy clay loam with 15 to 30 per cent gravel. The thickness of B horizon ranges from 40 to 62 cm. Its colour is in 7.5 YR hue with value and chroma 3 to 4. Its texture is sandy clay loam with gravel content of 15 to 35 per cent. The available water capacity is medium (100-150 mm/m).

Two phases were identified:

| KGHhB1g1 | Sandy clay loam surface, slope 1-3 %, slight erosion, gravelly (15-35 %) |
| KGHhB2g2 | Sandy clay loam surface, slope 1-3 %, moderate erosion, very gravelly (35-60 %) |

Landscape and Soil Profile Characteristics of Kutegoudanahundi (KGH) Series

4.1.6 Ravanaki (RNK) Series: Ravanaki soils are moderately shallow (50-75 cm), well drained, have dark brown to very dark grayish brown, calcareous sandy clay to clay soils. They have developed from granite gneiss and occur on nearly level to very gently sloping uplands.

The thickness of the solum ranges from 55 to 75 cm. The thickness of A horizon ranges from 15 to 20 cm. Its colour is in 7.5 YR and 10 YR hue with value 2 to 3 and chroma 2.5 to 4. The texture varies from sandy clay to clay with 10 to 15 per cent gravel. The thickness of B horizon ranges from 35 to 60 cm. Its colour is in 10 YR and 7.5 YR hue with value 2 to 6 and chroma 2 to 4. Its texture is sandy clay to clay with gravel content of 15 to 35 per cent. The available water capacity is low (51-100 mm/m).

Two phases were identified:

| RNKmB1g1 | Clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %) |
| RNKmB2g1 | Clay surface, slope 1-3 %, moderate erosion, gravelly (15-35 %) |

Landscape and Soil Profile Characteristics of Ravanaki (RNK) Series

4.1.7 Gollarahatti (GHT) Series: Gollarahatti soils are moderately deep (75-100 cm), well drained, have dark reddish brown to dark red sandy clay loam 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 78 to 98 cm. The thickness of A horizon ranges from   12 to 18cm. Its colour is in 5 YR and 2.5 YR hue with value 3 to 4 and chroma 4 to 6. Texture varies from loamy sand to sandy clay with 15 to 35 per cent gravel. The thickness of B horizon ranges from 66 to 81cm. Its colour is in 2.5 YR hue with value 3 to 4 and chroma 4 to 6. Texture is sandy clay loam to clay with 15 to 35 per cent gravel. The available water capacity is medium (100-150 mm/m).

Five phases were identified:

GHTcB3g2	Sandy loam surface, slope 1-3%, severe erosion, very gravelly (35-60 %)
GHTcC3g2	Sandy loam surface, slope 3-5%, severe erosion, very gravelly (35-60 %)
GHTcC3g3	Sandy loam surface, slope 3-5%, severe erosion, extremely gravelly (60-80 %)
GHThB2g2	Sandy clay loam surface, slope 1-3 %, moderate erosion, very gravelly (35-60 %)
GHThB2g3 R1St1	Sandy clay loam surface, slope 1-3 %, moderate erosion, extremely gravelly (60-80%), few to fairly rocky (<2-10%), stony (0.01-0.1%)

Landscape and Soil Profile Characteristics of Gollarahatti (GHT) Series

4.1.8 Kanchikere (KKR) Series: Kanchikere soils are moderately deep (75-100 cm), well drained, have dark brown to very dark brown clay loam to sandy 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 76 to 100 cm. The thickness of A horizon ranges from 11 to 20 cm. Its colour is in 7.5YR and 10 YR hue with value 3 to 5 and chroma 3 to 4. Texture varies from loamy sand to sandy clay. The thickness of B horizon ranges from 63 to 82 cm. Its colour is in 7.5 YR and 10 YR hue with value 3 to 5 and chroma 1 to 3. Texture is clay loam to sandy clay. The available water capacity is medium (100-150 mm/m).

Only one phase was identified:

KKRiA1	Sandy clay surface, slope 0-1 %, slight erosion
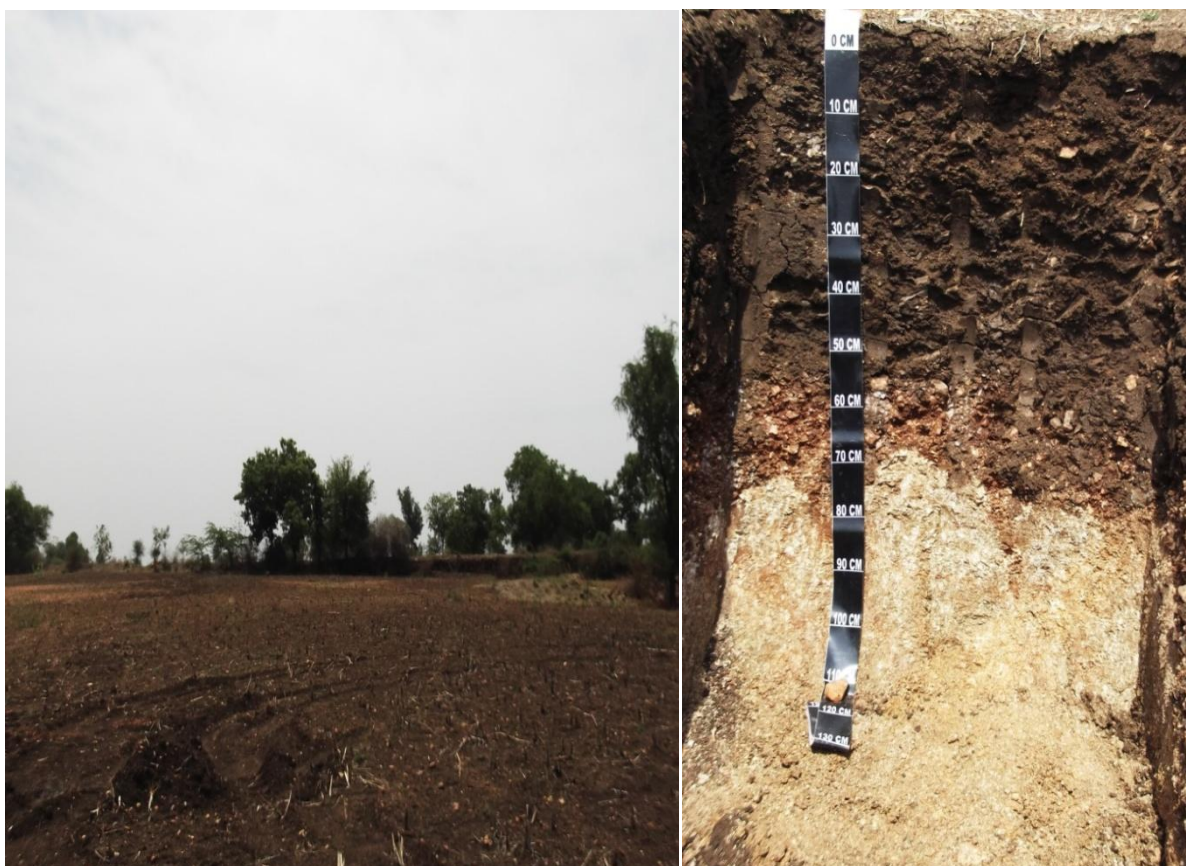
Landscape and Soil Profile Characteristics of Kanchikere (KKR) Series

4.1.9 Chikkamegheri (CKM) Series: Chikkamegheri soils are moderately deep (75-100 cm), well drained, have dark brown to dark reddish brown sandy clay soils. They have developed from granite gneiss and occur on nearly level 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 2.5 YR hue with value 2.5 to 3 and chroma 3 to 6. Its texture is sandy clay to clay with gravel content of <15 per cent. The available water capacity is low (51-100 mm/m).

Only one phase was identified:

CKMiA1g1	Sandy clay surface, slope 0-1 %, slight erosion, gravelly (15-35%)

Landscape and Soil Profile Characteristics of Chikkamegheri (CKM) Series

4.1.10 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 17cm. 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 medium (100-150 mm/m).

Three phases were identified:

BPRiB2g1	Sandy clay surface, slope 1-3 %, moderate erosion, gravelly (15-35 %)
BPRiB2g2	Sandy clay surface, slope 1-3 %, moderate erosion, very gravelly (35-60 %)
BPRmB2g1	Clay surface, slope 1-3 %, moderate erosion, gravelly (15-35 %)

Landscape and Soil Profile Characteristics of Balapur (BPR) Series

4.1.11 Vaddarahalli (VDH) Series: Vaddarahalli soils are deep (100-150 cm), well drained, have dark reddish brown to dark brown clayey soils. They have developed from granite gneiss and occur on nearly level to very gently sloping uplands.

The thickness of the solum ranges from 106 to 148 cm. The thickness of A horizon ranges from 13 to 23 cm. Its colour is in 7.5 YR and 10 YR hue with value 3 and chroma 3 to 4. The texture varies from sandy loam to clay. The thickness of B horizon ranges from 95 to 132 cm. Its colour is in 7.5 YR and 5 YR hue with value 3 to 4 and chroma 2 to 4. Its texture is sandy clay to clay. The available water capacity is high (150-200 mm/m).

Only one phase was identified:

VDHiB1g1	Sandy clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)

Landscape and Soil Profile Characteristics of Vaddarahalli (VDH) Series

4.1.12 Lakshmangudda (LGD) Series: Lakshmangudda soils are deep (100-150 cm), moderately well drained, have light olive brown to very dark gray, calcareous clay soils. They have developed from granite gneiss and occur on very gently sloping uplands.

The thickness of the solum ranges from 108 to 149 cm. The thickness of A horizon ranges from 16 to 20 cm. Its colour is in 7.5 YR and 10 YR hue with value and chroma 3 to 4. The texture varies from sandy clay to clay with 5 to 10 per cent gravel. The thickness of B horizon ranges from 90 to 130 cm. Its colour is in 2.5 Y, 10 YR and 7.5 YR hue with value 3 to 6 and chroma 1 to 3. Its texture is sandy clay to clay. These soils are calcareous that increase with depth. The available water capacity is very high (>200 mm/m).

Five phases were identified:

LGDiA1	Sandy clay surface, slope 0-1 %, slight erosion
LGDmA1g1	Clay surface, slope 0-1 %, slight erosion, gravelly (15-35 %)
LGDmB1	Clay surface, slope 1-3 %, slight erosion
LGDmB1g1	Clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)
LGDmB2g2	Clay surface, slope 1-3 %, moderate erosion, very gravelly (35-60 %)

Landscape and Soil Profile Characteristics of Lakshmangudda (LGD) Series

4.1.13 Budagumpa (BGP) Series: Budagumpa soils are very deep (>150 cm), well drained, black calcareous sandy clay to clay soils. They have developed from 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 7.5 YR and 10 YR hue with value 2 to 3 and chroma 2 to 4. The texture varies from sandy clay to clay with 5 to 10 per cent gravel. The thickness of B horizon ranges from 112 to 160 cm. Its colour is in 10 YR and 7.5 YR hue with value 3 to 5 and chroma 1 to 4. Its texture is clay with gravel content of 10 to 20 per cent. These soils are calcareous that increase with depth. The available water capacity is very high (>200 mm/m).

Three phases were identified:

BGPiB1	Sandy clay surface, slope 1-3 %, slight erosion
BGPiB1g1	Sandy clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)
BGPmB1	Clay surface, slope 1-3 %, slight erosion

Landscape and Soil Profile Characteristics of Budagumpa (BGP) Series

INTERPRETATION FOR LAND RESOURCE MANAGEMENT

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

5.1 Land Capability Classification

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

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 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 only.

The 30 soil map units identified in the Belhatti-6 microwatershed are grouped under 4 land capability classes and 9 land capability subclasses. About 98 per cent area in the microwatershed is suitable for agriculture (Fig. 5.1).

Good cultivable lands (Class II) cover a maximum of about 42 per cent area and are distributed in the southern, eastern and western part of the micowatershed with minor problems of soil and erosion. Moderately good cultivable lands (Class III) cover an area of about 33 per cent and are distributed in the northern, central and southern part of the microwatershed with moderate problems of erosion and soil. The fairly good cultivable lands (class IV) cover a small area of about 23 per cent. They have severe limitations of erosion and soil and are distributed in the northern and eastern part of the microwatershed.
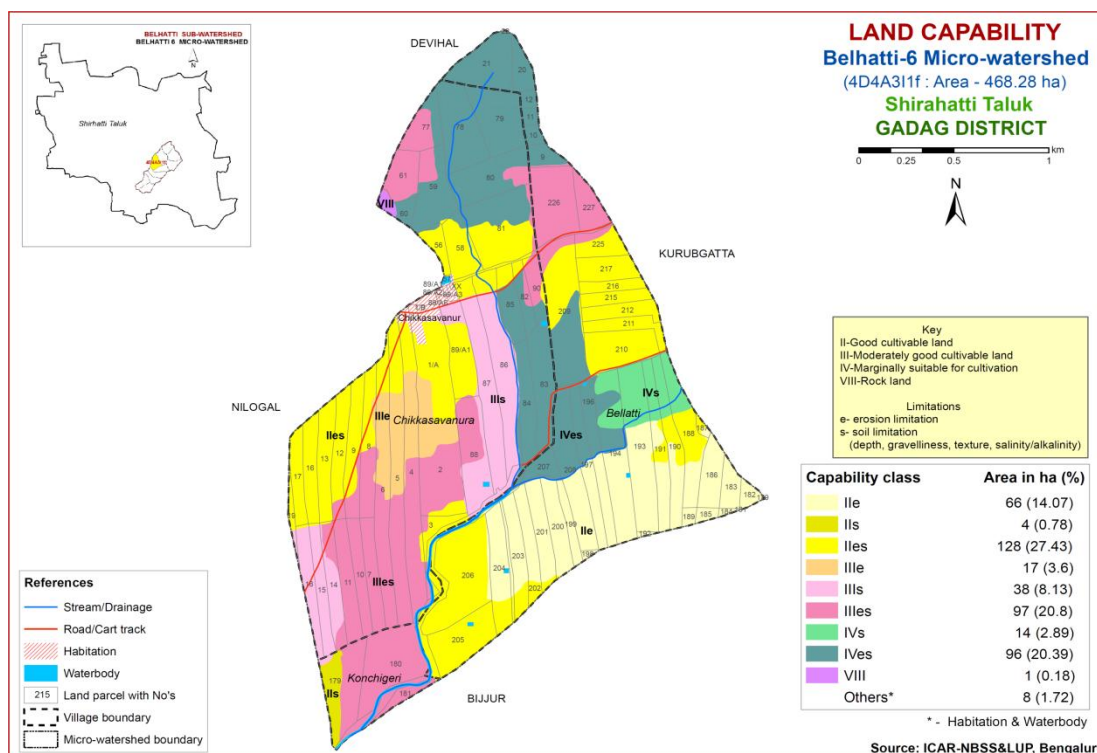
Fig. 5.1 Land Capability map of Belhatti-6 Microwatershed

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 prepared (Fig. 5.2).

Deep soils (100-150 cm) occur in maximum area of about 148 ha (32%) and are distributed in the southern and small area in northern part of the microwatershed. Very deep soils (>150 cm) occur in small area of 36 ha (8%) and are distributed in the eastern part of the microwatershed. Shallow soils (25-50 cm) occupy about 70 ha (15%) in the central, northern and southern part of the microwatershed. Moderately deep (75-100 cm) soils occupy an area of about 85 ha (18%) and are distributed in the northern and northeastern part of the microwatershed. Moderately shallow (50-75 cm) soils occupy about 121 ha (26%) and are distributed in the northern, eastern and western part of the microwatershed.

The most productive lands 184 ha (39%) with respect to soil rooting depth where all climatically adapted annual and perennial crops can be grown are deep (100-150 cm depth) and very deep soils (>150 cm depth) occurring in the northern and southern part of the microwatershed.

The most problem lands with a maximum area of about 70 ha (15%) having shallow (25-50 cm) rooting depth occur in the northern, central and southern part of the microwatershed. They are not suitable for growing agricultural crops but well suited for pasture, forestry or other recreational purposes. Occasionally, short duration crops may be grown if rainfall is normal.
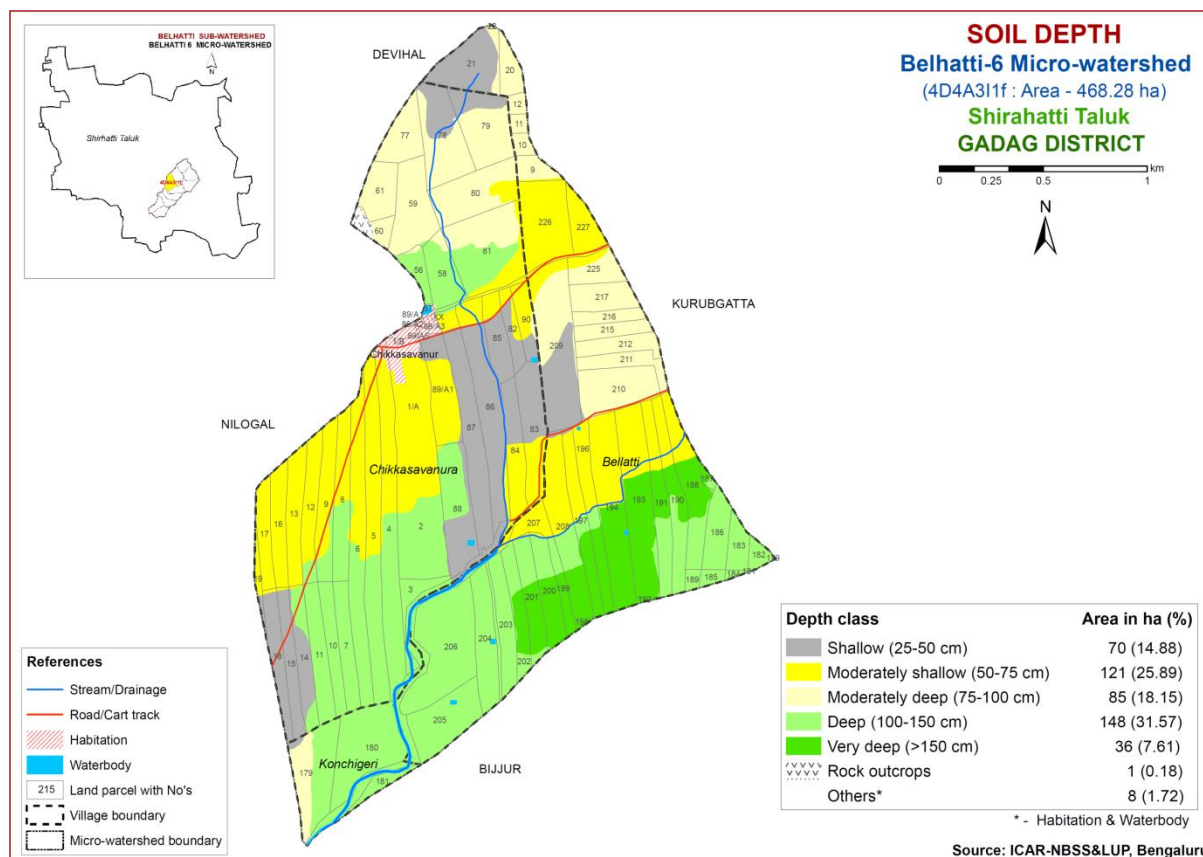
Fig. 5.2 Soil Depth map of Belhatti-6 Microwatershed

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.

Maximum area of 364 ha (78%) has soils that are clayey at the surface and are distributed in all parts except in the northern part of the microwatershed and about 95 ha

(20%) area has soils that are loamy soils. They are distributed in the northern part of the microwatershed (Fig. 5.3).

The most productive lands (78%) with respect to surface soil texture are the clayey soils that have high potential for soil-water retention and availability, and nutrient retention and availability, but have problems of drainage, infiltration, workability and other physical problems.
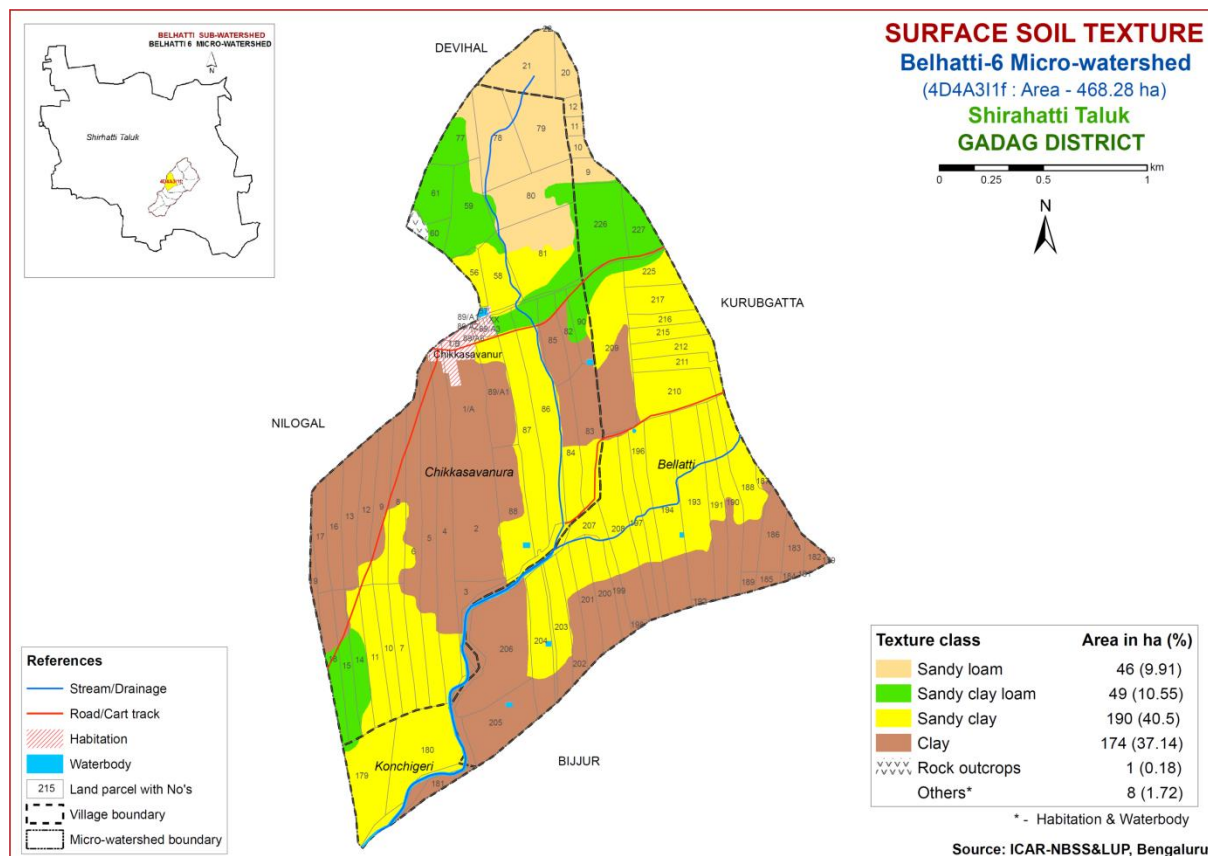
Fig. 5.3 Surface Soil Texture map of Belhatii-6 Microwatershed

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.

Maximum area in the microwatershed has soils that are gravelly (15-35%) covering about 219 ha (47%) and are distributed in the southern, western and northeastern part of the microwatershed (Fig. 5.4) followed by soils that are very gravelly (35-60%) covering about 154 ha (33%) and are distributed in the northern, southern and eastern part of the microwatershed. The soils that are non-gravelly (<15%) covering about 70 ha (15%) are distributed in the eastern part and small area in southern part of the microwatershed.

The most productive lands with respect to gravelliness are found to be 15 %. They are non-gravelly with less than 15 per cent gravel and have potential for growing both annual and perennial crops. The problem soils (37%) that are extremely gravelly (60-80%) and very gravelly (35-60%) where only short duration crops can be grown.
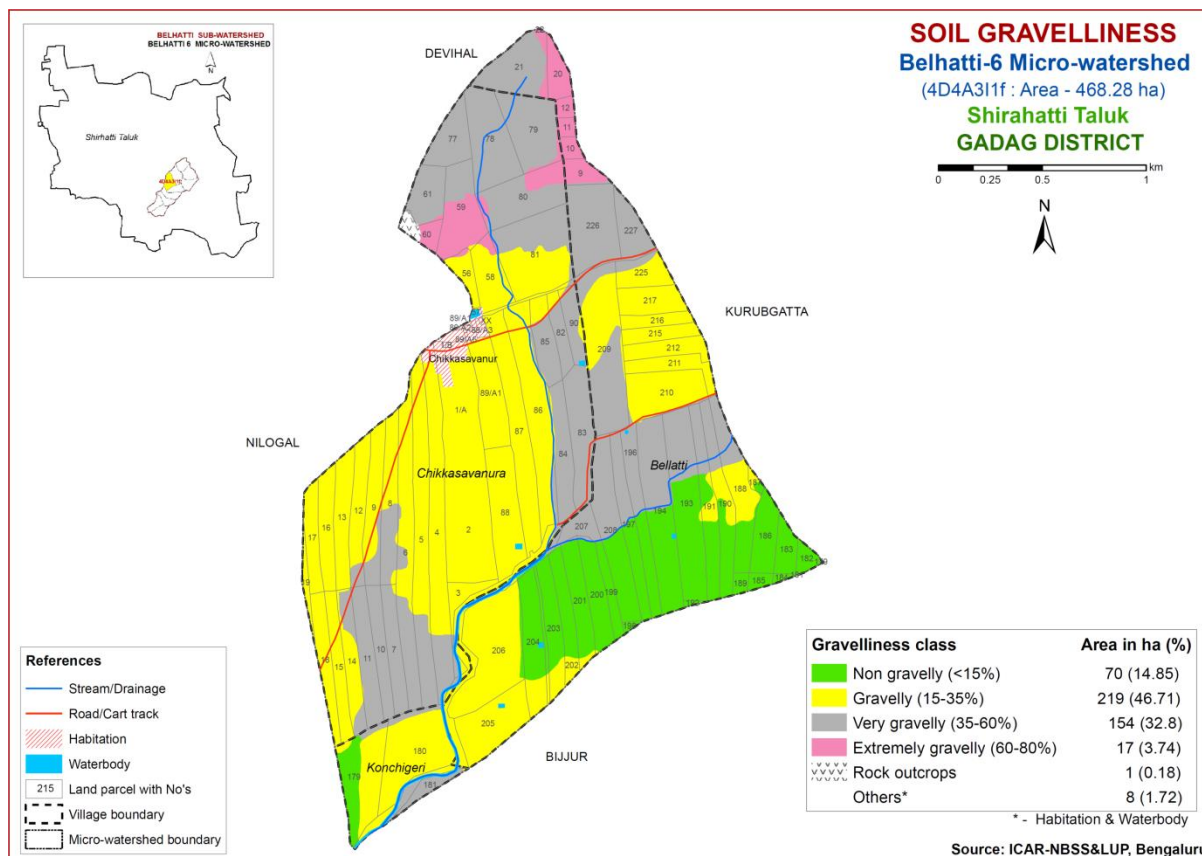
Fig. 5.4 Soil Gravelliness map of Belhatti-6 Microwatershed

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 prepared (Fig. 5.5).

Major area of about 283 ha (80%) in the microwatershed has soils that are low (51-100 mm/m) in available water capacity and are distributed in all parts except in the southeastern part of the microwatershed. An area of about 58 ha (12%) has soils that are very low (<50 mm/m) in available water capacity and are distributed in the northern and eastern part of the microwatershed A very small area of about 15 ha (3%) is medium in available water capacity and are distributed in the northern and southern part of the microwateshed. An area of 105 ha (22%) has soils that have very high (>200 mm/m) available water capacity and are distributed in the southeastern part of the microwatershed.

An area of about 105 ha (22%) has soils that have high potential (>200 mm/m) with regard to available water capacity where all climatically adapted long duration crops can be grown successfully.

About 56 ha (12%) 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.
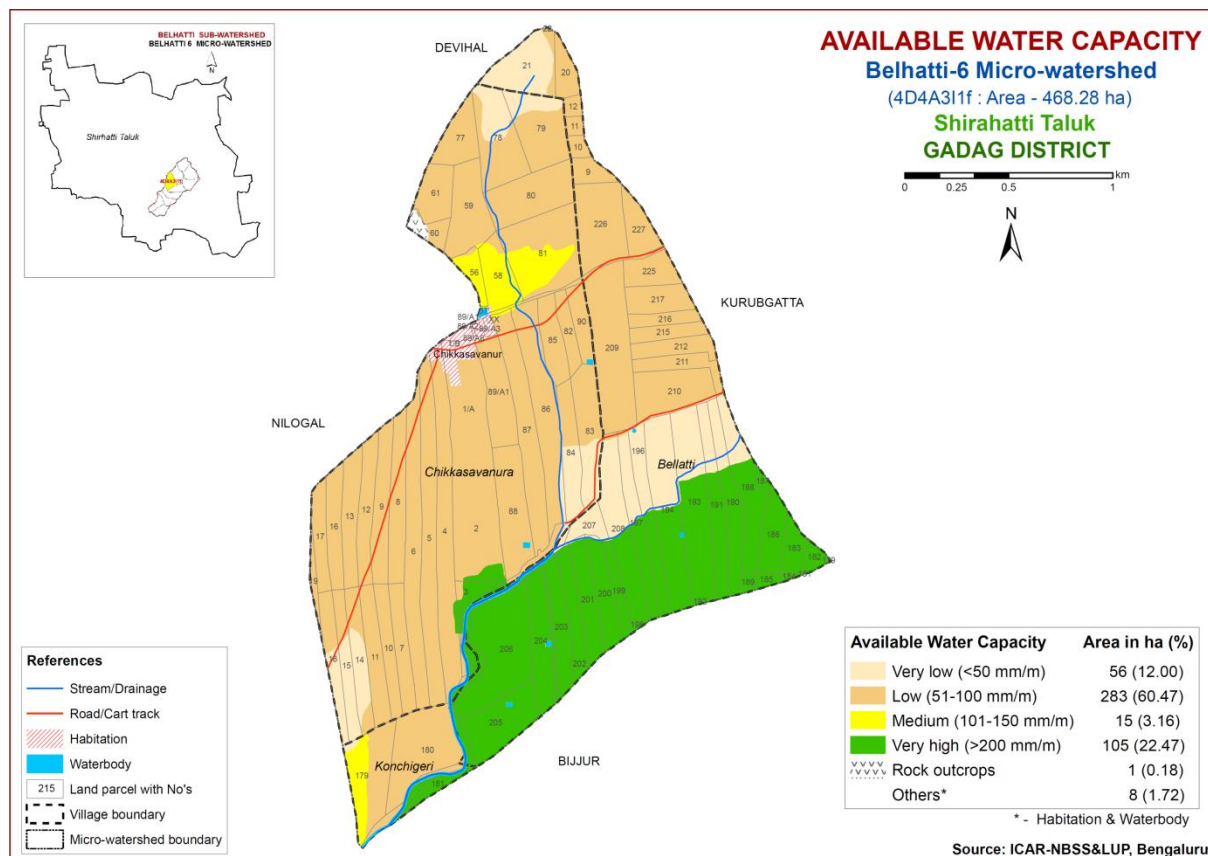
Fig. 5.5 Soil Available Water Capacity map of Belhatti-6 Microwatershed

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 prepared showing the area extent and geographic distribution of different slope classes in the microwatershed (Fig. 5.6).

Major area of about 361 ha (77%) falls under very gently sloping (1-3% slope) lands and are distributed in all parts of the microwatershed followed by a nearly level (0-1% slope) lands. It covers an area of about 72 ha (15%) and is distributed in the northeastern and southern part of the microwatershed.

A small area of about 26 ha (6%) falls under gently sloping (3-5%) and is distributed in the northern part of the microwatershed.

An area of about 433 ha (93%) 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.
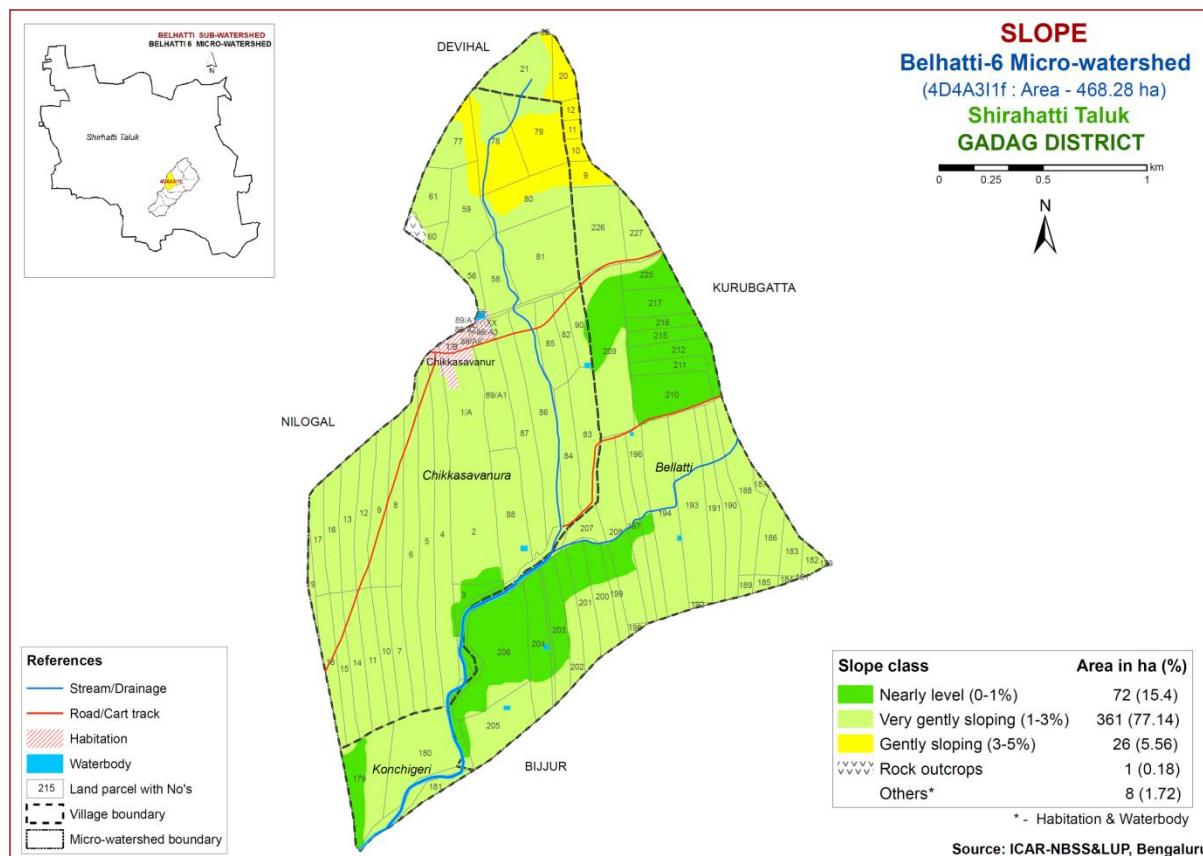
Fig. 5.6 Soil Slope map of Belhatti-6 Microwatershed

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

Soils that are slightly eroded (e1 class) cover a maximum area of about 250 ha (53%) in the microwatershed. They are distributed in all parts of the microwatershed. Moderately eroded (e2 class) soils cover an area of about 176 ha (36%) and are distributed in the central, southern and northern part of the microwatershed. Severely eroded (e3 class) soils cover a small area of about 34 ha (7%) and are distributed in the northern part of the microwatershed.

An area of about 34 ha (7%) in the microwatershed is problematic because of severe erosion. Top priority is to be given to these areas for taking up soil and water conservation and other land development measures. Next in priority would be an area of about 176 ha (38%) where the soils are moderately eroded.
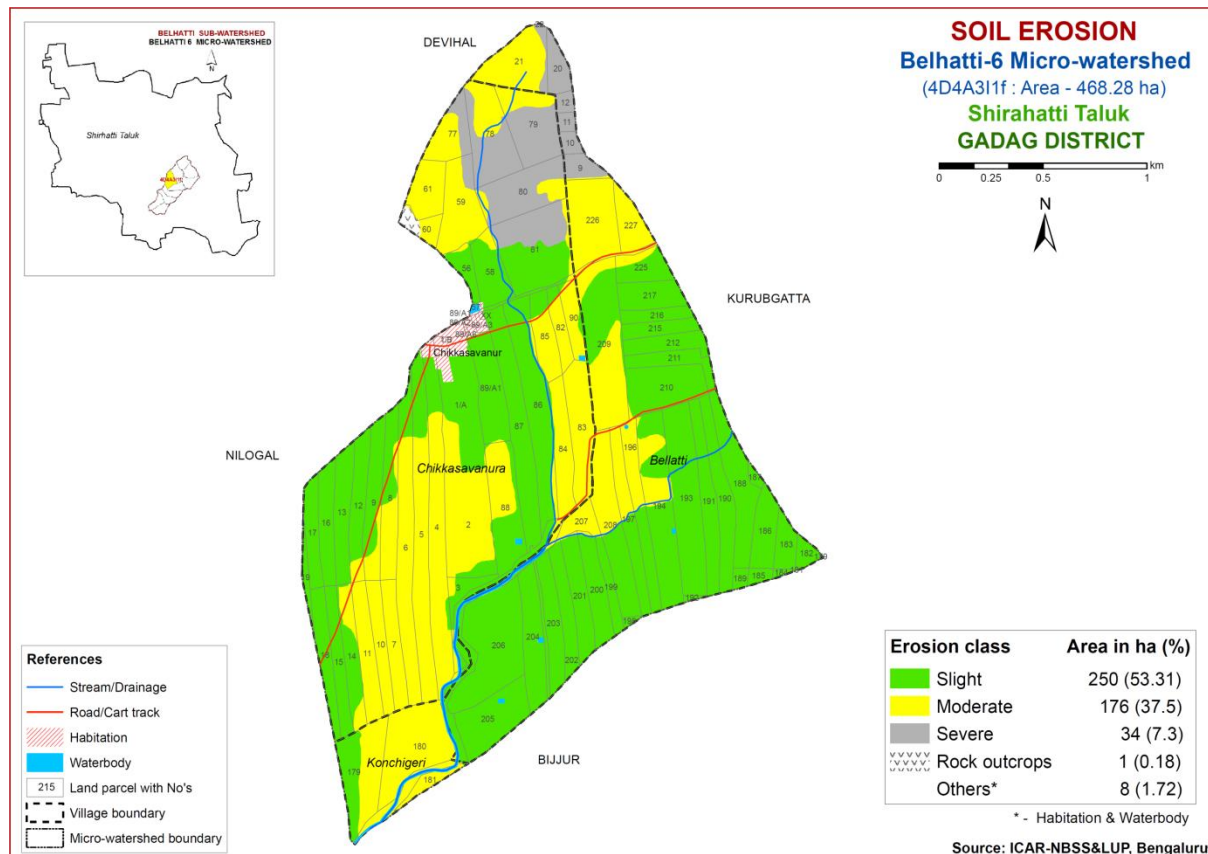
Fig. 5.7 Soil Erosion map of Belhatti-6 Microwatershed

FERTILITY STATUS

Soil fertility plays an important role in increasing crop yield. The adoption of high yielding varieties that require high amounts of nutrients has resulted in deficiency symptoms in crops and plants due to imbalanced fertilization and poor inherent fertility status. 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 2015 were analysed for pH, EC, organic carbon, available phosphorus and potassium, and for micronutrients like zinc, boron, copper, iron and manganese, and secondary nutrient sulphur.

Soil fertility data generated has been assessed and individual maps for all the nutrients for the microwatershed have been prepared. 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 Belhatti-6 microwatershed for soil reaction (pH) showed that about 95 ha (20%) area is moderately alkaline (pH 7.8-8.4) and is distributed in the southern, central, western and eastern part of the microwatershed. An area of about 81 ha (17%) is under slightly alkaline (pH 7.3-7.8) and is distributed in the northern part of the microwatershed. Maximum area of about 231 ha (49%) is under strongly alkaline (pH 8.4-9.0) and is distributed in the central, eastern and western part of the microwatershed followed by a very minor area of about 6 ha (1%) under very strongly alkaline (pH >9.0) and is distributed in the eastern part of the microwatershed. A small area of about 47 ha (10%) is under neutral (pH 6.5-7.3) and is distributed in the northern 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 are nonsaline.

6.3 Organic Carbon

The soil organic carbon content of the microwatershed is medium (0.5-0.75%) covering a maximum area of about 296 ha (63%) and is distributed in all parts except northern part of the microwatershed followed by an area of 164 ha (35%) is low (<0.5%) in organic carbon content and is distributed in the northern and southeastern part of the microwatershed (Fig.6.3).

6.4 Available Phosphorus

The soil analysis revealed that available phosphorus is low (<23 kg/ha) in maximum area of about 340 ha (76%) area (Fig.6.4) and is distributed in all parts except northern part of the microwatershed. There is an urgent need to increase the dose of phosphorous for all the crops by 25 per cent over the recommended dose to realize better crop performance. About 89 ha (19%) area in the microwatershed is medium (23-57 kg/ha) and is distributed in the northern part of the microwatershed. A small area of about 31 ha (7%) is high (>57 kg/ha) in available phosphorus.
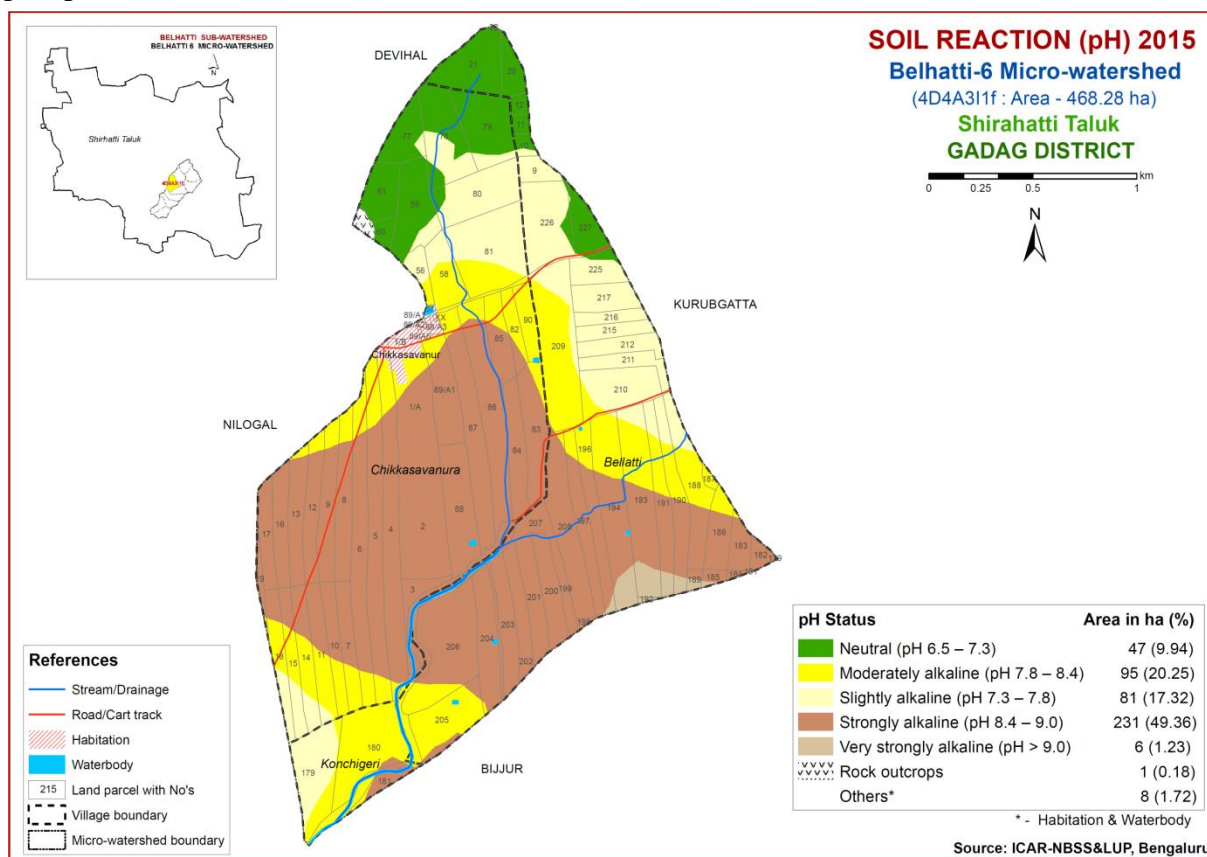
Fig.6.1 Soil Reaction (pH) map of Belhatti-6 Microwatershed
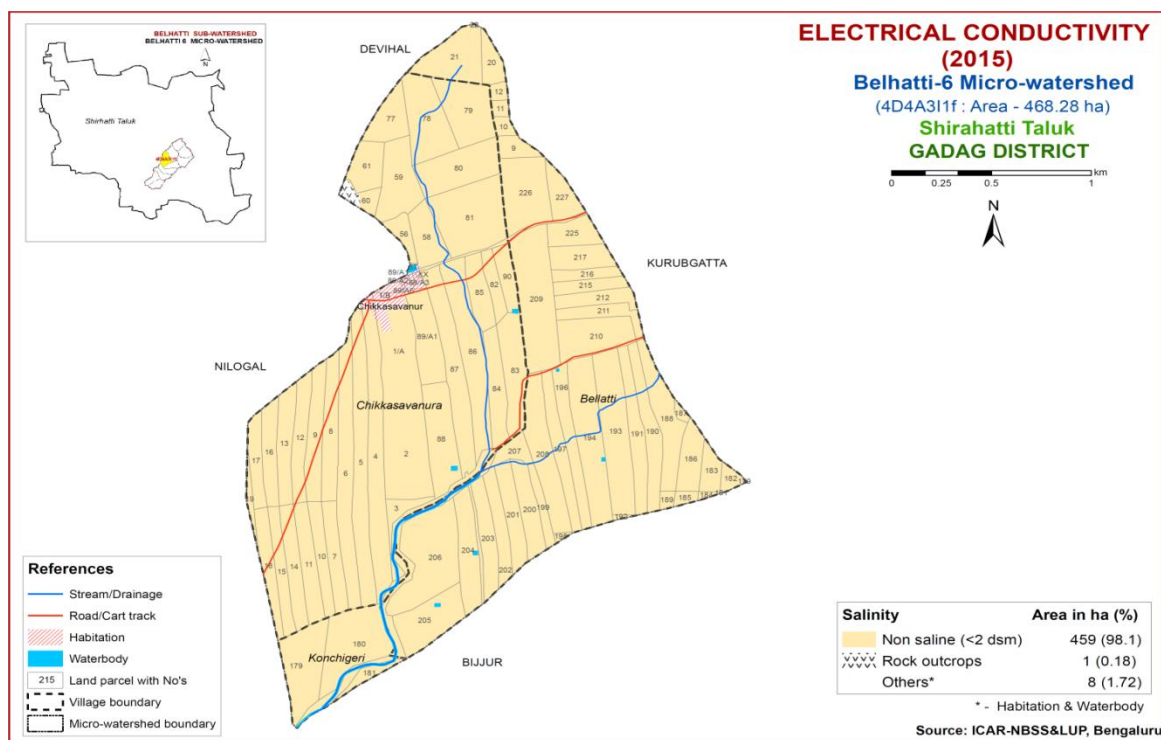
Fig.6.2 Electrical Conductivity (EC) map of Belhatti-6 Microwatershed
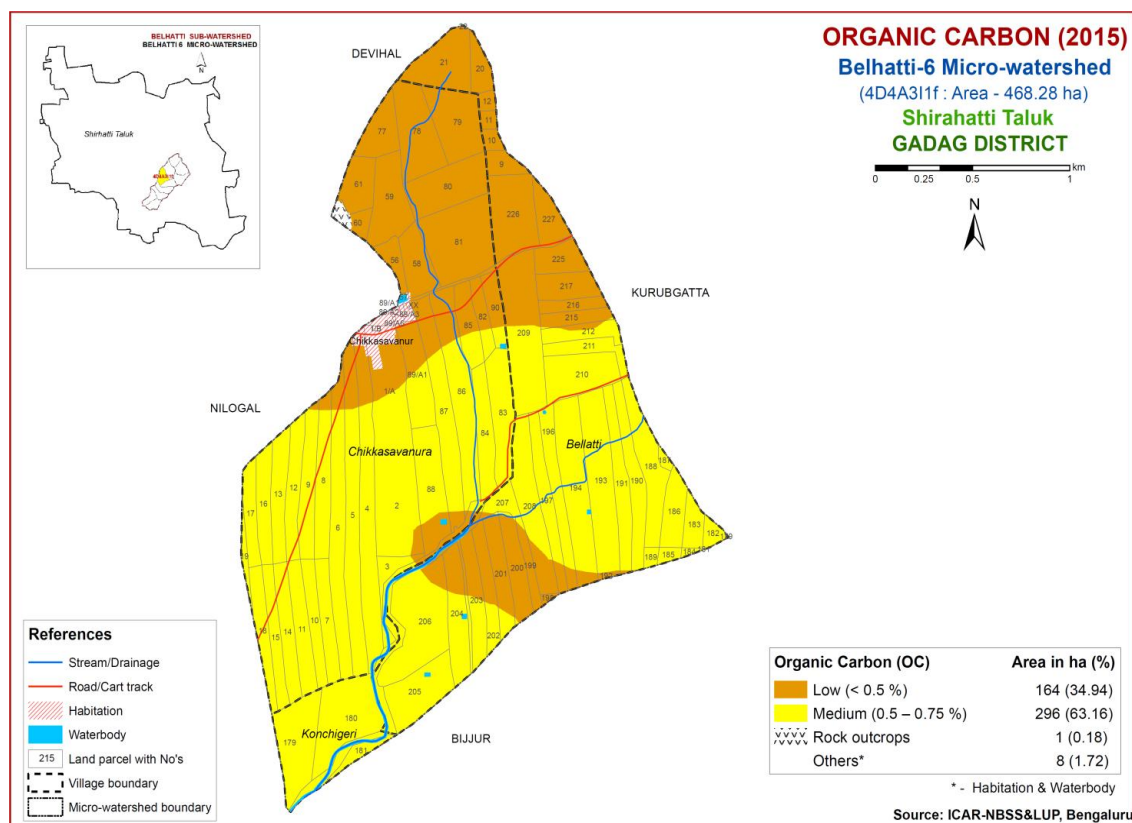
Fig.6.3 Soil Organic Carbon map of Belhatti-6 Microwatershed

49
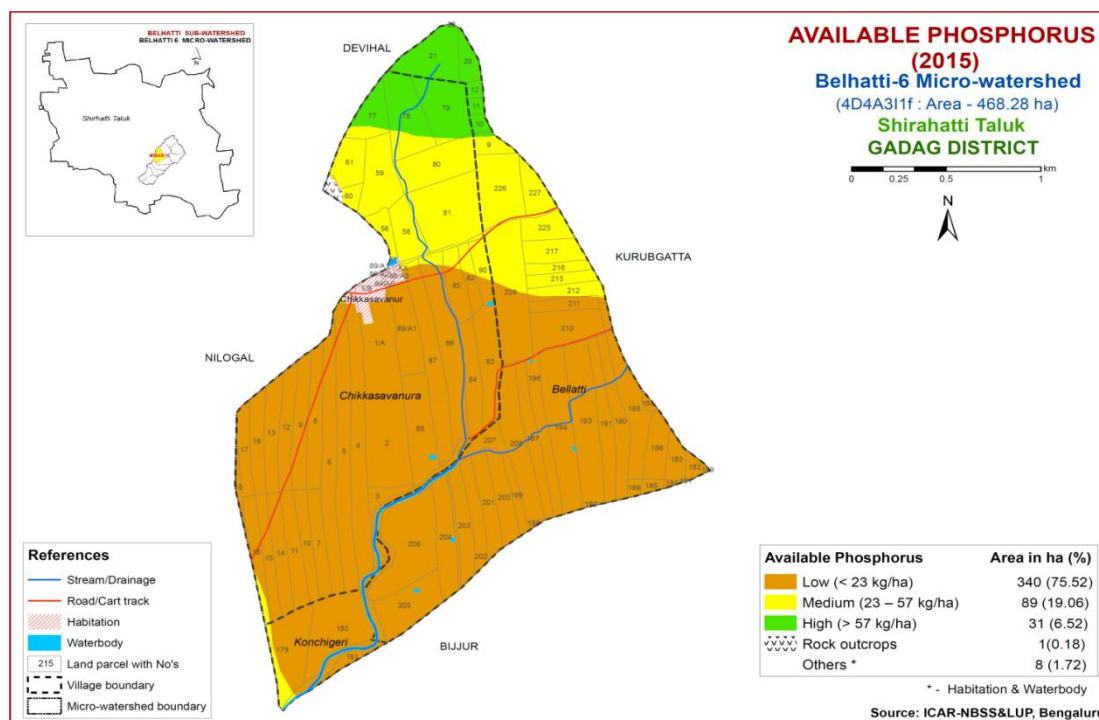
Fig.6.4 Soil available Phosphorus map of Belhatti-6 Microwatershed

6.5 Available Potassium

Available potassium content is medium (145-337 kg/ha) in maximum area of about 335 ha (71%) and is distributed in all parts of the microwatershed (Fig.6.5); high available potassium (>337 kg/ ha) content accounts for 119 ha (25%) and is distributed in the central and eastern part of the microwatershed. The available potassium content is low (<145 kg/ha) in a very small area of 6 ha (1%) and is distributed in the northern part of the microwatershed.

6.6 Available Sulphur

Available sulphur content is low (<10 ppm) in 106 ha (23%) area in the microwatershed and is distributed in the northern part of the microwatershed. An area of about 107 ha (23%) is medium (10-20 ppm) in available sulphur and is distributed in the central, southern and western part of the microwatershed (Fig.6.6). Available sulphur is high (>20 ppm) in maximum area of about 246 ha (53%) and is distributed in the southern and eastern part of the microwatershed.

6.7 Available Boron

Available boron content is low (<0.5 ppm) in the entire microwatershed area (Fig 6.7).

6.8 Available Iron

Available iron content is sufficient (>4.5 ppm) in maximum area of 386 ha (82%) and is distributed in all parts of the microwatershed and about 74 ha (16%) area is deficient in

available iron content and is distributed in the central and western part of the microwatershed (Fig 6.8).

6.9 Available Manganese

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

6.10 Available Copper

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

6.11 Available Zinc

Available zinc content is deficient (<0.6 ppm) in the entire microwatershed area (Fig 6.11).
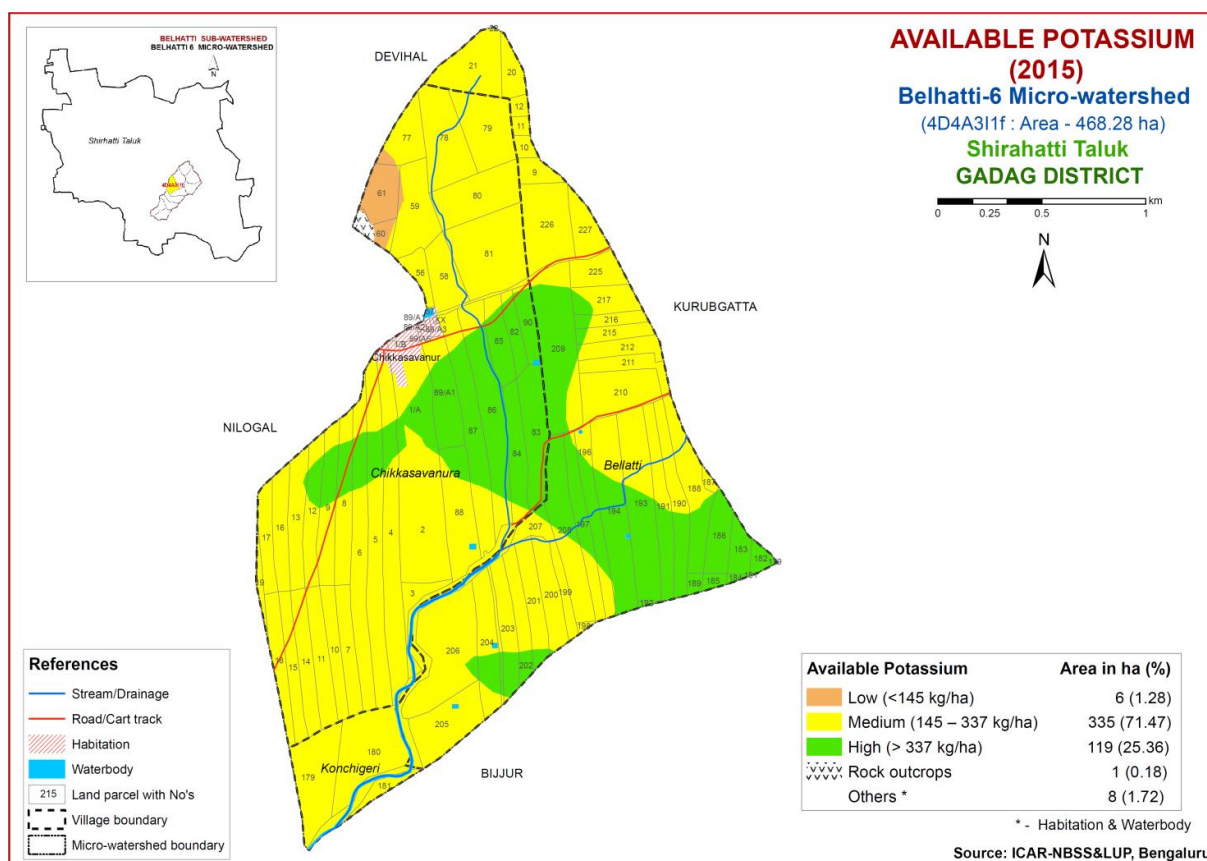
Fig.6.5 Soil available Potassium map of Belhatti-6 Microwatershed
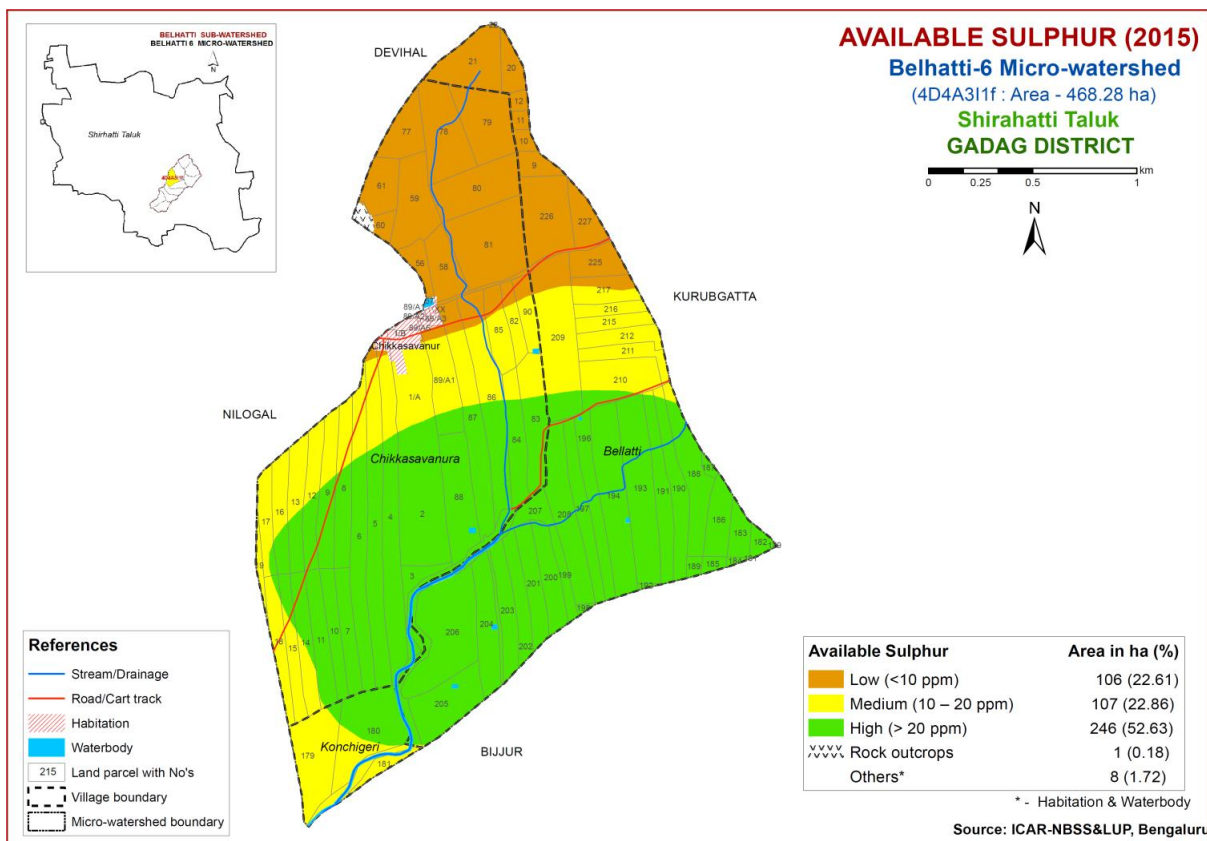
Fig.6.6 Soil available Sulphur map of Belhatti-6 Microwatershed
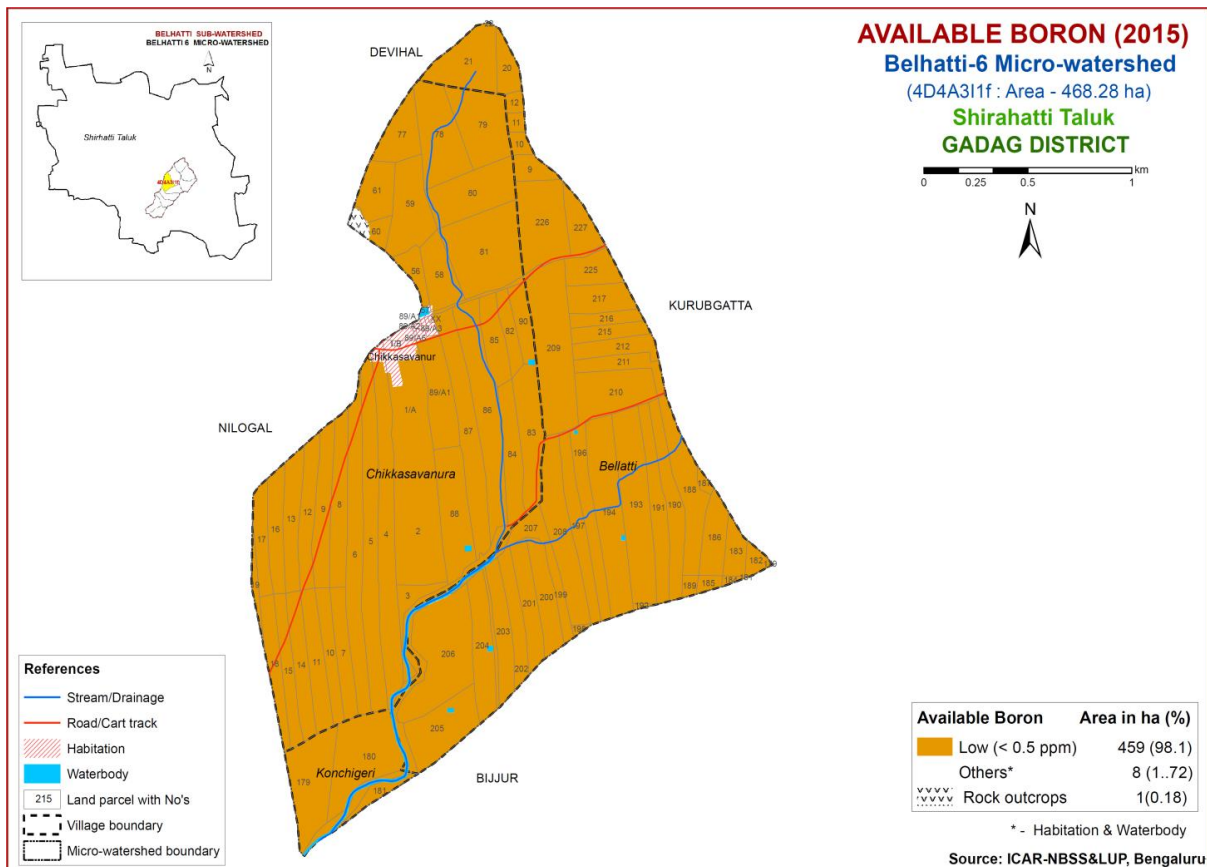
Fig.6.7 Soil available Boron map of Belhatti-6 Microwatershed
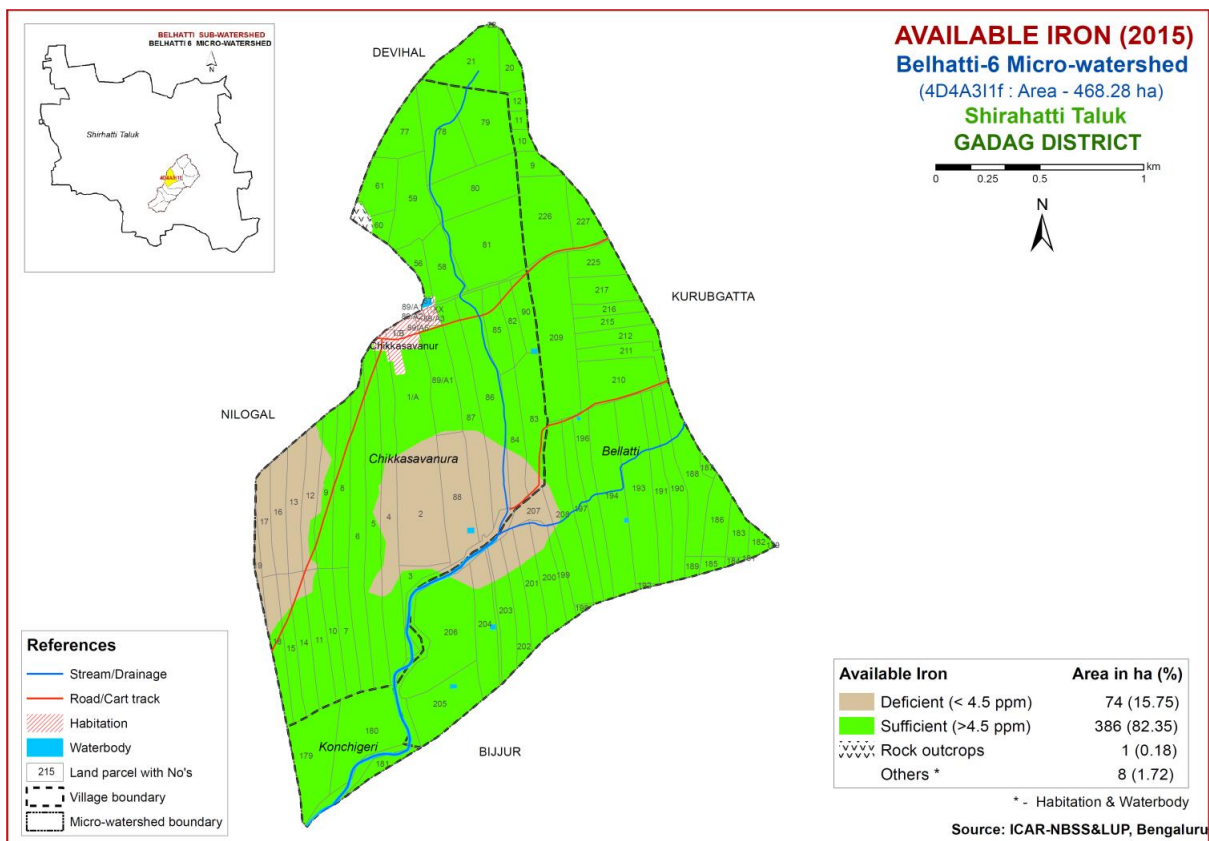
Fig.6.8 Soil available Iron map of Belhatti-6 Microwatershed
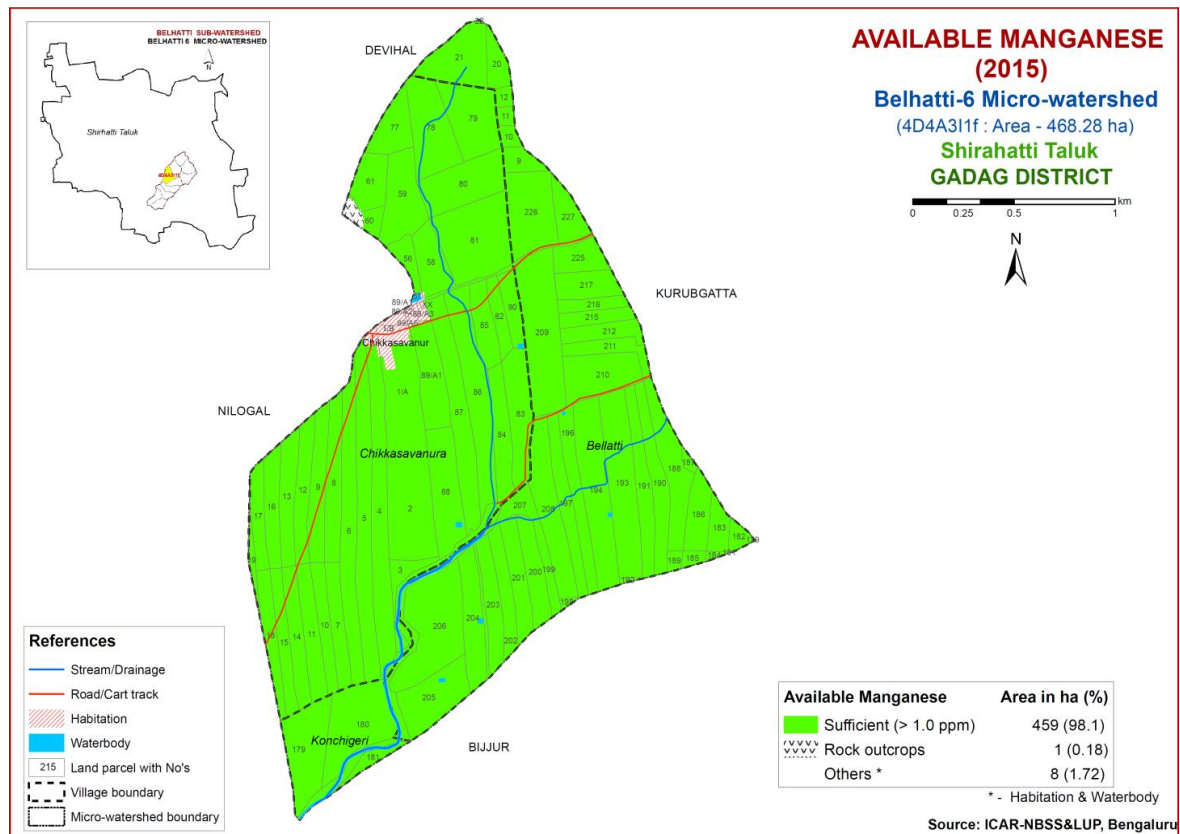
Fig.6.9 Soil available Manganese map of Belhatti-6 Microwatershed
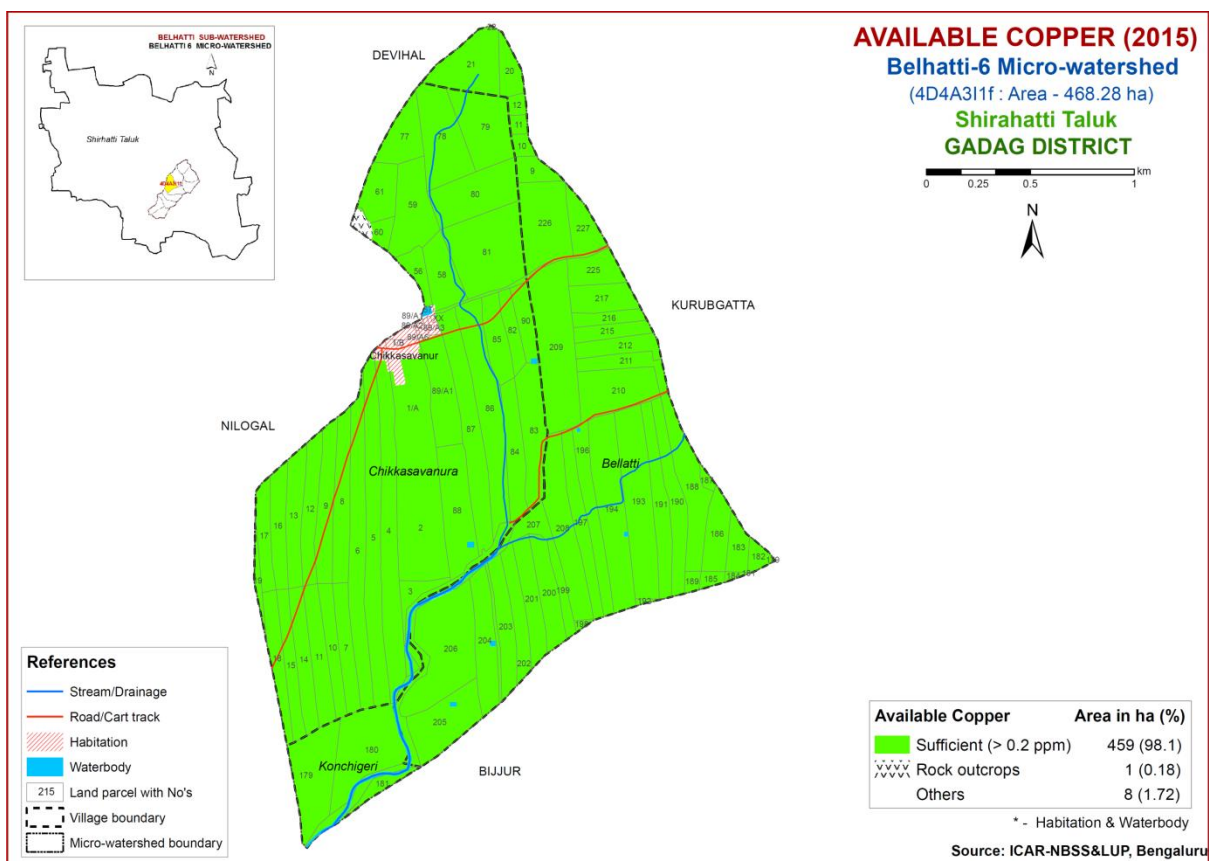
Fig.6.10 Soil available Copper map of Belhatti-6 Microwatershed
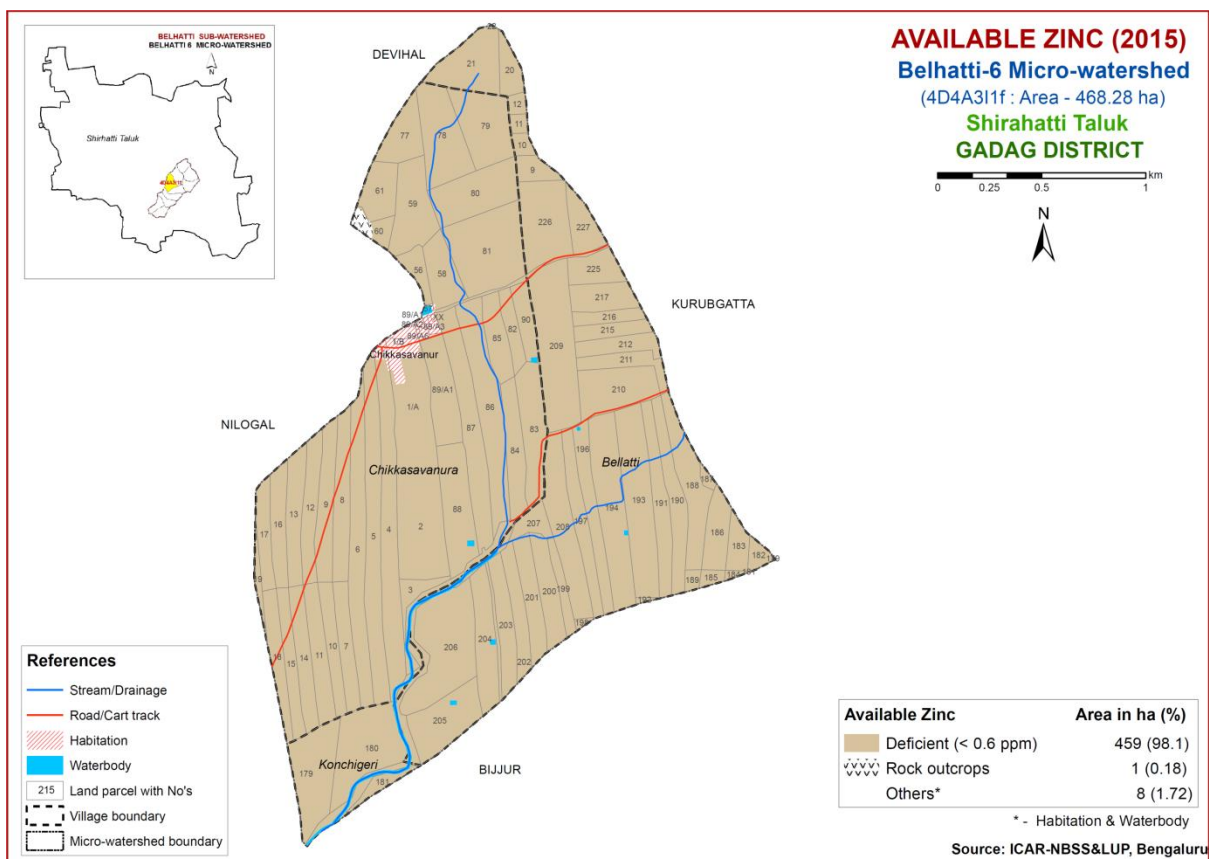
Fig.6.11 Soil available Zinc map of Belhatti-6 Microwatershed

54

LAND SUITABILITY FOR MAJOR CROPS

The soil and land resource units (soil phases) of Belhatti-6 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 and 'w' for drainage. These limitations are indicated as lower case letters to the class symbol. For example, moderately suitable land with the limitations of soil depth and erosion is designated as S2re. For the microwatershed, the soil mapping units were evaluated and classified up to subclass level.

Using the above criteria, the soil map units of the microwatershed were evaluated and land suitability maps for 21 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 11.02 lakh ha in Bijapur, Gulbarga, Raichur, Bidar, Belgaum, Dharwad, Bellary, Chitradurga, Mysore and Chamarajnagar 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 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 46 ha (10%) in the microwatershed has soils that are highly suitable (class S1) for growing sorghum crop. They have minor or no limitations for growing sorghum and are distributed mainly in the northern and southern part of the microwatershed. Major area of about 246 ha (53%) is moderately suitable (class S2) for growing sorghum and are distributed in the southern, northern and eastern part the microwatershed.

Table 7.1 Soil-Site Characteristics of Belhatti-6 Microwatershed

Soil Map Units	Climate (P) (mm)	Growing period (Days)	Drai-nage class	Soil depth (cm)	Soil texture		Gravelliness		AWC (mm/m)	Slope (%)	Erosion	pH	EC	ESP	CEC [Cmol (p$^+$) kg^{-1}]	BS (%)
					Surf-ace	Sub-sur-face	Surface (%)	Subsurface (%)								
KNHhB1g1	633	150	WD	25-50	scl	sc	15-35	<15	<50	1-3	Slight					
HRVcB2g2	633	150	WD	25-50	sl	scl	35-60	>35	<50	1-3	Moderate					
MTLiB1g1	633	150	WD	25-50	sc	sc-c	15-35	15-35	51-100	1-3	Slight					
MTLmB1g1	633	150	WD	25-50	c	sc-c	15-30	15-35	51-100	1-3	Slight					
MTLmB2g2	633	150	WD	25-50	c	sc-c	35-60	15-35	51-100	1-3	Slight					
LKRiB1g2	633	150	WD	50-75	sc	scl-c	35-60	40-60	<50	1-3	Slight					
LKRiB2g2	633	150	WD	50-75	sc	scl-c	35-60	40-60	<50	1-3	Moderate					
KGHhB1g1	633	150	WD	50-75	scl	scl	15-35	15-35	15-35	1-3	Slight					
KGHhB2g2	633	150	WD	50-75	scl	scl	35-60	15-35	15-35	1-3	Moderate					
RNKmB1g1	633	150	WD	50-75	c	sc-c	15-35	15-35	15-35	1-3	Slight					
RNKmB2g1	633	150	WD	50-75	c	sc-c	15-35	15-35	15-35	1-3	Moderate					
GHTcB3g2	633	150	WD	75-100	sl	scl	35-60	15-35	15-35	1-3	Severe					
GHTcC3g2	633	150	WD	75-100	sl	scl	35-60	15-35	15-35	3-5	Severe					
GHTcC3g3	633	150	WD	75-100	sl	scl	60-80	15-35	15-35	3-5	Severe					
GHThB2g2	633	150	WD	75-100	scl	scl	35-60	15-35	15-35	1-3	Moderate					
GHThB2g3R1St1	633	150	WD	75-100	scl	scl	60-80	15-35	15-35	1-3	Moderate					
KKRiA1	633	150	WD	75-100	sc	cl-sc	-	-	-	0-1	Slight					
CKMiA1g1	633	150	WD	75-100	sc	sc	15-35	-	-	0-1	Slight					
BPRiB2g1	633	150	WD	100-150	sc	sc-c	15-35	>35	>35	1-3	Moderate					
BPRiB2g2	633	150	WD	100-150	sc	sc-c	35-60	>35	>35	1-3	Moderate					
BPRmB2g1	633	150	WD	100-150	c	sc-c	15-35	>35	>35	1-3	Moderate					
VDHiB1g1	633	150	WD	100-150	sc	sc-c	15-35	-	-	1-3	Slight					
LGDiA1	633	150	WD	100-150	sc	sc-c	-	<15	<15	1-3	Slight					
LGDmA1g1	633	150	WD	100-150	c	sc-c	15-35	<15	<15	0-1	Slight					
LGDmB1	633	150	WD	100-150	c	sc-c	-	<15	<15	1-3	Slight					
LGDmB1g1	633	150	WD	100-150	c	sc-c	15-35	<15	<15	1-3	Slight					

LGDmB2g2	633	150	WD	100-150	c	sc-c	35-60	<15	<15	1-3	Moderate				
BGPiB1	633	150	WD	>150	sc	c	-	10-20	10-20	1-3	Slight				
BGPiB1g1	633	150	WD	>150	sc	c	15-35	10-20	10-20	1-3	Slight				
BGPmB1	633	150	WD	>150	c	c	-	10-20	10-20	1-3	Slight				

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

They have minor limitations of gravelliness, calcareousness and rooting depth. Marginally suitable lands (class S3) for growing sorghum occupy about 149 ha (32%) and mainly occur in the northern, central and western part of the microwatershed. They have moderate limitations of rooting depth, calcareousness and gravelliness. A small area of about 17 ha (4%) is not suitable for growing sorghum in the microwatershed and occur in the northern part of the microwatershed. They have very severe limitations of gravelliness and rooting depth.

Table 7.2 Crop suitability criteria for Sorghum

Crop requirement		Rating			
Soil –site characteristics	unit	Highly suitable(S1)	Moderately suitable(S2)	Marginally suitable(S3)	Not suitable (N)
Slope	%	2-3	3-8	8-15	>15
LGP	Days	120-150	120-90	<90	
Soil drainage	class	Well to mod.Well drained	imperfect	Poorly/excessively	V.poorly
Soil reaction	pH	6.0-8.0	5.5-5.98.1-8.5	<5.58.6-9.0	>9.0
Surface soil texture	Class	C, cl, sicl, sc	l, sil, sic	Sl, ls	S, fragmental skeletal
Soil depth	Cm	100-75	50-75	30-50	<30
Gravel content	% vol.	5-15	15-30	30-60	>60
Salinity (EC)	dSm^{-1}	2-4	4-8	8-10	>10
Sodicity (ESP)	%	5-8	8-10	10-15	>15
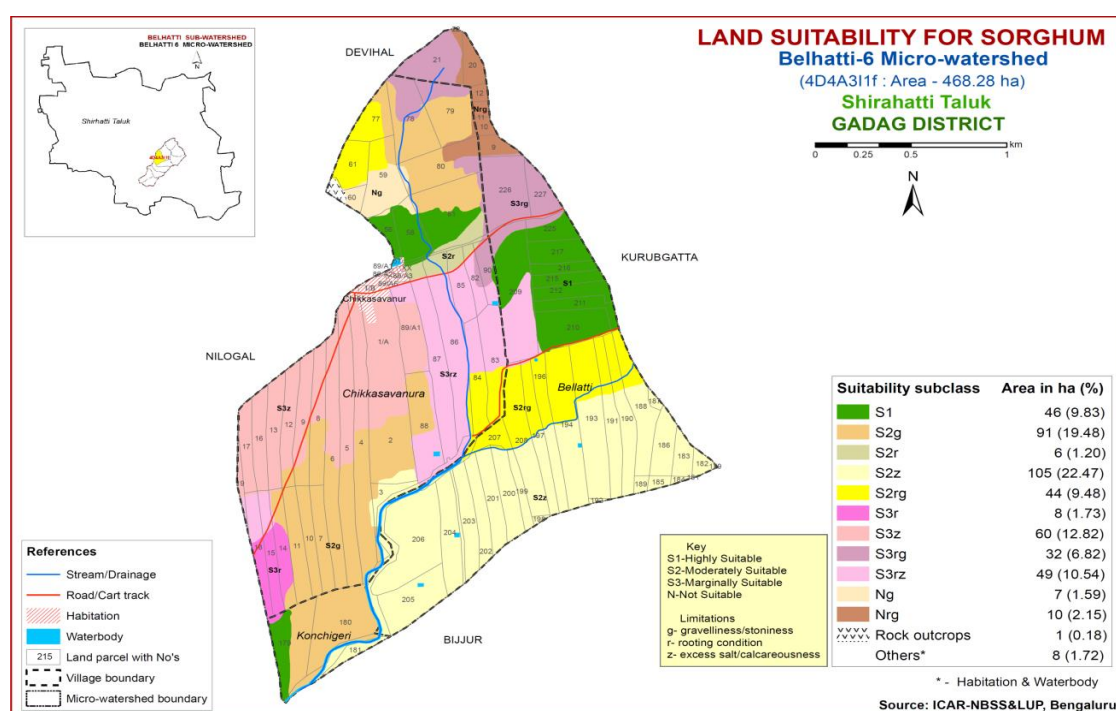
Fig. 7.1 Land Suitability map of Sorghum

7.2 Land Suitability for Maize (*Zea mays*)

Maize is the most important food crop grown in an area of 13.73 lakh ha in almost all the districts of the State. The crop requirements for growing maize (Table 7.3) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing maize was generated. The area and geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.2.

A small area of about 46 ha (10%) in the microwatershed has soils that are highly suitable (class S1) for growing maize crop. They have minor or no limitations for growing maize and are distributed in the northern and southern part of the microwatershed. Maximum area of about 220 ha (47%) is moderately suitable (class S2) for growing sorghum and are distributed in the northern, northeastern, western and southern part of the microwatershed. They have minor limitations of gravelliness, calcareousness and rooting depth. The marginally suitable (class S3) lands cover about 174 ha (37%) area in the microwatershed and occur in the northern, central and southeastern part of the microwatershed. They have moderate limitations of gravelliness, texture, calcareousness and rooting depth. About 17 ha (4%) area is not suitable for growing maize and occur in the northern part of the microwatershed. They have very severe limitations of gravelliness and rooting depth.

Table 7.3 Crop suitability criteria for Maize

Crop requirement		Rating			
Soil–site characteristics	Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N)
Slope	%	<3	3.5	5-8	
LGP	Days	>100	100-80	60-80	
Soil drainage	Class	Well drained	Mod. to imperfectly	Poorly/excessively	V.poorly
Soil reaction	pH	5.5-7.5	7.6-8.5	8.6-9.0	
Surface soil texture	Class	l, cl, scl, sil	Sl, sicl, sic	C(s-s), ls	S,fragmental
Soil depth	Cm	>75	50-75	25-50	<25
Gravel content	% vol.	<15	15-35	35-50	>50
Salinity (EC)	dSm^{-1}	<1.0	1.0-2.0	2.0-4.0	
Sodicity (ESP)	%	<10	10-15	>15	
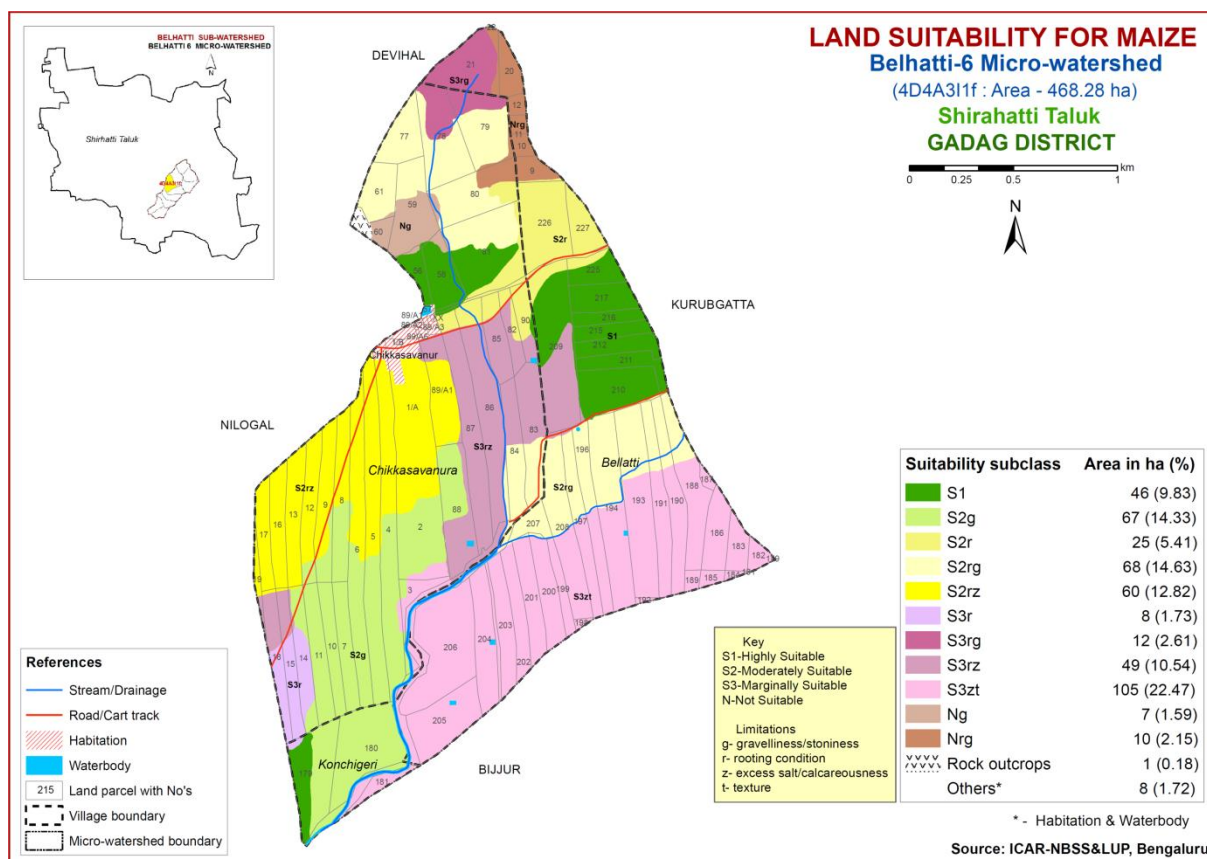
Fig. 7.2 Land Suitability map of Maize

7.3 Land Suitability for Bengalgram (*Cicer arietinum*)

Bengalgram is one of the major pulse crop grown in an area of 9.26 lakh ha in northern Karnataka in Bijapur, Gulbarga, Raichur, Bidar, Belgaum, Dharwad and Bellary districts. The crop requirements for growing Bengalgram (Table 7.4) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and land suitability map for growing Bengalgram was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.3.

A very minor area of about 4 ha (<1%) in the microwatershed has soils that are highly suitable (class S1) for growing Bengalgram. They have minor or no limitations for growing Bengalgram and are distributed in the southern part of the microwatershed. Major area of about 428 ha (92%) is moderately suitable (class S2) for Bengalgram. They are distributed in all parts of the microwatershed. They have minor limitations of texture, calcareousness, gravelliness and rooting depth. Marginally suitable lands (class S3) for growing Bengalgram occupy a minor area of about 9 ha (2%) and mainly occur in the western and central part of the microwatershed. They have moderate limitations of gravelliness. A small area of about 17 ha (4%) is not suitable for growing Bengalgram in the microwatershed and occur in the northern part of the microwatershed. They have very severe limitations of gravelliness.

Table 7.4 Crop suitability criteria for Bengalgram

Crop requirement		Rating			
Soil–site characteristics	unit	Highly suitable(S1)	Moderately suitable(S2)	Marginally suitable(S3)	Not suitable (N)
Slope	%	<3	3-5	5-10	>10
LGP	Days	>100	90-100	70-90	<70
Soil drainage	class	Well drained	Mod. to well drained; Imperfectly drained	Poorly drained; excessively drained	Very Poorly drained
Soil reaction	pH	6.0-7.5	5.5-5.77.6-8.0	8.1-9.0;4.5-5.4	>9.0
Surface soil texture	Class	l, scl, sil, cl,	sicl, sic, c	Sl, c>60%	S, fragmental
Soil depth	Cm	>75	51-75	25-50	<25
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	
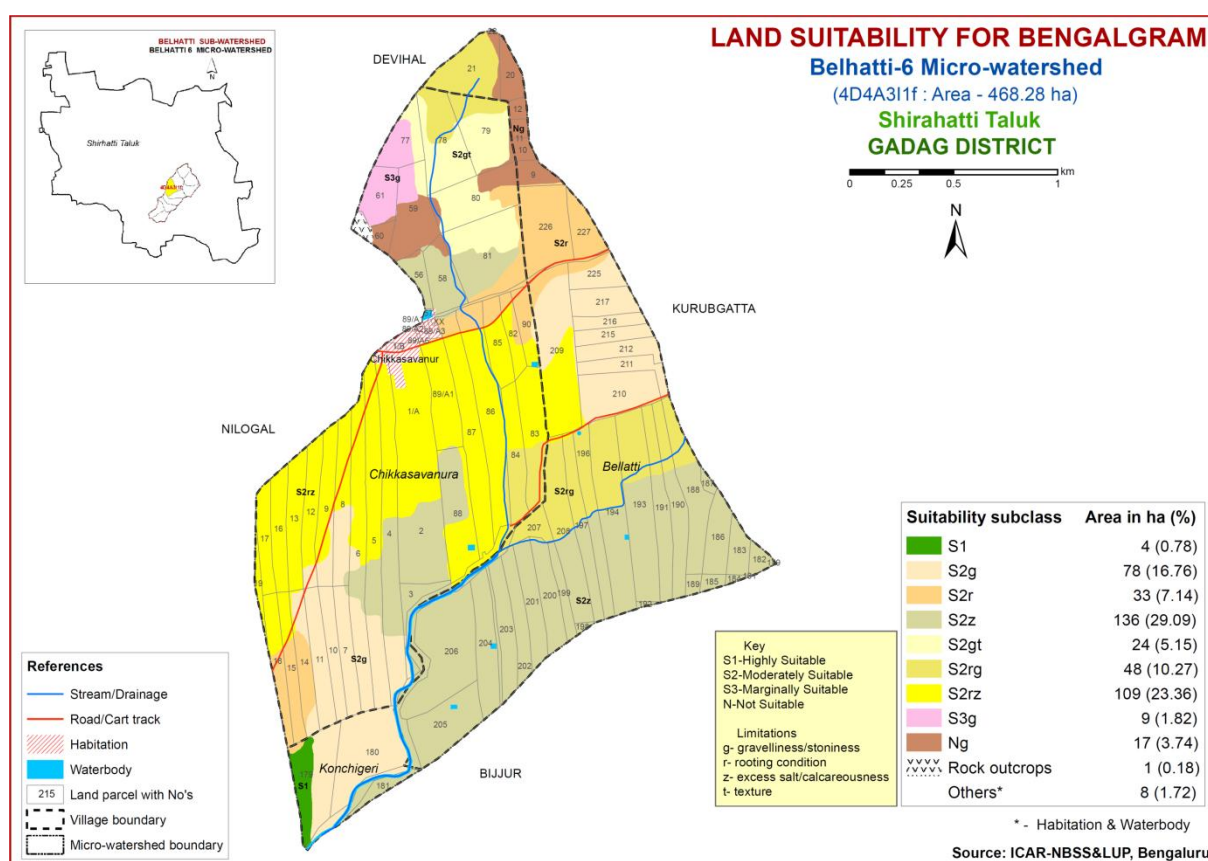
Fig. 7.3 Land Suitability map of Bengalgram

7.4 Land Suitability for Groundnut (*Arachis hypogaea*)

Groundnut is one of the major oilseed crop grown in an area of 6.5 lakh ha in Karnataka in most of the districts either as rainfed or irrigated crop. The crop requirements

for growing groundnut (Table 7.5) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and 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 7.4.

A small area of about 11 ha (2%) has soils that are highly suitable (class S1) for growing groundnut crop. They have minor or no limitations for growing groundnut and are distributed in the northern part of the microwatershed. About 176 ha (38%) area is moderately suitable (class S2) for groundnut and are distributed in the northern and southern part of the microwatershed. They have minor limitations of texture, rooting depth and gravelliness. Marginally suitable lands (class S3) for growing groundnut occupy major area of about 271 ha (58%) and are distributed in all parts of the microwatershed. They have moderate limitations of calcareousness, rooting depth, gravelliness and texture.

Table 7.5 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	
CaCO₃ 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	
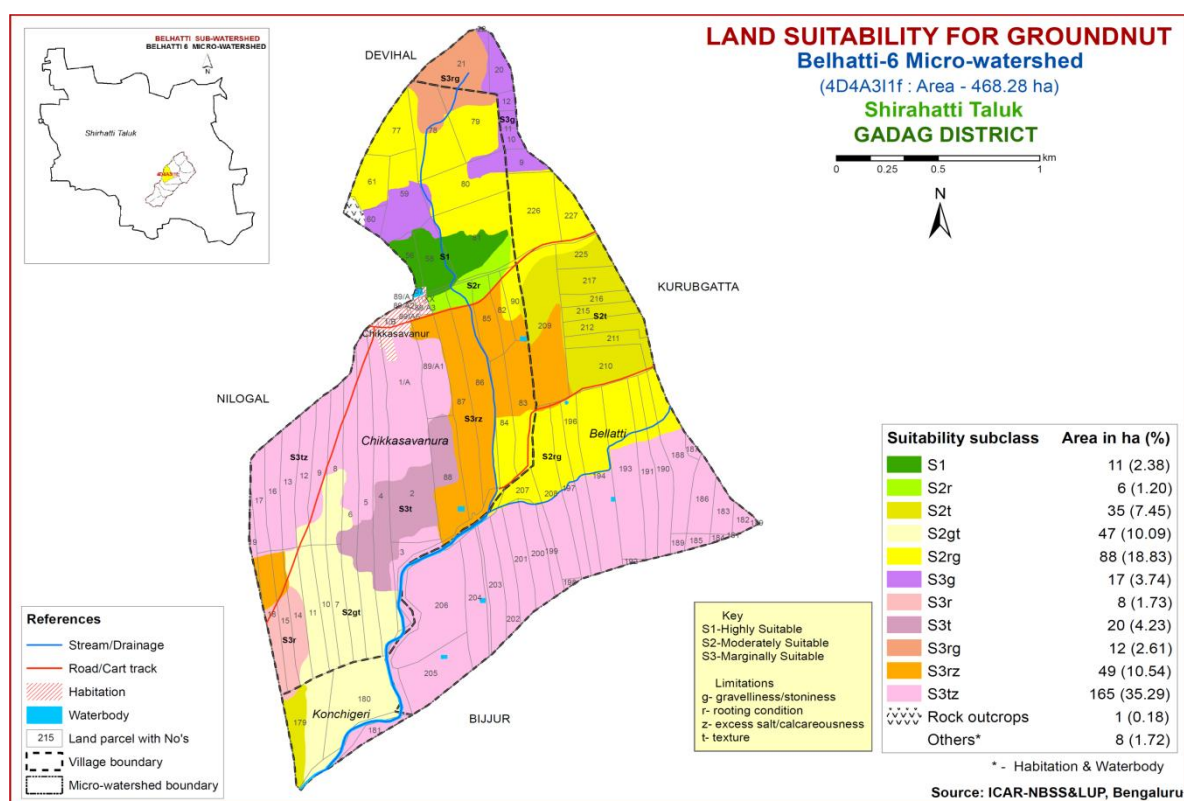
Fig. 7.4 Land Suitability map of Groundnut

63

7.5 Land Suitability for Sunflower (*Helianthus annus*)

Sunflower is the most important oilseed crop grown in an area of 4.1 lakh ha in the State in all the districts. The crop requirements for growing sunflower (Table 7.6) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing sunflower was generated. The area and geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.5.

A very small area of about 11 ha (2%) has soils that are highly suitable (class S1) for growing sunflower crop. They have minor or no limitations for growing sunflower and are distributed mainly in the northern part of the microwatershed. Moderately suitable (class S2) lands are found to occur in an area of about 173 ha (37%). They have minor limitations of gravelliness and rooting depth and are distributed in the northern and southeastern part of the microwatershed. The marginally suitable (class S3) lands cover maximum area of about 207 ha (44%) and occur in all parts of the microwatershed. They have moderate limitations of gravelliness, calcareousness sand rooting depth. A small area of about 69 ha (15%) is not suitable for growing sunflower and occur in the central and northern part of the microwatershed. They have very severe limitations of gravelliness, calcareousness and rooting depth.

Table 7.6 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	

LAND SUITABILITY FOR SUNFLOWER
Belhatti-6 Micro-watershed
(4D4A3I1f : Area - 468.28 ha)
Shirahatti Taluk
GADAG DISTRICT

Suitability subclass	Area in ha (%)
S1	11 (2.38)
S2r	35 (7.45)
S2z	105 (22.47)
S2rg	33 (6.97)
S3g	85 (18.06)
S3r	6 (1.20)
S3z	60 (12.82)
S3rg	56 (11.86)
Nr	8 (1.73)
Nrg	12 (2.61)
Nrz	49 (10.54)
Rock outcrops	1 (0.18)
Others*	8 (1.72)

* - Habitation & Waterbody
Source: ICAR-NBSS&LUP, Bengaluru
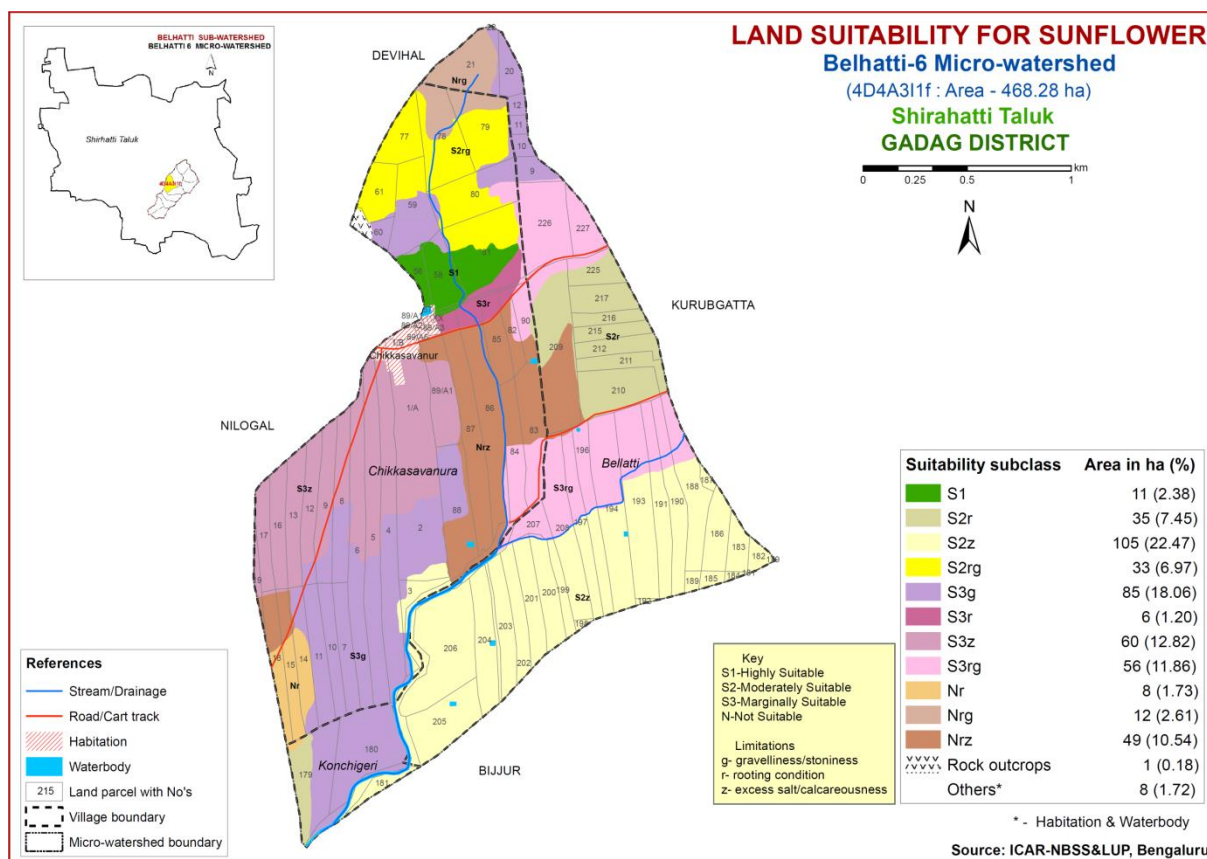
Fig. 7.5 Land Suitability map of Sunflower

7.6 Land Suitability for Cotton (*Gossypium hirsutum*)

Cotton is the most important fibre crop grown in the State in about 6.6 lakh ha area in Raichur, Dharwad, Belgaum, Gulbarga, Bijapur, Bidar, Bellary, Chitradurga and Chamarajnagar districts. The crop requirements for growing cotton (Table 7.7) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing cotton was generated and the area and geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.6.

Small area of about 15 ha (3%) in the microwatershed is highly suitable (class S1) for growing cotton. They have minor or no limitations for growing cotton and are distributed in the northern part of the microwatershed. Major area of about 336 ha (72%) has soils that are moderately suitable (class S2) with minor limitations of gravelliness, calcareousness and rooting depth. They are distributed in all parts of the microwatershed. The marginally suitable (class S3) lands cover about 91 ha (20%) and occur in the northern and central part of the microwatershed. They have moderate limitations of gravelliness, calcareousness and rooting depth. An area of 17 ha (4%) is not suitable for growing cotton and mainly occur in the northern part of the microwatershed. They have very severe limitations of gravelliness.

Table 7.7 Crop suitability criteria for Cotton

Crop requirement		Rating			
Soil–site characteristics	unit	Highly suitable (S1)	Moderately suitable(S2)	Marginally suitable(S3)	Not suitable (N)
Slope	%	1-2	2-3	3-5	>5
LGP	Days	180-240	120-180	<120	
Soil drainage	class	Well to moderately well	Imperfectly drained	Poor somewhat excessive	Stagnant/ Excessive
Soil reaction	pH	6.5-7.5	7.6-8.0	8.1-9.0	>9.0>6.5
Surface soil texture	Class	Sic, c	Sicl, cl	Si, sil, sc, scl, l	Sl, s,ls
Soil depth	Cm	100-150	60-100	30-60	<30
Gravel content	% vol.	<5	5-10	10-15	15-35
CaCO$_3$ in root zone	%	<3	3-5	5-10	10-20
Salinity (EC)	dSm^{-1}	2-4	4.0-8.0	8.0-12	>12
Sodicity (ESP)	%	5-10	10-20	20-30	>30
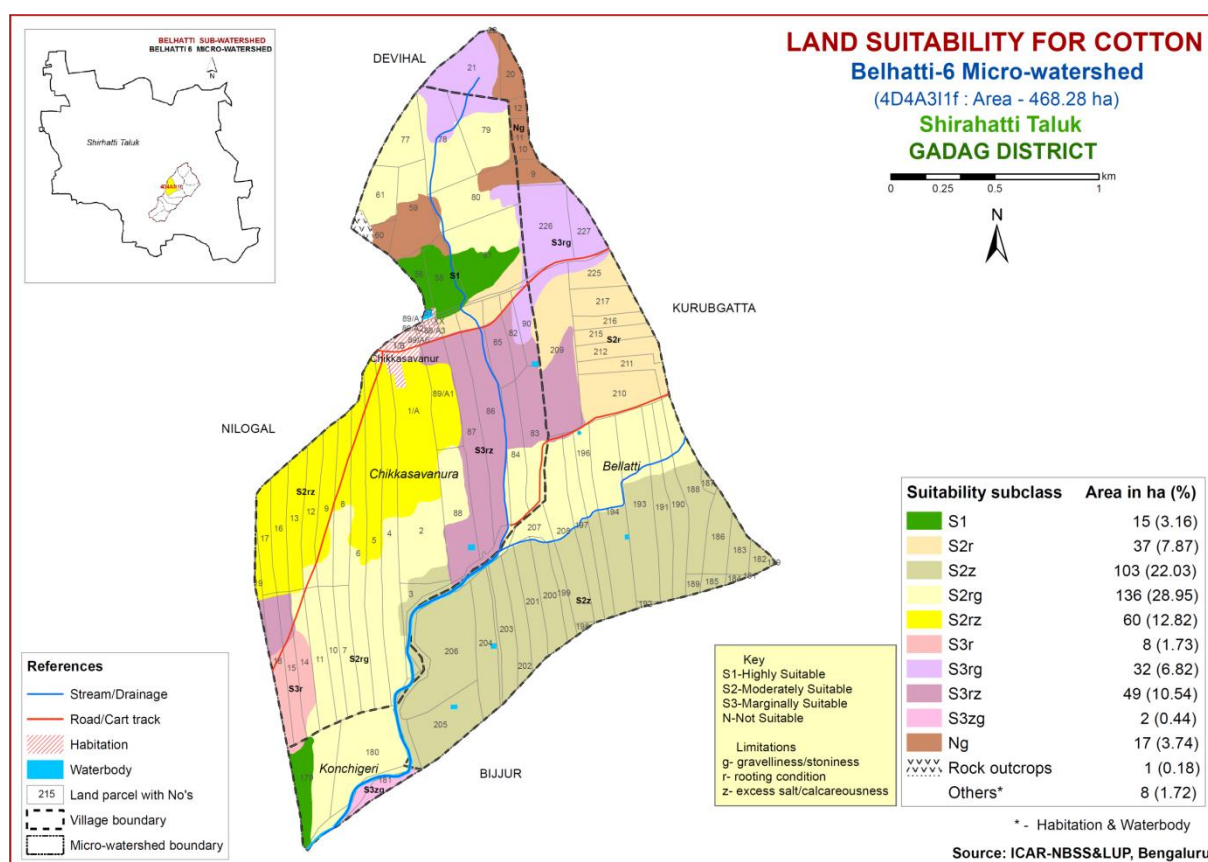
Fig. 7.6 Land Suitability map of Cotton

7.7 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 7.8) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and 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 7.7.

A very small area of about 11 ha (2%) in the microwatershed is highly suitable (class S1) for growing cotton. They have minor or no limitations for growing banana and are distributed in the northern part of the microwatershed. Major area of about 301 ha (64%) is moderately suitable (class S2) for growing banana and are distributed in the western, eastern and southern part of the microwatershed. They have minor limitations of rooting depth, gravelliness, calcareousness and texture. Marginally suitable (class S3) lands for growing banana occupy an area of about 79 ha (17%) and are distributed in the northern and eastern parts of the microwatershed. They have moderate limitations of rooting depth and gravelliness. A small area of about 69 ha (15%) is not suitable for growing banana in the microwatershed and occur in the northern, central and small area in the southwestern part of the microwatershed. They have very severe limitations of gravelliness, calcareousness and rooting depth.

Table 7.8 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
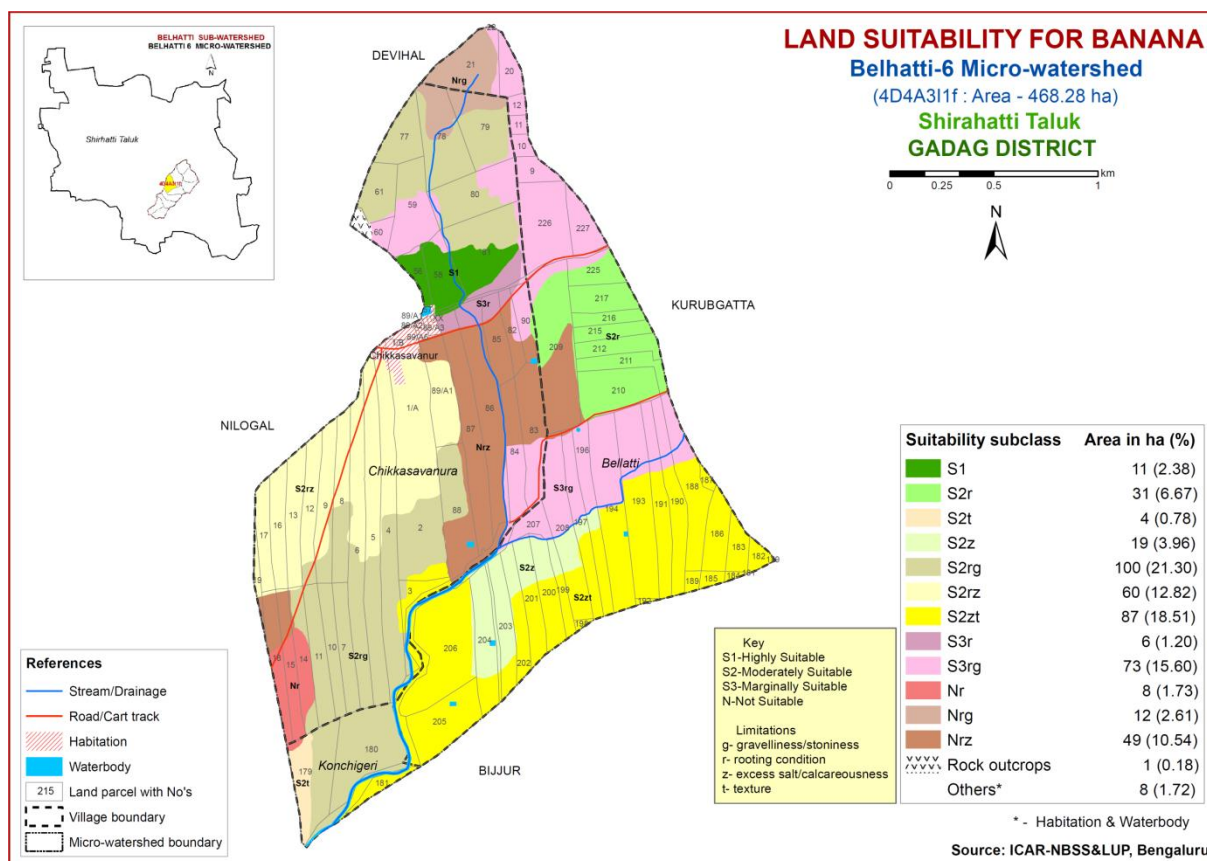
Fig. 7.7 Land Suitability map of Banana

7.8 Land Suitability for Pomegranate (*Punica granatum*)

Pomegranate is one of the commercially grown fruit crop in Karnataka in an area of 0.16 lakh ha mainly in Bijapur, Bagalkot, Koppal, Gadag and Chitradurga districts. The crop requirements for growing pomegranate (Table 7.9) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and 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 7.8.

A very small area of about 11 ha (2%) in the microwatershed is highly suitable (class S1) for growing pomegranate. They have minor or no limitations for growing pomegranate and are distributed in the northern part of the microwatershed. Major area of about 301 ha (64%) is moderately suitable (class S2) for pomegranate and are distributed in all parts of the microwatershed. They have minor limitations of texture, calcareousness, rooting depth and gravelliness. Marginally suitable (class S3) lands for growing pomegranate occur in about 79 ha (17%) and are distributed in the northeastern and northern part of the microwatershed. They have moderate limitations of rooting depth and gravelliness. A small area of about 69 ha (15%) is not suitable for growing pomegranate and mainly occur in the central and southern part of the microwatershed. They have very severe limitations of gravelliness, calcareousness and rooting depth.

Table 7.9 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	
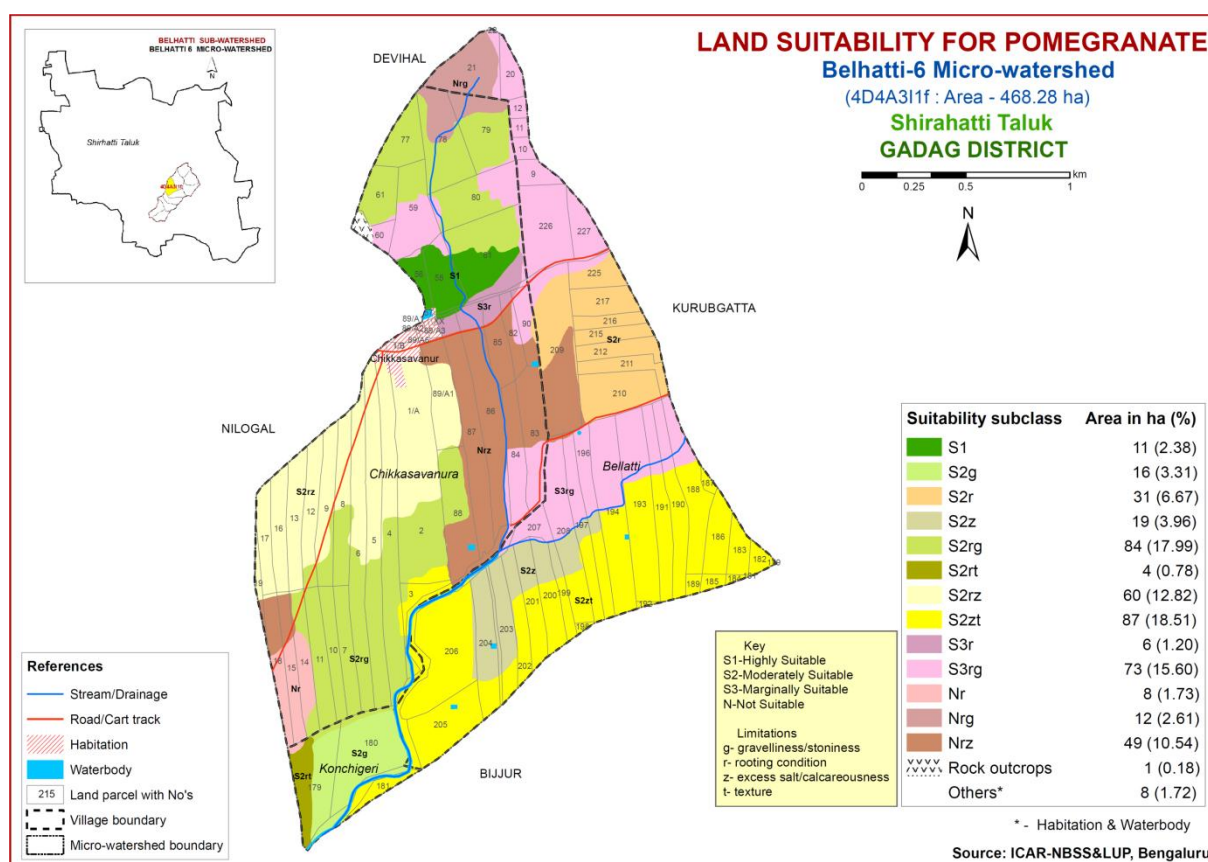
Fig. 7.8 Land Suitability map of Pomegranate

7.9 Land suitability for Mango (*Mangifera indica*)

Mango is the most important fruit crop grown in large area in almost all the districts of the State. The crop requirements (Table 7.10) for growing mango were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing mango was generated (Fig. 7.9).

A small area of about 11 ha (2%) in the microwatershed is moderately suitable (class S2) for growing mango and are distributed in the northern part of the microwatershed. They have minor limitations of rooting depth. The marginally suitable (class S3) lands cover maximum area of about 240 ha (69%) and are distributed in all parts of the microwatershed. They have moderate limitations of texture, rooting depth and calcareousness. An area of about 208 ha (45%) is not suitable for growing mango in the microwatershed and are distributed in the northeastern, central and southern part of the microwatershed. They have very severe limitations of gravelliness and rooting depth.

Table 7.10 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	
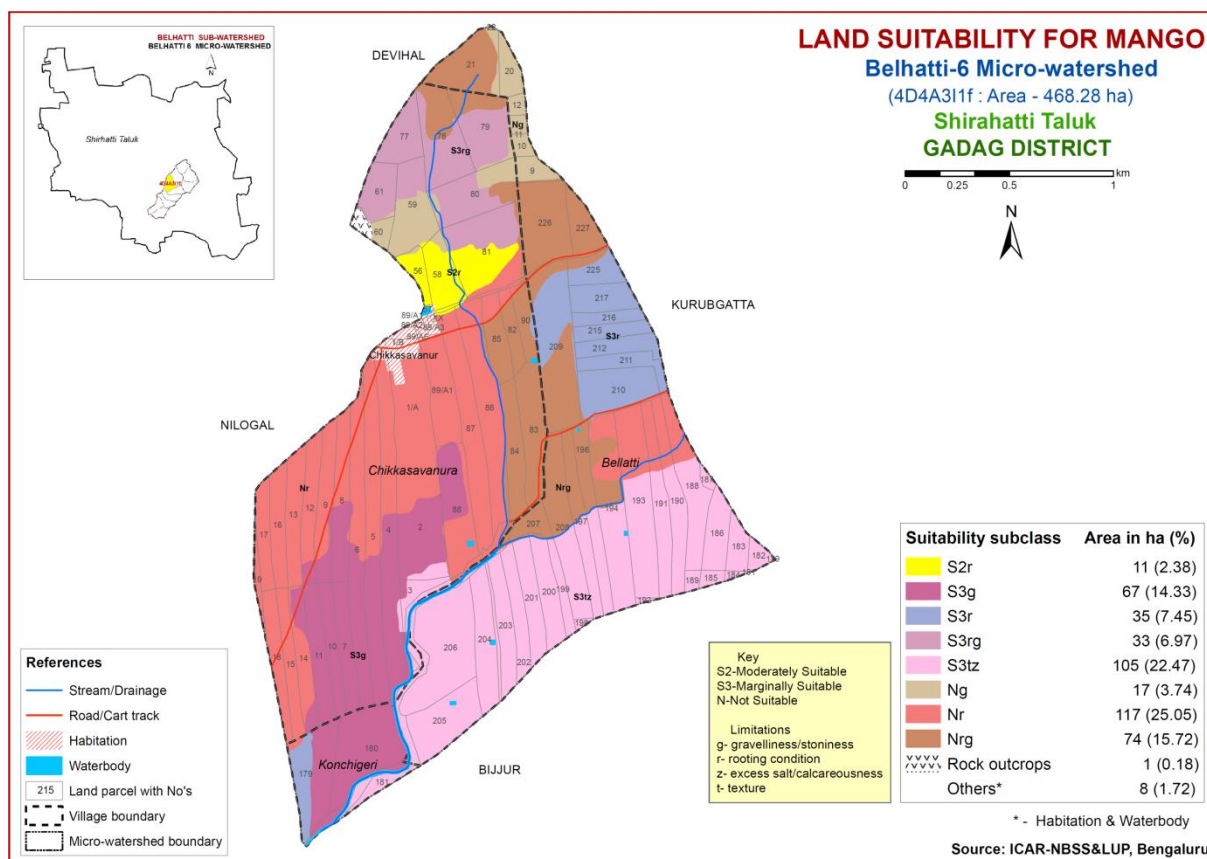
Fig. 7.9 Land Suitability map of Mango

7.10 Land suitability for Sapota (*Manilkara zapota*)

Sapota is the most important fruit crop grown in an area of 3.11 lakh ha in almost all the districts of the State. The crop requirements (Table 7.11) for growing sapota were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing sapota was generated (Fig. 7.10).

A very small area of about 11 ha (2%) in the microwatershed is highly suitable (class S1) for growing sapota. They have minor or no limitations for growing sapota and are distributed in the northern part of the microwatershed. Moderately suitable (class S2) lands found to occur in about 135 ha (29%). They have minor limitations of texture, gravelliness and rooting depth and are distributed in the southern and eastern part of the microwatershed. The marginally suitable (class S3) lands cover a maximum area of about 227 ha (48%) in the micowatershed and are distributed in all parts of the microwatershed. They have moderate limitations of gravellines, calcareousness and rooting depth. A small area of about 87 ha (19%) is not suitable for growing sapota and occur in the northern and small area in southern part of the microwatershed. They have very severe limitations of gravelliness and rooting depth.

Table 7.11 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
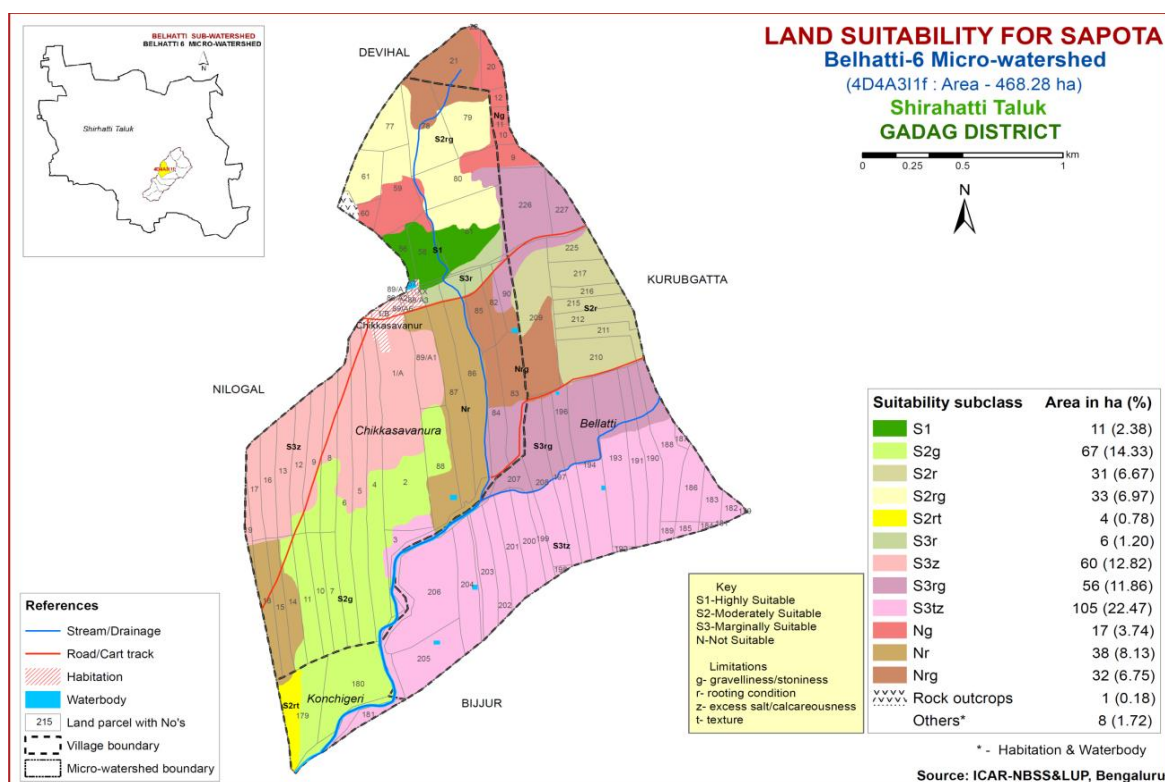
Fig. 7.10 Land Suitability map of Sapota

7.11 Land suitability for Guava (*Psidium guajava*)

Guava is the most important fruit crop grown in an area of 0.64 lakh ha in almost all the districts of the State. The crop requirements (Table 7.12) for growing guava were matched with the soil-site characteristics (7.1) and a land suitability map for growing guava was generated (Fig. 7.11).

A very small area of about 11 ha (2%) in the microwatershed is highly suitable (class S1) for growing Guava. They have minor or no limitations for growing guava and are distributed in the northern part of the microwatershed. About 131 ha (28%) area in the microwatershed is moderately suitable (class S2) for growing guava and are distributed in the northern and southern part of the microwatershed. They have minor limitations of gravelliness and rooting depth. The marginally suitable (class S3) lands cover a maximum area of about 231 ha (49%) and occur in all parts of the microwatershed. They have moderate limitations of gravelliness, texture, rooting depth and calcareousness. A small area of about 87 ha (19%) is not suitable for growing guava and occur in the northern and central part of the microwatershed. They have very severe limitations of gravelliness and rooting depth.

Table 7.12 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
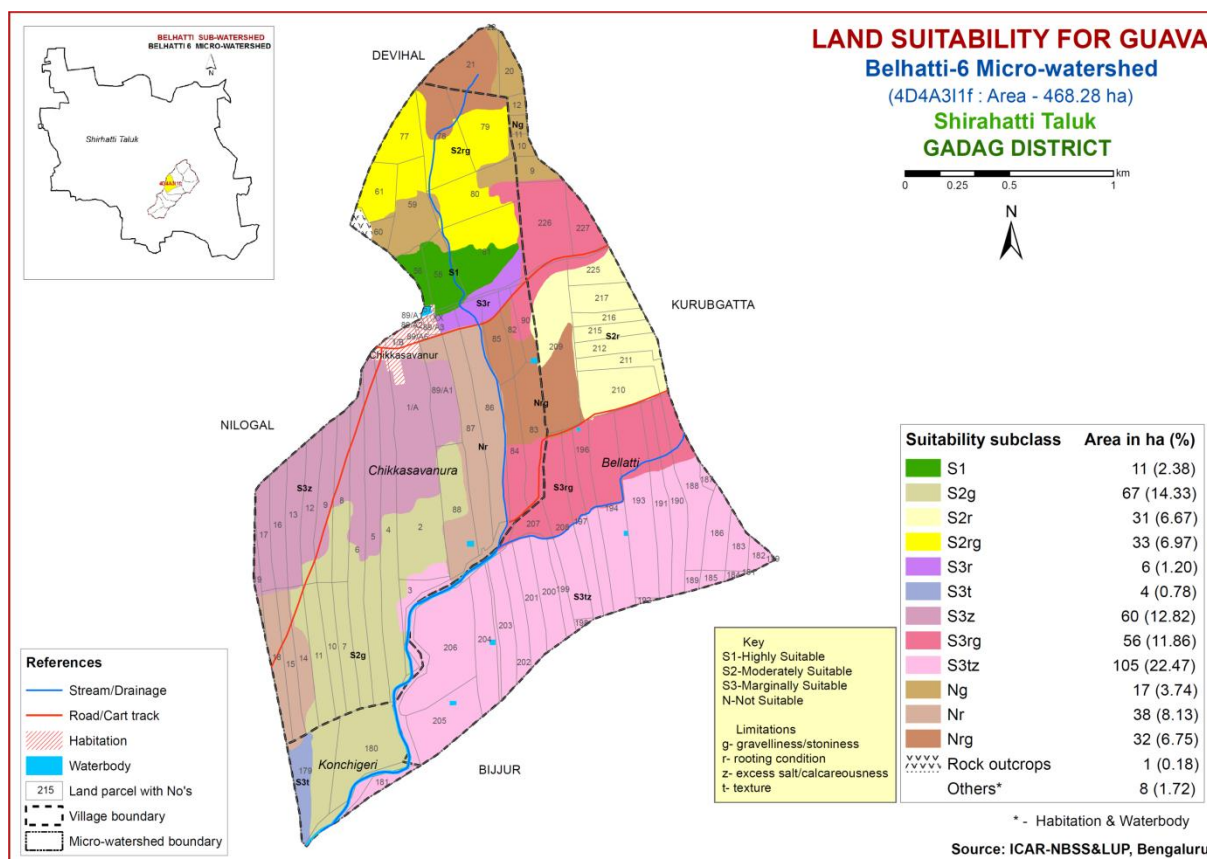
Fig. 7.11 Land Suitability map of Guava

7.12 Land Suitability for Jackfruit (*Artocarpus heterophyllus*)

Jackfruit is the most important fruit crop grown in almost all the districts of the State. The crop requirements for growing jackfruit were matched with the soil-site characteristics and a land suitability map for growing jackfruit was generated (Fig. 7.12).

Small area of about 78 ha (17%) is moderately suitable (class S2) for growing guava and are distributed in the northern and southern part of the microwatershed. They have minor limitations of gravelliness and rooting depth. The marginally suitable (class S3) lands cover a maximum area of about 294 ha (63%) and occur in all parts of the microwatershed. They have moderate limitations of gravelliness, texture, rooting depth and calcareousness. An area of about 87 ha (19%) is not suitable for growing jackfruit and occur in the central, northern and small area in the southwestern part of the microwatershed. They have very severe limitations of gravelliness and rooting depth.

74
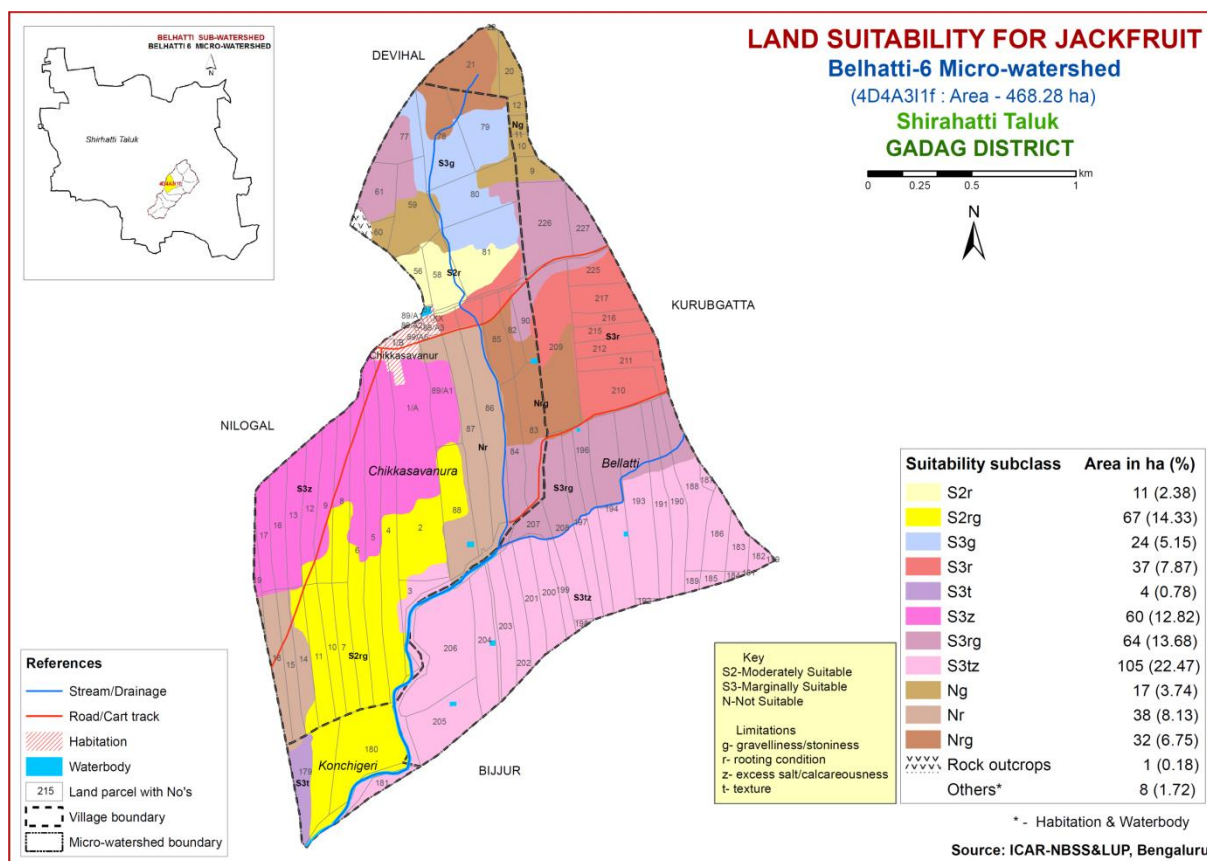
Fig. 7.12 Land Suitability map of Jackfruit

7.13 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 and a land suitability map for growing jamun was generated (Fig. 7.13).

An area of about 183 ha (39%) has soils that are moderately suitable (class S2) with minor limitations of texture, rooting depth, gravelliness and calcareousness and are distributed in the southeastern, southern and small area in northern part of the microwatershed. The marginally suitable (class S3) lands cover a maximum area of about 265 ha (39%) and occur in all parts of the microwatershed. They have moderate limitations of gravelliness, texture, rooting depth and calcareousness. A small area of about 87 ha (19%) is not suitable for growing jamun and occur in the northern part of the microwatershed. They have very severe limitations of gravelliness and rooting depth.
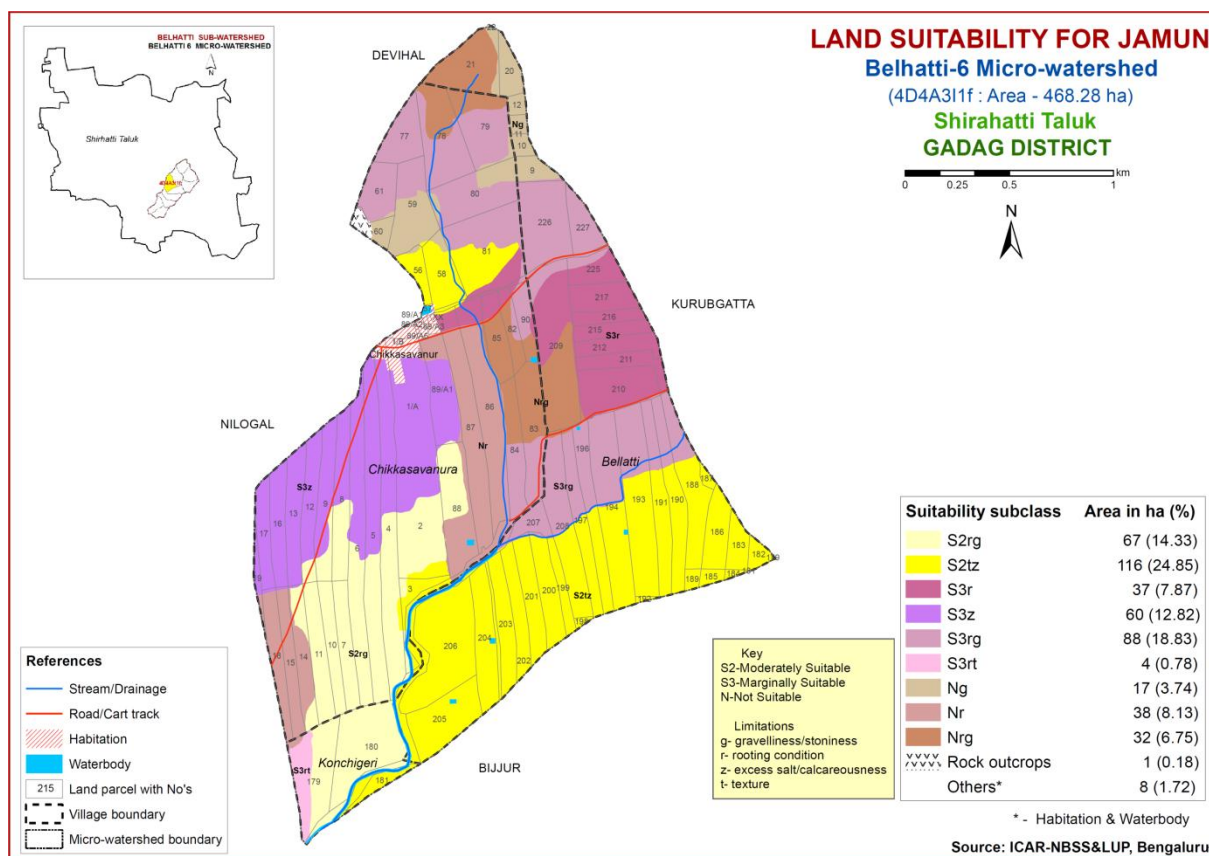
Fig. 7.13 Land Suitability map of Jamun

7.14 Land Suitability for Musambi (*Citrus limetta*)

Musambi is the important fruit crop grown in almost all the districts of the State. The crop requirements for growing musambi were matched with the soil-site characteristics and a land suitability map for growing musambi was generated (Fig. 7.14).

A very small area of about 11 ha (2%) in the microwatershed has soils that are highly suitable (class S1) for growing musambi crop. They have minor or no limitations for growing musambi and are distributed in the northern part of the microwatershed. Maximum area of about 231 ha (49%) has soils that are moderately suitable (class S2) with minor limitations of rooting depth, gravelliness and calcareousness. They are distributed in the central, northern and southern part of the microwatershed. The marginally suitable (class S3) lands cover about 130 ha (28%) and occur in the northern and central part of the microwatershed. They have moderate limitations of gravelliness, calcareousness and rooting depth. A small area of about 87 ha (19%) is not suitable for growing musambi and are distributed in the central and northern part of the microwatershed. They have very severe limitations of gravelliness and rooting depth.
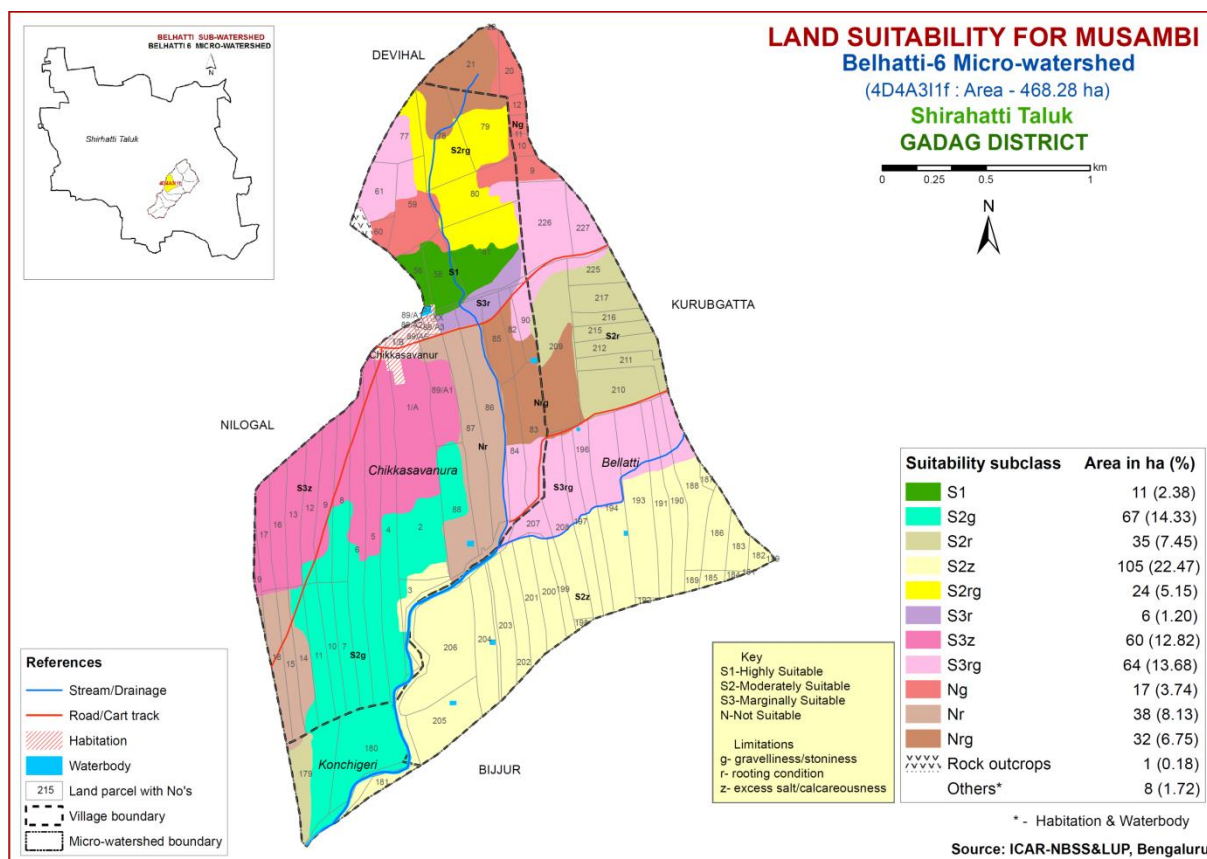
Fig. 7.14 Land Suitability map of Musambi

7.15 Land Suitability for Lime (*Citrus sp*)

Lime is one of the most important fruit crop grown in an area of 0.11 lakh ha in almost all the districts of the State. The crop requirements for growing lime (Table 7.13) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing lime was generated (Fig. 7.15).

A very small area of about 11 ha (2%) in the microwatershed has soils that are highly suitable (class S1) for growing lime. They have minor or no limitations for growing lime and are distributed in the northern part of the microwatershed. Maximum area of about 240 ha (51%) has soils that are moderately suitable (class S2) with minor limitations of rooting depth and calcareousness and are distributed in the central and eastern part of the microwatershed. The marginally suitable (class S3) lands cover about 122 ha (26%) and occur in the central and northern part of the microwatershed. They have moderate limitations of gravelliness, calcareousness and rooting depth. A small area of about 87 ha (19%) is not suitable for growing lime and occur in the northern part of the microwatershed. They have very severe limitations of gravelliness and rooting depth.

Table 7.13 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 24-27	31-35 20-23	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 calcareous	Upto 5	5-10	>10
Rooting conditions	Soil depth	Cm	>150	100-150	50-100	<50
	Gravel content	% vol.	Non gravelly	15-35	35-55	>55
Soil toxicity	Salinity	dS/m	Non saline	Upto 1.0	1.0-2.5	>2.5
	Sodicity	%	Non sodic	5-10	10-15	>15
Erosion	Slope	%	<3	3-5	5-10	
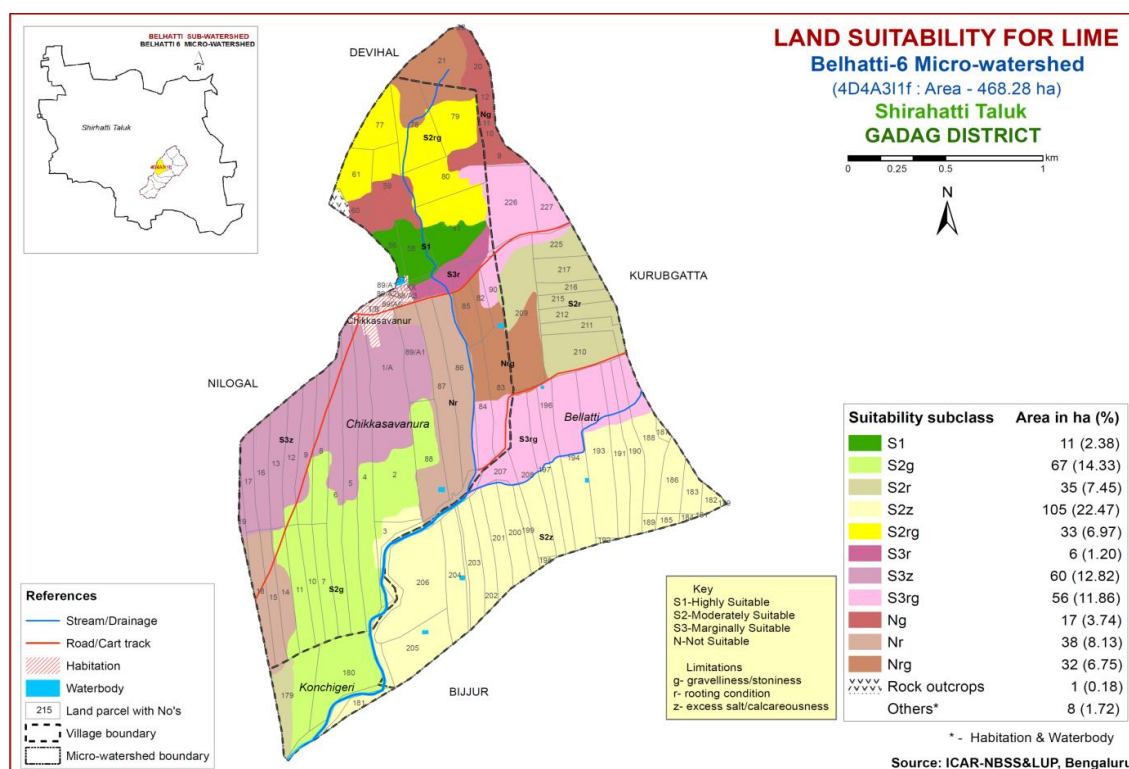
Fig. 7.15 Land Suitability map of Lime

**7.16 Land Suitability for Cashew (*Anacardium occidentale)*

Cashew is one of the most important fruit crop grown in an area of 1.24 lakh ha in almost all the districts of the State. The crop requirements for growing cashew (Table 7.13) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing cashew was generated (Fig. 7.15).

A very small area of about 11 ha (2%) in the microwatershed has soils that are highly suitable (class S1) for growing cashew. They have minor or no limitations for growing cashew and are distributed in the northern part of the microwatershed. Maximum area of about 236 ha (50%) has soils that are moderately suitable (class S2) with minor limitations of rooting depth, gravelliness and calcareousness and are distributed in the northern and central part of the microwatershed. The marginally suitable (class S3) lands cover a small area of about 61 ha (13%) and occur in the eastern and northern part of the microwatershed. They have moderate limitations of gravelliness and rooting depth. An area of about 151 ha (19%) is not suitable for growing cashew and occur in the central and northern part of the microwatershed. They have very severe limitations of gravelliness, texture, calcareousness and rooting depth.
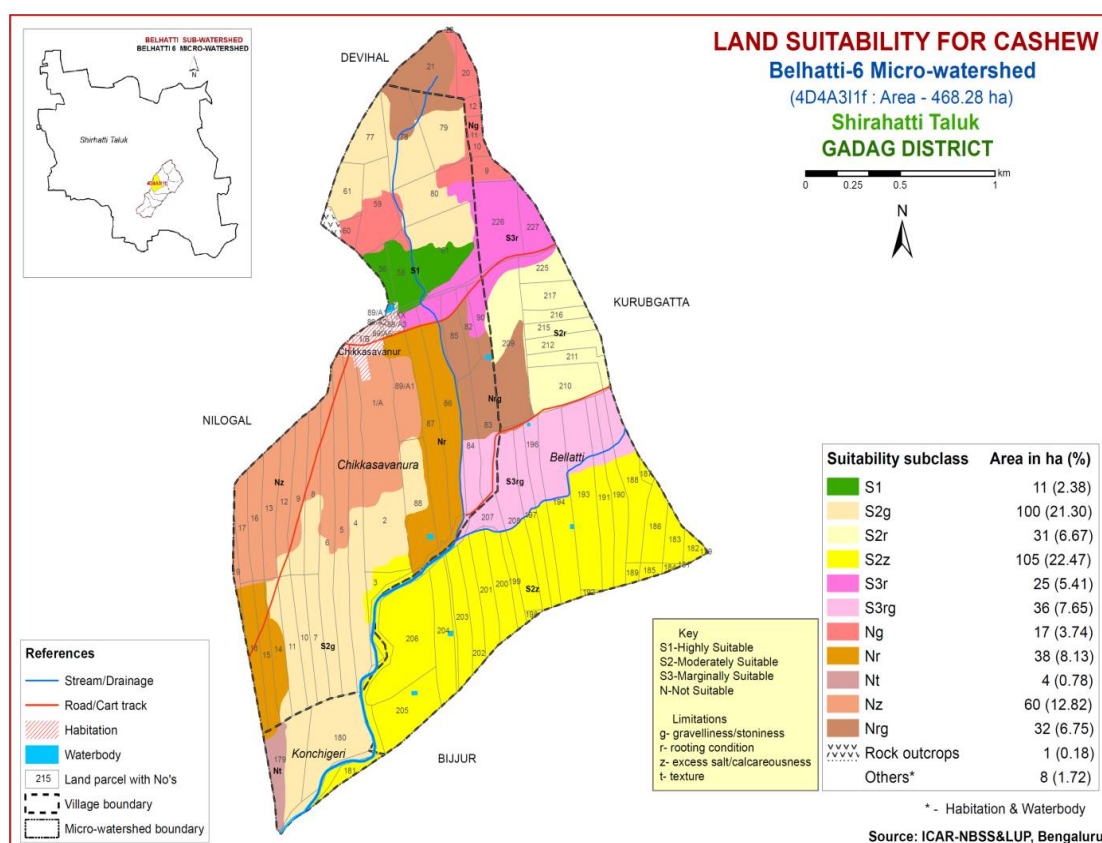
Fig. 7.16 Land Suitability map of Cashew

7.17 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 (Table 7.13) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing custard apple was generated (Fig. 7.15).

A small area of about 46 ha (10%) in the microwatershed has soils that are highly suitable (class S1) for growing custard apple. They have minor or no limitations for growing custard apple and are distributed in the northern and northeastern part of the microwatershed. Maximum area of about 327 ha (70%) has soils that are moderately suitable (class S2) with minor limitations of rooting depth, gravelliness and calcareousness and are distributed in all parts of the microwatershed. The marginally suitable (class S3) lands cover about 87 ha (19%) and occur in the central and northern part of the microwatershed. They have moderate limitations of gravelliness and rooting depth.
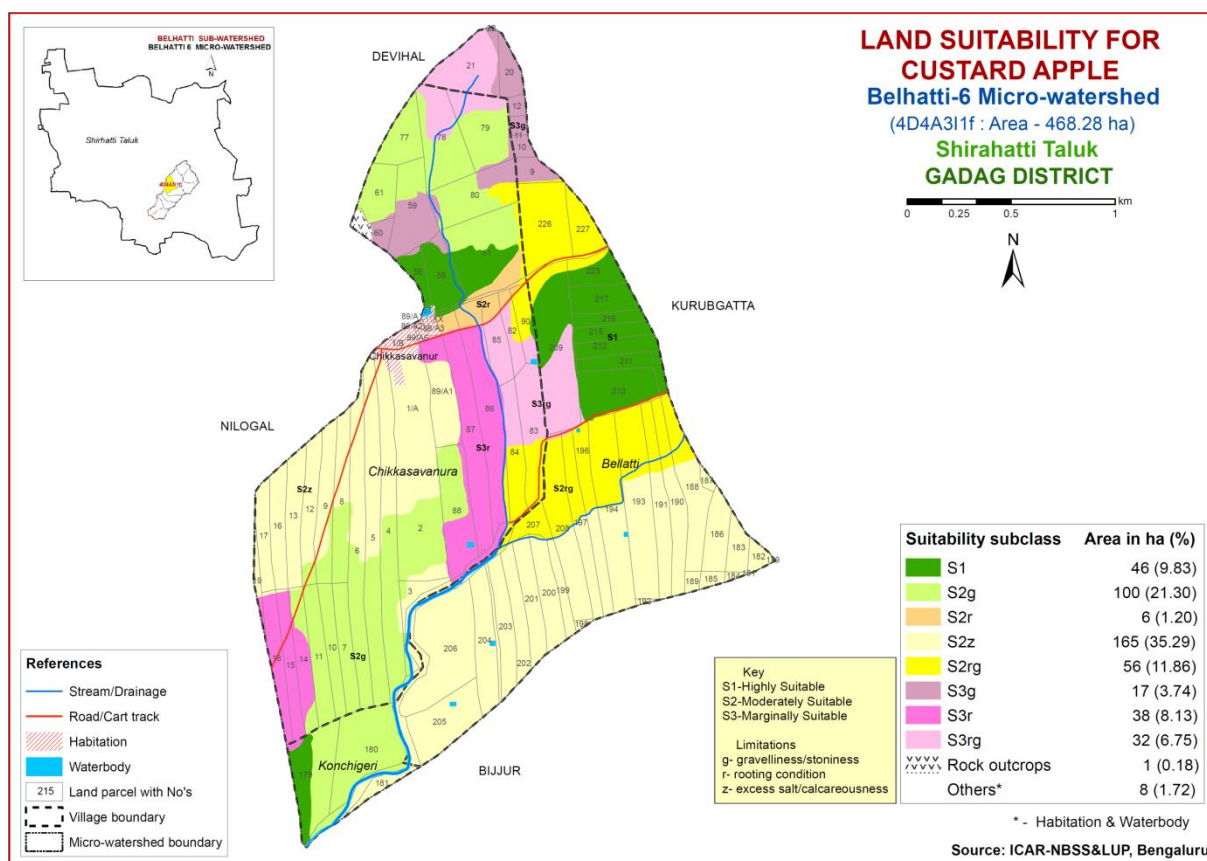
Fig. 7.17 Land Suitability map of Custard Apple

7.18 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 and a land suitability map for growing amla was generated (Fig. 7.18).

A small area of about 46 ha (10%) has soils that are highly suitable (class S1) for growing amla. They have minor or no limitations for growing amla and are distributed mainly in the northern and northeastern part of the microwatershed.. Maximum area of about 266 ha (57%) has soils that are moderately suitable (class S2) with minor limitations of rooting depth, gravelliness and calcareousness and are distributed in all parts of the microwatershed. The marginally suitable (class S3) lands cover about 147 ha (31%) area in the microwatershed and occur in the northern and central part of the microwatershed. They have moderate limitations of gravelliness, calcareousness and rooting depth.
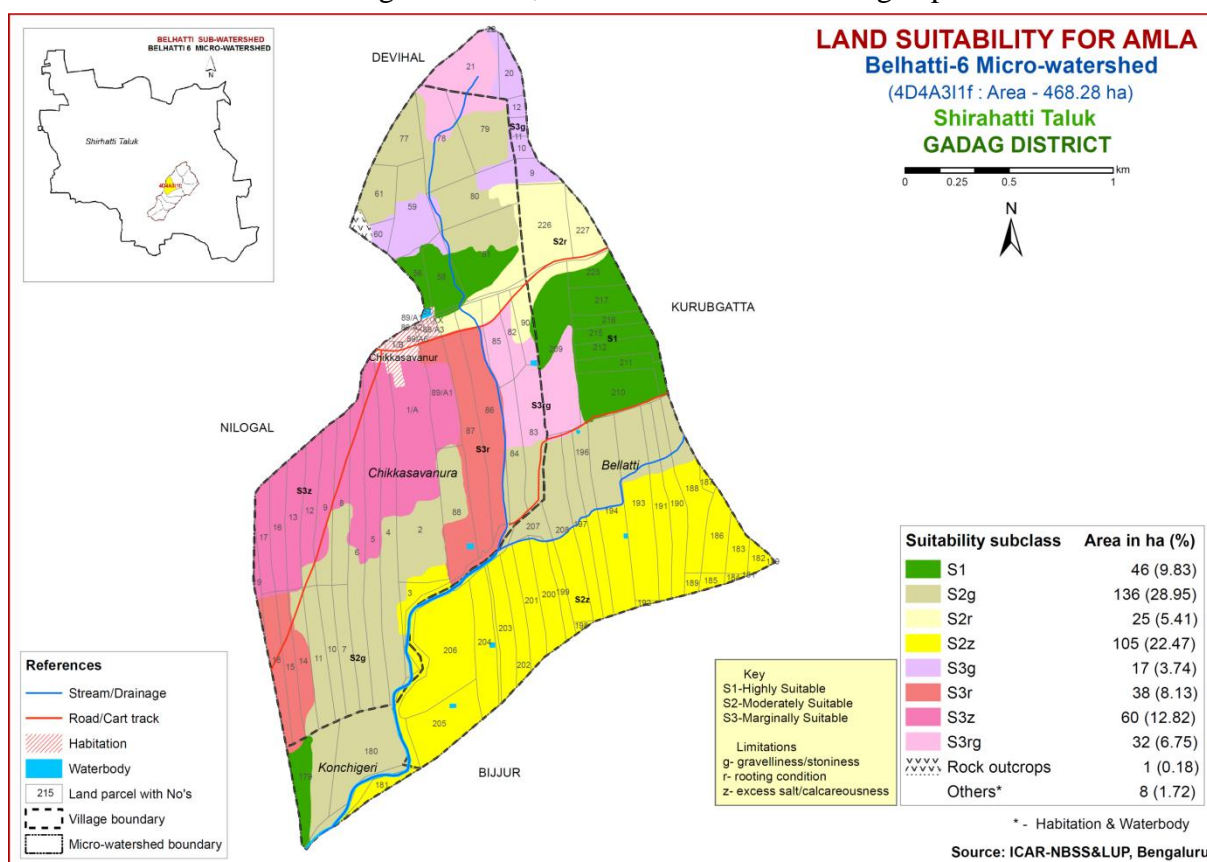
Fig. 7.18 Land Suitability map of Amla

7.19 Land Suitability for Tamarind (*Tamarindus indica*)

Tamarind is the most important spice crop grown in almost all the districts of the state. The crop requirements for growing tamarind were matched with the soil-site characteristics and a land suitability map for growing tamarind was generated. The area and geographical distribution of different suitability subclasses in the microwatershed is given in Fig. 7.19.

Area of about 183 ha (39%) has soils that are moderately suitable (class S2) with minor limitations of rooting depth, calcareousness and texture and are distributed in the eastern and southern part of the microwatershed. The marginally suitable (class S3) lands cover a small area of about 68 ha (14%) and occur in the northern part of the microwatershed. They have moderate limitations of rooting depth and texture. Major area of about 208 ha (45%) is not suitable for growing tamarind and occur in the northeastern, western and central part of the microwatershed. They have very severe limitations of rooting depth and gravelliness.
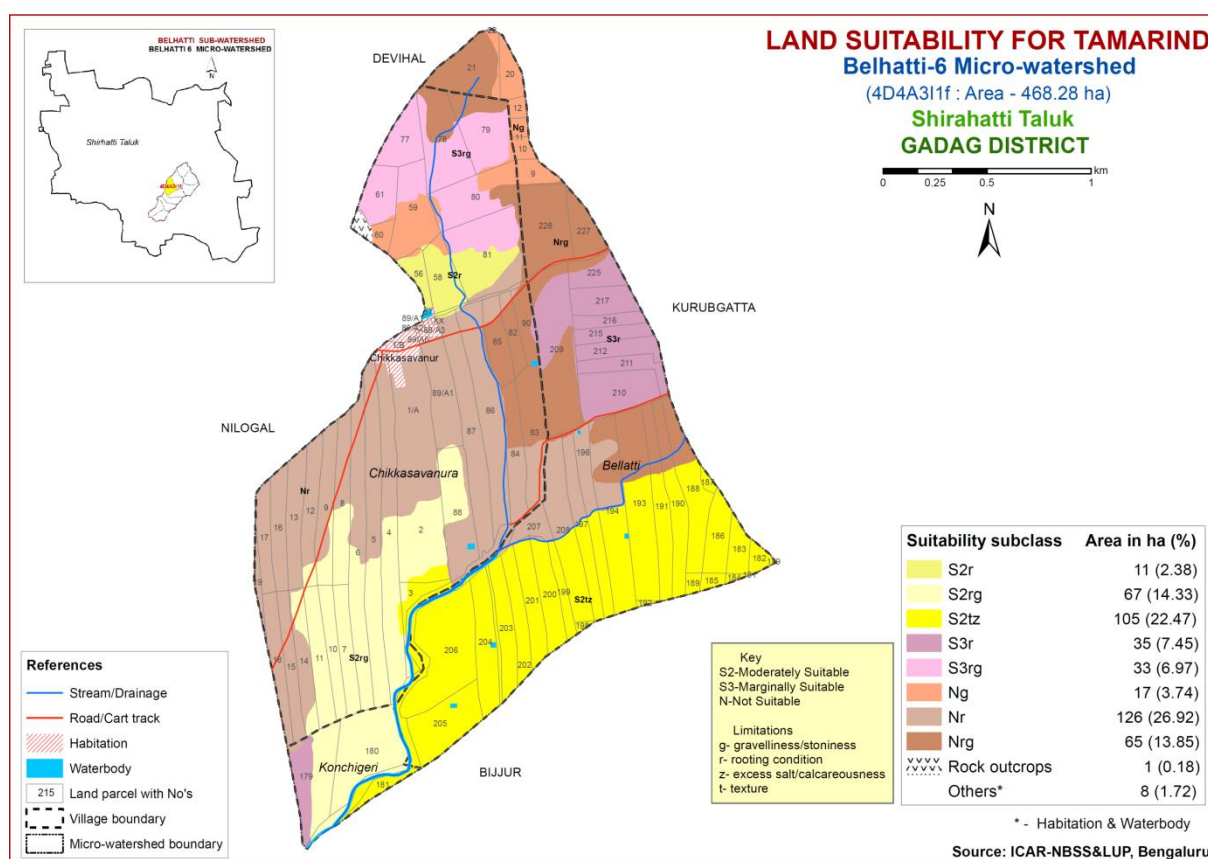
Fig. 7.19 Land Suitability map of Tamarind

7.20 Land Suitability for Marigold (*Tagetes erecta*)

Marigold is the most important flower crop grown in an area of 1858 ha in almost all the districts of the state. The crop requirements for growing marigold were matched with the soil-site characteristics and a land suitability map for growing marigold was generated. The area and geographical distribution of different suitability subclasses in the microwatershed is given in Fig. 7.20.

A small area of about 42 ha (9%) in the microwatershed has soils that are highly suitable (class S1) for growing marigold crop. They have minor or no limitations for growing marigold and are distributed mainly in the northern and northeastern part of the microwatershed. Major area of about 272 ha (58%) has soils that are moderately suitable (class S2) with minor limitations of gravelliness, rooting depth, texture and calcareousness and are distributed in all parts of the microwatershed. The marginally suitable (class S3) lands cover about 129 ha (28%) area and occur in the northern, central and southwestern part of the microwatershed. They have moderate limitations of calcareousness, rooting depth, gravelliness and texture. A very small area of about 17 ha (4%) is not suitable for growing marigold and occur in the northern part of the microwatershed. They have very severe limitation of gravelliness.
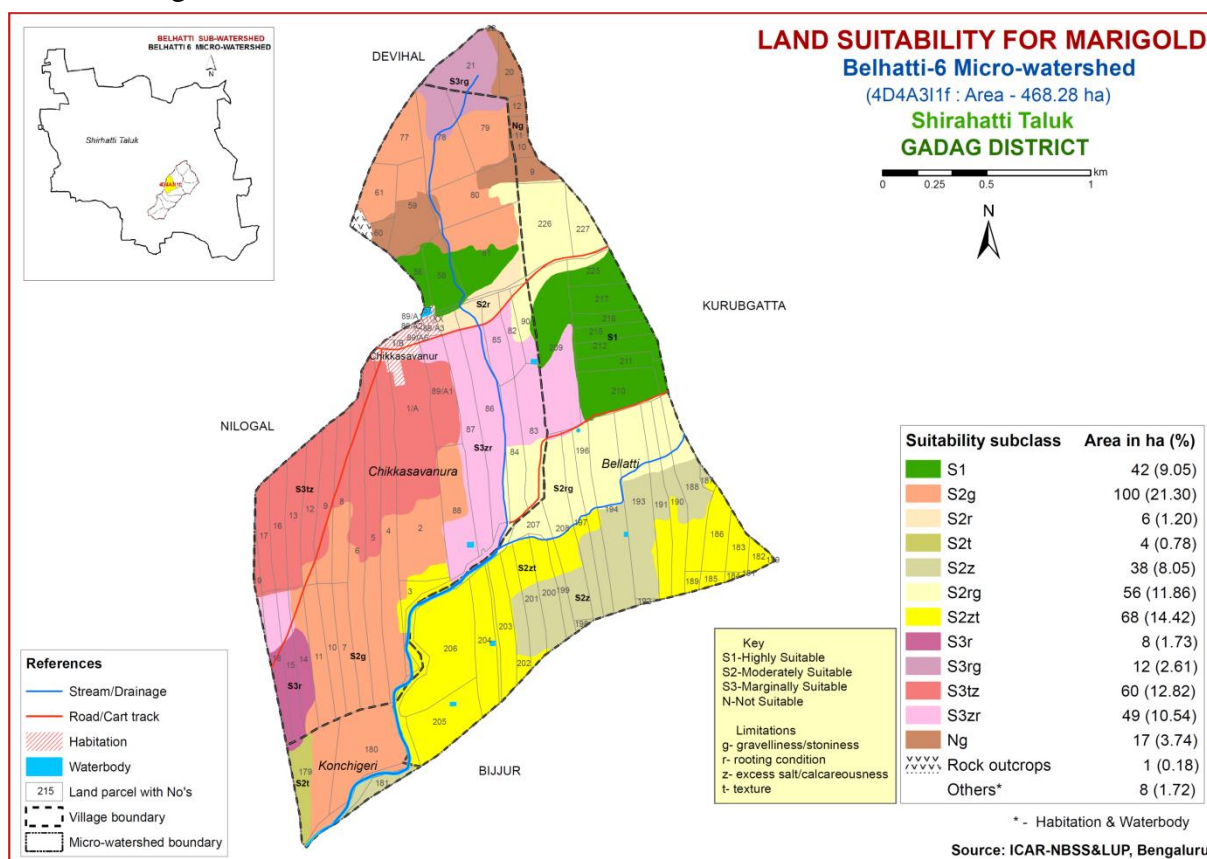
Fig. 7.20 Land Suitability map of Marigold

7.21 Land Suitability for Chrysanthemum (*Chrysanthemum indicum*)

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 for growing chrysanthemum were matched with the soil-site characteristics and a land suitability map for growing chrysanthemum was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed is given in Figure 7.21.

A small area of about 42 ha (9%) in the microwatershed has soils that are highly suitable (class S1) for growing chrysanthemum crop. They have minor or no limitations for growing chrysanthemum and are distributed mainly in the northern part of the microwatershed. Major area of about 272 ha (58%) has soils that are moderately suitable (class S2) with minor limitations of gravelliness, rooing depth, texture and calcareousness and are distributed in all parts of the microwatershed. The marginally suitable (class S3) lands cover about 129 ha (28%) area and occur in the northern, central and western part of the microwatershed. They have moderate limitations of rooting depth, gravelliness, calcareousness and texture. A very small area of about 17 ha (4%) is not suitable for growing chrysanthemum and occur in the northern part of the microwatershed. They have very severe limitations of gravelliness.
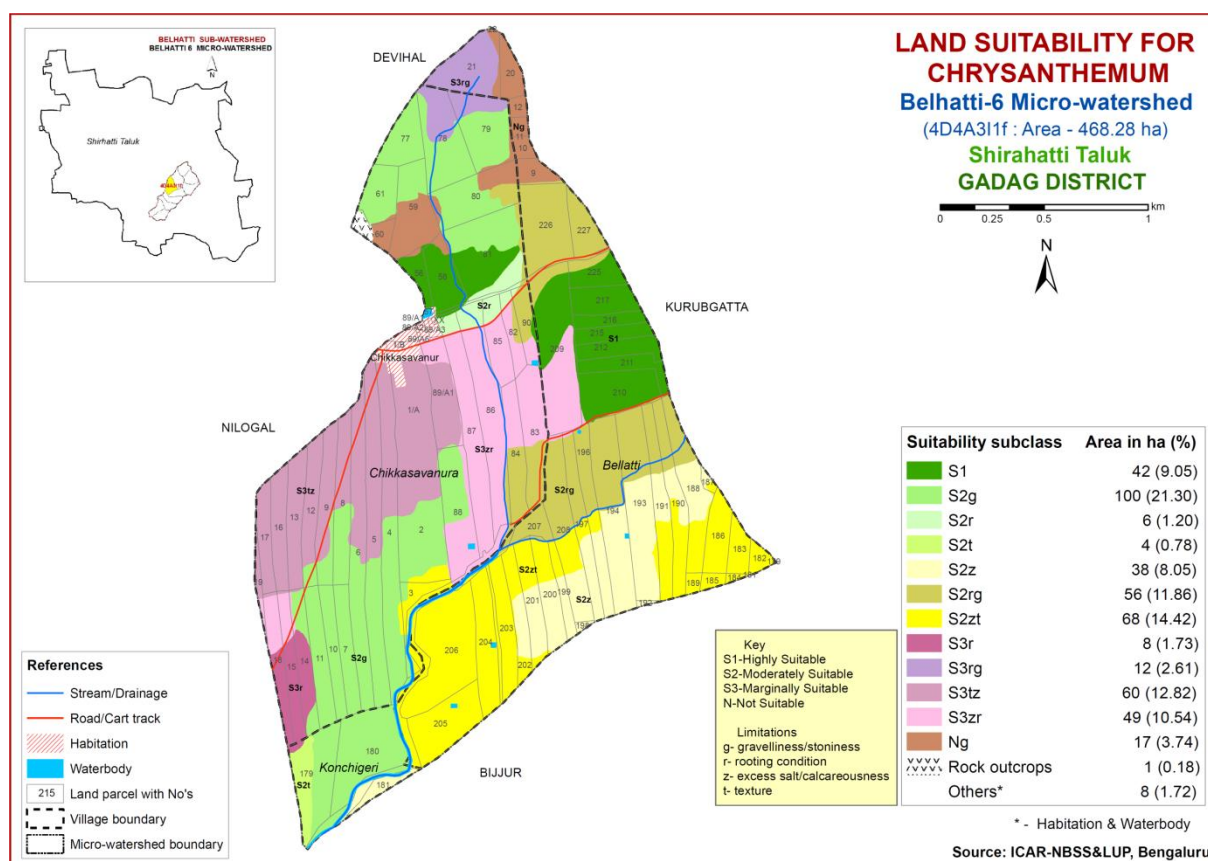
Fig. 7.21 Land Suitability map of Chrysanthemum

7.22 Land Management Units (LMUs)

The 30 soil map units identified in Belhatti-6 microwatershed have been regrouped into 8 Land Management Units (LMU's) for the purpose of preparing Proposed Crop Plan. Land Management Units are grouped based on the similarities in respect of the type of soil, the depth of the soil, the surface soil texture, gravel content, AWC, slope, erosion etc. and a Land Management Units map (Fig.7.22) has been prepared. These Land Management Units are expected to behave similarly for a given level of management.

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

LMU	Soil map unit number	Soil map units	Soil and site characteristics
1	28, 29, 30, 23, 24, 25, 26, 27, 17	BGPiB1, BGPiB1g1, BGPmB1, LGDiA1, LGDmA1g1, LGDmB1, LGDmB1g1, LGDmB2g2, KKRiA1	Very deep, gravelly cracking clay black soils with slopes of 0-3%, slight to moderate erosion and gravelly to very gravelly (15-60%)
2	22, 19, 20, 21	BPRiB2g1, BPRiB2g2, BPRmB2g1	Deep, gravelly red clayey soils with slopes of 1-3%, moderate erosion and gravelly to very gravelly (15-60%)
3	12, 13, 14, 15, 16,	GHTcB3g2, GHTcC3g2, GHTcC3g3, GHThB2g2, GHThB2g3R1St1,	Mod. deep red gravelly clayey soils with slopes of 1-5%, moderate to severe erosion and very gravelly to extremely gravelly (35-80%)
4	18	CKMiA1g1	Mod. deep red clayey soils with slopes of 0-1%, slight erosion and gravelly (15-35%)
5	10, 11	RNKmB1g1, RNKmB2g1	Moderately shallow, calcareous clay soils with slopes of 1-3%, slight to moderate erosion and gravelly (15-35%)
6	8, 9, 6, 7	KGHhB1g1, KGHhB2g2, LKRiB1g2, LKRiB2g2	Mod. shallow gravelly red loam soils with slopes of 1-3%, slight to moderate erosion and gravelly to very gravelly (15-60%)
7	3, 4, 5	MTLiB1g1, MTLmB1g1, MTLmB2g2	Shallow, black clayey soils with slopes of 1-3%, slight to moderate erosion and gravelly to very gravelly (15-60%)
8	1, 2	KNHhB1g1, HRVcB2g2	Shallow, red gravelly clay loam to clay soils with slopes of 1-3%, slight to moderate erosion and gravelly to very gravelly (15-60%)
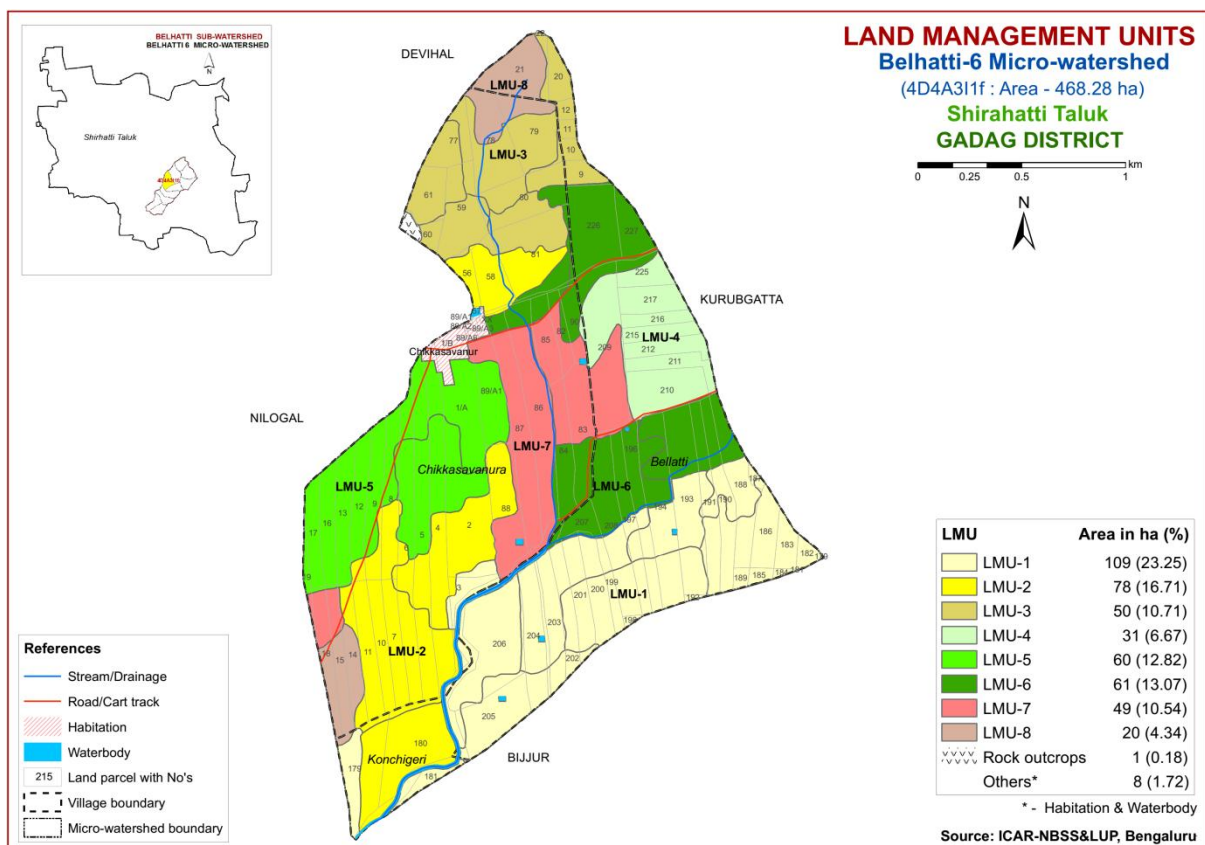
Fig. 7.22 Land Management Units Map- Belhatti-6 Microwatershed

7.23 Proposed Crop Plan for Belhatti-6 microwatershed

After assessing the land suitability for the 21 crops, the proposed crop plan has been prepared for the 8 identified LMUs by considering only the highly (class S1) and moderately (class S2) suitable lands for each of the 21 crops. The resultant proposed crop plan is presented below in Table 7.14

Table 7.14 Proposed Crop Plan for Belhatti-6 Microwatershed

LMU No	Mapping Units	Survey Number	Field Crops/Forestry	Suitable Horticulture Crops under Irrigation	Horticulture Crops with suitable Interventions	Recommended Interventions
LMU1 Area (109 ha)	28, 29, 30, 23, 24, 25, 26, 27, 17 (75-150 cm)	Belhati: 179,181,182,183, 184,185,186,187, 188,189,190,191, 192,198,199,200, 201,202,203,204, 205, 206 Chikkasavanura: 3 Konchigeri: 181	Redgram, Sorghum, Bajra, Cotton, Safflower, Bengal gram **Multiple/crop rotation:** Redgram+Fodder Sorghum, Pulses-Sorghum	**Vegetables**: Green Chillies, Bhendi, Drumstick **Flower crops:** Marigold, Gaillardia, Aster **Fruit crops:** Banana, lime, pomegranate	**Flower Crops:** Marigold, Gaillardia, Tuberose, Chrysanthemum **Perenial Components:** Tamarind, Custard Apple, Amla, Lime, Moosambi, Pomegranate **Vegetables**: Chillies, Bhendi, Crucifers	Drip irrigation, Mulching, suitable conservation practices (Crescent Bunding with Catch Pit etc)
LMU 2 Area (78 ha)	22, 19, 20, 21 (100-150 cm)	Chikkasavanura: 2,4,6,7,8,10,11,56, 58 Konchigeri: 179,180	Ragi, Maize, Groundnut, Sorghum, Sunflower, Bajra, Sesamum, Castor	**Perennial Component:** Mango, Tamarind, Aonla, Pomelo **Intercrops:** Groundnut, Hebbal Avare, Clusterbean, Coriander **Vegetables:** Tomato, Green Chillies, French Bean, Bhendi, Vegetable Cowpea, Cucurbits **Flower Crops:** Marigold, Gaillardia	Mango, Sapota, Guava, Lime, Banana, Papaya, Jamun **Mixed Orcharding:** Mango+Guava+Drumsticks+ Curryleaf Sapota+Guava+Drumsticks+ Curry leaf **Vegetables**: Tomoto, Capsicum, Green Chillies, French Bean, Bhendi, Crucifers, Cucurbits **Flower Crops:** Tuberose, Aster, Chrysanthemum, Rose, Jasmine, Spider Lilly	Drip irrigation, Mulching, suitable conservation practises

LMU 3 Area (50 ha)	12, 13, 14, 15, 16 (75-100 cm)	Belhatti: 9,10,11,12,20,22, Chikkasavanura: 59,60,61,77,78,79,80,81	Ragi, Maize, Groundnut, Sorghum, Sunflower, Bajra, Sesamum, Castor	**Perennial Component:** Mango, Tamarind, Aonla, Pomelo **Intercrops:** Groundnut, Hebbal Avare, Clusterbean, Coriander **Vegetables:** Green Chillies, French Bean, Bhendi, Vegetable Cowpea, Cucurbits **Flower Crops:** Marigold, Gaillardia	Mango, Sapota, Guava, Lime, Papaya, Jamun, Custard apple, lime **Mixed Orcharding:** Mango+Guava+Drumsticks+ Curry leaf Sapota+Guava+Drumsticks+Curry leaf **Vegetables**:Capsicum, Green Chillies, French Bean, Bhendi **Flower Crops:** Tuberose, Aster, Chrysanthemum, Rose, Jasmine, Spider Lilly	Drip irrigation, Mulching, suitable conservation practises
LMU 4 Area (31 ha)	18 (75-100 cm)	Belhatti: 188,194,196,209, 210,211,212,215, 216,217, 225 Chikkasavanura: 83, 90	Ragi, Maize, Groundnut, Sorghum, Sunflower, Bajra, Sesamum, Castor	**Perennial Component:** Mango, Tamarind, Aonla, Pomelo **Intercrops:** Groundnut, Hebbal Avare, Clusterbean, Coriander **Vegetables**:Tomato, Onion, Green Chillies, French Bean, Bhendi, Vegetable Cowpea, Cucurbits **Flower Crops:** Marigold, Gaillardia	Mango, Sapota, Guava, Lime, Papaya, Jamun, Custard apple, lime **Mixed Orcharding:** Mango+Guava+Drumsticks+ Curry leaf Sapota+Guava+Drumsticks+Curry leaf **Vegetables**:Capsicum, Green Chillies, French Bean, Bhendi **Flower Crops:** Tuberose, Aster, Chrysanthemum, Rose, Jasmine, Spider Lilly	

LMU 5 Area (60 ha)	10, 11 (50-75 cm)	Chikkasavanura: 1/A,5,9,12,13,16,17 ,19,89/A1	Sorghum, Cotton, Bajra, Bengal gram, Safflower, Redgram	**Vegetables:** Chillies, Tomato, Bhendi, Cabbage, Drumstick, Onion, Ridge Gouard, Ashguard	Bear, Fig, Aonla, Pomelo	-do-
LMU 6 Area(61 ha)	8, 9, 6, 7 (50-75 cm)	Belhatti: 193,194,196,197,20 7,208,226,227 Chikkasavanura: 84,90	Ragi, Sorghum, Maize, Bajra, Horsegram, Castor	Bear, Fig, Aonla, Bael, Wood Apple	Custard Apple, Bear, Fig, Aonla, Pommelo	-do-
LMU 7 Area (49 ha)	3, 4, 5 (25-50 cm)	Belhatti:209 Chikkasavanura: 82,83,85,86,87,88	Bengalgram, Cowpea, Greengram	-	-	-do-
LMU 8 Area (20 ha)	1, 2 (25-50 cm)	Belhatti:21 Chikkasavanura: 14,15,18	Groundnut, Horsegram, Greengram **Silviculture:** Simaruba, *Acacia auriculiformis,* Glyricidia, Subabul, Agave, Cassia sp.	-	-	-do-

SOIL HEALTH MANAGEMENT

8.1 Soil Health

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

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

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

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

Characteristics of Belhatti-6 Microwatershed
  ❖ The soil phases with sizeable area identified in the microwatershed belonged to the soil series of LGD (70 ha), BPR (67 ha), RNK (60 ha), GHT (50 ha), MTL (49 ha), BGP (37 ha), LKR (36 ha), CKM (31 ha), KGH (25 ha), HRV (12 ha), VDH (11 ha), KNH (8 ha) and KKR (4 ha).
  ❖ As per land capability classification, nearly 98 per cent area falls under arable land category (Class II, III and IV). The major limitations identified in the arable lands were soil and erosion.

❖ On the basis of soil reaction, about 95 ha (20%) area is moderately alkaline (pH 7.8-8.4) and about 81 ha (17%) is under slightly alkaline (pH 7.3-7.8). Maximum area of about 231 ha (49%) is under strongly alkaline (pH 8.4-9.0) and a very minor area of about 6 ha (1%) is under very strongly alkaline (pH >9.0). An area of about 47 ha (10%) 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.

Alkaline soils

(Slightly alkaline to moderately alkaline soils)

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

Neutral soils

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

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

Soil Degradation

Soil erosion is one of the major factor affecting the soil health in the microwatershed. Out of total 468 ha area in the microwatershed, major area of 210 ha is suffering from moderate and severe erosion. These areas need immediate soil and water conservation and, other land development and land husbandry practices for restoring soil health.

Disseminate information and communicate 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 younger farmers.

Inputs for Net Planning and Interventions needed

Net planning in IWMP is focusing on preparation of

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

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

❖ **Soil Depth:** The depth of a soil decides the amount of moisture and nutrients it can hold, what crops can be taken up or not, depending on the rooting depth and the length of growing period available for raising any crop. Deeper the soil, better for a wide variety of crops. If sufficient depth is not available for growing deep rooted crops, either choose medium or short duration crops or deeper planting pits need to be opened and additional good quality soil brought from outside has to be filled into the planting pits.

❖ **Surface soil texture:** Lighter soil texture in the top soil means, better rain water infiltration, less run-off and soil moisture conservation, less capillary rise and less evaporation losses. Lighter surface textured soils are amenable to good soil tilth and are highly suitable for crops like groundnut, root vegetables (carrot, raddish, potato etc) but not ideal for crops that need stagnant water like lowland paddy. Heavy textured soils are poor in water infiltration and percolation. They are prone for sheet erosion; such soils can be improved by sand mulching. The technology that is developed by the AICRP-Dryland Agriculture, Vijayapura, Karnataka can be adopted.

❖ **Gravelliness:** More gravel content is favorable for run-off harvesting but poor in soil moisture storage and nutrient availability. It is a significant parameter that decides the kind of crop to be raised.

❖ **Land Capability Classification:** The land capability map shows the areas suitable and not suitable for agriculture and the major constraints in each of the plot/survey number. Hence, one can decide what kind of enterprise is possible in each of these units. In general, erosion and soil are the major constraints in Belhatti-6 microwatershed.

❖ **Organic Carbon:** The OC content is medium (0.5-0.75%) in about 296 ha (63%) area and it is low (<0.5%) in 164 ha (35%) 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 460 ha area where OC is low <0.5% and medium (0.5-0.75%). For example, for rainfed maize, recommended level is 50 kg N per ha and an additional 12 kg /ha needs to be applied for all the crops grown in these plots.

❖ **Available Phosphorus**: In 340 ha (76%) area, the available phosphorus is low and about 89 ha (19%) area it is medium in available phosphorus, Hence for all the crops, 25% additional P-needs to be applied. It is high (>57 kg/ha) in 31 ha (7%) area.

❖ **Available Potassium:** Available potassium is medium in 335 ha (71%) area of the microwatershed whereas it is low in 6 ha (1%). Hence, in all these plots, for all the crops, an additional 25 % potassium may be applied. It is high in 119 ha (25%) area of the microwatershed.

❖ **Available Sulphur:** Available sulphur is a very critical nutrient for oilseed crops. It is low in 106 ha (23%) area of the microwatershed and medium in 107 ha (23%).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. About 246 ha (53%) is high in available sulphur.

❖ **Available iron:** It is deficient in a small area of 74 ha (16%) in the microwatershed. To manage iron deficiency, iron sulphate @ 25kg /ha needs to be applied for 2-3 years. It is sufficient in the rest of 386 ha (82 %) area in the microwatershed.

❖ **Available Zinc:** It is deficient in the entire area of the microwatershed. Application of zinc sulphate @25kg/ha is to be applied.

❖ **Soil alkalinity:** The microwatershed has 413 ha area with soils that are slightly to very strongly alkaline. These areas need application of gypsum and wherever calcium is in excess, iron pyrites and element sulphur can be recommended. Management practices like treating repeatedly with good quality water to drain out the excess salts and provision of subsurface drainage and growing of salt tolerant crops like Casuarina, Acasia, Neem, Ber etc, are recommended.

Land Suitability for various crops: Areas that are highly, moderately and marginally suitable for growing various crops are indicated. Along with the suitability, various constraints that are limiting the productivity are also indicated. For example, in case of cotton, gravel content, rooting depth and salinity/alkalinity are the major constraints in various plots. With suitable management interventions, the productivity can be enhanced. In order to increase water holding capacity of light textured soils, growing of green manure crops and application of organic manure is recommended.

SOIL AND WATER CONSERVATION TREATMENT PLAN

For preparing soil and water conservation treatment plan for Belhatti-6 Microwatershed, the land resource inventory database generated under Sujala-III project has been transformed as information through series of interpretative (thematic) maps using soil phase map as a base. The various thematic maps (1:7920 scale) generated were

- Soil depth
- Surface soil texture
- Available water capacity
- Soil slope
- Soil gravelliness
- Land capability
- Present land use and land cover
- Crop suitability maps
- Rainfall map
- Hydrology
- Water Resources
- Socio-economic data
- Contour plan with existing features- Network of waterways, pothissa boundaries, cut up/ minor terraces etc.
- Cadastral map (1:7920 scale)
- Satellite imagery (1:7920 scale)
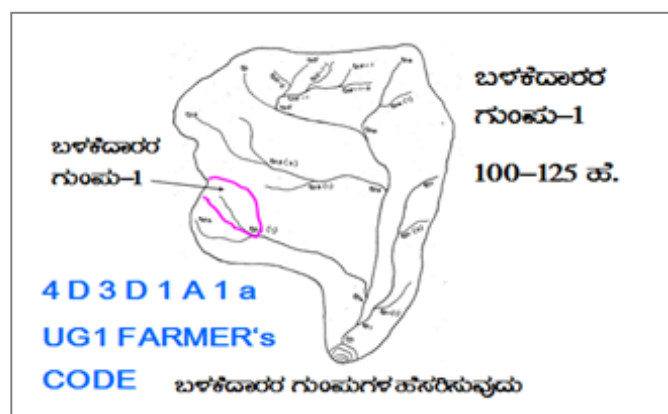
Apart from these, Hand Level/ Hydro Marker/ Dumpy Level/ Total Station and Kathedars' List has to be collected.

Steps for Survey and Preparation of Treatment Plan

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

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

9.1 Treatment Plan

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

9.1.1 Arable Land Treatment
A. BUNDING

Steps for Survey and Preparation of Treatment Plan	
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)

USER GROUP-1

CLASSIFICATION OF GULLIES

ಕೊರಕಲಿನ ವರ್ಗೀಕರಣ

UPPER REACH — ಮೇಲ್ಸ್ತರ 15 Ha.

MIDDLE REACH — ಮಧ್ಯಸ್ತರ 15 +10=25 ಹೆ.

LOWER REACH — ಕೆಳಸ್ತರ 25 ಹೆಕ್ಟರ್ ಗಿಂತ ಅಧಿಕ

POINT OF CONCENTRATION
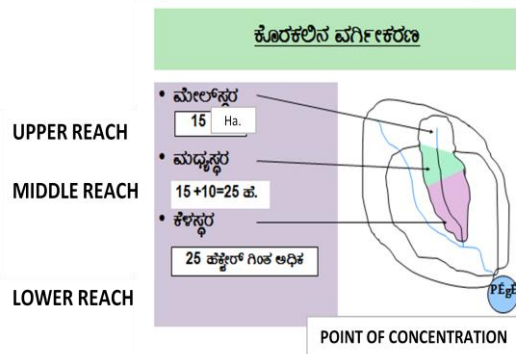
Measurement of Land Slope

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.

HAND LEVEL

SPIRIT LEVEL

EYE END

OBJECT END

HYDRO MARKER (WATER TUBE) STOP

GRADUATED SCALE

1.5
1.0
0.5
0.0

0.6

1.5

1.5
1.0
0.5
0.0

TUBE

A

FALL: 1.5 - 0.6 = 0.9 m.
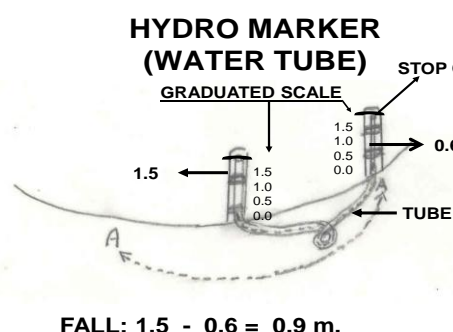
Vertical and Horizontal intervals between bunds as recommended by the Watershed Development Department.

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

Note: (i) The above intervals are maximum.

(ii) Considering the slope class and erosion status (A1….) 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 - loamy sand, <15% gravel). The recommended Sections for different soils are given below.

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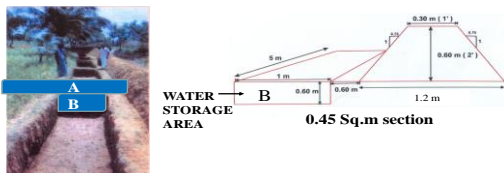
Top width (m)	Base width (m)	Height (m)	Side slope (Z:1;H:V)	Cross section (sq m)	Soil Texture	Remarks
0.3	0.9	0.3	01:01	0.18	Sandy loam	Vegetative bund
0.3	1.2	0.3	1.5:1	0.225	Sandy clay	
0.3	1.2	0.5	0.9:1	0.375	Red gravelly soils	
0.3	1.2	0.6	0.75:1	0.45		
0.3	1.5	0.6	01:01	0.54	Red sandy loam	
0.3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

Formation of Trench cum Bund

Dimensions of the Borrow Pits/ Trenches to be excavated (machinery are decided considering the Bund Section).
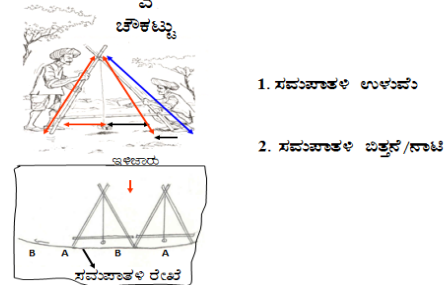
Details of Borrow Pit dimensions are given below

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

Bund section	Bund length	Earth quantity	Pit				Berm (pit to pit)	Soil depth class
m²	m	m³	L(m)	W (m)	D (m)	QUANTITY (m³)	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

   a) Existing waterways are marked on the cadastral map (1:7920 scale) and their dimensions are recorded.
   b) Considering the contour plan of the MWS, additional waterways/ modernization of the existing ones can be thought of.
   c) 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 Bunds 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 in water budgeting and quality of water in the wells and site suitability.

e) Detailed Levelling Survey using Dumpy Level / Total Station has to be carried out to arrive at the site-specific designs as shown in the Manual.

f) The location of ground water recharge structures are decided by examining the lineaments and fracture zones from geological maps.

g) Rainfall intensity data of the nearest Rain gauge station is considered for Hydrologic Designs.

h) Silt load to the Storage/Recharge structures is reduced by providing vegetative, boulder and 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 prepared which shows the spatial distribution and extent of area. An area of about 210 ha (45%) requires trench cum bunding and maximum area of about 249 ha (53%) area needs graded bunds or strengthening of existing bunds. The conservation plan prepared may be presented to all the stakeholders including farmers and

after including their suggestions, the conservation plan for the microwatershed may be finalised in a participatory approach.
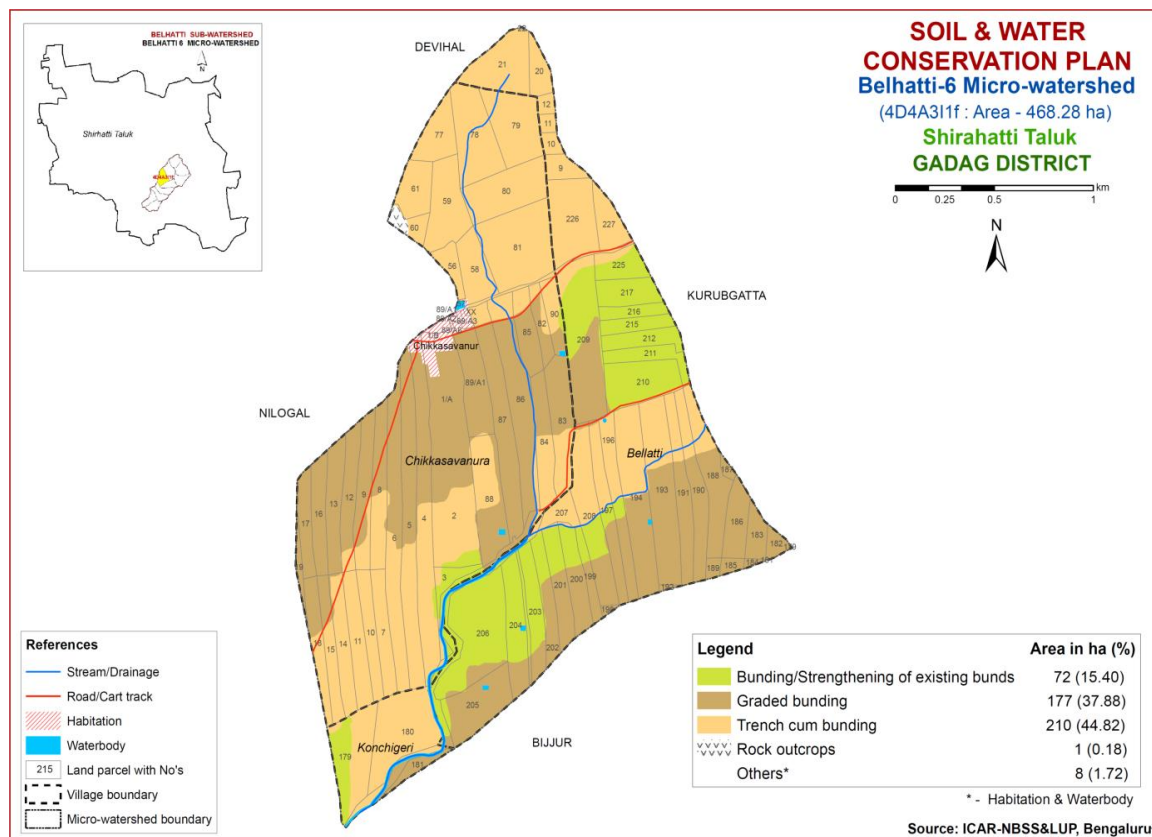
Fig. 9.1 Soil and Water Conservation Plan map of Belhatti-6 Microwatershed

9.3 Greening of Microwatershed

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

It is recommended to open pits during the 1st week of March along the contour and heap the dug out soil on the lower side of the slope in order to harness the flowing water and facilitate weathering of soil in the pit. Exposure of soil in the pit also prevents spread of pests and diseases 0due 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*.

100

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

References

1. FAO (1976) Framework for Land Evaluation, Food and Agriculture Organization, Rome.72 pp.

2. FAO (1983) Guidelines for Land Evaluation for Rainfed Agriculture, FAO, Rome, 237 pp.

3. IARI (1971) Soil Survey Manual, All India Soil and Land Use Survey Organization, IARI, New Delhi, 121 pp.

4. Katyal, J.C. and Rattan, R.K. (2003) Secondary and Micronutrients; Research Gap and future needs. Fert. News 48 (4); 9-20.

5. Naidu, L.G.K., Ramamurthy, V., Challa, O., Hegde, R. and Krishnan, P. (2006) Manual Soil Site Suitability Criteria for Major Crops, NBSS Publ. No. 129, NBSS &LUP, Nagpur, 118 pp.

6. Natarajan, A. and Dipak Sarkar (2010) Field Guide for Soil Survey, National Bureau of Soil Survey and Land Use Planning (ICAR), Nagpur, India.

7. Natarajan, A., Rajendra Hegde, Raj, J.N. and Shivananda Murthy, H.G. (2015) Implementation Manual for Sujala-III Project, Watershed Development Department, Bengaluru, Karnataka.

8. Sarma, V.A.K., Krishnan, P. and Budihal, S.L. (1987) Laboratory Manual, Tech. Bull. 23, NBSS &LUP, Nagpur.

9. Sehgal, J.L. (1990) Soil Resource Mapping of Different States of India; Why and How?, National Bureau of Soil Survey and Land Use Planning, Nagpur, 49 pp.

10. Shivaprasad, C.R., R.S. Reddy, J. Sehgal and M. Velayuthum (1998) Soils of Karnataka for Optimising Land Use, NBSS Publ. No. 47b, NBSS & LUP, Nagpur, India.

11. Soil Survey Staff (2006) Keys to Soil Taxonomy, Tenth edition, U.S. Department of Agriculture/ NRCS, Washington DC, U.S.A.

12. Soil Survey Staff (2012) Soil Survey Manual, Handbook No. 18, USDA, Washington DC, USA.

Appendix I
Soil Phase Information

Village	Survey No.	Total Area (ha)	Soils	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	CLU code	WELLS	Land Capa-bility	Conservation Plan
Bellatti	9	2.03	GHTcC3g3	LMU-5	Moderately deep (75-100 cm)	Sandy loam	Extremely gravelly (60-80%)	Low (51-100 mm/m)	Gently sloping (3-5%)	Severe	Current fallowland (Cf)	Not Available	IVes	Trench cum bunding
Bellatti	10	0.98	GHTcC3g3	LMU-5	Moderately deep (75-100 cm)	Sandy loam	Extremely gravelly (60-80%)	Low (51-100 mm/m)	Gently sloping (3-5%)	Severe	Greengram (Gg)	Not Available	IVes	Trench cum bunding
Bellatti	11	0.78	GHTcC3g3	LMU-5	Moderately deep (75-100 cm)	Sandy loam	Extremely gravelly (60-80%)	Low (51-100 mm/m)	Gently sloping (3-5%)	Severe	Maize (Mz)	Not Available	IVes	Trench cum bunding
Bellatti	12	0.84	GHTcC3g3	LMU-5	Moderately deep (75-100 cm)	Sandy loam	Extremely gravelly (60-80%)	Low (51-100 mm/m)	Gently sloping (3-5%)	Severe	Maize (Mz)	Not Available	IVes	Trench cum bunding
Bellatti	20	2.52	GHTcC3g3	LMU-5	Moderately deep (75-100 cm)	Sandy loam	Extremely gravelly (60-80%)	Low (51-100 mm/m)	Gently sloping (3-5%)	Severe	Greengram+Maize+Sorghum (Gg+Mz+Sg)	Not Available	IVes	Trench cum bunding
Bellatti	21	7.53	HRVcB2g2	LMU-11	Shallow (25-50 cm)	Sandy loam	Very gravelly (35-60%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallowland+Maize (Cf+Mz)	Not Available	IVes	Trench cum bunding
Bellatti	22	0.03	GHTcC3g3	LMU-5	Moderately deep (75-100 cm)	Sandy loam	Extremely gravelly (60-80%)	Low (51-100 mm/m)	Gently sloping (3-5%)	Severe	Not Available (NA)	Not Available	IVes	Trench cum bunding
Bellatti	179	0.03	LGDmB1	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Not Available (NA)	Not Available	IIe	Graded bunding
Bellatti	181	0.01	LGDmB1	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Not Available (NA)	Not Available	IIe	Graded bunding
Bellatti	182	1.23	LGDmB1	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Sugarcane (Sc)	Not Available	IIe	Graded bunding
Bellatti	183	2.36	LGDmB1	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Maize (Mz)	Not Available	IIe	Graded bunding
Bellatti	184	0.32	LGDmB1	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Greengram (Gg)	Not Available	IIe	Graded bunding
Bellatti	185	0.82	LGDmB1	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Maize (Mz)	Not Available	IIe	Graded bunding
Bellatti	186	4.04	LGDmB1	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Greengram+Maize (Gg+Mz)	Not Available	IIe	Graded bunding
Bellatti	187	0.52	BGPiB1g1	LMU-1	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Maize (Mz)	Not Available	IIes	Graded bunding
Bellatti	188	7.61	BGPiB1g1	LMU-1	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Banana+Maize+Sugarcane (Ba+Mz+Sc)	Not Available	IIes	Graded bunding
Bellatti	189	0.7	LGDmB1	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Maize (Mz)	Not Available	IIe	Graded bunding
Bellatti	190	6.17	LGDmB1	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Maize (Mz)	Not Available	IIe	Graded bunding

Village	Survey No.	Total Area (ha)	Soils	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	CLU code	WELLS	Land Cap-ability	Conservation Plan
Bellatti	191	6.03	LGDmB1	LMU-3	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Greengram+ Groundnut+ Maize+Pomogranate+ Sugarcane (Gg+Gn+Mz+Pg+Sc)	Not Available	IIe	Graded bunding
Bellatti	192	0.22	BGPmB1	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Maize (Mz)	Not Available	IIe	Graded bunding
Bellatti	193	12	LKRiB1g2	LMU-9	Moderately shallow (50-75 cm)	Sandy clay	Very gravelly (35-60%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Banana+Chilly+ Greengram+Mango +Maize+Sugarcane (Ba+Ch+Gg+Mn+ Mz+Sc)	Borewell	IVs	Trench cum bunding
Bellatti	194	11.7	LKRiB2g2	LMU-9	Moderately shallow (50-75 cm)	Sandy clay	Very gravelly (35-60%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Greengram+Mango+Maize+Onion+ Sugarcane (Gg+Mn+Mz+On+Sc)	Farmpond,Borewell,Borewell,Openwell,Openwell	IVes	Trench cum bunding
Bellatti	196	5.63	LKRiB2g2	LMU-9	Moderately shallow (50-75 cm)	Sandy clay	Very gravelly (35-60%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Onion (Mz+On)	Openwell	IVes	Trench cum bunding
Bellatti	197	5.39	LKRiB2g2	LMU-9	Moderately shallow (50-75 cm)	Sandy clay	Very gravelly (35-60%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Maize+Onion (Ct+Mz+On)	Not Available	IVes	Trench cum bunding
Bellatti	198	0.3	BGPmB1	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Not Available (NA)	Not Available	IIe	Graded bunding
Bellatti	199	2.08	BGPmB1	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Cotton+Maize+ Onion (Ct+Mz+On)	Borewell	IIe	Graded bunding
Bellatti	200	4.71	BGPmB1	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Pomogranate+Sugarcane (Mz+Pg+Sc)	Openwell, Openwell	IIe	Graded bunding
Bellatti	201	4.86	BGPmB1	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Maize (Mz)	Not Available	IIe	Graded bunding
Bellatti	202	4.14	BGPmB1	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Maize (Mz)	Not Available	IIe	Graded bunding
Bellatti	203	4.89	LGDiA1	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Maize (Mz)	Borewell	IIe	Bunding/Strengthening of existing bunds
Bellatti	204	6.4	LGDiA1	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Onion+Sugarcane (On+Sc)	Farmpond,Openwell,Borewell	IIe	Bunding/Strengthening of existing bunds

II

Village	Survey No.	Total Area (ha)	Soils	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	CLU code	WELLS	Land Capa-bility	Conservation Plan
Bellatti	205	7.69	LGDmB1g1	LMU-3	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Fallow land+Maize+Sugarcane (Fl+Mz+Sc)	Farmpond,Openwell	IIes	Graded bunding
Bellatti	206	14.1	LGDmA1g1	LMU-3	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Current fallowland+Cotton+Maize+Pomo-granate (Cf+Ct+Mz+Pg)	Borewell, Farmpond	IIes	Bunding/Strengthening of existing bunds
Bellatti	207	2.1	LKRiB2g2	LMU-9	Moderately shallow (50-75 cm)	Sandy clay	Very gravelly (35-60%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Mulberry (Ct+Mu)	Openwell	IVes	Trench cum bunding
Bellatti	208	9.25	LKRiB2g2	LMU-9	Moderately shallow (50-75 cm)	Sandy clay	Very gravelly (35-60%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Maize+Sugarcane (Ct+Mz+Sc)	Borewell, Openwell	IVes	Trench cum bunding
Bellatti	209	14	MTLmB2g2	LMU-10	Shallow (25-50 cm)	Clay	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Greengram+Maize (Gg+Mz)	Farmpond	IVes	Graded bunding
Bellatti	210	7.46	CKMiA1g1	LMU-5	Moderately deep (75-100 cm)	Sandy clay	Gravelly (15-35%)	Low (51-100 mm/m)	Nearly level (0-1%)	Slight	Maize (Mz)	Not Available	IIes	Bunding/Strengthening of existing bunds
Bellatti	211	3.23	CKMiA1g1	LMU-5	Moderately deep (75-100 cm)	Sandy clay	Gravelly (15-35%)	Low (51-100 mm/m)	Nearly level (0-1%)	Slight	Greengram+Maize (Gg+Mz)	Not Available	IIes	Bunding/Strengthening of existing bunds
Bellatti	212	3.3	CKMiA1g1	LMU-5	Moderately deep (75-100 cm)	Sandy clay	Gravelly (15-35%)	Low (51-100 mm/m)	Nearly level (0-1%)	Slight	Maize (Mz)	Not Available	IIes	Bunding/Strengthening of existing bunds
Bellatti	215	2.53	CKMiA1g1	LMU-5	Moderately deep (75-100 cm)	Sandy clay	Gravelly (15-35%)	Low (51-100 mm/m)	Nearly level (0-1%)	Slight	Current fallowland+Greengram+Maize (Cf+Gg+Mz)	Not Available	IIes	Bunding/Strengthening of existing bunds
Bellatti	216	2.08	CKMiA1g1	LMU-5	Moderately deep (75-100 cm)	Sandy clay	Gravelly (15-35%)	Low (51-100 mm/m)	Nearly level (0-1%)	Slight	Maize (Mz)	Not Available	IIes	Bunding/Strengthening of existing bunds
Bellatti	217	4.05	CKMiA1g1	LMU-5	Moderately deep (75-100 cm)	Sandy clay	Gravelly (15-35%)	Low (51-100 mm/m)	Nearly level (0-1%)	Slight	Maize (Mz)	Not Available	IIes	Bunding/Strengthening of existing bunds
Bellatti	225	3.57	CKMiA1g1	LMU-5	Moderately deep (75-100 cm)	Sandy clay	Gravelly (15-35%)	Low (51-100 mm/m)	Nearly level (0-1%)	Slight	Pomogranate+Sugarcane (Pg+Sc)	Not Available	IIes	Bunding/Strengthening of existing bunds

III

Village	Survey No.	Total Area (ha)	Soils	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	CLU code	WELLS	Land Capability	Conservation Plan
Bellatti	226	8.98	KGHhB2g2	LMU-8	Moderately shallow (50-75 cm)	Sandy clay loam	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallowland+Greengram+Sor-ghum (Cf+Gn+Sg)	Not Available	IIIes	Trench cum bunding
Bellatti	227	3.49	KGHhB2g2	LMU-8	Moderately shallow (50-75 cm)	Sandy clay loam	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIIes	Trench cum bunding
Bellatti	STRE AM	3.75	LGDmA1g1	LMU-3	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Waterbody	Not Available	IIes	Bunding/Strengthening of existing bunds
Chikkasa vanura	1/A	11.5	RNKmB1g1	LMU-7	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Chilly+Cotton+Maize+Onion (Ch+Ct+Mz+On)	Openwell	IIes	Graded bunding
Chikkasa vanura	1/B	0.1	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Chikkasa vanura	2	11.5	BPRmB2g1	LMU-4	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Chilly+Cotton+Greengram+Maize+Onion (Ch+Ct+Gg+Mz+On)	Not Available	IIIes	Trench cum bunding
Chikkasa vanura	3	2.4	LGDmA1g1	LMU-3	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Fallow land (Fl)	Not Available	IIes	Bunding/Strengthening of existing bunds
Chikkasa vanura	4	13.2	BPRmB2g1	LMU-4	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Chilly+Cotton+Maize+Onion+Sugarcane (Ch+Ct+Mz+On+Sc)	Not Available	IIIes	Trench cum bunding
Chikkasa vanura	5	12.2	RNKmB2g1	LMU-7	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Chilly+Cotton+ Greengram+ Maize+Onion+ Sugarcane (Ch+Ct+Gg+Mz+On+Sc)	Not Available	IIIe	Graded bunding
Chikkasa vanura	6	10.9	BPRiB2g2	LMU-4	Deep (100-150 cm)	Sandy clay	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallowland+Cotton+ Greengram+Maize+ Onion (Cf+Ct+Gg+Mz+On)	Not Available	IIIes	Trench cum bunding
Chikkasa vanura	7	4.32	BPRiB2g2	LMU-4	Deep (100-150 cm)	Sandy clay	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Greengram+Maize (Gg+Mz)	Not Available	IIIes	Trench cum bunding

Village	Survey No.	Total Area (ha)	Soils	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	CLU code	WELLS	Land Capability	Conservation Plan
Chikkasa vanura	8	6.01	BPRiB2g2	LMU-4	Deep (100-150 cm)	Sandy clay	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Maize (Ct+Mz)	Not Available	IIIes	Trench cum bunding
Chikkasa vanura	9	5.78	RNKmB1g1	LMU-7	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Current fallowland+Maize+Onion (Cf+Mz+On)	Not Available	IIes	Graded bunding
Chikkasa vanura	10	3.93	BPRiB2g2	LMU-4	Deep (100-150 cm)	Sandy clay	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIIes	Trench cum bunding
Chikkasa vanura	11	5.23	BPRiB2g2	LMU-4	Deep (100-150 cm)	Sandy clay	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Maize (Ct+Mz)	Not Available	IIIes	Trench cum bunding
Chikkasa vanura	12	4.95	RNKmB1g1	LMU-7	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Cotton+Maize (Ct+Mz)	Not Available	IIes	Graded bunding
Chikkasa vanura	13	5.03	RNKmB1g1	LMU-7	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Maize (Mz)	Not Available	IIes	Graded bunding
Chikkasa vanura	14	4.97	KNHhB1g1	LMU-11	Shallow (25-50 cm)	Sandy clay loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Maize (Mz)	Not Available	IIIs	Trench cum bunding
Chikkasa vanura	15	4.15	KNHhB1g1	LMU-11	Shallow (25-50 cm)	Sandy clay loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Cotton+Maize (Ct+Mz)	Not Available	IIIs	Trench cum bunding
Chikkasa vanura	16	4.26	RNKmB1g1	LMU-7	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Cotton+Maize+Onion (Ct+Mz+On)	Not Available	IIes	Graded bunding
Chikkasa vanura	17	3.42	RNKmB1g1	LMU-7	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Maize (Mz)	Not Available	IIes	Graded bunding
Chikkasa vanura	18	4.28	KNHhB1g1	LMU-11	Shallow (25-50 cm)	Sandy clay loam	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Current fallowland (Cf)	Not Available	IIIs	Trench cum bunding
Chikkasa vanura	19	1.05	RNKmB1g1	LMU-7	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Maize (Mz)	Not Available	IIes	Graded bunding
Chikkasa vanura	56	2.03	VDHiB1g1	LMU-2	Deep (100-150 cm)	Sandy clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize (Mz)	Not Available	IIes	Trench cum bunding
Chikkasa vanura	57_TANK	0.18	Waterbody	Others	Others	Others	Others	Others	Others	Others	Waterbody	Not Available	Others	Others
Chikkasa vanura	58	4.69	VDHiB1g1	LMU-2	Deep (100-150 cm)	Sandy clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Chilly+Maize (Ch+Mz)	Borewell	IIes	Trench cum bunding
Chikkasa vanura	59	7.41	GHThB2g3R1St1	LMU-5	Moderately deep (75-100 cm)	Sandy clay loam	Extremely gravelly (60-80%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallowland+Cotton+Eucalyptus (Cf+Ct+Eu)	Borewell	IVes	Trench cum bunding
Chikkasa vanura	60	2.1	GHThB2g3R1St1	LMU-5	Moderately deep (75-100 cm)	Sandy clay loam	Extremely gravelly (60-80%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Rock outcrops	Not Available	IVes	Trench cum bunding

v

Village	Survey No.	Total Area (ha)	Soils	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	CLU code	WELLS	Land Capability	Conservation Plan
Chikkasa vanura	61	4.2	GHThB2g2	LMU-5	Moderately deep (75-100 cm)	Sandy clay loam	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Chilly+Greengram +Sorghum (Ch+Gg+Sg)	Borewell, Borewell	IIIes	Trench cum bunding
Chikkasa vanura	77	4.57	GHThB2g2	LMU-5	Moderately deep (75-100 cm)	Sandy clay loam	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Fallow land+Groundnut+ Maize (Fl+Gn+Mz)	Not Available	IIIes	Trench cum bunding
Chikkasa vanura	78	8.96	GHTcC3g2	LMU-5	Moderately deep (75-100 cm)	Sandy loam	Very gravelly (35-60%)	Low (51-100 mm/m)	Gently sloping (3-5%)	Severe	Current fallowland+Chilly+ Maize (Cf+Ch+Mz)	Borewell, Farmpond	IVes	Trench cum bunding
Chikkasa vanura	79	8.22	GHTcC3g2	LMU-5	Moderately deep (75-100 cm)	Sandy loam	Very gravelly (35-60%)	Low (51-100 mm/m)	Gently sloping (3-5%)	Severe	Current fallowland+Fallow land+Groundnut+M aize (Cf+Fl+Gn+Mz)	Not Available	IVes	Trench cum bunding
Chikkasa vanura	80	8.42	GHTcB3g2	LMU-5	Moderately deep (75-100 cm)	Sandy loam	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Severe	Current fallowland+Greeng ram+Maize (Cf+Gn+Mz)	Borewell, Checkda m	IVes	Trench cum bunding
Chikkasa vanura	81	12.5	GHTcB3g2	LMU-5	Moderately deep (75-100 cm)	Sandy loam	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Severe	Current fallowland+Cotton+ Maize (Cf+Ct+Mz)	Not Available	IVes	Trench cum bunding
Chikkasa vanura	82	2.48	MTLmB2g2	LMU-10	Shallow (25-50 cm)	Clay	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IVes	Graded bunding
Chikkasa vanura	83	7.13	MTLmB2g2	LMU-10	Shallow (25-50 cm)	Clay	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Bamboo+Mulberry +Maize+Onion (Bb+Mu+Mz+On)	Not Available	IVes	Graded bunding
Chikkasa vanura	84	5.39	LKRiB2g2	LMU-9	Moderately shallow (50-75 cm)	Sandy clay	Very gravelly (35-60%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Mulberry+ Maize+Onion (Ct+Mu+Mz+On)	Not Available	IVes	Trench cum bunding
Chikkasa vanura	85	4.06	MTLmB2g2	LMU-10	Shallow (25-50 cm)	Clay	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IVes	Graded bunding
Chikkasa vanura	86	11.5	MTLiB1g1	LMU-10	Shallow (25-50 cm)	Sandy clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Chilly+Maize+Onio n (Ch+Mz+On)	4 Borewells, Openwell, Farmpond, Openwell	IIIs	Graded bunding
Chikkasa vanura	87	10.4	MTLiB1g1	LMU-10	Shallow (25-50 cm)	Sandy clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Current fallow land+Greengram+ Maize+Onion+Pomo granate+Sugarcane (Cf+Gg+Mz+On+Pg +Sc)	Borewell	IIIs	Graded bunding
Chikkasa vanura	88	8.41	MTLiB1g1	LMU-10	Shallow (25-50 cm)	Sandy clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Current fallowland+Chilly+ Maize+Onion (Cf+Ch+Mz+On)	Not Available	IIIs	Graded bunding

Village	Survey No.	Total Area (ha)	Soils	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	CLU code	WELLS	Land Capa-bility	Conserva-tion Plan
Chikkasavanura	89/A1	6.71	RNKmB1g1	LMU-7	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Cotton+Pomogranate+Sugarcane (Ct+Pg+Sc)	Borewell	IIes	Graded bunding
Chikkasavanura	89/A2	0.09	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Chikkasavanura	89/A3	0.38	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Chikkasavanura	89/A4	0.11	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Chikkasavanura	89/A5	0.02	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Chikkasavanura	89/A6	0.03	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Chikkasavanura	90	2.95	KGHhB2g2	LMU-8	Moderately shallow (50-75 cm)	Sandy clay loam	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IIIes	Trench cum bunding
Chikkasavanura	SETTLEMENT	0.63	Habitation	Others	Others	Others	Others	Others	Others	Others	Habitation	Not Available	Others	Others
Chikkasavanura	STREAM	2.95	LGDmA1g1	LMU-3	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Waterbody	Not Available	IIes	Bunding/Strengthening of existing bunds
Chikkasavanura	XX	0.08	Habitation	Others	Others	Others	Others	Others	Others	Others	Not Available (NA)	Not Available	Others	Others
Konchigeri	179	8.96	BPRiB2g1	LMU-4	Deep (100-150 cm)	Sandy clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIIes	Trench cum bunding
Konchigeri	180	10.9	BPRiB2g1	LMU-4	Deep (100-150 cm)	Sandy clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Eucalyptus+Maize (Ct+Eu+Mz)	Borewell	IIIes	Trench cum bunding
Konchigeri	181	1.59	LGDmB2g2	LMU-3	Deep (100-150 cm)	Clay	Very gravelly (35-60%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIIes	Graded bunding
Konchigeri	STREAM	2.31	BPRiB2g1	LMU-4	Deep (100-150 cm)	Sandy clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Waterbody	Not Available	IIIes	Trench cum bunding

VII

Appendix II
Soil Fertility Information

VILLAGE	Survey No.	Soil Reaction (pH)	EC	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Bellatti	9	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	10	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (< 0.5 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	11	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (< 0.5 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	12	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (< 0.5 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	20	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (< 0.5 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	21	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (< 0.5 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	22	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (< 0.5 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	179	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	181	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	182	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	183	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	184	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	185	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	186	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	187	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 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)	Deficient (< 0.6 ppm)
Bellatti	188	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 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)	Deficient (< 0.6 ppm)
Bellatti	189	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	190	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	191	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	192	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 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 (pH)	EC	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Bellatti	193	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	194	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	196	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	197	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	198	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 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)	Deficient (< 0.6 ppm)
Bellatti	199	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 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)	Deficient (< 0.6 ppm)
Bellatti	200	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 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)	Deficient (< 0.6 ppm)
Bellatti	201	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 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)	Deficient (< 0.6 ppm)
Bellatti	202	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 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)	Deficient (< 0.6 ppm)
Bellatti	203	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	204	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	205	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 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)	Deficient (< 0.6 ppm)
Bellatti	206	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	207	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	208	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	209	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 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)	Deficient (< 0.6 ppm)
Bellatti	210	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	211	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	212	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	215	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	216	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	217	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)

X

VILLAGE	Survey No.	Soil Reaction (pH)	EC	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Bellatti	225	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	226	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	227	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Bellatti	STREAM	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	1/A	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	1/B	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Chikkasavanura	2	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	3	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	4	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	5	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	6	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	7	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	8	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	9	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	10	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	11	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	12	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	13	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	14	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 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)	Deficient (< 0.6 ppm)
Chikkasavanura	15	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	16	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	17	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)

VILLAGE	Survey No.	Soil Reaction (pH)	EC	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Chikkasavanura	18	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	19	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	56	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	57_TANK	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Chikkasavanura	58	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	59	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	60	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Low (<145 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	61	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Low (<145 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	77	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (< 0.5 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	78	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (< 0.5 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	79	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Low (< 0.5 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	80	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	81	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	82	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 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)	Deficient (< 0.6 ppm)
Chikkasavanura	83	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	84	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	85	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 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)	Deficient (< 0.6 ppm)
Chikkasavanura	86	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	87	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	88	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	89/A1	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 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)	Deficient (< 0.6 ppm)
Chikkasavanura	89/A2	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others

VILLAGE	Survey No.	Soil Reaction (pH)	EC	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Chikkasavanura	89/A3	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Chikkasavanura	89/A4	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Chikkasavanura	89/A5	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Chikkasavanura	89/A6	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Chikkasavanura	90	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 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)	Deficient (< 0.6 ppm)
Chikkasavanura	SETTLEMENT	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Chikkasavanura	STREAM	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Chikkasavanura	XX	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Konchigeri	179	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	180	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 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)	Deficient (< 0.6 ppm)
Konchigeri	181	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	STREAM	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)

Appendix III

Soil Suitability Information

VILLAGE	Survey No.	Sorghum	Maize	Bengal gram	Ground-nut	Sunflower	Cotton	Tomato	Onion	Chilly	Guava	Mango	Sapota	Jack fruit	Jamun	Musambi	Lime	Cashew	Custard apple	Amla	Tamarind	Pomegranate	Banana	Marigold	Chrysanthemum
Bellatti	9	Nrg	Nrg	Ng	S3g	S3g	Ng	S3g	S3g	S3g	Ng	Ng	Ng	Ng	Ng	Ng	Ng	Ng	S3g	S3g	Ng	S3rg	S3rg	Ng	Ng
Bellatti	10	Nrg	Nrg	Ng	S3g	S3g	Ng	S3g	S3g	S3g	Ng	Ng	Ng	Ng	Ng	Ng	Ng	Ng	S3g	S3g	Ng	S3rg	S3rg	Ng	Ng
Bellatti	11	Nrg	Nrg	Ng	S3g	S3g	Ng	S3g	S3g	S3g	Ng	Ng	Ng	Ng	Ng	Ng	Ng	Ng	S3g	S3g	Ng	S3rg	S3rg	Ng	Ng
Bellatti	12	Nrg	Nrg	Ng	S3g	S3g	Ng	S3g	S3g	S3g	Ng	Ng	Ng	Ng	Ng	Ng	Ng	Ng	S3g	S3g	Ng	S3rg	S3rg	Ng	Ng
Bellatti	20	Nrg	Nrg	Ng	S3g	S3g	Ng	S3g	S3g	S3g	Ng	Ng	Ng	Ng	Ng	Ng	Ng	Ng	S3g	S3g	Ng	S3rg	S3rg	Ng	Ng
Bellatti	21	Nrg	S3rg	S2rg	S3rg	Nrg	S3rg	S3rg	S3gr	S3gr	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	S3rg	S3rg	Nrg	Nrg	Nrg	S3rg	S3rg
Bellatti	22	Nrg	Nrg	Ng	S3g	S3g	Ng	S3g	S3g	S3g	Ng	Ng	Ng	Ng	Ng	Ng	Ng	Ng	S3g	S3g	Ng	S3rg	S3rg	Ng	Ng
Bellatti	179	S2z	S3zt	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2zt	S2zt
Bellatti	181	S2z	S3zt	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2zt	S2zt
Bellatti	182	S2z	S3zt	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2zt	S2zt
Bellatti	183	S2z	S3zt	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2zt	S2zt
Bellatti	184	S2z	S3zt	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2zt	S2zt
Bellatti	185	S2z	S3zt	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2zt	S2zt
Bellatti	186	S2z	S3zt	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2zt	S2zt
Bellatti	187	S2z	S3zt	S2z	S3tz	S2z	S2z	S3zg	S3zg	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2z	S2z
Bellatti	188	S2z	S3zt	S2z	S3tz	S2z	S2z	S3zg	S3zg	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2z	S2z
Bellatti	189	S2z	S3zt	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2zt	S2zt
Bellatti	190	S2z	S3zt	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2zt	S2zt
Bellatti	191	S2z	S3zt	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2zt	S2zt
Bellatti	192	S2z	S3zt	S2z	S3tz	S2z	S2z	S3zg	S3zg	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2z	S2z
Bellatti	193	S2rg	S2rg	S2rg	S2rg	S3rg	S2rg	S2rg	S2gr	S2gr	S3rg	Nr	S3rg	S3rg	S3rg	S3rg	S3rg	S3rg	S2rg	S2g	Nrg	S3rg	S3rg	S2rg	S2rg
Bellatti	194	S2rg	S2rg	S2rg	S2rg	S3rg	S2rg	S2r	S2r	S2r	S3rg	Nrg	S3rg	S3rg	S3rg	S3rg	S3rg	S3rg	S2rg	S2g	Nr	S3rg	S3rg	S2rg	S2rg
Bellatti	196	S2rg	S2rg	S2rg	S2rg	S3rg	S2rg	S2r	S2r	S2r	S3rg	Nrg	S3rg	S3rg	S3rg	S3rg	S3rg	S3rg	S2rg	S2g	Nr	S3rg	S3rg	S2rg	S2rg

VILLAGE	Survey No.	Sorghum	Maize	Bengal gram	Ground-nut	Sunflower	Cotton	Tomato	Onion	Chilly	Guava	Mango	Sapota	Jackfruit	Jamun	Musambi	Lime	Cashew	Custard apple	Amla	Tamarind	Pomegranate	Banana	Marigold	Chrysanthemum
Bellatti	197	S2rg	S2rg	S2rg	S2rg	S3rg	S2rg	S2r	S2r	S2r	S3rg	Nrg	S3rg	S3rg	S3rg	S3rg	S3rg	S3rg	S2rg	S2g	Nr	S3rg	S3rg	S2rg	S2rg
Bellatti	198	S2z	S3zt	S2z	S3tz	S2z	S2z	S3zg	S3zg	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2z	S2z
Bellatti	199	S2z	S3zt	S2z	S3tz	S2z	S2z	S3zg	S3zg	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2z	S2z
Bellatti	200	S2z	S3zt	S2z	S3tz	S2z	S2z	S3zg	S3zg	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2z	S2z
Bellatti	201	S2z	S3zt	S2z	S3tz	S2z	S2z	S3zg	S3zg	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2z	S2z
Bellatti	202	S2z	S3zt	S2z	S3tz	S2z	S2z	S3zg	S3zg	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2z	S2z
Bellatti	203	S2z	S3zt	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2z	S2tz	S2z	S2z	S2zt	S2zt
Bellatti	204	S2z	S3zt	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2z	S2tz	S2z	S2z	S2zt	S2zt
Bellatti	205	S2z	S3zt	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2zt	S2zt
Bellatti	206	S2z	S3zt	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2zt	S2zt
Bellatti	207	S2rg	S2rg	S2rg	S2rg	S3rg	S2rg	S2r	S2r	S2r	S3rg	Nrg	S3rg	S3rg	S3rg	S3rg	S3rg	S3rg	S2rg	S2g	Nr	S3rg	S3rg	S2rg	S2rg
Bellatti	208	S2rg	S2rg	S2rg	S2rg	S3rg	S2rg	S2r	S2r	S2r	S3rg	Nrg	S3rg	S3rg	S3rg	S3rg	S3rg	S3rg	S2rg	S2g	Nr	S3rg	S3rg	S2rg	S2rg
Bellatti	209	S3rz	S3rz	S2rz	S3rz	Nrz	S3rz	S3zg	S3zg	S3zg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	S3rg	S3rg	Nrg	Nrz	Nrz	S3zr	S3zr
Bellatti	210	S1	S1	S2g	S2t	S2r	S2r	S1	S1	S1	S2r	S3r	S2r	S3r	S3r	S2r	S2r	S2r	S1	S1	S3r	S2r	S2r	S1	S1
Bellatti	211	S1	S1	S2g	S2t	S2r	S2r	S1	S1	S1	S2r	S3r	S2r	S3r	S3r	S2r	S2r	S2r	S1	S1	S3r	S2r	S2r	S1	S1
Bellatti	212	S1	S1	S2g	S2t	S2r	S2r	S1	S1	S1	S2r	S3r	S2r	S3r	S3r	S2r	S2r	S2r	S1	S1	S3r	S2r	S2r	S1	S1
Bellatti	215	S1	S1	S2g	S2t	S2r	S2r	S1	S1	S1	S2r	S3r	S2r	S3r	S3r	S2r	S2r	S2r	S1	S1	S3r	S2r	S2r	S1	S1
Bellatti	216	S1	S1	S2g	S2t	S2r	S2r	S1	S1	S1	S2r	S3r	S2r	S3r	S3r	S2r	S2r	S2r	S1	S1	S3r	S2r	S2r	S1	S1
Bellatti	217	S1	S1	S2g	S2t	S2r	S2r	S1	S1	S1	S2r	S3r	S2r	S3r	S3r	S2r	S2r	S2r	S1	S1	S3r	S2r	S2r	S1	S1
Bellatti	225	S1	S1	S2g	S2t	S2r	S2r	S1	S1	S1	S2r	S3r	S2r	S3r	S3r	S2r	S2r	S2r	S1	S1	S3r	S2r	S2r	S1	S1
Bellatti	226	S3rg	S2r	S2r	S2rg	S3rg	S3rg	S2rg	S2gr	S2gr	S3rg	Nrg	S3rg	S3rg	S3rg	S3rg	S3rg	S3r	S2rg	S2r	Nrg	S3rg	S3rg	S2rg	S2rg
Bellatti	227	S3rg	S2r	S2r	S2rg	S3rg	S3rg	S2rg	S2gr	S2gr	S3rg	Nrg	S3rg	S3rg	S3rg	S3rg	S3rg	S3r	S2rg	S2r	Nrg	S3rg	S3rg	S2rg	S2rg
Bellatti	STREAM	S2z	S3zt	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2zt	S2zt

XVI

VILLAGE	Survey No.	Sorghum	Maize	Bengal gram	Ground-nut	Sunflower	Cotton	Tomato	Onion	Chilly	Guava	Mango	Sapota	Jack fruit	Jamun	Musambi	Lime	Cashew	Custard apple	Amla	Tamarind	Pome-granate	Banana	Mari-gold	Chrysan-themum
Chikkasavanura	1/A	S3z	S2rz	S2rz	S3tz	S3z	S2rz	S3tz	S3tz	S2z	S3z	Nr	S3z	S3z	S3z	S3z	S3z	Nz	S2z	S3z	Nr	S2rz	S2rz	S3tz	S3tz
Chikkasavanura	1/B	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Chikkasavanura	2	S2g	S2g	S2z	S3t	S3g	S2rg	S2g	S2g	S2g	S2g	S3g	S2g	S2rg	S2rg	S2g	S2g	S2g	S2g	S2g	S2g	S2rg	S2rg	S2g	S2g
Chikkasavanura	3	S2z	S3zt	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2zt
Chikkasavanura	4	S2g	S2g	S2z	S3t	S3g	S2rg	S2g	S2g	S2g	S2g	S3g	S2g	S2rg	S2rg	S2g	S2g	S2g	S2g	S2g	S2g	S2rg	S2rg	S2g	S2g
Chikkasavanura	5	S3z	S2rz	S2rz	S3tz	S3z	S2rz	S3tz	S3tz	S2z	S3z	Nr	S3z	S3z	S3z	S3z	S3z	Nz	S2z	S3z	Nr	S2rz	S2rz	S3tz	S3tz
Chikkasavanura	6	S2g	S2g	S2g	S2gt	S3g	S2rg	S2g	S2g	S2g	S2g	S3g	S2g	S2rg	S2rg	S2g	S2g	S2g	S2g	S2g	S2g	S2rg	S2rg	S2g	S2g
Chikkasavanura	7	S2g	S2g	S2g	S2gt	S3g	S2rg	S2g	S2g	S2g	S2g	S3g	S2g	S2rg	S2rg	S2g	S2g	S2g	S2g	S2g	S2g	S2rg	S2rg	S2g	S2g
Chikkasavanura	8	S2g	S2g	S2g	S2gt	S3g	S2rg	S2g	S2g	S2g	S2g	S3g	S2g	S2rg	S2rg	S2g	S2g	S2g	S2g	S2g	S2g	S2rg	S2rg	S2g	S2g
Chikkasavanura	9	S3z	S2rz	S2rz	S3tz	S3z	S2rz	S3tz	S3tz	S2z	S3z	Nr	S3z	S3z	S3z	S3z	S3z	Nz	S2z	S3z	Nr	S2rz	S2rz	S3tz	S3tz
Chikkasavanura	10	S2g	S2g	S2g	S2gt	S3g	S2rg	S2g	S2g	S2g	S2g	S3g	S2g	S2rg	S2rg	S2g	S2g	S2g	S2g	S2g	S2g	S2rg	S2rg	S2g	S2g
Chikkasavanura	11	S2g	S2g	S2g	S2gt	S3g	S2rg	S2g	S2g	S2g	S2g	S3g	S2g	S2rg	S2rg	S2g	S2g	S2g	S2g	S2g	S2g	S2rg	S2rg	S2g	S2g
Chikkasavanura	12	S3z	S2rz	S2rz	S3tz	S3z	S2rz	S3tz	S3tz	S2z	S3z	Nr	S3z	S3z	S3z	S3z	S3z	Nz	S2z	S3z	Nr	S2rz	S2rz	S3tz	S3tz
Chikkasavanura	13	S3z	S2rz	S2rz	S3tz	S3z	S2rz	S3tz	S3tz	S2z	S3z	Nr	S3z	S3z	S3z	S3z	S3z	Nz	S2z	S3z	Nr	S2rz	S2rz	S3tz	S3tz
Chikkasavanura	14	S3r	S3r	S2r	S3r	Nr	S3r	S3r	S3r	S3r	Nr	Nr	Nr	Nr	Nr	Nr	Nr	Nr	S3r	S3r	Nr	Nr	Nr	S3r	S3r
Chikkasavanura	15	S3r	S3r	S2r	S3r	Nr	S3r	S3r	S3r	S3r	Nr	Nr	Nr	Nr	Nr	Nr	Nr	Nr	S3r	S3r	Nr	Nr	Nr	S3r	S3r
Chikkasavanura	16	S3z	S2rz	S2rz	S3tz	S3z	S2rz	S3tz	S3tz	S2z	S3z	Nr	S3z	S3z	S3z	S3z	S3z	Nz	S2z	S3z	Nr	S2rz	S2rz	S3tz	S3tz
Chikkasavanura	17	S3z	S2rz	S2rz	S3tz	S3z	S2rz	S3tz	S3tz	S2z	S3z	Nr	S3z	S3z	S3z	S3z	S3z	Nz	S2z	S3z	Nr	S2rz	S2rz	S3tz	S3tz
Chikkasavanura	18	S3r	S3r	S2r	S3r	Nr	S3r	S3r	S3r	S3r	Nr	Nr	Nr	Nr	Nr	Nr	Nr	Nr	S3r	S3r	Nr	Nr	Nr	S3r	S3r
Chikkasavanura	19	S3z	S2rz	S2rz	S3tz	S3z	S2rz	S3tz	S3tz	S2z	S3z	Nr	S3z	S3z	S3z	S3z	S3z	Nz	S2z	S3z	Nr	S2rz	S2rz	S3tz	S3tz
Chikkasavanura	56	S1	S1	S2z	S1	S1	S1	S1	S1	S2	S1	S2r	S1	S2r	S2tz	S1	S1	S1	S1	S1	S1	S2r	S1	S1	S1

VILLAGE	Survey No.	Sorghum	Maize	Bengal gram	Ground-nut	Sunflower	Cotton	Tomato	Onion	Chilly	Guava	Mango	Sapota	Jackfruit	Jamun	Musambi	Lime	Cashew	Custard apple	Amla	Tamarind	Pomegranate	Banana	Marigold	Chrysanthemum
Chikkasavanura	57_TANK	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Chikkasavanura	58	S1	S1	S2z	S1	S1	S1	S1	S1	S2	S1	S2r	S1	S2r	S2tz	S1	S1	S1	S1	S1	S2r	S1	S1	S1	S1
Chikkasavanura	59	Ng	Ng	Ng	S3g	S3g	Ng	S3rg	S3gr	S3gr	Ng	Ng	Ng	Ng	Ng	Ng	Ng	Ng	S3g	S3g	Ng	S3rg	S3rg	Ng	Ng
Chikkasavanura	60	Ng	Ng	Ng	S3g	S3g	Ng	S3rg	S3gr	S3gr	Ng	Ng	Ng	Ng	Ng	Ng	Ng	Ng	S3g	S3g	Ng	S3rg	S3rg	Ng	Ng
Chikkasavanura	61	S2rg	S2rg	S3g	S2rg	S2rg	S2rg	S2rg	S2gr	S2gr	S2rg	S3rg	S2rg	S3rg	S3rg	S3rg	S2rg	S2g	S2g	S2g	S2g	S3rg	S2rg	S2rg	S2g	S2g
Chikkasavanura	77	S2rg	S2rg	S3g	S2rg	S2rg	S2rg	S2rg	S2gr	S2gr	S2rg	S3rg	S2rg	S3rg	S3rg	S3rg	S2rg	S2g	S2g	S2g	S3rg	S2rg	S2rg	S2g	S2g
Chikkasavanura	78	S2g	S2rg	S2gt	S2rg	S2rg	S2rg	S2rg	S2gr	S2gr	S2rg	S3rg	S2rg	S3g	S3rg	S2rg	S2rg	S2g	S2g	S2g	S3rg	S2rg	S2rg	S2g	S2g
Chikkasavanura	79	S2g	S2rg	S2gt	S2rg	S2rg	S2rg	S2rg	S2gr	S2gr	S2rg	S3rg	S2rg	S3g	S3rg	S2rg	S2rg	S2g	S2g	S2g	S3rg	S2rg	S2rg	S2g	S2g
Chikkasavanura	80	S2g	S2rg	S2gt	S2rg	S2rg	S2rg	S2rg	S2gr	S2gr	S2rg	S3rg	S2rg	S3g	S3rg	S2rg	S2rg	S2g	S2g	S2g	S3rg	S2rg	S2rg	S2g	S2g
Chikkasavanura	81	S2g	S2rg	S2gt	S2rg	S2rg	S2rg	S2rg	S2gr	S2gr	S2rg	S3rg	S2rg	S3g	S3rg	S2rg	S2rg	S2g	S2g	S2g	S3rg	S2rg	S2rg	S2g	S2g
Chikkasavanura	82	S3rz	S3rz	S2rz	S3rz	Nrz	S3rz	S3zg	S3zg	S3zg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	S3rg	S3rg	Nrg	Nrz	Nrz	S3zr	S3zr
Chikkasavanura	83	S3rz	S3rz	S2rz	S3rz	Nrz	S3rz	S3zg	S3zg	S3zg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	S3rg	S3rg	Nrg	Nrz	Nrz	S3zr	S3zr
Chikkasavanura	84	S2rg	S2rg	S2rg	S2rg	S3rg	S2rg	S2r	S2r	S2r	S3rg	Nrg	S3rg	S3rg	S3rg	S3rg	S3rg	S3rg	S2rg	S2g	Nr	S3rg	S3rg	S2rg	S2rg
Chikkasavanura	85	S3rz	S3rz	S2rz	S3rz	Nrz	S3rz	S3zg	S3zg	S3zg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	S3rg	S3rg	Nrg	Nrz	Nrz	S3zr	S3zr
Chikkasavanura	86	S3rz	S3rz	S2rz	S3rz	Nrz	S3rz	S3tz	S3tz	S3z	Nr	Nr	Nr	Nr	Nr	Nr	Nr	Nr	S3r	S3r	Nr	Nrz	Nrz	S3zr	S3zr
Chikkasavanura	87	S3rz	S3rz	S2rz	S3rz	Nrz	S3rz	S3tz	S3tz	S3z	Nr	Nr	Nr	Nr	Nr	Nr	Nr	Nr	S3r	S3r	Nr	Nrz	Nrz	S3zr	S3zr
Chikkasavanura	88	S3rz	S3rz	S2rz	S3rz	Nrz	S3rz	S3tz	S3tz	S3z	Nr	Nr	Nr	Nr	Nr	Nr	Nr	Nr	S3r	S3r	Nr	Nrz	Nrz	S3zr	S3zr
Chikkasavanura	89/A1	S3z	S2rz	S2rz	S3tz	S3z	S2rz	S3tz	S3tz	S2z	S3z	Nr	S3z	S3z	S3z	S3z	S3z	Nz	S2z	S3z	Nr	S2rz	S2rz	S3tz	S3tz
Chikkasavanura	89/A2	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Chikkasavanura	89/A3	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Chikkasavanura	89/A4	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others

VILLAGE	Survey No.	Sorghum	Maize	Bengal gram	Groundnut	Sunflower	Cotton	Tomato	Onion	Chilly	Guava	Mango	Sapota	Jackfruit	Jamun	Musambi	Lime	Cashew	Custard apple	Amla	Tamarind	Pomegranate	Banana	Marigold	Chrysanthemum
Chikkasavanura	89/A5	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Chikkasavanura	89/A6	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Chikkasavanura	90	S3rg	S2r	S2r	S2rg	S3rg	S3rg	S2rg	S2gr	S2gr	S3rg	Nrg	S3rg	S3rg	S3rg	S3rg	S3rg	S3r	S2rg	S2r	Nrg	S3rg	S3rg	S2rg	S2rg
Chikkasavanura	SETTLEMENT	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Chikkasavanura	STREAM	S2z	S3zt	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2zt	S2zt
Chikkasavanura	XX	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Konchigeri	179	S2g	S2g	S2g	S2gt	S3g	S2rg	S2g	S2g	S2g	S2g	S3g	S2g	S2rg	S2rg	S2g	S2g	S2g	S2g	S2g	S2rg	S2g	S2rg	S2g	S2g
Konchigeri	180	S2g	S2g	S2g	S2gt	S3g	S2rg	S2g	S2g	S2g	S2g	S3g	S2g	S2rg	S2rg	S2g	S2g	S2g	S2g	S2g	S2rg	S2g	S2rg	S2g	S2g
Konchigeri	181	S2z	S3zt	S2z	S3tz	S2z	S3zg	S3zg	S3zg	S2zg	S3tz	S3tz	S3tz	S3tz	S2tz	S2z	S2z	S2z	S2z	S2z	S2tz	S2zt	S2zt	S2z	S2z
Konchigeri	STREAM	S2g	S2g	S2g	S2gt	S3g	S2rg	S2g	S2g	S2g	S2g	S3g	S2g	S2rg	S2rg	S2g	S2g	S2g	S2g	S2g	S2rg	S2g	S2rg	S2g	S2g

xx

PART-B

SOCIO-ECONOMIC STATUS OF FARM HOUSEHOLDS

CONTENTS

LIST OF TABLES

LIST OF FIGURES

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: *Belhatti-6 micro-watershed (Belhatti sub-watershed, Shirahatti taluk, Gadag district) is located in between $15^03'$ – $15^05'$ North latitudes and $75^036'$ – $75^039'$ East longitudes, covering an area of about 468 ha, bounded by Nilogal, Kurubgatta, Devihal and Bijjur villages with length of growing period (LGP) 150-180 days. We used soil resource map as basis for sampling farm households to test the hypothesis that soil quality influence crop selection, and conservation investment of farm households. The level of technology adoption and productivity gaps and livelihood patterns were analyses. The cost of soil degradation and ecosystem services were quantified.*

Results: *The socio-economic outputs for the Belhatti-6 micro-watershed (Belhatti sub-watershed, Shirahatti taluk, Gadag district) are presented here.*

Social Indicators;
* ❖ *Male and female ratio is 55.6 to 44.4 per cent to the total sample population.*
* ❖ *Younger age 18 to 50 years group of population is around 52.8 per cent to the total population.*
* ❖ *Literacy population is around 97.2 per cent.*
* ❖ *Social groups belong to scheduled caste (SC) is around 9.1 per cent.*
* ❖ *Liquefied petroleum gas (LPG) is the source of energy for a cooking among 63.6 cent.*
* ❖ *About 45.5 per cent of households have a yashaswini health card.*
* ❖ *Majority of farm households (36.4 %) are having MGNREGA card for rural employment.*
* ❖ *Dependence on ration cards for food grains through public distribution system is around 63.6 per cent.*
* ❖ *Swach bharath program providing closed toilet facilities around 90.9 per cent of sample households.*
* ❖ *Institutional participation is only 6.4 per cent of sample households.*
* ❖ *Women participation in decisions making are around 90.9 per cent of households were found.*

Economic Indicators;

- ❖ *The average land holding is 2.4 ha indicates that majority of farm households are belong to small and medium farmers. The dry land of 46.7 % and irrigated land 13.7 % of total cultivated land area among the sample farmers.*
- ❖ *Agriculture is the main occupation among 56.9 per cent and agriculture is the main and agriculture labour is subsidiary occupation for 29.2 per cent of sample households.*
- ❖ *The average value of domestic assets is around Rs. 92494 per household. Mobile and television are popular mass media communication.*
- ❖ *The average value of farm assets is around Rs. 121609 per household, about 72.7 per cent of sample farmers having plough and sprayer (45.5 %).*
- ❖ *The average value of livestock is around Rs. 29198 per household; about 81 per cent of household are having livestock.*
- ❖ *The average per capital food consumption is around 853.9 grams (1798.6 kilo calories) against national institute of nutrition (NIN) recommendation at 827 gram. Around 36.4 per cent of sample households are consuming less than the NIN recommendation.*
- ❖ *The annual average income is around Rs. 20120 per household. Among the entire farm households in these study area comes under the below poverty line.*
- ❖ *The per capita monthly average expenditure is around Rs.1365.*

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. 635 per ha/year. The total cost of annual soil nutrients is around Rs. 296230 per year for the total area of 468.28 ha.*
- ❖ *The average value of ecosystem service for food grain production is around Rs. 9324/ ha/year. Per hectare food grain production services is maximum in onion (Rs. 22221) followed by chilli (Rs. 20671), cotton (Rs. 13608), bengal gram (Rs. 7344), maize (Rs. 4623), sorghum (Rs. 1311) and groundnut is negative returns.*
- ❖ *The average value of ecosystem service for fodder production is around Rs. 1573/ ha/year. Per hectare fodder production services is maximum in maize (Rs. 1806) followed by sorghum (Rs. 1339).*
- ❖ *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 bengal gram (Rs. 39669) followed by cotton (Rs. 34831), sorghum (Rs. 23705), maize (Rs. 23676), groundnut (Rs. 18488), onion (Rs. 16598) and chilli (Rs. 3833).*

2

Economic Land Evaluation;

❖ *The major cropping pattern is maize (48.7 %) followed by sorghum (16.7 %), onion (11.2 %), bengalgram (9.7%), groundnut (7.8%) and cotton (6.0 %).*

❖ *In Belhatti-6 micro-watershed major soil of Muttal (MTL) soils series are having shallow soil depth cover around 10.5 % of area. On this soil farmers are presently growing bengalgram (9.1%), chilli (17.9 %), cotton (16.9 %), maize (16.9 %), onion (18.0 %) and sorghum (21.2%). Ravanki (RNK) soils are having moderately shallow soil depth cover around 12.81 % of area; the major crops are maize. Chikkamegheri (CKM) series having moderately deep soil depth cover around 6.66 % of areas; crops are maize (80 %) and onion (20 %). Balapur (BPR) series are having deep soil depth cover around 14.32 % of area; crops are groundnut (25 %), sorghum (75 %) and Lakshmangudda (LGD) series having deep soil depth cover around 14.84 % of area, the major crops grown are groundnut (37.1%), maize (35.3 %) and sorghum (27.6 %).*

❖ *The total cost of cultivation and benefit cost ratio (BCR) in study area for maize ranges between Rs.25791/ha in RNK soil (with BCR of 1.13) and Rs.21143/ha in LGD soil (with BCR of 1.31).*

❖ *In sorghum the cost of cultivation range between Rs 20790/ha in BPR soil (with BCR of 1.00) and Rs.13082/ha in MTL soil (with BCR of 1.01).*

❖ *In onion the cost of cultivation ranges between Rs.54232/ha in CKM soil (with BCR of 1.35) and Rs. 20322/ha in MTL soil (with BCR of 1.14).*

❖ *In groundnut cost of cultivation range between is Rs.45590/ha in BPR soil (with BCR of 1.00) and Rs. 31872 in LGD soil (with BCR of 1.02).*

❖ *In chilli the cost of cultivation in MTL soil is Rs 21836/ha (with BCR of 1.65).*

❖ *In bengal gram the cost of cultivation in MTL soil is Rs.22526/ha (with BCR of 1.33) and cotton the cost of cultivation in MTL soil is Rs.21836/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 maize (74 to 79.7%), sorghum (64.8 to 85.9%), onion (59.5 to 90.5%), groundnut (56.6 to65.6%), chilli (96.3 %), cotton (49.4%) and bengalgram (60.8 %).*

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.

METHODOLOGY

Study area

Belhatti-6 micro-watershed located in Northern Transition Zone of Karnataka **(**Figure 1**):** Extends over all area of 1.13 M ha of which 0.86 M ha is under cultivation. Nearly 0.052 M ha in the zone enjoys irrigation facilities. Elevation ranges between 450-900 m MSL with most parts situated between 800 and 900 m. Shallow to black soils and red loams are distributed in equal proportion. The average annual rainfall ranges from 620 to 1300 mm of which more than 60 per cent is received during the southwest monsoon (*kharif*). Sorghum, rice, groundnut, maize, chilli, pulses, sugarcane, tobacco and cotton are the major crops of the zone. It's represents Agro Ecological Sub Region (AESR) 6.4 having LGP 150-180 days.

Belhatti-6 micro-watershed (Belhatti sub-watershed, Shirahatti taluk, Gadag district) is located in between $15^0 3'$ – $15^0 5'$ North latitudes and $75^0 36'$ – $75^0 39'$ East longitudes, covering an area of about 468 ha, bounded by Nilogal, Kurubgatta, Devihal and Bijjur 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 Evelution System (Figure 2).
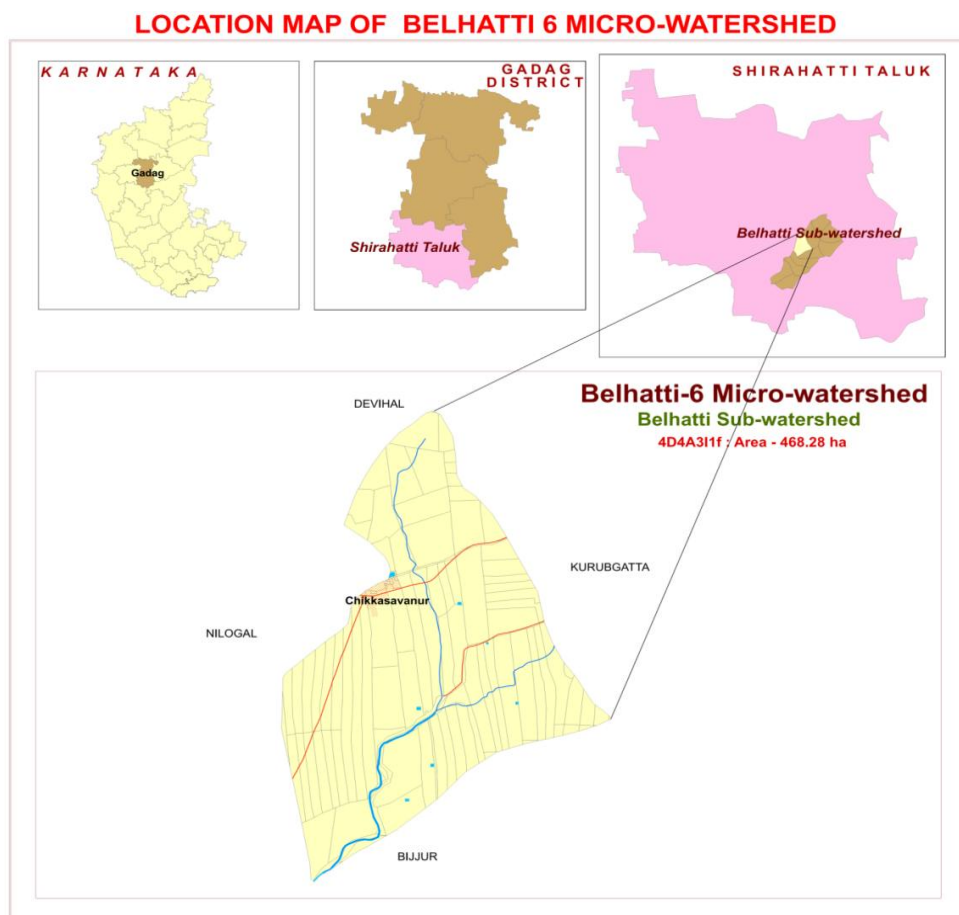
Figure 1: Location of study area

Steps followed in socio-economic assessment

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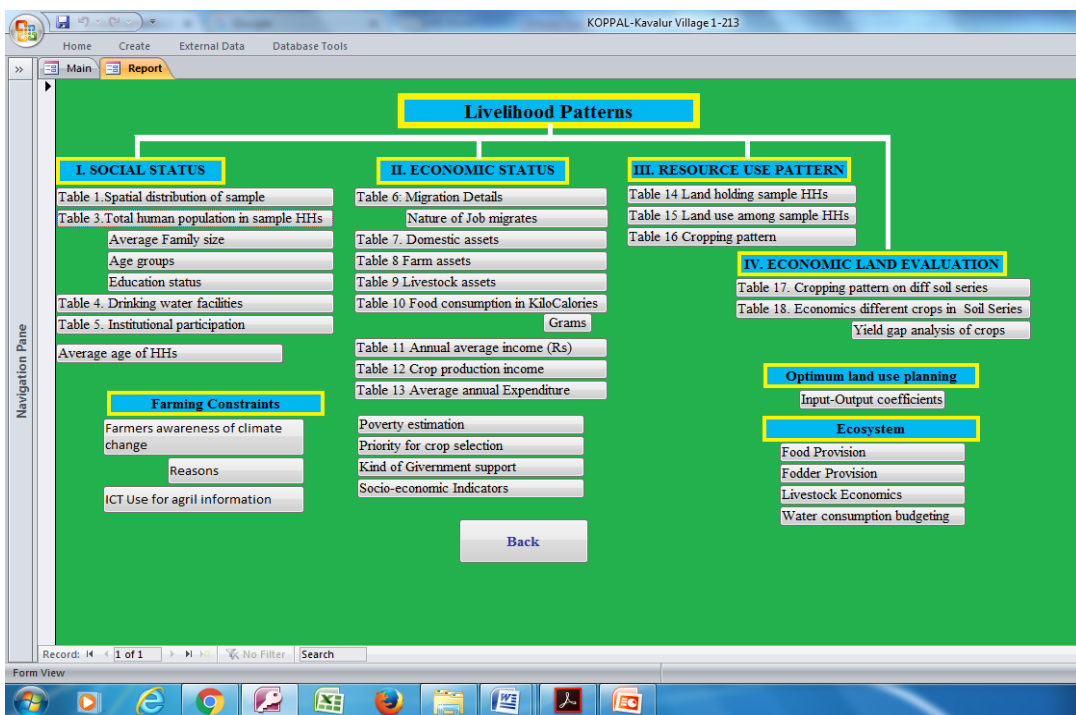
Figure 2: ALPES FRAMEWORK

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

Operational Cost = cost of seeds, fertilizers, pesticides. Cost of human and bullock labour, cost of machinery, cost of irrigation water + interest on working capital.

Gross returns = Yield (Quintals/hectare)*Price (Rs/Quintal)
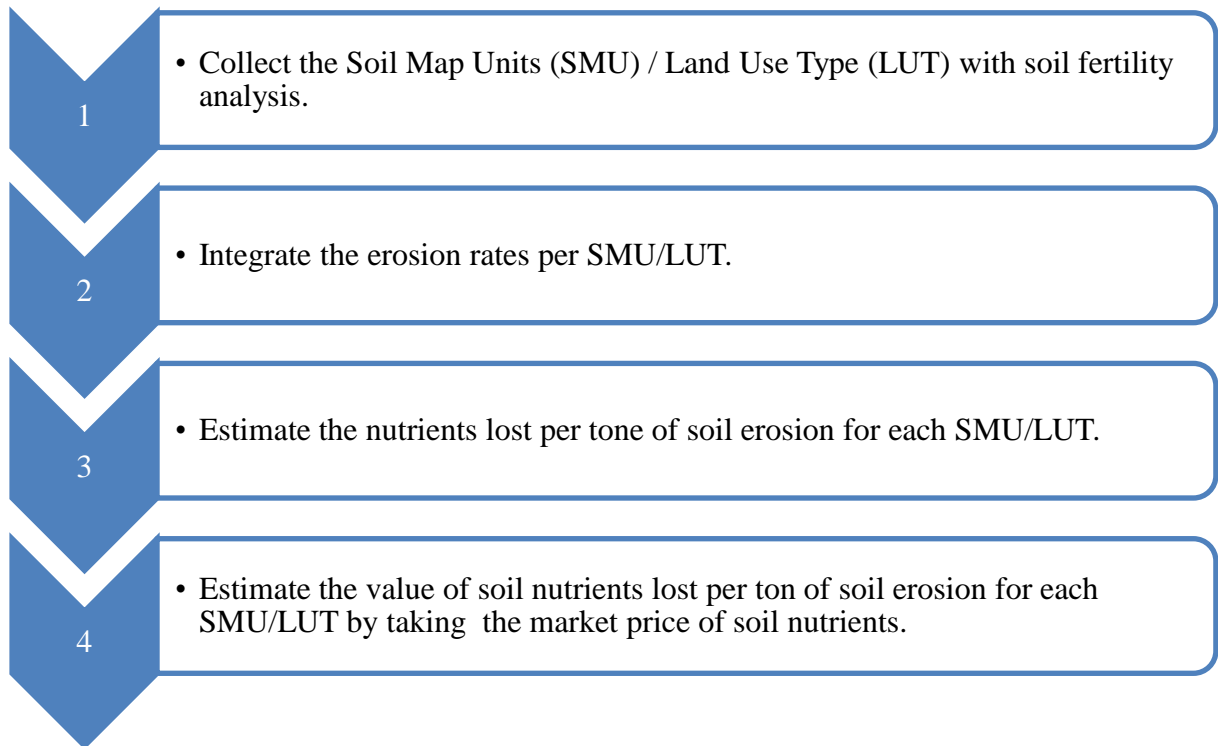
Net returns = Gross returns-Operational cost.

Benefit Cost Ratio = Net returns/Total cost.

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

Economic Valuation of Soil ecosystem services:

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

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

1
- Collect the Soil Map Units (SMU) / Land Use Type (LUT) with soil fertility analysis.

2
- Integrate the erosion rates per SMU/LUT.

3
- Estimate the nutrients lost per tone of soil erosion for each SMU/LUT.

4
- Estimate the value of soil nutrients lost per ton of soil erosion for each SMU/LUT by taking the market price of soil nutrients.

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 72, out of which 55.6, per cent were males and 44.4, per cent females. Average family size of the households is 6.5. 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 (40.3 %) followed by 0 to18 years (30.6 %), more than 50 years (16.7 %) and 18 to 30 years (12.5 %). Hence, in the study area in general, the respondents were of young and middle age, indicating thereby that the households had almost settled with whatever livelihood options they were practicing and sample respondents were young by age who could venture into various options of livelihood sources. Data on literacy indicated that 2.8 per cent of respondents were illiterate and 97.2 per cent literate (Table 1).

Table 1: Human population among sample households in Belhatti-6 Micro watershed

Particulars	Units	Value
Total human population in sample HHs	Number	72
Male	% to total Population	55.6
Female	% to total Population	44.4
Average family size	Number	6.5
Age group		
0 to 18 years	% to total Population	30.6
18 to 30 years	% to total Population	12.5
30 to 50 years	% to total Population	40.3
>50 years	% to total Population	16.7
Average age	Age in years	32.7
Education Status		
Illiterates	% to total Population	2.8
Literates	% to total Population	97.2
Primary School (<5 Class)	% to total Population	33.3
Middle School (6- 8 Class)	% to total Population	18.1
High School (9- 10 Class)	% to total Population	30.6
Others	% to total Population	15.3

The ethnic groups among the sample farm households found to be 90.9 per cent belonging to other backward castes (OBC) and 9.1 per cent belonging to scheduled caste

(SC) (Table 2 and Figure 3). About 36.4 per cent of sample households are using fire wood and gas 63.6 per cent as source of fuel for cooking. All the sample farmers are having electricity connection. About 45.5 per cent are sample households having health cards. Majority (36.4 %) are having MNREGA job cards for employment generation. About 63.6 per cent of farm households are having ration cards for taking food grains from public distribution system. About 90.9 per cent of farm households are having toilet facilities.

Table 2: Basic needs of sample households in Belhatti-6 Microwatershed

Particulars	Units	Value
Social groups		
SC	% of Households	9.1
OBC	% of Households	90.9
Types of fuel use for cooking		
Fire wood	% of Households	36.4
Gas	% of Households	63.6
Energy supply for home		
Electricity	% of Households	100.0
Number of households having Health card		
Yes	% of Households	45.5
No	% of Households	54.5
MGNREGA Card		
Yes	% of Households	36.4
No	% of Households	63.6
Ration Card		
Yes	% of Households	63.6
No	% of Households	36.4
Households with toilet		
Yes	% of Households	90.9
No	% of Households	9.1
Drinking water facilities		
Tube Well	% of Households	63.64
Tank	% of Households	36.36

The data collected on the source of drinking water in the study area is presented in Table 2. Majority of the sample respondents are having tube well (63.64%) source for water supply for domestic purpose and about 36.3 per cent was tank source.
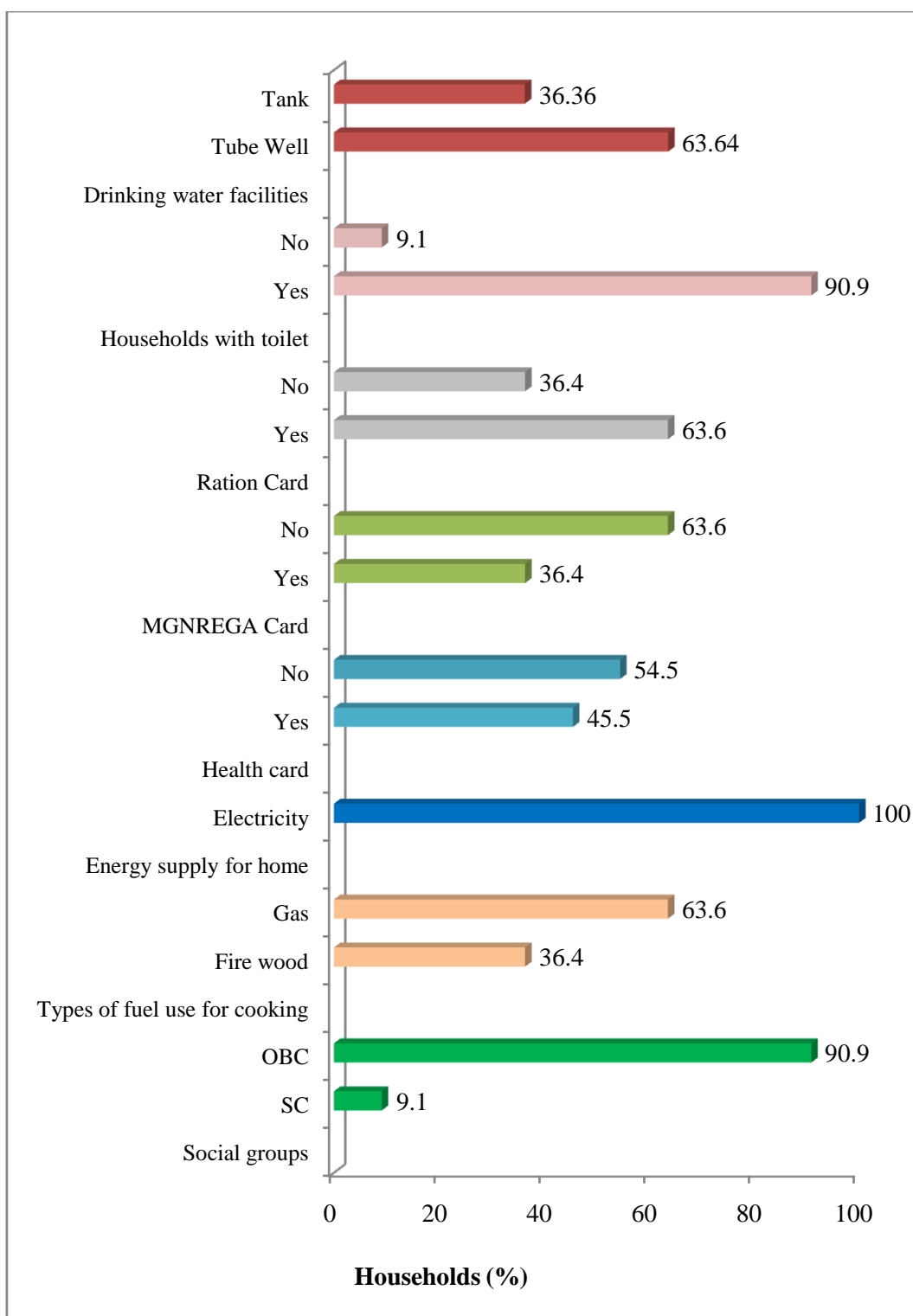
Figure 3: Basic needs of sample households in Belhatti-6 Microwatershed

Only 6.4 per cent of the farmers are participating in community based organizations (Table 3). Among them majority were participating in self help groups were 4.1 percent and remaining 2.1 per participating in cooperative societies – marketing and user groups, each

Table 3: Institutional participation among the sample population in Belhatti-6 Microwatershed

Particulars	Units	Value
No. of people participating	% to total	6.4
Co-operative Societies - Marketing	% to total	1.3
Self help groups(SHG's)	% to total	4.1
Users groups	% to total	1.0
No. of people not participating	% to total	93.6

The occupational pattern (Table 4) among sample households shows that agriculture is the main occupation around 56.9 per cent of farmers followed by agriculture is the main and subsidiary occupations like agricultural labour (29.2 %), non agriculture labour (1.4 %) and govt service (2.8 %). Dairy farming and trade and business are the main occupation of 2.8 and 1.4 per cent for respectively of the sample farmers.

Table 4: Occupational pattern in sample population in Belhatti-6 Microwatershed

Occupation		% to total
Main	**Subsidiary**	
Agriculture	Agriculture	56.9
	Agriculture Labour	29.2
	Non Agriculture Labour	1.4
	Govt. service	2.8
Dairy farming		2.8
Trade and business		1.4
Studying		5.6
Grand Total		100.0
Family labour availability		**Man days/month**
Male		55.0
Female		34.0
Total		89.0

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 mobile phones (90.9%) followed by television (100 %), mixer/grinder (90.9 %), motorcycle (81.8%) and bicycle (18.2 %). The average value of domestic assets is around Rs. 92494 per households.

Table 5: Domestic assets among the sample households in Belhatti-6 Microwatershed

Particulars	% of households	Average value in Rs
Bicycle	18.2	2750
Dvd/Cvd	9.1	3000
Four wheeler	9.1	650000
Mixer/grinder	90.9	3040
Mobile Phone	90.9	7300
Motorcycle	81.8	50000
Refrigerator	9.1	15000
Television	100.0	8864
Average Value	92494	
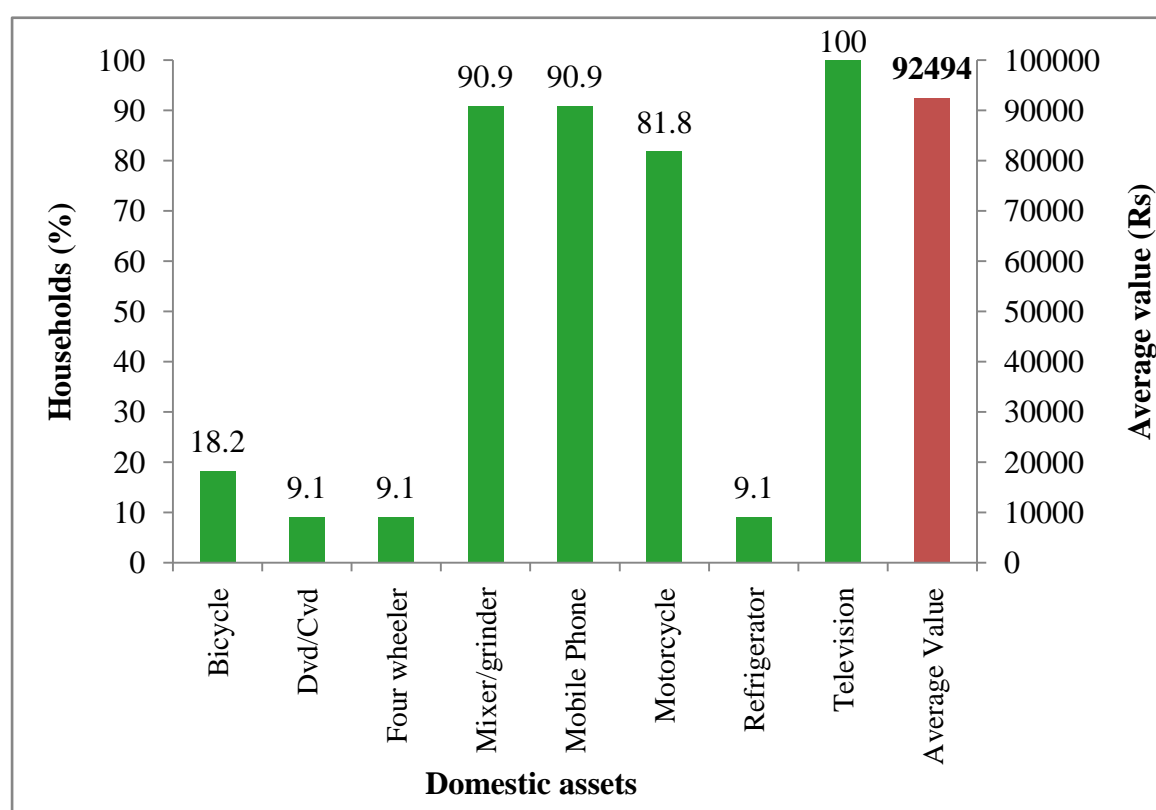
Figure 4: Domestic assets among the sample households in Belhatti-6 Microwatershed

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 weeder (72.7 %) plough (72.7 %), bullock cart (54.5 %), seed cum fertiliser drill (54.5 %) sprayer (45.5 %) tractor (18.2 %) and drip/sprinkler (9.1%) found highest among the sample farmers. The average value of farm assets is around Rs. 121609 per households (Table 6 and Figure 5).

Table 6: Farm assets among samples households in Belhatti-6 Microwatershed

Particulars	% of households	Average value in Rs
Bullock cart	54.5	25667
Drip/Sprinkler	9.1	13000
Plough	72.7	4425
Seed cum fertiliser drill	54.5	3667
Sprayer	45.5	4060
Tractor	18.2	800000
Weeder	72.7	444
Average Value		121609
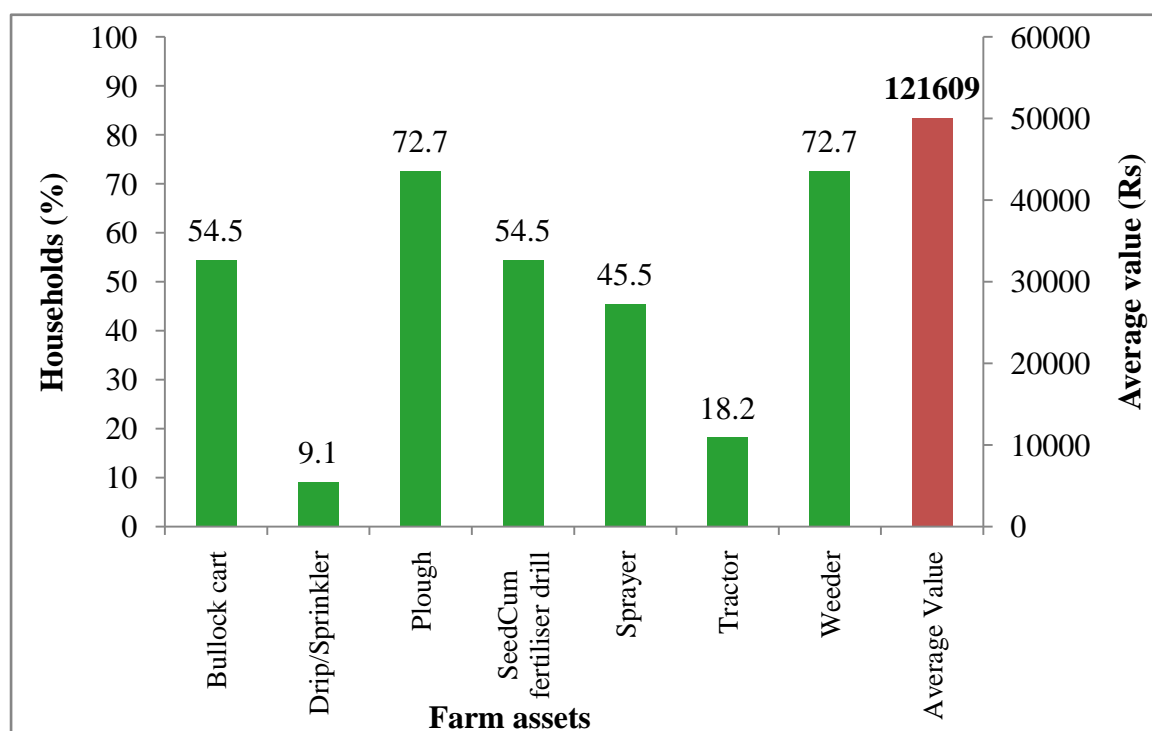
Figure5: Farm assets among samples households in Belhatti-6 Microwatershed

Table 7: Livestock assets among sample households in Belhatti-6 Microwatershed

Particulars	% of livestock population	Average value in Rs
Local Dry Cow	5.9	15000
Local Milching Cow	11.8	17500
Crossbred Dry Cow	11.8	20000
Dry Buffalos	17.6	23333
Milching Buffalos	11.8	27500
Bullocks	29.4	84400
Sheeps	11.8	7500
Grand Total	100.0	38353
Average value		29198

18

Livestock is an integral component of the conventional farming systems (Table 7 and Figure 6). The highest livestock population is bullocks were around 29.4 per cent followed by dry buffalos (17.6 %), crossbred milching cow (11.8 %), local milching cow (11.8 %), sheep's (11.8 %) and local dry cow (5.9 %).The average livestock value was Rs 29198 per household.
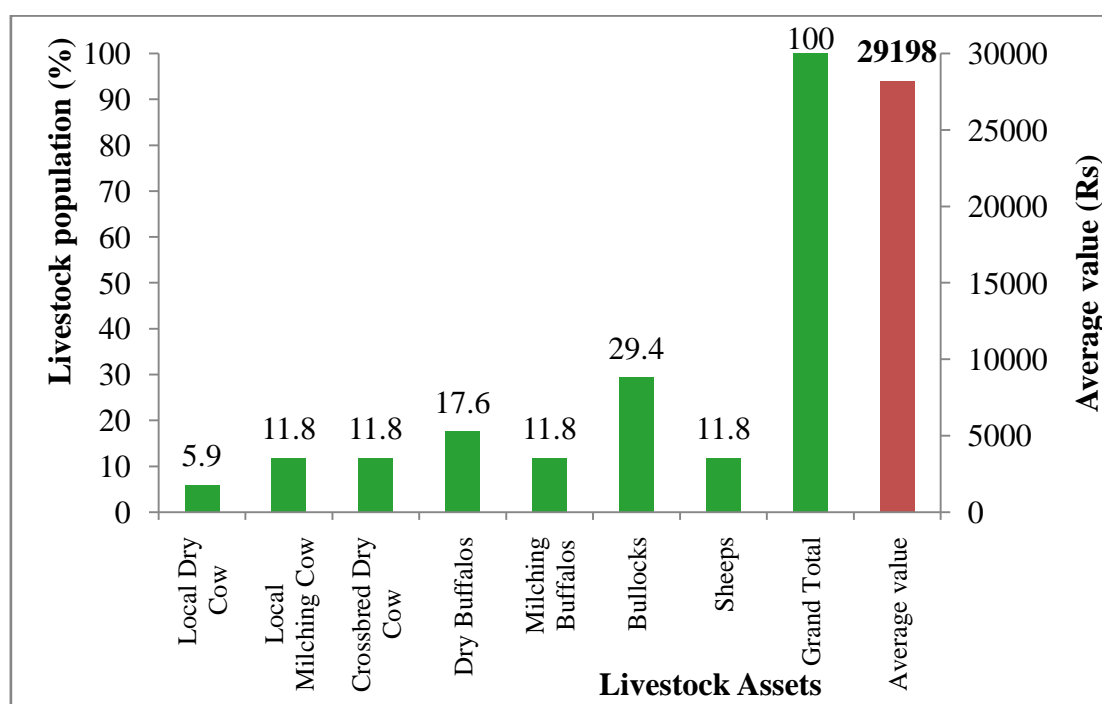

Figure 6: Livestock assets among sample households in Belhatti-6 Microwatershed

Average milk produced in sample households is 638 litters/ annum. Among the farm households, groundnut, sorghum and maize are the main crops for domestic food and fodder for animals. About 1886 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 Belhatti-6 Microwatershed

Particulars	
Name of the Livestock	**Ltr./Lactation/animal**
Local Milching Cow	810
Milching Buffalos	465
Average Milk Produced	638
Fodder produces	**Fodder yield (kg/ha.)**
Groundnut	3058
Maize	1468
Sorghum	1132
Average fodder availability	1886
Livestock having households (%)	81
Livestock population (Numbers)	108

A woman participation in decision making is in this micro-watershed is presented in Table 9. About 9.1 per cent of women participation in local organisation activates, about 90.9 per cent women earning for her family requirement and 90.9 per cent of women taking decision in her family and agriculture related activities and 9.1 per cent women elected as panchayat member in these study area.

Table 9: Women empowerment of sample households in Belhatti-6 Micro watershed

% of grand total

Particulars	Yes	No
Women participation in local organization activities	9.1	90.9
Women elected as panchayat member	9.1	90.9
Women earning for her family requirement	90.9	9.1
Women taking decision in her family and agriculture related activities	90.9	9.1

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 1149.1 kcal per person. The other important food items consumed was pulses 181.9 kcal followed by cooking oil 168.4 kcal, milk 118.3 kcal, vegetables 37.3 kcal, egg 136.1 kcal and meat 17.2 kcal. In the sampled households, farmers were consuming less (1798.6 kcal) than NIN- recommended food requirement (2250 kcal).

Table 10: Per capita daily consumption of food among the sample households in Belhatti-6 Micro watershed

| Particulars	NIN recommendation (gram/ per day/ person)	Present level of consumption (gram/ per day/ person)	Kilo Calories /day/person
Cereals	396	338.0	1149.1
Pulses	43	53.0	181.9
Milk	200	182.1	118.4
Vegetables	143	155.6	37.3
Cooking Oil	31	29.6	168.5
Egg	0.5	84.1	126.2
Meat	14.2	11.5	17.3
Total	**827.7**	**853.9**	**1798.6**
Threshold of NIN recommendation		827 gram*	2250 Kcal*
% Below NIN		36.4	90.9
% Above NIN		63.6	9.1

Note: * day/person
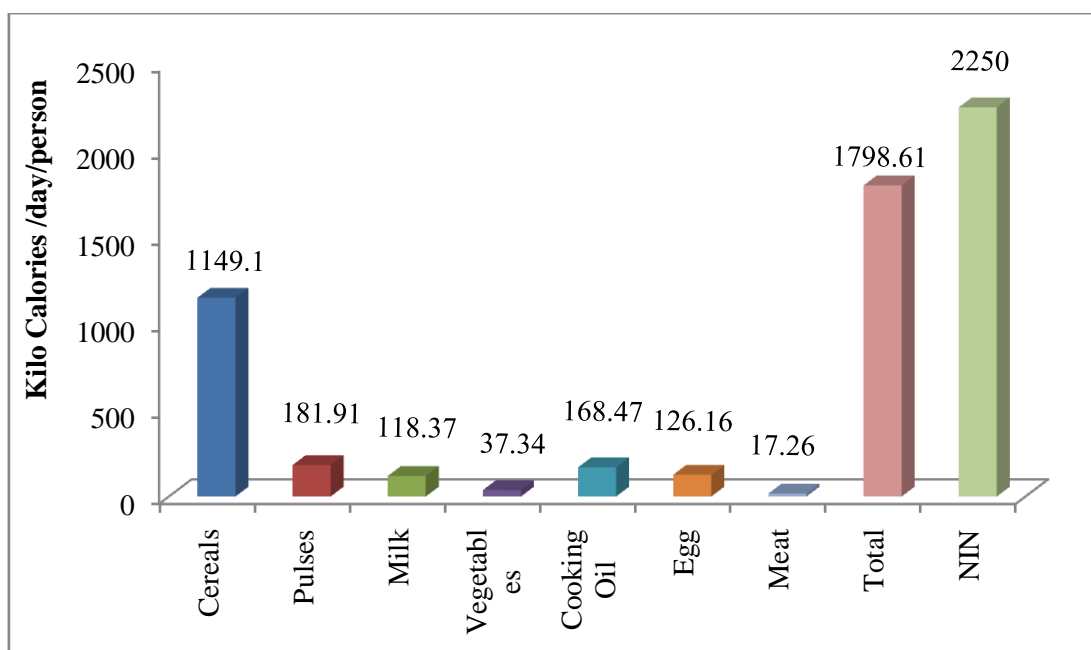
Figure 7: Per capita daily consumption of food among the sample households in Belhatti-6 Microwatershed

Annual income of the sample HHs: The average annual household income is around Rs 20120. Major source of income to the farmers in the study area is from crop production (Rs 15043) followed by livestock (Rs.5078). The monthly per capita income is Rs. 256 which is less than the threshold monthly income of Rs 975 for considering above poverty line. Due to the fact that erratic rainfall and shortage of water, farmers are diverting from crop production activities to enable the household for a comfortable livelihood. The incomes from the other aforesaid sources are very meagre (Table 11).

Table 11: Annual average income of HHs from various sources in Belhatti-6 Microwatershed

Particulars	Income *
Nonfarm income (Rs)	0 (0)
Livestock income (Rs)	5078 (36.4)
Crop Production (Rs)	15043 (100)
Total Annual Income (Rs)	20120
Average monthly per capita income (Rs)	*256*
Threshold for Poverty level (Rs 975 per month/person)	
% of households below poverty line	100.0
% of households above poverty line	0.0

* 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. 61964) followed by education, clothing, social

21

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 1365 and among all the farm households are below poverty line (Table 12 and Figure 8).

Table 12: Average annual expenditure of sample HHs in Belhatti-6 Micro watershed

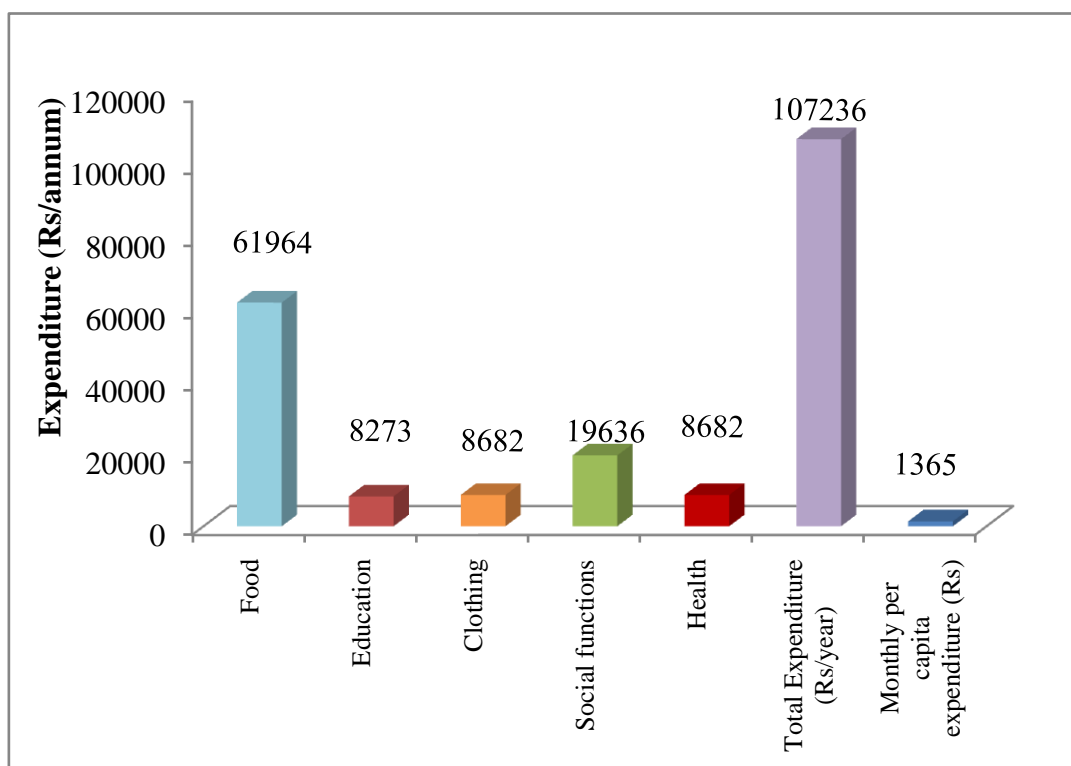| Particulars	Value in Rupees	Per cent
Food	61964	57.8
Education	8273	7.7
Clothing	8682	8.1
Social functions	19636	18.3
Health	8682	8.1
Total Expenditure (Rs/year)	107236	100.0
Monthly per capita expenditure (Rs)	1365	

Figure 8: Average annual expenditure of sample HHs in Belhatti-6 Microwatershed

Land holding: Total sample household is total area cultivated by them is 25.9 ha. The average land holding of sample HHs is 2.4 ha. Large number of households (54.6 %) belong to small size group with an average land holding size of 1.6 ha followed by the medium size (36.4 %) with an average land holding is 2.9 ha and large size (9.1 %) with an average land holding is 4.5 ha (Table 13).

Table 13: Distribution of land holding among the sample households in Belhatti-6 micro-watershed

Particulars	Units	Values
Small farmers		
Total land	ha	9.7
Sample size	percent	54.6
Average land holding	ha	1.6
Medium farmers		
Total land	ha	11.7
Sample size	percent	36.4
Average land holding	ha	2.9
Large farmers		
Total land	ha	4.5
Sample size	percent	9.1
Average land holding	ha	4.5
Total sample households		
Total land	ha	25.9
Sample size	percent	100
Average land holding	ha	2.4

Land use: The total land holding in the Belhatti-6 micro-watershed is 25.9 ha (Table 14). Of which 12.1 ha is rain fed land and 13.1 ha is irrigated land. The average land holding per household is worked out to be 2.36 ha.

Table 14: Land use among samples households in Belhatti-6 Microwatershed

Particulars	Per cent	Area in ha
Irrigated land	53.0	13.7
Rainfed Land	46.7	12.1
Fallow Land	0.3	0.1
Total land holding	100.0	25.9
Average land holding	2.4	

In the micro-watershed, the prevalent present land uses under perennial plants are neem trees (34.3 %), followed by jalli trees (33.3 %) coconut trees (25.5 %), baniyan tree (5.9 %) and tamarind (1.0 %) (Table 15).

Table 15: Number of trees/plants covered in sample farm households in Belhatti-6 Microwatershed

Particulars	Number of Plants/trees	Per cent
Banyan tree(Alada)	6	5.9
Coconut	26	25.5
Jalli	34	33.3
Neem trees	35	34.3
Tamarind	1	1.0
Grand Total	102	100.0

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

The present dominant crops grown in dry lands in the study area were by maize (39.7%) followed by onion (11.2 %), bengal gram (6.5%), groundnut (6.3 %), cotton (6.0%) and sorghum (4.7%) which are taken during Kharif and groundnut (1.5 %), bengalgram (3.2 %), maize (9.0 %) and sorghum (12.0 %) during Rabi season respectively. The crop intensity was 134 per cent (Table 16 and Figure 9).

Table 16: Present cropping pattern and cropping intensity in Belhatti-6 Micro watershed
% to Grand Total

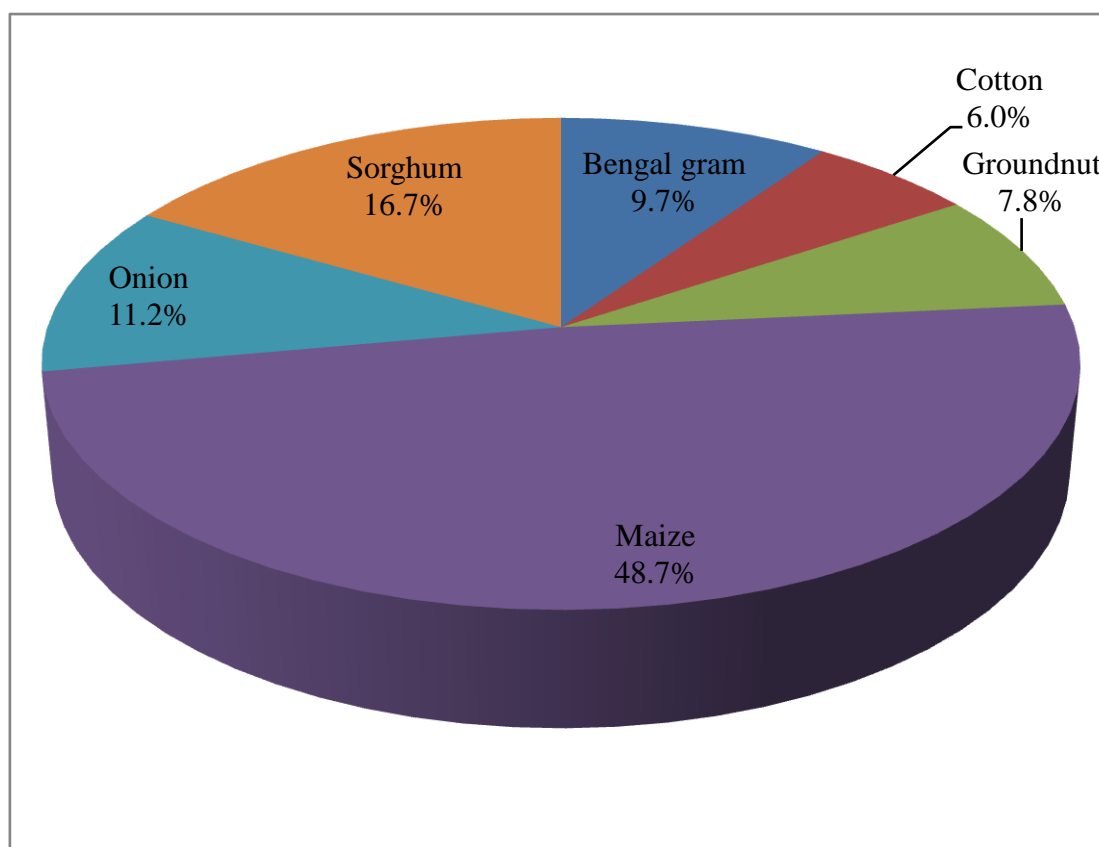| Crops	Kharif	Rabi	Grand Total
Bengal gram	6.5	3.2	9.7
Cotton	6.0	0.0	6.0
Groundnut	6.3	1.5	7.8
Maize	39.7	9.0	48.7
Onion	11.2	0.0	11.2
Sorghum	4.7	12.0	16.7
Grand Total	**74.3**	**25.7**	**100.0**
Cropping intensity (%)	134		

Figure 9: Present cropping pattern in Belhatti-6 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 Belhatti-6 micro-watershed, 13 soil series are identified and mapped (Table 17)The distribution of major soil series are Lakshmangudda (LGD) covering an area around 69.60 ha (14.84 %) followed by Balapur (BPR) 67.1 ha(14.32 %), Ravanki (RNK) 60.04 ha(12.81 %), Gollarahatti (GHT) 50.14 ha (10.68 %), Muttal (MTL) 49.34 ha (10.52 %), Lakkur (LKR) 35.75 ha (7.65 %), Budagumpa (BGP) 35.63 ha (7.60 %), Chikkamegheri (CKM) 31.22 ha (6.66 %), Kutegoudanahundi (KGH) 25.33 ha (4.4 %), Harve (HRV) 12.24 ha (2.61 %), Vaddarahalli (VDH) 11.14 ha (2.37 %), Kanchanahalli (KNH) 8.5 ha (1.73 %) and Kanchikere (KKR) 3.65 ha (0.78 %).

Table 17: Distribution of soil series in Belhatti-6 Micro watershed

Sl. No	Soil Series	Mapping Unit Description	Area in ha (%)
1	KNH	Kanchanahalli soils are shallow (25-50 cm), well drained, have dark reddish brown sandy clay soils occurring on very gently sloping uplands under cultivation	8.10 (1.73)
2	HRV	Harve soils are shallow (25-50 cm), well drained, have reddish brown to dark red sandy clay loam soils occurring on very gently sloping uplands under cultivation	12.24 (2.61)
3	MTL	Muttal soils are shallow (25 - 50 cm), well drained, have dark brown to very dark grayish brown calcareous sandy clay to clay soils occurring on very gently sloping uplands under cultivation	49.34 (10.52)
4	LKR	Lakkur soils are moderately shallow (50-75 cm), well drained, have reddish brown to dark red gravelly sandy clay loam to sandy clay red soils occurring on very gently sloping uplands under cultivation	35.75 (7.65)
5	KGH	Kutegoudanahundi soils are moderately shallow (50 - 75 cm), well drained, have brown to dark brown loamy sand to sandy loam soils occurring on very gently sloping uplands under cultivation	25.33 (4.4)
6	RNK	Ravanki soils are moderately shallow (50-75 cm), well drained, black calcareous sandy clay to clay soils occurring on very gently sloping uplands under cultivation	60.04 (12.81)
7	GHT	Gollarahatti soils are moderately deep (75-100 cm), well drained, have dark reddish brown to dark red sandy clay loam to clay soils occurring on very gently to gently sloping uplands under cultivation	50.14 (10.68)
8	KKR	Kanchikere soils are moderately deep (75-100 cm), well drained, have dark brown to very dark brown clay loam to sandy clay soils occurring nearly level uplands under cultivation	3.65 (0.78)
9	CKM	Chikkamegheri soils are moderately deep (75-100 cm), well drained,	31.22

		have dark brown to dark reddish brown sandy clay soils occurring on nearly level uplands under cultivation	(6.66)
10	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 to gently sloping uplands under cultivation	67.1 (14.32)
11	VDH	Vaddarahalli soils are deep (100 - 150 cm), well drained, have dark reddish brown to dark brown clayey soils occurring on very gently sloping uplands under cultivation	11.14 (2.37)
12	LGD	Lakshmangudda soils are deep (100 - 150 cm), well drained, have light olive brown to very dark gray calcareous clay soils occurring on nearly level to very gently sloping uplands under cultivation	69.60 (14.84)
13	BGP	Budagumpa soils are very deep (>150 cm), well drained, black calcareous gravelly clay soils occurring on nearly level to very gently sloping uplands under cultivation	35.63 (7.60)

Present cropping pattern on different soil series are given in Table 18. Crops grown on Muttal soils are bengalgram, chilli, cotton, onion and sorghum. Maize on Ravanki soils. Maize and onion Chikkamegheri soil grow. Balapura soils are groundnut, sorghum grow. Lakshmangudda soil are groundnut, maize and sorghum grow.

Table 18: Cropping pattern on major soil series in Belhatti-6 Microwatershed

(Area in per cent)

Soil Series	Soil Depth	Crops	Dry		Irrigated	Grand Total
			Kharif	Rabi	Kharif	
MTL	Shallow (25-50 cm)	Bengalgram	0.0	9.1	0.0	9.1
		Chillies	17.9	0.0	0.0	17.9
		Cotton	16.9	0.0	0.0	16.9
		Maize	0.0	0.0	16.9	16.9
		Onion	18.0	0.0	0.0	18.0
		Sorghum	0.0	21.2	0.0	21.2
RNK	Moderately shallow (50-75 cm)	Maize	0.0	0.0	100.0	100.0
BPR	Deep (100-150 cm)	Groundnut	0.0	25.0	0.0	25.0
		Sorghum	0.0	75.0	0.0	75.0
CKM	Moderately deep (75-100 cm)	Maize	0.0	0.0	80.0	80.0
		Onion	0.0	0.0	20.0	20.0
LGD	Deep (100-150 cm)	Groundnut	0.0	0.0	37.1	37.1
		Maize	35.3	0.0	0.0	35.3
		Sorghum	27.6	0.0	0.0	27.6

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 Belhatti-6 Micro watershed.

Soil Series	Small Farmers	Medium Farmers	Large Farmers
RNK		Maize (1.13)	
BPR	Groundnut(1.00)& Sorghum (1.00)		
CKM	Maize (1.21)	Maize(1.50)& Onion(1.73)	
LGD	Groundnut(1.02)& Sorghum (1.18)	Maize (1.31)	
MTL	Chillies (1.65) & Onion (1.14)	Maize (1.36)	Bengalgram (1.33) Cotton(1.62) & Sorghum (1.01)

The productivity of different crops grown in Belhatti-6 micro-watershed 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 onion ranges between Rs.54223/ha in CKM soil (with BCR of 1.73) and Rs.20322/ha in MTL soil (with BCR of 1.14), groundnut range between Rs 45590/ha in BPR soil (with of 1.00) and Rs.31872/ha in LGD soil (with BCR of 1.02), sorghum cost of cultivation in BPR soil is Rs.20790/ha (with BCR of 1.00) and Rs. 13082/ha in MTL soil (with BCR of 1.01), maize range between Rs.25719/ha in RNK soil (with BCR of 1.13) and Rs.21143/ha in LGD soil (with BCR of 1.31), bengal gram cost of cultivation in MTL soil is Rs 22526/ha (with BCR of 1.33), chilli cost of cultivation in MTL soil Rs. 31758/ha (with BCR of 1.65) and cotton cost of cultivation in MTL soil is Rs.21836/ha (with BCR of 1.62).

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 1366137 in chillies and a minimum of Rs 23096 in sorghum cultivation.

Table 20: Economic land evaluation and bridging yield gap for different crops in Belhatti-6 micro-watershed

Particulars	MTL (25-50 cm)						RNK (50-75cm)	CKM (75-100 cm)		BPR (100-150 cm)		LGD (100-150 cm)		
	Bengal gram	Chillies	Cotton	Maize	Onion	Sorghum	Maize	Maize	Onion	Ground nut	Sorghum	Ground nut	Maize	Sorghum
Total cost (Rs/ha)	22526	31758	21837	23099	20322	13082	25719	23601	54232	45590	20791	31872	21143	15857
Gross Return (Rs/ha)	29870	52429	35445	31431	23247	13239	29052	30813	93860	45695	20830	32463	27602	18763
Net returns (Rs/ha)	7344	20671	13608	8332	2925	157	3332	7212	39628	105	40	591	6459	2905
BCR	1.33	1.65	1.62	1.36	1.14	1.01	1.13	1.35	1.73	1.00	1.00	1.02	1.31	1.18
Farmers Practices (FP)														
FYM (t/ha)	2.3	2.9	1.3	0.6	1.8	2.0	1.5	1.0	2.5	2.5	1.7	1.2	0.6	0.8
Nitrogen (kg/ha)	48.2	51.3	48.2	82.5	107.6	48.2	31.6	103.1	103.8	94.4	94.4	122.6	81.6	69.7
Phosphorus (kg/ha)	35.1	27.1	35.1	65.6	67.6	35.1	71.7	98.7	99.6	77.7	77.7	68.5	73.4	36.9
Potash (kg/ha)	24.1	0.0	24.1	22.5	0.0	24.1	54.7	16.0	18.8	10.6	10.6	0.0	15.9	0.0
Grain (Qtl/ha)	5.8	11.8	8.8	21.9	23.5	4.0	17.0	19.4	100.0	7.5	10.0	6.0	17.5	9.6
Price of Yield (Rs/Qtl)	5200	4500	4100	1380	1000	3200	1500	1413	950	5100	2000	5200	1500	1700
Soil test based fertilizer Recommendation (STBR)														
FYM (t/ha)	7.4	24.7	12.4	8.6	29.6	7.4	8.6	8.6	29.6	8.6	7.4	8.6	8.6	7.4
Nitrogen (kg/ha)	18.5	123.5	148.2	123.5	123.5	81.5	123.5	144.1	154.4	24.7	81.5	24.7	123.5	81.5
Phosphorus (kg/ha)	46.3	77.2	92.6	77.2	92.6	71.0	77.2	61.8	74.1	77.2	71.0	77.2	77.2	71.0
Potash (kg/ha)	27.8	46.3	55.6	24.1	92.6	29.6	32.1	32.1	123.5	30.9	39.5	30.9	24.1	29.6
Grain (Qtl/ha)	14.8	321.1	17.3	84.0	247.0	28.4	84.0	84.0	247.0	17.3	28.4	17.3	84.0	28.4
% of Adoption/yield gap (STBR-FP) / (STBR)														
FYM (%)	68.6	88.1	89.9	92.8	94.0	73.0	82.4	88.8	91.6	71.1	77.5	86.2	92.8	89.2
Nitrogen (%)	-160.3	58.5	67.5	33.2	12.8	40.8	74.4	28.4	32.8	-282.1	-15.8	-396.4	34.0	14.5
Phosphorus (%)	24.3	64.9	62.1	15.0	27.0	50.6	7.1	-59.8	-34.4	-0.7	-9.4	11.3	4.9	48.1
Potash (%)	13.2	100.0	56.6	6.6	100.0	18.6	-70.3	50.0	0.0	65.6	73.1	100.0	0.0	100.0
Grain (%)	60.8	96.3	49.4	74.0	90.5	85.9	79.7	76.8	59.5	56.6	64.8	65.6	79.2	66.1
Value of yield and Fertilizer (Rs)														
Additional Cost (Rs/ha)	5295	25747	15461	9052	31017	7501	8020	6861	28721	5691	5872	7281	8851	8846
Additional Benefits (Rs/ha)	46831	1391884	35014	85705	223471	78096	100454	91210	139650	49929	36810	58956	99720	31942
Net change Income (Rs/ha)	41536	1366137	19553	76653	192454	70595	92434	84350	110929	44238	30938	51674	90869	23096

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 644 per ha/year. The total cost of annual soil nutrients is around Rs 296230 per year for the total area of 468.28 ha.

Table 21: Estimation of onsite cost of soil erosion in Belhatti-6 Microwatershed

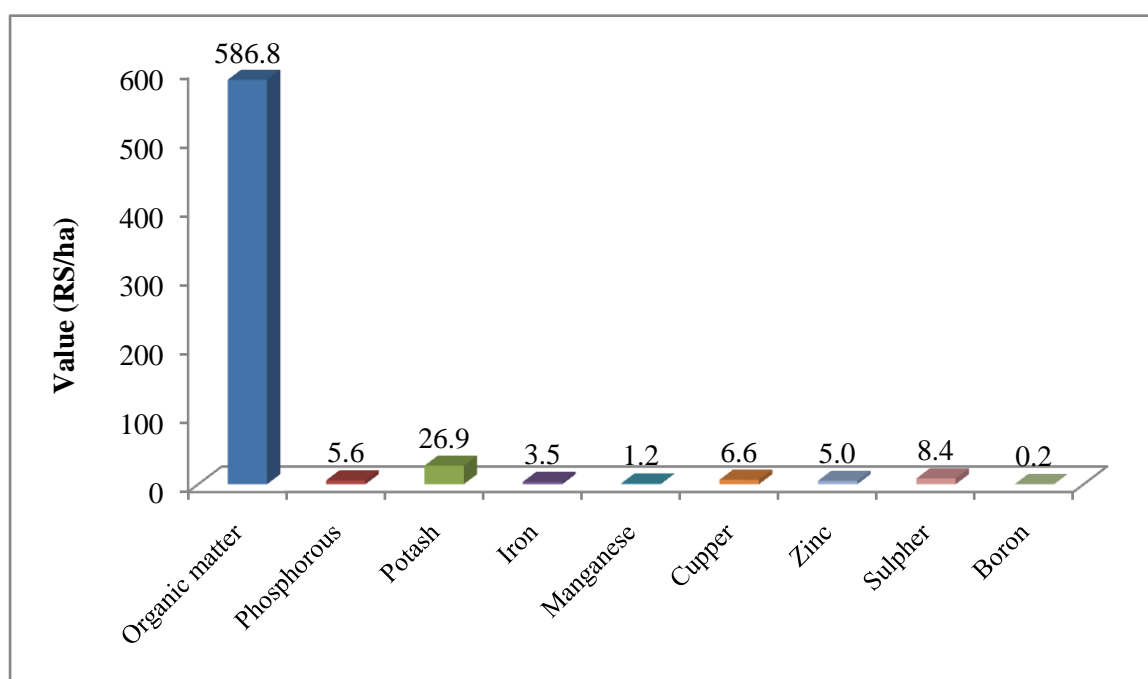| Particulars	Quantity(kg)		Value (Rs)	
	Per ha	Total	Per ha	Total
Organic matter	93.14	42845	586.79	269925
Phosphorous	0.13	58	5.56	2558
Potash	1.35	619	26.91	12377
Iron	0.07	33	3.46	1593
Manganese	0.00	2	1.19	547
Cupper	0.01	5	6.55	3011
Zinc	0.13	58	5.00	2302
Sulpher	0.21	96	8.37	3850
Boron	0.00	2	0.15	68
Total	110.96	43718	643.98	296230

Figure 10: Estimation of onsite cost of soil erosion in Belhatti-6   micro-watershed

29

The average value of ecosystem service for food grain production is around Rs. 9324/ ha/year (Table 22 and Figure 11). Per hectare food grain production services is maximum in onion (Rs. 22221) followed by chilli (Rs. 20671), cotton (Rs. 13608), bengal gram (Rs.7344), maize (Rs. 4623), sorghum (Rs. 1311) and groundnut and is negative returns.

Table 22: Ecosystem services of food grain production in Belhatti-6 Micro watershed

| Production items	Crops	Area in ha	Yield (Qtl/ha)	Price (Rs/Qtl)	Gross Returns (Rs/ha)	Cost of Cultivation (Rs/ha)	Net Returns (Rs/ha)
Cereals	Maize	10	19	1448	28055	23433	4623
	Sorghum	5	8	2300	17888	16577	1311
Pulses	Bengal gram	1	6	5200	29870	22526	7344
Oil seeds	Groundnut	2	7	5150	34224	38731	-4507
Vegetables	Chillies	2	12	4500	52429	31758	20671
	Onion	3	61	975	59498	37277	22221
Commercial Crops	Cotton	2	9	4100	35445	21837	13608
Average value		23	17	3382	36773	27448	9324
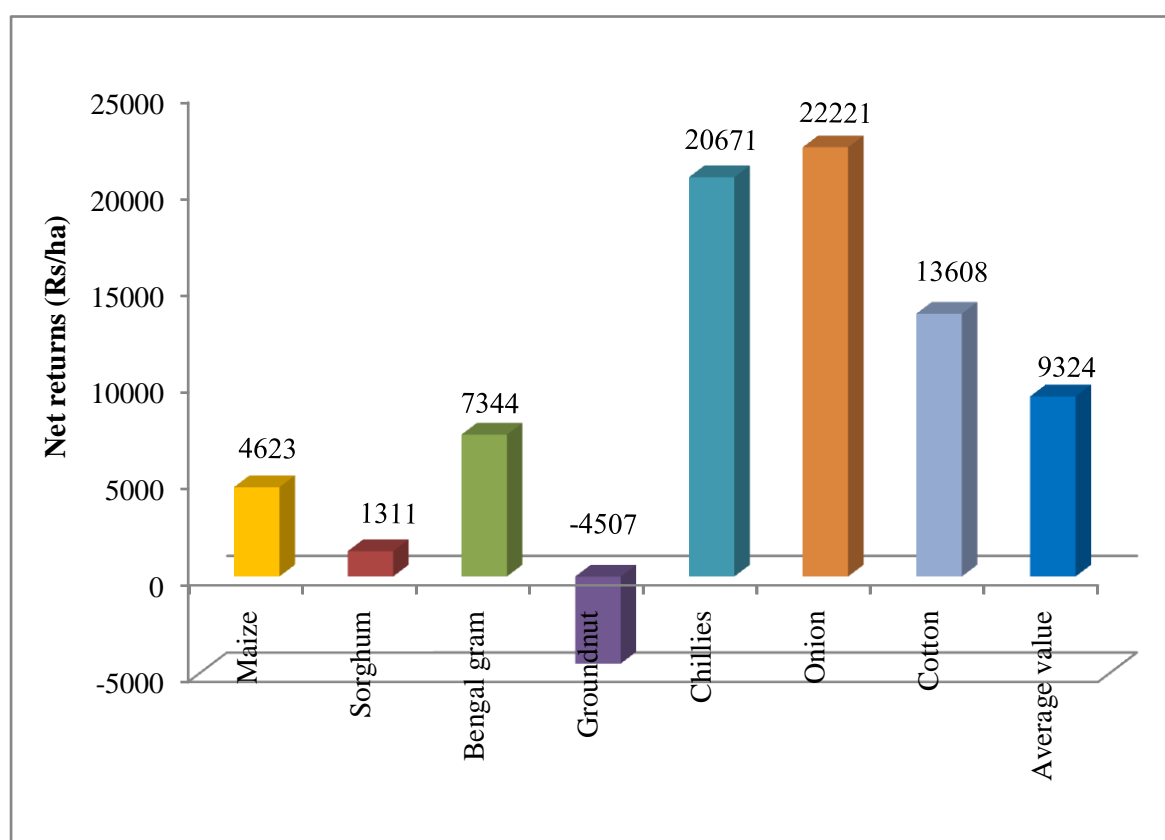
Figure 11: Ecosystem services of food grain production in Belhatti-6 Microwatershed

The average value of ecosystem service for fodder production is around Rs 1573/ ha/year (Table 23). Per hectare fodder production services is maximum in maize (Rs 1806) and sorghum (Rs 1339)

Table 23: Ecosystem services of fodder production in Belhatti-6 Micro watershed

Production items	Crops	Area in ha	Yield (Qtl/ha)	Price (Rs/Qtl)	Net Returns (Rs/ha)
Cereals	Maize	9.5	2.0	1230	1806
	Sorghum	4.5	1.0	1183	1339
Average value		14.0	1.5	1207	1573

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 Bengal gram (Rs. 60694) followed by cotton (Rs. 59710), sorghum (Rs 53817), bajra (Rs 52810), sunflower (Rs 37915), green gram (Rs 35038), maize (Rs 20463) and wheat (Rs 19072).
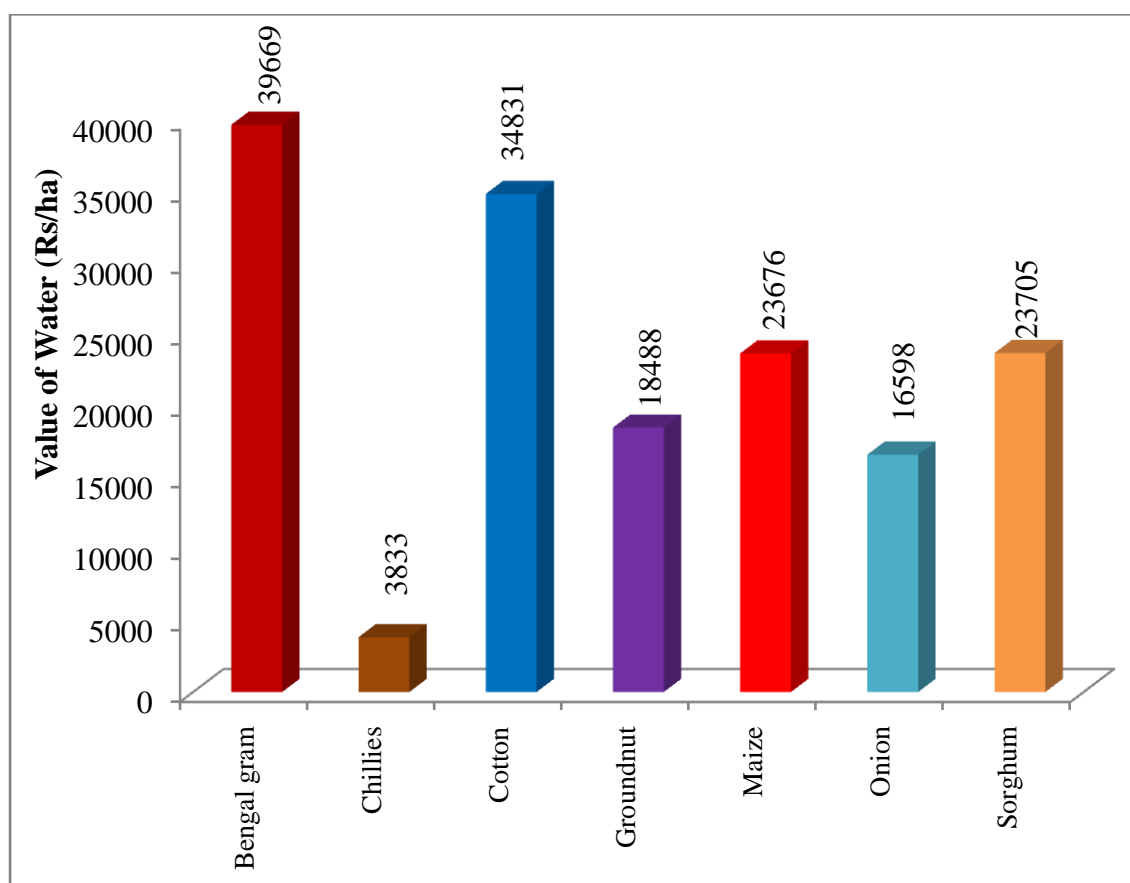

Figure 12: Ecosystem services of water supply in Belhatti-6 Microwatershed

Table 24: Ecosystem services of water supply in Belhatti-6 Micro watershed

Crops	Yield (Qtl/ha)	Virtual water (cubic meter) per ha	Value of Water (Rs/ha)	Water consumption (Cubic meters/Qtl)
Bengal gram	5.7	3967	39669	691
Chillies	11.7	383	3833	33
Cotton	8.6	3483	34831	403
Groundnut	6.6	1849	18488	278
Maize	19.4	2368	23676	122
Onion	61	1660	16598	27
Sorghum	7.8	2371	23705	305
Average value	121	2297	22971	266

The main farming constraints Balbatti - 6 Microwatershed to be found less rainfall, damage of crops by wild animals. Majority of farmers depend up on bank of the sources of loan for purpose of crop production. Farmers to sell the agriculture produce through regulated and the farmers getting the agriculture related information on 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 Belhatti-6 Microwatershed

Sl.No	Particulars	Per cent
1	Less Rainfall	100.0
2	Lack of good quality seeds	9.1
3	High Crop Pests & Diseases	9.1
4	Lack of transportation	9.1
5	Lack of storage	9.1
6	Damage of crops by Wild Animals	81.8
7	Non availability of Plant Protection Chemicals	90.9
8	**Source of loan**	
	Money Leander	100.0
9	**Market for selling**	
	Regulated	9.1
	Village market	90.9
10	**Sources of Agri-Technology information**	
	Newspaper	81.8
	Television	18.2

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.