ICAR-NBSS&LUP Sujala MWS Publ.21

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद
Agrisearch with a human touch

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

BIJJUR-1 (4D4A3J2a) MICRO WATERSHED

Shirahatti 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

WATERSHED DEVELOPMENT DEPARTMENT
GOVT. OF KARNATAKA, BANGALORE

About ICAR - NBSS&LUP

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

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

Citation: Rajendra Hegde, Ramesh Kumar, S.C., K.V. Niranjana, S. Srinivas, M.Lalitha, B.A. Dhanorkar, R.S. Reddy and S.K. Singh (2019). ""Land Resource Inventory and Socio-Economic Status of Farm Households for Watershed Planning and Development of Bijjur-1 (4D4A3J2a) Microwatershed, Shirahatti Taluk, Gadag District, Karnataka", ICAR-NBSS&LUP Sujala MWS Publ. 21, ICAR – NBSS & LUP, RC, Bangalore. p.101 & 32.

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

ICAR-NBSS&LUP Sujala MWS Publ. 21

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद
Agrisearch with a human touch

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

BIJJUR-1 (4D4A3J2a) MICROWATERSHED

Shirahatti 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

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 Bijjur-1 Microwatershed, Shirahatti Taluk, Gadag 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 Principal Scientist, Head & Project Leader, Sujala-III Project ICAR-NBSS&LUP, Regional Centre, Bangalore	**Dr. S.K.Singh** Director, ICAR-NBSS&LUP Coordinator, Sujala-III Project Nagpur
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 Bijjur-1 microwatershed was conducted using village cadastral maps and IRS satellite imagery on 1:7920 scale. The false colour composites of IRS imagery were interpreted for physiography and the physiographic delineations were used as base for mapping soils. The soils were studied in several transects and a soil map was generated with phases of soil series as mapping units. Random checks were made all over the area outside the transects to confirm and validate the soil map unit boundries. The soil map shows the geographic distribution and extent, characteristics, classification and use potentials of the soils in the micro-wartershed.

The present study covers an area of 560 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 99 per cent is covered by soils, one 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 25 soil phases (management units) and 7 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 degree of suitability along with constraints were generated.*
- *About 99 per cent area in the microwatershed is suitable for agriculture.*
- *About 21 per cent of the soils are deep (100-150 cm), about 30 per cent are moderately deep (75-100 cm) soils, 45 per cent are moderately shallow to shallow (25-75 cm) and two per cent are very shallow (25-75 cm).*
- *About 96 per cent of the area has clayey soils and 3 per cent are loamy soils at the surface.*
- *About 6 per cent of the area has non-gravelly (<15%) soils, 33 per cent gravelly soils (15-35 %), 58 per cent very gravelly (35- 60%) soils and 3 per cent extremely gravelly (60-80%) soils.*
- *About 18 per cent of the area has soils that are very high (>200mm/m) in available water capacity, 56 per cent medium (100-150 mm/m) and about 25 per cent low (50-100 mm/m) and very low (<50mm/m).*
- *About 99 per cent of the area has nearly level (0-1%) to very gently sloping (1-3% slope) lands.*
- *An area of about 43 per cent has soils that are slightly eroded (e1), 42 per cent moderately eroded (e2) and 14 per cent soils are severe eroded (e3).*
- *An area of about 7 per cent has soils that are moderately alkaline (pH 7.8 to 8.4), 91 per cent strongly to very strongly alkaline (pH 8.4 to >9.0) and only one per cent has soils that are slightly alkaline (pH 7.3-7.8).*

- *The Electrical Conductivity (EC) of the soils are dominantly <2 dsm^{-1}indicating that the soils are non-saline.*
- *About 87 per cent medium (0.5-0.75%) and 12 per cent low (<0.5%) in organic carbon.*
- *The entire area of about 99 per cent has soils that are low (<23 kg/ha) in available phosphorus.*
- *About 27 per cent medium (145-337 kg/ha) and 73 per cent high (>337 kg/ha) in available potassium.*
- *Available sulphur is low (<10 ppm) in about 49 per cent area and medium (10-20 ppm) in about 51 per cent area.*
- *Available boron is low (0.5 ppm) in about 89 per cent area, 9 per cent medium (0.5-1.0 ppm) and 2 per cent high (>1.0 ppm).*
- *Available iron, manganese and copper are sufficient in all the soils.*
- *About 99 per cent area has soils that are deficient (<0.6 ppm) in available zinc.*
- *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	*191 (34)*	*100 (18)*		*Jackfruit*	*-*	*16 (3)*
Maize	*-*	*40 (7)*		*Jamun*	*-*	*81 (24)*
Bengalgram	*150 (27)*	*377 (67)*		*Musambi*	*57 (10)*	*216 (39)*
Groundnut	*-*	*16 (3)*		*Lime*	*21 (4)*	*252 (45)*
Sunflower	*21 (4)*	*252 (45)*		*Cashew*	*-*	*-*
Cotton	*150 (27)*	*249 (45)*		*Custard Apple*	*150 (27)*	*123 (22)*
Banana	*-*	*274 (49)*		*Amla*	*21 (4)*	*252(45)*
Pomegranate	*-*	*251 (45)*		*Tamarind*	*-*	*180 (32)*
Mango	*-*	*139 (25)*		*Marigold*	*-*	*449 (80)*
Sapota	*-*	*16 (3)*		*Chrysanthemum*	*-*	*449 (80)*
Guava	*-*	*60 (11)*				

- *Apart from the individual crop suitability, a proposed crop plan has been prepared for the 7 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.*

Chapter 1

INTRODUCTION

Soil is a finite natural resource that is central to sustainable agriculture and food security. Over the years, this precious resource is faced with the problems of erosion, salinity, alkalinity, degradation, depletion of nutrients and even decline in availability of land for agriculture. It is a known fact, that it takes thousands of years to form a few centimetres of soil, thus, soil is a precious gift of nature. The area available for agriculture is about 51 per cent of the total geographical area and more than 60 per cent of the people are still dependant on agriculture for their livelihood. However, the capacity of a soil to produce is limited and the limits to the production are set by its intrinsic characteristics, agroclimatic setting, and use and management. There is therefore, tremendous pressure on land and water resources, which is causing decline in soil-health and stagnation in productivity. As much as 121 m ha of land is reportedly degraded which leads to impaired soil quality. It is imperative that steps are urgently taken to check and reverse land degradation without any further loss of time. The improvements in productivity will have to come from sustainable intensification measures that make the most effective use of land and water resources. Soil erosion alone has degraded about 35 lakh ha. Almost all the 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 been made to upscale the soil resource information from 1:250000 and 1:50000 scale to the LEU map in Goa and other states. An attempt will be made later 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 will be taken as an example.

The land resource inventory data and maps presented here aims to provide site specific database for Bijjur-1 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.

Chapter 2

GEOGRAPHICAL SETTING

2.1 Location and Extent

The Bijjur-1 microwatershed (Kanakavad subwatershed) is located in the central part of northern Karnataka in Shirahatti Taluk, Gadag District, Karnataka State (Fig.2.1). It comprises of parts of Bijjur, Konchigeri and Alagilawada villages. It lies between 15^0 01' to 15^0 03' North latitudes and 75^0 37' to 75^0 40' East longitudes and covers an area of 560 ha. It is about 60 km south of Gadag and is surrounded by Narayanpur village on the north, Hosur village on the northeast, Nagarmaduvu in the southwest, Govankoppa on the southeast and Chikkasavanur on the west.

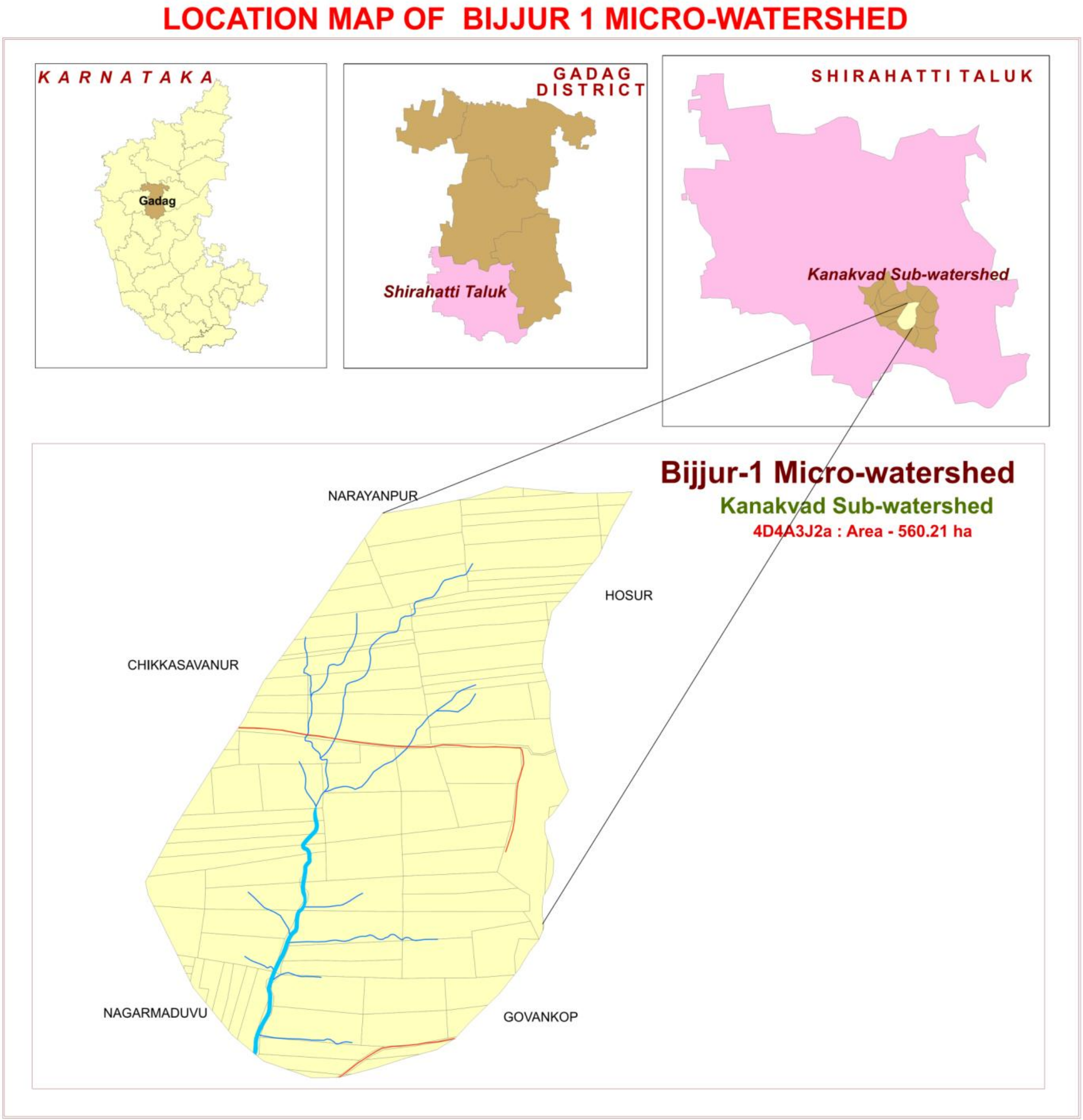


Fig.2.1 Location map of Bijjur-1 Microwatershed

2.2 Geology

Major rock formations observed in the microwatershed are the Peninsular Gneiss (Fig.2.2a), Gadag Schist (Fig. 2.2b) with thick coating of iron oxides and Banded Ferruginous Quartzite (Fig.2.2c). The ridges have capping of Banded Ferruginous Quartzite (BFQ), whereas side slopes near the streams are dominated by schist. They are fine grained and show a distinct weathering pattern similar to that of basalt. Due to its fine texture, the soils formed from these rocks are mostly clayey in nature. The presence of iron rich banded ferruginous quartzite is responsible for the dark red colour of the soils observed in the subwatersheds. The granite gneiss consists primarily of quartz, feldspar, biotite and hornblende.

Fig.2.2a Granite gneiss

Fig.2.2b Gadag Schist

Fig.2.2c Banded Ferrugenous Quartzite

2.3 Physiography

Physiographically, the area has been broadly divided into two landscapes based on geology. They are Granite gneiss and Schist. 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 556 to 584 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 villages. This is reflected in the failure of many bore wells in the villages. If the available rain water is properly harnessed by constructing tanks and recharge structures at appropriate places in the 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). Of the total rainfall, maximum of 363 mm precipitation takes place during south–west monsoon period from June to September, north-east monsoon contributes about 165 mm and prevails from October to early December 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	

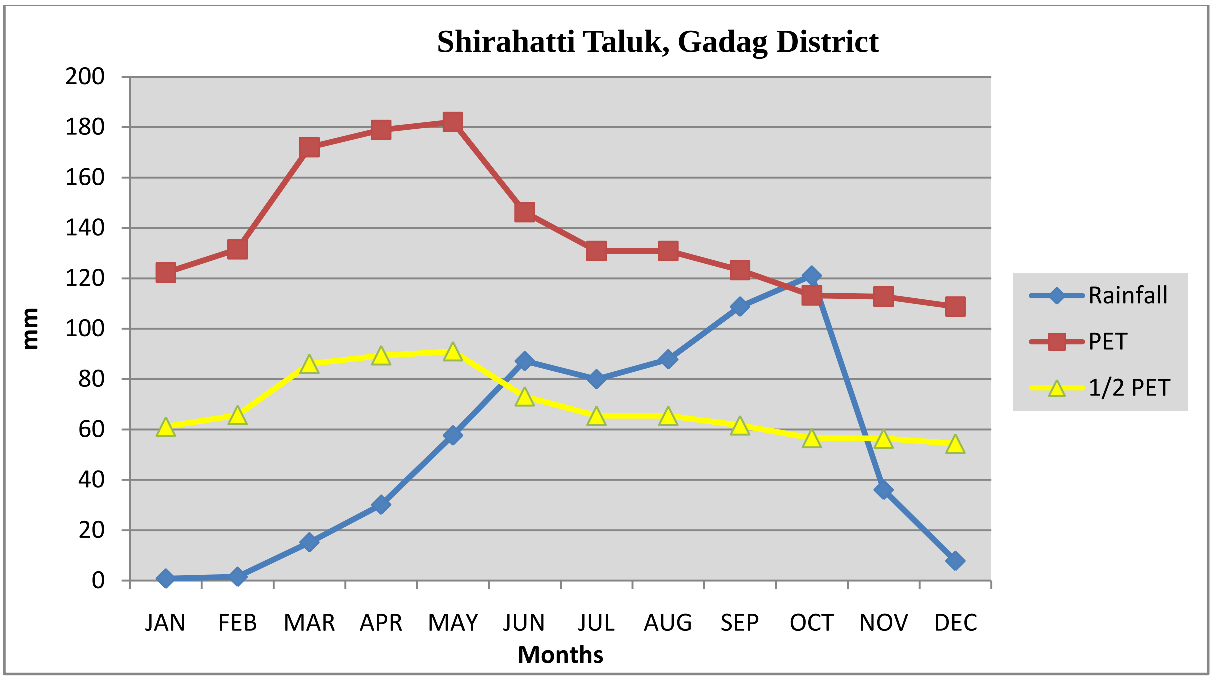


Fig. 2.3 Rainfall distribution in Shirahatti Taluk,Gadag District

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 Bijjur-1 microwatershed is presented in Fig.2.4.

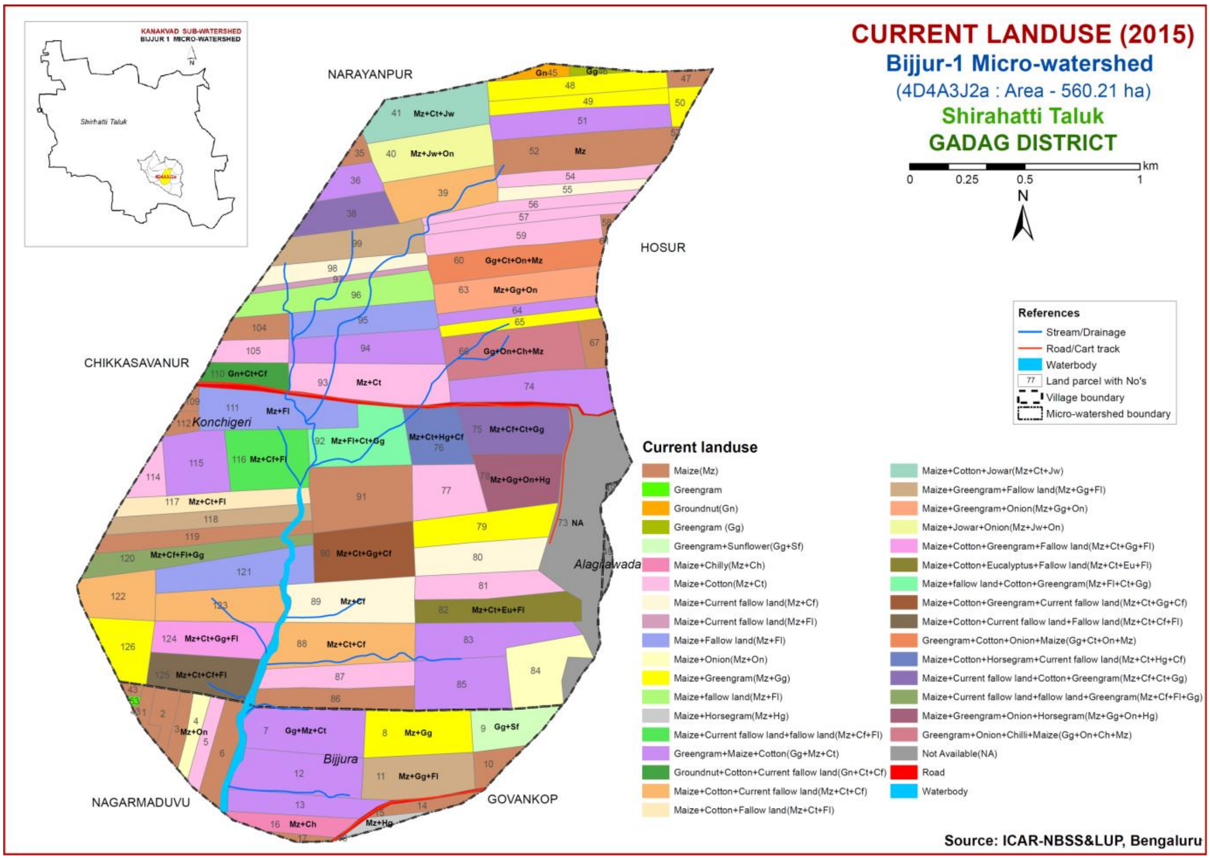


Fig.2.4 Current Land Use map of Bijjur-1 Microwatershed

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 Bijjur-1 microwatershed in 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	

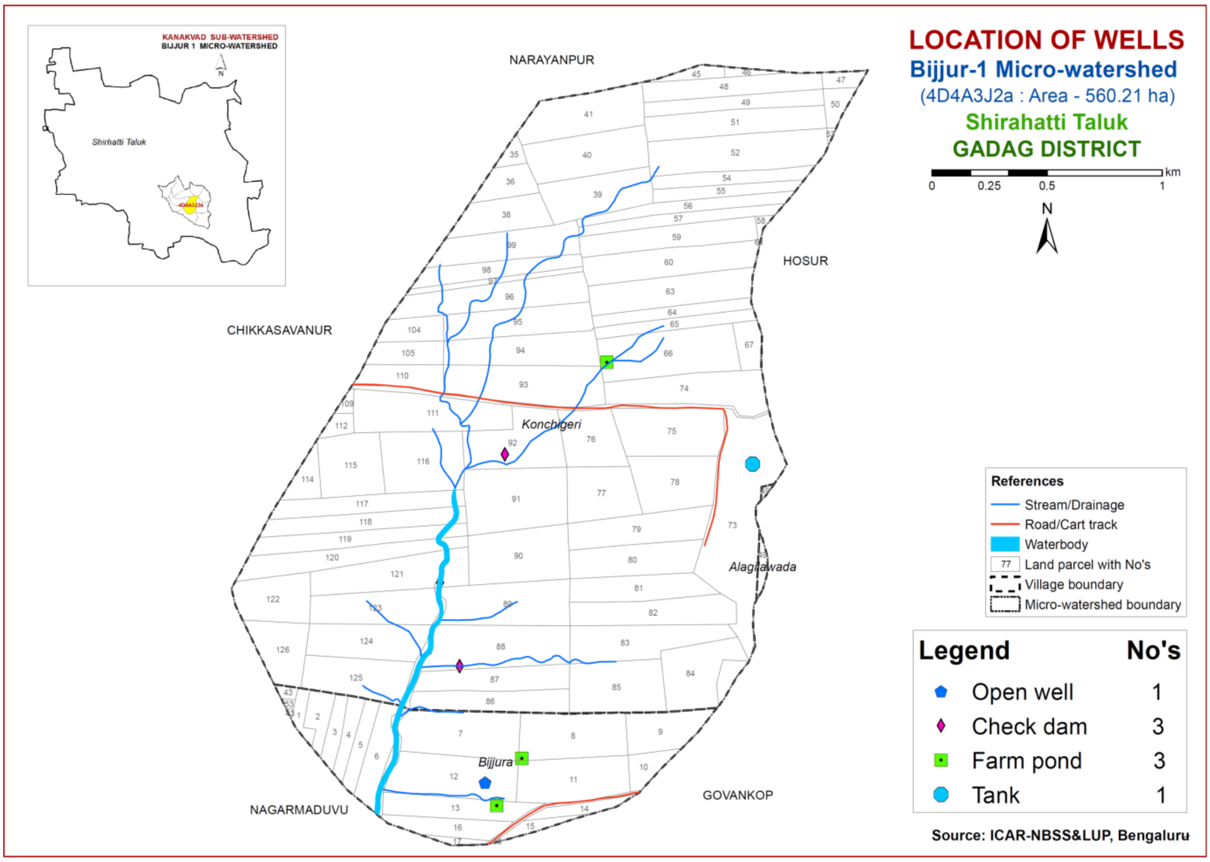
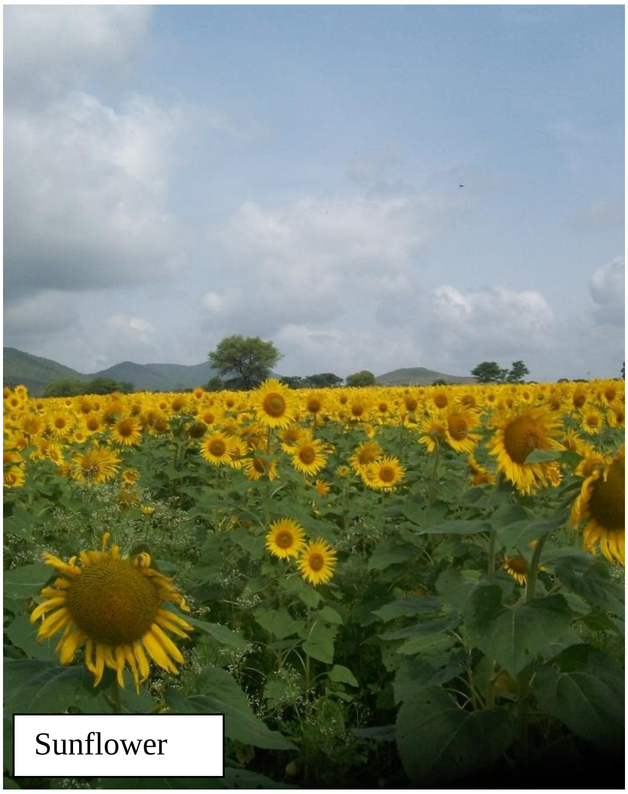


Fig.2.5 Location of Wells and Conservation Structures map of Bijjur-1 Microwatershed



Different crops and cropping systems in Bijjur-1 Microwatershed

Different crops and cropping systems in Bijjur-1 Microwatershed

Chapter 3

SURVEY METHODOLOGY

The purpose of land resource inventory is to delineate similar areas (soil series and phases), which respond or expected to respond similarly to a given level of management. This was achieved in Bijjur-1 microwatershed by the detailed study of all the soil characteristics (depth, texture, colour, structure, consistence, coarse fragments, porosity, soil reaction, soil horizons etc.) and site characteristics (slope 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 an area of 560 ha. The methodology followed for carrying out land resource inventory was as per the guidelines given in Soil Survey Manual (IARI, 1971; Soil Survey Staff, 2006; Natarajan *et al.*, 2015) which is briefly described below.

3.1 Base Maps

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

3.2 Image Interpretation for Physiography

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

Image Interpretation Legend for Physiography

G- Granite gneiss landscape

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

S-Schist landscape

S1		Uplands
	S11	Summits, greenish blue
	S12	Side slopes, greenish grey
S2		Very gently sloping uplands
	S21	Very gently sloping uplands, greenish grey
	S22	Very gently sloping uplands, medium grey
	S23	Very gently sloping uplands, dark grey
	S24	Very gently sloping uplands, light green (scrub lands)
	S25	Very gently sloping uplands, grey and pink
	S26	Very gently sloping uplands, whitish grey (eroded)

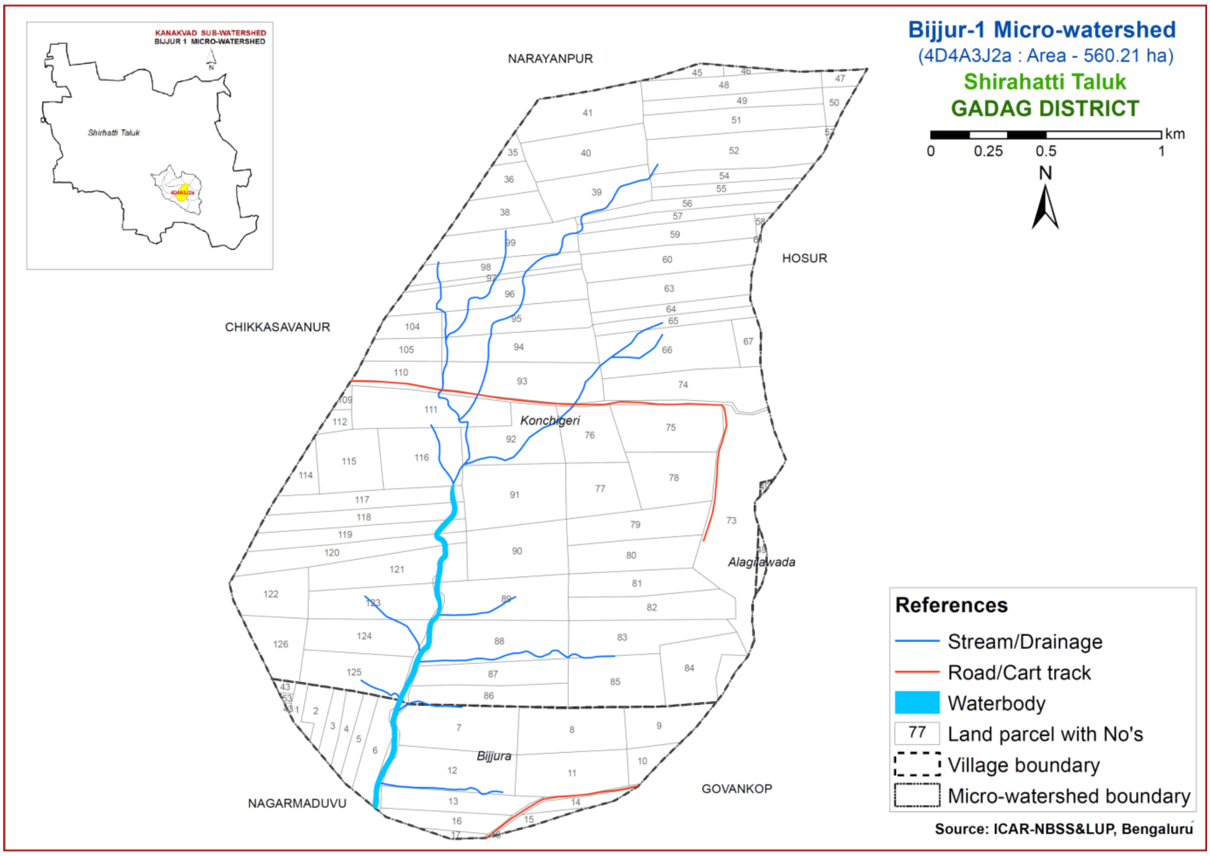


Fig 3.1 Scanned and Digitized Cadastral map of Bijjur-1 Microwatershed

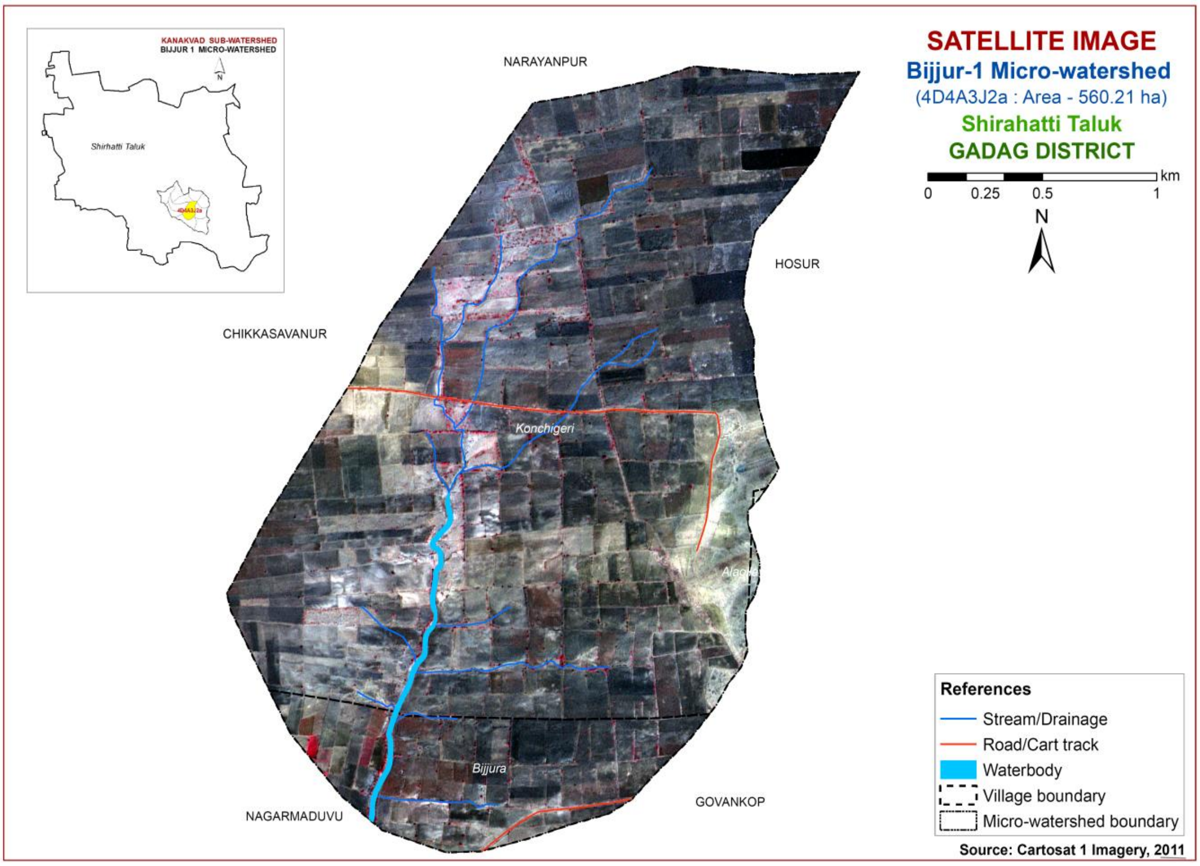


Fig.3.2 Satellite Image of Bijjur-1 Microwatershed

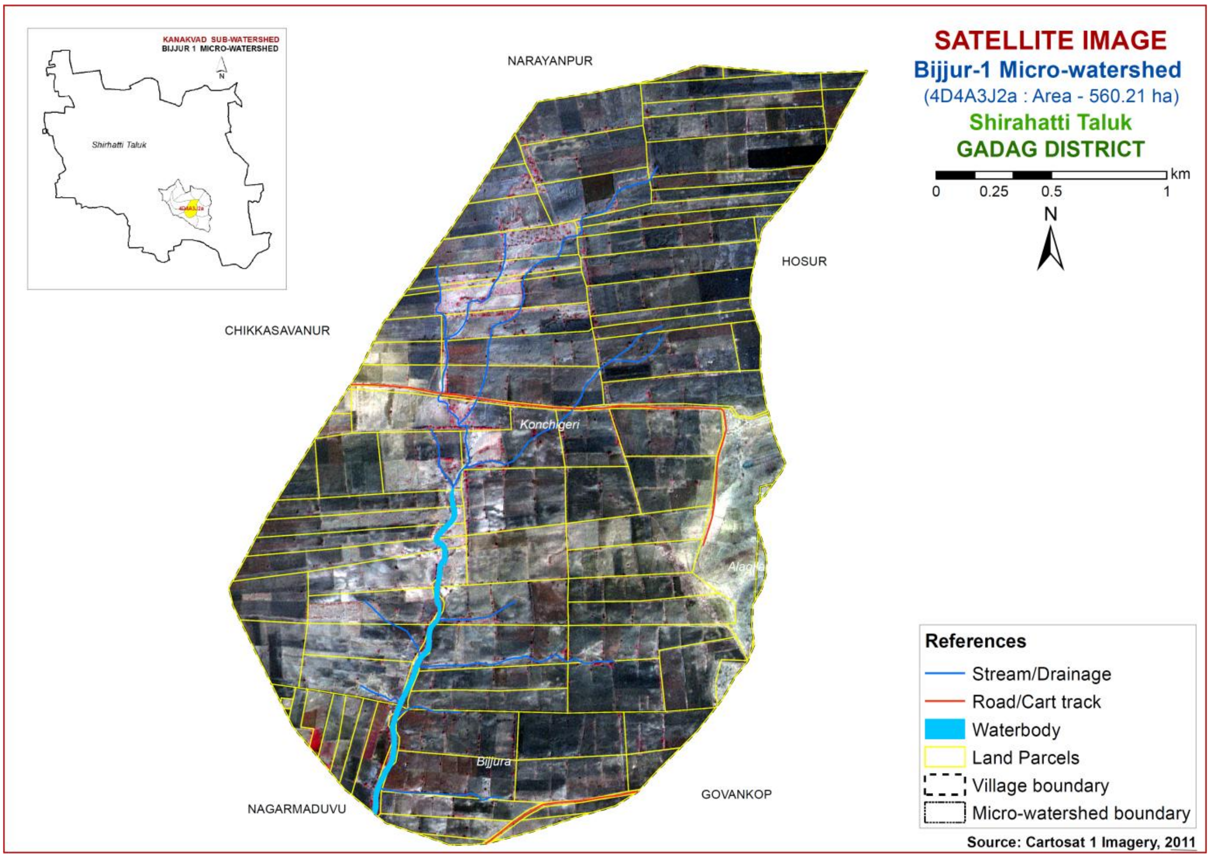


Fig.3.3 Cadastral map overlaid on IRS PAN+LISS IV merged imagery of Bijjur-1 Microwatershed

3.3 Field Investigation

The field boundaries and survey numbers given on the cadastral sheet were located on the ground by following permanent features like roads, cart tracks, nallas, streams, tanks etc., and wherever changes were noticed, they were incorporated on the microwatershed cadastral map. Preliminary traverse of the microwatershed was carried out with the help of cadastral map, imagery and toposheets. While traversing, landforms and physiographic units identified were checked and preliminary soil legend was prepared by studying soils at few selected places.

Then, intensive traversing of each physiographic unit like hills, ridges and uplands was carried out. Based on the variability observed on the surface, transects 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 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 Bijjur-1 microwatershed.

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

Sl. No	Soil Series	Depth (cm)	Colour	Texture	Gravel (%)	Horizon sequence	Calcareo-usness
Soils of Granite gneiss Landscape							
1	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
2	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
Soils of Schist Landscape							
3	Shirol (Srl)	<25	5YR3/3,3/4 7.5YR3/2, 3/3	cl,c	10-20	Ap-Cr	-
4	Kabulayathkatti (Klk)	<25	5YR3/3,3/4 2.5YR4/6	scl	>35	Ap-Cr	-
5	Attikatti (Akt)	25-50	2.5YR3/2,3/3 5YR4/4	cl,c	10-30	Ap-Bw-Cr	-
6	Yelisirunj (Ysj)	25-50	7.5YR2/2,2.5/3,4/2 10YR3/1,3/2	cl-c	<15	Ap-Bw-Cr	-
7	Sirunj (Srj)	25-50	10YR3/2, 5/4	c	>35	Ap-Bwk-Crk	es-ev
8	Venkatapur (Vkp)	50-75	10YR3/1 2.5Y2.5/1,3/1 7.5YR2.5/1	c	15-35	Ap-Bw-Cr	es
9	Jelligeri (Jlg)	75-100	10YR2/1,2/2,3/1 7.5YR2.5/2,3/1, 3/2,3/3	c	-	Ap-Bw-Cr	-
10	Varvi (Vrv)	75-100	10YR2/1, 3/1, 3/2, 2.5Y 2.5/1, 4/2, 7.5YR3/1, 3/2, 3/3	c	<15	Ap-Bss-Crk	e-es
11	Dhoni (Dni)	100-150	2.5YR3/4 5YR3/3,3/4	cl,sc,c	>35	Ap-Bw-Cr	-

12	Mahalingapur Tanda (Mpt)	100-150	10YR2/2,3/1,3/2, 3/3,4/2 7.5YR2.5/3, 3/2	c	-	Ap-Bw-Crk	-
13	Kalasapur (Kpr)	100-150	10YR2/1,2/2,3/1	c	<15	Ap-Bw-Cr	e

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 (89 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 13 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 25 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 25 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 25 soil phases identified and mapped in the microwatershed were regrouped into 7 Land Management Units (LMU's) for the purpose of preparing a proposed crop plan for sustained development of the microwatershed. The database (soil phases) generated under LRI was utilized for identifying Land Management Units (LMUs) based on the management needs. One or more than one soil site characteristic having influence on the management have been chosen for identification and delineation of LMUs. For Bijjur-1 microwatershed, five soil and site characteristics, namely soil depth, soil texture, slope, erosion and gravel content have been considered for defining LMUs. The land management units are expected to behave similarly for a given level of management.

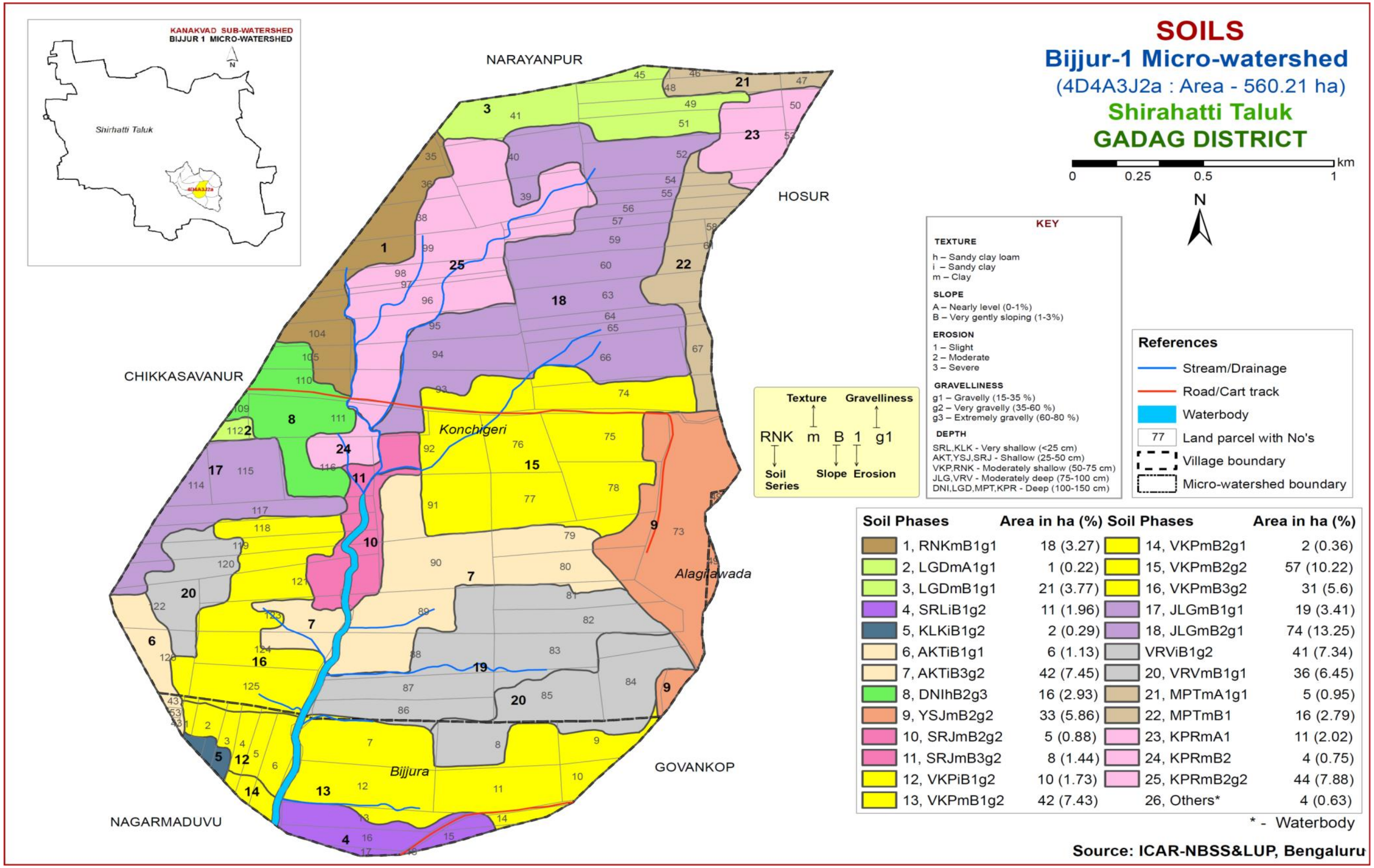


Fig 3.4 Soil Phase or Management units of Bijjur-1 Microwatershed

Table 3.2 Soil map unit description of Bijjur-1 Microwatershed

Soil No.	Soil Series	Soil Phase	Mapping Unit Description	Area in ha (%)
SOILS OF GRANITE GNEISS LANDSCAPE				
	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		**18.29 (3.26)**
1		RNKmB1g1	Clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)	18.29 (3.26)
	LGD	Lakshmangudda soils are deep (100-150 cm), well drained, have light olive brown to very dark gray calcareous sandy clay to clay soils occurring on nearly level to very gently sloping uplands under cultivation		**22.36 (3.99)**
2		LGDmA1g1	Clay surface, slope 0-1 %, slight erosion, gravelly (15-35 %)	1.23 (0.22)
3		LGDmB1g1	Clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)	21.13 (3.77)
SOILS OF SCHIST LANDSCAPE				
	SRL	Shirol soils are very shallow (<25 cm), well drained, have dark reddish brown clayey soils occurring on very gently sloping uplands under cultivation		**11.00 (1.96)**
4		SRLiB1g2	Sandy clay surface, slope 1-3%, slight erosion, very gravelly (35-60 %)	11.00 (1.96)
	KLK	Kabulayathkatti soils are very shallow (<25 cm), well drained, have dark reddish brown gravelly sandy clay loam soils occurring on very gently sloping uplands under cultivation		**1.62 (0.28)**
5		KLKiB1g2	Sandy clay surface, slope 1-3 %, slight erosion, very gravelly (35-60 %)	1.62 (0.28)
	AKT	Attikatti soils are shallow (25-50 cm), well drained, have dark reddish brown to dusky red clay loam to clay soils occurring on very gently sloping uplands under cultivation		**48.07 (8.57)**
6		AKTiB1g1	Sandy clay surface, slope 1-3%, slight erosion, gravelly (15-35 %)	6.36 (1.13)
7		AKTiB3g2	Sandy clay surface, slope 1-3%, severe erosion, very gravelly (35-60 %)	41.71 (7.44)
	DNI	Dhoni soils are deep (100-150 cm), well drained, have dark reddish brown gravelly clay soils occurring on gently to very gently sloping uplands under cultivation		**16.44 (2.93)**
8		DNIhB2g3	Sandy clay loam surface, slope 1-3%, moderate erosion, extremely gravelly (60-80 %)	16.44 (2.93)

	YSJ	Yelisirunj soils are shallow (25-50 cm), well drained, have very dark brown to very dark grayish brown clay soils occurring on very gently sloping uplands under cultivation		**32.83 (5.86)**
9		YSJmB2g2	Clay surface, slope 1-3 %, moderate erosion, very gravelly (35-60 %)	32.83 (5.86)
	SRJ	Shirunj soils are shallow (25-50 cm), well drained, have very dark greyish brown cracking gravelly clay soils occurring on very gently sloping uplands under cultivation		**12.96 (2.30)**
10		SRJmB2g2	Clay surface, slope 1-3%, moderate erosion, very gravelly (35-60 %)	4.91 (0.87)
11		SRJmB3g2	Clay surface, slope 1-3%, severe erosion, very gravelly (35-60 %)	8.05 (1.43)
	VKP	Venkatapur soils are moderately shallow (50-75 cm), well drained, have very dark greyish brown cracking clay soils occurring on very gently sloping uplands under cultivation		**141.98 (25.59)**
12		VKPiB1g2	Sandy clay surface, slope 1-3%, slight erosion, very gravelly (35-60%)	9.67 (1.72)
13		VKPmB1g2	Clay surface, slope 1-3%, slight erosion, very gravelly (35-60 %)	41.62 (7.42)
14		VKPmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35 %)	2.04 (0.63)
15		VKPmB2g2	Clay surface, slope 1-3%, moderate erosion, very gravelly (35-60 %)	57.28 (10.22)
16		VKPmB3g2	Clay surface, slope 1-3%, severe erosion, very gravelly (35-60 %)	31.37 (5.60)
	JLG	Jelligeri soils are moderately deep (75-100 cm), moderately well drained, very dark brown to dark brown and black cracking clay soils occurring on very gently sloping uplands under cultivation		**93.32 (16.65)**
17		JLGmB1g1	Clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)	19.08 (3.40)
18		JLGmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35 %)	74.24 (13.25)
	VRV	Varavi soils are moderately deep (75-100 cm), moderately well drained, have very dark brown cracking clay calcareous soils occurring on very gently sloping uplands under cultivation		**77.23 (13.77)**
19		VRViB1g2	Sandy clay surface, slope 1-3 %, slight erosion, very gravelly (35-60 %)	41.12 (7.33)
20		VRVmB1g1	Clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)	36.11 (6.44)

	MPT	Mahalingapur Tanda soils are deep (100-150 cm), moderately well drained, have very dark brown to very dark grayish brown cracking clay soils occurring on nearly level to very gently sloping uplands under cultivation		**20.92 (3.72)**
21		MPTmA1g1	Clay surface, slope 0-1 %, slight erosion, gravelly (15-35 %)	5.31 (0.94)
22		MPTmB1	Clay surface, slope 1-3 %, slight erosion	15.61 (2.78)
	KPR	Kalasapur soils are deep (100-150 cm), moderately well drained, have very dark gray to very dark grayish brown, calcareous cracking clay soils occurring on nearly level to very gently sloping uplands under cultivation		**59.66 (10.64)**
23		KPRmA1	Clay surface, slope 0-1 %, slight erosion	11.32 (2.02)
24		KPRmB2	Clay surface, slope 1-3 %, moderate erosion	4.20 (0.74)
25		KPRmB2g2	Clay surface, slope 1-3 %, moderate erosion, very gravelly (35-60 %)	44.14 (7.88)
26		Waterbody		3.55 (0.63)

Chapter 4

THE SOILS

Detailed information pertaining to the nature, extent and distribution of different kinds of soils occurring in Bijjur-1 microwatershed is provided in this chapter. The microwatershed area has been broadly divided into two landscapes based on geology, *viz*.1. Granite gneiss and 2. Schist. In all, 13 soil series are identified in the two landscapes. Of these, 2 soil series are identified in the granite gneiss landscape and 11 series in schist landscape. Soil formation is the result of the combined effect of environmental and terrain factors that are reflected in soil morphology. In both landscapes, soil formation is dominantly influenced by the parent material, climate and relief. Maximum area of about 516 ha (92%) has soils that are developed from schist followed by a very small area of about 41 ha (7%) under granite gneiss.

A brief description of each of the 13 soil series identified followed by 25 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, 2 soil series are identified and mapped. Of these, Lakshmangudda (LGD) soil series occupies maximum area of about 22 ha (4%). The brief description of each soil series and their phases identified in the microwatershed are given below.

4.1.1 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 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).

Only one phase was identified:

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

Landscape and Soil Profile Characteristics of Ravanaki (RNK) Series

4.1.2 Lakshmangudda (LGD) Series: Lakshmangudda soils are deep (100-150 cm), moderately well drained, have light olive brown to very dark gray, calcareous sandy clay to 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).

Two phases were identified:

LGDmA1g1	Clay surface, slope 0-1 %, slight erosion, gravelly (15-35 %)
LGDmB1g1	Clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)

Landscape and Soil Profile Characteristics of Lakshmangudda (LGD) Series

4.2 Soils of Schist Landscape

In this landscape, 11 soil series are identified and mapped. Of these, Venkatapur (VKP) soil series occupies maximum area of about 142 ha (26%). The brief description of each series along with the soil phases identified and mapped is given below.

4.2.1 Shirol (SRL) Series: Shirol soils are very shallow (<25 cm), well drained, reddish brown to dark red clayey soils. They are developed from schist and occur on very gently sloping uplands.

The depth of the soil is less than 25 cm. Its colour is in hue 5 YR and 7.5 YR with value 2.5 to 3 and chroma 3 to 6. Texture is dominantly clay with less than 15 per cent gravel. The available water capacity is very low (<50 mm/m).

Only one phase was identified:

SRLiB1g2	Sandy clay surface, slope 1-3%, slight erosion, very gravelly (35-60 %)

Landscape and Soil Profile Characteristics of Shirol (SRL) Series

4.2.2 Kabulayathkatti (KLK) Series: Kabulayathkatti soils are very shallow (<25 cm), well drained, have reddish brown to dark red sandy clay loam soils. They have developed from schist and occur on very gently to moderately sloping uplands.

The thickness of the solum ranges from less than 23 cm. The thickness of A horizon ranges from 12 to 17 cm. Its colour is in 5 YR and 2.5 YR hue with value 3 to 4 and chroma 4 to 6. The texture is sandy clay loam with 35 to 60 per cent gravel. The available water capacity is very low (<50 mm/m).

Only one phase was identified:

KLKiB1g2	Sandy clay surface, slope 1-3 %, slight erosion, very gravelly (35-60 %)

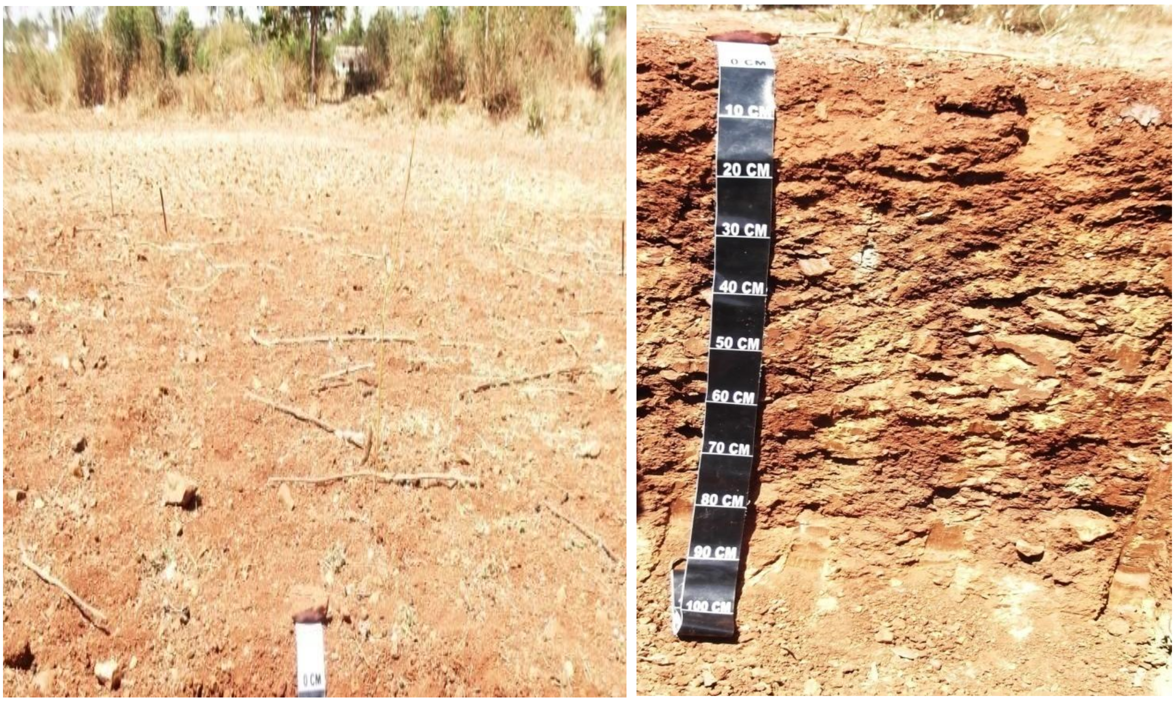
Landscape and Soil Profile Characteristics of Kabulayathkatti (KLK) Series

4.2.3 Attikatti (AKT) Series: Attikatti soils are shallow (25-50 cm), well drained, have dark reddish brown to dusky red clay loam to clay soils. They are developed from schist and occur on very gently sloping uplands.

The thickness of the solum ranges from 26 to 48 cm. Thickness of A horizon ranges from 12 to 18 cm. Its colour is in hue 5 YR and 2.5 YR with value 3 and chroma 3 to 4. The texture is clay loam to clay. The thickness of B horizon ranges from 14 to 30 cm. Its colour is in hue 2.5 YR and 5 YR with value 3 to 4 and chroma 2 to 4. Its texture is dominantly clay. The available water capacity is very low (<50 mm/m).

Two phases were identified:

AKTiB1g1	Sandy clay surface, slope 1-3%, slight erosion, gravelly (15-35 %)
AKTiB3g2	Sandy clay surface, slope 1-3%, severe erosion, very gravelly (35-60 %)



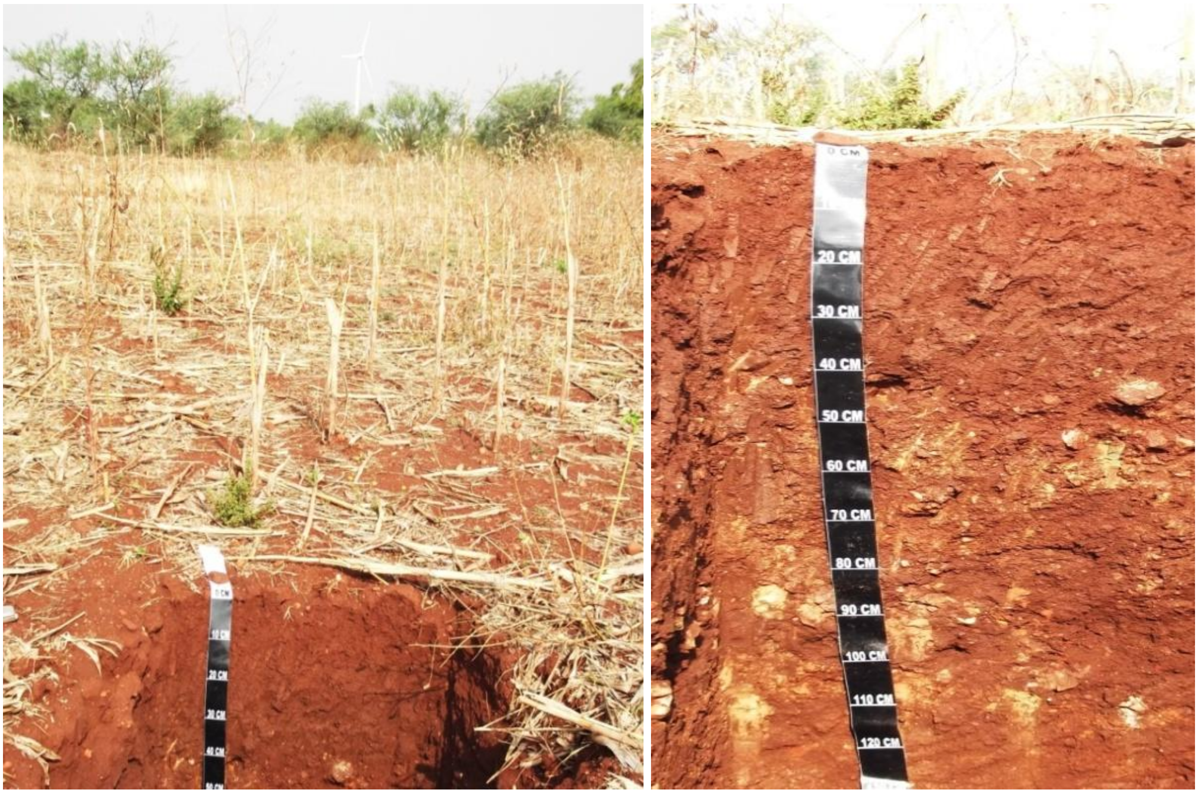
Landscape and Soil Profile Characteristics of Attikatti (AKT) Series

4.2.4 Dhoni (DNI) Series: Dhoni soils are deep (100-150 cm), well drained, dark reddish brown to dark red gravelly clay soils. They are developed from schist and occur on very gently sloping uplands.

The thickness of the solum ranges from 117 to 148 cm. The thickness of A horizon ranges from 13 to 21 cm. Its colour is in hue 7.5YR and 5YR with value 2 to 3 and chroma 3 to 4. Its texture is clay. The thickness of B horizon ranges from 104 to 124 cm. Its colour is in hue 2.5 YR and 5 YR with value 3 and chroma 4. Its texture is clay loam to clay. The available water capacity is low (51-100 mm/m).

Only one phase was identified:

DNIhB2g3	Sandy clay loam surface, slope 1-3%, moderate erosion, extremely gravelly (60-80 %)



Landscape and soil Profile Characteristics of Dhoni (DNI) Series

4.2.5 Yelisirunj (YSJ) Series: Yelisirunj soils are shallow (25-50 cm), well drained, have very dark brown to very dark grayish brown clay soils. They have developed from schist and occur on very gently sloping uplands.

Landscape and Soil Profile Characteristics of Yelisirunj (YSJ) Series

The thickness of the solum ranges from 28 to 49 cm. The thickness of A horizon ranges from 12 to 20 cm. Its colour is in hue 7.5 YR and 10 YR with value 2 to 4 and chroma 1 to 3. Texture is dominantly clay loam. The thickness of B horizon ranges from 16 to 29 cm. Its colour is in hue 7.5 YR and 10 YR with value 2 to 4 and chroma 1 to 3. Its texture is dominantly clay. The available water capacity is low (51-100 mm/m).

Only one phase was identified:

YSJmB2g2	Clay surface, slope 1-3 %, moderate erosion, very gravelly (35-60 %)

4.2.6 Sirunj (SRJ) Series: Sirunj soils are shallow (25-50 cm), well drained, have dark brown to very dark grayish brown clay soils. They have developed from schist and occur on very gently sloping uplands.

The thickness of the solum ranges from 27 to 48 cm. The thickness of A horizon ranges from 10 to 20 cm. Its colour is in 10 YR hue with value 2 to 3 and chroma 2 to 4. The texture varies from sandy clay to clay with 10 to 30 per cent gravel. The thickness of B horizon ranges from 25 to 38 cm. Its colour is in 10 YR hue with value 3 to 5 and chroma 2 to 4. Its texture is clay with gravel content of more than 35 per cent. The available water capacity is very low (<50 mm/m).

Two phases were identified:

SRJmB2g2	Clay surface, slope 1-3%, moderate erosion, very gravelly (35-60 %)
SRJmB3g2	Clay surface, slope 1-3%, severe erosion, very gravelly (35-60 %)

4.2.7 Venkatapur (VKP) Series: Venkatapur soils are moderately shallow (50-75 cm), well drained, have very dark brown to very dark gray clay soils. They have developed from schist and occur on very gently sloping uplands.

The thickness of the solum ranges from 51 to 73 cm. The thickness of A horizon ranges from 15 to 23 cm. Its colour is in 7.5 YR and 10 YR hue with value 2.5 to 3 and chroma 2 to 3. The texture varies from sandy clay to clay with 10 to 20 per cent gravel. The thickness of B horizon ranges from 28 to 55 cm. Its colour is in 2.5 Y, 10 YR and 7.5 YR hue with value 2.5 to 3 and chroma 2 to 3. Its texture is clay with gravel content of 15 to 35 per cent. The available water capacity is medium (101-150 mm/m).

Five phases were identified:

VKPiB1g2	Sandy clay surface, slope 1-3%, slight erosion, very gravelly (35-60%)
VKPmB1g2	Clay surface, slope 1-3%, slight erosion, very gravelly (35-60 %)
VKPmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35 %)
VKPmB2g2	Clay surface, slope 1-3%, moderate erosion, very gravelly (35-60 %)
VKPmB3g2	Clay surface, slope 1-3%, severe erosion, very gravelly (35-60 %)

Landscape and Soil Profile Characteristics of Venkatapur (VKP) Series

4.2.8 Jelligeri (JLG) Series: Jelligeri soils are moderately deep (75-100 cm), moderately well drained, very dark brown to dark brown and black cracking clay soils. They have developed from schist and occur on very gently sloping uplands.

The thickness of the solum ranges from 78 to 98 cm. The thickness of A horizon ranges from 15 to 20 cm. Its colour is in hue 10 YR and 7.5 YR with value 2 to 3 and chroma 1 to 3. Its texture is dominantly clay. The thickness of B horizon ranges from 63 to 78 cm. Its colour is in hue 10 YR and 7.5 YR with value 2 to 3 and chroma 1 to 3. Its texture is dominantly clay. The available water capacity is medium (101-150 mm/m).

Two phases were identified:

JLGmB1g1	Clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)
JLGmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35 %)

Landscape and Soil Profile Characteristics of Jelligeri (JLG) Series

4.2.9 Varavi (VRV) Series: Varavi soils are moderately deep (75-100 cm), moderately well drained, dark gray to very dark grayish brown and black cracking clay calcareous soils. They have developed from schist and occur on very gently sloping uplands.

The thickness of the solum ranges from 76 to 98 cm. Thickness of A horizon ranges from 18 to 25 cm. Its colour is in hue 7.5 YR with value 3 and chroma 2. The texture is clay. The thickness of B horizon ranges from 58 to 73 cm. Its colour is in hue 10 YR and 7.5 YR with value 2 to 4 and chroma 2 to 3. Its texture is dominantly clay. The available water capacity is medium (101-150 mm/m).

Two phases were identified:

VRViB1g2	Sandy clay surface, slope 1-3 %, slight erosion, very gravelly (35-60 %)
VRVmB1g1	Clay surface, slope 1-3 %, slight erosion, gravelly (15-35 %)

Landscape and Soil Profile Characteristics of Varavi (VRV) Series

4.2.10 Mahalingapur Tanda (MPT) Series: Mahalingapur Tanda soils are deep (100-150 cm), moderately well drained, very dark brown to very dark grayish brown cracking clay soils. They have developed from schist and occur on very gently sloping uplands.

The thickness of the solum ranges from 117 to 145 cm. The thickness of A horizon ranges from 13 to 21 cm. Its colour is in hue 10 YR and 7.5 YR with value 2 to 4 and chroma 1 to 3. Its texture is dominantly clay. The thickness of B horizon ranges from 104 to 124 cm. Its colour is in hue 10 YR and 7.5 YR with value 2 to 4 and chroma 1 to 3. Its texture is dominantly clay. The available water capacity is very high (>200mm/m).

Two phases were identified:

MPTmA1g1	Clay surface, slope 0-1 %, slight erosion, gravelly (15-35%)
MPTmB1	Clay surface, slope 1-3 %, slight erosion

Landscape and Soil Profile Characteristics of Mahalingapur Tanda (MPT) Series

4.2.11 Kalasapur (KPR) Series: Kalasapur soils are deep (100-150 cm), moderately well drained, have very dark gray to very dark grayish brown, calcareous cracking clay soils. They have developed from schist and occur on very gently sloping uplands.

The thickness of the solum ranges from 102 to 148 cm. The thickness of A horizon ranges from 12 to 28 cm. Its colour is in 10 YR hue with value 2 to 3 and chroma 1 to 2. The texture varies from clay loam to clay. The thickness of B horizon ranges from 98 to 136 cm. Its colour is in 10 YR hue with value 2 to 3 and chroma 1 to 2. Its texture is clay. These soils are slightly effervescent with dilute HCL. The available water capacity is very high (>200mm/m).

Three phases were identified:

KPRmA1	Clay surface, slope 0-1 %, slight erosion
KPRmB2	Clay surface, slope 1-3 %, moderate erosion
KPRmB2g2	Clay surface, slope 1-3 %, moderate erosion, very gravelly (35-60 %)

Landscape and soil profile characteristics of Kalasapur (KPR) Series

Chapter 5

INTERPRETATION FOR LAND RESOURCE MANAGEMENT

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

5.1 Land Capability Classification

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

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

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

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

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

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

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

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

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

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

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

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

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

The land capability subclasses are recognised based on the dominant limitations observed within the given capability class. The subclasses are designated by adding a lower case letter like ‘e’, ‘w’, ‘s’, or ‘c’ to the class numeral. The subclass “e” indicates that the main hazard is risk of erosion, “w” indicates drainage or wetness as a limitation for plant growth, “s” indicates shallow soil depth, coarse or heavy textures, calcareousness, salinity/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 have similar soil and land characteristics that respond similarly to a given level of management. The soils of the microwatershed have been classified upto land capability subclass level.

The 25 soil map units identified in the Bijjur-1 microwatershed are grouped under 3 land capability classes and 8 land capability subclasses (Fig. 5.1). About 99 per cent area in the microwatershed is suitable for agriculture.

Of the lands suitable for agriculture, about 20 per cent are good cultivable lands (Class II) with minor limitations of soil characteristics and soil erosion and are distributed in the western, northern and southeastern part of the microwatershed.

Moderately good cultivable lands (Class III) cover an area of about 60 per cent and are distributed in all parts of the microwatershed with moderate problems of erosion and soil.

The fairly good lands (class IV) cover about 20 per cent area. They have very severe limitations of erosion and soil and are distributed in the southern and central part of the microwatershed.

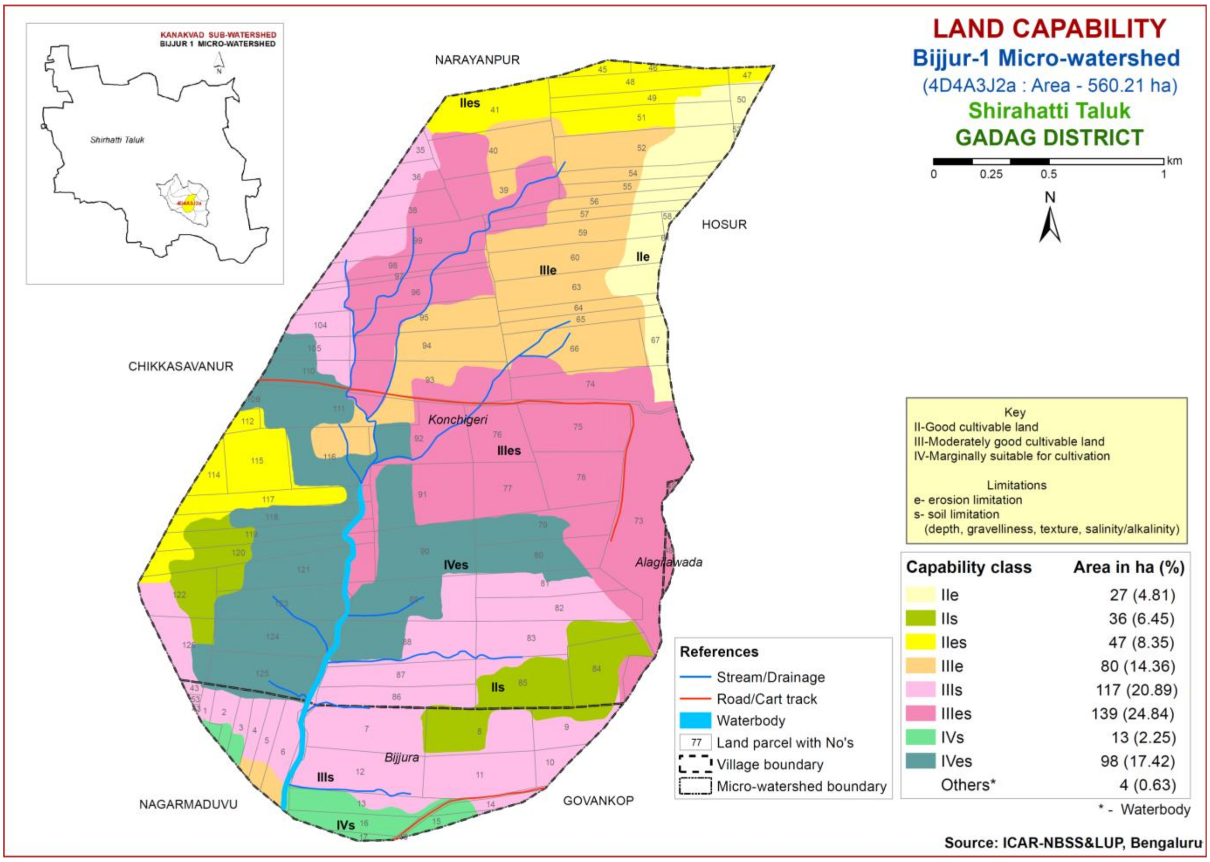


Fig. 5.1 Land Capability map of Bijjur-1 Microwatershed

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).

Moderately deep (75-100 cm) soils occupy maximum area of about 171 ha (30%) in the central, southeastern and western part of the microwatershed. Deep soils (100-150 cm) occur in about 119 ha (21%) and are distributed in the northwestern, northern and northeastern part of the microwatershed. Moderately shallow (50-75 cm) soils occupy about 160 ha (29%) and are distributed in the southern and central part of the microwatershed. Shallow soils (25-50 cm) occupy about 94 ha (17%) in the eastern and central part of the microwatershed. A small area of about 13 ha is under very shallow (<25 cm) and is distributed in the southern part of the microwatershed.

The most productive lands (21%) with respect to soil rooting depth where all climatically adapted annual and perennial crops can be grown are deep soils (100 to 150 cm depth) occurring in northeastern, northern and northwestern part of the microwatershed.

The most problematic lands (19%) having very shallow (<25 cm) and shallow (25-50 cm) rooting depth occur in the southern, central and eastern 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.

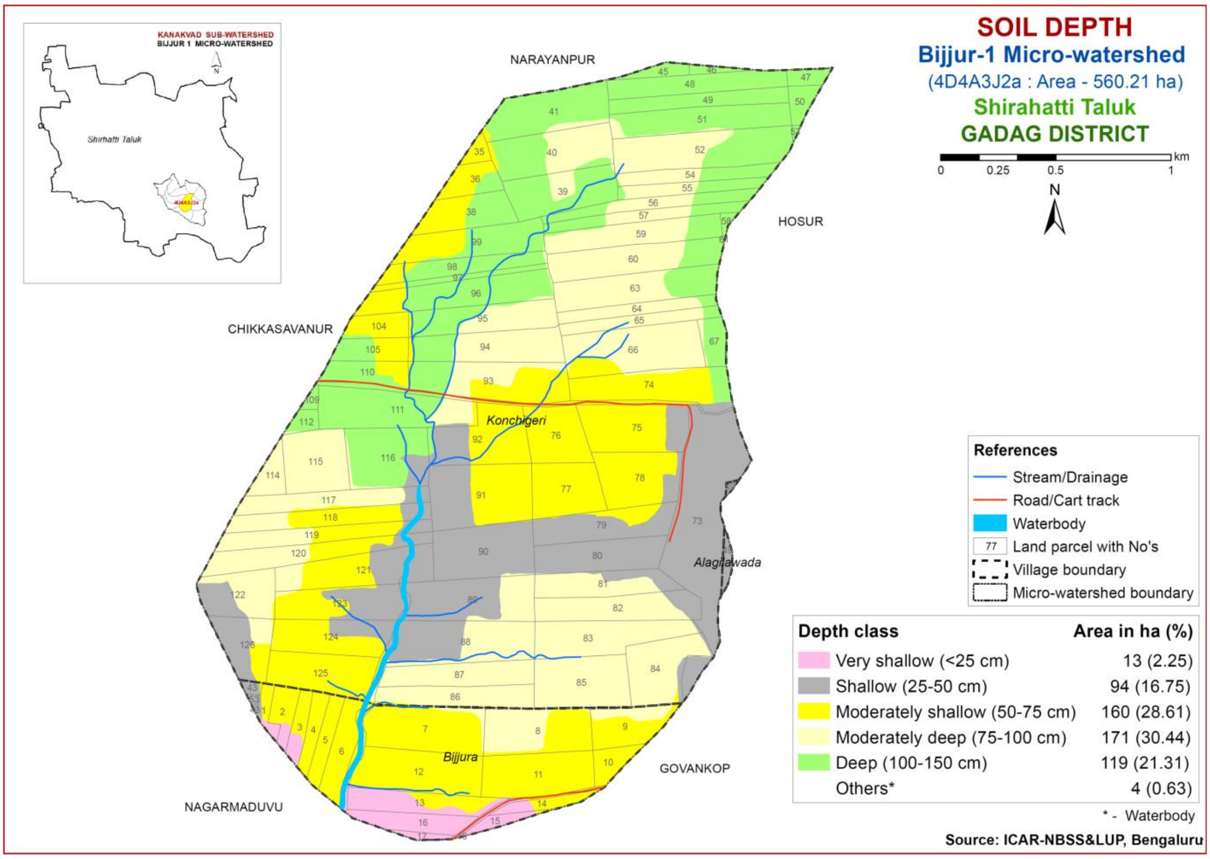


Fig. 5.1 Soil Depth map of Bijjur-1 microwatershed

5.3 Surface Soil Texture

Texture is an expression to indicate the coarseness or fineness of the soil as determined by the relative proportion of primary particles of sand, silt and clay. It has a direct bearing on the structure, porosity, adhesion and consistence. The surface layer of a soil to a depth of about 25 cm is the layer that is most used by crops and plants. The surface soil textural class provides a guide to understanding soil-water retention and availability, nutrient holding capacity, infiltration, workability, drainage, physical and chemical behaviour, microbial activity and crop suitability.

The maximum area of 540 ha (96%) has soils that are clayey at the surface and are distributed all parts of the microwatershed and a very minor area has soils that are loamy (16 ha, 3%). They are distributed in the western part of the microwatershed (Fig. 5.3).

The most productive lands (96%) 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.

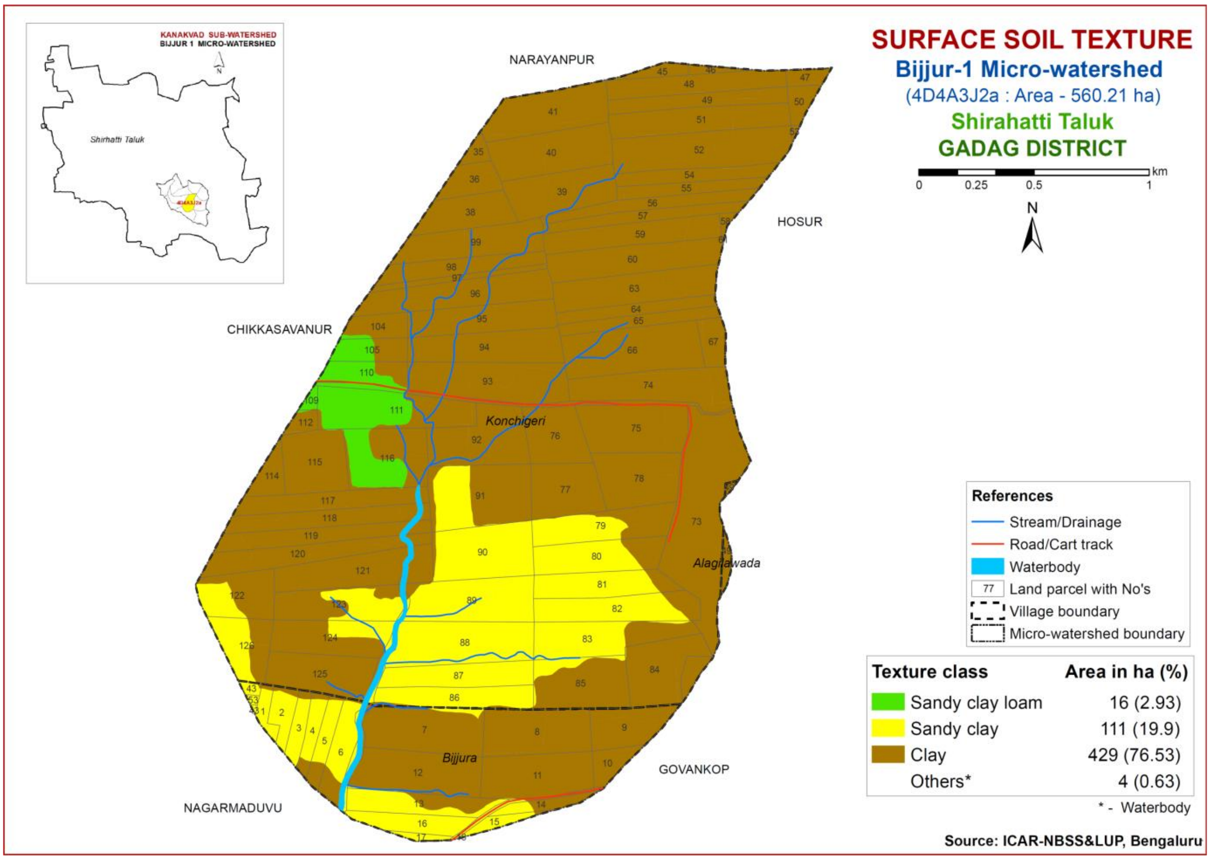


Fig. 5.3 Surface Soil Texture map of Bijjur-1 Microwatershed

5.4 Soil Gravelliness

Gravel is the term used for describing coarse fragments between 2 mm and 7.5 cm diameter and stones for those between 7.5 cm and 25 cm. The presence of gravel and stones in soil reduces the volume of soil responsible for moisture and nutrient storage, drainage, infiltration and runoff and hinders plant growth by impeding root growth and seedling emergence, intercultural operations and farm mechanization.

The soils that are gravelly (15-35%) cover about 184 ha (33%) and are distributed in the western, northwestern and northern part of the microwatershed (Fig. 5.4). The maximum area in the microwatershed has soils that are very gravelly (35-60%) covering about 325 ha (58%) and are distributed in the eastern, southern and central part of the microwatershed. The soils that are nongravelly (<15%) cover about 31 ha (6%) and are distributed in the northeastern and central part of the microwatershed. A very small area of about 16 ha (3%) in the microwatershed has soils that are extremely gravelly (60-80%) and are distributed in the western part of the microwatershed.

The most productive lands with respect to gravelliness are found to be 6 per cent. They are non-gravelly with less than 15 per cent gravel and have potential for growing both annual and perennial crops. The problem soils (61%) that are very gravelly (35-60%) and extremely gravelly (60-80%) where only short duration crops can be grown.

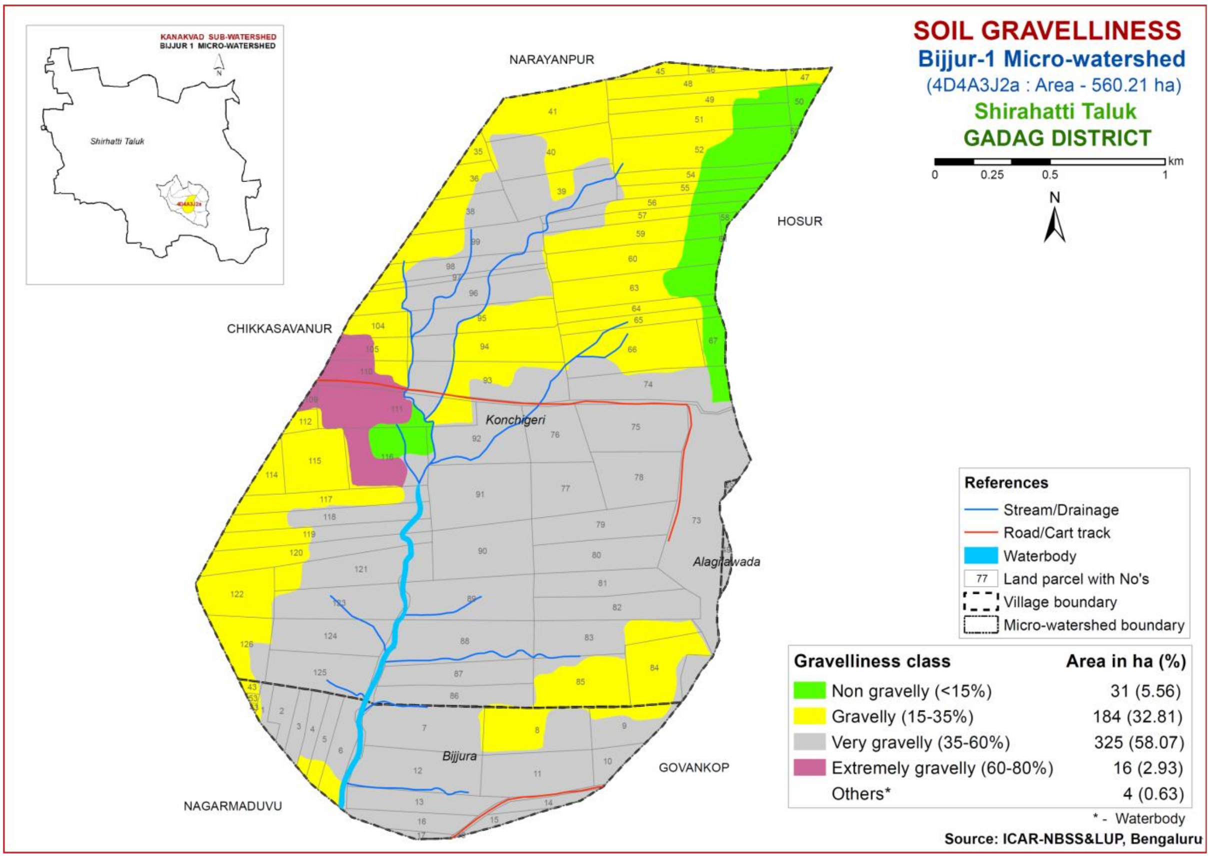


Fig. 5.4 Soil Gravelliness map of Bijjur-1 Microwatershed

5.5 Available Water Capacity

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

The major area in the microwatershed has soils that are medium (101-150 mm/m) in available water capacity. They occur in about 313 ha (56%) and are distributed in the central, southeastern, southern and western part of the microwatershed. An area of about 103 ha (18%) in the microwatershed has soils that have very high (>200 mm/m) available water capacity and are distributed in the northwestern, northern and northeastern part of the microwatershed.

An area of about 51 ha (9%) has soils that are low (51-100 mm/m) in available water capacity and are distributed in the northwestern and eastern part of the microwatershed. An area of about 90 ha (16%) has soils that are very low (<50 mm/m) in available water capacity and are distributed in the central and southern part of the microwatershed.

An area of about 103 ha (18%) 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 141 ha (15%) area in the microwatershed has soils that are problematic (<50 to 100 mm/m) 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.

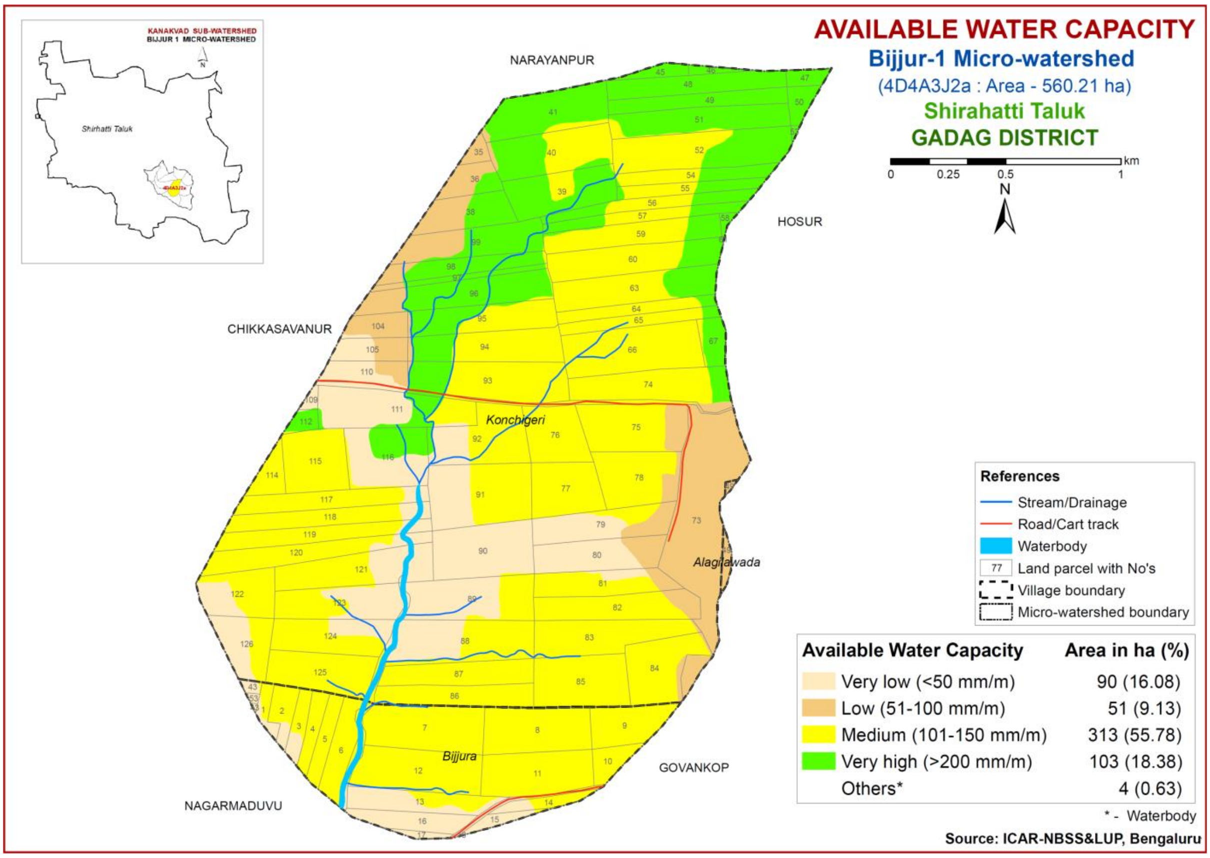


Fig. 5.5 Soil Available Water Capacity map of Bijjur-1 Microwatershed

5.6 Soil Slope

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

The major area of the microwatershed falls under very gently sloping (1-3% slope) class. It covers an area of about 539 ha (96%) and is distributed in all parts of the microwatershed followed by nearly level (0-1% slope) lands. It covers a very small area of about 18 ha (3%) and is distributed in northeastern and western part of the microwatershed.

An area of about 557 ha (99%) 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.

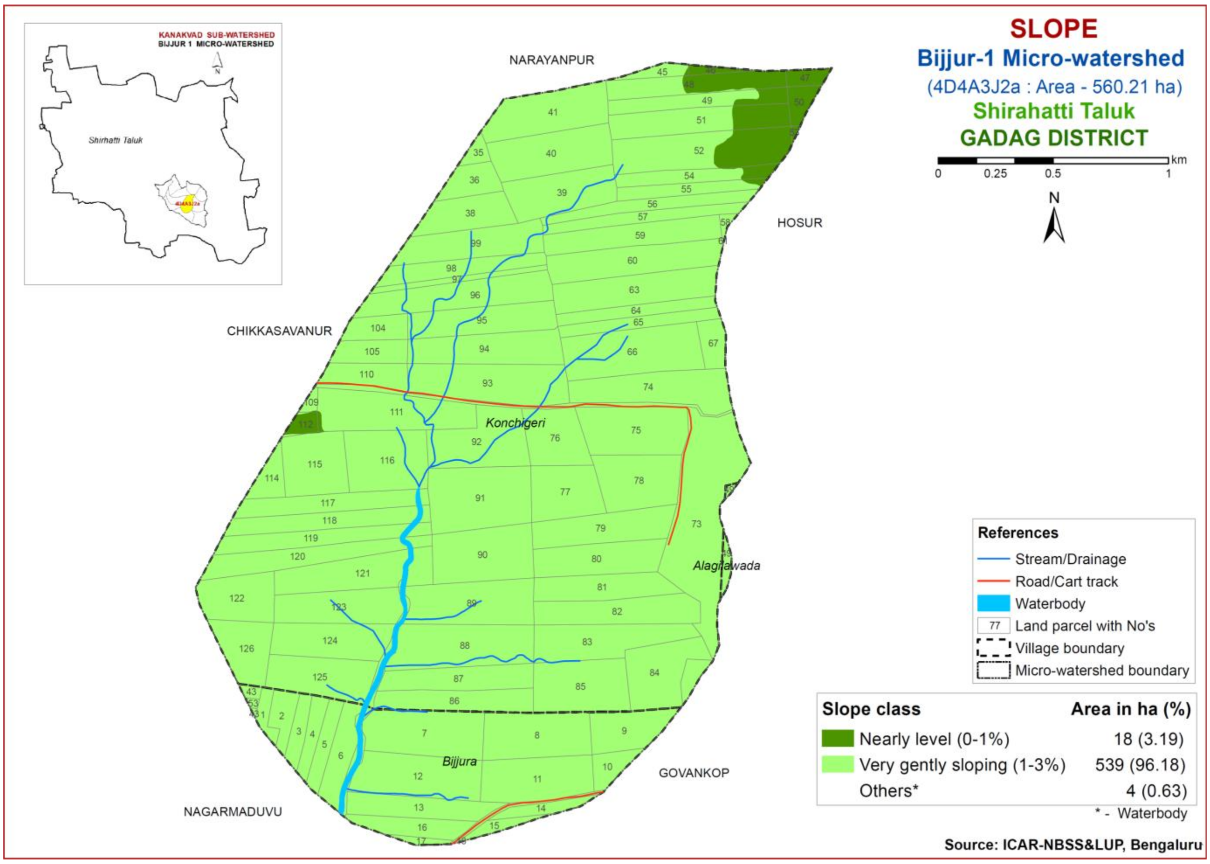


Fig. 5.6 Soil Slope map of Bijjur-1 Microwatershed

5.7 Soil Erosion

Soil erosion refers to the wearing away of the earth's surface by the forces of water, wind and ice involving detachment and transport of soil by raindrop impact. It is used for accelerated soil erosion resulting from disturbance of the natural landscape by burning, excessive grazing and indiscriminate felling of forest trees and tillage, all usually by man. The erosion classes showing an estimate of the current erosion status as judged from 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 an area of about 239 ha (43%) in the microwatershed. They are distributed in all parts of the microwatershed. Moderately eroded (e2 class) soils cover an area of about 236 ha (42%) and are distributed in central, eastern and northern part of the microwatershed. Severely eroded (e3 class) soils cover an area of about 81 ha (14%) and are distributed in the central part of the microwatershed.

An area of about 81 ha (14%) 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 236 ha (42%) where the soils are moderately eroded.

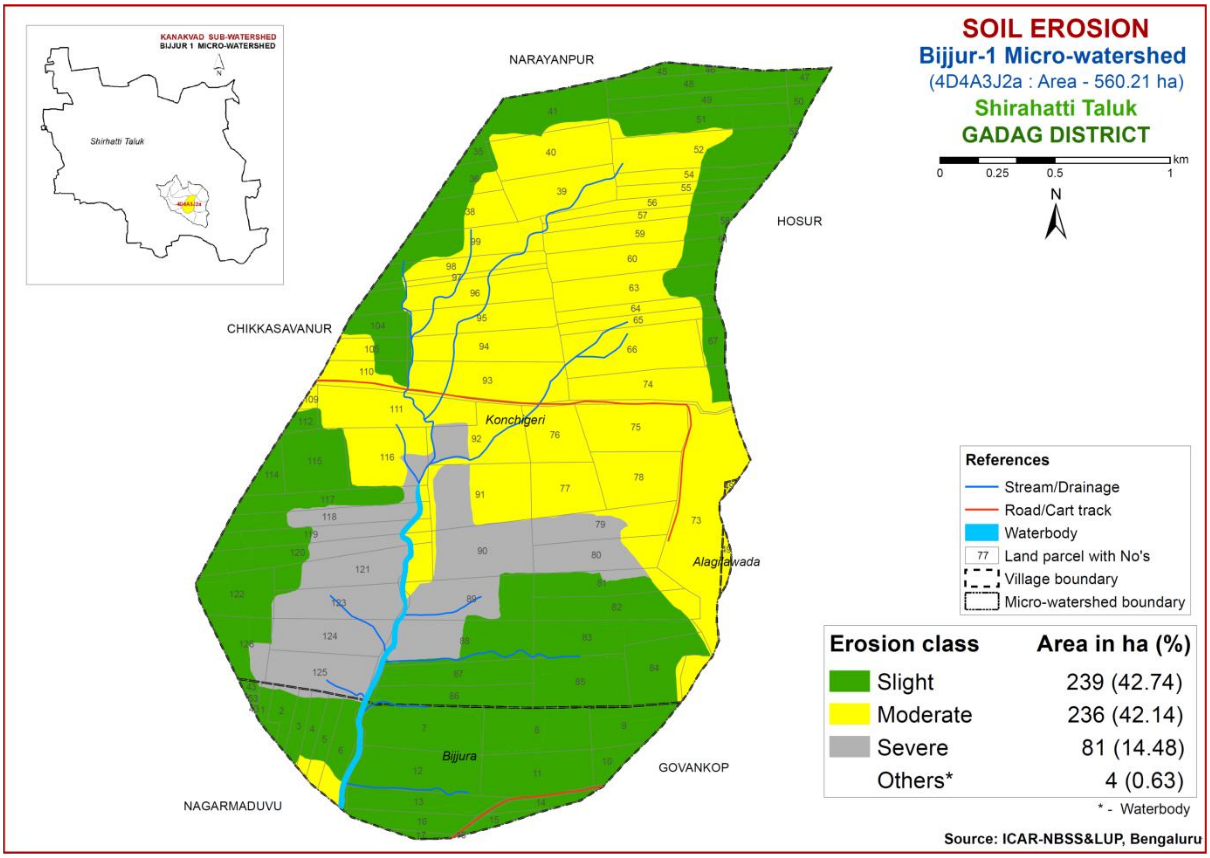


Fig. 5.7 Soil Erosion map of Bijjur-1 Microwatershed

Chapter 6

FERTILITY STATUS

Soil fertility plays an important role in increasing crop yield. The adoption of high yielding varieties that require high amounts of nutrients has resulted in deficiency symptoms in crops and plants due to imbalanced fertilization and poor inherent fertility status. 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 generated using kriging method under GIS. The village/survey number wise fertility data for the microwatershed is given in Appendix-II.

6.1 Soil Reaction (pH)

The soil analysis of the Bijjur-1 microwatershed for soil reaction (pH) showed that about 40 ha (7%) area is moderately alkaline (pH 7.8-8.4) and is distributed in the eastern part of the microwatershed. About 80 ha (14%) area is under very strongly alkaline (pH >9.0) and is distributed in the western part of the microwatershed. The major area of about 428 ha (76%) is under strongly alkaline (pH 8.4-9.0) and is distributed in all parts of the microwatershed (Fig.6.1). Small area of about 8 ha (1%) is slightly alkaline (pH 7.3-7.8) in reaction and is distributed in the eastern part of the microwatershed.

6.2 Electrical Conductivity (EC)

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

6.3 Organic Carbon

The soil organic carbon content of the entire microwatershed area is medium (0.5-0.75%) covering about 489 ha (87%) and an area of 68 ha (12%) is low (>0.5%) in organic carbon content and is distributed in the northwestern part of the microwatershed (Fig.6.3).

6.4 Available Phosphorus

The soil analysis revealed that the entire microwatershed area is low in available phosphorus (<23 kg/ha). 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 (Fig. 6.4).

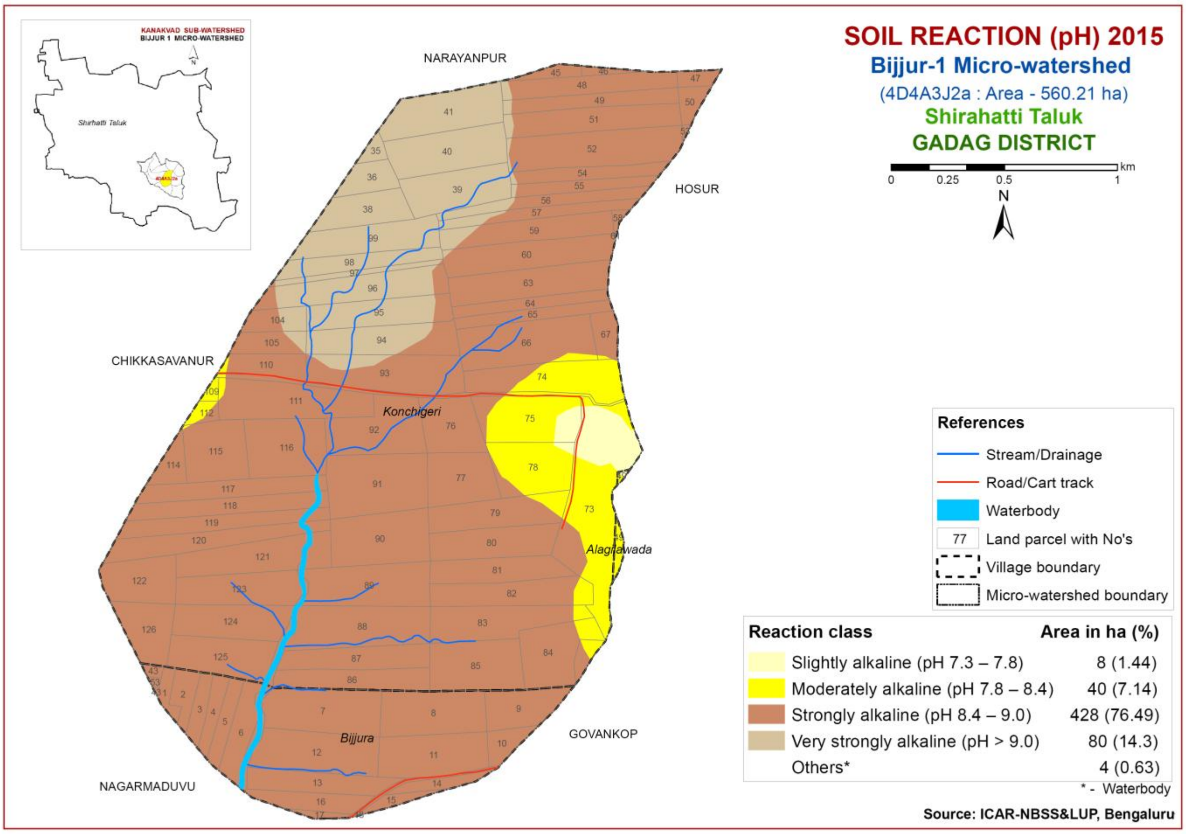


Fig.6.1 Soil Reaction (pH) map of Bijjur-1 Microwatershed

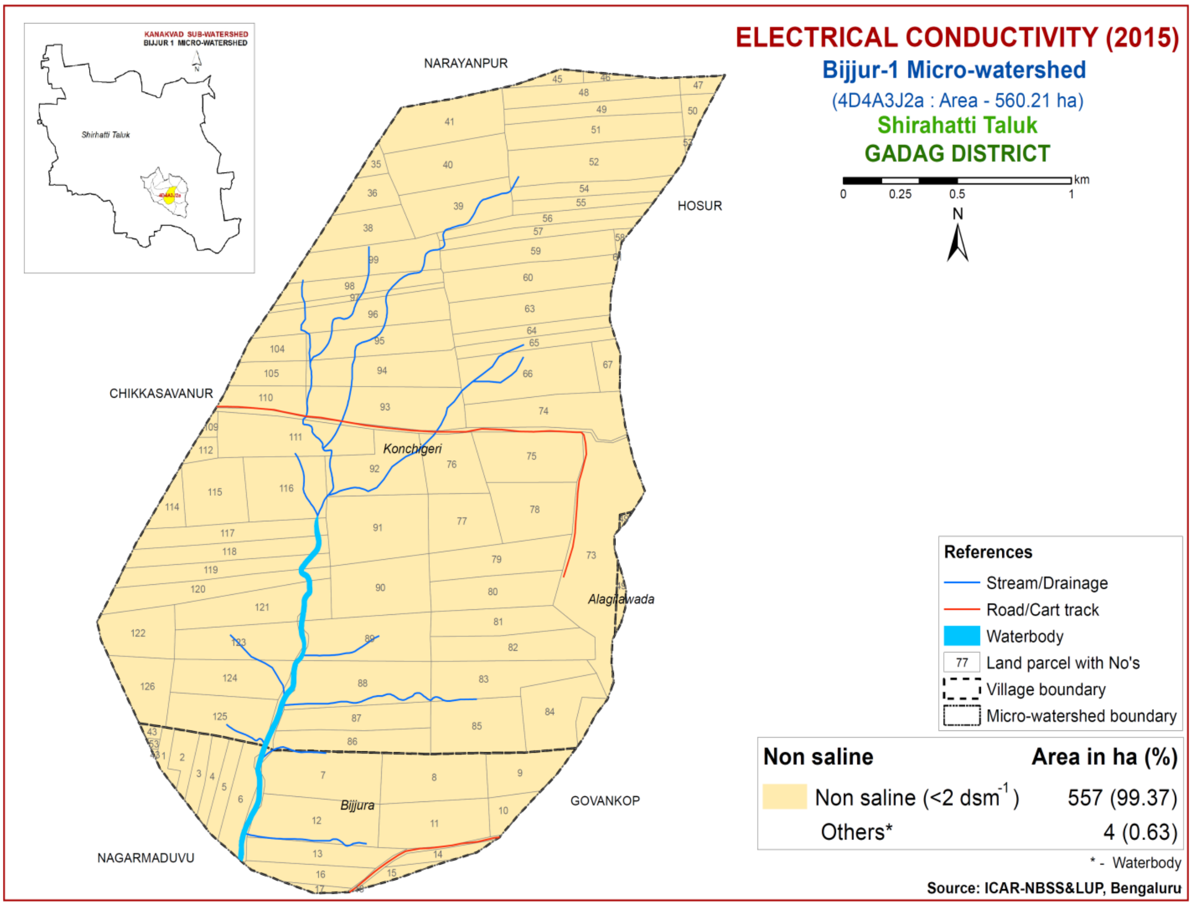


Fig.6.2 Electrical Conductivity (EC) map of Bijjur-1 Microwatershed

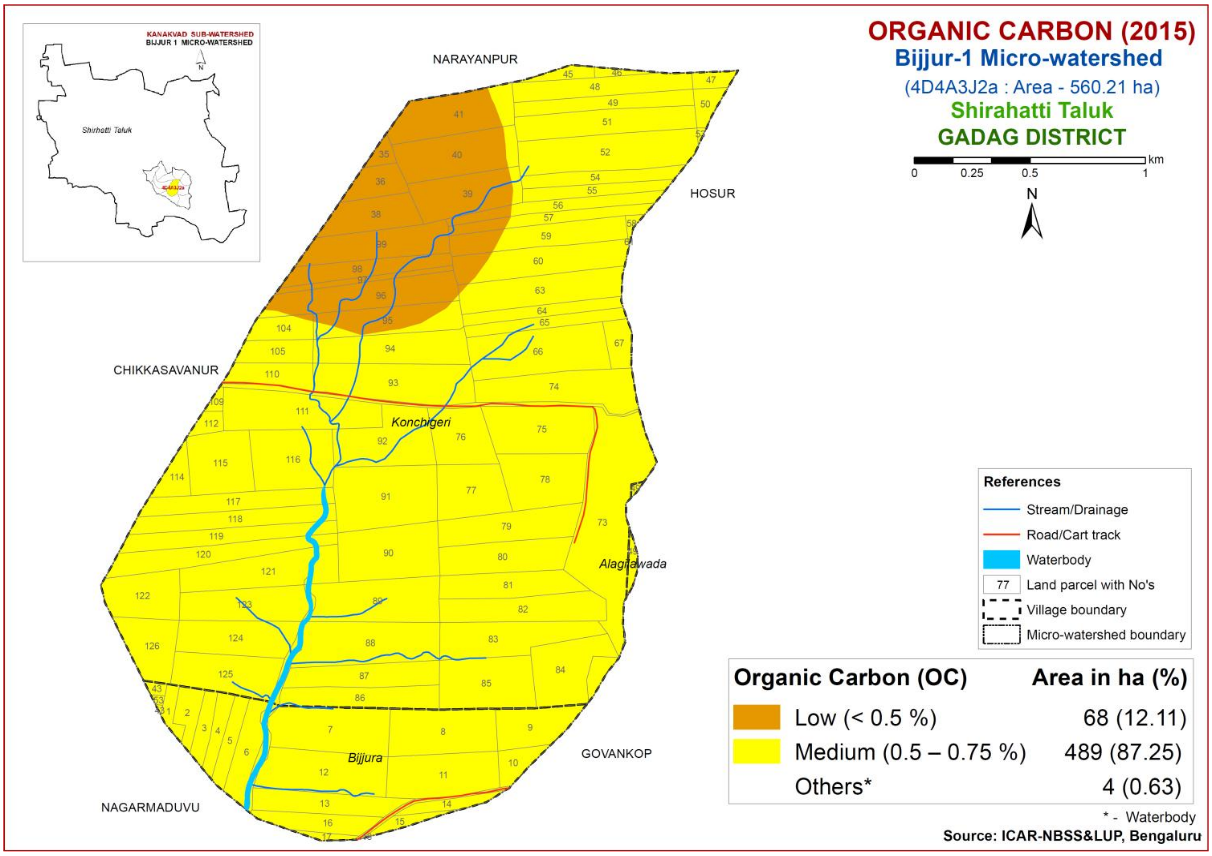


Fig.6.3 Soil Organic Carbon map of Bijjur-1 Microwatershed

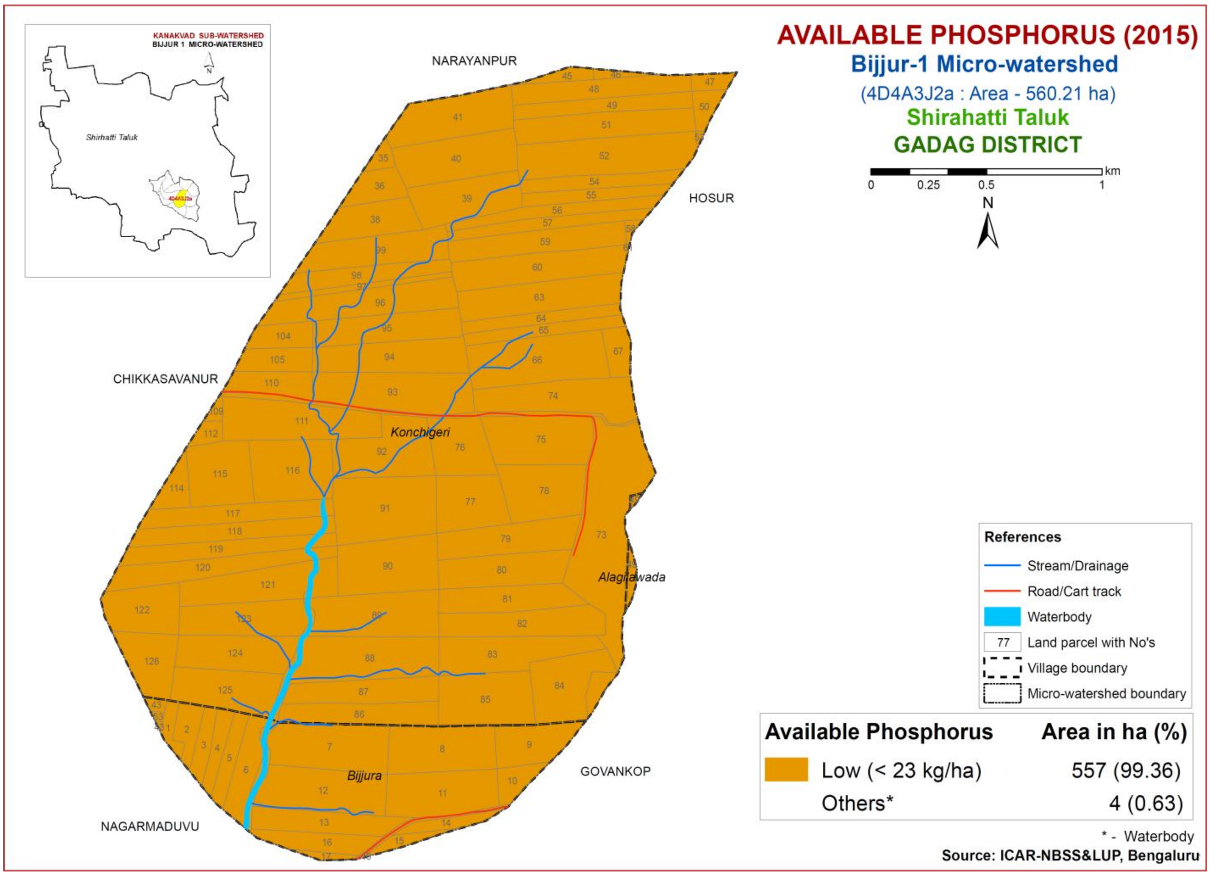


Fig.6.4 Soil available Phosphorus map of Bijjur-1 Microwatershed

6.5 Available Potassium

Available potassium content is medium (145-337 kg/ha) in 149 ha (27%) area and is distributed in all parts of the microwatershed (Fig.6.5); high available potassium (>337 kg/ha) content accounts for 407 ha (73%) and is distributed in all parts of the microwatershed.

6.6 Available Sulphur

Available sulphur content is low (<10 ppm) in 273 ha (49%) area in the microwatershed and is distributed in the southern, western and southeastern part of the microwatershed. An area of about 284 ha (51%) is medium (10-20 ppm) in available sulphur and is distributed in northern and eastern part of the microwatershed (Fig.6.6).

6.7 Available Boron

Available boron content is low (<0.5 ppm) in 496 ha (89%) area and is distributed in all parts of the microwatershed. About 51 ha (9%) has soils that are medium (0.5-1.0 ppm) in available boron (Fig 6.7) and is distributed in the northeastern and northwestern part of the microwatershed. A very small area of 10 ha (2%) is high (>1.0 ppm) in available boron and is distributed in the northeastern part of the microwatershed.

6.8 Available Iron

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

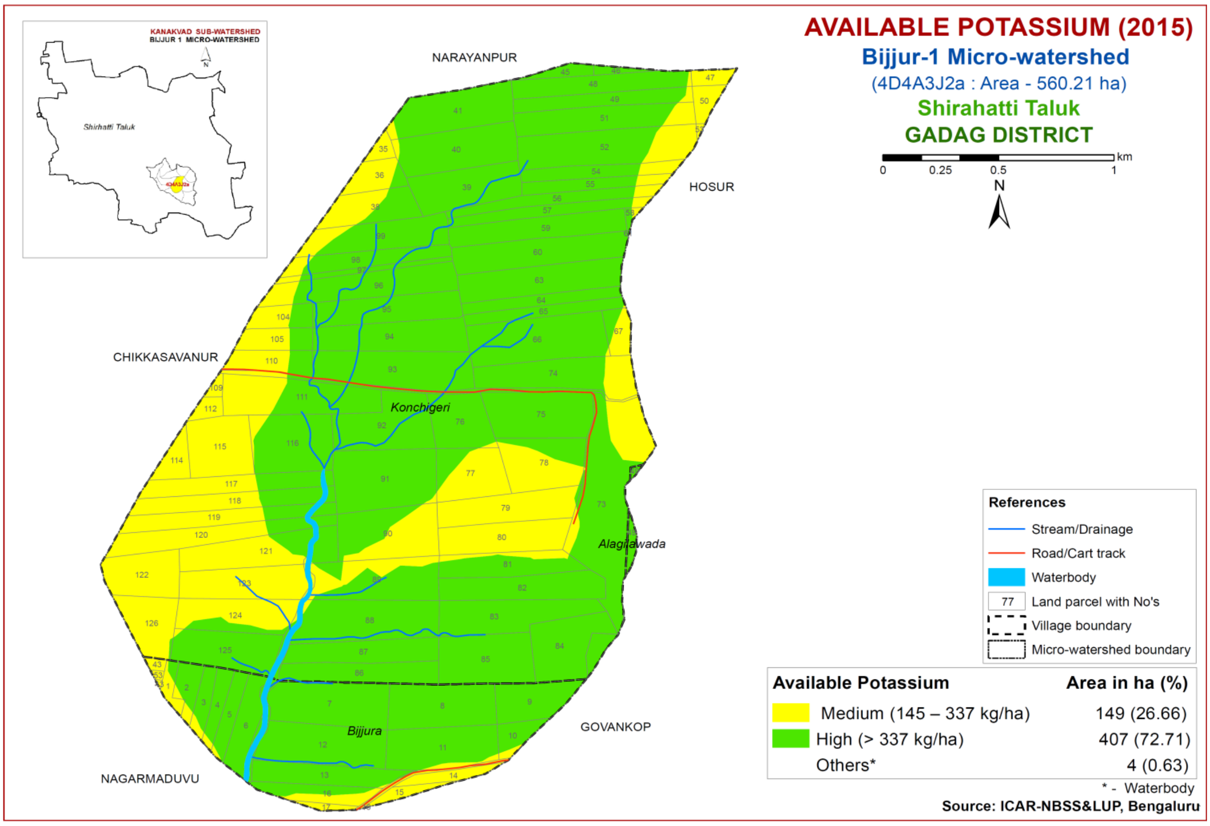


Fig.6.5 Soil available Potassium map of Bijjur-1 Microwatershed

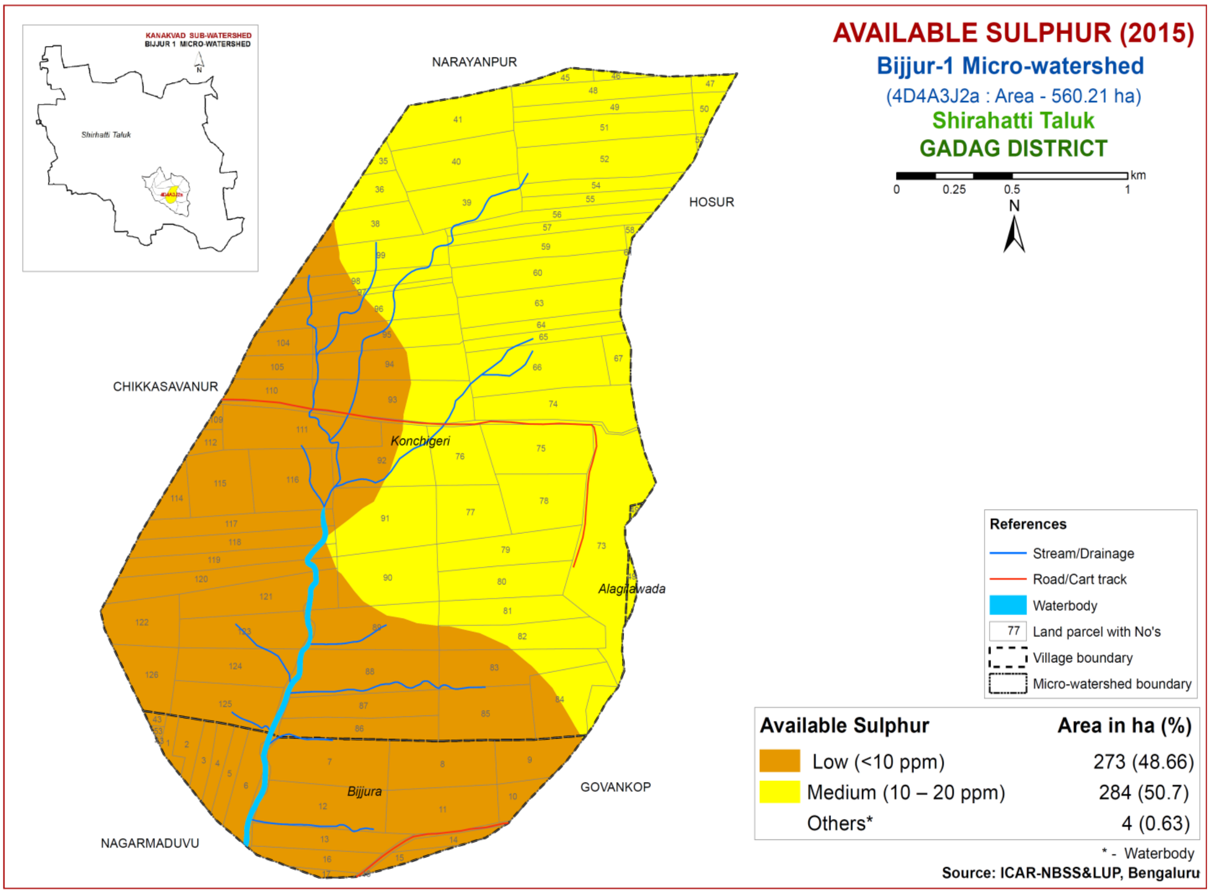


Fig.6.6 Soil available Sulphur map of Bijjur-1 Microwatershed

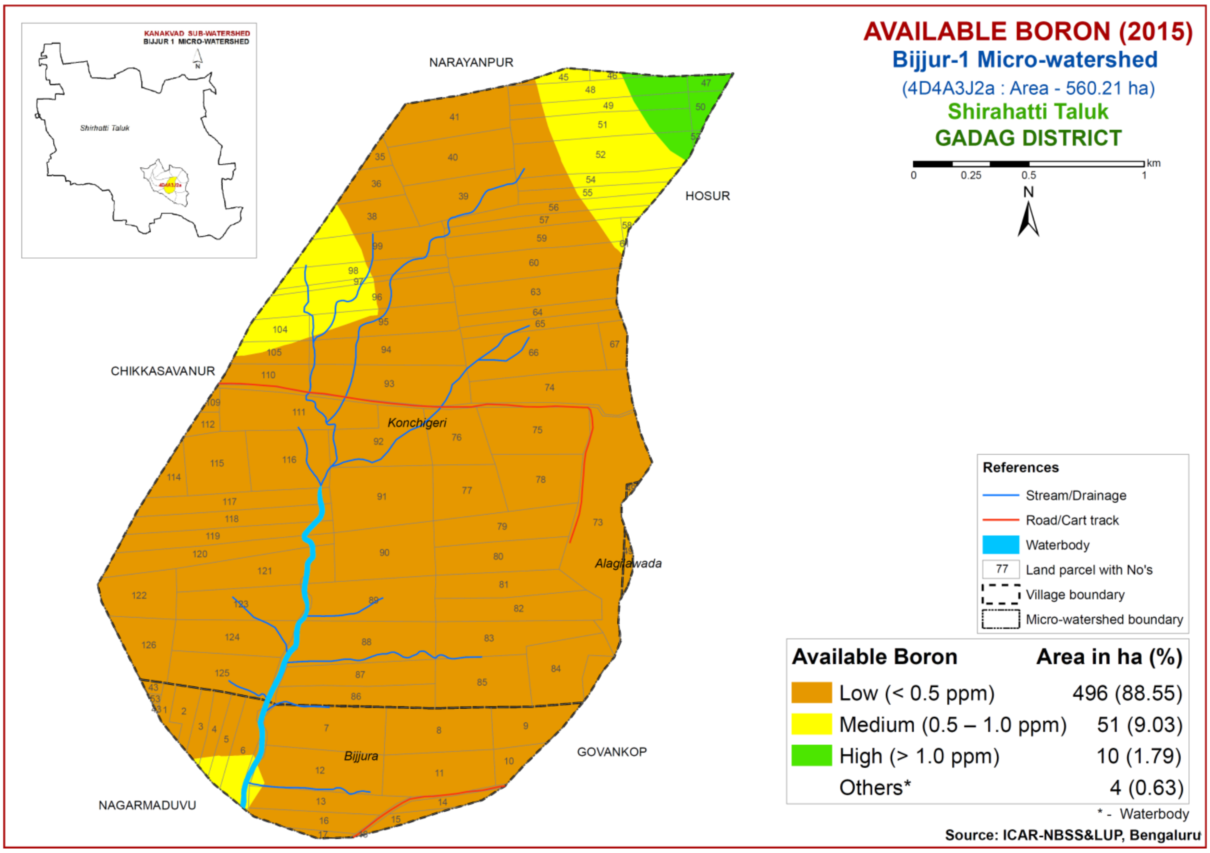


Fig.6.7 Soil available Boron map of Bijjur-1 Microwatershed

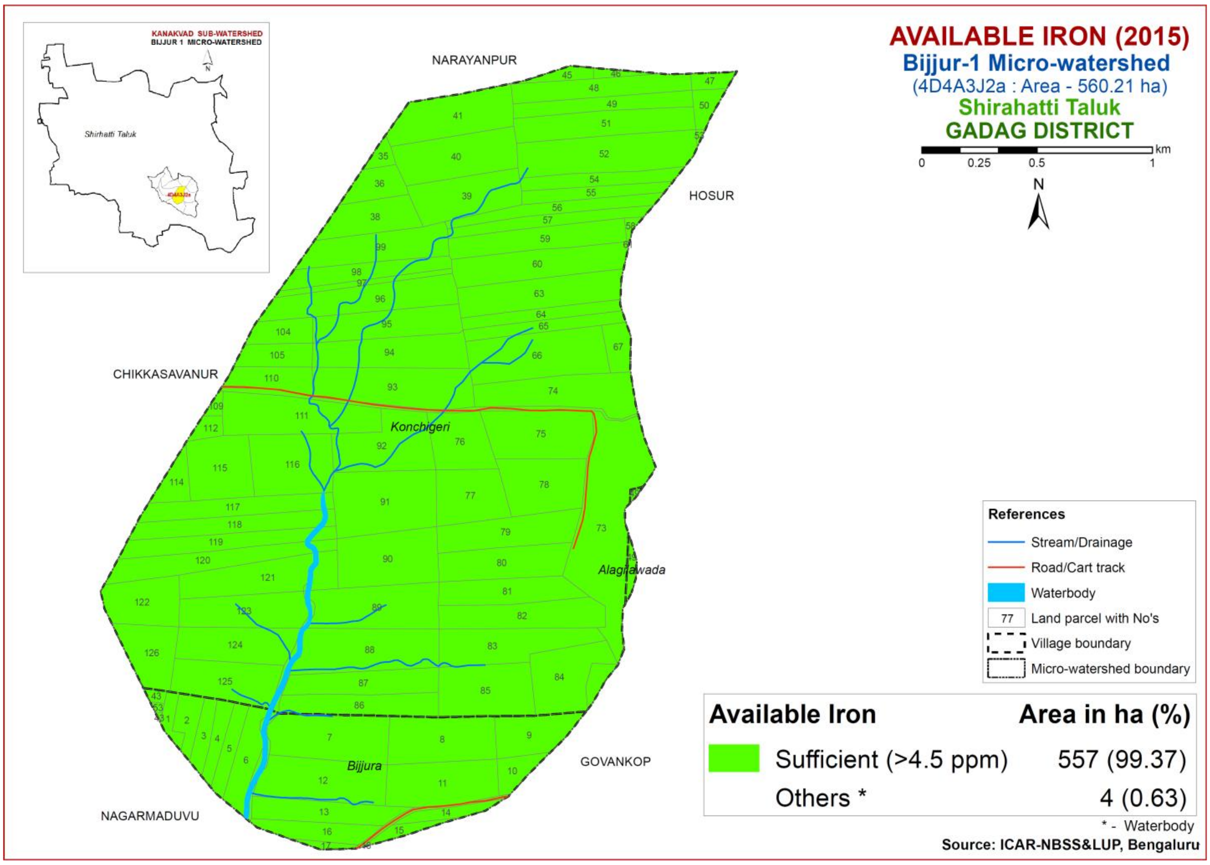


Fig.6.8 Soil available Iron map of Bijjur-1 Microwatershed

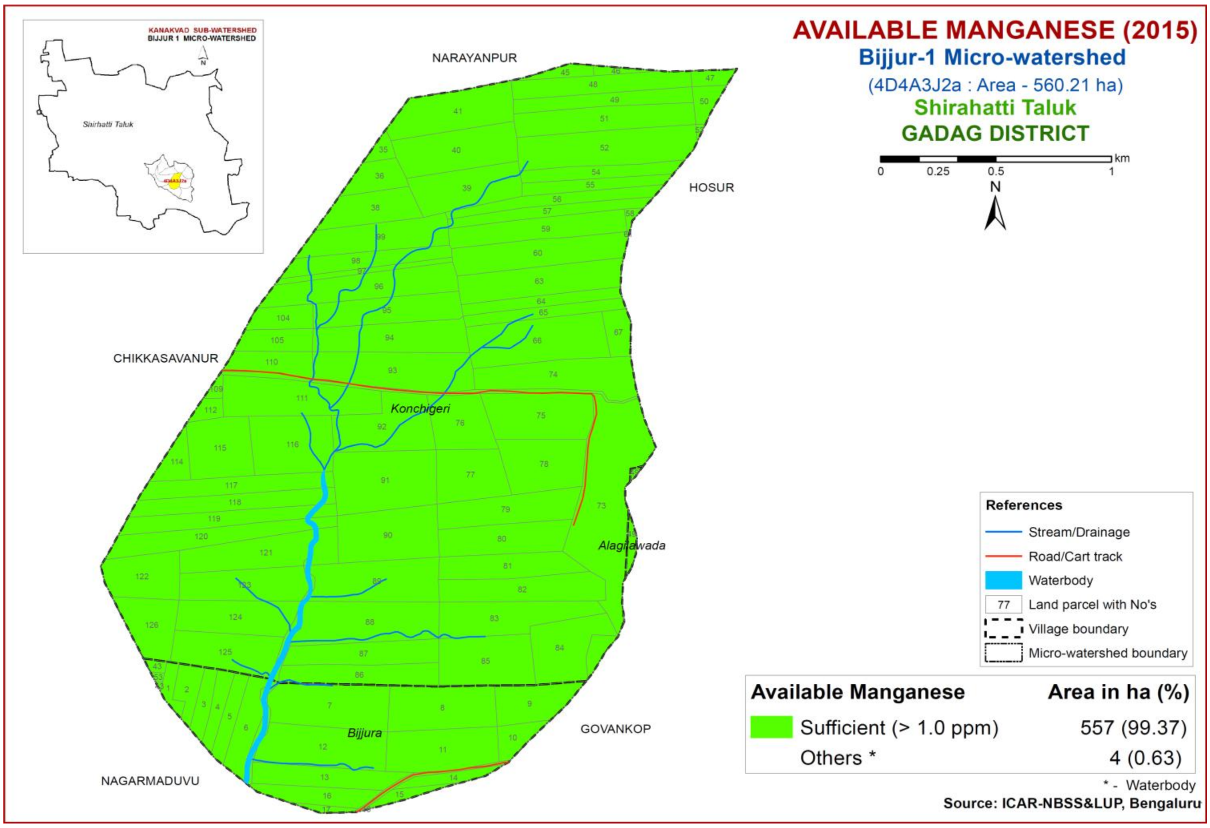


Fig.6.9 Soil available Manganese map of Bijjur-1 Microwatershed

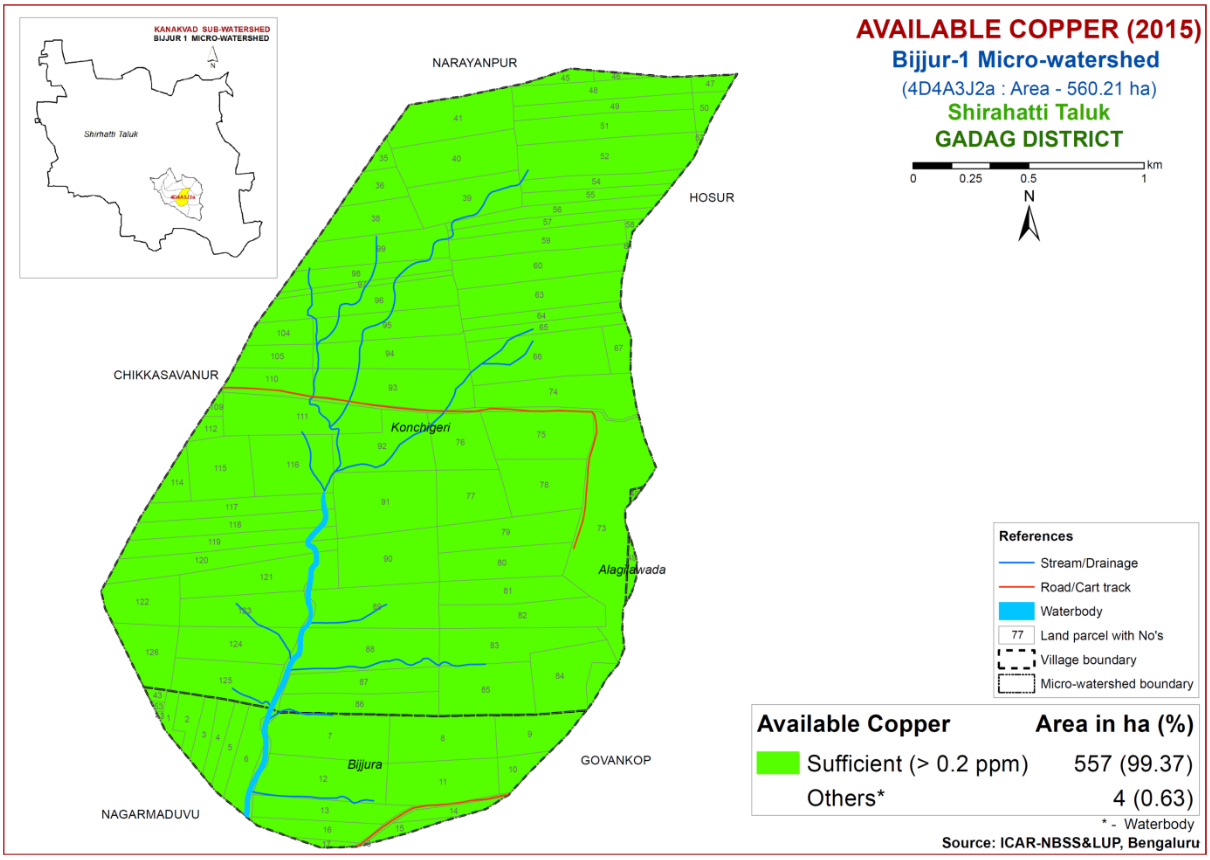


Fig.6.10 Soil available Copper map of Bijjur-1 Microwatershed

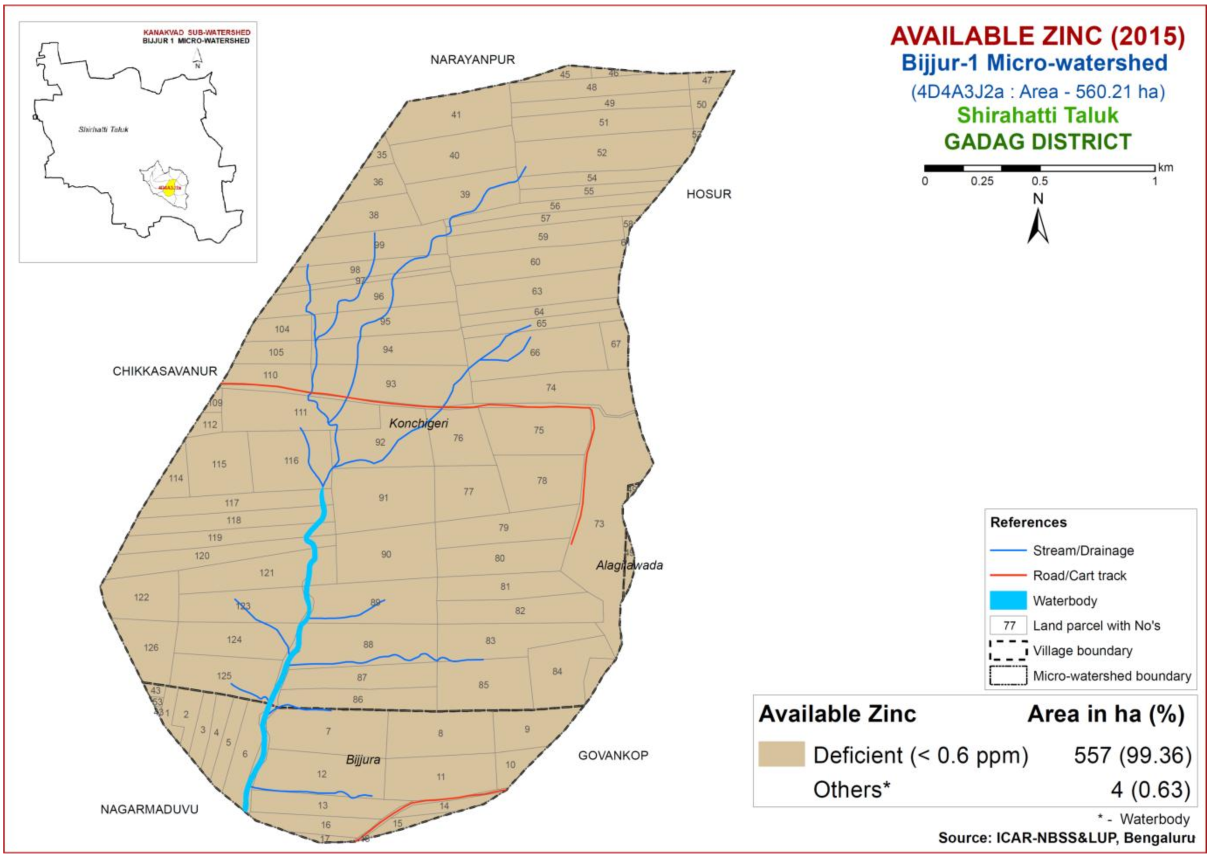


Fig.6.11 Soil available Zinc map of Bijjur-1 Microwatershed

LAND SUITABILITY FOR MAJOR CROPS

The soil and land resource units (soil phases) of Bijjur-1 microwatershed were assessed for their suitability for growing food, fibre, fodder and horticulture crops by following the procedure as outlined in FAO, 1976 and 1983. Crop requirements were developed for each of the crop from the available research data, Naidu *et. al.* (2006) and Natarajan *et. al* (2015). The crop requirements were matched with the soil and land characteristics (Table 7.1) to arrive at the crop suitability. In FAO land suitability classification, two orders are recognized. Order S-Suitable and Order N-Not suitable. The orders have classes, subclasses and units. Order-S has three classes, Class S1-Highly Suitable, Class S2-Moderately Suitable and Class S3-Marginally Suitable. Order N has two classes, N1-Currently not Suitable and N2-Permanently not Suitable. There are no subclasses within the class S1 as they will have very minor or no limitations for crop growth. Classes S2 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 prepared. 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 northern Karnataka in Bijapur, Kalaburgi, Raichur, Bidar, Belgaum, Dharwad and Bellary districts. The crop requirements for growing sorghum (Table 7.2) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and land suitability map for growing sorghum was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed is given in Figure. 7.1.

An area of about 191 ha (34%) in the microwatershed has soils that are highly suitable (class S1) for growing sorghum crop. They are distributed mainly in the southeastern, central and western part of the microwatershed. They have minor or no limitations for growing sorghum.

Table 7.1 Soil-Site Characteristics of Bijjur-1 microwatershed

Soil Map Units	Climate (P) (mm)	Growing period (Days)	Drai-nage class	Soil depth (cm)	Soil texture		Gravelliness		AWC (mm/m)	Slope (%)	Erosion	pH	EC	ESP	CEC [Cmol (p+) kg-1]	BS (%)
					Surf-ace	Sub-surface	Surface (%)	Subsurface (%)								
RNKmB1g1	633	150	WD	50-75	c	sc-c	15-35	15-35	51-100	1-3	slight					
LGDmA1g1	633	150	MWD	100-150	c	sc-c	15-35	<15	>200	0-1	slight					
LGDmB1g1	633	150	MWD	100-150	c	sc-c	15-35	<15	>200	1-3	slight					
SRLiB1g2	633	150	WD	<25	sc	cl, c	35-60	10-20	<50	1-3	slight					
KLKiB1g2	633	150	WD	<25	sc	scl	35-60	>35	<50	1-3	slight					
AKTiB1g1	633	150	WD	25-50	sc	cl, c	15-35	10-30	<50	1-3	slight					
AKTiB3g2	633	150	WD	25-50	sc	cl, c	35-60	10-30	<50	1-3	severe					
DNIhB2g3	633	150	MWD	100-150	scl	cl, sc, c	60-80	>35	51-100	1-3	moderate					
YSJmB2g2	633	150	WD	25-50	c	cl-c	35-60	<15	51-100	1-3	moderate					
SRJmB2g2	633	150	WD	25-50	c	c	35-60	>35	<50	1-3	moderate					
SRJmB3g2	633	150	WD	25-50	c	c	35-60	>35	<50	1-3	severe					
VKPiB1g2	633	150	WD	50-75	sc	c	35-60	15-35	101-150	1-3	slight					
VKPmB1g2	633	150	WD	50-75	c	c	35-60	15-35	101-150	1-3	slight					
VKPmB2g1	633	150	WD	50-75	c	c	15-35	15-35	101-150	1-3	moderate					
VKPmB2g2	633	150	WD	50-75	c	c	35-60	15-35	101-150	1-3	moderate					
VKPmB3g2	633	150	WD	50-75	c	c	35-60	15-35	101-150	1-3	severe					
JLGmB1g1	633	150	MWD	75-100	c	c	15-35	-	101-150	1-3	slight					
JLGmB2g1	633	150	MWD	75-100	c	c	15-35	-	101-150	1-3	moderate					
VRViB1g2	633	150	MWD	75-100	sc	c	35-60	<15	101-150	1-3	slight					
VRVmB1g1	633	150	MWD	75-100	c	c	15-35	<15	101-150	1-3	slight					
MPTmA1g1	633	150	MWD	100-150	c	c	15-35	-	>200	0-1	slight					
MPTmB1	633	150	MWD	100-150	c	c	-	-	>200	1-3	slight					
KPRmA1	633	150	MWD	100-150	c	c	-	<15	>200	0-1	slight					
KPRmB2	633	150	MWD	100-150	c	c	-	<15	>200	1-3	moderate					
KPRmB2g2	633	150	MWD	100-150	c	c	35-60	<15	>200	1-3	moderate					

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

About 100 ha (18%) area is moderately suitable (class S2) for sorghum and they are distributed in northern and northeastern part of the microwatershed. They have minor limitations of calcareousness and gravelliness.Marginally suitable lands (class S3) for growing sorghum occupy about 236 ha (42%) and mainly occur in the central, eastern, southern and northeastern part of the microwatershed. They have moderate limitations of rooting depth, calcareousness and gravelliness. A small area of about 29 ha (5%) is not suitable for growing sorghum in the microwatershed and occur in the southern and western part of the microwatershed. They have 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	5.5-5.9 8.1-8.5	<5.5 8.6-9.0	>9.0
Surface soil texture	Class	C, cl, sicl, sc	l, sil, sic	Sl, ls	S, fragmental skeletal
Soil depth	Cm	100-75	50-75	30-50	<30
Gravel content	% vol.	5-15	15-30	30-60	>60
Salinity (EC)	dSm^{-1}	2-4	4-8	8-10	>10
Sodicity (ESP)	%	5-8	8-10	10-15	>15

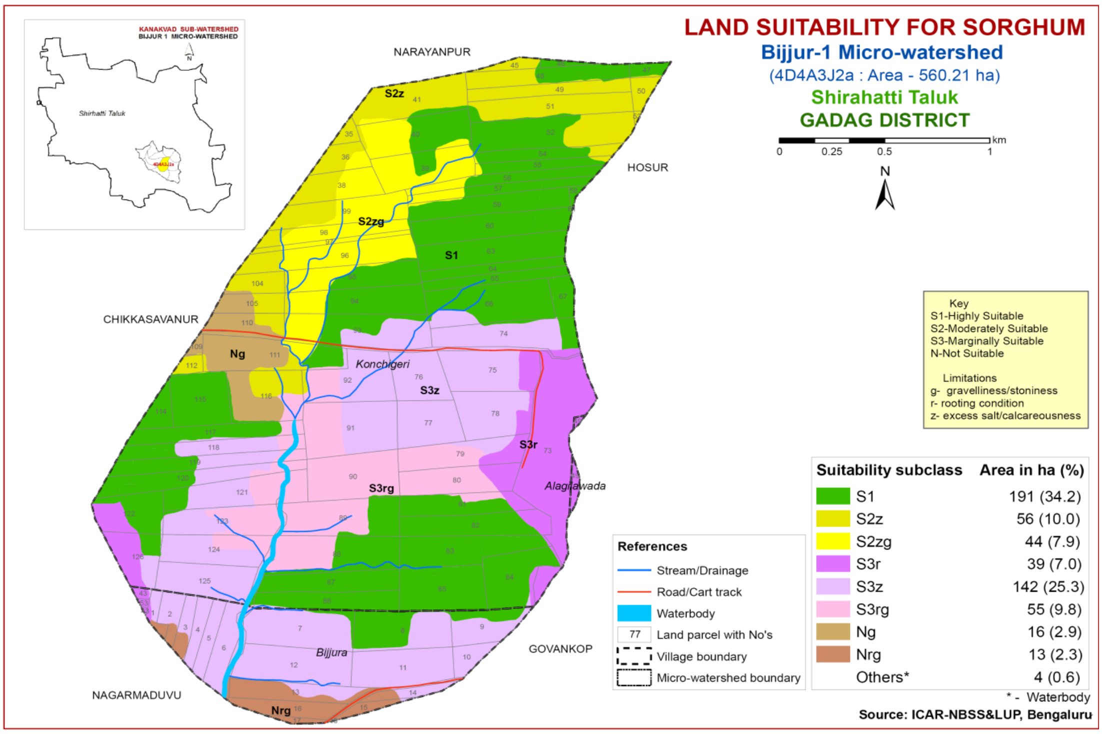


Fig. 7.1 Land Suitability map of Sorghum

7.2 Land Suitability for Maize (*Zea mays*)

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

An area of about 40 ha (7%) in the microwatershed has soils that are moderately suitable (class S2) for growing maize crop. They are distributed mainly in the northwestern part of the microwatershed. The marginally suitable (class S3) lands cover about 487 ha (87%) area and occur in all parts the microwatershed. They have moderate limitations of gravelliness, texture, calcareousness and rooting depth. About 29 ha (5%) area is not suitable for growing maize and occur in the western and southern part of the microwatershed. They have 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	

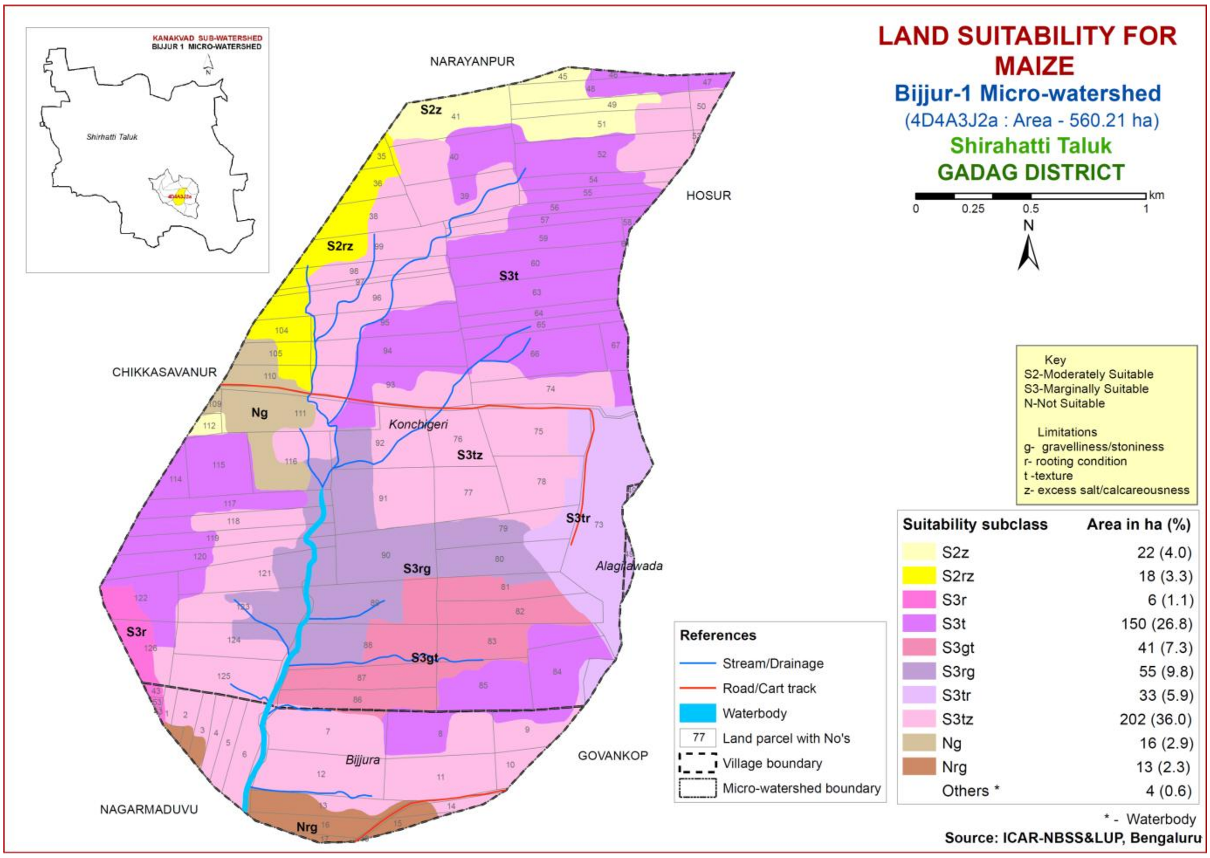


Fig. 7.2 Land Suitability map of Maize

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

Bengal gram is one of the major pulse crop grown in an area of 9.26 lakh ha in northen Karnataka in Bijapur, Gulbarga, Raichur, Bidar, Belgaum, Dharwad and Bellary districrts. The crop requirements for growing Bengal gram (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 Bengal gram was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed is given in Figure 7.3.

An area of about 150 ha (27%) area in the microwatershed has soils that are highly suitable (class S1) for growing Bengal gram. They are distributed mainly in the western, central, southeastern and northeastern part of the microwatershed. They have minor or no limitations for growing Bengal gram. About 377 ha (67%) area is moderately suitable (class S2) for Bengal gram and 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 Bengal gram occupy about 13 ha (2%) and mainly occur in the southern part of the microwatershed. They have moderate limitations of gravelliness and rooting depth. An area of about 16 ha (3%) is not suitable for growing Bengal gram and occur in the western part of the microwatershed. They have severe limitations of gravelliness.

Table 7.4 Crop suitability criteria for Bengal gram

Crop requirement		Rating			
Soil–site characteristics	unit	Highly suitable (S1)	Moderately Suitable (S2)	Marginally suitable (S3)	Not suitable (N)
Slope	%	<3	3-5	5-10	>10
LGP	Days	>100	90-100	70-90	<70
Soil drainage	class	Well drained	Mod. to well drained; imperfectly drained	Poorly drained; excessively drained	Very Poorly drained
Soil reaction	pH	6.0-7.5	5.5-5.7 7.6-8.0	8.1-9.0;4.5-5.4	>9.0
Surface soil texture	Class	l, scl, sil, cl,	sicl, sic, c	Sl, c>60%	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	

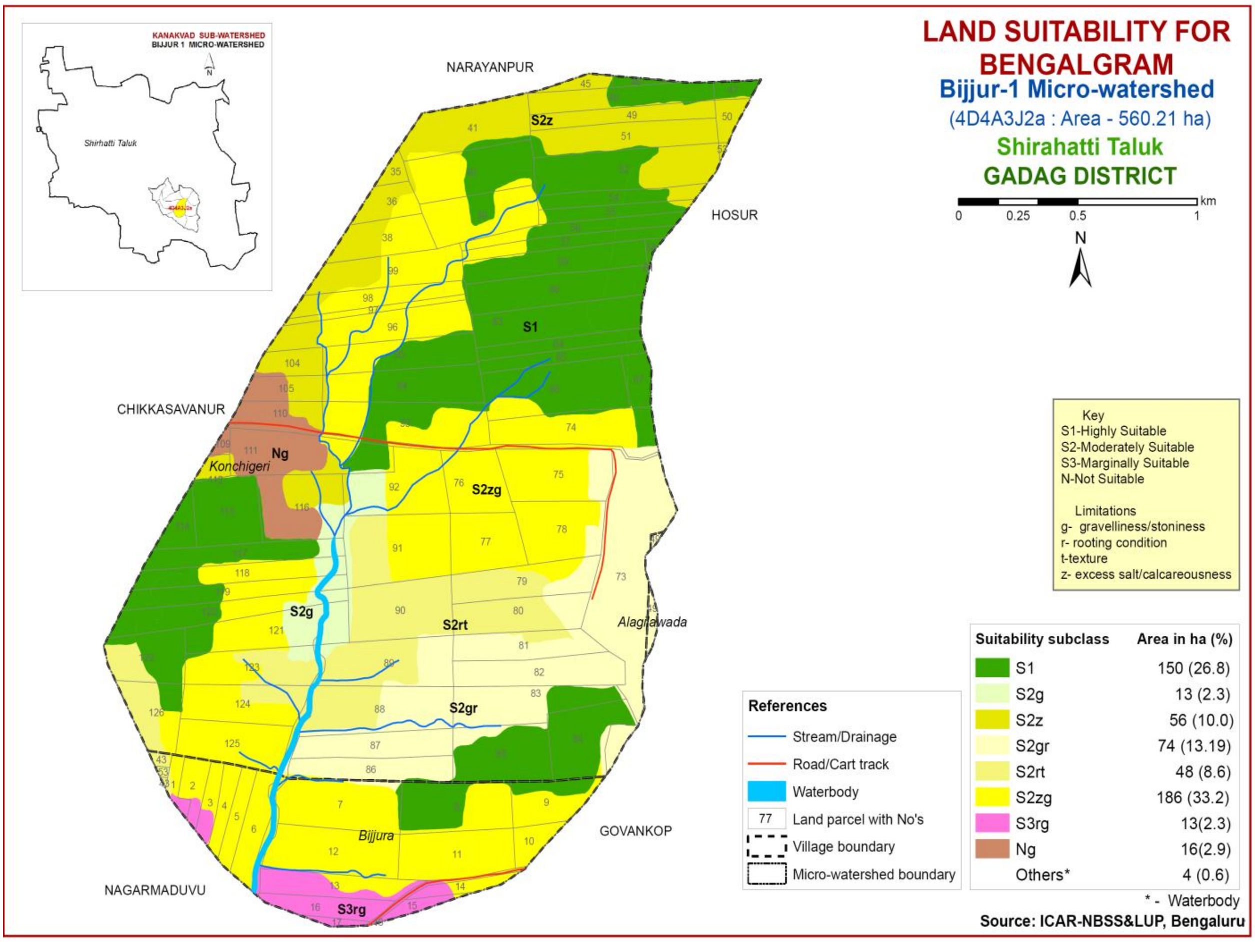


Fig. 7.3 Land Suitability map of Bengal gram

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.

About 16 ha (3%) area is moderately suitable (class S2) for groundnut and they are distributed in the western part of the microwatershed. They have minor limitations of texture and gravelliness. Marginally suitable lands (class S3) for growing groundnut occupy major area of about 527 ha (95%) and are distributed in all parts of the microwatershed. They have moderate limitations of calcareousness, gravelliness, rooting depth and texture. An area of about 13 ha (2%) is not suitable for growing groundnut and occur in the southern part of the microwatershed. They have severe limitations of gravelliness and rooting depth.

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 rained	imperfectly drained	Poorly drained
Soil reaction	pH	6.0-8.0	8.1-8.5 5.5-5.9	>8.5 <5.5	
Surface soil texture	Class	l, cl, sil, sc, sicl	Sc, sic, c,	S, ls, sl c (>60%)	S, fragmental
Soil depth	Cm	>75	50-75	25-50	<25
Gravel content	% vol.	<35	35-50	>50	
$CaCO_3$ in root zone	%	high	Medium	low	
Salinity (EC)	dSm^{-1}	<2.0	2.0-4.0	4.0-8.0	
Sodicity (ESP)	%	<5	5-10	>10	

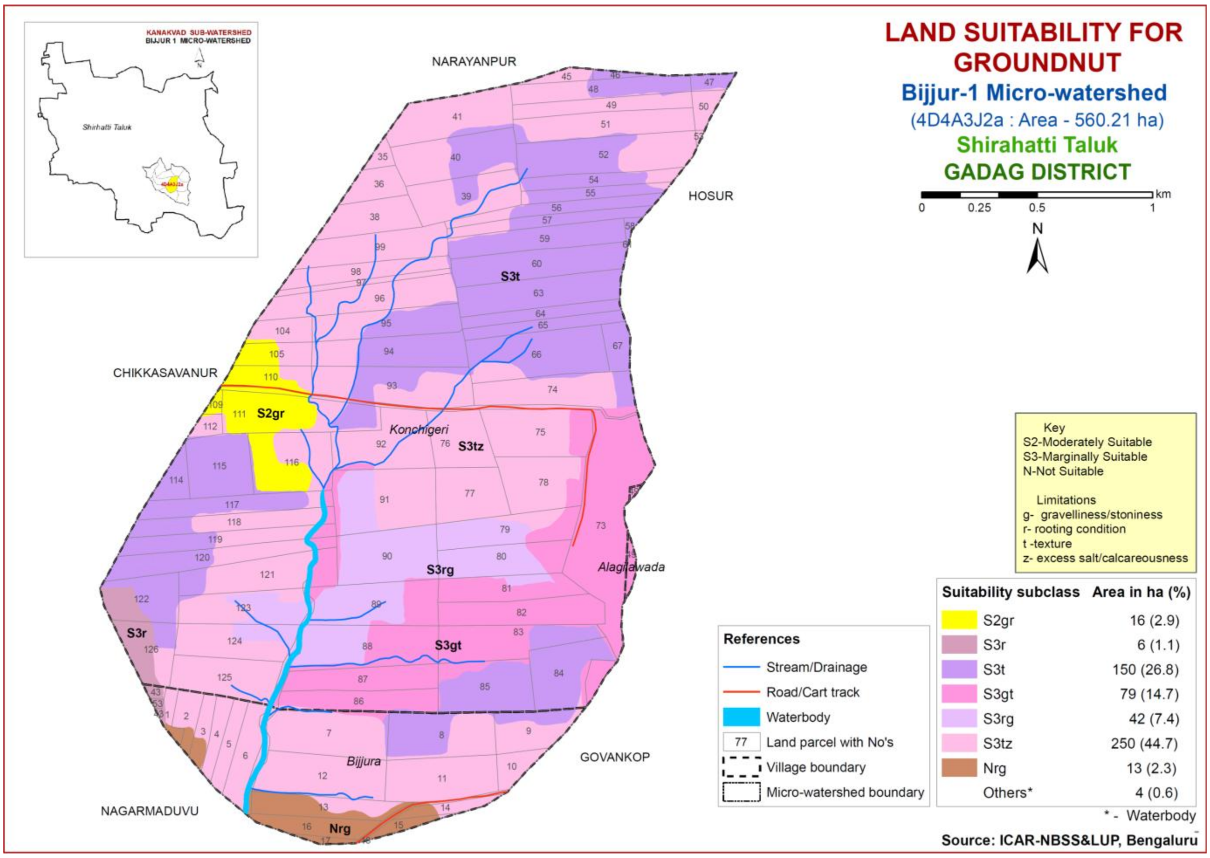


Fig. 7.4 Land Suitability map of Groundnut

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 extent and geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.5.

An area of about 21 ha (4%) in the microwatershed has soils that are highly suitable (class S1) for growing sunflower crop. They are distributed mainly in the northeastern part of the microwatershed. They have minor or no limitations for growing sunflower. Moderately suitable (class S2) lands are found to occur in major area of about 252 ha (45%). They have 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 160 ha (29%) area in the microwatershed and mainly occur in the northwestern, central and southern part of the microwatershed. They have moderate limitations of calcareousness, gravelliness and rooting depth. About 122 ha (22%) areas is not suitable for growing sunflower and occur in the western, central, eastern and southern part of the microwatershed. They have severe limitations of gravelliness 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	8.1-8.5 5.5-6.4	8.6-9.0;4.5-5.4	>9.0 <4.5
Surface soil texture	Class	l, cl, sil, sc	Scl, sic, c,	c (>60%), sl	ls, s
Soil depth	Cm	>100	75-100	50-75	<50
Gravel content	% vol.	<15	15-35	35-60	>60
Salinity (EC)	dSm^{-1}	<1.0	1.0-2.0	>2.0	
Sodicity (ESP)	%	<10	10-15	>15	

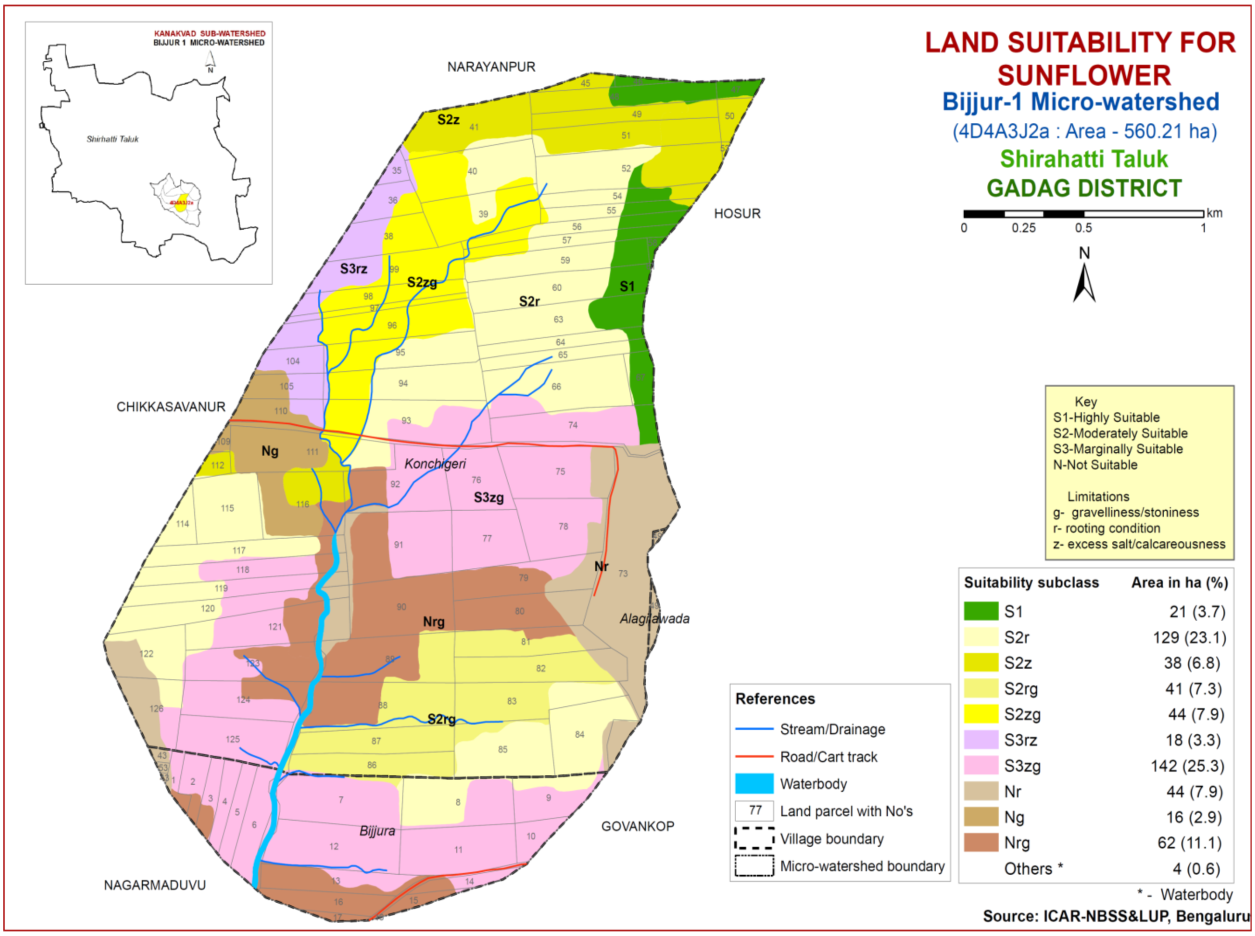


Fig. 7.5 Land Suitability map of Sunflower

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, Kalaburgi, Bijapur, Bidar, Bellary, Chitradurga and Chamarajnagar districts. The crop requirements for growing cotton (Table 7.7) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing cotton was generated. The area extent and geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.6.

An area of about 150 ha (27%) in the microwatershed is highly suitable (class S1) for growing cotton and distributed in the southeastern, western, central and northeastern part of the microwatershed. An area of about 249 ha (45%) 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 144 ha (26%) area in the microwatershed and distributed in the eastern, central and southwestern part of the microwatershed. They have moderate limitations of gravelliness, calcareousness and rooting depth. An area of about 13 ha (2%) is not suitable for growing cotton and occur in the southern part of the microwatershed. They have very severe limitations of gravelliness and rooting depth.

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

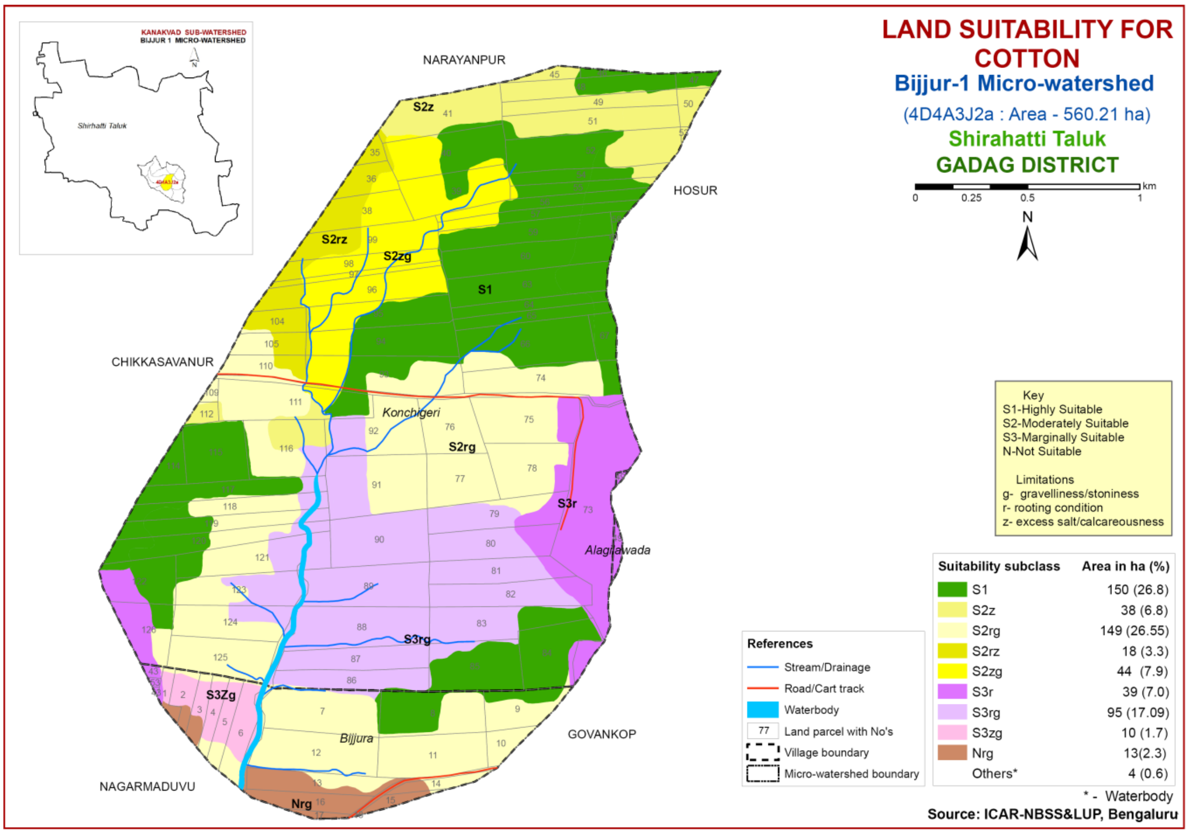


Fig. 7.6 Land Suitability map of Cotton

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.

An area of about 274 ha (49%) is moderately suitable (class S2) for growing banana and are distributed in the northern, western and southeastern part of the microwatershed. They have minor limitations of rooting depth, texture and calcareousness. Marginally suitable (class S3) lands for growing banana occupy an area of about 176 ha (31%) and are distributed in the southern, central and northwestern part of the microwatershed. They have moderate limitations of rooting depth, texture, calcareousness and gravelliness. An area of about 106 ha (19%) is not suitable for growing banana in the microwatershed and occur in the eastern, central and southern part of the microwatershed. They have severe limitations of gravelliness 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

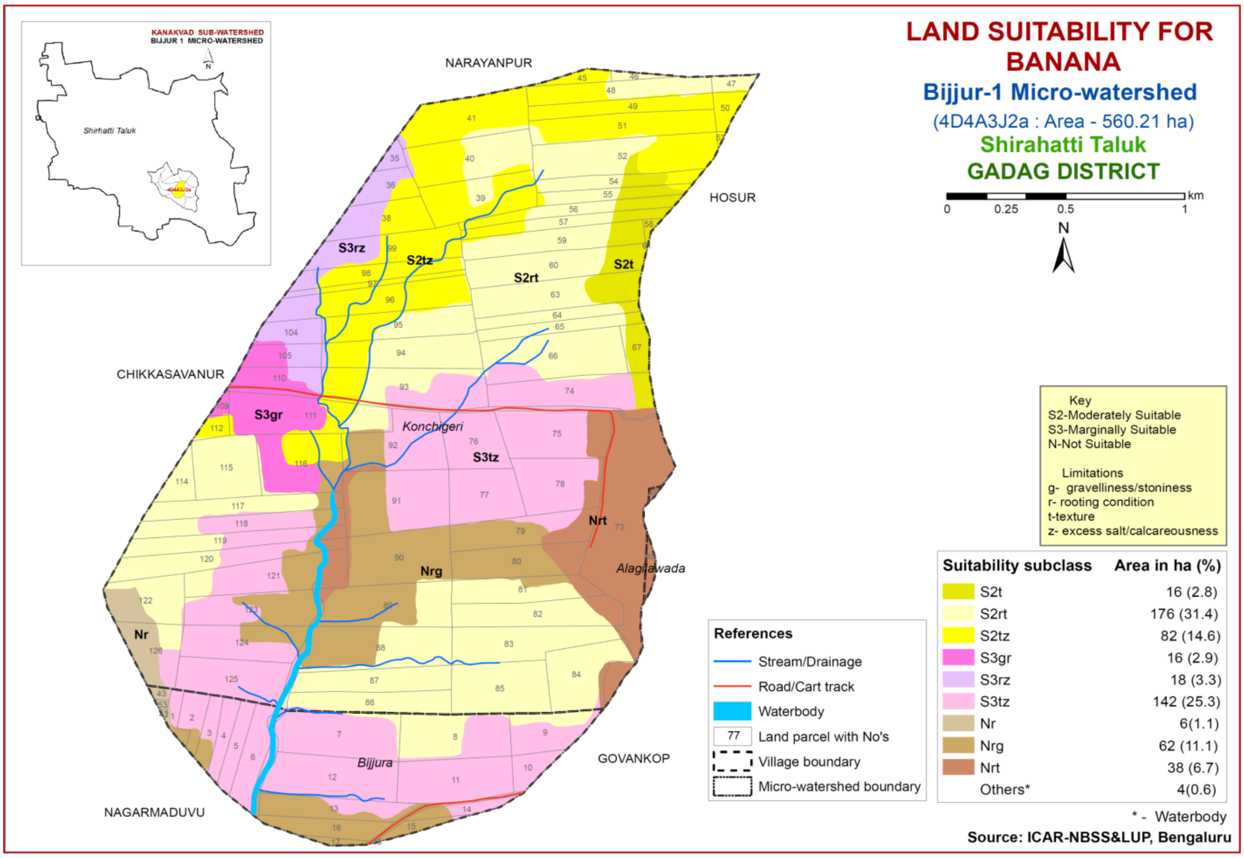


Fig. 7.7 Land Suitability map of Banana

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.

The major area of about 251 ha (45%) is moderately suitable (class S2) for pomegranate and distributed in all parts of the microwatershed. They have minor limitations of texture, calcareousness and rooting depth. Marginally suitable (class S3) lands for growing pomegranate occur in about 199 ha (35%) mainly in the southern, central and northeastern part of the microwatershed. They have moderate limitations of texture, calcareousness, rooting depth and gravelliness. An area of about 106 ha (19%) is not suitable for growing pomegranate in the microwatershed and occur in the eastern, central and southern part of the microwatershed. They have severe limitations of gravelliness 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	Tempera-ture 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	

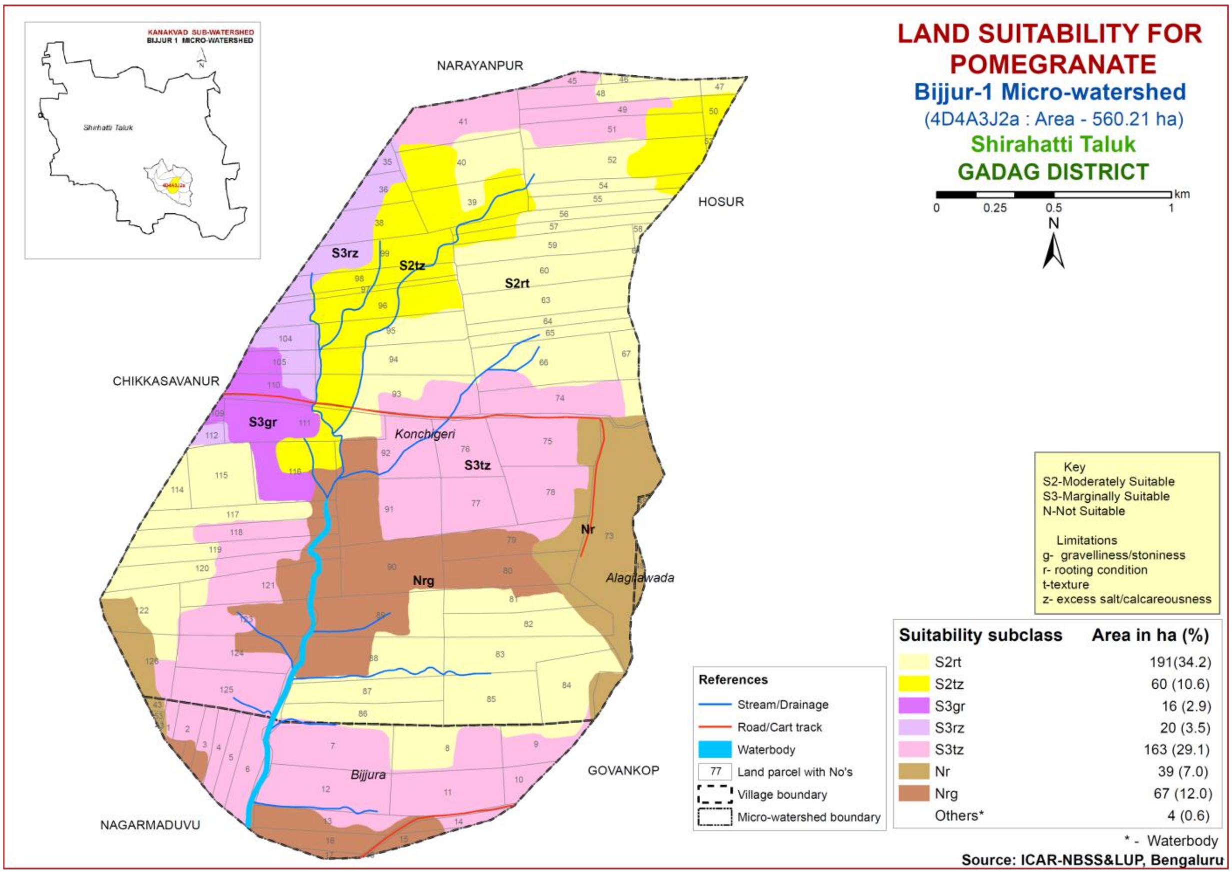


Fig. 7.8 Land Suitability map of Pomegranate

7.9 Land suitability for Mango (*Mangifera indica*)

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

An area of about 139 ha (25%) in the microwatershed is moderately suitable (class S2) for growing mango and are distributed in the northern and southeastern part of the microwatershed. They have minor limitations of texture, gravelliness and calcareousness for growing mango. The marginally suitable (class S3) lands cover maximum area of about 134 ha (24%) and are distributed in the central, western and southeastern part of the microwatershed. They have moderate limitations of texture and rooting depth.

An area of about 282 ha (50%) is not suitable for growing mango in the microwatershed and occur in all parts of the microwatershed. They have severe limitations of gravelliness, calcareousness 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	

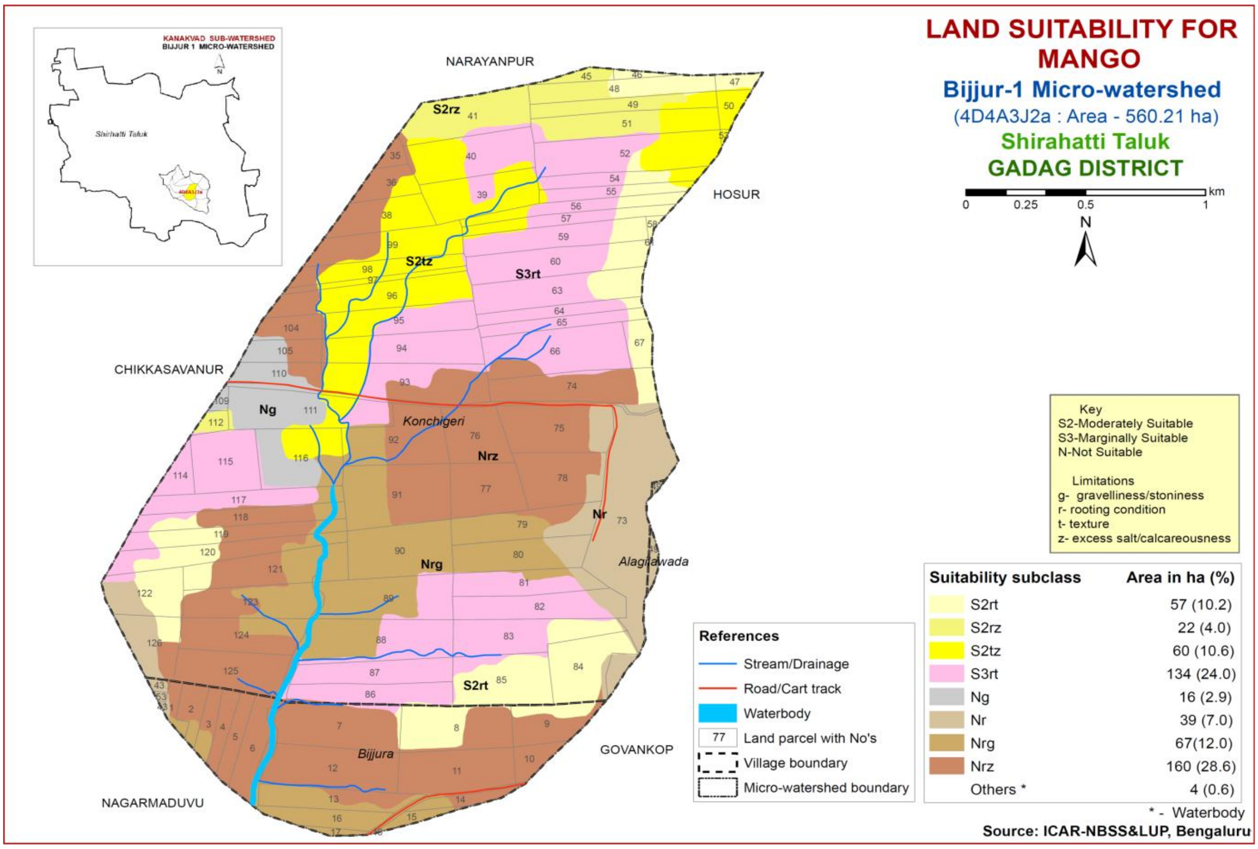


Fig. 7.9 Land Suitability map of Mango

7.10 Land suitability for Sapota (*Manilkara zapota*)

Sapota is the most important fruit crop grown in almost all the districts of the state. The crop requirements for growing sapota (Table 7.11) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing sapota was generated. The area extent and geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.10.

The moderately suitable (class S2) lands found to occur in about 16 ha (3%) that have minor limitations of gravelliness. They are distributed in the western part of the microwatershed. The marginally suitable (class S3) lands cover about 433 ha (77%) area and are distributed in all parts of the microwatershed. They have moderate limitations of gravelliness, texture, calcareousness and rooting depth.

An area of about 106 ha (19%) is not suitable for growing sapota in the microwatershed and occur in the southern, central and eastern part of the microwatershed. They have 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 availabiliy	Texture	Class	Scl, l, cl, sil	Sl, sicl, sc	C (<60%)	ls, s, C (>60%)
	pH	1:2.5	6.0-7.5	7.6-8.0 5.0-5.9	8.1-9.0 4.5-4.9	>9.0 <4.5
	$CaCO_3$ in root zone	%	Non calcareous	<10	10-15	>15
Rooting conditions	Soil depth	cm	>150	75-150	50-75	<50
	Gravel content	% vol.	Non gravelly	<15	15-35	<35
Soil toxicity	Salinity	dS/m	Non saline	Up to 1.0	1.0-2.0	2.0-4.0
	Sodicity	%	Non sodic	10-15	15-25	>25
Erosion	Slope	%	<3	3-5	5-10	>10

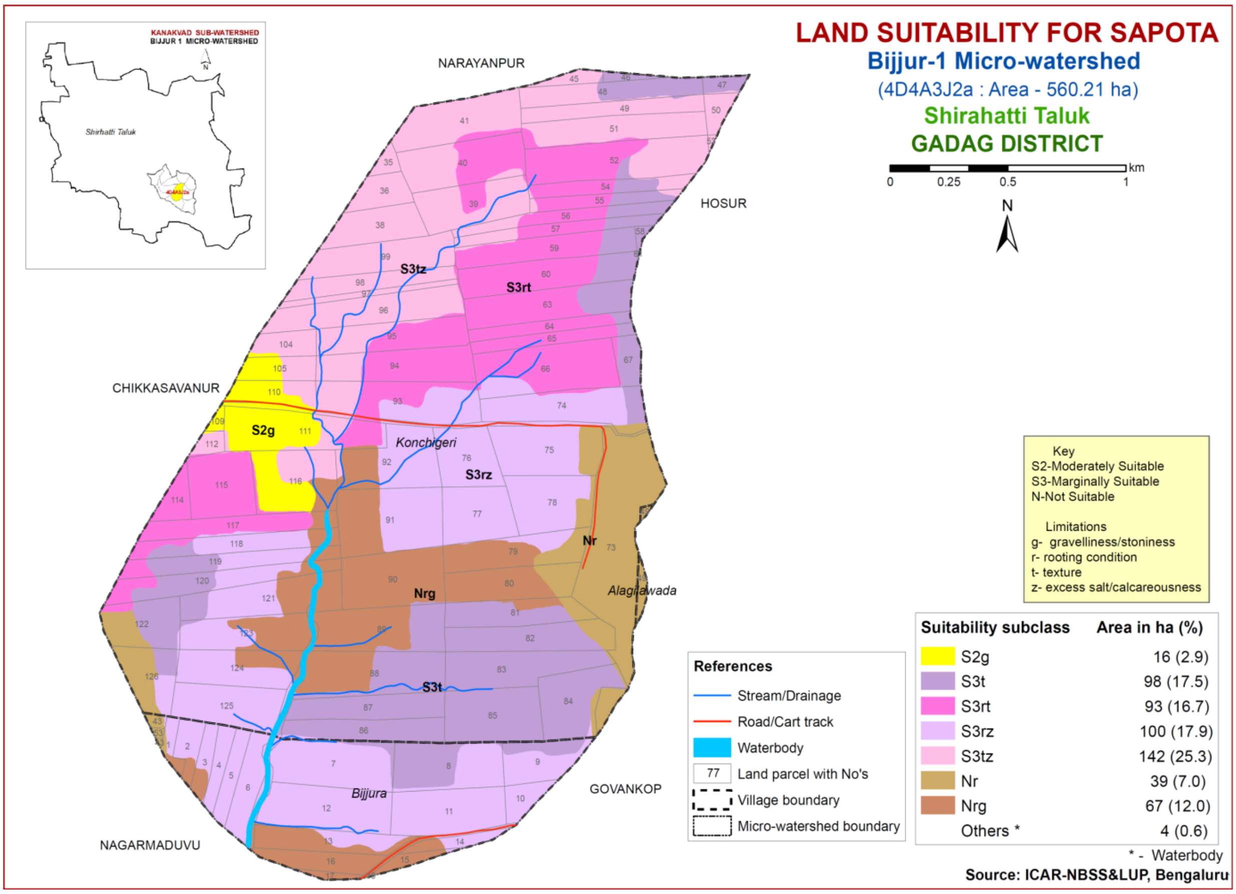


Fig. 7.10 Land Suitability map of Sapota

7.11 Land suitability for Guava (*Psidium guajava*)

Guava is the most important fruit crop grown in the State in Raichur, Dharwad, Belgaum, Kalaburgi, Bijapur, Bidar, Bellary, Chitradurga, Bangalore and Chamarajnagar districts. The crop requirements for growing guava (Table 7.12) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing guava was generated. The area extent and geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.11.

An area of about 60 ha (11%) in the microwatershed is moderately suitable (class S2) for growing guava and are distributed in the northwestern and northeastern part of the microwatershed. They have minor limitations of calcareousness and rooting depth.

The marginally suitable (class S3) lands cover about 374 ha (67%) area and occur in all parts of the microwatershed. They have moderate limitations of texture and calcareousness. An area of about 122 ha (22%) is not suitable for growing guava in the microwatershed and occur in the central, eastern and southern part of the microwatershed. They have 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

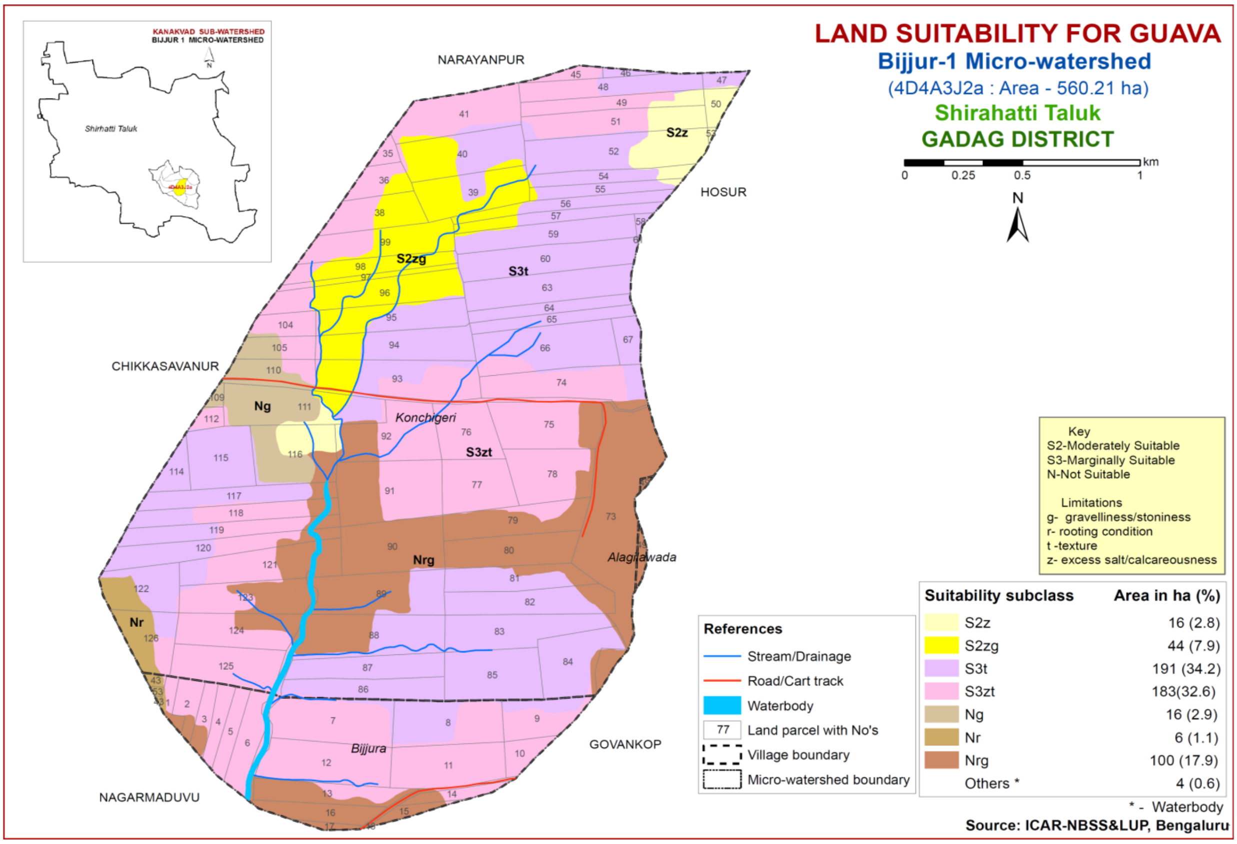


Fig. 7.11 Land Suitability map of Guava

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. The area extent and geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.12.

An area of about 16 ha (3%) in the microwatershed is moderately suitable (class S2) for growing jackfruit and are distributed in the western part of the microwatershed. They have minor limitations of gravelliness.

The marginally suitable (class S3) lands cover a maximum area of about 433 ha (77%) and occur in all parts of the microwatershed. They have moderate limitations of texture and calcareousness. An area of about 106 ha (19%) is not suitable for growing jackfruit in the microwatershed and occur in the eastern, southern and central part of the microwatershed. They have severe limitations of gravelliness and rooting depth.

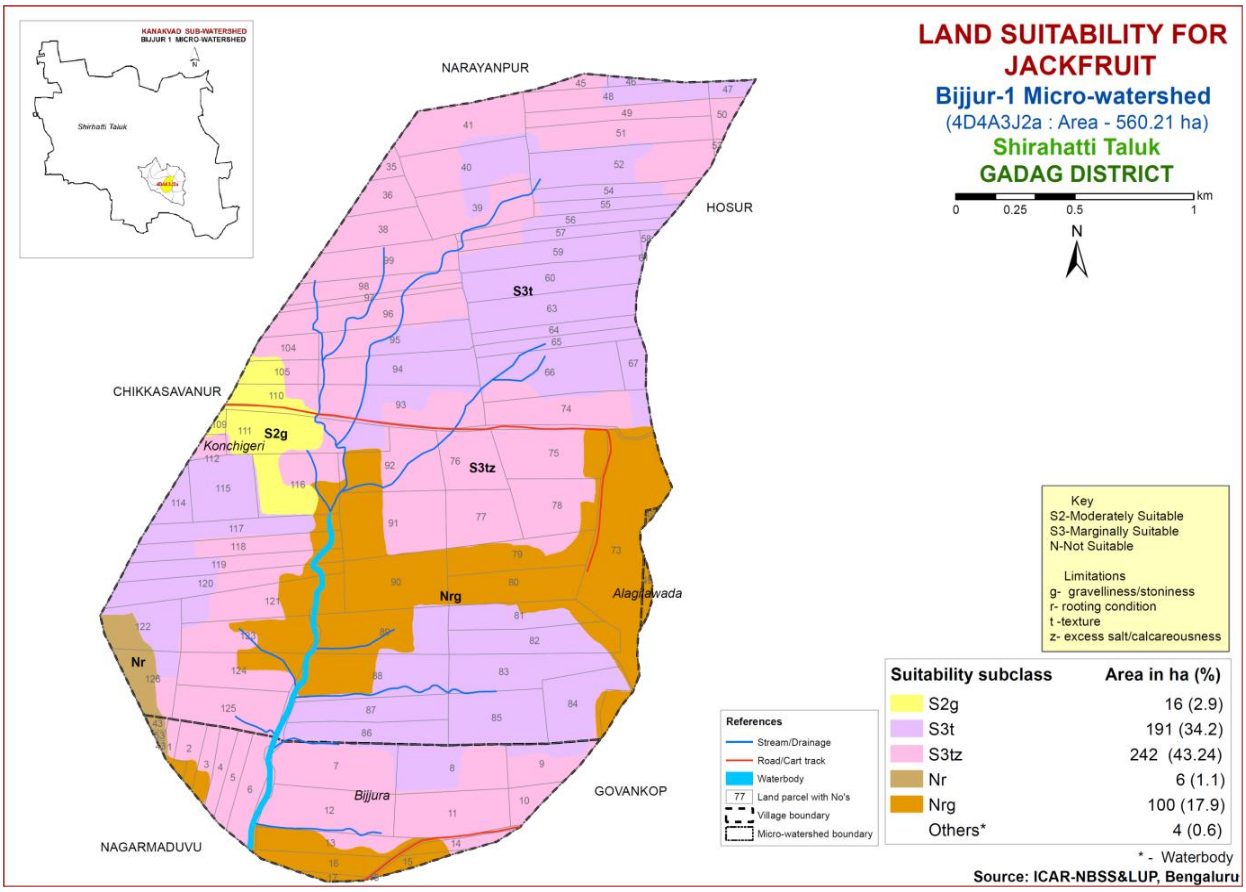


Fig. 7.12 Land Suitability map of Jackfruit

7.13 Land Suitability for Jamun (*Syzygium cumini*)

Jamun is the most important fruit crop grown in almost all the districts of the state. The crop requirements for growing jamun were matched with the soil-site characteristics and a land suitability map for growing jamun was generated. The area extent and geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.13.

An area of about 81 ha (24%) has soils that are moderately suitable (class S2) with minor limitations of texture. They are distributed in the northwestern and northeastern part of the microwatershed.

The marginally suitable (class S3) lands cover a maximum area of about 352 ha (63%) and occur in all parts of the microwatershed. They have moderate limitations of texture, rooting depth and calcareousness.

An area of about 122 ha (22%) is not suitable for growing jamun in the microwatershed and occur in the central, eastern and southern part of the microwatershed. They have severe limitations of gravelliness and rooting depth.

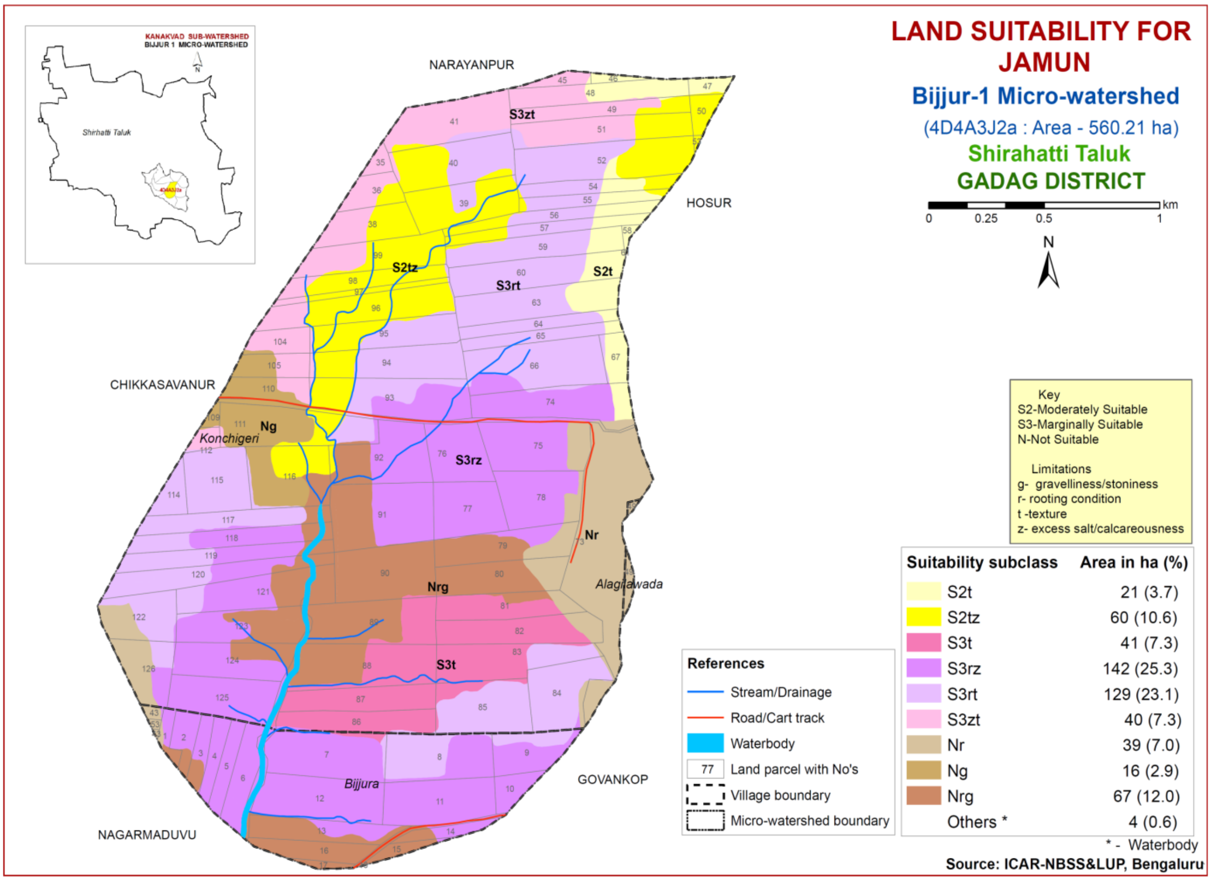


Fig. 7.13 Land Suitability map of Jamun

7.14 Land Suitability for Musambi (*Citrus limetta*)

Musambi is the most important fruit crop grown in almost all the districts of the state. The crop requirements for growing musambi were matched with the soil-site characteristics and a land suitability map for growing musambi was generated. The area extent and geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.14.

An area of about 57 ha (10%) in the microwatershed has soils that are highly suitable (class S1) for growing musambi crop. They are distributed mainly in the northeastern, southwestern and southeastern part of the microwatershed. They have minor or no limitations for growing musambi. An area of about 216 ha (39%) has soils that are moderately suitable (class S2) with minor limitations of rooting depth, gravelliness and calcareousness. They are distributed in the central, northern, western and southeastern part of the microwatershed.

The marginally suitable (class S3) lands cover about 142 ha (25%) and occur in the central, southwestern and southeastern part of the microwatershed. They have moderate limitations of calcareousness and rooting depth.

An area of about 140 ha (25%) is not suitable for growing musambi and occur in the northwestern, central and eastern part of the microwatershed. They have severe limitations of gravelliness, calcareousness and rooting depth.

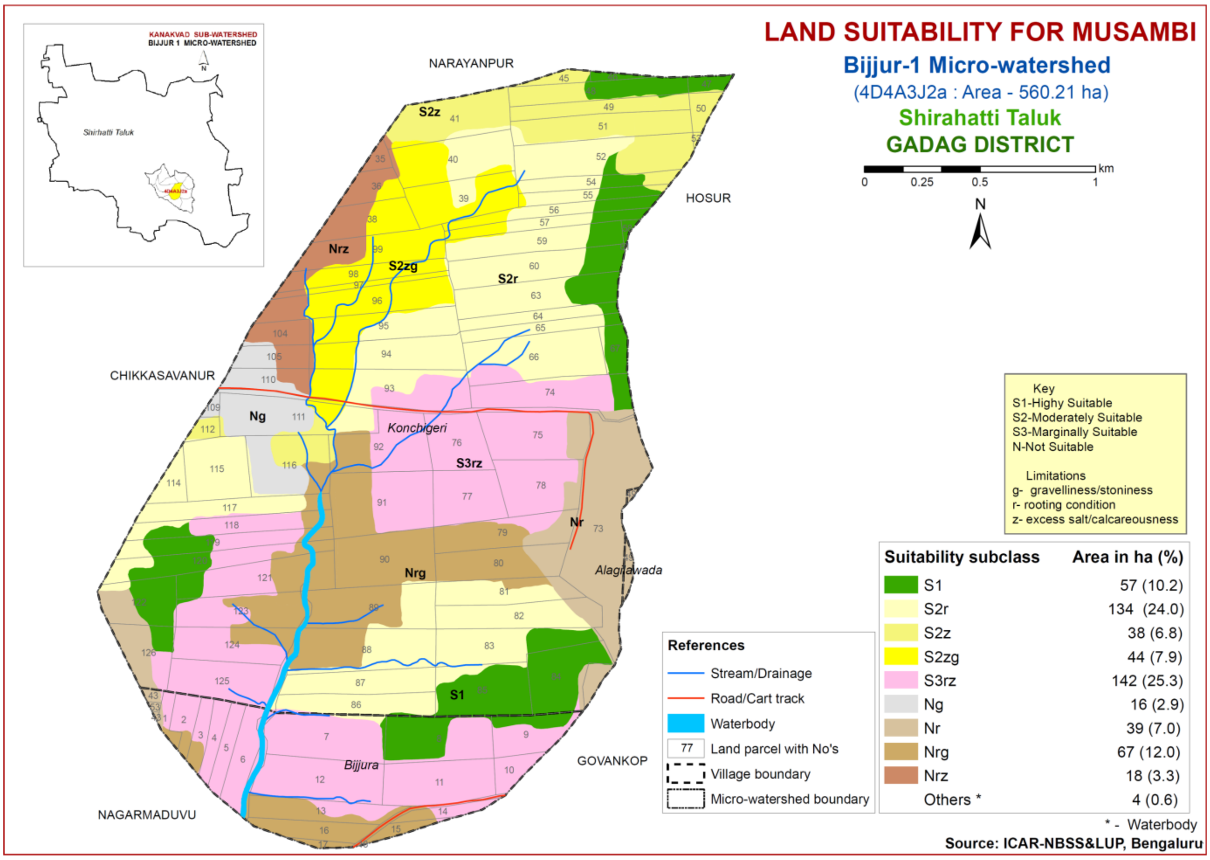


Fig. 7.14 Land Suitability map of Musambi

7.15 Land Suitability for Lime (*Citrus sp*)

Lime is 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. The area extent and geographic distribution of different suitability subclasses in the microwatershed is given in Figure 7.15.

An area of about 21 ha (4%) in the microwatershed has soils that are highly suitable (class S1) for growing lime. They are distributed mainly in the northeastern part of the microwatershed. They have minor or no limitations for growing lime.

About 252 ha (45%) area has soils that are moderately suitable (class S2) with minor limitations of rooting depth, gravelliness and calcareousness. They are distributed in the central, northern, western and southeastern part of the microwatershed. The marginally suitable (class S3) lands cover about 160 ha (29%) and occur in the central, northwestern and southern part of the microwatershed. They have moderate limitations of calcareousness. An area of about 122 ha (22%) is not suitable for growing lime and occur in the eastern, central and southern part of the microwatershed. They have 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	Temp. in growing season	^{0}C	28-30	31-35 24-27	36-40 20-23	>40 <20
Soil moisture	Growing period	Days	240-265	180-240	150-180	<150
Soil aeration	Soil drainage	class	Well drained	Mod. to imperfectly drained	poorly	Very poorly
Nutrient availability	Texture	Class	Scl, l, sicl, cl, s	Sc, sc, c	C (>70%)	S, ls
	pH	1:2.5	6.0-7.5	5.5-6.4 7.6-8.0	4.0-5.4 8.1-8.5	<4.0 >8.5
	$CaCO_3$ in root zone	%	Non calcareous	Upto 5	5-10	>10
Rooting 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	

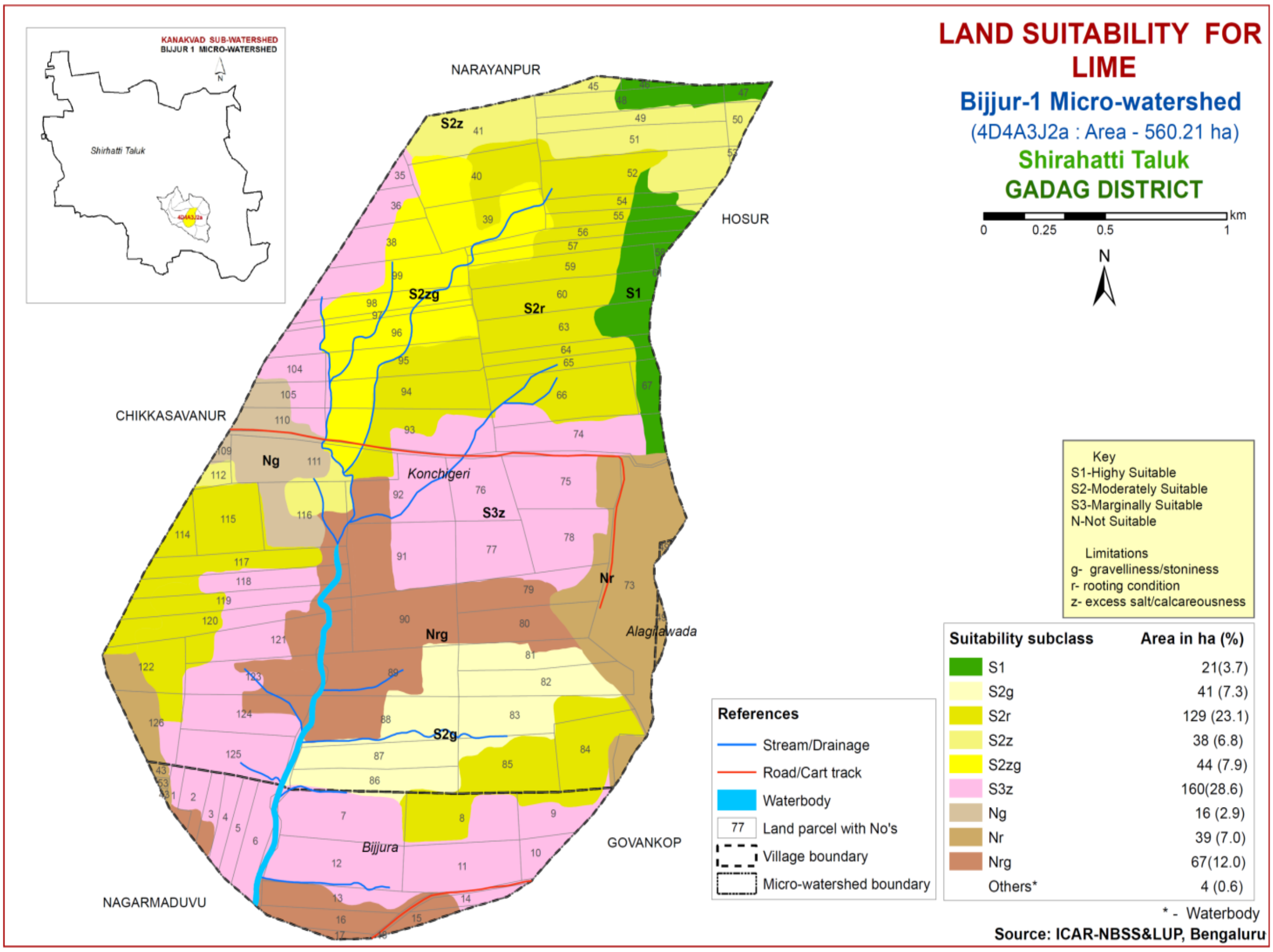


Fig. 7.15 Land Suitability map of Lime

7.16 Land Suitability for Cashew (*Anacardium occidentale)*

Cashew is the most important plantation crop grown in an area of 1.24 lakh ha in almost all the districts. The crop requirements for growing Cashew were matched with the soil-site characteristics and a land suitability map for growing Cashew was generated. The area and geographic distribution of different suitability subclasses in the microwatershed is given in Figure 7.16.

The entire area is not suitable for growing cashew in the microwatershed. They have severe limitations of gravelliness, texture, calcareousness and rooting depth.

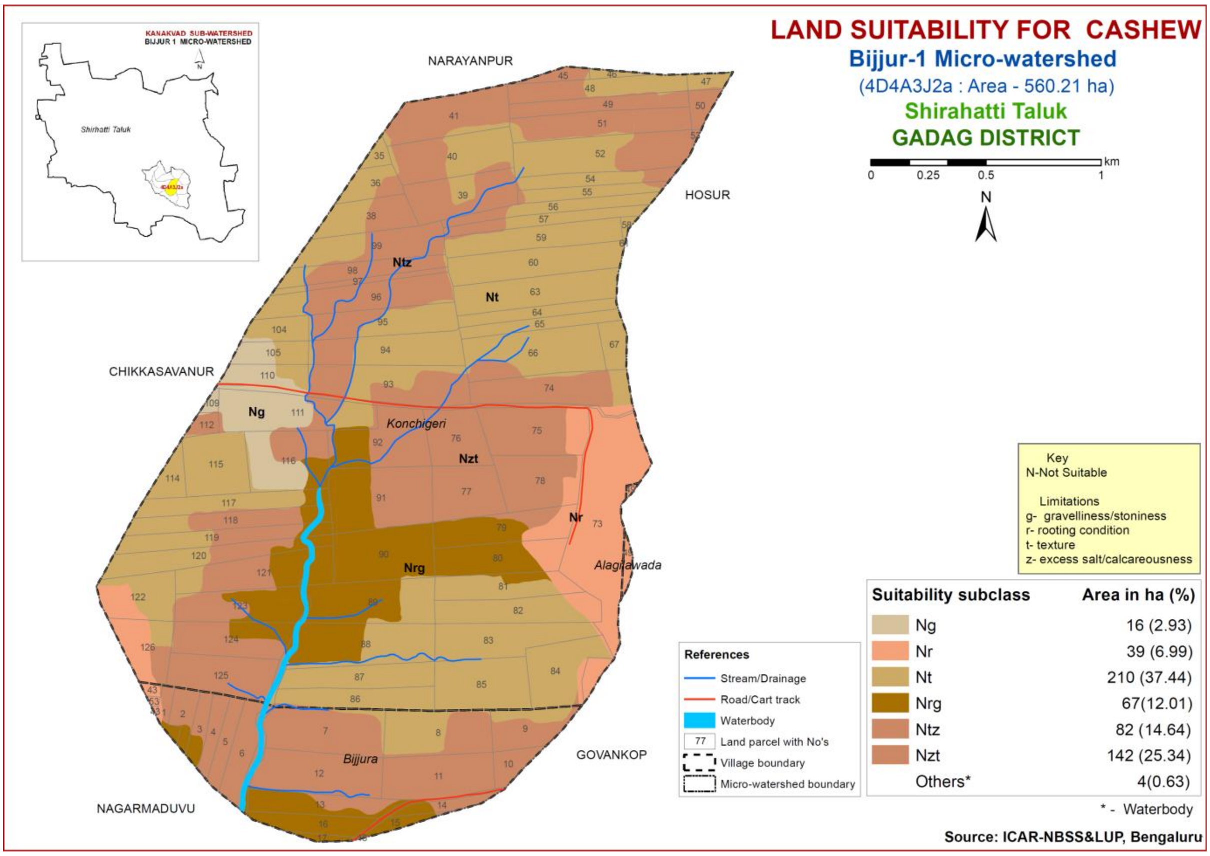


Fig. 7.16 Land Suitability map of Cashew

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

Custard apple is the most important fruit crop grown in almost all the districts of the state. The crop requirements for growing custard apple were matched with the soil-site characteristics and a land suitability map for growing custard apple was generated. The area extent and geographic distribution of different suitability subclasses in the microwatershed is given in Figure 7.17.

An area of about 150 ha (27%) in the microwatershed has soils that are highly suitable (class S1) for growing custard apple. They are distributed mainly in the northeastern, southeastern and western part of the microwatershed. They have minor or no limitations for growing custard apple.

An area of about 123 ha (22%) has soils that are moderately suitable (class S2) with minor limitations of gravelliness and calcareousness. They are distributed in the northwestern and southeastern part of the microwatershed.

The marginally suitable (class S3) lands cover about 224 ha (40%) area and occur in central, northwestern and southern part of the microwatershed. They have moderate limitations of gravelliness, calcareousness and rooting depth.

An area of about 59 ha (10%) is not suitable for growing custard apple in the microwatershed and occur in the northeastern part of the microwatershed. They have very severe limitations of gravelliness and rooting depth.

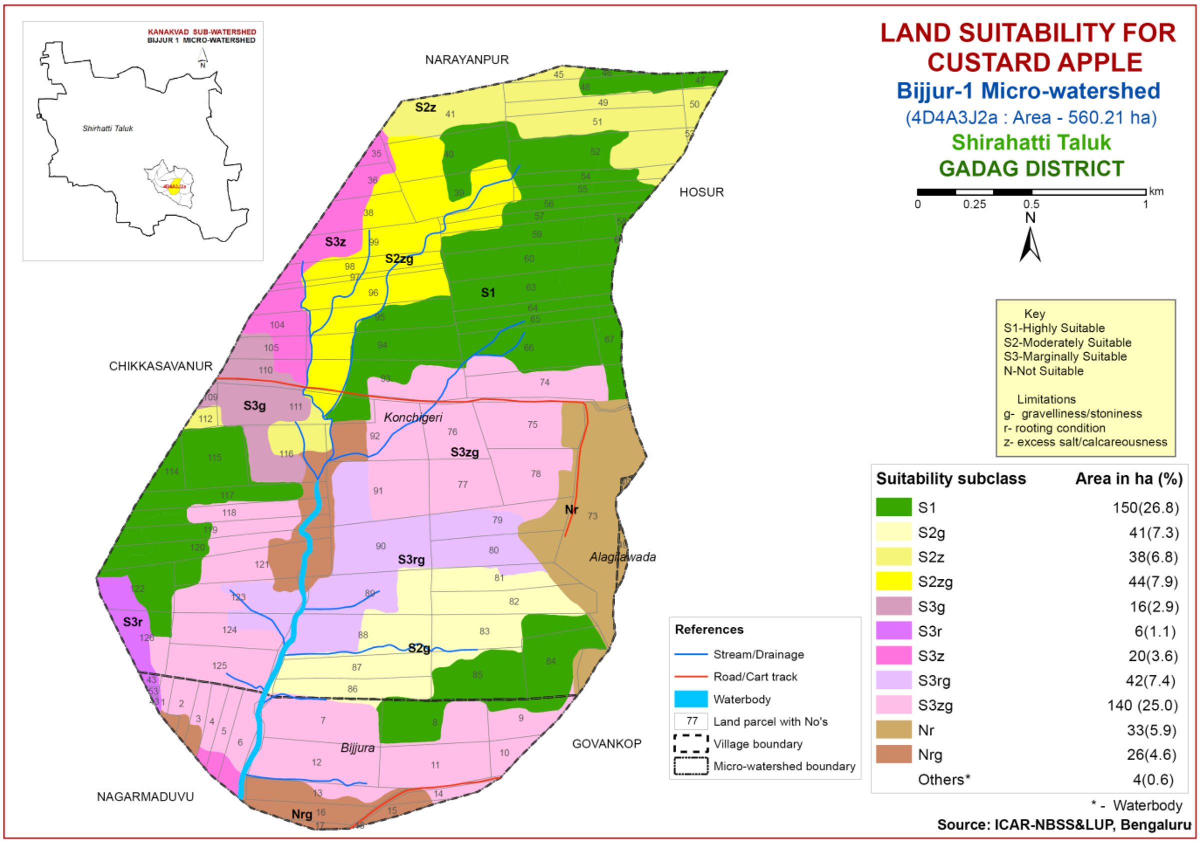


Fig. 7.17 Land Suitability map of Custard Apple

7.18 Land Suitability for Amla (*Phyllanthus emblica*)

Amla is the most important fruit crop grown in almost all the districts of the state. The crop requirements for growing amla were matched with the soil-site characteristics and a land suitability map for growing amla was generated. The area extent and geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.18.

An area of about 21 ha (4%) in the microwatershed has soils that are highly suitable (class S1) for growing amla. They are distributed mainly in the northeastern part of the microwatershed. They have minor or no limitations for growing amla. An area of about 252 ha (45%) has soils that are moderately suitable (class S2) with minor limitations of rooting depth, gravelliness and calcareousness. They are distributed in the central, northern, western and southeastern part of the microwatershed.

The marginally suitable (class S3) lands cover about 270 ha (48%) area in the microwatershed and occur in all parts of the microwatershed. They have moderate limitations of gravelliness, calcareousness and rooting depth.

An area of about 13 ha (2%) is not suitable for growing amla in the microwatershed and occur in the southern part of the microwatershed. They have severe limitations of gravelliness and rooting depth.

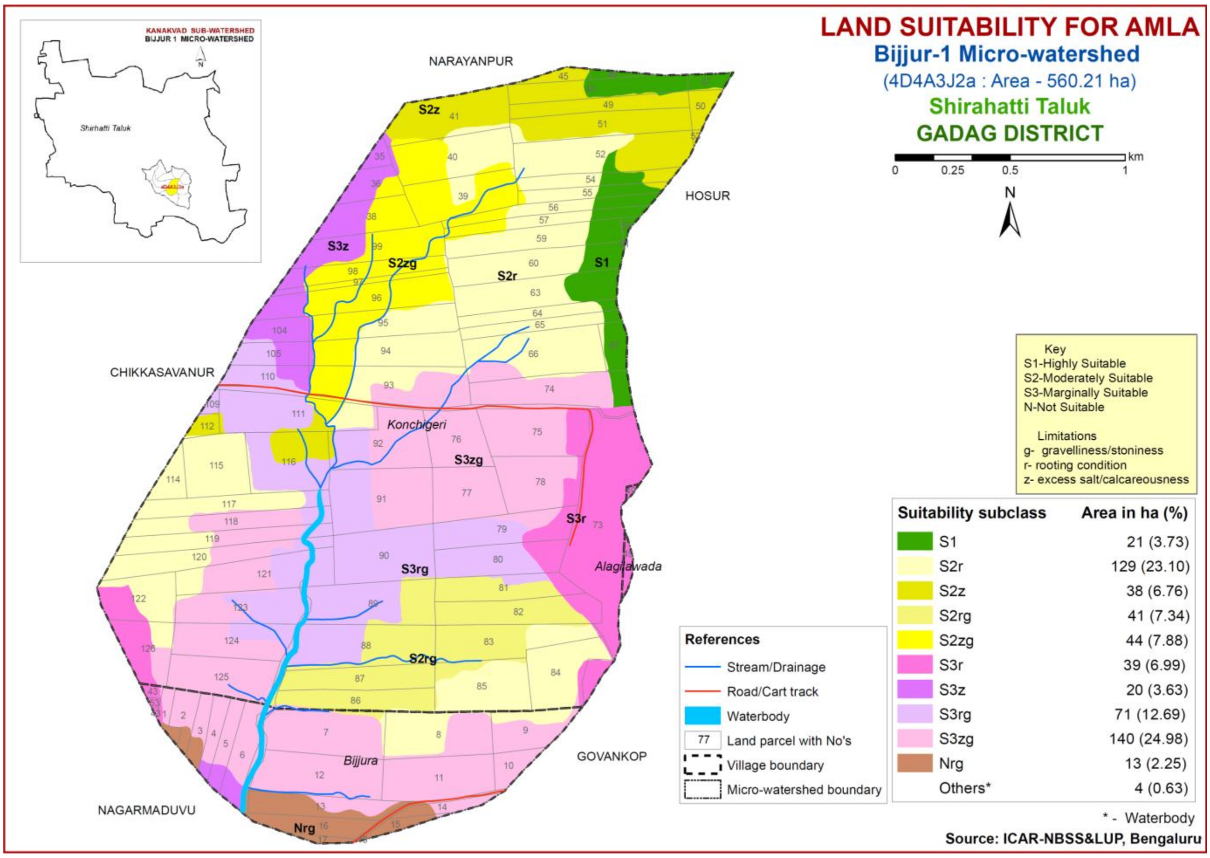


Fig. 7.18 Land Suitability map of Amla

7.19 Land Suitability for Tamarind (*Tamarindus indica*)

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

An area of about 180 ha (32%) has soils that are moderately suitable (class S2) with minor limitations of texture and calcareousness. They are distributed in the northeastern, northwestern, southwestern and southeastern part of the microwatershed. The marginally suitable (class S3) lands cover about 93 ha (17%) area and occur in the central and western part of the microwatershed. They have moderate limitations of rooting depth and texture. An area of about 283 ha (50%) is not suitable for growing tamarind and occur in all parts of the microwatershed. They have severe limitations of rooting depth, calcareousness and gravelliness.

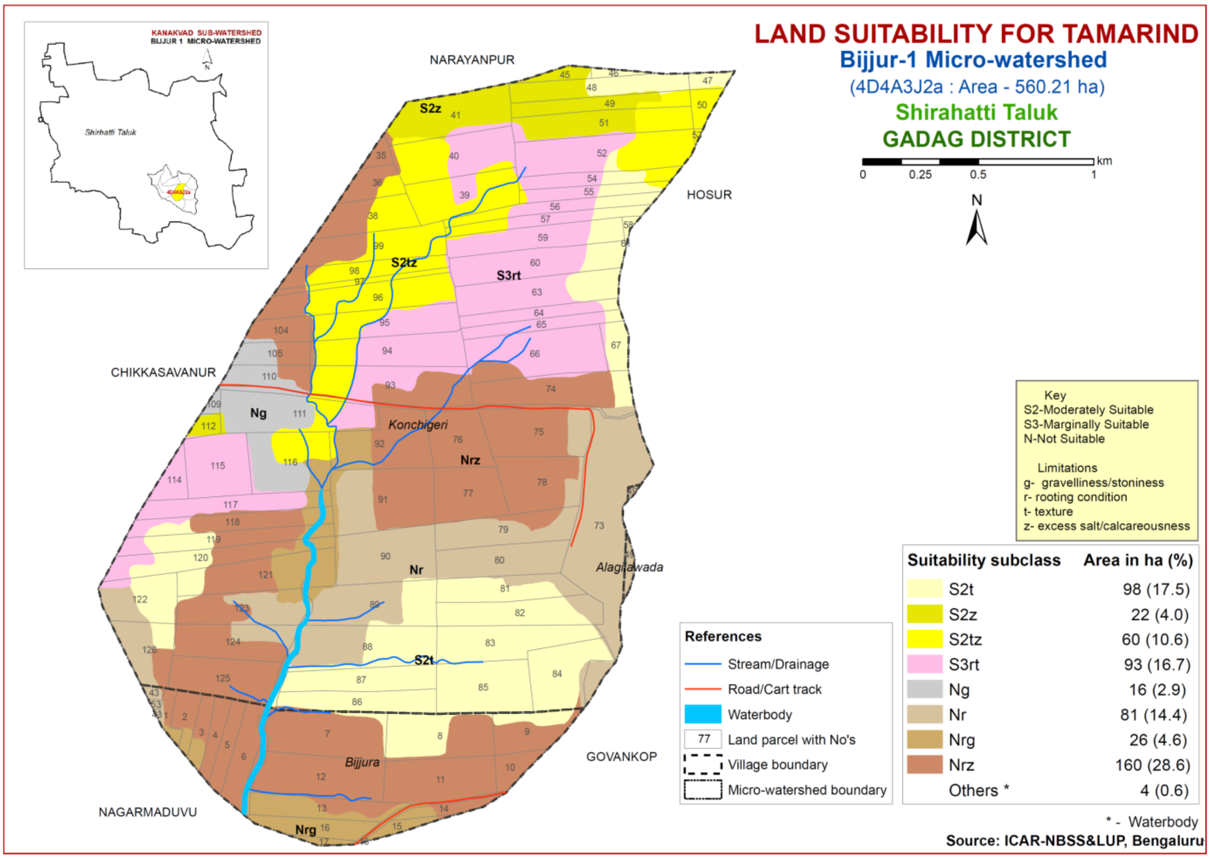


Fig. 7.19 Land Suitability map of Tamarind

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.

The major area of about 449 ha (80%) in the microwatershed has soils that are moderately suitable (class S2) for growing marigold crop. They are distributed in all parts of the microwatershed. They have minor limitations of gravelliness, texture, calcareousness and rooting depth for growing marigold.

The marginally suitable (class S3) lands cover about 94 ha (17%) area in the microwatershed and occur in the central and eastern part of the microwatershed. They have moderate limitations of rooting depth and gravelliness. An area of about 13 ha (2%) is not suitable for growing marigold in the microwatershed and occur in the southern part of the microwatershed. They have very severe limitations of gravelliness and rooting depth.

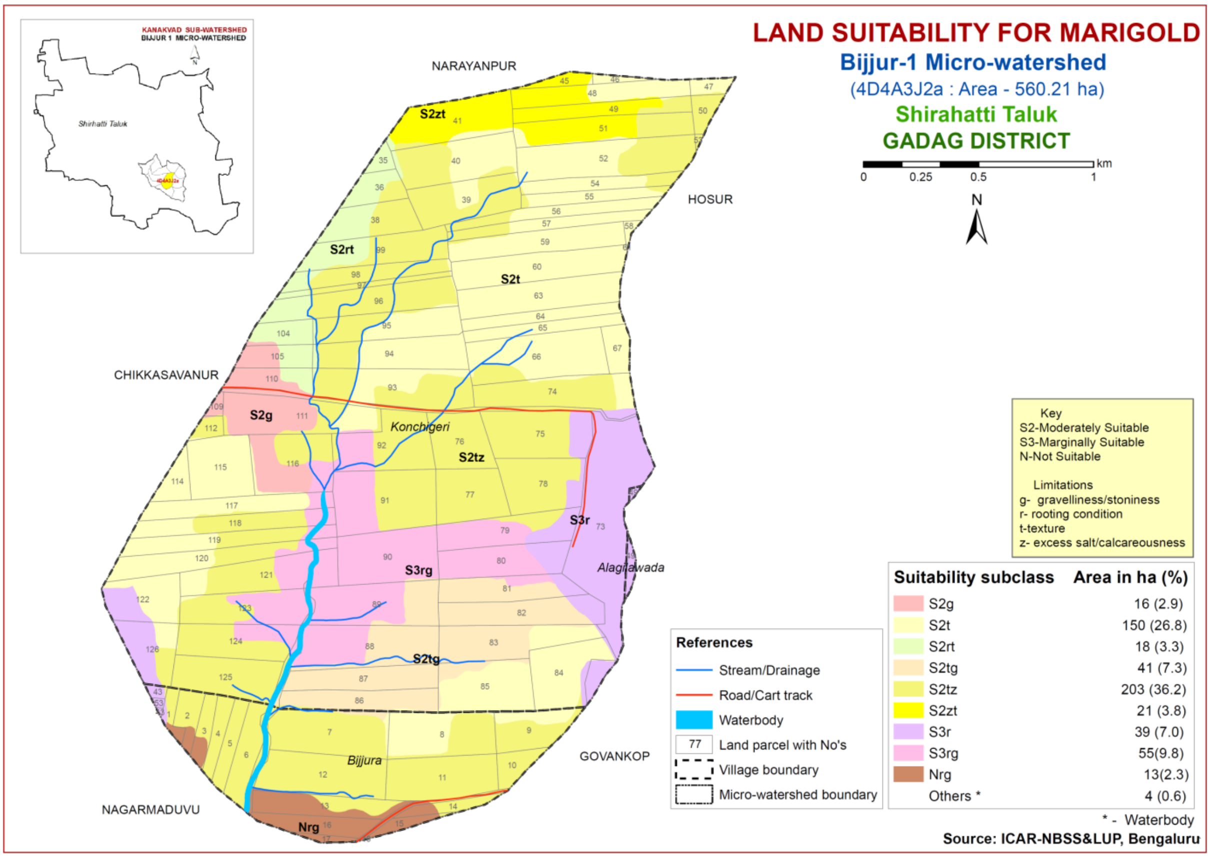


Fig. 7.20 Land Suitability map of Marigold

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.

The major area of about 449 ha (80%) has soils that are moderately suitable (class S2) with minor limitations of gravelliness, texture, rooting depth and calcareousness. They are distributed in all parts of the microwatershed.

The marginally suitable (class S3) lands cover about 94 ha (17%) area in the microwatershed and occur in the central and eastern part of the microwatershed. They have moderate limitations of rooting depth and gravelliness. An area of about 13 ha (2%) is not suitable for growing chrysanthemum in the microwatershed and occur in the southern part of the microwatershed. They have very severe limitations of gravelliness and rooting depth.

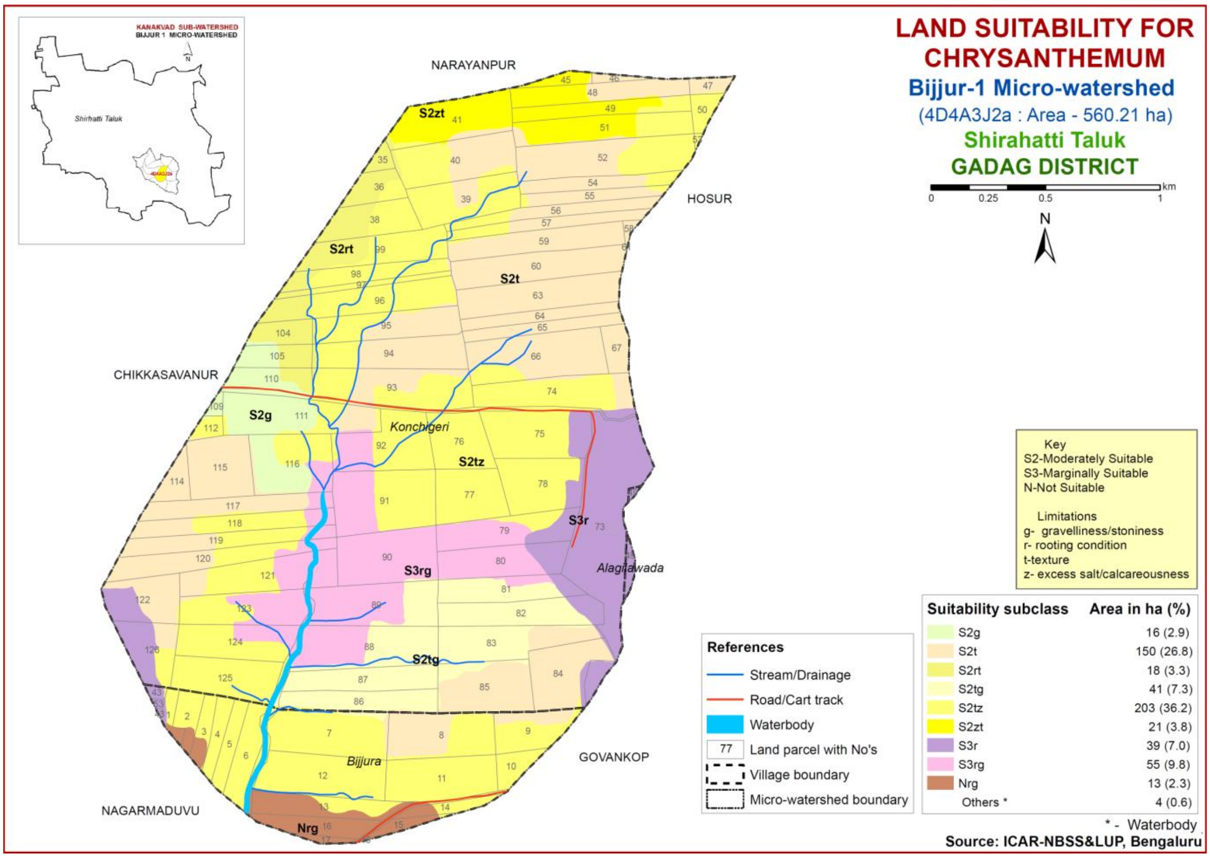


Fig. 7.21 Land Suitability map of Chrysanthemum

7.22 Land Management Units (LMUs)

The 25 soil map units identified in Bijjur-1 microwatershed have been regrouped into 7 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 generated. These Land Management Units are expected to behave similarly for a given level of management.

The map units that have been grouped into 7 land management units along with brief description of soil and site characteristics are given below.

LMUs	Soil Map units	Soil and Site characteristics
1	LGDmA1g1, LGDmB1g1, MPTmA1g1, MPTmB1, KPRmA1, KPRmB2, KPRmB2g2	Deep, cracking clay soils with slopes of 0-3%, gravelly to very gravelly (15-60%) and slight to moderate erosion
2	DNIhB2g3	Deep, gravelly red clay soils with slopes of 1-3%, gravelly (60-80%) and severe erosion
3	JLGmB1g1, JLGmB2g1, VRViB1g2, VRVmB1g1	Moderately deep, cracking clay soils with slopes of 1-3%, gravelly to very gravelly (15-60%) and slight to moderate erosion

4	RNKmB1g1,VKPiB1g2, VKPmB1g2, VKPmB2g1, VKPmB2g2, VKPmB3g2	Moderately shallow, cracking clay soils with slopes of 1-3%, gravelly to very gravelly (15-60%) and slight to severe erosion
5	AKTiB1g1, AKTiB3g2	Shallow, red gravelly clay soils with slopes of 1-3%, gravelly to very gravelly (15-60%) and slight to severe erosion
6	YSJmB2g2, SRJmB2g2, SRJmB3g2	Shallow, gravelly clay soils with slopes of 1-3%, very gravelly (35-60%) and moderate to severe erosion
7	SRLiB1g2, KLKiB1g2	Very shallow, gravelly clay loam to clay soils with slopes of 1-3%, very gravelly (35-60%) and slight erosion

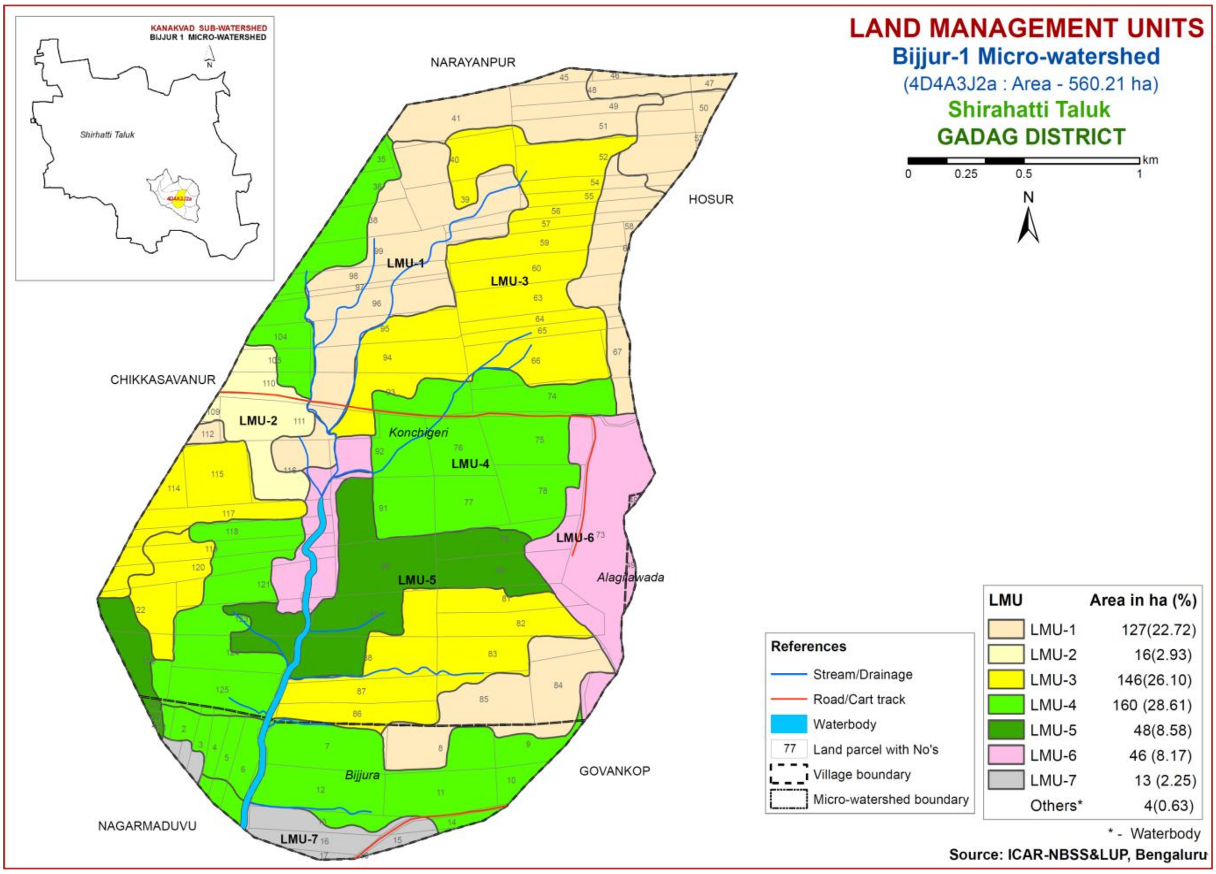


Fig. 7.22 Land Management Units map- Bijjur-1 Microwatershed

7.23 Proposed Crop Plan for Bijjur-1 Microwatershed

After assessing the land suitability for the 21 crops, the proposed crop plan has been prepared for the 7 identified LMUs by considering only the highly (class S1) and moderately suitable (class S2) 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 Bijjur-1 microwatershed

LMU No	Mapping Units	Survey Number	Field Crops/Forestry	Suitable Horticulture Crops under Irrigation	Horticulture Crops with suitable Interventions	Recommended Interventions
LMU1 (127 ha, 23%)	2, 3, 21, 22, 23, 24, 25 (100-150 cm)	**Bijjur:** 8 **Konchigeri**:38,39, 41,45,46,47,48,49, 50,51,53,58,61,67, 84,85,96,97,98,99, 112	Sorghum, Redgram, Cotton, Sunflower, Safflower, Linseed, Coriander, Bajra, Bengal gram **Multiple Crop rotation:** Redgram+Fodder jowar Pulses+Sorghum	**Vegetables:** Chillies, Tomato, Bhendi, Onion, Cabbage **Perenial Components:** Amla, Lime, Musambi, Pomegranate, Drumstick	**Flower Crops:** Marigold, Gaillardia, Tuberose, Chrysanthemum **Vegetables:** Bhendi, Crucifers **Perennial components:** Tamarind, Custard Apple, Amla, Lime	Drip irrigation, Mulching, other suitable conservation practises
LMU 2 (16 ha, 3%)	8 (100-150 cm)	**Konchigeri**: 105,109,110,111, 116	Ragi, Maize, Groundnut, Sorghum, Sunflower, Bajra, Sesamum, Castor	**Intercrops:** Groundnut, Hebbal Avare, Clusterbean, Coriander **Vegetables:** Tomato, Green Chillies, French Bean, Bhendi, Vegetable Cowpea, Cucurbits **Flower Crops:** Marigold, Gaillardia **Perennial Component:** Mango, Aonla, Banana, Papaya	**Vegetables**:Green Chillies, French Bean, Bhendi, Crucifers, Cucurbits **Flower Crops:** Tuberose, Aster, Chrysanthemum, Rose, Jasmine, Spider Lilly **Fruit crops:** Sapota, Guava, Lime, Jamun, Pomelo **Mixed Orchards:** Mango+Guava+Drumstick+ Curry leaf Sapota+Guava+Drumstick+Curry leaf	Drip irrigation, Mulching, suitable conservation practises

LMU 3 (146 ha, 26%)	17, 18, 19, 20 (75-100 cm)	**Konchigeri**: 40,52,54,55,56, 57,59,60,63,64, 65,66,81,82,83, 86,87,88,94,95, 114,115,117,120, 122	**Sole Crop:** Sorghum, Bajra, Sunflower, Cotton, Safflower **Multiple/Crop rotation:** Redgram+Maize, Redgram+Fodder jowar, Pulses-Sorghum	**Vegetables:** Chillies, Tomato, Bhendi, Onion, Cabbage, **Perenial Components:** Musambi, Pomegranate	**Vegetables*:*** Chillies, Bhendi, Crucifers, Drumstick **Flower Crops:** Marigold, Gaillardia, Tuberose, Chrysanthemum **Perenial Components*:*** Tamarind, Custard Apple, Amla, Lime	Drip irrigation, Mulching, other suitable conservation practices
LMU 4 (160 ha, 29%)	1, 12, 13, 14, 15, 16 (50-75 cm)	**Bijjur**:1,2,3,4,5,6, 7,9,10,11,12,14 Konchigeri:35,36, 74,75,76,77,78,91, 92,93,104,118,119, 121,123,124,125	Sorghum, Cotton, Bajra, Bengal gram, Safflower, Redgram	**Vegetables:** Chillies, Tomato, Bhendi, Cabbage, Drumstick, Onion, Ridge Gouard, Ashguard	Bear, Fig, Aonla, Pomelo	-do-
LMU 5 (48 ha, 9%)	6, 7 (25-50 cm)	**Bijjur:** 43,53 **Konchigeri**: 79,80,89,90,126	Groundnut, Horsegram, Greengram **Silviculture:** Simaruba, *Acacia auriculiformis,* Glyricidia, Subabul, Agave, Cassia sp.	-	-	-do-
LMU 6 (46 ha, 8%)	9, 10, 11 (<25 cm)	**Alagilawada:** 49 **Konchigeri**:73	Bengalgram, Cowpea, Greengram	-	-	-do-
LMU 7 (13 ha, 2%)	4,5 (<25 cm)	**Bijjur**: 13, 15,16,17,18	Anjan Grass, Marvel Grass, *Styloxanthes hamata*	-	-	-do-

Chapter 8

SOIL HEALTH MANAGEMENT

8.1 Soil Health

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

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

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

The most important characterististics of a healthy soil are

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

Characteristics of Bijjur-1 microwatershed

- The soil phases with sizeable area identified in the microwatershed belonged to the soil series of VKP (142 ha), VRV (77 ha), JLG (93 ha), KPR (60 ha), AKT (48 ha), YSJ (33 ha), LGD (22 ha), MPT (21 ha), RNK (18 ha), DNI (16 ha), SRJ (13 ha) and SRL (11 ha),
- As per land capability classification, nearly 99 per cent area comes under arable land category (Class II, III and IV) and one per cent area belongs to nonarable land category. The major limitations identified in the arable lands were soil erosion and soil characteristics.

- ❖ On the basis of soil reaction, very strongly alkaline (pH >9.0) soils occupy about 80 ha (14%), strongly alkaline (pH 8.4-9.0) soils occupy about 428 ha (76%), about 40 ha (7%) is moderately alkaline (pH 7.8-8.4) and slightly alkaline (pH 7.3-7.8) soils cover about 8 ha (1%). Thus, soils of the entire microwatershed are alkaline in reaction.

Soil Health Management

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

Alkaline soils

(Slightly alkaline to moderately alkaline soils)

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

Neutral soils

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

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

Soil Degradation

Soil erosion is one of the major factor affecting the soil health in the microwatershed. Out of a total area of 560 ha in the microwatershed, major area of 317 ha is suffering from either moderate or 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.

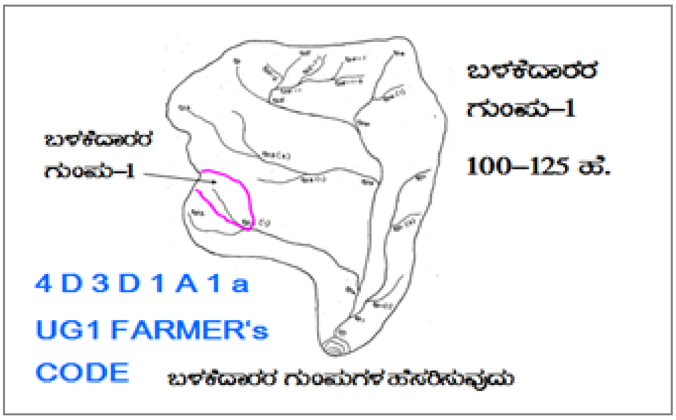
- ❖ **Soil Depth:** The depth of a soil decides the amount of moisture and nutrients it can hold, what crops can be taken up or not, depending on the rooting depth and the length of growing period available for raising any crop. Deeper the soil, better for a wide variety of crops. If sufficient depth 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 Bijjur-1 microwatershed.
- ❖ **Organic Carbon:** The OC content is medium (0.5-0.75%) in about 489 ha (87%) area and low (<0.5%) in about 68 ha (12%). 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 557 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**: The available phosphorus is low in the entire microwatershed area. Hence for all the crops, 25% additional P needs to be applied.
- ❖ **Available Potassium:** Available potassium is medium in 149 ha (27%) area in the microwatershed. Hence, in all these plots, for all crops, additional 25% potassium may be applied. It is high in 407 ha (73%) area of the microwatershed.
- ❖ **Available Sulphur:** Available sulphur is a very critical nutrient for oilseed crops. It is low in 273 ha (49%) area of the microwatershed and medium in 284 ha (51%). These areas need to be applied with magnesium sulphate or gypsum or Factamphos (p) fertitilizer (13% sulphur) for 2-3 years for the deficiency to be corrected.
- ❖ **Available Iron:** It is sufficient in the entire area of the microwatershed. To manage iron deficiency, iron sulphate @ 25 kg/ha needs to be applied for 2-3 years.
- ❖ **Available Zinc:** It is deficient in the entire area of the microwatershed. Application of zinc sulphate @25 kg/ha is to be applied.
- ❖ **Soil alkalinity:** The microwatershed has 548 ha area with soils that are moderately 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 Bijjur-1 microwatershed, the land resource inventory database generated under Sujala-III project has been transformed as information through series of interpretative (thematic) maps using soil phase map as a base. The various thematic maps (1:7920 scale) generated were

- Soil depth
- Surface soil texture
- Soil gravelliness
- Available water capacity
- Soil slope
- Soil erosion
- Land capability
- Present land use 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.

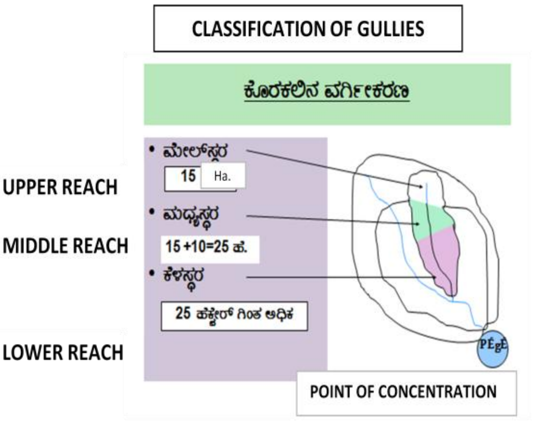
- Naming of user groups and farmers
- Identification of arable and non arable lands
- Identification of drainage lines and gullies
- Identification of non treatable areas
- Identification of priority areas in the arable lands
- Treatment plan for arable lands
- Location of water harvesting and recharge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

9.1 Treatment Plan

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

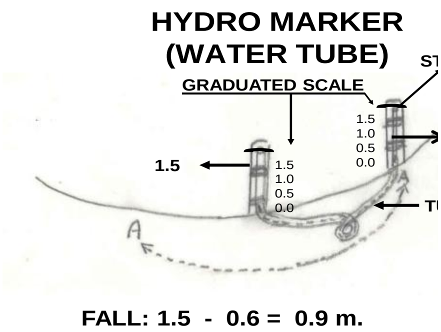
9.1.1 Arable Land Treatment

A. BUNDING

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

Measurement of Land Slope

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



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

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

Note: (i) The above intervals are maximum.

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

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

Section of the Bund

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

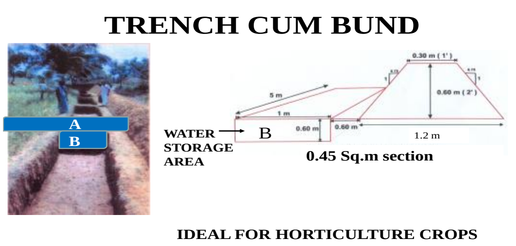
Recommended Bund Section

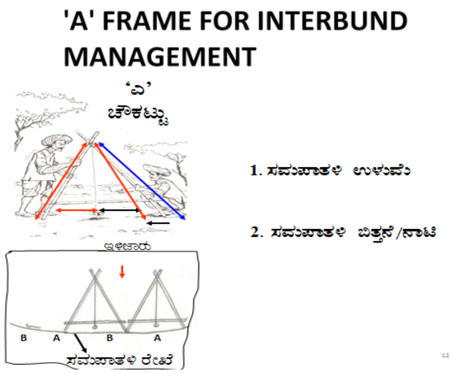
Top width (m)	Base width (m)	Height (m)	Side slope (Z:1;H:V)	Cross section (sq m)	Soil Texture	Remarks
0.3	0.9	0.3	01:01	0.18	Sandy loam	Vegetative bund
0.3	1.2	0.3	1.5:1	0.225	Sandy clay	
0.3	1.2	0.5	0.9:1	0.375	Red gravelly soils	
0.3	1.2	0.6	0.75:1	0.45		
0.3	1.5	0.6	01:01	0.54	Red sandy loam	
0.3	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
m^2	m	m^3	L(m)	W(m)	D(m)	QUANTITY (m^3)	m	
0.375	6	2.25	5.85	0.85	0.45	2.24	0.15	Shallow
0.45	6	2.7	5.4	1.2	0.43	2.79	0.6	Shallow
0.45	6	2.7	5	0.85	0.65	2.76	1	Moderately Shallow
0.54	5.6	3.02	5.5	0.85	0.7	3.27	0.1	Moderately shallow
0.54	5.5	2.97	5	1.2	0.5	3	0.5	Shallow
0.72	6.2	4.46	6	1.2	0.7	5.04	0.2	Moderately shallow
0.72	5.2	3.74	5.1	0.85	0.9	3.9	0.1	Moderately deep

B. Waterways

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 77 ha (14%) requires trench cum bunding, about 462 ha (82%) area needs graded bunds. The minimum area of about 18 ha (3%) requires bunding/ 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.

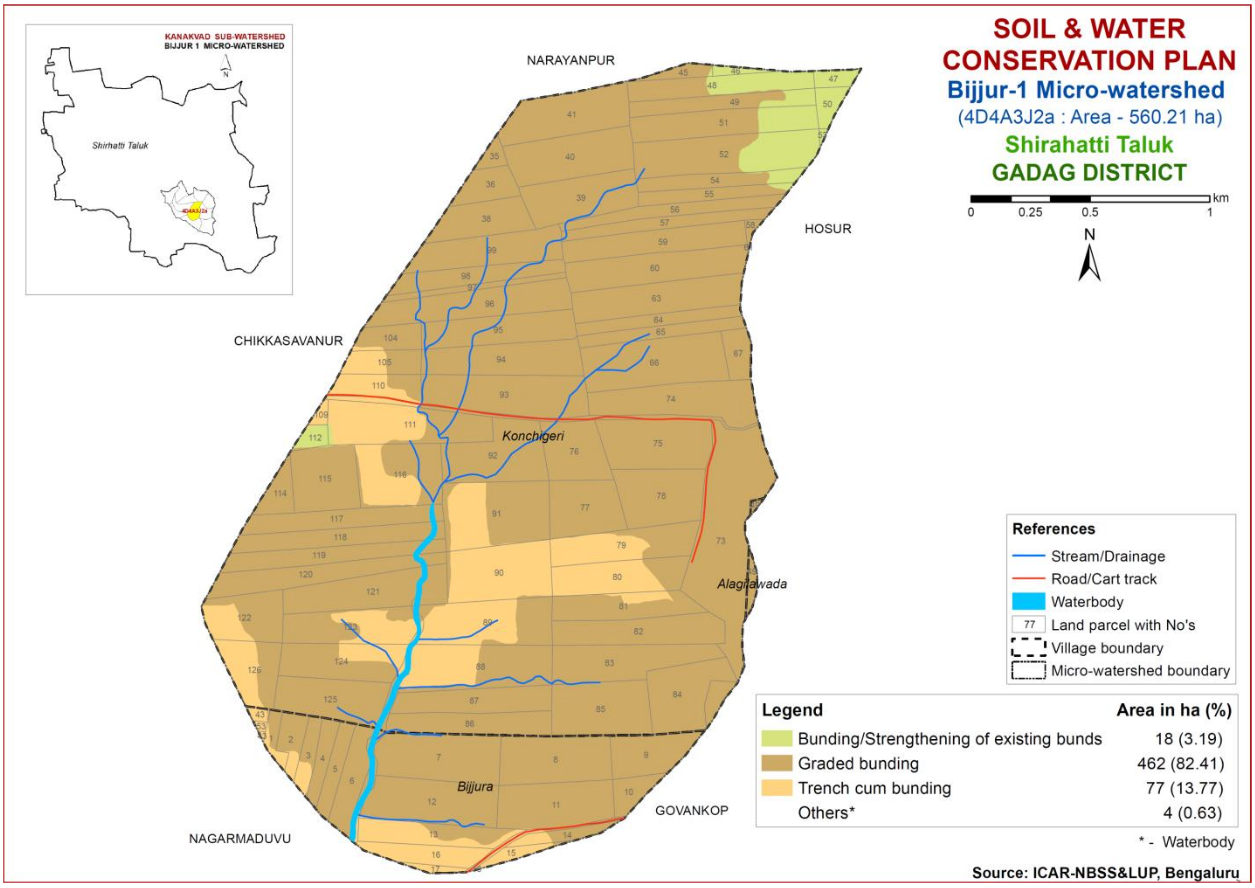


Fig. 9.1 Soil and Water Conservation Plan map of Bijjur-1 Microwatershed

9.3 Greening of Microwatershed

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

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

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

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

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 Karntaka 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

Bijjur – 1 Microwatershed - Soil Phase Information

VILLAGE	Sur-vey No.	Total Area (ha)	Soils	Land Management Unit	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	CLU code	WELLS	Land Capability	Conservation Plan
Konchigeri	35	1.02	RNKmB1g1	LMU-4	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Maize(Mz)	Not Available	IIIs	Graded bunding
Konchigeri	36	3.1	RNKmB1g1	LMU-4	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Greengram+Maize+Cotton(Gg+Mz+Ct)	Not Available	IIIs	Graded bunding
Konchigeri	38	5.54	KPRmB2g2	LMU-1	Deep (100-150 cm)	Clay	Very gravelly (35-60%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Current fallow land+Cotton+Greengram(Mz+Cf+Ct+Gg)	Not Available	IIIes	Graded bunding
Konchigeri	39	8.03	KPRmB2g2	LMU-1	Deep (100-150 cm)	Clay	Very gravelly (35-60%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Cotton+Current fallow land(Mz+Ct+Cf)	Not Available	IIIes	Graded bunding
Konchigeri	40	9.29	JLGmB2g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Jowar+Onion(Mz+Jw+On)	Not Available	IIIe	Graded bunding
Konchigeri	41	9.15	LGDmB1g1	LMU-1	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Cotton+Jowar(Mz+Ct+Jw)	Not Available	IIes	Graded bunding
Konchigeri	45	1.31	LGDmB1g1	LMU-1	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Groundnut(Gn)	Not Available	IIes	Graded bunding
Konchigeri	46	0.69	MPTmA1g1	LMU-1	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Greengram (Gg)	Not Available	IIes	Bunding/Strengthening of existing bunds
Konchigeri	47	1.24	MPTmA1g1	LMU-1	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Maize(Mz)	Not Available	IIes	Bunding/Strengthening of existing bunds
Konchigeri	48	6.33	MPTmA1g1	LMU-1	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Maize+Greengram(Mz+Gg)	Not Available	IIes	Bunding/Strengthening of existing bunds
Konchigeri	49	4.9	LGDmB1g1	LMU-1	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Greengram(Mz+Gg)	Not Available	IIes	Graded bunding
Konchigeri	50	1.6	KPRmA1	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Maize+Greengram(Mz+Gg)	Not Available	IIe	Bunding/Strengthening of existing bunds
Konchigeri	51	8.22	LGDmB1g1	LMU-1	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Greengram+Maize+Cotton(Gg+Mz+Ct)	Not Available	IIes	Graded bunding
Konchigeri	52	11.9	JLGmB2g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize(Mz)	Not Available	IIIe	Graded bunding

VILLAGE	Sur-vey No.	Total Area (ha)	Soils	Land Management Unit	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	CLU code	WELLS	Land Capability	Conservation Plan
Konchigeri	53	0.16	KPRmA1	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Maize(Mz)	Not Available	IIe	Bunding/Strengthening of existing bunds
Konchigeri	54	3.95	JLGmB2g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Cotton(Mz+Ct)	Not Available	IIIe	Graded bunding
Konchigeri	55	3.25	JLGmB2g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Current fallow land(Mz+Cf)	Not Available	IIIe	Graded bunding
Konchigeri	56	4.44	JLGmB2g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Cotton(Mz+Ct)	Not Available	IIIe	Graded bunding
Konchigeri	57	4.18	JLGmB2g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Cotton(Mz+Ct)	Not Available	IIIe	Graded bunding
Konchigeri	58	0.4	MPTmB1	LMU-1	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
Konchigeri	59	7.43	JLGmB2g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Cotton(Mz+Ct)	Not Available	IIIe	Graded bunding
Konchigeri	60	9.1	JLGmB2g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Greengram+Cotton+Onion+Maize(Gg+Ct+On+Mz)	Not Available	IIIe	Graded bunding
Konchigeri	61	0.02	MPTmB1	LMU-1	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
Konchigeri	63	9.15	JLGmB2g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Greengram+Onion(Mz+Gg+On)	Not Available	IIIe	Graded bunding
Konchigeri	64	3.49	JLGmB2g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Greengram+Maize+Cotton(Gg+Mz+Ct)	Not Available	IIIe	Graded bunding
Konchigeri	65	3.57	JLGmB2g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Greengram(Mz+Gg)	Not Available	IIIe	Graded bunding
Konchigeri	66	11.6	JLGmB2g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Greengram+Onion+Chilli+Maize(Gg+On+Ch+Mz)	Farm pond	IIIe	Graded bunding
Konchigeri	67	2.22	MPTmB1	LMU-1	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
Konchigeri	73	21.6	YSJmB2g2	LMU-6	Shallow (25-50 cm)	Clay	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available(NA)	Tank	IIIes	Graded bunding

VILLAGE	Sur-vey No.	Total Area (ha)	Soils	Land Management Unit	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	CLU code	WELLS	Land Capability	Conservation Plan
Konchigeri	74	9.41	VKPmB2g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Greengram+Maize+Cotton(Gg+Mz+Ct)	Not Available	IIIes	Graded bunding
Konchigeri	75	9.3	VKPmB2g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Current fallow land+Cotton+Greengram(Mz+Cf+Ct+Gg)	Not Available	IIIes	Graded bunding
Konchigeri	76	6.17	VKPmB2g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Cotton+Horsegram+Current fallow land(Mz+Ct+Hg+Cf)	Not Available	IIIes	Graded bunding
Konchigeri	77	6.78	VKPmB2g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Cotton(Mz+Ct)	Not Available	IIIes	Graded bunding
Konchigeri	78	8.12	VKPmB2g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Greengram+Onion+Horsegram(Mz+Gg+On+Hg)	Not Available	IIIes	Graded bunding
Konchigeri	79	7.71	AKTiB3g2	LMU-5	Shallow (25-50 cm)	Sandy clay	Very gravelly (35-60%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Severe	Maize+Greengram(Mz+Gg)	Not Available	IVes	Trench cum bunding
Konchigeri	80	7.45	AKTiB3g2	LMU-5	Shallow (25-50 cm)	Sandy clay	Very gravelly (35-60%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Severe	Maize+Current fallow land(Mz+Cf)	Not Available	IVes	Trench cum bunding
Konchigeri	81	6.35	VRViB1g2	LMU-3	Moderately deep (75-100 cm)	Sandy clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Cotton(Mz+Ct)	Not Available	IIIs	Graded bunding
Konchigeri	82	7.94	VRViB1g2	LMU-3	Moderately deep (75-100 cm)	Sandy clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Cotton+Eucalyptus+Fallow land(Mz+Ct+Eu+Fl)	Not Available	IIIs	Graded bunding
Konchigeri	83	8.75	VRViB1g2	LMU-3	Moderately deep (75-100 cm)	Sandy clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Greengram+Maize+Cotton(Gg+Mz+Ct)	Not Available	IIIs	Graded bunding
Konchigeri	84	7.66	VRVmB1g1	LMU-1	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Onion(Mz+On)	Not Available	IIs	Graded bunding
Konchigeri	85	9.08	VRVmB1g1	LMU-1	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Greengram+Maize+Cotton(Gg+Mz+Ct)	Not Available	IIs	Graded bunding
Konchigeri	86	6.25	VRViB1g2	LMU-3	Moderately deep (75-100 cm)	Sandy clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize(Mz)	Not Available	IIIs	Graded bunding
Konchigeri	87	6.48	VRViB1g2	LMU-3	Moderately deep (75-100 cm)	Sandy clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Cotton(Mz+Ct)	Not Available	IIIs	Graded bunding
Konchigeri	88	11.1	VRViB1g2	LMU-3	Moderately deep (75-100 cm)	Sandy clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Cotton+Current fallow land(Mz+Ct+Cf)	Check dam	IIIs	Graded bunding

VILLAGE	Sur-vey No.	Total Area (ha)	Soils	Land Management Unit	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	CLU code	WELLS	Land Capability	Conservation Plan
Konchigeri	89	10.1	AKTiB3g2	LMU-5	Shallow (25-50 cm)	Sandy clay	Very gravelly (35-60%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Severe	Maize+Current fallow land(Mz+Cf)	Not Available	IVes	Trench cum bunding
Konchigeri	90	9.85	AKTiB3g2	LMU-5	Shallow (25-50 cm)	Sandy clay	Very gravelly (35-60%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Severe	Maize+Cotton+Greengram+Current fallow land(Mz+Ct+Gg+Cf)	Not Available	IVes	Trench cum bunding
Konchigeri	91	11.7	VKPmB2g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize(Mz)	Not Available	IIIes	Graded bunding
Konchigeri	92	9.1	VKPmB2g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+fallow land+Cotton+Greengram(Mz+Fl+Ct+Gg)	Check dam	IIIes	Graded bunding
Konchigeri	93	11	VKPmB2g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Cotton(Mz+Ct)	Not Available	IIIes	Graded bunding
Konchigeri	94	8.65	JLGmB2g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Greengram+Maize+Cotton(Gg+Mz+Ct)	Not Available	IIIe	Graded bunding
Konchigeri	95	7.55	JLGmB2g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Fallow land(Mz+Fl)	Not Available	IIIe	Graded bunding
Konchigeri	96	9.54	KPRmB2g2	LMU-1	Deep (100-150 cm)	Clay	Very gravelly (35-60%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+fallow land(Mz+Fl)	Not Available	IIIes	Graded bunding
Konchigeri	97	1.77	KPRmB2g2	LMU-1	Deep (100-150 cm)	Clay	Very gravelly (35-60%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Current fallow land(Mz+Fl)	Not Available	IIIes	Graded bunding
Konchigeri	98	5.08	KPRmB2g2	LMU-1	Deep (100-150 cm)	Clay	Very gravelly (35-60%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Current fallow land(Mz+Cf)	Not Available	IIIes	Graded bunding
Konchigeri	99	7.89	KPRmB2g2	LMU-1	Deep (100-150 cm)	Clay	Very gravelly (35-60%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Greengram+Fallow land(Mz+Gg+Fl)	Not Available	IIIes	Graded bunding
Konchigeri	104	2.78	RNKmB1g1	LMU-4	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Slight	Maize(Mz)	Not Available	IIIs	Graded bunding
Konchigeri	105	3.16	DNIhB2g3	LMU-2	Deep (100-150 cm)	Sandy clay loam	Extremely gravelly (60-80%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Cotton(Mz+Ct)	Not Available	IVes	Trench cum bunding
Konchigeri	109	0.54	DNIhB2g3	LMU-2	Deep (100-150 cm)	Sandy clay loam	Extremely gravelly (60-80%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Maize(Mz)	Not Available	IVes	Trench cum bunding
Konchigeri	110	3.71	DNIhB2g3	LMU-2	Deep (100-150 cm)	Sandy clay loam	Extremely gravelly (60-80%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Cotton+Current fallow land(Gn+Ct+Cf)	Not Available	IVes	Trench cum bunding

VILLAGE	Survey No.	Total Area (ha)	Soils	Land Management Unit	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	CLU code	WELLS	Land Capability	Conservation Plan
Konchigeri	111	10.4	DNIhB2g3	LMU-2	Deep (100-150 cm)	Sandy clay loam	Extremely gravelly (60-80%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Fallow land(Mz+Fl)	Not Available	IVes	Trench cum bunding
Konchigeri	112	1.13	LGDmA1g1	LMU-1	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Nearly level (0-1%)	Slight	Maize(Mz)	Not Available	IIes	Bunding/Strengthening of existing bunds
Konchigeri	114	2.31	JLGmB1g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Cotton(Mz+Ct)	Not Available	IIes	Graded bunding
Konchigeri	115	7.29	JLGmB1g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Greengram+Maize+Cotton(Gg+Mz+Ct)	Not Available	IIes	Graded bunding
Konchigeri	116	9.1	DNIhB2g3	LMU-2	Deep (100-150 cm)	Sandy clay loam	Extremely gravelly (60-80%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Current fallow land+fallow land(Mz+Cf+Fl)	Not Available	IVes	Trench cum bunding
Konchigeri	117	6.34	JLGmB1g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Cotton+Fallow land(Mz+Ct+Fl)	Not Available	IIes	Graded bunding
Konchigeri	118	6.46	VKPmB3g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	Maize+Greengram+Fallow land(Mz+Gg+Fl)	Not Available	IVes	Graded bunding
Konchigeri	119	6.19	VKPmB3g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	Maize(Mz)	Not Available	IVes	Graded bunding
Konchigeri	120	7.44	VRVmB1g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Current fallow land+fallow land+Greengram(Mz+Cf+Fl+Gg)	Not Available	IIs	Graded bunding
Konchigeri	121	9.38	VKPmB3g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	Maize+Fallow land(Mz+Fl)	Check dam	IVes	Graded bunding
Konchigeri	122	6.29	VRVmB1g1	LMU-3	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Cotton+Current fallow land(Mz+Ct+Cf)	Not Available	IIs	Graded bunding
Konchigeri	123	7.72	VKPmB3g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	Maize+Cotton+Current fallow land(Mz+Ct+Cf)	Not Available	IVes	Graded bunding
Konchigeri	124	7.57	VKPmB3g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	Maize+Cotton+Greengram+Fallow land(Mz+Ct+Gg+Fl)	Not Available	IVes	Graded bunding
Konchigeri	125	7.63	VKPmB3g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	Maize+Cotton+Current fallow land+Fallow land(Mz+Ct+Cf+Fl)	Not Available	IVes	Graded bunding
Konchigeri	126	5.58	AKTiB1g1	LMU-5	Shallow (25-50 cm)	Sandy clay	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Greengram(Mz+Gg)	Not Available	IIIs	Trench cum bunding

VILLAGE	Sur-vey No.	Total Area (ha)	Soils	Land Management Unit	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	CLU code	WELLS	Land Capability	Conservation Plan
Alagilawada	49	1.02	YSJmB2g2	LMU-6	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	IIIes	Graded bunding
Bijjura	1	1.26	VKPiB1g2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize(Mz)	Not Available	IIIs	Graded bunding
Bijjura	2	2.26	VKPiB1g2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize(Mz)	Not Available	IIIs	Graded bunding
Bijjura	3	1.97	VKPiB1g2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize(Mz)	Not Available	IIIs	Graded bunding
Bijjura	4	2.17	VKPiB1g2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Onion(Mz+On)	Not Available	IIIs	Graded bunding
Bijjura	5	2.56	VKPiB1g2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Cotton(Mz+Ct)	Not Available	IIIs	Graded bunding
Bijjura	6	4.2	VKPiB1g2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize(Mz)	Not Available	IIIs	Graded bunding
Bijjura	7	9.97	VKPmB1g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Greengram+Maize+Cotton(Gg+Mz+Ct)	Not Available	IIIs	Graded bunding
Bijjura	8	9.04	VRVmB1g1	LMU-1	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Greengram(Mz+Gg)	Farm pond	IIs	Graded bunding
Bijjura	9	5.4	VKPmB1g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Greengram+Sunflower(Gg+Sf)	Not Available	IIIs	Graded bunding
Bijjura	10	2.19	VKPmB1g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize(Mz)	Not Available	IIIs	Graded bunding
Bijjura	11	8.73	VKPmB1g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Greengram+Fallow land(Mz+Gg+Fl)	Not Available	IIIs	Graded bunding
Bijjura	12	9.79	VKPmB1g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Greengram+Maize+Cotton(Gg+Mz+Ct)	Open well	IIIs	Graded bunding
Bijjura	13	5.72	SRLiB1g2	LMU-7	Very shallow (<25 cm)	Sandy clay	Very gravelly (35-60%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Greengram+Maize+Cotton(Gg+Mz+Ct)	Farm pond	IVs	Trench cum bunding
Bijjura	14	1.88	VKPmB1g2	LMU-4	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Slight	Maize(Mz)	Not Available	IIIs	Graded bunding

VILLAGE	Sur-vey No.	Total Area (ha)	Soils	Land Management Unit	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	CLU code	WELLS	Land Capability	Conservation Plan
Bijjura	15	1.31	SRLiB1g2	LMU-7	Very shallow (<25 cm)	Sandy clay	Very gravelly (35-60%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Horsegram(Mz+Hg)	Not Available	IVs	Trench cum bunding
Bijjura	16	3.85	SRLiB1g2	LMU-7	Very shallow (<25 cm)	Sandy clay	Very gravelly (35-60%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Maize+Chilly(Mz+Ch)	Not Available	IVs	Trench cum bunding
Bijjura	17	0.66	SRLiB1g2	LMU-7	Very shallow (<25 cm)	Sandy clay	Very gravelly (35-60%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Maize(Mz)	Not Available	IVs	Trench cum bunding
Bijjura	18	0.02	SRLiB1g2	LMU-7	Very shallow (<25 cm)	Sandy clay	Very gravelly (35-60%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Not Available(NA)	Not Available	IVs	Trench cum bunding
Bijjura	43	0.53	AKTiB1g1	LMU-5	Shallow (25-50 cm)	Sandy clay	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Maize(Mz)	Not Available	IIIs	Trench cum bunding
Bijjura	53	0.19	AKTiB1g1	LMU-5	Shallow (25-50 cm)	Sandy clay	Gravelly (15-35%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Slight	Greengram	Not Available	IIIs	Trench cum bunding

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
Konchigeri	35	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5 %)	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	36	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5 %)	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	38	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5 %)	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	39	Very strongly alkaline (pH > 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)
Konchigeri	40	Very strongly alkaline (pH > 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)
Konchigeri	41	Very strongly alkaline (pH > 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)
Konchigeri	45	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)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	46	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)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	47	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)	High (> 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	48	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)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	49	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)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	51	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)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	52	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)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	53	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)	High (> 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	54	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)	Medium (0.5 – 1.0 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
Konchigeri	55	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)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	56	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)
Konchigeri	57	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)
Konchigeri	58	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)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	59	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)
Konchigeri	60	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)
Konchigeri	61	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)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	63	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)
Konchigeri	64	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)
Konchigeri	65	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)
Konchigeri	66	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)
Konchigeri	67	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	73	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)
Konchigeri	74	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)
Konchigeri	75	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)
Konchigeri	76	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)
Konchigeri	77	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	78	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)
Konchigeri	79	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)

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
Konchigeri	**80**	**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	**81**	**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)**
Konchigeri	**82**	**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)**
Konchigeri	**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)**	**Low (<10 ppm)**	**Low (< 0.5 ppm)**	**Sufficient (>4.5 ppm)**	**Sufficient (> 1.0 ppm)**	**Sufficient (> 0.2 ppm)**	**Deficient (< 0.6 ppm)**
Konchigeri	**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)**	**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	**85**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Konchigeri	**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)**	**Low (<10 ppm)**	**Low (< 0.5 ppm)**	**Sufficient (>4.5 ppm)**	**Sufficient (> 1.0 ppm)**	**Sufficient (> 0.2 ppm)**	**Deficient (< 0.6 ppm)**
Konchigeri	**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)**	**Low (<10 ppm)**	**Low (< 0.5 ppm)**	**Sufficient (>4.5 ppm)**	**Sufficient (> 1.0 ppm)**	**Sufficient (> 0.2 ppm)**	**Deficient (< 0.6 ppm)**
Konchigeri	**88**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Konchigeri	**89**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Konchigeri	**90**	**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	**91**	**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)**
Konchigeri	**92**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Konchigeri	**93**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Konchigeri	**94**	**Very strongly alkaline (pH > 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Konchigeri	**95**	**Very strongly alkaline (pH > 9.0)**	**Non saline (<2 dsm)**	**Low (< 0.5 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Konchigeri	**96**	**Very strongly alkaline (pH > 9.0)**	**Non saline (<2 dsm)**	**Low (< 0.5 %)**	**Low (< 23 kg/ha)**	**High (> 337 kg/ha)**	**Low (<10 ppm)**	**Medium (0.5 – 1.0 ppm)**	**Sufficient (>4.5 ppm)**	**Sufficient (> 1.0 ppm)**	**Sufficient (> 0.2 ppm)**	**Deficient (< 0.6 ppm)**
Konchigeri	**97**	**Very strongly alkaline (pH > 9.0)**	**Non saline (<2 dsm)**	**Low (< 0.5 %)**	**Low (< 23 kg/ha)**	**High (> 337 kg/ha)**	**Medium (10 – 20 ppm)**	**Medium (0.5 – 1.0 ppm)**	**Sufficient (>4.5 ppm)**	**Sufficient (> 1.0 ppm)**	**Sufficient (> 0.2 ppm)**	**Deficient (< 0.6 ppm)**
Konchigeri	**98**	**Very strongly alkaline (pH > 9.0)**	**Non saline (<2 dsm)**	**Low (< 0.5 %)**	**Low (< 23 kg/ha)**	**High (> 337 kg/ha)**	**Medium (10 – 20 ppm)**	**Medium (0.5 – 1.0 ppm)**	**Sufficient (>4.5 ppm)**	**Sufficient (> 1.0 ppm)**	**Sufficient (> 0.2 ppm)**	**Deficient (< 0.6 ppm)**
Konchigeri	**99**	**Very strongly alkaline (pH > 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)**

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
Konchigeri	104	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	105	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	109	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)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	110	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	111	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 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)
Konchigeri	112	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)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	114	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	115	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	116	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	High (> 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)
Konchigeri	117	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	118	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	119	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	120	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	121	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	122	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	123	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	124	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Konchigeri	126	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Alagilawada	49	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)

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
Bijjura	**1**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**Medium (145 – 337 kg/ha)**	**Low (<10 ppm)**	**Low (< 0.5 ppm)**	**Sufficient (>4.5 ppm)**	**Sufficient (> 1.0 ppm)**	**Sufficient (> 0.2 ppm)**	**Deficient (< 0.6 ppm)**
Bijjura	**2**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Bijjura	**3**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Bijjura	**4**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Bijjura	**5**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Bijjura	**6**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Bijjura	**7**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Bijjura	**8**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Bijjura	**9**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Bijjura	**10**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Bijjura	**11**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Bijjura	**12**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Bijjura	**13**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Bijjura	**14**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**Medium (145 – 337 kg/ha)**	**Low (<10 ppm)**	**Low (< 0.5 ppm)**	**Sufficient (>4.5 ppm)**	**Sufficient (> 1.0 ppm)**	**Sufficient (> 0.2 ppm)**	**Deficient (< 0.6 ppm)**
Bijjura	**15**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**Medium (145 – 337 kg/ha)**	**Low (<10 ppm)**	**Low (< 0.5 ppm)**	**Sufficient (>4.5 ppm)**	**Sufficient (> 1.0 ppm)**	**Sufficient (> 0.2 ppm)**	**Deficient (< 0.6 ppm)**
Bijjura	**16**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**High (> 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)**
Bijjura	**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)**	**Low (<10 ppm)**	**Low (< 0.5 ppm)**	**Sufficient (>4.5 ppm)**	**Sufficient (> 1.0 ppm)**	**Sufficient (> 0.2 ppm)**	**Deficient (< 0.6 ppm)**
Bijjura	**18**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**Medium (145 – 337 kg/ha)**	**Low (<10 ppm)**	**Low (< 0.5 ppm)**	**Sufficient (>4.5 ppm)**	**Sufficient (> 1.0 ppm)**	**Sufficient (> 0.2 ppm)**	**Deficient (< 0.6 ppm)**
Bijjura	**43**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**Medium (145 – 337 kg/ha)**	**Low (<10 ppm)**	**Low (< 0.5 ppm)**	**Sufficient (>4.5 ppm)**	**Sufficient (> 1.0 ppm)**	**Sufficient (> 0.2 ppm)**	**Deficient (< 0.6 ppm)**
Bijjura	**53**	**Strongly alkaline (pH 8.4 – 9.0)**	**Non saline (<2 dsm)**	**Medium (0.5 – 0.75 %)**	**Low (< 23 kg/ha)**	**Medium (145 – 337 kg/ha)**	**Low (<10 ppm)**	**Low (< 0.5 ppm)**	**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	Groundnut	Sunflower	Cotton	Tomato	Onion	Chilly	Guava	Mango	Sapota	Jackfruit	Jamun	Musambi	Lime	Cashew	Custard apple	Amla	Tamarind	Pomegranate	Banana	Mari-gold	Chrysanthemum
Konchigeri	35	S2z	S2rz	S2z	S3tz	S3rz	S2rz	S3zt	S3zt	S2t	S3zt	Nrz	S3tz	S3tz	S3zt	Nrz	S3z	Nt	S3z	S3z	Nrz	S3rz	S3rz	S2rt	S2rt
Konchigeri	36	S2z	S2rz	S2z	S3tz	S3rz	S2rz	S3zt	S3zt	S2t	S3zt	Nrz	S3tz	S3tz	S3zt	Nrz	S3z	Nt	S3z	S3z	Nrz	S3rz	S3rz	S2rt	S2rt
Konchigeri	38	S2zg	S3tz	S2zg	S3tz	S2zg	S2zg	S3zg	S3zg	S2zg	S2zg	S2tz	S3tz	S3tz	S2tz	S2zg	S2zg	Ntz	S2zg	S2zg	S2tz	S2tz	S2tz	S2tz	S2tz
Konchigeri	39	S2zg	S3tz	S2zg	S3tz	S2zg	S2zg	S3zg	S3zg	S2zg	S2zg	S2tz	S3tz	S3tz	S2tz	S2zg	S2zg	Ntz	S2zg	S2zg	S2tz	S2tz	S2tz	S2tz	S2tz
Konchigeri	40	S1	S3t	S1	S3t	S2r	S1	S2t	S2t	S1	S3t	S3rt	S3rt	S3t	S3rt	S2r	S2r	Nt	S1	S2r	S3rt	S2rt	S2rt	S2t	S2t
Konchigeri	41	S2z	S2z	S2z	S3tz	S2z	S2z	S3zt	S3zt	S2z	S3zt	S2rz	S3tz	S3tz	S3zt	S2z	S2z	Ntz	S2z	S2z	S2z	S3tz	S2tz	S2zt	S2zt
Konchigeri	45	S2z	S2z	S2z	S3tz	S2z	S2z	S3zt	S3zt	S2z	S3zt	S2rz	S3tz	S3tz	S3zt	S2z	S2z	Ntz	S2z	S2z	S2z	S3tz	S2tz	S2zt	S2zt
Konchigeri	46	S1	S3t	S1	S3t	S1	S1	S2t	S2t	S1	S3t	S2rt	S3t	S3t	S2t	S1	S1	Nt	S1	S1	S2t	S2rt	S2rt	S2t	S2t
Konchigeri	47	S1	S3t	S1	S3t	S1	S1	S2t	S2t	S1	S3t	S2rt	S3t	S3t	S2t	S1	S1	Nt	S1	S1	S2t	S2rt	S2rt	S2t	S2t
Konchigeri	48	S1	S3t	S1	S3t	S1	S1	S2t	S2t	S1	S3t	S2rt	S3t	S3t	S2t	S1	S1	Nt	S1	S1	S2t	S2rt	S2rt	S2t	S2t
Konchigeri	49	S2z	S2z	S2z	S3tz	S2z	S2z	S3zt	S3zt	S2z	S3zt	S2rz	S3tz	S3tz	S3zt	S2z	S2z	Ntz	S2z	S2z	S2z	S3tz	S2tz	S2zt	S2zt
Konchigeri	50	S2z	S3tz	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S2z	S2tz	S3tz	S3tz	S2tz	S2z	S2z	Ntz	S2z	S2z	S2tz	S2tz	S2tz	S2tz	S2tz
Konchigeri	51	S2z	S2z	S2z	S3tz	S2z	S2z	S3zt	S3zt	S2z	S3zt	S2rz	S3tz	S3tz	S3zt	S2z	S2z	Ntz	S2z	S2z	S2z	S3tz	S2tz	S2zt	S2zt
Konchigeri	52	S1	S3t	S1	S3t	S2r	S1	S2t	S2t	S1	S3t	S3rt	S3rt	S3t	S3rt	S2r	S2r	Nt	S1	S2r	S3rt	S2rt	S2rt	S2t	S2t
Konchigeri	53	S2z	S3tz	S2z	S3tz	S2z	S2z	S3tz	S3tz	S2z	S2z	S2tz	S3tz	S3tz	S2tz	S2z	S2z	Ntz	S2z	S2z	S2tz	S2tz	S2tz	S2tz	S2tz
Konchigeri	54	S1	S3t	S1	S3t	S2r	S1	S2t	S2t	S1	S3t	S3rt	S3rt	S3t	S3rt	S2r	S2r	Nt	S1	S2r	S3rt	S2rt	S2rt	S2t	S2t
Konchigeri	55	S1	S3t	S1	S3t	S2r	S1	S2t	S2t	S1	S3t	S3rt	S3rt	S3t	S3rt	S2r	S2r	Nt	S1	S2r	S3rt	S2rt	S2rt	S2t	S2t
Konchigeri	56	S1	S3t	S1	S3t	S2r	S1	S2t	S2t	S1	S3t	S3rt	S3rt	S3t	S3rt	S2r	S2r	Nt	S1	S2r	S3rt	S2rt	S2rt	S2t	S2t
Konchigeri	57	S1	S3t	S1	S3t	S2r	S1	S2t	S2t	S1	S3t	S3rt	S3rt	S3t	S3rt	S2r	S2r	Nt	S1	S2r	S3rt	S2rt	S2rt	S2t	S2t
Konchigeri	58	S1	S3t	S1	S3t	S1	S1	S2t	S2t	S1	S3t	S2rt	S3t	S3t	S2t	S1	S1	Nt	S1	S1	S2t	S2rt	S2t	S2t	S2t
Konchigeri	59	S1	S3t	S1	S3t	S2r	S1	S2t	S2t	S1	S3t	S3rt	S3rt	S3t	S3rt	S2r	S2r	Nt	S1	S2r	S3rt	S2rt	S2rt	S2t	S2t
Konchigeri	60	S1	S3t	S1	S3t	S2r	S1	S2t	S2t	S1	S3t	S3rt	S3rt	S3t	S3rt	S2r	S2r	Nt	S1	S2r	S3rt	S2rt	S2rt	S2t	S2t
Konchigeri	61	S1	S3t	S1	S3t	S1	S1	S2t	S2t	S1	S3t	S2rt	S3t	S3t	S2t	S1	S1	Nt	S1	S1	S2t	S2rt	S2t	S2t	S2t
Konchigeri	63	S1	S3t	S1	S3t	S2r	S1	S2t	S2t	S1	S3t	S3rt	S3rt	S3t	S3rt	S2r	S2r	Nt	S1	S2r	S3rt	S2rt	S2rt	S2t	S2t
Konchigeri	64	S1	S3t	S1	S3t	S2r	S1	S2t	S2t	S1	S3t	S3rt	S3rt	S3t	S3rt	S2r	S2r	Nt	S1	S2r	S3rt	S2rt	S2rt	S2t	S2t
Konchigeri	65	S1	S3t	S1	S3t	S2r	S1	S2t	S2t	S1	S3t	S3rt	S3rt	S3t	S3rt	S2r	S2r	Nt	S1	S2r	S3rt	S2rt	S2rt	S2t	S2t
Konchigeri	66	S1	S3t	S1	S3t	S2r	S1	S2t	S2t	S1	S3t	S3rt	S3rt	S3t	S3rt	S2r	S2r	Nt	S1	S2r	S3rt	S2rt	S2rt	S2t	S2t
Konchigeri	67	S1	S3t	S1	S3t	S1	S1	S2t	S2t	S1	S3t	S2rt	S3t	S3t	S2t	S1	S1	Nt	S1	S1	S2t	S2rt	S2t	S2t	S2t

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	Mari-gold	Chrysanthemum
Konchigeri	73	S3r	S3tr	S2gr	S3gt	Nr	S3r	S3tg	S3tg	S3gr	Nrg	Nr	Nr	Nrg	Nr	Nr	Nr	Nr	Nr	S3r	Nr	Nr	Nrt	S3r	S3r
Konchigeri	74	S3z	S3tz	S2zg	S3tz	S3zg	S2rg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Konchigeri	75	S3z	S3tz	S2zg	S3tz	S3zg	S2rg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Konchigeri	76	S3z	S3tz	S2zg	S3tz	S3zg	S2rg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Konchigeri	77	S3z	S3tz	S2zg	S3tz	S3zg	S2rg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Konchigeri	78	S3z	S3tz	S2zg	S3tz	S3zg	S2rg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Konchigeri	79	S3rg	S3rg	S2rt	S3rg	Nrg	S3rg	S3rg	S3rg	S3rg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	S3rg	S3rg	Nr	Nrg	Nrg	S3rg	S3rg
Konchigeri	80	S3rg	S3rg	S2rt	S3rg	Nrg	S3rg	S3rg	S3rg	S3rg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	S3rg	S3rg	Nr	Nrg	Nrg	S3rg	S3rg
Konchigeri	81	S1	S3gt	S2gr	S3gt	S2rg	S3rg	S3tz	S3tz	S2z	S3t	S3rt	S3t	S3t	S3t	S2r	S2g	Nt	S2g	S2rg	S2t	S2rt	S2rt	S2tg	S2tg
Konchigeri	82	S1	S3gt	S2gr	S3gt	S2rg	S3rg	S3tz	S3tz	S2z	S3t	S3rt	S3t	S3t	S3t	S2r	S2g	Nt	S2g	S2rg	S2t	S2rt	S2rt	S2tg	S2tg
Konchigeri	83	S1	S3gt	S2gr	S3gt	S2rg	S3rg	S3tz	S3tz	S2z	S3t	S3rt	S3t	S3t	S3t	S2r	S2g	Nt	S2g	S2rg	S2t	S2rt	S2rt	S2tg	S2tg
Konchigeri	84	S1	S3t	S1	S3t	S2r	S1	S3tz	S3tz	S2z	S3t	S2rt	S3t	S3t	S3rt	S1	S2r	Nt	S1	S2r	S2t	S2rt	S2rt	S2t	S2t
Konchigeri	85	S1	S3t	S1	S3t	S2r	S1	S3tz	S3tz	S2z	S3t	S2rt	S3t	S3t	S3rt	S1	S2r	Nt	S1	S2r	S2t	S2rt	S2rt	S2t	S2t
Konchigeri	86	S1	S3gt	S2gr	S3gt	S2rg	S3rg	S3tz	S3tz	S2z	S3t	S3rt	S3t	S3t	S3t	S2r	S2g	Nt	S2g	S2rg	S2t	S2rt	S2rt	S2tg	S2tg
Konchigeri	87	S1	S3gt	S2gr	S3gt	S2rg	S3rg	S3tz	S3tz	S2z	S3t	S3rt	S3t	S3t	S3t	S2r	S2g	Nt	S2g	S2rg	S2t	S2rt	S2rt	S2tg	S2tg
Konchigeri	88	S1	S3gt	S2gr	S3gt	S2rg	S3rg	S3tz	S3tz	S2z	S3t	S3rt	S3t	S3t	S3t	S2r	S2g	Nt	S2g	S2rg	S2t	S2rt	S2rt	S2tg	S2tg
Konchigeri	89	S3rg	S3rg	S2rt	S3rg	Nrg	S3rg	S3rg	S3rg	S3rg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	S3rg	S3rg	Nr	Nrg	Nrg	S3rg	S3rg
Konchigeri	90	S3rg	S3rg	S2rt	S3rg	Nrg	S3rg	S3rg	S3rg	S3rg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	Nrg	S3rg	S3rg	Nr	Nrg	Nrg	S3rg	S3rg
Konchigeri	91	S3z	S3tz	S2zg	S3tz	S3zg	S2rg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Konchigeri	92	S3z	S3tz	S2zg	S3tz	S3zg	S2rg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Konchigeri	93	S3z	S3tz	S2zg	S3tz	S3zg	S2rg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Konchigeri	94	S1	S3t	S1	S3t	S2r	S1	S2t	S2t	S1	S3t	S3rt	S3rt	S3t	S3rt	S2r	S2r	Nt	S1	S2r	S3rt	S2rt	S2rt	S2t	S2t
Konchigeri	95	S1	S3t	S1	S3t	S2r	S1	S2t	S2t	S1	S3t	S3rt	S3rt	S3t	S3rt	S2r	S2r	Nt	S1	S2r	S3rt	S2rt	S2rt	S2t	S2t
Konchigeri	96	S2zg	S3tz	S2zg	S3tz	S2zg	S2zg	S3zg	S3zg	S2zg	S2zg	S2tz	S3tz	S3tz	S2tz	S2zg	S2zg	Ntz	S2zg	S2zg	S2tz	S2tz	S2tz	S2tz	S2tz
Konchigeri	97	S2zg	S3tz	S2zg	S3tz	S2zg	S2zg	S3zg	S3zg	S2zg	S2zg	S2tz	S3tz	S3tz	S2tz	S2zg	S2zg	Ntz	S2zg	S2zg	S2tz	S2tz	S2tz	S2tz	S2tz
Konchigeri	98	S2zg	S3tz	S2zg	S3tz	S2zg	S2zg	S3zg	S3zg	S2zg	S2zg	S2tz	S3tz	S3tz	S2tz	S2zg	S2zg	Ntz	S2zg	S2zg	S2tz	S2tz	S2tz	S2tz	S2tz
Konchigeri	99	S2zg	S3tz	S2zg	S3tz	S2zg	S2zg	S3zg	S3zg	S2zg	S2zg	S2tz	S3tz	S3tz	S2tz	S2zg	S2zg	Ntz	S2zg	S2zg	S2tz	S2tz	S2tz	S2tz	S2tz
Konchigeri	104	S2z	S2rz	S2z	S3tz	S3rz	S2rz	S3zt	S3zt	S2t	S3zt	Nrz	S3tz	S3tz	S3zt	Nrz	S3z	Nt	S3z	S3z	Nrz	S3rz	S3rz	S2rt	S2rt

VILLAGE	Sur vey No.	Sorghum	Mai ze	Bengal gram	Gro und-nut	Sun flowe r	Cott on	Tom ato	Oni on	Chilly	Guava	Mango	Sapo ta	Jackf ruit	Jam un	Musa mbi	Lime	Cas hew	Cust ard apple	Amla	Tam arin d	Pomeg ranate	Ban ana	Mar i-gold	Chrysa nthem um
Konchigeri	105	Ng	Ng	Ng	S2gr	Ng	S2rg	S2g	S2g	S2g	Ng	Ng	S2g	S2g	Ng	Ng	Ng	Ng	S3g	S3rg	Ng	S3gr	S3gr	S2g	S2g
Konchigeri	109	Ng	Ng	Ng	S2gr	Ng	S2rg	S2g	S2g	S2g	Ng	Ng	S2g	S2g	Ng	Ng	Ng	Ng	S3g	S3rg	Ng	S3gr	S3gr	S2g	S2g
Konchigeri	110	Ng	Ng	Ng	S2gr	Ng	S2rg	S2g	S2g	S2g	Ng	Ng	S2g	S2g	Ng	Ng	Ng	Ng	S3g	S3rg	Ng	S3gr	S3gr	S2g	S2g
Konchigeri	111	Ng	Ng	Ng	S2gr	Ng	S2rg	S2g	S2g	S2g	Ng	Ng	S2g	S2g	Ng	Ng	Ng	Ng	S3g	S3rg	Ng	S3gr	S3gr	S2g	S2g
Konchigeri	112	S2z	S2z	S2z	S3tz	S2z	S2z	S3zt	S3zt	S2z	S3zt	S2rz	S3tz	S3tz	S3zt	S2z	S2z	Ntz	S2z	S2z	S2z	S3rz	S2tz	S2tz	S2tz
Konchigeri	114	S1	S3t	S1	S3t	S2r	S1	S2t	S2t	S1	S3t	S3rt	S3rt	S3t	S3rt	S2r	S2r	Nt	S1	S2r	S3rt	S2rt	S2rt	S2t	S2t
Konchigeri	115	S1	S3t	S1	S3t	S2r	S1	S2t	S2t	S1	S3t	S3rt	S3rt	S3t	S3rt	S2r	S2r	Nt	S1	S2r	S3rt	S2rt	S2rt	S2t	S2t
Konchigeri	116	Ng	Ng	Ng	S2gr	Ng	S2rg	S2g	S2g	S2g	Ng	Ng	S2g	S2g	Ng	Ng	Ng	Ng	S3g	S3rg	Ng	S3gr	S3gr	S2g	S2g
Konchigeri	117	S1	S3t	S1	S3t	S2r	S1	S2t	S2t	S1	S3t	S3rt	S3rt	S3t	S3rt	S2r	S2r	Nt	S1	S2r	S3rt	S2rt	S2rt	S2t	S2t
Konchigeri	118	S3z	S3tz	S2zg	S3tz	S3zg	S2rg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Konchigeri	119	S3z	S3tz	S2zg	S3tz	S3zg	S2rg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Konchigeri	120	S1	S3t	S1	S3t	S2r	S1	S3tz	S3tz	S2z	S3t	S2rt	S3t	S3t	S3rt	S1	S2r	Nt	S1	S2r	S2t	S2rt	S2rt	S2t	S2t
Konchigeri	121	S3z	S3tz	S2zg	S3tz	S3zg	S2rg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Konchigeri	122	S1	S3t	S1	S3t	S2r	S1	S3tz	S3tz	S2z	S3t	S2rt	S3t	S3t	S3rt	S1	S2r	Nt	S1	S2r	S2t	S2rt	S2rt	S2t	S2t
Konchigeri	123	S3z	S3tz	S2zg	S3tz	S3zg	S2rg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Konchigeri	124	S3z	S3tz	S2zg	S3tz	S3zg	S2rg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Konchigeri	125	S3z	S3tz	S2zg	S3tz	S3zg	S2rg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Konchigeri	126	S3r	S3r	S2rt	S3r	Nr	S3r	S3r	S3r	S3r	Nr	Nr	Nr	Nr	Nr	Nr	Nr	Nr	S3r	S3r	Nr	Nr	Nr	S3r	S3r
Alagilawa da	49	S3r	S3tr	S2gr	S3gt	Nr	S3r	S3tg	S3tg	S3gr	Nrg	Nr	Nr	Nrg	Nr	Nr	Nr	Nr	Nr	S3r	Nr	Nr	Nrt	S3r	S3r
Bijjura	1	S3z	S3tz	S2zg	S3tz	S3zg	S3Zg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Bijjura	2	S3z	S3tz	S2zg	S3tz	S3zg	S3Zg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Bijjura	3	S3z	S3tz	S2zg	S3tz	S3zg	S3Zg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Bijjura	4	S3z	S3tz	S2zg	S3tz	S3zg	S3Zg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Bijjura	5	S3z	S3tz	S2zg	S3tz	S3zg	S3Zg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Bijjura	6	S3z	S3tz	S2zg	S3tz	S3zg	S3Zg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Bijjura	7	S3z	S3tz	S2zg	S3tz	S3zg	S2rg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz
Bijjura	8	S1	S3t	S1	S3t	S2r	S1	S3tz	S3tz	S2z	S3t	S2rt	S3t	S3t	S3rt	S1	S2r	Nt	S1	S2r	S2t	S2rt	S2rt	S2t	S2t
Bijjura	9	S3z	S3tz	S2zg	S3tz	S3zg	S2rg	S3zg	S3zg	S2zg	S3zt	Nrz	S3rz	S3tz	S3rz	S3rz	S3z	Nzt	S3zg	S3zg	Nrz	S3tz	S3tz	S2tz	S2tz

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	Mari-gold	Chrysanthemum
Bijjura	**10**	**S3z**	**S3tz**	**S2zg**	**S3tz**	**S3zg**	**S2rg**	**S3zg**	**S3zg**	**S2zg**	**S3zt**	**Nrz**	**S3rz**	**S3tz**	**S3rz**	**S3rz**	**S3z**	**Nzt**	**S3zg**	**S3zg**	**Nrz**	**S3tz**	**S3tz**	**S2tz**	**S2tz**
Bijjura	**11**	**S3z**	**S3tz**	**S2zg**	**S3tz**	**S3zg**	**S2rg**	**S3zg**	**S3zg**	**S2zg**	**S3zt**	**Nrz**	**S3rz**	**S3tz**	**S3rz**	**S3rz**	**S3z**	**Nzt**	**S3zg**	**S3zg**	**Nrz**	**S3tz**	**S3tz**	**S2tz**	**S2tz**
Bijjura	**12**	**S3z**	**S3tz**	**S2zg**	**S3tz**	**S3zg**	**S2rg**	**S3zg**	**S3zg**	**S2zg**	**S3zt**	**Nrz**	**S3rz**	**S3tz**	**S3rz**	**S3rz**	**S3z**	**Nzt**	**S3zg**	**S3zg**	**Nrz**	**S3tz**	**S3tz**	**S2tz**	**S2tz**
Bijjura	**13**	**Nrg**	**Nrg**	**S3rg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**
Bijjura	**14**	**S3z**	**S3tz**	**S2zg**	**S3tz**	**S3zg**	**S2rg**	**S3zg**	**S3zg**	**S2zg**	**S3zt**	**Nrz**	**S3rz**	**S3tz**	**S3rz**	**S3rz**	**S3z**	**Nzt**	**S3zg**	**S3zg**	**Nrz**	**S3tz**	**S3tz**	**S2tz**	**S2tz**
Bijjura	**15**	**Nrg**	**Nrg**	**S3rg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**
Bijjura	**16**	**Nrg**	**Nrg**	**S3rg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**
Bijjura	**17**	**Nrg**	**Nrg**	**S3rg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**
Bijjura	**18**	**Nrg**	**Nrg**	**S3rg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**	**Nrg**
Bijjura	**43**	**S3r**	**S3r**	**S2rt**	**S3r**	**Nr**	**S3r**	**S3r**	**S3r**	**S3r**	**Nr**	**Nr**	**Nr**	**Nr**	**Nr**	**Nr**	**Nr**	**Nr**	**S3r**	**S3r**	**Nr**	**Nr**	**Nr**	**S3r**	**S3r**
Bijjura	**53**	**S3r**	**S3r**	**S2rt**	**S3r**	**Nr**	**S3r**	**S3r**	**S3r**	**S3r**	**Nr**	**Nr**	**Nr**	**Nr**	**Nr**	**Nr**	**Nr**	**Nr**	**S3r**	**S3r**	**Nr**	**Nr**	**Nr**	**S3r**	**S3r**

PART-B

SOCIO-ECONOMIC STATUS OF FARM HOUSEHOLDS

CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

EXECUTIVE SUMMARY

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

Methodology: *Bijjur-1 Micro-watershed (Kanakvad sub-watershed, Shirahatti taluk, Gadag district) is located in between $15^0 1'$ – $15^0 3'$ North latitudes and $75^0 37'$ – $75^0 40'$ East longitudes, covering an area of about 560 ha, bounded by Chiksavanur, Govankop, Hosur, Narayanapur and Nagarmaduvu 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 Bijjur-1 Microwatershed (Kanakvad sub-watershed, Shirahatti taluk, Gadag district are presented here.*

Social Indicators;

- *Male and female ratio is 58.6 to 41.4 per cent to the total sample population.*
- *Younger age 18 to 50 years group of population is around 50 per cent to the total population.*
- *Literacy population is around 77.6 per cent.*
- *Social groups belong to schedules caste (SC) is around 30 per cent.*
- *Fire wood is the major source of energy for a cooking among 80 per cent.*
- *About 50 per cent of households have a yashaswini health card.*
- *Majority of farm households (50 %) are having MGNREGA card for rural employment.*
- *Dependence on ration cards for food grains through public distribution system is around 90 per cent.*
- *Swachha bharath program providing closed toilet facilities around 80 per cent of sample households.*
- *Institutional participation is only 1.7 per cent of sample households.*
- *Rural migration to urban centre for employment is prevalent among 0.5 per cent of farm households.*
- *Women participation in decisions making for agriculture production among all sample households was found.*

Economic Indicators;

- *The average land holding is 1.7 ha indicates that majority of farm households are belong to small and medium farmers. The total cultivated land of dry land condition among the sample farmers.*
- *Agriculture is the main occupation among 9.5 per cent and agriculture is the main and non agriculture labour is subsidiary occupation for 59.9 per cent of sample households.*
- *The average value of domestic assets is around Rs.30526 per household. Mobile and television are popular mass media communication.*
- *The average value of farm assets is around Rs.81730 per household, about 60 per cent of sample farmers having plough and bullock cart.*
- *The average value of livestock is around Rs. 22800 per household; about 81.3 per cent of household are having livestock.*
- *The average per capita food consumption is around 766.3 grams (1601.8 kilo calories) against national institute of nutrition (NIN) recommendation at 827 gram. Around 80 per cent of sample households are consuming less than the NIN recommendation.*
- *The annual average income is around Rs.21480 per household. Among all sample farm households are below poverty line.*
- *The per capita monthly average expenditure is around Rs.961.*

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.1068 per ha/year. The total cost of annual soil nutrients is around Rs. 593586 per year for the total area of 560 ha.*
- *The average value of ecosystem service for food grain production is around Rs. 1075 ha/year. Per hectare food grains production services is maximum in maize (Rs. 3920) followed by sunflower (Rs. 3519), sorghum (Rs. 1654) and horse gram (Rs. 1615), cotton (Rs. 2564) and ground nut is negative returns.*
- *The average value of ecosystem service for fodder production is Rs. 1505 ha/year. Per hectare fodder production services is maximum in groundnut (Rs. 4940) followed by maize (Rs. 2142), sorghum (Rs. 1455) and horse gram (Rs. 494/).*
- *The data on water requirement for producing one quintal of grain is considered for estimating the total value of water required for crop production. The per hectare value of water used and value of water was maximum in cotton (Rs.69661) fallowed by maize (Rs. 20545), horse gram (Rs.15205), ground nut (Rs. 20614), sorghum (Rs. 28693) and sunflower (Rs. 27713).*

Economic Land Evaluation;

- *The major cropping pattern is followed by maize (61.3 %) fallowed by sorghum (17.6 %), sunflower (6.4 %), horse gram (6.3 %), cotton (4.2 %) and groundnut (4.2 %).*
- *In Bijjur-1 Microwatershed, major soil are soils of banded ferruginous quartzite landscape of Attikatti (AKT) series is having shallow soil depth cover around 8.6 % of area; on this soil farmers are presently growing maize (92.5 %) and groundnut (7.5 %). Yelisirunj (YSJ) is also having shallow soil depth cover around 5.9 % of area, the crops are sorghum. Venkatapur (VKP) soil series having moderately shallow soil depth cover around 25.6 % of areas, crops are maize. Jelligere (JLG) soil series having moderately deep soil depth cover around 16.6 % of area, crops are horse gram (41.6 %), maize (16.8 %) and sunflower (41.6 %). Varavi (VRV) soil series are having moderately deep soil depth cover around 13.8 % of area; the major crops grown are cotton (32.8 %), maize (18 %) and sorghum (49.2 %). Dhoni (DNI) soil series are having deep soil depth covers around 2.9 % of area, the major crop grown is maize. Kalasapur (KPR) soil series having deep soil depth cover 10.64 % of area; crops are sorghum.*
- *The total cost of cultivation and benefit cost ratio (BCR) in study area for maize ranges between Rs. 35712/ha in JLG soil (with BCR of 1.14) and Rs. 1339/ha in VKP soil (with BCR of 2.06).*
- *In sorghum the cost of cultivation range between Rs. 16589/ha in VRV soil (with of 1.13) and Rs.14829/ha in YSJ soil (with BCR of 1.22).*
- *In groundnut the cost of cultivation in AKT soil is Rs. 43872/ha (with BCR of 0.96).*
- *In horse gram the cost of cultivation in JLG soil Rs. 20615/ha (with BCR of 1.14).*
- *In sunflower the cost of cultivation in JLG soil is Rs.17064/ha (with BCR of 1.21) and cotton the cost of cultivation in VRV soil is Rs. 40661/ha (with BCR of 1.06).*
- *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 (70.5 to 84.8%), sorghum (64.8 to 68 %), groundnut (56.6 %), horse gram (49.4 %) and sunflower (49.4%).*

Chapter 2

INTRODUCTION

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

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

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

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

Objectives of the study

1. To characterize socio-economic status of farm households

2. To evaluate the economic viability of land use and land related constraints

3. To estimate the ecosystem service provided by the watershed and

4. To suggest alternatives for sustainable agriculture production.

Chapter 3

METHODOLOGY

Study area

Bijjur-1 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 grown. It's represents Agro Ecological Sub Region (AESR) 6.4 having LGP 150-180 days.

Bijjur-1 Microwatershed (Kanakvad sub-watershed, Shirahatti taluk, Gadag district) is located in between $15^0$1' – $15^0$3' North latitudes and $75^0$37' – $75^0$40' East longitudes, covering an area of about 560 ha, bounded by Chikasavanur, Govankop, Hosur, Narayanapur and Nagarmaduvu villages.

Sampling Procedure:

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

Sources of data and analysis:

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

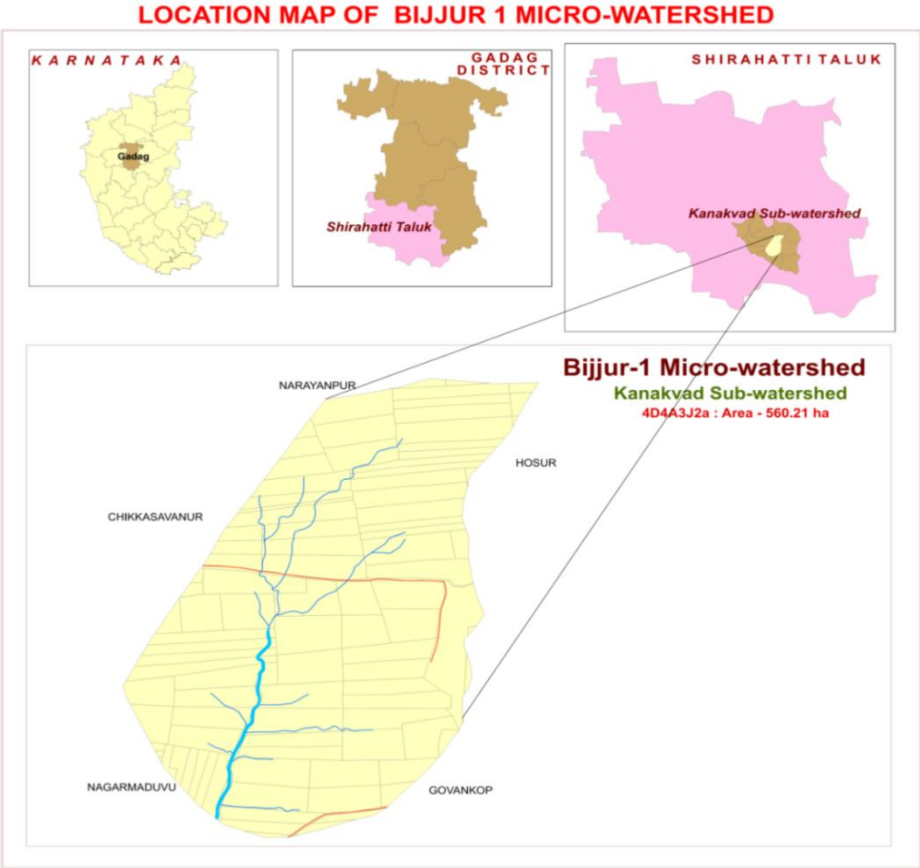


Figure 1: Location of study area

Steps followed in socio-economic assessment

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

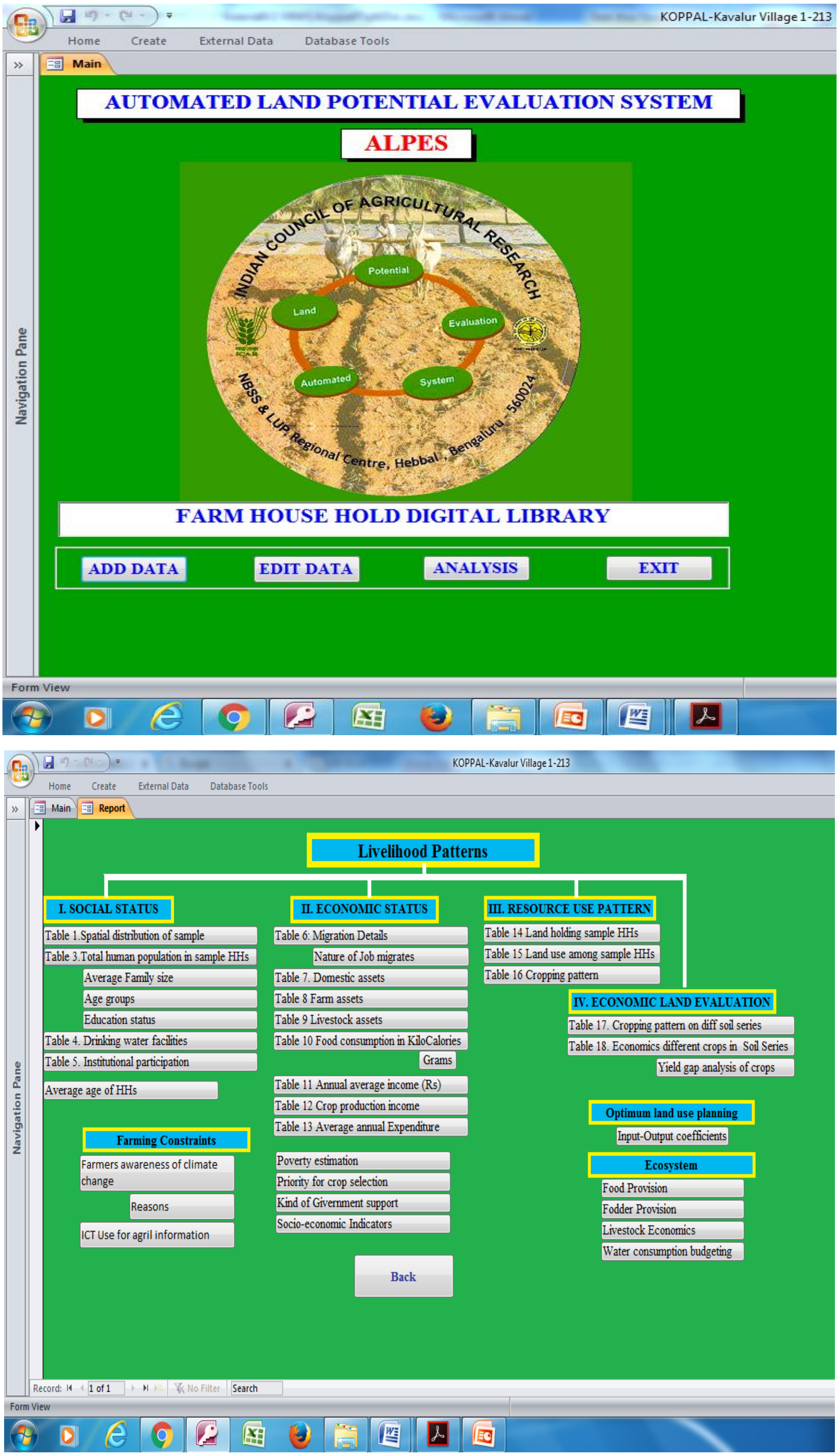


Figure 2: ALPES FRAMEWORK

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

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

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

Economic Valuation of Soil ecosystem services:

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

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

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

Chapter 4

RESULTS AND DISCUSSIONS

The demographic information shows that the household population dynamics encompasses the socioeconomic status of the farmer. For a rural family, the household size should be optimal to earn a comfortable livelihood through farm and non-farm wage earning. The total number of population in watershed area was 58, out of which 58.6 per cent were males and 41.4 per cent females. Average family size of the households is 5.8 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 (32.8%) followed by 0 to18year (29.3%), more than 50 years (20.7%) and 18 to 30 years (17.2%). Hence, in the study area in general, the respondents were of young and middle age, indicating thereby that the households had almost settled with whatever livelihood options they were practicing and sample respondents were young by age who could venture into various options of livelihood sources. Data on literacy indicated that 77.6 per cent of respondents were literate and 22.4 per cent illiterate (Table 1).

Table 1: Human population among sample households in Bijjur-1 Microwatershed

Particulars	**Units**	**Value**
Total human population in sample HHs	Number	58
Male	% to total Population	58.6
Female	% to total Population	41.4
Average family size	Number	5.8
Age group		
0 to 18 years	% to total Population	29.3
18 to 30 years	% to total Population	17.2
30 to 50 years	% to total Population	32.8
>50 years	% to total Population	20.7
Average age	Age in years	34.8
Education Status		
Illiterates	% to total Population	22.4
Literates	% to total Population	77.6
Primary School (<5 class)	% to total Population	12.1
Middle School (6- 8 class)	% to total Population	22.4
High School (9- 10 class)	% to total Population	24.1
Others	% to total Population	19.0

The ethnic groups among the sample farm households found to be 70.0 per cent belonging to other backward classes (OBC) (Table 2 and Figure 3). About 80.0 per cent of sample households are using fire wood and liquefied petroleum gas (20.0 %) as source of fuel for cooking. All the sample farmers are having electricity connection. About 50 per cent are sample households having health cards. Majority (50.0%) are having MGNREGA job cards for employment generation. About 10.0 per cent of farm households are having ration cards for taking food grains from public distribution system. About 80 per cent of farm households are having toilet facilities.

Table 2: Basic needs of sample households in Bijjur-1 Micro watershed

Particulars	Units	Value
Social groups		
ST	% of Households	30.0
OBC	% of Households	70.0
Types of fuel use for cooking		
Fire wood	% of Households	80.0
Gas	% of Households	20.0
Energy supply for home		
Electricity	% of Households	100.0
Number of households having Health card		
Yes	% of Households	50.0
No	% of Households	50.0
MGNREGA Card		
Yes	% of Households	50.0
No	% of Households	50.0
Ration Card		
Yes	% of Households	90.0
No	% of Households	10.0
Households with toilet		
Yes	% of Households	80.0
No	% of Households	20.0
Drinking water facilities		
Tube Well	% of Households	100

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

Only 1.7 per cent of the farmers are participating in community based organizations in village panchayat (Table 3).

Table 3: Institutional participation among the sample population in Bijjur-1 Micro watershed

Particulars	Units	Value
No. of people participating	% to total	1.7
Village panchayat	% of total	1.7
No. of people not participating	% to total	98.3

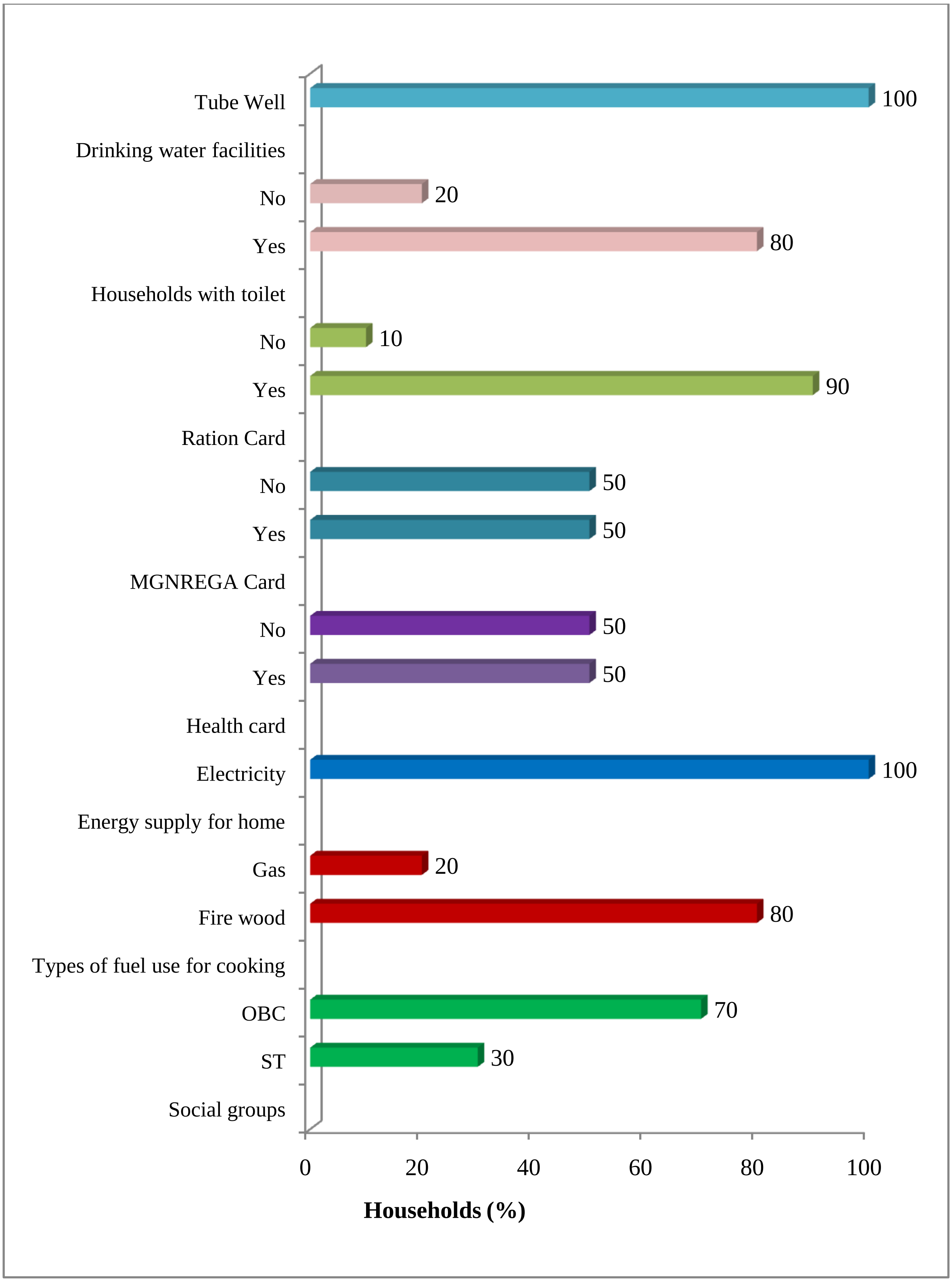


Figure 3: Basic needs of sample households in Bijjur-1 Microwatershed

The data on migration in Bijjur-1 Microwatershed is given in Table 4. It indicated that around 6.9 per cent of samples households were migrated. The average distance travelled for seeking employment is 450 km.

Table 4: Migration details among the sample households in Bijjur-1 Microwatershed

Particulars	Value
% of households showing migration	6.9
% of persons migrating	10.0
No. of months migrated in a year	8.0
Average Distance of migration(Km)	450.0
Nature of job (%)	
Job/wage/work	100.0

The occupational pattern (Table 5) among sample households shows that agriculture is the main occupation around 40.4 per cent of farmers followed by subsidiary occupations like agricultural labour (54.8%) and private service (4.8%).

Table 5: Occupational pattern in sample population in Bijjur-1 Microwatershed

Occupation		% to total
Main	Subsidiary	
Agriculture	Agriculture	40.4
	Agriculture labour	54.8
	Private service	4.8
Grand Total		100
Family labour availability		**Man days/month**
Male		45.00
Female		26.00
Total		71.00

The important assets especially with reference to domestic assets were analyzed and are given in Table 6 and Figure 4. The important domestic assets possessed by all categories of farmers are mobile phones (100%) followed by television (90.0 %), mixer/grinder (50.0 %), motorcycle (40.0 %), bicycle (100 %) and four wheeler (10.0 %). The average value of domestic assets is around Rs.30526 per households.

Table 6: Domestic assets among the sample households in Bijjur-1 Microwatershed

Particulars	% of households	Average value in Rs
Bicycle	10.0	3000
Four wheeler	10.0	120000
Mixer/grinder	50.0	3400
Mobile Phone	100.0	3400
Motorcycle	40.0	46250
Television	90.0	7111
Average Value	30526	

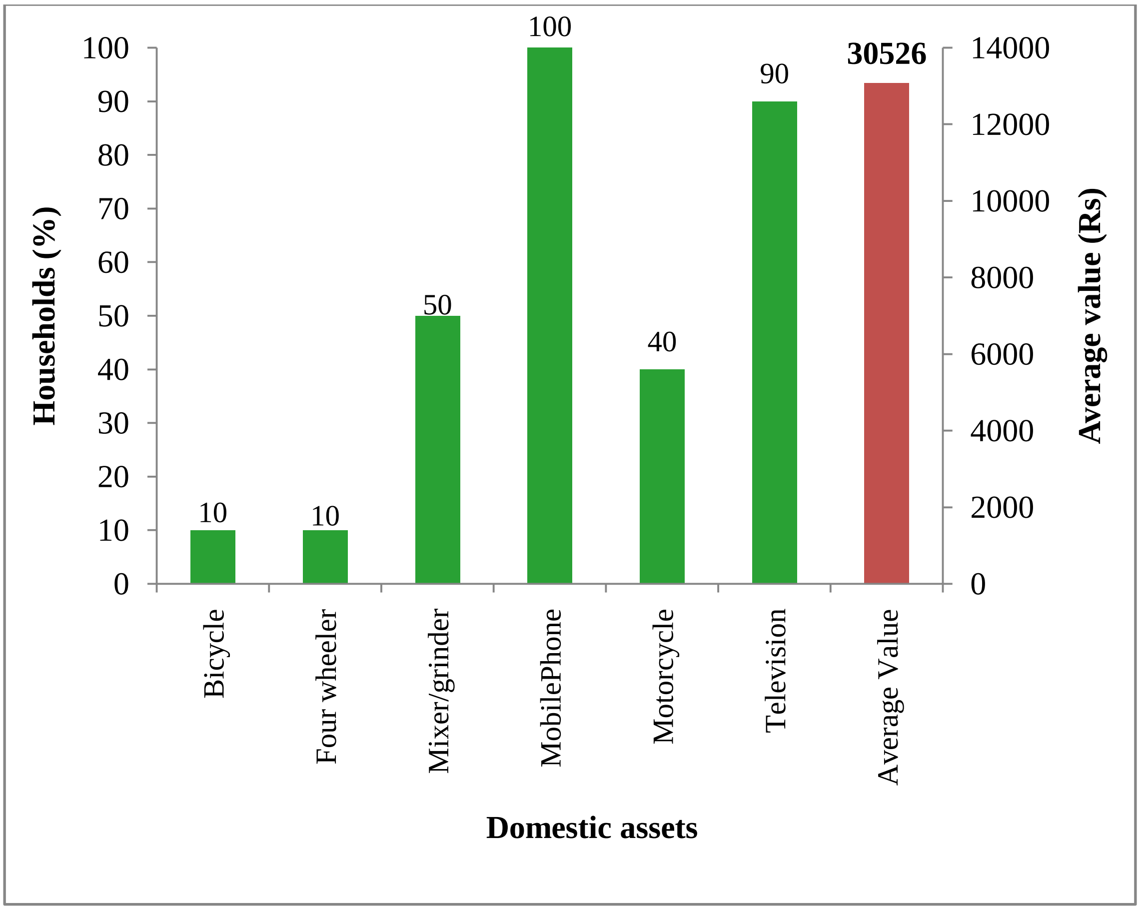


Figure 4: Domestic assets among the sample households in Bijjur-1 Microwatershed

The most popularly owned farm equipments were sickles, plough, cattle shed; pump sets, bullock cart, and sprayer. Plough and sickle were commonly present in all the sampled farmers; these were primary implements in agriculture. The per cent of households owned bullock cart (60.0 %), weeder (60.0 %), plough (50.0 %), seed cum fertilizer drill (40.0 %), sprayer (30.0 %), tractor (10.0 %) and power tiller (10.0 %) was found highest among the sample farmers. The average value of farm assets is around Rs. 81730 per households (Table 7 and Figure 4).

Table 7: Farm assets among samples households in Bijjur-1 Micro watershed

Particulars	% of households	Average value in Rs
Bullock cart	60.0	20167
Plough	60.0	2367
Power tiller	10.0	30000
Seed Cum fertiliser drill	40.0	14250
Sprayer	30.0	5000
Tractor	10.0	500000
Weeder	60.0	325
Average Value	81730	

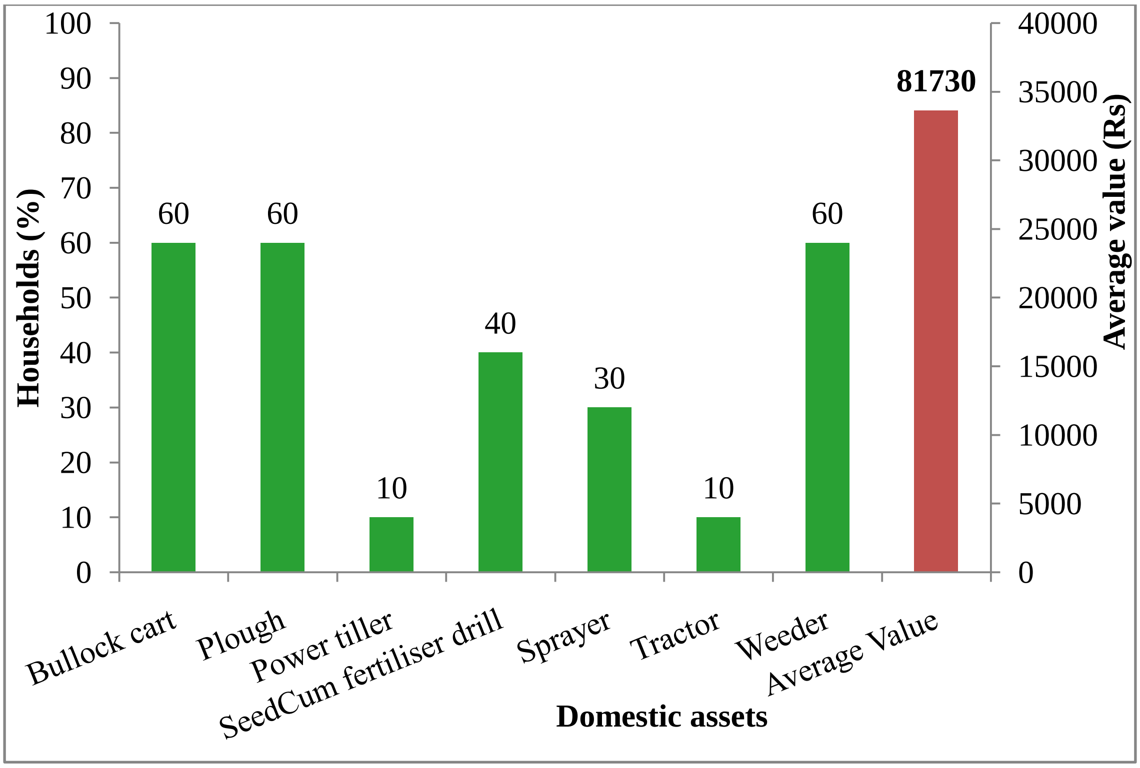


Figure 5: Farm assets among samples households in Bijjur-1 Microwatershed

Livestock is an integral component of the conventional farming systems (Table 8 and Figure 6). The highest livestock population is bullocks (38.5%), local milching cow (38.5%), local dry cow (7.7%), crossbred dry cow (7.7%) and sheep's (7.7%).The average livestock value was Rs. 22800 per household.

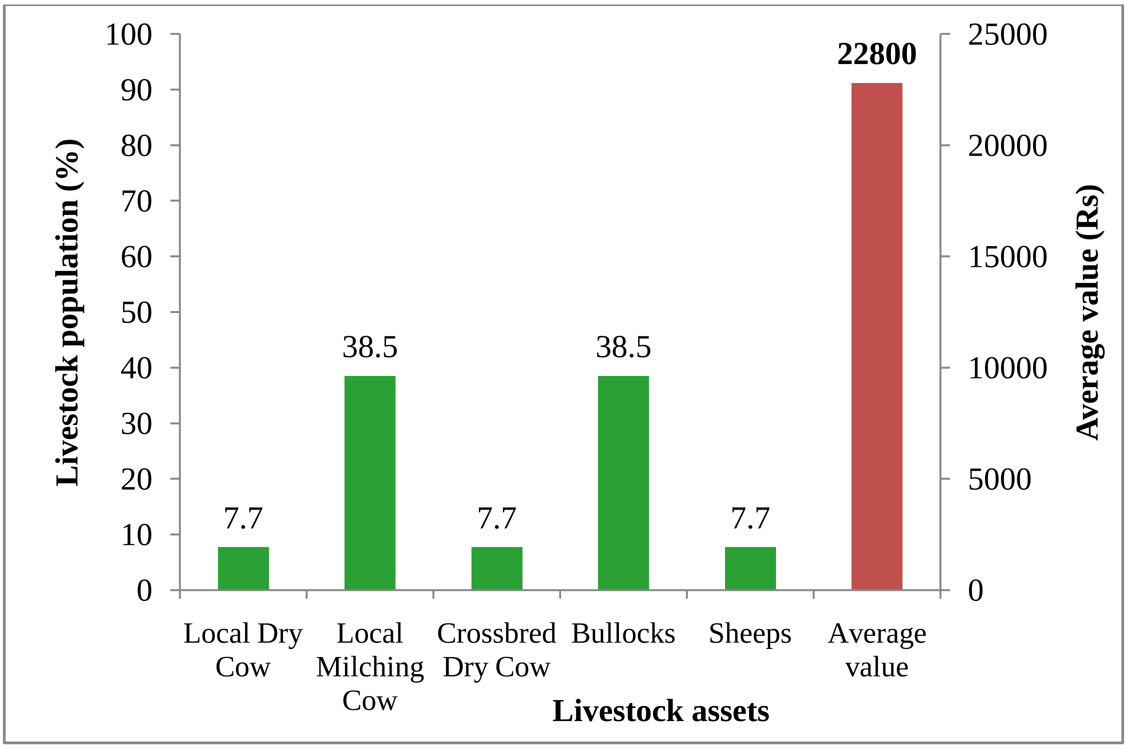


Figure 6: Livestock assets among sample households in Bijjur-1 Micro-watershed

Table 8: Livestock assets among sample households in Bijjur-1 Microwatershed

Particulars	% of livestock population	Average value in Rs
Local Dry Cow	7.7	10000
Local Milching Cow	38.5	18000
Crossbred Dry Cow	7.7	10000
Bullocks	38.5	71000
Sheeps	7.7	5000
Average value	22800	

Average milk produced in sample households is 360 litters/ annum. Among the farm households, maize, sorghum, horse gram and groundnut are the main crops for domestic food and fodder for animals. About 2165 kg /ha of average fodder is available per season for the livestock feeding (Table 9).

Table 9: Milk produced and fodder availability of sample households in Bijjur-1 Micro watershed

Particulars	
Name of the Livestock	**Ltr./Lactation/animal**
Local milching Cow	360
Fodder produces	**Fodder yield (kg/ha.)**
Maize	2651
Sorghum	1841
Groundnut	2500
Horse gram	1667
Average fodder availability	2165
Livestock having households (%)	81.3
Livestock population (Numbers)	23

A woman participation in decision making is in this micro-watershed is presented in Table 10. About 80 per cent of women earning for her family requirement and women taking decision in her family and agriculture related activities.

Table 10: Women empowerment of sample households in Bijjur-1 Microwatershed

% to Grand Total

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

The food intake in terms of kilo calorie (kcal) per person per day was calculated and presented in the Table 11 and Figure 7. More quantity of cereals is consumed by sample farmers which accounted for 938.9 kcal per person. The other important food items consumed was pulses 189.1 kcal followed by cooking oil 157.2 kcal, milk 98.9 kcal, vegetables 31.5 kcal, egg 163.3 kcal and meat 23 kcal. In the sampled households, farmers were consuming less (1601.8 kcal) than NIN- recommended food requirement (2250 kcal).

Table 11: Per capita daily consumption of food among the sample households in Bijjur-1 Micro watershed

Particulars	NIN recommendation (gram/ per day/ person)	Present level of consumption (gram/ per day/ person)	Kilo Calories /day/person
Cereals	396	276.1	938.9
Pulses	43	55.1	189.1
Milk	200	152.2	98.9
Vegetables	143	131.1	31.5
Cooking Oil	31	27.6	157.2
Egg	0.5	108.9	163.3
Meat	14.2	15.3	23.0
Total	**827.7**	**766.3**	**1601.8**
Threshold of NIN recommendation		827 gram*	2250 Kcal*
% Below NIN		70	80
% Above NIN		30	20

Note: * day/person

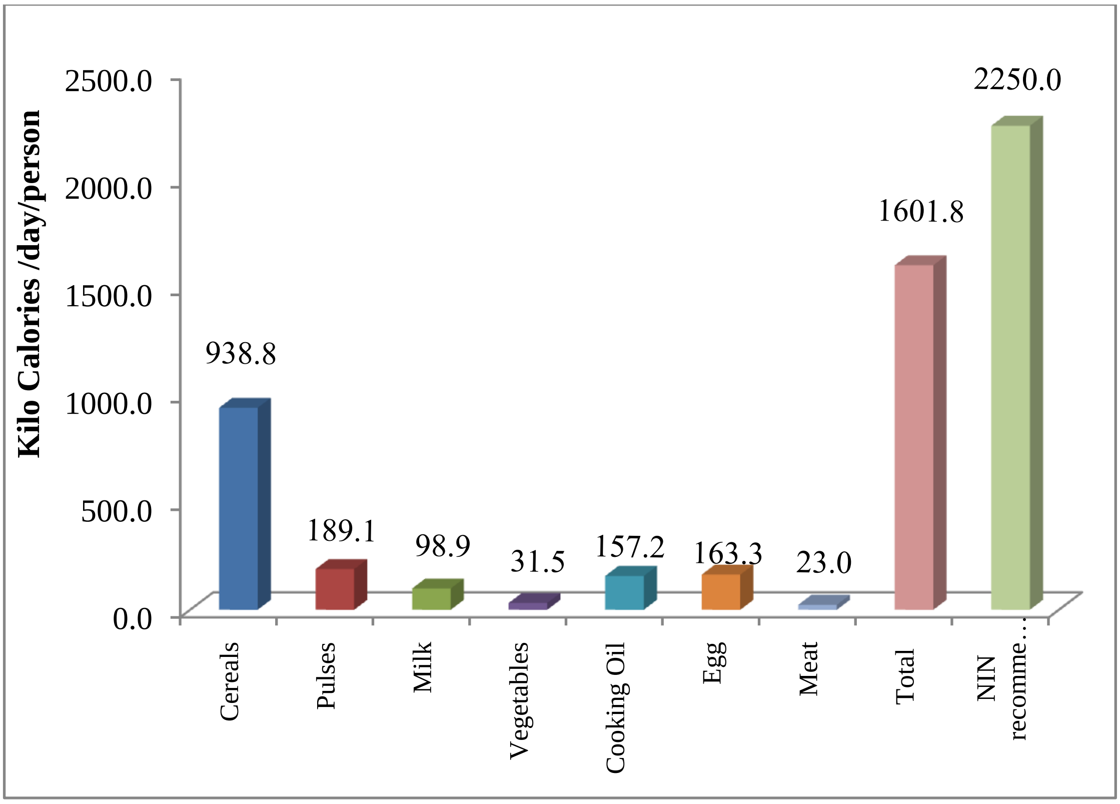


Figure 7: Per capita daily consumption of food among the sample households in Bijjur-1 Microwatershed

Annual income of the sample HHs: The total annual household income is around Rs 21480 Major source of income crop production income to the farmers in the study area is from (Rs. 10582) followed by non farm income (Rs. 7552), livestock income (Rs. 3346). The average monthly per capita income is Rs 308.63, which is less than the threshold monthly income of Rs 975 for considering below 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 12).

Table 12: Annual average income of HHs from various sources in Bijjur-1 Micro watershed

Particulars	Income *
Nonfarm income (Rs)	7552 (10)
Livestock income (Rs)	3346 (50)
Crop Production (Rs)	10582(100)
Total Annual Income (Rs)	***21480***
Average monthly per capita income (Rs)	308
Threshold for Poverty level (Rs 975 per month/person)	
% of households below poverty line	100
% of households above poverty line	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.46524) followed by education, clothing, social function and health. Now a day's education is most important among all of us. In today's competitive world, education is a necessity for man after food, clothing, and shelter. It is the only fundamental way by which a desired change in the society can happen. The average per capita monthly expenditure is around Rs 961 and about 10 per cent of farm households are below poverty line (Table 13 and Figure 8).

Table 13: Average annual expenditure of sample HHs in Bijjur-1 Microwatershed

Particulars	Value in Rupees	Per cent
Food	46524	69.6
Education	6350	9.5
Clothing	4740	7.1
Social functions	3150	4.7
Health	6100	9.1
Total Expenditure (Rs/year)	66864	100.0
Monthly per capita expenditure (Rs)	961	

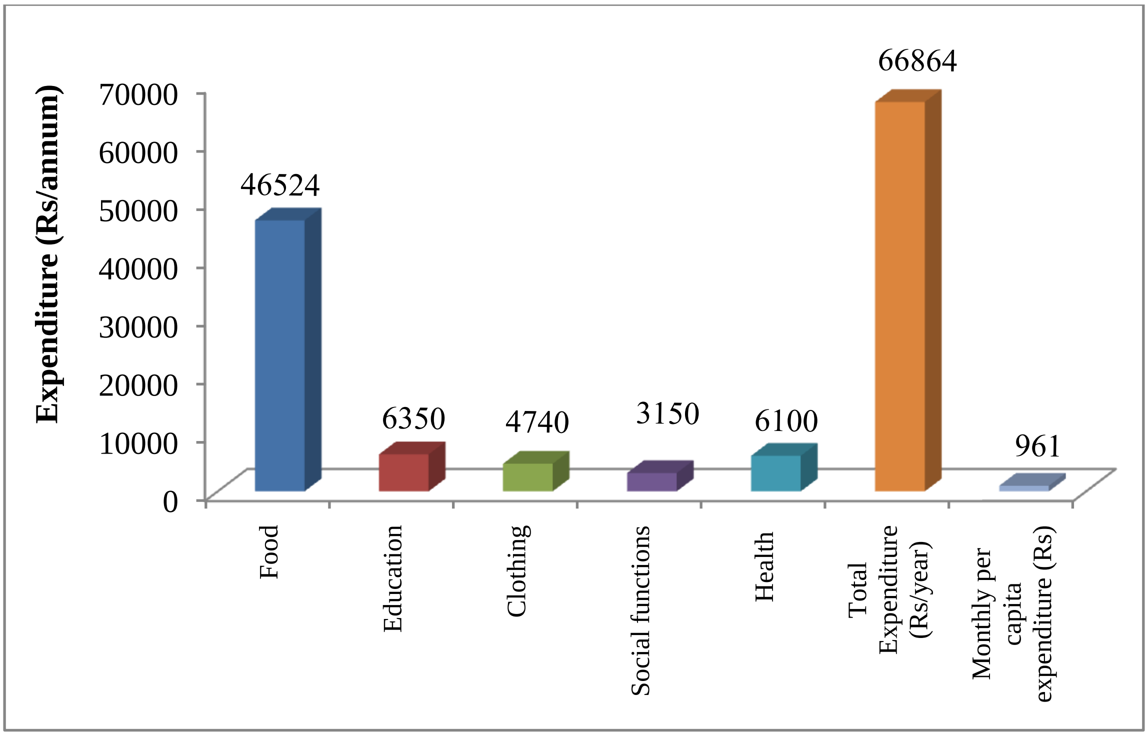


Figure 8: Average annual expenditure of sample HHs in Bijjur-1 Micro watershed

Land holding: Total area cultivated by them is 16.8 ha. The average land holding of sample HHs is 1.7 ha. Large number of sample HHs (70 %) belongs to small size group with an average land holding of 1.1 ha and the medium size group (30 %) with an average holding size of 3.0 ha (Table 14).

Table 14: Distribution of land holding among the sample households in Bijjur-1 micro-watershed

Particulars	Units	Values
Small farmers		
Total land	ha	7.8
Sample size	Per cent	70.0
Average land holding	ha	1.1
Medium farmers		
Total land	ha	9.0
Sample size	Per cent	30.0
Average land holding	ha	3.0
Total sample households		
Total land	ha	16.8
Sample size	Per cent	100.0
Average land holding	ha	1.7

Land use: The average land holding in the Bijjur-1 Microwatershed is 16.8 ha (Table 15). Of which 16.8 ha is rainfed land condition. The total land holding per household is worked out to be 16.8 ha.

Table 15: Land use among samples households in Bijjur-1 Microwatershed

Particulars	Per cent	Area in ha
Irrigated land	0.0	0.0
Rainfed Land	100.0	16.8
Fallow Land	0.0	0.0
Total land holding	100.0	16.8
Average land holding	1.7	

In the Micro-watershed, the prevalent present land uses under perennial plants are Banni trees (15.4%) followed by Neem trees (84.6%) (Table 16).

Table 16: Number of trees/plants covered in sample farm households in Bijjur-1 Micro watershed.

Particulars	Number of Plants/trees	Per cent
Banni tree(shami tree)	2	15.4
Neem trees	11	84.6
Grand Total	13	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 and irrigated land in the study area were by maize (61.3%) followed by horse gram (6.3%), sorghum (4.6%), groundnut (4.2%), cotton (4.2%) which are taken during Kharif and sorghum (13.0%) and sunflower (6.3%) during Rabi season respectively (Table 17 and Figure 9).

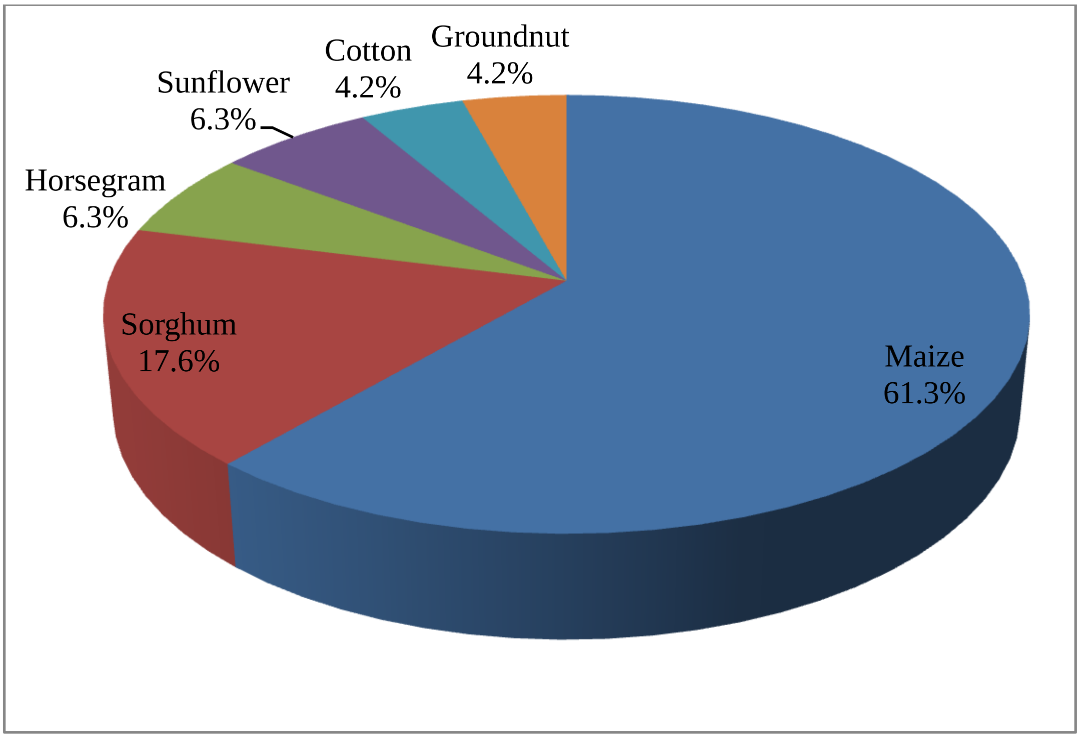


Figure 9: Present cropping pattern in Bijjur-1 Microwatershed

Table 17: Present cropping pattern and cropping intensity in Bijjur-1 Microwatershed % to Grand Total

Crops	Kharif	Rabi	Grand Total
Maize	61.3	0.00	61.3
Sorghum	4.6	13.0	17.6
Horsegram	6.3	0.0	6.3
Sunflower	0.0	6.3	6.3
Cotton	4.2	0.0	4.2
Groundnut	4.2	0.0	4.2
Grand Total	80.7	19.3	100.0
Cropping intensity (%)	124		

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 Bijjur-1 Microwatershed, 13 soil series are identified and mapped (Table 18). The distribution of major soils of granite gneiss landscape series Venkatapur (VKP) are covering an area around 142.0 ha (25.6%) followed by Jelligere (JLG) 93.3 ha (16.7%), Varavi (VRV) 77.2 ha (13.8%), Kalasapur 59.7 ha (10.6%), Attikatti (AKT) 48.1 ha (8.6%), Yelisirunj (YSJ) 32.8 ha (5.9%), Dhoni (DNI) 16.4 ha (2.9%), Lakshmanagudda (LGD) 22.4 ha (4.0%), Mahalingapura (MPT) 20.92ha (3.7%), Ravanki (RNK) 18.3 ha (3.3%), Shirol (SRL) 11 ha (2.0%), Shirunj (SRJ) 13.0 ha (2.3%), Kabulayathakatti (KLK) 1.6 ha (0.3%) and Water body is 3.5ha (0.6%).

Table 18: Distribution of soil series in Bijjur-1 Microwatershed

Soil No.	Soil Series	Mapping Unit Description	Area in ha (%)
SOILS OF GRANITE GNEISS LANDSCAPE			
1	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	18.3 (3.3)
2	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	22.4 (4.0)
SOILS OF BANDED FERRUGINOUS QUARTZITE (BFQ) LANDSCAPE			
3	SRL	Shirol soils are very shallow (<25 cm), well drained, have dark reddish brown clayey soils occurring on very gently sloping uplands under cultivation	11.0 (2.0)
4	KLK	Kabulayathkatti soils are very shallow (<25 cm), well drained,	1.6

		have dark reddish brown gravelly sandy clay loam soils occurring on very gently sloping uplands under rainfed cultivation	(0.3)
5	AKT	Attikatti soils are shallow (25-50 cm), well drained, have dark reddish brown to dusky red clay loam to clay soils occurring on very gently sloping uplands under cultivation	48.1 (8.6)
6	DNI	Dhoni soils are deep (100-150 cm), well drained, have dark reddish brown gravelly clay soils occurring on gently to very gently sloping uplands under rainfed cultivation	16.4 (2.9)
SOILS OF SCHIST LANDSCAPE			
7	YSJ	Yelisirunj soils are shallow (25-50 cm), well drained, have very dark brown to very dark grayish brown clay soils occurring on very gently sloping uplands under cultivation	32.83 (5.86)
8	SRJ	Shirunj soils are shallow (25-50 cm), well drained, have very dark greyish brown cracking gravelly clay soils occurring on very gently sloping uplands under cultivation	13.0 (2.3)
9	VKP	Venkatapur soils are moderately shallow (50-75 cm), well drained, have very dark greyish brown cracking clay soils occurring on very gently sloping uplands under cultivation	142.0 (25.6)
10	JLG	Jelligeri soils are moderately deep (75-100 cm), moderately well drained, very dark brown to dark brown and black cracking clay soils occurring on very gently sloping uplands under cultivation	93.3 (16.6)
11	VRV	Varavi soils are moderately deep (75-100 cm), moderately well drained, have very dark brown cracking clay soils occurring on very gently sloping uplands under cultivation	77.2 (13.8)
12	MPT	Mahalingapur Tanda soils are deep (100-150 cm), moderately well drained, have very dark brown to very dark grayish brown cracking clay soils occurring on nearly level to very gently sloping uplands under cultivation	20.9 (3.7)
13	KPR	Kalasapur soils are deep (100-150 cm), moderately well drained, have very dark gray to very dark grayish brown calcareous cracking clay soils occurring on nearly level to very gently sloping uplands under cultivation	59.7 (10.6)
Water body			3.5(0.6)

Present cropping pattern on different soil series are given in Table 19. Groundnut and maize on Attikatti soils is grown. Sorghum is grown on Yelisirunj soils. Maize is Venkatapur soils are grown. Horse gram, maize and sunflower are Jelligere soils are grown. Cotton, maize and sorghum is Varavi soils are grown. Maize is Dhoni soils are grown. Sorghum is Kalasapur soils are grown.

Table 19: Cropping pattern on major soil series in Bijjur-1 Microwatershed

(Area in per cent)

Soil Series	Soil Depth	Crops	Dry		Grand Total
			Kharif	Rabi	
AKT	Shallow (25-50 cm)	Groundnut	7.5	0.0	7.5
		Maize	92.5	0.0	92.5
YSJ	Shallow (25-50 cm)	Sorghum	0.0	100.0	100.0
VKP	Moderately shallow (50-75 cm)	Maize	100.0	0.0	100.0
JLG	Moderately deep (75-100 cm)	Horse gram	71.3	0.0	41.6
		Maize	28.7	0.0	16.8
		Sunflower	0.0	100.0	41.6
VRV	Moderately deep (75-100 cm)	Cotton	100.0	0.0	32.8
		Maize		26.8	18.0
		Sorghum		73.2	49.2
DNI	Deep (100-150 cm)	Maize	100.0	0.0	100.0
KPR	Deep (100-150 cm)	Sorghum	100.0	0.0	100.0

Land is used for agricultural use for growing cereals, pulse, oilseeds and commercial crops. The soil/ land potential are measures in terms of physical yield and net income. The alternative land use options for each micro-watershed are given below (Table 20).

Table 20: Alternative land use options for different size group of farmers (Benefit Cost Ratio) in Bijjur-1 Microwatershed.

Soil Series	Small farmers	Medium Farmers
AKT	Groundnut (0.96), Maize (0.99).	Maize (2.18).
YSJ	Sorghum (1.22).	
VKP	Maize (2.06).	
JLG	Horse gram (1.10), Maize (1.14), Sunflower (1.21)	
VRV	Maize (0.95).	Cotton (1.06), Sorghum (1.13).
DNI		Maize (1.49).
KPR	Sorghum (1.24).	

The productivity of different crops grown in Bijjur-1 Microwatershed under potential yield of the crops is given in Table 21.

The data on cost of cultivation and benefit cost ratio (BCR) of different crops is given in Table 21. The total cost of cultivation in study area for maize ranges between Rs.35712/ha in JLG soil (with BCR of 1.14) and Rs.1339/ha in VKP soil (with BCR of 2.06), sorghum range between Rs 16589/ha in VRV soil (with of 1.13) and Rs.14829/ha in YSJ soil (With BCR of 1.22), groundnut cost of cultivation in AKT soil is RS. 43872/ha (BCR of 0.96), horse gram cost of cultivation in JLG soil is Rs. 20615/ha (BCR of 1.1), sunflower cost of cultivation in JLG soil is Rs.17064/ha (With BCR of 1.21) and cotton cost of cultivation in VRV soil is Rs. 40661/ha (BCR of 1.06).

Table 21: Economic land evaluation and bridging yield gap for different crops in Bijjur-1 Microwatershed

Particulars	AKT (25-50 cm)		YSJ (25-50 cm)	VKP (50-75 cm)	JLG (75-100 cm)			VRV (75-100 cm)			DNI (100-150cm)	KPR (100-150 cm)
	Ground nut	Maize	Sorg hum	Maize	Horse gram	Maize	Sun flower	Cotton	Maize	Sorg hum	Maize	Sorghum
Total cost (Rs/ha)	43872	14771	14829	13339	20615	35712	17064	40661	30345	16589	15494	16338
Gross Return (Rs/ha)	41990	20378	18134	27483	22724	40826	20583	43225	28742	18772	23156	20209
Net returns (Rs/ha)	-1882	5607	3306	14145	2109	5115	3519	2564	-1603	2183	7662	3871
BCR	0.96	1.59	1.22	2.06	1.10	1.14	1.21	1.06	0.95	1.13	1.49	1.24
Farmers Practices (FP)												
FYM (t/ha)	2.5	1.6	0.0	1.2	1.7	4.1	1.7	2.5	4.5	0.0	1.3	2.3
Nitrogen (kg/ha)	77.5	66.0	40.0	48.1	81.0	84.7	81.0	96.0	93.2	96.0	59.2	72.7
Phosphorus (kg/ha)	64.6	53.3	32.8	54.0	68.1	95.0	68.1	106.5	104.5	106.5	65.5	52.3
Potash (kg/ha)	7.1	4.7	14.6	0.0	10.6	0.0	10.6	10.6	0.0	10.6	8.0	0.0
Grain (Qtl/ha)	7.5	12.8	9.5	17.6	5.0	24.8	8.3	17.5	18.2	10.0	15.6	9.1
Price of Yield (Rs/Qtl)	5000	1500	1800	1500	4500	1500	2500	2500	1400	1800	1400	2000
Soil test based fertilizer Recommendation (STBR)												
FYM (t/ha)	8.6	8.6	7.4	8.6	0.0	8.6	6.6	12.4	8.6	7.4	8.6	7.4
Nitrogen (kg/ha)	24.7	123.5	81.5	123.5	24.7	123.5	55.2	148.2	123.5	81.5	123.5	101.9
Phosphorus (kg/ha)	77.2	77.2	71.0	77.2	46.3	77.2	74.1	92.6	77.2	71.0	77.2	71.0
Potash (kg/ha)	30.9	32.1	29.6	32.1	18.5	24.1	27.8	55.6	32.1	29.6	24.1	29.6
Grain (Qtl/ha)	17.3	84.0	28.4	84.0	9.9	84.0	16.5	17.3	84.0	28.4	84.0	28.4
% of Adoption/yield gap (STBR-FP) / (STBR)												
FYM (%)	71.1	82.0	100.0	86.4	0	52.2	74.7	79.8	47.4	100.0	85.5	69.3
Nitrogen (%)	-213.8	46.6	51.0	61.0	-228.1	31.4	-46.9	35.2	24.5	-17.8	52.0	28.6
Phosphorus (%)	16.3	30.9	53.8	30.1	-47.1	-23.1	8.1	-14.9	-35.4	-49.9	15.2	26.4
Potash (%)	77.1	85.3	50.6	100.0	42.6	100.0	61.8	80.9	0.0	64.2	66.9	100.0
Grain (%)	56.6	84.8	66.6	79.0	49.4	70.5	49.4	-1.2	78.3	64.8	81.4	68.0
Value of yield and Fertilizer (Rs)												
Additional Cost (Rs/ha)	6542	9375	9889	10039	-3145	4674	5216	10766	3902	6056	9004	6905
Additional Benefits (Rs/ha)	48950	106771	34040	99562	21960	88780	20333	-525	92117	33129	95697	38628
Net change Income (Rs/ha)	42408	97396	24152	89523	25105	84106	15118	-11291	88216	27073	86693	31724

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 21. 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. 97395 in Maize and a minimum of Rs. 15118 in sunflower cultivation.

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

The onsite cost of different soil nutrients lost due to soil erosion is given in Table 22 and Figure 10. The total value of soil nutrient loss is around Rs 1067.60 per ha/year. The total cost of annual soil nutrients is around Rs. 593586 per year for the total area of 560 ha.

Table 22: Estimation of onsite cost of soil erosion in Bijjur-1 Microwatershed

Particulars	**Quantity(kg)**		**Value (Rs)**	
	Per ha	**Total**	**Per ha**	**Total**
Organic matter	156.59	87067	986.55	548520
Phosphorous	0.03	19	1.54	853
Potash	2.52	1400	50.36	28001
Iron	0.09	49	4.27	2376
Manganese	0.00	2	1.23	684
Cupper	0.02	12	12.04	6695
Zinc	0.12	67	4.83	2685
Sulpher	0.16	91	6.56	3649
Boron	0.01	3	0.22	124
Total	225.16	88711	1067.60	593586

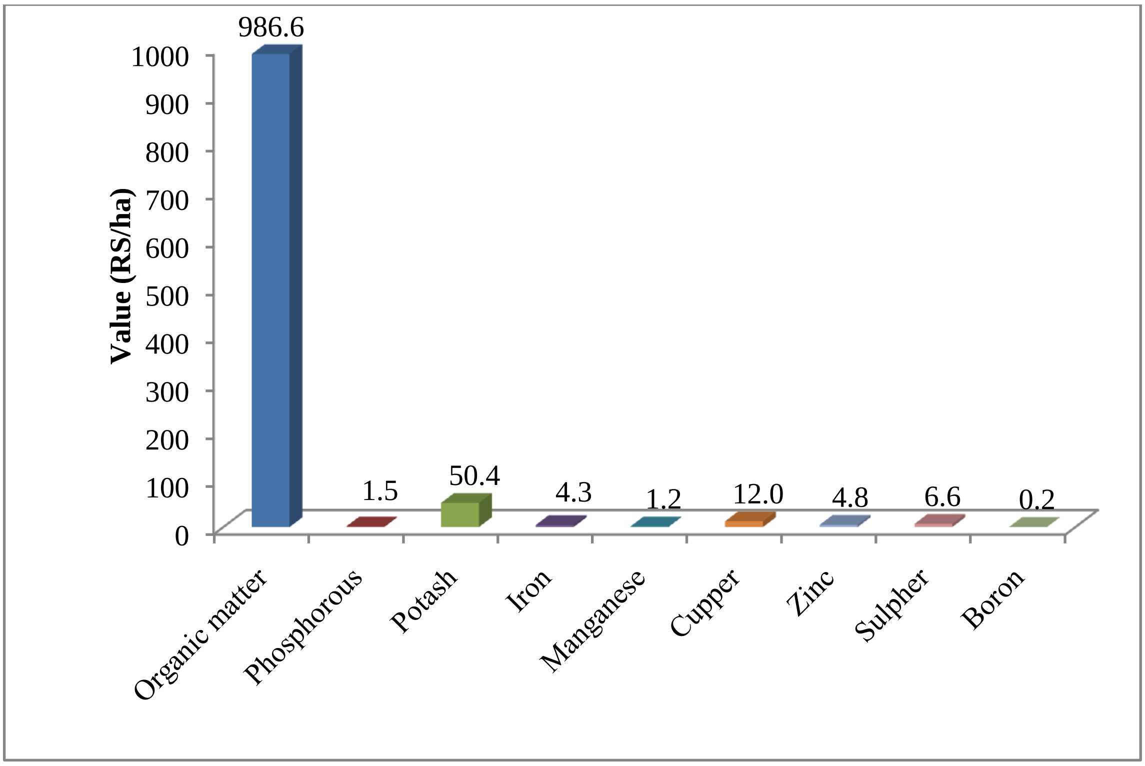


Figure 10: Estimation of onsite cost of soil erosion in Bijjur-1 Microwatershed

The average value of ecosystem service for food grain production is around Rs 1075 ha/year (Table 23 and Figure 11). Per hectare food grain production services is maximum in maize (Rs 3920) followed by sunflower (Rs. 3519), sorghum (Rs. 1654), horse gram (Rs.1615), cotton (Rs.2564) and ground nut is negative returns.

Table 23: Ecosystem services of food grains production in Bijjur-1 Microwatershed

Production items	Crops	Area in ha	Yield (Qtl/ha)	Price (Rs/Qtl)	Gross Returns (Rs/ha)	Cost of Cultivation (Rs/ha)	Net Returns (Rs/ha)
Cereals	Maize	10.9	17	1467	24659	20739	3920
	Sorghum	3.4	9	1867	17573	15918	1654
Pulses	Horse gram	1.2	5	4500	22230	20615	1615
Oil seeds	Groundnut	0.4	7	5000	37050	43872	-6822
	Sunflower	1.2	8	2500	20583	17064	3519
Commercial Crops	Cotton	0.8	17	2500	43225	40661	2564
Average Value		17.9	11	2972	27553	26478	1075

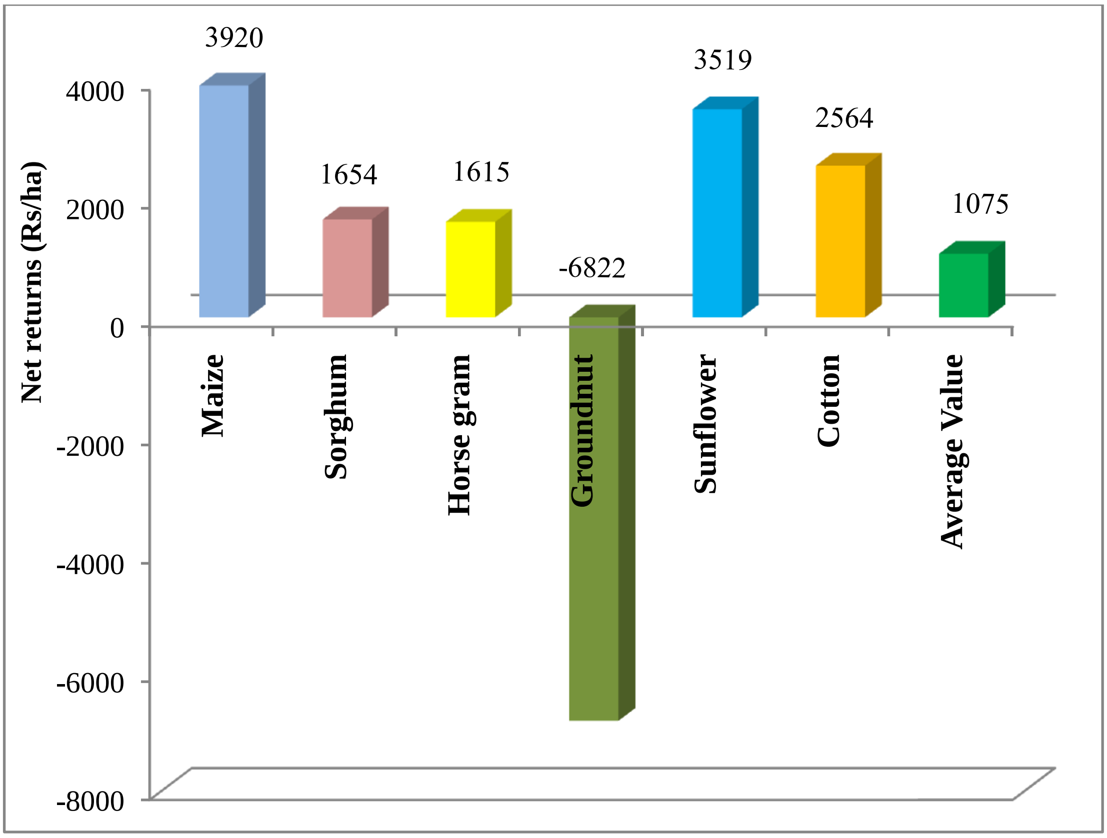


Figure 11: Ecosystem services of food grains production in Bijjur-1 Microwatershed

The average value of ecosystem service for fodder production is around Rs.1505 ha/year (Table 24). Per hectare fodder production services is maximum in groundnut (Rs. 4940) followed by maize (Rs. 2142), sorghum (Rs. 1455) and horse gram (Rs. 494).

Table 24: Ecosystem services of fodder grains production in Bijjur-1 Microwatershed

Production items	Crops	Area in ha	Yield (Qtl/ha)	Price (Rs/Qtl)	Net Returns (Rs/ha)
Cereals	Maize	10.9	2.5	867	2142
	Sorghum	3.4	1.8	800	1455
Pulses	Horsegram	1.2	0.8	600	494
Oil seeds	Groundnut	0.4	4.9	1000	4940
Average value		17.9	1.7	544	1505

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 maximum (Table 25 and Figure12) in cotton (Rs.69661) fallowed by maize (Rs.20545), horse gram (Rs.15205), ground nut (Rs. 20614), sorghum (Rs. 28693) and sunflower (Rs 27713).

Table 25: Ecosystem services of water supply in Bijjur-1 Microwatershed

Crops	Yield (Qtl/ha)	Virtual water (cubic meter) / ha	Value of Water (Rs/ha)	Water consumption (Cubic meters/Qtl)
Cotton	17.3	6966.1	69661	402.9
Groundnut	7.4	2061.5	20615	278.2
Horsegram	4.9	1520.5	15205	307.8
Maize	16.8	2054.6	20546	122.2
Sorghum	9.4	2869.3	28693	304.8
Sunflower	8.2	2771.3	27713	336.6
Average value	10.7	3040.6	30406	292.1

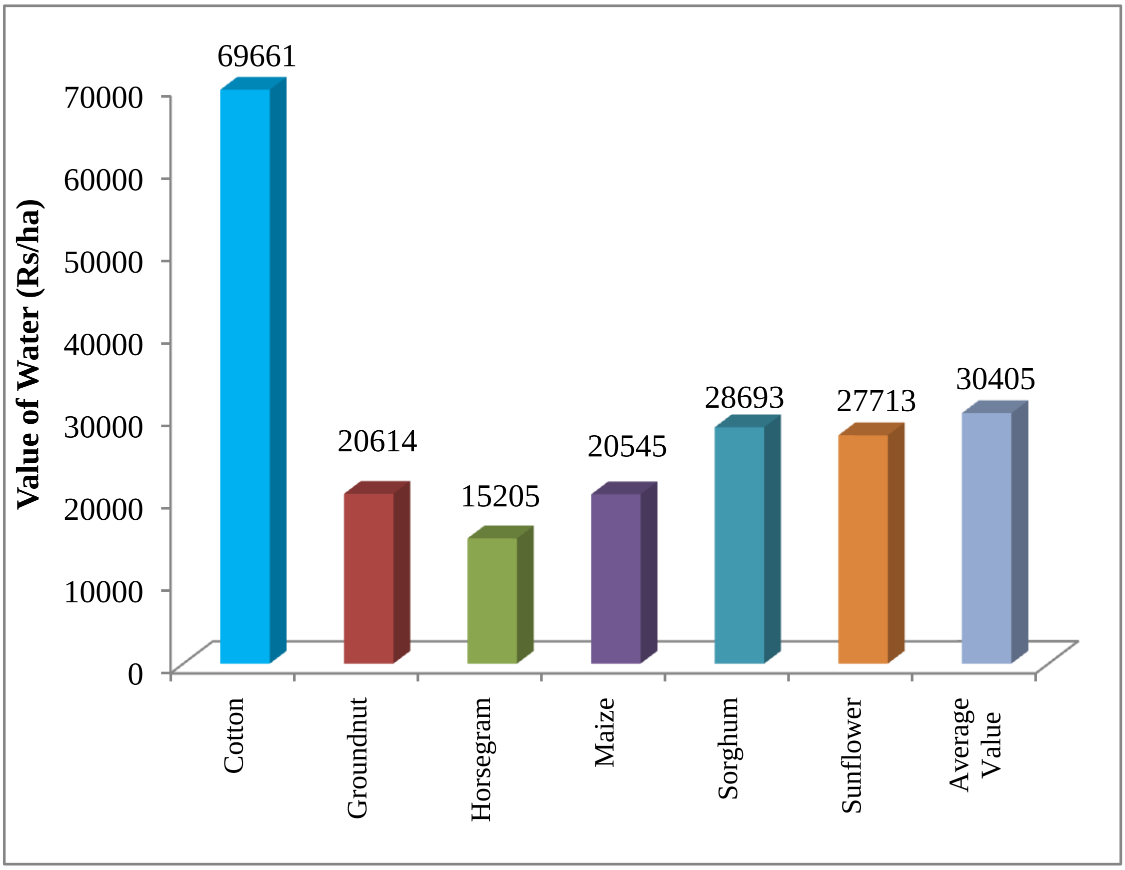


Figure 12: Ecosystem services of water supply in Bijjur-1 Microwatershed

The main farming constraints in Bijjur-1 Microwatershed to be found are less rainfall, lack of good quality seeds, lack of storage, damage of crops by wild animals and non availability of plant protection chemicals. Majority of farmers depend up on money lender of the sources of loan for purpose of crop production. Farmers to sell the agriculture produce through village market and the farmers getting the agriculture related information on newspaper and television. Farmers reported that they are not getting timely support/extension services from the concerned development department (Table 26).

Table 26: Farming constraints related land resources of sample households in Bijjur-1 Microwatershed

Sl. No	Particulars	Per cent
1	Less Rainfall	70
2	Lack of transportation	10
3	Damage of crops by Wild Animals	70
4	Non availability of Plant Protection Chemicals	80
5	**Source of loan**	
	Money Leander	90
	Village merchants	10
6	**Market for selling**	
	Village market	100
7	**Sources of Agri-Technology information**	
	Newspaper	100

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