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

## DADAL (4D5B1P2d) MICROWATERSHED

**Sydhapura Hobli, Yadgir Taluk and District, Karnataka**

Karnataka Watershed Development Project – II

**SUJALA – III**

**World Bank funded Project**

THE WORLD BANK

ICAR – NATIONAL BUREAU OF SOIL SURVEY AND LAND USE PLANNING

ICAR - NBSS & LUP

WATERSHED DEVELOPMENT DEPARTMENT
GOVT. OF KARNATAKA, BANGALORE

## About ICAR - NBSS&LUP

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

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

**Citation:** Rajendra Hegde, Ramesh kumar, S.C., B.A. Dhanorkar, S. Srinivas, M. Lalitha, K.V. Niranjana, R.S. Reddy and S.K. Singh (2017). "Land Resource Inventory and Socio-Economic Status of Farm Households for Watershed Planning and Development of Dadal (4D5B1P2d) Microwatershed, Sydhapura Hobli, Yadgir Taluk & District, Karnataka", ICAR-NBSS&LUP Sujala MWS Publ.35, ICAR – NBSS & LUP, RC, Bangalore. p.103 & 28.

**TO OBTAIN COPIES,**

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

Amaravati Road, NAGPUR - 440 033, India

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

Telefax : 0712-2522534

E-Mail : director@nbsslup.ernet.in

Website URL : nbsslup.in

Or

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

Phone : (080) 23412242, 23510350 (O)

Telefax : 080-23510350

E-Mail : nbssrcb@gmail.com

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

## DADAL (4D5B1P2d) MICROWATERSHED

**Sydhapura Hobli, Yadgir Taluk & District, Karnataka**

**Karnataka Watershed Development Project – II**

**Sujala-III**

**World Bank funded Project**

THE WORLD BANK

**ICAR – NATIONAL BUREAU OF SOIL SURVEY AND LAND USE PLANNING**

ICAR - NBSS & LUP

**WATERSHED DEVELOPMENT DEPARTMENT, GOVT. OF KARNATAKA, BANGALORE**

## 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 Dadal Microwatershed, Yadgir Taluk, Yadgir 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 micro-watershed. The project report with the accompanying maps for the microwatershed will provide required detailed database for evolving effective land use plan, alternative land use options and conservation plans for the planners, administrators, agricutural extention personnel, KVK officials, developmental departments and other land users to manage the land resources in a sustainable manner.

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

Nagpur
Date: 15.11.2017

**S.K. SINGH**
Director, ICAR - NBSS&LUP, Nagpur

# Contributors

| | |
|---|---|
| **Dr. Rajendra Hegde**<br>Principal Scientist, Head &<br>Project Leader, Sujala-III Project<br>ICAR-NBSS&LUP, Regional Centre<br>Bangalore | **Dr. S.K. Singh**<br>Director, ICAR-NBSS&LUP<br>Coordinator, Sujala-III Project<br>Nagpur |
| **Soil Survey, Mapping & Report Preparation** | |
| Dr. B.A. Dhanorkar | Sh. R.S.Reddy |
| Dr. K.V. Niranjana | Sh. Venkata Giriyappa |
| | Dr. H.R.Savitha |
| | Smt. Chaitra, S.P. |
| | Sh. Nagendra, B.R. |
| | Dr. B. Gayathri |
| | Dr. Gopali Bardhan |
| | Sh. Somashekar, T.N. |
| **Field Work** | |
| Sh. C.Bache Gowda | Sh. Mahesh, D.B. |
| Sh. Somashekar | Sh. Ashok, S. Sindagi |
| Sh. M. Jayaramaiah | Sh. Veerabhadrappa |
| | Sh. Kailash. |
| | Sh. Yogesh, H.N. |
| | Sh. Kamalesh, Avate. |
| | Sh. Sharan Kumar Uppar |
| | Sh. Kalaveerachari, Kammar |
| | Sh. Arun, N. Kambar |
| | Sh. Anand |
| | Sh. Manohar, Y. Hosamane |
| | Sh. Pramod, Navale |
| | Sh. Ramesh Hangargi |
| | Sh. Santhosha |
| | Sh. Prasanna kumar, N. S. |
| | Sh. Rakesh Achalkar |
| **GIS Work** | |
| Dr. S.Srinivas | Sh. A.G. Devendra Prasad |
| Dr. M.Ramesh | Sh. Abhijith Sastry, N.S. |
| Sh. D.H.Venkatesh | Sh. Nagendra Babu Kolukondu |
| Smt.K.Sujatha | Sh. Avinash |
| Smt. K.V.Archana | Sh. Amar Suputhra, S. |
| Sh. N.Maddileti | Sh. Deepak M.J. |
| | Sh. Madappaswamy |
| | Smt. K.Karunya Lakshmi |
| | Ms. Seema, K.V. |
| | Ms. Ramireddy Lakshmi Silpa |
| | Ms. Bhanu Rekha, T. |
| | Ms. Rajata Bhat |
| | Ms. Shruthi |
| | Ms. Suman, S. |

| | |
|---|---|
| **Laboratory Analysis** | |
| Dr. M. Lalitha | Ms. Thara, V.R. |
| Smt. Arti Koyal | Ms. Roopa, G. |
| Smt. Parvathy, S. | Ms. Vindhya, N.G. |
| | Ms. Shwetha N.K. |
| | Ms. Pavana Kumari, P. |
| | Ms. Leelavathy K.U. |
| | Ms. Rashmi, N. |
| | Ms. Padmaja, S. |
| | Ms. Veena, M. |
| | Ms. Chaithrashree, B |
| | Ms. Shwetha N |
| | |
| **Socio-economic Analysis** | |
| Dr. Ramesh Kumar, S.C. | Sh. M.K. Prakashanaik |
| | Sh. Sowmya K.B |
| | Sh. Prathibha, D.G |
| | Sh. Pradyumna, K |
| | Sh. Vijay kumar lamani |
| | Sh. Rajendra D |
| | |
| **Soil & Water Conservation** | |
| Sh. Sunil P. Maske | |
| | |
| **Watershed Development Department, GoK, Bangalore** | |
| Sh. Rajeev Ranjan IFS<br>Project Director & Commissioner, WDD | Dr. A. Natarajan<br>NRM Consultant, Sujala-III Project |
| Dr. S.D. Pathak IFS<br>Executive Director &<br>Chief Conservator of Forests, WDD | |

# PART-A

## LAND RESOURCE INVENTORY

# Contents

## LIST OF TABLES

## LIST OF FIGURES

## *EXECUTIVE SUMMARY*

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

*The present study covers an area of 568 ha in Dadal microwatershed in Yadgir taluk of Yadgir district, Karnataka. The climate is semiarid and categorized as drought-prone with an average annual rainfall of 866 mm, of which about 652 mm is received during south–west monsoon, 138 mm during north-east and the remaining 76 mm during the rest of the year. An area of about 96 per cent is covered by soils, four per cent by waterbodies, settlements and others. The salient findings from the land resource inventory are summarized briefly below.*

- *The soils belong to 9 soil series and 15 soil phases (management units) and 4 land use classes.*
- *The length of crop growing period is about 120-150 days starting from the 1$^{st}$ week of June to 4$^{th}$ 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 96 per cent area is suitable for agriculture and 4 per cent is not suitable for agriculture but well suited for forestry, pasture, agro forestry, silvi-pasture, recreation, installation of wind mills and as habitat for wildlife.*
- *About 11 per cent of the soils are moderately deep (75-100cm), about 69 per cent deep (100-150cm) to very deep (>150 cm) and 17 per cent are shallow to moderately shallow (25-75 cm) soils.*
- *About 81 per cent of the area has clayey soils and 15 per cent loamy soils at the surface.*
- *About 89 per cent of the area has non-gravelly and 7 per cent gravelly soils (15-35 % gravel).*
- *About 69 per cent of the area has soils that are very high (>200mm/m) in available water capacity, 17 per cent medium (100-150 mm/m) and about 11 per cent low (51-100 mm/m) to very low (<50 mm/m).*
- *About 96 per cent of the area has very gently sloping (1-3%) lands.*
- *An area of about 4 per cent has soils that are slightly eroded (e1), 85 per cent moderately eroded (e2) and 8 per cent severely eroded (e3).*
- *An area of about 25 per cent has soils that are moderately alkaline (pH 7.8 to 8.4), about 61 per cent strongly alkaline (pH 8.4-9.0) and about 10 per cent very strongly alkaline (pH >9.0) in soil reaction.*

- *The Electrical Conductivity (EC) of the soils are dominantly <2 $dsm^{-1}$ indicating that the soils are non-saline.*
- *About 71 per cent medium (0.5-0.75%), 8 per cent low (<0.5%) and 17 per cent high (>0.75%) in organic carbon.*
- *An area of 22 per cent has soils that are low (<23 kg/ha), 73 per cent medium (23-57 kg/ha) and only 1 per cent high (>57 kg/ha) in available phosphorus.*
- *About 49 per cent medium (145-337 kg/ha) and 47 per cent high (>337 kg/ha) in available potassium.*
- *Available sulphur is low (<10 ppm) in about 69 per cent area, medium (10-20 ppm) in 26 per cent and high (>20 ppm) in about 2 per cent area.*
- *Available boron is low (<0.5 ppm) in about 2 per cent, 58 per cent medium (0.5-1.0 ppm) and high (>1.0 ppm) in about 35 per cent.*
- *About 14 per cent area has soils that are deficient (<4.5 ppm) in available iron and 82 per cent sufficient (>4.5 ppm).*
- *Available manganese and copper are sufficient in all the soils.*
- *Available zinc is deficient in all the soils.*
- *The land suitability for 27 major crops grown in the microwatershed was 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 Dadal microwatershed***

| *Crop* | *Suitability Area in ha (%)* | | | *Crop* | *Suitability Area in ha (%)* | |
|---|---|---|---|---|---|---|
| | *Highly suitable (S1)* | *Moderately suitable (S2)* | | | *Highly suitable (S1)* | *Moderately suitable (S2)* |
| *Sorghum* | - | *503 (89)* | | *Guava* | - | - |
| *Maize* | - | *16 (3)* | | *Pomegranate* | - | *450 (79)* |
| *Red gram* | - | *450 (79)* | | *Jackfruit* | - | - |
| *Bajra* | - | *503 (89)* | | *Jamun* | - | *390(69)* |
| *Ground nut* | - | *16 (3)* | | *Musambi* | - | *450 (79)* |
| *Sunflower* | - | *450 (79)* | | *Lime* | - | *450 (79)* |
| *Cotton* | - | *503 (89)* | | *Cashew* | - | - |
| *Bengalgram* | - | *503 (89)* | | *Custard apple* | | *503 (89)* |
| *Chilli* | - | *503 (89)* | | *Amla* | - | *503 (89)* |
| *Tomato* | - | *16 (3)* | | *Tamarind* | - | *390(69)* |
| *Drumstick* | - | *450 (79)* | | *Marigold* | - | *503 (89)* |
| *Mulberry* | - | - | | *Chrysanthemum* | - | *503 (89)* |
| *Mango* | - | - | | | | |
| *Sapota* | - | - | | | | |

*Apart from the individual crop suitability, a proposed crop plan has been prepared for the 4 identified LUCs by considering only the highly and moderately suitable lands for different crops and cropping systems with food, fibre and horticulture crops that helps in maintaining the ecological balance in the microwatershed*

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

*Chapter 1*

# INTRODUCTION

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

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

The soil and land resource inventories made so far in Karnataka had limited utility because the surveys were of different types, scales and intensities carried out at different times with specific objectives. Hence, there is an urgent need to generate detailed site-

specific farm level database on various land resources for all the villages/watersheds in a time bound manner that would help to protect the valuable soil and land resources and also to stabilize 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 like slope, erosion, gravelliness and stoniness, climate, water, topography, geology, hydrology, vegetation, crops, land use pattern, animal population, socio-economic conditions, infrastructure, marketing facilities and various schemes and developmental works of the government etc. From the data collected at farm level, the specific problems and potentials of the area can be identified and highlighted, conservation measures required for the area can be planned on a scientific footing, suitability of the area for various uses can be worked out and finally viable and sustainable land use options suitable for each and every land holding can be prescribed.

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

The land resource inventory aims to provide site specific database for Dadal microwatershed in Yadgir Taluk and Yadgir 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 Dadal micro-watershed is located in the northeastern part of Karnataka in Yadgir Taluk, Yadgir District, Karnataka State (Fig.2.1). It comprises of part of Balacheda, Daddala, Kadechoora, Rachanhalli and Shettilli villages. It lies between $16^0$ 31' and $16^0$ 33' north latitudes and $77^0$ 16' and $77^0$ 19' east longitudes and covers an area of 568 ha. It is surrounded by Dadal on north, Kadechoora on southeast and Shettilli village on southwest side.

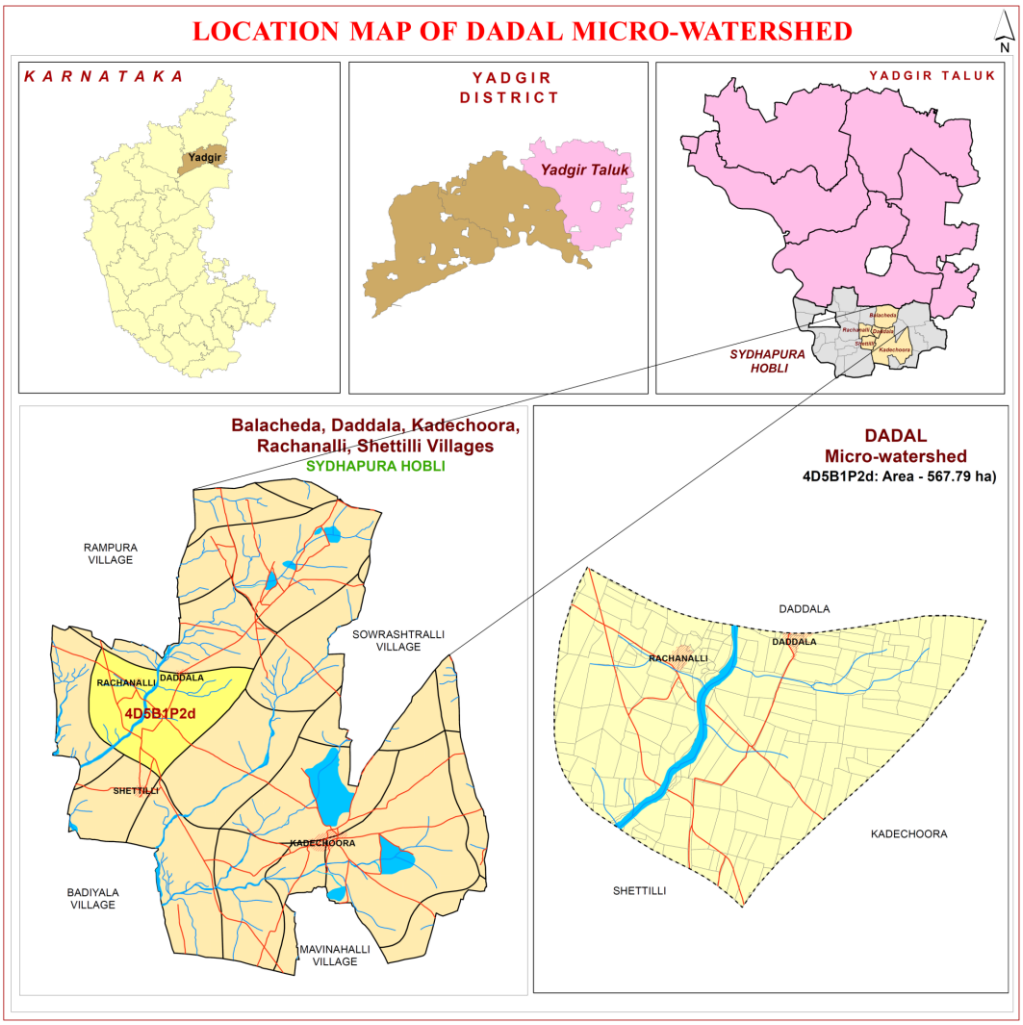



Fig.2.1 Location map of Dadal Microwatershed

## 2.2 Geology

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

10 m. Dolerite dykes and quartz veins are common with variable width and found to occur in Dadal village. The most widespread and characteristic development of alluvium in the watershed region lying between the rivers Krishna and Bhima is a wide belt, the underlying formation is gneiss and alluvial soils occur over gneiss, limestone and shale are far more extensive and homogeneous than those found on the Deccan Trap country lying to the north of the river Krishna. The soil thickness of the alluvium generally is limited to less than a meter, except in river valleys where it is very deep extending to tens of meters. Such soils are transported and represent palaeo black soil originally formed at higher elevation, but now occupying river valleys.

Fig.2.2a Granite and granite gneiss rocks

Fig. 2.2b Alluvium

## 2.3 Physiography

Physiographically, the area has been identified as granite gneiss and alluvial landscape based on geology. The area has been further subdivided into five landforms, *viz;* mounds/ridges, summits, side slopes and very gently sloping uplands plains and valleys based on slope and its relief features. The elevation ranges from 359-376 m above MSL. The mounds and ridges are mostly covered by rock outcrops.

## 2.4 Drainage

The area is drained by several parallel streams like Bori, Amerja and Kanga which finally join the river Bhima along its course. Though, they are not a perennial, during rainy season they carries large quantities of rain water. The microwatershed has only few small tanks which are not capable of storing the water that flows during the rainy season. Due to this, the ground water recharge is very much affected. This is reflected in the failure of many bore wells in the villages. If the available rain water is properly harnessed by constructing new tanks and recharge structures at appropriate places in the villages, then the drinking and irrigation needs of the area can be easily met. The drainage network is parallel to sub parallel and dendritic.

## 2.5 Climate

The Yadgir district lies in the northern plains of Karnataka and falls under semiarid tract of the state and is categorized as drought- prone with total annual rainfall of 866 mm (Table 2.1). Of the total rainfall, maximum of 652 mm is received during the south–west monsoon period from June to September, the north-east monsoon from October to early December contributes about 138 mm, and the remaining 76 mm during the rest of the year. The summer season starts during the middle of February and continues up to the first week of June. The period from December to the middle of February is the coldest season. December is the coldest month with mean daily maximum and minimum temperatures being $29.5^0$C and $10^0$C respectively. During peak summer, temperature shoots up to $45^0$C. Relative humidity varies from 26% in summer to 62% in winter. Rainfall distribution is shown in Figure 2.3. The average Potential Evapo-Transpiration (PET) is 141 mm and varies from a low of 81 mm in December to 199 mm in the month of May. The PET is always higher than precipitation in all the months except end of June to end of September. Generally, the Length of crop Growing Period (LGP) is 120-150 days and starts from 1$^{st}$ week of June to 4$^{th}$ week of October.

**Table 2.1 Mean Monthly Rainfall, PET, 1/2 PET at Yadgir Taluk, Yadgir District**

| Sl.No. | Months | Rainfall | PET | 1/2 PET |
|---|---|---|---|---|
| 1 | January | 4.30 | 86.0 | 43.0 |
| 2 | February | 2.30 | 125.5 | 62.7 |
| 3 | March | 15.10 | 166.0 | 83.0 |
| 4 | April | 18.50 | 179.8 | 89.9 |
| 5 | May | 36.0 | 198.8 | 97.9 |
| 6 | June | 118.0 | 175.1 | 87.5 |
| 7 | July | 171.80 | 156.3 | 78.1 |
| 8 | August | 182.9 | 150.3 | 75.1 |
| 9 | September | 179.7 | 142.0 | 71.0 |
| 10 | October | 105.3 | 138.5 | 69.2 |
| 11 | November | 26.4 | 97.60 | 48.6 |
| 12 | December | 6.0 | 80.90 | 40.4 |
| **Total** | | **866.3** | **141.4** | |

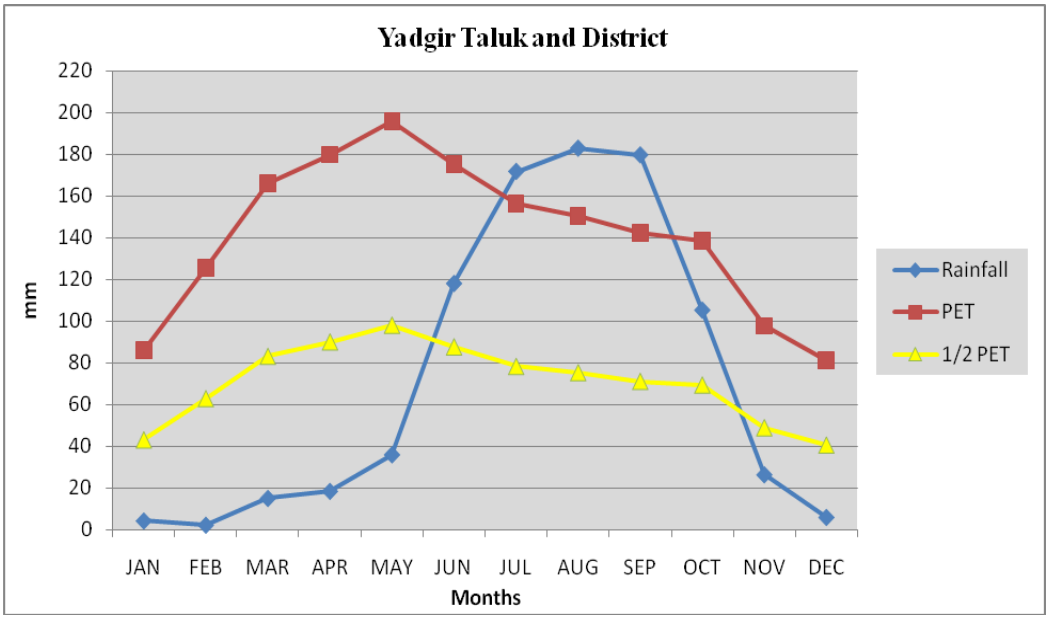



Fig 2.3 Rainfall distribution in Yadgir Taluk, Yadgir District

## 2.6 Natural Vegetation

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

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

## 2.7 Land Utilization

About 72 per cent area (Table 2.2) in Yadgir district is cultivated at present. An area of about 2 per cent is permanently under pasture, 20 per cent under current fallows and 6 per cent under non-agricultural land and 5 per cent under currently barren. Forests occupy an area of about 7 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, sunflower, groundnut, red gram, mango, pomegranate, marigold and sapota. 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 Dadal microwatershed is presented in Fig.2.4. The different crops and cropping systems adopted in the microwatershed is presented in the Figures 2.5 and 2.6. Simultaneously, enumeration of wells (bore wells and open wells) and other conservation strctures in the microwatershed was made and their location in different survey numbers is located on the cadastral map. Map showing the location of wells stuctures and other water bodies in the Dadal microwatershed is given in Fig.2.7.

Table 2.2 Land Utilization in Yadgir District

| **Sl. No**. | **Agricultural land use** | **Area ( ha)** | **Per cent** |
|---|---|---|---|
| 1. | Total geographical area | 516088 | |
| 2. | Total cultivated area | 373617 | 72.4 |
| 3. | Area sown more than once | 74081 | 14.3 |
| 4. | Trees and grooves | 737 | 0.14 |
| 5. | Forest | 33773 | 6.54 |
| 6. | Cultivable wasteland | 2385 | 0.46 |
| 7. | Permanent Pasture land | 11755 | 2.28 |
| 8. | Barren land | 27954 | 5.41 |
| 9. | Non- Agriculture land | 29623 | 5.73 |
| 10. | Current Fallows | 105212 | 20.4 |

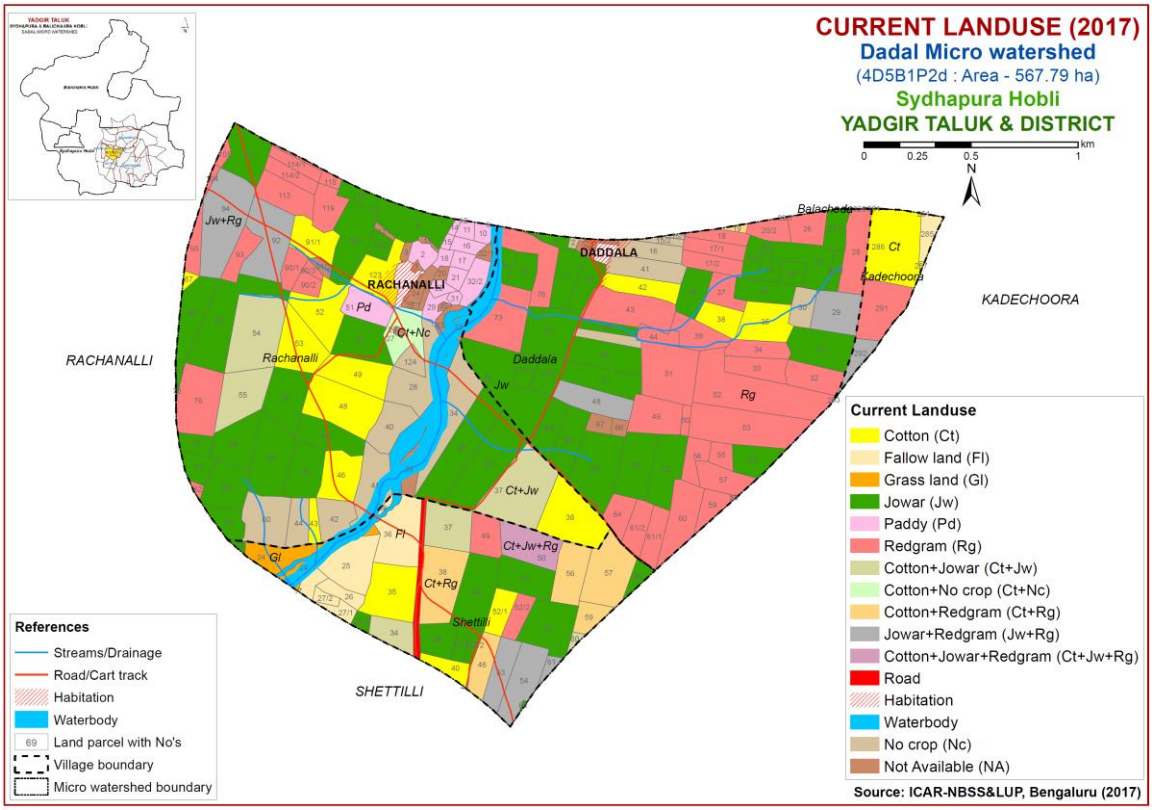



Fig.2.4 Current Land Use map of Dadal Microwatershed


Fig. 2.5. Different Crops and Cropping Systems in Dadal Microwatershed

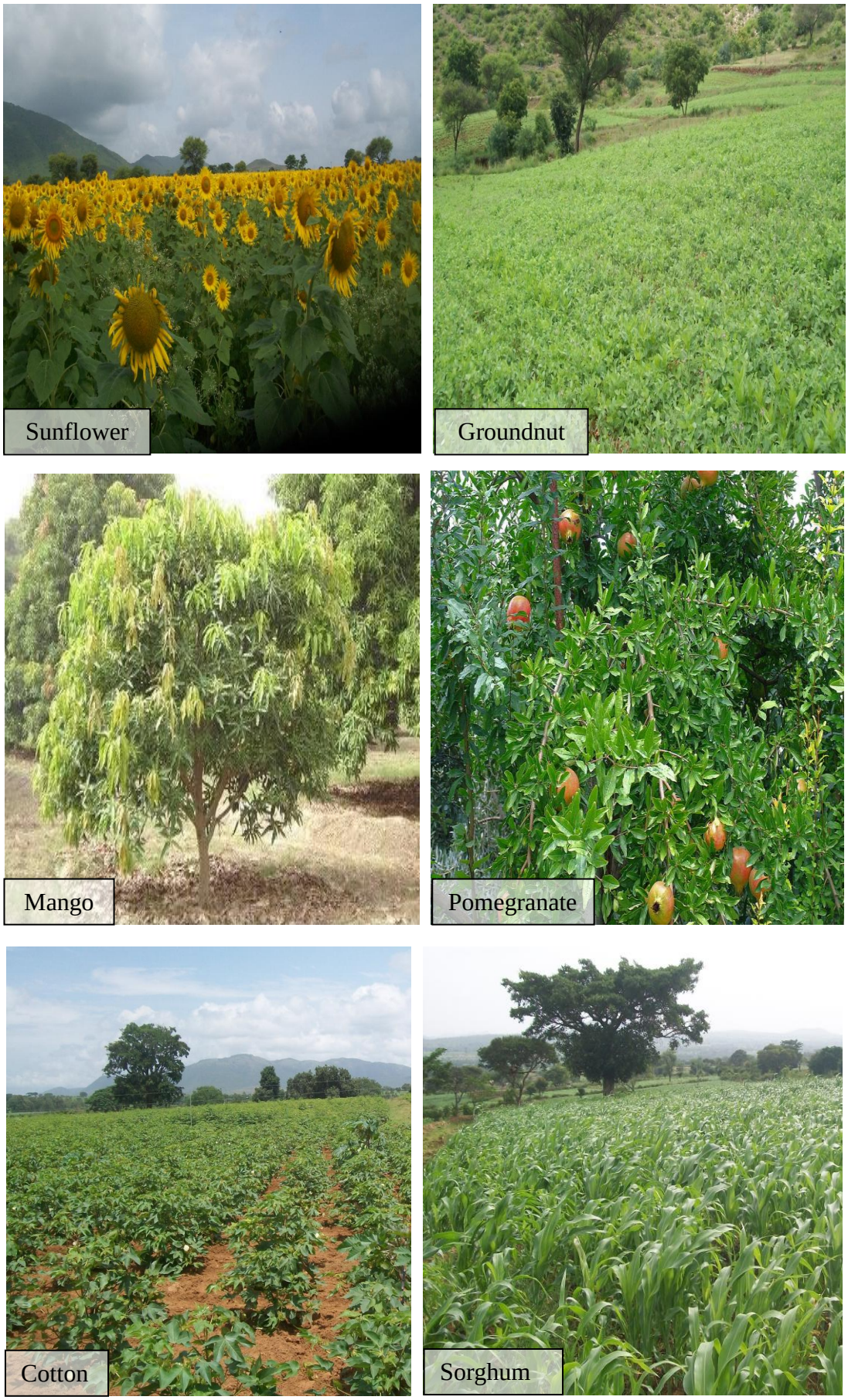



Fig. 2.6. Different Crops and Cropping Systems in Dadal Microwatershed

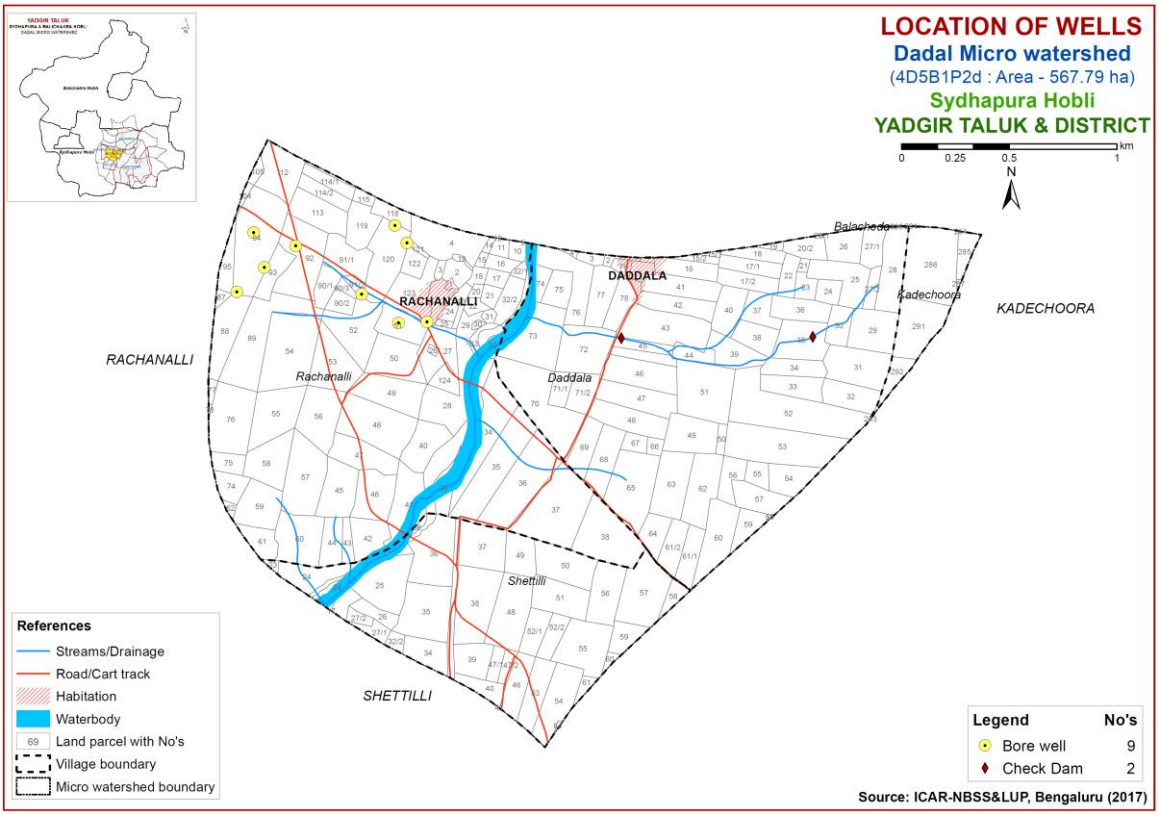



Fig.2.7 Location of Wells and other structures in Dadal Microwatershed

*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 Dadal microwatershed by the detailed study of all the soil characteristics (depth, texture, colour, structure, consistence, coarse fragments, porosity, soil reaction, soil horizons etc.) and site (slope of the land, erosion, drainage, occurrence of rock fragments etc.) followed by grouping of similar areas based on soil-site characteristics into homogeneous (management units) units and showing their area extent and geographic distribution on the microwatershed cadastral map. The detailed survey at 1:7920 scale was carried out in 568 ha area. The methodology followed for carrying out land resource inventory was as per the guidelines given in Soil Survey Manual (IARI, 1971; Soil Survey Staff, 2006; Natarajan *et al.*, 2015) which is briefly described below.

## 3.1 Base Maps

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

## 3.2 Image Interpretation for Physiography

False Colour Composites (FCCs) of Cartosat-I and LISS-IV merged satellite data covering microwatershed area was visually interpreted using image interpretation elements and all the available collateral data with local knowledge. The delineated physiographic boundaries were transferred on to a cadastral map overlaid on satellite imagery. Physiographically, the area has been identified as granite and granite gneiss landscape and alluvial landscape. It was divided into five landforms, *viz;* ridges and mounds, gently and very gently sloping uplands and lowlands based on slope and image characteristics. 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 Landform

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

### DSe – Alluvial plains

#### DSe 1 – Summit

DSe 11 –

DSe 12 –

#### DSe 2 – Very genetly sloping

DSe 21 – Very gently sloping, dark gray tone

DSe 22 – Very gently sloping, medium gray tone

DSe 23 – Very gently sloping, yellowish grey tone

DSe 24 – Very gently sloping, whitish grey tone

DSe 25 – Very gently sloping, whitish/ eroded/ calcareous tone

DSe 26- Very gently sloping, medium pink

**DSe 3 – Valley/ Lowland**

DSe 31 – Whitish gray/Calcareous

DSe 32 – Gray with pink patches

DSe 33 – Medium gray tone

DSe 34 – Lightish gray tone

DSe 35 – Dark gray tone

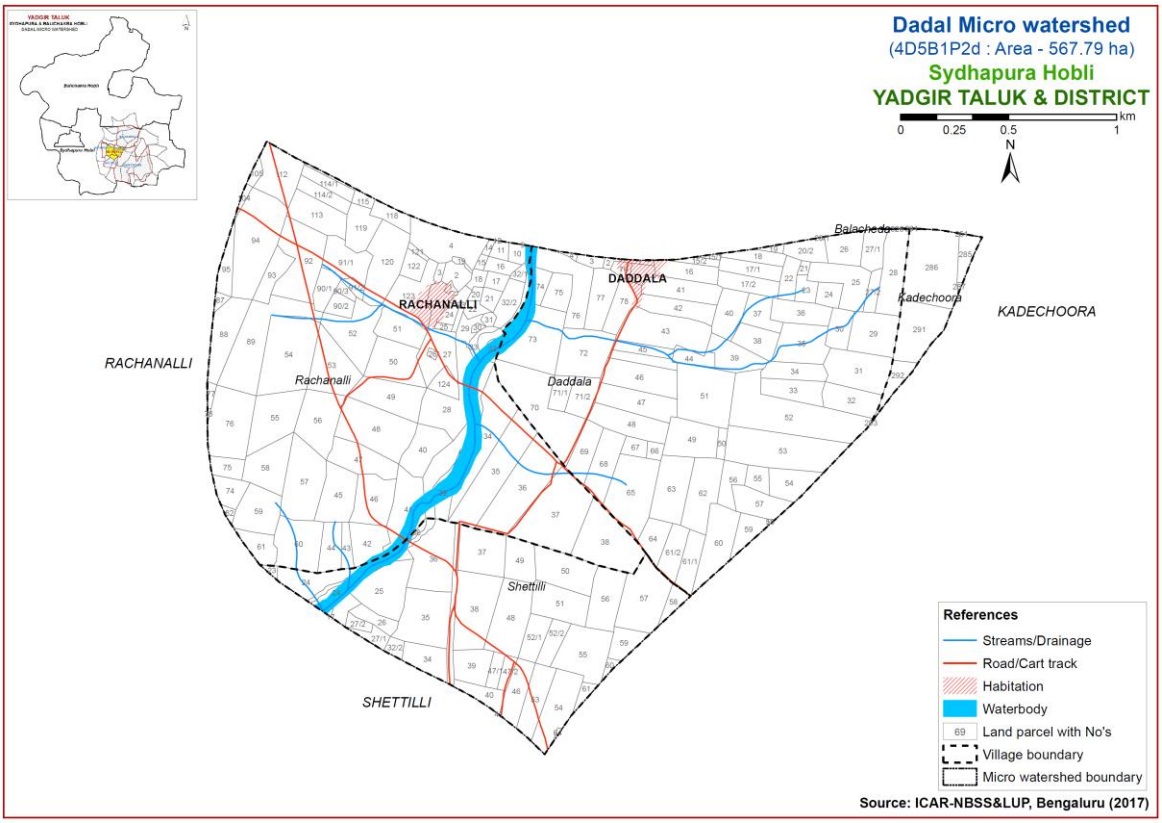



Fig 3.1 Scanned and Digitized Cadastral map of Dadal Microwatershed

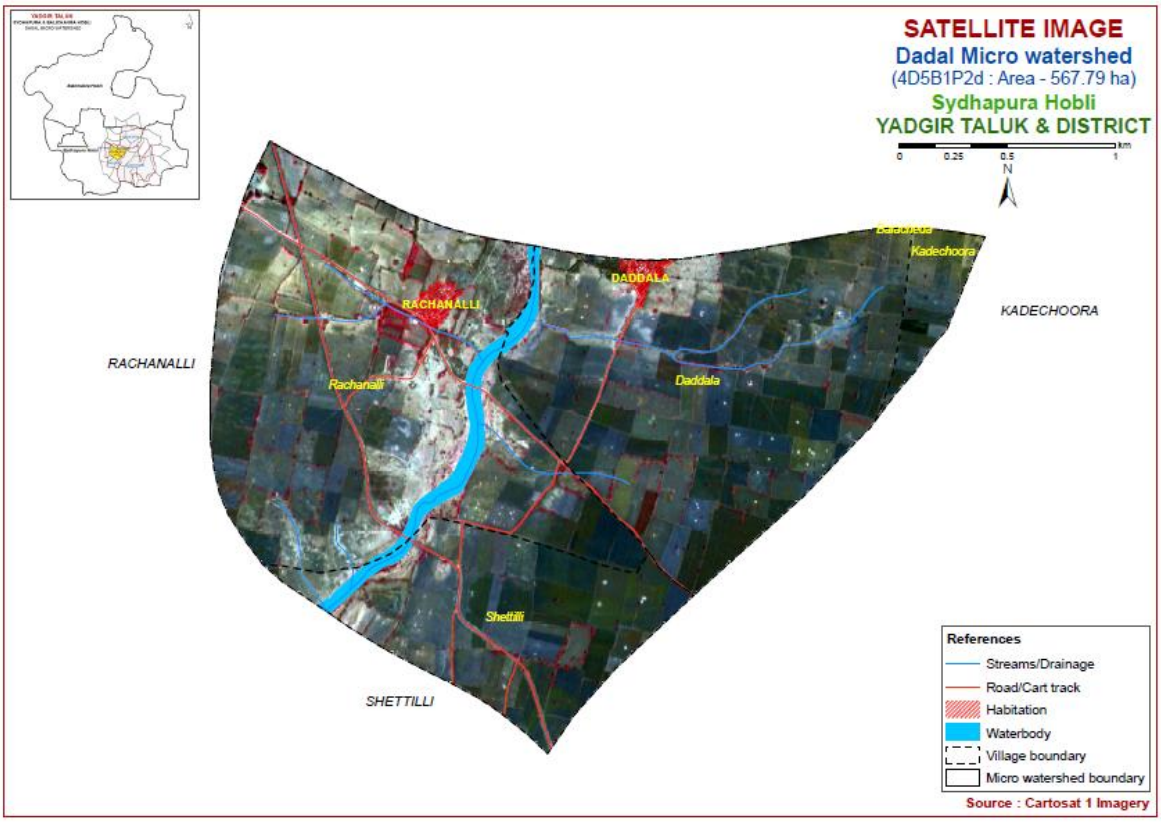



Fig.3.2 Satellite Image of Dadal Microwatershed

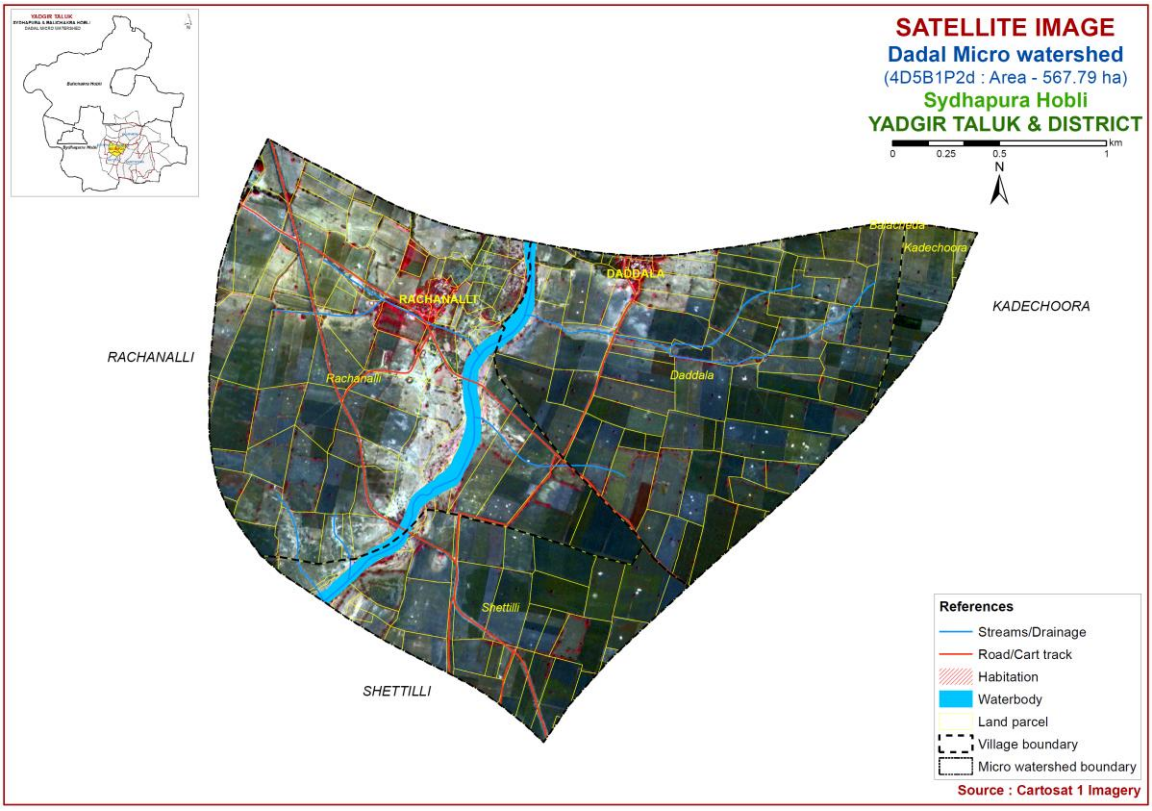



Fig.3.3 Cadastral map overlaid on IRS PAN+LISS IV merged imagery of Dadal Microwatershed

### 3.3 Field Investigation

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 a few selected places. 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. 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-site 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 soil series are given in Table 3.1. Based on the above characteristics, 9 soil series were identified in the Dadal microwatershed.

**Table 3.1 Differentiating Characteristics used for Identifying Soil Series**

**(Characteristics are of Series Control Section)**

| **SOILS OF GRANITE AND GRANITE GNEISS LANDSCAPE** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl. No.** | **Soil Series** | **Depth (cm)** | **Colour** | **Texture** | **Gravel (%)** | **Horizon sequence** | **Calcar-eousness** |
| 1 | Halegera (HLG) | 50-75 | 10YR3/2,4/4 7.5YR4/3, 4/2 | Scl-sc | - | Ap- Bw | 2-3 |
| 2 | Yalleri (YLR) | 50-75 | 2.5YR3/4, 4/4 5YR3/4, 7.5YR4/4 | sc | 15-35 | Ap-Bt | - |
| **SOIL OF ALLUVIAL LANDSCAPE** | | | | | | | |
| 1 | Gudalagunta (GDL) | 25-50 | 10YR3/1 | Sc-c | - | Ap- Bw | 1-2 |
| 2 | Kyathanala (KYT) | 25-50 | 7.5YR4/4,5/6 5YR3/3,4/4 | Scl-sc | - | Ap- Bw | - |
| 3 | Balched (BLD) | 50-75 | 10YR3/2,2/1 | c | - | Ap- Bw | 1-2 |
| 4 | Rachanalli (RHN) | 75-100 | 10YR3/2,4/3 | Sc-c | - | Ap- Bw | 1-2 |
| 5 | Kadlura (KDR) | 100-150 | 10YR3/1,3/2,4/1, 5/2 | Sc-c | - | Ap- Bw | 1-2 |
| 6 | Sowrashtrahalli (SWR) | 100-150 | 10YR4/1,3/2,3/1 | c | | Ap- Bss | 1-2 |
| 7 | Hegganakera (HGN) | >150 | 10YR4/2,4/1,3/1, 4/1 | c | | Ap- Bss | 1-2 |

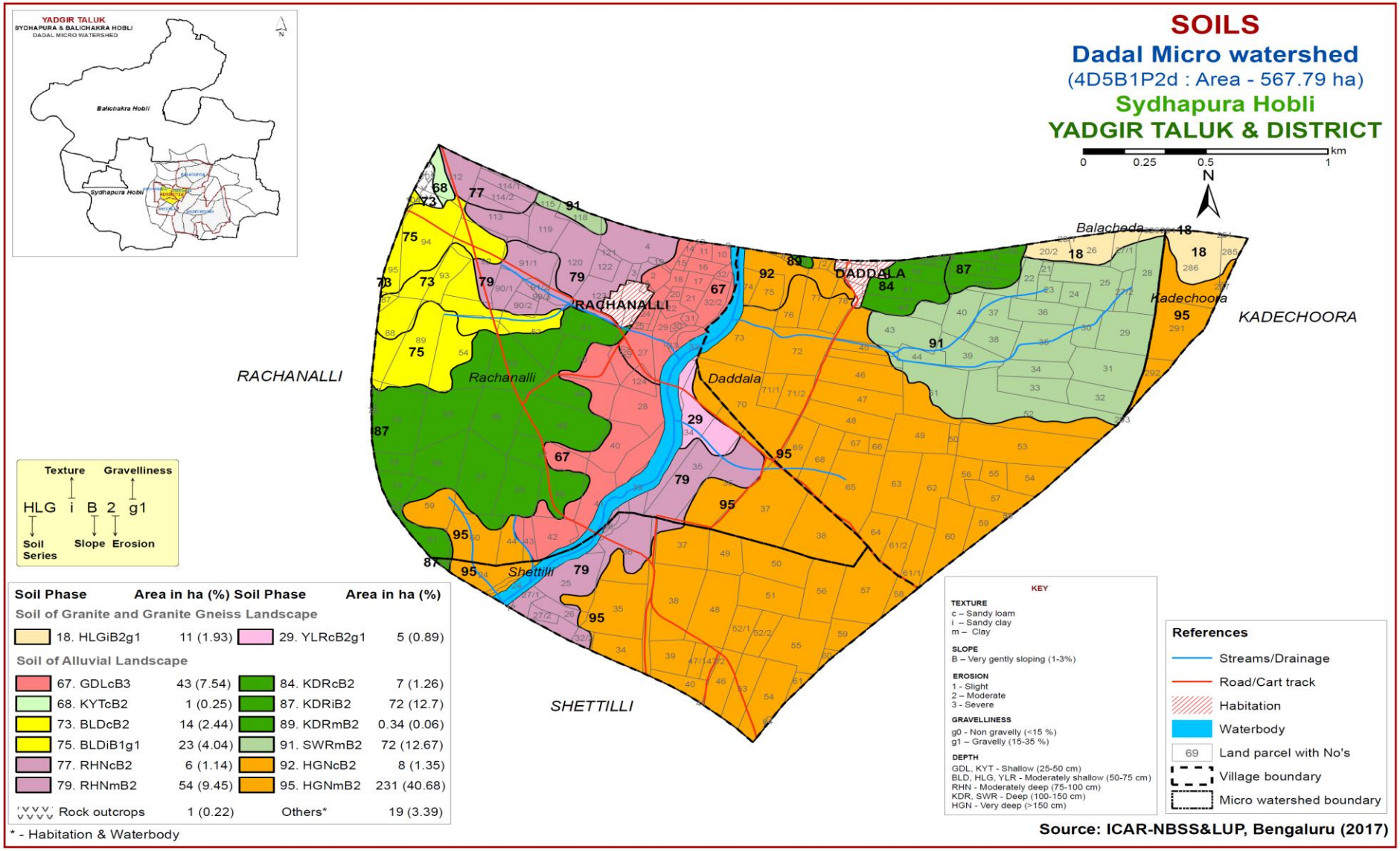



Fig 3.4 Soil phase or management units map of Dadal Microwatershed

### 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 in the year 2017 from farmer's fields (28 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 for 11 elements including pH and EC were generated using kriging for the microwatershed.

### 3.5 Finalization of Soil Maps

The area under each soil series was further separated and mapped as 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 9 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 15 mapping units representing 9 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 15 phases identified and 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 15 soil phases identified and mapped in the microwatershed were regrouped into 4 land use classes (LUC's) for the purpose of preparing a proposed crop plan for sustained development of the microwatershed. The database (soil phases) generated under LRI was utilized for identifying land use classes (LUC's) based on the management needs. One or more than one soil site characteristic having influence on the management have been choosen for identification and delineation of LUCs. For Dadal microwatershed, five soil and site characteristics, namely soil depth, soil texture, slope, erosion and gravel content have been considered for defining LUCs. The land use classes are expected to behave similarly for a given level of management.

**Table 3.2 Soil Map Unit description of Dadal microwatershed**

| Soil Series | Map Symbol | Soil Map Unit | Mapping Unit Description | Area in ha (%) |
|---|---|---|---|---|
| **Soil of Granite and Granite Gneiss Landscape** | | | | |
| HLG | Halagere soils are moderately shallow (50-75 cm), moderately well drained, have very dark grayish brown to dark yellowish brown, calcareous sandy clay to clay soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation. | | | **11.0 (1.93)** |
| 1 | HLGiB 2g1 | Sandy clay surface, slope 1-3%, moderate erosion, gravelly (15-35%) | | 11.0 (1.93) |
| YLR | Yalleri soils are moderately shallow (50-75 cm), well drained, have very dark reddish brown to dark brown gravelly sandy clay red soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation. | | | **5.0 (0.89)** |
| 2 | YLRcB 2g1 | Sandy loam surface, slope 1-3%, moderate erosion, gravelly (15-35%) | | 5.0 (0.89) |
| **Soil of Alluvial Landscape** | | | | |
| GDL | Gudalagunta soils are shallow (25-50 cm), well drained, have very dark gray, calcareous cracking sandy clay to clay soils. They have developed from alluvium and occur on very gently to gently sloping uplands under cultivation. | | | **43.0 (7.54)** |
| 3 | GDLcB 3 | Sandy loam surface, slope 1-3%, severe erosion | | 43.0 (7.54) |
| KYT | Kyathanala soils are shallow (25-50 cm), well drained, have dark brown to strong brown and dark reddish brown sandy clay loam to sandy clay calcareous soils. They have developed from alluvium and occur on very gently sloping plains under cultivation. | | | **1.0 (0.25)** |
| 4 | KYTcB 2 | Sandy loam surface, slope 1-3%, moderate erosion | | 1.0 (0.25) |
| BLD | Balched soils are moderately shallow (50-75 cm), moderately well drained, have black to very dark grayish brown calcareous clay soils. They are developed from alluvium and occur on very gently to gently sloping plains under cultivation. | | | **37.0 (6.48)** |
| 5 | BLDcB 2 | Sandy loam surface, slope 1-3%, moderate erosion | | 14.0 (2.44) |
| 6 | BLDiB1 g1 | Sandy clay surface, slope 1-3%, slight erosion, gravelly (15-35%) | | 23.0 (4.04) |
| RHN | Rachanalli soils are moderately deep (75-100 cm), moderately | | | **60.0** |

| | | | |
|---|---|---|---|
| | well drained, very dark grayish brown to dark brown calcareous cracking sandy clay and clay soils. They have developed from alluvium and occur on very gently to gently sloping plains under cultivation. | | **(10.59)** |
| 7 | RHNcB2 | Sandy loam surface, slope 1-3%, moderate erosion | 6.0 (1.14) |
| 8 | RHNmB2 | Clay surface, slope 1-3%, moderate erosion | 54.0 (9.45) |
| KDR | Kudlura soils are deep (100-150 cm), moderately well drained, very dark gray to grayish brown, calcareous cracking sandy clay to clay soils. They have developed from alluvium and occur on nearly level to very gently sloping plains under cultivation. | | **79.34 (14.02)** |
| 9 | KDRcB2 | Sandy loam surface, slope 1-3%, moderate erosion | 7.0 (1.26) |
| 10 | KDRiB2 | Sandy clay surface, slope 1-3%, moderate erosion | 72.0 (12.7) |
| 11 | KDRmB2 | Clay surface, slope 1-3%, moderate erosion | 0.34 (0.06) |
| SWR | Sowrashtrahalli soils are deep (100-150 cm), moderately well drained, very dark gray to dark gray calcareous black cracking clay soils. They have developed from alluvium and occur on very gently to gently sloping uplands under cultivation. | | **72.0 (12.67)** |
| 12 | SWRmB2 | Clay surface, slope 1-3%, moderate erosion | 72.0 (12.67) |
| HGN | Hegganakera soils are very deep (>150 cm), moderately well drained, very dark gray to dark grayish brown calcareous black cracking clay soils. They have developed from alluvium and occur on very gently to gently sloping uplands under cultivation. | | **239.0 (42.03)** |
| 13 | HGNcB2 | Sandy loam surface, slope 1-3%, moderate erosion | 8.0 (1.35) |
| 14 | HGNmB2 | Clay surface, slope 1-3%, moderate erosion | 231.0 (40.68) |
| 15 | | Rock lands | 1.0 (0.22) |
| **MISCELLANEOUS LAND** | | | |
| | Others | | 19.0 (3.39) |

*Chapter 4*

# THE SOILS

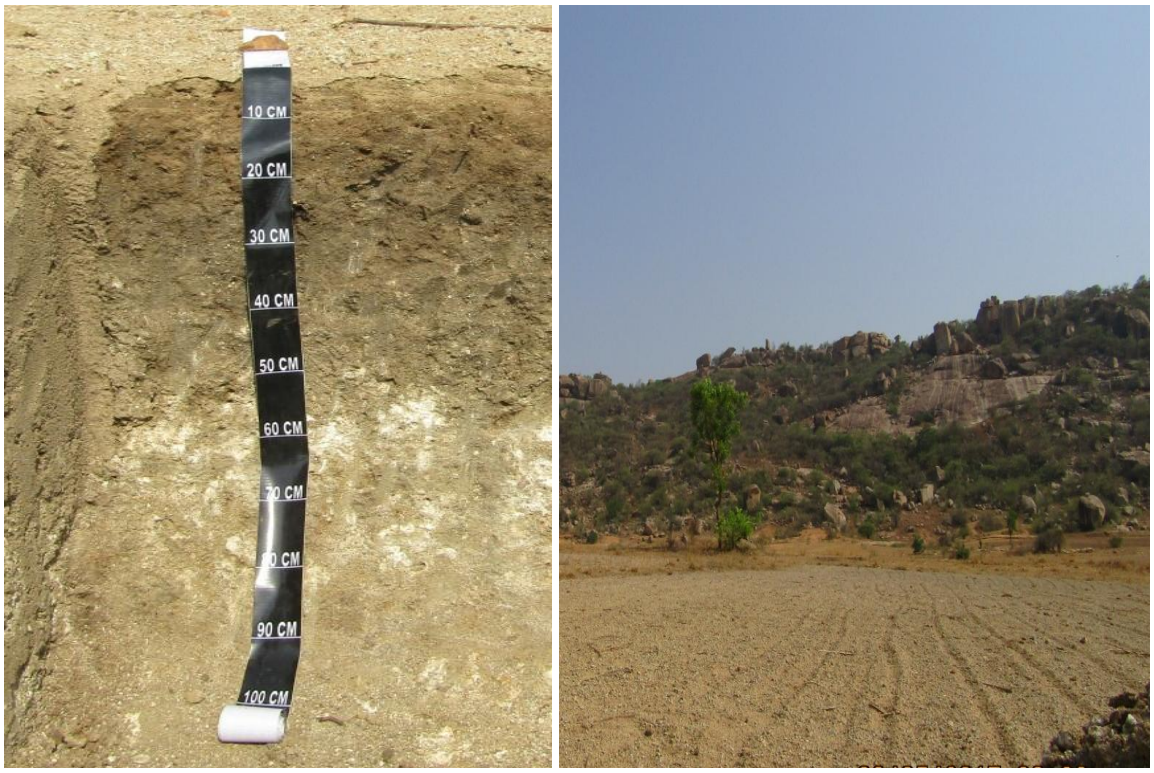
Detailed information pertaining to the nature, extent and distribution of different kinds of soils occurring in Dadal microwatershed is provided in this chapter. The microwatershed area has been identified as granite gneiss and alluvial landscape. In all, 9 soil series were identified in these landscapes. Soil formation is the result of the combined effect of environmental and terrain factors that are reflected in soil morphology. In the granite gneiss and alluvial landscapes, it is by parent material, time and climate. A brief description of each of the 9 soil series identified followed by 15 soil phases (management units) mapped under each series 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 and Granite Gneiss Landscape

In this landscape, 2 soil series are identified and mapped and occupy small area in the microwatershed. Halagere (HGL) soil series occupies an area of about 11 ha (2%) followed by Yalleri (YLR) about 5 ha (1%). The brief description of these two series along with the soil phases identified and mapped is given below.

**4.1.1 Halagere (HLG) Series:** Halagere soils are moderately shallow (50-75 cm), moderately well drained, have very dark grayish brown to dark yellowish brown, calcareous sandy clay to clay soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation.

The thickness of the solum ranges from 51 to 75 cm. The thickness of A horizon ranges from 9 to 15 cm. Its colour is in 7.5 YR and 10 YR hue with value 3 to 4 and chroma 2 to 4. The texture is loamy sand to sandy clay loam. The thickness of B horizon ranges from 44 to 66 cm. Its colour is in 10 YR and 7.5 YR hue with value 3 to 4 and chroma 2 to 3. Its texture is sandy clay loam to clay loam and sandy clay. The available water capacity is low (51-100 mm/m). Only one phase was identified and mapped.




Landscape and Soil Profile characteristics of Halagere (HLG) Series

**4.1.2 Yalleri (YLR) Series:** Yalleri soils are moderately shallow (50-75 cm), well drained, have very dark reddish brown to dark brown gravelly sandy clay red soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation.

The thickness of the solum ranges from 50 to 74 cm. The thickness of A horizon ranges from 10 to 13 cm. Its colour is in 7.5 YR and 5 YR hue with value and chroma 2 to 4. The texture is sandy loam, loamy sand, and sandy clay loam. The thickness of B horizon ranges from 45 to 64 cm. Its colour is in 10 YR, 7.5 YR and 5 YR hue with value 2 to 4 and chroma 2 to 4. Its texture is sandy clay with gravel content of 15-35 per cent. The available water capacity is very low (<50 mm/m).Only one phase was identified and mapped.

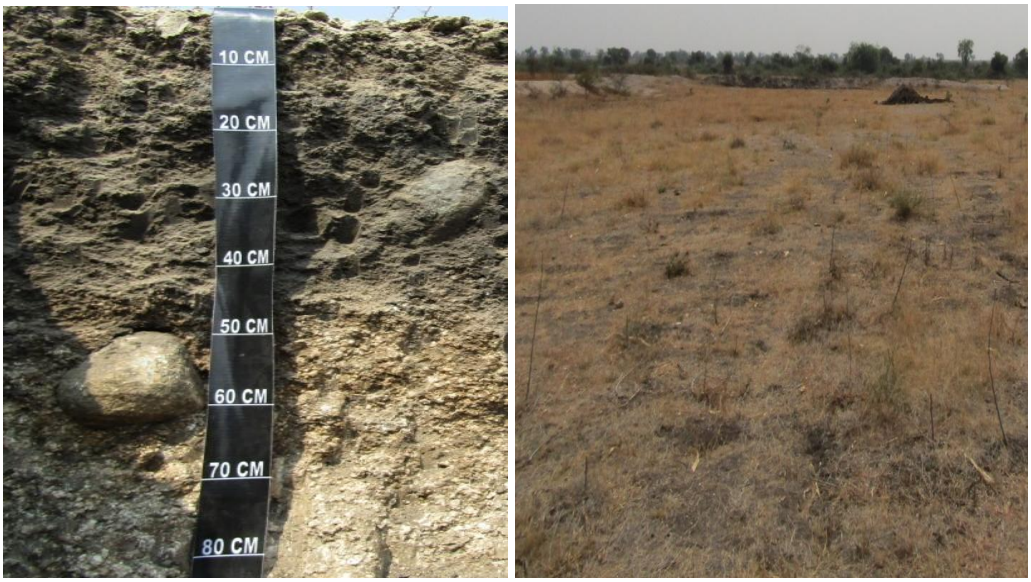

Landscape and Soil Profile characteristics of Yalleri (YLR) Series

**4.2 Soils of Alluvial Landscape**

In this landscape, 7 soil series are identified and mapped. Kadlura Hegganakera (HGN) soil series occupies major area of about 239 ha (42%) followed by Kadlura (KDR) about 79 ha (14%). The brief description of each soil series along with the soil phases identified and mapped is given below.

**4.2.1 Gudalagunta (GDL) Series:** Gudalagunta soils are shallow (25-50 cm), well drained, have very dark gray, calcareous cracking sandy clay to clay soils. They have developed from alluvium and occur on very gently sloping plains under cultivation.

The thickness of the solum ranges from 26 to 49 cm. The thickness of A horizon ranges from 6 to 13 cm. Its colour is in 10YR hue with value 3 to 4 and chroma 1 to 3. The texture is sandy clay. The thickness of B horizon ranges from 22 to 42 cm. Its colour is in 10 YR hue with value 3 to 4 and chroma 1 to 2. Its texture is clay and is calcareous. The available water capacity is low (51-100 mm/m). Only one phase was identified and mapped.




Landscape and Soil Profile characteristics of Gudalagunta (GDL) Series

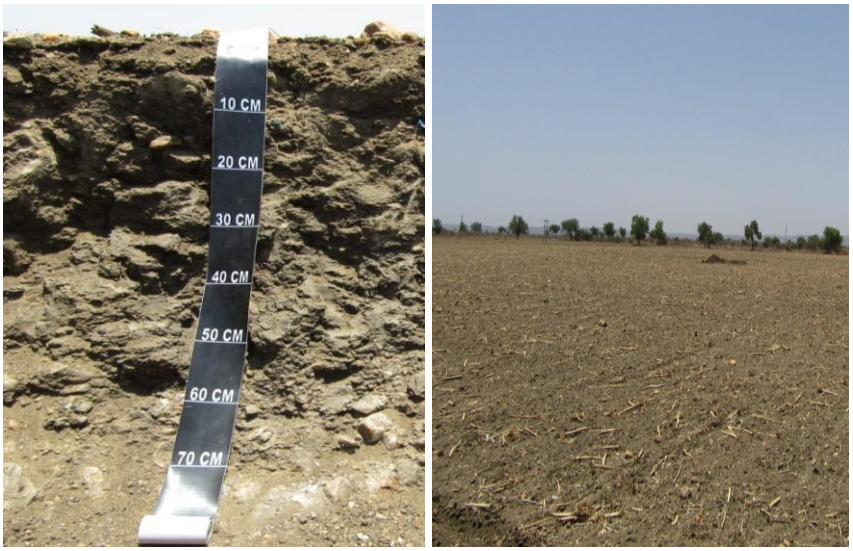
**4.2.2 Kyathanala (KYT) Series:** Kyathanala soils are shallow (25-50 cm), well drained, have dark brown to strong brown and dark reddish brown sandy clay loam to sandy clay calcareous soils. They have developed from alluvium and occur on very gently sloping plains under cultivation.

The thickness of the solum ranges from 25 to 49 cm. The thickness of A horizon ranges from 5 to 11 cm. Its colour is in 5YR hue with value and chroma of 3 to 4. The texture is sandy clay. The thickness of B horizon ranges from 20 to 44 cm. Its colour is in 5 YR and 7.5 YR hue with value 3 to 4 and chroma 4 to 6. Its texture is sandy clay loam to sandy clay. The available water capacity is low (51-100 mm/m). Only one phase was identified and mapped.


Landscape and Soil Profile characteristics of Kyathanala (KYT) Series

**4.2.3 Balched (BLD) Series:** Balched soils are moderately shallow (50-75 cm), moderately well drained, have black to very dark grayish brown calcareous cracking clay soils. They are developed from alluvium and occur on very gently sloping plains under cultivation.

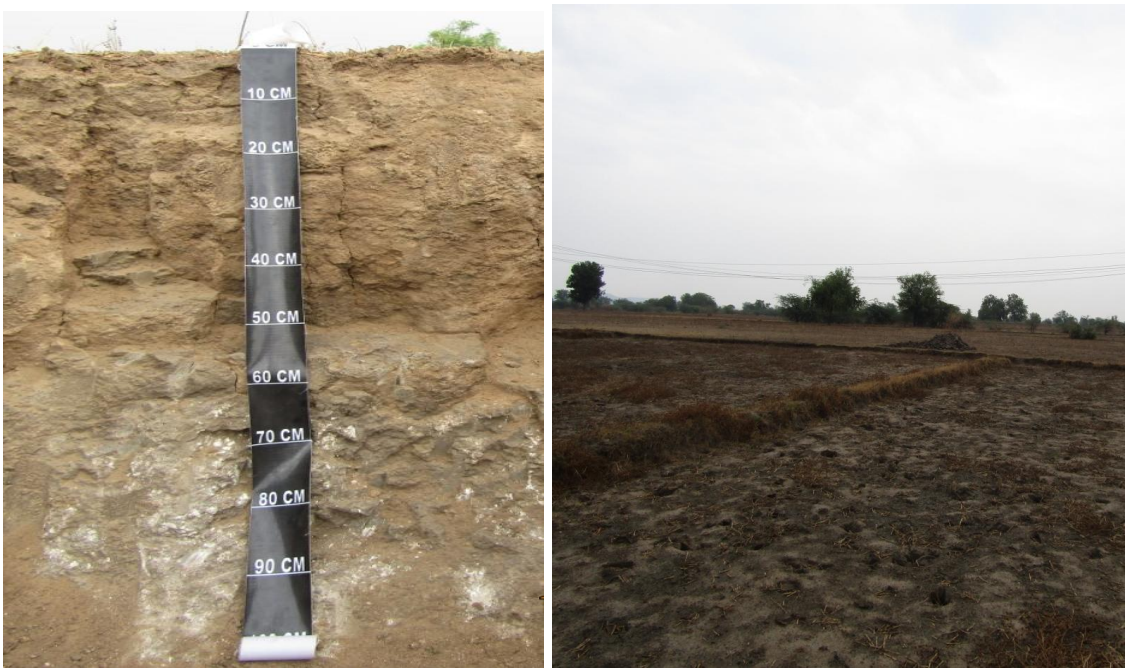
The thickness of the solum ranges from 50-75 cm. Thickness of A horizon ranges from 5 to 10 cm. Its colour is in hue 10 YR and 7.5 YR with value 3 to 4 and chroma 1to 3. The texture varies from sandy clay to clay. The thickness of B horizon ranges from 41 to 69 cm. Its colour is in 10 YR hue with value 2 to 4 and chroma 1 to 2. The texture is dominantly clay and is calcareous. The available water capacity is high (150-200 mm/m). Two phases were identified and mapped.




Landscape and Soil Profile characteristics of Balched (BLD) Series

**4.2.4 Rachanalli (RHN) Series:** Rachanalli soils are moderately deep (75-100 cm), moderately well drained, very dark grayish brown to dark brown sandy clay calcareous cracking clay soils. They have developed from alluvium and occur on very gently sloping plains under cultivation.

The thickness of the solum ranges from 76 to 100 cm. The thickness of A horizon ranges from 6 to 13 cm. Its colour is in hue 10 YR with value 3 to 4 and chroma 2 to 4. Its texture varies from sandy loam to sandy clay loam and sandy clay. The thickness of B horizon ranges from 66 to 92 cm. Its colour is in hue 10 YR with value 3 to 4 and chroma 1 to 3. Its texture is sandy clay and clay. The available water capacity is high (150-200 mm/m).Two phases were identified and mapped.




Landscape and Soil Profile characteristics of Rachanalli (RHN) Series

**4.2.5 Kadlura (KDR) Series:** Kudlura soils are deep (100-150 cm), moderately well drained, very dark gray to grayish brown, calcareous cracking sandy clay to clay soils. They have developed from alluvium and occur on nearly level to very gently sloping plains under cultivation.

The thickness of the solum ranges from 110 to 149 cm. The thickness of A horizon ranges from 6 to 22 cm. Its colour is in 10 YR hue with value 3 to 4 and chroma 1 to 2. The texture ranges from sandy loam, sandy clay loam, sandy clay and clay. The thickness of B horizon ranges from 115 to 143 cm. Its colour is in 10 YR hue with value 3 to 4 and chroma 1 to 3. Texture is sandy clay loam, sandy clay to clay and is calcareous in nature. The available water capacity is very high (>200 mm/m).Three phases were identified and mapped.


Landscape and Soil Profile characteristics of Kudlura (KDR) Series

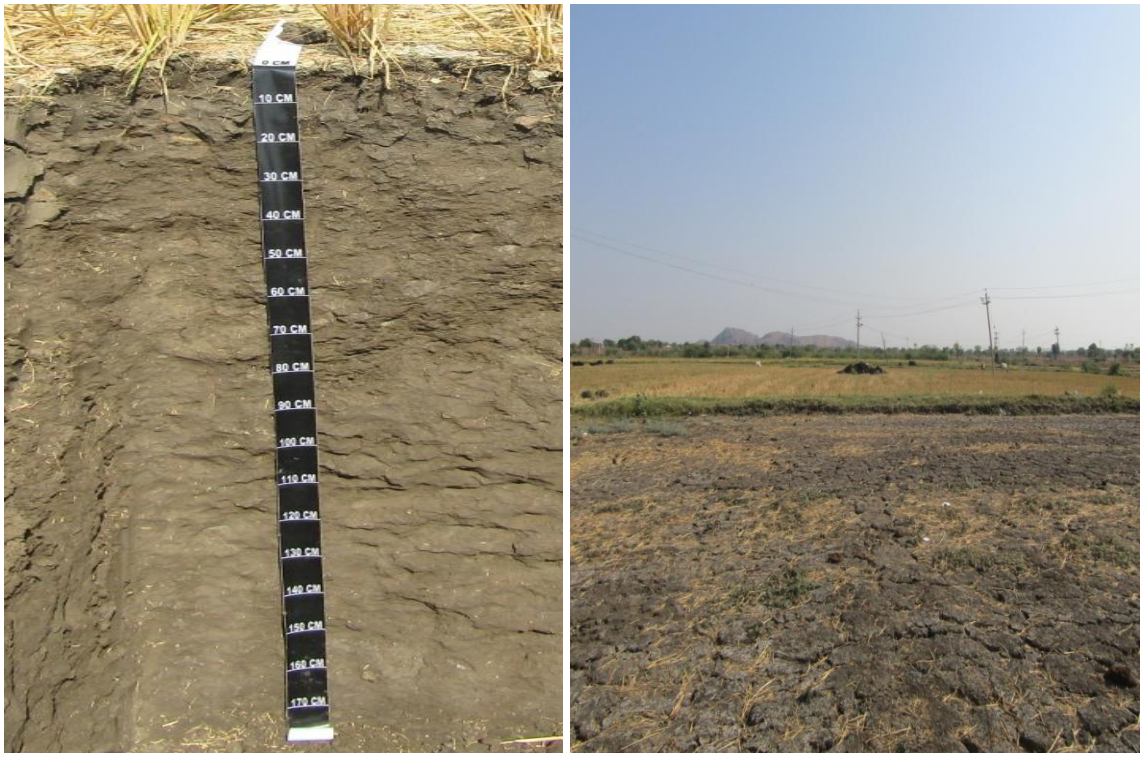
**4.2.6 Sowrashtrahalli (SWR) Series:** Sowrashtrahalli soils are deep (100-150 cm), moderately well drained very dark gray to dark gray calcareous black cracking clay soils. They have developed from alluvium and occur on very gently sloping plains under cultivation.

The thickness of the solum ranges from 107 to 150 cm. The thickness of A horizon ranges from 7 to 13 cm. Its colour is in 10 YR hue with value 2 to 4 and chroma 1 to 2. The texture varies from sandy clay to clay. The thickness of B horizon ranges from 104 to 142 cm. Its colour is in 10 YR hue with value 2 to 4 and chroma 1 to 2. The texture is clay and is calcareous. The available water capacity is very high (>200 mm/m). Only one phase was identified and mapped.


Landscape and Soil Profile characteristics of Sowrashtrahalli (SWR) Series

**4.2.7 Hegganakera (HGN) Series:** Hegganakera soils are very deep (>150 cm), moderately well drained, very dark gray to dark grayish brown calcareous black cracking clay soils. They have developed from alluvium and occur on very gently sloping plains under cultivation.

The thickness of the solum is more than 150 cm. The thickness of A horizon ranges from 7 to 9 cm. Its colour is in 10 YR hue with value 3 to 4 and chroma 1 to 3 with clay texture. The thickness of B horizon ranges from 152 to 175 cm. Its colour is in 10 YR hue with value 2 to 4 and chroma 1 to 3. Its texture is clay. The available water capacity is very high (>200 mm/m).Two phases were identified and mapped.




Landscape and Soil Profile characteristics of Hegganakera (HGN) 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, soil texture, coarse fragments, available water capacity, soil slope, soil erosion, soil reaction etc. These are interpreted from the data base generated through land resource inventory and several thematic maps are generated. These would help in identifying the areas suitable for growing crops and, soil and water conservation measures and structures needed thus helping to maintain good soil health for sustained crop production. The various thematic maps generated are described below.

## 5.1 Land Capability Classification

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The 15 soil map units identified in the Dadal microwatershed are grouped under 2 land capability classes and 3 land capability subclasses. About 96 per cent area in the microwatershed is suitable for agriculture (Fig. 5.1) and 4 per cent is not suitable for agriculture but well suited for grazing or forestry, recreation and wildlife.

Good cultivable lands (Class II) cover about 89 per cent area and are distributed in all parts of the micowatershed with minor problems of soil and erosion. Moderately good cultivable lands (Class III) cover an area of about 8 per cent and are distributed in the central and northern part of the microwatershed with moderate problems of soil and erosion.

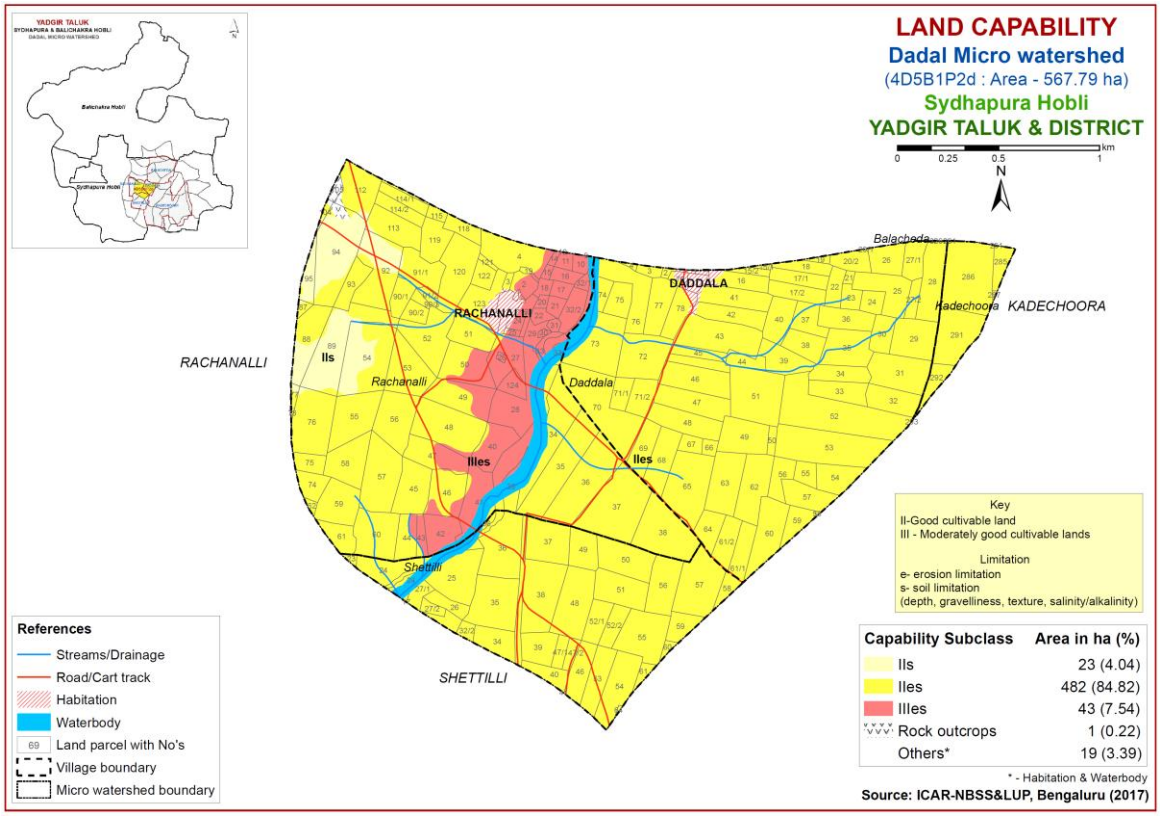



Fig. 5.1 Land Capability map of Dadal Microwatershed

## 5.2 Soil Depth

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

Deep soils (100-150 cm) occur in about 152 ha (27%) and are distributed in the northeastern, western and northwestern part of the microwatershed. Very deep soils (>150 cm) occur in maximum area of about 239 ha (42%) and are distributed in the southern, northern, eastern, northeastern and southwestern part of the microwatershed. Moderately deep soils (75-100 cm) occur in an area of about 60 ha (11%) and are distributed in the southwestern, central and northwestern part of the microwatershed. An area of about 53 ha (9%) is moderately shallow soils (50-75 cm) and are distributed in the northwestern, northeastern and central part of the microwatershed. Shallow soils (25-50 cm) occupy an area of about 44 ha (8%) and are distributed in the central, northern and western part of the microwatershed.

The most productive lands coverng about 391 ha (69%) with respect to soil rooting depth where all climatically adapted annual and perennial crops can be grown are deep (100-150 cm) to very deep (>150 cm) occurring in all parts of the microwatershed.

The most problem lands with an area of about 44 ha (8%) having shallow (25-50 cm) rooting depth occur in the central, northern and western part of the microwatershed. They are not suitable for growing agricultural crops but well suited for pasture, forestry or other recreational purposes. Occasionally, short duration crops may be grown if rainfall is normal.

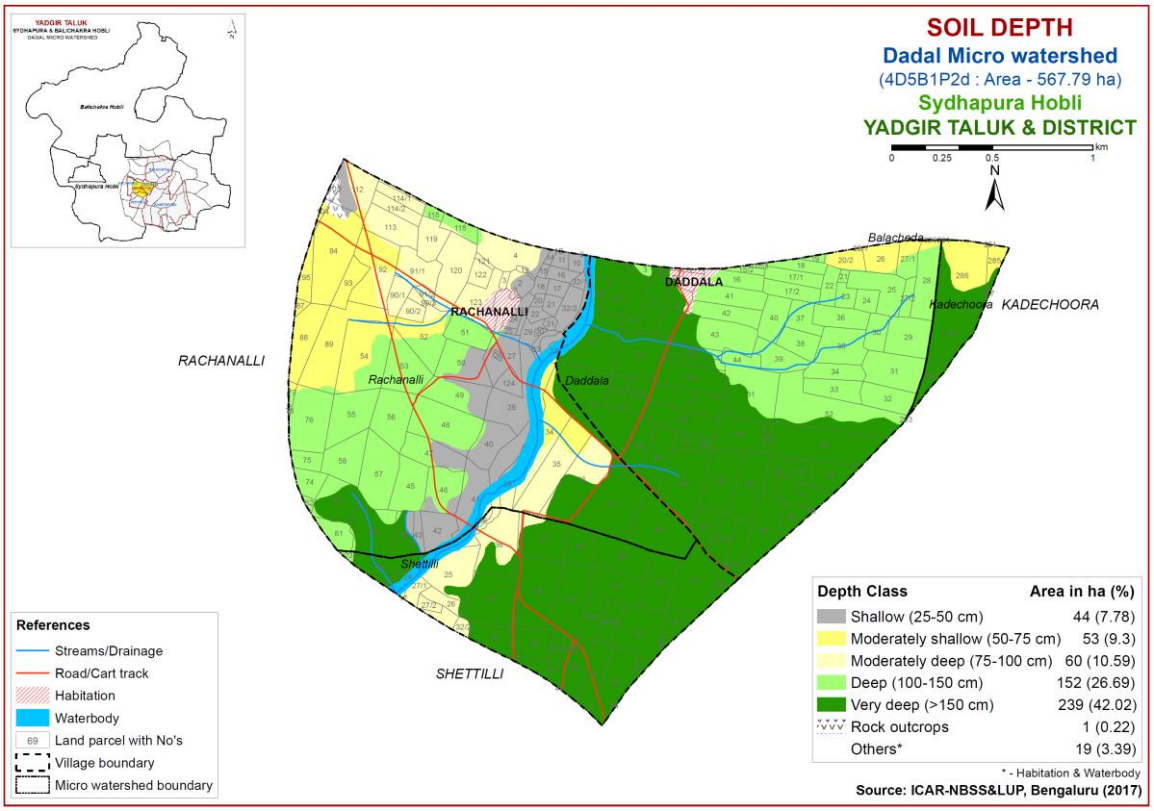



Fig. 5.2 Soil Depth map of Dadal Microwatershed

### 5.3 Surface Soil Texture

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

Maximum area of about 463 ha (81%) is clayey soils and are distributed in all parts of the microwatershed. Loamy soils occupy an area of about 84 ha (15%) distributed in the central, northern, northwestern and northeastern part of the microwatershed.

The most productive lands (86%) with respect to surface soil texture are the loamy and clayey soils (Fig. 5.3). Clayey soils high potential for soil-water retention and availability, and nutrient retention and availability, but have more problems of drainage, infiltration, workability and other physical problems, whereas loamy soils have no problems of drainage, infiltration, workability and other physical problems.

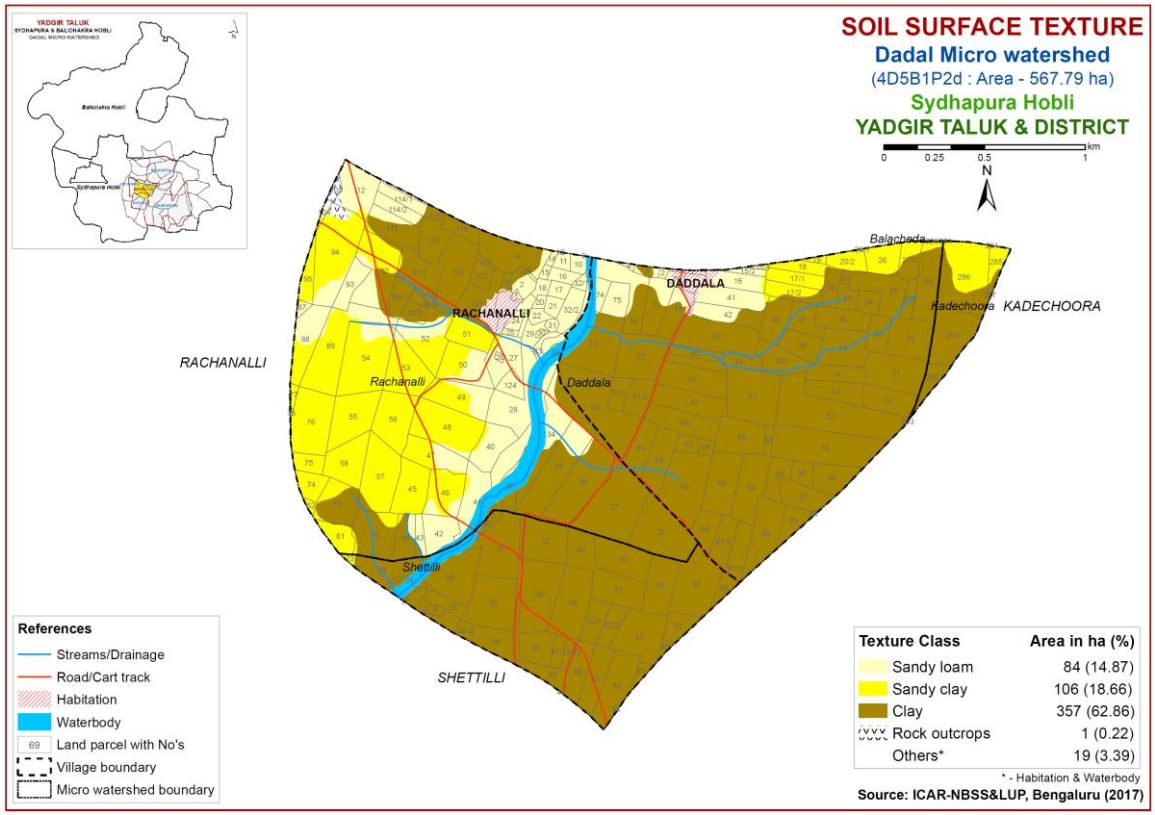



Fig. 5.3 Surface Soil Texture map of Dadal Microwatershed

## 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 the soil reduces the volume of soil responsible for moisture and nutrient storage, drainage, infiltration and runoff and hinders plant growth by impeding root growth and seedling emergence, intercultural operations and farm mechanization. The gravelliness classes used in LRI were used to classify the soils and using these classes a gravelliness map was generated. The area extent and their geographical distribution in the microwatershed is shown in Figure 5.4.

An area has soils that are gravelly (15-35%) covering about 39 ha (7%) and are distributed in the northwestern, northeastern and central part the microwatershed

(Fig.5.4). Maximum area of about 508 ha (90%) in the microwatershed are non gravelly (<15%) and are distributed in all parts of the microwatershed.

The most productive lands with respect to gravelliness are found to be 96 per cent. They are non gravelly (<15%) and gravelly (15-35%) and have potential for growing both annual and perennial crops.

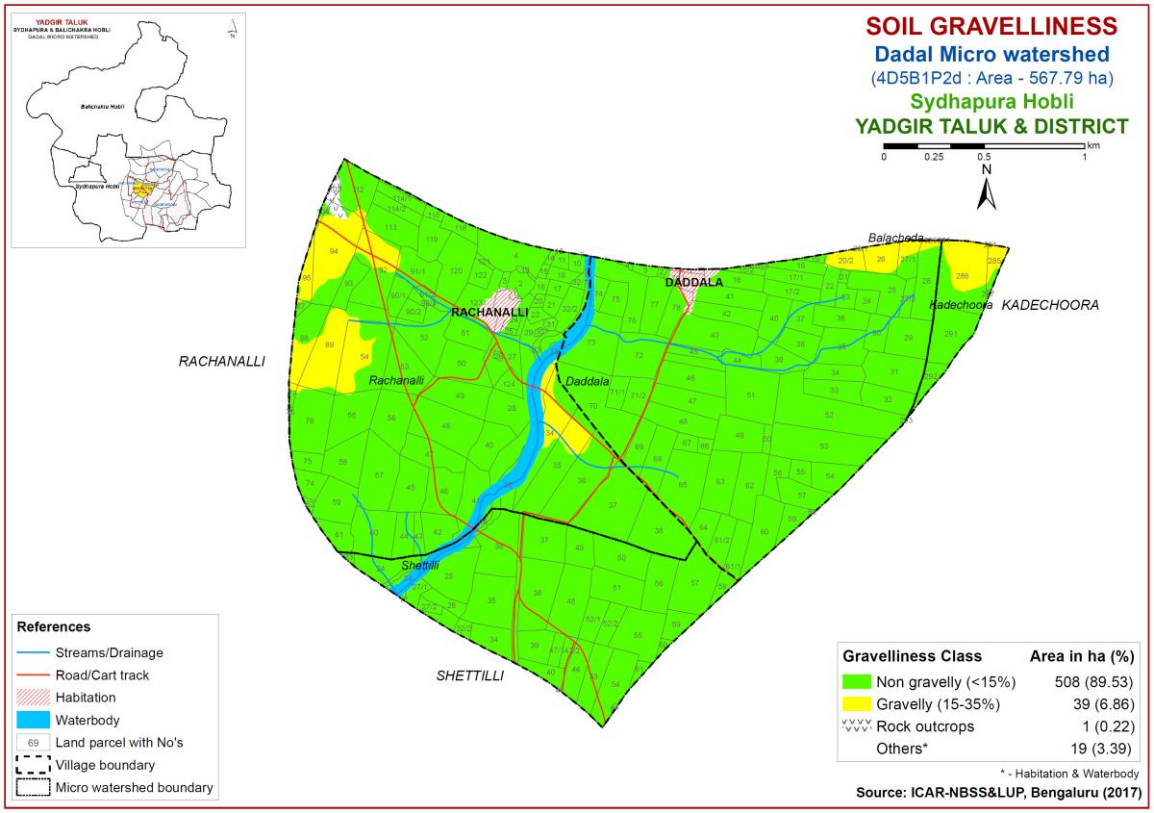



Fig. 5.4 Soil Gravelliness map of Dadal Microwatershed

## 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 classes an AWC map was generated. The area extent and their geographical distribution in the microwatershed is shown in Figure 5.5.

An area of about 44 ha (8%) has soils that are very low (<50 mm/m) in available water capacity and are distributed in the central part of the microwatershed. A small area of about 16 ha (3%) has soils that are low (51-100 mm/m) in available water capacity and are distributed in the central and northeastern part of the microwatershed. An area in the

microwatershed has soils that are medium (101-150 mm/m) in available water capacity. They occur in about 97 ha (17%) and are distributed in the southwestern, central and northwestern part of the microwatershed. The soils that are very high (>200 mm/m) in AWC covering major area of about 390 ha (69%) are distributed in all parts of the microwatershed.

An area of about 390 ha (69%) has soils that have very high potential (>200 mm/m) with regard to available water capacity and are distributed in all parts of the microwatershed. In these areas, if the rainfall is normal and well distributed, all climatically adapted long duration annual and perennial crops can be grown. About 60 ha (11%) area in the microwatershed has soils that are problematic with regard to available water capacity. Here, only the 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.

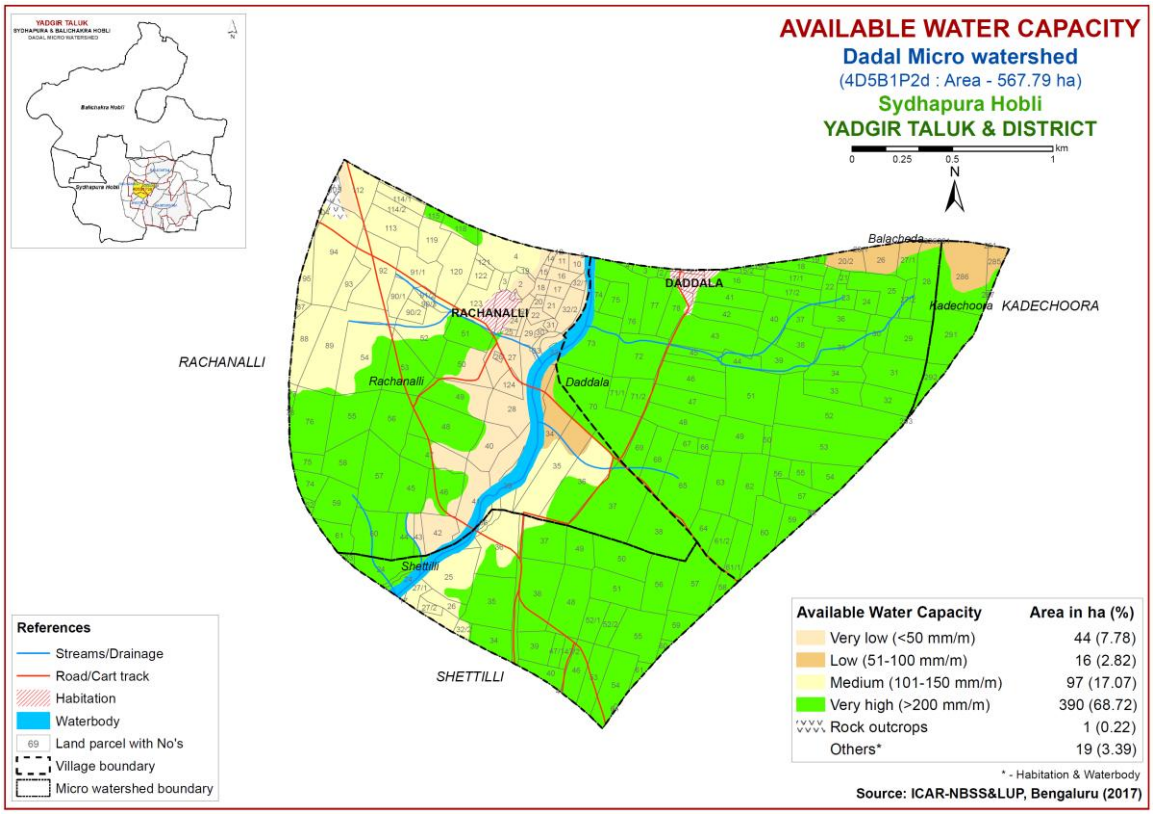



Fig. 5.5 Soil Available Water Capacity map of Dadal Microwatershed

## 5.6 Soil Slope

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

Entire area in the microwatershed falls under very gently sloping (1-3%) slope class. It covers an area of about 547 ha (96%) and is distributed in all parts of the microwatershed.

An area of about 547 ha (96%) 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.

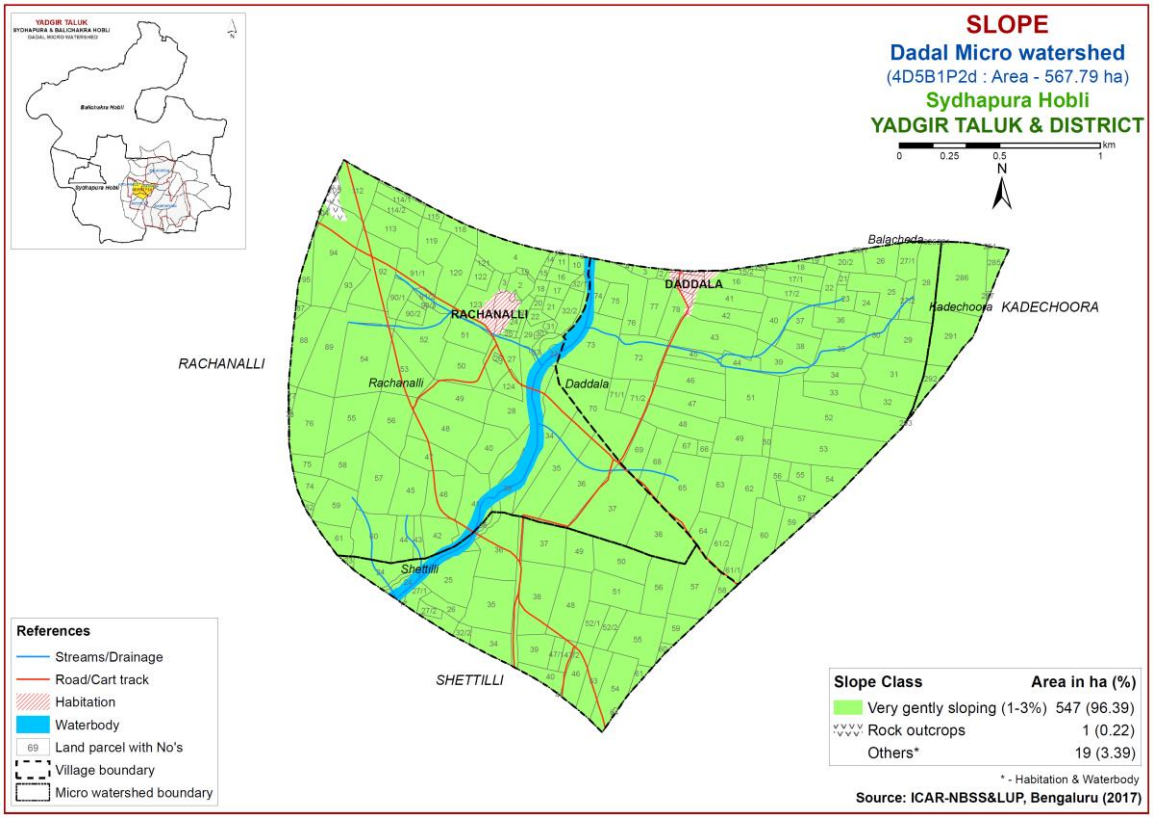



Fig. 5.6 Soil Slope map of Dadal Microwatershed

## 5.7 Soil Erosion

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

Soils that are slightly eroded (e1 class) cover a small area of about 23 ha (4%) and are distributed in northwestern part of the microwatershed. Soils that are moderately eroded (e2 class) cover a major area of about 482 ha (85%) and are distributed in all parts of the microwatershed. Severely eroded (e3 class) soils cover an area of about 43 ha (8%) and are distributed in the central and northern part of the microwatershed.

Top priority is to be given to 43 ha area where they are severely eroded for taking up soil and water conservation and other land development measures followed by moderately eroded lands that cover about 482 ha.

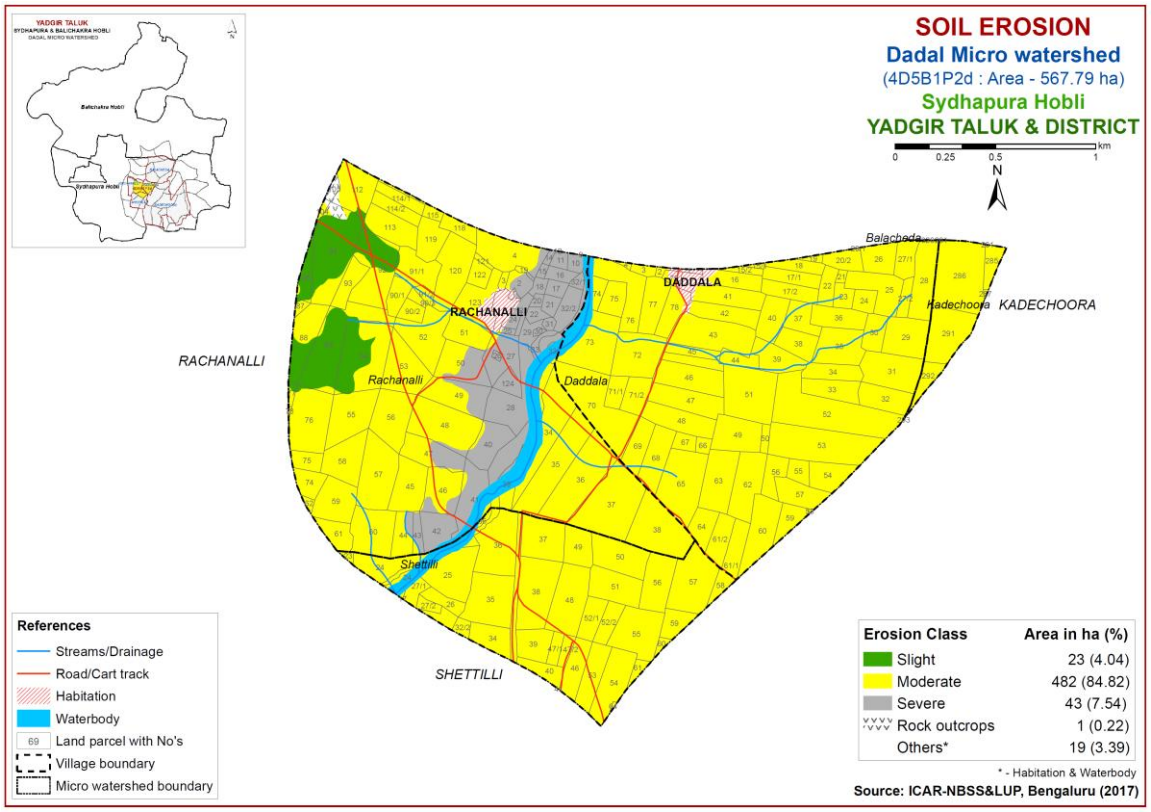



Fig. 5.7 Soil Erosion map of Dadal Microwatershed

*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 (28 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 2017 were analysed for pH, EC, organic carbon, available phosphorus and potassium and for micronutrients like zinc, 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 The village/survey number wise fertility data for the microwatershed is given in Appendix-II.

## 6.1 Soil Reaction (pH)

The soil fertility analysis of the Dadal microwatershed for soil reaction (pH) showed that an area of about 142 ha (25%) is moderately alkaline (pH 7.8-8.4) in reaction and is distributed in the southeastern, eastern, northeastern and northwestern part of the microwatershed (Fig.6.1). Major area of about 348 ha (61%) area is strongly alkaline (pH 8.4-9.0) and is distributed in all parts of the microwatershed. Very strongly alkaline (pH >9.0) is around 57 ha (10%) area and is distributed in the central, northern and southwestern part of the microwatershed.

## 6.2 Electrical Conductivity (EC)

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

## 6.3 Organic Carbon

The soil organic carbon content (Fig.6.3) of the soils in the microwatershed is high (>0.75%) in an area of about 97 ha (17%) that are distributed in the northern, northeastern, eastern and southwestern part of the microwatershed. Medium (0.5-0.75%) organic carbon content accounts major area of about 403 ha (71%) and is distributed in all parts of the microwatershed. Low (<0.5%) organic carbon content accounts an area of about 47 ha (8%) and is distributed in central part of the microwatershed.

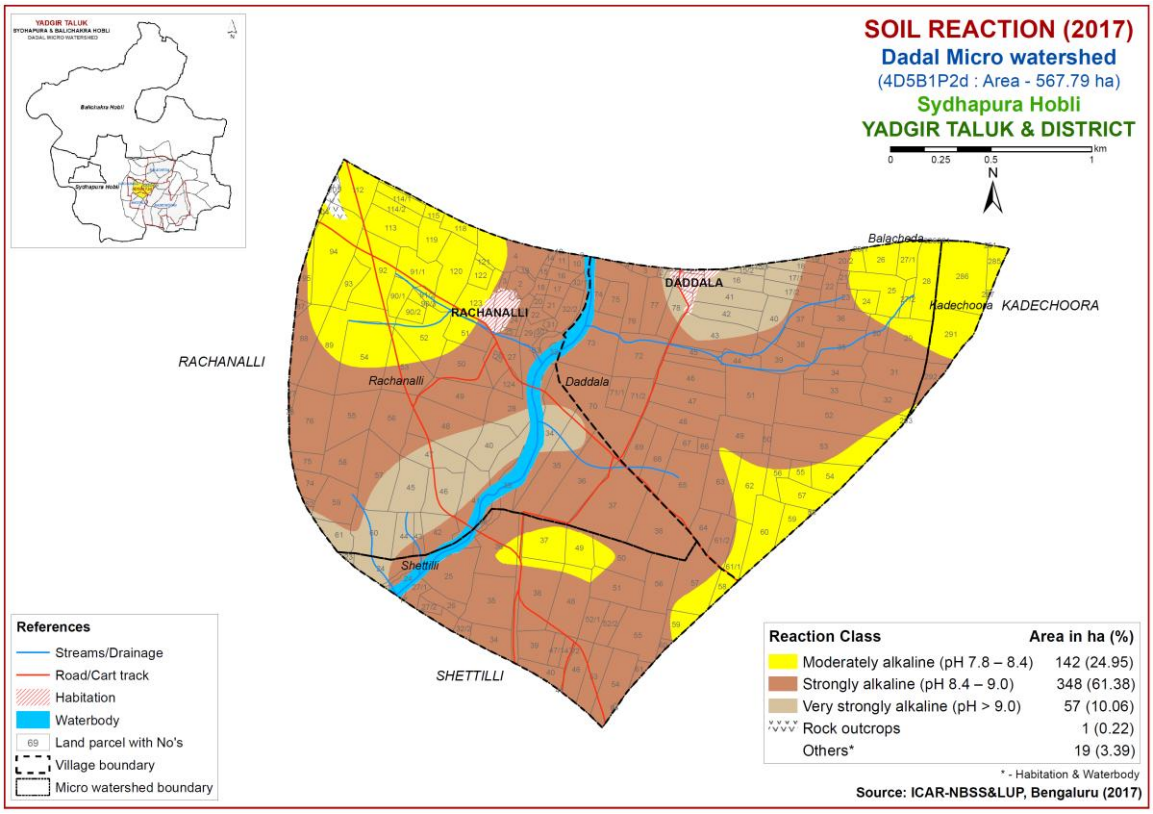



Fig.6.1 Soil Reaction (pH) map of Dadal Microwatershed

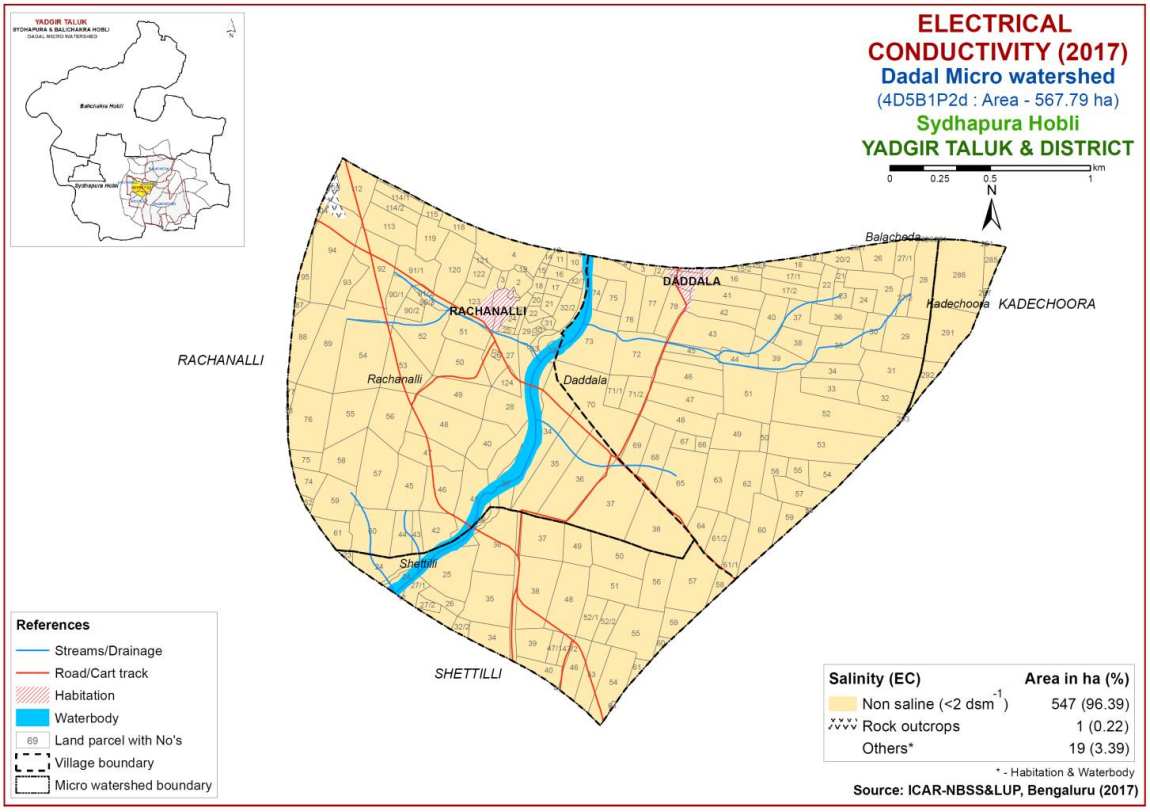



Fig.6.2 Electrical Conductivity (EC) map of Dadal Microwatershed

### 6.4 Available Phosphorus

The soil fertility analysis revealed that available phosphorus (Fig.6.4) is low (<23 kg/ha) in an area of about 128 ha (23%) and is distributed in southern, southwestern, southeastern and northern part of the microwatershed. There is an urgent need to increase the dose of phosphorous for all the crops by 25 per cent over the recommended dose to realize better crop performance. Major area of about 416 ha (73%) is medium (23-57 kg/ha) in available phosphorus and is distributed in all parts of the microwatershed. A very small area of about 4 ha (1%) is high (>57 kg/ha) in available phosphorus and is distributed in the northeastern part of the microwatershed.

### 6.5 Available Potassium

Available potassium content (Fig.6.5) is medium (145-337 kg/ha) in major area of 279 ha (49%) and is distributed in the western, northwestern, central, northeastern and eastern of the microwatershed. High available potassium (>337 kg/ha) content accounts for an area of 268 ha (47%) and is distributed in the southern, southwestern, southeastern, northern, eastern and central part of the microwatershed.

### 6.6 Available Sulphur

Available sulphur content is medium (10-20 ppm) in an area of about 146 ha (26%) and is distributed in the `western, southwestern, southeastern, southern and northern part of the microwatershed. Available sulphur is low (<10 ppm) in major area of 390 ha (69%) and is distributed in all parts of the microwatershed and high (>20 ppm) in very small area of 11 ha (2 %) and are distributed in the southern, western and northern part of the microwatershed (Fig.6.6).

### 6.7 Available Boron

Available boron content (Fig.6.7) is medium (0.5-1.0 ppm) in major area of about 332 ha (58%) and is distributed in all parts of the microwatershed. An area of about 14 ha (2%) is low (<0.5ppm) in available boron and are distributed in the northeastern part of microwatershed. An area of about 201 ha (35%) is high (>1.0 ppm) in available boron and are distributed in the northern, central, eastern and western part of microwatershed.

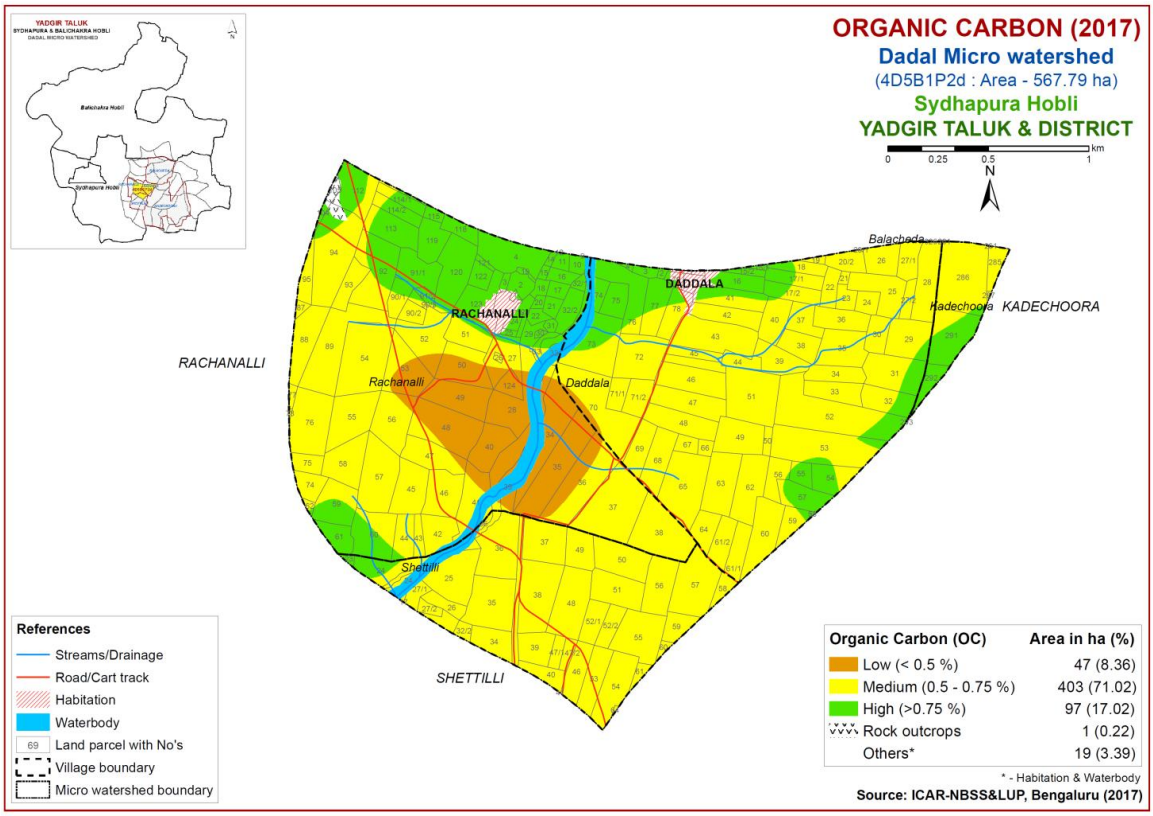



Fig.6.3 Soil Organic Carbon map of Dadal Microwatershed

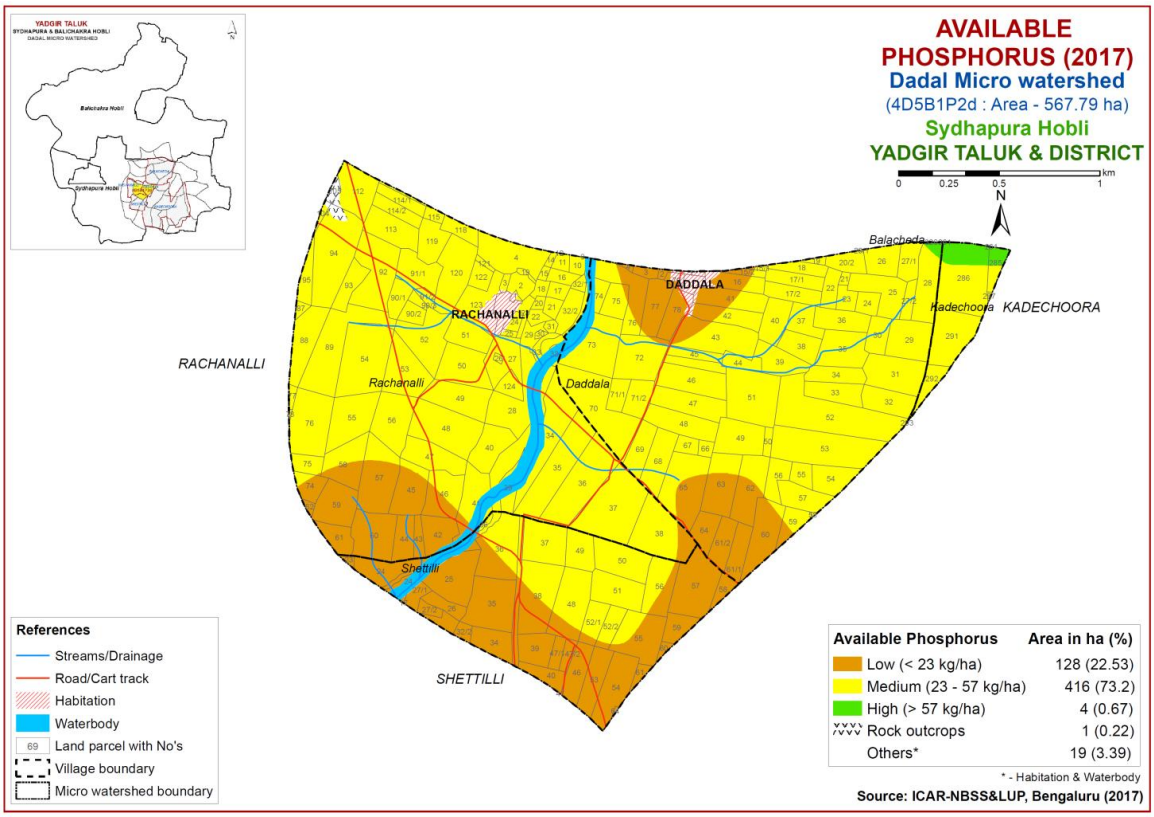



Fig.6.4 Soil available Phosphorus map of Dadal Microwatershed

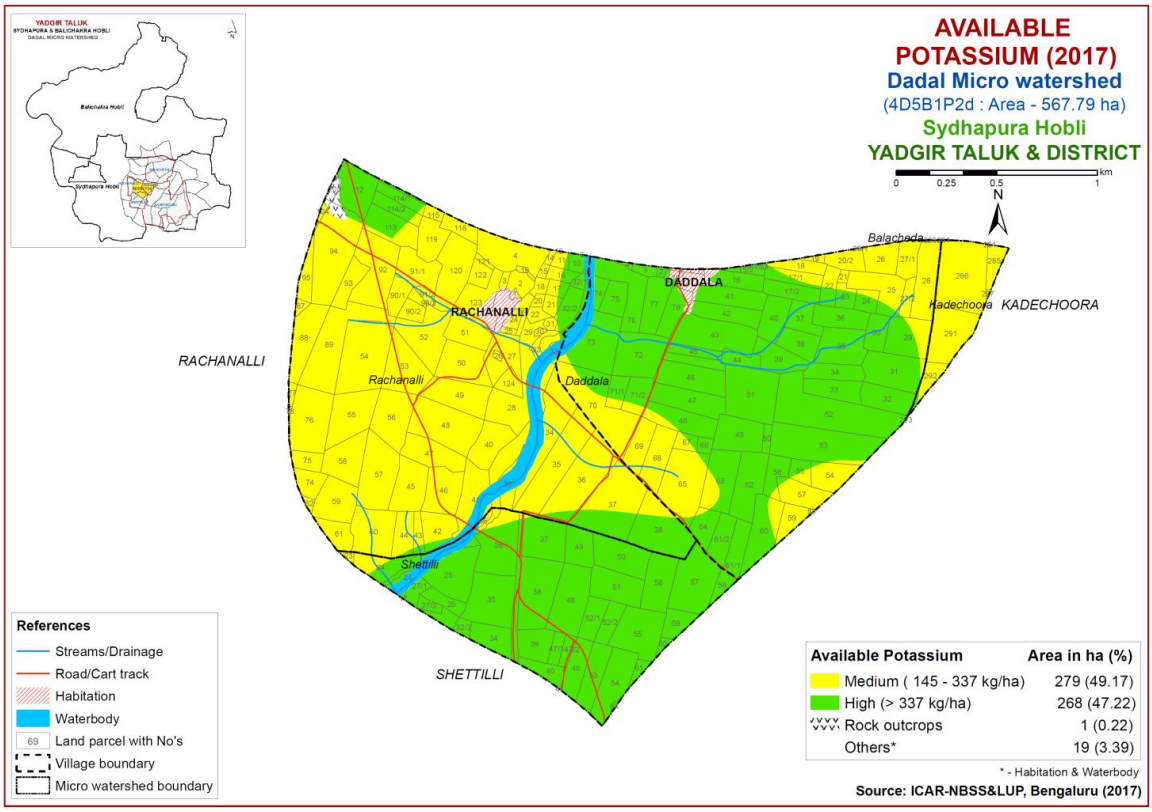



Fig.6.5 Soil available Potassium map of Dadal Microwatershed

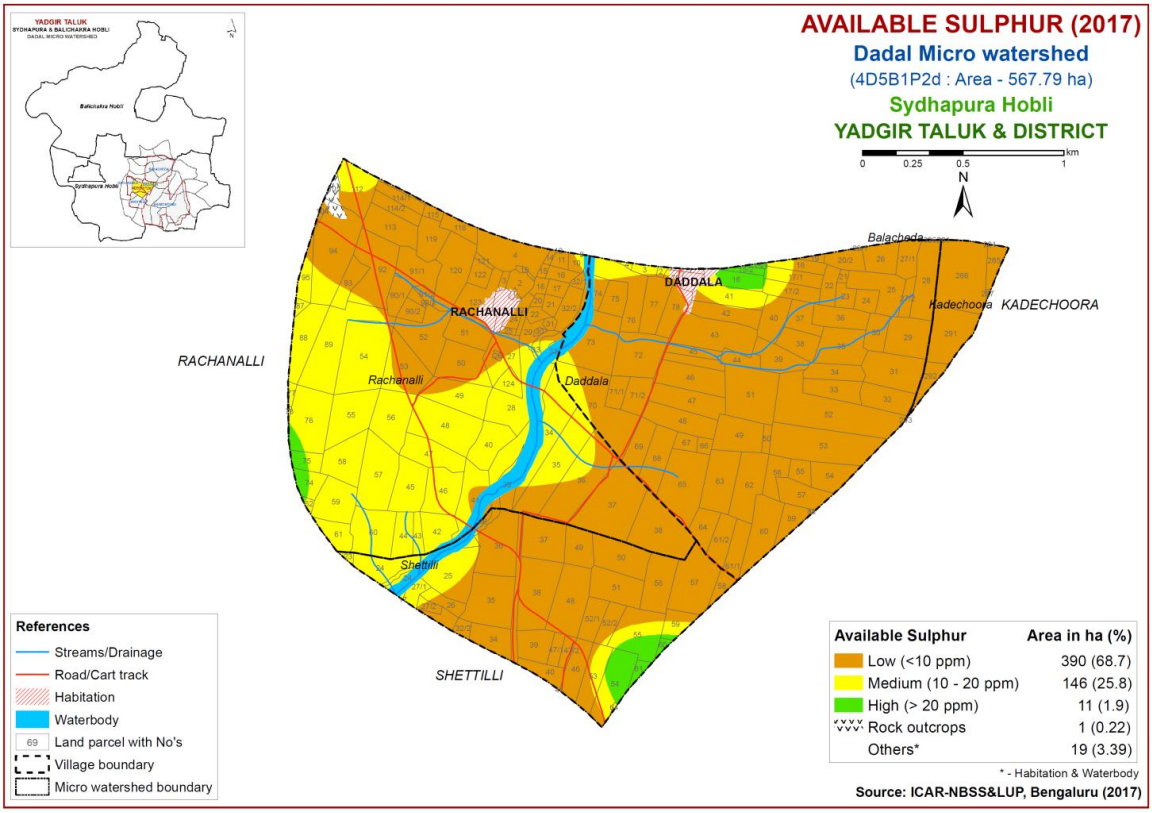



Fig.6.6 Soil available Sulphur map of Dadal Microwatershed

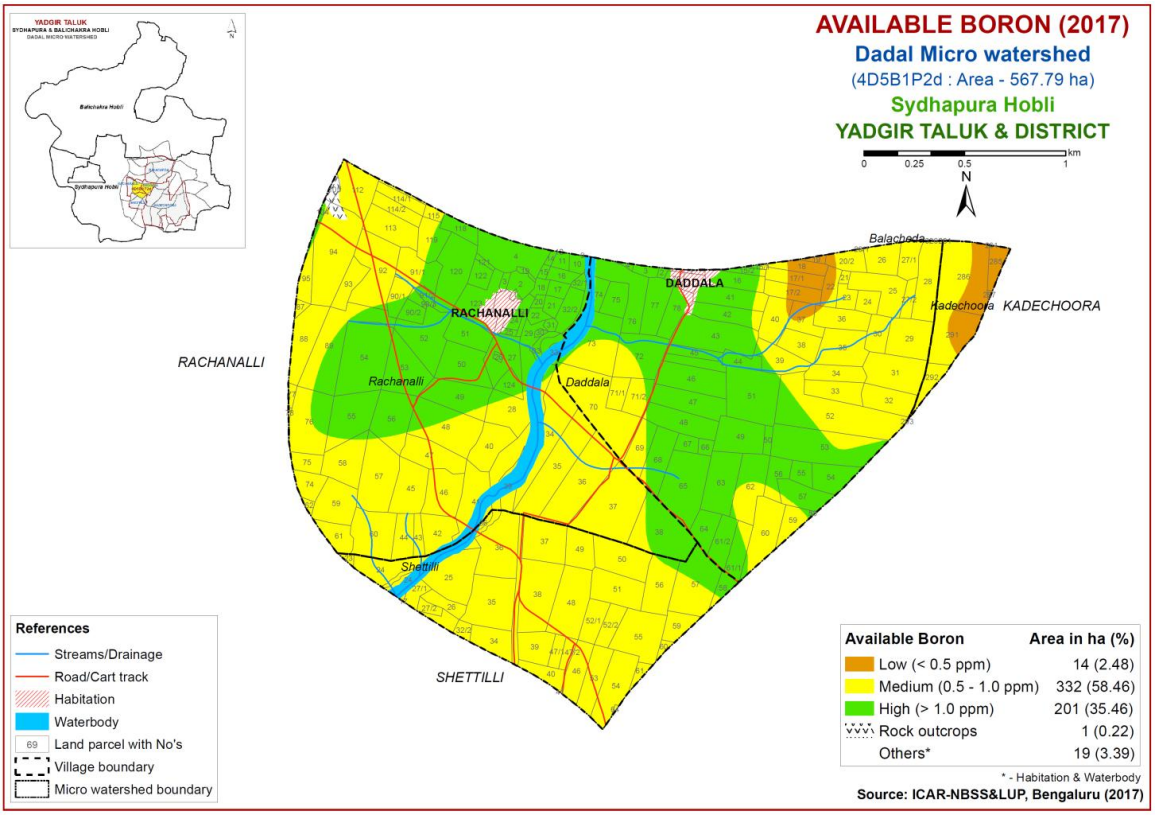



Fig.6.7 Soil available Boron map of Dadal Microwatershed

### 6.8 Available Iron

Available iron content is sufficient (>4.5 ppm) in major area of about 465 ha (82%) and is distributed in all parts of the microwatershed. It is deficient (<4.5 ppm) in an area of about 82 ha (14%) and is distributed in the northern and central part of the microwatershed. (Fig 6.8).

### 6.9 Available Manganese

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

### 6.10 Available Copper

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

### 6.11 Available Zinc

Available zinc content is deficient (< 0.6 ppm) in the entire microwatershed area (Fig 6.11).

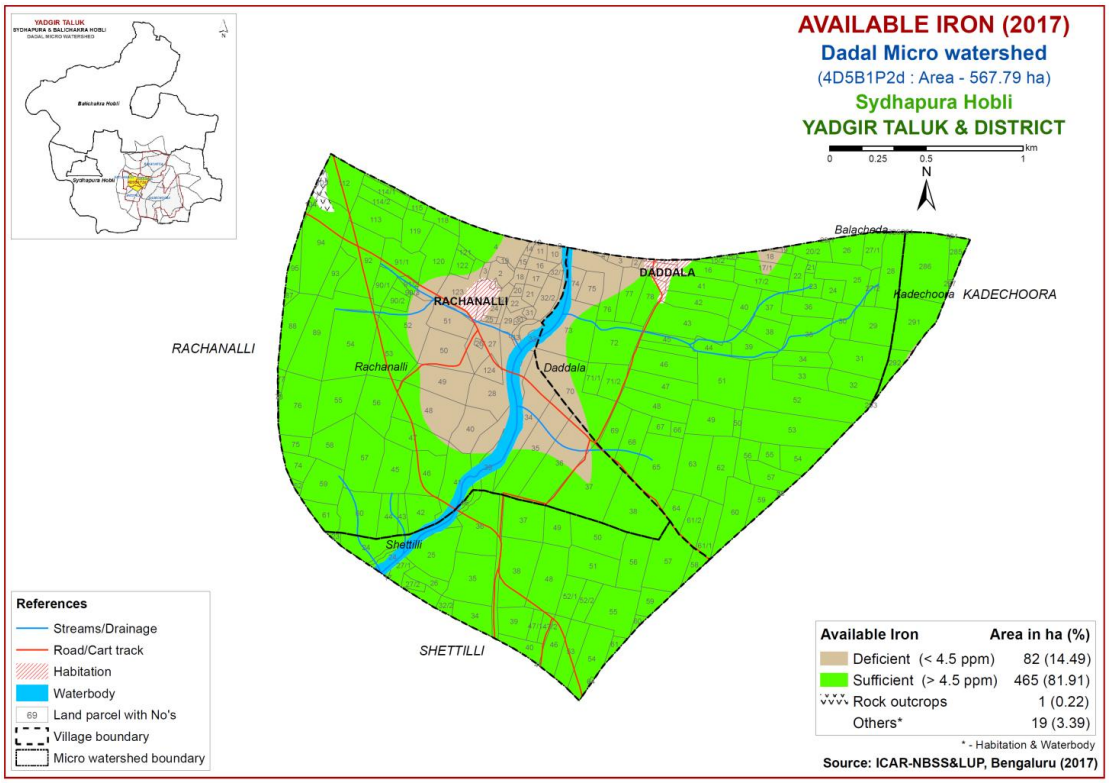



Fig.6.8 Soil available Iron map of Dadal Microwatershed

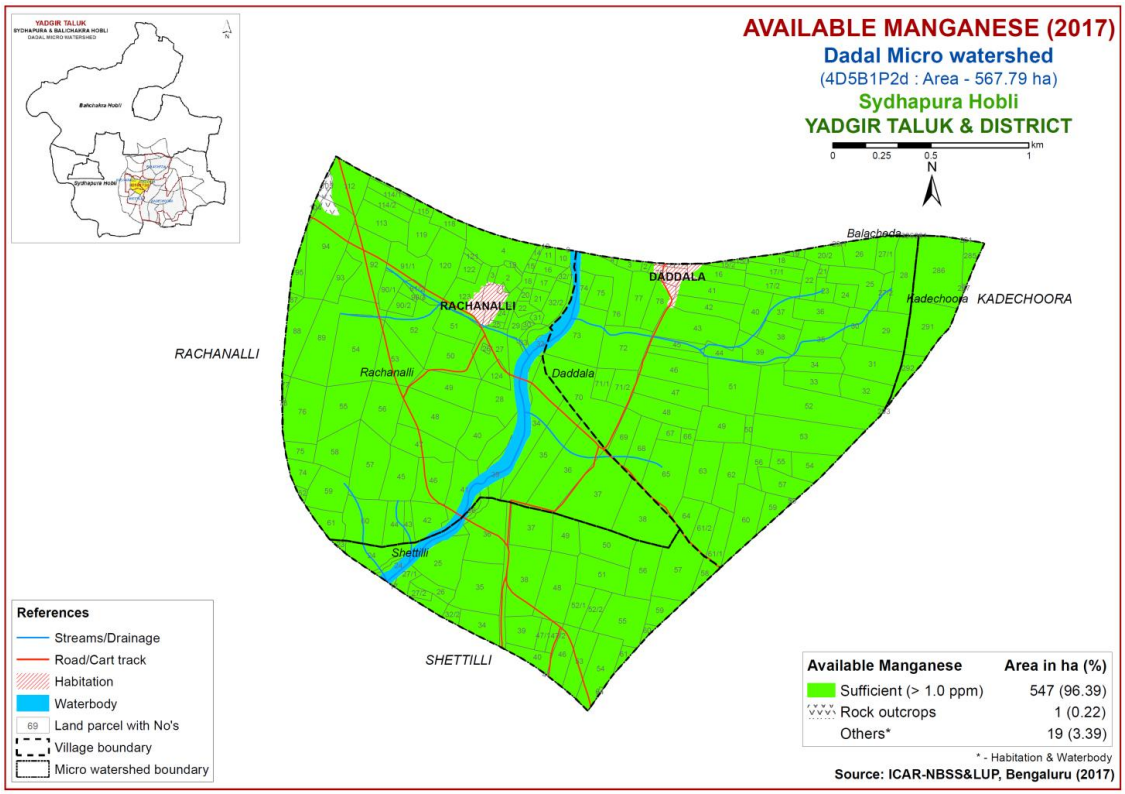



Fig.6.9 Soil available Manganese map of Dadal Microwatershed

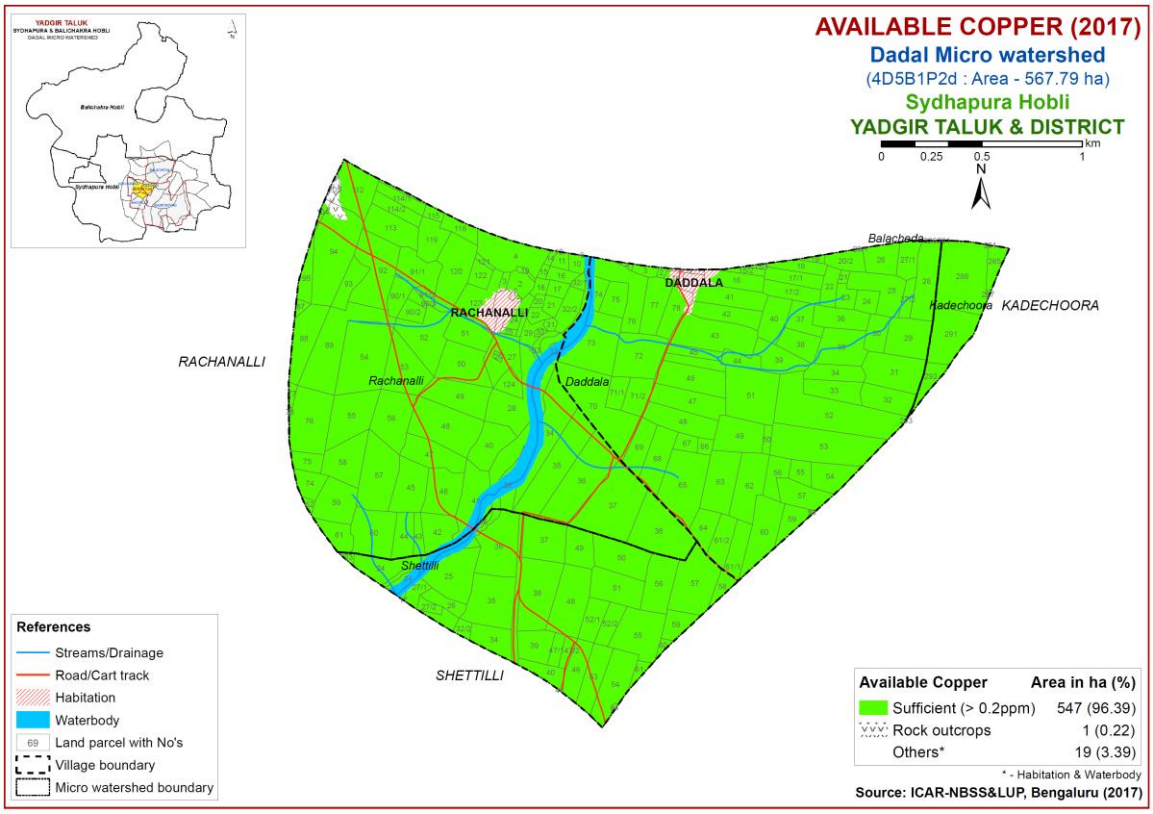



Fig.6.10 Soil available Copper map of Dadal Microwatershed

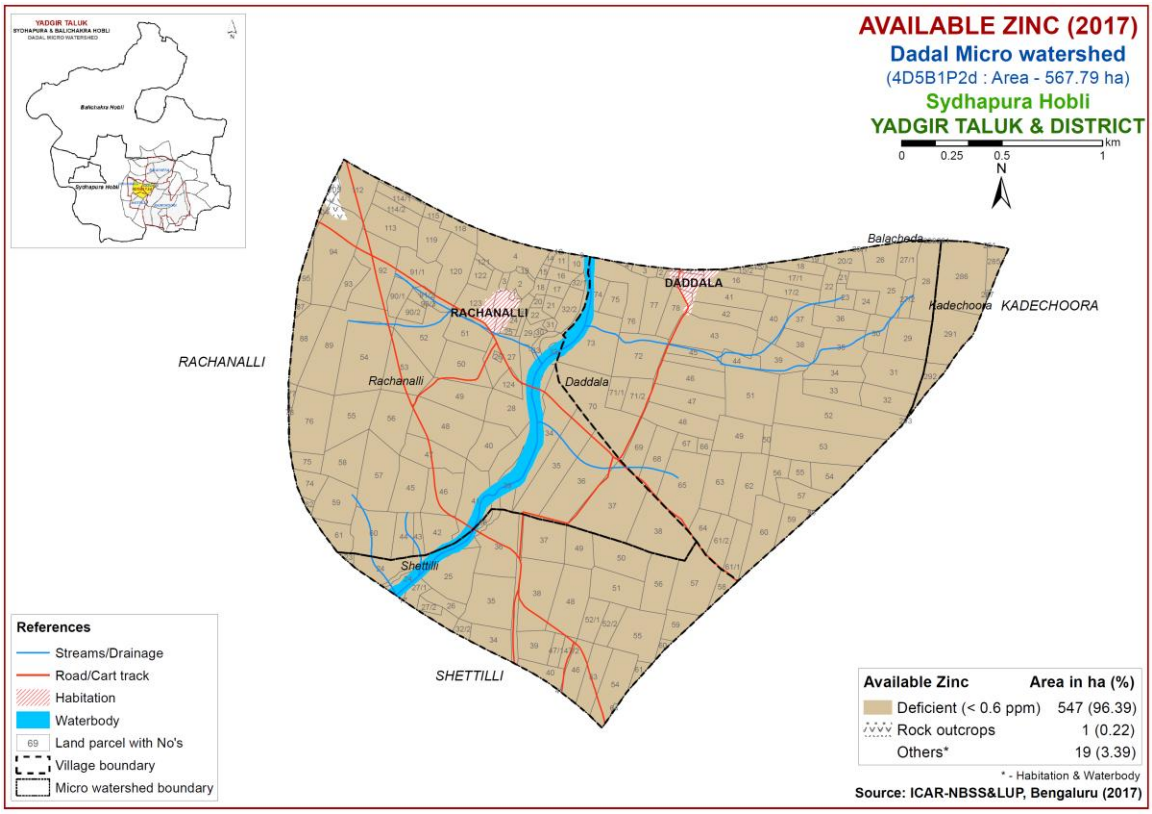



Fig.6.11 Soil available Zinc map of Dadal Microwatershed

*Chapter 7*

# LAND SUITABILITY FOR MAJOR CROPS

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

Using the above criteria, the soil map units of the microwatershed were evaluated and land suitability maps for 26 major annual and perennial crops grown in the state were generated. The detailed information on the kind of suitability of each of the soil phase for the crops assessed are given village/ survey number wise for the microwatershed in Appendix-III.

## 7.1 Land Suitability for Sorghum (*Sorghum bicolor*)

Sorghum is one of the major crops grown in Karnataka in an area of 10.47 lakh ha in 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.

**Table 7.1 Soil-Site Characteristics of Dadal Microwatershed**

| Soil Map Units | Climate (P) (mm) | Growing period (Days) | Drainage class | Soil depth (cm) | Soil texture | | Gravelliness | | AWC (mm/m) | Slope (%) | Erosion | pH | EC | ESP | CEC [Cmol ($p^+$) $kg^{-1}$] | BS (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Surf-ace | Sub-surface | Surface (%) | Subsurface (%) | | | | | | | | |
| HLGiB2g1 | 866 | 150 | WD | 50-75 | sc | scl-sc | 15-35 | - | 100 | 1-3 | Moderate | | | | | |
| YLRcB2g1 | 866 | 150 | WD | 50-75 | sl | sc | 15-35 | 15-35 | 100 | 1-3 | Moderate | | | | | |
| GDLcB3 | 866 | 150 | WD | 25-50 | sl | Sc-c | - | - | 75 | 1-3 | Severe | | | | | |
| KYTcB2 | 866 | 150 | WD | 25-50 | sl | scl-sc | - | - | 50 | 1-3 | Moderate | | | | | |
| BLDcB2 | 866 | 150 | WD | 50-75 | sl | c | - | - | 150 | 1-3 | Moderate | | | | | |
| BLDiB1g1 | 866 | 150 | WD | 50-75 | sc | c | 15-35 | - | 150 | 1-3 | Slight | | | | | |
| RHNcB2 | 866 | 150 | WD | 75-100 | sl | Sc-c | - | - | 150 | 1-3 | Moderate | | | | | |
| RHNmB2 | 866 | 150 | WD | 75-100 | c | Sc-c | - | - | 150 | 1-3 | Moderate | | | | | |
| KDRcB2 | 866 | 150 | WD | 100-150 | sl | Sc-c | - | - | >200 | 1-3 | Moderate | | | | | |
| KDRiB2 | 866 | 150 | WD | 100-150 | sc | Sc-c | - | - | >200 | 1-3 | Moderate | | | | | |
| KDRmB2 | 866 | 150 | WD | 100-150 | c | Sc-c | - | - | >200 | 1-3 | Moderate | | | | | |
| SWRmB2 | 866 | 150 | WD | 100-150 | c | c | - | - | >200 | 1-3 | Moderate | | | | | |
| HGNcB2 | 866 | 150 | WD | >150 | sl | c | - | - | >200 | 1-3 | Moderate | | | | | |
| HGNmB2 | 866 | 150 | WD | >150 | c | c | - | - | >200 | 1-3 | Moderate | | | | | |

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

In Dadal microwatershed, there are no lands that are highly (Class S1) suitable for growing sorghum. Major area of about 503 ha (89%) is moderately suitable (Class S2) for growing sorghum and are distributed in all parts of the microwatershed. They have moderate limitations of gravelliness, drainage, excess salt and rooting depth. Marginally suitable lands (Class S3) occupy very small area of about 44 ha (8%) and are distributed in the central and northern part of the microwatershed. They have severe limitations of rooting depth and excess salt.

**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. drained | imperfect | Poorly/excessively | V. poorly |
| Soil reaction | pH | 6.0-8.0 | 5.5-5.9<br>8.1-8.5 | <5.5<br>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 |

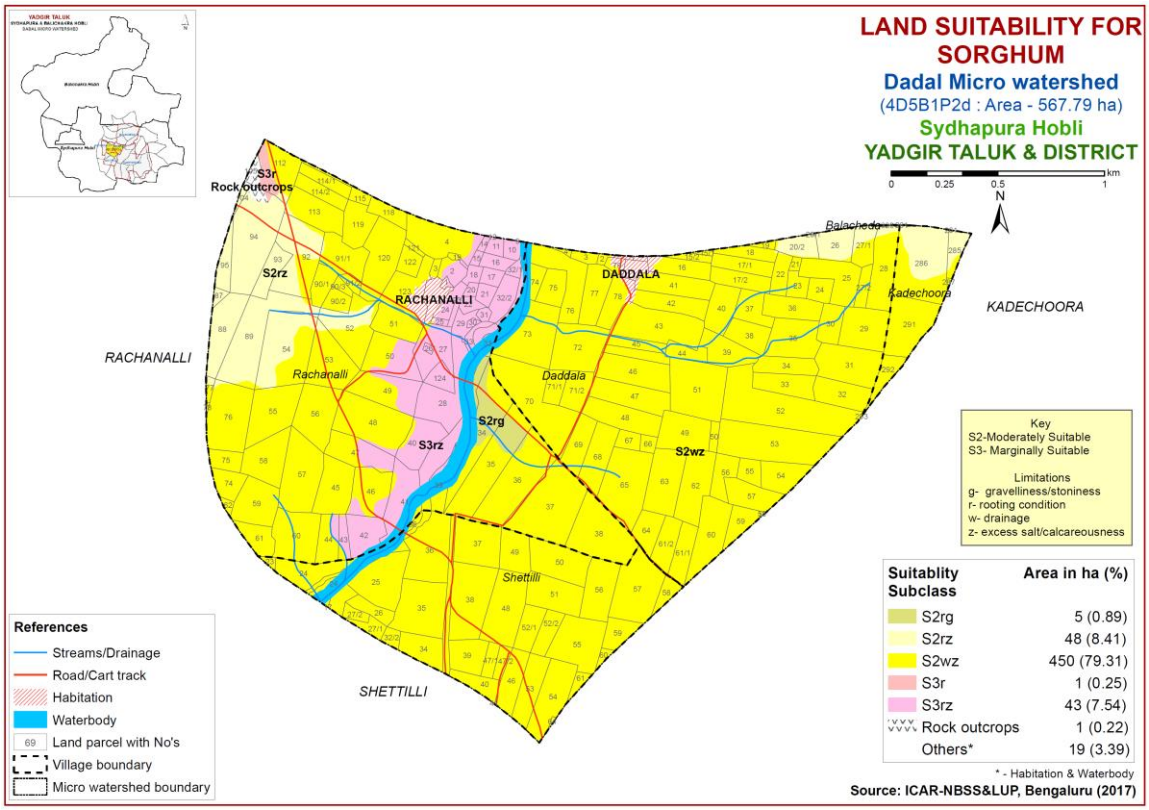



Fig. 7.1 Land Suitability map of Sorghum

### 7.2 Land Suitability for Maize (*Zea mays*)

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

In Dadal microwatershed, there are no lands that are highly (Class S1) suitable for growing maize. The moderately suitable (Class S2) lands cover a very small area of about 16 ha (3%) and occur in the northeastern and central part of the microwatershed. They have moderate limitations of gravelliness, excess salt and rooting depth. The marginally suitable (Class S3) lands cover major area of about 531 ha (94%) and occur in all parts of the microwatershed. They have severe limitations of texture, drainage, excess salt 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 | |

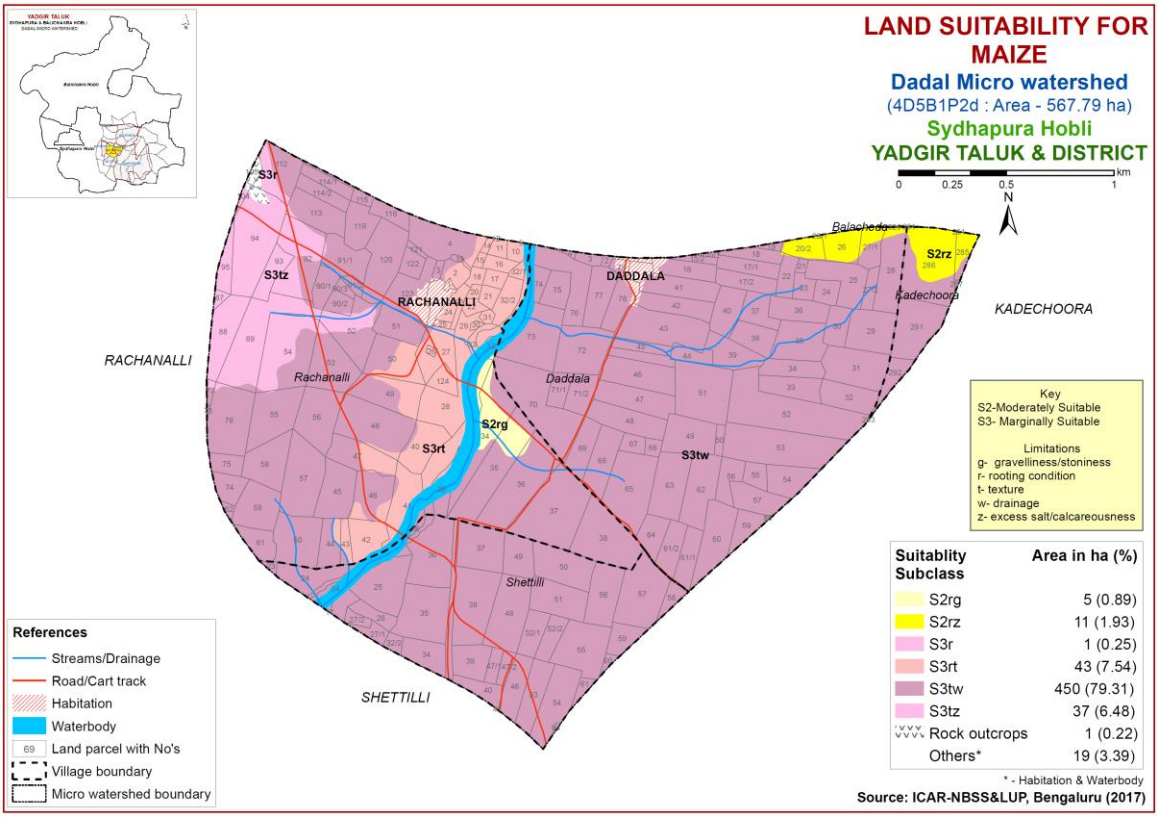



Fig. 7.2 Land Suitability map of Maize

### 7.3 Land Suitability for Red gram (*Cajanus cajan*)

Red gram is one of the major pulse crop grown in an area of 7.28 lakh ha mainly in northern Karnataka in Bijapur, Kalaburgi, Raichur, Bidar, Belgaum, Dharwad and Bellary districts. The crop requirements for growing red gram (Table 7.4) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map for growing red gram was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed is given in Figure 7.3.

In Dadal microwatershed, there are no lands that are highly (Class S1) suitable for growing redgram. Major area of about 450 ha (79%) is moderately suitable (Class S2) for red gram and is distributed in all parts of the microwatershed. They have moderate limitations of texture, rooting depth and drainage. An area of about 53 ha (9%) is marginally suitable (Class S3) for growing red gram and are distributed in the northwestern, central and northeastern part of the microwatershed. They have major limitations of rooting depth, gravelliness, drainage and excess salt. An area of about 44 ha (8%) is not suitable (Class N) for growing red gram and are distributed in the northern and central part of the microwatershed. They have severe limitations of rooting depth and excess salt.

**Table 7.4 Crop suitability criteria for Red gram**

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

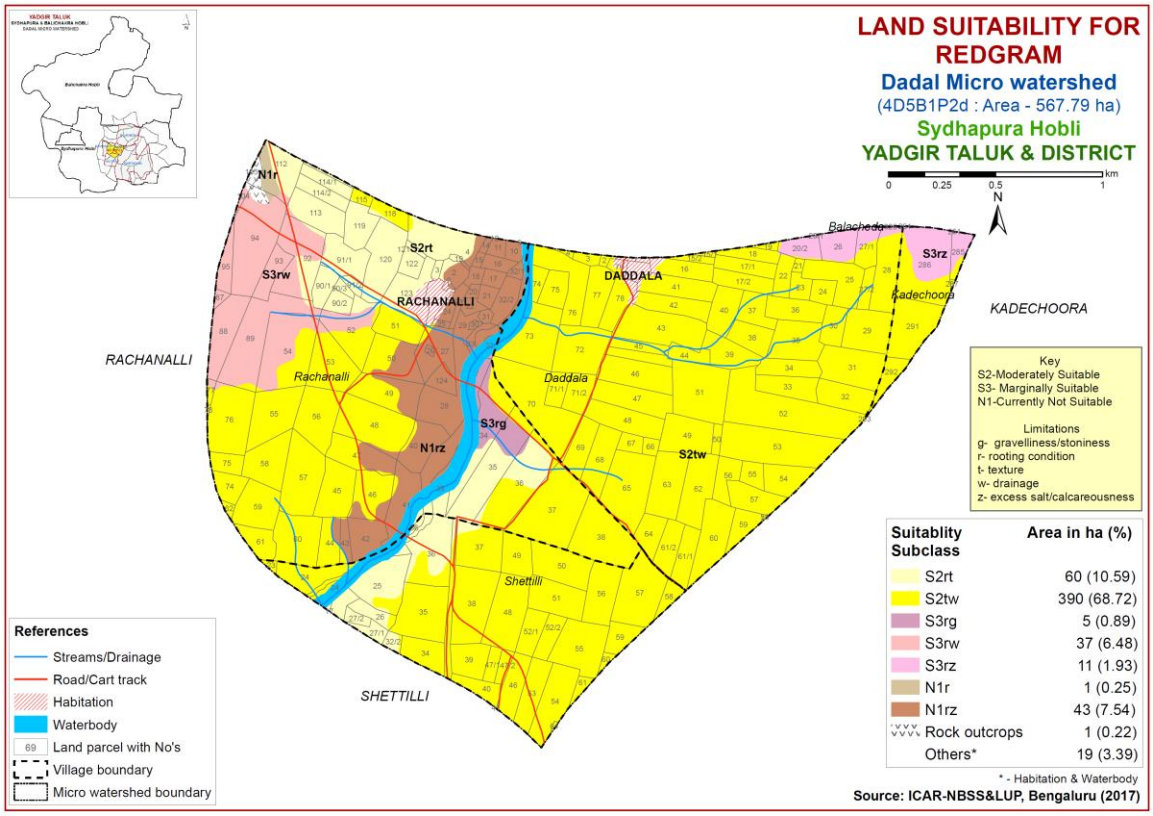



Fig. 7.3 Land Suitability map of Red gram

### 7.4 Land Suitability for Bajra (*Pennisetum glaucum)*

Bajra is the most important millet crop grown in an area of 2.34 lakh ha in the northern districts of Karnataka state. The crop requirements for growing bajra were matched with the soil-site characteristics and a land suitability map for growing bajra was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.4.

In Dadal microwatershed, there are no lands that are highly (Class S1) suitable for growing bajra. Major area of about 503 ha (89%) is moderately suitable (Class S2) for growing bajra and are distributed in all parts of the microwatershed. They have moderate limitations of texture, drainage, excess salt and rooting depth. Marginally suitable lands (Class S3) occupy an area of about 44 ha (8%) and distributed in the central and northern part of the microwatershed. They have severe limitations of rooting depth and excess salt.

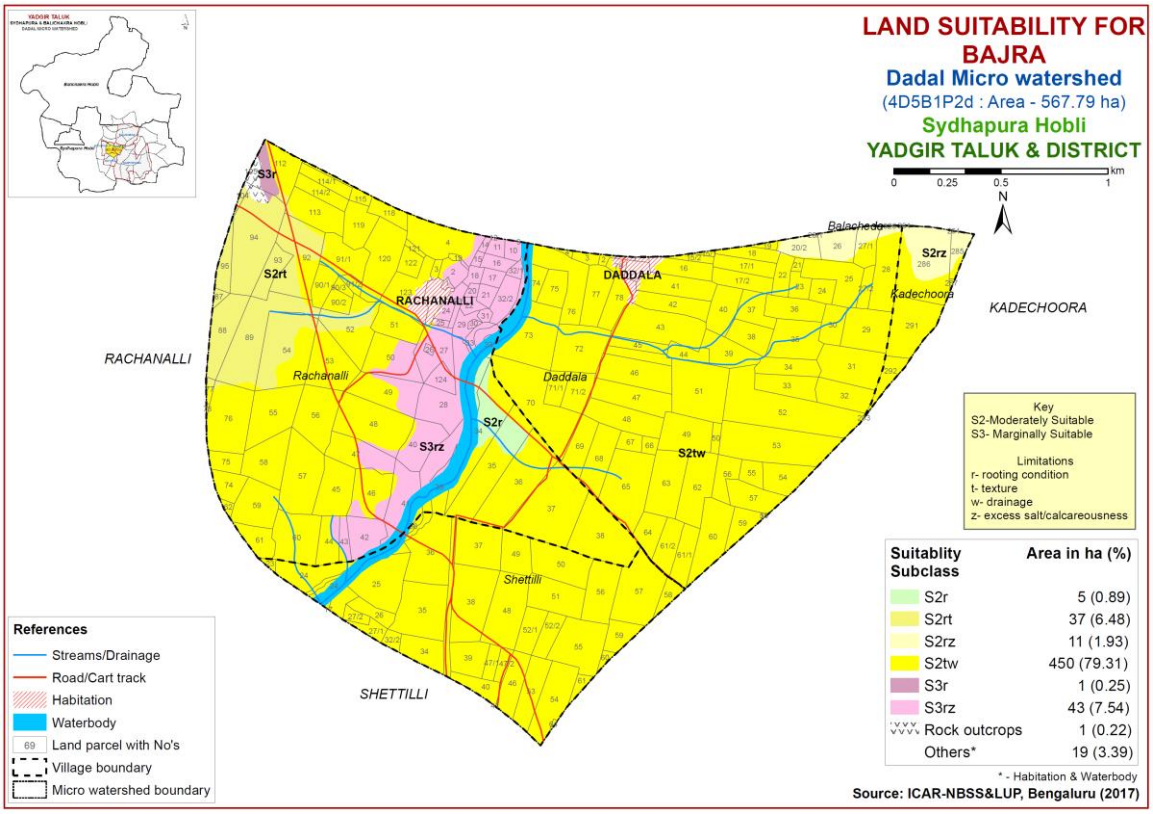



Fig. 7.4 Land Suitability map of Bajra

### 7.5 Land suitability for Groundnut (*Arachis hypogaea*)

Groundnut is the most important oilseed crop grown in an area of 6.54 lakh ha in almost all the districts of the State. The crop requirements for growing groundnut (Table 7.5) were matched with the soil-site characteristics (Table 7.1) of soils of the microwatershed and a land suitability map for growing groundnut was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.5.

In Dadal microwatershed, there are no lands that are highly (Class S1) suitable for growing groundnut. A small area of about 16 ha (3%) is moderately suitable (Class S2) for growing groundnut and are distributed in the central and northeastern part of the microwatershed. They have moderate limitations of excess salt and rooting depth. Marginally suitable lands (Class S3) occupy major area of about 531 ha (94%) and are distributed in all parts of the microwatershed. They have severe limitations of rooting depth, texture and drainage.

**Table 7.5 Land suitability criteria for Groundnut**

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

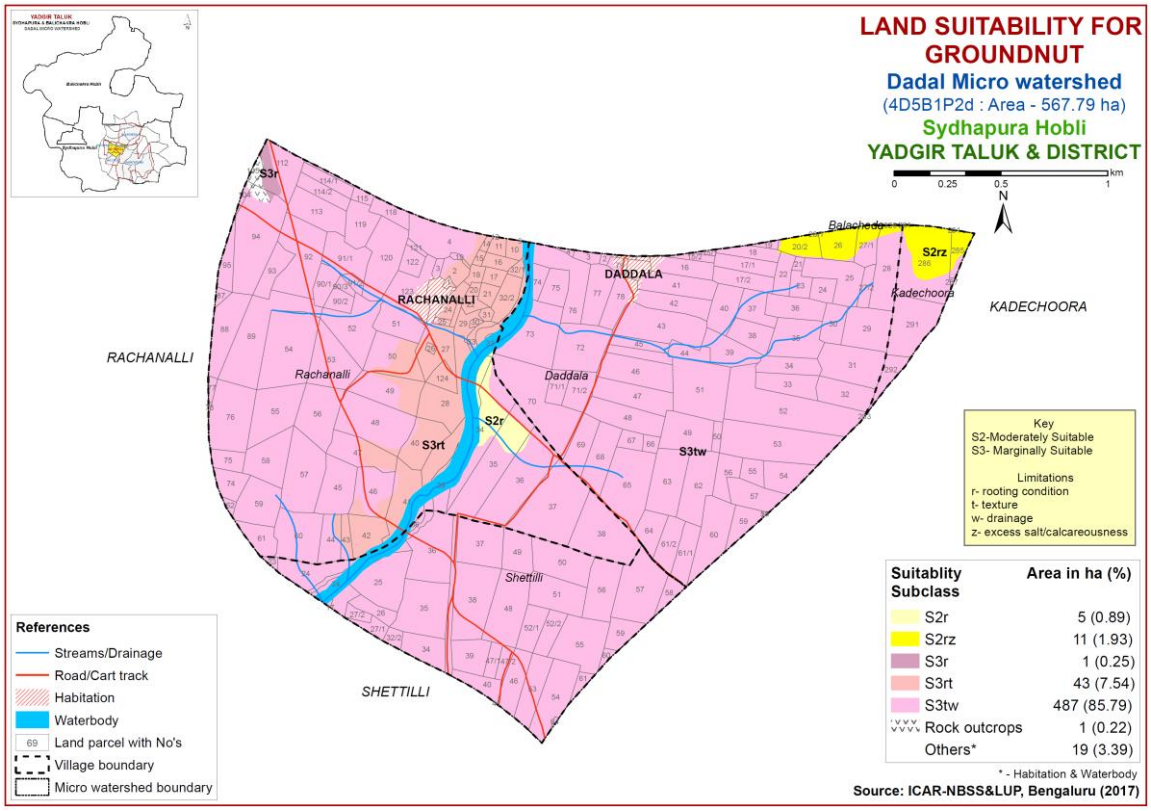



Fig. 7.5 Land Suitability map of Groundnut

### 7.6 Land Suitability for Sunflower (*Helianthus annus*)

Sunflower is the most important oilseed crop grown in an area of 3.56 lakh ha in the State in all the districts. The crop requirements for growing sunflower (Table 7.6) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing sunflower was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.6.

In Dadal microwatershed, there are no lands that are highly (Class S1) suitable for growing sunflower. Major area of about 450 ha (79%) is moderately suitable (Class S2) for sunflower and is distributed in all parts of the microwatershed. They have moderate limitations of rooting depth and drainage. An area of about 53 ha (9%) is marginally suitable (Class S3) for growing sunflower and are distributed in the northwestern, central and northeastern part of the microwatershed. They have major limitations of rooting depth, gravelliness, drainage and excess salt. An area of about 44 ha (8%) is not suitable (Class N) for growing sunflower and are distributed in the northern and central part of the microwatershed. They have severe limitations of rooting depth and excess salt.

**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 drained | imperfectly drained | Poorly drained |
| Soil reaction | pH | 6.5-8.0 | 8.1-8.5<br>5.5-6.4 | 8.6-9.0;<br>4.5-5.4 | >9.0<br><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 | |

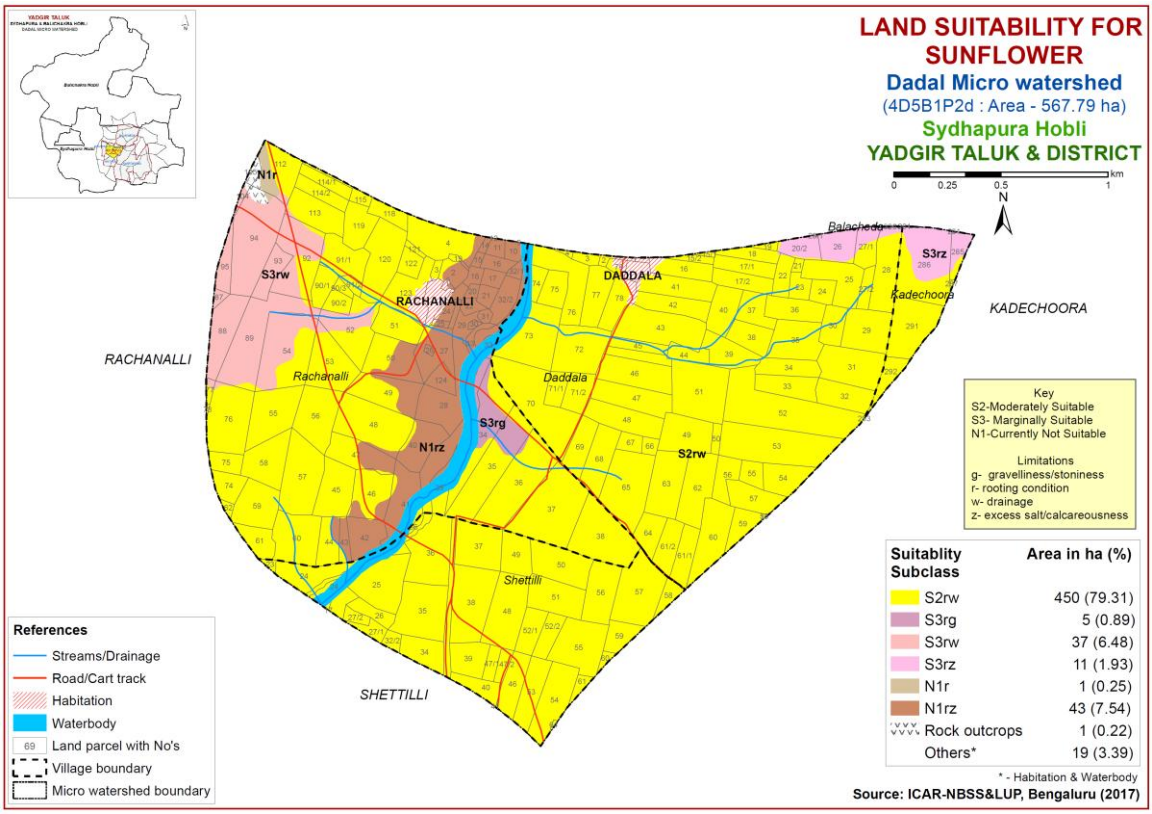



Fig. 7.6 Land Suitability map of Sunflower

### 7.7 Land Suitability for Cotton (*Gossypium hirsutum*)

Cotton is the most important fibre crop grown in the state in about 8.75 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 their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.7.

In Dadal microwatershed, there are no lands that are highly (Class S1) suitable for growing cotton. Major area of about 503 ha (89%) is moderately suitable (Class S2) for growing cotton and are distributed in all parts of the microwatershed. They have moderate limitations of gravelliness, drainage, excess salt and rooting depth. Marginally suitable lands (Class S3) occupy an area of about 44 ha (8%) and are distributed in the central and northern part of the microwatershed. They have severe limitations of rooting depth and excess salt.

**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 |

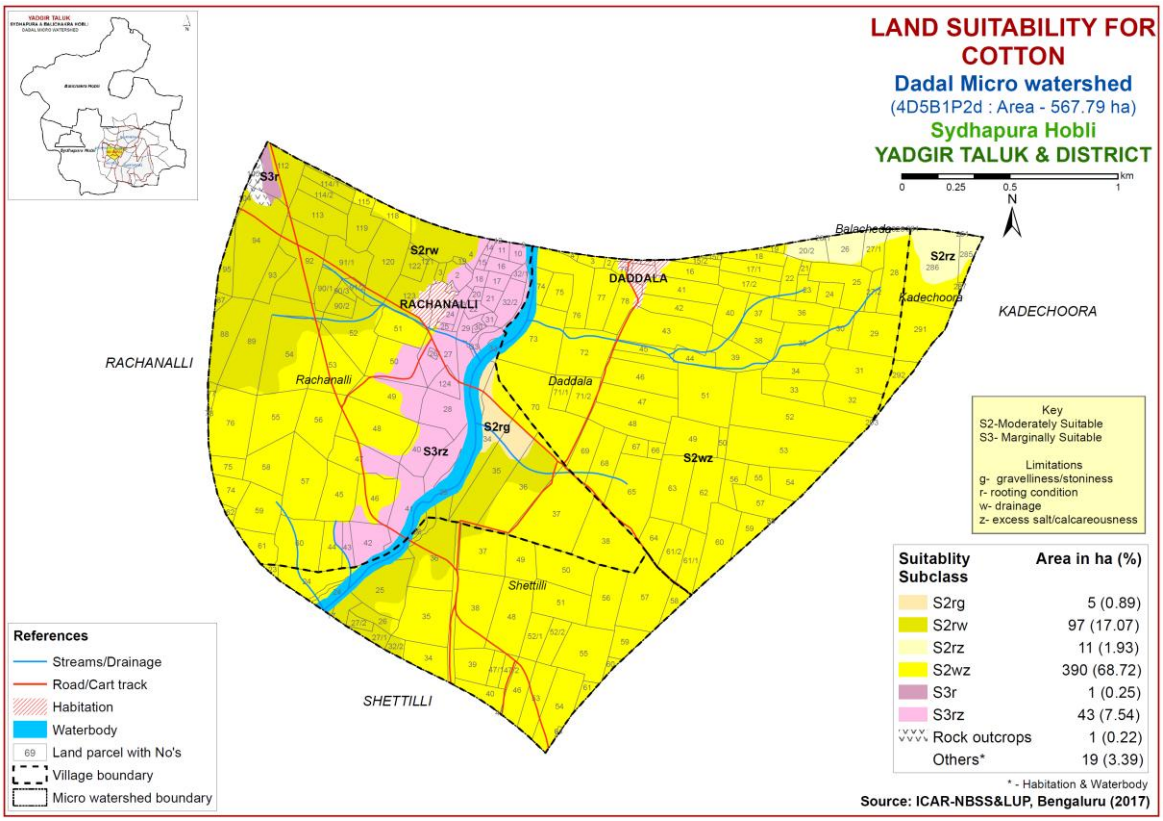



Fig. 7.7 Land Suitability map of Cotton

### 7.8 Land Suitability for Bengal gram (*Cicer aerativum*)

Bengal gram is the most important pulse crop grown in about 9.39 lakh ha area in Bijapur, Raichur, Kalaburgi, Dharwad, Belgaum and Bellary districts. The crop requirements for growing Bengal gram (Table 7.8) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing Bengal gram was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.8.

In Dadal microwatershed, there are no lands that are highly (Class S1) suitable for growing bengal gram. Major area of about 503 ha (89%) is moderately suitable (Class S2) for growing bengalgram and are distributed in all parts of the microwatershed. They have moderate limitations of gravelliness, drainage, excess salt and rooting depth. Marginally suitable lands (Class S3) occupy an area of about 44 ha (8%) and are distributed in the central and northern part of the microwatershed. They have severe limitations of rooting depth and excess salt.

**Table 7.8 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% | |
| Soil depth | Cm | >75 | 51-75 | 25-50 | <25 |
| Gravel content | % vol. | <15 | 15-35 | >35 | |
| Salinity (ECe) | $dsm^{-1}$ | <1.0 | 1.0-2.0 | >2.0 | |
| Sodicity (ESP) | % | <10 | 10-15 | >15 | |

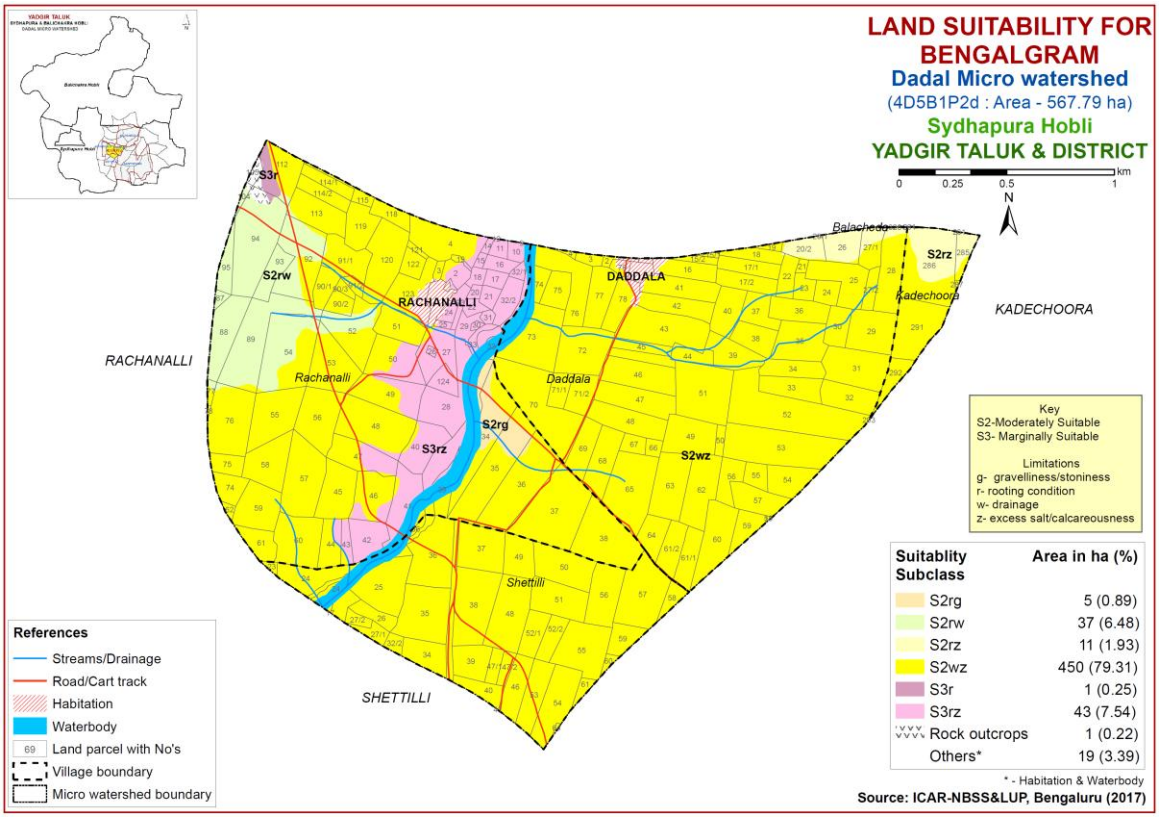



Fig. 7.8 Land Suitability map of Bengal gram

### 7.9 Land Suitability for Chilli (*Capsicum annuum)*

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

In Dadal microwatershed, there are no lands that are highly (Class S1) suitable for growing chilli. Major area of about 503 ha (89%) is moderately suitable (Class S2) for growing chilli and are distributed in all parts of the microwatershed. They have moderate limitations of gravelliness, texture, drainage, excess salt and rooting depth. Marginally suitable lands (Class S3) occupy an area of about 44 ha (8%) and are distributed in the central and northern part of the microwatershed. They have severe limitations of rooting depth and texture.

**Table 7.9 Crop suitability criteria for Chilli**

| Crop requirement | | Rating | | | |
|---|---|---|---|---|---|
| **Soil –site characteristics** | **Unit** | **Highly suitable (S1)** | **Moderately Suitable (S2)** | **Marginally suitable (S3)** | **Not suitable (N)** |
| Mean temperature in growing season | $^0$c | 20-30 | 30-35, 13-15 | 35-40, 10-12 | >40,<10 |
| Slope | % | <3 | 3-5 | 5-10 | >10 |
| LGP | Days | >150 | 120-150 | 90-120 | <90 |
| Soil drainage | class | Well drained | Moderately drained | Imp./ poor drained/excessively | Very poorly drained |
| Soil reaction | pH | 6.5-7.8, 6.0-7.0 | 7.8-8.4 | 8.4-9.0, 5.0-5.9 | >9.0 |
| Surface soil texture | Class | scl, cl, sil | sl, sc, sic,c(m/k) | C(ss), ls, s | |
| Soil depth | Cm | >75 | 50-75 | 25-50 | <25 |
| Gravel content | % vol. | <15 | 15-35 | 35-60 | >60 |
| Salinity (ECe) | $dsm^{-1}$ | <1.0 | 1.0-2.0 | 2.0-4.0 | <4 |
| Sodicity (ESP) | % | <5 | 5-10 | 10-15 | |

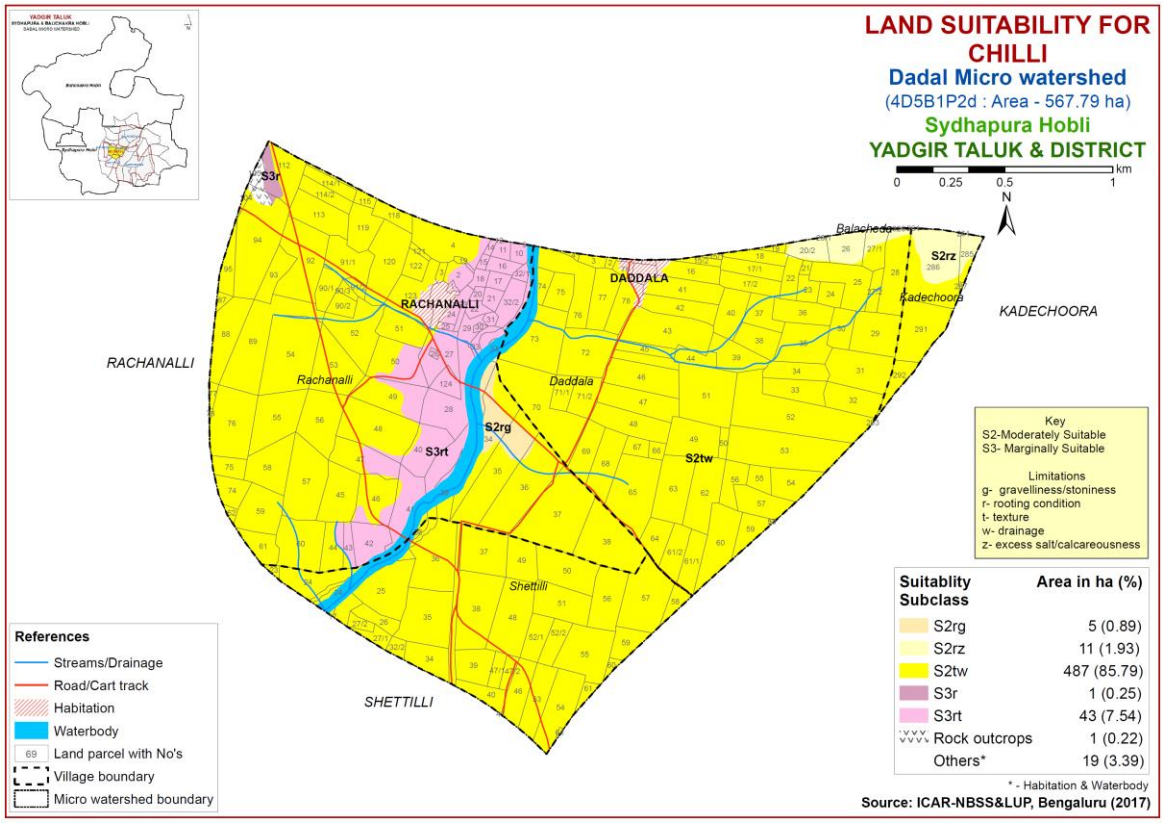



Fig 7.9 Land Suitability map of Chilli

### 7.10 Land Suitability for Tomato *(Lycopersicon esculentum*)

Tomato is the most important fruit crop grown in about 0.61 lakh ha covering almost all the district of the state. The crop requirements for growing tomato (Table 7.10) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing tomato was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.10.

In Dadal microwatershed, there are no lands that are highly (Class S1) suitable for growing tomato. A small area of about 16 ha (3%) is moderately suitable (Class S2) for growing tomato and are distributed in the central and northeastern part of the microwatershed. They have moderate limitations of gravelliness, excess salt and rooting depth. Marginally suitable lands (Class S3) occupy major area of about 531 ha (94%) and are distributed in all parts of the microwatershed. They have severe limitations of rooting depth, drainage and texture.

**Table 7.10 Crop suitability criteria for Tomato**

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

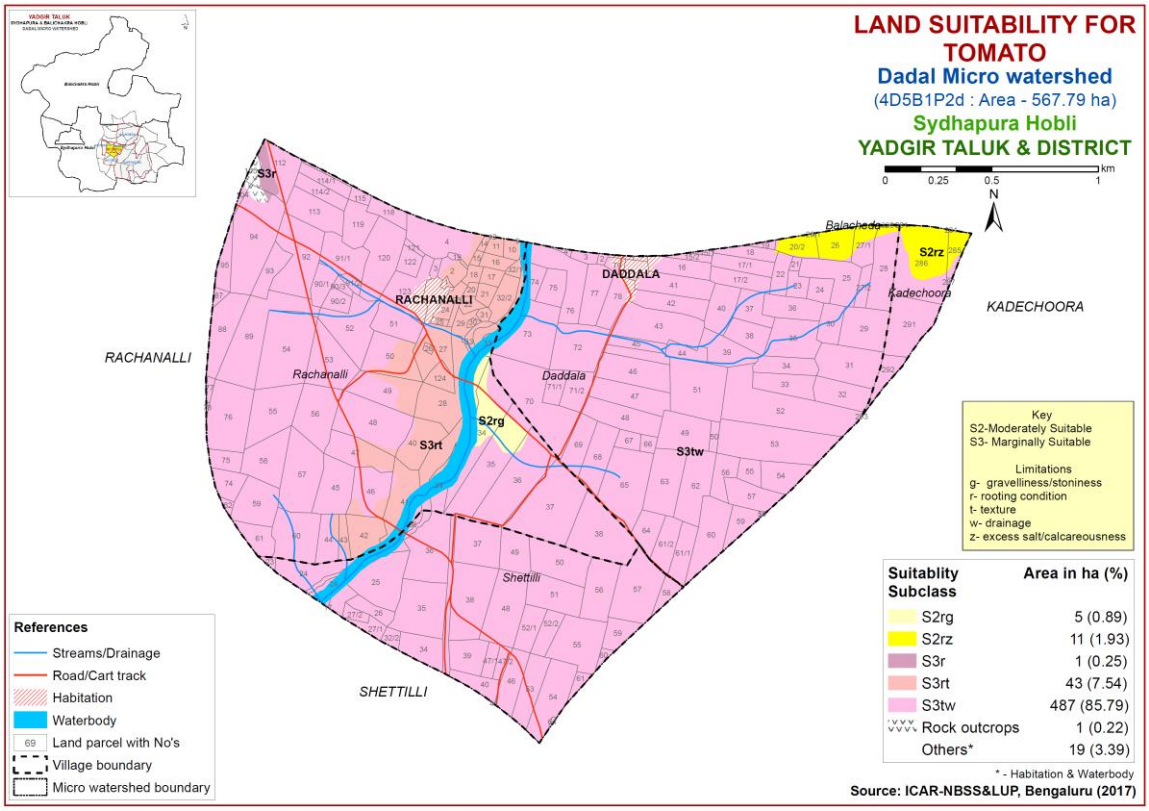



Fig 7.10 Land Suitability map of Tomato

### 7.11 Land Suitability for Drumstick (*Moringa oleifera*)

Drumstick is the most important vegetable crop grown in about 2403 ha in the state. The crop requirements for growing drumstick (Table 7.11) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing drumstick was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.11.

In Dadal microwatershed, there are no lands that are highly (Class S1) suitable for growing drumstick. Major area of about 450 ha (79%) is moderately suitable (Class S2) for drumstick and is distributed dominantly in all parts of the microwatershed. They have moderate limitations of rooting depth, texture and drainage. An area of about 53 ha (9%) is marginally suitable (Class S3) for growing drumstick and are distributed in the northwestern, central and northeastern part of the microwatershed. They have severe limitations of rooting depth and excess salt. An area of about 44 ha (8%) is not suitable (Class N) for growing drumstick and are distributed in the northern and central part of the microwatershed. They have severe limitations of rooting depth and excess salt.

**Table 7.11 Crop suitability criteria for Drumstick**

| Crop requirement | | | Rating | | | |
|---|---|---|---|---|---|---|
| Soil –site characteristics | | Unit | Highly suitable (S1) | Moderately Suitable (S2) | Marginally suitable (S3) | Not suitable (N) |
| Soil aeration | Soil drainage | Class | Well drained | Moderately well drained | Poorly drained | V. Poorly drained |
| Nutrient availability | Texture | Class | Sc, scl, cl, c (red) | Sl, c (black) | ls | S |
| | pH | 1:2.5 | 5.5-6.5 | 5-5.5, 6.5-7.3 | 7.8-8.4 | >8.4 |
| Rooting conditions | Soil depth | Cm | >100 | 75-100 | 50-75 | <50 |
| | Gravel content | % vol. | 0-35 | 35-60 | 60-80 | >80 |
| Erosion | Slope | % | 0-3 | 3-10 | - | >10 |

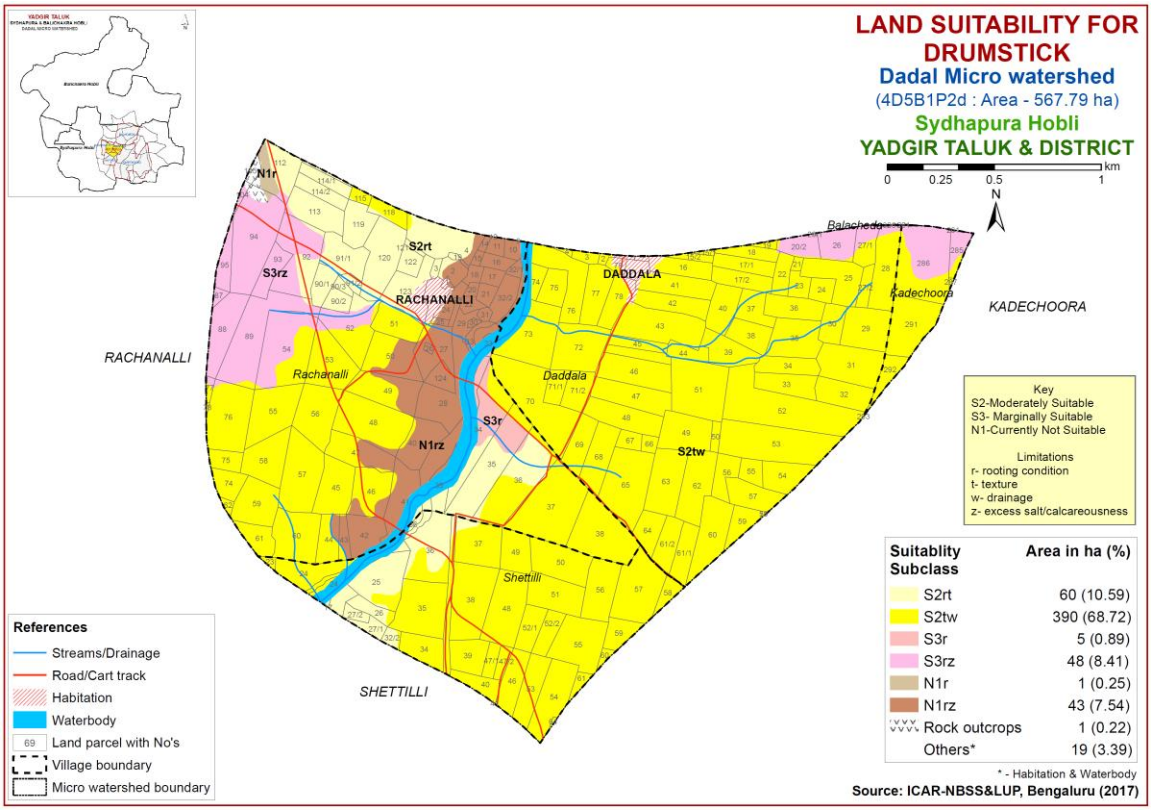



Fig 7.11 Land Suitability map of Drumstick

## 7.12 Land Suitability for Mulberry (*Morus nigra* )

Mulberry is the important crop grown in about 1,66000 ha area in all the districts of the state. The crop requirements for growing mulberry (Table 7.12) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing mulberry was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.12.

In Dadal microwatershed, there are no lands that are highly (Class S1) and moderately (Class S2) suitable for growing mulberry. Major area of about 503 ha (89%) is marginally suitable (Class S3) for growing mulberry and are distributed in all parts of the microwatershed. They have severe limitations of gravelliness, texture, drainage, excess salt and rooting depth. Not suitable lands (Class N) occupy an area of about 44 ha (8%) and distributed in the central and northern part of the microwatershed. They have very severe limitations of rooting depth and texture.

**Table 7.12 Crop suitability criteria for Mulberry**

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

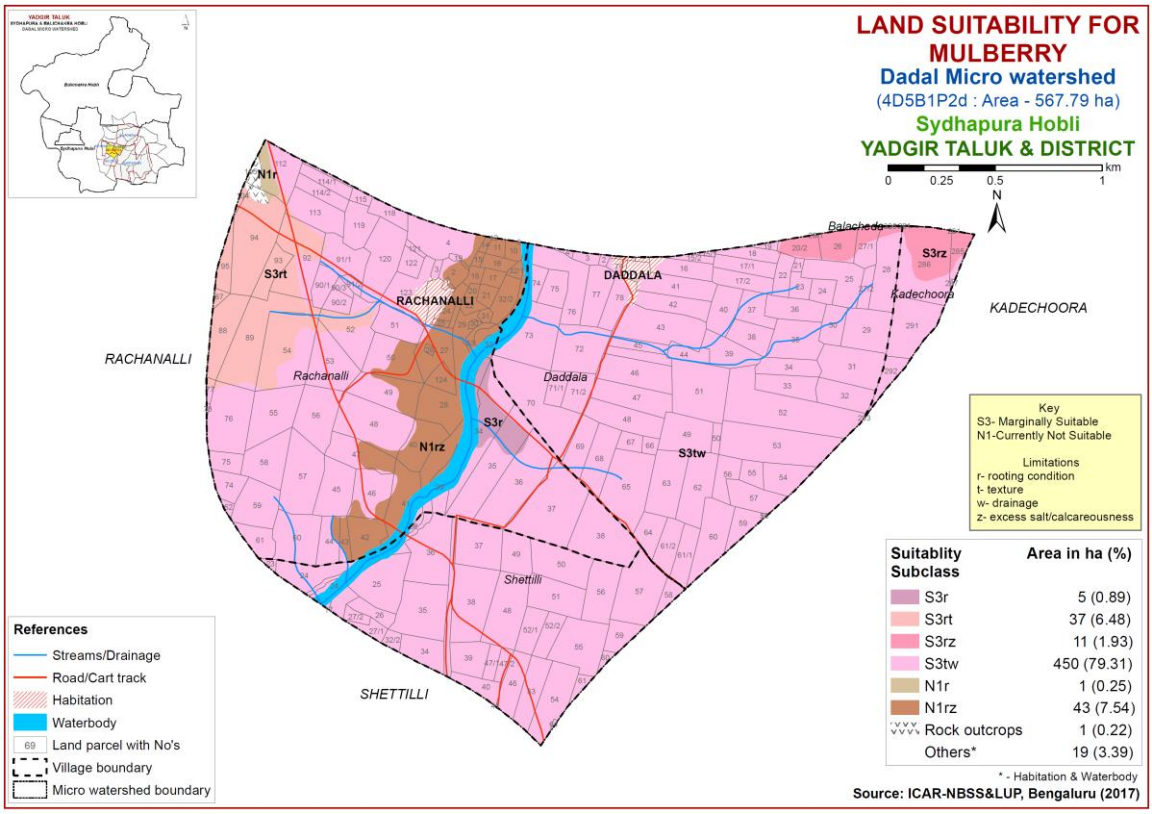



Fig 7.12 Land Suitability map of Mulberry

### 7.13 Land Suitability for Mango (*Mangifera indica*)

Mango is the most important fruit crop grown in about 173080 ha in all the districts of the State. The crop requirements for growing mango (Table 7.13) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing mango was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.13.

No highly (Class S1) and moderately (Class S2) suitable lands are available for growing mango in the Dadal microwatershed. Major area of about 450 ha (79%) is marginally suitable (Class S3) for growing mango and are distributed in all parts of the microwatershed. They have severe limitations of texture, drainage and rooting depth. Not suitable lands (Class N) occupy an area of about 97 ha (17%) and are distributed in the central, northeastern, northwestern and northern part of the microwatershed. They have very severe limitations of rooting depth and excesssalt.

**Table 7.13 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<br>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 | 8.6-9.0 4.0-4.9 | >9.0 <4.0 |
| | OC | % | High | medium | low | |
| | $CaCO_3$ in root zone | % | Non calcareous | <5 | 5-10 | >10 |
| Rooting conditions | Soil depth | cm | >200 | 125-200 | 75-125 | <75 |
| | Gravel content | % vol. | Non gravelly | <15 | 15-35 | >35 |
| Soil toxicity | Salinity | dS/m | Non saline | <2.0 | 2.0-3.0 | >3.0 |
| | Sodicity | % | Non sodic | <10 | 10-15 | >15 |
| Erosion | Slope | % | <3 | 3-5 | 5-10 | |

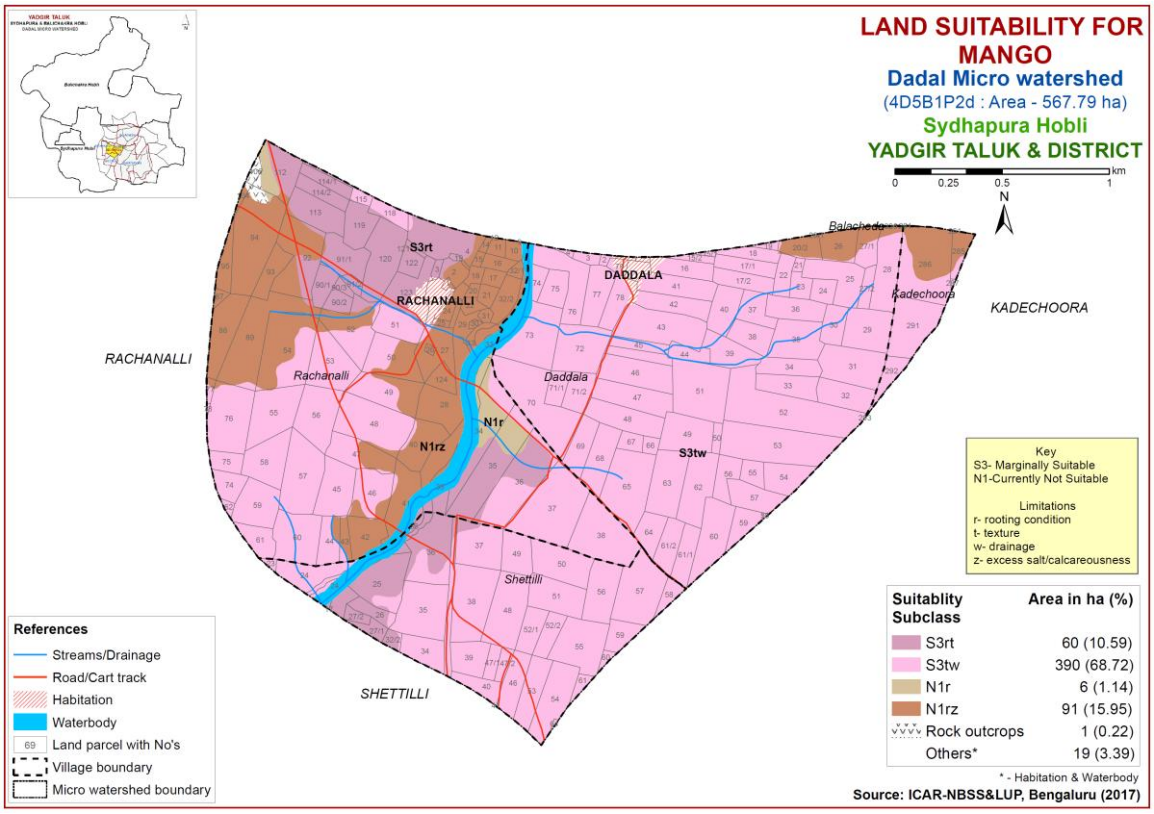



Fig. 7.13 Land Suitability map of Mango

### 7.14 Land Suitability for Sapota (*Manilkara zapota*)

Sapota is the most important fruit crop grown in about 29373 ha in almost all the districts of the state. The crop requirements for growing sapota (Table 7.14) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing sapota was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.14.

In Dadal microwatershed, there are no lands that are highly (Class S1) and moderately suitable (Class S2) for growing sapota. Major area of about 503 ha (89%) is marginally suitable (Class S3) for growing sapota and are distributed in all parts of the microwatershed. They have severe limitations of texture, drainage, excess salt and rooting depth. Not suitable lands (Class N) occupy an area of about 44 ha (8%) and are distributed in the central and northern part of the microwatershed. They have very severe limitations of rooting depth and excess salt.

**Table 7.14 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<br>24-27 | 37-42<br>20-23 | >42<br><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<br>5.0-5.9 | 8.1-9.0<br>4.5-4.9 | >9.0<br><4.5 |
| | $CaCO_3$ in root zone | % | Non calcareous | <10 | 10-15 | >15 |
| Rooting conditions | Soil depth | cm | >150 | 75-150 | 50-75 | <50 |
| | Gravel content | % vol. | Non gravelly | <15 | 15-35 | <35 |
| Soil toxicity | Salinity | dS/m | Non saline | Up to 1.0 | 1.0-2.0 | 2.0-4.0 |
| | Sodicity | % | Non sodic | 10-15 | 15-25 | >25 |
| Erosion | Slope | % | <3 | 3-5 | 5-10 | >10 |

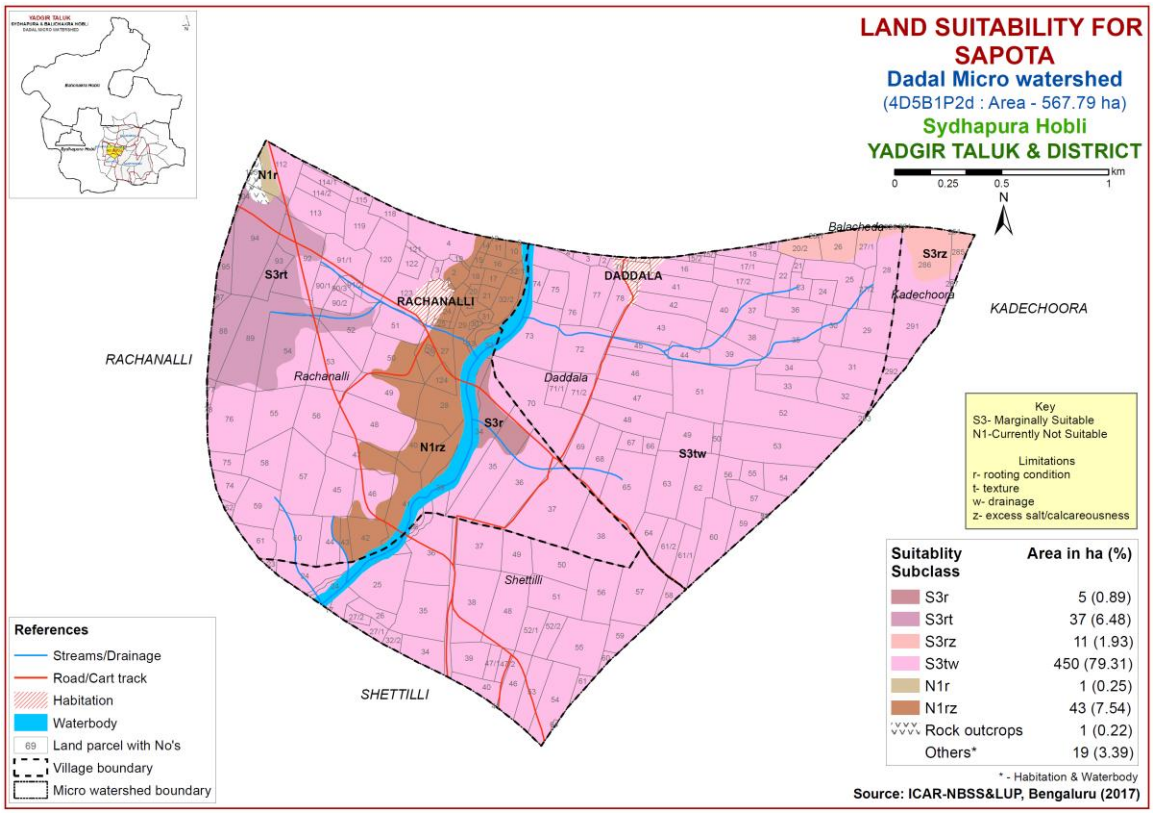



Fig. 7.14 Land Suitability map of Sapota

### 7.15 Land Suitability for Guava (*Psidium guajava*)

Guava is the most important fruit crop grown in about 6558 ha in the State of Raichur, Dharwad, Belgaum, Kalaburgi, Bijapur, Bidar, Bellary, Chitradurga, Bangalore, Kolar, Chikkaballapur and Chamarajnagar districts. The crop requirements for growing guava (Table 7.15) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing guava was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.15.

In Dadal microwatershed, there are no lands that are highly (Class S1) and moderately suitable (Class S2) for growing guava. Major area of about 503 ha (89%) is marginally suitable (Class S3) for growing guava and are distributed in all parts of the microwatershed. They have severe limitations of texture, drainage, excess salt and rooting depth. Not suitable lands (Class N) occupy an area of about 44 ha (8%) and are distributed in the central and northern part of the microwatershed. They have very severe limitations of rooting depth, texture and excess salt.

**Table 7.15 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<br>24-27 | 37-42<br>20-23 | |
| Soil moisture | Growing period | Days | >150 | 120-150 | 90-120 | <90 |
| Soil aeration | Soil drainage | class | Well drained | Mod. to imperfectly | poor | Very poor |
| Nutrient availability | Texture | Class | Scl, l, cl, sil | Sl,sicl,sic.,sc, c | C (<60%) | C (>60%) |
| | pH | 1:2.5 | 6.0-7.5 | 7.6-8.0:5.0-5.9 | 8.1-8.5:4.5-4.9 | >8.5:<4.5 |
| | $CaCO_3$ in root zone | % | Non calcareous | <10 | 10-15 | >15 |
| Rooting conditions | Soil depth | cm | >100 | 75-100 | 50-75 | <50 |
| | Gravel content | % vol. | <15 | 15-35 | >35 | |
| Soil toxicity | Salinity | dS/m | <2.0 | 2.0-4.0 | 4.0-6.0 | |
| | Sodicity | % | Non sodic | 10-15 | 15-25 | >25 |
| Erosion | Slope | % | <3 | 3-5 | 5-10 | >10 |

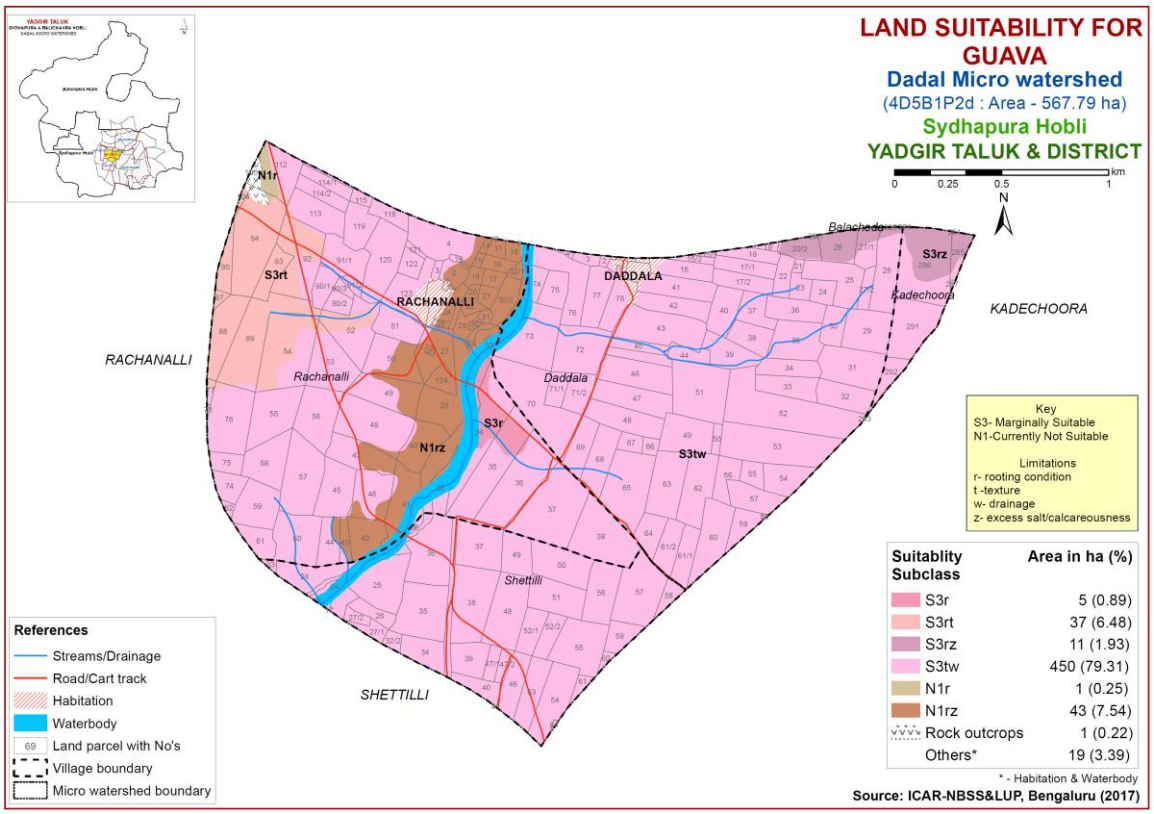



Fig 7.15 Land Suitability map of Guava

## 7.16 Land Suitability for Pomegranate (*Punica granatum*)

Pomegranate is the most important fruit crop commercially grown in about 18488 ha in karnataka in an area of about 0.16 lakh ha mainly in Bijapur, Bagalkot, Koppal, Gadag and Chitradurga districts. The crop requirements for growing pomegranate (Table 7.16) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing pomegranate was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.16.

In Dadal microwatershed, there are no lands that are highly (Class S1) suitable for growing pomegranate. Major area of about 450 ha (79%) is moderately suitable (Class S2) for pomegranate and is distributed dominantly in all parts of the microwatershed. They have moderate limitations of rooting depth, texture and drainage. An area of about 53 ha (9%) is marginally suitable (Class S3) for growing pomegranate and are distributed in the northwestern, central and northeastern part of the microwatershed. They have severe limitations of rooting depth, drainage and texture. An area of about 44 ha (8%) is not suitable (Class N) for growing pomegranate and are distributed in the northern and central part of the microwatershed. They have very severe limitations of rooting depth and excess salt.

**Table 7.16 Crop suitability criteria for Pomegranate**

| Crop requirement | | | Rating | | | |
|---|---|---|---|---|---|---|
| Soil –site characteristics | | Unit | Highly suitable (S1) | Moderately Suitable (S2) | Marginally suitable (S3) | Not suitable (N) |
| climate | Temperature in growing season | | 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 | |
| | pH | 1:2.5 | 5.5-7.5 | 7.6-8.5 | 8.6-9.0 | |
| Rooting conditions | Soil depth | Cm | >100 | 75-100 | 50-75 | <50 |
| | Gravel content | % vol. | nil | 15-35 | >35 | |
| Soil toxicity | Salinity | ds/m | Nil | <9 | >9 | <50 |
| | Sodicity | % | nil | | | |
| Erosion | Slope | % | <3 | 3-5 | 5-10 | |

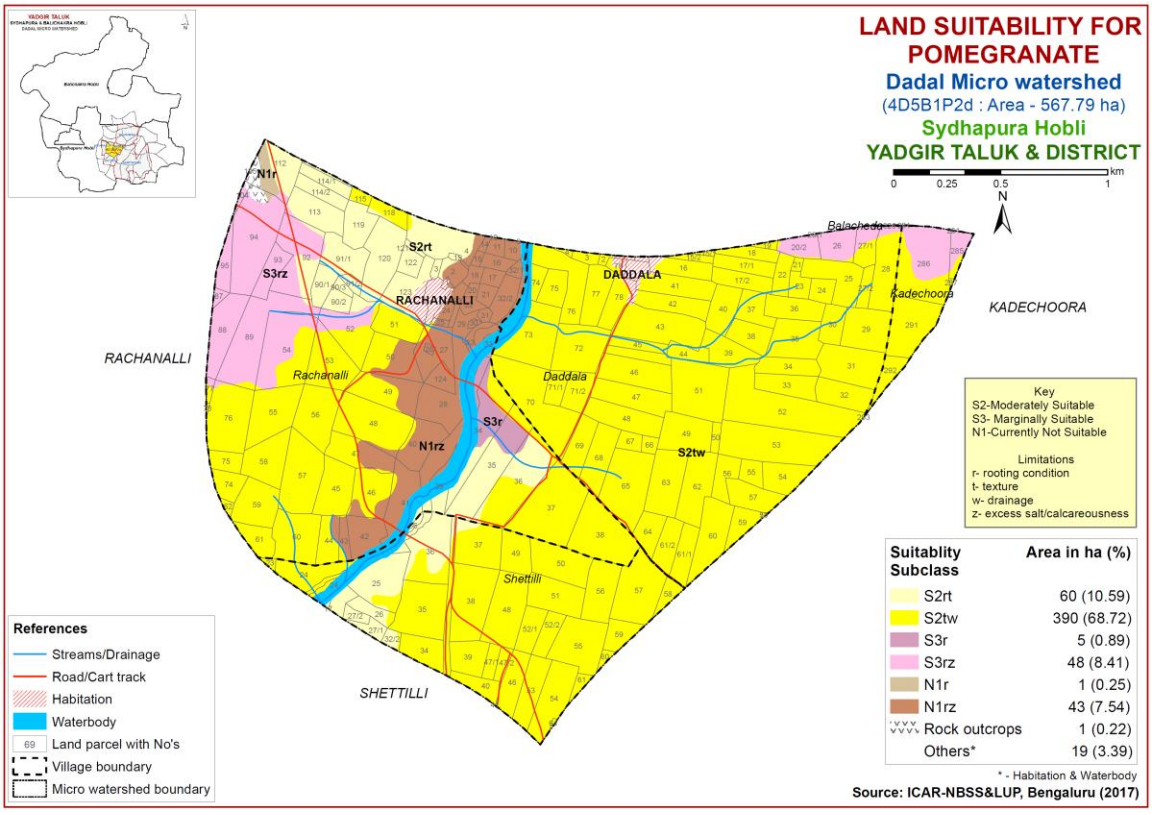



Fig 7.16 Land Suitability map of Pomegranate

### 7.17 Land Suitability for Jackfruit (*Artocarpus heterophyllus*)

Jackfruit is the most important fruit crop grown in 5368 ha in almost all the districts of the state. The crop requirements for growing jackfruit (Table 7.17) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing jackfruit was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.17.

No highly (Class S1) and moderately (Class S2) suitable lands are available for growing jackfruit in the microwatershed. Major area of about 503 ha (89%) is marginally suitable (Class S3) for growing jackfruit and are distributed in all parts of the microwatershed. They have severe limitations of texture, drainage, excess salt and rooting depth. Not suitable lands (Class N) occupy an area of about 44 ha (8%) and are distributed in the central and northern part of the microwatershed. They have very severe limitations of rooting depth and excess salt.

**Table 7.17 Crop suitability criteria for Jackfruit**

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

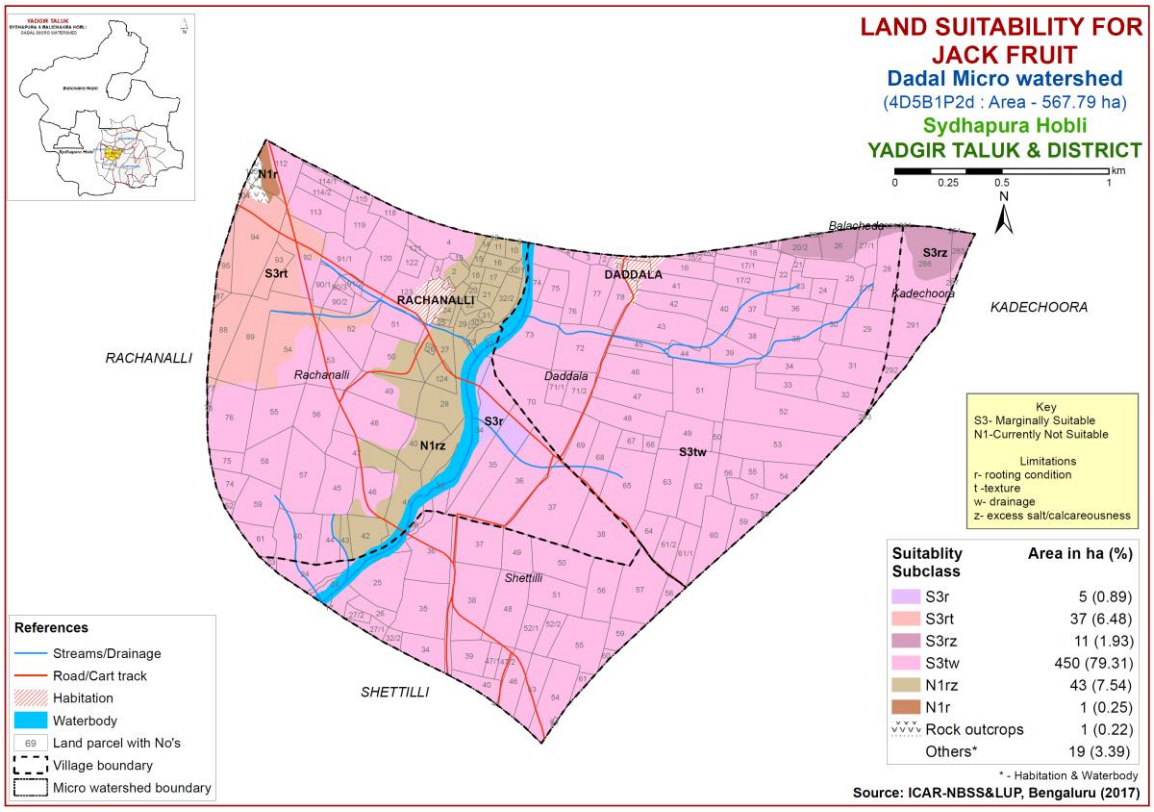



Fig 7.17 Land Suitability map of Jackfruit

### 7.18 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 (Table 7.18) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing jamun was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.18.

No highly (Class S1) suitable lands are available for growing jamun in the microwatershed. The moderately suitable (Class S2) lands found to occur in major area of about 390 ha (69%). The soils have moderate limitations of texture and drainage. They are distributed in all parts of the microwatershed. The marginally suitable (Class S3) lands cover about an area of 113 ha (20%) and mainly occur in the central, northwestern, northeastern and southwestern part of the microwatershed. They have severe limitations of rooting depth, excess salt and texture. An area of about 44 ha (8%) is not suitable (Class N) for growing jamun and occur in the northern and central part of the microwatershed. They have severe limitations of rooting depth and excess salt.

**Table 7.18 Crop suitability criteria for Jamun**

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

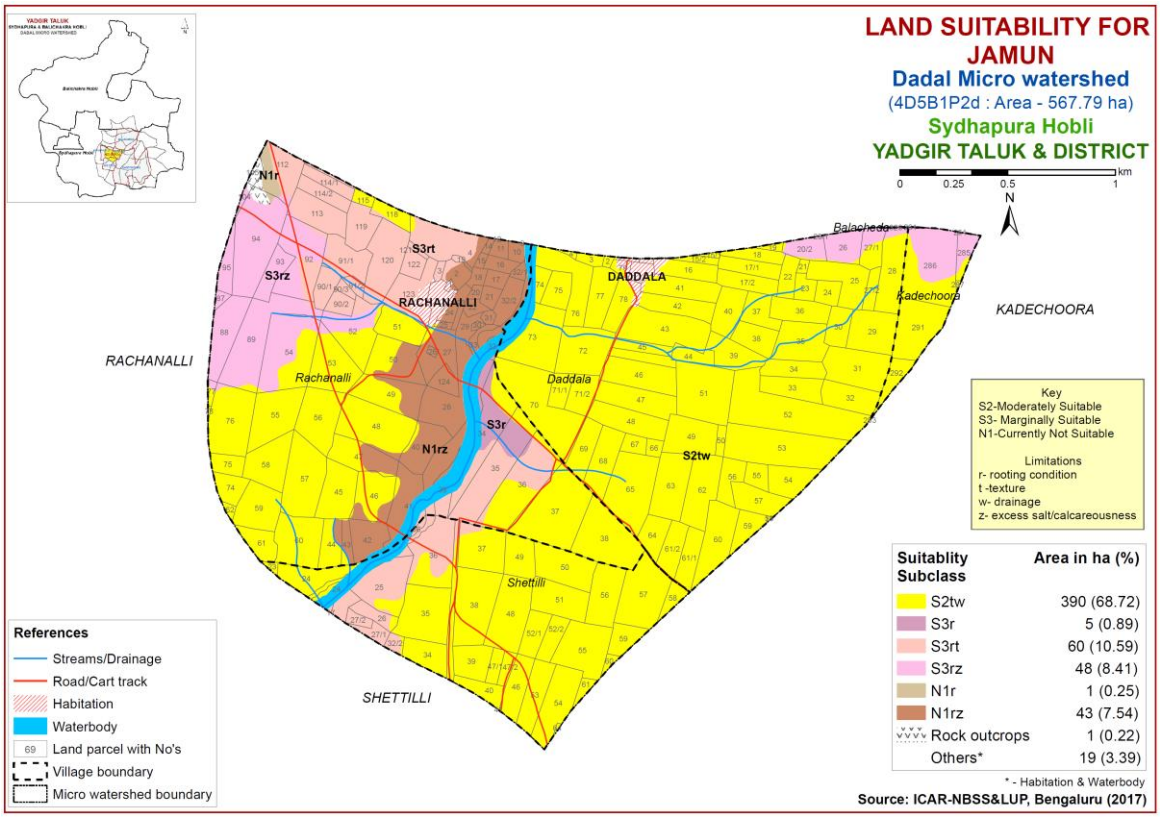



Fig 7.18 Land Suitability map of Jamun

## 7.19 Land Suitability for Musambi (*Citrus limetta*)

Musambi is the most important fruit crop grown in an area of 5446 ha in almost all the districts of the state. The crop requirements for growing musambi were matched with the soil-site characteristics and a land suitability map for growing musambi was

generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.19.

No highly (Class S1) suitable lands are available for growing musambi in the microwatershed. The moderately suitable (Class S2) lands found to occur in major area of about 450 ha (79%). The soils have moderate limitations of rooting depth, excess salt and drainage. They are distributed in all parts of the microwatershed. The marginally suitable (Class S3) lands cover about an area of 53 ha (9%) and mainly occur in the central, northwestern, northeastern and southwestern part of the microwatershed. They have severe limitations of rooting depth and excess salt. An area of about 44 ha (8%) is not suitable (Class N) for growing musambi and occur in the northern and central part of the microwatershed. They have very severe limitations of rooting depth and excess salt.

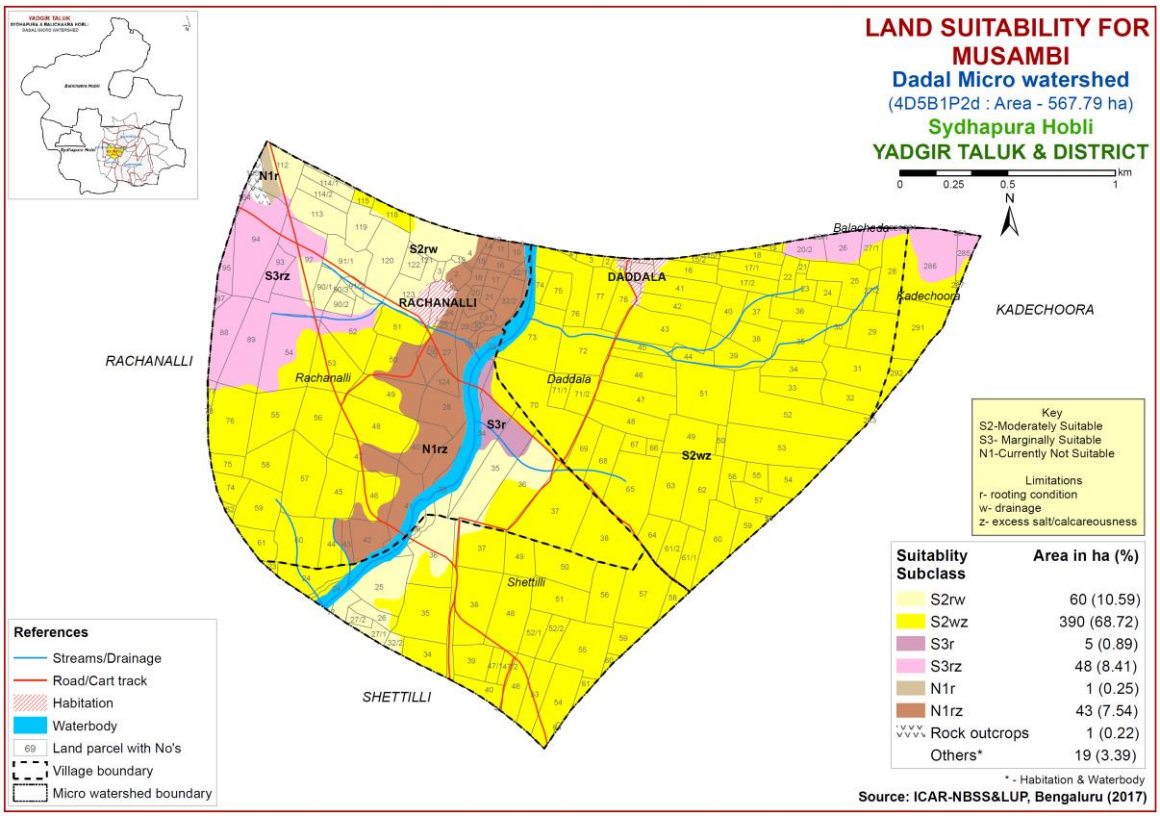



Fig 7.19 Land Suitability map of Musambi

### 7.20 Land Suitability for Lime (*Citrus sp*)

Lime is the most important fruit crop grown in 11752 ha in almost all the districts of the state. The crop requirements for growing lime (Table 7.19) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing lime was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed is given in Figure 7.20.

No highly (Class S1) suitable lands are available for growing lime in the microwatershed. The moderately suitable (Class S2) lands found to occur in major area of

about 450 ha (79%). The soils have moderate limitations of rooting depth, excess salt and drainage. They are distributed in all parts of the microwatershed. The marginally suitable (Class S3) lands cover about an area of 53 ha (9%) and mainly occur in the central, northwestern, northeastern and southwestern part of the microwatershed. They have severe limitations of rooting depth and excess salt. An area of about 44 ha (8%) is not suitable (Class N) for growing lime and occur in the northern and central part of the microwatershed. They have very severe limitations of rooting depth and excess salt.

**Table 7.19 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<br>24-27 | 36-40<br>20-23 | >40<br><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 condition | Soil depth | cm | >150 | 100-150 | 50-100 | <50 |
| | Gravel content | % vol. | Non gravelly | 15-35 | 35-55 | >55 |
| Soil toxicity | Salinity | dS/m | Non saline | Upto 1.0 | 1.0-2.5 | >2.5 |
| | Sodicity | % | Non sodic | 5-10 | 10-15 | >15 |
| Erosion | Slope | % | <3 | 3-5 | 5-10 | |

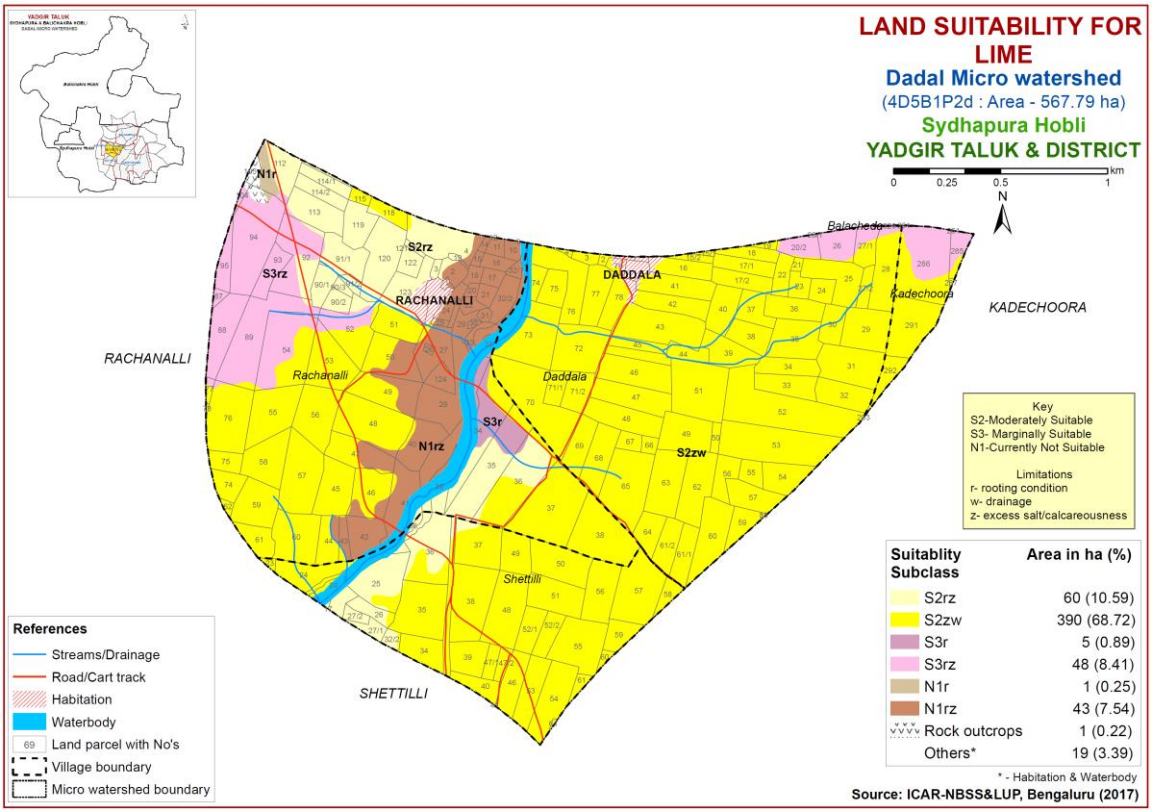



Fig 7.20 Land Suitability map of Lime

### 7.21 Land Suitability for Cashew (*Anacardium occidentale)*

Cashew is the most important plantation crop grown in an area of about 70552 ha in almost all the districts. The crop requirements for growing Cashew (Table 7.20) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing Cashew was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed is given in Figure 7.21.

No highly (Class S1) and moderately suitable (Class S2) lands are available for growing cashew in the microwatershed. The marginally suitable (Class S3) lands found to occur in very small area of about 5 ha (1%). The soils have severe limitation of rooting depth. They are distributed in the central part of the microwatershed. Major area of about 542 ha (95%) is not suitable (Class N) for growing cashew and occur in all parts of the microwatershed. They have very severe limitations of rooting depth, texture and excess salt.

**Table 7.20 Crop suitability criteria for Cashew**

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

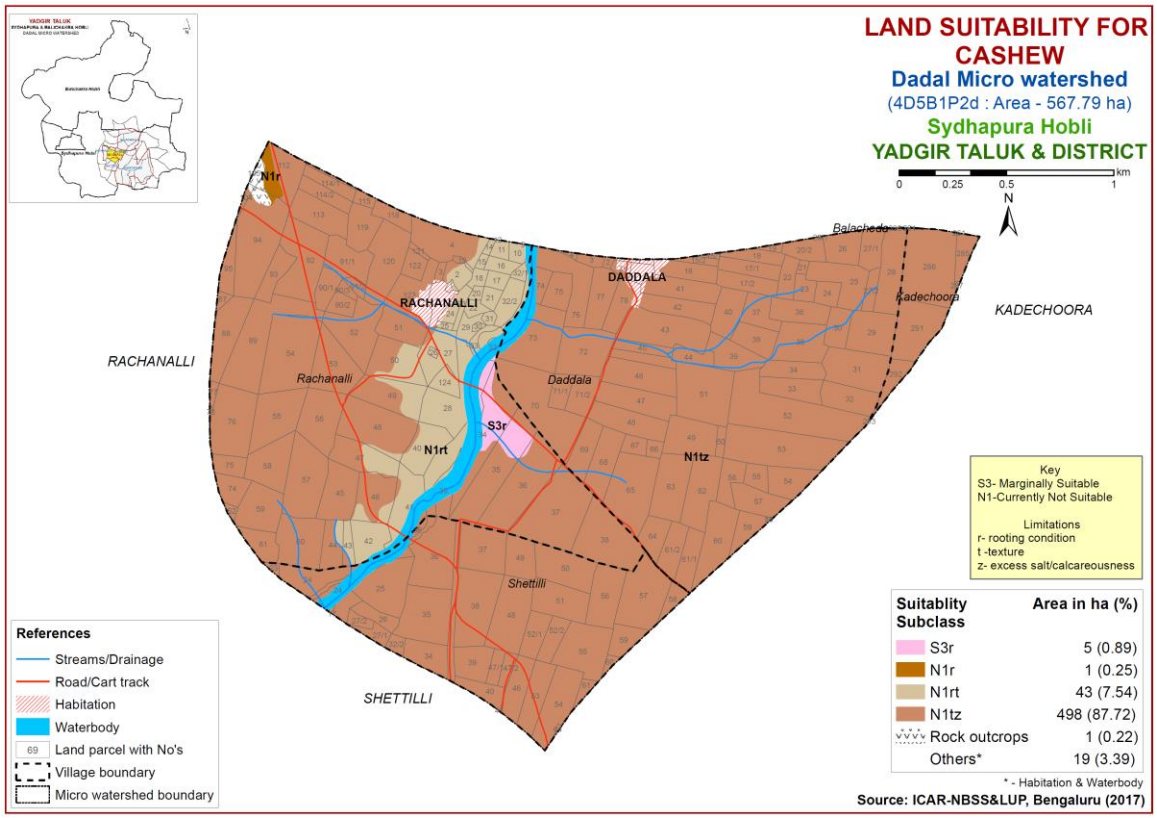



Fig 7.21 Land Suitability map of Cashew

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

Custard apple is the most important fruit crop grown in 1426 ha in almost all the districts of the state. The crop requirements for growing custard apple (Table 7.21) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing custard apple was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed is given in Figure 7.22.

No highly (Class S1) suitable lands are available for growing custard apple in the microwatershed. Major area of about 503 ha (89%) is moderately suitable (Class S2) for growing custard apple and are distributed in all parts of the microwatershed. They have moderate limitations of texture, drainage, excess salt and rooting depth. Marginally suitable lands (Class S3) occupy an area of about 44 ha (8%) and are distributed in the central and northern part of the microwatershed. They have severe limitations of rooting depth and excess salt.

**Table 7.21 Crop suitability criteria for Custard Apple**

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

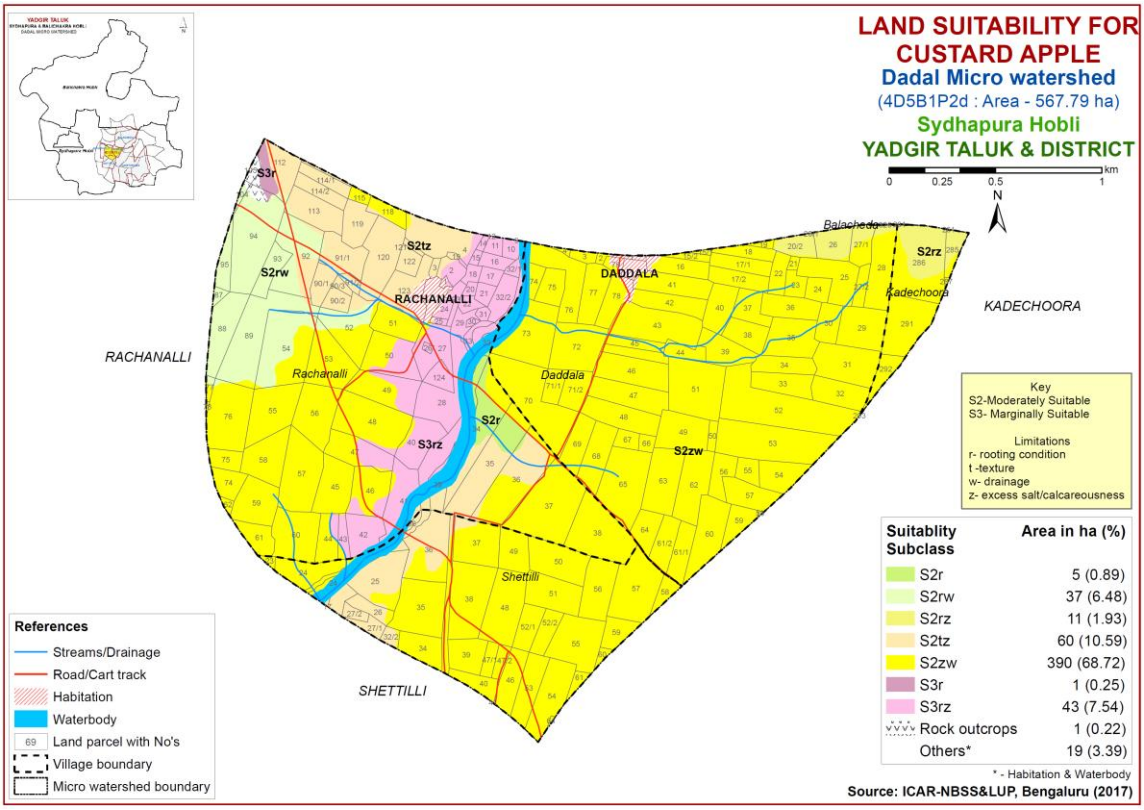



Fig 7.22 Land Suitability map of Custard Apple

### 7.23 Land Suitability for Amla (*Phyllanthus emblica*)

Amla is the most important medicinal plant grown in 151 ha in almost all the districts of the state. The crop requirements for growing amla (Table 7.22) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing amla was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.23.

No highly (Class S1) suitable lands are available for growing amla in the microwatershed. Major area of about 503 ha (89%) is moderately suitable (Class S2) for growing amla and are distributed in all parts of the microwatershed. They have moderate limitations of texture, drainage, excess salt and rooting depth. Marginally suitable lands (Class S3) occupy an area of about 44 ha (8%) and are distributed in the central and northern part of the microwatershed. They have severe limitations of rooting depth and excess salt.

**Table 7.22 Crop suitability criteria for Amla**

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

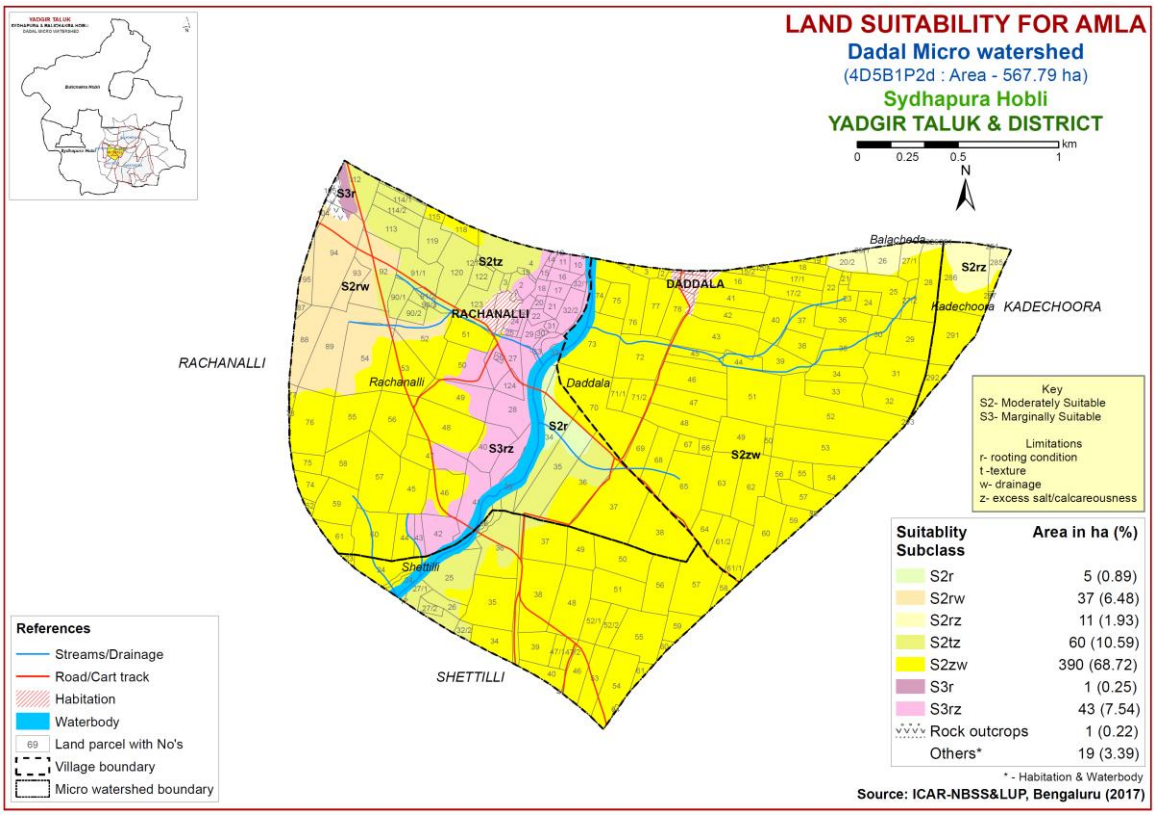



Fig 7.23 Land Suitability map of Amla

### 7.24 Land Suitability for Tamarind (*Tamarindus indica*)

Tamarind is the most important spice crop raised in 14897 ha in all the districts of the state. The crop requirements for growing tamarind (Table 7.23) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing tamarind was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed is given in Figure 7.24.

No highly (Class S1) suitable lands are available for growing tamarind in the Dadal microwatershed. Moderately suitable (Class S2) lands are found to occur in major area of about 390 ha (69%). The soils have moderate limitation of texture and drainage. They are distributed in all parts of the microwatershed. The marginally suitable (Class S3) lands cover an area of about 60 ha (11%) and mainly occur in the central, southwestern and northwestern part of the microwatershed. They have severe limitations of rooting depth and drainage. An area of about 97 ha (17%) is not suitable (Class N) for growing tamarind and occur in the northern, central, western and northeastern part of the microwatershed. The soils have very severe limitation of excess salt and rooting depth.

**Table 7.23 Crop suitability criteria for Tamarind**

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

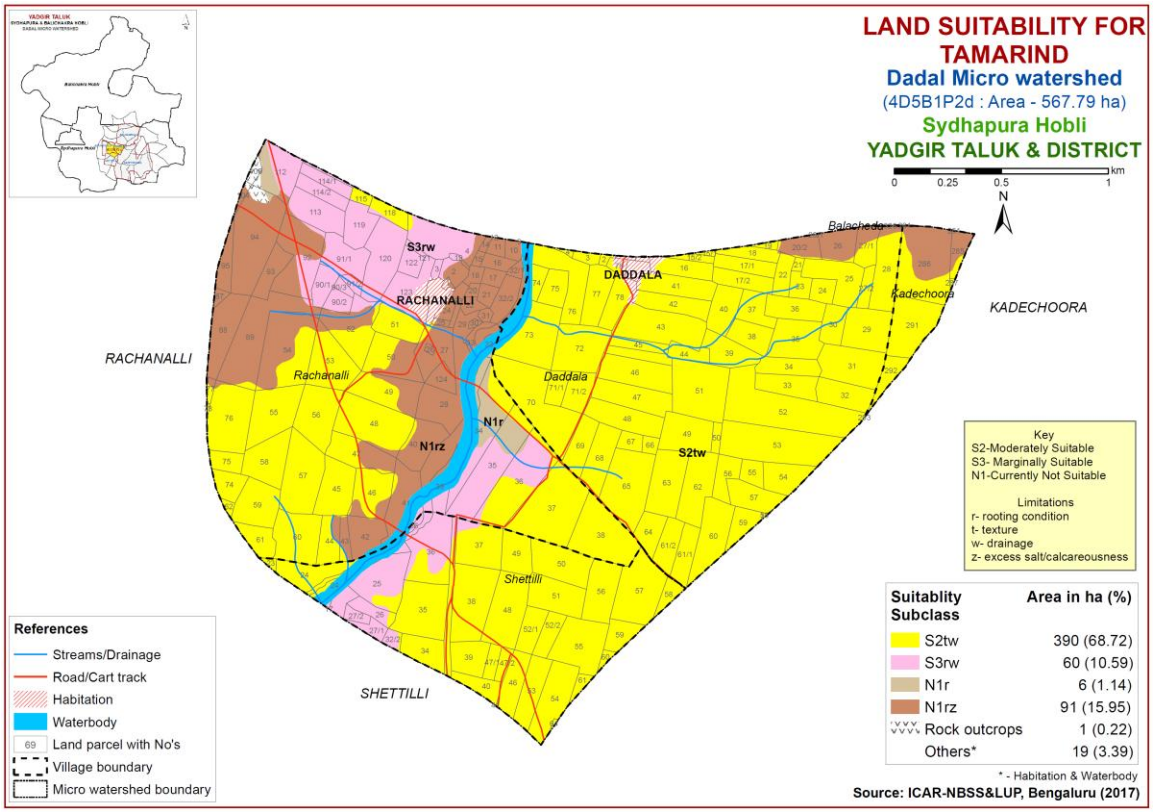



Fig 7.24 Land Suitability map of Tamarind

## 7.25 Land suitability for Marigold (*Tagetes sps.)*

Marigold is the most important flower crop grown in an area of 9108 ha in almost all the districts of the State. The crop requirements for growing marigold (Table 7.24) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing marigold was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.25.

No highly (Class S1) suitable lands are available for growing marigold in the microwatershed. Major area of about 503 ha (89%) is moderately suitable (Class S2) for growing marigold and are distributed in all parts of the microwatershed. They have moderate limitations of texture, drainage, excess salt and rooting depth. Marginally suitable lands (Class S3) occupy an area of about 44 ha (8%) and are distributed in the central and northern part of the microwatershed. They have severe limitations of rooting depth and excess salt.

**Table 7.24 Land suitability criteria for Marigold**

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

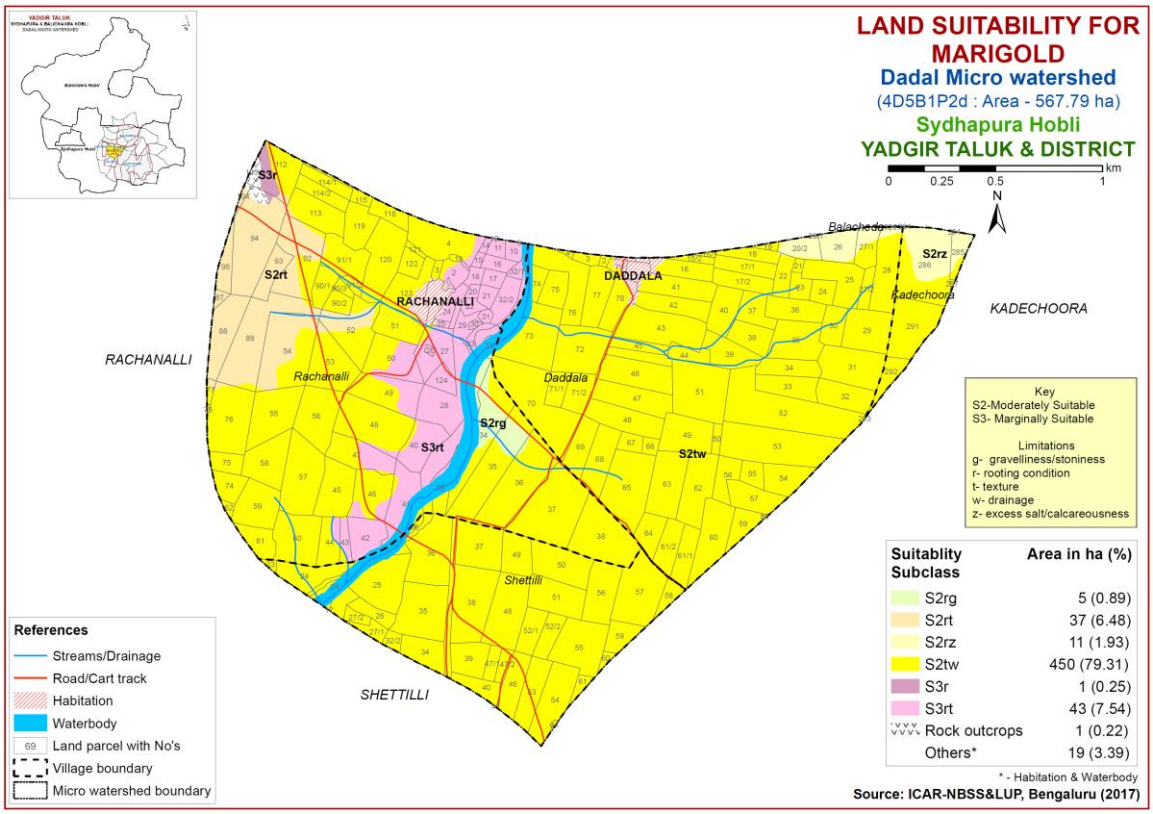



Fig. 7.25 Land Suitability map of Marigold

### 7.26 Land suitability for Chrysanthemum (*Dendranthema grandiflora*)

Chrysanthemum is the most important flower crop grown in an area of 4978 ha in almost all the districts of the State. The crop requirements for growing chrysanthemum (Table 7.25) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing chrysanthemum was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.26.

No highly (Class S1) suitable lands are available for growing chrysanthemum in the microwatershed. Major area of about 503 ha (89%) is moderately suitable (Class S2) for growing chrysanthemum and are distributed in all parts of the microwatershed. They have moderate limitations of texture, drainage, excess salt and rooting depth. Marginally suitable lands (Class S3) occupy an area of about 44 ha (8%) and are distributed in the central and northern part of the microwatershed. They have severe limitations of rooting depth and excess salt.

Table 7.25 Land suitability criteria for Chrysanthemum

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

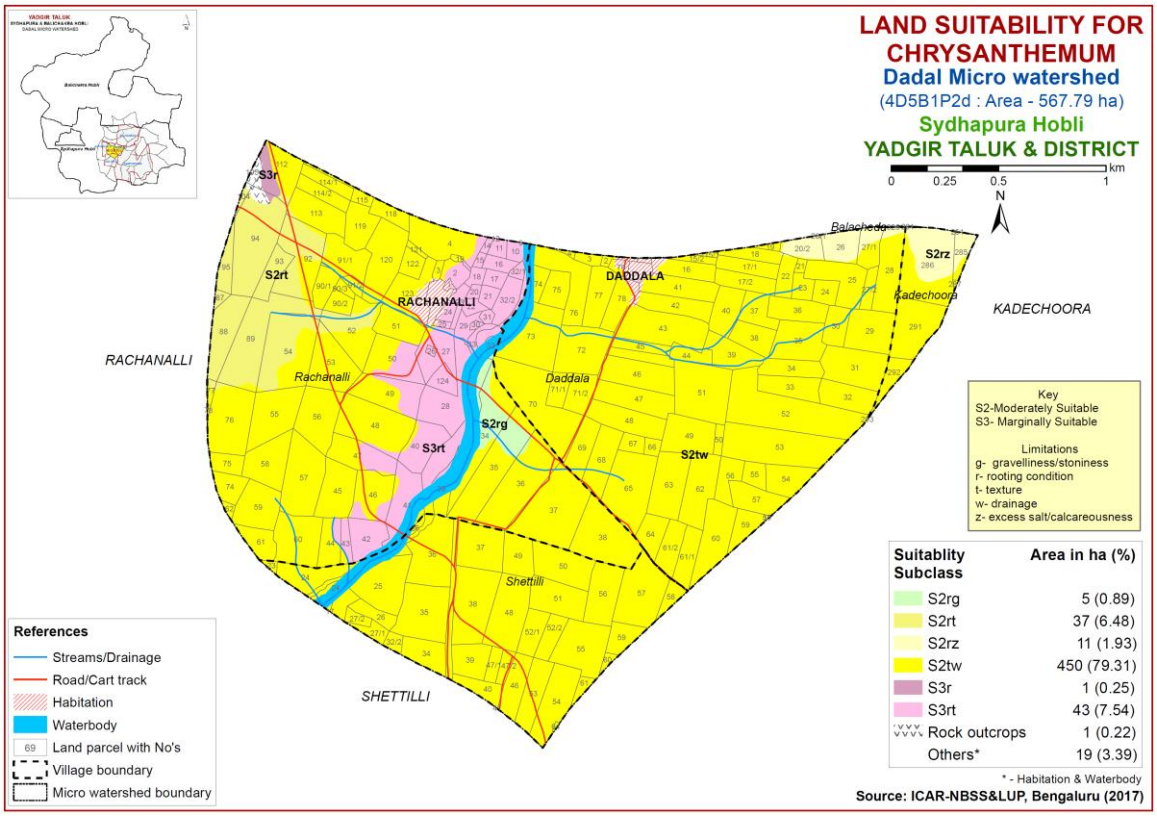



Fig. 7.26 Land Suitability map of Chrysanthemum

### 7.27 Proposed Crop Plan for Dadal Microwatershed

After assessing the land suitability for the 26 crops, a proposed crop plan has been prepared for the 4 identified LUCs by considering only the highly (Class S1) and moderately (Class S2) suitable lands for each of the 26 crops. The resultant proposed crop plan is presented in Table 7.26.

**Table 7.26 Proposed Crop Plan for Dadal (4D5B1P2d) Micro watershed**

| Proposed Land Use Class | Soil Map Units | Survey Number | Field Crops | Horticulture Crops | Suitable Interventions |
|---|---|---|---|---|---|
| 1 | 77.RHNcB2<br>79.RHNmB2<br>84.KDRcB2<br>87.KDRiB2<br>89.KDRmB2<br>91.SWRmB2<br>92.HGNcB2<br>95.HGNmB2<br>(Moderately deep to very deep black clay soils) | Daddala:4,15/1,15/2,16,17/1,17/2,18,19,2,21,22,23 ,24,25, 27/1,27/2,28,29,3,30,31,32,33,34,35,36,37, 38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53, 54,55,56,57,58,59,60,61/1,61/2,62,63,64,65,66,67, 68,69,70, 71/1,71/2,72,73,74,75,76,77,78,XX<br>Kadechoora:287,291,292,293<br>Rachanalli:112,113,114/1,114/2,115, 118,119,120,121,122,123,19,3,35,36,37,38,4,44,45 , 46,47,48,49,51,52,53,55,56,57,58,59,60,61,62,74, 75,76,77,78,90/1,90/2,90/3,91/1,91/2<br>Shettilli:17,23,24,25,26,27/1,27/2, 32/2,34,35,36,37,38,39,40,41,46,47/1,47/2,48,49, 50,51,52/1,52/2,53,54,55,56,57,58,59,60,61,64 | Sunflower, Sorghum, Cotton, Bengal gram, Safflower, Linseed, Bajra | **Fruit crops:** Pomegranate, Tamarind, Jamun, , Lime, Musambi, Amla, Custard apple,<br>**Vegetables:**Drumstick, Chilli, Coriander<br>**Flowers:** Marigold, Chrysanthemum | Application of FYM, Biofertilizers and micronutrients, drip irrigation, Mulching, suitable soil and water conservation practices |
| 2 | 73.BLDcB2<br>75.BLDiB1g1<br>18.HLGiB2g1<br>(Moderately shallow, black sandy clay to sandy clay loam soils) | Balacheda:<br>261,326<br>Daddala:<br>20/1,20/2,26<br>Kadechoora:<br>285,286<br>Rachanalli:<br>104,54,87,88,89,92,93,94,95 | Maize, Sorghum, Groundnut, Bengal gram, Bajra | **Fruit crops:**, Amla, Custard apple,<br>**Vegetables:** Tomato, Chilli, Coriander<br>**Flowers:** Marigold, Chrysanthemum | Application of FYM, Biofertilizers and micronutrients, drip irrigation, Mulching, suitable soil and water conservation practices |
| 3 | 29. YLRcB2g1<br>(Moderately shallow, red clay soils) | Rachanalli:<br>34 | Maize, Sorghum, Groundnut, Bajra, Redgram | **Fruit crops:** Amla, Custard apple<br>**Vegetables:** Tomato, Chilli<br>**Flowers:** Marigold Chrysanthemum | Drip irrigation, mulching, suitable conservation practices (Crescent Bunding with Catch Pit etc) |
| 4 | 67.GDLcB3<br>(Shallow, black clay soils) | Rachanalli:<br>10,11,12,124,13,14,15,16,17,18, 2,20,21,22,23,24,25,26,27,28,29,30,31,32/1,32/2 ,40,41,42,43,50,9 | Bengal gram, Horsegram, Coriander | **Agri-Silvi-Pasture:** Custard apple, Amla**,** Hybrid Napier, *Styloxanthes hamata*, Glyricidia, *Styloxanthes scabra* | Use of short duration varieties, sowing across the slope, drip irrigation and mulching is recommended |

*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 characteristics of a healthy soil are**

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

**Characteristics of Dadal Microwatershed**

- The soil phases with sizeable area identified in the microwatershed belonged to the soil series of HGN (239 ha), KDR (79 ha), SWR (72 ha), RHN (60 ha), GDL (43 ha), BLD (37 ha), HLG (11 ha), YLR (5 ha) and KYT (1 ha).
- As per land capability classification, nearly 96 per cent area comes under arable land category (Class II and III) and 4 per cent area belongs to nonarable land category. The major limitations identified in the arable lands were soil and erosion.
- On the basis of soil reaction, about 348 ha (61%) area is strongly alkaline (pH 8.4-9.0) followed by moderately alkaline (pH 7.8-8.4) soils in 142 ha (25%). An area of

about 57 ha (10%) is very strongly alkaline (pH >9.0) in reaction. Thus, about 96 per cent of the soils in the 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 total area of 568 ha in the microwatershed, major area of 525 ha is suffering from either moderate or severe erosion. These areas need immediate soil and water conservation and other 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 the younger farmers.

**Inputs for Net Planning and Interventions needed**

Net planning in IWMP is focusing on preparation of

1. Soil and Water Conservation Treatment Plan 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 may 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 Dadal microwatershed.
- **Organic Carbon:** In about 403 ha (71%) area, the OC content is medium (0.5-0.75%), about 97 ha (17%) area it is high (>0.75%) and in about 47 ha (8 %) area is low (<0.5 %). 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 cost 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 500 ha area where OC is less than 0.5-0.75%. For example, for rainfed maize, recommended level is 50 kg N per ha and an additional 12 kg /ha needs to be applied for all the crops grown in these plots.
- **Available Phosphorus**: In 128 ha (23%) area, the available phosphorus is low, an area of about 416 ha (73%) it is medium and an area of about 4 ha (<1%) is high in available phosphorus in the microwatershed. Hence for all the crops, 25% additional P-needs to be applied, where it is low or medium in available phosphorus.
- **Available Potassium:** Available potassium is medium in 279 ha (49%) area of the microwatershed. Hence, in all these plots, for all crops, additional 25 % potassium may be applied. It is high in 268 ha (47%) area of the microwatershed.
- **Available Sulphur:** Available sulphur is a very critical nutrient for oilseed crops. It is low in 390 ha (69%) area of the microwatershed and medium in 146 ha (26%).These areas need to be applied with magnesium sulphate or gypsum or Factamphos (p) fertilizer (13% sulphur) for 2-3 years for the deficiency to be corrected. High in small area of about 11 ha (2%) in the microwatershed.
- **Available iron:** It is deficient in 82 ha (14%) area and it is sufficient in 465 ha (82%) area in the microwatershed.
- **Available Zinc:** Entire area is deficient in available zinc content. Application of zinc sulphate @25kg/ha is to be applied.

**Soil alkalinity:** The microwatershed has 547 ha area with soils that are alkaline in reaction. 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.

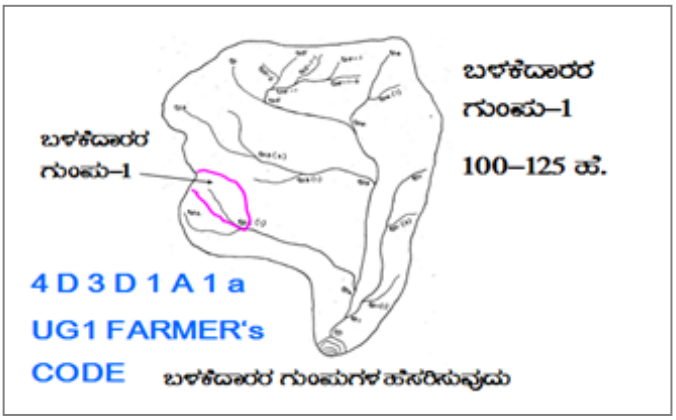
**Land Suitability for various crops:** Areas that are highly, moderately and marginally suitable for growing various crops are indicated. Along with the suitability, various constraints that are limiting the productivity are also indicated. For example, in case of cotton, gravel content, rooting depth 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.

*Chapter 9*

# SOIL AND WATER CONSERVATION TREATMENT PLAN

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

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




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

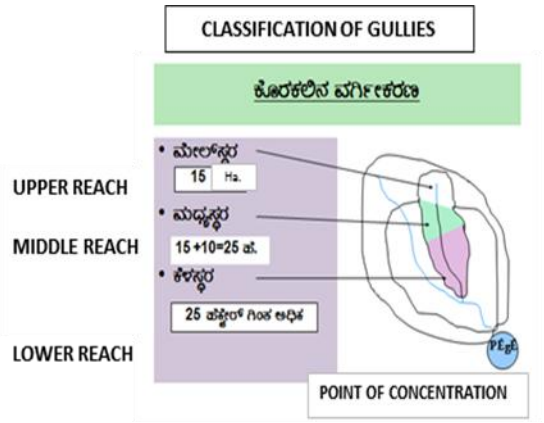
- Naming of user groups and farmers
- Identification of arable and non arable lands
- Identification of drainage lines and gullies
- Identification of non treatable areas
- Identification of priority areas in the arable lands
- Treatment plan for arable lands
- Location of water harvesting and recharge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

## 9.1 Treatment Plan

The treatment plan recommended for arable lands is briefly described below

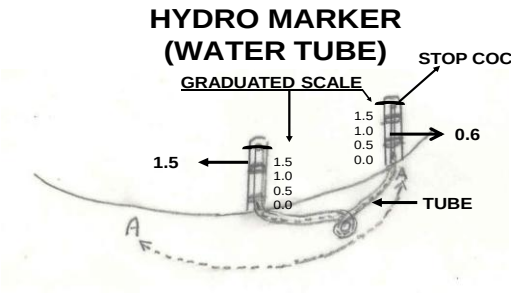
### 9.1.1 Arable Land Treatment

### 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<br>Existing network of waterways, pothissa boundaries, grass belts, natural drainage lines/ watercourse, cut ups/ terraces are marked on the cadastral map to the scale<br>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.


**FALL: 1.5 - 0.6 = 0.9 m.**

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

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

**Note:** (i) The above intervals are maximum.

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

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

**Section of the Bund**

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

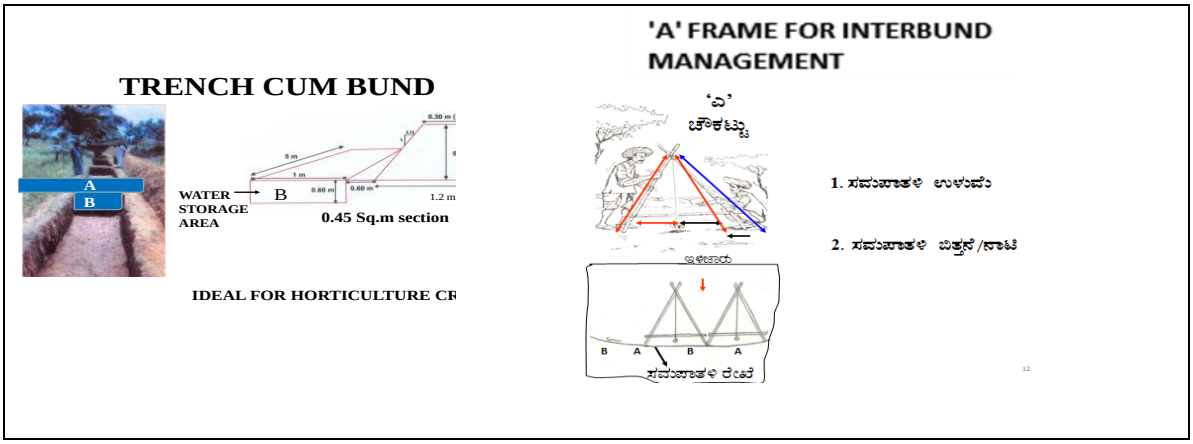
**Recommended Bund Section**

| Top width (m) | Base width (m) | Height (m) | Side slope (Z:1;H:V) | Cross section (sq m) | Soil Texture | Remarks |
|---|---|---|---|---|---|---|
| 0.3 | 0.9 | 0.3 | 01:01 | 0.18 | Sandy loam | Vegetative bund |
| 0.3 | 1.2 | 0.3 | 1.5:1 | 0.225 | Sandy clay | |
| 0.3 | 1.2 | 0.5 | 0.9:1 | 0.375 | Red gravelly soil | |
| 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. Water Ways**

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

**C. Farm Ponds**

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

**D. Diversion Channel**

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

### 9.1.2 Non-Arable Land Treatment

Depending on the gravelliness and crops preferred by the farmers, the concerned authorities can decide appropriate treatment plan. The recommended treatments may be Contour Trench, Staggered Trench, Crescent Bund, Boulder Bund or Pebble Bund 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 drainage lines (gullies/ nalas/ hallas) and existing structures are marked to the scale and storage capacity of the existing water bodies are documented.
b) The drainage line will be demarcated into Upper Reach, Middle Reach and Lower Reach.
c) Considering the Catchment, Nala bed and bank conditions, suitable structures are decided.
d) Number of storage structures (Check dam/ Nala bund/ Percolation tank) will be decided considering the commitments and available runoff in water budgeting and quality of water in the wells and site suitability.
e) Detailed Levelling Survey using Dumpy Level / Total Station has to be carried out to arrive at the site-specific designs as shown in the Manual.
f) The location of ground water recharge structures are decided by examining the lineaments and fracture zones from geological maps.
g) Rainfall intensity data of the nearest Rain gauge station is considered for Hydrologic Designs.
h) Silt load to the Storage/Recharge structures is reduced by providing vegetative, boulder and 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. Major area of about 542 ha (95%) requires graded bunding / strengthening of field bunds and 5 ha (1%) area required trench cum bunding.

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.

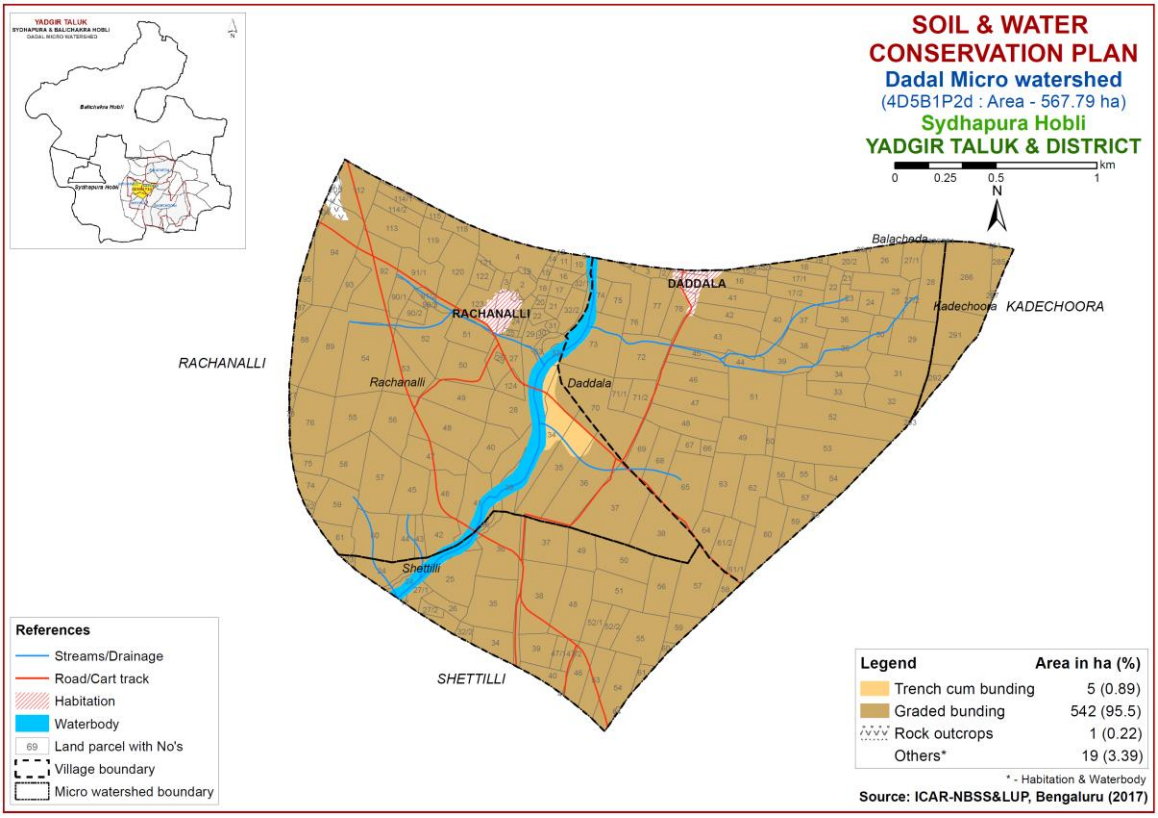



Fig. 9.1 Soil and Water Conservation Plan map of Dadal Microwatershed

## 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 and field bunds for growing annual and perennial crops. The method of planting these trees is given below.

It is recommended to open pits during the 1$^{st}$ week of March along the contour and heap the dug out soil on the lower side of the slope in order to harness the flowing water and facilitate weathering of soil in the pit. Exposure of soil in the pit also prevents spread of pests and diseases due to scorching sun rays. The pits should be filled with mixture of soil and organic manure during the second week of April and keep ready with sufficiently

tall seedlings produced either in poly bags or in root trainer nurseries so that planting can be done during the 2nd or 3rd week of April depending on the rainfall.

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

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

## 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

## Daddal Microwatershed

### Soil Phase Information

| Village | Survey Number | Total Area (ha) | Soil Phase | LMU | Soil Depth | Surface Soil Texture | Soil Gravelliness | AWC | Slope | Soil Erosion | CLU Code | WELLS | LCC | Conservation Plan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daddal | 1 | 0.28 | Others | Others | Others | Others | Others | Others | Others | Others | Not Available (NA) | Not Available | Others | Others |
| Daddal | 2 | 0.24 | HGNcB2 | LMU-1 | Very deep (>150 cm) | Sandy loam | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | No crop (Nc) | Not Available | IIes | Graded bunding |
| Daddal | 3 | 0.6 | KDRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 4 | 0.16 | HGNcB2 | LMU-1 | Very deep (>150 cm) | Sandy loam | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 15/1 | 0.18 | KDRcB2 | LMU-1 | Deep (100-150 cm) | Sandy loam | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | No crop (Nc) | Not Available | IIes | Graded bunding |
| Daddal | 15/2 | 0.61 | KDRcB2 | LMU-1 | Deep (100-150 cm) | Sandy loam | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | No crop (Nc) | Not Available | IIes | Graded bunding |
| Daddal | 16 | 2.31 | KDRcB2 | LMU-1 | Deep (100-150 cm) | Sandy loam | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | No crop (Nc) | Not Available | IIes | Graded bunding |
| Daddal | 17/1 | 1.94 | KDRiB2 | LMU-1 | Deep (100-150 cm) | Sandy clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 17/2 | 2.17 | KDRiB2 | LMU-1 | Deep (100-150 cm) | Sandy clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 18 | 1.47 | KDRiB2 | LMU-1 | Deep (100-150 cm) | Sandy clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 19 | 0.32 | KDRiB2 | LMU-1 | Deep (100-150 cm) | Sandy clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Cotton+Redgram (Ct+Rg) | Not Available | IIes | Graded bunding |
| Daddal | 20/1 | 0.02 | HLGiB2g1 | LMU-2 | Moderately shallow (50-75 cm) | Sandy clay | Gravelly (15-35%) | Low (51-100 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 20/2 | 1.78 | HLGiB2g1 | LMU-2 | Moderately shallow (50-75 cm) | Sandy clay | Gravelly (15-35%) | Low (51-100 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 21 | 0.3 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 22 | 1.48 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 23 | 1.11 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 24 | 1.23 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 25 | 3.86 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 26 | 2.41 | HLGiB2g1 | LMU-2 | Moderately shallow (50-75 cm) | Sandy clay | Gravelly (15-35%) | Low (51-100 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 27/1 | 1.89 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 27/2 | 1.04 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 28 | 4.32 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |

| Village | Survey Number | Total Area (ha) | Soil Phase | LMU | Soil Depth | Surface Soil Texture | Soil Gravelliness | AWC | Slope | Soil Erosion | CLU Code | WELLS | LCC | Conservation Plan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daddal | 29 | 4.08 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar+Redgram (Jw+Rg) | Not Available | IIes | Graded bunding |
| Daddal | 30 | 1.91 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | No crop (Nc) | Not Available | IIes | Graded bunding |
| Daddal | 31 | 4.94 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 32 | 3.04 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 33 | 2.76 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 34 | 2.31 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 35 | 4.14 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Cotton (Ct) | 1 Check Dam | IIes | Graded bunding |
| Daddal | 36 | 2.76 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 37 | 2.11 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 38 | 2.33 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Cotton (Ct) | Not Available | IIes | Graded bunding |
| Daddal | 39 | 2.94 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 40 | 2.74 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 41 | 3.31 | KDRcB2 | LMU-1 | Deep (100-150 cm) | Sandy loam | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | No crop (Nc) | Not Available | IIes | Graded bunding |
| Daddal | 42 | 2.9 | KDRcB2 | LMU-1 | Deep (100-150 cm) | Sandy loam | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Cotton (Ct) | Not Available | IIes | Graded bunding |
| Daddal | 43 | 6.08 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 44 | 1.31 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 45 | 1.34 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | 1 Check Dam | IIes | Graded bunding |
| Daddal | 46 | 4.32 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 47 | 3.96 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 48 | 3.78 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar+Redgram (Jw+Rg) | Not Available | IIes | Graded bunding |
| Daddal | 49 | 3.92 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 50 | 0.56 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 51 | 6.6 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |

| Village | Survey Number | Total Area (ha) | Soil Phase | LMU | Soil Depth | Surface Soil Texture | Soil Gravelliness | AWC | Slope | Soil Erosion | CLU Code | WELLS | LCC | Conservation Plan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daddal | 52 | 10.67 | SWRmB2 | LMU-1 | Deep (100-150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 53 | 8.39 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 54 | 2.66 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 55 | 1.21 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 56 | 1.91 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 57 | 2.75 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 58 | 0.05 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 59 | 1.76 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 60 | 4.57 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 61/1 | 2.27 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 61/2 | 2.29 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 62 | 4.51 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 63 | 4.63 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 64 | 2.06 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 65 | 6.72 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 66 | 0.58 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Not Available (NA) | Not Available | IIes | Graded bunding |
| Daddal | 67 | 0.93 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Not Available (NA) | Not Available | IIes | Graded bunding |
| Daddal | 68 | 3.54 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 69 | 2.53 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 70 | 8.37 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 71/1 | 1.41 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 71/2 | 2.19 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 72 | 5.05 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |

| Village | Survey Number | Total Area (ha) | Soil Phase | LMU | Soil Depth | Surface Soil Texture | Soil Gravelliness | AWC | Slope | Soil Erosion | CLU Code | WELLS | LCC | Conservation Plan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daddal | 73 | 7.12 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 74 | 1 | HGNcB2 | LMU-1 | Very deep (>150 cm) | Sandy loam | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 75 | 1.92 | HGNcB2 | LMU-1 | Very deep (>150 cm) | Sandy loam | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 76 | 4.38 | HGNcB2 | LMU-1 | Very deep (>150 cm) | Sandy loam | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Redgram (Rg) | Not Available | IIes | Graded bunding |
| Daddal | 77 | 3.04 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 78 | 2.4 | HGNmB2 | LMU-1 | Very deep (>150 cm) | Clay | Non gravelly (<15%) | Very high (>200 mm/m) | Very gently sloping (1-3%) | Moderate | Jowar (Jw) | Not Available | IIes | Graded bunding |
| Daddal | 79 | 0.59 | Others | Others | Others | Others | Others | Others | Others | Others | Not Available (NA) | Not Available | Others | Others |

# Appendix II

## Daddal Microwatershed

### Soil Fertility Information

| Village | Survey Number | Soil Reaction | Salinity | Organic Carbon | Available Phosphorus | Available Potassium | Available Sulphur | Available Boron | Available Iron | Available Manganese | Available Copper | Available Zinc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daddal | 1 | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others |
| Daddal | 2 | Very strongly alkaline (pH > 9.0) | Non saline (<2 dsm ) | High (>0.75 %) | Low (< 23 kg/ha) | High (> 337 kg/ha) | Medium (10 - 20 ppm) | High (> 1.0 ppm) | Deficient (< 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 3 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | High (>0.75 %) | Low (< 23 kg/ha) | High (> 337 kg/ha) | Medium (10 - 20 ppm) | High (> 1.0 ppm) | Deficient (< 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 4 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | High (>0.75 %) | Low (< 23 kg/ha) | High (> 337 kg/ha) | Medium (10 - 20 ppm) | High (> 1.0 ppm) | Deficient (< 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 15/1 | Very strongly alkaline (pH > 9.0) | Non saline (<2 dsm ) | High (>0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | High (> 20 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 15/2 | Very strongly alkaline (pH > 9.0) | Non saline (<2 dsm ) | High (>0.75 %) | Low (< 23 kg/ha) | High (> 337 kg/ha) | High (> 20 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 16 | Very strongly alkaline (pH > 9.0) | Non saline (<2 dsm ) | High (>0.75 %) | Low (< 23 kg/ha) | High (> 337 kg/ha) | High (> 20 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 17/1 | Very strongly alkaline (pH > 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | Low (< 0.5 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 17/2 | Very strongly alkaline (pH > 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Low (< 0.5 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 18 | Very strongly alkaline (pH > 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | Low (< 0.5 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 19 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | Low (< 0.5 ppm) | Deficient (< 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 20/1 | Moderately alkaline (pH 7.8 – 8.4) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 20/2 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 21 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 22 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | Low (< 0.5 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 23 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 24 | Moderately alkaline (pH 7.8 – 8.4) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 25 | Moderately alkaline (pH 7.8 – 8.4) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 26 | Moderately alkaline (pH 7.8 – 8.4) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 27/1 | Moderately alkaline (pH 7.8 – 8.4) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 27/2 | Moderately alkaline (pH 7.8 – 8.4) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 28 | Moderately alkaline (pH 7.8 – 8.4) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |

| Village | Survey Number | Soil Reaction | Salinity | Organic Carbon | Available Phosphorus | Available Potassium | Available Sulphur | Available Boron | Available Iron | Available Manganese | Available Copper | Available Zinc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daddal | 29 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 30 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 31 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 32 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 33 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 34 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 35 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 36 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 37 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 38 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 39 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 40 | Very strongly alkaline (pH > 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 41 | Very strongly alkaline (pH > 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Low (< 23 kg/ha) | High (> 337 kg/ha) | Medium (10 - 20 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 42 | Very strongly alkaline (pH > 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 43 | Very strongly alkaline (pH > 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 44 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 45 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 46 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 47 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 48 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 49 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 50 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 51 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |

| Village | Survey Number | Soil Reaction | Salinity | Organic Carbon | Available Phosphorus | Available Potassium | Available Sulphur | Available Boron | Available Iron | Available Manganese | Available Copper | Available Zinc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daddal | 52 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 53 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 54 | Moderately alkaline (pH 7.8 – 8.4) | Non saline (<2 dsm ) | High (>0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 55 | Moderately alkaline (pH 7.8 – 8.4) | Non saline (<2 dsm ) | High (>0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 56 | Moderately alkaline (pH 7.8 – 8.4) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 57 | Moderately alkaline (pH 7.8 – 8.4) | Non saline (<2 dsm ) | High (>0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 58 | Moderately alkaline (pH 7.8 – 8.4) | Non saline (<2 dsm ) | High (>0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 59 | Moderately alkaline (pH 7.8 – 8.4) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 60 | Moderately alkaline (pH 7.8 – 8.4) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | 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 (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 61/1 | Moderately alkaline (pH 7.8 – 8.4) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Low (< 23 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 61/2 | 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) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 62 | Moderately alkaline (pH 7.8 – 8.4) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | 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 (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 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) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 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) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 65 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 66 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 67 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 68 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 69 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 70 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | Medium ( 145 - 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 71/1 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 71/2 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 72 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |

| Village | Survey Number | Soil Reaction | Salinity | Organic Carbon | Available Phosphorus | Available Potassium | Available Sulphur | Available Boron | Available Iron | Available Manganese | Available Copper | Available Zinc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daddal | 73 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | Medium (0.5 - 0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | Medium (0.5 - 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 74 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | High (>0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Deficient (< 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 75 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | High (>0.75 %) | Medium (23 - 57 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Deficient (< 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 76 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | High (>0.75 %) | Low (< 23 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Deficient (< 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 77 | Strongly alkaline (pH 8.4 – 9.0) | Non saline (<2 dsm ) | High (>0.75 %) | Low (< 23 kg/ha) | High (> 337 kg/ha) | Low (<10 ppm) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 78 | 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) | High (> 1.0 ppm) | Sufficient (> 4.5 ppm) | Sufficient (> 1.0 ppm) | Sufficient (> 0.2ppm) | Deficient (< 0.6 ppm) |
| Daddal | 79 | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others |

# Appendix III

## Daddal Microwatershed

### Soil Suitability Information

| Village | Survey Number | Sorgham | Maize | Redgram | Bajra | Groundnut | Sunflower | Cotton | Bengalgram | Chilly | Tomato | Mango | Sapota | Guava | Pomegranate | Jackfruit | Jamun | Musambi | Lime | Cashew | Custard-apple | Amla | Tamarind | Marigold | Chrysanthemum | Dstick_Leg | MB_Leg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daddal | 1 | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others |
| Daddal | 2 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 3 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 4 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 15/1 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 15/2 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 16 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 17/1 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 17/2 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 18 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 19 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 20/1 | S2rz | S2rz | S3rz | S2rz | S2rz | S3rz | S2rz | S2rz | S2rz | S2rz | N1rz | S3rz | S3rz | S3rz | S3rz | S3rz | S3rz | S3rz | N1tz | S2rz | S2rz | N1rz | S2rz | S2rz | S3rz | S3rz |
| Daddal | 20/2 | S2rz | S2rz | S3rz | S2rz | S2rz | S3rz | S2rz | S2rz | S2rz | S2rz | N1rz | S3rz | S3rz | S3rz | S3rz | S3rz | S3rz | S3rz | N1tz | S2rz | S2rz | N1rz | S2rz | S2rz | S3rz | S3rz |
| Daddal | 21 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 22 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 23 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 24 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 25 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 26 | S2rz | S2rz | S3rz | S2rz | S2rz | S3rz | S2rz | S2rz | S2rz | S2rz | N1rz | S3rz | S3rz | S3rz | S3rz | S3rz | S3rz | S3rz | N1tz | S2rz | S2rz | N1rz | S2rz | S2rz | S3rz | S3rz |
| Daddal | 27/1 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |

| Village | Survey Number | Sorgham | Maize | Redgram | Bajra | Groundnut | Sunflower | Cotton | Bengalgram | Chilly | Tomato | Mango | Sapota | Guava | Pomegranate | Jackfruit | Jamun | Musambi | Lime | Cashew | Custard-apple | Amla | Tamarind | Marigold | Chrysanthemum | Dstick_Leg | MB_Leg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daddal | 27/2 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 28 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 29 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 30 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 31 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 32 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 33 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 34 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 35 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 36 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 37 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 38 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 39 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 40 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 41 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 42 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 43 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 44 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 45 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 46 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 47 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 48 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |

| Village | Survey Number | Sorgham | Maize | Redgram | Bajra | Groundnut | Sunflower | Cotton | Bengalgram | Chilly | Tomato | Mango | Sapota | Guava | Pomegranate | Jackfruit | Jamun | Musambi | Lime | Cashew | Custard-apple | Amla | Tamarind | Marigold | Chrysanthemum | Dstick_Leg | MB_Leg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daddal | 49 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 50 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 51 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 52 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 53 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 54 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 55 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 56 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 57 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 58 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 59 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 60 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 61/1 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 61/2 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 62 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 63 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 64 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 65 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 66 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 67 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 68 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 69 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S3tw |

| Village | Survey Number | Sorgham | Maize | Redgram | Bajra | Groundnut | Sunflower | Cotton | Bengalgram | Chilly | Tomato | Mango | Sapota | Guava | Pomegranate | Jackfruit | Jamun | Musambi | Lime | Cashew | Custard-apple | Amla | Tamarind | Marigold | Chrysanthemum | Dstick_Leg | MB_Leg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daddal | 70 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 71/1 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 71/2 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 72 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 73 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 74 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 75 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 76 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 77 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 78 | S2wz | S3tw | S2tw | S2tw | S3tw | S2rw | S2wz | S2wz | S2tw | S3tw | S3tw | S3tw | S3tw | S2tw | S3tw | S2tw | S2wz | S2zw | N1tz | S2zw | S2zw | S2tw | S2tw | S2tw | S2tw | S2tw | S3tw |
| Daddal | 79 | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others | Others |

# 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:*** *The Dadal micro-watershed (Yadgir taluk and district) is located in between $16^0$31' – $16^0$33' North latitudes and $77^0$16' – $77^0$19' East longitudes, covering an area of about 567.79 ha, bounded by Balacheda, Daddala, Kadechoora, Rachanallii and Shettilli villages with length of growing period (LGP) 120-150 days. We used soil resource map as basis for sampling farm households to test the hypothesis that soil quality influence crop selection, and conservation investment of farm households. The level of technology adoption and productivity gaps and livelihood patterns were analyses. The cost of soil degradation and ecosystem services were quantified.*

***Results:*** *The socio-economic outputs for the Dadal micro-watershed in Yadgir taluk and district are presented here.*

***Social Indicators;***

- *Male and female ratio is 65.3 to 34.7 per cent to the total sample population.*
- *Younger age group 18 to 50 of population is around 60.56 per cent to the total population.*
- *Literacy population is around 59.6 per cent.*
- *Social groups belong to other backward caste (OBC) are around 70 per cent.*
- *Fire wood is the source of energy for a cooking among all sample households.*
- *About 44.2 per cent of households have a yashaswini health card.*
- *About 9.3 per cent farm households having MGNREGA card for rural employment.*
- *Dependence on ration cards for food grains through public distribution system is around 95.3 per cent.*
- *Swach bharath program providing closed toilet facilities around 37.2 per cent of sample households.*
- *Women participation in decisions making are around 95 per cent of households were found.*

***Economic Indicators;***

- *The average land holding is 1.39 ha indicates that majority of farm households are belong to marginal and small farmers. The account for dry land of 59.9 ha among the total cultivated land among the sample households.*

- *Agriculture is the main occupation is only 17.4 per cent and agriculture is the main and non agriculture labour is subsidiary occupation for 51.2 per cent of sample households.*
- *The average value of domestic assets is around Rs.11109 per household. Mobile and television are popular media mass communication.*
- *The average value of farm assets is around Rs.207653 per household, about 25.58 per cent of sample farmers are owing plough.*
- *The average value of livestock is around Rs.23165 per household; about 79.17 per cent of household are having livestock.*
- *The average per capita food consumption is around 1131.2 grams (2651.2 kilo calories) against national institute of nutrition recommendation at 827 gram. Around 47 per cent of sample households are consuming more than the NIN recommendation.*
- *The annual average income is around Rs. 57157 per household. About 100 per cent of farm households are below poverty line.*
- *The per capita monthly average expenditure is around Rs.3546.*

***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 average value of ecosystem service for food grain production is around Rs. Rs.16379/ ha/year. Per hectare food grain production services is maximum in cotton (Rs.27737) followed by paddy (Rs.21084), maize (Rs.16045), green gram (Rs. 13626), red gram (Rs. 11567) and groundnut (Rs. 10212).*
- *The average value of ecosystem service for fodder production is around Rs.1413/ ha/year. Per hectare fodder production services is maximum in maize (Rs. 2223) followed by groundnut (Rs.1029), and paddy (Rs.988).*
- *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 value of per hectare water used and value of water was maximum in red gram (Rs.47632) followed by cotton (Rs.46455), green gram (Rs.42645), paddy (Rs. 42471), groundnut (Rs. 27916) and maize (Rs. 26410).*

***Economic Land Evaluation;***

- *The major cropping pattern is redgram (41.6 %) followed by cotton (37.6 %), groundnut (9 %), paddy (4.7 %), green gram (4.1 %) and maize (2.7 %).*
- *In Dadal micro watershed, major soils are Soil of Granite and Granite Gneiss Landscape of Hegganakera (HGN) series are having very deep soil deep cover around 42.03 % of area. On this soil farmers are presently growing cotton (81.7 %) and redgram (18.3 %). Kudlura (KDR) and Sowrashtrahalli (SWR) are having deep soil depth cover around 14.02 % and 12.64 % of areas, respectively the*

*crops are cotton, groundnut, paddy, red gram, and green gram. Rachanalli (RHN) soil is having moderately deep soil depth cover around 10.59 % of area; crops are cotton and red gram. Balched (BLD) and Yalleri (YLR) are having moderately shallow soil depth cover around 6.48 % and 0.25 % of areas, respectively; crops are groundnut, red gram, cotton and maize.*

- *The total cost of cultivation and benefit cost ratio (BCR) in study area for cotton ranges between Rs.41969/ha in BLD soil (with BCR of 1.41) and Rs.19813/ha in SWR soil (with BCR of 3.62).*
- *In green gram the cost of cultivation is Rs.14162/ha in SWR soil (with BCR of 1.96).*
- *In groundnut the costs of cultivation range between Rs.28742/ha in YLR soil (with BCR of 1.68) and Rs.28009/ha in KDR soil (with BCR of 1.27).*
- *In maize the cost of cultivation is Rs.35825/ha in BLD soil (with BCR of 1.48).*
- *In paddy the cost of cultivation range between is Rs. 31583/ha in SWR soil (with BCR of 1.61) and Rs. 28742 in KDR soil (with BCR of 1.70).*
- *In red gram the cost of cultivation range between is Rs. 30294/ha in HGN soil (with BCR of 1.28) and Rs. 15964/ha in YLR soil (with BCR of 2.01).*
- *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 soils 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 cotton (19 to 66.3 %), maize (62 %), paddy (54.2 to 56 %), and red gram (27.3 to 47.6 %).*

*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*

The Dadal micro-watershed is located in North-eastern Dry Zone of Karnataka (Figure 1): The total geographic area of this zone is about 1.76 M ha covering 8 taluks of Gulbarga district and 3 taluks of Raichur. Net cultivated area in the zone is about 1.31 M ha of which about 0.09 M ha are irrigated. The mean elevation of the zone is 300-450 m MSL. The main soil type is deep to very deep soils with small pockets of shallow to medium black soils. The zone is cropped predominantly during rabi due to insufficient rainfall (465-785 mm). The principal crops of the zone are jowar, bajra, oilseeds, pulses, cotton and sugarcane. It's represented Agro Ecological Sub Region (AESR) 6.2 with LGP 120-150 days.

Dadal micro-watershed (Yadgir taluk, Yadgir district) is located in between $16^0$31' – $16^0$33' North latitudes and $77^0$16' – $77^0$19' East longitudes, covering an area of about 567.79 ha, bounded by Balacheda, Daddala, Kadechoora, Rachanallii and Shettilli 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).

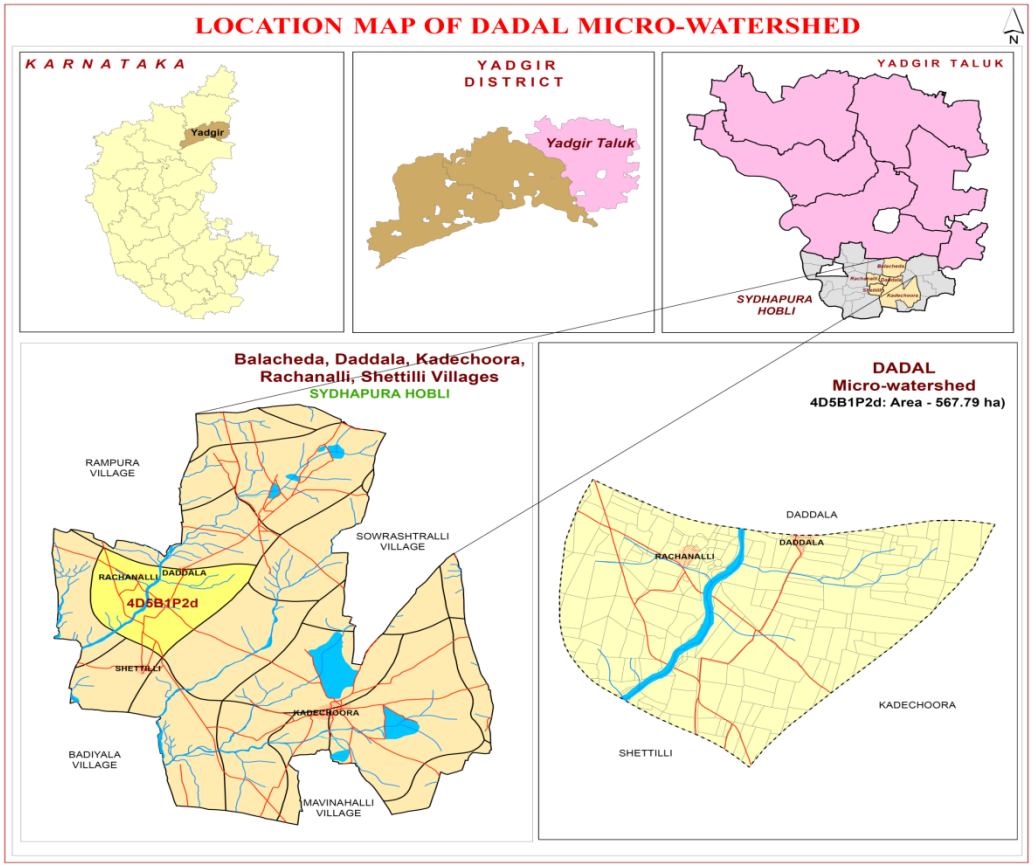
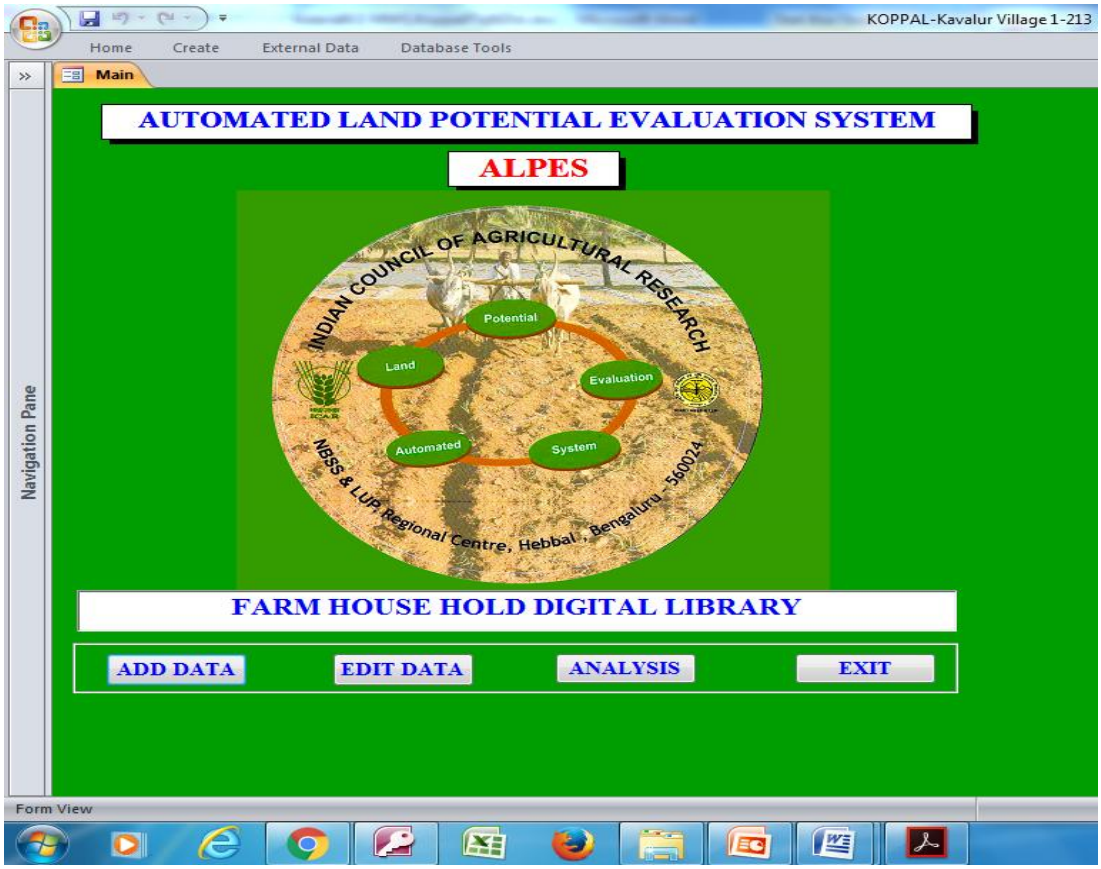



Figure 1: Location of study area

**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 .



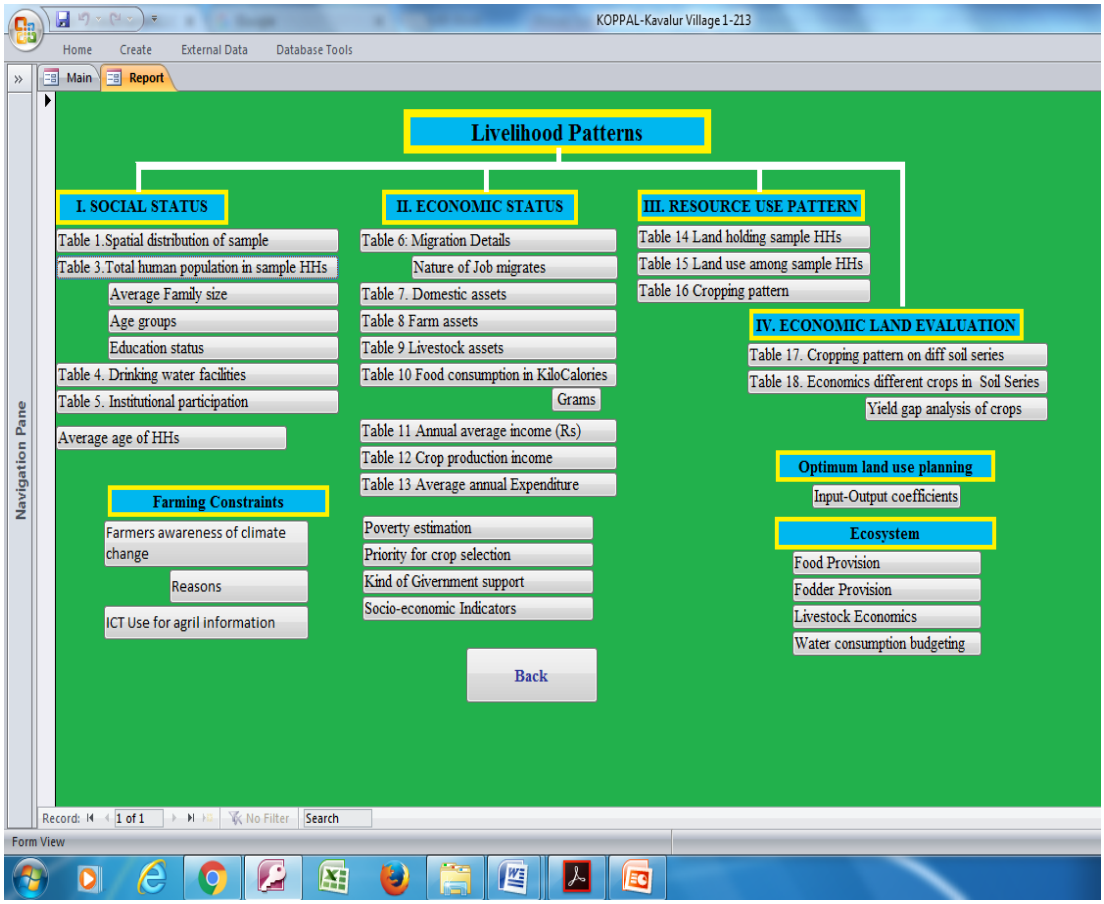




Figure 2: ALPES FRAMEWORK

The sample farmers were post classified in to marginal and small (0.0 to <=2 acres), medium and semi medium (>2 to <=10 acres) and large (>10 acres). 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 213, out of which 65.3 per cent were males and 34.7 per cent females. Average family size of the households is 4.95 among the sample population.

**Table 1: Human population among sample households in Dadal Microwatershed**

| Particulars | MF(73) | | SF(111) | | SMF(25) | | MDF(4) | | ALL (213) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Male | 49 | 67.1 | 71 | 64 | 16 | 64 | 3 | 75 | 139 | 65.3 |
| Female | 24 | 32.9 | 40 | 36 | 9 | 36 | 1 | 25 | 74 | 34.7 |
| Total human population in sample HHs | 73 | 100 | 111 | 100 | 25 | 100 | 4 | 100 | 213 | 100 |
| Average family size | 5.21 | | 4.83 | | 5.00 | | 4.00 | | 4.95 | |

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 18 to 30 years (34.74 %) followed by 0 to18 years (26.76 %), 30 to 50 years (25.82 %) and more than 50 years (12.68 %). Hence, in the study area in general, the respondents were of young and middle age, indicating there by 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 (Table 2).

**Table 2: Age groups among the sample population in Dadal micro-watershed**

| Particulars | MF(73) | | SF(111) | | SMF(25) | | MDF(4) | | ALL (213) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| 0 to 18 years | 20 | 27.40 | 31 | 27.93 | 4 | 16.00 | 2 | 50 | 57 | 26.76 |
| 18 to 30 years | 24 | 32.88 | 39 | 35.14 | 9 | 36.00 | 2 | 50 | 74 | 34.74 |
| 30 to 50 years | 20 | 27.40 | 28 | 25.23 | 7 | 28.00 | | 0 | 55 | 25.82 |
| >50 years | 9 | 12.33 | 13 | 11.71 | 5 | 20.00 | | 0 | 27 | 12.68 |
| Grand total | 73 | 100.00 | 111 | 100.00 | 25 | 100 | 4 | 100 | 213 | 100.00 |
| Average age | 31.1 | | 30.5 | | 35.9 | | 17.5 | | 31.1 | |

Data on literacy (Table 3) indicated that 40.4 per cent of respondents were illiterate and 59.6 per cent literate with highest of primary school education (15 %) followed by the middle school education (13.1 %), high school education (14.6 %), senior secondary education (5.6 %), graduates (7.0 %), technical (3.8 %) and post graduates (0.5 %).

The ethnic groups among the sample farm households found to be 70 per cent belonging to other backward castes (OBC) followed by 19 per cent belong to scheduled caste (SC), 9.3 per cent belong to scheduled tribes (ST) and 2.3 per cent belonging to general caste among the sample population (Table 4 and Figure 3).

**Table 3: Education status among the sample population in Ramapur-2 micro-watershed**

| Education Status | MF(73) | | SF(111) | | SMF(25) | | MDF(4) | | ALL (213) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Illiterates | 30 | 41.1 | 46 | 41.4 | 10 | 40.0 | | 0.0 | 86 | 40.4 |
| Literates | 43 | 58.9 | 65 | 58.6 | 15 | 60.0 | 4 | 100 | 127 | 59.6 |
| Primary School (<5 class) | 13 | 17.8 | 16 | 14.4 | | 0.0 | 3 | 75.0 | 32 | 15.0 |
| Middle School (6- 8 Class) | 10 | 13.7 | 13 | 11.7 | 5 | 20.0 | | 0.0 | 28 | 13.1 |
| High School (9- 10 Class | 12 | 16.4 | 14 | 12.6 | 4 | 16.0 | 1 | 25.0 | 31 | 14.6 |
| Senior secondary | 4 | 5.5 | 5 | 4.5 | 3 | 12.0 | | 0.0 | 12 | 5.6 |
| Graduate | 2 | 2.7 | 11 | 9.9 | 2 | 8.0 | | 0.0 | 15 | 7.0 |
| Post graduate | 1 | 1.4 | | 0.0 | | 0.0 | | 0.0 | 1 | 0.5 |
| Technical | 1 | 1.4 | 6 | 5.4 | 1 | 4.0 | | 0.0 | 8 | 3.8 |
| Grand Total | 73 | 100 | 111 | 100 | 25 | 100 | 4 | 100 | 213 | 100 |

**Table 4: Social groups among sample households in Dadal Microwatershed**

| Particulars | MF(14) | | SF(23) | | SMF(5) | | MDF(1) | | ALL (43) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| SC | | 0 | 5 | 22 | 3 | 60 | | 0 | 8 | 19 |
| ST | 3 | 21 | 1 | 4.3 | | 0 | | 0 | 4 | 9.3 |
| OBC | 11 | 79 | 16 | 70 | 2 | 40 | 1 | 100 | 30 | 70 |
| General | | 0 | 1 | 4.3 | | 0 | | 0 | 1 | 2.3 |
| Grand total | 14 | 100 | 23 | 100 | 5 | 100 | 1 | 100 | 43 | 100 |

Among the entire sample households are using fire wood as source of fuel for cooking. Around 95.3 per cent of the sample farmers are having electricity connection. About 44.29.3 per cent are sample households having health cards. Only 9.3 per cent of having MNREGA job cards for employment generation. About 95.3 per cent of farm households are having ration cards for taking food grains from public distribution system. About 9.3 per cent of farm households are having toilet facilities (Table 5).

**Table 5: Basic needs of sample households in Dadal Microwatershed**

| Particulars | MF(14) | | SF(23) | | SMF(5) | | MDF(1) | | ALL (43) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| **Types of fuel use for cooking** | | | | | | | | | | |
| Fire wood | 14 | 100.0 | 23 | 100.0 | 5 | 100.0 | 1 | 100.0 | 43 | 100.0 |
| **Energy supply for home** | | | | | | | | | | |
| Electricity | 12 | 85.7 | 23 | 100.0 | 5 | 100.0 | 1 | 100.0 | 41 | 95.3 |
| Solar lamp | 2 | 14.3 | | 0.0 | | 0.0 | | 0.0 | 2 | 4.7 |
| **Health Card** | | | | | | | | | | |
| Yes | 6 | 42.9 | 11 | 47.8 | 2 | 40.0 | | 0.0 | 19 | 44.2 |
| No | 8 | 57.1 | 12 | 52.2 | 3 | 60.0 | 1 | 100.0 | 24 | 55.8 |
| **NREGA** | | | | | | | | | | |
| Yes | 1 | 7.1 | 1 | 4.3 | 2 | 40.0 | | 0.0 | 4 | 9.3 |
| No | 13 | 92.9 | 22 | 95.7 | 3 | 60.0 | 1 | 100.0 | 39 | 90.7 |
| **Ration Card** | | | | | | | | | | |
| Yes | 12 | 85.7 | 23 | 100.0 | 5 | 100.0 | 1 | 100.0 | 41 | 95.3 |
| No | 2 | 14.3 | | 0.0 | | 0.0 | | 0.0 | 2 | 4.7 |
| **Household with toilet** | | | | | | | | | | |
| Yes | 7 | 50.0 | 6 | 26.1 | 3 | 60.0 | | 0.0 | 16 | 37.2 |
| No | 7 | 50.0 | 17 | 73.9 | 2 | 40.0 | 1 | 100.0 | 27 | 62.8 |
| **Drinking Water** | | | | | | | | | | |
| Tank | 2 | 14.3 | 1 | 4.3 | 1 | 20.0 | | 0.0 | 4 | 9.3 |
| Tube Well | 12 | 85.7 | 22 | 95.7 | 4 | 80.0 | 1 | 100.0 | 39 | 90.7 |

The data collected on the source of drinking water in the study area is presented in Table 5. Majority of the sample respondents are having tube well source for water supply for domestic purpose with share of 90.7 per cent.

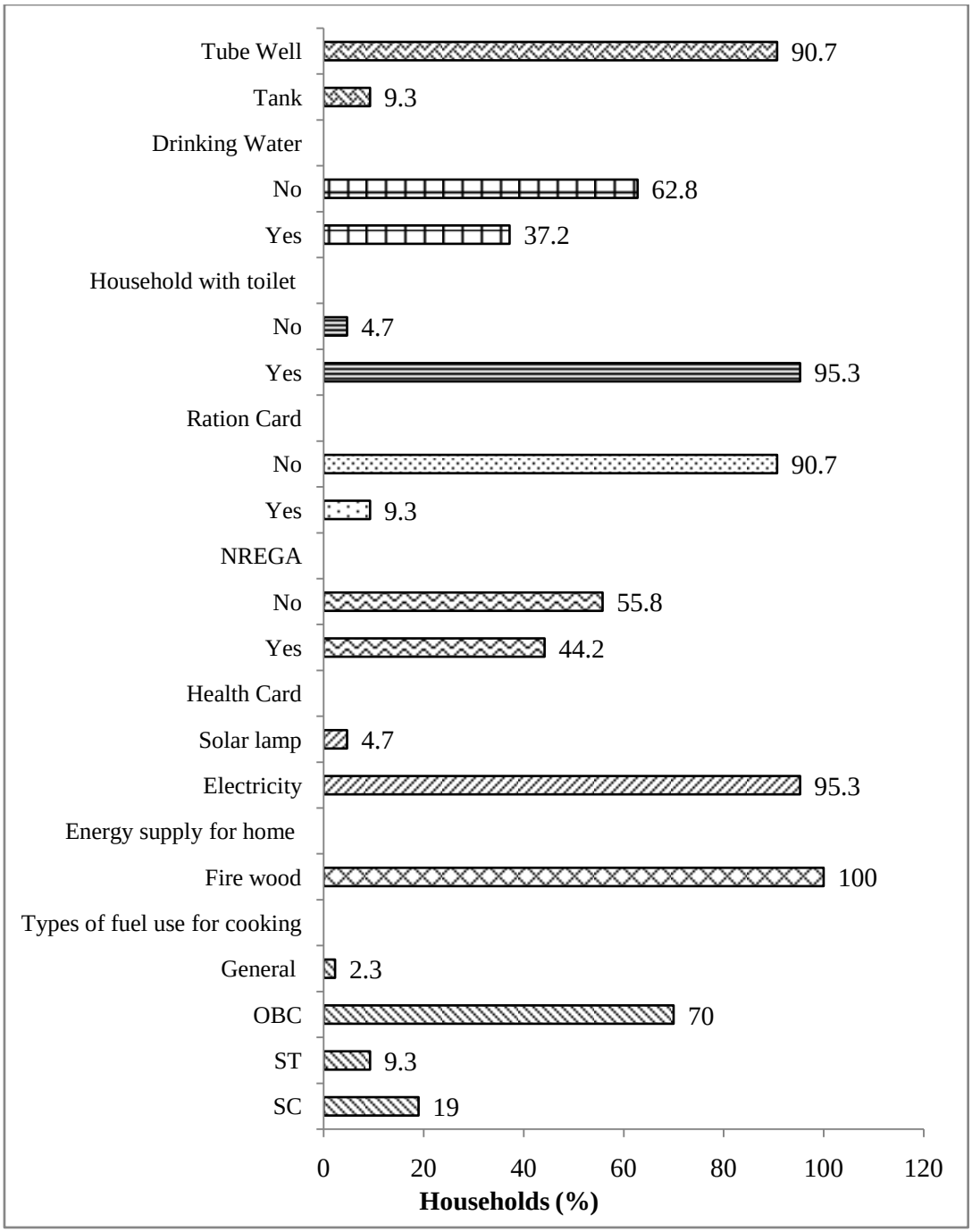



Figure 3: Basic needs of sample households in Dadal Microwatershed

The occupational pattern (Table 6) among sample households shows that agriculture is the main occupation is around 17.4 per cent and agriculture is a main and non agriculture labour is subsidiary occupations around 51.2 per cent of population. Household's industries/ artisan activity, government services and private services are main occupation of 0.5 per cent, 0.9 per cent and 3.3 per cent of sample population, respectively.

**Table 6: Occupational pattern in sample population in Dadal Microwatershed**

| Occupation | | MF (73) | | SF (111) | | SMF (25) | | MDF (4) | | ALL (213) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Main** | **Subsidiary** | **No.** | **%** | **No.** | **%** | **No.** | **%** | **No.** | **%** | **No.** | **%** |
| Agriculture | Agriculture | 10 | 13.7 | 21 | 18.9 | 6 | 24.0 | | 0.0 | 37 | 17.4 |
| | Non Agriculture Labour | 40 | 54.8 | 52 | 46.8 | 15 | 60.0 | 2 | 50.0 | 109 | 51.2 |
| HH Industries/Artisan activity | | | 0.0 | | 0.0 | | 0.0 | 1 | 25.0 | 1 | 0.5 |
| Govt. service | | 2 | 2.7 | | 0.0 | | 0.0 | | 0.0 | 2 | 0.9 |
| Private service | | 2 | 2.7 | 4 | 3.6 | 1 | 4.0 | | 0.0 | 7 | 3.3 |
| Studying | | 19 | 26.0 | 34 | 30.6 | 3 | 12.0 | 1 | 25.0 | 57 | 26.8 |
| Grand Total | | 73 | 100 | 111 | 100 | 25 | 100 | 4 | 100 | 213 | 100 |
| **Family labour availability** | | | | | | | | | | **Man days/month** | |
| Male | | 62 | 67.5 | 71 | 70.1 | 75 | 62.2 | 25 | 55.6 | 68 | 68.2 |
| Female | | 30 | 32.5 | 30 | 29.9 | 46 | 37.8 | 20 | 44.4 | 32 | 31.8 |
| **Total** | | 92 | 100 | 101 | 100 | 121 | 100 | 45 | 100 | 99 | 100 |

The important assets especially with reference to domestic assets were analyzed and are given in Table 7 and Figure 4. The important domestic assets possessed by all categories of farmers are television (100 %) followed by mobile phones (95.3 %), motorcycle (1.6 %), bicycle (4.7 %), mixer/grinder (2.3 %) and landline phone (2.3 %). The average value of domestic assets is around Rs.11109 per households.

**Table 7: Domestic assets among the sample households in Dadal Microwatershed**

| Particulars | MF(14) | | SF(23) | | SMF(5) | | MDF(1) | | ALL (43) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | % of HHs | Value | % of HHs | Value | % of HHs | Value | % of HHs | Value | % of HHs | Value |
| Bicycle | 14.3 | 4000 | 0.0 | | | | | | 4.7 | 4000 |
| Landline Phone | 0.0 | | 4.3 | 10000 | | | | | 2.3 | 10000 |
| Mixer/grinder | 7.1 | 2000 | 0.0 | | | | | | 2.3 | 2000 |
| Mobile Phone | 92.9 | 4000 | 95.7 | 6045 | 100 | 2800 | 100 | 10000 | 95.3 | 5098 |
| Motorcycle | 0.0 | | 17.4 | 45000 | 20 | 3000 | | | 11.6 | 36600 |
| Television | 100 | 8929 | 100 | 8913 | 100 | 9000 | 100 | 10000 | 100 | 8953 |
| Average value | 4732 | | 17490 | | 4933 | | 10000 | | 11109 | |

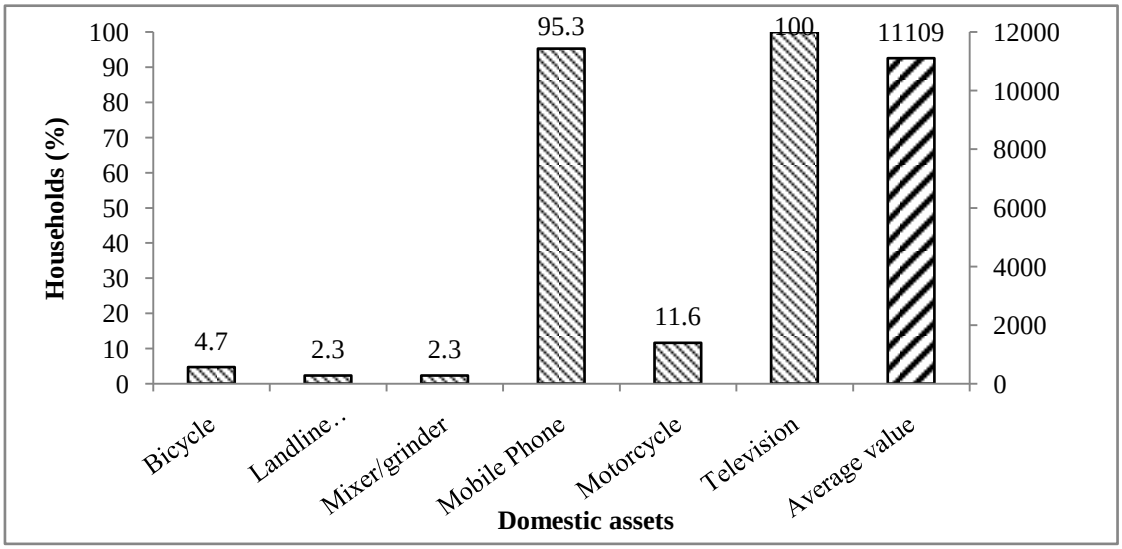



Figure 4: Domestic assets among the sample households in Dadal Microwatershed

The most popularly owned farm equipments were sickles, plough, cattle shed; pump sets, chaff cutter, bullock cart, sprayer and thresher. Plough and sickle were commonly present in all the sampled farmers; these were primary implements in agriculture. The per cent of households owned bullock cart (23.3 %), plough (25.58 %), tractor (4.65 %), sprayer (2.33 %) and weeder (11.63 %) was found highest among the sample farmers. the average value of farm assets is around Rs.207653 per households (Table 8 and Figure 5).

**Table 8: Farm assets among samples households in Dadal Microwatershed**

| Particulars | MF(14) | | SF(23) | | SMF(5) | | MDF(1) | | ALL (43) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | % of HHs | Value | % of HHs | Value | % of HHs | Value | % of HHs | Value | % of HHs | Value |
| Bullock cart | 7.14 | 20000 | 26.09 | 10500 | 40 | 6500 | 100 | 30000 | 23.26 | 12600 |
| Plough | 7.14 | 2000 | 26.09 | 2833 | 60 | 4833 | 100 | 20000 | 25.58 | 4864 |
| Sprayer | 7.14 | 15000 | 0.00 | | 0 | | 0 | | 2.33 | 15000 |
| Tractor | 7.14 | 1000000 | 4.35 | 1000000 | 0 | | 0 | | 4.65 | 1000000 |
| Weeder | | | 17.39 | 6375 | 20 | 3500 | 0 | | 11.63 | 5800 |
| Average value | 259250 | | 254927 | | 4944 | | 25000 | | 207653 | |

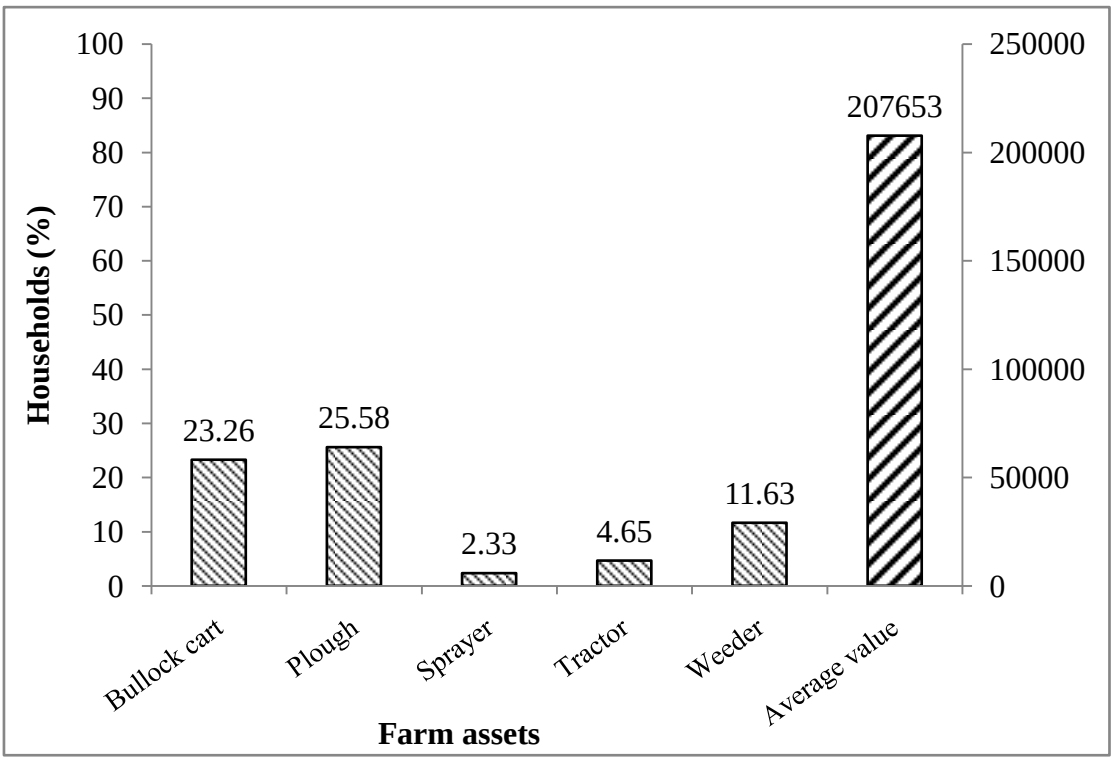



Figure 5: Farm assets among samples households in Dadal Microwatershed

Livestock is an integral component of the conventional farming systems (Table 6 and Figure 6). The highest livestock population is local dry cow were around 234.88 per cent followed by bullocks (32.56 %), dry buffalos (2.33 %), local milching cow (20.93 %), sheeps (6.98 %), goats (11.63 %) and poultry (23.26 %). The average livestock value was Rs. 23165 per households.

**Table 9: Livestock assets among sample households in Dadal micro-watershed**

| Livestock | MF(14) | | SF(23) | | SMF(5) | | MDF(1) | | ALL (43) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | % of HHs | Value | % of HHs | Value | % of HHs | Value | % of HHs | Value | % of HHs | Value |
| Local Dry Cow | 35.71 | 8000 | 30.43 | 10714 | 60 | 16667 | 0 | | 34.88 | 11000 |
| Local Milching Cow | 14.29 | 10000 | 21.74 | 12000 | 20 | 20000 | 100 | 10000 | 20.93 | 12222 |
| Dry Buffalos | 0.00 | | 4.35 | 10000 | 0 | | 0 | | 2.33 | 10000 |
| Bullocks | 21.43 | 100000 | 26.09 | 86667 | 80 | 100000 | 100 | 100000 | 32.56 | 94286 |
| Goats | 14.29 | | 13.04 | 18000 | 0 | | 0 | | 11.63 | 18000 |
| Sheeps | 0.00 | 20000 | 13.04 | 13333 | 0 | | 0 | | 6.98 | 16000 |
| Poultry | 14.29 | 493 | 30.43 | 757 | 20 | 180 | 0 | | 23.26 | 647 |
| **Average value** | 27699 | | 21639 | | 34212 | | 55000 | | 23165 | |

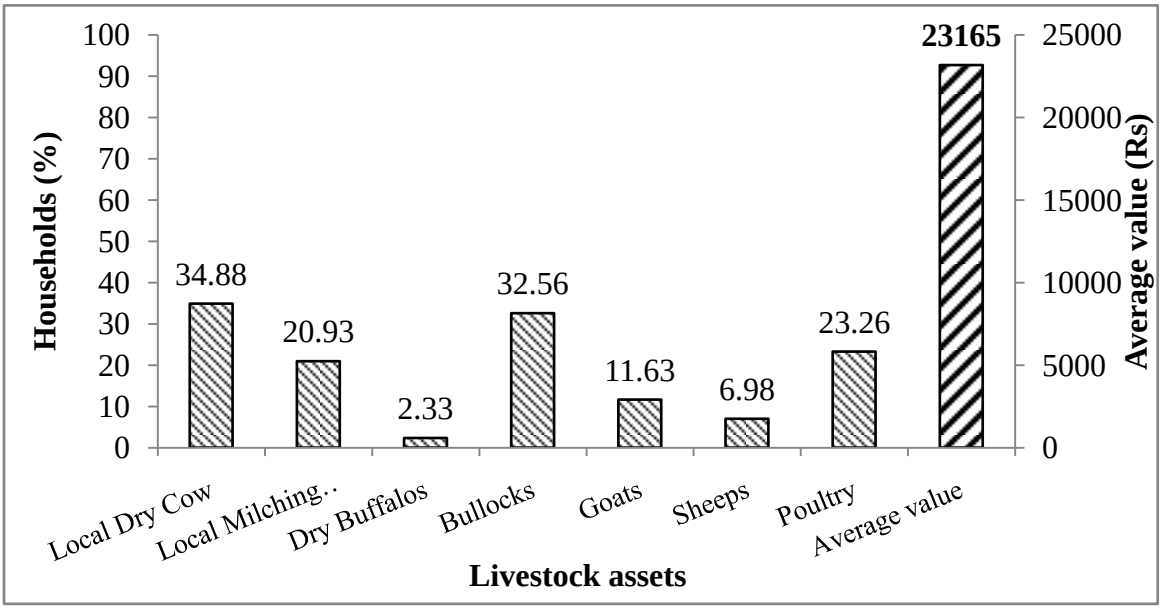



Figure 6: Livestock assets among sample households in Dadal micro-watershed

Average milk produced in sample households is 1403 litters/ annum. Among the farm households, maize groundnut and paddy are the main crops for domestic food and fodder for animals. About 1583 kg /ha of average fodder is available per season for the livestock feeding (Table 10).

**Table 10: Milk produced and fodder availability of sample households in Dadal Microwatershed**

| Particulars | MF(14) | SF(23) | SMF(5) | MDF(1) | ALL (43) |
|---|---|---|---|---|---|
| **Name of the livestock** | | | | | **Ltr./Lactation/animal** |
| Local milching cow | 1240 | 1582 | 1280 | 960 | 1403 |
| ***Average value (Rs).*** | ***1240*** | ***1582*** | ***1280*** | ***960*** | ***1403*** |
| **Fodder produces** | | | | | **Fodder yield (kg/ha)** |
| Maize | | 1625 | | | 1625 |
| Groundnut | | 625 | 625 | | 625 |
| Paddy | 2500 | | 2500 | | 2500 |
| ***Average fodder availability*** | ***2500*** | ***1125*** | ***1563*** | ***0*** | ***1583*** |
| Livestock having households (%) | 73.68 | 76.19 | 100.00 | 100.00 | 79.17 |
| Livestock population (Numbers) | 821 | 79 | 19 | 3 | 922 |

A woman participation in decision making is in this micro-watershed is presented in Table 11. About 98 per cent women earning for her family requirement and 95 per cent of women taking decision in her family and agriculture related activities.

**Table 11: Women empowerment of sample households in Dadal Microwatershed**

| Particulars | MF(14) | | SF(23) | | SMF(5) | | MDF(1) | | ALL (43) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Women participation in local organization activities | | | | | | | | | | |
| Yes | | | | | | | | | | |
| No | 14 | 100 | 23 | 100 | 5 | 100 | 1 | 100 | 43 | 100 |
| Women participation in Elected Panchayth | | | | | | | | | | |
| Yes | | 0 | | 0 | | 0 | | 0 | | 0 |
| No | 14 | 100 | 23 | 100 | 5 | 100 | 1 | 100 | 43 | 100 |
| Women earning for her family requirement | | | | | | | | | | |
| Yes | 14 | 100 | 22 | 96 | 5 | 100 | 1 | 100 | 42 | 98 |
| No | | 0 | 1 | 4 | | 0 | | 0 | 1 | 2 |
| Women taking decision in her family and agriculture related activities | | | | | | | | | | |
| Yes | 14 | 100 | 21 | 91 | 5 | 100 | 1 | 100 | 41 | 95 |
| No | | 0 | 2 | 9 | | 0 | | 0 | 2 | 5 |
| Grand Total | 14 | 100 | 23 | 100 | 5 | 100 | 1 | 100 | 43 | 100 |

The food intake in terms of kilo calorie (kcal) per person per day was calculated and presented in the Table 12 and Figure 7. More quantity of cereals is consumed by sample farmers which accounted for 1662.4 kcal per person. The other important food items consumed was pulses 289.5 kcal followed by cooking oil 194.1 kcal, milk 74.6 kcal, vegetables 34.8 kcal, egg 326.4 kcal and meat 69.3 kcal. In the sampled households farmers were consuming more (2651.2 kcal) than NIN- recommended food requirement (2250 kcal).

**Table 12: Per capita daily consumption of food among the sample households in Dadal Microwatershed**

| Particulars | NIN recommendation (gram/per day/person/) | Present level of consumption (gram/per day/person) | Kilo calories / day/person |
|---|---|---|---|
| Cereals | 396 | 489.0 | 1662.4 |
| Pulses | 43 | 84.4 | 289.5 |
| Milk | 200 | 114.7 | 74.6 |
| Vegetables | 143 | 145.2 | 34.8 |
| Cooking Oil | 31 | 34.0 | 194.1 |
| Egg | 0.48 | 217.6 | 326.4 |
| Meat | 14.2 | 46.2 | 69.3 |
| Total | **827.68** | 1131.2 | 2651.2 |
| **Threshold of NIN recommendation** | | **827*** | **2250*** |
| Below NIN | | 26 | 47 |
| Above NIN | | 74 | 53 |

Note: * day/person

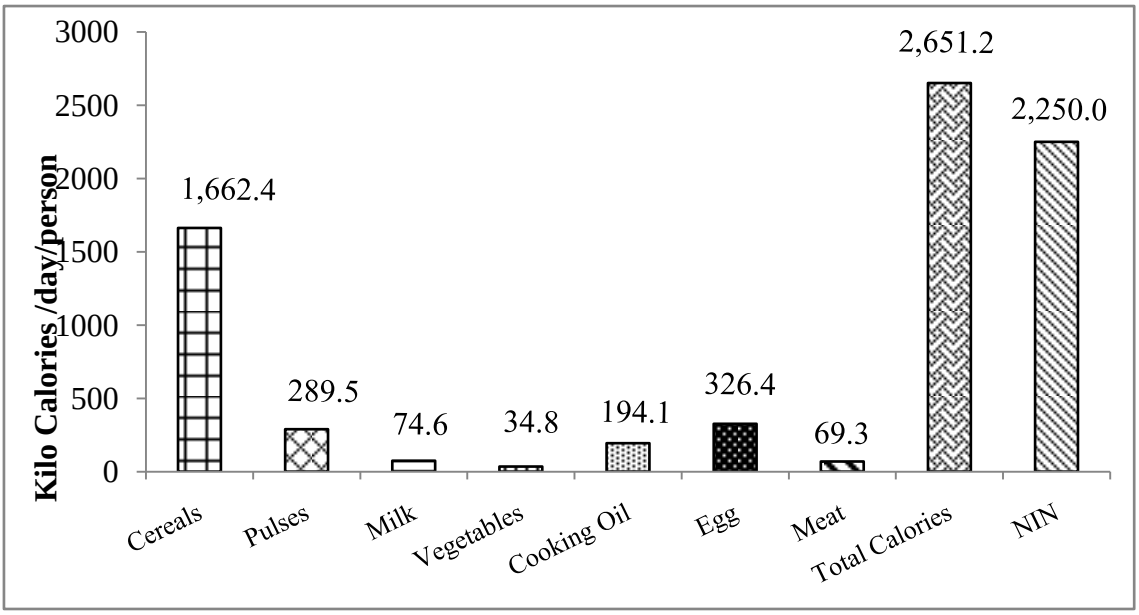



Figure 7: Per capita daily consumption of food among the sample households in Dadal Microwatershed

**Annual income of the sample HHs:** The average annual household income is around Rs. 57157. Major source of income to the farmers in the study area is from livestock (Rs.33212) followed by crop production (Rs. 23947). The monthly per capita income is Rs. 962, which is less than the threshold monthly income of Rs.975 for considering above poverty line. Due to the fact that erratic rainfall and shortage of water, farmers are diverting from crop production activities to enable the household for a comfortable livelihood. The incomes from the other aforesaid sources are very meagre (Table 13).

**Table 13: Annual average income of HHs from various sources in Dadal Microwatershed**

| Particulars | **MF (14)*** | **SF (23)*** | **SMF (5)*** | **MDF (1)*** | **ALL (43)*** |
|---|---|---|---|---|---|
| Nonfarm income | (0) | (0) | (0) | (0) | (0) |
| Livestock income | 32738 (14) | 42106 (22) | 33938 (20) | -11030 (100) | 33212 (21) |
| Crop Production | 11805 (100) | 29190 (100) | 27755 (100) | 54206 (100) | 23945 (100) |
| ***Total Income (Rs)*** | ***44543*** | ***71295*** | ***61693*** | ***43176*** | ***57157*** |
| Average monthly per capita income (Rs) | 712 | 1231 | 1028 | 899 | 962 |
| **Thresholds for poverty level (Rs 975 per month/person)** | | | | | |
| % of households Above poverty line | 100 | 100 | 100 | 100 | 100 |
| % of households below poverty line | 0 | 0 | 0 | 0 | 0 |

* Figure in the parenthesis indicates %of households

The average annual expenditure of farm households indicated that farmers in the study area spend highest on food (Rs.63212) 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.3546 and about 100 per cent of farm households are below poverty line (Table 14 and Figure 8).

**Table 14: Average annual expenditure of sample HHs in Dadal Microwatershed**

| Particulars | MF(14) | | SF(23) | | SMF(5) | | MDF(1) | | ALL (43) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Food | 59109 | 31.0 | 59452 | 28.6 | 81456 | 29.9 | 115920 | 46.2 | 63212 | 30.0 |
| Education | 6857 | 3.6 | 7087 | 3.4 | 37000 | 13.6 | 0 | 0.0 | 10326 | 4.9 |
| Clothing | 12571 | 6.6 | 9522 | 4.6 | 20000 | 7.3 | 10000 | 4.0 | 11744 | 5.6 |
| Social functions | 98571 | 51.8 | 117826 | 56.6 | 118000 | 43.3 | 100000 | 39.9 | 111163 | 52.7 |
| Health | 13286 | 7.0 | 14130 | 6.8 | 16000 | 5.9 | 25000 | 10.0 | 14326 | 6.8 |
| Total | 190394 | 100.0 | 208017 | 100.0 | 272456 | 100.0 | 250920 | 100.0 | 210770 | 100.0 |
| Monthly per capita | 3043 | | 3592 | | 4541 | | 5228 | | 3546 | |

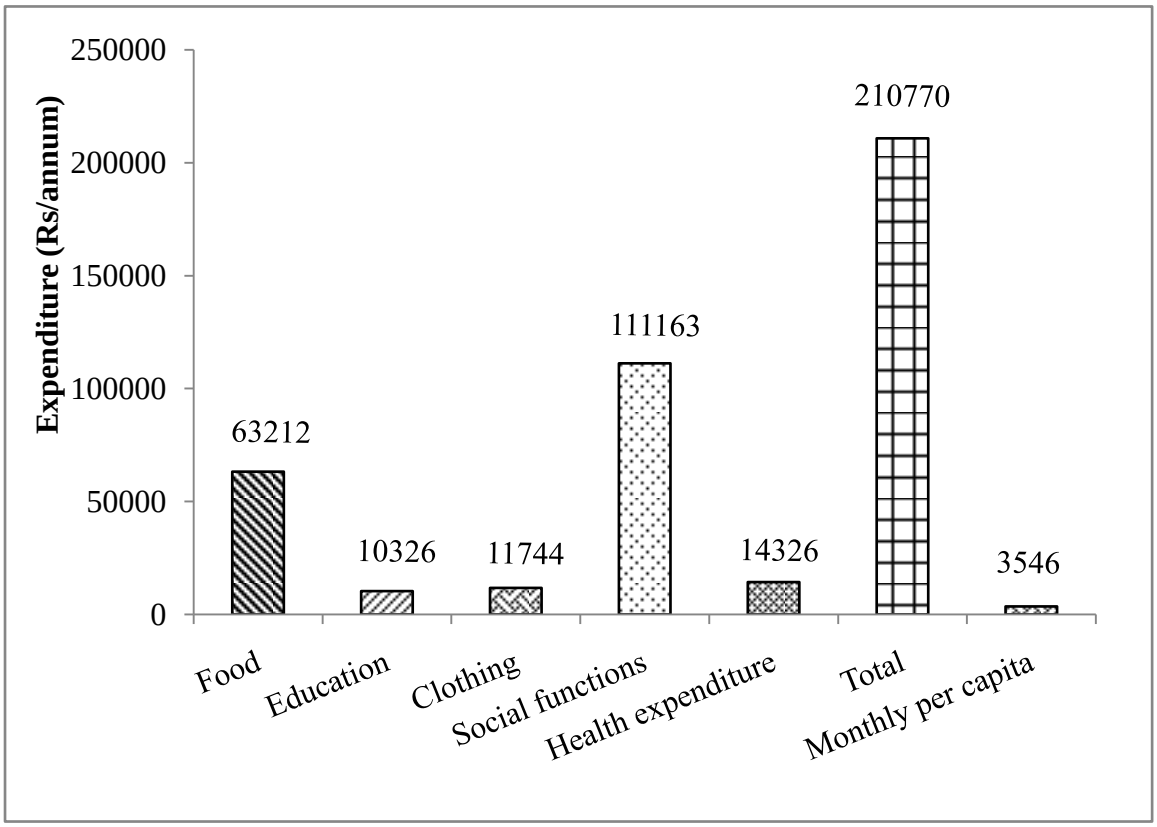



Figure 8: Average annual expenditure of sample HHs in Dadal Microwatershed

**Land holding:** Total sample households are 43 and total area cultivated by them is 59.90 ha. The average land holding of sample HHs is 1.39 ha. the large number of households is (23) belong to small size group with an average holding size of 1.41 ha followed by marginal farmers (14) with an average holding size of 0.79 ha, semi-medium farmers (5) with an average land holding is 2.46 ha and medium size groups (1) with an average land holding is 4.05 ha (Table 15).

**Table 15: Distribution of land holding among the sample households in Dadal micro-watershed**

| Size groups | Particulars | Value |
|---|---|---|
| Marginal Farmers | Total sample HHs in number | 14 |
| | Total land holding (ha) | 11.09 |
| | Avg of Total land holding (ha) | 0.79 |
| Small Farmers | Total sample HHs in number | 23 |
| | Total land holding (ha) | 32.48 |
| | Avg of Total land holding (ha) | 1.41 |
| Semi-Medium Farmers | Total sample HHs in number | 5 |
| | Total land holding (ha) | 12.29 |
| | Avg of Total land holding (ha) | 2.46 |
| Medium Farmers | Total sample HHs in number | 1 |
| | Total land holding (ha) | 4.05 |
| | Avg of Total land holding (ha) | 4.05 |
| Total sample households | Total sample HHs in number | 43 |
| | Total land holding (ha) | 59.90 |
| | Avg of Total land holding (ha) | 1.39 |

**Land use**: The total land holding in the Dadal micro-watershed is 59.9 ha it's a dry land condition (Table 16). The average land holding per household is worked out to be 1.39 ha.

**Table 16: Land use among samples households in Dadal Microwatershed**

| Particulars | MF(14) | | SF(23) | | SMF(5) | | MDF(1) | | ALL (43) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Area in ha | % | Area in ha | % | Area in ha | % | Area in ha | % | Area in ha | % |
| Irrigated land | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dry land | 11.1 | 100.0 | 32.5 | 100.0 | 12.3 | 100.0 | 4.0 | 100.0 | 59.9 | 100.0 |
| Fallow land | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total land | 11.1 | 100.0 | 32.5 | 100.0 | 12.3 | 100.0 | 4.0 | 100.0 | 59.9 | 100.0 |
| Average of land area | 0.79 | | 1.41 | | 2.46 | | 4.05 | | 1.39 | |

In the micro-watershed, the prevalent present land uses under perennial plants are neem trees (80.3 %) followed by peeple tree (9 %), banyan tree (4.1 %), mango (2.5 %), tamarind (2.5 %), coconut (0.8 %) and lime (0.8 %) (Table 17).

**Table 17: Number of trees/plants covered in sample farm households in Dadal Microwatershed**

| Plants | MF(14) | | SF(23) | | SMF(5) | | MDF(1) | | ALL (43) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Banyan tree(Alada) | | 0.0 | 5 | 7.7 | | 0.0 | | 0.0 | 5 | 4.1 |
| Coconut | | 0.0 | | 0.0 | 1 | 3.3 | | 0.0 | 1 | 0.8 |
| Lime | | 0.0 | 1 | 1.5 | | 0.0 | | 0.0 | 1 | 0.8 |
| Mango | 1 | 4.3 | 1 | 1.5 | | 0.0 | 1 | 25.0 | 3 | 2.5 |
| Neem trees | 21 | 91.3 | 46 | 70.8 | 29 | 96.7 | 2 | 50.0 | 98 | 80.3 |
| Peeple tree(Arali) | | 0.0 | 10 | 15.4 | | 0.0 | 1 | 25.0 | 11 | 9.0 |
| Tamarind | 1 | 4.3 | 2 | 3.1 | | 0.0 | | 0.0 | 3 | 2.5 |
| Grand Total | 23 | 100.0 | 65 | 100.0 | 30 | 100.0 | 4 | 100.0 | 122 | 100.0 |

The land use decisions are usually based on experience of farmers, tradition, expected profit, personal preferences, resources and social requirements. The present dominant crops grown in dry lands in the study area were by redgram (41.5 %) followed by cotton (37.8 %), groundnut (9 %), green gram (4.1 %), paddy (3.3 %) and maize (2.7 %) which are taken during Kharif season and paddy (1.6 %) under with rabi season, respectively. The cropping intensity was 102 per cent (Table 18 and Figure 9).

**Table 18: Present cropping pattern and cropping intensity in Dadal Microwatershed**

| Crops/Season | MF(14) | | SF(23) | | SMF(5) | | MDF(1) | | ALL (43) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Area in ha** | **%** | **Area in ha** | **%** | **Area in ha** | **%** | **Area in ha** | **%** | **Area in ha** | **%** |
| ***Kharif*** | ***10.9*** | ***100*** | ***31.9*** | ***100.0*** | ***11.5*** | ***92.5*** | ***4.0*** | ***100*** | ***58.3*** | ***98.4*** |
| Red gram | 4.0 | 37.0 | 14.4 | 45.1 | 2.1 | 17.0 | 4.0 | 100.0 | 24.6 | 41.5 |
| Cotton | 4.9 | 45.2 | 13.0 | 40.7 | 4.5 | 36.3 | | 0.0 | 22.4 | 37.8 |
| Groundnut | | 0.0 | 2.9 | 9.1 | 2.4 | 19.6 | | 0.0 | 5.3 | 9.0 |
| Green gram | | 0.0 | | 0.0 | 2.4 | 19.6 | | 0.0 | 2.4 | 4.1 |
| Paddy | 1.9 | 17.8 | | 0.0 | | 0.0 | | 0.0 | 1.9 | 3.3 |
| Maize | | 0.0 | 1.6 | 5.1 | | 0.0 | | 0.0 | 1.6 | 2.7 |
| ***Rabi*** | ***0.0*** | | | ***0.0*** | ***0.9*** | ***7.5*** | | ***0.0*** | ***0.9*** | ***1.6*** |
| Paddy | | 0.0 | | 0.0 | 0.9 | 7.5 | | 0.0 | 0.9 | 1.6 |
| ***Total*** | 10.9 | 100.0 | 31.9 | 100.0 | 12.4 | 100.0 | 4.0 | 100.0 | 59.3 | 100.0 |
| ***Cropping intensity (%)*** | 100 | | 100 | | 108 | | 100 | | 102 | |

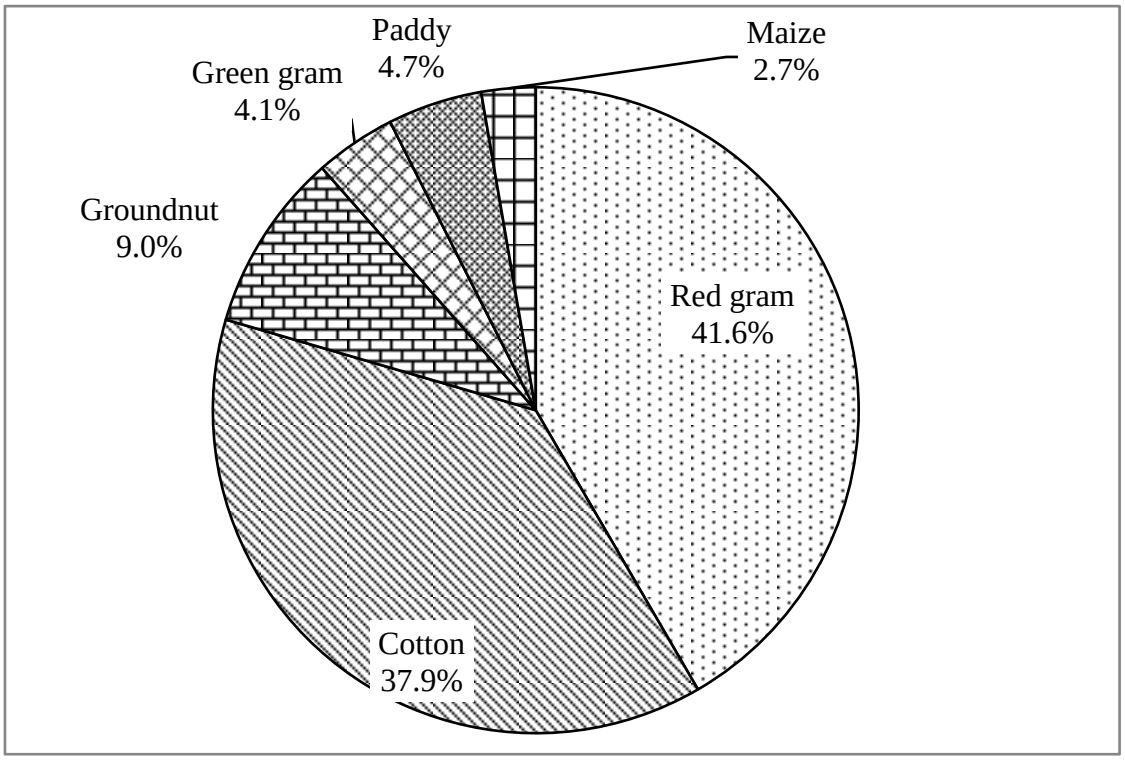



Figure 9: Present cropping pattern in Dadal Microwatershed

**Economic land evaluation**

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

In Dadal micro-watershed, 9 soil series are identified and mapped (Table 19). The distribution of major soil series are Hegganakera covering an area around 239 ha (42.03 %) followed by Kudlura 79.34 ha (14.02 %), Rachanalli 60 ha (10.59 %), Sowrashtrahalli 72 ha (12.64 %), Gudalagunta 43 ha (7.54 %), Balched 37 ha (6.48 %), Halagera 11 (1.93 %), Yalleri 5 ha (0.89 %), and Kyathanala 1ha (0.25 %).

**Table 19: Distribution of soil series in Dadal Microwatershed**

| Soil No | Soil Series | Mapping Unit Description | Area in Ha (%) |
|---|---|---|---|
| Soil of Granite and Granite Gneiss Landscape | | | |
| 1 | HLG | Halagera soils are moderately shallow (50-75 cm), moderately well drained, have dark brown to dark yellowish brown and dark grayish brown, calcareous sandy clay loam to sandy clay alluvial soils occurring on very gently sloping uplands under cultivation | 11 (1.93) |
| 2 | YLR | Yalleri soils are moderately shallow (50-75 cm), well drained, have brown to reddish brown and dark reddish brown, gravelly sandy clay red soils occurring on very gently to gently sloping uplands under cultivation | 5 (0.89) |
| Soil of Alluvial Landscape | | | |
| 3 | GDL | Gudalagunta soils are shallow (25-50 cm), well drained, have very dark gray, calcareous sandy clay to clay alluvial soils occurring on very gently sloping uplands under cultivation | 43 (7.54) |
| 4 | KYT | Kyathanala soils are shallow (25-50 cm), well drained, have brown to strong brown and reddish to dark reddish brown, sandy clay loam to sandy clay alluvial soils occurring on very gently sloping uplands under cultivation | 1 (0.25) |
| 5 | BLD | Balched soils are moderately shallow (50-75 cm), moderately well drained, have very dark gray to very dark grayish brown, calcareous alluvial clay soils occurring on very gently sloping uplands under cultivation | 37 (6.48) |
| 6 | RHN | Rachanalli soils are moderately deep (75-100 cm), moderately well drained, have brown to very dark grayish brown, sandy clay to calcareous alluvial clay soils occurring on very gently sloping uplands under cultivation | 60 (10.59) |
| 7 | KDR | Kudlura soils are deep (100-150 cm), moderately well drained, have dark gray to very dark grayish brown, calcareous sandy clay to clay alluvial soils occurring on nearly level to very gently sloping uplands under cultivation | 79.34 (14.02) |
| 8 | SWR | Sowrashtrahalli soils are deep (100-150 cm), moderately well drained, have dark gray to very dark grayish brown, calcareous black cracking clay soils occurring on very gently sloping uplands under cultivation | 72 (12.67) |
| 9 | HGN | Hegganakera soils are very deep (>150 cm), moderately well drained, have dark gray to very dark grayish brown and brown, calcareous black cracking clay soils occurring on very gently sloping uplands under cultivation | 239 (42.03) |

Present cropping pattern on different soil series are given in Table 20. Crops grown on HGN soils are cotton and redgram. Cotton, green nut, paddy and redgram on SWR soils are grown. Groundnut, cotton, paddy and redgram are grown on KDR soils. Cotton

and redgram on RHN soils are grow. Cotton, maize and redgram on BLD soils are grow. Groundnut, and redgram on YLR soils can grow and Cotton on GDL soil can grow.

**Table 20: Cropping pattern on major soil series in Dadal micro-watershed**

(Area in per cent)

| Soil Series | Soil Depth | Crops | Kharif | | Grand Total |
|---|---|---|---|---|---|
| | | | Dry | Irrigated | |
| GDL | Shallow (25-50 cm) | Cotton | 100.0 | 0.0 | 100.0 |
| YLR | Moderately shallow (50-75 cm) | Groundnut | 18.8 | 0.0 | 18.8 |
| | | Redgram | 30.6 | 0.0 | 30.6 |
| BLD | Moderately shallow (50-75 cm) | Cotton | 11.8 | 0.0 | 11.8 |
| | | Maize | 23.5 | 0.0 | 23.5 |
| | | Redgram | 64.7 | 0.0 | 64.7 |
| RHN | Moderately deep (75-100 cm) | Cotton | 10.8 | 0.0 | 10.8 |
| | | Redgram | 89.2 | 0.0 | 89.2 |
| KDR | Deep (100-150 cm) | Cotton | 34.0 | 0.0 | 34.0 |
| | | Groundnut | 33.3 | 0.0 | 33.3 |
| | | Paddy | 0.0 | 16.0 | 16.0 |
| | | Redgram | 16.7 | 0.0 | 16.7 |
| SWR | Deep (100-150 cm) | Cotton | 40.0 | 0.0 | 40.0 |
| | | Greengram | 17.1 | 0.0 | 17.1 |
| | | Paddy | 5.7 | 0.0 | 5.7 |
| | | Redgram | 37.1 | 0.0 | 37.1 |
| HGN | Very deep (>150 cm) | Cotton | 81.7 | 0.0 | 81.7 |
| | | Redgram | 18.3 | 0.0 | 18.3 |

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 21).

**Table 21: Alternative land use options for different size group of farmers (Benefit Cost Ratio) in Dadal Microwatershed.**

| Soil Series | MF(14) | SF(23) | SMF(5) | MDF(1) |
|---|---|---|---|---|
| GDL | Cotton(1.17) | | | |
| YLR | | Groundnut(1.68) | Redgram(2.01) | |
| BLD | Cotton(1.41) | Maize(1.48)<br>Redgram(1.54) | | |
| RHN | Cotton(1.17)<br>Redgram(1.11) | Redgram(1.48) | | |
| SWR | | Cotton(4.24)<br>Redgram(1.6) | Cotton(1.77)<br>Greengram(1.96)<br>Paddy(1.61) | Redgram(1.82) |
| KDR | Cotton(1.07)<br>Paddy(1.7)<br>Redgram(1.72) | Groundnut(1.32)<br>Redgram(1.57) | Cotton(1.28)<br>Groundnut(1.23) | |
| HGN | Cotton(2.18)<br>Redgram(1.15) | Cotton(2.39)<br>Redgram(1.42) | | |

The productivity of different crops grown in Dadal micro-watershed under potential yield of the crops is given in Table 22.

The data on cost of cultivation and benefit cost ratio (BCR) of different crops is given in Tables 22. The total cost of cultivation in study area for cotton ranges between Rs.41969/ha in BLD soil (with BCR of 1.41) and Rs.19813/ha in SWR soil (with BCR of 3.62), green gram the cost of cultivation is Rs.14162/ha in SWR soil (with BCR of 1.96), groundnut range between Rs.28742/ha in YLR soil (with BCR of 1.68) and Rs.28009/ha in KDR soil (with BCR of 1.27), maize the cost of cultivation is Rs.35825/ha in BLD soil (with BCR of 1.48), paddy range between is Rs. 31583/ha in SWR soil (with BCR of 1.61) and Rs. 28742 in KDR soil (with BCR of 1.70), red gram range between is Rs. 30294/ha in HGN soil (with BCR of 1.28) and Rs. 15964/ha in YLR soil (with BCR of 2.01).

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 22 and 22a. 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.84528 in maize and a minimum of Rs.962 in red gram cultivation.

**Table 22: Economic land evaluation and bridging yield gap for different crops in Dadal micro-watershed**

| Soil Series | GDL (25-50 cm) | YLR (50-75 cm) | | BLD (50-75 cm) | | | RHN (75-100 cm) | | SWR (100-150 cm) | | | | KDR (100-150 cm) | | | | HGN (>150 cm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cotton | Ground nut | Red gram | Cot ton | Maize | Red gram | Cot ton | Red gram | Cot ton | Green gram | Paddy | Red gram | Cot ton | Ground nut | Paddy | Red gram | Cot ton | Red gram |
| Total cost (Rs/ha) | 26429 | 28742 | 15964 | 41969 | 35825 | 22292 | 28583 | 27945 | 19813 | 14162 | 31583 | 19693 | 30106 | 28009 | 28742 | 31891 | 24359 | 30294 |
| Gross Return (Rs/ha) | 30875 | 48165 | 32063 | 59280 | 52858 | 33619 | 33345 | 35019 | 57633 | 27788 | 50882 | 33345 | 35366 | 36124 | 53002 | 52488 | 53981 | 39520 |
| Net returns (Rs/ha) | 4446 | 19423 | 16098 | 17311 | 17033 | 11327 | 4762 | 7074 | 37820 | 13626 | 19299 | 13652 | 5260 | 8115 | 24261 | 20597 | 29622 | 9226 |
| B:C | 1.17 | 1.68 | 2.01 | 1.41 | 1.48 | 1.54 | 1.17 | 1.29 | 3.62 | 1.96 | 1.61 | 1.71 | 1.18 | 1.27 | 1.70 | 1.64 | 2.32 | 1.28 |
| **Farmers Practices (FP)** | | | | | | | | | | | | | | | | | | |
| FYM (t/ha) | 2.5 | 1.6 | 1.0 | 2.5 | 2.5 | 1.6 | 2.5 | 2.0 | 1.1 | 0.8 | 1.3 | 1.2 | 2.7 | 1.0 | 1.6 | 2.7 | 2.3 | 3.4 |
| Nitrogen (kg/ha) | 80.0 | 56.6 | 57.7 | 121.3 | 160.6 | 67.3 | 90.0 | 77.2 | 86.0 | 26.7 | 117.1 | 63.8 | 55.4 | 63.3 | 103.4 | 77.3 | 72.5 | 54.1 |
| Phosphorus (kg/ha) | 57.5 | 42.6 | 42.8 | 111.3 | 121.9 | 55.3 | 73.8 | 62.8 | 70.1 | 19.2 | 91.0 | 60.1 | 48.9 | 60.7 | 121.1 | 58.5 | 55.3 | 64.7 |
| Potash (kg/ha) | 0.0 | 6.6 | 8.2 | 21.3 | 31.9 | 5.3 | 0.0 | 8.8 | 17.5 | 0.0 | 0.0 | 7.1 | 4.8 | 8.9 | 13.3 | 10.6 | 2.3 | 0.0 |
| Grain (Qtl/ha) | 6.3 | 11.7 | 7.2 | 15.0 | 21.9 | 8.0 | 7.5 | 8.3 | 12.5 | 6.3 | 25.0 | 7.9 | 8.1 | 9.4 | 26.0 | 12.5 | 12.3 | 10.0 |
| Price of Yield (Rs/Qtl) | 5000 | 4000 | 4500 | 4000 | 2400 | 4333 | 4500 | 4333 | 4400 | 4500 | 2000 | 4250 | 4500 | 3750 | 2000 | 4250 | 4411 | 4000 |
| **Soil test based fertilizer Recommendation (STBR)** | | | | | | | | | | | | | | | | | | |
| FYM (t/ha) | 12.5 | 7.5 | 7.5 | 12.5 | 7.5 | 7.5 | 12.5 | 7.5 | 12.5 | 7.5 | 9.9 | 7.5 | 12.5 | 7.5 | 9.9 | 7.5 | 12.5 | 7.5 |
| Nitrogen (kg/ha) | 112.5 | 31.3 | 31.3 | 150.0 | 100.0 | 25.0 | 187.5 | 18.8 | 150.0 | 13.0 | 100.0 | 21.9 | 168.8 | 25.0 | 100.0 | 25.0 | 145.8 | 21.9 |
| Phosphorus (kg/ha) | 75.0 | 50.0 | 50.0 | 75.0 | 50.0 | 50.0 | 75.0 | 50.0 | 75.0 | 25.0 | 50.0 | 50.0 | 75.0 | 50.0 | 50.0 | 56.3 | 87.5 | 56.3 |
| Potash (kg/ha) | 56.3 | 25.0 | 25.0 | 75.0 | 25.0 | 25.0 | 75.0 | 21.9 | 56.3 | 18.8 | 37.5 | 21.9 | 75.0 | 25.0 | 50.0 | 25.0 | 60.4 | 18.8 |
| Grain (Qtl/ha) | 18.5 | 9.0 | 13.8 | 18.5 | 57.5 | 13.8 | 18.5 | 13.8 | 18.5 | 6.3 | 56.8 | 13.8 | 18.5 | 9.0 | 56.8 | 13.8 | 18.5 | 13.8 |
| **% of Adoption/yield gap (STBR-FP) / (STBR)** | | | | | | | | | | | | | | | | | | |
| FYM (%) | 80.0 | 79.2 | 87.2 | 80.0 | 66.7 | 78.7 | 80.0 | 73.7 | 91.3 | 88.9 | 87.3 | 83.9 | 78.4 | 86.1 | 84.2 | 63.9 | 81.7 | 54.2 |
| Nitrogen (%) | 28.9 | -81.3 | -84.6 | 19.2 | -60.6 | -169.0 | 52.0 | -311.5 | 42.6 | -105.1 | -17.1 | -191.6 | 67.2 | -153.3 | -3.4 | -209.2 | 50.3 | -147.1 |
| Phosphorus (%) | 23.3 | 14.8 | 14.4 | -48.3 | -143.8 | -10.6 | 1.7 | -25.6 | 6.5 | 23.3 | -82.1 | -20.2 | 34.8 | -21.5 | -142.2 | -4.1 | 36.8 | -15.0 |
| Potash (%) | 100.0 | 73.4 | 67.3 | 71.7 | -27.5 | 78.8 | 100.0 | 59.9 | 69.0 | 100.0 | 100.0 | 67.6 | 93.6 | 64.6 | 73.4 | 57.5 | 96.2 | 100.0 |
| Grain (%) | 66.3 | -30.2 | 47.6 | 19.0 | 62.0 | 41.9 | 59.5 | 39.8 | 32.5 | 0.0 | 56.0 | 42.4 | 56.3 | -4.2 | 54.2 | 9.1 | 33.4 | 27.3 |
| **Value of yield and Fertilizer (Rs)** | | | | | | | | | | | | | | | | | | |
| Additional Cost (Rs/ha) | 12285 | 6327 | 6875 | 9825 | 973 | 5556 | 12725 | 4529 | 13175 | 7134 | 7369 | 5641 | 13711 | 5849 | 5883 | 4351 | 13667 | 3680 |
| Additional Benefits (Rs/ha) | 61350 | -10875 | 29423 | 14080 | 85500 | 24977 | 49590 | 23697 | 26488 | 0 | 63600 | 24792 | 46905 | -1406 | 61517 | 5313 | 27313 | 15000 |
| Net change income (Rs/ha) | 49065 | -17202 | 22548 | 4255 | 84528 | 19421 | 36865 | 19167 | 13314 | -7134 | 56231 | 19151 | 33194 | -7255 | 55634 | 962 | 13647 | 11320 |

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 average value of ecosystem service for food grain production is around Rs.16379/ ha/year (Table 24 and Figure 10). Per hectare food grain production services is maximum in cotton (Rs.27737) followed by paddy (Rs.21084), maize (Rs.16045), green gram (Rs. 13626), red gram (Rs. 11567) and groundnut (Rs. 10212).

**Table 24: Ecosystem services of food grain production in Dadal 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 | 1.62 | 21.61 | 2400 | 51870 | 35825 | 16045 |
| | Paddy | 2.75 | 25.39 | 2000 | 50772 | 29689 | 21084 |
| Pulses | Greengram | 2.43 | 6.18 | 4500 | 27788 | 14162 | 13626 |
| | Redgram | 22.97 | 8.75 | 4281 | 37459 | 25892 | 11567 |
| Oil seeds | Groundnut | 5.34 | 10.03 | 3833 | 38465 | 28253 | 10212 |
| Commercial crops | Cotton | 23.04 | 11.53 | 4428 | 51053 | 25315 | 25737 |
| Average value | | 58.15 | 13.91 | 3574 | 42901 | 26522 | 16379 |

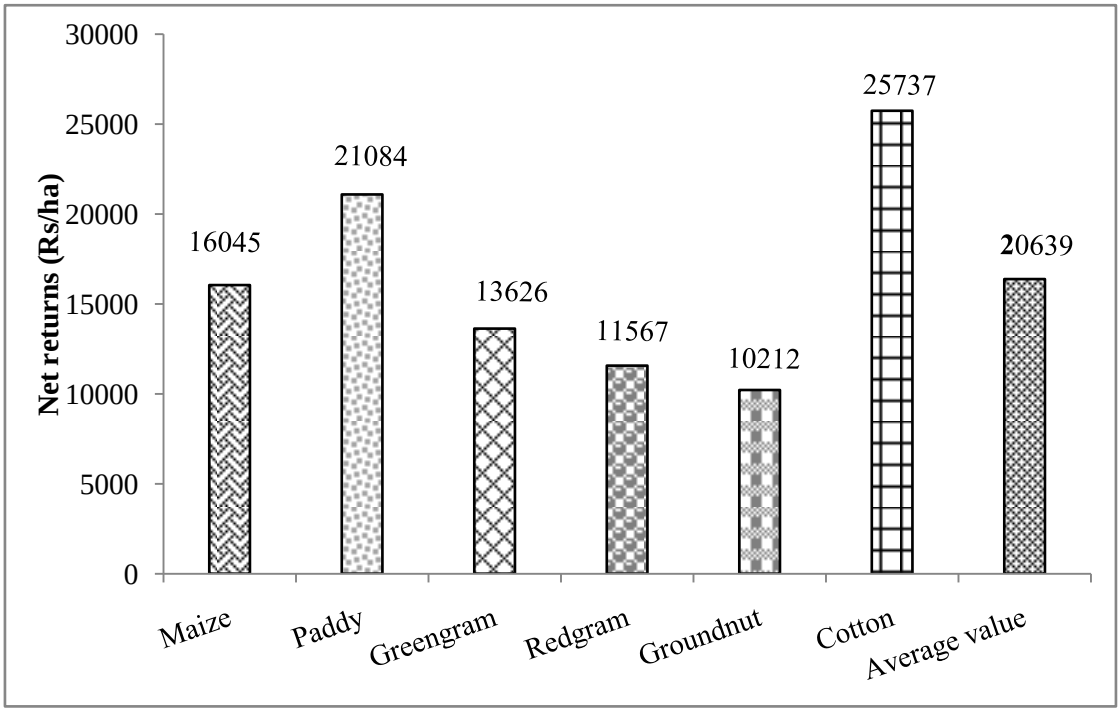



Figure 10: Ecosystem services of food production in Dadal Microwatershed

The average value of ecosystem service for fodder production is around Rs.1413/ ha/year (Table 25). Per hectare fodder production services is maximum in maize (Rs. 2223) followed by groundnut (Rs.1029), and paddy (Rs.988).

**Table 25: Ecosystem services of fodder production in Dadal Microwatershed**

| Production items | Crops | Area in ha | Yield (Qtl/ha) | Price (Rs/Qtl) | Net Returns (Rs/ha) |
|---|---|---|---|---|---|
| Cereals | Maize | 1.6 | 1.9 | 1200 | 2223 |
| | Paddy | 2.8 | 1.1 | 900 | 988 |
| Oil seeds | Groundnut | 5.3 | 0.9 | 1200 | 1029 |
| Average Value | | 9.7 | 1.3 | 1100 | 1413 |

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 value of per hector water used was maximum (Table 26 and Figure 11) in red gram (Rs.47632) followed by cotton (Rs.46455), green gram (Rs.42645), paddy (Rs. 42471), groundnut (Rs. 27916) and maize (Rs. 26410).

**Table 26: Ecosystem services of water supply in Dadal Microwatershed**

| Crops | Yield (Qtl/ha) | Virtual water (cubic meter) per ha | Value of Water (Rs/ha) | Water consumption (Cubic meters/Qtl) |
|---|---|---|---|---|
| Cotton | 11.53 | 4645 | 46455 | 403 |
| Greengram | 6.18 | 4264 | 42645 | 691 |
| Groundnut | 10.03 | 2792 | 27916 | 278 |
| Maize | 21.61 | 2641 | 26410 | 122 |
| Paddy | 25.39 | 4247 | 42471 | 167 |
| Redgram | 8.75 | 4763 | 47632 | 544 |
| Average value | 13.91 | 3892 | 38921 | 368 |

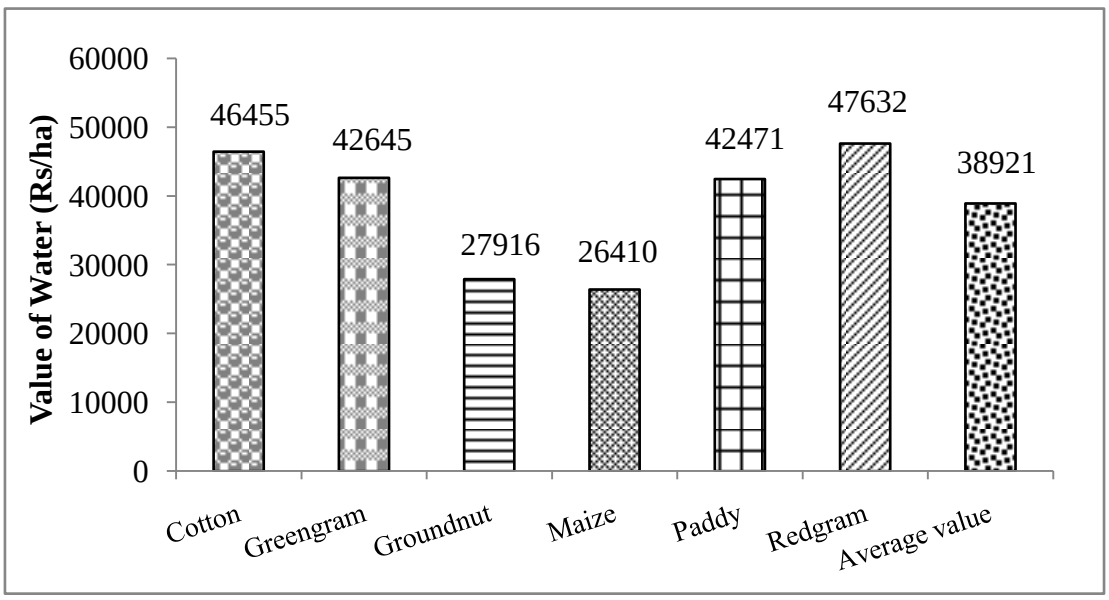



Figure 11: Ecosystem services of water supply in Dadal Microwatershed

The main constraints in farming is climate change particularly decline in rainfall and increasing temperature. Farmers reported that they are not getting timely support/extension services from the concerned development department (Table 27).

**Table 27: Farming constraints related land resources of sample households in Dadal Microwatershed**

| Particulars | Per cent |
|---|---|
| **Farmers awareness of climate change** | |
| Yes | 0 |
| No | 100 |
| **Perception on climate change** | |
| Decrease in rainfall | 0.0 |
| Increase in temperature | 0.0 |
| **Availability agricultural technology information** | |
| Yes | 3 |
| No | 97 |

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.