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

NAGARALADODDI-2 (4D2D6P2c) MICROWATERSHED

Sydhapur 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.

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PREFACE

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

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

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

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

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

ICAR-NBSS&LUP, Regional Centre, Bangalore has taken up a project sponsored by the Karnataka Watershed Development Project-II, (Sujala-III), Government of Karnataka funded by the World Bank under Component-1 Land Resource Inventry. This study was taken up to demonstrate the utility of such a database in reviewing, monitoring and evaluating all the land based watershed development programs on a scientific footing. To meet the requirements of various land use planners at grassroots level, the present study on "Land Resource Inventory and Socio-Economic Status of Farm Households for Watershed Planning and Development of Nagaraladoddi-2 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   **S.K. SINGH**
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PART-A
LAND RESOURCE INVENTORY

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EXECUTIVE SUMMARY

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

The present study covers an area of 295 ha in Yadgir taluk & 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. Entire area of 295 ha (100%) in the microwatershed is covered by soils. The salient findings from the land resource inventory are summarized briefly below.

- ❖ *The soils belong to 5 soil series and 5 soil phases (management units) and 4 land management units.*
- ❖ *The length of crop growing period is about 120-150 days starting from 1ˢᵗ week of June to 4ᵗʰ 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 320 m grid interval.*
- ❖ *Land suitability for growing 26 major agricultural and horticultural crops was assessed and maps showing the degree of suitability along with constraints were generated.*
- ❖ *Entire area in the microwatershed is suitable for agriculture.*
- ❖ *About 56 per cent area of the microwatershed has soils that are deep (100 to 150 cm), 10 per cent soils are moderately deep (75-100 cm) and 34 per cent soils are shallow to moderately shallow (25-75 cm).*
- ❖ *About 5 per cent area in the microwatershed has sandy (loamy sand) soils and 95 per cent clayey (sandy clay and clay) soils.*
- ❖ *Entire area in the microwatershed is has non gravelly (<15%) at the surface.*
- ❖ *About 5 per cent area of the microwatershed is very low (<50 mm/m) in available water capacity, 29 per cent low (51-100 mm/m), 10 per cent medium (101-150 mm/m) and 56 per cent area is very high (>200 mm/m) in available water capacity.*
- ❖ *Entire area in the microwatershed has very gently sloping (1-3% slope) lands.*

❖ *Entire area in the microwatershed is moderately (e2) eroded.*

❖ *An area of about 1 per cent is slightly alkaline (pH 7.3-7.8), 59 per cent is moderately alkaline (pH 7.8-8.4) and 40 per cent is strongly alkaline (pH 8.4-9.0) in reaction.*

❖ *The Electrical Conductivity (EC) of the soils in the entire area of the microwatershed is <2 dsm^{-1}indicating that the soils are non-saline.*

❖ *About 38 per cent of soils are low (<0.5%), 47 per cent of soils are medium (0.5-0.75%) and 15 per cent of soils are high (>0.75%) in organic carbon.*

❖ *About 70 per cent area is low (<23 kg/ha), 22 per cent area is medium (23-57 kg/ha) and 8 per cent area is high (>57 kg/ha) in available phosphorus.*

❖ *Available potassium is medium in all the soils of the microwatershed.*

❖ *Available sulphur is low (<10 ppm) in an area of about 67 per cent, 17 per cent of the soils are medium (10 -20 ppm) and 16 per cent of the soils are high in the microwatershed.*

❖ *Available boron is low (<0.5 ppm) in an area of about 70 per cent and medium (0.5-1.0 ppm) in 30 per cent area of the microwatershed.*

❖ *Available iron is deficient (<4.5 ppm) in an area of about 35 per cent and sufficient (>4.5 ppm) in 65 per cent area of the microwatershed.*

❖ *Available manganese is sufficient in all the soils of the microwatershed.*

❖ *Available copper is sufficient (>0.2 ppm) in 292 ha (99%) area and deficient (<0.2 ppm) in 2 ha (1%) area of the microwatershed.*

❖ *Available zinc is deficient (<0.6 ppm) in the entire area of the microwatershed*

❖ *The land suitability for 26 major agricultural and horticultural 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, market price and finally the demand and supply position.*

Land suitability for various crops in the Microwatershed

Crop	Suitability Area in ha (%)		Crop	Suitability Area in ha (%)	
	Highly suitable (S1)	Moderately suitable (S2)		Highly suitable (S1)	Moderately suitable (S2)
Sorghum	194(66)	87(29)	Sapota	-	-
Maize	-	252(85)	Guava	-	-
Redgram	-	194(66)	Pomegranate	-	194(66)
Bajra	29(10)	252(85)	Jackfruit	-	-
Groundnut	-	87(29)	Jamun	-	165(56)
Sunflower	72(24)	122(42)	Musambi	72(24)	122(42)
Cotton	165(56)	116(39)	Lime	72(24)	122(42)
Bengal gram	194(66)	87(29)	Cashew	-	-
Chilli	-	281(95)	Custard apple	72(24)	209(71)
Tomato	-	159(53)	Amla	-	281(95)
Drumstick	-	194(66)	Tamarind	-	165(56)
Mulberry	-	-	Marigold	-	281(95)
Mango	-	-	Chrysanthemum	-	281(95)

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

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

❖ Soil and water conservation 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. This would help in not only supplementing the farm income but also provide fodder and fuel and generate lot of biomass which would help in maintaining an ecological balance and also contribute to mitigating the climate change.

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 in more than 3.5 lakh ha in the irrigated areas of the State. Nutrient depletion and declining factor productivity is common in both rainfed and irrigated areas. The degradation is continuing at an alarming rate and there appears to be no systematic effort among the stakeholders to contain this process. In recent times, an aberration of weather due to climate change phenomenon has added another dimension leading to unpredictable 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. These, demand 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.

The land resource inventory aims to provide site-specific database for Nagaraladoddi-2 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.

GEOGRAPHICAL SETTING

2.1 Location and Extent

The Nagaraladoddi-2 microwatershed is located in the northern part of Karnataka in Yadgir Taluk and District, Karnataka State (Fig. 2.1). It lies between 16^0 31' and 16^0 33' north latitudes and 77^0 24' and 77^0 25' east longitudes and covers an area of 295 ha. It is about 36 km from Yadgir town. It comprises and surrounded by Duppalli village on the eastern side and Telangana state on the north, east and southern part of the microwatershed.
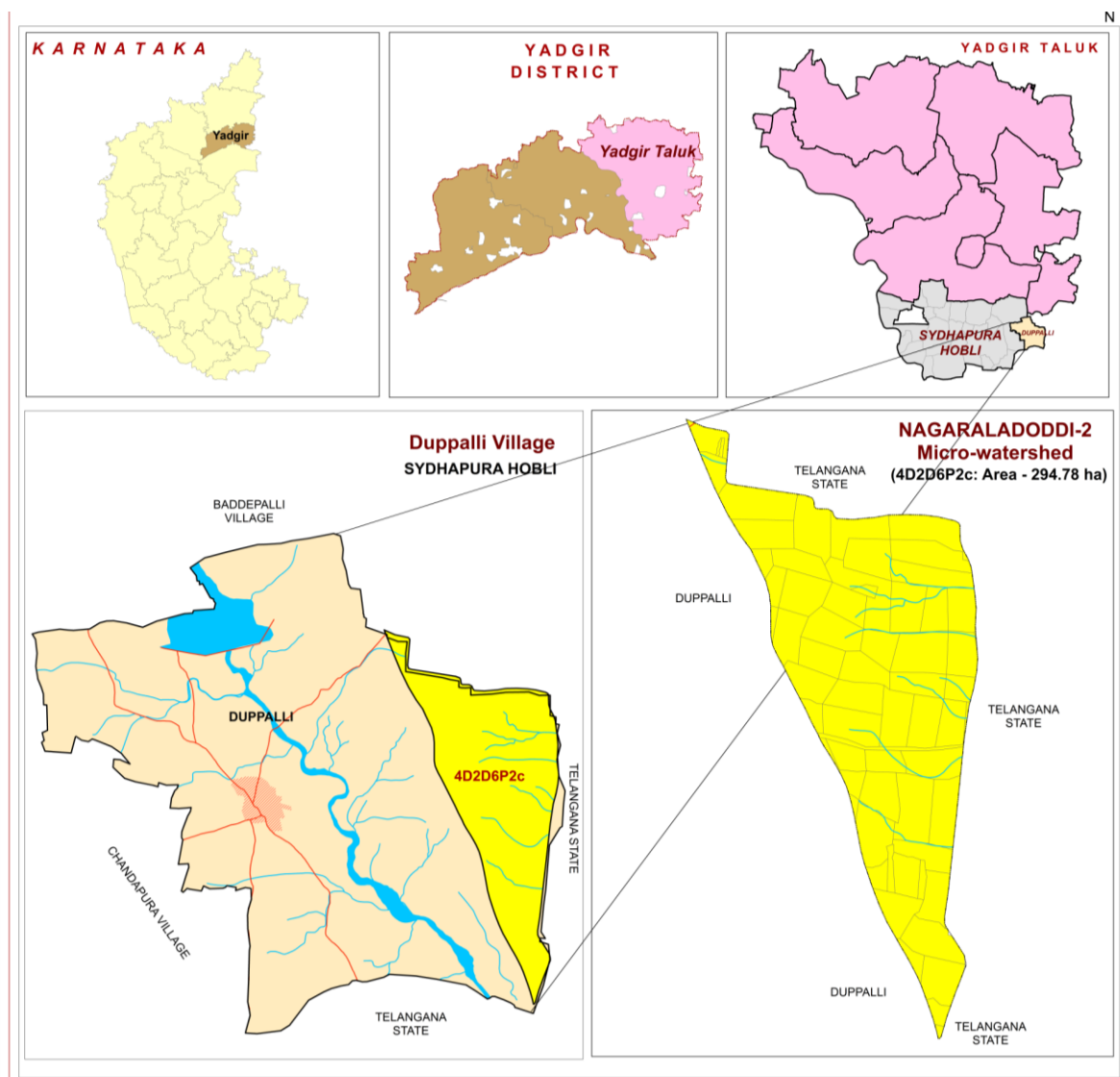
Fig. 2.1 Location map of Nagaraladoddi-2 microwatershed

2.2 Geology

Major rock formations observed in the microwatershed are granite gneiss (Figs. 2.2). 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 the village.

Fig. 2.2 Granite and granite gneiss rocks

2.3 Physiography

Physiographically, the area has been identified as granite gneiss landscape based on geology. The microwatershed area has been further divided into hills/ridges, summits, very gently sloping uplands, plains and valleys based on slope and its relief features. The elevation ranges from 368-378 m above MSL.

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 perennial, during rainy season they carry 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 cold season. December is the coldest month with mean daily maximum and minimum temperatures being 29.5^0C and 10^0C respectively. During peak summer, temperature shoots up to 45^0C. 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 July to end of September. Generally, the Length of crop Growing Period (LGP) is 120-150 days and starts from 1st week of June to 4th week of October.

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

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**	
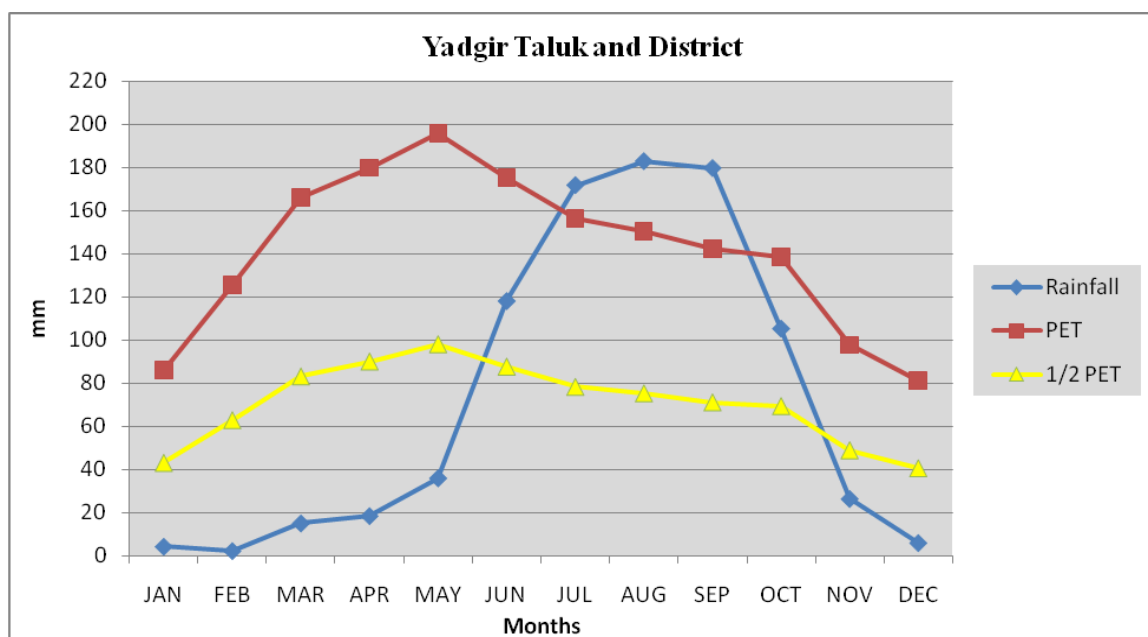
Fig 2.3 Rainfall distribution in Yadgir Taluk

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 taluk 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, mango, pomegranate and marigold. The different crops and cropping systems adopted in the microwatershed is presented in the Figures 2.4 a & b. While carrying out land resource inventory, the land use/land cover particulars are collected from all the survey numbers and a current land use map of the microwatershed is prepared. The current land use map prepared shows the arable and non-arable lands, other land uses and different types of crops grown in the area. The current land use map of Nagaraladoddi-2 microwatershed is presented in Fig. 2.5. Simultaneously, enumeration of wells (bore wells and open wells) and other conservation structures in the microwatershed was made and their location in different survey numbers is marked on the cadastral map.

Table 2.2 Land Utilization in Yadgir Taluk

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 a. Different Crops and Cropping Systems in Nagaraladoddi-2 Microwatershed
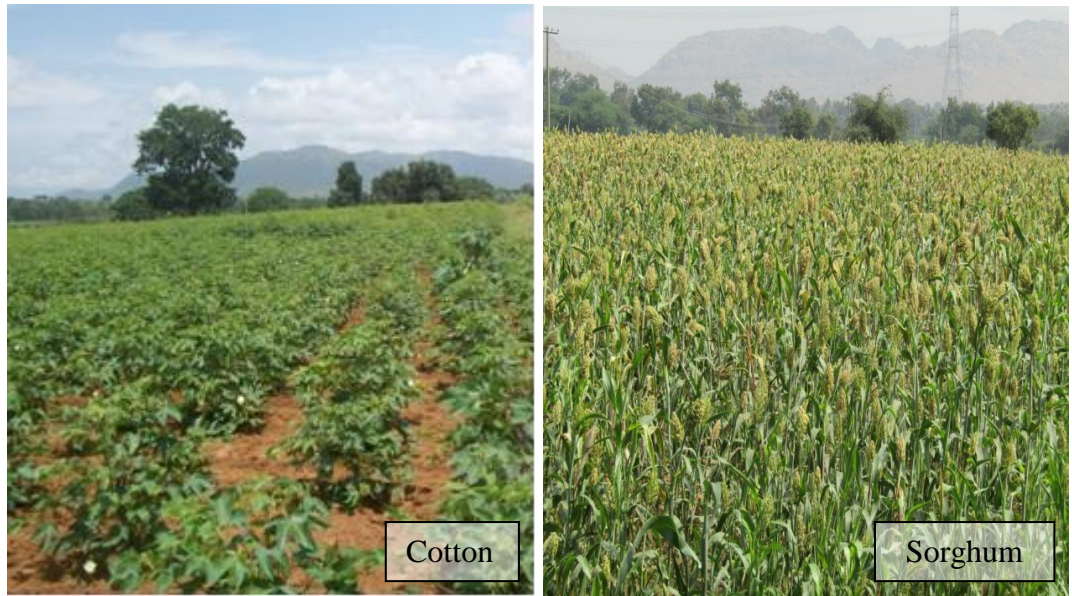
Fig. 2.4 b. Different Crops and Cropping Systems in Nagaraladoddi-2 Microwatershed
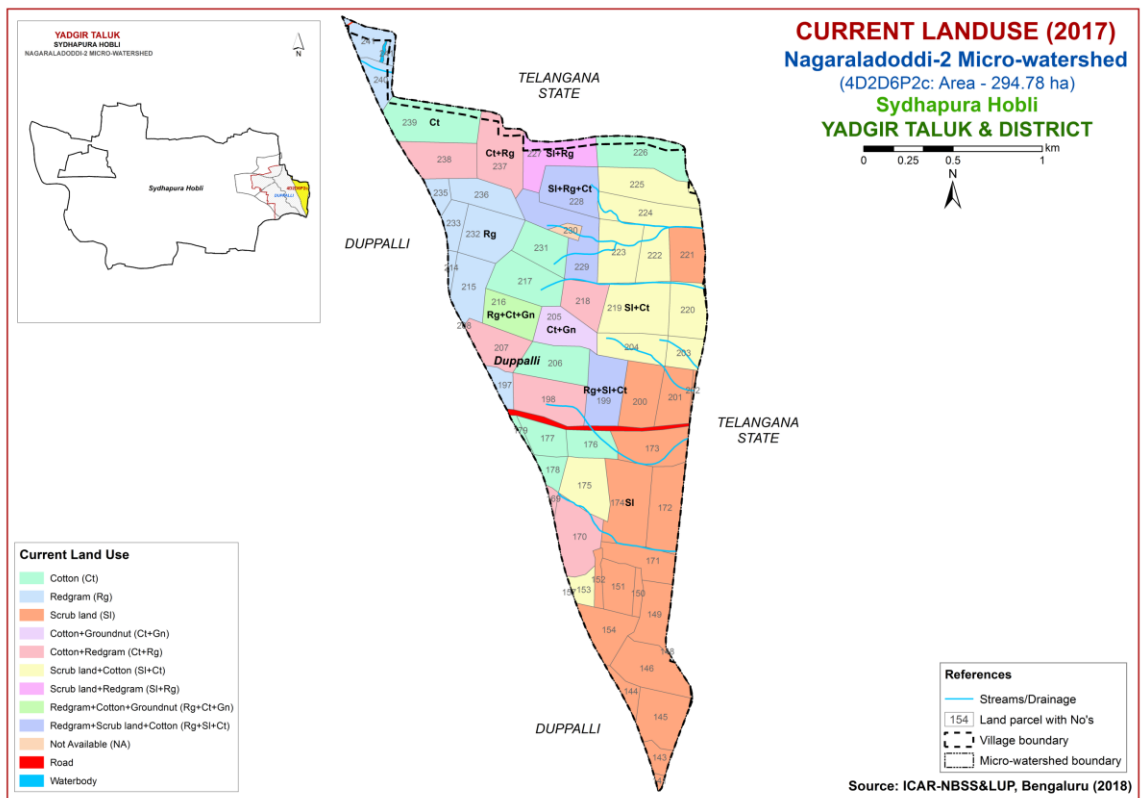
Fig. 2.5 Current Land Use map of Nagaraladoddi-2 microwatershed

SURVEY METHODOLOGY

The purpose of land resource inventory is to delineate similar areas (soil series and phases), which respond or expected to respond similarly for a given level of management. This was achieved in Nagaraladoddi-2 microwatershed by the detailed study of all the soil characteristics (depth, texture, colour, structure, consistence, coarse fragments, porosity, soil reaction, soil horizons etc.) and site characteristics (slope 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 area extent and their geographic distribution on the microwatershed cadastral map. The detailed survey at 1:7920 scale was carried out in 295 ha area. The methodology followed for carrying out land resource inventory was as per the guidelines given in Soil Survey Manual (IARI, 1971; Soil Survey Staff, 2006; Natarajan *et al.,* 2015) which is briefly described below.

3.1 Base Maps

The detailed survey of the land resources occurring in the microwatershed was carried out by using digitized cadastral map and satellite imagery as a base supplied by the KSRSAC. 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 gneiss 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 Landscape

G1		Hills/ Ridges/ Mounds
	G11	Summits
	G12	Side slopes
		G121 Side slopes with dark grey tones
G2		Uplands
	G21	Summits
	G22	Gently sloping uplands
		G221 Gently sloping uplands, yellowish green (eroded)
		G222 Gently sloping uplands, yellowish white (severely eroded)
	G23	Very gently sloping uplands
		G231 Very gently sloping uplands, yellowish green
		G232 Very gently sloping uplands, medium green and pink
		G233 Very gently sloping uplands, pink and green (scrub land)
		G234 Very gently sloping uplands, medium greenish grey
		G235 Very gently sloping uplands, yellowish white (eroded)
		G236 Very gently sloping uplands, dark green
		G237 Very gently sloping uplands, medium pink (coconut garden)
		G238 Very gently sloping uplands, pink and bluish white (eroded)
G3		Valleys/ lowlands
	G31	Valleys, pink tones
	G32	Valleys gray mixed with pink tones
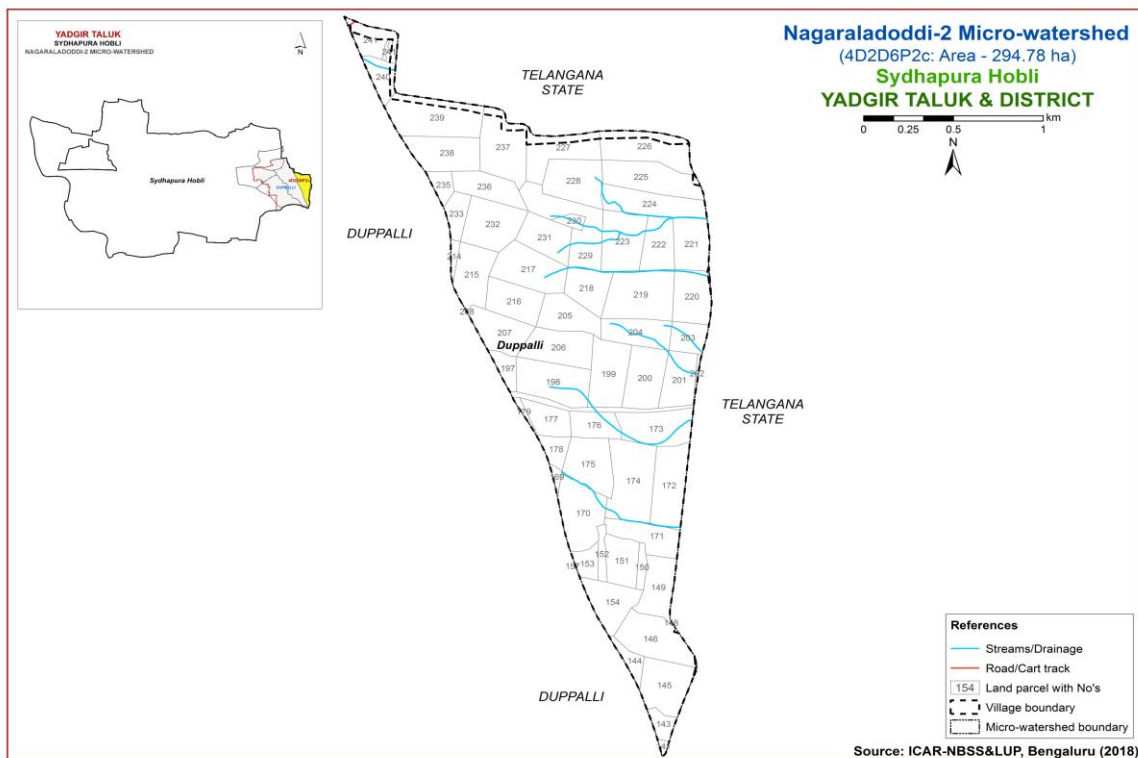
Fig 3.1 Scanned and Digitized Cadastral map of Nagaraladoddi-2 microwatershed
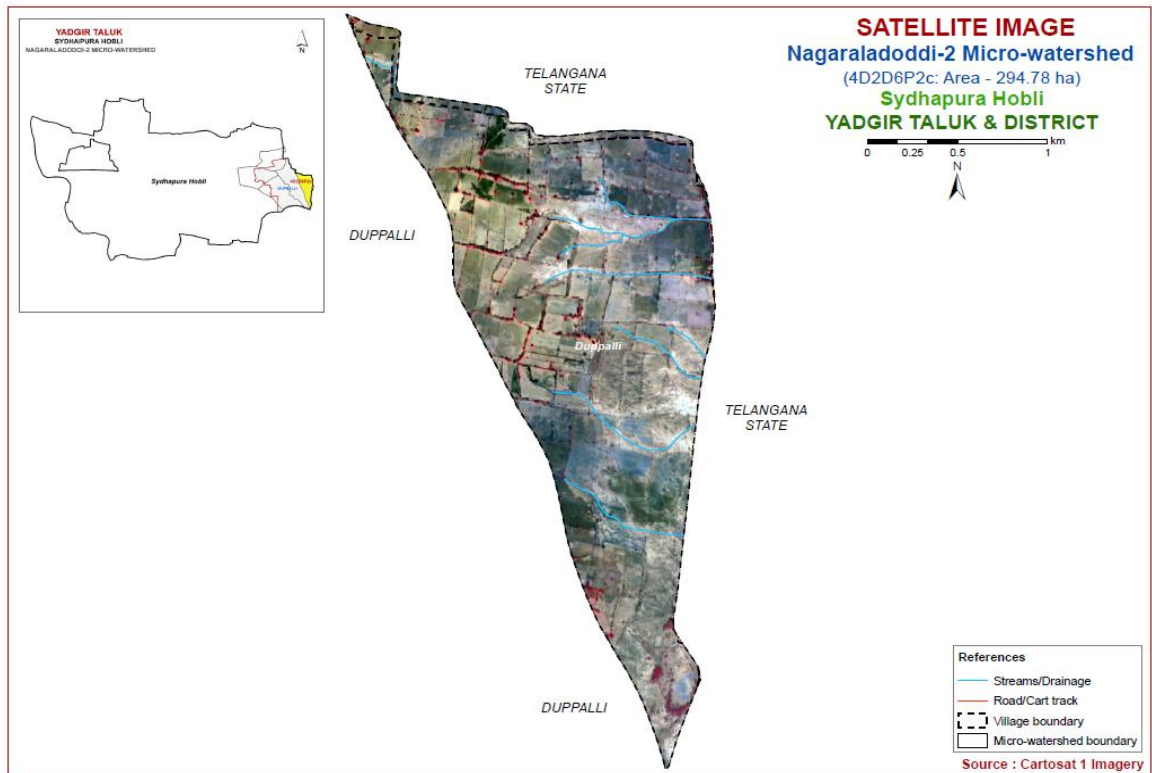
Fig.3.2 Satellite Image of Nagaraladoddi-2 microwatershed
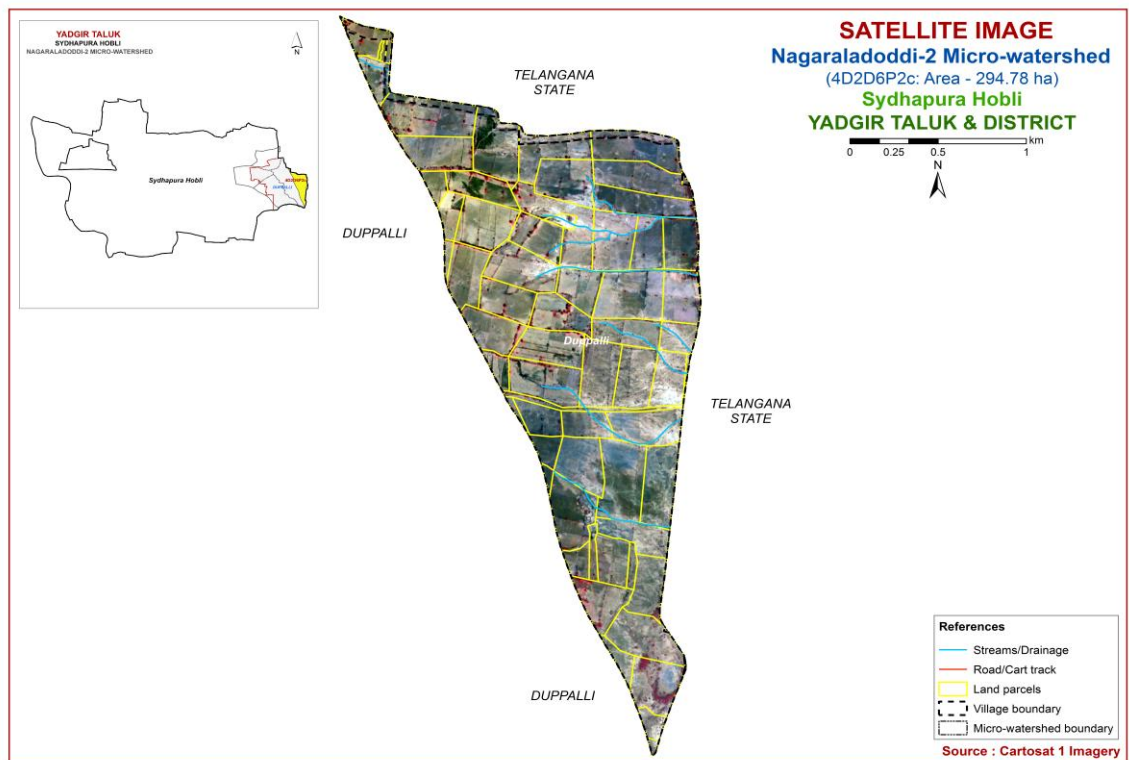
Fig.3.3 Cadastral map overlaid on IRS PAN+LISS IV merged imagery of Nagaraladoddi-2 microwatershed

3.3 Field Investigation

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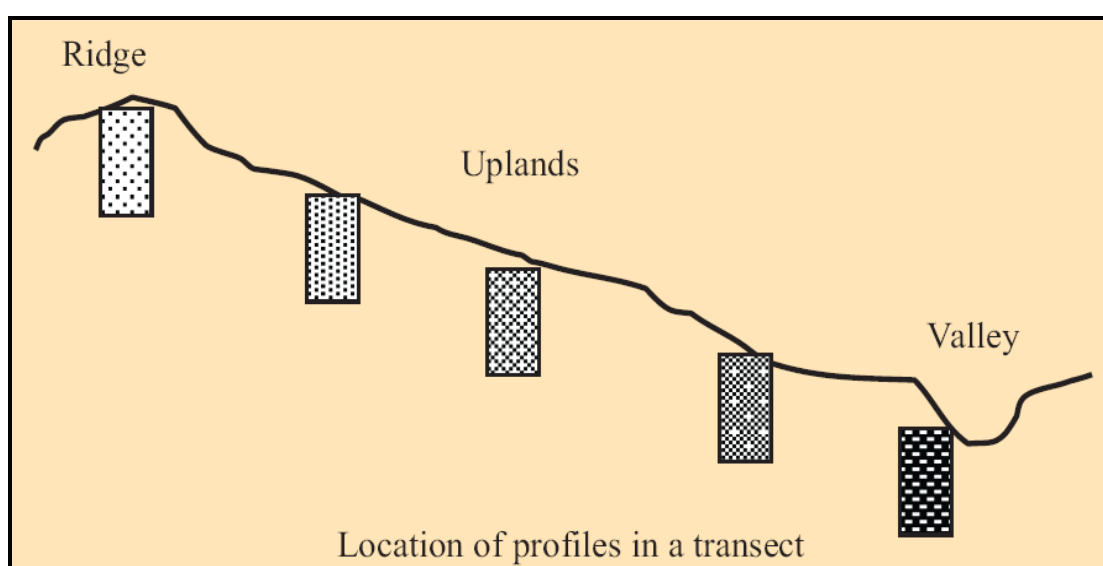
Fig: 3.4. Location of profiles in a transect

In the selected transect, soil profiles were located (Fig. 3.4) 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, soil profiles (vertical cut showing the soil layers from surface to the rock) were opened upto 200 cm or to the depth limited by rock or hard substratum and studied in detail for all their morphological and physical characteristics. The soil and site characteristics were recorded for all profile sites on a standard proforma as per the guidelines given in USDA Soil Survey Manual (Soil Survey Staff, 2012). Apart from the transect study, profiles were also studied at random, almost like in a grid pattern, outside the transect areas.

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, 5 soil series were identified in the Nagaraladoddi-2 microwatershed.

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

Sl. no.	Soil Series	Depth (cm)	Colour (moist)	Text ure	Gravel (%)	Horizon sequence	Calcare ousness
			Soils of Granite Gneiss Landscape				
1	BDL (Badiyala)	25-50	7.5 YR 2.5/3, 2.5/2, 3/3 10 YR 3/4, 4/3	sl	-	Ap-Bw	e
2	YLR (Yalleri)	50-75	2.5 YR 3/4, 4/4 5 YR 3/4,7.5 YR 4/4	c	15-35	Ap-Bt	-
3	GWD (Gowdagera)	75-100	10 YR 3/1, 3/2, 4/2	scl	-	Ap-Bw	es
4	ANR (Anur)	100-150	10 YR 4/3,4/1	c	-	Ap-Bw	es
5	VKS (Vankasambar)	100-150	10YR5/3,4/2,2/1,2/2, 3/2,4/3	scl	-	Ap-Bw	es

3.4 Soil Mapping

The area under each soil series was further separated into 5 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 soil map (Fig. 3.5) in the form of symbols. During the survey many profile pits, few minipits and a few auger bores representing different landforms occurring in the microwatershed were studied. In addition to the profile study, spot observations in the form of minipits, road cuts, terrace cuts etc., were studied to validate the soil boundaries on the soil map.

The soil map shows the geographic distribution of 5 soil mapping units representing 5 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 5 soil phases mapped in the microwatershed. Each mapping unit (soil phase) delineated on the map has similar soil and site characteristics. In other words, all the farms or survey numbers included in one phase will have similar management needs and have to be treated accordingly.

3.5 Laboratory Characterization

Soil samples for each soil series 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 320 m grid interval were analyzed in the laboratory (Katyal and Rattan, 2003). By linking the

soil fertility data to the survey numbers through GIS using Kriging method soil fertility maps for the 11 elements including pH and EC were generated for the microwatershed.

Table 3.2 Soil Map Unit description of Nagaraladoddi-2 microwatershed

Soil No*	Soil Series	Soil Phase	Mapping Unit Description	Area in ha (%)
			Soil of Granite Gneiss Landscape	
	BDL		Badiyala soils are shallow (25-50 cm), well drained, have dark brown to very dark brown and dark yellowish brown, slightly calcareous, sandy loam soils occurring on very gently to gently sloping uplands under cultivation	**14 (4.75)**
2		BDLbB2	Loamy sand surface, slope 1-3%, moderate erosion	14 (4.75)
	YLR		Yalleri soils are moderately shallow (50-75 cm), well drained, have brown to reddish brown and dark reddish brown, gravelly clay red soils occurring on very gently to gently sloping uplands under cultivation	**87 (29.42)**
31		YLRiB2	Sandy clay surface, slope 1-3%, moderate erosion	87 (29.42)
	GWD		Gowdagera soils are moderately deep (75-100 cm), moderately well drained, have dark grayish brown to very dark grayish brown, calcareous, sandy clay loam black soils occurring on very gently sloping uplands under cultivation	**29 (9.77)**
127		GWDmB2	Clay surface, slope 1-3%, moderate erosion	29 (9.77)
	ANR		Anur soils are deep (100-150 cm), moderately well drained, have dark gray to brown, calcareous, clay soils occurring on very gently sloping uplands under cultivation	**72 (24.46)**
55		ANRiB2	Sandy clay surface, slope 1-3%, moderate erosion	72 (24.46)
	VKS		Vankasambar soils are deep (100-150 cm), moderately well drained, have brown to very dark grayish brown and very dark brown, calcareous, sandy clay loam black soils occurring on very gently sloping lowlands under cultivation	**93 (31.59)**
117		VKSiB2	Sandy clay surface, slope 1-3%, moderate erosion	93 (31.59)

3.6 Land Management Units (LMU's)

The 5 soil phases identified and mapped in the microwatershed were grouped into 4 Land Management Units (LMU's) for the purpose of preparing a Proposed Crop Plan for sustained development of the microwatershed. The database (soil phases) generated under LRI was utilized for identifying Land Management Units (LMU's) based on the management needs. One or more than one soil site characteristic having influence on the management have been chosen for identification and delineation of LMUs. For Nagaraladoddi-2 microwatershed, five soil and site characteristics, namely soil depth, soil texture, slope, erosion and gravel content have been considered for defining LMUs. The Land Management Units are expected to behave similarly for a given level of management.
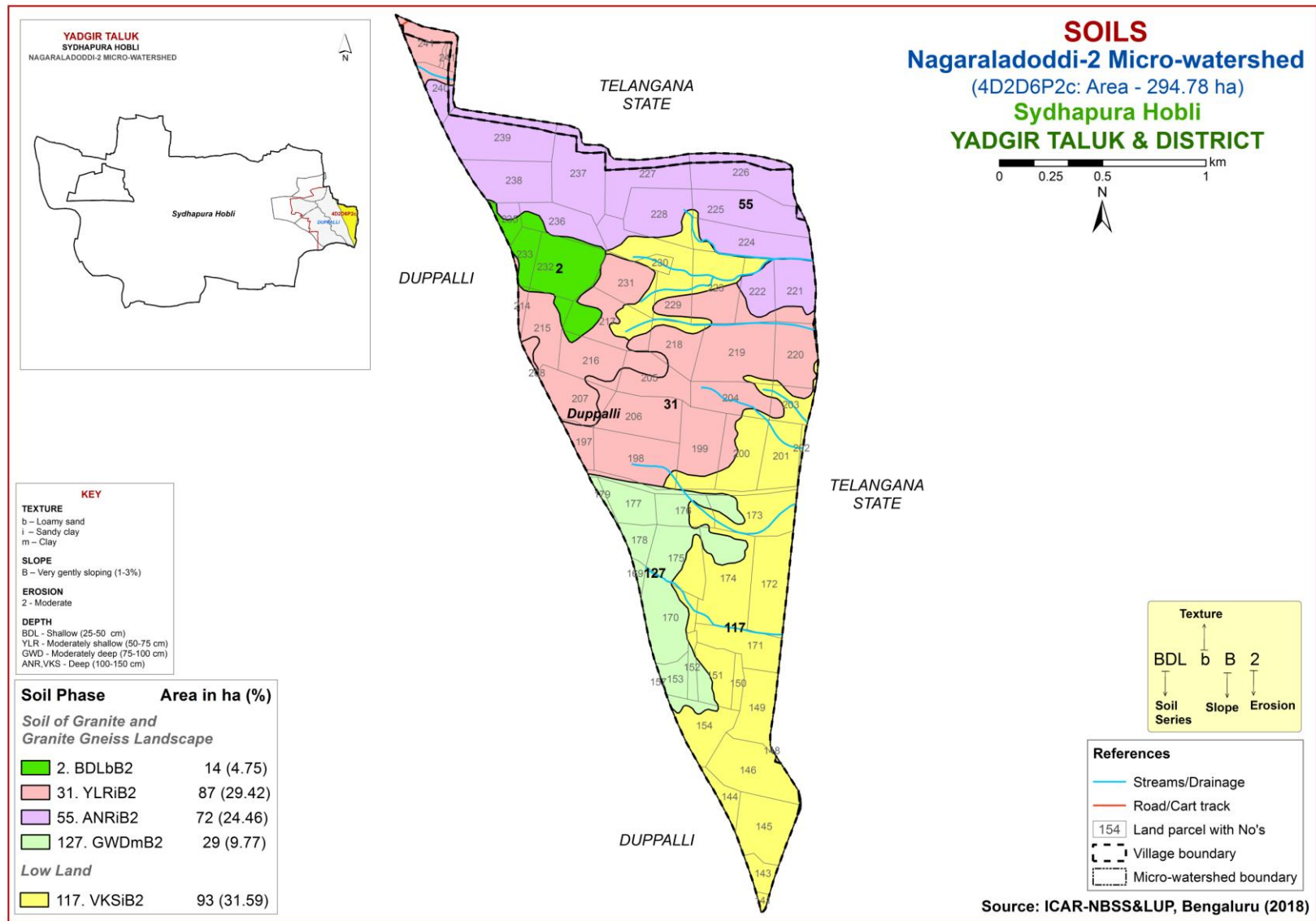
Fig 3.5 Soil phase or management units map of Nagaraladoddi-2 microwatershed

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THE SOILS

Detailed information pertaining to the nature, extent and distribution of different kinds of soils occurring in Nagaraladoddi-2 microwatershed is provided in this chapter. The microwatershed area has been identified as granite gneiss landscape based on geology. In all, 5 soil series were identified in this landscape. Soil formation is the result of the combined effect of environmental and terrain factors that are reflected in soil morphology. In the granite gneiss landscape, it is by parent material, relief, time and climate.

A brief description of each of the 5 soil series identified followed by 5 soil phases (management units) mapped (Fig. 3.4) are furnished below. The physical and chemical characteristics of soil series identified in Nagaraladoddi-2 microwatershed are given in Table 4.1 along with soil classification. The soils in any one map unit differ from place to place in their depth, texture, slope, gravelliness, erosion or any other site characteristics that affect management. The soil phase map can be used for identifying the suitability of areas for growing specific crops or for other alternative uses and also for deciding the type of conservation structures needed. The detailed information on soil and site-characteristics like soil depth, surface soil texture, slope, erosion, gravelliness, AWC, LCC etc, with respect to each of the soil phase identified is given village/survey number wise for the microwatershed in Appendix-I.

4.1 Soils of granite gneiss Landscape

In this landscape, 5 soil series are identified and mapped. Of these, VKS series occupies an area of 93 ha (32%) followed by YLR 87 ha (29%), ANR 72 ha (24%), GWD 29 ha (10%) and BDL 14 ha (5%). Brief description of each series identified and number of soil phases mapped is given below.

4.1.1 Badiyala (BDL) Series: Badiyala soils are shallow (25-50 cm), well drained, have very dark brown to dark yellow brown and dark brown, slightly calcareous sandy loam soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation. The Badiyala series has been classified as a member of the coarse-loamy, mixed, isohyperthermic family of Fluventic Haplustepts.

The thickness of the solum ranges from 28 to 50 cm. The thickness of A horizon ranges from 4 to 12 cm. Its colour is in 10YR hue with value 3 to 4 and chroma 3 to 4. The texture is loamy sand, sandy clay loam and sandy clay. The thickness of B horizon ranges from 27 to 45 cm. Its colour is in 10 YR and 7.5 YR hue with value 2 to 4 and chroma 3 to 4. Its texture is sandy loam to sandy clay loam and sandy clay and is slightly calcareous. The available water capacity is very low (<50mm/m). Only one soil phase was identified and mapped.

Landscape and soil profile characteristics of Badiyala (BDL) 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 clay soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation. The Yalleri series has been classified as a member of the fine, mixed, isohyperthermic family of Typic Haplustalfs.

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 clay with gravel content of 15-35 per cent. The available water capacity is low (51-100 mm/m). Only one soil phase was identified and mapped.

Landscape and Soil Profile characteristics of Yalleri (YLR) Series

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4.1.3 Gowdagera (GWD) Series: Gowdagera soils are moderately deep (75-100 cm), moderately well drained, have very dark gray to dark grayish brown, sodic, calcareous sandy clay loam soils. They are developed from weathered granite gneiss and occur on very gently sloping uplands under cultivation. The Gowdagera series has been classified as a member of the fine-loamy, mixed (calcareous) isohyperthermic family of Typic Haplustepts.

The thickness of the solum ranges from 76 to 100 cm. The thickness of A horizon ranges from 8 to 16 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. The thickness of B horizon ranges from 61 to 91 cm. Its colour is in hue 10 YR with value 2 to 4 and chroma 1 to 4. Its texture is sandy clay loam to sandy clay and is calcareous. These are sodic with ESP more than 15 per cent ranging from 44 to 121 per cent. The available water capacity is medium (101-150 mm/m). Only one soil phase was identified and mapped.

Landscape and Soil Profile characteristics of Gowdagera (GWD) Series

4.1.4 Anur (ANR) Series: Anur soils are deep (100-150 cm), moderately well drained, have dark gray to dark brown, sodic, calcareous clay soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation. The Anur series has been classified as a member of the fine, mixed, (calcareous), isohyperthermic family of Typic Haplustepts.

The thickness of the solum ranges from 102 to 148 cm. The thickness of A-horizon ranges from 9 to 17 cm. Its colour is in 10 YR hue with value 3 to 4 and chroma 2 to 4. The texture ranges from loamy sand to sandy clay loam and sandy clay and are calcareous. The thickness of B horizon ranges from 102 to 135 cm. Its colour is in 10 YR hue with value 3 to 5 and chroma 1 to 6. Texture is sandy clay loam to sandy clay and clay and is calcareous. These are sodic with ESP ranging from 17 to 72 per cent. The

available water capacity is very high (>200 mm/m). Only one soil phase was identified and mapped.

Landscape and Soil Profile characteristics of Anur (ANR) Series

4.1.5 Vankasambar (VKS) Series: Vankasambar soils are deep (100-150 cm), moderately well drained, very dark brown to brown, sodic, calcareous sandy clay loam soils. They are developed from colluvio-alluvium of granite gneiss and occur on very gently to gently sloping lowlands under cultivation. The Vankasambar series has been classified as a member of the fine-loamy, mixed, (calcareous) isohyperthermic family of Typic Haplustepts.

The thickness of the solum ranges from 120 to 150 cm. The thickness of A horizon ranges from   9 to 22 cm. Its colour is in 10 YR hue with value 4 to 5 and chroma 2 to 5. The texture varies from loamy sand, sandy clay loam and sandy clay. The thickness of B horizon ranges from 102 to 138 cm. Its colour is in 10 YR hue with value 2 to 5 and chroma 2 to 4. Texture is sandy clay loam to sandy clay and is calcareous. These are sodic with ESP more than 15 per cent ranging from 10 to 118 per cent. The available water capacity is very high (>200 mm/m). Only one soil phase was identified and mapped.

Landscape and Soil Profile characteristics of Vankasambar (VKS) Series

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

Soil Series: Badiyala (BDL) **Pedon:** R-5
Location: $16^0 37'10.0"$N $77^0 20'21.5"$, Gudalagunta village, Balichakra hobli, Yadgir taluk and district
Analysis at: NBSS&LUP, Regional Centre, Bengaluru   **Classification:** Coarse-loamy, mixed, isohyperthermic Fluventic Haplustepts

| Depth (cm) | Horizon | Size class and particle diameter (mm) | | | | | | | | Coarse fragments w/w (%) | Texture Class (USDA) | % Moisture | |
| | | Total | | | Sand | | | | | | | | |
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-12	Ap	87.13	7.04	5.83	10.03	24.32	23.61	23.51	5.67	<15	ls	6.27	2.44
12-28	Bw1	64.63	13.30	22.07	6.74	13.07	22.30	17.01	5.50	<15	scl	16.34	7.83
28-52	BC	73.11	12.02	14.87	3.93	16.03	26.89	18.41	7.86	<15	sl	12.94	5.47

| Depth (cm) | pH (1:2.5) | | | E.C. (1:2.5) | O.C. | CaCO$_3$ | Exchangeable bases | | | | | CEC | CEC/ Clay | Base saturation | ESP |
| | Water | CaCl$_2$ | M KCl | dS m^{-1} | % | % | Ca | Mg | K | Na | Total | | | % | % |
							cmol kg^{-1}								
0-12	6.20	-	-	0.074	1.00	0.00	2.80	0.98	0.14	0.01	3.92	4.20	0.72	93	0.20
12-28	9.04	-	-	0.253	0.80	3.20	-	-	0.16	0.69	-	16.90	0.77	100	4.09
28-52	9.41	-	-	0.364	1.10	3.60	-	-	0.16	1.39	-	11.10	0.75	100	12.52

Contd...

Soil Series: Yalleri (YLR) **Pedon:** R-16
Location: 16⁰32'54.3"N 77⁰22'71.2"E, Duppalli village, Sydhapura hobli, Yadgir taluk and district
Analysis at: NBSS&LUP, Regional Centre, Bengaluru   **Classification:** Fine, mixed, isohyperthermic Typic Haplustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-5	Ap	81.69	5.44	12.87	6.10	8.65	33.88	21.57	11.50	-	sl	8.60	3.37
5-34	Bt1	38.78	6.73	54.49	3.38	9.91	12.42	8.93	4.14	-	c	25.33	15.82
34-75	Bt2	40.35	2.90	56.75	12.91	6.83	10.30	7.48	2.82	35-60	c	24.49	16.20

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	CaCO₃	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	CaCl₂	M KCl	dS m⁻¹	%	%	cmol kg⁻¹							%	%
0-5	6.91	-	-	0.069	0.70	0.00	5.29	1.37	0.28	0.03	6.96	6.90	0.54	100	0.45
5-34	7.05	-	-	0.053	0.62	0.00	16.43	3.89	0.26	0.09	20.67	21.60	0.40	96	0.42
34-75	7.25	-	-	0.058	0.59	0.00	15.22	3.46	0.25	0.14	19.06	19.90	0.35	96	0.69

Contd...

Soil Series: Gowdagera (GWD) **Pedon:** R-13

Location: $16^0 38'24.4''$N $77^0 21'24.0''$E, Madhawara village, Balichakara hobli, Yadgir taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bengaluru   **Classification:** Fine-loamy, mixed (calcareous) isohyperthermic Typic Haplustepts

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-18	Ap	79.61	13.94	6.45	14.17	17.53	23.65	17.02	7.24	-	ls	11.36	3.86
18-42	BW1	69.09	10.58	21.06	10.54	16.58	22.01	14.43	5.53	-	scl	31.62	12.30
42-81	Bw2	51.37	13.51	35.60	7.59	10.55	16.24	11.60	5.38	-	sc	67.57	26.89

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	CaCO$_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
	Water	CaCl$_2$	M KCl	dS m^{-1}	%	%	Ca	Mg	K	Na	Total			%	%
							cmol kg^{-1}								
0-18	9.89	-	-	0.74	0.66	1.20	-	-	0.18	3.63	-	8.35	1.29	100	43.51
18-42	10.82	-	-	1.60	0.27	5.76	-	-	0.19	19.23	-	15.84	0.75	100	121.42
42-81	10.83	-	-	2.30	0.27	7.80	-	-	0.40	26.71	-	26.54	0.75	100	100.67

Contd...

Soil Series: Anur (ANR) **Pedon:** R-15

Location: $16^0 32'45.0''$N $77^0 23'57.4''$E, Duppalli village, Sydhapura hobli, Yadgir taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bengaluru   **Classification:** Fine, mixed (calcareous), isohyperthermic Typic Haplustepts

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-18	Ap	64.60	13.44	21.96	7.33	10.42	18.68	20.12	8.05	<15	scl	16.59	7.96
18-49	Bw1	56.66	12.19	31.15	4.73	9.80	18.66	17.02	6.45	-	scl	33.38	13.51
49-95	Bw2	39.94	17.81	42.25	3.09	3.30	15.44	10.65	7.45	<15	c	44.68	25.23
95-123	Bw3	30.65	17.58	51.77	1.50	5.57	10.18	9.65	3.75	<15	c	54.94	32.07

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	CaCO₃	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
	Water	CaCl₂	M KCl	dS m⁻¹	%	%	Ca	Mg	K	Na	Total			%	%
	Water	CaCl₂	M KCl	dS m⁻¹	%	%	cmol kg⁻¹							%	%
0-18	10.17	-	-	0.365	0.48	6.11	-	-	0.25	3.52	-	19.90	0.91	100	17.70
18-49	10.32	-	-	1.38	0.30	6.76	-	-	0.21	16.03	-	24.60	0.79	100	65.17
49-95	10.08	-	-	2.55	0.17	6.11	-	-	0.33	21.49	-	32.60	0.77	100	65.91
95-123	9.92	-	-	2.56	0.12	7.93	-	-	0.51	26.03	-	36.00	0.70	100	72.30

Contd...

Soil Series: Vankasambar (VKS) **Pedon:** R-11
Location: $16^0 34'49.4"$N $77^0 22'46.5"$N, Baddepalli village, Sydhapura hobli, Yadgir taluk and district
Analysis at: NBSS&LUP, Regional Centre, Bengaluru   **Classification:** Fine-loamy, mixed, (calcareous) isohyperthermic Typic Haplustepts

| Depth (cm) | Horizon | Size class and particle diameter (mm) | | | | | | | | Coarse fragments w/w (%) | Texture Class (USDA) | % Moisture | |
| | | Total | | | Sand | | | | | | | | |
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine 0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-14	Ap	61.32	10.31	28.37	7.14	12.07	16.04	19.03	7.05	-	scl	20.65	11.25
14-37	Bw1	62.63	8.72	28.65	9.88	14.50	16.19	15.57	6.49	-	scl	24.37	11.33
37-80	Bw2	61.43	9.14	29.43	4.84	15.45	18.01	16.73	6.40	-	scl	41.96	13.39
80-108	Bw3	55.39	11.75	32.86	4.06	5.99	23.87	15.39	6.08	-	scl	45.20	15.45

| Depth (cm) | pH (1:2.5) | | | E.C. (1:2.5) | O.C. | CaCO$_3$ | Exchangeable bases | | | | | CEC | CEC/ Clay | Base saturation | ESP |
	Water	CaCl$_2$	M KCl	dS m^{-1}	%	%	Ca	Mg	K	Na	Total			%	%
0-14	9.10	-	-	0.586	0.96	5.72	-	-	0.54	1.74	-	17.57	0.62	100	9.92
14-37	10.35	-	-	0.595	0.52	7.80	-	-	0.50	4.24	-	16.65	0.58	100	25.48
37-80	10.39	-	-	2.14	0.28	12.35	-	-	0.64	15.89	-	13.45	0.46	100	118.11
80-108	11.15	-	-	3	0.32	11.70	-	-	0.74	20.69	-	22.58	0.69	100	91.64

INTERPRETATION FOR LAND RESOURCE MANAGEMENT

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

5.1 Land Capability Classification

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

Soil characteristics: Depth, texture, gravel content, calcareousness.
Land characteristics: Slope, erosion, drainage, rock outcrops.
Climate: Total rainfall and its distribution, and length of crop growing period.

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

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

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

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

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

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

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

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

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

The land capability subclasses are recognised based on the dominant limitations observed within a given land capability class. The subclasses are designated by adding a lower case letter like 'e', 'w', 's', or 'c' to the class numeral. The subclass "e" indicates that the main hazard is risk of erosion, "w" indicates drainage or wetness as a limitation for plant growth, "s" indicates shallow soil depth, coarse or heavy textures, calcareousness, salinity/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 5 soil map units identified in the Nagaraladoddi-2 microwatershed are grouped under 2 land capability classes and 3 land capability subclasses (Fig. 5.1).

Entire area of the microwatershed is suitable for agriculture. Maximum area of 281 ha (95%) is good cultivable lands (Class II) that have minor limitations of soil, erosion and drainage and require moderate conservation practices and are distributed in the major part of the microwatershed. Moderately good cultivable lands (Class III) cover an area of 14 ha (5%) and are distributed in the northwestern part of the microwatershed with moderate problems of erosion and soil that require special conservation practices.
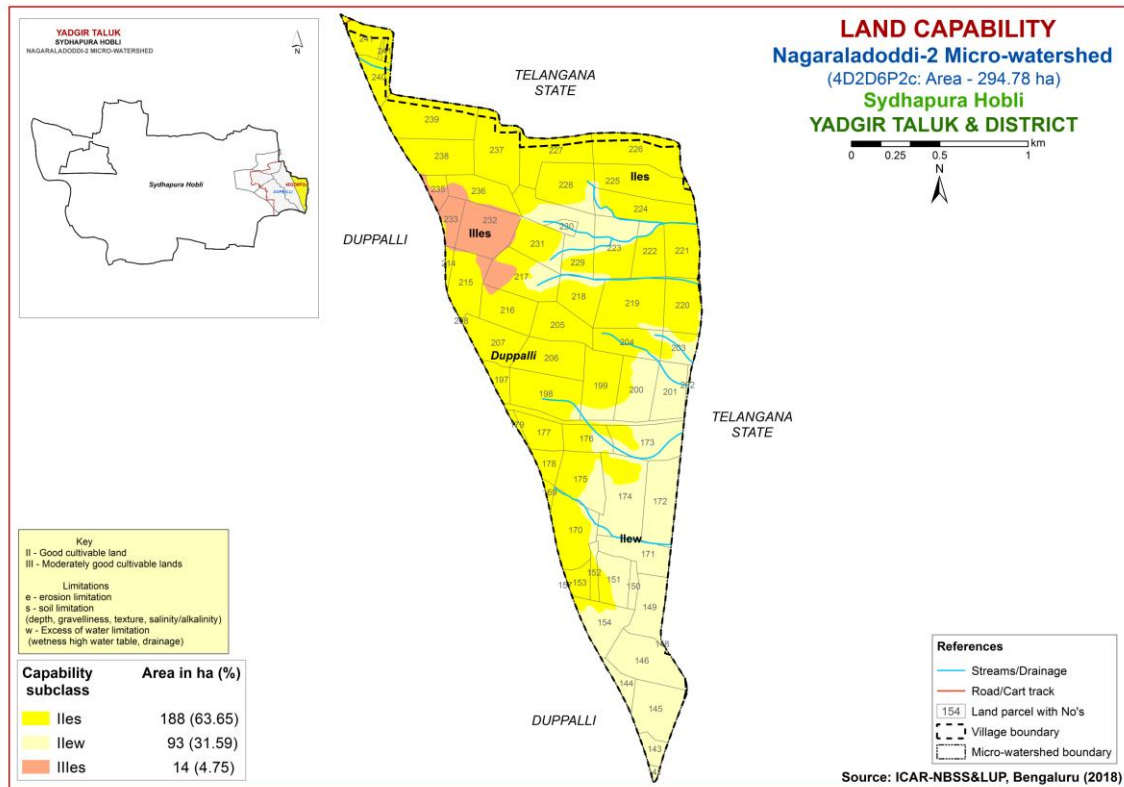
Fig. 5.1 Land Capability map of Nagaraladoddi-2 microwatershed

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 Figure 5.2.

Shallow (25-50 cm) soils occupy a small area of 14 ha (5%) and are distributed in the northwestern part of the microwatershed. An area of 87 ha (29%) is moderately shallow (50-75 cm) and are distributed in the northern, western, central and eastern part of the microwatershed. Moderately deep soils (75-100 cm) occur in an area of 29 ha (10%) and are distributed in the southern part of the microwatershed. Deep (100-150 cm) soils cover in a maximum area of 165 ha (56%) and are distributed in all parts of the microwatershed.

The most problem lands with a small area of about 14 ha (5%) having shallow (25-50 cm) rooting depth. They are suitable for growing short duration agricultural crops but well suited for pasture, forestry or other recreational purposes. The most productive

lands covering about 165 ha (56%) with respect to soil rooting depth where all climatically adapted annual and perennial crops can be grown are deep (100-150 cm) soils occurring in the major part of the microwatershed.
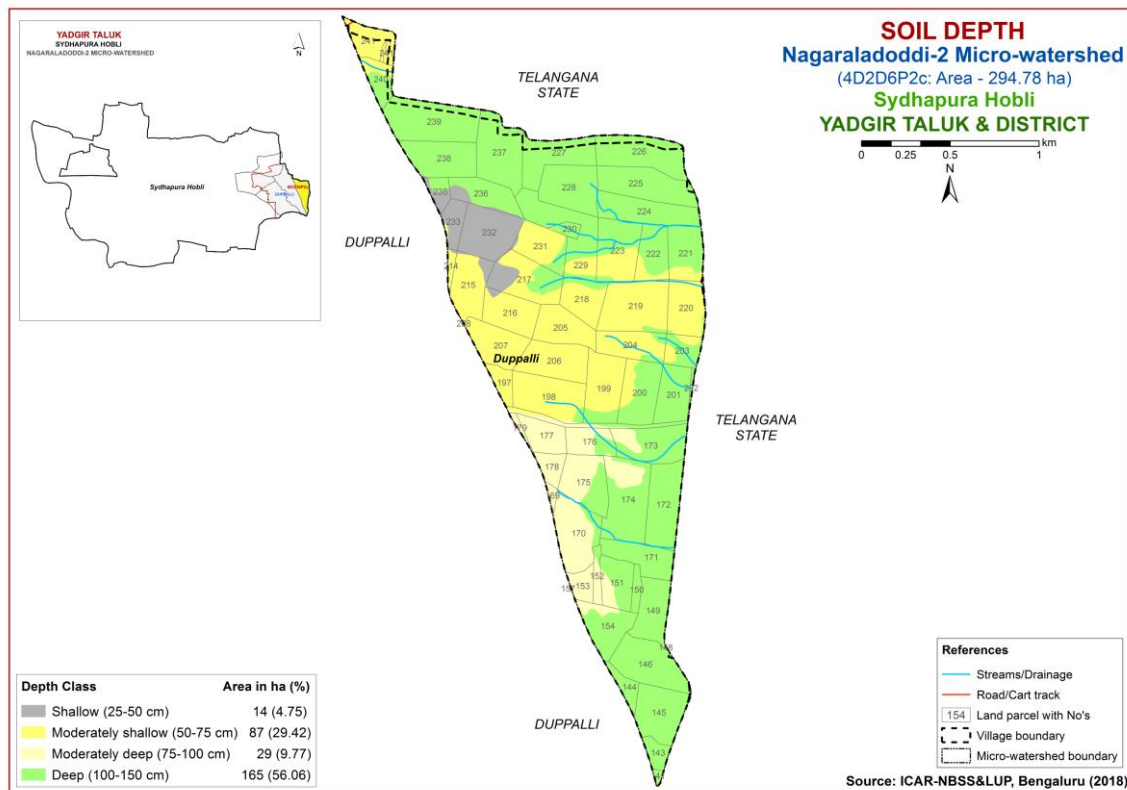
Fig. 5.2 Soil Depth map of Nagaraladoddi-2 microwatershed

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 281 ha (95%) has clayey (sandy clay and clay) soils at the surface and are distributed in all parts of the microwatershed. Sandy (loamy sand) soils occupy an area of about 14 ha (5%) and are distributed in the northwestern part of the microwatershed.

The major area of the microwatershed is most productive lands with respect to surface soil texture are clayey and loamy soils that have high potential for soil-water retention and availability, and nutrient retention and availability, but clayey soils have

more problems of drainage, infiltration, workability and other physical problems. The problem soils cover about 14 ha (5%) that have low nutrient status and low moisture.
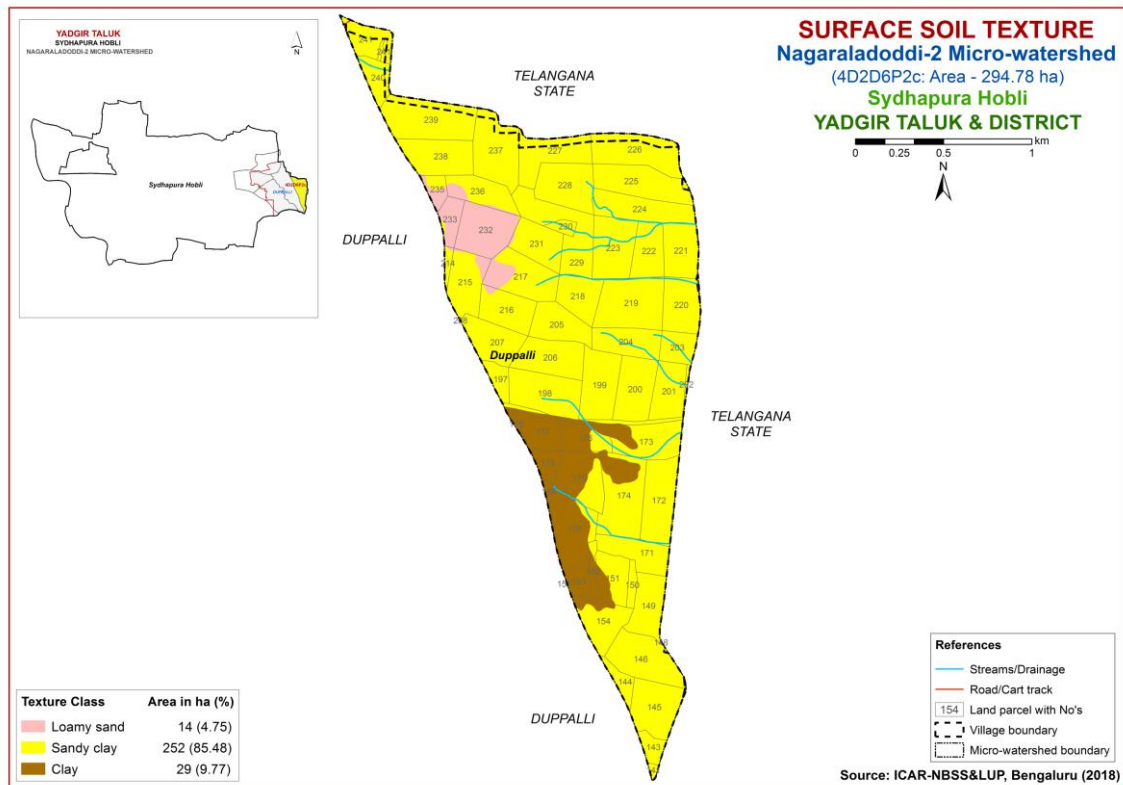
Fig. 5.3 Surface Soil Texture map of Nagaraladoddi-2 microwatershed

5.4 Soil Gravelliness

Gravel is the term used for describing coarse fragments between 2 mm and 7.5 cm diameter and stones for those between 7.5 cm and 25 cm. The presence of gravel and stones in 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.

Entire area of the microwatershed has soils that are non gravelly (<15%) and occur in all parts of the microwatershed.

The most productive lands with respect to gravelliness are found to be 100 per cent. They are non gravelly (<15%) and have potential for growing all annual and perennial crops.
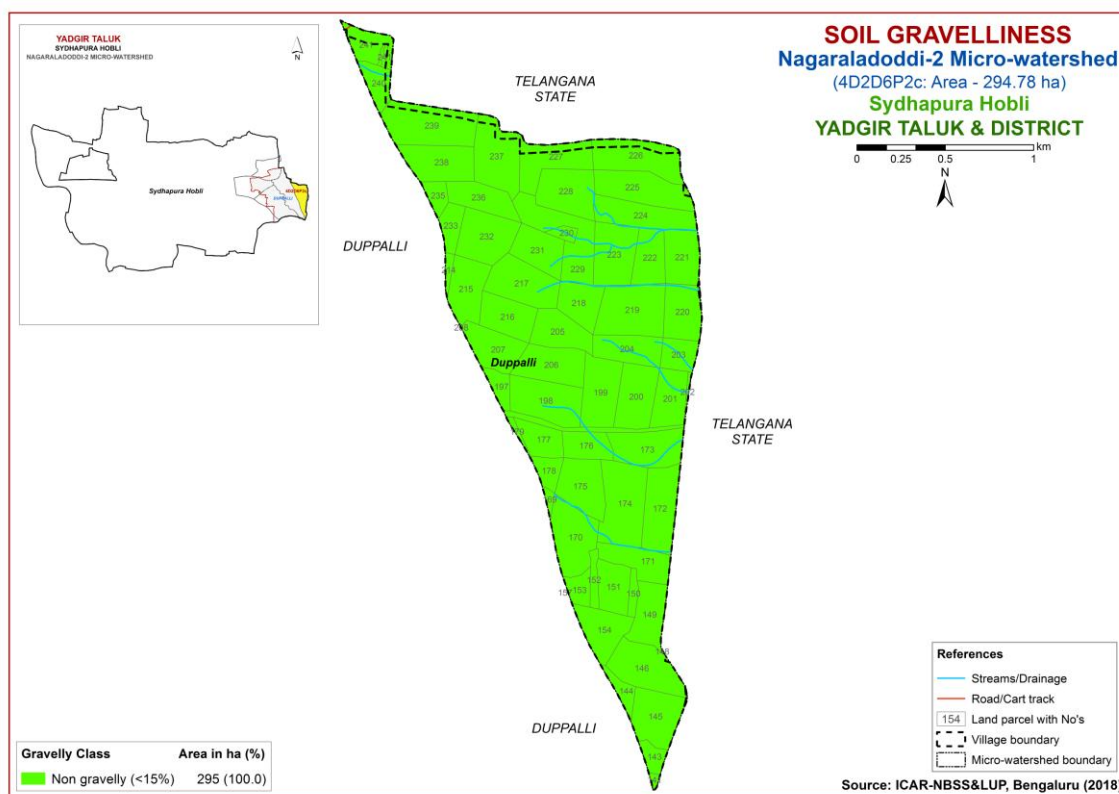
Fig. 5.4 Soil Gravelliness map of Nagaraladoddi-2 microwatershed

5.5 Available Water Capacity

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

A small area of 14 ha (5%) has soils that are very low (<50 mm/m) in available water capacity and are distributed in the northwestern part of the microwatershed. An area of about 87 ha (29%) has soils that are low (51-100 mm/m) in available water capacity and are distributed in the northern, western, central and eastern part of the microwatershed. An area of about 29 ha (10%) has soils that are medium (101-150 mm/m) in available water capacity and are distributed in the southern part of the microwatershed. Major area of 165 ha (56%) has soils that are very high (>200 mm/m) in available water capacity and are distributed in all parts of the microwatershed.

About 101 ha (34%) area in the microwatershed has soils that are relatively problematic with regard to available water capacity. Here, only short or medium duration crops can be grown and the probability of crop failure is very high. These areas are best

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put to other alternative uses. The most productive soils cover about 165 ha (56%) where all climatically adapted long duration crops can be grown.
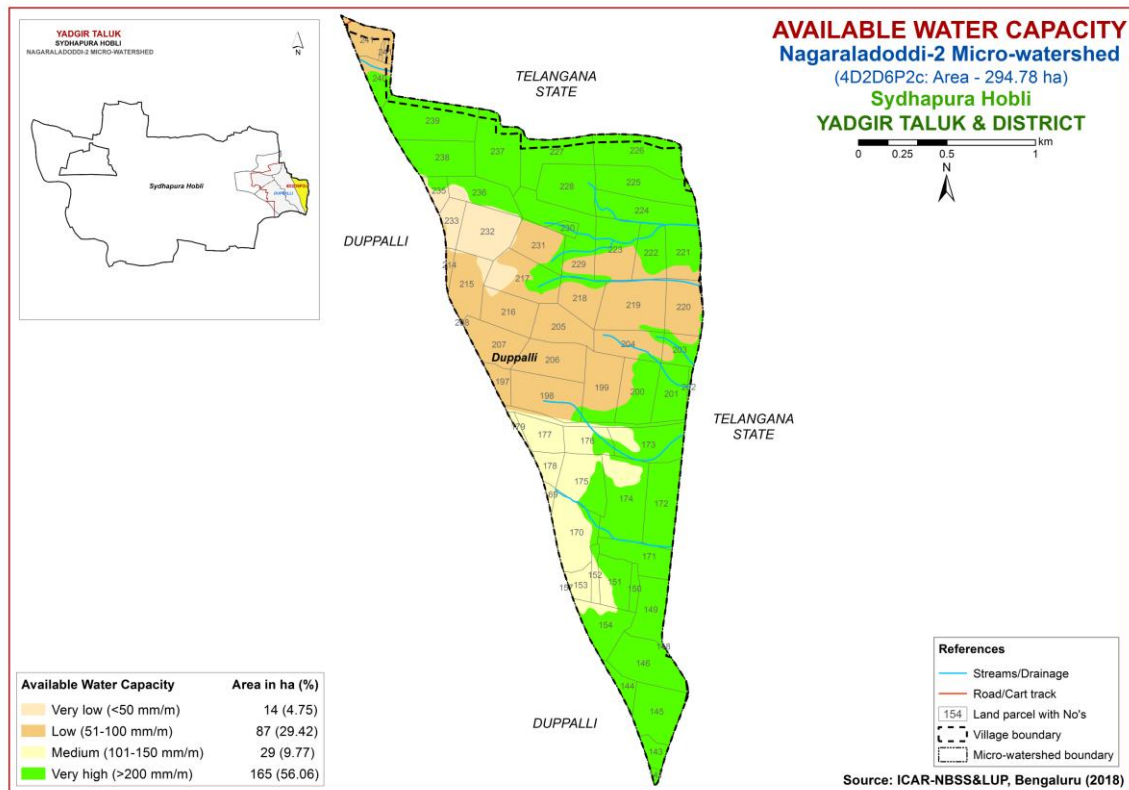
Fig. 5.5 Soil Available Water Capacity map of Nagaraladoddi-2 microwatershed

5.6 Soil Slope

Soil slope refers to the inclination of the surface of the land. It is defined by gradient, shape and length, and is an integral feature of any soil as a natural body. Slope is considered important in soil genesis, land use and land development. The length and gradient of slope influences the rate of runoff, infiltration, erosion and deposition. The soil map units were grouped into 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%) lands. It covers an area of about 295 ha (100%) and is distributed in all parts of the microwatershed.

In these gently sloping lands, all climatically adapted annual and perennial crops can be grown without much soil and water conservation and other land development measures.
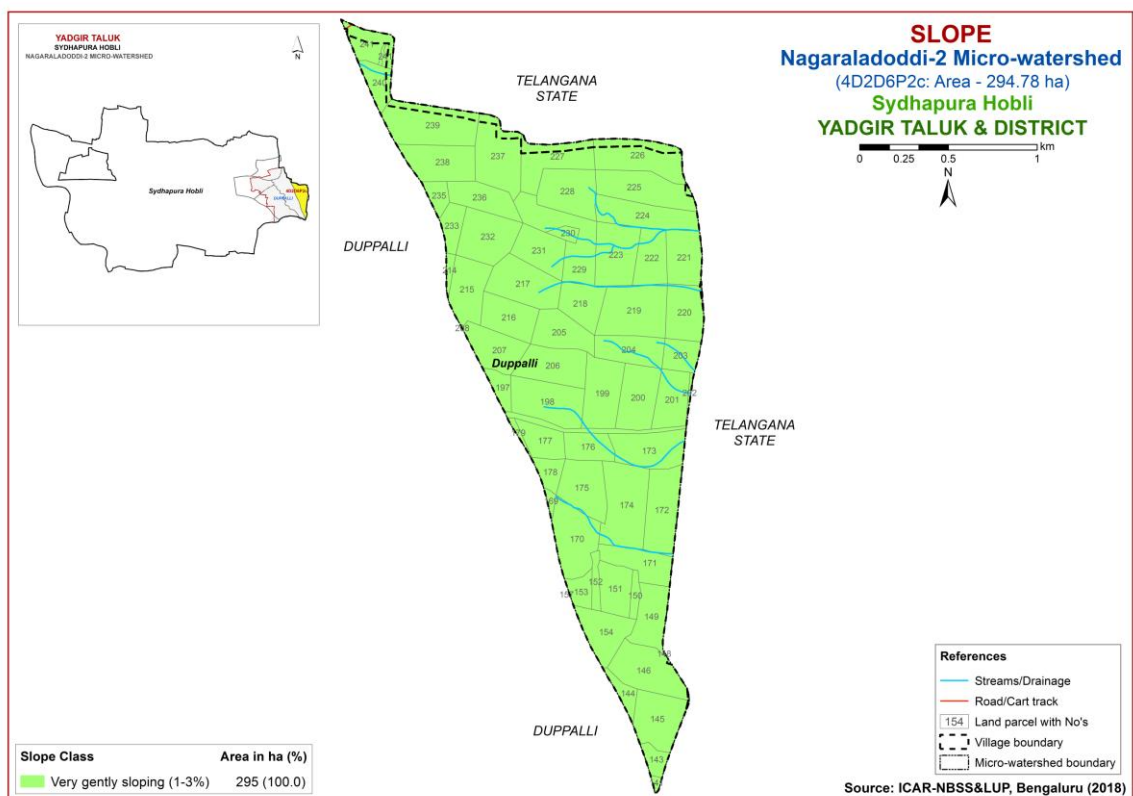
Fig. 5.6 Soil Slope map of Nagaraladoddi-2 microwatershed

5.7 Soil Erosion

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

Soils that are moderately eroded (e2 class) cover entire area of 295 ha (100%) and are distributed in all parts of the microwatershed. Entire area of the microwatershed needs soil and water conservation and other land development measures for restoring the soil health.
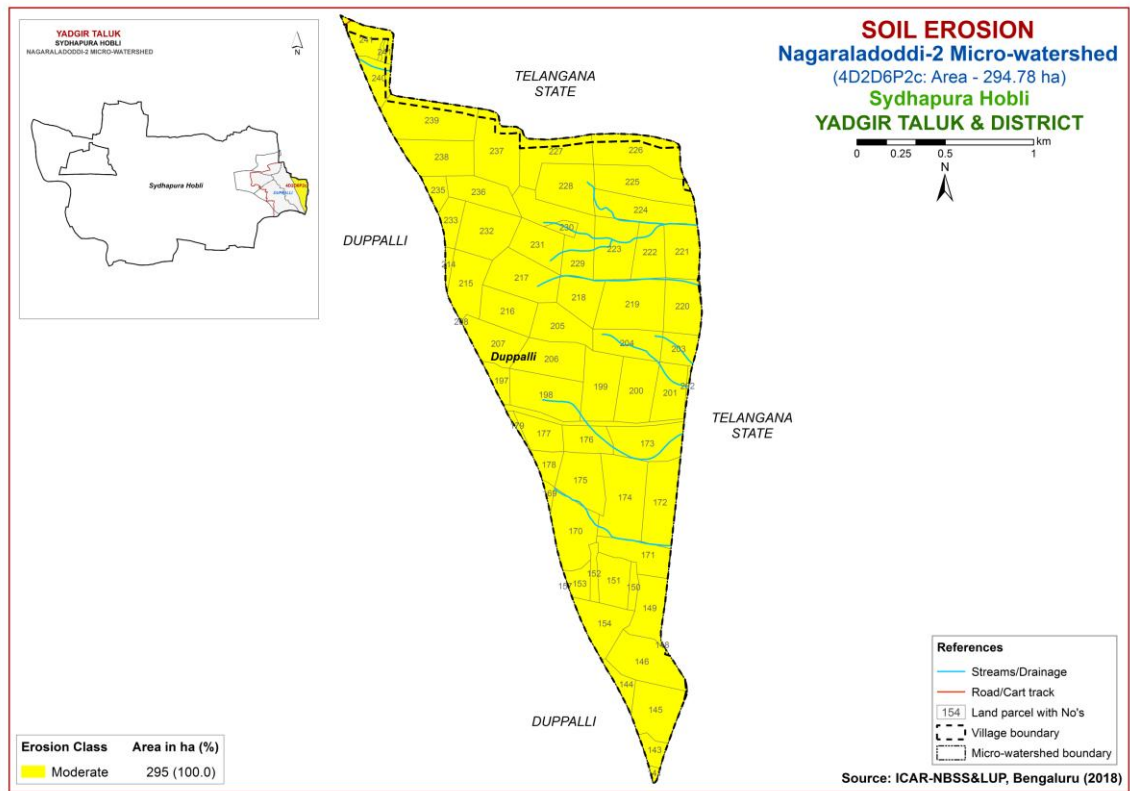
Fig. 5.7 Soil Erosion map of Nagaraladoddi-2 microwatershed

FERTILITY STATUS

Soil fertility plays an important role in increasing crop yield. The adoption of high yielding varieties that require high amounts of nutrients has resulted in deficiency symptoms in crops and plants due to imbalanced fertilization and poor inherent fertility status, as these areas are characterised by low rainfall and high temperatures. Hence, it is necessary to know the fertility (macro and micro nutrients) status of the soils of the watersheds for assessing the kind and amount of fertilizers required for each of the crop intended to be grown. For this purpose, the surface soil samples collected from the grid points (one soil sample at every 320 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 under GIS. 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 Nagaraladoddi-2 microwatershed for soil reaction (pH) showed that a small area of 2 ha (1%) is slightly alkaline (pH 7.3-7.8) and are distributed in the northern part of the microwatershed. Maximum area of 175 ha (59%) is moderately alkaline (pH 7.8-8.4) in reaction and are distributed in all parts of the microwatershed. An area of 118 ha (40%) is strongly alkaline (pH 8.4-9.0) and are distributed in the northern and eastern part of the microwatershed (Fig. 6.1). Thus, all the soils in the microwatershed are alkaline in reaction.

6.2 Electrical Conductivity (EC)

The Electrical Conductivity of the soils is <2 dS m^{-1} in the entire microwatershed and as such the soils are non-saline (Fig. 6.2).

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 45 ha (15%) and are distributed in the northern, eastern, western, central and southern part of the microwatershed. Medium (0.5-0.75%) in organic carbon content cover a maximum area of 138 ha (47%) and is distributed in all parts of the microwatershed. An area of 112 ha (38%) is low (<0.5%) and are distributed in the northwestern, central, eastern and southern part of the microwatershed.
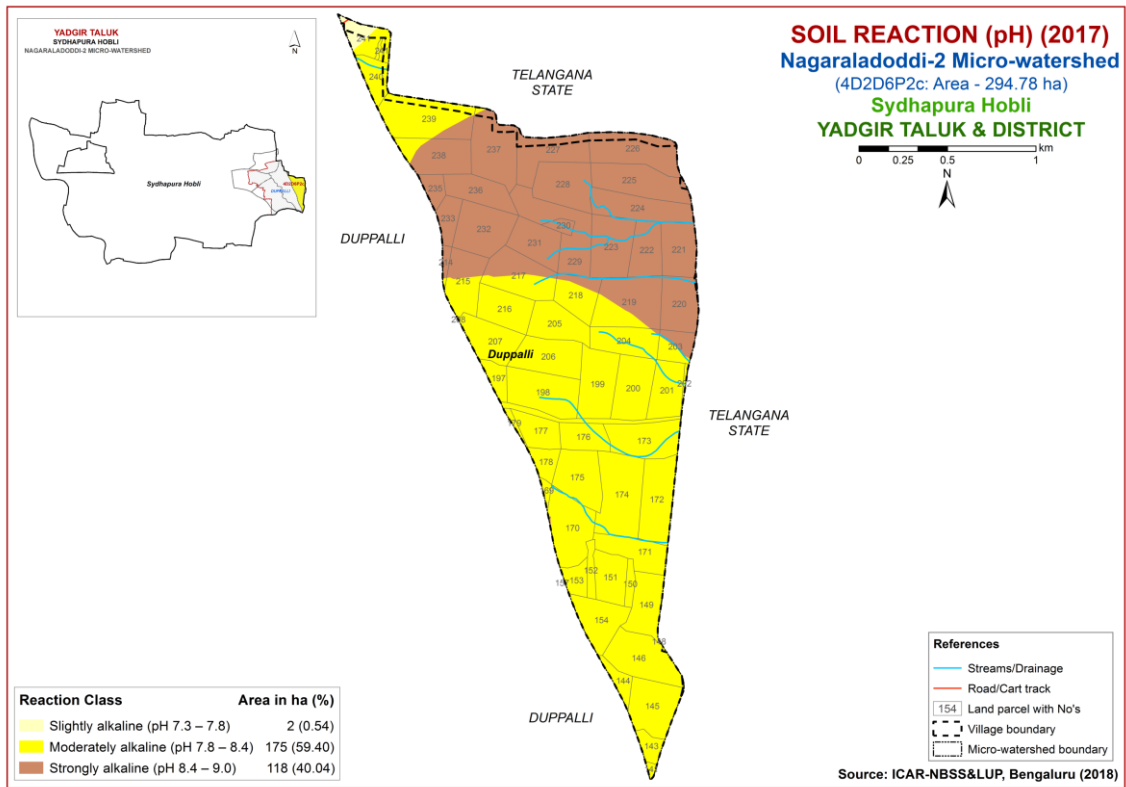
Fig.6.1 Soil Reaction (pH) map of Nagaraladoddi-2 microwatershed
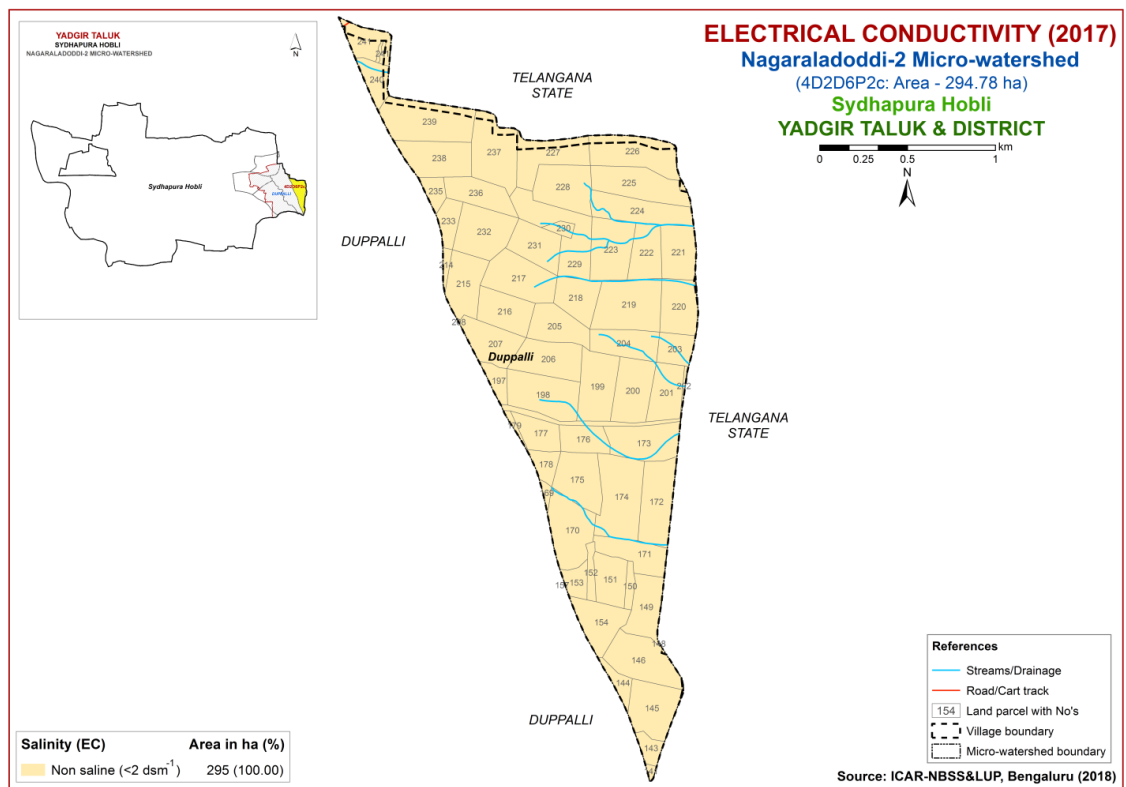
Fig.6.2 Electrical Conductivity (EC) map of Nagaraladoddi-2 microwatershed

6.4 Available Phosphorus

The soil fertility analysis revealed that available phosphorus (Fig. 6.4) is low (<23 kg/ha) in a maximum area of 205 ha (70%) and are distributed in all parts of the microwatershed. Medium (23-57 kg/ha) in an area of 66 ha (22%) and are distributed in the northern, central and southern part of the microwatershed. An area of 24 ha (8%) is high (>57 kg/ha) in available phosphorus and are distributed in the central and southern part of the microwatershed. There is an urgent need to increase the dose of phosphorous in soils that are low and medium for all the crops by 25 per cent over the recommended dose to realize better crop performance.

6.5 Available Potassium

Available potassium content (Fig. 6.5) is medium (145-337 kg/ha) in the entire area and are distributed in all parts of the microwatershed.

6.6 Available Sulphur

Soils that are high in available sulphur content (>20 ppm) cover an area of 48 ha (16%) and are distributed in the southern part of the microwatershed. Medium (10-20 ppm) in an area of about 50 ha (17%) and are distributed in the northeastern and southwestern part of the microwatershed. Available sulphur is low (<10 ppm) in a maximum area of 196 ha (67%) and are distributed in all parts of the microwatershed (Fig. 6.6). The areas that are low and medium in available sulphur need to be applied with magnesium sulphate or gypsum or factomphos (p) fertilizer (13% sulphur) for 2-3 years for the deficiency to be corrected.

6.7 Available Boron

Available boron content (Fig. 6.7) is low (<0.5 ppm) in a maximum area of 205 ha (70%) and are distributed in all parts of the microwatershed. An area of about 89 ha (30%) is medium (0.5-1.0 ppm) and are distributed in the northeastern and southern part of microwatershed.

6.8 Available Iron

Available iron content is sufficient (>4.5 ppm) in maximum area of 191 ha (65%) and are distributed in all parts of the microwatershed. It is deficient (<4.5 ppm) in an area of about 103 ha (35%) and are distributed in the northern, northeastern and southern 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).
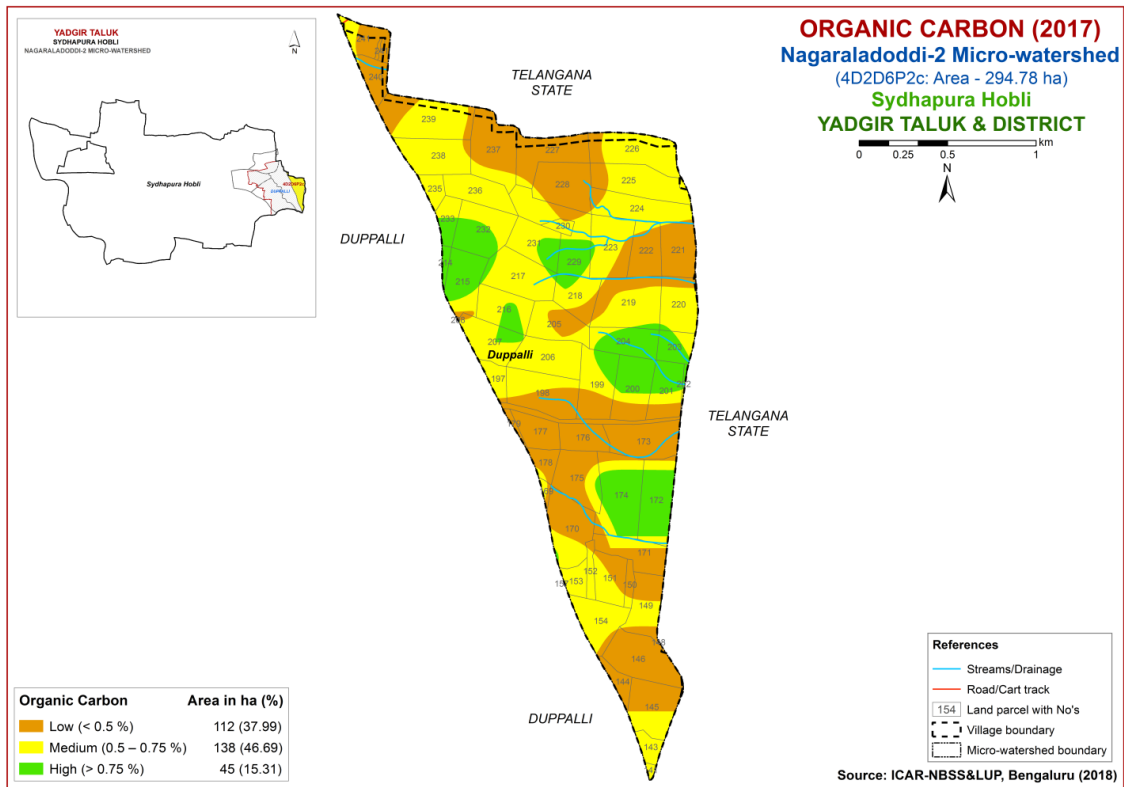
Fig.6.3 Soil Organic Carbon map of Nagaraladoddi-2 microwatershed

Organic Carbon	Area in ha (%)
Low (< 0.5 %)	112 (37.99)
Medium (0.5 – 0.75 %)	138 (46.69)
High (> 0.75 %)	45 (15.31)
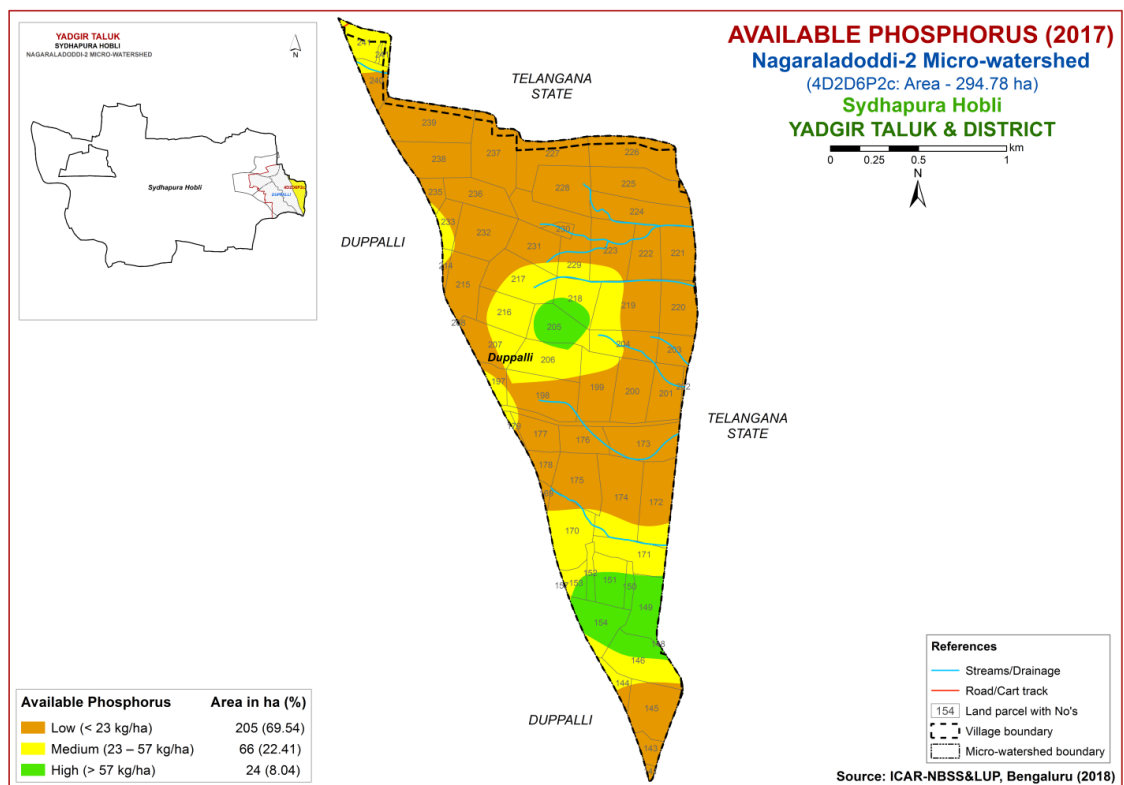
Fig.6.4 Soil available Phosphorus map of Nagaraladoddi-2 microwatershed

Available Phosphorus	Area in ha (%)
Low (< 23 kg/ha)	205 (69.54)
Medium (23 – 57 kg/ha)	66 (22.41)
High (> 57 kg/ha)	24 (8.04)
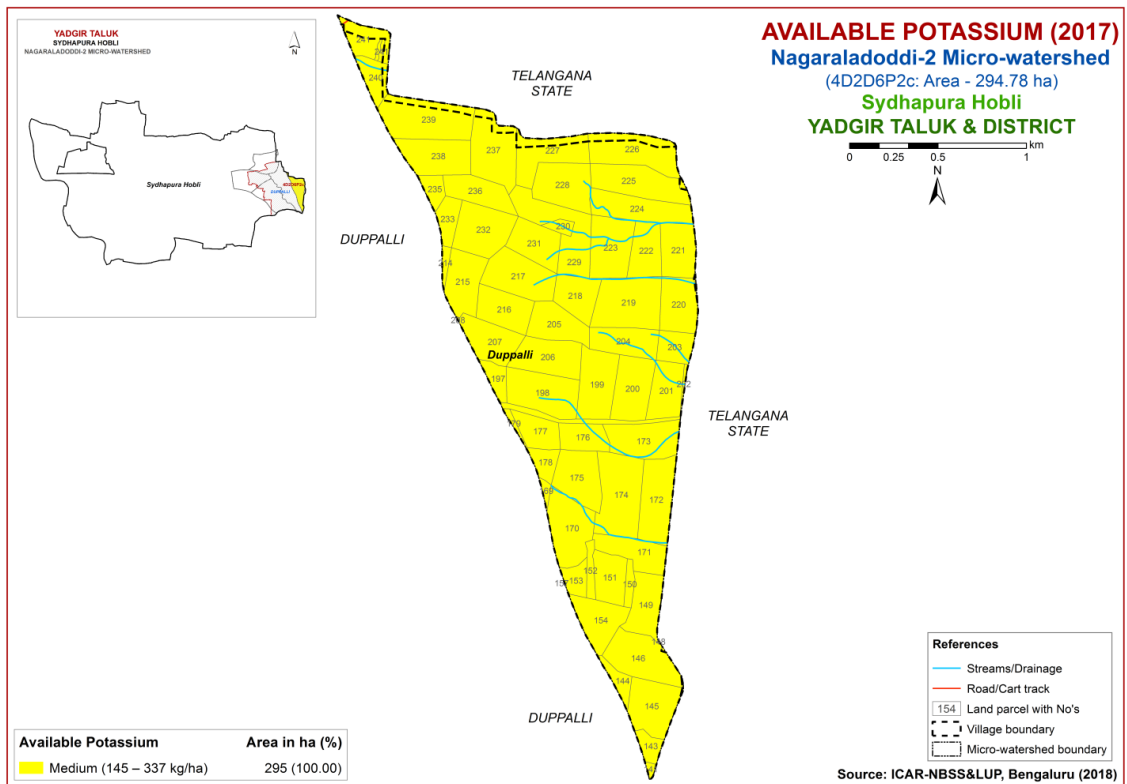
Fig. 6.5 Soil available Potassium map of Nagaraladoddi-2 microwatershed
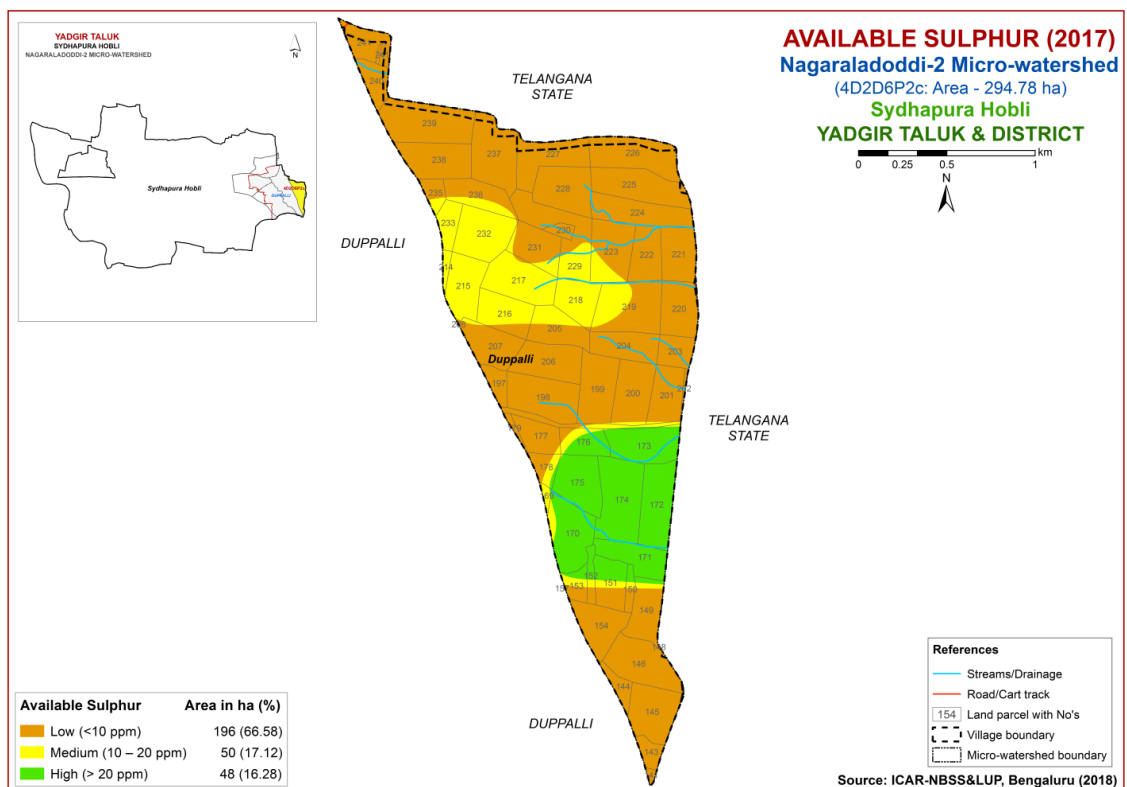
Fig. 6.6 Soil available Sulphur map of Nagaraladoddi-2 microwatershed
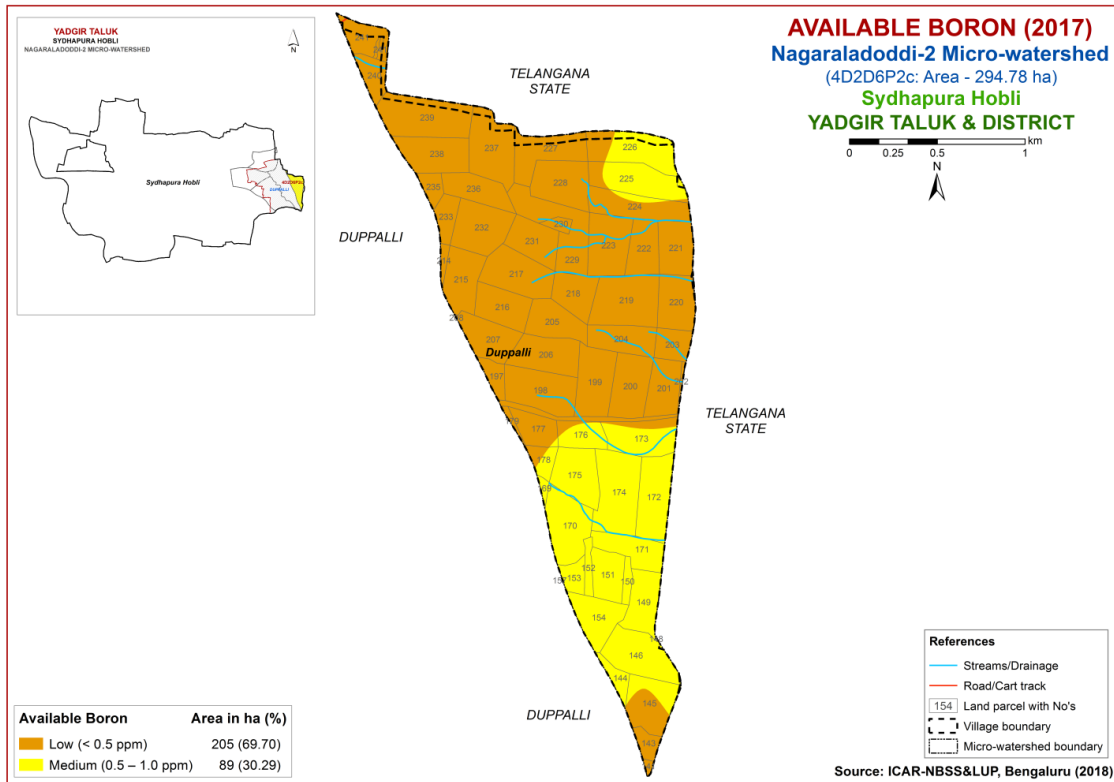
Fig. 6.7 Soil available Boron map of Nagaraladoddi-2 microwatershed

6.10 Available Copper

Available copper content is sufficient (>0.2 ppm) in a maximum area of 292 ha (99%) and are distributed in all parts of the microwatershed. It is deficient (<0.2 ppm) in an area of 2 ha (1%) and are distributed in the eastern part of the microwatershed (Fig 6.10).

6.11 Available Zinc

Available zinc content is deficient (<0.6 ppm) in the entire area of the microwatershed (Fig 6.11).
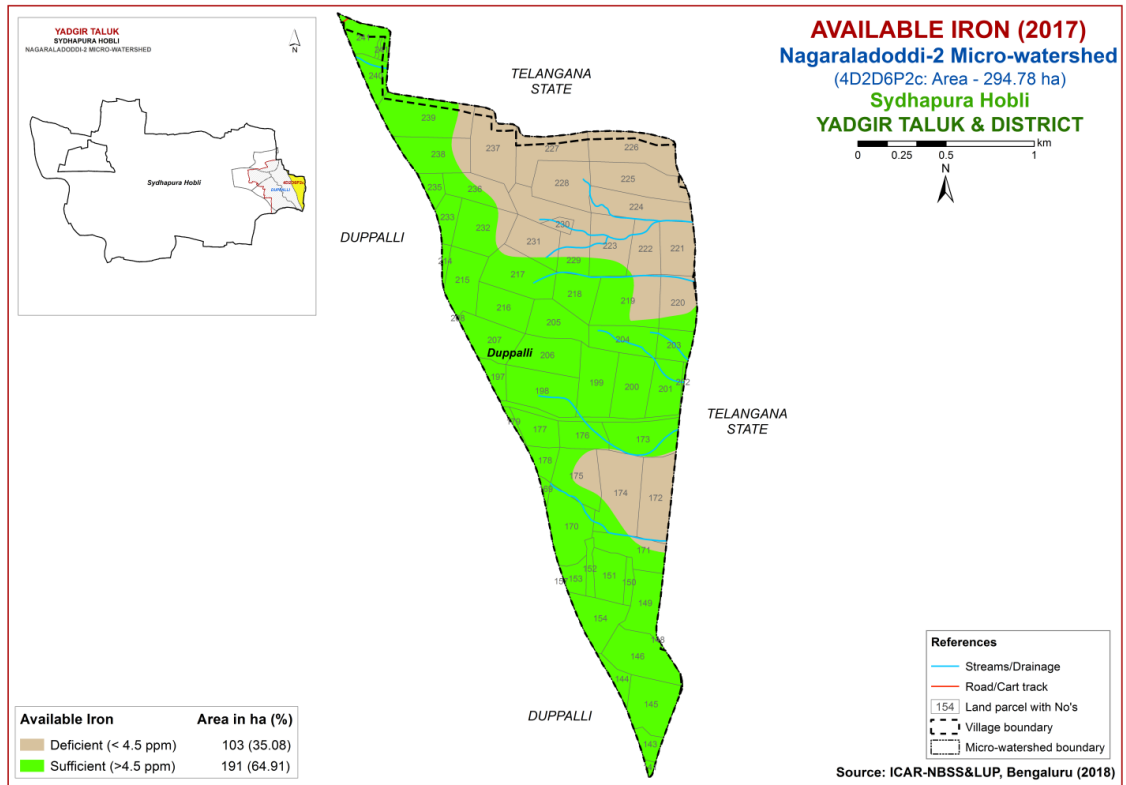
Fig. 6.8 Soil available Iron map of Nagaraladoddi-2 microwatershed
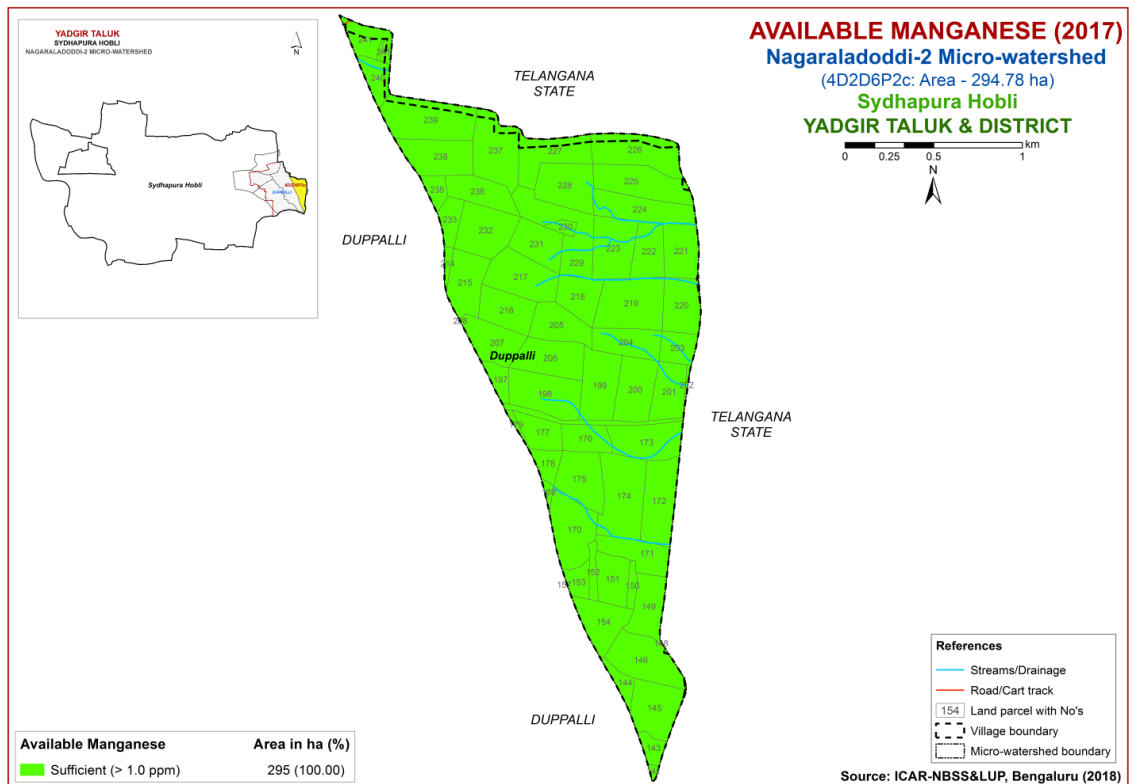
Fig. 6.9 Soil available Manganese map of Nagaraladoddi-2 microwatershed
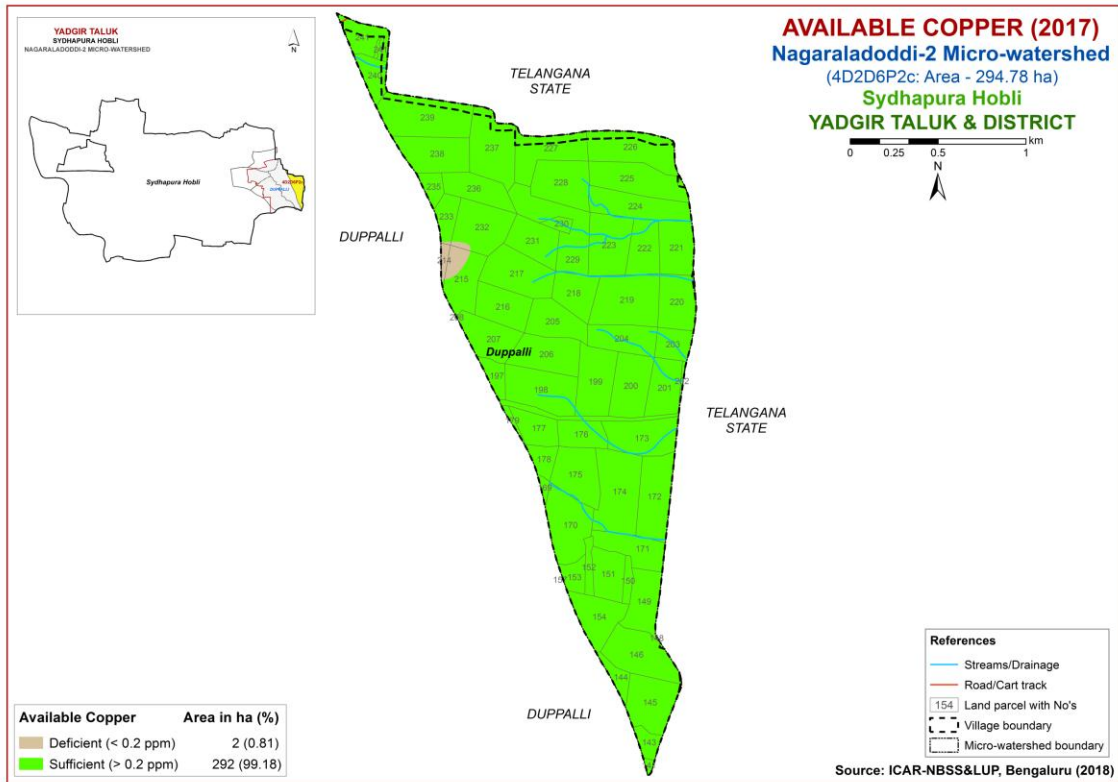
Fig. 6.10 Soil available Copper map of Nagaraladoddi-2 microwatershed
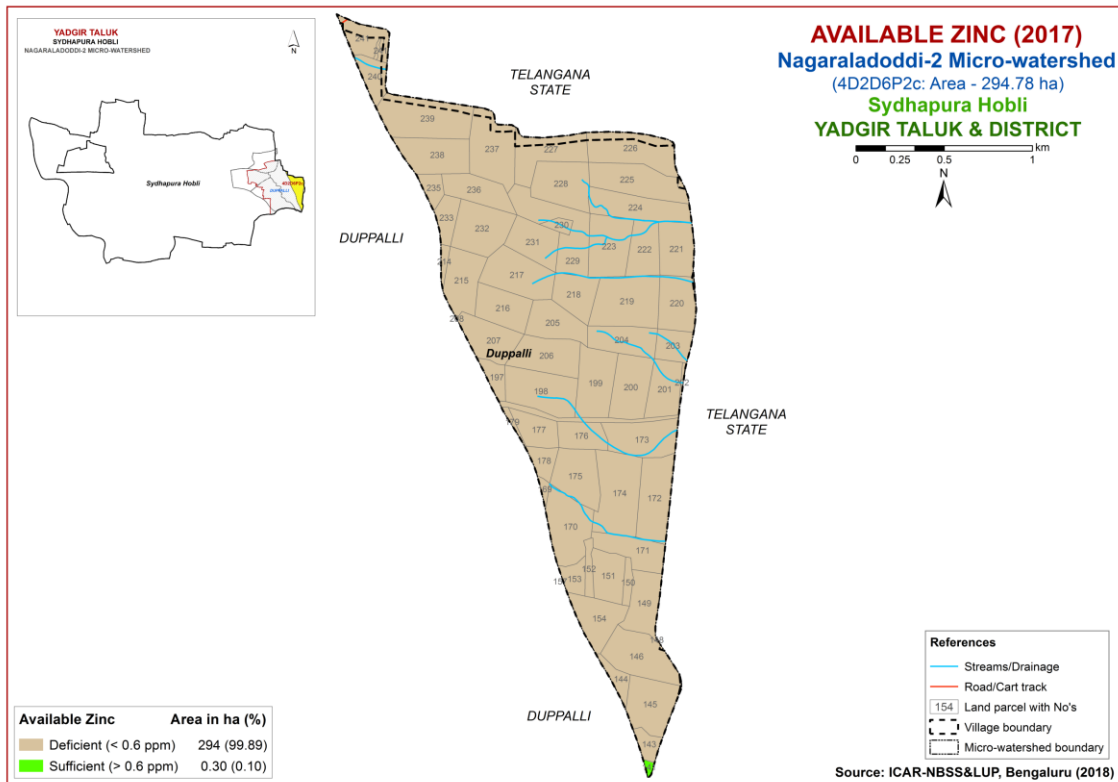
Fig. 6.11 Soil available Zinc map of Nagaraladoddi-2 microwatershed

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LAND SUITABILITY FOR MAJOR CROPS

The soil and land resource units (soil phases) of Nagaraladoddi-2 microwatershed were assessed for their suitability for growing food, fodder, fibre and other horticulture crops by following the procedure as outlined in FAO, 1976 and 1983. Crop requirements were developed for each of the crop from the available research data, and also by referring to Naidu *et al.* (2006) and Natarajan *et al* (2015). The 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, S3 and N1 are divided into subclasses based on the kinds of limitations encountered. The limitations that affect crop production are 'c' for erratic rainfall and its distribution and length of growing period (LGP), 'e' for erosion hazard, 'r' for rooting condition, 't' for lighter or heavy texture, 'g' for gravelliness or stoniness, 'n' for nutrient availability, 'l' for topography, 'm' for moisture availability, 'z' for calcareousness 's' for sodium 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 agricultural and horticultural 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 crop grown 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 a land suitability map for growing sorghum was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.1.

Highly suitable (Class S1) lands for growing sorghum occur in a maximum area of 194 ha (66%) and distributed in all parts of the microwatershed. An area of about 87 ha (29%) is moderately suitable (Class S2) and are distributed in the northern, western, central and eastern part of the microwatershed with minor limitation of rooting depth.

Marginally suitable (Class S3) lands occur in an area of about 14 ha (5%) and are distributed in the northwestern part of the microwatershed with major limitation of rooting depth.

Table 7.1 Soil-Site Characteristics of Nagaraladoddi-2 microwatershed

Soil Map Units	Climate (P) (mm)	Growing period (Days)	Drain-age Class	Soil depth (cm)	Soil texture Sur-face	Soil texture Sub-surface	Gravelliness Surface (%)	Gravelliness Sub-surface (%)	AWC (mm/m)	Slope (%)	Erosion	pH	EC (dSm^{-1})	ESP (%)	CEC [Cmol (p$^+$)kg^{-1}]	BS (%)
BDLbB2	866	150	WD	25-50	ls	sl	-	-	<50	1-3	moderate	6.20	0.07	0.20	4.20	93
YLRiB2	866	150	WD	50-75	sc	c	-	15-35	51-100	1-3	moderate	6.91	0.07	0.45	6.90	100
GWDmB2	866	150	MWD	75-100	c	scl	-	-	101-150	1-3	moderate	9.89	0.74	43.51	8.35	100
ANRhB2	866	150	MWD	100-150	scl	c	-	-	>200	1-3	moderate	10.17	0.36	17.70	19.90	100
VKSiB2	866	150	MWD	100-150	sc	scl	-	-	>200	1-3	moderate	9.10	0.58	9.92	17.57	100

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

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	5.5-5.9,8.1-8.5	<5.5,8.6-9.0	>9.0
Surface soil texture	Class	c, cl, sicl, sc	l, sil, sic	sl, ls	s,fragmental skeletal
Soil depth	cm	100-75	50-75	30-50	<30
Gravel content	% vol.	5-15	15-30	30-60	>60
Salinity (EC)	dS m^{-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 one of the most important food crop grown in an area of 13.37 lakh ha in all the districts of the State. The crop requirements for growing maize (Table 7.3) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing maize was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.2.

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	
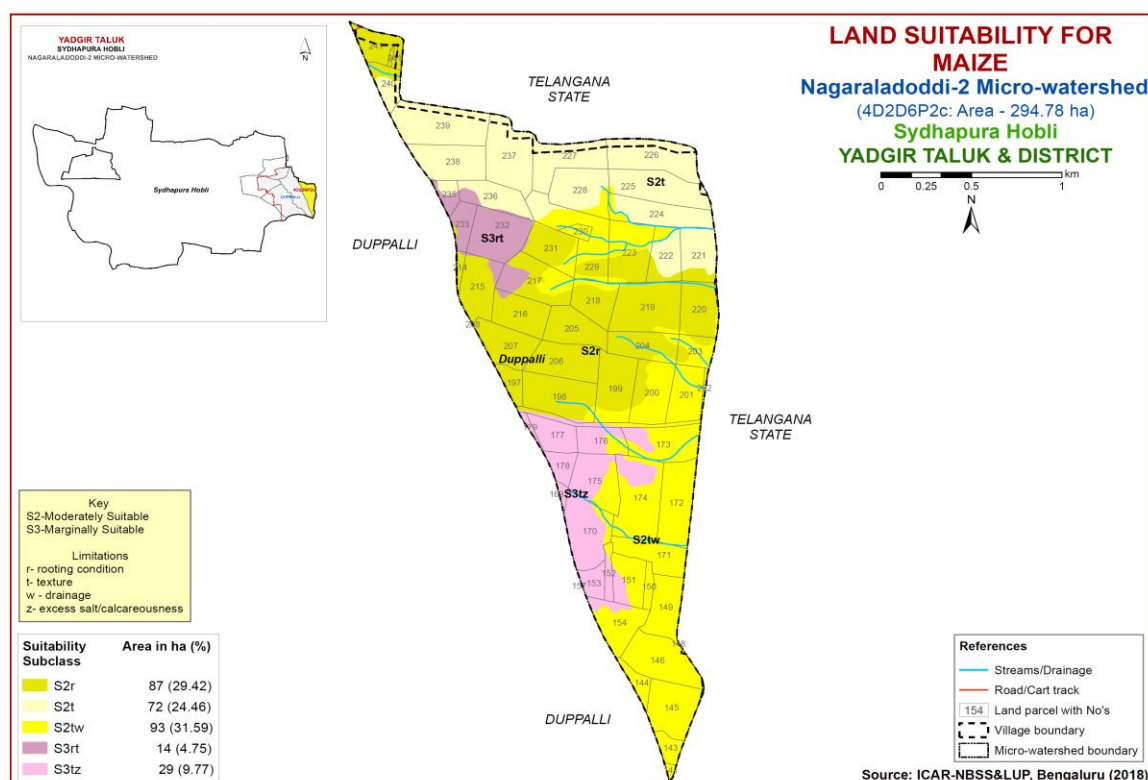
Fig. 7.2 Land Suitability map of Maize

There are no highly (Class S1) suitable lands for growing maize in the microwatershed. Moderately suitable (Class S2) lands for growing maize occur in a maximum area of about 252 ha (85%) and are distributed in all parts of the

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microwatershed with minor limitation of rooting depth, texture and drainage. An area of about 43 ha (15%) is marginally suitable (Class S3) for growing maize and are distributed in the western and southern part of the microwatershed with major limitations of calcareousness, texture and rooting depth.

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.

There are no lands that are highly (Class S1) suitable for growing red gram. Maximum area of about 194 ha (66%) is moderately suitable (Class S2) and are distributed in all parts of the microwatershed. They have minor limitations of texture, rooting depth, drainage and calcareousness. An area of about 101 ha (34%) is marginally suitable (Class S3) for growing red gram and are distributed in the western, central and eastern part of the microwatershed. They have major limitations of rooting depth and texture.

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	
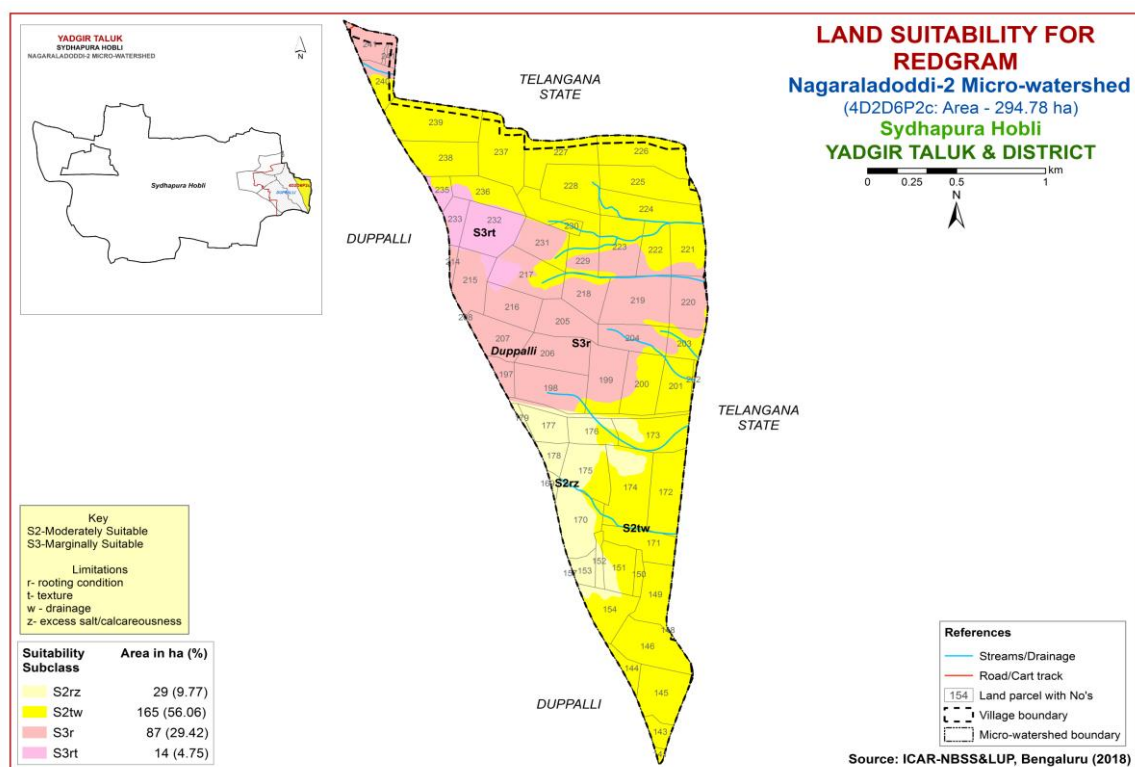
Fig. 7.3 Land Suitability map of Red gram

7.4 Land Suitability for Bajra (*Pennisetum glaucum)*

Bajra is one of 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 (Table 7.5) were matched with the soil-site characteristics (Table 7.1) 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.

Table 7.5 Crop suitability criteria for Bajra

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	5.5-5.9,8.1-8.5	<5.5,8.6-9.0	>9.0
Surface soil texture	Class	c, cl, sicl, sc	l, sil, sic	sl, ls	s,fragmental skeletal
Soil depth	cm	100-75	50-75	30-50	<30
Gravel content	% vol.	5-15	15-30	30-60	>60
Salinity (EC)	dSm^{-1}	2-4	4-8	8-10	>10
Sodicity (ESP)	%	5-8	8-10	10-15	>15

Fig. 7.4 Land Suitability map of Bajra

Highly suitable (Class S1) lands for growing bajra occur in an area of about 29 ha (10%) and are distributed in the southern part of the microwatershed. Maximum area of about 252 ha (85%) is moderately suitable (Class S2) and are distributed in all parts of the microwatershed with minor limitations of rooting depth, texture, calcareousness and drainage. Marginally suitable (Class S3) lands cover an area of about 14 ha (5%) and are distributed in the eastern part of the microwatershed with major limitations of rooting depth and texture.

7.5 Land suitability for Groundnut (*Arachis hypogaea*)

Groundnut is one of the major 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 7.6) 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.

There are no highly (Class S1) suitable lands for growing groundnut in the microwatershed. An area of 87 ha (29%) is moderately (Class S2) suitable for growing groundnut and are distributed in the northern, western, central and western part of the microwatershed with minor limitation of rooting depth. Marginally suitable (Class S3) lands cover a maximum area of about 208 ha (71%) and are distributed in all parts of the microwatershed. They have major limitations of texture, rooting depth, calcareousness and drainage.

Table 7.6 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 drained	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	
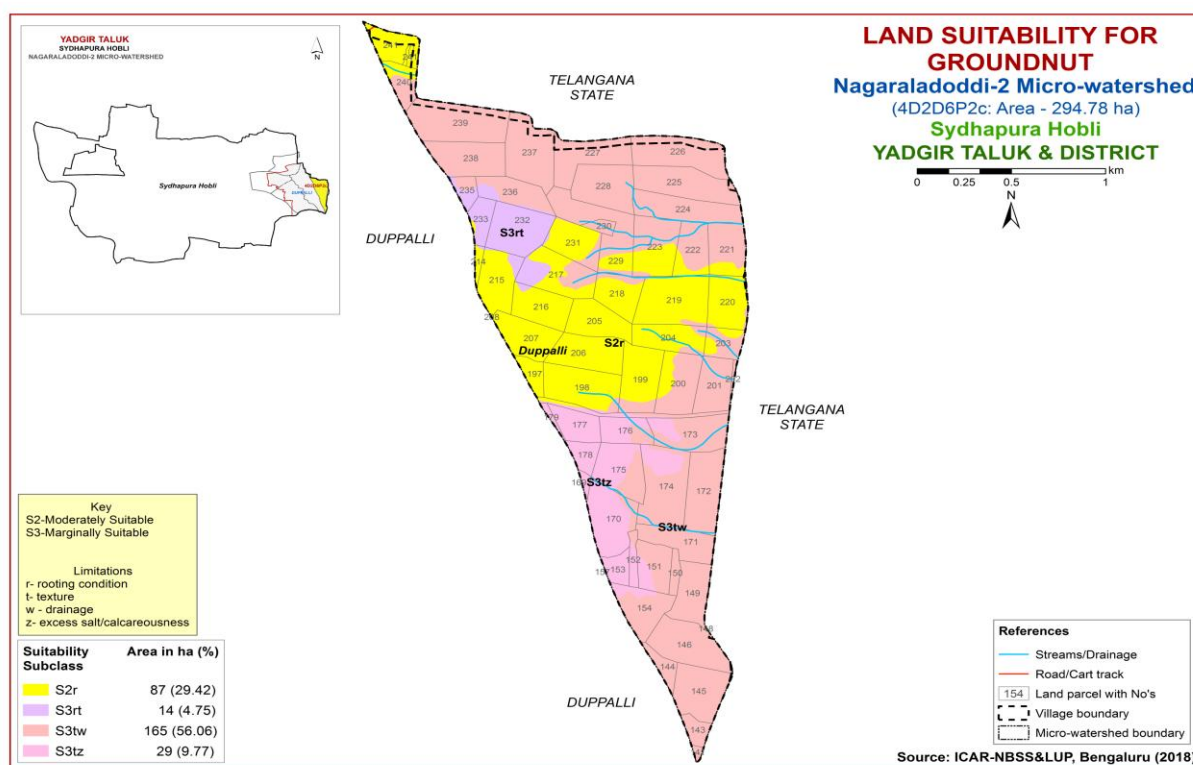
Fig. 7.5 Land Suitability map of Groundnut

7.6 Land Suitability for Sunflower (*Helianthus annus*)

Sunflower is one of the most important oilseed crop grown in an area of 3.56 lakh ha in the State in all the districts. The crop requirements for growing sunflower (Table 7.7) 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.

Table 7.7 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	8.1-8.5,5.5-6.4	8.6-9.0;4.5-5.4	>9.0,<4.5
Surface soil texture	Class	l, cl, sil, sc	scl, sic, c,	c (>60%), sl	ls, s
Soil depth	cm	>100	75-100	50-75	<50
Gravel content	%vol.	<15	15-35	35-60	>60
Salinity (EC)	dSm^{-1}	<1.0	1.0-2.0	>2.0	
Sodicity (ESP)	%	<10	10-15	>15	
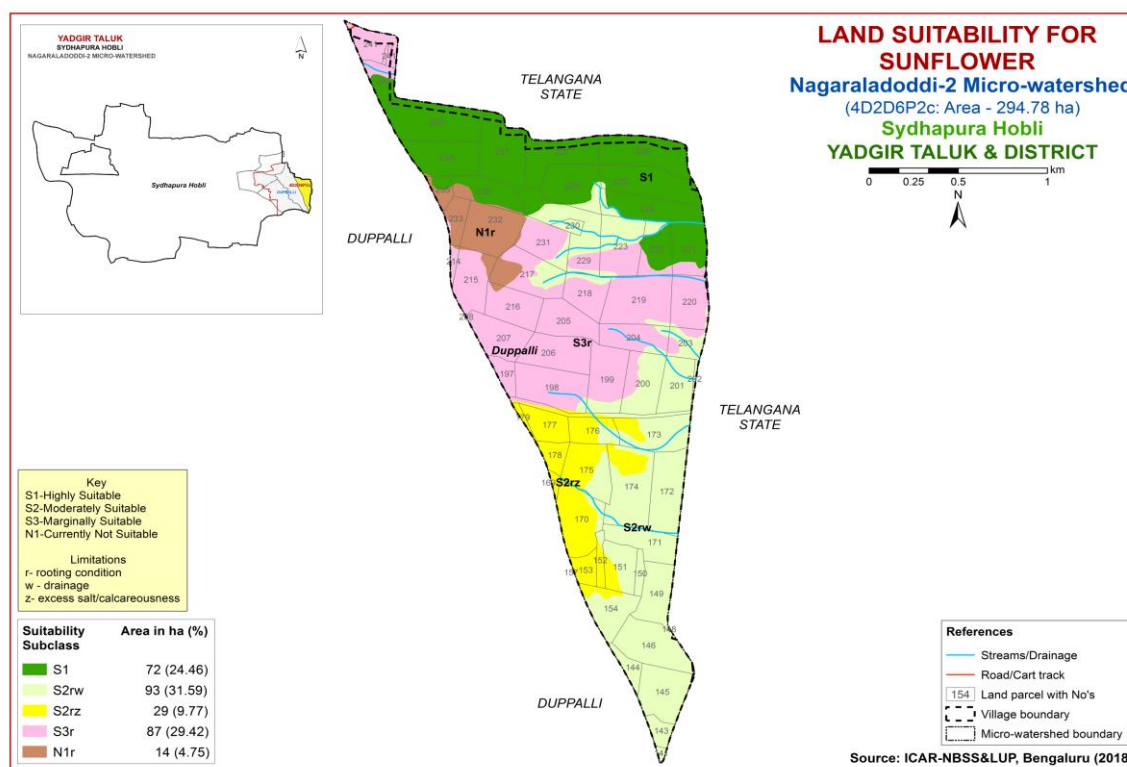
Fig. 7.6 Land Suitability map of Sunflower

An area of about 72 ha (24%) is highly (Class S1) suitable for growing sunflower and are distributed in the northern part of the microwatershed. Maximum area of about 122 ha (42%) is moderately suitable (Class S2) for sunflower and are distributed in all parts of the microwatershed. They have minor limitations of rooting depth, calcareousness and drainage. An area of about 87 ha (29%) is marginally suitable (Class S3) and are distributed in the northern, western, central and eastern part of the microwatershed. They have major limitation of rooting depth. An area of 14 ha (5%) is currently not suitable (Class N1) for growing sunflower and are distributed in the western part of the microwatershed with severe limitation of rooting depth.

7.7 Land Suitability for Cotton (*Gossypium hirsutum*)

Cotton is one of the most important fibre crop grown in the state in about 8.75 lakh ha area in Raichur, Dharwad, Belgaum, Kalaburgi, Bijapur, Bidar, Bellary, Chitradurga and Chamarajnagar districts. The crop requirements for growing cotton (Table 7.8) 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.

Maximum area of about 165 ha (56%) is highly (Class S1) suitable for growing cotton and are distributed in all parts of the microwatershed. An area of about 116 ha (39%) is moderately suitable (Class S2) for growing cotton and are distributed in the western, central and eastern part of the microwatershed with minor limitations of calcareousness and rooting depth. Marginally suitable (Class S3) lands occupy an area of 14 ha (5%) and are distributed in the western part of the microwatershed with major limitation of rooting depth.

Table 7.8 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
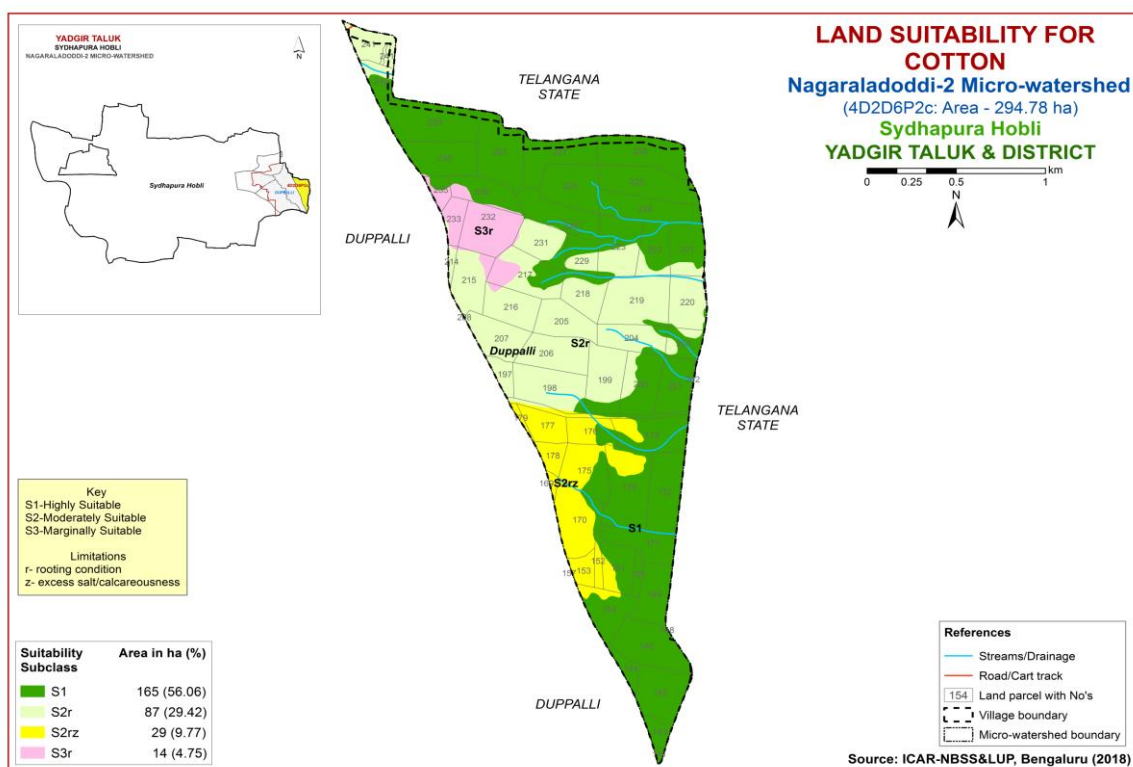
Fig. 7.7 Land Suitability map of Cotton

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

Bengal gram is one of 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 7.9) 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.

Table 7.9 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; imp. 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	
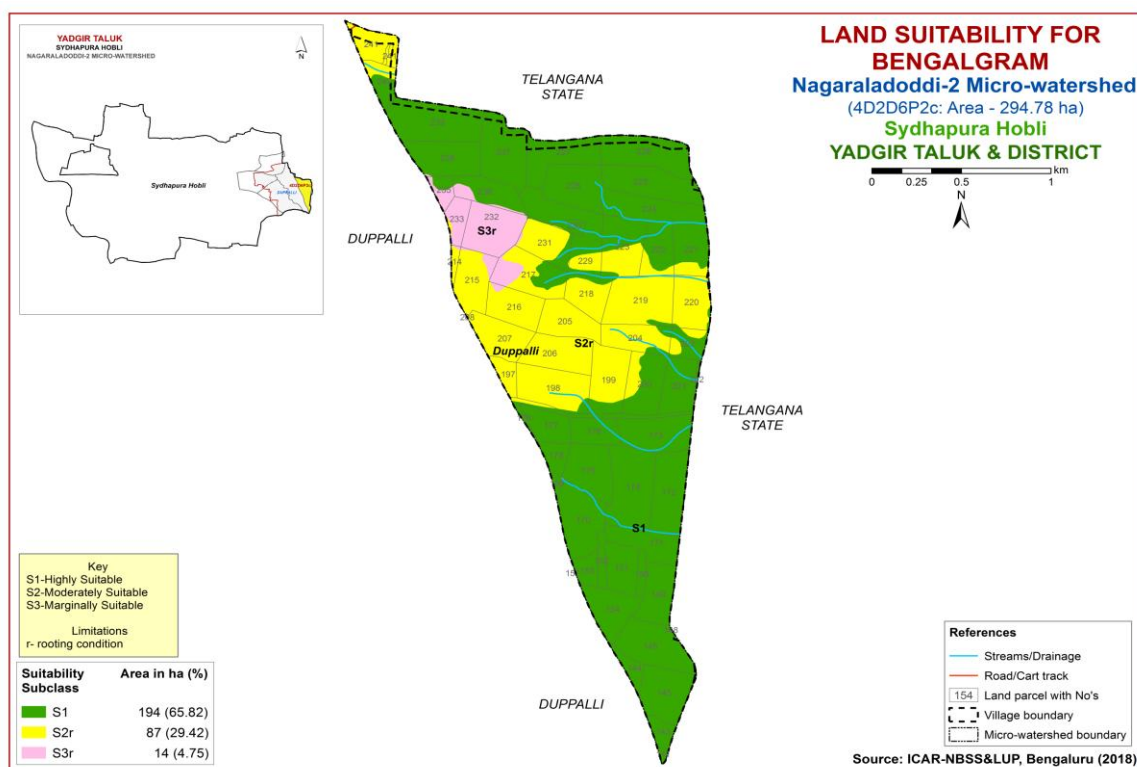
Fig. 7.8 Land Suitability map of Bengal gram

Maximum area of about 194 ha (66%) is highly (Class S1) suitable for growing Bengal gram and are distributed in all parts of the microwatershed. An area of about 87 ha (29%) is moderately suitable (Class S2) for growing Bengal gram and are distributed in the northern, western, central and eastern part of the microwatershed with minor limitation of rooting depth. Marginally suitable (Class S3) lands occupy an area of 14 ha (5%) and are distributed in the western part of the microwatershed with major limitation of rooting depth.

7.9 Land Suitability for Chilli (*Capsicum annuum)*

Chilli is one of the most important fruit and spice crop grown in about 0.42 lakh ha in Karnataka State. The crop requirements for growing chilli (Table 7.10) 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.

No highly (Class S1) suitable lands available for growing chilli in the microwatershed. Maximum area of about 281 ha (95%) is moderately suitable (Class S2) and are distributed in all parts of the microwatershed. They have minor limitations of texture, drainage, calcareousness and rooting depth. Marginally suitable lands (Class S3) occupy an area of about 14 ha (5%) and are distributed in the western part of the microwatershed. They have major limitations of rooting depth and texture.

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Table 7.10 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 temp. 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	V. 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	
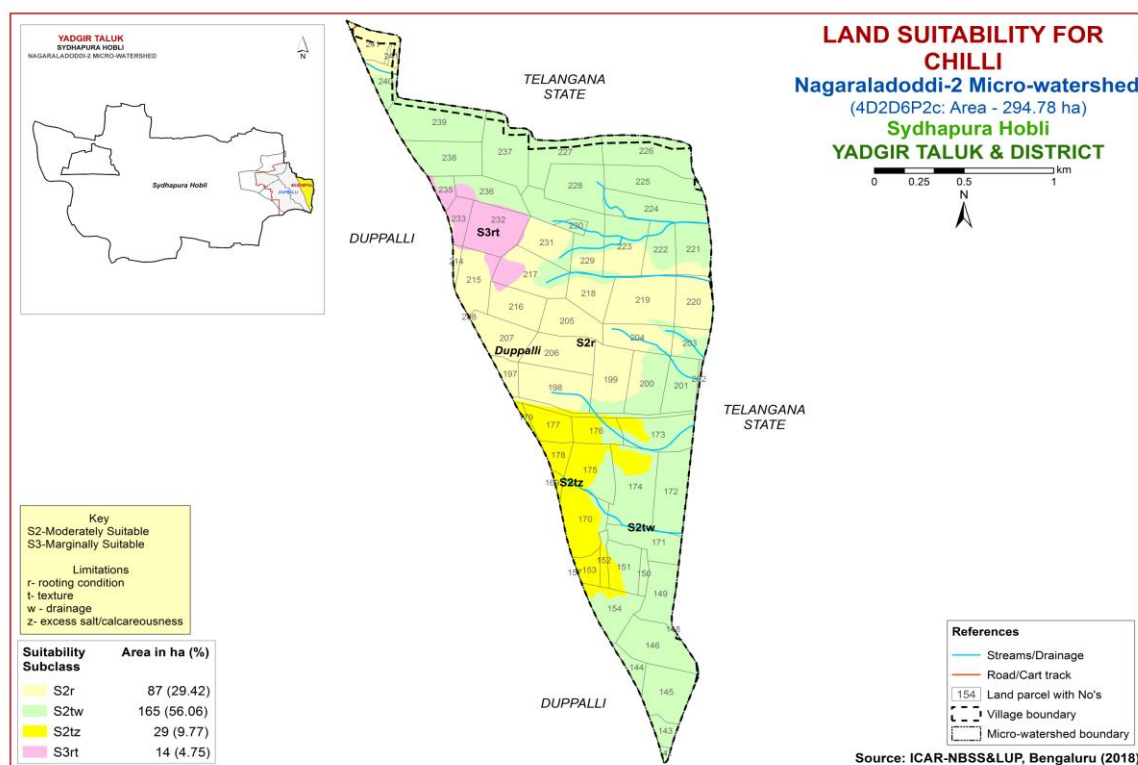
Fig 7.9 Land Suitability map of Chilli

7.10 Land Suitability for Tomato (*Lycopersicon esculentum*)

Tomato is one of 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 7.11) 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.

Table 7.11 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 content	%vol.	<15	15-35	>35	
Soil toxicity	Salinity	ds/m	Non saline	slight	strongly	
	Sodicity (ESP)	%	<10	10-15	>15	-
Erosion	Slope	%	1-3	3-5	5-10	>10
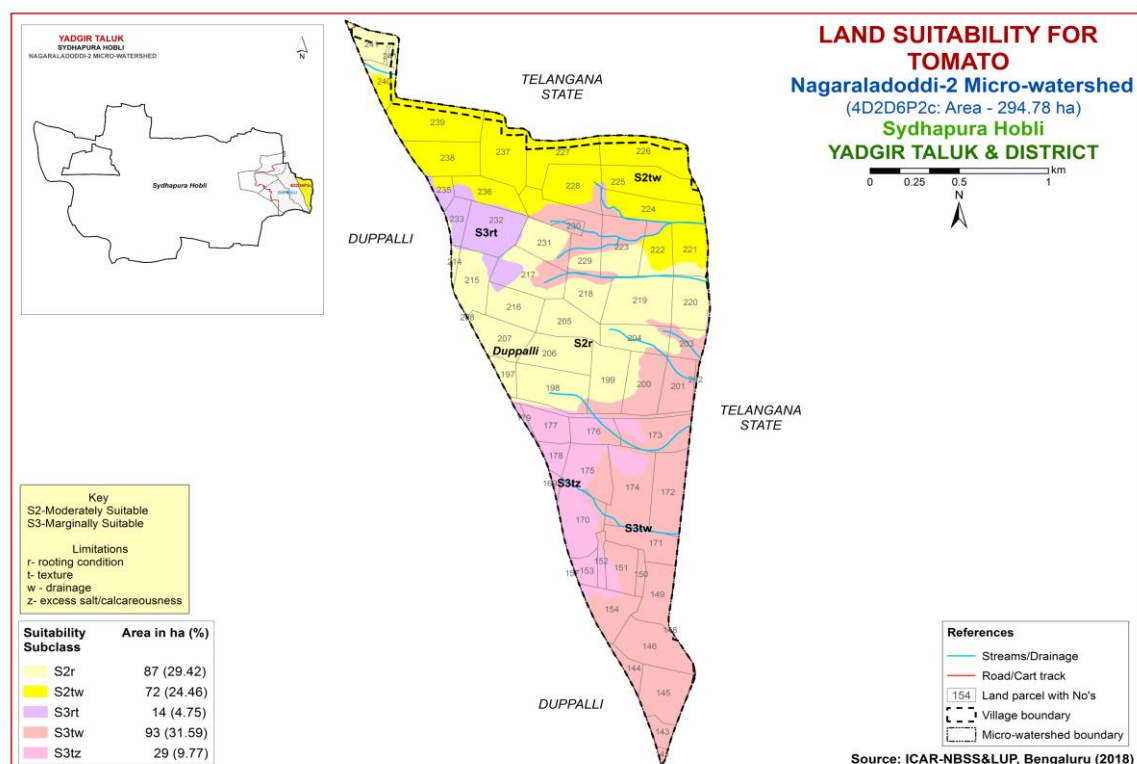
Fig 7.10 Land Suitability map of Tomato

There are no highly (Class S1) suitable lands for growing tomato. Maximum area of about 159 ha (53%) is moderately suitable (Class S2) for growing tomato and are

distributed in all parts of the microwatershed with minor limitations of rooting depth, texture and drainage. The marginally suitable (Class S3) lands cover an area of about 136 ha (47%) and are distributed in the western, central and southern part of the microwatershed. They have major limitations of texture, rooting depth, calcareousness and drainage.

7.11 Land Suitability for Drumstick (*Moringa oleifera*)

Drumstick is one of the most important vegetable crop grown in about 2403 ha in the state. The crop requirements for growing drumstick (Table 7.12) 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.

Table 7.12 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
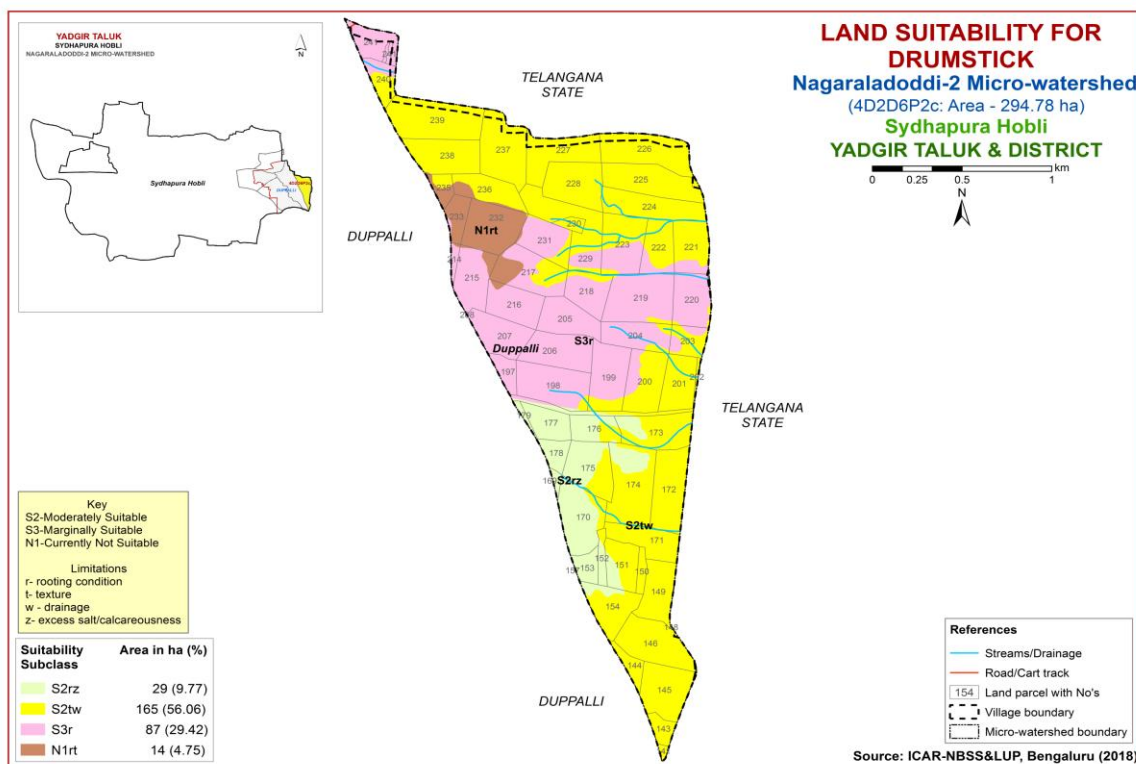
Fig 7.11 Land Suitability map of Drumstick

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There are no highly (Class S1) suitable lands for growing drumstick in the microwatershed. Maximum area of about 194 ha (66%) is moderately suitable (Class S2) and are distributed in all parts of the microwatershed. They have minor limitations of texture, rooting depth, calcareousness and drainage. An area of about 87 ha (29%) is marginally suitable (Class S3) and are distributed in the northern, western, central and eastern part of the microwatershed with major limitations of rooting depth, calcareousness, texture and drainage. Currently not suitable (Class N1) lands occupy an area of about 14 ha (5%) for drumstick and are distributed in the western part of the microwatershed with severe limitations of rooting depth and texture.

7.12 Land Suitability for Mulberry (*Morus nigra*)

Mulberry is the important leaf crop grown for rearing silk worms in about 1,66,000 ha area in all the districts of the state. The crop requirements for growing mulberry (Table 7.13) 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.

There are no highly (Class S1) and moderately suitable (Class S2) lands available for growing mulberry in the microwatershed. Maximum area of about 281 ha (95%) is marginally suitable (Class S3) and are distributed in all parts of the microwatershed. They have moderate limitations of rooting condition, texture and drainage. Currently not suitable (Class N1) lands occupy an area of about 14 ha (5%) for mulberry and are distributed in the western part of the microwatershed with severe limitations of rooting depth and texture.

Table 7.13 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
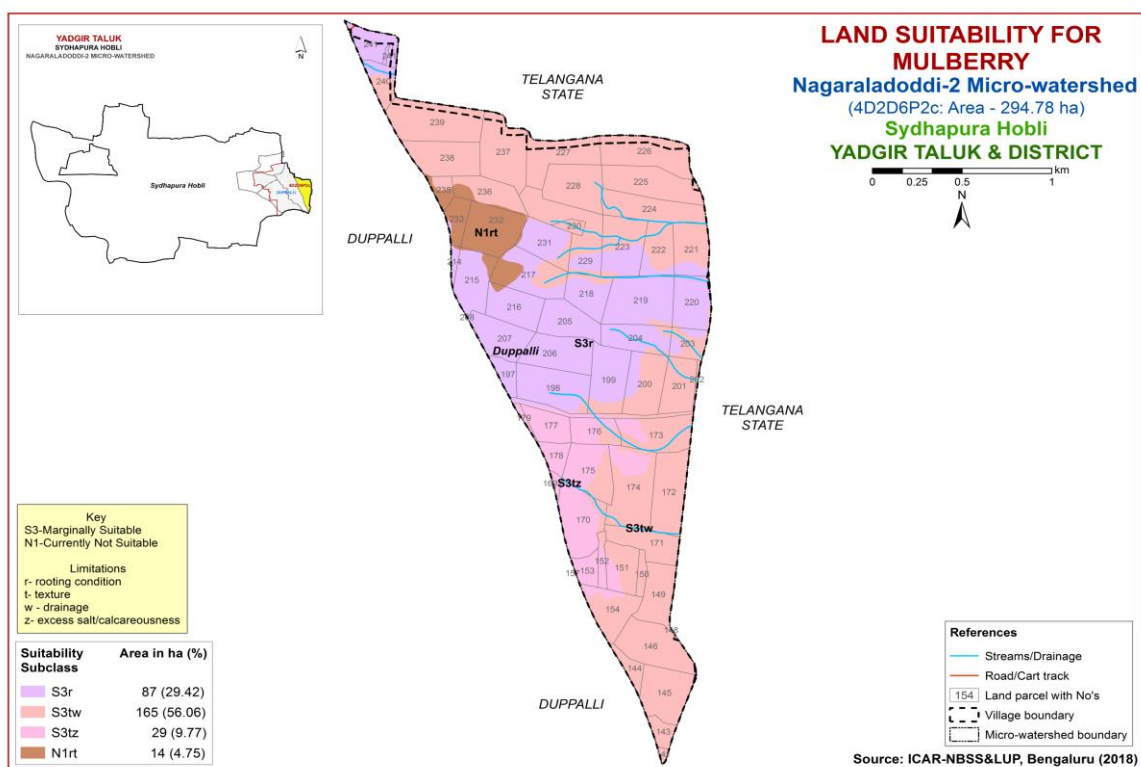
Fig 7.12 Land Suitability map of Mulberry

7.13 Land Suitability for Mango (*Mangifera indica*)

Mango is one of the most important fruit crop grown in about 173080 ha in all the districts of the State. The crop requirements for growing mango (Table 7.14) 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.

There are no highly (Class S1) and moderately suitable (Class S2) lands available for growing mango in the microwatershed. Maximum area of about 194 ha (66%) is marginally suitable (Class S3) and are distributed in all parts of the microwatershed. They have moderate limitations of texture, drainage, calcareousness and rooting condition. Currently not suitable lands (Class N1) occupy an area of 101 ha (34%) and are distributed in the northern, eastern, central and western part of the microwatershed. They have severe limitation of rooting depth.

Table 7.14 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	Temperature in growing season	^{0}C	28-32	24-27 33-35	36-40	20-24
	Min. temp. before flowering	^{0}C	10-15	15-22	>22	
Soil moisture	Growing period	Days	>180	150-180	120-150	<120
Soil aeration	Soil drainage	class	Well drained	Mod. To imp. drained	Poor drained	V.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	
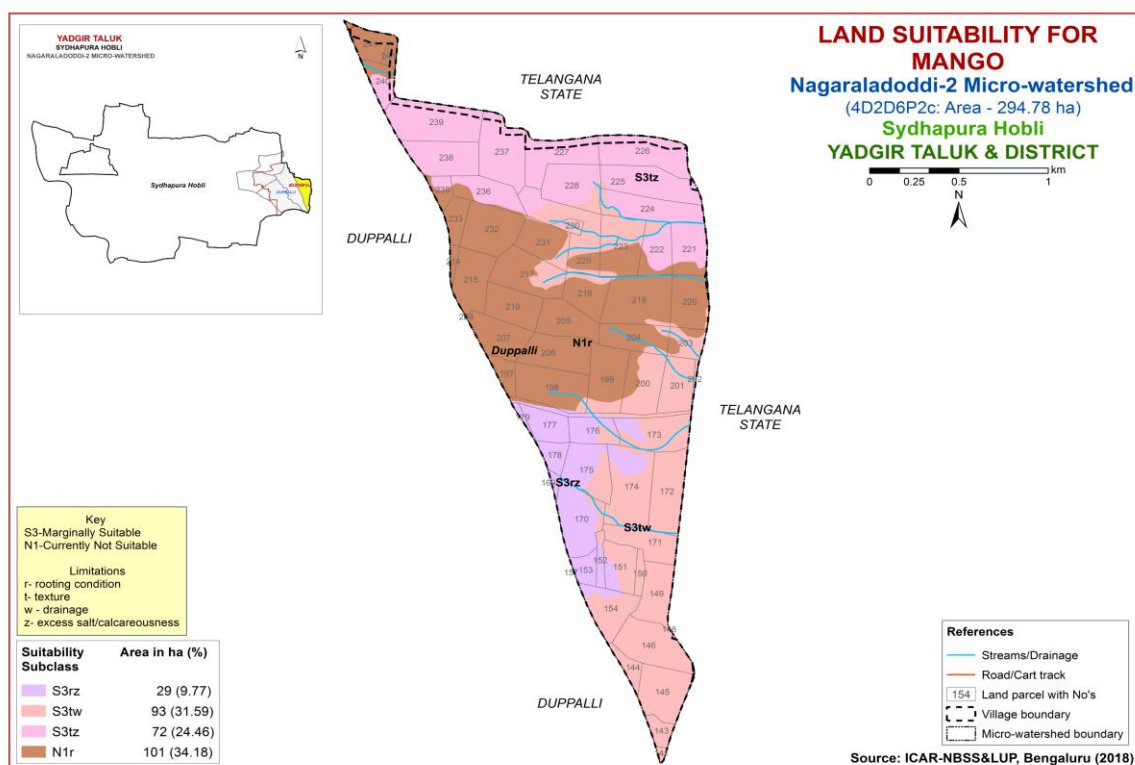
Fig. 7.13 Land Suitability map of Mango

7.14 Land Suitability for Sapota (*Manilkara zapota*)

Sapota is one of 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 7.15) 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.

There are no highly (Class S1) and moderately suitable (Class S2) lands available for growing sapota in the microwatershed. Maximum area of about 281 ha (95%) is marginally suitable (Class S3) and are distributed in all parts of the microwatershed. They have moderate limitations of texture, rooting depth, calcareousness and drainage. An area of about 14 ha (5%) is currently not suitable (Class N1) and are distributed in the western part of the microwatershed with severe limitation of rooting depth.

Table 7.15 Crop suitability criteria for Sapota

Crop requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable(S1)**	**Moderately suitable(S2)**	**Marginally suitable (S3)**	**Not suitable(N)**
Climate	Temperature in growing season	^{0}C	28-32	33-36 24-27	37-42 20-23	>42 <18
Soil moisture	Growing period	Days	>150	120-150	90-120	<120
Soil aeration	Soil drainage	class	Well drained	Moderately well drained	Imperfectly drained	Poorly drained
Nutrient availability	Texture	Class	scl, l, cl, sil	sl, sicl, sc	c (<60%)	ls, s, c (>60%)
	pH	1:2.5	6.0-7.5	7.6-8.0,5.0-5.9	8.1-9.0,4.5-4.9	>9.0,<4.5
	$CaCO_3$ in root zone	%	Non calcareous	<10	10-15	>15
Rooting conditions	Soil depth	cm	>150	75-150	50-75	<50
	Gravel content	%vol.	Non gravelly	<15	15-35	<35
Soil toxicity	Salinity	dS/m	Non saline	Up to 1.0	1.0-2.0	2.0-4.0
	Sodicity	%	Non sodic	10-15	15-25	>25
Erosion	Slope	%	<3	3-5	5-10	>10
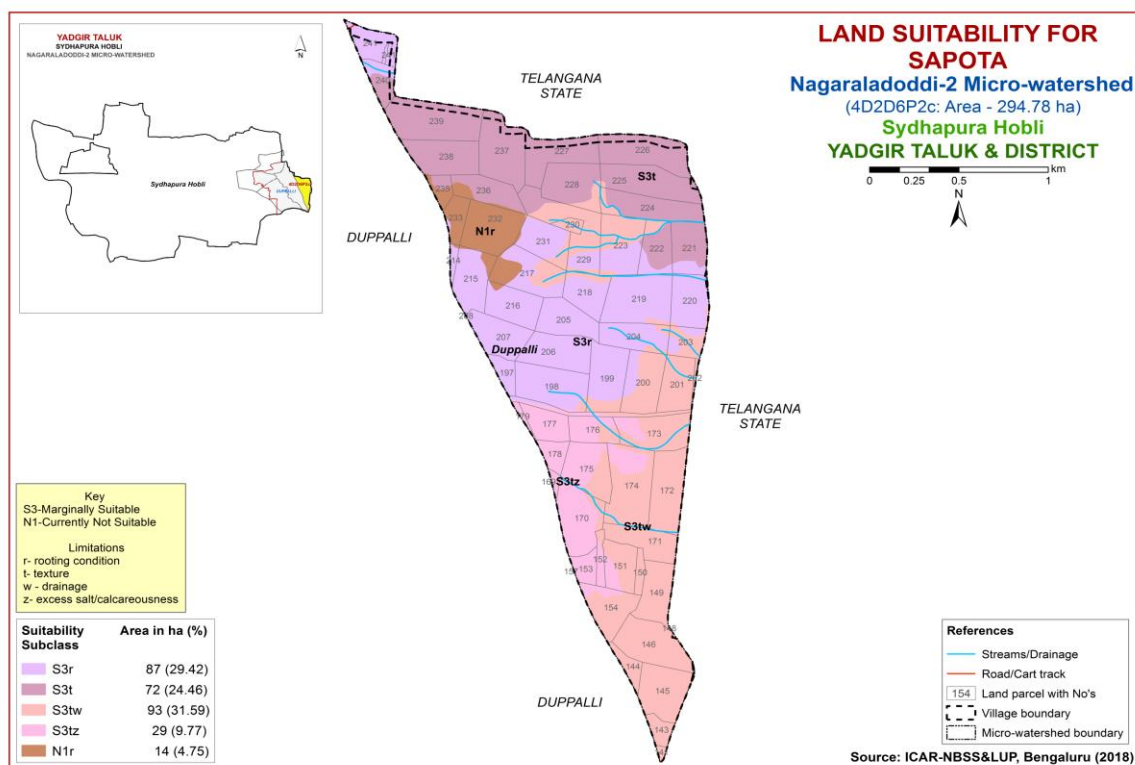
Fig. 7.14 Land Suitability map of Sapota

7.15 Land Suitability for Guava (*Psidium guajava*)

Guava is one of 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 7.16) 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.

There are no highly (Class S1) and moderately (Class S2) suitable lands available for growing guava in the microwatershed. Maximum area of about 281 ha (95%) is marginally suitable (Class S3) for growing guava and are distributed in all parts of the microwatershed. They have moderate limitations of texture, drainage, calcareousness and rooting depth. Currently not suitable (Class N1) lands occur in an area of about 14 ha (5%) and are distributed in the western part of the microwaterhsed. They have severe limitations of rooting depth and texture.

Table 7.16 Crop suitability criteria for Guava

Crop requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable(S3)**	**Not suitable(N)**
Climate	Temperature in growing season	^{0}C	28-32	33-36 24-27	37-42 20-23	
Soil moisture	Growing period	Days	>150	120-150	90-120	<90
Soil aeration	Soil drainage	class	Well drained	Mod. to imperfectly	poor	Very poor
Nutrient availability	Texture	Class	scl, l, cl, sil	sl, sicl, sic., sc,c	c (<60%)	c (>60%)
	pH	1:2.5	6.0-7.5	7.6-8.0:5.0-5.9	8.1-8.5:4.5-4.9	>8.5:<4.5
	CaCO$_3$ in root zone	%	Non calcareous	<10	10-15	>15
Rooting conditions	Soil depth	cm	>100	75-100	50-75	<50
	Gravel content	% vol.	<15	15-35	>35	
Soil toxicity	Salinity	dS/m	<2.0	2.0-4.0	4.0-6.0	
	Sodicity	%	Non sodic	10-15	15-25	>25
Erosion	Slope	%	<3	3-5	5-10	>10
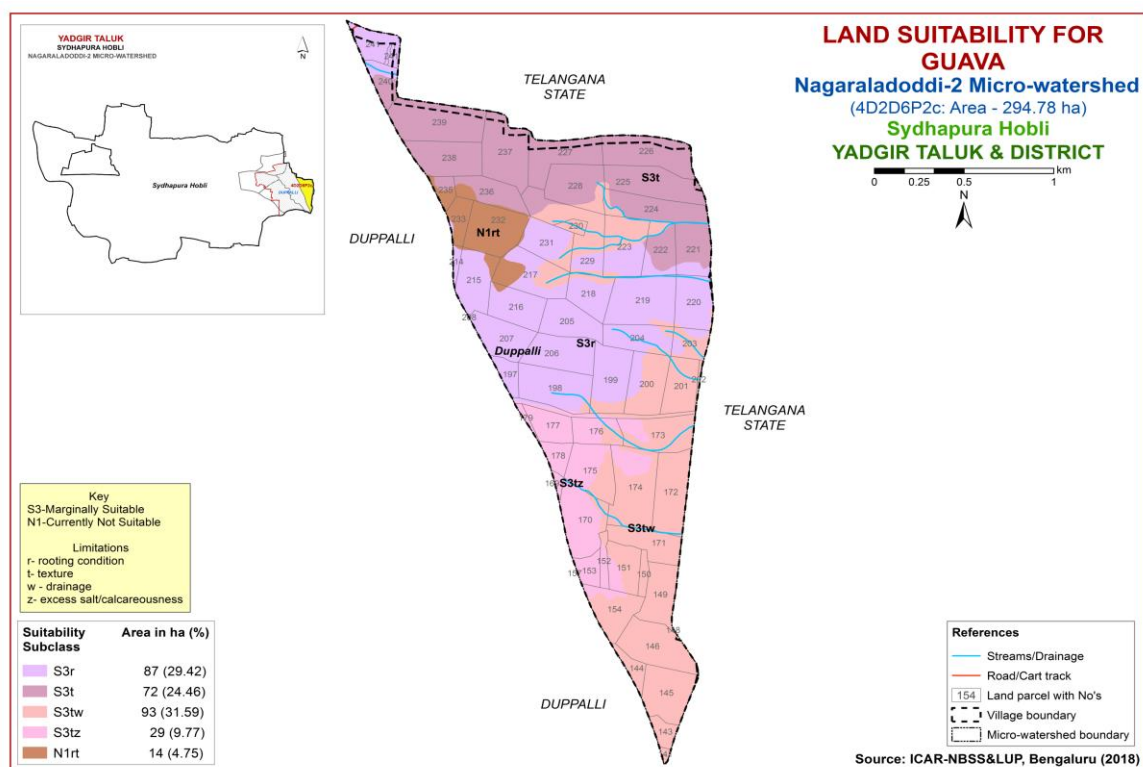
Fig 7.15 Land Suitability map of Guava

7.16 Land Suitability for Pomegranate (*Punica granatum*)

Pomegranate is one of 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,

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Koppal, Gadag and Chitradurga districts. The crop requirements for growing pomegranate (Table 7.17) 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.

Table 7.17 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	
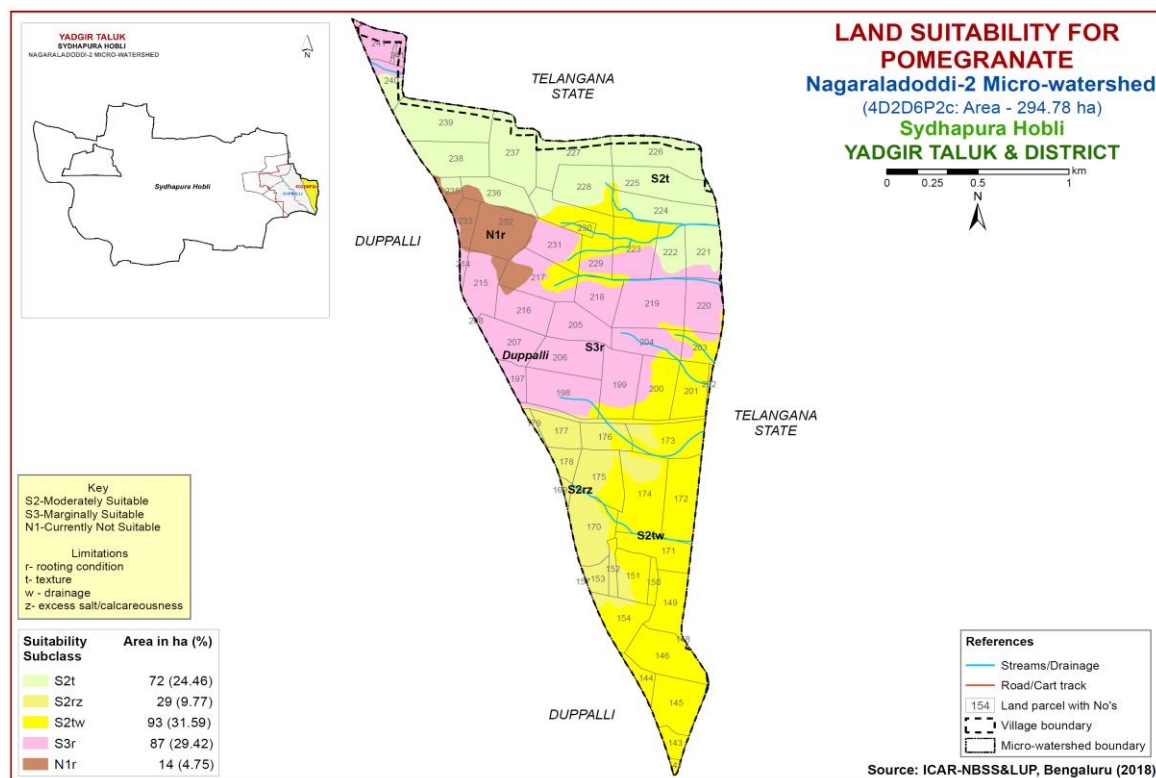
Fig 7.16 Land Suitability map of Pomegranate

No highly suitable (Class S1) lands available for growing pomegranate in the microwatershed. Maximum area of about 194 ha (66%) is moderately suitable (Class S2) for pomegranate and are distributed in all parts of the microwatershed. They have minor limitations of texture, rooting depth, calcareousness and drainage. An area of about 87 ha (29%) is marginally suitable (Class S3) and are distributed in the northern, western, central and eastern part of the microwatershed. They have moderate limitation of rooting depth. Currently not suitable lands (Class N1) occur in an area of 14 ha (5%) and are distributed in the western part of the microwatershed. They have severe limitation of rooting condition.

7.17 Land Suitability for Jackfruit (*Artocarpus heterophyllus*)

Jackfruit is one of the most important fruit crop grown in 5368 ha in almost all the districts of the State. The crop requirements for growing jackfruit (Table 7.18) 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.

There are no highly (Class S1) and moderately suitable (Class S2) lands for growing jackfruit in the microwatershed. Maximum area of about 281 ha (95%) is marginally suitable (Class S3) and are distributed in all parts of the microwatershed. They have moderate limitations of texture, drainage, calcareousness and rooting depth. Currently not suitable lands (Class N1) occur in an area of about 14 ha (5%) and are distributed in the western part of the microwatershed with severe limitations of rooting depth and texture.

Table 7.18 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	-
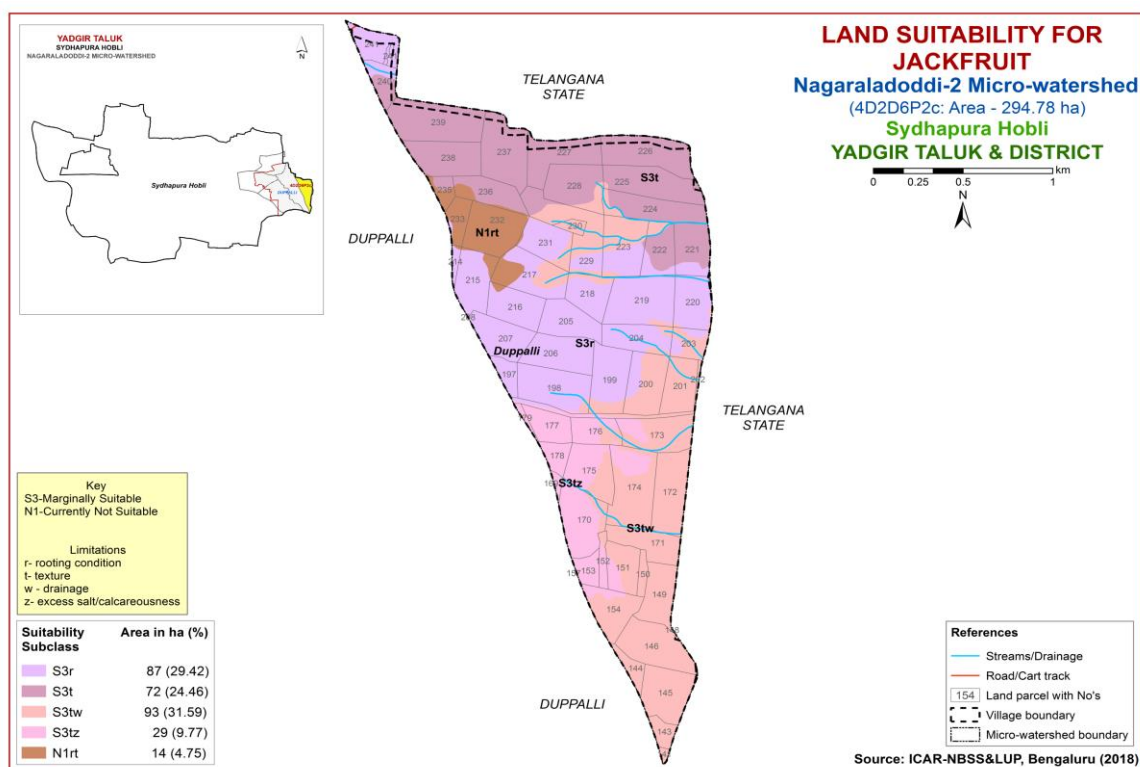
Fig 7.17 Land Suitability map of Jackfruit

7.18 Land Suitability for Jamun (*Syzygium cumini*)

Jamun is one of the most important fruit crop grown in almost all the districts of the state. The crop requirements for growing jamun (Table 7.19) 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 suitable (Class S1) lands available for growing jamun in the microwatershed. Maximum area of about 165 ha (56%) is moderately suitable (Class S2) for jamun and are distributed in all parts of the microwatershed. They have minor limitations of texture and drainage. An area of about 116 ha (39%) is marginally suitable (Class S3) and are distributed in the northern, western, central and eastern part of the microwatershed. They have moderate limitation of rooting depth. Currently not suitable lands (Class N1) occur in an area of 14 ha (5%) and are distributed in the western part of the microwatershed. They have severe limitation of rooting condition.

Table 7.19 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
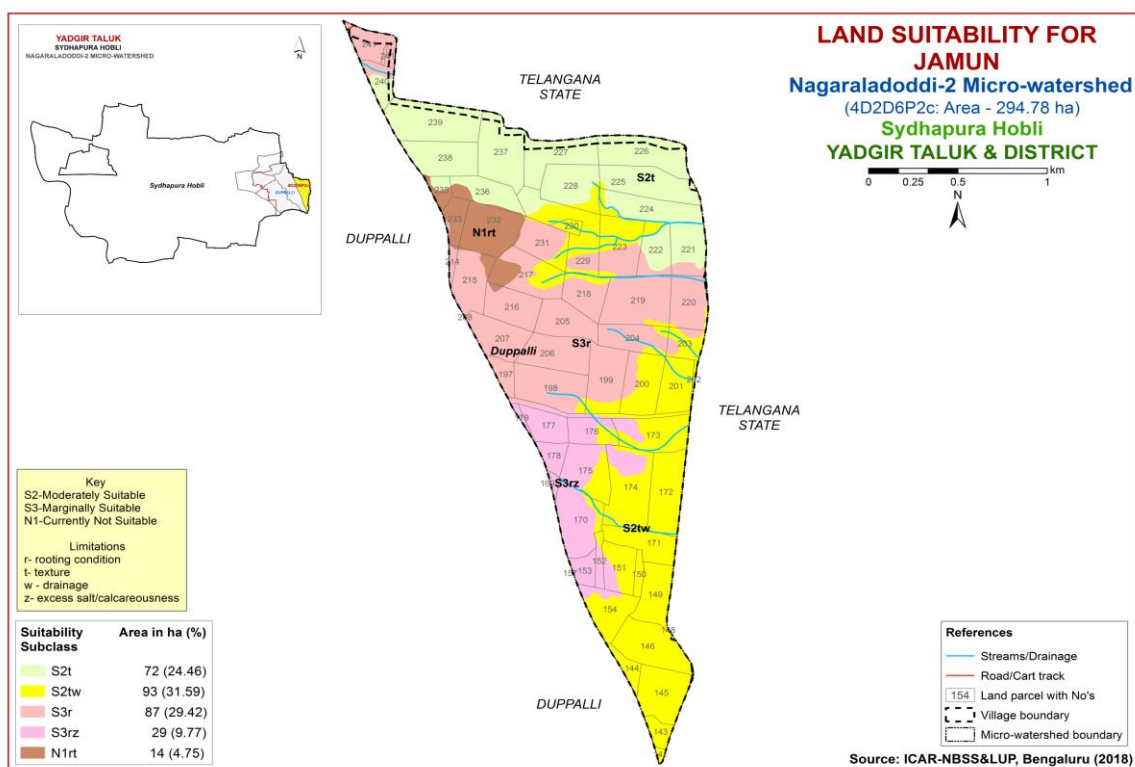
Fig 7.18 Land Suitability map of Jamun

7.19 Land Suitability for Musambi (*Citrus limetta*)

Musambi is one of the most important fruit crop grown in an area of 5446 ha in almost all the districts of the State. The crop requirements for growing musambi (Table 7.20) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing musambi was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.19.

Highly suitable (Class S1) lands for growing musambi occur in an area of about 72 ha (24%) and are distributed in the northern part of the microwatershed. Maximum area of about 122 ha (42%) is moderately suitable (Class S2) for growing musambi and are distributed in all parts of the microwatershed with minor limitations of calcareousness, drainage and rooting depth. Marginally suitable lands (Class S3) for growing musambi occur in an area of 87 ha (29%) and are distributed in the western, central and eastern part of the microwatershed with major limitation of rooting depth. An area of about 14 ha (5%) is currently not suitable (Class N1) for growing musambi and are distributed in the northwestern part of the microwatershed with severe limitation of rooting depth.

Table 7.20 Crop suitability criteria for Musambi

Crop requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable(S1)**	**Moderately suitable(S2)**	**Marginally suitable(S3)**	**Not suitable(N)**
Climate	Temperature in growing season	^{0}C	28-30	31-35 24-27	36-40 20-23	>40 <20
Soil moisture	Growing period	Days	240-265	180-240	150-180	<150
Soil aeration	Soil drainage	Class	Well drained	Mod. to imp. 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 7.19 Land Suitability map of Musambi

7.20 Land Suitability for Lime (*Citrus sp*)

Lime is one of the most important fruit crop grown in 11752 ha in almost all the districts of the State. The crop requirements for growing lime (Table 7.21) 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.

Table 7.21 Crop suitability criteria for Lime

Crop requirement			Rating			
Soil –site characteristics		Unit	Highly suitable(S1)	Moderately suitable(S2)	Marginally suitable(S3)	Not uitable(N)
Climate	Temperature in growing season	^{0}C	28-30	31-35 24-27	36-40 20-23	>40 <20
Soil moisture	Growing period	Days	240-265	180-240	150-180	<150
Soil aeration	Soil drainage	class	Well drained	Mod. to imp. 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

Highly suitable (Class S1) lands for growing lime occur in an area of about 72 ha (24%) and are distributed in the northern part of the microwatershed. Maximum area of

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about 122 ha (42%) is moderately suitable (Class S2) for growing lime and are distributed in all parts of the microwatershed with minor limitations of calcareousness, drainage and rooting depth. Marginally suitable lands (Class S3) for growing lime occur in an area of 87 ha (29%) and are distributed in the western, central and eastern part of the microwatershed with major limitation of rooting depth. An area of about 14 ha (5%) is currently not suitable (Class N1) for growing lime and are distributed in the northwestern part of the microwatershed with severe limitation of rooting depth.

7.21 Land Suitability for Cashew (*Anacardium occidentale)*

Cashew is one of the most important plantation nut crop grown in an area of about 70552 ha in almost all the districts. The crop requirements for growing Cashew (Table 7.22) 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.

There are no highly (Class S1) and moderately (Class S2) suitable lands for growing cashew in the microwatershed. An area of about 87 ha (29%) is marginally (Class S3) suitable for growing cashew and are distributed in the northern, western, central and eastern part of the microwatershed with major limitation of rooting depth. Currently not suitable (Class N1) lands for growing cashew occur in a maximum area of 208 ha (71%) and occur in all parts of the microwatershed. They have severe limitations of rooting depth, texture and calcareousness.

Table 7.22 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	
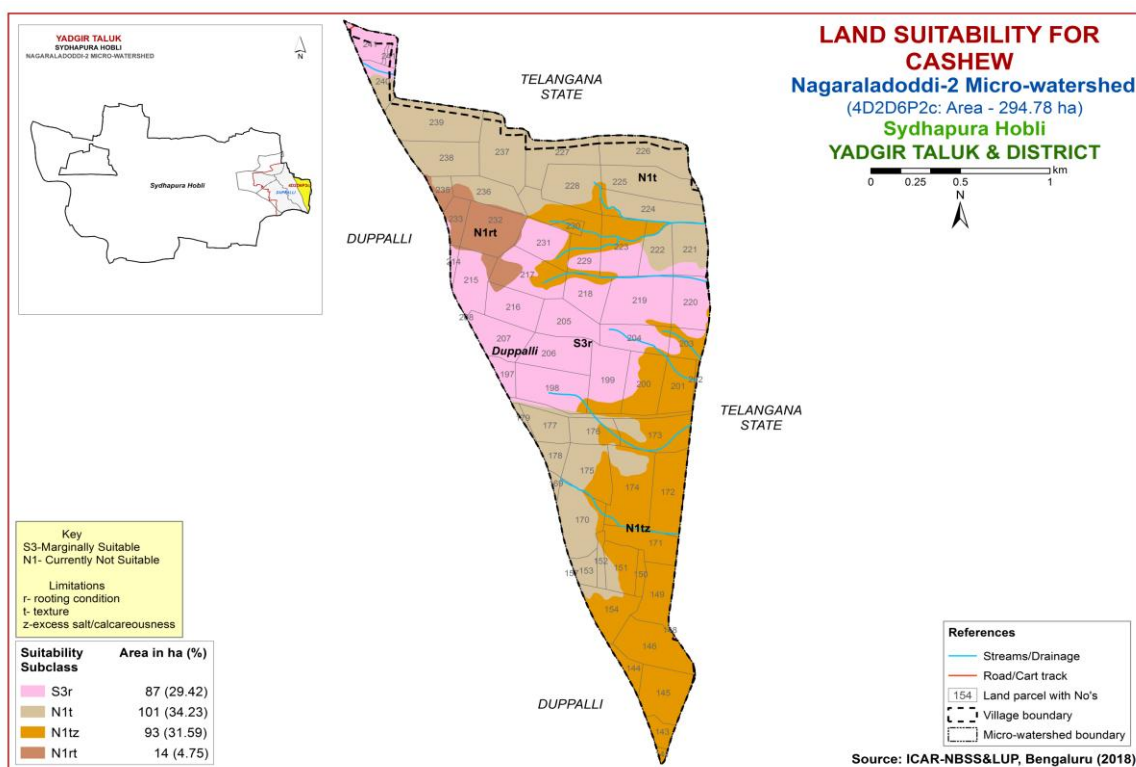
Fig 7.21 Land Suitability map of Cashew

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

Custard apple is one of 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 7.23) 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.

Table 7.23 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.	>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	
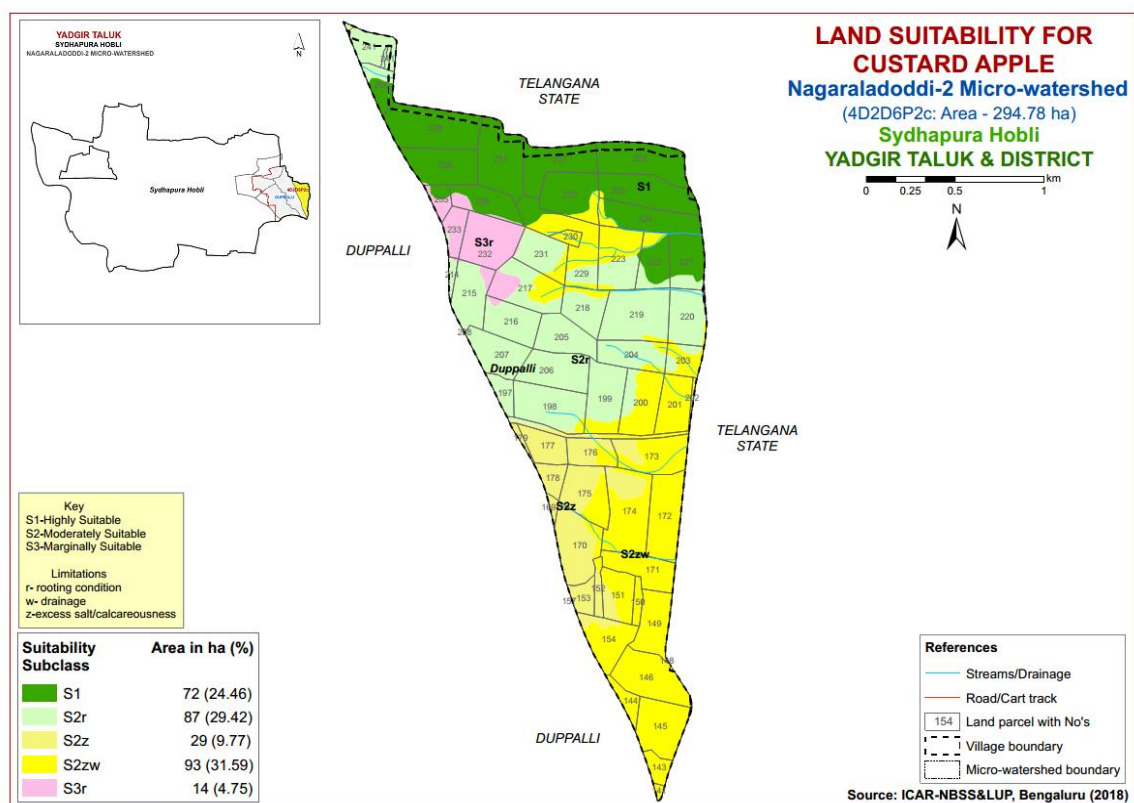
Fig 7.22 Land Suitability map of Custard Apple

An area of about 72 ha (24%) is highly (Class S1) suitable for growing custard apple and are distributed in the northern part of the microwatershed. Maximum area of about 209 ha (71%) is moderately suitable (Class S2) and are distributed in all parts of the microwatershed. They have minor limitations of drainage, calcareousness and rooting depth. Marginally suitable lands (Class S3) occur in an area of 14 ha (5%) and are distributed in the northwestern part of the microwatershed with major limitation of rooting depth.

7.23 Land Suitability for Amla (*Phyllanthus emblica*)

Amla is one of the most important medicinal and fruit plant grown in 151 ha in almost all the districts of the state. The crop requirements for growing amla (Table 7.24) 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 suitable (Class S1) lands are available for growing Amla. Maximum area of about 281 ha (95%) is moderately suitable (Class S2) for growing Amla and are distributed in all parts of the microwatershed. They have minor limitations of texture, calcareousness, drainage and rooting depth. An area of about 14 ha (5%) is marginally suitable (class S3) and are distributed in the northwestern part of the microwatershed with major limitations of rooting depth and texture.

Table 7.24 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
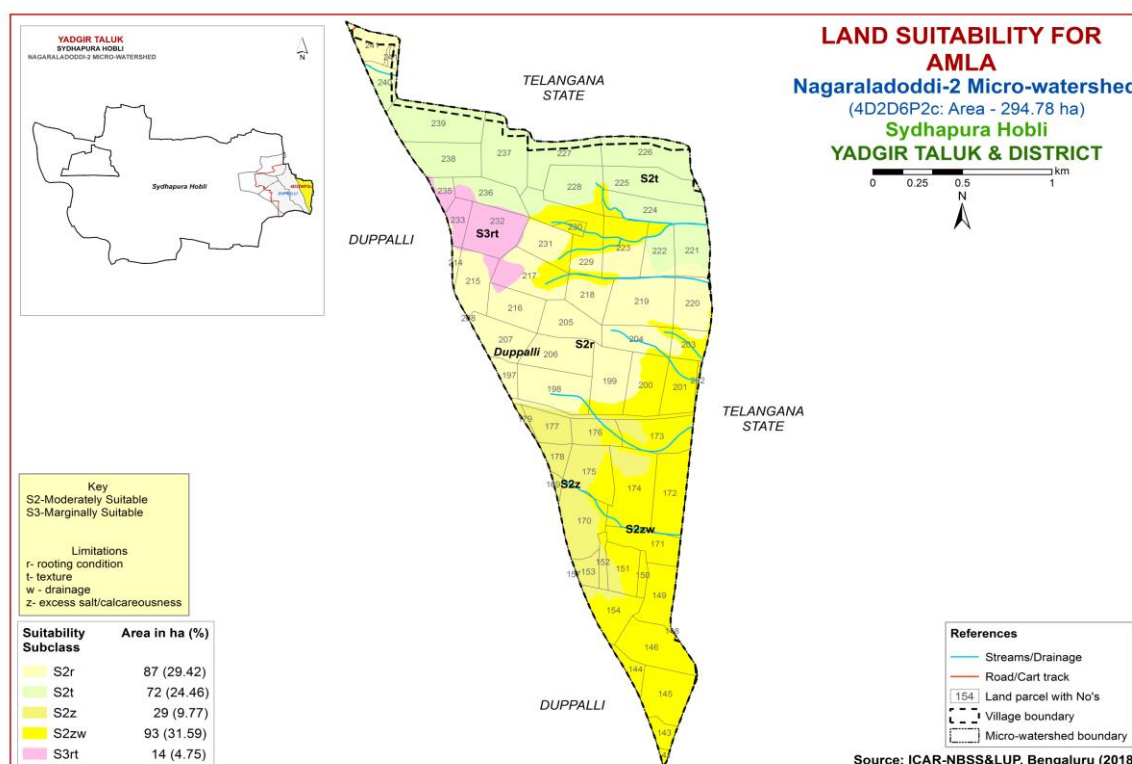
Fig 7.23 Land Suitability map of Amla

7.24 Land Suitability for Tamarind (*Tamarindus indica*)

Tamarind is one of the most important spice crop raised in 14897 ha in all the districts of the state. The crop requirements for growing tamarind (Table 7.25) 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.

There are no highly (Class S1) suitable lands for growing Tamarind in the microwatershed. Maximum area of about 165 ha (56%) is moderately suitable (Class S2) and are distributed in all parts of the microwatershed. They have minor limitations of texture and drainage. An area of about 29 ha (10%) is marginally suitable (Class S3) and are distributed in the southern part of the microwatershed. They have moderate

limitations of rooting depth and calcareousness. Currently not suitable (Class N1) lands occupy an area of about 101 ha (34%) for growing Tamarind and are distributed in the northern, western, central and eastern part of the microwatershed with severe limitations of rooting depth and texture.

Table 7.25 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
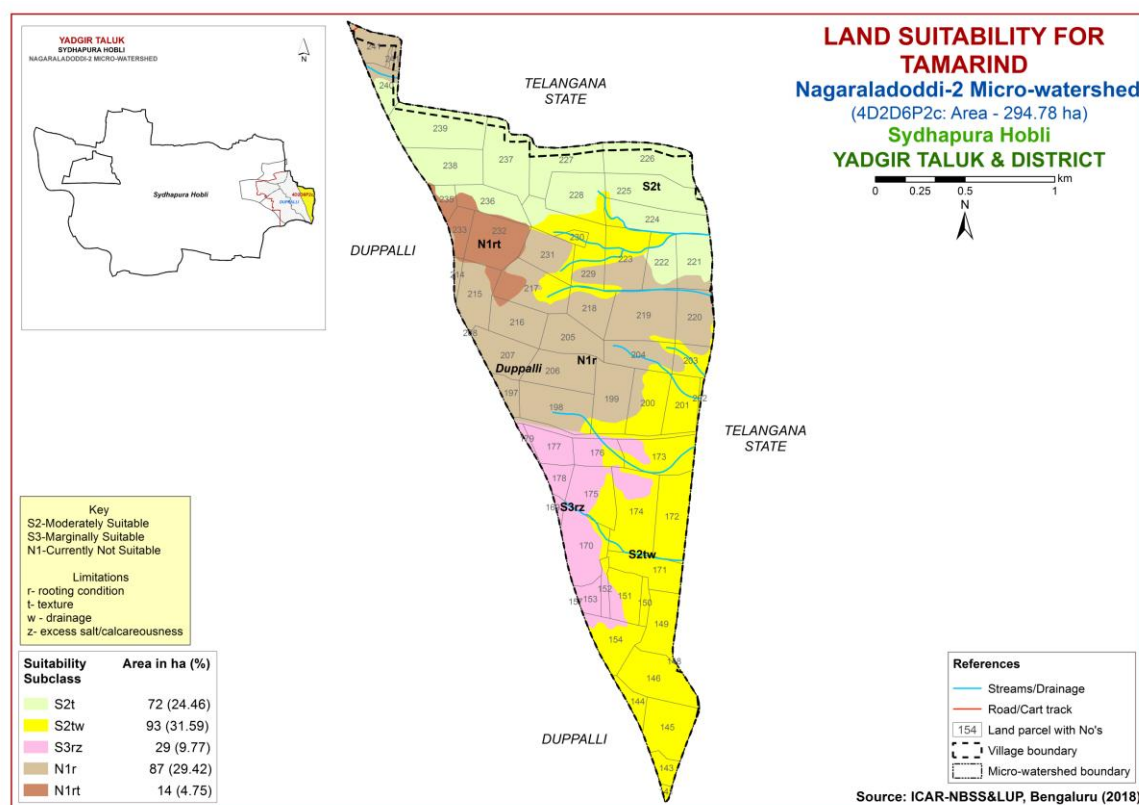
Fig 7.24 Land Suitability map of Tamarind

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

Marigold is one of the most important flower crop grown in an area of 9108 ha in almost all the districts of the State. The crop requirements for growing marigold (Table 7.26) 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.

Table 7.26 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	^{0}C	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

There are no highly (Class S1) suitable lands for growing Marigold in the microwatershed. Maximum area of about 281 ha (95%) is moderately suitable (Class S2) for growing Marigold and are distributed in all parts of the microwatershed. They have minor limitations of texture, calcareousness, drainage and rooting depth. Maximum area

of about 14 ha (5%) is marginally suitable (class S3) and are distributed in the northwestern part of the microwatershed with major limitations of rooting depth and texture.

7.26 Land suitability for Chrysanthemum (*Dendranthema grandiflora*)

Chrysanthemum is one of the most important flower crop grown in an area of 4978 ha in almost all the districts of the State. The crop requirements for growing chrysanthemum (Table 7.27) 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.

There are no highly (Class S1) suitable lands for growing chrysanthemum in the microwatershed. Maximum area of about 281 ha (95%) is moderately suitable (Class S2) for growing chrysanthemum and are distributed in all parts of the microwatershed. They have minor limitations of texture, calcareousness, drainage and rooting depth. Maximum area of about 14 ha (5%) is marginally suitable (class S3) and are distributed in the northwestern part of the microwatershed with major limitations of rooting depth and texture.

Table 7.27 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 Land Management Units (LMUs)

The 5 soil map units identified in Nagaraladoddi-2 microwatershed have been grouped into 4 Land Management Units (LMU's) for the purpose of preparing a Proposed Crop Plan. Land Management Units are grouped based on the similarities in respect of the type of soil, the depth of the soil, the surface soil texture, gravel content, AWC, slope, erosion etc. and a Land Management Units map (Fig. 7.27) has been generated. These Land Management Units are expected to behave similarly for a given level of management.

The 5 soil map units that have been grouped into four Land Management Units along with brief description of soil and site characteristics are given below.

LMU NO.	Soil map units	Soil and site characteristics
1	55.ANRiB2 127.GWDmB2	Moderately deep to deep (75-150 cm), black clay soils, 1-3% slope, moderate erosion
2	117.VKSiB2	Deep (100-150 cm), black sandy clay soils , 1-3% slope, moderate erosion
3	31. YLRiB2	Moderately shallow (50-75 cm), red sandy clay soils, 1-3% slope, moderate erosion
4	2 .BDLbB2	Shallow (25-50 cm), black loamy sand soils , 1-3% slope, moderate erosion
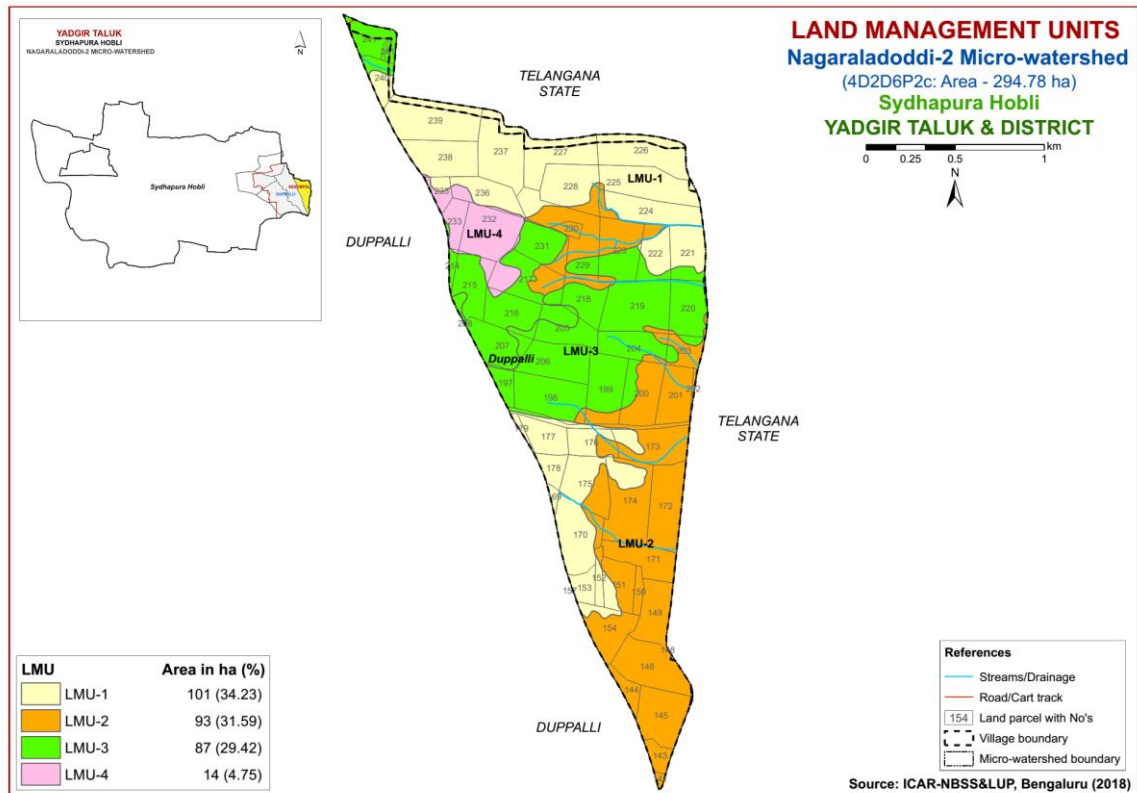
Fig. 7.27 Land Management Units (LMU's) map of Nagaraladoddi-2 microwatershed

7.28 Proposed Crop Plan for Nagaraladoddi-2 microwatershed

After assessing the land suitability for the 26 crops, a proposed crop plan has been prepared for the 4 identified LMUs 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 7.28 Proposed Crop Plan for Nagaraladoddi-2Micro watershed

Proposed LMU	Soil Map Units	Survey Number	Soil and site characteristics	Field Crops	Horticulture Crops	Suitable Interventions
1	55.ANRiB2 127.GWDmB2	**Duppalli:**152,153,157,169,170,175, 176,177,178,179,221,222,224,225, 226,227, 228,236,237,238, 239,240	Moderately deep to deep (75-150 cm), black clay soils, 1-3% slope, moderate erosion	Sunflower, Sorghum, Maize, Cotton, Bengal gram, Soybean, Safflower, Linseed, Bajra	**Fruit crops:** Jamun, Pomegranate, Lime, Musambi, Tamarind, Amla, Custard apple **Vegetables:** Bhendi, Drumstick, Chilli, Coriander **Flowers:** Marigold, Chrysanthemum	Application of FYM, Biofertilizers and micronutrients, drip irrigation, Mulching, suitable soil and water conservation practices
2	117.VKSiB2	**Duppalli:**141,143,144,145,146,148, 149,150,151,154,171,172,173,174, 200,201, 202,203,223,229, 230	Deep (100-150 cm), black sandy clay soils , 1-3% slope, moderate erosion	Sunflower, Cotton, Bengal gram, Bajra	**Fruit crops:** Lime, Musambi, Amla, Jamun **Vegetables:** Drumstick, Chilli, Coriander **Flowers:** Marigold, Chrysanthemum	Application of FYM, Biofertilizers and micronutrients, suitable soil and water conservation practices
3	31. YLRiB2	**Duppalli:**197,198,199,204,205,206, 207,208,214,215,216,217,218,219, 220,231, 241	Moderately shallow (50-75 cm), red sandy clay soils, 1-3% slope, moderate erosion	Maize, Sorghum, Groundnut, Bajra, Red gram	**Fruit crops:** Amla, Custard apple **Vegetables:** Tomato, Chilli **Flowers:** Marigold Chrysanthemum	Drip irrigation, mulching, suitable soil and water conservation practices (Crescent Bunding with Catch Pit etc)
4	2 .BDLbB2	**Duppalli:** 232,233,235	Shallow (25-50 cm), black loamy sand soils , 1-3% slope, moderate erosion	Bengal gram, Linseed, Safflower, Coriander	**Agri-Silvi-Pasture:** Hybrid Napier, *Styloxanthes hamata, Styloxanthes scabra*	Use of short duration varieties, sowing across the slope, drip irrigation and mulching is recommended

SOIL HEALTH MANAGEMENT

8.1 Soil Health

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

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

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

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

Characteristics of Nagaraladoddi-2 microwatershed
➢ The soil phases with sizeable area identified in the microwatershed belonged to the soil series of VKS 93 ha (32%), YLR 87 ha (29%), ANR 72 ha (24%), GWD 29 ha (10%) and BDL 14 ha (5%).
➢ As per land capability classification, entire area of the microwatershed falls under arable land category (Class II & III). The major limitations identified in the arable lands were soil, wetness and erosion.

➤ On the basis of soil reaction, about 2 ha (1%) is slightly alkaline (pH 7.3-7.8), 175 ha (59%) is moderately alkaline (pH 7.8-8.4) and 118 ha (40%) is strongly alkaline (pH 8.4-9.0).

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 cover entire area of the microwatershed.

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).

Soil Degradation

Soil erosion is one of the major factor affecting the soil health in the microwatershed. Entire area of the microwatershed is suffering from moderate erosion. The moderately eroded areas need immediate soil and water conservation and, other land development and land husbandry practices for restoring soil health.

Dissemination of Information and Communication of Benefits

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

Inputs for Net Planning (Saturation Plan) and Interventions needed

Net planning (Saturation Plan) 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 (Saturation Plan) are briefly presented below.

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

❖ **Surface Soil Texture:** Lighter soil texture in the top soil means, better rain water infiltration, less run-off and soil moisture conservation, less capillary rise and less evaporation losses. Lighter surface textured soils are amenable to good soil tilth and are highly suitable for crops like groundnut, 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 favourable 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 Nagaraladoddi-2 microwatershed.

❖ **Organic Carbon:** The OC content (an index of available Nitrogen) is low (<0.5%) in an area of 112 ha (38%), 138 ha (47%) medium (0.5-0.75%) and about 45 ha (15%) area high (>0.75%). In the areas of low and medium OC, it 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 250 ha area where OC is low (<0.5%) and medium (0.5-0.75%). For example, for rainfed maize, recommended level is 50 kg N per ha and an additional 12 kg /ha needs to be applied for all the crops grown in these plots.

❖ **Available Phosphorus**: Available Phosphorus is low (<23 kg/ha) in an area of 205 ha (70%), medium (23-57 kg/ha) in an area of 66 ha (22%) and high (>57 kg/ha) in an

area of 24 ha (8%). For all the crops, 25% additional P needs to be applied where available P is low and medium.

❖ **Available Potassium:** Entire area in the microwatershed is medium (145-337 kg/ha) in available Potassium. Additional 25% potassium may be applied for all the areas.

❖ **Available Sulphur:** Available sulphur is a very critical nutrient for oilseed crops, it is low in 196 ha (67%), medium in 50 ha (17%) and high in 48 ha (16%). Low and medium 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.

❖ **Available Boron:** An area of 205 ha (70%) is low and 89 ha (30%) is medium. For areas that are low and medium, application of sodium borate @ 10 kg/ha as soil application or 0.2 % borax as foliar spray is recommended.

❖ **Available Iron:** An area of about 103 ha (35%) is deficient and 191 ha (65%) in the microwatershed is sufficient in available iron. To manage iron deficiency, iron sulphate @ 25 kg/ha needs to be applied for 2-3 years.

❖ **Available Manganese:** An entire area of the microwatershed is sufficient in available manganese.

❖ **Available Copper:** An area of about 2 ha (1%) is deficient and 292 ha (99%) in the microwatershed is sufficient in available copper.

❖ **Available Zinc:** An entire area of the microwatershed is deficient in available zinc content. Application of zinc sulphate @ 25 kg/ha is to be recommended for these areas.

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

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

SOIL AND WATER CONSERVATION TREATMENT PLAN

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

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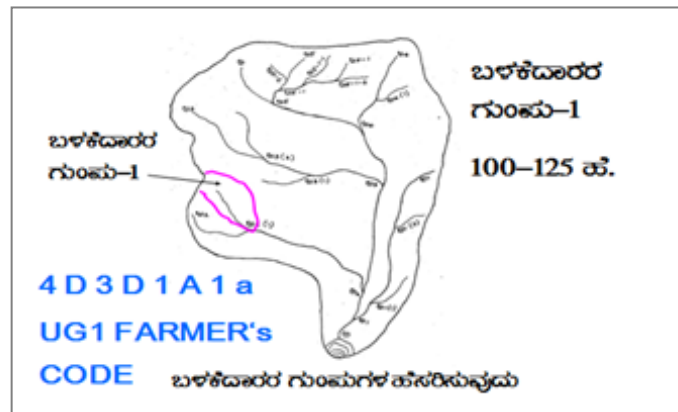
Apart from these, Hand Level/ Hydro Marker/ Dumpy Level/ Total Station and *Kathedars'* List needs to be collected.

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 • Existing network of waterways, pothissa boundaries, grass belts, natural drainage lines/ watercourse, cut ups/ terraces are marked on the cadastral map to the scale • Drainage lines are demarcated into	

Small gullies	(up to 5 ha catchment)
Medium gullies	(5-15 ha catchment)
Ravines	(15-25 ha catchment) and
Halla/Nala	(more than 25ha catchment)

Measurement of Land Slope

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

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

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

Note: (i) The above intervals are maximum.

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

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

Section of the Bund

Bund section is decided considering the soil texture class and gravelliness class (bg_0... b=loamy sand, $g_0 = <15\%$ 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 clayey soils	
0.45	2	0.75	01:01	0.92		
0.45	2.4	0.75	1.3:1	1.07	Shallow black clayey soils	
0.6	3.1	0.7	1.78:1	1.29	Medium black clayey soils	
0.5	3	0.85	1.47:1	1.49		

Formation of Trench cum Bund

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

Details of Borrow Pit dimensions are given below:

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

Bund section	Bund length	Earth quantity	Pit				Berm (pit to pit)	Soil depth class
m²	m	m³	L(m)	W(m)	D(m)	Quantity (m³)	m	
0.375	6	2.25	5.85	0.85	0.45	2.24	0.15	Shallow
0.45	6	2.7	5.4	1.2	0.43	2.79	0.6	Shallow
0.45	6	2.7	5	0.85	0.65	2.76	1	Moderately Shallow
0.54	5.6	3.02	5.5	0.85	0.7	3.27	0.1	Moderately shallow
0.54	5.5	2.97	5	1.2	0.5	3	0.5	Shallow
0.72	6.2	4.46	6	1.2	0.7	5.04	0.2	Moderately shallow
0.72	5.2	3.74	5.1	0.85	0.9	3.9	0.1	Moderately deep

B. 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.

9.1.3 Treatment of Natural Water Course/ Drainage Lines

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

b) The drainage line will be demarcated into Upper Reach, Middle Reach and Lower Reach.

c) Considering the Catchment, *Nala* bed and bank conditions, suitable structures are decided.

d) Number of storage structures (Check dam/ *Nala* bund/ Percolation tank) will be decided considering the commitments and available runoff in water budgeting and quality of water in the wells and site suitability.

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

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

g) Rainfall intensity data of the nearest Rain Gauge Station is considered for Hydrologic Designs.

h) Silt load to the Storage/Recharge Structures is reduced by providing vegetative, boulder and earthen checks in the natural water course. Location and design details are given in the Manual.

9.2 Recommended Soil and Water Conservation Measures

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

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

A map (Fig. 9.1) showing soil and water conservation plan with different kinds of structures recommended has been prepared which shows the spatial distribution and extent of area. An area of about 87 ha (29%) requires Trench cum Bunding and 208 ha (71%) needs Graded Bunding.

The conservation plan prepared may be presented to all the stakeholders including farmers and after considering their suggestions, the conservation plan for the microwatershed may be finalised in a participatory approach.
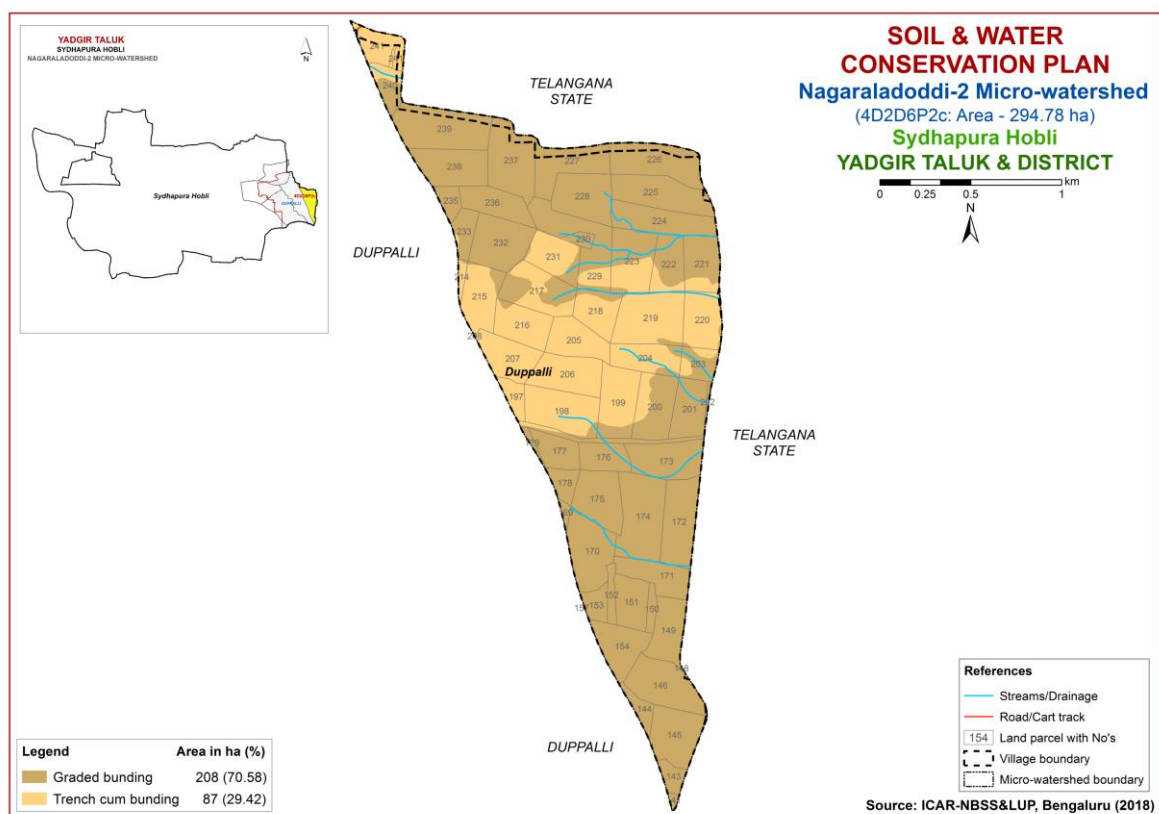
Fig. 9.1 Soil and Water Conservation Plan map of Nagaraladoddi-2 microwatershed

9.3 Greening of Microwatershed

As part of the greening programme in the watersheds, it is envisaged to plant a variety of horticultural and other tree plants that are edible, economical and produce lot of biomass which helps to restore the ecological balance in the watersheds. The lands that are suitable for greening programme are non-arable lands (land capability classes V, VI, VII and VIII) and also the lands that are not suitable or marginally suitable 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 1st week of March along the contour and heap the dug out soil on the lower side of the slope in order to harness the flowing water and facilitate weathering of soil in the pit. Exposure of soil in the pit also prevents spread of pests and diseases due to scorching sun rays. The pits should be filled with mixture of soil and organic manure during the second week of April and keep ready with sufficiently tall seedlings produced either in poly bags or in root trainer nurseries so that planting can be done during the 2nd or 3rd week of April depending on the rainfall.

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

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	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
Nagaraladoddi-2Micro watershed
Soil Phase Information

Village	Survey NO	Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Duppalli	141	0.31	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIew	Graded bunding
Duppalli	143	1.6	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIew	Graded bunding
Duppalli	144	1.65	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIew	Graded bunding
Duppalli	145	6.58	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIew	Graded bunding
Duppalli	146	7.5	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIew	Graded bunding
Duppalli	148	0.02	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IIew	Graded bunding
Duppalli	149	5.14	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIew	Graded bunding
Duppalli	150	1.04	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIew	Graded bunding
Duppalli	151	4.26	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIew	Graded bunding
Duppalli	152	1.23	GWDmB2	LMU-1	Moderately deep (75-100 cm)	Clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIes	Graded bunding
Duppalli	153	1.92	GWDmB2	LMU-1	Moderately deep (75-100 cm)	Clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Scrubland+Cotton (Sl+Ct)	Not Available	IIes	Graded bunding
Duppalli	154	5.37	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIew	Graded bunding
Duppalli	157	0.01	GWDmB2	LMU-1	Moderately deep (75-100 cm)	Clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIes	Graded bunding
Duppalli	169	0.51	GWDmB2	LMU-1	Moderately deep (75-100 cm)	Clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Graded bunding
Duppalli	170	7.36	GWDmB2	LMU-1	Moderately deep (75-100 cm)	Clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Graded bunding
Duppalli	171	4.91	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIew	Graded bunding
Duppalli	172	7.29	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIew	Graded bunding
Duppalli	173	6.63	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIew	Graded bunding
Duppalli	174	9.58	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIew	Graded bunding
Duppalli	175	6.31	GWDmB2	LMU-1	Moderately deep (75-100 cm)	Clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Scrubland+Cotton (Sl+Ct)	Not Available	IIes	Graded bunding
Duppalli	176	3.57	GWDmB2	LMU-1	Moderately deep (75-100 cm)	Clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Duppalli	177	3.54	GWDmB2	LMU-1	Moderately deep (75-100 cm)	Clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding

Village	Survey NO	Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Duppalli	178	1.98	GWDmB2	LMU-1	Moderately deep (75-100 cm)	Clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Duppalli	179	0.46	GWDmB2	LMU-1	Moderately deep (75-100 cm)	Clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Duppalli	197	1.84	YLRiB2	LMU-3	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	TCB
Duppalli	198	7.73	YLRiB2	LMU-3	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	TCB
Duppalli	199	6.8	YLRiB2	LMU-3	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram+Scrubland+Cotton (Rg+Sl+Ct)	Not Available	IIes	TCB
Duppalli	200	6.35	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIew	Graded bunding
Duppalli	201	4.86	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIew	Graded bunding
Duppalli	202	0.3	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIew	Graded bunding
Duppalli	203	2.94	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrubland+Cotton (Sl+Ct)	Not Available	IIew	Graded bunding
Duppalli	204	5.1	YLRiB2	LMU-3	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Scrubland+Cotton (Sl+Ct)	Not Available	IIes	TCB
Duppalli	205	5.16	YLRiB2	LMU-3	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Groundnut (Ct+Gn)	Not Available	IIes	TCB
Duppalli	206	6.37	YLRiB2	LMU-3	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	TCB
Duppalli	207	5.4	YLRiB2	LMU-3	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	TCB
Duppalli	208	0	YLRiB2	LMU-3	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	TCB
Duppalli	214	0.69	YLRiB2	LMU-3	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	TCB
Duppalli	215	5.75	YLRiB2	LMU-3	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	TCB
Duppalli	216	5.3	YLRiB2	LMU-3	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram+Cotton+Groundnut (Rg+Ct+Gn)	Not Available	IIes	TCB
Duppalli	217	7.37	YLRiB2	LMU-3	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	TCB
Duppalli	218	4.54	YLRiB2	LMU-3	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	TCB
Duppalli	219	9.06	YLRiB2	LMU-3	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Scrubland+Cotton (Sl+Ct)	Not Available	IIes	TCB
Duppalli	220	5.43	YLRiB2	LMU-3	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Scrubland+Cotton (Sl+Ct)	Not Available	IIes	TCB
Duppalli	221	5.08	ANRiB2	LMU-1	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrub land (Sl)	Not Available	IIes	Graded bunding

Village	Survey NO	Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Duppalli	222	4.55	ANRiB2	LMU-1	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrubland+Cotton (Sl+Ct)	Not Available	IIes	Graded bunding
Duppalli	223	6.85	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrubland+Cotton (Sl+Ct)	Not Available	IIew	Graded bunding
Duppalli	224	6.49	ANRiB2	LMU-1	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrubland+Cotton (Sl+Ct)	Not Available	IIes	Graded bunding
Duppalli	225	7.38	ANRiB2	LMU-1	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrubland+Cotton (Sl+Ct)	Not Available	IIes	Graded bunding
Duppalli	226	5.96	ANRiB2	LMU-1	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Duppalli	227	4.88	ANRiB2	LMU-1	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrubland+Redgram (Sl+Rg)	Not Available	IIes	Graded bunding
Duppalli	228	6.78	ANRiB2	LMU-1	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrubland+Redgram+Cotton (Sl+Rg+Ct)	Not Available	IIes	Graded bunding
Duppalli	229	8.44	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Scrubland+Redgram+Cotton (Sl+Rg+Ct)	Not Available	IIew	Graded bunding
Duppalli	230	0.88	VKSiB2	LMU-2	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IIew	Graded bunding
Duppalli	231	5.11	YLRiB2	LMU-3	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	TCB
Duppalli	232	7	BDLbB2	LMU-4	Shallow (25-50 cm)	Loamy sand	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIIes	Graded bunding
Duppalli	233	2.4	BDLbB2	LMU-4	Shallow (25-50 cm)	Loamy sand	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIIes	Graded bunding
Duppalli	235	1.68	BDLbB2	LMU-4	Shallow (25-50 cm)	Loamy sand	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIIes	Graded bunding
Duppalli	236	4.78	ANRiB2	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
Duppalli	237	7.12	ANRiB2	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
Duppalli	238	6.56	ANRiB2	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
Duppalli	239	7.81	ANRiB2	LMU-1	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Duppalli	240	2.28	ANRiB2	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
Duppalli	241	1.83	YLRiB2	LMU-3	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	TCB

Appendix II

Village	Survey NO	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Duppalli	141	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Duppalli	143	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	144	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	145	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	146	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	148	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	High (> 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 (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	149	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	High (> 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 (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	150	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	High (> 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 (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	151	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	152	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	153	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 (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	154	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	High (> 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 (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	157	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 (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	169	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	170	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	171	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	172	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Medium (0.5 – 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	173	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	174	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Medium (0.5 – 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	175	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	176	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	High (> 20 ppm)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	177	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)

Village	Survey NO	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Duppalli	178	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Medium (0.5 – 1.0 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	179	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	197	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	198	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	199	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	200	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	201	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	202	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	203	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	High (> 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	204	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	205	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	206	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	207	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	208	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	214	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	High (> 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Deficient (< 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	215	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	216	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	217	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	218	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	219	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	220	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	221	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	222	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	223	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)

Village	Survey NO	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Duppalli	224	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	225	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Medium (0.5 – 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	226	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Medium (0.5 – 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	227	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	228	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	229	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	230	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	231	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	232	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	High (> 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	233	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	235	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	236	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	237	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	238	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	239	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	240	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Low (< 23 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Duppalli	241	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)

Appendix III

Nagaraladoddi-2 Micro watershed
Soil Suitability Information

Village	Survey NO	Mango	Maize	Sapota	Sorghum	Guava	Cotton	Tamarind	Lime	Bengalgram	Sunflower	Red gram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Bajra	Drumstick	Mulberry
Duppalli	141	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	143	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	144	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	145	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	146	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	148	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	149	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	150	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	151	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	152	S3rz	S3tz	S3tz	S1	S3tz	S2rz	S3rz	S2rz	S1	S2rz	S2rz	S2z	S3tz	S2z	N1t	S3rz	S2rz	S3tz	S2tz	S3tz	S2tz	S2tz	S2rz	S1	S2rz	S3tz
Duppalli	153	S3rz	S3tz	S3tz	S1	S3tz	S2rz	S3rz	S2rz	S1	S2rz	S2rz	S2z	S3tz	S2z	N1t	S3rz	S2rz	S3tz	S2tz	S3tz	S2tz	S2tz	S2rz	S1	S2rz	S3tz
Duppalli	154	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	157	S3rz	S3tz	S3tz	S1	S3tz	S2rz	S3rz	S2rz	S1	S2rz	S2rz	S2z	S3tz	S2z	N1t	S3rz	S2rz	S3tz	S2tz	S3tz	S2tz	S2tz	S2tz	S2tz	S2rz	S3tz
Duppalli	169	S3rz	S3tz	S3tz	S1	S3tz	S2rz	S3rz	S2rz	S1	S2rz	S2rz	S2z	S3tz	S2z	N1t	S3rz	S2rz	S3tz	S2tz	S3tz	S2tz	S2tz	S2tz	S2tz	S2rz	S3tz
Duppalli	170	S3rz	S3tz	S3tz	S1	S3tz	S2rz	S3rz	S2rz	S1	S2rz	S2rz	S2z	S3tz	S2z	N1t	S3rz	S2rz	S3tz	S2tz	S3tz	S2tz	S2tz	S2tz	S2tz	S2rz	S3tz
Duppalli	171	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	172	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	173	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	174	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	175	S3rz	S3tz	S3tz	S1	S3tz	S2rz	S3rz	S2rz	S1	S2rz	S2rz	S2z	S3tz	S2z	N1t	S3rz	S2rz	S3tz	S2tz	S3tz	S2tz	S2tz	S2rz	S1	S2rz	S3tz
Duppalli	176	S3rz	S3tz	S3tz	S1	S3tz	S2rz	S3rz	S2rz	S1	S2rz	S2rz	S2z	S3tz	S2z	N1t	S3rz	S2rz	S3tz	S2tz	S3tz	S2tz	S2tz	S2rz	S1	S2rz	S3tz
Duppalli	177	S3rz	S3tz	S3tz	S1	S3tz	S2rz	S3rz	S2rz	S1	S2rz	S2rz	S2z	S3tz	S2z	N1t	S3rz	S2rz	S3tz	S2tz	S3tz	S2tz	S2tz	S2rz	S1	S2rz	S3tz
Duppalli	178	S3rz	S3tz	S3tz	S1	S3tz	S2rz	S3rz	S2rz	S1	S2rz	S2rz	S2z	S3tz	S2z	N1t	S3rz	S2rz	S3tz	S2tz	S3tz	S2tz	S2tz	S2rz	S1	S2rz	S3tz
Duppalli	179	S3rz	S3tz	S3tz	S1	S3tz	S2rz	S3rz	S2rz	S1	S2rz	S2rz	S2z	S3tz	S2z	N1t	S3rz	S2rz	S3tz	S2tz	S3tz	S2tz	S2tz	S2rz	S1	S2rz	S3tz
Duppalli	197	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r
Duppalli	198	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r
Duppalli	199	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r
Duppalli	200	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	201	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	202	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	203	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	204	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r
Duppalli	205	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r
Duppalli	206	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r
Duppalli	207	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r
Duppalli	208	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r
Duppalli	214	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r
Duppalli	215	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r
Duppalli	216	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r
Duppalli	217	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r

Village	Survey NO	Mango	Maize	Sapota	Sorghum	Guava	Cotton	Tamarind	Lime	Bengalgram	Sunflower	Red gram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Bajra	Drumstick	Mulberry
Duppalli	218	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r	S3r
Duppalli	219	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S2r	S2r	S3r	S3r
Duppalli	220	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S2r	S2r	S3r	S3r
Duppalli	221	S3tz	S2t	S3t	S1	S3t	S1	S2t	S1	S1	S1	S2tw	S2t	S3t	S1	N1t	S2t	S1	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S2t	S2tz	S2tw
Duppalli	222	S3tz	S2t	S3t	S1	S3t	S1	S2t	S1	S1	S1	S2tw	S2t	S3t	S1	N1t	S2t	S1	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S2t	S2tz	S2tw
Duppalli	223	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	224	S3tz	S2t	S3t	S1	S3t	S1	S2t	S1	S1	S1	S2tw	S2t	S3t	S1	N1t	S2t	S1	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S2t	S2tz	S2tw
Duppalli	225	S3tz	S2t	S3t	S1	S3t	S1	S2t	S1	S1	S1	S2tw	S2t	S3t	S1	N1t	S2t	S1	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S2t	S2tz	S2tw
Duppalli	226	S3tz	S2t	S3t	S1	S3t	S1	S2t	S1	S1	S1	S2tw	S2t	S3t	S1	N1t	S2t	S1	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S2t	S2tz	S2tw
Duppalli	227	S3tz	S2t	S3t	S1	S3t	S1	S2t	S1	S1	S1	S2tw	S2t	S3t	S1	N1t	S2t	S1	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S2t	S2tz	S2tw
Duppalli	228	S3tz	S2t	S3t	S1	S3t	S1	S2t	S1	S1	S1	S2tw	S2t	S3t	S1	N1t	S2t	S1	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S2t	S2tz	S2tw
Duppalli	229	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	230	S3tw	S2tw	S3tw	S1	S3tw	S1	S2tw	S2zw	S1	S2rw	S2tw	S2zw	S3tw	S2zw	N1tz	S2tw	S2zw	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Duppalli	231	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S2r	S2r	S3r	S3r
Duppalli	232	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Duppalli	233	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Duppalli	235	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Duppalli	236	S3tz	S2t	S3t	S1	S3t	S1	S2t	S1	S1	S1	S2tw	S2t	S3t	S1	N1t	S2t	S1	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S2t	S2tz	S2tw
Duppalli	237	S3tz	S2t	S3t	S1	S3t	S1	S2t	S1	S1	S1	S2tw	S2t	S3t	S1	N1t	S2t	S1	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S2t	S2tz	S2tw
Duppalli	238	S3tz	S2t	S3t	S1	S3t	S1	S2t	S1	S1	S1	S2tw	S2t	S3t	S1	N1t	S2t	S1	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S2t	S2tz	S2tw
Duppalli	239	S3tz	S2t	S3t	S1	S3t	S1	S2t	S1	S1	S1	S2tw	S2t	S3t	S1	N1t	S2t	S1	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S2t	S2tz	S2tw
Duppalli	240	S3tz	S2t	S3t	S1	S3t	S1	S2t	S1	S1	S1	S2tw	S2t	S3t	S1	N1t	S2t	S1	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S2t	S2tz	S2tw
Duppalli	241	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S2r	S2r	S3r	S3r

PART-B

SOCIO-ECONOMIC STATUS OF FARM HOUSEHOLDS

CONTENTS

LIST OF TABLES

FINDINGS OF THE SOCIO-ECONOMIC SURVEY

❖ *The survey was conducted in Nagaraladoddi-2 is located at North latitude 16⁰ 33' 23.838" and 16⁰ 31' 6.086" and East longitude 77⁰ 25' 9.296" and 77⁰ 24' 10.745'' covering an area of about 294.61 ha coming under Duppalli village of Yadagiri taluk.*

❖ *Socio-economic analysis of Nagaraladoddi-2 micro watersheds of Ajalapur sub-watershed, Yadgiri taluk & District indicated that, out of the total sample of 35 farmers were sampled in Nagaraladoddi-2 micro-watershed among households surveyed 9 (25.71%) were marginal, 9 (25.71%) were small, 11 (31.43 %) were semi medium and 3 (8.57 %) were medium farmers. 3 landless farmers were also interviewed for the survey.*

❖ *The population characteristics of households indicated that, there were 80 (53.69%) men and 69 (46.31 %) were women. The average population of landless was 3.3, marginal farmers were 3.9, small farmers were 4.2, semi medium farmers were 4.7 and medium farmers were 4.7.*

❖ *Majority of the respondents (46.31%) were in the age group of 16-35 years.*

❖ *Education level of the sample households indicated that, there were 46.31 per cent illiterates, 43.63 per cent pre university education and 4.03 per cent attained graduation.*

❖ *About, 51.43 per cent of household heads practicing agriculture and 42.86 per cent of the household heads were engaged as agricultural labourers.*

❖ *Agriculture was the major occupation for 22.82 per cent of the household members.*

❖ *In the study area, 80.00 per cent of the households possess katcha house and 5.71 per cent possess pucca house.*

❖ *The durable assets owned by the households showed that, 74.29 per cent possess TV, 48.57 per cent possess mixer grinder, 94.29 per cent possess mobile phones and 28.57 per cent possess motor cycles.*

❖ *Farm implements owned by the households indicated that, 25.71 per cent of the households possess plough, 2.86 per cent possess tractor, 5.71 per cent possess bullock cart.*

❖ *Regarding livestock possession by the households, 11.43 per cent possess local cow and 5.71 per cent possess buffalo.*

❖ *The average labour availability in the study area showed that, own labour men available in the micro watershed was 1.35, women available in the micro watershed was 1.19, hired labour (men) available was 9.84 and hired labour (women) available was 14.9.*

❖ *Out of the total land holding of the sample respondents 85.73 per cent (57.30 ha) of the area is under dry condition and the remaining 11.44 per cent area is irrigated land.*

- *There were 4.00 live bore wells and 4.00 dry bore wells among the sampled households.*
- *Bore well was the major source of irrigation for 11.43 per cent of the households.*
- *The major crops grown by sample farmers are Red gram, Paddy, Cotton, Jowar and Groundnut and cropping intensity was recorded as 100.00 per cent.*
- *Out of the sample households 91.43 percent possessed bank account and 74.29 per cent of them have savings in the account.*
- *About 74.29 per cent of the respondents borrowed credit from various sources.*
- *Among the credit borrowed by households, 11.11 per cent have borrowed loan from commercial banks and 188.89 per cent from co-operative/Grameena bank.*
- *Majority of the respondents (100.00%) have borrowed loan for agriculture purpose.*
- *Regarding the opinion on institutional sources of credit, 83.33 per cent of the households opined that credit helped to perform timely agricultural operations, while, only 16.67 per cent respondents opined that loan amount was adequate to fulfil their requirement.*
- *The per hectare cost of cultivation for Red gram, Paddy, Cotton, Jowar and Groundnut was Rs.40477.88, 46971.35, 32690.13, 49477.76 and 66158.16 with benefit cost ratio of 1:1.20, 1: 0.95, 1: 1.70, 1: 1.10 and 1:0.65 respectively.*
- *Further, 14.29 per cent of the households opined that dry fodder was adequate and 5.71 per cent of the households have opined that the green fodder was adequate.*
- *The average annual gross income of the farmers was Rs. 98685.71 in micro-watershed, of which Rs. 70914.29 comes from agriculture.*
- *Sampled households have grown 2 horticulture trees and 9 forestry trees together in the fields and back yards.*
- *About 14.29 per cent of the households shown interest to cultivate horticultural crops.*
- *Households have an average investment capacity of Rs. 9171.43 for land development and Rs. 457.14 for irrigation facility.*
- *Source of funds for additional investment is concerned 62.86 per cent depends on bank loan for land development activities.*
- *Regarding marketing channels, 45.71 per cent of the households have sold agricultural produce to the local/village merchants, while, 51.43 per cent have sold in regulated markets.*
- *Further, 88.57 per cent of the households have used tractor for the transport of agriculture commodity.*
- *Majority of the farmers (91.43%) have experienced soil and water erosion problems in the watershed and 91.43 per cent of the households were interested towards soil testing.*

- *Fire was the major source of fuel for domestic use for 85.71 per cent of the households and 25.71 per cent households has LPG connection.*
- *Piped supply was the major source for drinking water for 97.14 per cent of the households.*
- *Electricity was the major source of light for 97.14 per cent of the households.*
- *In the study area, 45.71 per cent of the households possess toilet facility.*
- *Regarding possession of PDS card, 100.00 per cent of the households possessed BPL card.*
- *Households opined that, the requirement of cereals (94.29%), pulses (91.43%) and oilseeds (34.29%) are adequate for consumption.*
- *Farming constraints experienced by households in the micro watersheds were lower fertility status of the soil (85.71%) wild animal menace on farm field (80.00%), frequent incidence of pest and diseases (77.14%), inadequacy of irrigation water (80.00%), high cost of fertilizers and plant protection chemicals (77.14%), high rate of interest on credit (88.57%), low price for the agricultural commodities (88.57%), lack of marketing facilities in the area (80.00%), inadequate extension services (60.00%) and lack of transport for safe transport of the agricultural produce to the market (88.57%).*

INTRODUCTION

Soil and water are the two precious natural resources which are essential for crop production and existence of life on earth. Rainfed agriculture is under severe stress due to various constraints related to agriculture like uneven and erratic distribution of rainfall, indiscriminate use of fertilizers, chemicals and pesticides, adoption of improper land management practices, soil erosion, decline in soil fertility, decline in ground water resources leading to low crop productivity. The area under rainfed agriculture has to be managed effectively using the best available practices to enhance the production of food, fodder and fuel. This is possible if the land resources are characterized at each parcel of land through detailed land resource inventory using the best available techniques of remote sensing, GPS and GIS. The watershed development programs are aimed at the sustainable distribution of its resources and the process of creating and implementing plans, programs, and projects to sustain and enhance watershed functions that affect the plant, animal and human communities within a watershed boundary.

World Bank funded KWDP II, SUJALA III project was implemented in with Broad objective of demonstrating more effective watershed management through greater integration of programmes related to rain-fed agriculture, innovative and science based approaches and strengthen institutional capacities and If successful, it is expected that the systems and tools could be mainstreamed into the overall IWMP in the State of Karnataka and in time, throughout other IWMP operations in India. With this background the socio-economic survey has been carried out with following specific objectives:

1. To understand the demographic features of the households in the micro-watershed
2. To understand the extent of family labour available and additional employment opportunities available within the village.
3. To know the status of assets of households in the micro-watershed for suggesting possible improvements.
4. To study the cropping pattern, cropped area and productivity levels of different households in micro-watershed.
5. To determine the type and extent of livestock owned by different categories of HHs
6. Availability of fodder and level of livestock management.

Scope and importance of survey

Survey helps in identification of different socio-economic and resource use-patterns of farmers at the Micro watershed. Household survey provides demographic features, labor force, and levels of education; land ownership and asset position (including livestock and other household assets) of surveyed households; and cropping patterns, input intensities, and average crop yields from farmers' fields. It also discusses crop utilization and the degree of commercialization of production in the areas; farmers'

access to and utilization of credit from formal and informal sources; and the level of adoption and use of soil, water, and pest management technologies.

METHODOLOGY

The description of the methods, components selected for the survey and procedures followed in conducting the baseline survey are furnished under the following heads.

1. Description of the study area

Yadgir District is one of the 30 districts of Karnataka state in southern India. This district was carved out from the erstwhile Gulbarga district as the 30th district of Karnataka on 10 April 2010. Yadgir town is the administrative headquarters of the district. The district comprises of 3 taluks namely, Shahapur, Yadgiri and Shorapur (There are 16 hoblies, 117 Gram Panchayats, 4 Municipalities,8 Towns/ Urban agglomeration and 487 inhabited & 32 un-inhabited villages The district occupies an area of 5,160.88 km².

Yadgir district is the second smallest district in the state, area wise is very rich in cultural traditions. The vast stretch of fertile black soil of the district is known for bumper red gram and jowar crops. The district is a "Daal bowl" of the state. The district is also known for cluster of cement industries and a distinct stone popularly known as "Malakheda Stone". Two main rivers, Krishna and Bhima, and a few tributaries flow in this region. Krishna and Bhima Rivers drain the district. They constitute the two major river basins of the district. Kagna and Amarja are the two sub - basins of Bhima River, which occur within the geographical area of the district

According to the 2011 census Yadgir district has a population of 1, 172,985, roughly equal to the nation of Timor-Lesteor the US state of Rhode Island. This gives it a ranking of 404th in India (out of a total of 640). The district has a population density of 224 inhabitants per square kilometre (580/sq mi). Its population growth rate over the decade 2001-2011 was 22.67%. Yadgir has a sex ratio of 984 females for every 1000 males, and a literacy rate of 52.36%.

2. Locale of the survey and description of the micro-watershed and

The study was conducted in Nagaraladoddi-2 micro-watershed (Ajalapur sub-watershed, Yadgiri taluk & District) is located at North latitude 16^0 33' 23.838" and 16^0 31' 6.086" and East longitude 77^0 25' 9.296" and 77^0 24' 10.745"covering an area of about 294.61 ha bounded by unde Duppalli Village.

3. Selection of the respondents for the study

The micro-watershed is marked with 320 square meters grids. One farmer from every alternate grid in the micro-watershed was selected for the study and interviewed for socio-economic data. Totally 35 households were interviewed for the survey.

4. The parameters considered for socio-economic survey of households

Two forms of data were collected from the micro-watershed which includes primary data from the farm households and secondary data about the villages under the micro-watershed jurisdiction.

The following parameters were considered for the primary data collection about the socio-economic data of the households, (1) Demographic information, (2) Farm and durable assets owned by households, (3) Livestock possession, (4) Labour availability, (5) Level of migration in the village, Land holding, (7) Cropping pattern, (8) Source of irrigation, (9) Borrowing status, (10) Cost of cultivation of major crops, (11) Economics of subsidiary activities, (12) Fodder availability, (13) Family annual income from different sources, (14) Horticulture and forestry species grown, (15) Additional investment capacity, (16) Marketing practices, (17) Status of soil and water conservation structure, (18) Access to basic needs and (19) Constraints and suggestion.

The following parameters were considered for the secondary data regarding the villages under the micro-watershed jurisdiction, (1) Number of villages in each micro-watershed jurisdiction, (2) Village wise number of households, (3) Geographical area of the villages, (4) Cultivable are a including rainfed and irrigated, (5) Number and type of house in each village, (6) Human and livestock population, (7) Facilities in the village such as roads, transport facility for conveyance, drinking water supply, street light and (8) Community based organizations in the villages.

5. Development of interview schedule and data collection

Taking into the consideration the objectives of the survey, an interview schedule was prepared after thorough consultation with the experts in the field of social sciences. A comprehensive interview schedule covering all the major parameters for measuring the socio-economic situation was developed.

6. Tools used to analyze the data

The statistical components such as frequency and percentage were used to analyze the data.

Abbreviations used in the report

LL=Landless
MF=Marginal Farmers
SF=Small farmers
SMF=Semi medium farmers
MDF=Medium farmers
LF=Large Farmers

FINDINGS OF THE SURVEY

This chapter deals with systematic presentation of results of the survey. Keeping in view the objectives, the salient features of the survey are presented under the following headings.

Households sampled for socio-economic survey: The data on households sampled for socio economic survey in Nagaraladoddi-2 Micro watershed is presented in Table 1 and it indicated that 35 farmers were sampled in Nagaraladoddi-2 micro-watershed among households surveyed 9 (25.71%) were marginal, 9 (25.71%) were small, 11 (31.43 %) were semi medium and 3 (8.57 %) were medium farmers. 3 landless farmers were also interviewed for the survey.

Table 1. Households sampled for socio economic survey in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Farmers	3	8.57	9	25.7	9	25.7	11	31.4	3	8.57	35	100

Population characteristics: The population characteristics of households sampled for socio-economic survey in Nagaraladoddi-2 Micro watershed is presented in Table 2. The data indicated that, there were 80 (53.69%) men and 69 (46.31%) were women. The average population of landless was 3.3, marginal farmers were 3.9, small farmers were 4.2, semi medium farmers were 4.7 and medium farmers were 4.7.

Table 2. Population characteristics in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (10)		MF (35)		SF (38)		SMF (52)		MDF (14)		All (149)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Men	7	70	19	54	19	50	28	53.9	7	50	80	53.7
2	Women	3	30	16	46	19	50	24	46.2	7	50	69	46.3
	Total	10	100	35	100	38	100	52	100	14	100	149	100
	Average	3.3		3.9		4.2		4.7		4.7		4.3	

Age wise classification of population: The age wise classification of household members in Nagaraladoddi-2 Micro watershed is presented in Table 3. The indicated that, 34 (22.82%) of population were 0-15 years of age, 69 (46.31%) were 16-35 years of age, 41(27.52%) were 36-60 years of age and 5 (3.36 %) were above 61 years of age.

Table 3: Age wise classification of members of the household in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (10)		MF (35)		SF (38)		SMF (52)		MDF (14)		All (149)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	0-15 years of age	0	0	8	22.9	11	29	12	23.08	3	21	34	22.82
2	16-35 years of age	5	50	18	51.4	16	42.1	23	44.23	7	50	69	46.31
3	36-60 years of age	5	50	8	22.9	8	21.1	17	32.69	3	21	41	27.52
4	> 61 years	0	0	1	2.86	3	7.89	0	0	1	7.1	5	3.36
	Total	10	100	35	100	38	100	52	100	14	100	149	100

Education level of household members: Education level of household members in Nagaraladoddi-2 Micro watershed is presented in Table 4. The results indicated that, there were 46.31 per cent of illiterates, 20.13 per cent of them had primary school education, 4.70 per cent middle school education, 10.74 per cent high school education, 4.03 per cent of them had PUC education, 4.03 per cent attained graduation and 9.40 them had other education.

Table 4. Education level of members of the household in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (10)		MF (35)		SF (38)		SMF (52)		MDF (14)		All (149)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Illiterate	6	60	16	45.7	15	39.5	23	44.2	9	64.29	69	46.3
2	Primary School	1	10	3	8.57	8	21.1	16	30.8	2	14.29	30	20.1
3	Middle School	1	10	2	5.71	2	5.26	2	3.85	0	0	7	4.7
4	High School	1	10	3	8.57	7	18.4	5	9.62	0	0	16	10.7
5	PUC	1	10	2	5.71	1	2.63	1	1.92	1	7.14	6	4.03
6	Degree	0	0	2	5.71	0	0	3	5.77	1	7.14	6	4.03
7	Masters	0	0	0	0	0	0	1	1.92	0	0	1	0.67
8	Others	0	0	7	20	5	13.2	1	1.92	1	7.14	14	9.4
	Total	10	100	35	100	38	100	52	100	14	100	149	100

Occupation of head of households: The data regarding the occupation of the household heads in Nagaraladoddi-2 Micro watershed is presented in Table 5. The results indicate that, 51.43 per cent of households heads were practicing agriculture, 42.86 per cent of the household heads were agricultural Labour and housewife (2.86%).

Table 5: Occupation of heads of households in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Agriculture	1	33	5	56	4	44.44	8	73	0	0	18	51.43
2	Agricultural Labour	2	67	3	33	5	55.56	3	27	2	66.7	15	42.86
3	Others	0	0	1	11	0	0	0	0	0	0	1	2.86
4	Housewife	0	0	0	0	0	0	0	0	1	33.3	1	2.86
	Total	3	100	9	100	9	100	11	100	3	100	35	100

Table 6: Occupation of members of the household in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (10)		MF (35)		SF (38)		SMF (52)		MDF (14)		All (149)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Agriculture	2	20	10	28.6	5	13.16	17	32.69	0	0	34	22.8
2	Agricultural Labour	5	50	10	28.6	15	39.47	14	26.92	8	57	52	34.9
3	Private Service	1	10	1	2.86	1	2.63	2	3.85	0	0	5	3.36
4	Student	1	10	4	11.4	7	18.42	13	25	4	29	29	19.5
5	Others	0	0	1	2.86	1	2.63	0	0	0	0	2	1.34
6	Housewife	1	10	2	5.71	4	10.53	5	9.62	1	7.1	13	8.72
7	Children	0	0	7	20	5	13.16	1	1.92	1	7.1	14	9.4
	Total	10	100	35	100	38	100	52	100	14	100	149	100

Occupation of the members of the household: The data regarding the occupation of the household members in Nagaraladoddi-2 Micro watershed is presented in Table 6. The results indicate that, agriculture was the major occupation for 22.82 per cent of the household members, 34.90 per cent were agricultural labour, 19.46 per cent were working in pursuing education, 8.72 per cent were involved as housewife and 9.40 per cent were children.

Institutional Participation of household members: The data regarding the institutional participation of the household members in Nagaraladoddi-2 Micro watershed is presented in Table 7. The results show that, out of the total family members in the households 100 per cent of them were not participating in any of the institutions.

Table 7: Institutional Participation of household member in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (10)		MF (35)		SF (38)		SMF (52)		MDF (14)		All (149)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	No Participation	10	100	35	100	38	100	52	100	14	100	149	100
	Total	10	100	35	100	38	100	52	100	14	100	149	100

Type of house owned: The data regarding the type of house owned by the households in Nagaraladoddi-2 Micro watershed is presented in Table 8. The results indicate that, 14.29 percent possess thatched house, 80.00 per cent of the households possess katcha house, 5.71 per cent possess pacca house.

Table 8. Type of house owned by households in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (10)		MF (35)		SF (38)		SMF (52)		MDF (14)		All (149)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Thatched	2	67	1	11	0	0	1	9.09	1	33	5	14.29
2	Katcha	1	33	8	89	7	77.78	10	90.9	2	67	28	80
3	Pucca/RCC	0	0	0	0	2	22.22	0	0	0	0	2	5.71
	Total	3	100	9	100	9	100	11	100	3	100	35	100

Durable assets owned by the households: The data regarding the Durable Assets owned by the households in Nagaraladoddi-2 Micro watershed is presented in Table 9. The results shows that, 74.29 per cent possess TV, 48.57 per cent possess mixer grinder, 28.57 per cent possess motor cycle, 94.29 per cent possess mobile phones.

Table 9. Durable assets owned by households in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Television	3	100	5	56	6	66.7	9	82	3	100	26	74.29
2	Mixer/Grinder	1	33	6	67	5	55.6	3	27	2	66.7	17	48.57
3	Motor Cycle	1	33	3	33	4	44.4	2	18	0	0	10	28.57
4	Auto	0	0	1	11	0	0	0	0	0	0	1	2.86
5	Mobile Phone	3	100	8	89	8	88.9	11	100	3	100	33	94.29
6	Blank	0	0	1	11	1	11.1	0	0	0	0	2	5.71

Average value of durable assets: The data regarding the average value of durable assets owned by the households in Nagaraladoddi-2 Micro watershed is presented in Table 10. The result shows that, the average value of television was Rs.6846.00, mixer grinder was Rs.1805.00, motor cycle was Rs. 60000.00 and mobile phone was Rs.2083.00.

Table 10. Average value of durable assets owned in Nagaraladoddi-2 micro-watershed

Average Value (Rs.)

Sl.No.	Particulars	LL (3)	MF (9)	SF (9)	SMF (11)	MDF (3)	All (35)
1	Television	6000	5800	12500	4222	6000	6846
2	Mixer/Grinder	1500	1700	2000	1833	1750	1805
3	Motor Cycle	35000	60000	62500	67500	0	60000
4	Auto	0	200000	0	0	0	200000
5	Mobile Phone	2750	1769	1923	2384	2000	2083

Farm implements owned: The data regarding the farm implements owned by the households in Nagaraladoddi-2 Micro watershed is presented in Table 11. About 5.71 per cent of the households possess Bullock Cart, 25.71 per cent possess plough, 51.43 per cent possess Weeder, 2.86 per cent possess tractor.

Table 11. Farm implements owned in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Bullock Cart	0	0	0	0	1	11.11	1	9.09	0	0	2	5.71
2	Plough	0	0	2	22.2	2	22.22	4	36.4	1	33.3	9	25.71
3	Power Tiller	0	0	0	0	1	11.11	0	0	0	0	1	2.86
4	Tractor	0	0	0	0	1	11.11	0	0	0	0	1	2.86
5	Weeder	1	33	5	55.6	6	66.67	4	36.4	2	66.7	18	51.43
6	Thresher	0	0	1	11.1	1	11.11	1	9.09	0	0	3	8.57
7	Blank	2	67	4	44.4	3	33.33	7	63.6	1	33.3	17	48.57

Average value of farm implements: The data regarding the average value of farm Implements owned by the households in Nagaraladoddi-2 Micro watershed is presented in Table 12. The results show that the average value of plough was Rs.4055.00, bullock Cart was Rs.19000.00, weeder was Rs.138.00 and tractor Rs. 600000.

Table 12. Average value of farm implements in Nagaraladoddi-2 micro-watershed

Average Value (Rs.)

Sl.No.	Particulars	LL (3)	MF (9)	SF (9)	SMF (11)	MDF (3)	All (35)
1	Bullock Cart	0	0	20000	18000	0	19000
2	Plough	0	2000	4500	5375	2000	4055
3	Power Tiller	0	0	200000	0	0	200000
4	Tractor	0	0	600000	0	0	600000
5	Weeder	100	155	183	120	76	138
6	Thresher	0	2000	1800	1000	0	1450

Livestock possession by the households: The data regarding the Livestock possession by the households in Nagaraladoddi-2 Micro watershed is presented in Table 13. The indicate that, 20.00 per cent of the households possess bullocks, 11.43 per cent possess

local cow, 5.71 per cent possess buffalo, 8.57 per cent possess crossbred cow, 2.86 per cent possess sheep and 2.86 per cent possess goat.

Table 13. Livestock possession by households in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Bullock	0	0	2	22	1	11.11	4	36	0	0	7	20
2	Local cow	0	0	1	11	0	0	3	27	0	0	4	11.43
3	Crossbred cow	0	0	1	11	0	0	1	9.1	1	33.3	3	8.57
4	Buffalo	0	0	0	0	0	0	1	9.1	1	33.3	2	5.71
5	Sheep	0	0	0	0	0	0	1	9.1	0	0	1	2.86
6	Goat	0	0	0	0	0	0	0	0	1	33.3	1	2.86
7	blank	3	100	8	89	8	88.89	4	36	1	33.3	24	68.57

Average Labour availability: The data regarding the average labour availability in Nagaraladoddi-2 Micro watershed is presented in Table 14. The indicated that, own labour men available in the micro watershed was 1.35, women available in the micro watershed was 1.19, hired labour (men) available was 9.84 and hired labour (women) available was 14.9.

Table 14. Average labour availability in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)	MF (9)	SF (9)	SMF (11)	MDF (3)	All (35)
		N	N	N	N	N	N
1	Hired labour Female	0	8.22	18.13	14.82	26.7	14.9
2	Own Labour Female	0	1	1.13	1.36	1.33	1.19
3	Own labour Male	0	1.44	1	1.55	1.33	1.35
4	Hired labour Male	0	5.56	11.75	10.36	15.7	9.84

Adequacy of hired labour: The data regarding the adequacy of hired labour in Nagaraladoddi-2 Micro watershed is presented in Table 15. The results indicate that, 88.57 per cent of the household opined that hired labour was adequate.

Table 15. Adequacy of hired labour in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Adequate	0	0	9	100	8	88.9	11	100	3	100	31	88.6

Distribution of land (ha): The data regarding the distribution of land (ha) in Nagaraladoddi-2 Micro watershed is presented in Table 16. The results indicate that, 49.12 ha (85.73%) of dry land and 6.56 ha (11.44 %) of irrigated land.

Table 16. Distribution of land (ha) in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Dry	0	0	5.51	100	11.39	87.56	24.13	90.58	8.09	66.7	49.12	85.73
2	Irrigated	0	0	0	0	0	0	2.51	9.42	4.05	33.3	6.56	11.44
3	Permanent Fallow	0	0	0	0	1.62	12.44	0	0	0	0	1.62	2.83
	Total	0	100	5.51	100	13.01	100	26.64	100	12.14	100	57.3	100

Average value of land (ha): The data regarding the average land value (Rs./ha) in Nagaraladoddi-2 Micro watershed is presented in Table 17. The results show that the

average value of dry land was Rs.267593.51 and the average value of irrigated land was Rs.198209.88.

Table 17. Average value of land (ha) in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)	MF (9)	SF (9)	SMF (11)	MDF (3)	All (35)
		N	N	N	N	N	N
1	Dry	0	580749.5	307104.8	184359.3	247000	267593.5
2	Irrigated	0	0	0	358548.4	98800	198209.9
3	Permanent Fallow	0	0	370500	0	0	370500

Status of bore wells: The data regarding the status of bore wells in Nagaraladoddi-2 Micro watershed is presented in Table 18. The results indicate that, there were 4 De-functioning bore wells and 4 functioning bore wells among the sampled households in micro watershed.

Table 18. Status of bore wells in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)	MF (9)	SF (9)	SMF (11)	MDF (3)	All (35)
		N	N	N	N	N	N
1	De-functioning	0	1	0	2	1	4
2	Functioning	0	1	0	2	1	4

Source of irrigation: The data regarding the source of irrigation in Nagaraladoddi-2 Micro watershed is presented in Table 19. The results that bore well were major source of irrigation for 11.43 per cent of the households.

Table 19. Source of irrigation in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Bore Well	0	0	1	11.1	0	0	2	18.2	1	33.33	4	11.43

Depth of water (Avg. In meters): The data regarding the depth of water in Nagaraladoddi-2 Micro watershed is presented in Table 20. The results revealed that, the depth of bore well was 7.62 meter.

Table 20. Depth of water (Avg. In meters) in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)	MF (9)	SF (9)	SMF (11)	MDF (3)	All (35)
		N	N	N	N	N	N
1	Bore Well	0	0.85	0	15.24	30.48	7.62

Irrigated Area (ha): The data regarding the irrigated area (ha) in Nagaraladoddi-2 Micro watershed is presented in Table 21. The results indicate that, the availability of irrigation water was used for kharif crops was 3.64 ha.

Table 21. Irrigated Area (ha) in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)	MF (9)	SF (9)	SMF (11)	MDF (3)	All (35)
1	Kharif	0	0	0	1.21	2.43	3.64
	Total	0	0	0	1.21	2.43	3.64

Cropping pattern: The data regarding the cropping pattern in Nagaraladoddi-2 Micro watershed is presented in Table 22. The results indicate that, farmers have grown Cotton

(18.45 ha), Red gram (12.50 ha), Cotton (10.68 ha), Paddy (6.72 ha), Red gram (2.53 ha), Groundnut (0.81 ha) and Jowar (0.55 ha).

Table 22. Cropping pattern in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)	MF (9)	SF (9)	SMF (11)	MDF (3)	All (35)
1	Kharif - Cotton	0	1.62	2.66	9.31	4.86	18.45
2	Kharif - Red gram	0	0.83	3.47	6.58	1.62	12.5
3	Rabi - Cotton	0	1.7	2.43	2.51	4.05	10.68
4	Kharif - Paddy	0	0.81	1.62	4.29	0	6.72
5	Rabi - Red gram	0	0	0	2.53	0	2.53
6	Kharif - Groundnut	0	0	0.81	0	0	0.81
7	Kharif - Jowar	0	0.55	0	0	0	0.55

Cropping intensity: The data regarding the cropping intensity in Nagaraladoddi-2 Micro watershed is presented in Table 23. The results indicate that, the cropping intensity was 100.00 per cent.

Table 23. Cropping intensity (%) in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)	MF (9)	SF (9)	SMF (11)	MDF (3)	All (35)
1	Cropping Intensity	0	100	100	100	100	100

Possession of bank account and savings: The data regarding the possession of bank account and saving in Nagaraladoddi-2 micro-watershed is presented in Table 24. The results indicate that, 91.43 cent of the households posses bank account and 74.29 per cent of them have savings.

Table 24. Possession of Bank account and savings in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Account	3	100	8	88.89	9	100	9	81.82	3	100	32	91.43
2	Savings	2	66.67	8	88.89	6	66.67	8	72.73	2	66.67	26	74.29

Borrowing status: The data regarding the borrowing status in Nagaraladoddi-2 micro-watershed is presented in Table 25. The results indicate that, 74.29 percent of the sample farmers have borrowed credit from different sources.

Table 25. Borrowing status in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Credit Availed	2	66.67	8	88.89	6	66.7	8	72.7	2	67	26	74.29

Table 26. Source of credit borrowed by households in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (1)		MF (1)		SF (3)		SMF (3)		MDF (1)		All (9)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Commercial Bank	0	0	0	0	0	0	0	0	1	100	1	11.11
2	Friends/Relatives	1	100	0	0	0	0	0	0	0	0	1	11.11
3	Grameena Bank	0	0	4	400	8	267	3	100	2	200	17	188.9

Source of credit: The data regarding the source of credit availed by households in Nagaraladoddi-2 micro-watershed is presented in Table 26. The result shows that, 11.11 per cent have borrowed loan from commercial banks and 11.11 per cent have borrowed

loan from Friends/Relatives and 188.89 per cent have borrowed loan from Grameena Bank.

Avg. Credit amount: The data regarding the avg. Credit amount in Nagaraladoddi-2 micro-watershed is presented in Table 27. The results show that, farmers have borrowed Avg. Credit of Rs.207777.78 from different sources.

Table 27. Avg. Credit amount in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (1)	MF (1)	SF (3)	SMF (3)	MDF (1)	All (9)
		N	N	N	N	N	N
1	Average Credit	25000	385000	126667	226667	400000	207778

Purpose of credit borrowed (institutional Source): The data regarding the purpose of credit borrowed - Institutional Credit in Nagaraladoddi-2 micro-watershed is presented in Table 28. The results indicate that, 100.00 per cent of the households have borrowed loan for agriculture.

Table 28. Purpose of credit borrowed (institutional Source) by households in Nagaraladoddi-2 micro-watershed

SN	Particulars	MF (4)		SF (8)		SMF (3)		MDF (3)		All (18)	
		N	%	N	%	N	%	N	%	N	%
1	Agriculture production	4	100	8	100	3	100	3	100	18	100

Repayment status of household (institutional Source): The data regarding the repayment status of credit borrowed from institutional Source by households in Nagaraladoddi-2 micro watershed is presented in Table 29. The results indicate that, 11.11 per cent of the households have partially paid, 72.22 per cent have unpaid and 16.67 percent have fully paid.

Table 29. Repayment status of household (institutional Source) in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (0)		MF (4)		SF (8)		SMF (3)		MDF (3)		All (18)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Partially paid	0	0	0	0	1	12.5	1	33.33	0	0	2	11.11
2	Un paid	0	0	3	75	6	75	2	66.67	2	66.67	13	72.22
3	Fully paid	0	0	1	25	1	12.5	0	0	1	33.33	3	16.67

Opinion regarding institutional sources of credit: The results (Table 30) indicate that, 83.33 per cent of the households opined that credit helped to perform timely agricultural operations, 16.67 per cent Loan amount was adequate to fulfil the requirement.

Table 30. Opinion regarding institutional sources of credit in Nagaraladoddi-2 micro-watershed

Sl. No.	Particulars	MF(4)		SF(8)		SMF(3)		MDF(3)		All 18)	
		N	%	N	%	N	%	N	%	N	%
1	Helped to perform timely agricultural operations	3	75	8	100	2	67	2	67	15	83.3
2	Loan amount was adequate to fulfil the requirement	1	25	0	0	1	33	1	33	3	16.7

Cost of Cultivation of Red gram: The data regarding the cost of cultivation (Rs/ha) of Red gram in Nagaraladoddi-2 micro watershed is presented in Table 31.a. The results indicate that, the total cost of cultivation (Rs/ha) for Red gram was Rs. 40477.88. The gross income realized by the farmers was Rs. 47046.69. The net income from Red gram cultivation was Rs.6568.81, thus the benefit cost ratio was found to be 1:1.20.

Table 31(a). Cost of Cultivation of Red gram in Nagaraladoddi-2 micro-watershed

Sl.No	Particulars		Units	Phy Units	Value(Rs.)	% to C3
I	Cost A1					
1	Hired Human Labour		Man days	40.46	8095.47	20
2	Bullock		Pairs/day	2.71	2085.5	5.15
3	Tractor		Hours	3.52	2984.81	7.37
4	Machinery		Hours	0	0	0
5	Seed Main Crop (Establishment and Maintenance)		Kgs (Rs.)	12.72	1407.76	3.48
6	Seed Inter Crop		Kgs.	0	0	0
7	FYM		Quintal	3.05	7505.55	18.54
8	Fertilizer + micronutrients		Quintal	6.37	5485.88	13.55
9	Pesticides (PPC)		Kgs /liters	2.16	1684.96	4.16
10	Irrigation		Number	4.94	0	0
11	Repairs			0	181.82	0.45
13	Depreciation charges			0	40.79	0.1
II	Cost B1					
16	Interest on working capital				1930.1	4.77
17	**Cost B1 = (Cost A1 + sum of 15 and 16)**				31402.64	77.58
III	Cost B2					
18	Rental Value of Land				334.72	0.83
19	**Cost B2 = (Cost B1 + Rental value)**				31737.36	78.41
IV	Cost C1					
20	Family Human Labour			21.19	5060.71	12.5
21	**Cost C1 = (Cost B2 + Family Labour)**				36798.07	90.91
V	Cost C2					
22	Risk Premium				0	0
23	**Cost C2 = (Cost C1 + Risk Premium)**				36798.07	90.91
VI	Cost C3					
24	Managerial Cost				3679.81	9.09
25	**Cost C3 = (Cost C2 + Managerial Cost)**				40477.88	100
VII	Economics of the Crop					
a.	Main Product	a) Main Product (q)		8.48	47020.56	
		b) Main Crop Sales Price (Rs.)			5545.45	
	By Product	e) Main Product (q)		0.14	26.13	
		f) Main Crop Sales Price (Rs.)			181.82	
b.	Gross Income (Rs.)				47046.69	
c.	Net Income (Rs.)				6568.81	
d.	Cost per Quintal (Rs./q.)				4773.83	
e.	Benefit Cost Ratio (BC Ratio)				1:1.2	

Cost of Cultivation of Paddy: The data regarding the cost of cultivation (Rs/ha) of Paddy in Nagaraladoddi-2 micro watershed is presented in Table 31.b. The results indicate that, the total cost of cultivation (Rs/ha) for Paddy was Rs. 46971.35. The gross income realized by the farmers was Rs. 43506.76. The net income from Paddy cultivation was Rs.-3464.59, thus the benefit cost ratio was found to be 1:0.95.

Table 31(b). Cost of Cultivation of Paddy in Nagaraladoddi-2 micro-watershed

Sl.No	Particulars	Units	Phy Units	Value(Rs.)	% to C3
I	**Cost A1**				
1	Hired Human Labour	Man days	33.33	5919.72	12.6
2	Bullock	Pairs/day	1.35	852.9	1.82
3	Tractor	Hours	3.55	2568.1	5.47
4	Machinery	Hours	0.16	0	0
5	Seed Main Crop (Establishment and Maintenance)	Kgs (Rs.)	46.03	9066.59	19.3
6	Seed Inter Crop	Kgs.	0	0	0
7	FYM	Quintal	3.43	8565.49	18.24
8	Fertilizer + micronutrients	Quintal	8.41	7067.91	15.05
9	Pesticides (PPC)	Kgs / liters	1.7	1312.42	2.79
10	Irrigation	Number	3.29	0	0
11	Repairs		0	750	1.6
13	Depreciation charges		0	154.81	0.33
II	**Cost B1**				
16	Interest on working capital			3121.49	6.65
17	**Cost B1 = (Cost A1 + sum of 15 and 16)**			39379.43	83.84
III	**Cost B2**				
18	Rental Value of Land			295.83	0.63
19	**Cost B2 = (Cost B1 + Rental value)**			39675.27	84.47
IV	**Cost C1**				
20	Family Human Labour		12.97	3025.96	6.44
21	**Cost C1 = (Cost B2 + Family Labour)**			42701.23	90.91
V	**Cost C2**				
22	Risk Premium			0	0
23	**Cost C2 = (Cost C1 + Risk Premium)**			42701.23	90.91
VI	**Cost C3**				
24	Managerial Cost			4270.12	9.09
25	**Cost C3 = (Cost C2 + Managerial Cost)**			46971.35	100
VII	**Economics of the Crop**				
a.	Main Product	a) Main Product (q)	26.1	43062.94	
		b) Main Crop Sales Price (Rs.)		1650	
	By Product	e) Main Product (q)	1.18	443.83	
		f) Main Crop Sales Price (Rs.)		375	
b.	Gross Income (Rs.)			43506.76	
c.	Net Income (Rs.)			-3464.59	
d.	Cost per Quintal (Rs./q.)			1799.75	
e.	Benefit Cost Ratio (BC Ratio)			1:0.95	

Cost of Cultivation of Cotton: The data regarding the cost of cultivation (Rs/ha) of Cotton in Nagaraladoddi-2 micro watershed is presented in Table 31.c. The results indicate, the total cost of cultivation (Rs/ha) for Cotton was Rs.32690.13. The gross income realized by the farmers was Rs. 54615.25. The net income from Cotton cultivation was Rs. 21925.12, thus the benefit cost ratio was found to be 1:1.70.

Table 31(c). Cost of Cultivation of Cotton in Nagaraladoddi-2 micro-watershed

Sl.No	Particulars		Units	Phy Units	Value(Rs.)	% to C3
I	**Cost A1**					
1	Hired Human Labour		Mandays	29.01	5095.2	15.59
2	Bullock		Pairs/day	1.25	794.01	2.43
3	Tractor		Hours	3.21	2619.08	8.01
4	Machinery		Hours	0	0	0
5	Seed Main Crop (Establishment and Maintenance)		Kgs (Rs.)	5.02	4817.23	14.74
6	Seed Inter Crop		Kgs.	0	0	0
7	FYM		Quintal	1.95	4863.78	14.88
8	Fertilizer + micronutrients		Quintal	5	4303.36	13.16
9	Pesticides (PPC)		Kgs/liters	1.63	1133.24	3.47
10	Irrigation		Number	2.81	0	0
11	Repairs			0	444.44	1.36
12	Msc. Charges (Marketing costs etc)			0	0	0
13	Depreciation charges			0	718.09	2.2
14	Land revenue and Taxes			0	0	0
II	**Cost B1**					
16	Interest on working capital				1814.11	5.55
17	**Cost B1 = (Cost A1 + sum of 15 and 16)**				26602.56	81.38
III	**Cost B2**					
18	Rental Value of Land				351.85	1.08
19	**Cost B2 = (Cost B1 + Rental value)**				26954.41	82.45
IV	**Cost C1**					
20	Family Human Labour			12.41	2763.89	8.45
21	**Cost C1 = (Cost B2 + Family Labour)**				29718.3	90.91
V	**Cost C2**					
22	Risk Premium				0	0
23	**Cost C2 = (Cost C1 + Risk Premium)**				29718.3	90.91
VI	**Cost C3**					
24	Managerial Cost				2971.83	9.09
25	**Cost C3 = (Cost C2 + Managerial Cost)**				32690.13	100
VII	**Economics of the Crop**					
a.	Main Product	a) Main Product (q)		10.92	54615.25	
		b) Main Crop Sales Price (Rs.)			5000	
b.	Gross Income (Rs.)				54615.25	
c.	Net Income (Rs.)				21925.12	
d.	Cost per Quintal (Rs./q.)				2992.77	
e.	Benefit Cost Ratio (BC Ratio)				1:1.7	

Cost of Cultivation of Jowar: The data regarding the cost of cultivation (Rs/ha) of Jowar in Nagaraladoddi-2 micro watershed is presented in Table 31.d. The results indicate that, the total cost of cultivation (Rs/ha) for Jowar was Rs. 49477.76. The gross income realized by the farmers was Rs.52883.33. The net income from Jowar cultivation was Rs. 3405.58, thus the benefit cost ratio was found to be 1:1.10.

Table 31(d). Cost of Cultivation of Jowar in Nagaraladoddi-2 micro-watershed

Sl.No	Particulars		Units	Phy Units	Value(Rs.)	% to C3
I	Cost A1					
1	Hired Human Labour		Man days	37.53	5787.08	11.7
2	Bullock		Pairs/day	2.11	1266.67	2.56
3	Tractor		Hours	7.23	5061.39	10.23
4	Machinery		Hours	0	0	0
5	Seed Main Crop (Establishment and Maintenance)		Kgs (Rs.)	25.91	1828.75	3.7
6	Seed Inter Crop		Kgs.	0	0	0
7	FYM		Quintal	0	0	0
8	Fertilizer + micronutrients		Quintal	15.52	12006.94	24.27
9	Pesticides (PPC)		Kgs / liters	2.11	1055.56	2.13
10	Irrigation		Number	0	0	0
11	Repairs			0	0	0
12	Msc. Charges (Marketing costs etc)			0	0	0
13	Depreciation charges			0	85.61	0.17
14	Land revenue and Taxes			0	0	0
II	Cost B1					
16	Interest on working capital				1786.95	3.61
17	**Cost B1 = (Cost A1 + sum of 15 and 16)**				28878.94	58.37
III	Cost B2					
18	Rental Value of Land				283.33	0.57
19	**Cost B2 = (Cost B1 + Rental value)**				29162.28	58.94
IV	Cost C1					
20	Family Human Labour			68.24	15817.5	31.97
21	**Cost C1 = (Cost B2 + Family Labour)**				44979.78	90.91
V	Cost C2					
22	Risk Premium				0	0
23	**Cost C2 = (Cost C1 + Risk Premium)**				44979.78	90.91
VI	Cost C3					
24	Managerial Cost				4497.98	9.09
25	**Cost C3 = (Cost C2 + Managerial Cost)**				49477.76	100
VII	**Economics of the Crop**					
a.	Main Product	a) Main Product (q)		17.63	52883.33	
		b) Main Crop Sales Price (Rs.)			3000	
b.	Gross Income (Rs.)				52883.33	
c.	Net Income (Rs.)				3405.58	
d.	Cost per Quintal (Rs./q.)				2806.81	
e.	Benefit Cost Ratio (BC Ratio)				1:1.1	

Cost of Cultivation of Groundnut: The data regarding the cost of cultivation (Rs/ha) of Groundnut in Nagaraladoddi-2 micro watershed is presented in Table 31.e. The results indicate that, the total cost of cultivation (Rs/ha) for Groundnut was Rs.66158.16. The gross income realized by the farmers was Rs. 37050.00. The net income from Groundnut cultivation was Rs. -29108.16, thus the benefit cost ratio was found to be 1:0.65.

Table 31(e). Cost of Cultivation of Groundnut in Nagaraladoddi-2 micro-watershed

Sl.No	Particulars		Units	Phy Units	Value(Rs.)	% to C3
I	Cost A1					
1	Hired Human Labour		Man days	27.17	4260.75	6.44
2	Bullock		Pairs/day	2.47	1482	2.24
3	Tractor		Hours	3.71	2593.5	3.92
4	Machinery		Hours	0	0	0
5	Seed Main Crop (Establishment and Maintenance)		Kgs (Rs.)	135.85	9509.5	14.37
6	Seed Inter Crop		Kgs.	0	0	0
7	FYM		Quintal	12.35	24700	37.33
8	Fertilizer + micronutrients		Quintal	7.41	6422	9.71
9	Pesticides (PPC)		Kgs / liters	3.71	1852.5	2.8
10	Irrigation		Number	0	0	0
11	Repairs			0	0	0
12	Msc. Charges (Marketing costs etc)			0	0	0
13	Depreciation charges			0	51.87	0.08
14	Land revenue and Taxes			0	0	0
II	Cost B1					
16	Interest on working capital				5098.08	7.71
17	**Cost B1 = (Cost A1 + sum of 15 and 16)**				55970.2	84.6
III	Cost B2					
18	Rental Value of Land				283.33	0.43
19	**Cost B2 = (Cost B1 + Rental value)**				56253.53	85.03
IV	Cost C1					
20	Family Human Labour			17.29	3890.25	5.88
21	**Cost C1 = (Cost B2 + Family Labour)**				60143.78	90.91
V	Cost C2					
22	Risk Premium				0	0
23	**Cost C2 = (Cost C1 + Risk Premium)**				60143.78	90.91
VI	Cost C3					
24	Managerial Cost				6014.38	9.09
25	**Cost C3 = (Cost C2 + Managerial Cost)**				66158.16	100
VII	Economics of the Crop					
a.	Main Product	a) Main Product (q)		6.18	37050	
		b) Main Crop Sales Price (Rs.)			6000	
b.	Gross Income (Rs.)				37050	
c.	Net Income (Rs.)				-29108.16	
d.	Cost per Quintal (Rs./q.)				10713.87	
e.	Benefit Cost Ratio (BC Ratio)				1:0.65	

Adequacy of fodder: The data regarding the adequacy of fodder in Nagaraladoddi-2 Micro watershed is presented in Table 32. The results indicate that, 14.29 per cent of the households opined that dry fodder was adequate and 17.14 per cent of them opined dry fodder was inadequate. With respect to green fodder availability, 5.71 percent of them opined it was sufficient.

Table 32. Adequacy of fodder in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Adequate-Dry Fodder	0	0	0	0	0	0	4	36.4	1	33.3	5	14.29
2	Inadequate-Dry Fodder	0	0	2	22.22	0	0	3	27.3	1	33.3	6	17.14
3	Adequate-Green Fodder	0	0	0	0	0	0	1	9.09	1	33.3	2	5.71

Average annual gross income: The data regarding the annual gross income in Nagaraladoddi-2 Micro watershed is presented in Table 33. The results indicate that, the farmers have annual gross income of Rs. 98685.71 in micro-watershed, of which Rs. 70914.29 is from agriculture itself.

Table 33. Average annual gross income in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)	MF (9)	SF (9)	SMF (11)	MDF (3)	All (35)
		Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1	Business	0	2222.22	0	0	0	571.43
2	Wage	25000	22222.2	34888.9	20090.9	26666.7	25428.6
3	Agriculture	6666.67	30111.1	57222.2	105818	170667	70914.3
4	Dairy Farm	0	0	0	3636.36	666.67	1200
5	Goat Farming	0	0	0	1818.18	0	571.43
	Income(Rs.)	31666.7	54555.6	92111.1	131364	198000	98685.7

Average annual Expenditure: The data regarding the average annual expenditure in Nagaraladoddi-2 Micro watershed is presented in Table 34. The results indicate that, the farmers have annual gross expenditure of Rs. 241027.78 in micro-watershed, of which Rs. 31428.57 is from agriculture itself.

Table 34. Average annual Expenditure in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)	MF (9)	SF (9)	SMF (11)	MDF (3)	All (35)
		Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1	Service/salary	0	0	0	0	0	0
2	Business	0	2000	0	0	0	57.14
3	Wage	17500	4166.67	9777.78	7125	5666.67	6342.86
4	Agriculture	15000	16333.3	31125	44000	68333.3	31428.6
5	Dairy Farm	0	0	0	12000	0	342.86
6	Goat Farming	0	0	0	8000	0	228.57
	Total	32500	22500	40902.8	71125	74000	241028

Horticulture species grown: The data regarding horticulture species grown in Nagaraladoddi-2 Micro watershed is presented in Table 35. The results indicate that, the total number of horticultural trees grown (both field and backyard) by the sampled households were Mango (2).

Table 35. Horticulture species grown in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		F	B	F	B	F	B	F	B	F	B	F	B
1	Mango	0	0	0	0	2	0	0	0	0	0	2	0

*F= Field B=Back Yard

Interest towards cultivation of horticulture crops: The data regarding Table (36) indicates that, 14.29 per cent of the households shown interest to cultivate horticultural crops.

Table 36. Interest towards cultivation of horticulture crops in Nagaraladoddi-2 micro-watershed

Sl. No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Interested towards cultivation of horticulture crops	0	0	3	33	2	22	0	0	0	0	5	14.3

Forest species grown: The data regarding forest species grown in Nagaraladoddi-2 Micro watershed is presented in Table 37. The results indicate that, households have planted 9 neem trees together in both field and backyard.

Table 37. Forest species grown in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		F	B	F	B	F	B	F	B	F	B	F	B
1	Neem	0	0	0	0	4	0	2	0	3	0	9	0

*F= Field B=Back Yard

Average additional investment capacity: The data regarding average additional investment capacity in Nagaraladoddi-2 Micro watershed is presented in Table 38. The results indicate that, households have an average investment capacity of Rs. 9171.43 for land development, Rs. 457.14 for creation of irrigation facility, Rs.4314.29 for adoption of improved livestock breeds and Rs.514.29 adoption of improved crop production activities.

Table 38. Average additional investment capacity of households in Nagaraladoddi-2 micro-watershed

Sl. No.	Particulars	LL (3)	MF (9)	SF (9)	SMF (11)	MDF (3)	All (35)
		Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1	Land development	0	6888.89	12444.4	8363.64	18333.3	9171.43
2	Irrigation facility	0	0	0	727.27	2666.67	457.14
3	Improved crop production	0	2666.67	3555.56	6818.18	6666.67	4314.29
4	Improved livestock management	0	0	0	1090.91	2000	514.29

Source of funds for additional investment: The data regarding source of funds for additional investment in Nagaraladoddi-2 Micro watershed is presented in Table 39. The results indicate that, the sources of finance raised from bank as a loan and from own sources for land development were 62.86.

Table 39. Source of funds for additional investment in Nagaraladoddi-2 micro-watershed

Sl.No	Item	Land development		Irrigation facility		Improved crop production		Improved livestock management	
		N	%	N	%	N	%	N	%
1	Own funds	22	62.86	2	5.71	21	60	3	8.57

Marketing of agricultural produce: The data regarding marketing of the agricultural produce in Nagaraladoddi-2 Micro watershed is presented in Table 40. The results indicated that, 97.05 percent of output of Cotton was sold in the market with average price of Rs. 5000.00; 80.00 percent of output of Groundnut was sold in the market with average price of Rs. 6000.00; 100.00 percent of output of Jowar was sold in the market with average price of Rs. 3000.00 and 100.00 percent of output of Onion was sold in the market with average price of Rs. 600.00.

Table 40. Marketing of agricultural produce in Nagaraladoddi-2 micro-watershed

Sl.No	Crops	Output obtained (q)	Output retained (q)	Output sold (q)	Output sold (%)	Avg. Price obtained (Rs/q)
1	Cotton	305	9	296	97	5000
2	Groundnut	5	1	4	80	6000
3	Jowar	7	0	7	100	3000
4	Onion	7	0	7	100	600
5	Paddy	155	15	140	90	1650
6	Redgram	128	13	115	90	5545

Marketing channels used for sale of agricultural produce: The data regarding marketing channels used for sale of agricultural produce in Nagaraladoddi-2 Micro watershed is presented in Table 41. The results indicated that, 45.71 cent of the households have sold agricultural produce to the local/village merchants, 51.43 per cent of regulated market and 8.57 per cent of cooperative marketing society.

Table 41. Marketing channels used for sale of agricultural produce in Nagaraladoddi-2 micro-watershed

Sl. No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Local/village Merchant	0	0	6	67	1	11.1	6	54.6	3	100	16	45.71
2	Regulated Market	0	0	3	33	6	66.7	7	63.6	2	66.7	18	51.43
3	Cooperative marketing Society	0	0	0	0	2	22.2	1	9.09	0	0	3	8.57

Mode of transport of agricultural produce: The data regarding mode of transport of agricultural produce in Nagaraladoddi-2 Micro watershed is presented in Table 42. The results indicated that, 88.57 cent of the households have used tractor and 14.29 per cent have used Cart.

Table 42. Mode of transport of agricultural produce in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Cart	0	0	1	11	0	0	4	36.4	0	0	5	14.29
2	Tractor	0	0	8	89	8	88.9	10	90.9	5	167	31	88.57
3	Truck	0	0	0	0	1	11.1	0	0	0	0	1	2.86

Incidence of soil and water erosion problems: The data regarding incidence of incidence of soil and water erosion problems in Nagaraladoddi-2 Micro watershed is presented in Table 43. The results indicate that, 91.43 per cent of the households have experienced soil and water erosion problems.

Table 43. Incidence of soil and water erosion problems in Nagaraladoddi-2 micro-watershed

Sl. No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Soil and water erosion problems in the farm	0	0	9	100	8	88.9	12	109	3	100	32	91.43

Interest towards soil testing: The data regarding Interest shown towards soil testing in Nagaraladoddi-2 Micro watershed is presented in Table 44. The results indicated that, 91.43 per cent of the households were interested towards soil testing.

Table 44. Interest regarding soil testing in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Interest in soil test	0	0	10	111	8	88.9	11	100	3	100	32	91.43

Usage pattern of fuel for domestic use: The data on usage pattern of fuel for domestic use in Nagaraladoddi-2 Micro watershed is presented in Table 45. The results indicated that, firewood was the major source of fuel for domestic use for 85.71 per cent of the households followed by LPG (25.71%).

Table 45. Usage pattern of fuel for domestic use in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Fire Wood	3	100	8	88.9	8	88.9	8	72.7	3	100	30	85.71
2	LPG	2	66.7	1	11.1	1	11.1	4	36.4	1	33.3	9	25.71

Table 46. Source of drinking water in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Piped supply	3	100	9	100	9	100	10	90.9	3	100	34	97.14
2	Lake/ Tank	0	0	0	0	0	0	1	9.09	0	0	1	2.86

Source of drinking water: The data on source of drinking water in Nagaraladoddi-2 Micro watershed is presented in Table 46. The results indicated that, tank supply of water

was the major source for drinking water for 2.86 per cent of the households followed by piped waters supply (97.14 %).

Source of light: The data on source of light in Nagaraladoddi-2 Micro watershed is presented in Table 47. The results indicated that, electricity was the major source of light for 97.14 per cent of the households.

Table 47. Source of light in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Electricity	3	100	9	100	9	100	11	100	2	66.7	34	97.1

Existence of sanitary toilet facility: The data on availability of toilet facility in Nagaraladoddi-2 Micro watershed is presented in Table 48. The results indicated that, 45.71 per cent of the households possess toilets.

Table 48. Existence of sanitary toilet facility in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Sanitary toilet facility	2	66.7	5	56	2	22.22	5	45	2	66.7	16	45.7

Possession of PDS card: The data regarding possession of PDS card in Nagaraladoddi-2 Micro watershed is presented in Table 49. The results indicated that, 100.00per cent of the households possessed BPL card.

Table 49. Possession of PDS card in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	BPL	3	100	9	100	9	100	11	100	3	100	35	100

Participation in NREGA programme: The data regarding Participation in NREGA programme in Nagaraladoddi-2 Micro watershed is presented in Table 50. The results indicated that, only 5.71 percent of the households have participated in NREGA programme.

Table 50. Participation in NREGA programme in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Participation in NREGA programme	0	0	1	11.1	0	0	1	9.09	0	0	2	5.71

Adequacy of food items: The data regarding adequacy of food items in Nagaraladoddi-2 Micro watershed is presented in Table 51. The results indicated that, the extent of adequacy of food items for cereals, pulses, Oilseeds and vegetables were 94.29, 91.43, 34.29, 37.14 per cent respectively, similarly for Fruits (22.86%), milk (42.86%), Egg (17.14%), and Meat (8.57%).

Table 51. Adequacy of food items in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Cereals	2	66.7	8	88.9	8	88.89	12	109	3	100	33	94.29
2	Pulses	2	66.7	8	88.9	8	88.89	11	100	3	100	32	91.43
3	Oilseed	0	0	2	22.2	2	22.22	7	63.6	1	33.33	12	34.29
4	Vegetables	1	33.3	3	33.3	1	11.11	6	54.6	2	66.67	13	37.14
5	Fruits	1	33.3	2	22.2	3	33.33	1	9.09	1	33.33	8	22.86
6	Milk	1	33.3	5	55.6	3	33.33	5	45.5	1	33.33	15	42.86
7	Egg	2	66.7	1	11.1	1	11.11	0	0	2	66.67	6	17.14
8	Meat	2	66.7	0	0	0	0	0	0	1	33.33	3	8.57

Inadequacy of food items: The data regarding in adequacy of food items in Nagaraladoddi-2 Micro watershed is presented in Table 52. The results indicated that, the extent of in adequacy of food items for cereals, pulses, Oilseeds and vegetables were 8.57, 8.57, 31.43, 25.71 and 37.14 per cent respectively, similarly for fruits (54.29%), milk (34.29%), egg (31.43%) and meat (37.14%).

Table 52. Inadequacy of food items in Nagaraladoddi-2 micro-watershed

Sl.No.	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Cereals	1	33.3	1	11.1	1	11.11	0	0	0	0	3	8.57
2	Pulses	1	33.3	1	11.1	1	11.11	0	0	0	0	3	8.57
3	Oilseed	3	100	1	11.1	3	33.33	3	27.3	1	33.33	11	31.43
4	Vegetables	2	66.7	0	0	4	44.44	3	27.3	0	0	9	25.71
5	Fruits	1	33.3	2	22.2	5	55.56	9	81.8	2	66.67	19	54.29
6	Milk	1	33.3	4	44.4	2	22.22	4	36.4	1	33.33	12	34.29
7	Egg	0	0	2	22.2	2	22.22	7	63.6	0	0	11	31.43
8	Meat	0	0	3	33.3	2	22.22	7	63.6	1	33.33	13	37.14

Farming constraints: The data regarding farming constraints experienced by households in Nagaraladoddi-2 Micro watershed is presented in Table 53. The results indicated that, lower fertility status of the soil was the constraint experienced by (85.71 %) per cent of the households, wild animal menace on farm field (80.00%), frequent incidence of pest and diseases (77.14%), inadequacy of irrigation water (80.00%), high cost of fertilizers and plant protection chemicals (77.14%), high rate of interest on credit (88.57%), low price for the agricultural commodities (88.57 %), lack of marketing facilities in the area (80.00%), inadequate extension services (60.00 %) and lack of transport for safe transport of the agricultural produce to the market (88.57%).

Table 53. Farming constraints experienced in Nagaraladoddi-2 micro-watershed

SN	Particulars	LL (3)		MF (9)		SF (9)		SMF (11)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Lower fertility status of the soil	0	0	9	100	7	77.78	11	100	3	100	30	85.71
2	Wild animal menace on farm field	0	0	7	77.78	7	77.78	11	100	3	100	28	80
3	Frequent incidence of pest and diseases	0	0	8	88.89	7	77.78	10	90.91	2	66.67	27	77.14
4	Inadequacy of irrigation water	0	0	8	88.89	7	77.78	10	90.91	3	100	28	80
5	High cost of Fertilizers and plant protection chemicals	0	0	9	100	8	88.89	9	81.82	1	33.33	27	77.14
6	High rate of interest on credit	0	0	8	88.89	8	88.89	11	100	4	133.33	31	88.57
7	Low price for the agricultural commodities	0	0	9	100	8	88.89	11	100	3	100	31	88.57
8	Lack of marketing facilities in the area	0	0	8	88.89	6	66.67	11	100	3	100	28	80
9	Inadequate extension services	0	0	7	77.78	3	33.33	8	72.73	3	100	21	60
10	Lack of transport for safe transport of the Agril produce to the market.	0	0	9	100	8	88.89	11	100	3	100	31	88.57

SUMMARY AND IMPLICATIONS

In order to assess the socio-economic condition of the farmers in the watershed 35 households located in the micro watershed were interviewed for the survey. The study was conducted in Nagaraladoddi-2 micro-watershed (Ajalapur sub-watershed, Yadgiri taluk & District) is located at North latitude 16^0 33' 23.838" and 16^0 31' 6.086" and East longitude 77^0 25' 9.296" and 77^0 24' 10.745"covering an area of about 294.61 ha bounded by unde Duppalli village.

Socio-economic analysis of Nagaraladoddi-2 micro watersheds of Ajalapur sub-watershed, Yadgiri taluk & District indicated that, out of the total sample of 35 farmers were sampled in Nagaraladoddi-2 micro-watershed among households surveyed 9 (25.71%) were marginal, 9 (25.71%) were small, 11 (31.43 %) were semi medium and 3 (8.57 %) were medium farmers. 3 landless farmers were also interviewed for the survey. The population characteristics of households indicated that, there were 80 (53.69%) men and 69 (46.31 %) were women. The average population of landless was 3.3, marginal farmers were 3.9, small farmers were 4.2, semi medium farmers were 4.7 and medium farmers were 4.7. Majority of the respondents (46.31%) were in the age group of 16-35 years.

Education level of the sample households indicated that, there were 46.31 per cent illiterates, 43.63 per cent pre university education and 4.03 per cent attained graduation. About, 51.43 per cent of household heads practicing agriculture and 42.86 per cent of the household heads were engaged as agricultural labourers. Agriculture was the major occupation for 22.82 per cent of the household members.

In the study area, 80.00 per cent of the households possess katcha house and 5.71 per cent possess pucca house. The durable assets owned by the households showed that, 74.29 per cent possess TV, 48.57 per cent possess mixer grinder, 94.29 per cent possess mobile phones and 28.57 per cent possess motor cycles.

Farm implements owned by the households indicated that, 25.71 per cent of the households possess plough, 2.86 per cent possess tractor, 5.71 per cent possess bullock cart. Regarding livestock possession by the households, 11.43 per cent possess local cow and 5.71 per cent possess buffalo.

The average labour availability in the study area showed that, own labour men available in the micro watershed was 1.35, women available in the micro watershed was 1.19, hired labour (men) available was 9.84 and hired labour (women) available was 14.9. Out of the total land holding of the sample respondents 85.73 per cent (57.30 ha) of the area is under dry condition and the remaining 11.44 per cent area is irrigated land.

There were 4.00 live bore wells and 4.00 dry bore wells among the sampled households. Bore well was the major source of irrigation for 11.43 per cent of the

households. The major crops grown by sample farmers are Red gram, Paddy, Cotton, Jowar and Groundnut and cropping intensity was recorded as 100.00 per cent.

Out of the sample households 91.43 percent possessed bank account and 74.29 per cent of them have savings in the account. About 74.29 per cent of the respondents borrowed credit from various sources. Among the credit borrowed by households, 11.11 per cent have borrowed loan from commercial banks and 188.89 per cent from co-operative/Grameena bank. Majority of the respondents (100.00%) have borrowed loan for agriculture purpose.

Regarding the opinion on institutional sources of credit, 83.33 per cent of the households opined that credit helped to perform timely agricultural operations, while, only 16.67 per cent respondents opined that loan amount was adequate to fulfil their requirement. The per hectare cost of cultivation for Red gram, Paddy, Cotton, Jowar and Groundnut was Rs.40477.88 , 46971.35, 32690.13, 49477.76 and 66158.16 with benefit cost ratio of 1:1.20, 1: 0.95, 1: 1.70, 1: 1.10 and 1:0.65 respectively.

Further, 14.29 per cent of the households opined that dry fodder was adequate and 5.71 per cent of the households have opined that the green fodder was adequate. The average annual gross income of the farmers was Rs. 98685.71 in micro-watershed, of which Rs. 70914.29 comes from agriculture.

Sampled households have grown 2 horticulture trees and 9 forestry trees together in the fields and back yards. About 14.29 per cent of the households shown interest to cultivate horticultural crops. Households have an average investment capacity of Rs. 9171.43 for land development and Rs. 457.14 for irrigation facility. Source of funds for additional investment is concerned 62.86 per cent depends on bank loan for land development activities.

Regarding marketing channels, 45.71 per cent of the households have sold agricultural produce to the local/village merchants, while, 51.43 per cent have sold in regulated markets. Further, 88.57 per cent of the households have used tractor for the transport of agriculture commodity. Majority of the farmers (91.43%) have experienced soil and water erosion problems in the watershed and 91.43 per cent of the households were interested towards soil testing.

Fire was the major source of fuel for domestic use for 85.71 per cent of the households and 25.71 per cent households has LPG connection. Piped supply was the major source for drinking water for 97.14 per cent of the households. Electricity was the major source of light for 97.14 per cent of the households.

In the study area, 45.71 per cent of the households possess toilet facility. Regarding possession of PDS card, 100.00 per cent of the households possessed BPL card. Households opined that, the requirement of cereals (94.29%), pulses (91.43%) and oilseeds (34.29%) are adequate for consumption.

Farming constraints experienced by households in the micro watersheds were lower fertility status of the soil (85.71%) wild animal menace on farm field (80.00%), frequent incidence of pest and diseases (77.14%), inadequacy of irrigation water (80.00%), high cost of fertilizers and plant protection chemicals (77.14%), high rate of interest on credit (88.57%), low price for the agricultural commodities (88.57%), lack of marketing facilities in the area (80.00%), inadequate extension services (60.00%), lack of transport for safe transport of the agricultural produce to the market (88.57%).

Implications of the survey

✓ Result indicated that, there were 46.31 per cent were illiterate hence, extension methodologies such as demonstration, street play, drama, video shows will be effective in dissemination of the technologies in the micro watershed.

✓ The data indicate that, 80.00 per cent of the households possess katcha house. Hence, the development department while implementing the watershed plan should focus on agriculture to enhance the productivity of major crops in the area to increase the income of the farmers.

✓ Results indicated that the local institutional participation of the household members in the micro watershed is minimal hence, activities like membership campaign, awareness creation about the benefits of membership in local institutions and strengths of organized groups must be conveyed.

✓ Majority of the households in the watershed have experience in use of mobile phones, and television hence, these mass media can be effectively utilized for transfer of technology as well as for information dissemination.

✓ The farm machinery/implement possession in the micro watershed was found to be minimum the reasons may lack of knowledge or lack of financial ability which can be addressed through training on use of different farm implements, providing information on different sources of finance for purchase of farm implements.

✓ The possession of livestock such as crossbred cow found is less hence, farmers must be made aware of the benefits of crossbred cow in increased milk production.

✓ The possession of livestock such as sheep, goat and poultry was found to be low hence, farmers may be informed the role of subsidiary enterprises in enhancing the income and information on financial support for subsidiary activities.

✓ The data indicate that, job/work was the reason for all the migrants hence, farmers may be trained on profitable agriculture or self employment such has animal husbandry, plate making, sheep rearing, goat rearing, rabbit rearing with suitable information on sources of financial support.

✓ The results indicate that there was a change in quality of life due to migration hence, the developmental departments should take actions to arrest migration and to improve the quality of the life in rural areas.

✓ Households possess 49.12ha (85.73 %) of dry land and 6.56ha (11.44 %) of irrigated land hence, the availability of the dry land agricultural technologies such as short duration crops, high yielding drought resistance crop varieties, drip irrigation technology and subsidy information will be helpful for the farmers to enhance the productivity of land and as well as farmers income.

✓ Few of the bore well in micro watershed found non functional hence, farmers may be trained on possibility of bore well rejuvenation.

✓ Bore well was major source of irrigation for 11.43 per cent of the households. hence, in order to increase the area under irrigation as well as to increase the water use efficiency farmers may trained on drip irrigation and provide the information on subsidy for drip irrigation equipment's along with the information on different agencies which provides the financial assistance for drip irrigation.

✓ The cropping intensity in the micro watershed was found to be (100.00 %) hence, care must be taken by the implementing agency to bring uncultivated land into cultivation through suitable measures.

✓ Many of the household members have borrowed loan from cooperative banks which has higher rate of interest hence, farmers may be sensitized on the different sources of credit with lesser interest rate such SHGs etc.

✓ The results indicated the non availability of both green and dry fodder throughout the year hence, fodder development activities can be taken up in the micro watershed.

✓ The average annual gross income of the households Rs.70914.29 from agriculture, Rs.571.43 from business and Rs. 25428.57 from wages and. Agriculture was found to be the major source of income for households hence; the development activities should focus on productivity enhancement, marketing arrangements and agricultural technology dissemination to have a direct impact on the farmers.

✓ The cultivation of forest species is found minimal hence, information and production technology related to agro-forestry and integrated farming system.

✓ The data indicated that, 91.43 per cent of the households have experienced soil and water erosion problems. Hence, those farmers who reported the soil and water erosion problems may be given attention while implementation of the watershed development plan.

✓ The data indicated that, 91.43 per cent of the households have interest in soil testing hence, farmers must be provided with the information on various institutions which are involved in soil testing for the benefit of the farmers.

✓ Except summer ploughing the adoption of other soil and water conservation structures is minimum hence, the farmers in the micro watershed should be sensitized on the use of different conservation structures for soil water conservation.

✓ Cereals and pulses found be adequate for per cent of the households respectively hence, farm households and the farm women must be trained on importance of balanced nutrition and role of vegetable, milk, egg, meat in balanced diet.

✓ Lower fertility status of the soil (85.71%), wild animal menace on farm field (80.00%), frequent incidence of pest and diseases (77.14%), high cost of fertilizers and plant protection chemicals (77.14%), high rate of interest on credit (88.57%), low price for the agricultural commodities (88.57%), lack of marketing facilities in the area (80.00%), inadequate extension services (60.00%), lack of transport for safe transport of the agricultural produce to the market (88.57%) were the major farming constraints experienced hence, these constraints must be addressed immediately for the welfare of the farmers. Awareness to be created among the farmers to approach nearest KVKs/RSKs and other developmental departments for technical and for subsidized inputs and utilize the well established regulated markets, approaching the contract firms, direct markets to avoid the involvement of middlemen.