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ICAR-NBSS&LUP Sujala SWs-LRI Atlas No. 62

Land Resource and Hydrological Inventory of Mothakapalli Sub-watershed for Watershed Planning and Development Yadgir Taluk, Yadgir District, Karnataka (AESR 6.2)

Sujala – III
Karnataka Watershed Development Project- II
Funded by World Bank



ICAR - NBSS & LUP



ICAR - National Bureau of Soil Survey and Land Use Planning, Bangalore
Watershed Development Department, Govt. of Karnataka, Bangalore

About ICAR - NBSS&LUP

The 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 optimizing 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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PART - A

Land Resource Inventory of Mothakapalli Sub-watershed for Watershed Planning and Development Yadgir Taluk, Yadgir District, Karnataka (AESR 6.2)

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How to read and use the Atlas

The Land Resource Inventory of Mothakapalli Sub-watershed (Yadgir Taluk, Yadgir District) for Watershed Planning (AESR 6.2) was undertaken to provide comprehensive site-specific cadastral level information useful for farm level planning and integrated development of the area under Sujala – III, Karnataka Watershed Development Project- II.

This atlas contains the basic information on kinds of soils, their geographic distribution, characteristics and classification. The soil map and soil based thematic maps derived from soils data on soil depth, soil gravelliness, slope, land suitability for various crops and land use management maps are presented on 1:12,500 scale. The maps of fertility status (soil reaction, organic carbon, available phosphorus, available potassium, available sulphur, available calcium, available copper, available manganese, available zinc, available iron, available boron and salinity (EC) on 1:12,500 scale were derived from grid point sampling of the surface soils from the watersheds.

The atlas illustrates maps and tables that depict the soil resources of the watershed and the need for their sustainable management.

The user, depending on his/her requirement, can refer this atlas first by identifying his/her field and survey number on the village soil map and by referring the soil legend which is provided in tabular form after the soil map for details pertaining to his/her area of interest.

The atlas explains in simple terms the different kinds of soils present in the watershed, their potentials and problems through a series of thematic maps that help to develop site-specific plans as well as the need to conserve and manage this increasingly threatened natural resource through sustainable land use management. The Land Resource Atlas contains database collected at land parcel/ survey number level on soils, climate, water, vegetation, crops and cropping patterns, socio-economic conditions, marketing facilities *etc.* helps in identifying soil and water conservation measures required, suitability for crops and other uses and finally for preparing a viable and sustainable land use options for each and every land parcel.

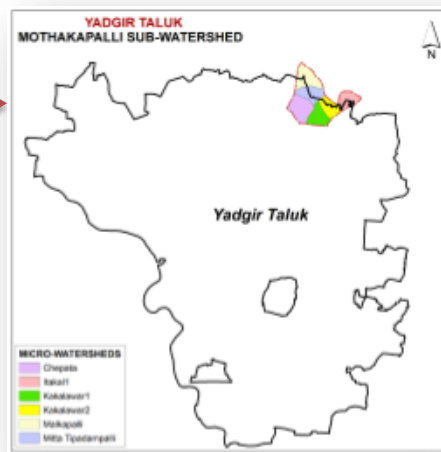
For easy map reading and understanding the information contain in different maps, the physical, cultural and scientific symbols used in the maps are illustrated in the form of colors, graphics and tables.

Physical, Cultural and Scientific symbols used in the Atlas

Each map in the atlas sheet is complemented with the physical, cultural and scientific symbols to facilitate easy map reading.

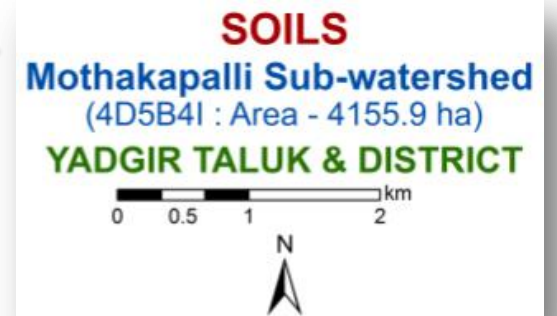
Inset map

Inset provided in each map conveys its strategic location i.e. Taluk, Sub-watershed and Sub-watershed.



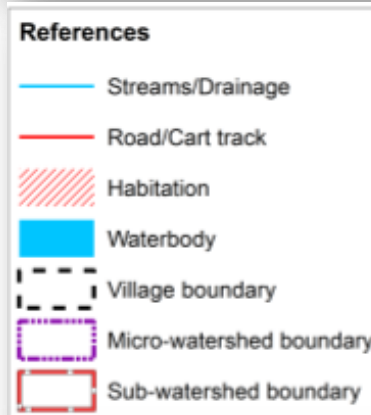
Map title

Map title conveys the relevance of thematic information presented along with a graphical scale, geographical location and watershed details in text form.



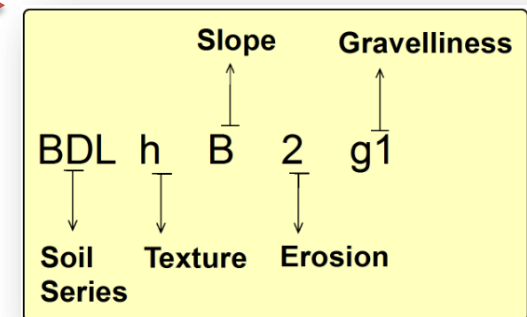
Legends and symbols

Two legends accompany each map, a map reference, which depicts geographic features and a thematic legend which portrays spatial information. Picking up the symbol and colour of a particular enables one to go to the legends to obtain the required information.



Soil Units

The soil map may be read at different levels. The most detailed level is that of the soil phase. Soil phases are distinguished within soil series mainly based on differences in surface of soil texture, slope, gravelliness, erosion, etc.



Map colours

Different shades of colours are used as an aid to distinguish the different classes of soils, crop suitability and other maps.

Soil Phase	Area in ha (%)	Soil Phase	Area in ha (%)
4, BDLhB2	17 (0.41)	56, ANRIB3g1	74 (1.77)
5, BDLIB2	91 (2.18)	62, BMNmB2	198 (4.76)
6, BDLIB3	107 (2.57)	63, BMNmB2g1	237 (5.7)
162, BDLhB2g1	134 (3.22)	159, BMNmA1	2 (0.05)
174, BDLcB2g2	21 (0.5)	64, BMDcB2	18 (0.43)
30, YLRcC3	21 (0.52)	65, BMDIB2g1	45 (1.09)
31, YLRIB2	51 (1.22)	107, DSBhB2	70 (1.68)
33, HSLIB2	123 (2.96)	121, DSBcB2	8 (0.19)
48, NGPIB2	42 (1.01)	109, VNkmB2g1	3 (0.07)
49, NGPmB2	423 (10.17)	23, JNKIB2g1	56 (1.35)
146, NGPmB2g1	715 (17.21)	110, JNKhB2	24 (0.57)
Low Land			
100, VKSmB1	96 (2.3)	Rock outcrops	59 (1.42)
158, SGRIA1	73 (1.75)	Others*	152 (3.66)

Soil and plot boundaries

Soil units shown on the map are represented by both the color and a numeral. The soil boundaries are superimposed on land parcel with revenue survey number boundaries to visualize its spatial extent.



Map key

There are many thematic types to be differentiated on the map solely based on colour. Therefore soils and suitability types and their limitations are distinguished by colours with a combination of alpha-numeric characters.

KEY	
TEXTURE	EROSION
b - Loamy sand	1 - Slight
c - Sandy loam	2 - Moderate
h - Sandy clay loam	3 - Severe
i - Sandy clay	
m - Clay	
SLOPE	GRAVELLINESS
A - Nearly level (0-1%)	g1 - Gravelly (15-35%)
B - Very gently sloping (1-3%)	g2 - Very gravelly (35-60%)
C - Gently sloping (3-5%)	
DEPTH	
BDP, KKR - Very shallow (<25 cm)	
BDL, DSB, HTK, VNK - Shallow (25-50 cm)	
JNK, YLR - Moderately shallow (50-75 cm)	
BLC, GWD, HSL, KBD, SHT - Moderately deep (75-100 cm)	
ANR, BGD, MDG, NGP, VKS - Deep (100-150 cm)	
BMD, BMN, SGR - Very deep (>150 cm)	

Key	
S1- Highly Suitable	
S2- Moderately Suitable	
S3- Marginally Suitable	
N1- Currently Not Suitable	
N2- Permanently Not Suitable	
Limitations	
g- gravelliness/stoniness	
l- topography	
n- nutrient availability	
r- rooting condition	
t- texture	
z- excess salt/calcareousness	

1. Introduction

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

The watershed management programs are aimed at designing suitable soil and water conservation measures, productivity enhancement of existing crops, crop diversification with horticultural species, greening the wastelands with forestry species of multiple uses and improving the livelihood opportunities for landless people.

The objectives can be met to a great extent when an appropriate Natural Resources Management (NRM) plan is prepared and implemented. It is essential to have site specific Land Resources Inventory (LRI) indicating the potentials and constraints for developing such a site specific plan. LRI can be obtained by carrying out detailed characterization and mapping of all the existing land resources like soils, climate, water, minerals and rocks, vegetation, crops, land use pattern, socio-economic conditions, infrastructure, marketing facilities and various schemes and developmental works of the government. 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 to the farmer and other land users of the area.

The major landforms identified in the Sub-watershed are uplands and low lands. The database was generated by using cadastral map of the village as a base along with high resolution satellite imagery (IRS LISS IV and Cartosat-1). The objectives of the land resource survey, carried out in the Mothakapalli Sub-watershed covering an area of 4155.9 ha are indicated below.

- Detailed characterization of all the land resources like soil, water, land use, cropping pattern and other resources available at parcel level in the village.
- Delineation of homogenous areas based on soil-site characteristics into management units.
- Collection and interpretation of climatic and agronomical data for crop planning.
- Identification of problems and potentials of the area and strategies for their management.
- Assessment of the suitability of land resources for various crops and other uses.
- Establishment of village level digital land resources database in a GIS framework.
- Enable the watershed and other line departments to prepare an action plan for the integrated development of the watershed.

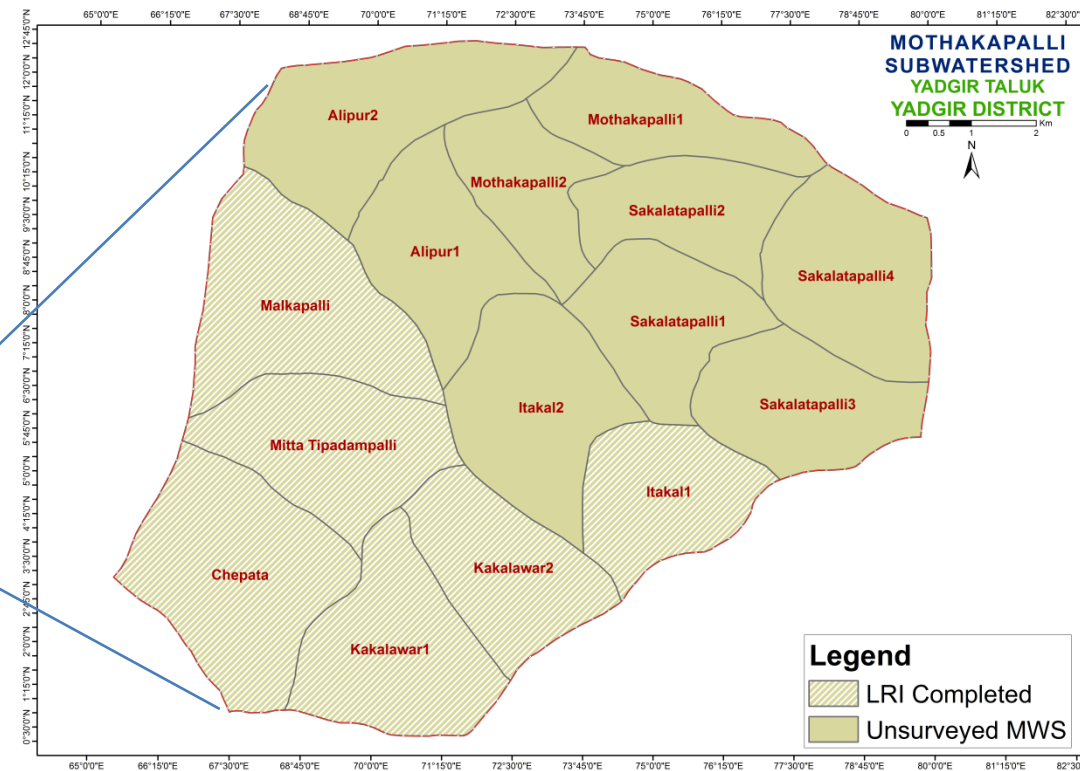
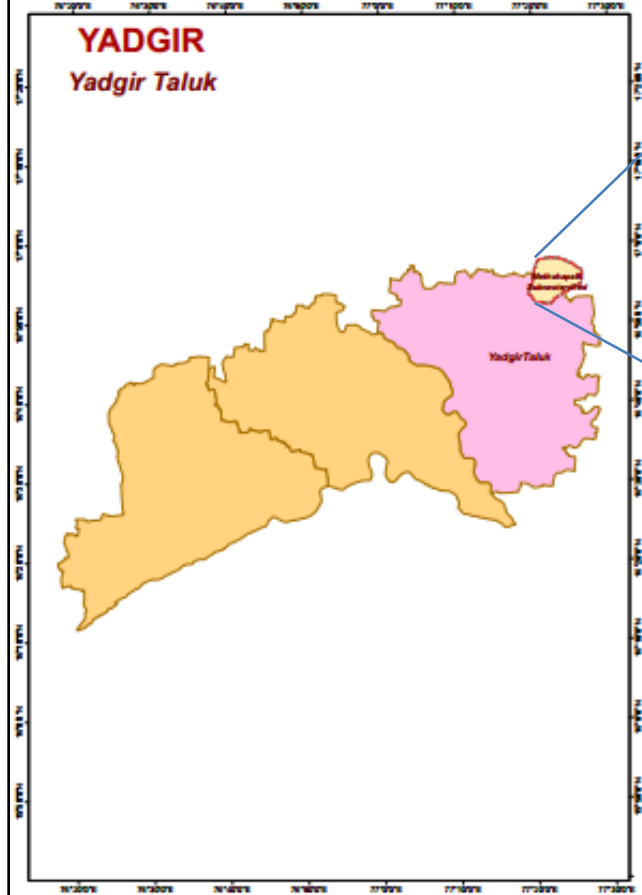
2. General Description of Sub-watershed

The Yadgir, popularly called as “Yadavagiri” by the local people, district came to existence on 30th Dec 2009 by carving out of east-while Kalaburagi district of Karnataka with a geographical area of 5234.4 square kilometers, located in the northern part of the state. It lies between north latitudes’ 16° 52’ – 16° 57’ and east longitudes 77° 19’ – 77° 24’. The climate of the district is very hot and dry. The district has an average annual rainfall of 636 mm. Soils are well drained red sandy loam to medium deep black soils. This may be the weathering product of gneissic and granite terrain. Agriculture in Yadgir district is dependent upon rainfall, irrigation tanks, wells, streams etc. The major agricultural crops grown are Jawar, Groundnut, Cotton, Red gram, Bengal gram etc.

As a pilot study, **ICAR-NBSS&LUP, Bangalore** carried out the generation of Sub-watershed (SWs) - LRI for the Mothakapalli SWs (code– 4D5B4I) in Yadgir taluk, Yadgir district. It was selected for data base generation under Sujala III project. This sub-watershed encompasses of 15 MWs namely Alipur-1 (4D5B4I1i), Alipur-2 (4D5B4I1j), Chepata (4D5B4I2c), Itakal-1 (4D5B4I1e), Itakal-2 (4D5B4I1f), Kakalawar-1 (4D5B4I2a), Kakalawar-2 (4D5B4I2b), Malkapalli (4D5B4I2e), Mitta Tipadampalli (4D5B4I2d), Mothakapalli-1 (4D5B4I1g), Mothakapalli-2 (4D5B4I1h), Sakalatapalli-1 (4D5B4I1c), Sakalatapalli-2 (4D5B4I1d), Sakalatapalli-3 (4D5B4I1b) and Sakalatapalli-4 (4D5B4I1a). Land Resource Inventory (LRI) was generated for six among the fifteen micro-watersheds.

2.1. Location and Extent

LOCATION MAP OF MOTHAKAPALLI SUB-WATERSHED



Mothakapalli sub-watershed (Yadgir Taluk, Yadgir District) is located between 16°52'5''-16°58'1'' North latitudes and 77°19'8''- 77°26'15'' East longitudes, covering an area of about 9192 ha.

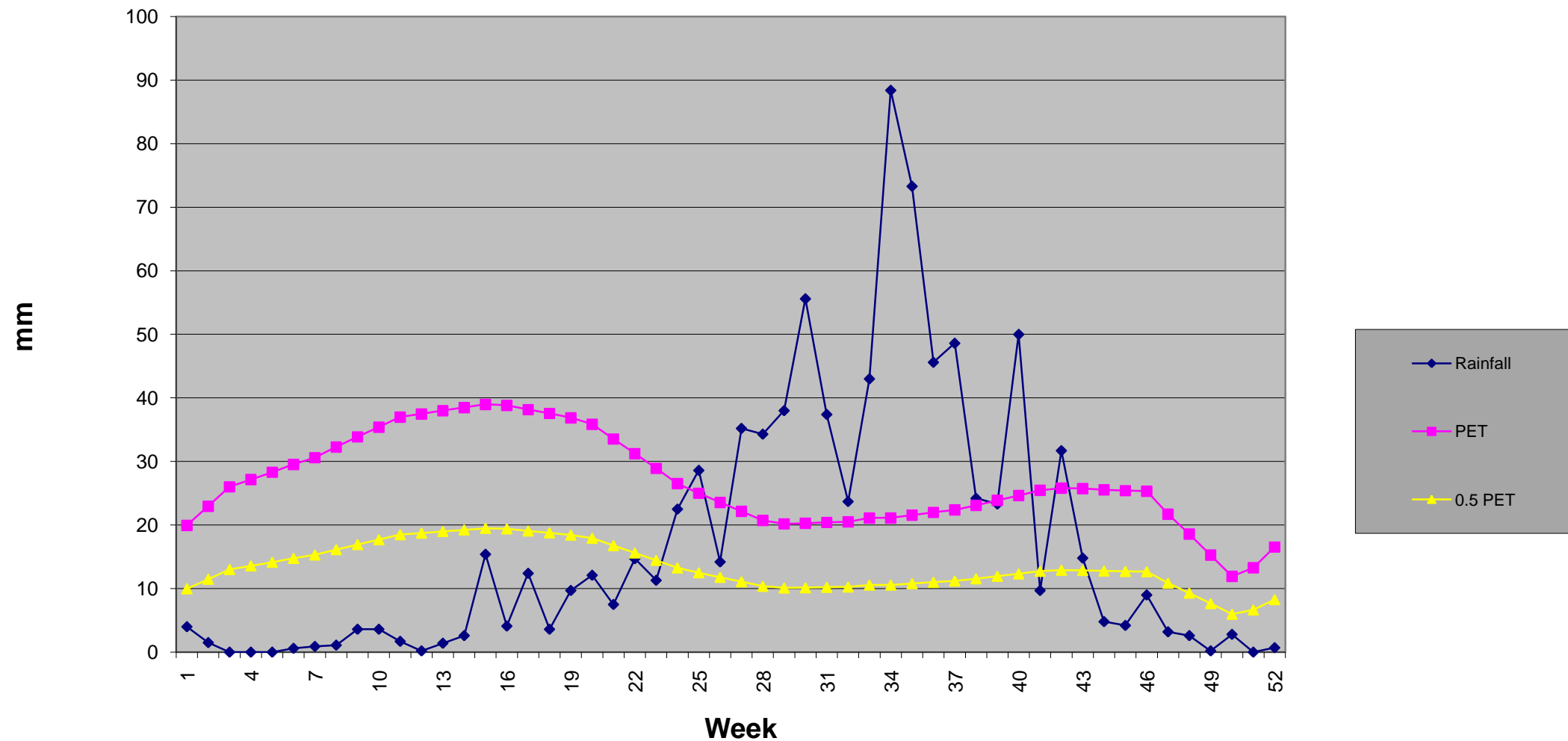
Agro Ecological Sub Region (AESR) 6.2: Central and Western Maharashtra Plateau and North Karnataka Plateau and North Western Telangana Plateau, hot moist semi-arid ESR with shallow and medium loamy to clayey Black soils (medium and deep clayey Black soils as inclusion), medium to high AWC and LGP 120-150 days.

Agro-climatic Zone 2: North-eastern Dry Zone: The total geographic area of this zone is about 1.76 M ha covering 8 taluks of Gulbarga district and 3 taluks of Raichur. Net cultivated area in the zone is about 1.31 M ha of which about 0.09 M ha are irrigated. The mean elevation of the zone is 300-450 m MSL. The main soil type is deep to very deep soils with small pockets of shallow to medium black soils. The zone is cropped predominantly during rabi due to insufficient rainfall (465-785 mm). The principal crops of the zone are jowar, bajra, oilseeds, pulses, cotton and sugarcane.

NOTE: Land Resource Inventory (LRI) was generated for six among the fifteen micro-watersheds

Climate

Gurumitkal Hobli, Yadgir Taluk and Yadgir District

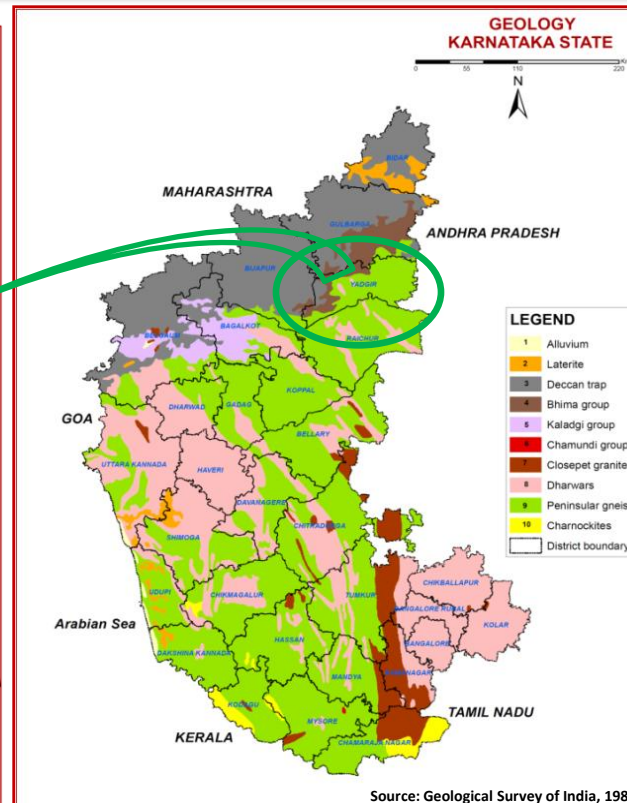
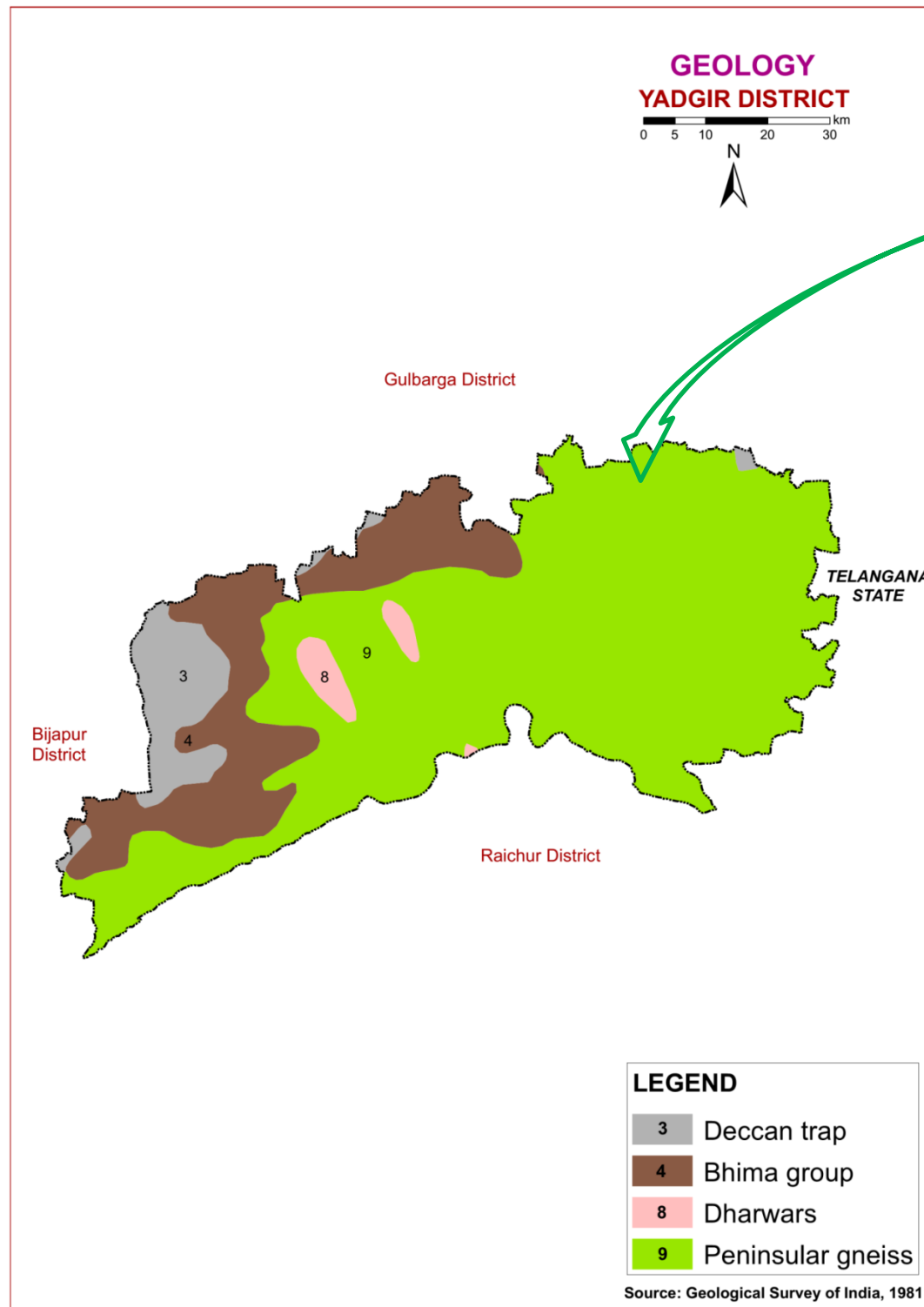


Length of Growing Period (LGP) is varying from June 4th week to 3rd week of October (120 - 150 days)

Annual Rainfall : 882 mm. in the Gurumitkal Hobli, Yadgir Taluk & District

Source: KSNDMC (1980-2011)

2.3. Geology



GEOLOGY - KARNATAKA STATE

Karnataka forms part of the Peninsular Shield, which is an ancient stable block of the earth's crust. The shield is composed of geologically ancient rocks of diverse origin. These rocks have undergone various degrees of metamorphism and crushing. Overlying these ancient rocks are Proterozoic, late Cretaceous to Palaeocene, Palaeocene to Recent, and Recent sediments.

In the stratigraphic succession of rocks in Karnataka the Archaean group is the oldest, followed by Proterozoic, Mesozoic and Cainozoic formations.

GEOLOGY - YADGIR DISTRICT

Mesozoic Group

Towards the end of the Cretaceous Period there was tremendous volcanic activity in the Peninsular part of India with eruption of a series of lava flows which came out through fissures and cracks. This formation is known as the Deccan Trap.

Deccan Trap: The Deccan Trap covers an area of 25,000 sq. km. Eight lava flows have been identified in Karnataka, horizontally overlying the older formations. The thickness of the individual flows averages about five metres. The Deccan Trap is relatively uniform in petrographic character. The most common type is augite basalt. Dominant colour is greyish green; texture ranges from cryptocrystalline to glassy. The rock is often vesicular and scoriaceous.

Upper Proterozoic Group

Formations of the Upper Proterozoic in Karnataka are closepet granites, Chamundi granites, Kaladgi series and Bhima series.

Bhima series

This series, equivalent to the Kurnool formations, is named after the Bhima river and occurs in Bijapur and Gulbarga districts. It covers an area of about 4200 sq. km and is overlain by the Deccan trap. The group consists of horizontal, unfossiliferous, unmetamorphosed sedimentary rocks such as sandstones, green, purple and black shales, and cream and bluish limestones. The thickness is about 477 metres.

Dharwar schists

The Dharwar schists consist of a complex series of crystalline schists associated with ultrabasic rocks such as amphibolite, peridotites and dunites. These schists are found in long, narrow bands of various dimensions running NW-SE through the Peninsular Gneiss. The Dharwars are divided into Upper and Lower.

Upper Dharwars are equivalent to the Archaean to Lower Proterozoic, and are divided into Bababudan.

Lower Dharwars occur in Mysore district and include amphibolite schist, quartzite, ironstone and marble.

Peninsular Gneiss

Exposed over a large area of Karnataka in all the districts except Bidar is the Peninsular Gneiss which is a heterogeneous mixture of several types of granitic rocks such as banded gneisses, granitic gneisses, granites and gneissic granites, granodiorites and diorites. The banded gneisses consist of white bands of quartz-feldspar alternating with dark bands of biotite, hornblende, and minor accessories. The granite group includes granites of all shades with varying composition. Peninsular gneiss seems to have formed by the granitization of the older rocks.

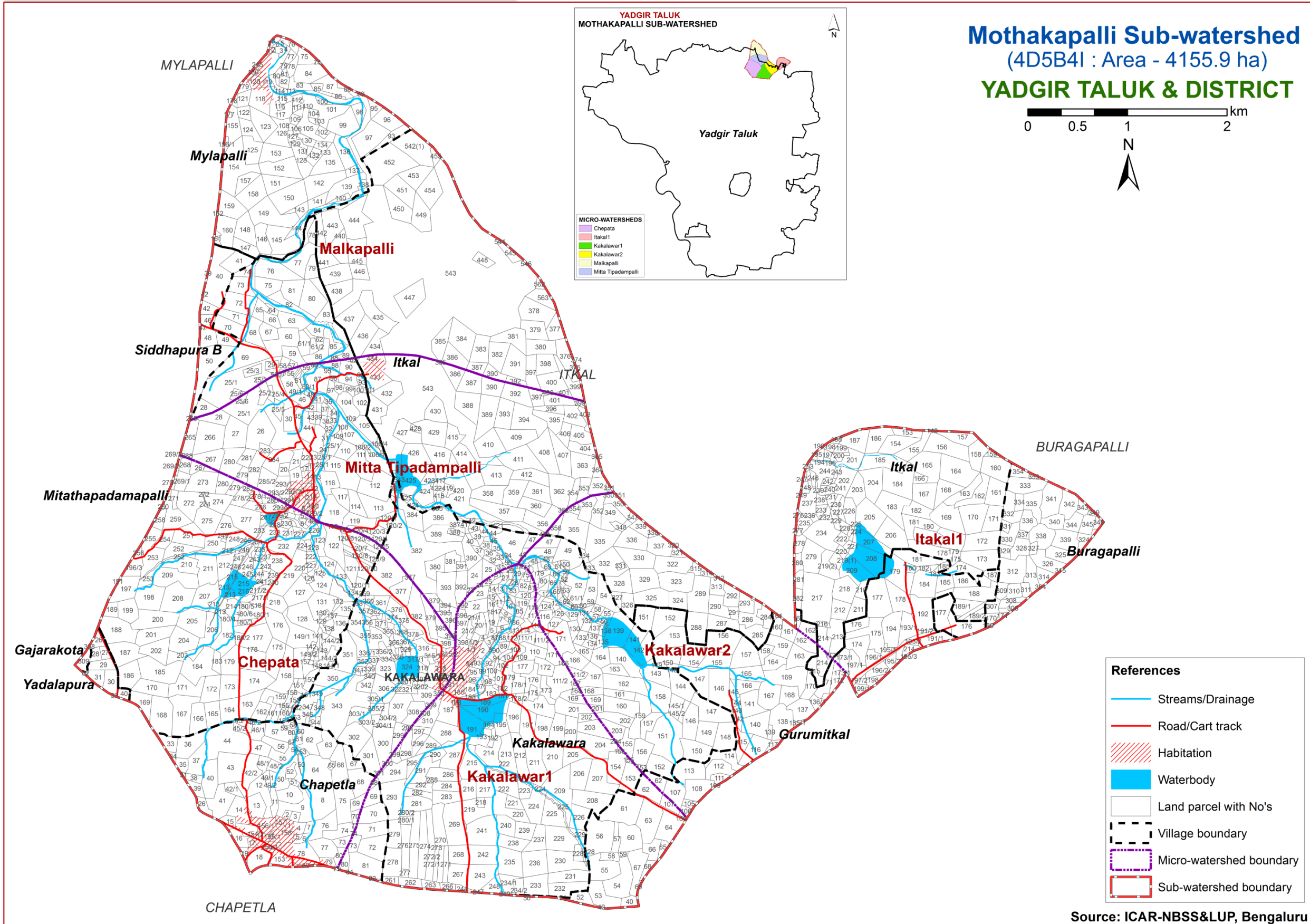
3. Survey Methodology

Sequence of activities in generation of LRI

- Traversing the watershed using cadastral maps and imagery as base
- Identifying landforms, geology, land use and other features
- Selecting fields representing land units
- Opening profiles to 2 m depth
- Studying soil and site characteristics
- Grouping similar areas based on their soil-site characteristics into land management units
- Preparation of crop, soil and water conservation plan
- Socio-economic evaluation

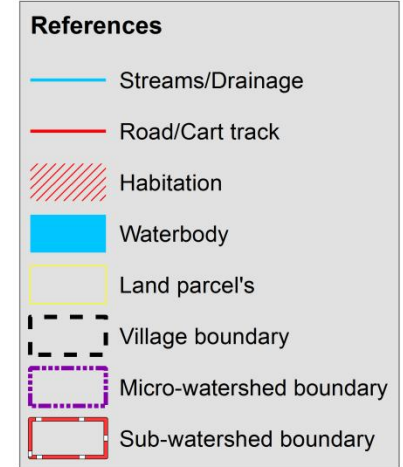
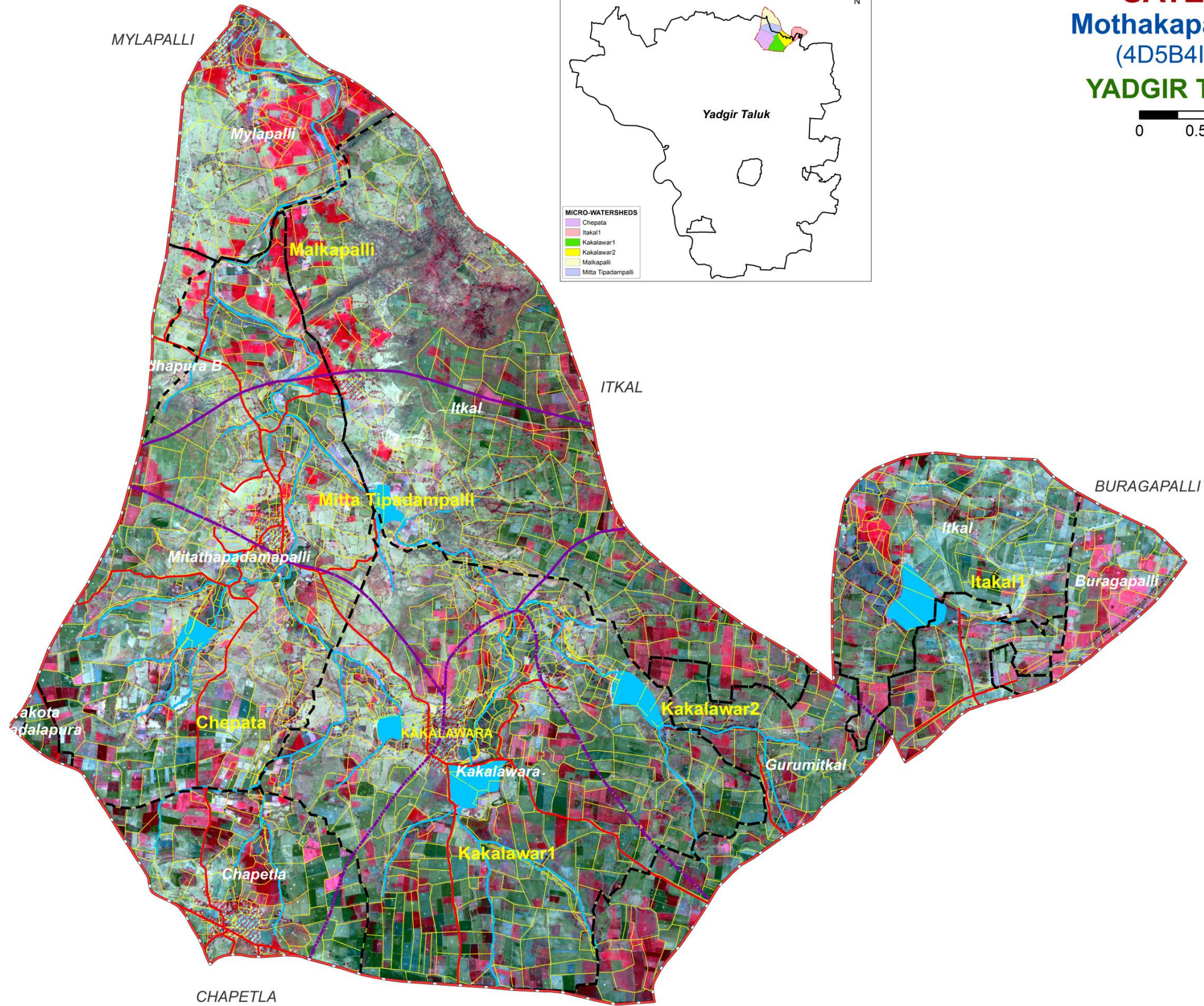
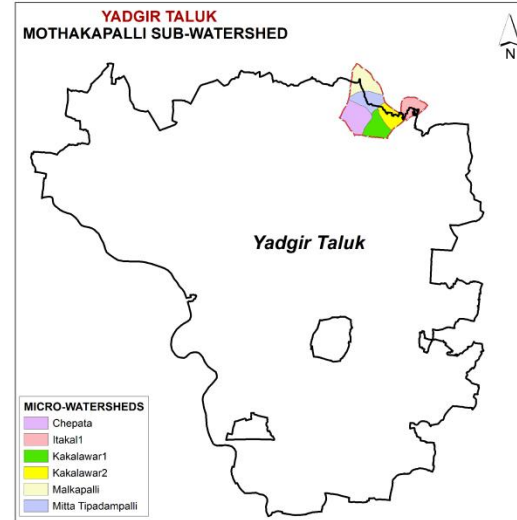
The required site and soil characteristics are described and recorded on a standard proforma by following the protocols and guidelines given in the soil survey manual and field guide. Collection of soil samples from representative pedons for laboratory characterization and collection of surface soil samples from selected fields covering most of the management units for macro and micro-nutrient analysis is being carried out (320m grid intervals). Further processing of data at chemical lab and GIS lab are carried out to generate various thematic maps for each of the study area.

3.1. Database Used - Cadastral map



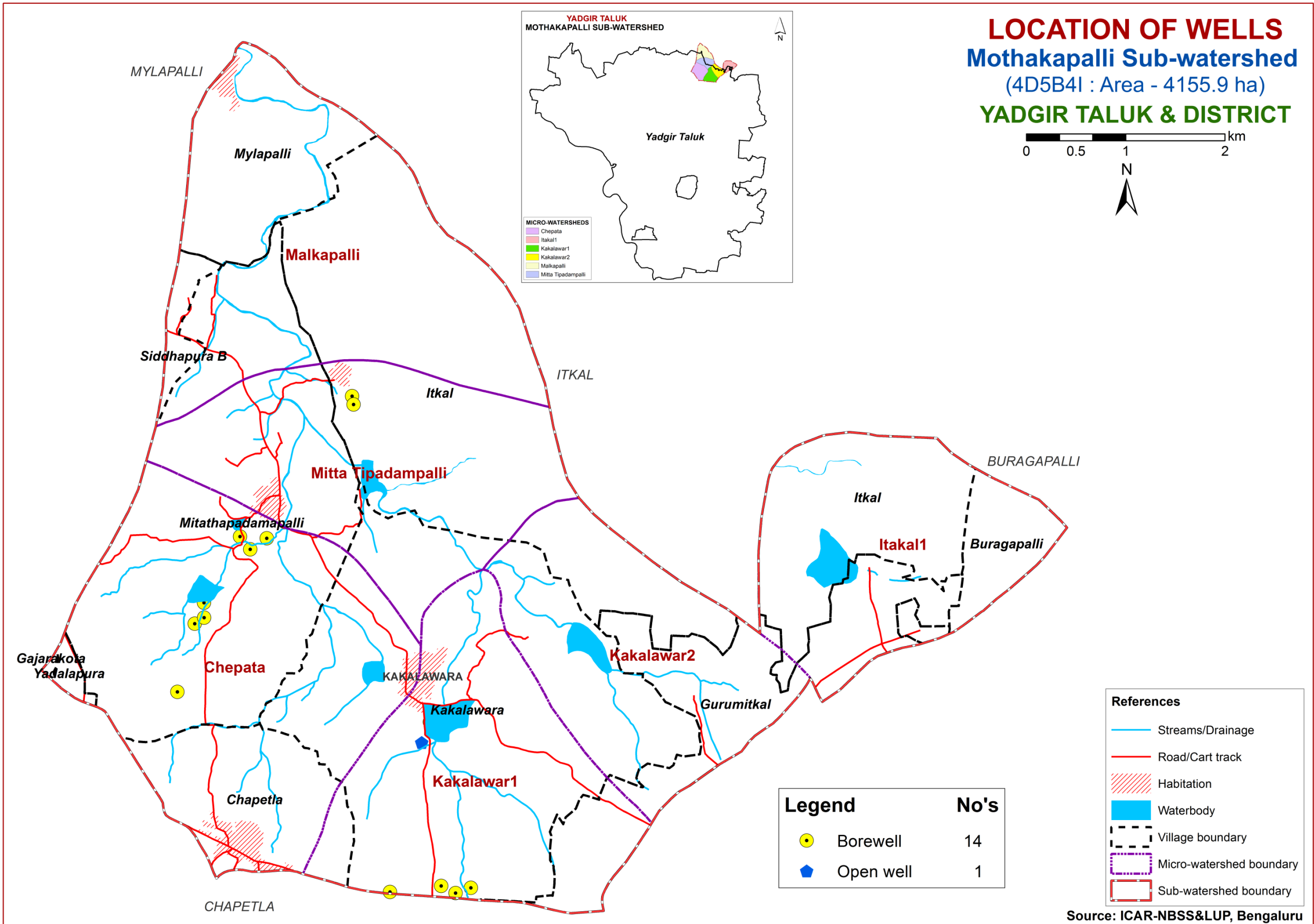
3.2. Database Used - Satellite Image

SATELLITE IMAGE Mothakapalli Sub-watershed (4D5B4I : Area - 4155.9 ha) YADGIR TALUK & DISTRICT



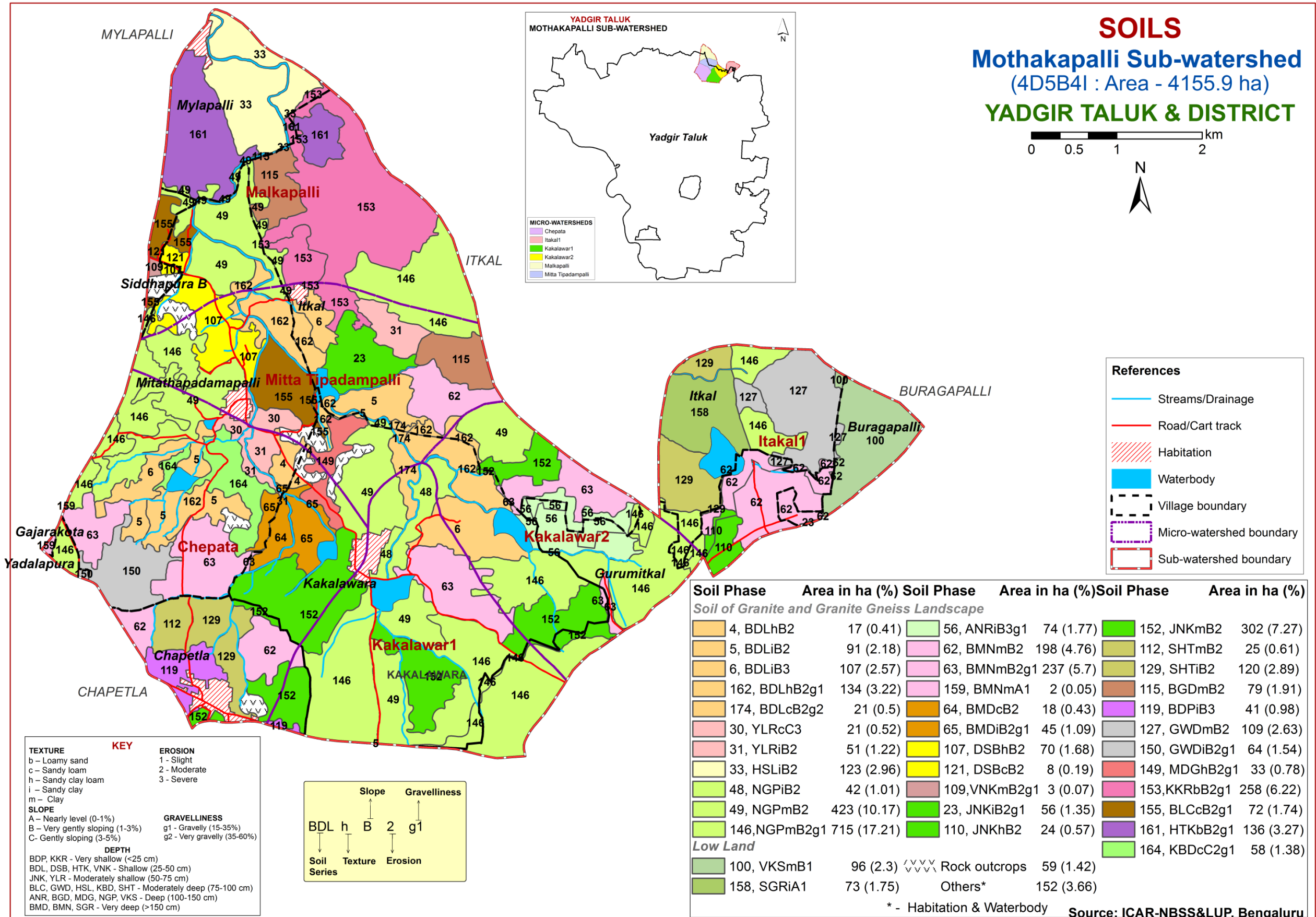
Source: Cartosat-1 Imagery, 2011

3.3. Location of Wells



Source: ICAR-NBSS&LUP, Bengaluru

4. The Soils



4.1 Mapping unit description of Mothakapalli (4D5B4I) Sub-watershed in Yadgir Taluk, Yadgir district

Soil map unit No*	Soil Series	Soil Phase Symbol	Mapping Unit Description	Area in ha (%)
Soils of Granite and Granite gneiss Landscape				
	BDP	Baddeppalli soils are very shallow (<25 cm), well drained, have dark brown to dark reddish brown, calcareous sandy clay loam soils occurring on very gently sloping uplands under cultivation		41 (0.98)
119		BDPiB3	Sandy clay surface, slope 1-3%, severe erosion	41 (0.98)
	KKR	Kakalawar soils are very shallow (<25 cm), well drained, have dark brown sandy loam soils occurring on very gently sloping uplands under cultivation		258 (6.22)
153		KKRbB2g1	Loamy sand surface, slope 1-3%, moderate erosion, gravelly (15-35%)	258 (6.22)
	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		370 (8.88)
4		BDLhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	17 (0.41)
5		BDLiB2	Sandy clay surface, slope 1-3%, moderate erosion	91 (2.18)
6		BDLiB3	Sandy clay surface, slope 1-3%, severe erosion	107 (2.57)
162		BDLhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	134 (3.22)
174		BDLcB2g2	Sandy clay surface, slope 1-3%, moderate erosion, very gravelly (35-60%)	21 (0.5)
	DSB	Dastharabad soils are shallow (25-50 cm), well drained, have dark brown to very dark brown, gravelly clay soils occurring on very gently to gently sloping uplands under cultivation		70 (1.68)
107		DSBhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	70 (1.68)
	VNK	Vanakanahalli soils are shallow (25-50 cm), well drained, have dark reddish brown, sandy clay red soils occurring on very gently to moderately sloping uplands under cultivation		3 (0.07)
109		VNKmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	3 (0.07)
	DSB	Dastharabad soils are shallow (25-50 cm), well drained, have dark brown to very dark brown, gravelly clay soils occurring on very gently to gently sloping uplands under cultivation		8 (0.19)
121		DSBcB2	Sandy clay surface, slope 1-3%, moderate erosion	8 (0.19)
	HTK	Hattikuni soils are shallow (25-50 cm), well drained, have dark yellowish brown sandy loam soils occurring on very gently sloping uplands under cultivation		136 (3.27)
161		HTKbB2g1	Loamy sand surface, slope 1-3%, moderate erosion, gravelly (15-35%)	136 (3.27)

Soil map unit No*	Soil Series	Soil Phase Symbol	Mapping Unit Description	Area in ha (%)
Soils of Granite and Granite gneiss Landscape				
	JNK	Jinkera soils are moderately shallow (50-75 cm), well drained, have dark brown to very dark grayish brown, slightly calcareous sandy clay loam soils occurring on very gently sloping uplands under cultivation		382 (9.19)
23		JNKiB2g1	Sandy clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	56 (1.35)
110		JNKhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	24 (0.57)
152		JNKmB2	Clay surface, slope 1-3%, moderate erosion	302 (7.27)
	JNK	Jinkera soils are moderately shallow (50-75 cm), well drained, have dark brown to very dark grayish brown, slightly calcareous sandy clay loam soils occurring on very gently sloping uplands under cultivation		382 (9.19)
23		JNKiB2g1	Sandy clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	56 (1.35)
110		JNKhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	24 (0.57)
152		JNKmB2	Clay surface, slope 1-3%, moderate erosion	302 (7.27)
	YLR	Yalleri soils are moderately shallow (50-75 cm), well drained, have brown to reddish brown and dark reddish brown, clay red soils occurring on very gently to gently sloping uplands under cultivation		72 (1.74)
30		YLRcC3	Sandy loam surface, slope 1-3%, severe erosion	21 (0.52)
31		YLRiB2	Sandy clay surface, slope 1-3%, moderate erosion	51 (1.22)
	HSL	Hosalli soils are moderately deep (75-100 cm), moderately well drained, have yellowish brown to dark yellowish brown, slightly calcareous sandy clay soils occurring on very gently sloping uplands under cultivation		123 (2.96)
33		HSLiB2	Sandy clay surface, slope 1-3%, moderate erosion	123 (2.96)
	SHT	Shettalli soils are moderately deep (75-100 cm), well drained, have very dark gray, slightly calcareous gravelly sandy clay soils occurring on very gently sloping uplands under cultivation		145 (3.5)
112		SHTmB2	Clay surface, slope 1-3%, moderate erosion	25 (0.61)
129		SHTiB2	Sandy clay surface, slope 1-3%, moderate erosion	120 (2.89)
	GWD	Gowdagera soils are moderately deep (75-100 cm), moderately well drained, have dark grayish brown to very dark grayish brown, calcareous sodic sandy clay loam soils occurring on very gently sloping uplands under cultivation		173 (4.17)
127		GWDmB2	Clay surface, slope 1-3%, moderate erosion	109 (2.63)
150		GWDiB2g1	Sandy clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	64 (1.54)

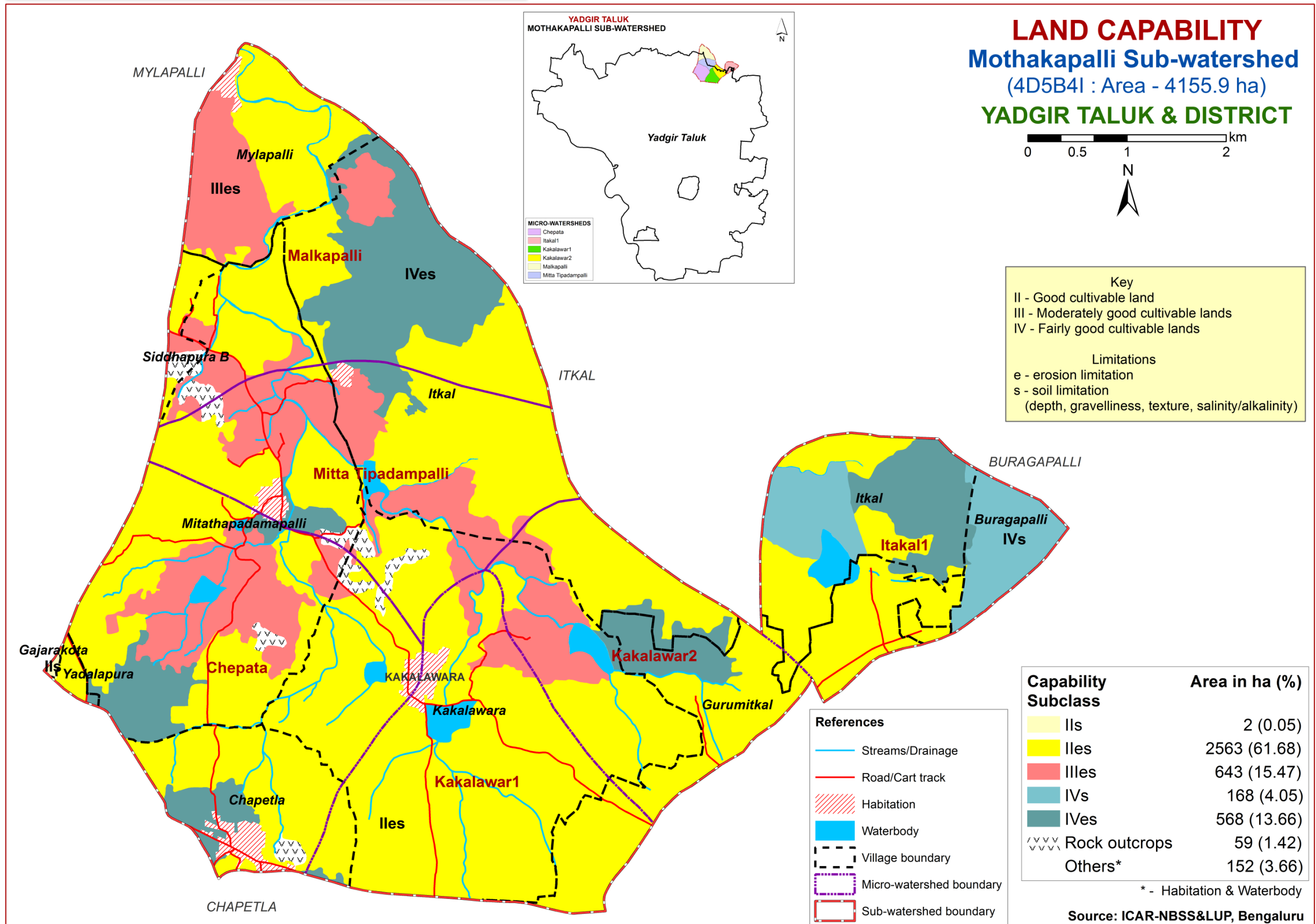
Soil map unit No*	Soil Series	Soil Phase Symbol	Mapping Unit Description	Area in ha (%)
Soils of Granite and Granite gneiss Landscape				
	BLC	Balichakra soils are moderately deep (75-100 cm), well drained, have reddish brown to dark reddish brown, sandy clay loam red soils occurring on very gently sloping uplands under cultivation		72 (1.74)
155		BLCcB2g1	Sandy loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	72 (1.74)
	KBD	Kalabelagundi soils are moderately deep (75-100 cm), well drained, have reddish brown to dark reddish brown and dark reddish gray, gravelly sandy clay loam soils occurring on very gently sloping uplands under cultivation		58 (1.38)
164		KBDcC2g1	Sandy loam surface, slope 3-5%, moderate erosion, gravelly (15-35%)	58 (1.38)
	NGP	Nagalapur soils are deep (100-150 cm), moderately well drained, have very dark gray to very dark grayish brown, black calcareous cracking clay soils occurring on very gently sloping uplands under cultivation		1180 (28.39)
48		NGPiB2	Sandy clay surface, slope 1-3%, moderate erosion	42 (1.01)
49		NGPmB2	Clay surface, slope 1-3%, moderate erosion	423 (10.17)
146		NGPmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	715 (17.21)
	ANR	Anur soils are deep (100-150 cm), moderately well drained, have dark gray to dark brown, calcareous sodic clay soils occurring on very gently to gently sloping uplands under cultivation		74 (1.77)
56		ANRiB3g1	Sandy clay surface, slope 1-3%, severe erosion, gravelly (15-35%)	74 (1.77)
	BGD	Belagundi soils are deep (100-150 cm) well drained, have brown to dark yellowish brown, slightly calcareous clayey soils occurring on nearly level to very gently sloping uplands under cultivation		79 (1.91)
115		BGDmB2	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	
	MDG	Mundargi soils are deep (100-150 cm), well drained, have brown to dark yellowish brown, sandy clay loam soils occurring on very gently sloping uplands under cultivation		33 (0.78)
149		MDGhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	33 (0.78)
	BMN	Bhimanahalli soils are very deep (>150 cm), moderately well drained, have very dark gray, calcareous cracking clay black soils occurring on very gently sloping uplands under cultivation		437 (10.51)
62		BMNmB2	Clay surface, slope 1-3%, moderate erosion	198 (4.76)
63		BMNmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	237 (5.7)
159		BMNmA1	Clay surface, slope 0-1%, slight erosion	2 (0.05)

Soil map unit No*	Soil Series	Soil Phase Symbol	Mapping Unit Description	Area in ha (%)
Soils of Granite and Granite gneiss Landscape				
	BMD	Bomraddoddi soils are very deep (>150 cm), well drained, have dark reddish brown to dark grey, reddish brown, dark brown and yellowish red, slightly calcareous sandy clay loam soils occurring on nearly level to very gently sloping uplands under cultivation		63 (1.52)
64		BMDcB2	Sandy loam surface, slope 1-3%, moderate erosion	18 (0.43)
65		BMDiB2g1	Sandy clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	45 (1.09)
	VKS	Vankasambar soils are deep (100-150 cm), well drained, very dark brown to brown, sodic calcareous sandy clay loam soils occurring on very gently to gently sloping lowlands under cultivation		96 (2.3)
100		VKSmb1	Clay surface, slope 1-3%, slight erosion	
	SGR	Sangwar soils are very deep (>150 cm), moderately well drained, have dark gray to very dark gray, calcareous sodic cracking clay soils occurring on nearly level to very gently sloping lowlands under cultivation		73 (1.75)
158		SGRiA1	Clay surface, slope 0-1%, slight erosion	73 (1.75)
999		Rock outcrops	Rock lands, both massive and bouldery with little or no soil	59 (1.42)
1000		Others		152 (3.66)

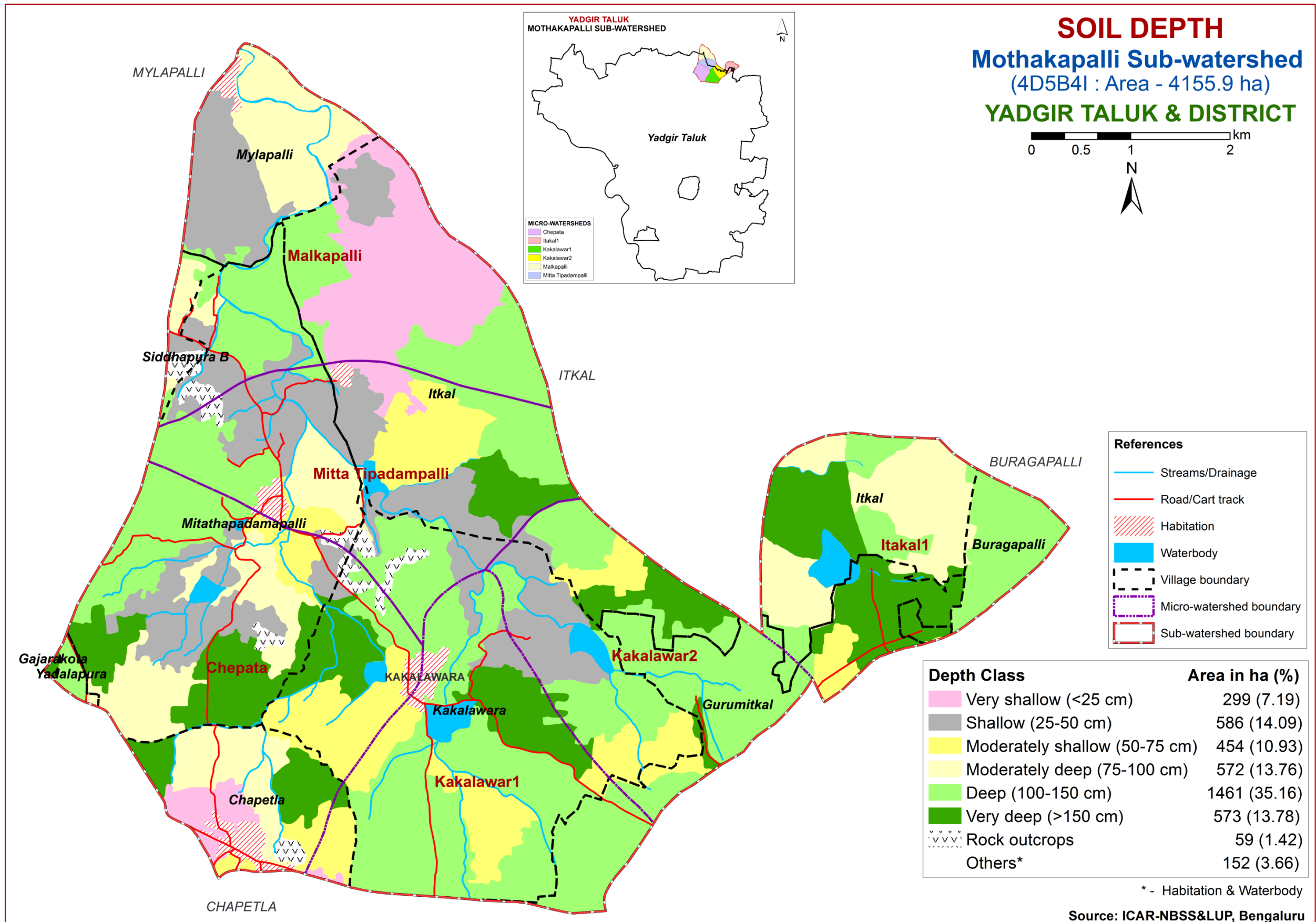
* Soil map unit numbers are continuous for the taluk, not for the sub-watershed

5. Soil Survey Interpretations

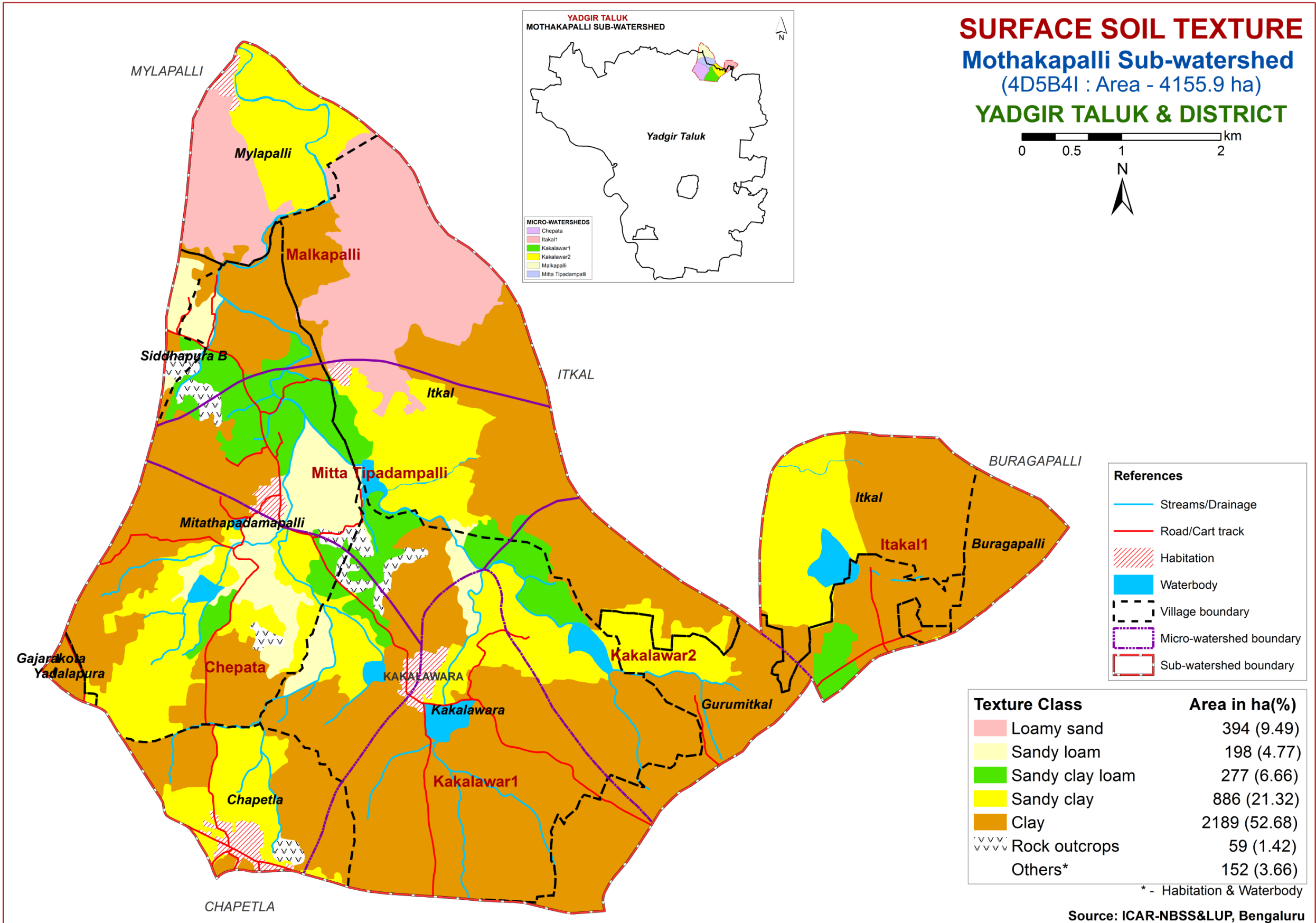
5.1. Land Capability Classification



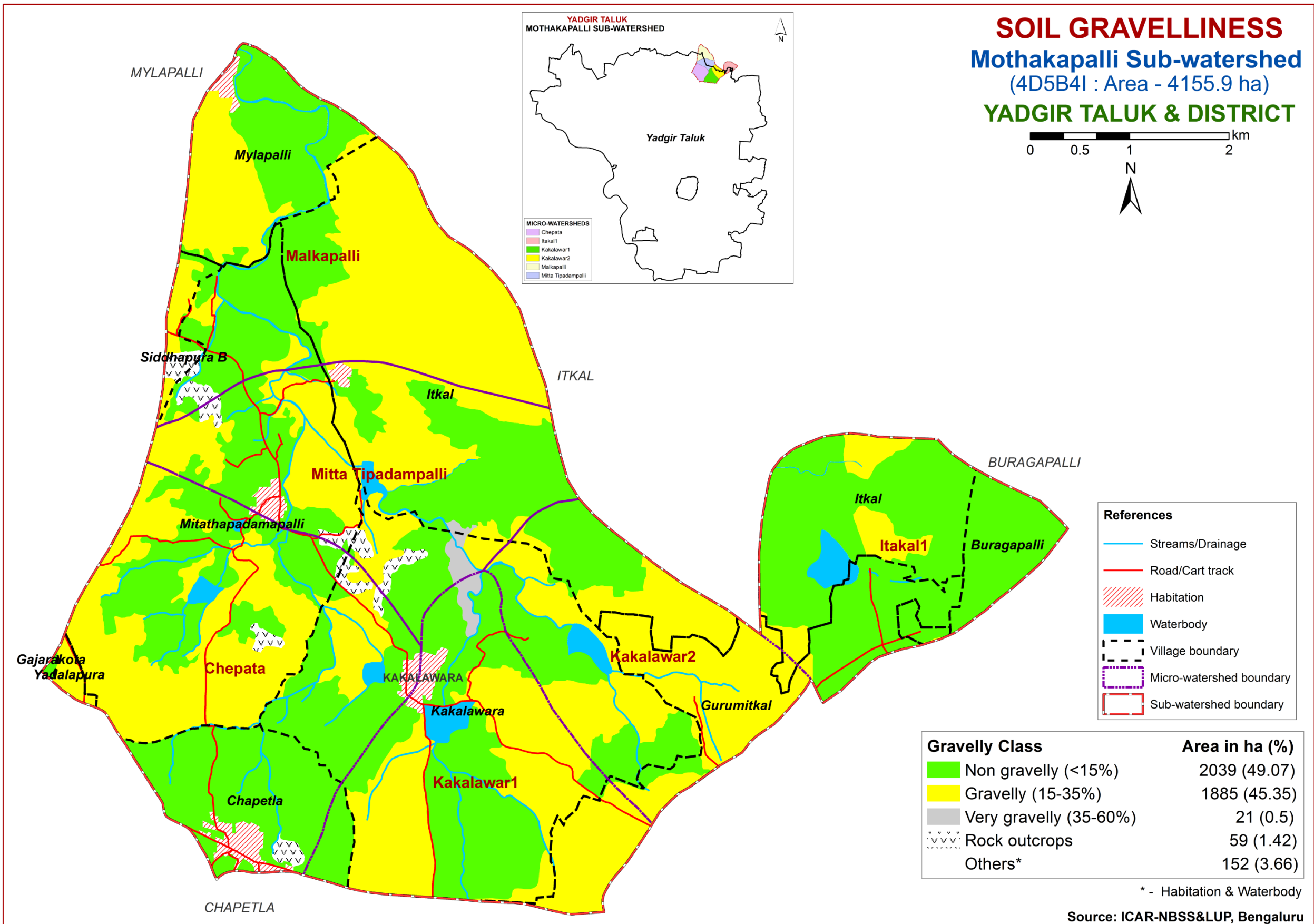
5.2. Soil Depth



5.3. Surface Soil Texture

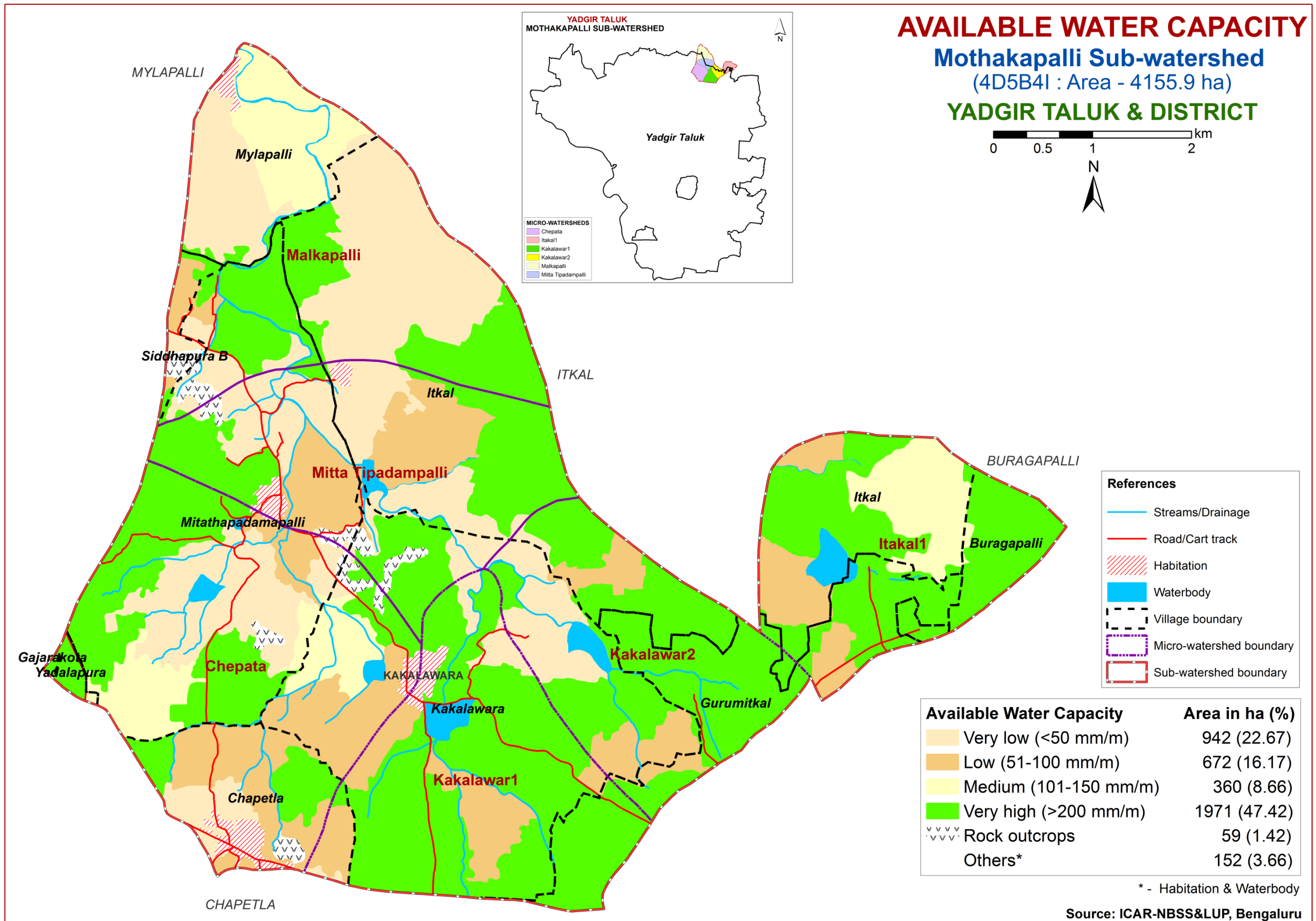


5.4. Surface Soil Gravelliness

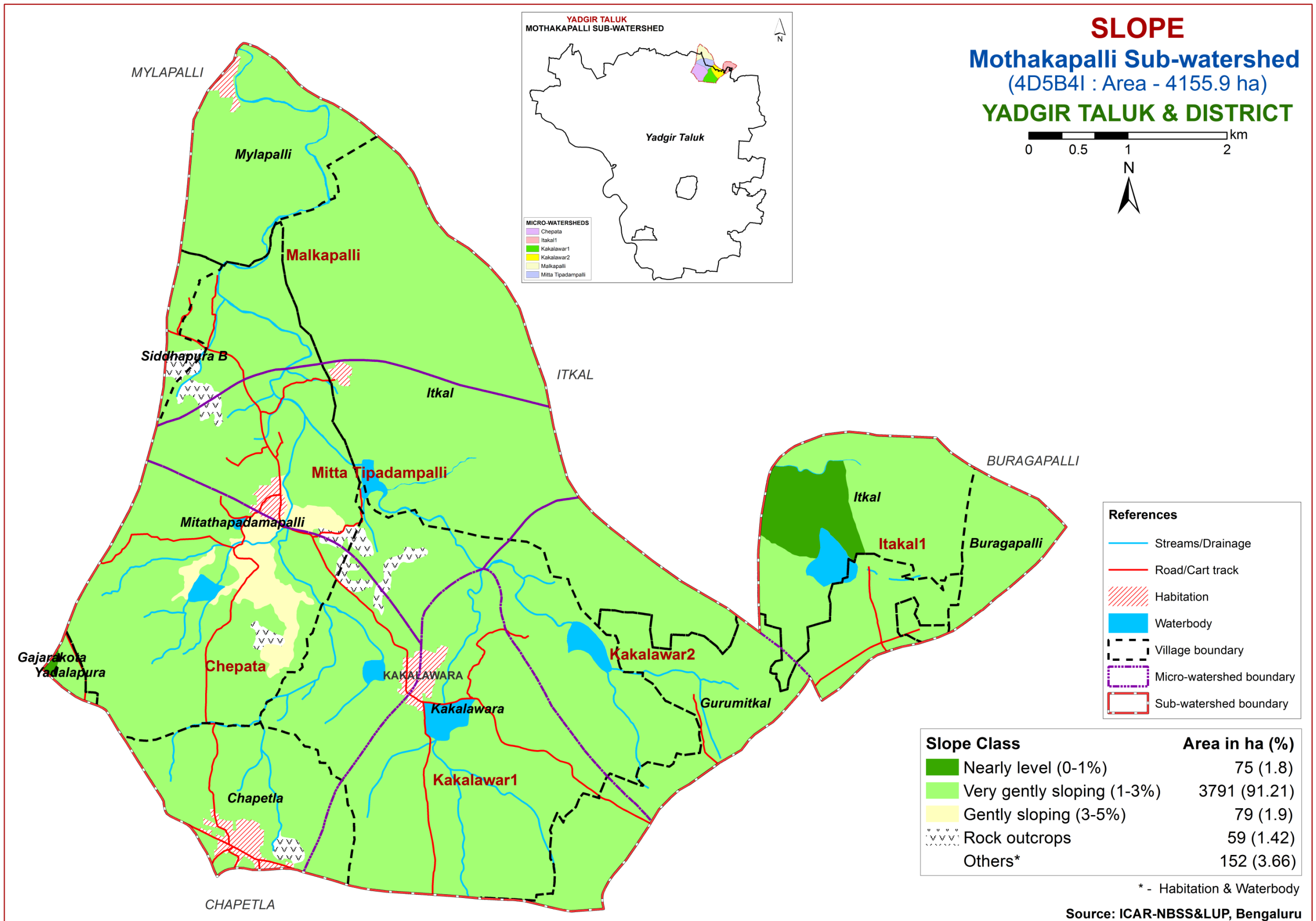


Source: ICAR-NBSS&LUP, Bengaluru

5.5. Available Water Capacity



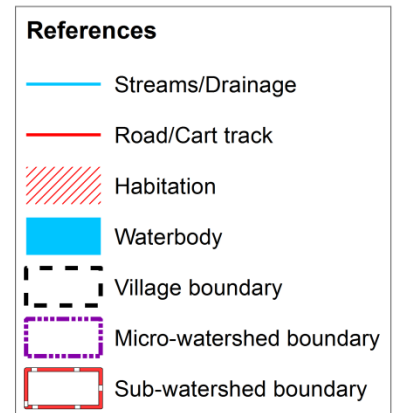
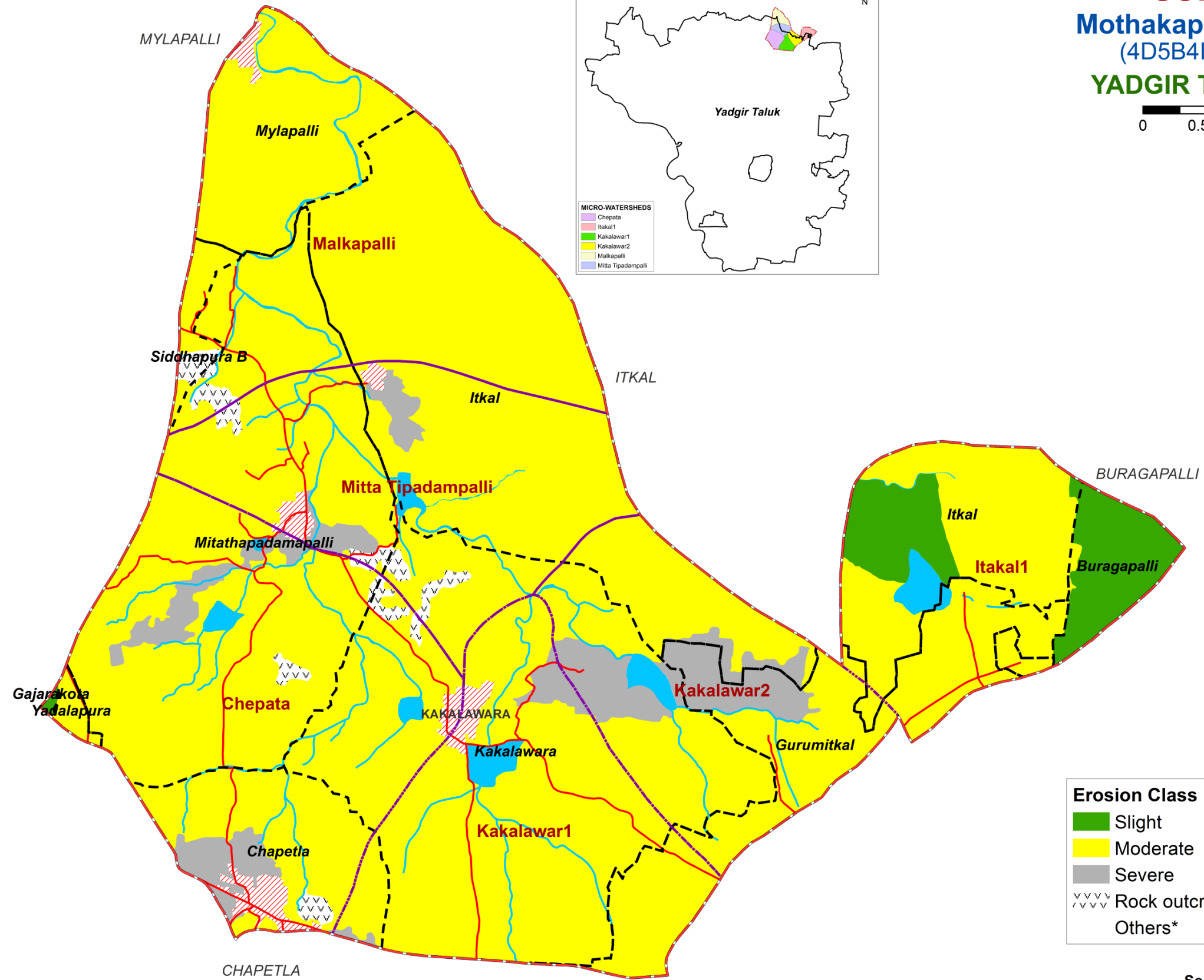
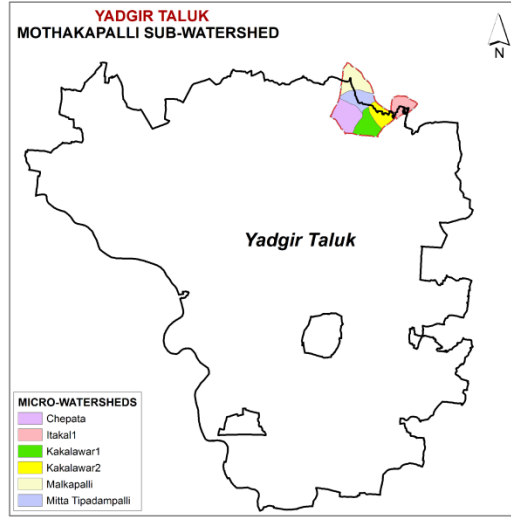
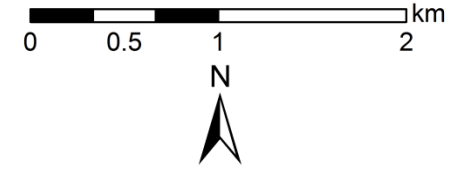
5.6.Slope



Source: ICAR-NBSS&LUP, Bengaluru

5.7. Soil Erosion

SOIL EROSION Mothakapalli Sub-watershed (4D5B4I : Area - 4155.9 ha) YADGIR TALUK & DISTRICT



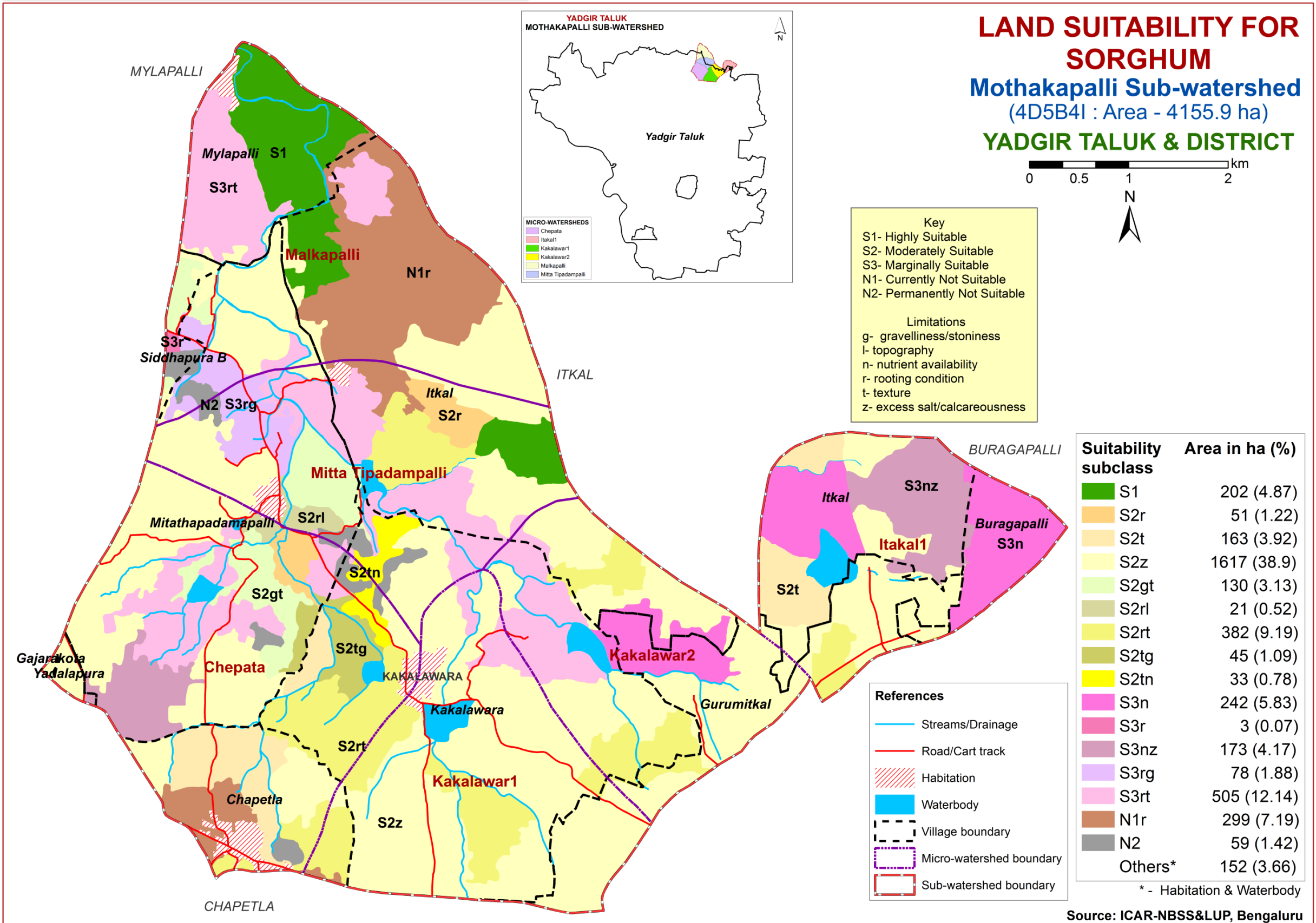
Erosion Class	Area in ha(%)
Slight	171 (4.1)
Moderate	3531 (84.97)
Severe	243 (5.84)
Rock outcrops	59 (1.42)
Others*	152 (3.66)

* - Habitation & Waterbody

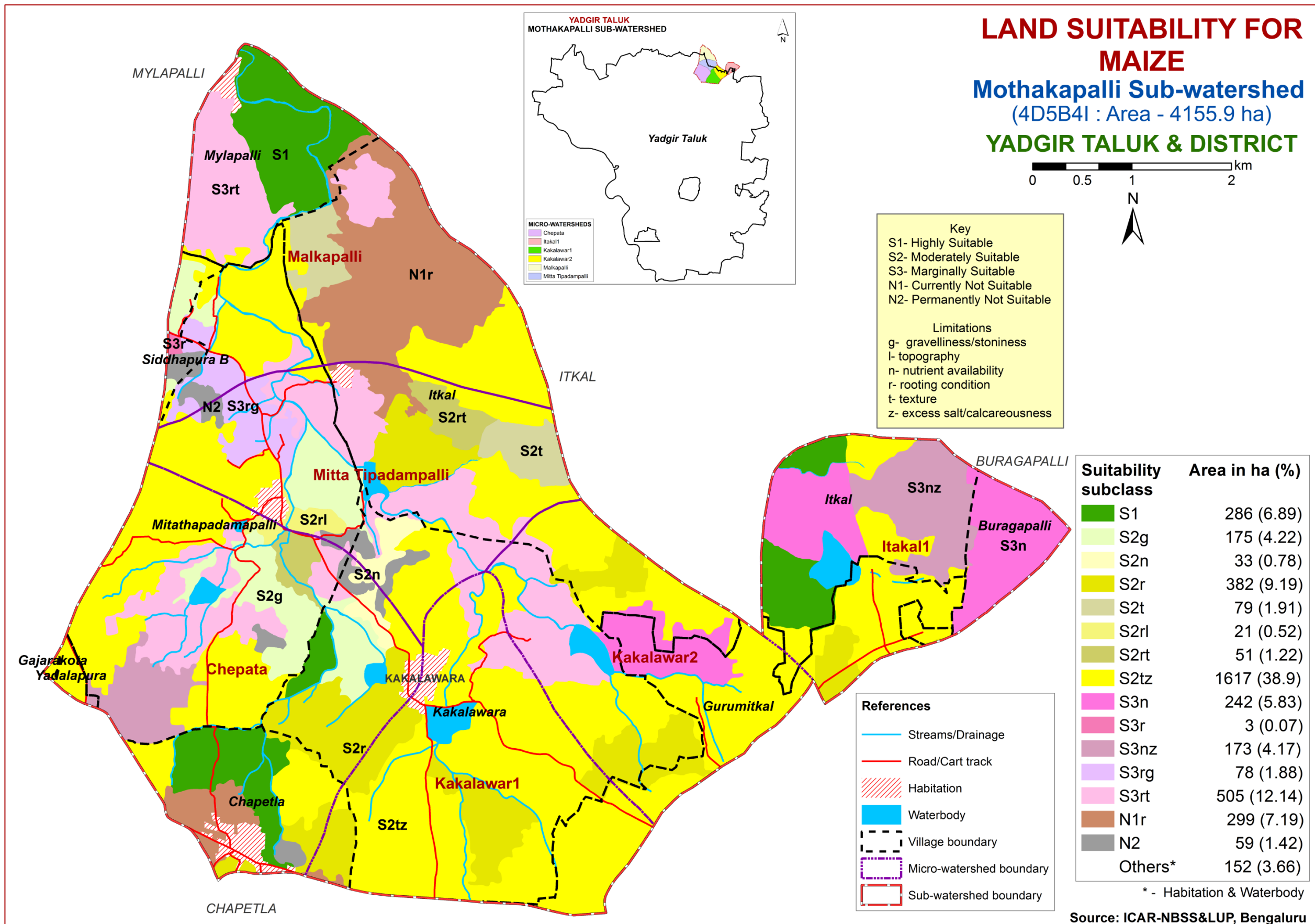
Source: ICAR-NBSS&LUP, Bengaluru

6. Land Suitability for Major Crops

6.1. Land Suitability for Sorghum

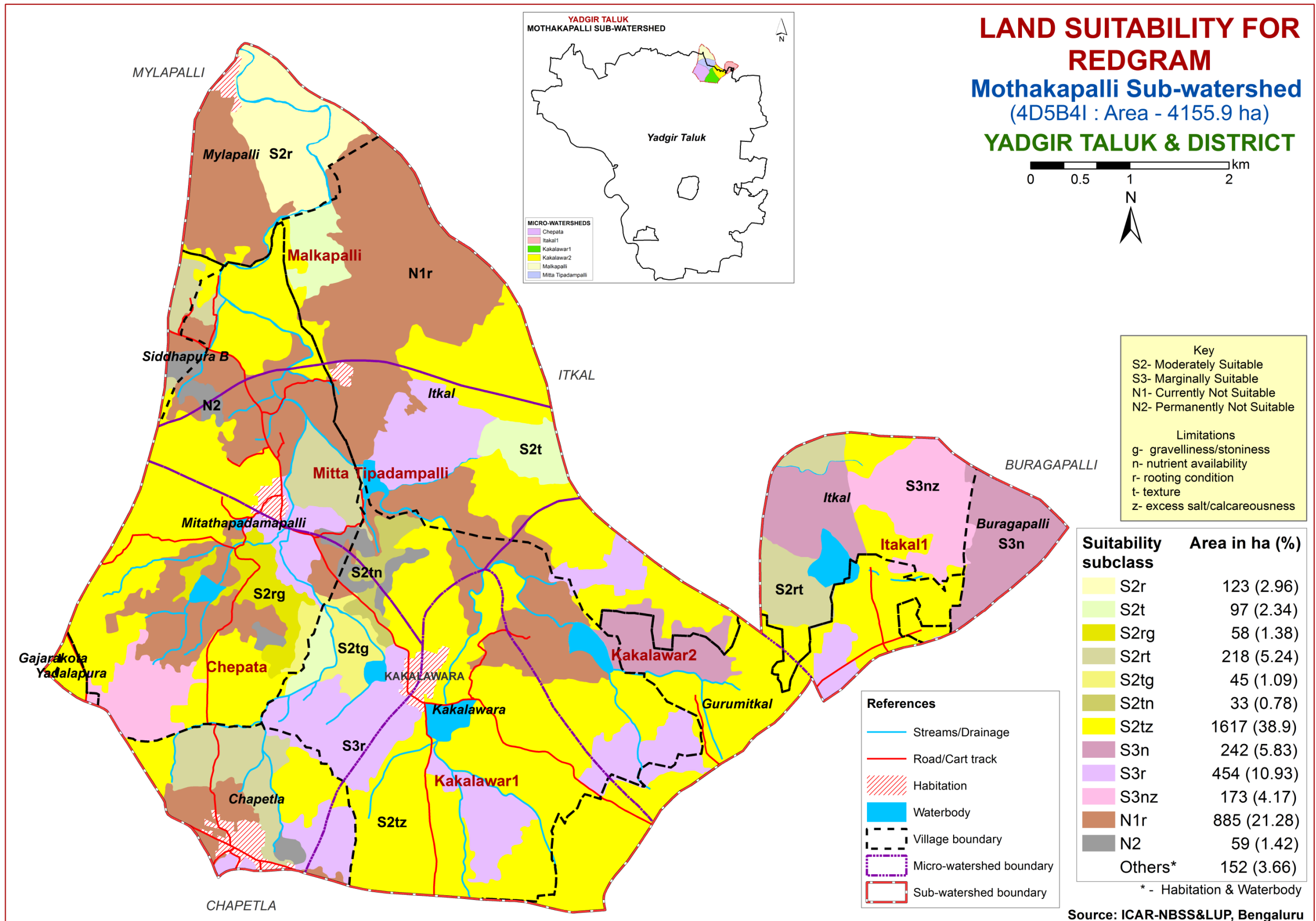


6.2. Land Suitability for Maize



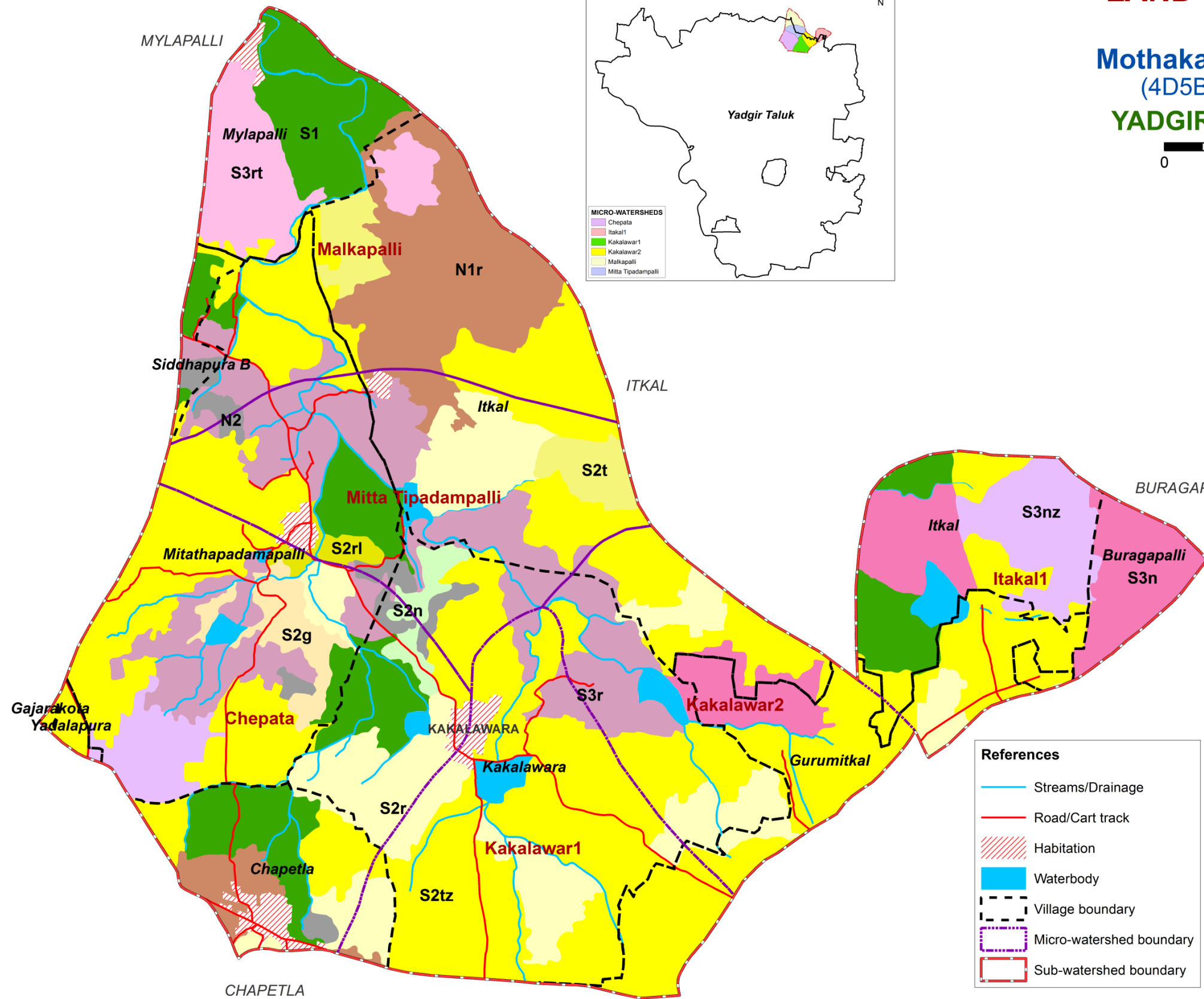
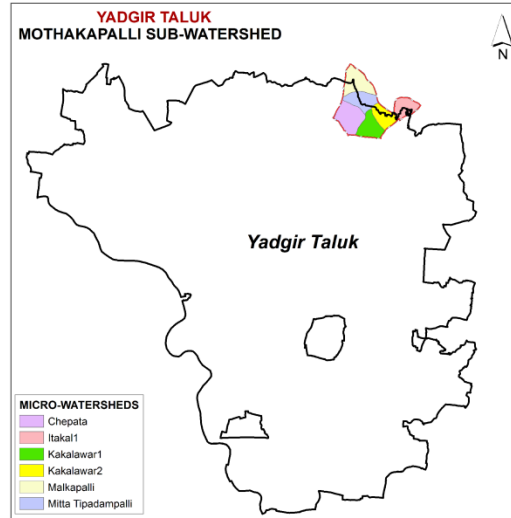
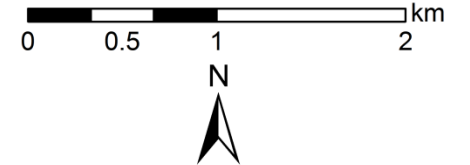
Source: ICAR-NBSS&LUP, Bengaluru

6.3. Land Suitability for Redgram



6.4. Land Suitability for Bajra

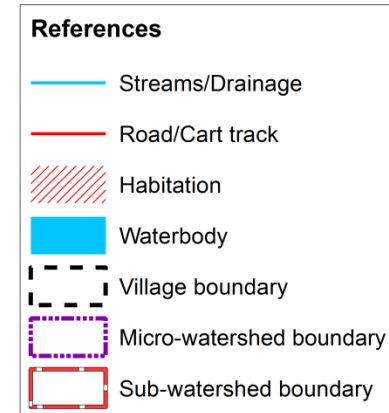
LAND SUITABILITY FOR BAJRA Mothakapalli Sub-watershed (4D5B4I : Area - 4155.9 ha) YADGIR TALUK & DISTRICT



Key
 S1- Highly Suitable
 S2- Moderately Suitable
 S3- Marginally Suitable
 N1- Currently Not Suitable
 N2- Permanently Not Suitable

Limitations
 g- gravelliness/stoniness
 l- topography
 n- nutrient availability
 r- rooting condition
 t- texture
 z- excess salt/calcareousness

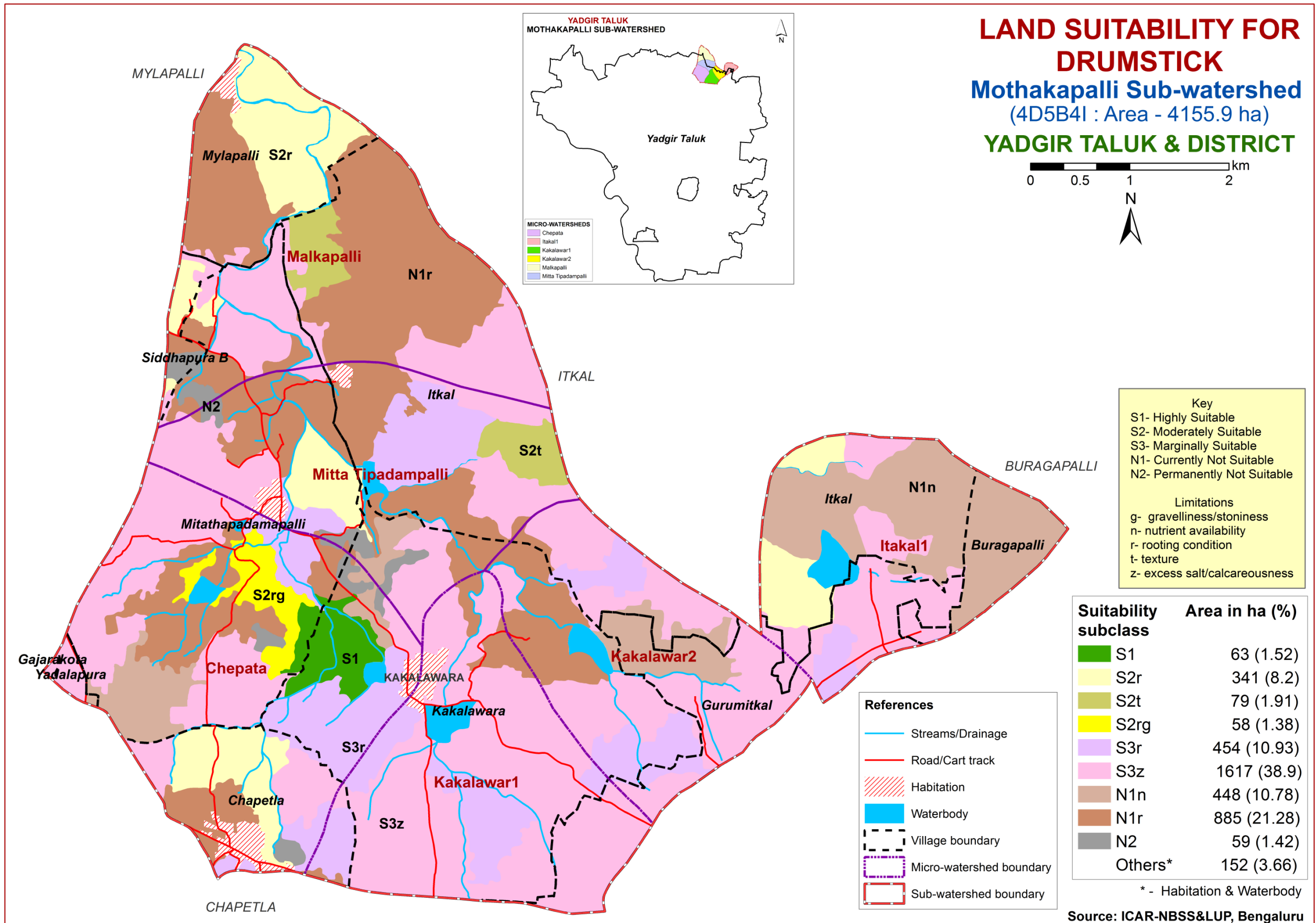
Suitability subclass	Area in ha (%)
S1	404 (9.72)
S2g	58 (1.38)
S2n	33 (0.78)
S2r	433 (10.41)
S2t	79 (1.91)
S2rl	21 (0.52)
S2tz	1617 (38.9)
S3n	242 (5.83)
S3r	450 (10.82)
S3nz	173 (4.17)
S3rt	136 (3.27)
N1r	299 (7.19)
N2	59 (1.42)
Others*	152 (3.66)



* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

6.5. Land Suitability for Drumstick

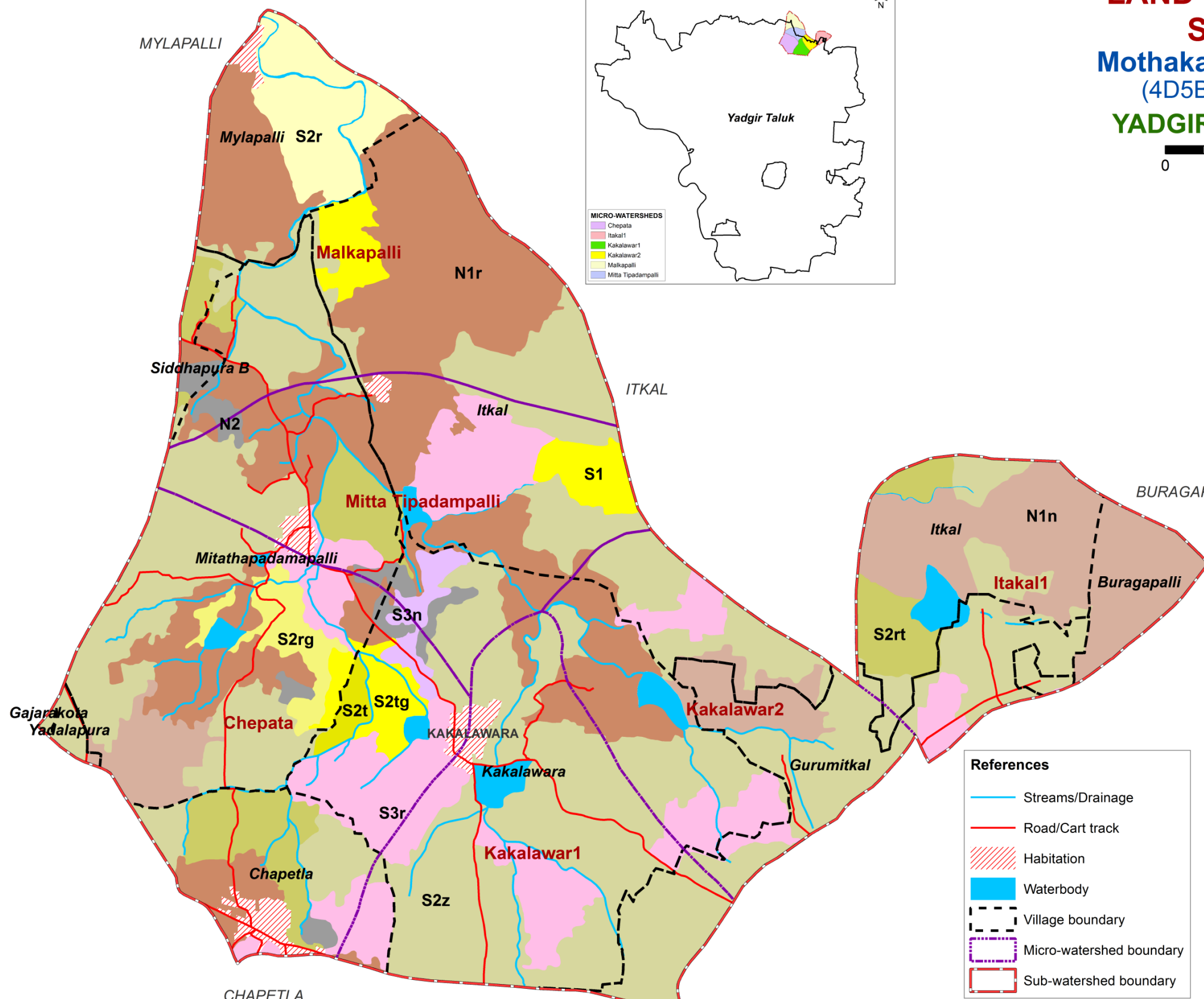
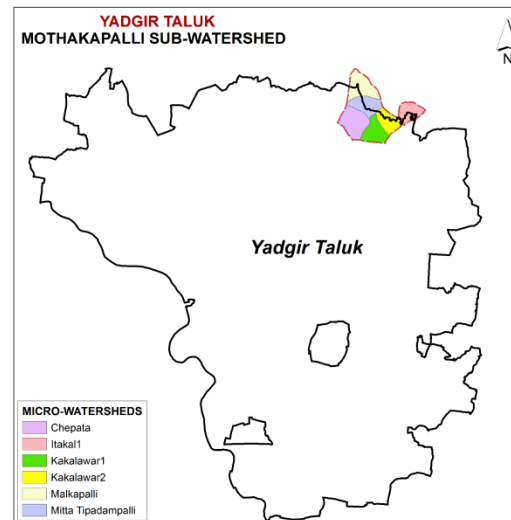


Source: ICAR-NBSS&LUP, Bengaluru

6.6. Land Suitability for Sunflower

LAND SUITABILITY FOR SUNFLOWER Mothakapalli Sub-watershed (4D5B4I : Area - 4155.9 ha) YADGIR TALUK & DISTRICT

0 0.5 1 2 km



Key
 S1- Highly Suitable
 S2- Moderately Suitable
 S3- Marginally Suitable
 N1- Currently Not Suitable
 N2- Permanently Not Suitable

Limitations
 g- gravelliness/stoniness
 n- nutrient availability
 r- rooting condition
 t- texture
 z- excess salt/calcareousness

Suitability subclass	Area in ha (%)
S1	79 (1.91)
S2r	123 (2.96)
S2t	18 (0.43)
S2z	1617 (38.9)
S2rg	58 (1.38)
S2rt	218 (5.24)
S2tg	45 (1.09)
S3n	33 (0.78)
S3r	454 (10.93)
N1n	416 (10.0)
N1r	885 (21.28)
N2	59 (1.42)
Others*	152 (3.66)

References

- Streams/Drainage
- Road/Cart track
- Habitation
- Waterbody
- Village boundary
- Micro-watershed boundary
- Sub-watershed boundary

* - Habitation & Waterbody

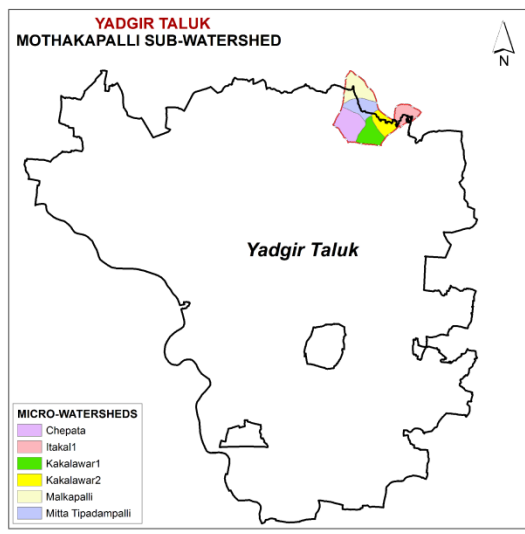
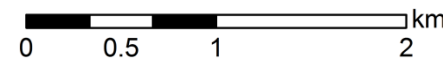
Source: ICAR-NBSS&LUP, Bengaluru

6.7. Land Suitability for Cotton

LAND SUITABILITY FOR COTTON

Mothakapalli Sub-watershed
(4D5B4I : Area - 4155.9 ha)

YADGIR TALUK & DISTRICT

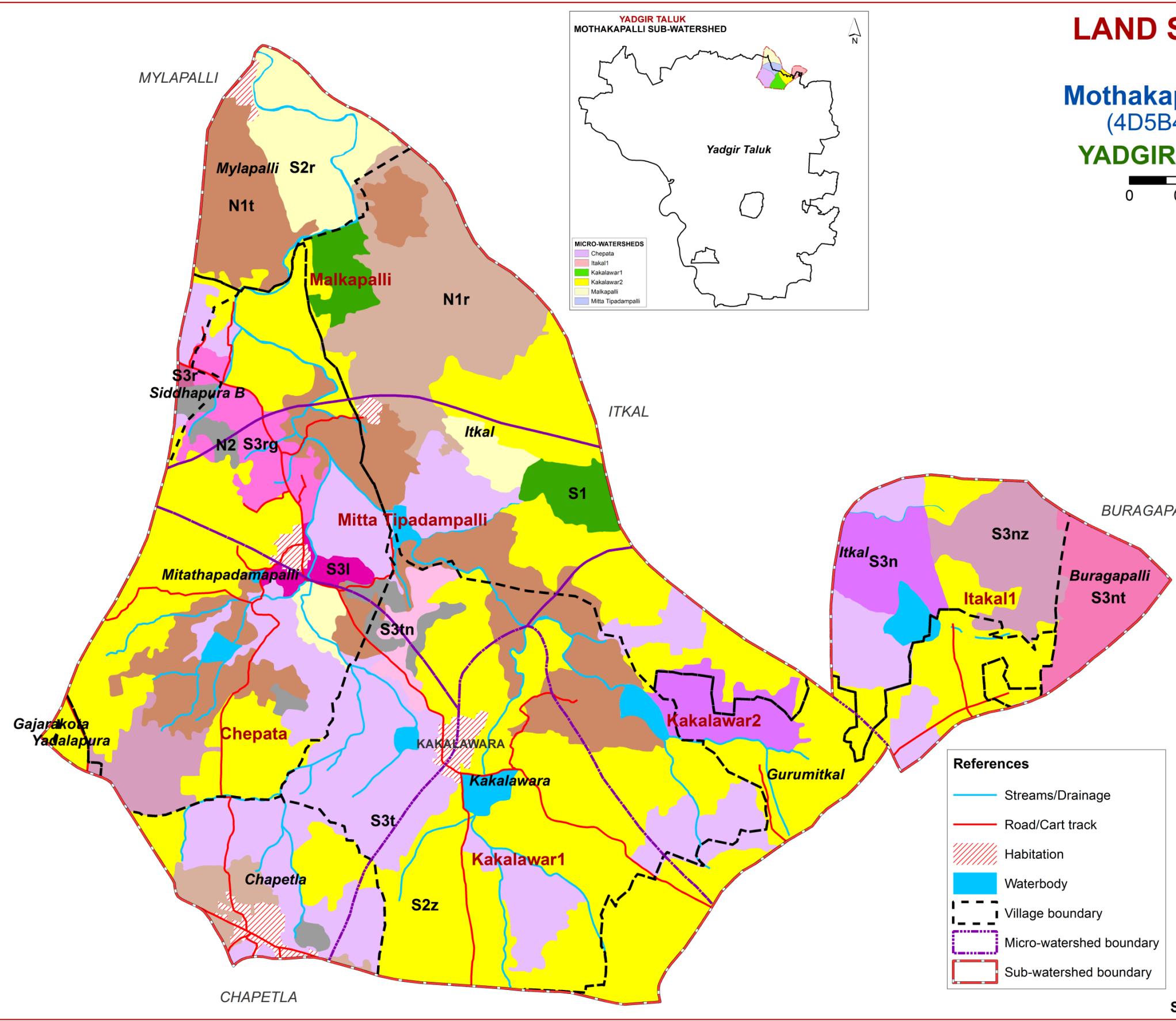


Key

- S1- Highly Suitable
- S2- Moderately Suitable
- S3- Marginally Suitable
- N1- Currently Not Suitable
- N2- Permanently Not Suitable

Limitations

- g- gravelliness/stoniness
- l- topography
- n- nutrient availability
- r- rooting condition
- t- texture
- z- excess salt/calcareousness



Suitability subclass	Area in ha (%)
S1	79 (1.91)
S2r	174 (4.19)
S2z	1617 (38.9)
S3l	21 (0.52)
S3n	146 (3.52)
S3r	3 (0.07)
S3t	720 (17.34)
S3nt	96 (2.3)
S3nz	173 (4.17)
S3rg	78 (1.88)
S3tn	33 (0.78)
N1r	299 (7.19)
N1t	505 (12.14)
N2	59 (1.42)
Others*	152 (3.66)

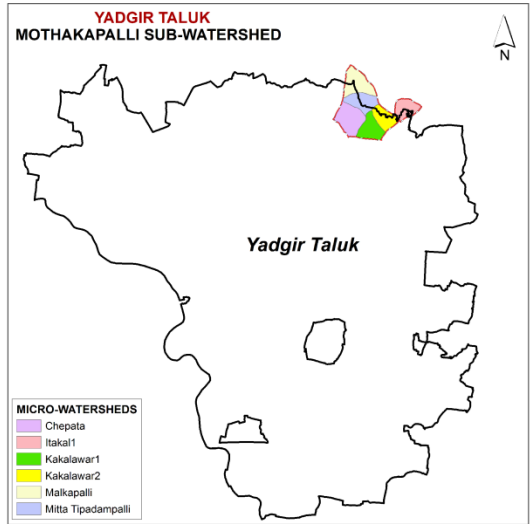
References

- Streams/Drainage
- Road/Cart track
- Habitation
- Waterbody
- Village boundary
- Micro-watershed boundary
- Sub-watershed boundary

* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

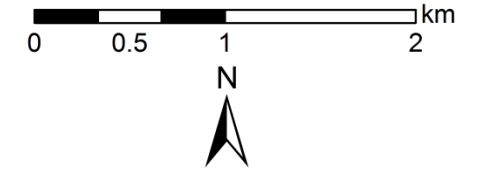
6.8. Land Suitability for Chilli



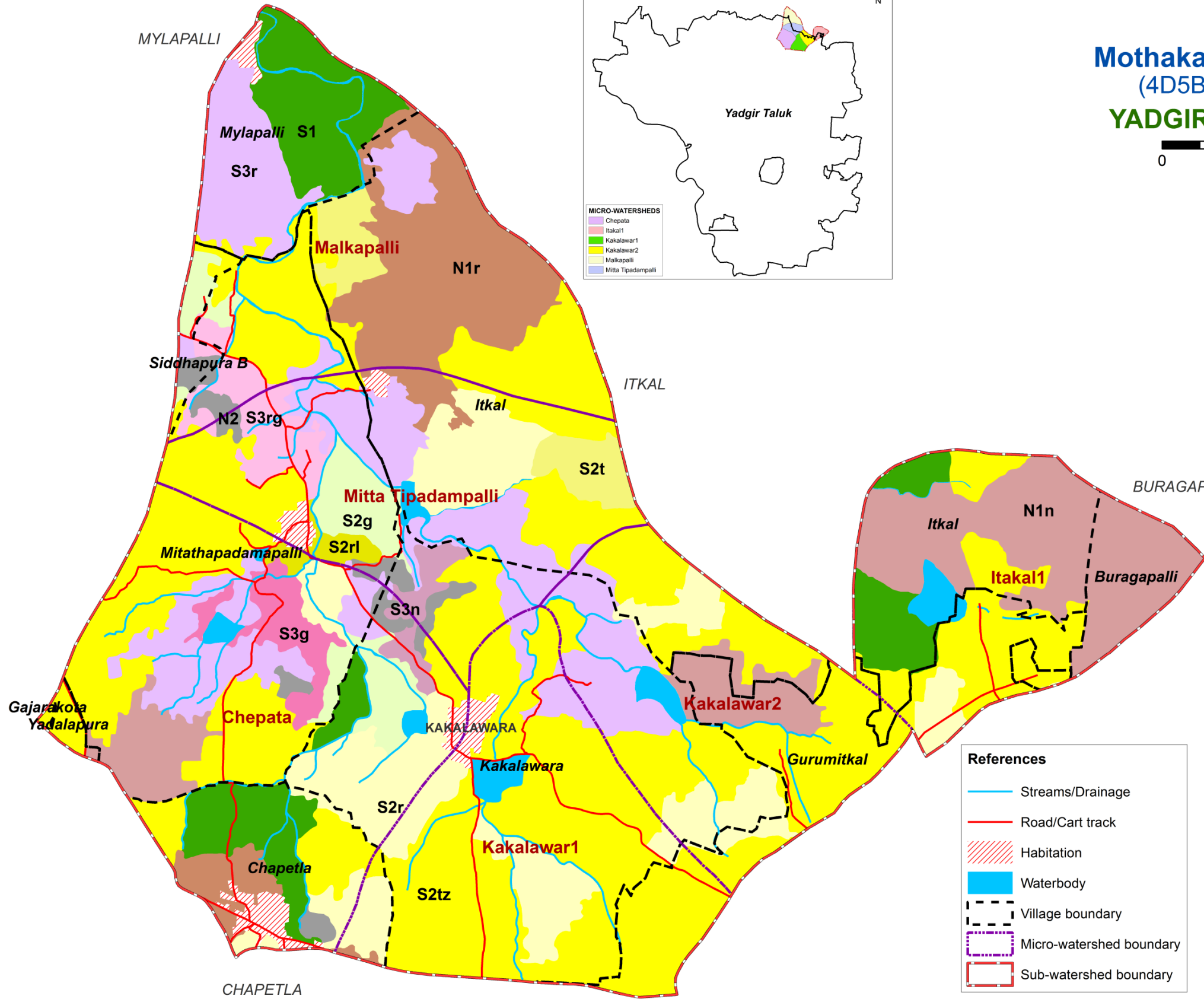
LAND SUITABILITY FOR CHILLI

Mothakapalli Sub-watershed (4D5B4I : Area - 4155.9 ha)

YADGIR TALUK & DISTRICT



Key	
S1- Highly Suitable	
S2- Moderately Suitable	
S3- Marginally Suitable	
N1- Currently Not Suitable	
N2- Permanently Not Suitable	
Limitations	
g- gravelliness/stoniness	
l- topography	
n- nutrient availability	
r- rooting condition	
t- texture	
z- excess salt/calcareousness	



Suitability subclass	Area in ha (%)
S1	286 (6.89)
S2g	118 (2.84)
S2r	433 (10.41)
S2t	79 (1.91)
S2rl	21 (0.52)
S2tz	1617 (38.9)
S3g	58 (1.38)
S3n	33 (0.78)
S3r	507 (12.21)
S3rg	78 (1.88)
N1n	416 (10.0)
N1r	299 (7.19)
N2	59 (1.42)
Others*	152 (3.66)

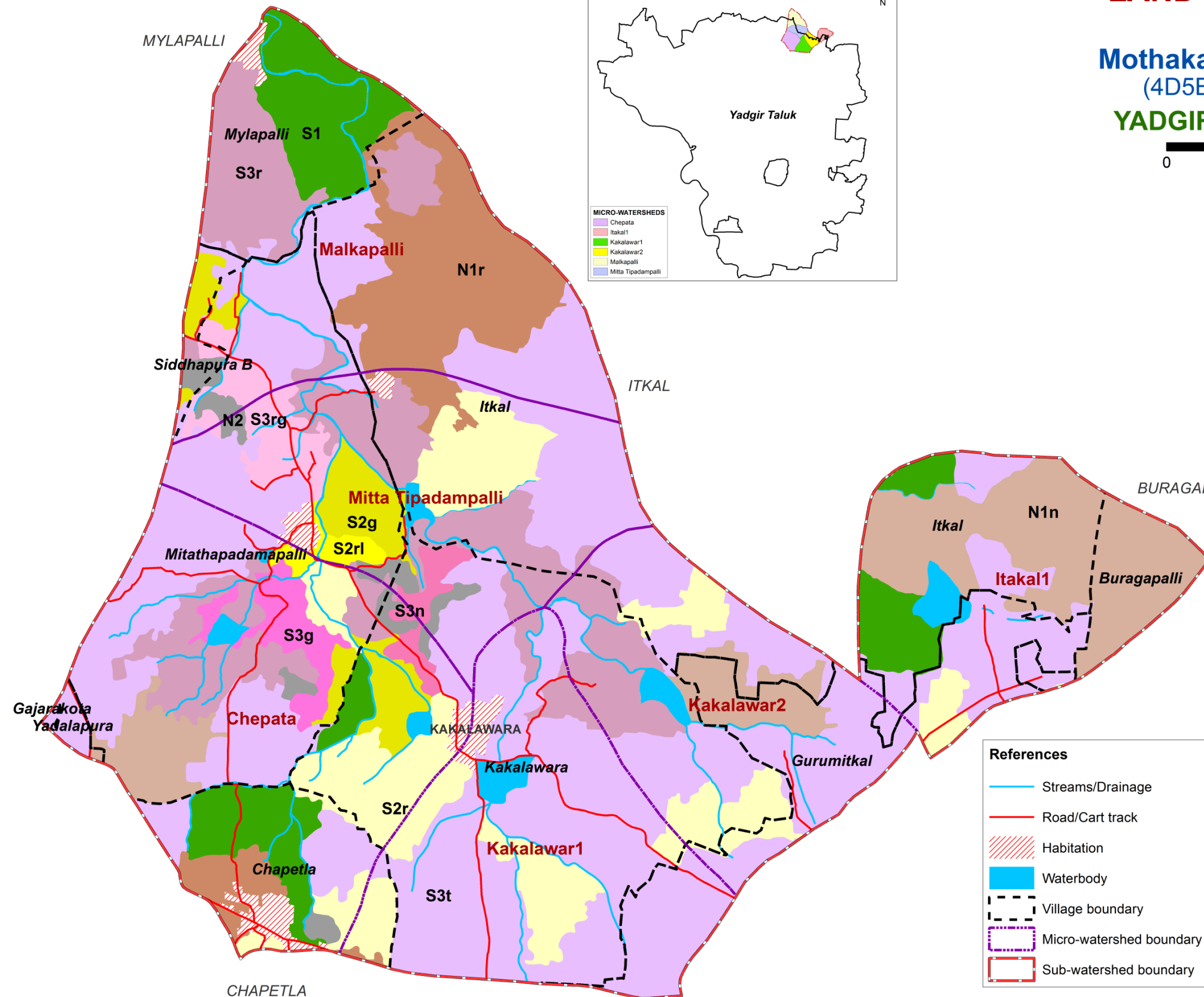
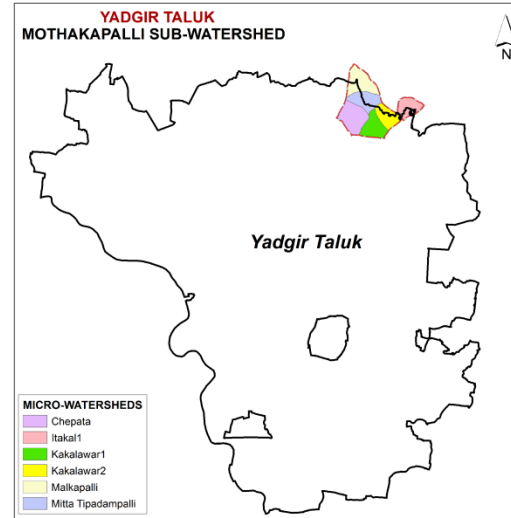
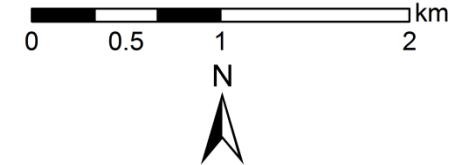
References	
	Streams/Drainage
	Road/Cart track
	Habitation
	Waterbody
	Village boundary
	Micro-watershed boundary
	Sub-watershed boundary

* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

6.9. Land Suitability for Tomato

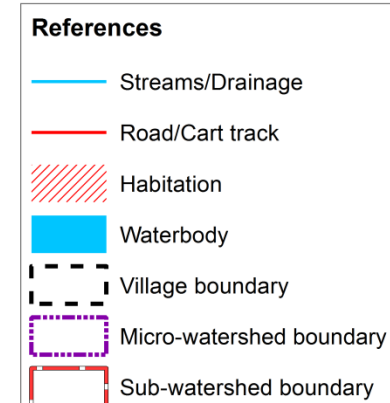
LAND SUITABILITY FOR TOMATO Mothakapalli Sub-watershed (4D5B4I : Area - 4155.9 ha) YADGIR TALUK & DISTRICT



Key
 S1- Highly Suitable
 S2- Moderately Suitable
 S3- Marginally Suitable
 N1- Currently Not Suitable
 N2- Permanently Not Suitable

Limitations
 g- gravelliness/stoniness
 l- topography
 n- nutrient availability
 r- rooting condition
 t- texture

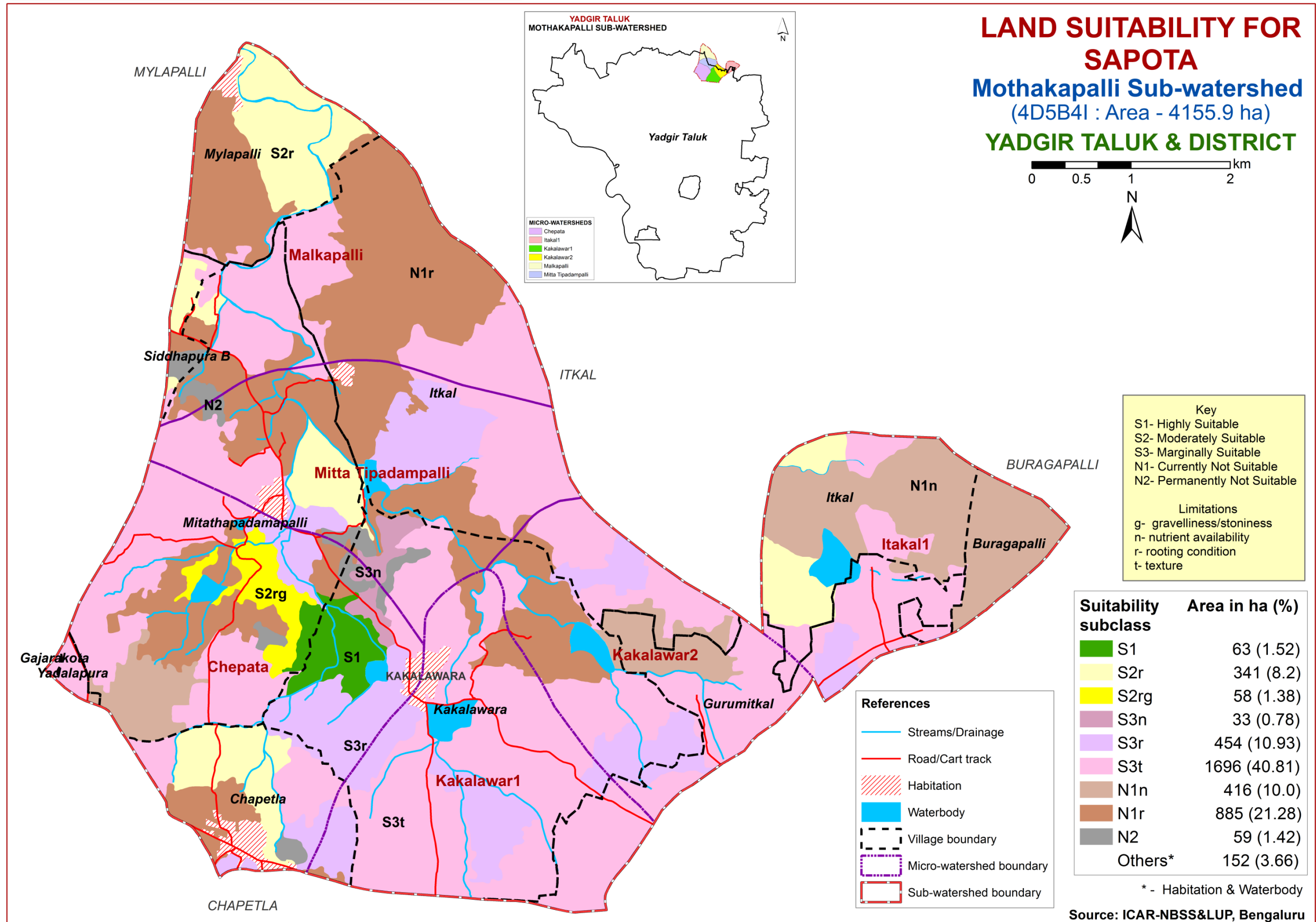
Suitability subclass	Area in ha (%)
S1	286 (6.89)
S2g	118 (2.84)
S2r	433 (10.41)
S2rl	21 (0.52)
S3g	58 (1.38)
S3n	33 (0.78)
S3r	507 (12.21)
S3t	1696 (40.81)
S3rg	78 (1.88)
N1n	416 (10.0)
N1r	299 (7.19)
N2	59 (1.42)
Others*	152 (3.66)



* - Habitation & Waterbody

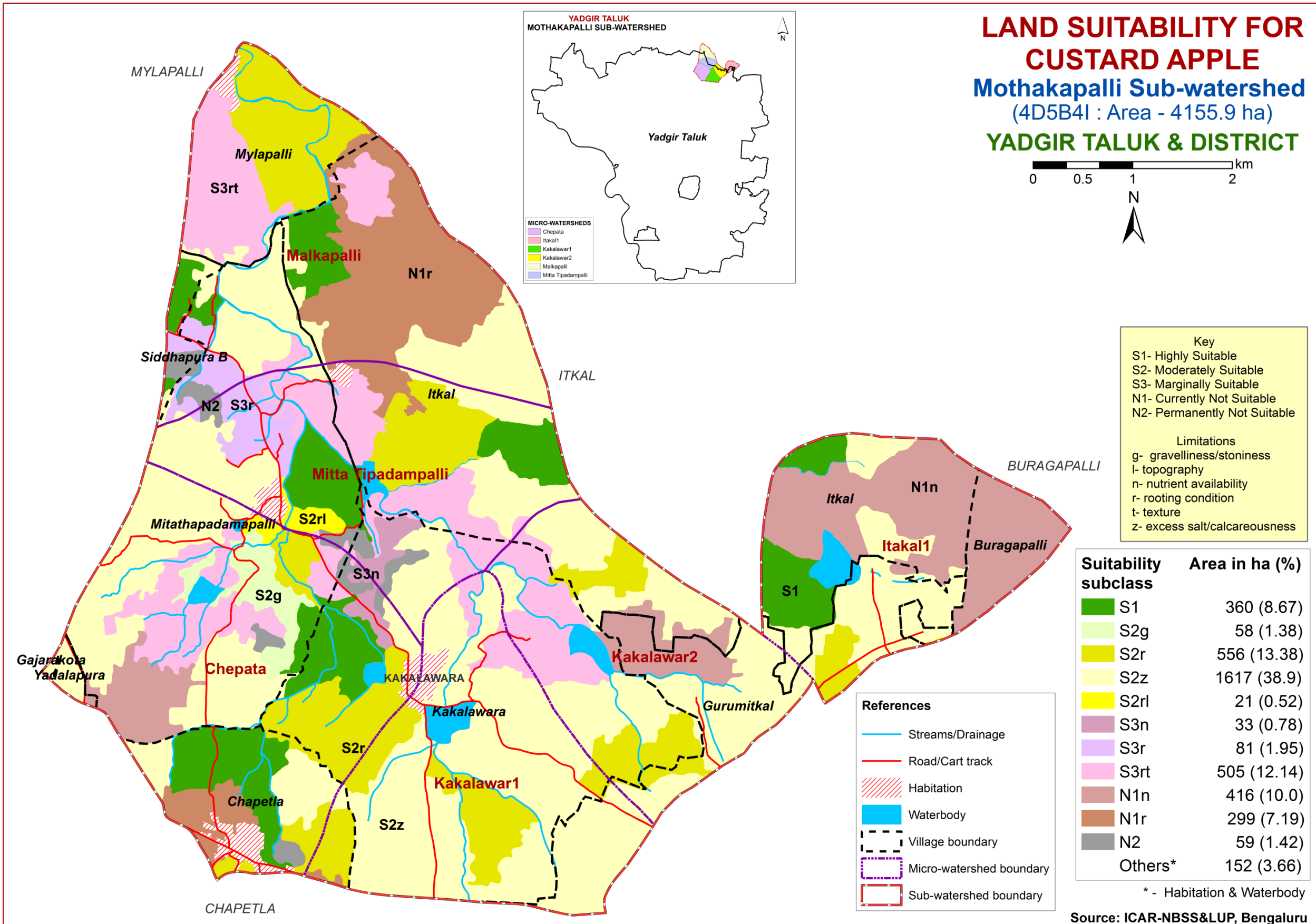
Source: ICAR-NBSS&LUP, Bengaluru

6.10. Land Suitability for Sapota



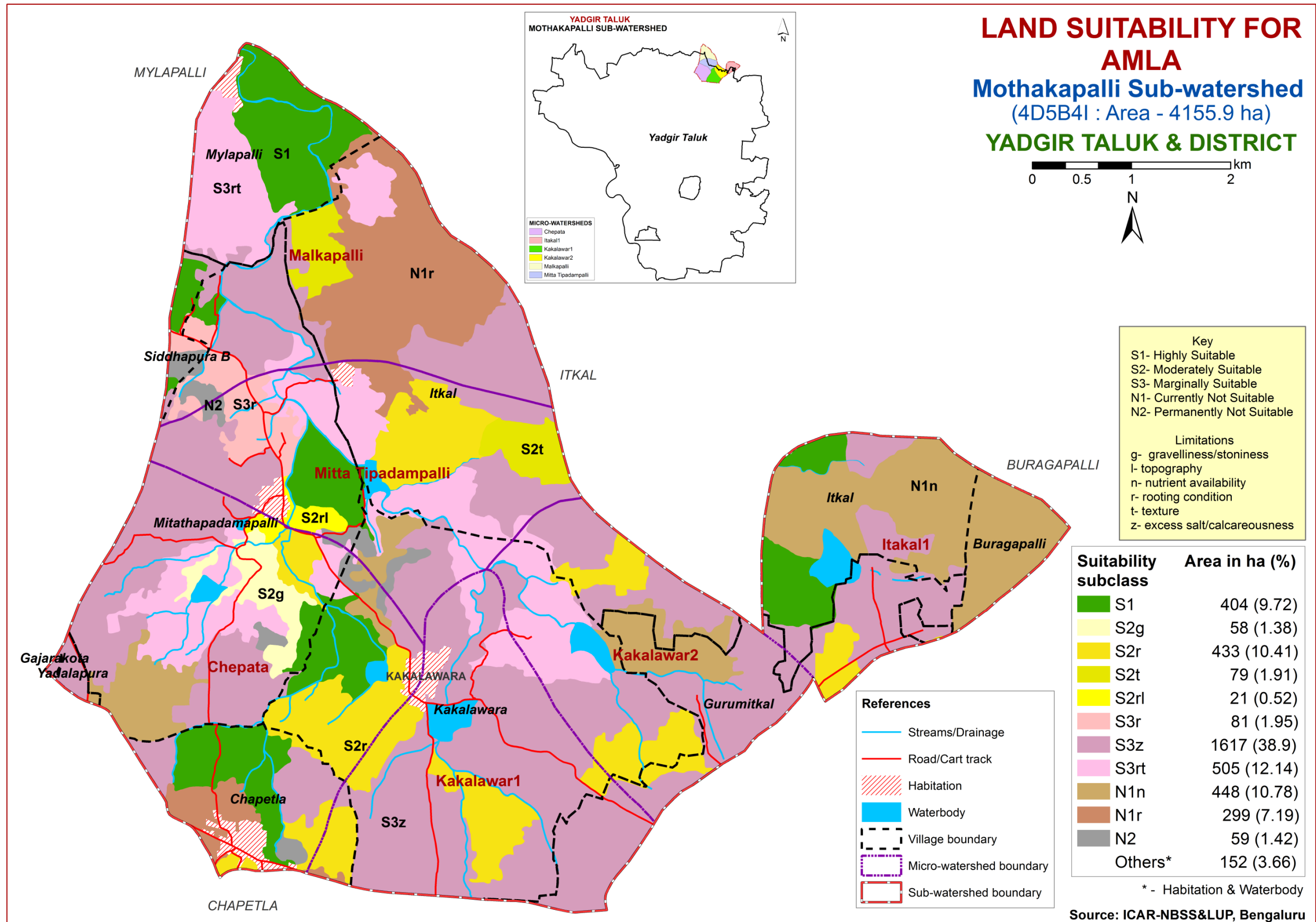
Source: ICAR-NBSS&LUP, Bengaluru

6.11. Land Suitability for Custard Apple



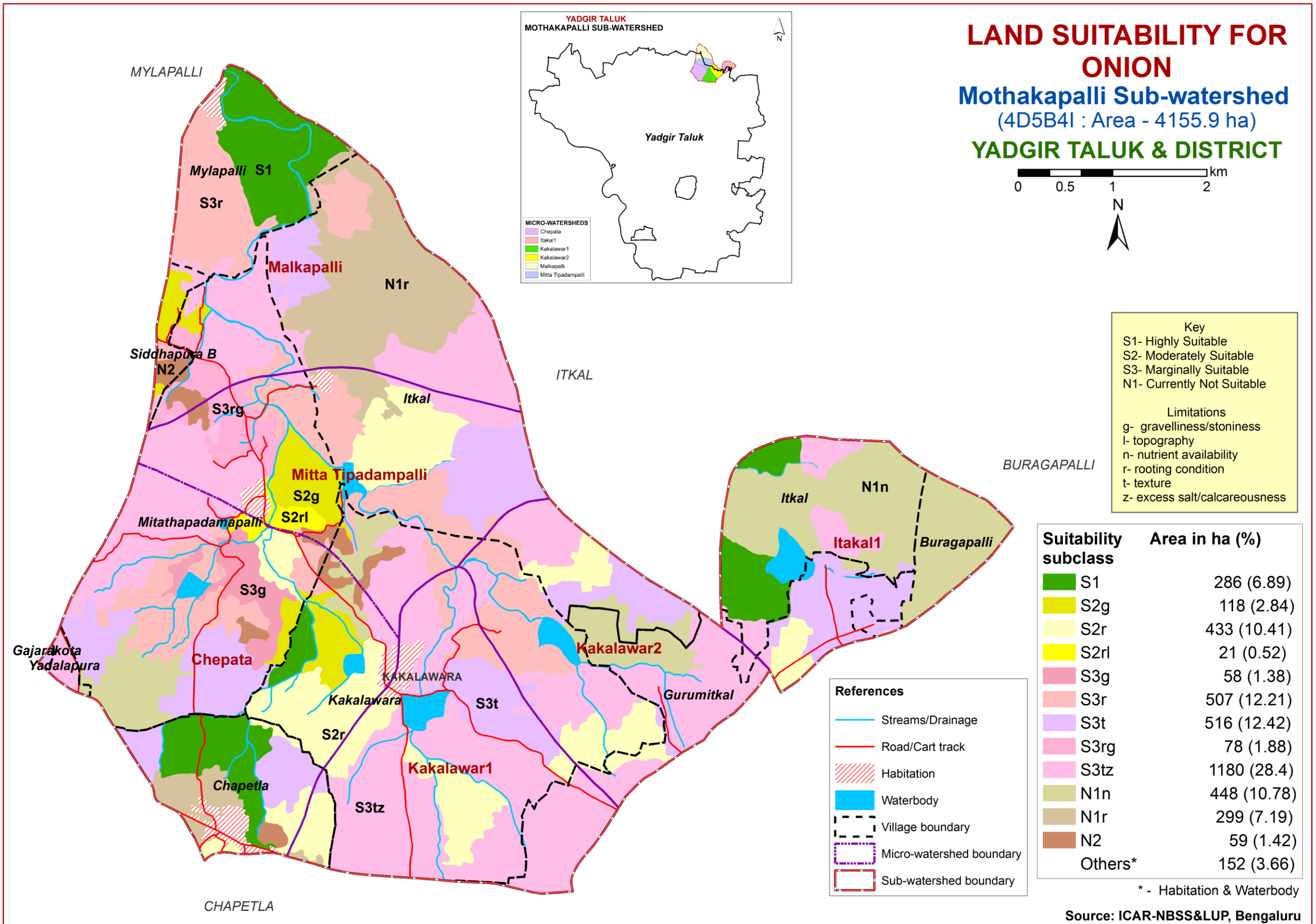
Source: ICAR-NBSS&LUP, Bengaluru

6.12. Land Suitability for Amla



Source: ICAR-NBSS&LUP, Bengaluru

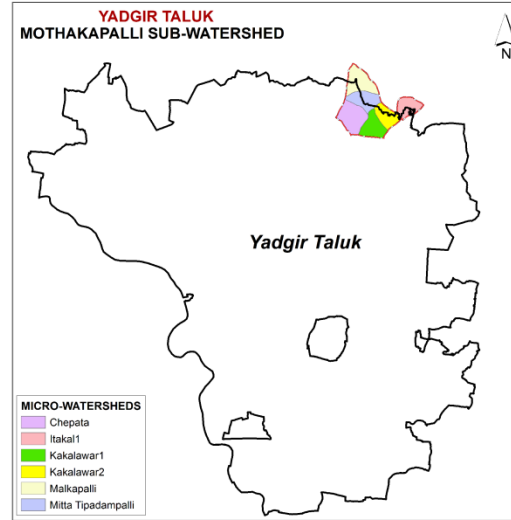
6.13. Land Suitability for Onion



6. 14.Land Suitability for Marigold

LAND SUITABILITY FOR MARIGOLD Mothakapalli Sub-watershed (4D5B4I : Area - 4155.9 ha) YADGIR TALUK & DISTRICT

0 0.5 1 2 km

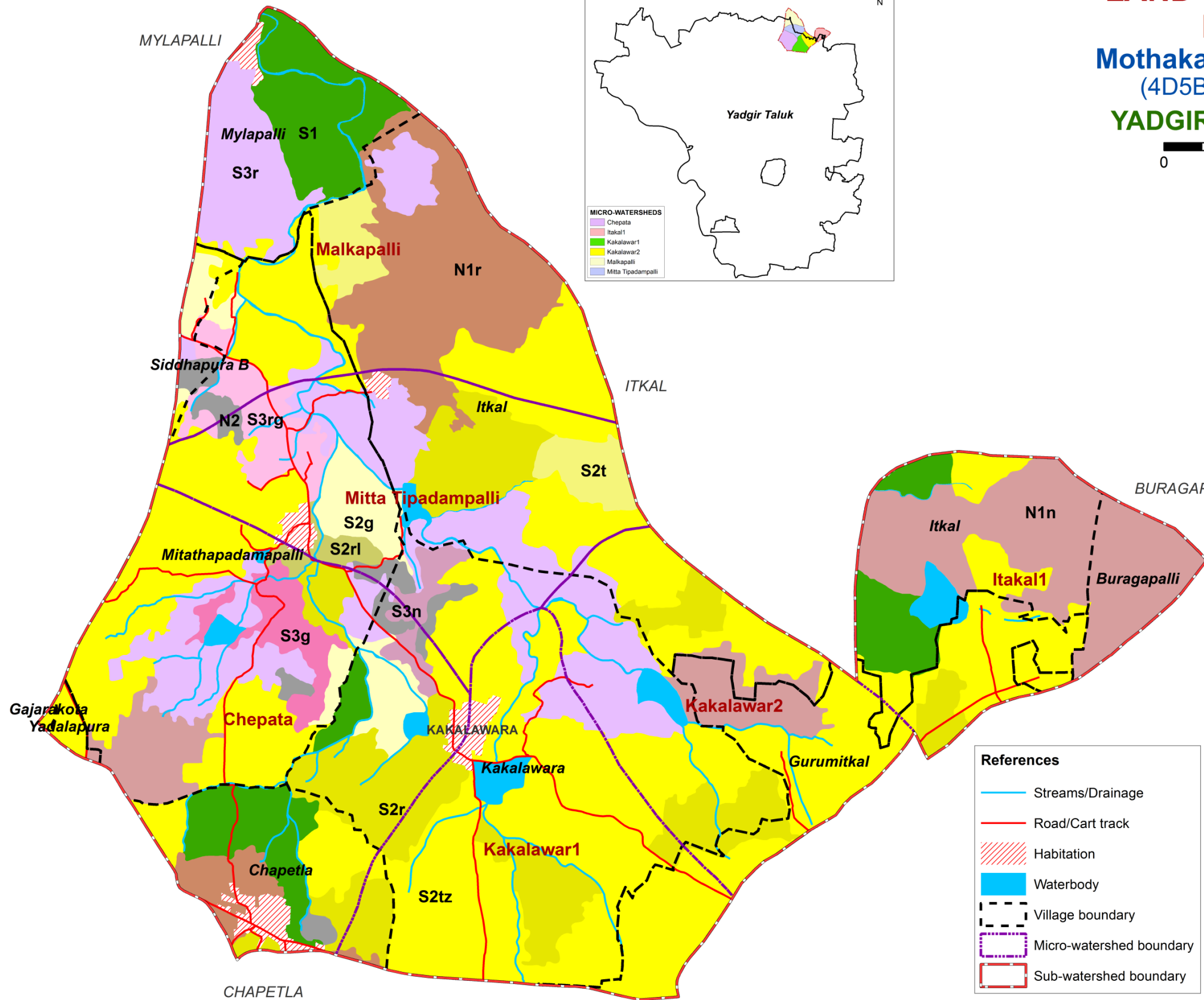


Key

S1- Highly Suitable
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable
N2- Permanently Not Suitable

Limitations

g- gravelliness/stoniness
l- topography
n- nutrient availability
r- rooting condition
t- texture
z- excess salt/calcareousness



Suitability subclass	Area in ha (%)
S1	286 (6.89)
S2g	118 (2.84)
S2r	433 (10.41)
S2t	79 (1.91)
S2rl	21 (0.52)
S2tz	1617 (38.9)
S3g	58 (1.38)
S3n	33 (0.78)
S3r	507 (12.21)
S3rg	78 (1.88)
N1n	416 (10.0)
N1r	299 (7.19)
N2	59 (1.42)
Others*	152 (3.66)

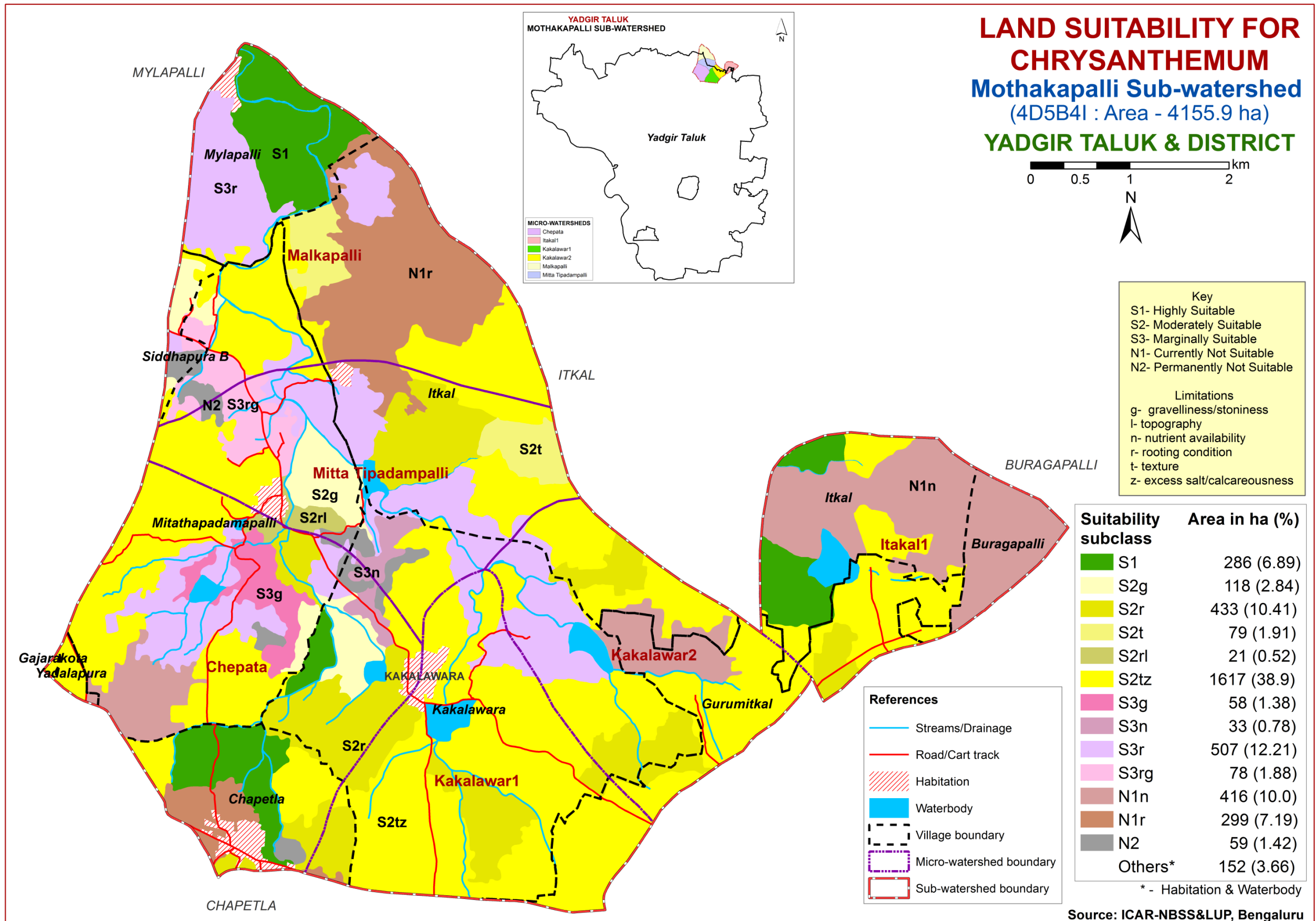
References

- Streams/Drainage
- Road/Cart track
- Habitation
- Waterbody
- Village boundary
- Micro-watershed boundary
- Sub-watershed boundary

* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

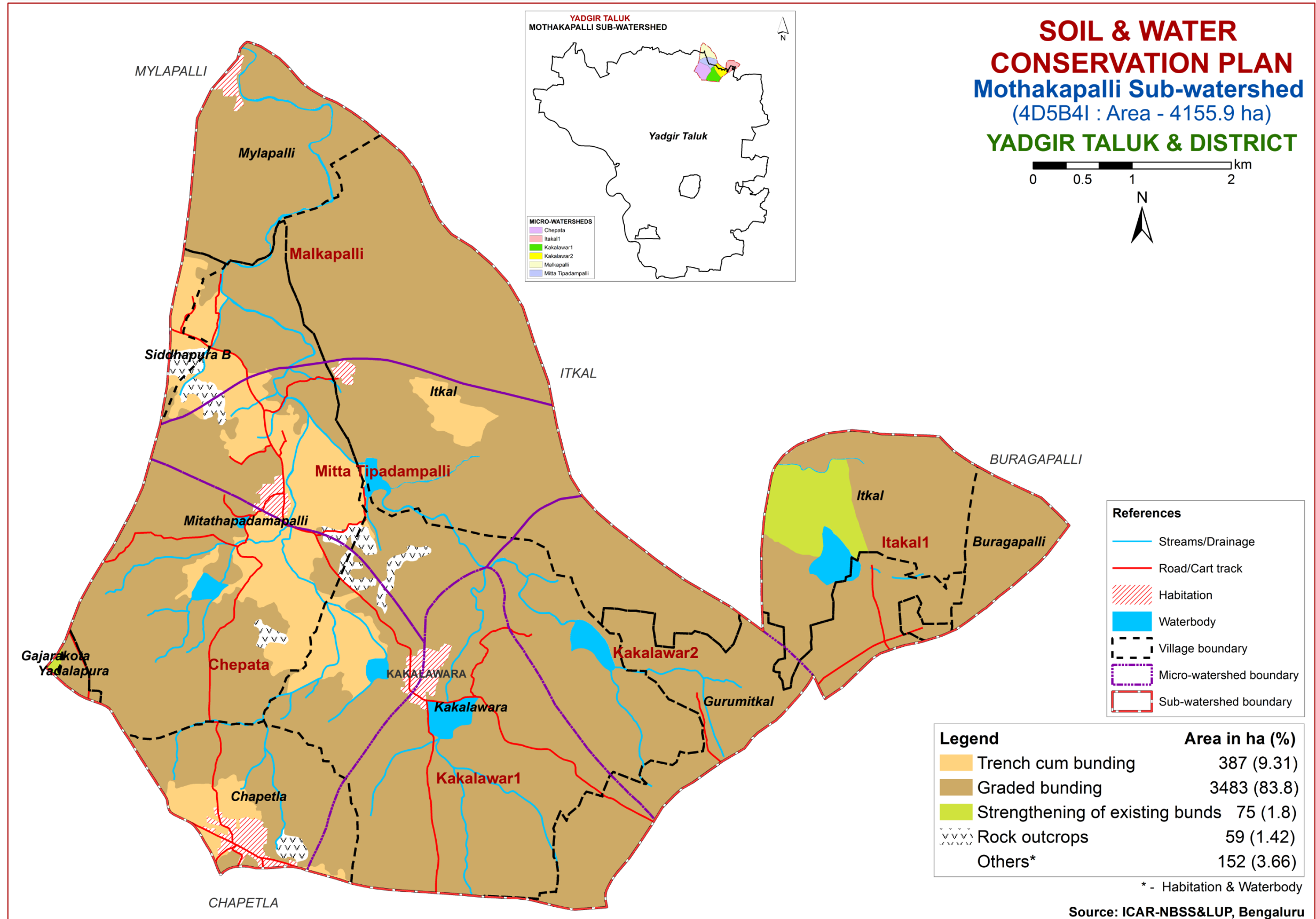
6.15. Land Suitability for Chrysanthemum



Source: ICAR-NBSS&LUP, Bengaluru

7. Soil and Water Conservation Measures

7.1. Soil & Water Conservation Plan



8. Table. Proposed Crop Plan for Mothakapalli Sub-watershed, Gurumitkal Hobli, Yadgir Taluk, Yadgir District based on soil-site–crop suitability Assessment

LMU.No	Soil Map Units	Field Crops/ Commercial crops	Horticulture Crops (Rainfed/Irrigated)	Suitable Interventions
1	56.ANRiB3g1 150.GWDiB2g1 127.GWDmB2 158.SGRiA1 100.VKSmB1 (Sodic soils)	-	Agri-Silvi-Pasture Ber, Aonla, Acacia sp. Dhaincha, Rhodes grass, Para grass ,Bermuda grass	Application of gypsum, iron pyrites and elemental sulphur. Addition of farm yard manures, green manures and providing subsurface drainage
2	115.BGDmB2 159.BMNmA1 62.BMNmB2 63.BMNmB2g1 33.HSLiB2 48.NGPiB2 49.NGPmB2 146.NGPmB2g1 129.SHTiB2 112.SHTmB2 (Moderately deep to very deep, black clay soils)	Maize, sorghum, Sunflower, Cotton, Red gram, Bengalgram, Bajra	Fruit crops: Lime, Musambi, Custard apple, Pomegranate Vegetables: Chilli, Bhendi Flowers: Marigold,Chrysanthemum	Application of FYM, Biofertilizers and micronutrients, drip irrigation, mulching, suitable soil and water conservation practices
3	155.BLCcB2g1 64.BMDcB2 65.BMDiB2g1 (Moderately deep to very deep, red sandy clay loam soils)	Sunflower, Sorghum, Maize, Groundnut, Red gram, Bajra	Fruit crops: Mango, Musambi, Sapota, Tamarind, Pomegranate, Amla, Custard apple, Guava, Jackfruit, Jamun, Lime Vegetables: Tomato, Onion, Bhendi, Chilli, Brinjal, Drumstick, Coriander Flowers: Marigold, Chrysanthemum	Application of FYM, Biofertilizers and micronutrients, drip irrigation, Mulching, suitable soil and water conservation practices
4	164.KBDcC2g1 (Moderately deep, red gravelly loamy soils)	Groundnut, Bajra, Horse gram, Castor, Mulberry	Fruit crops: Musambi, Lime, Jamun, Jackfruit Amla, Custard apple, Tamarind Vegetable crops: Drumstick, Curry leaves	Drip irrigation, mulching, suitable soil and water conservation practises (Crescent Bunding with Catch Pit etc)

LMU.No	Soil Map Units	Field Crops/ Commercial crops	Horticulture Crops (Rainfed/Irrigated)	Suitable Interventions
5	149.MDGhB2g1 (Deep, strongly alkaline soils)	Sorghum, Maize, Bajra	Agri-Silvi-Pasture Ber, Aonla, Acacia sp. Dhaincha, Rhodes grass, Para grass, Bermuda grass	Application of gypsum, iron pyrites and elemental sulphur. Addition of farm yard manures, green manures and providing subsurface drainage
6	30.YLRcC3 31.YLRiB2 (Moderately shallow, red clay soils)	Maize, sorghum Groundnut, Bajra, Cotton	Fruit crops: Amla, Custard apple Vegetables: Tomato, Chilli, Brinjal, Bhendi, Onion Flowers: Marigold, Chrysanthemum	Application of FYM, Bio fertilizers and micronutrients, drip irrigation, Mulching, suitable soil and water conservation practices
7	110.JNKhB2 23.JNKiB2g1 152.JNKmB2 (Moderately shallow, sandy clay loam soils)	Maize, sorghum Groundnut, Bajra	Fruit crops: Amla, Custard apple Vegetables: Tomato, Chilli, Brinjal, Bhendi, Onion Flowers: Marigold, Chrysanthemum	Application of FYM, Biofertilizers and micronutrients, drip irrigation, Mulching, suitable soil and water conservation practices
8	174.BDLcB2g2 4.BDLhB2 162.BDLhB2g1 5.BDLiB2 6.BDLiB3 119.BDPiB3 121.DSBcB2 107.DSBhB2 161.HTKbB2g1 153.KKRbB2g1 109.VNKmB2g1 (Shallow to very shallow soils)	-	Agri-Silvi-Pasture: Hybrid Napier, <i>Styloxanthes hamata</i> , Glyricidia, <i>Styloxanthes scabra</i>	Use of short duration varieties, sowing across the slope and split application of nitrogen fertilizers

PART - B

Hydrological Inventory of Mothakapalli Sub-watershed, Yadgir Taluk, Yadgir District, Karnataka for Watershed Planning and Development



Sujala - III

**Karnataka Watershed Development Project-II
Watershed Development Department
Government of Karnataka**



Hydrological Inventory of Mothakapalli Sub-watershed, Yadgir Taluk, Yadgir District, Karnataka for Watershed Planning and Development



ICAR - NBSS & LUP

Prepared by

**ICAR-National Bureau of Soil Survey and Land Use Planning
Regional Centre, Hebbal, Bangalore - 560 024**

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nbssrcb@gmail.com**



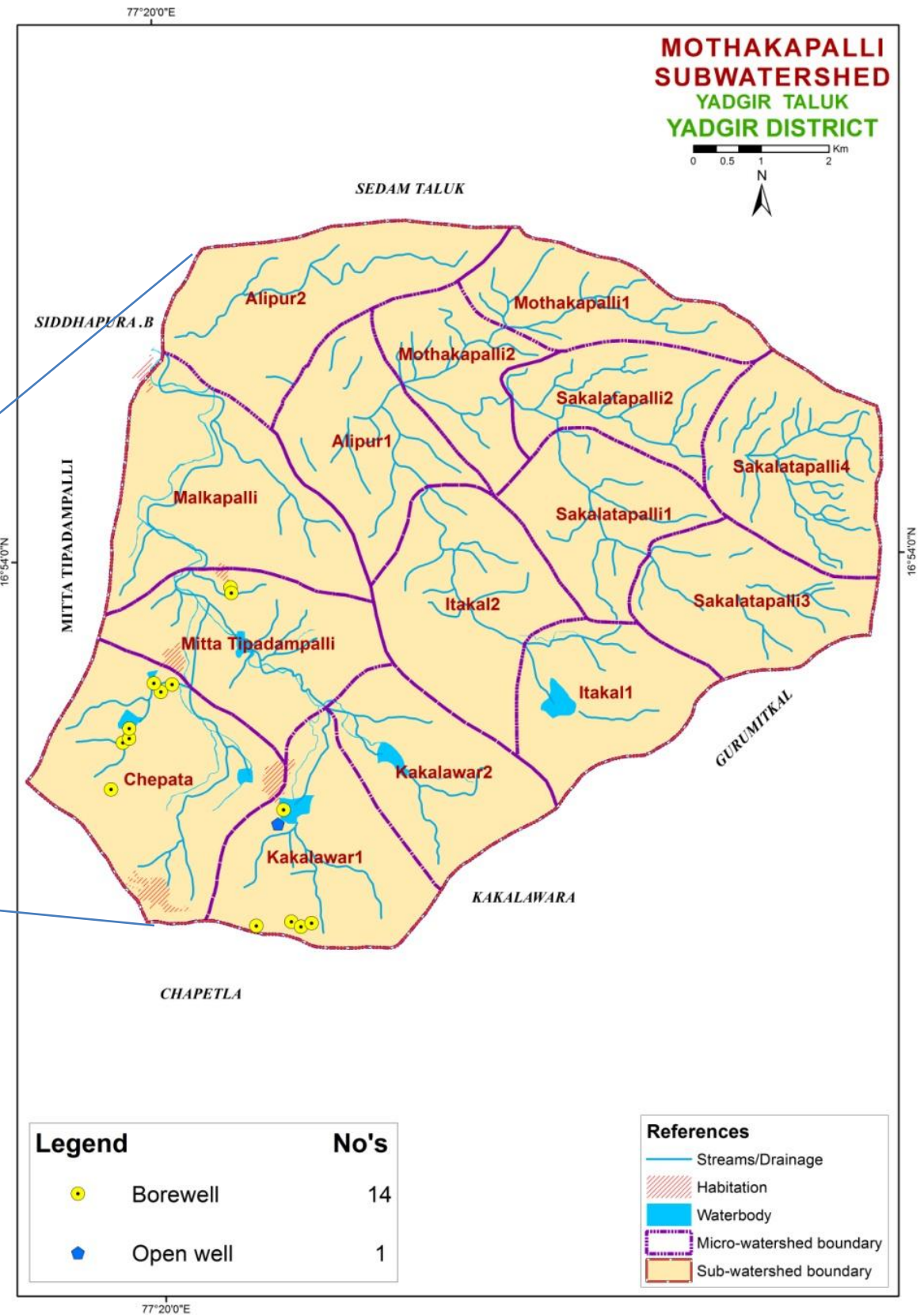
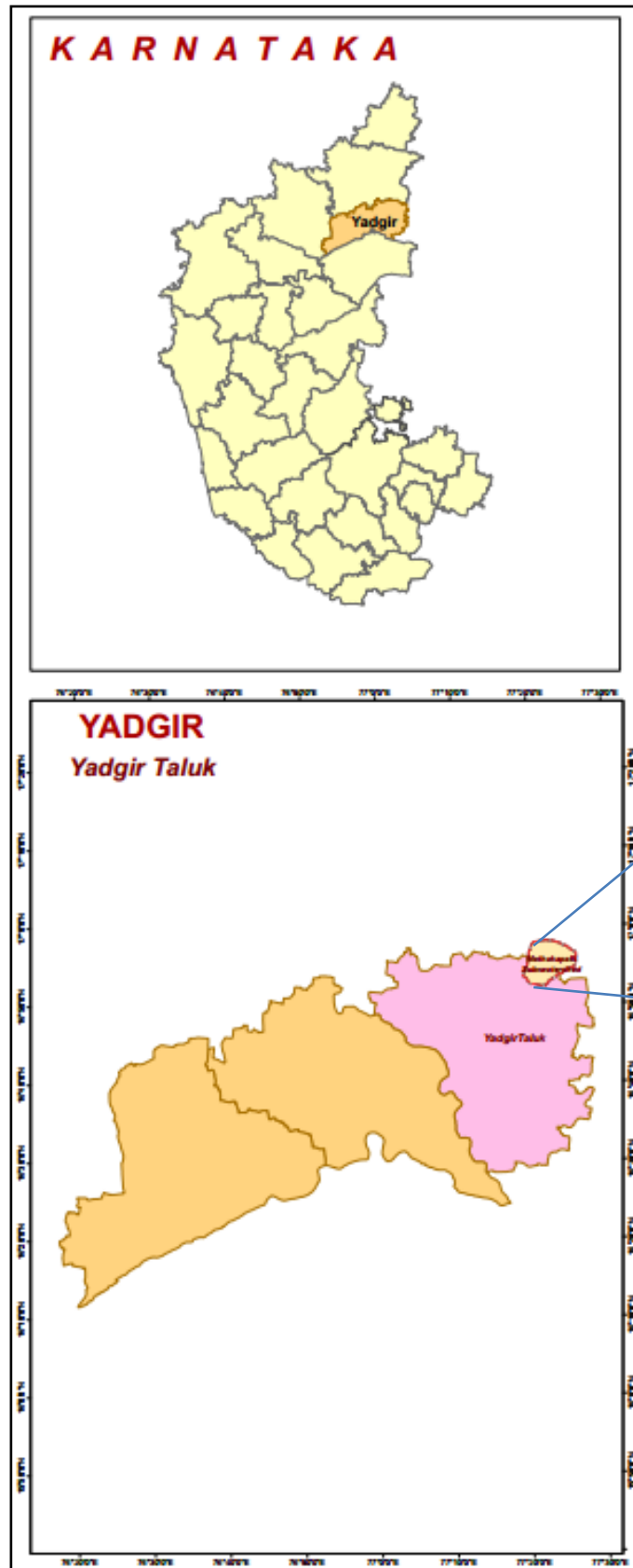
Details of Hydrology Team of LRI Partner Responsible for Preparation of Atlas

Name	Designation
Dr. Rajendra Hegde	Principal Scientist & Head Coordinator
Dr. S. Srinivas	Principal Scientist
Dr. K .V. Niranjana	Chief Technical Officer
Sh. R.S.Reddy	Consultant
Sh. A.G.Devendra Prasad	Consultant
Smt. K.Karunya Lakshmi	Research Associate
Ms. Seema, K.V.	Senior Research Fellow
Dr. Sekhar Muddu (Reviewed and approved)	Professor & Lead Scientist, Dept. of Civil Engineering & ICWaR, IISc, Bangalore
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INTRODUCTION

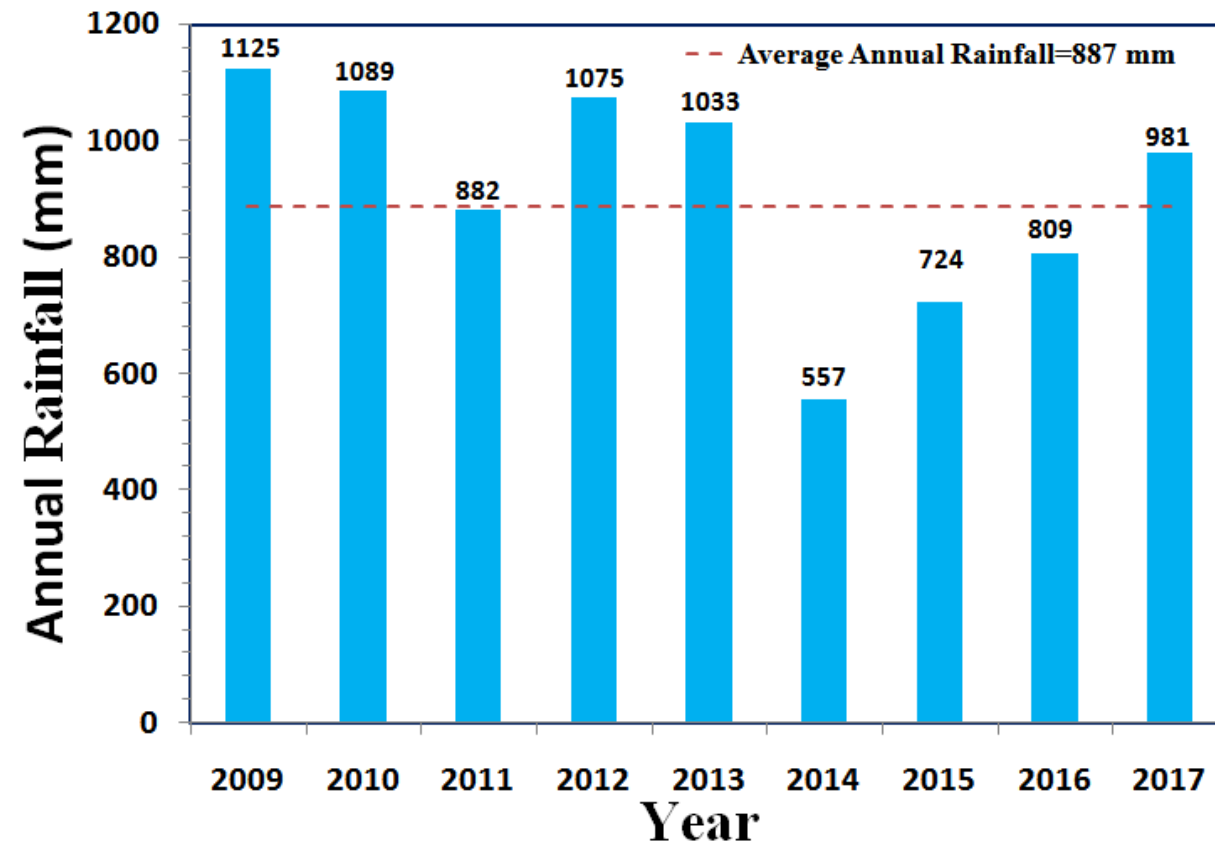
- The inventory and documentation of spatial and temporal changes in hydrological components of Mothakapalli sub-watershed (4D5B1I) in Yadgir Taluk, Yadgir District, has been undertaken for integrated planning, development and management.
- Mothakapalli sub-watershed (Yadgir Taluk, Yadgir District) is located between 16^o52'5''-16^o58'1'' North latitudes and 77^o19'8''- 77^o26'15'' East longitudes, covering an area of about 9192 ha.
- This sub-watershed encompasses of 15 MWs namely Alipur-1 (4D5B4I1i), Alipur-2 (4D5B4I1j), Chepata (4D5B4I2c), Itakal-1 (4D5B4I1e), Itakal-2 (4D5B4I1f), Kakalawar-1 (4D5B4I2a), Kakalawar-2 (4D5B4I2b), Malkapalli (4D5B4I2e), Mitta Tipadampalli (4D5B4I2d), Mothakapalli-1 (4D5B4I1g), Mothakapalli-2 (4D5B4I1h), Sakalatapalli-1 (4D5B4I1c), Sakalatapalli-2 (4D5B4I1d), Sakalatapalli-3 (4D5B4I1b) and Sakalatapalli-4 (4D5B4I1a). Land Resource Inventory (LRI) was generated for six among fifteen micro-watersheds.
- Average annual rainfall (1960-2014) of the Hobli (Block) pertaining to the sub-watershed is 887 mm.
- In this sub-watershed major *kharif* crops grown are Maize, Cotton, Sunflower, Groundnut, Red gram, Chilly, Soybean, Paddy and major *rabi* crops are Sorghum, Bengalgram, Bajra.
- Hydrological components namely rainfall (annual, *kharif*, *rabi* and summer), PET, AET, runoff, surface soil moisture, ground water status and water balance are presented.

LOCATION MAP OF MOTHAKAPALLI SUB-WATERSHED



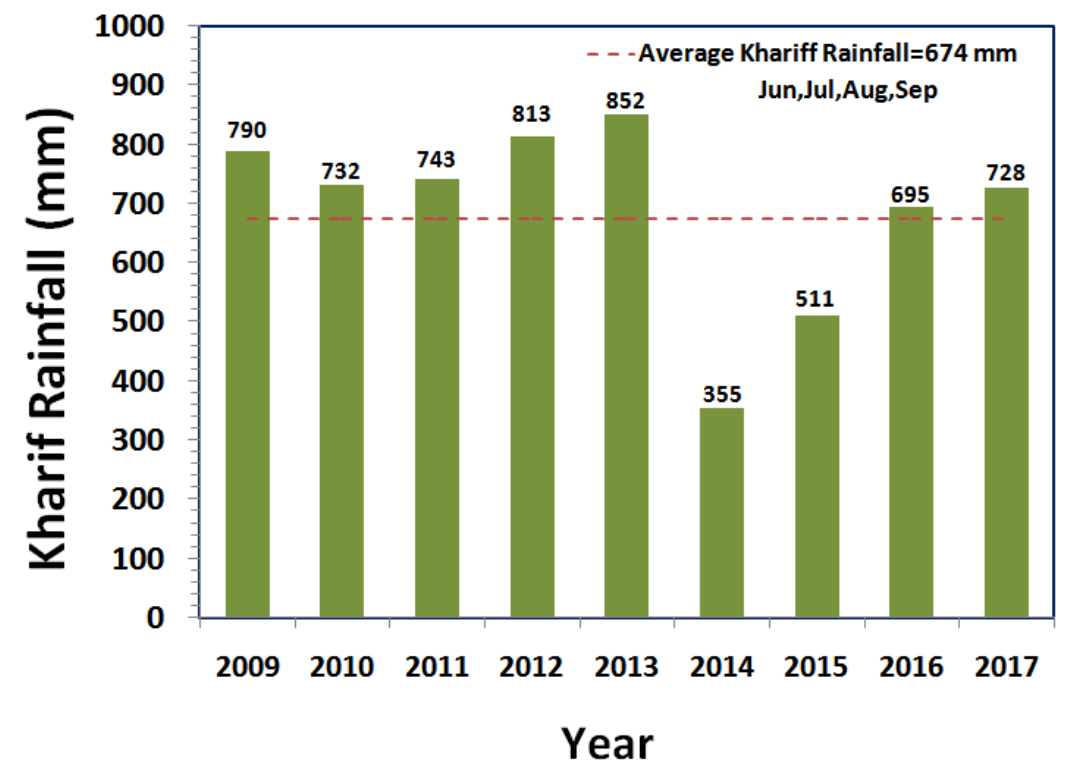
Soil & Water Conservation Structures in Mothakapalli sub-watershed, Yadgir Taluk, Yadgir District

RAINFALL INDEX

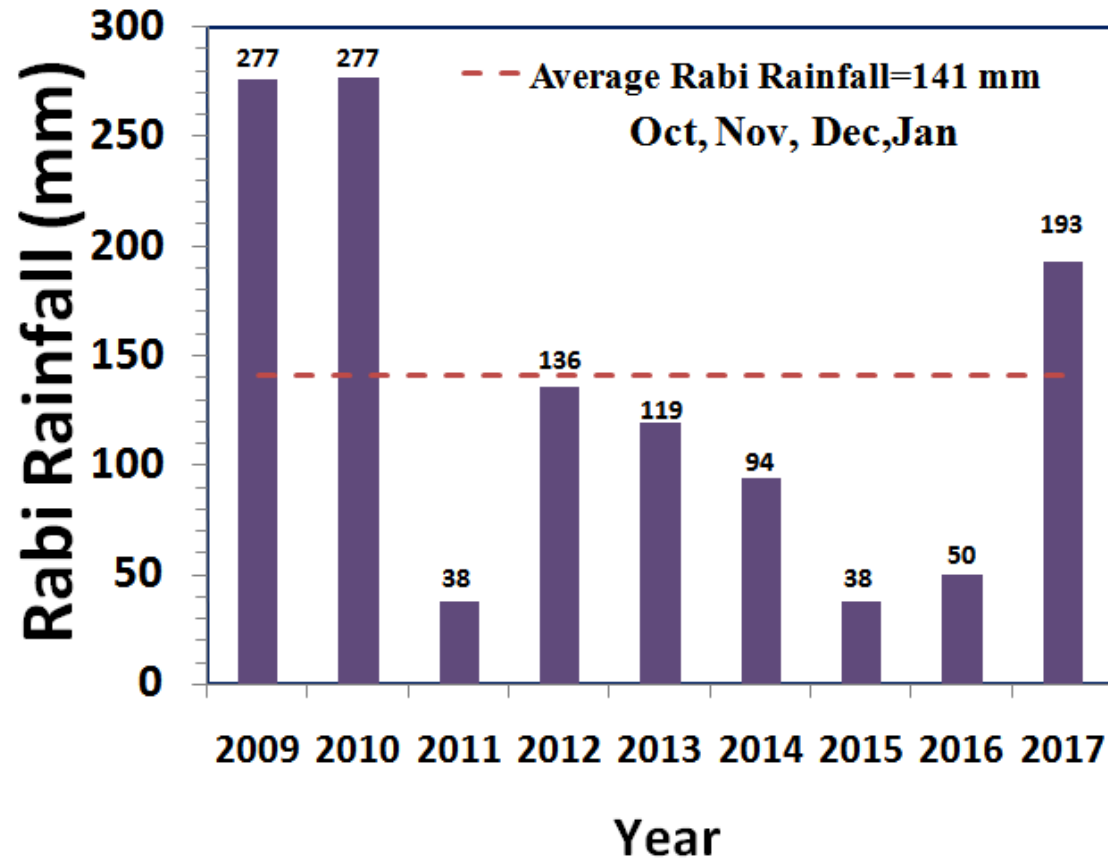


The average annual rainfall (1960-2014) recorded at the Yadgir station in Yadgir taluk of Yadgir district is 887 mm. The annual rainfall at Gurmatkal station (Hobli H.Q.) is presented. During the years 2014, 2015 and 2016 the annual rainfall was deficient by 37%, 18% and 9% respectively.

The *kharif* rainfall (Jun–Sep) is an average about 75% of the annual rainfall and it typically follows the annual rainfall patterns. During the years 2014 and 2015 the annual rainfall was deficient by 47% and 24% respectively.

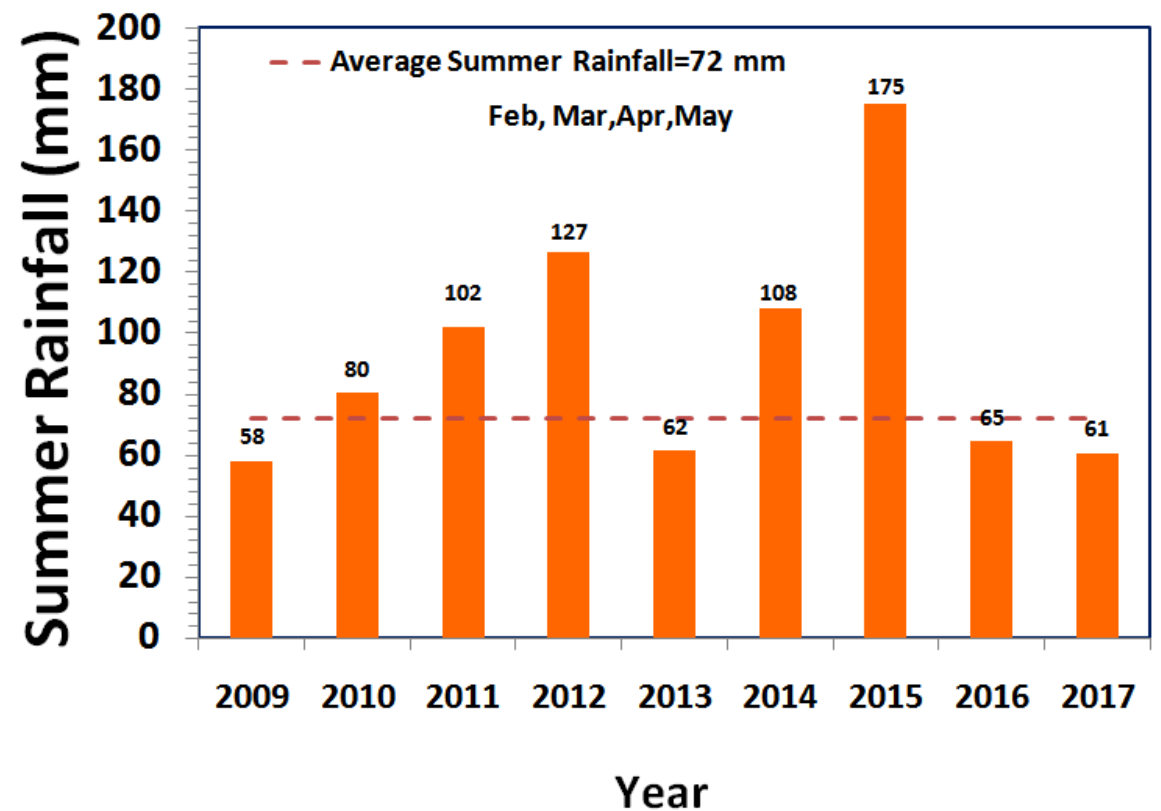


RAINFALL INDEX

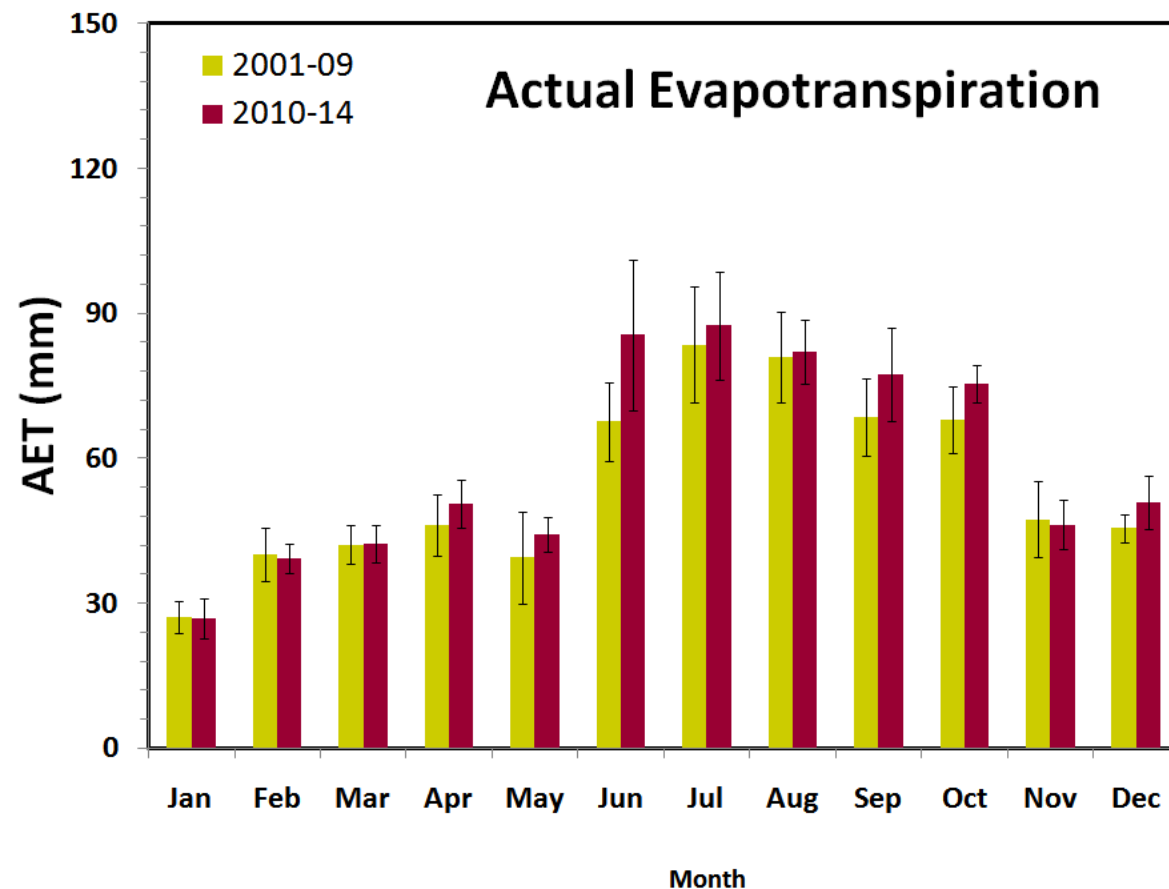
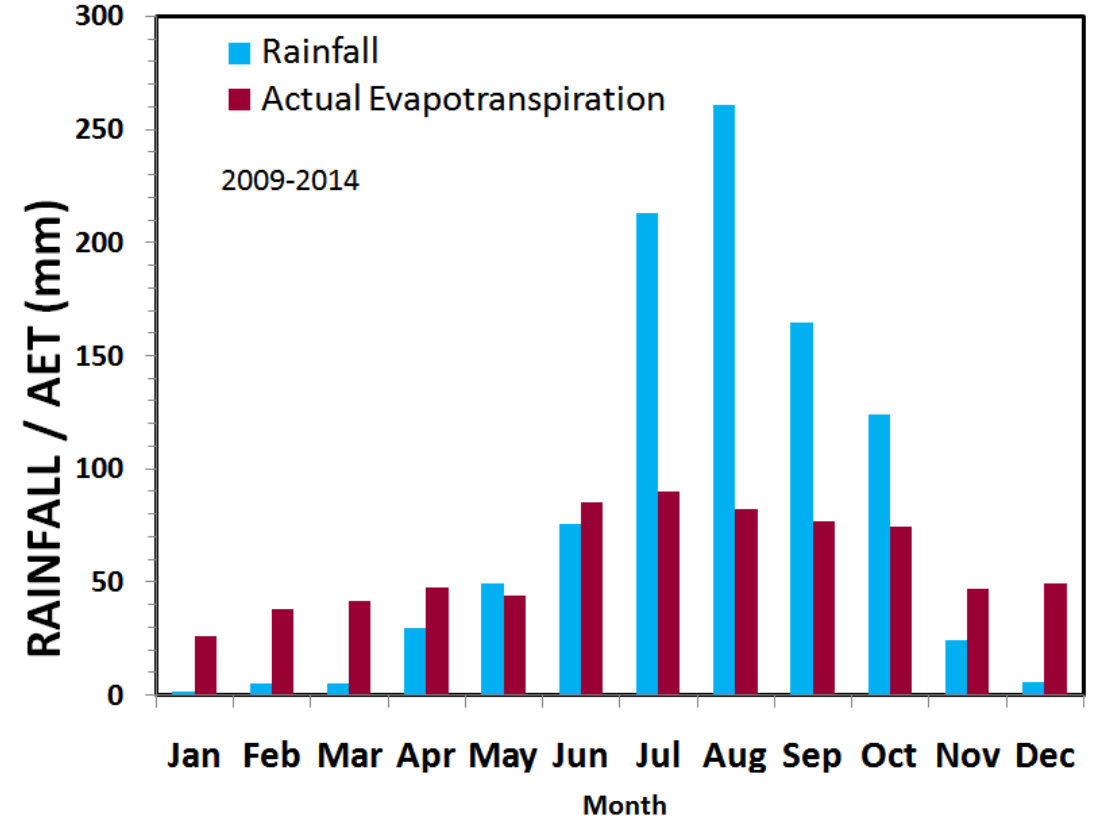
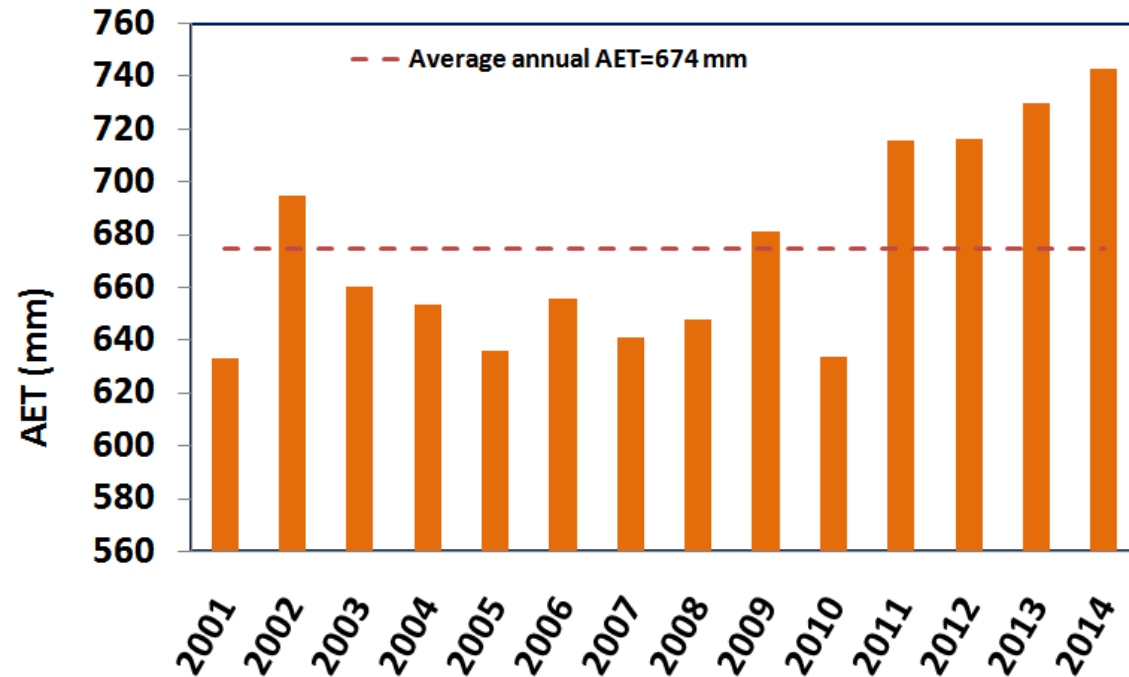


The average *rabi* rainfall (Oct-Jan) is about 14% of the Average annual rainfall. During the years 2011, 2012, 2013, 2014, 2015 and 2016 the annual rainfall was deficient by 73%, 4%, 16%, 33%, 73% and 65% respectively.

The average summer rainfall (Feb-May) is about 11% of the average annual rainfall.

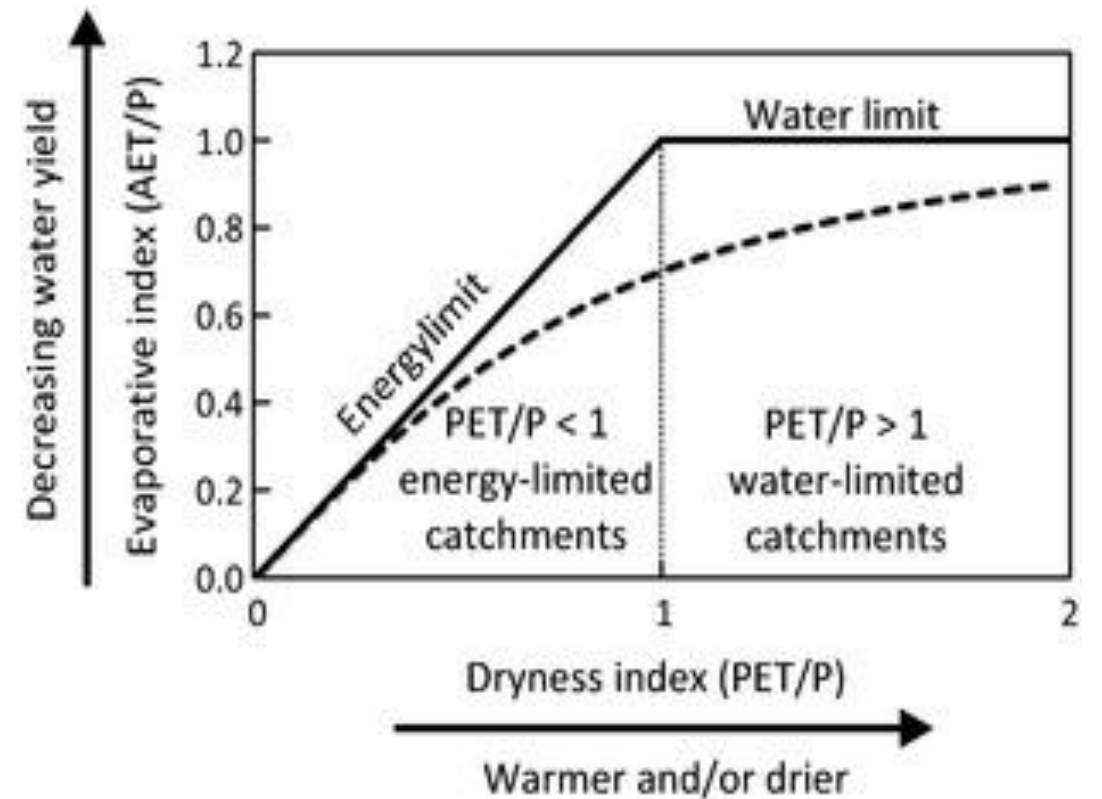
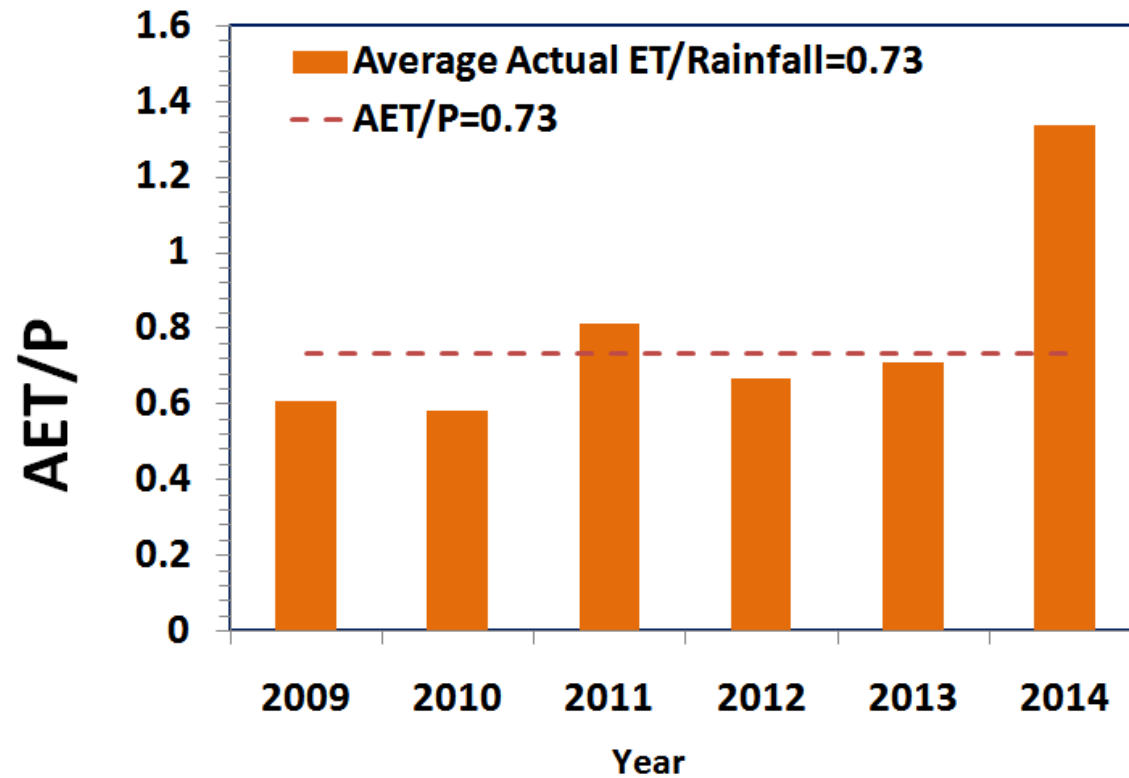


EVAPOTRANSPIRATION

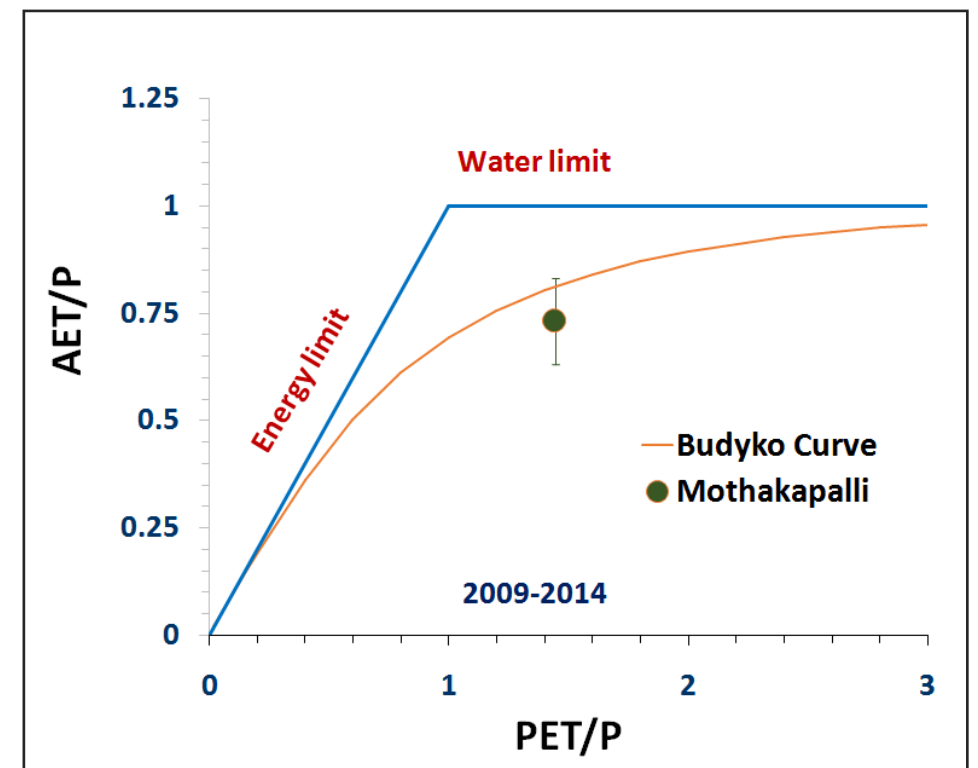


The average annual actual ET is lower than the average rainfall. During *kharif*, average rainfall and AET was found to be 674 mm and 335 mm respectively, whereas in *rabi* it was about 141 mm and 197 mm. The annual ET increased by 7% during 2010-2014 compared to 2001-2009 .

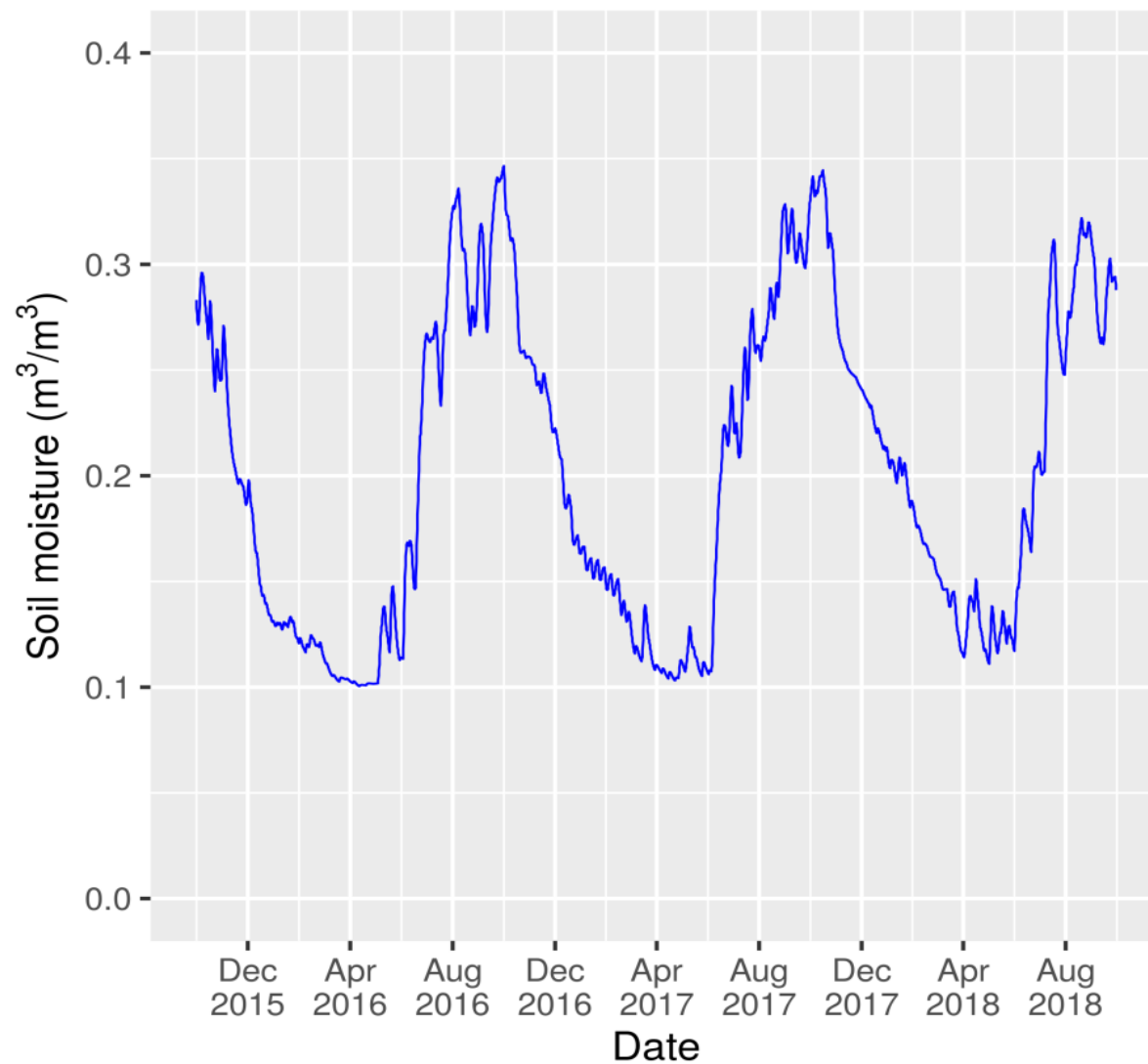
EVAPOTRANSPIRATION INDEX



The average AET/P ratio was about 73%, which is lower than the sustainable limit of about 80%. Watershed water balance is sustainable due to higher rainfall during the *kharif* season.

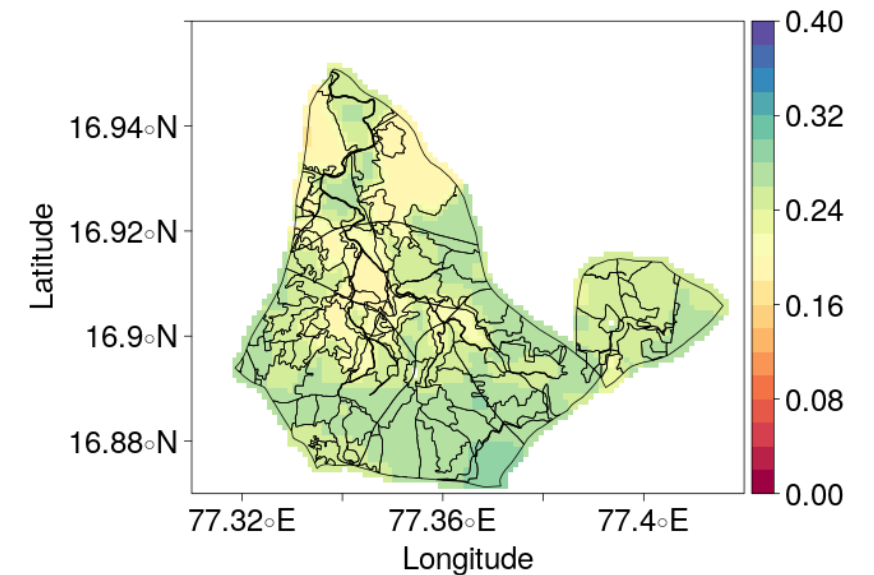


SATELLITE RETRIEVED SOIL MOISTURE

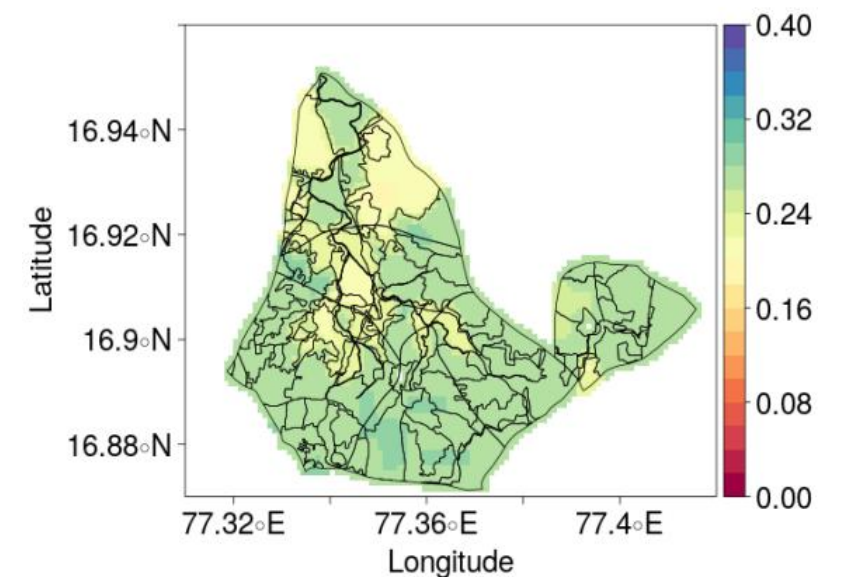


The method developed for retrieving soil moisture from multi-satellite observations allowed to map surface soil moisture behavior in the micro-watershed. The available surface moisture was varied in the range of 15-32 % in *kharif* and 13-34% in *rabi* seasons of 2016 and 12-33% in *Kharif* and 17-34% in *rabi* seasons of 2017.

Mothakapalli- Rabi Soil Moisture



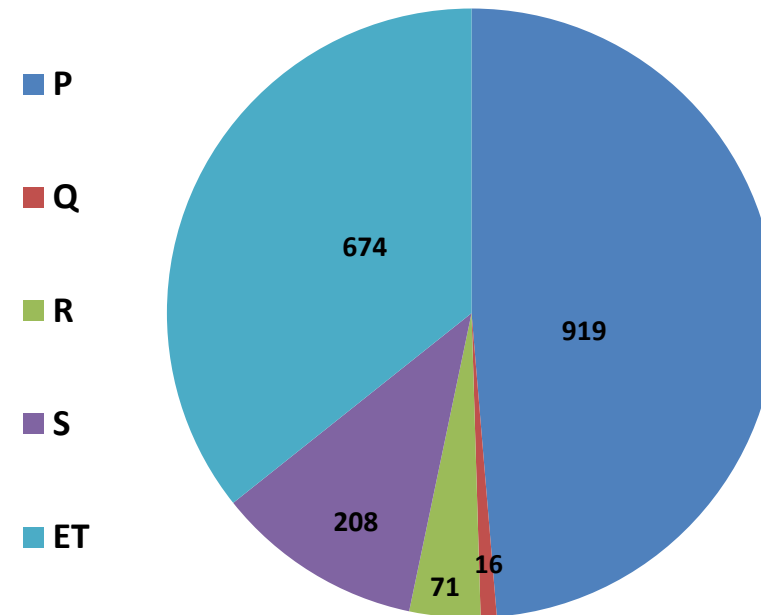
Mothakapalli- Kharif Soil Moisture



WATER BALANCE

$$Q = P - E - R - S$$

- Q = Runoff
- P = Precipitation
- E = Evapotranspiration
- R = Groundwater recharge
- S = Soil moisture storage change

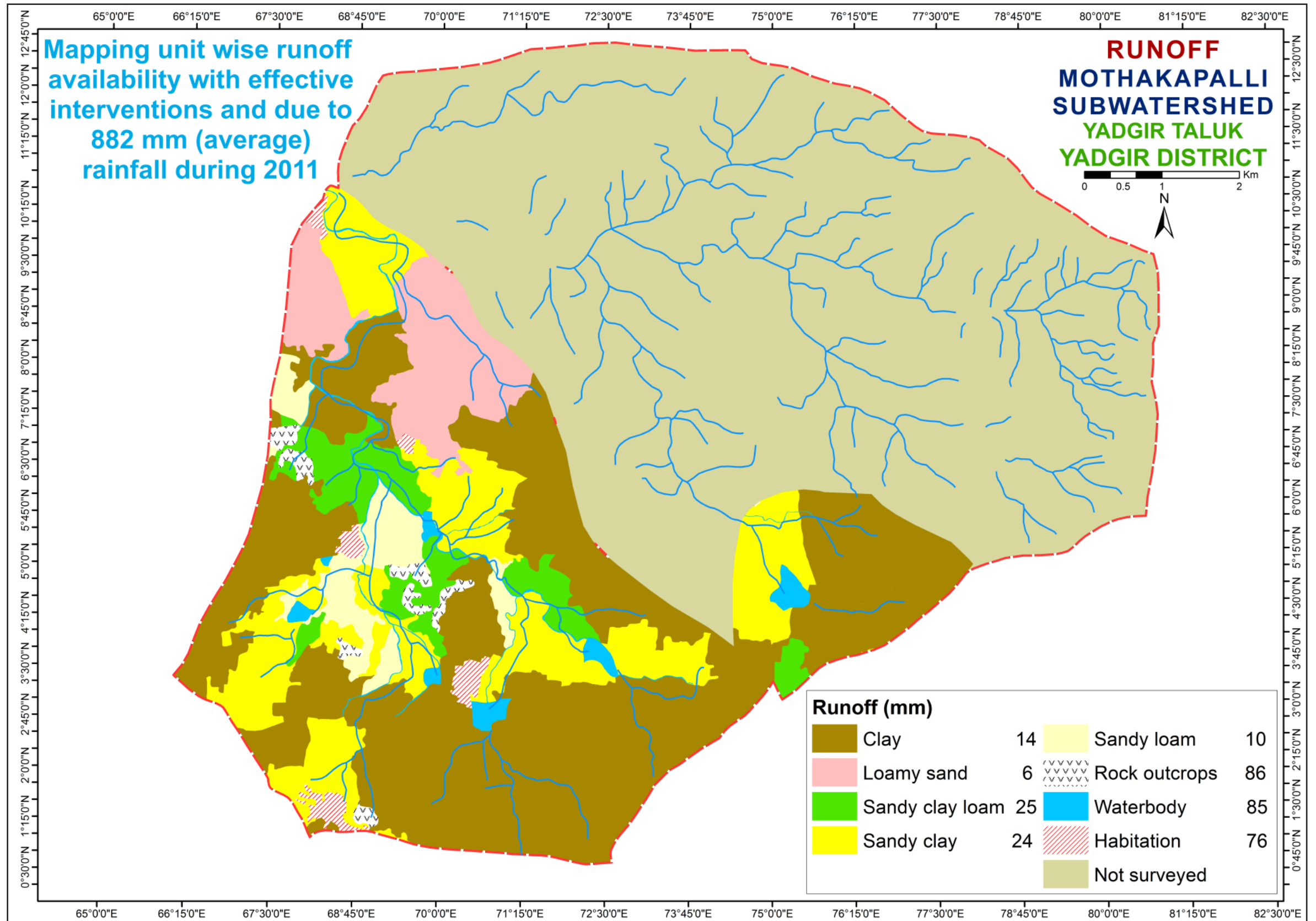


During July-October months, Precipitation is higher than Evapotranspiration, hence Runoff can occur in the watershed.

P = 919 mm (average of 2009-2017) ET = 674 mm R = 71 mm S = 208 mm Q = 16 mm

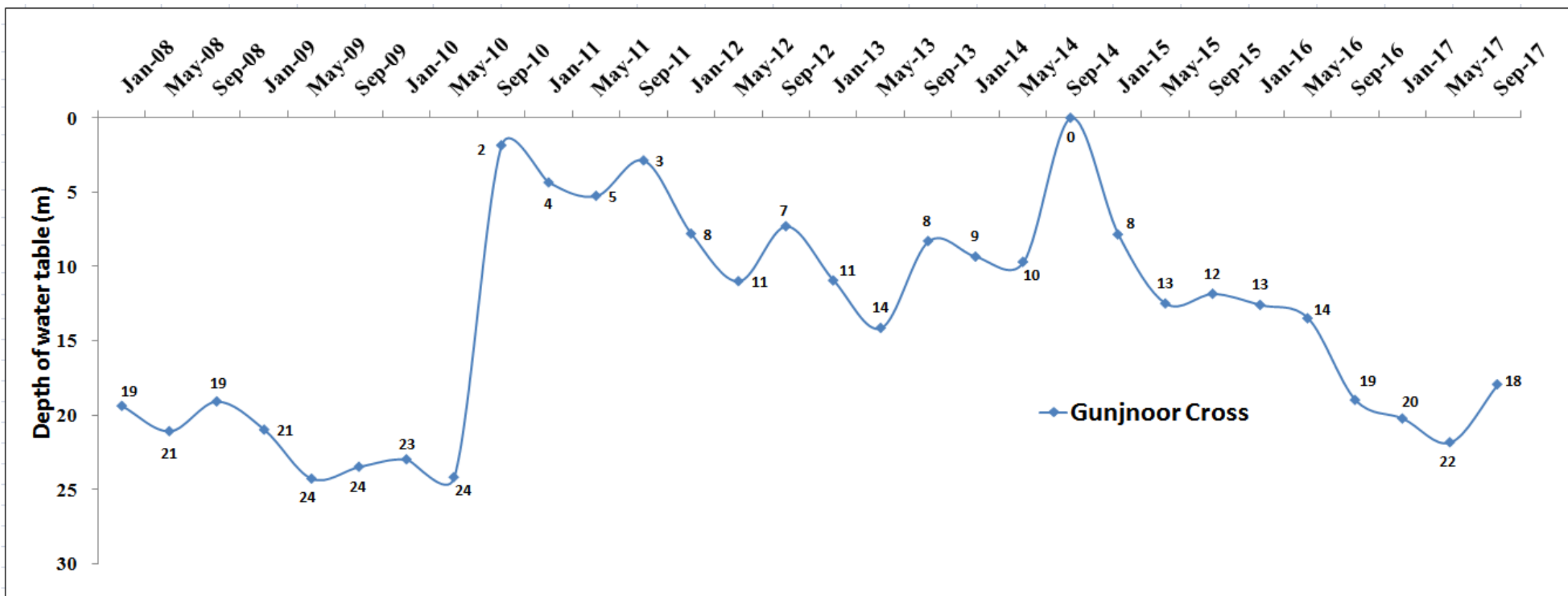
Sl. No.	Parameters	Average_ 2011 (mm)
1.	Rainfall	882
2.	Runoff availability with existing conditions	67
3.	Runoff availability with effective interventions	19
4.	Runoff allowed as environmental flow at the outlet	3
5.	Runoff excess for harvesting by construction of structures	16

RUNOFF



GROUND WATER STATUS

GUNJNOOR CROSS STATION



The total number of wells present in Mothakapalli Sub-watershed as per LRI data is 15 wells (14 Bore wells & 1 open well). The groundwater level shown above is from the data obtained from Dept. of Mines & Geology for the nearest station Gunjnoor Cross. The graph depicts the groundwater level during the years 2008-2017 were slightly varying, where as during the year 2014 was found constant.

SUMMARY

- The average annual rainfall of 887 mm in the Mothakapalli sub-watershed as recorded from the Gurmatkal station data.
- 75%, 14% and 11% of the annual rainfall occurs during *kharif*, *rabi* and summer seasons respectively and exhibited a higher temporal variability.
- The evapotranspiration estimation tool developed indicates that the watershed water balance is in sustainable condition.
- The estimated runoff available to use is 16 mm for an average annual rainfall of 919 mm (2009-2017). The utilizable groundwater is 49.7 mm (70% of 71 mm recharge estimated). This means the total available water resource combining the soil moisture store for kharif & rabi (208 mm) and utilizable runoff plus recharge is 274 (=208+16+50)
- The average actual evapotranspiration estimated in the watershed based on the current land use and irrigation practices for the kharif and rabi seasons is 531 mm. Hence the amount of water use for kharif and rabi seasons may be estimated as 664 mm (i.e. 125% of AET). This demand for the two seasons is higher by 390 mm, i.e. (664-274). The AET in June-Sept months is only 47% of rainfall. Hence, there is a good opportunity to harvest the excess water through watershed management practices for utilizing during rabi season.
- The total number of wells present in Mothakapalli Sub-watershed as per LRI data is 15 wells (14 Bore wells & 1 open well). The groundwater level shown above is from the data obtained from Dept. of Mines & Geology for the nearest station Gunjnoor Cross. The graph depicts the groundwater level during the years 2008-2017 were slightly varying, where as during the year 2014 was found constant.