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Land Resource and Hydrological Inventory of Duganur 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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TO OBTAIN COPIES,

Please write to:

Director, ICAR - NBSS & LUP,
Amaravati Road, Nagpur,
Maharashtra - 440 033, India
Phone : +91-712-2500386, 2500545 (O)
Telefax : +91-712-2500534
E-Mail : director.nbsslup@icar.gov.in
Website URL : https://www.nbsslup.in

Or

Head, Regional Centre, ICAR - NBSS & LUP,
Hebbal, Bangalore,
Karnataka - 560 024, India
Phone : +91-80-23412242, 23410993 (O)
Telefax : +91-80-23510350
E-Mail : hd_rcb.nbsslup@icar.gov.in
nbssrcb@gmail.com

PART - A

Land Resource Inventory of Duganur Sub-watershed for Watershed Planning and Development

Yadgir Taluk, Yadgir District, Karnataka (AESR 6.2)

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Contributors

Dr. Rajendra Hegde Principal Scientist, Head & Project Leader, Sujala-III Project ICAR-NBSS&LUP, Regional Centre, Bangalore - 24	**Dr. P. Chandran** Director, ICAR-NBSS&LUP Coordinator, Sujala-III Project Nagpur - 33	
Field Work, Mapping & Report Preparation		
Dr. B.A. Dhanorkar	Sh. R.S.Reddy	Sh. Somasekhar, T.N.
Dr. K.V. Niranjana	Dr. Mahendra Kumar, M.B.	Smt. Chaitra, S.P.
	Dr. Gopali Bardhan	Ms. Arpitha, G.M.
Field Work		
Sh. C.Bache Gowda	Sh. Ashok, S. Sindagi	Sh. Manohar, Y. Hosamane
Sh. Somashekar	Sh. Veerabhadrappa	Sh. Pramod, Navale
Sh. M. Jayaramaiah	Sh. Kailash.	Sh. Ramesh Hangargi
	Sh. Yogesh, H.N.	Sh. Rakesh, Achalkar
	Sh. Kamalesh, Avate.	
	Sh. Sharan Kumar Uppar	
	Sh. Kalaveerachari, Kammar	
	Sh. Arun, N. Kambar	
GIS Work		
Dr. S.Srinivas	Sh. A.G.Devendra Prasad	
Dr. M.Ramesh	Sh. Prakashanaik, M.K.	
Sh. D.H.Venkatesh	Smt. K.Karunya Lakshmi	
Smt. K.V.Archana	Ms. Seema, K.V.	
Sh. N. Maddileti	Ms. Karuna Kulkarani	
	Sh. Madappaswamy	
	Sh. Rajendra, D.	
	Smt. Prathibha, D.G.	
	Ms. Sowmya, K.B.	
	Ms. Vidya, P.C.	

Laboratory Analysis	
Dr. M. Lalitha	Ms. Vindhya, N.G.
Smt. Arti Koyal	Ms. P. Pavanakumari, P.
Smt. Parvathy, S.	Ms. Rashmi, N.
	Ms. Leelavathy, K.U.
	Smt. Usha Kiran, G.
	Ms. Chaithra, H.K.
	Ms. Gayathri Chalageri
Soil & Water Conservation	
Sh. Sunil P. Maske	
Watershed Development Department, GoK, Bangalore	
Sh. Prabhash Chandra Ray, IFS Project Director & Commissioner, WDD	Dr. A. Natarajan NRM Consultant, Sujala-III Project
Sh. Padmaya Naik, A. Executive Director, WDD	

How to read and use the Atlas

The Land Resource Inventory of Duganur 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.

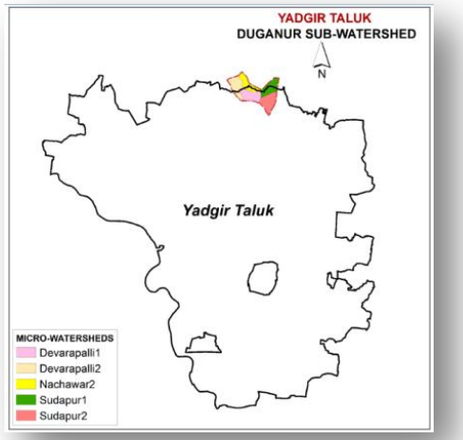
For easy map reading and understanding the information contain in different maps, the physical, cultural and scientific symbols used in the maps are illustrated in the form of colors, graphics and tables.

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.

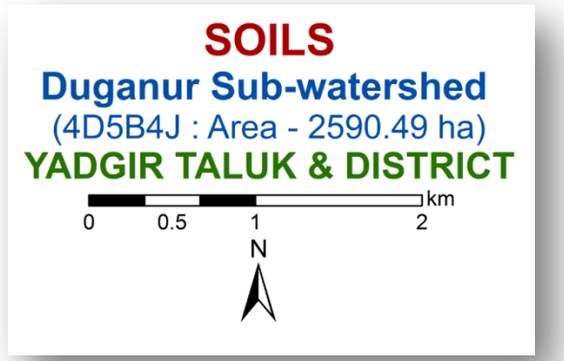
Inset map

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



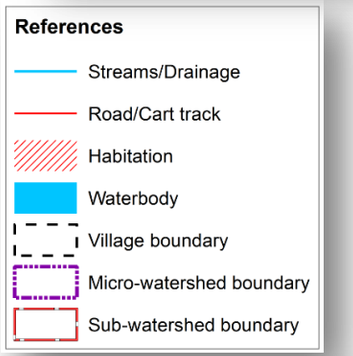
Map title

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



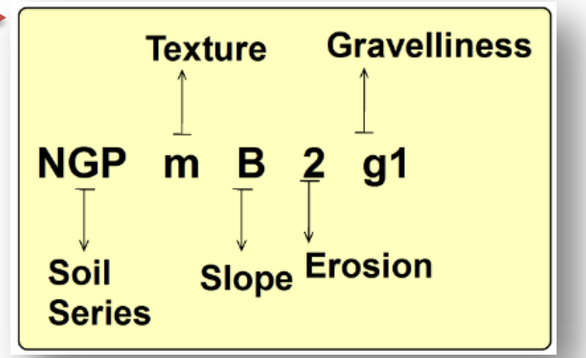
Legends and symbols

*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.*



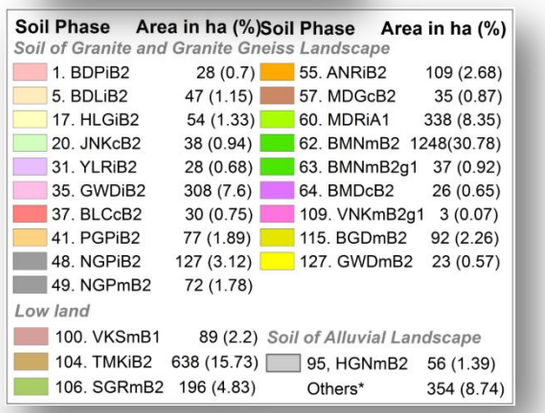
Soil Units

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

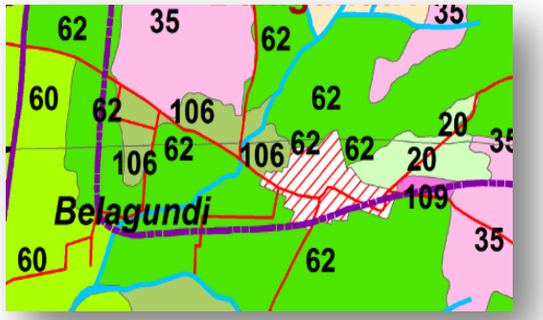
Different shades of colours are used as an aid to distinguish the different classes of soils, crop suitability and other maps.



Soil Phase	Area in ha (%)	Soil Phase	Area in ha (%)
Soil of Granite and Granite Gneiss Landscape			
1. BDPiB2	28 (0.7)	55. ANRiB2	109 (2.68)
5. BDLiB2	47 (1.15)	57. MDGcB2	35 (0.87)
17. HLGiB2	54 (1.33)	60. MDRiA1	338 (8.35)
20. JNKcB2	38 (0.94)	62. BMNmB2	1248(30.78)
31. YLRiB2	28 (0.68)	63. BMNmB2g1	37 (0.92)
35. GWDiB2	308 (7.6)	64. BMDcB2	26 (0.65)
37. BLCcB2	30 (0.75)	109. VNKmB2g1	3 (0.07)
41. PGPiB2	77 (1.89)	115. BGDmB2	92 (2.26)
48. NGPiB2	127 (3.12)	127. GWDmB2	23 (0.57)
49. NGPmB2	72 (1.78)		
Low land			
100. VKSmB1	89 (2.2)	*Soil of Alluvial Landscape*	
104. TMKiB2	638 (15.73)	95, HGNmB2	56 (1.39)
106. SGRmB2	196 (4.83)	Others*	354 (8.74)

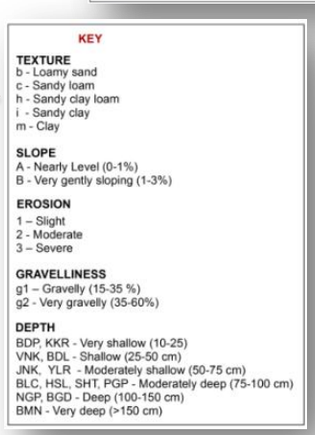
Soil and plot boundaries

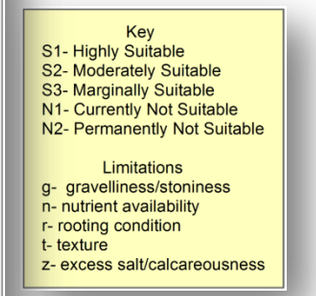
Soil units shown on the map are represented by both the color and a numeral. The soil boundaries are superimposed on land parcel with revenue survey number boundaries to visualize its spatial extent.



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.





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 Duganur Sub-watershed covering an area of 2590.49 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.

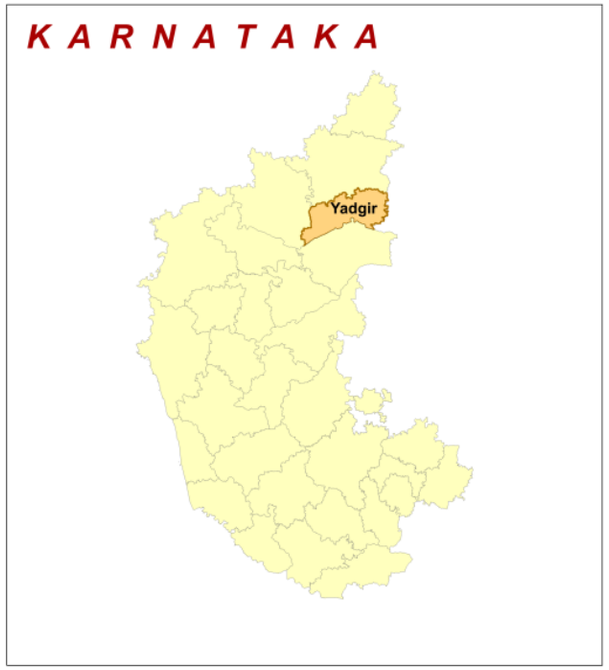
2. General Description of Sub-watershed

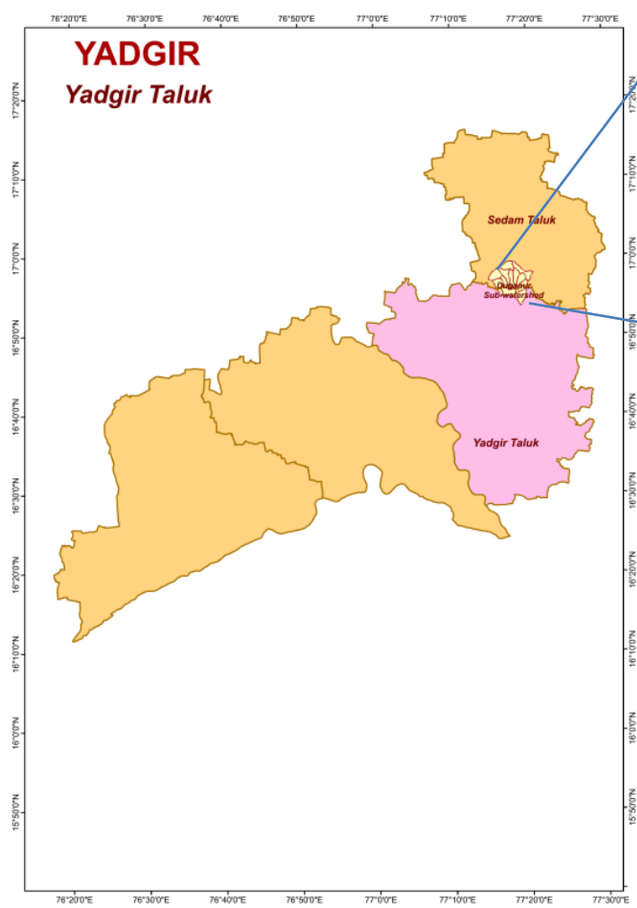
The Yadgir, popularly called as “Yadavagiri” by the local people, district came to existence on 30th Dec 2009 by carving out of erst-while Kalaburagi district of Karnataka with a geographical area of 5234.4 square kilometers, located in the northern part of the state. It lies between north latitudes’ $16^0$57’ – $16^0$59’ and east longitudes 77^0 12’ – 77^0 13’. 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 Jowar, Groundnut, Cotton, Red gram, Bengal gram etc.

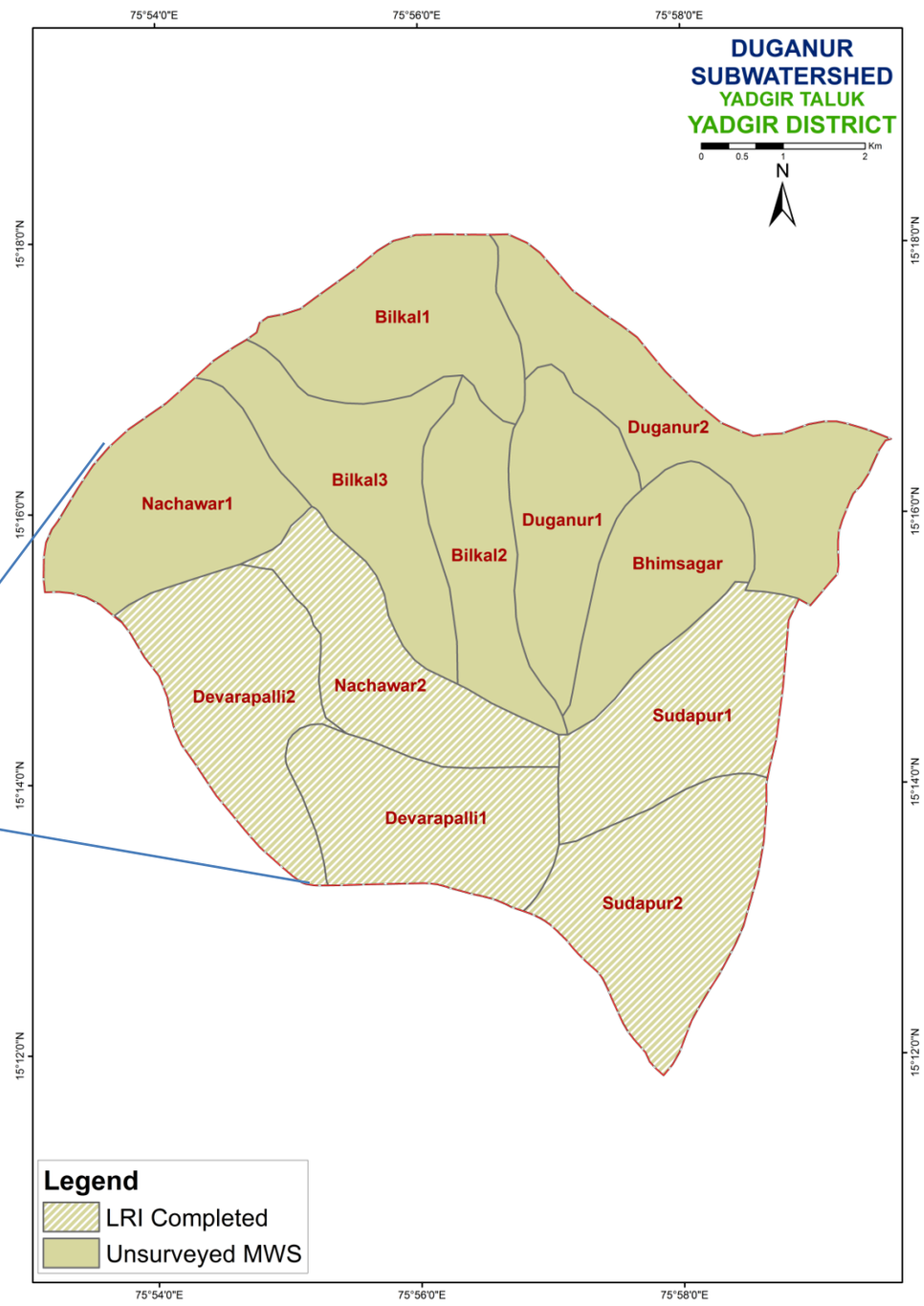
As a pilot study, **ICAR-NBSS&LUP, Bangalore** carried out the generation of Sub-watershed (SWs) -LRI for the Duganur SWs (code– 4D5B4J) in Yadgir taluk, Yadgir district. It was selected for data base generation under Sujala III project. This sub-watershed encompasses of 12 MWs namely, Bilkal-1 (4D5B4J1g), Duganur-2 (4D5B4J2e), Bilkal-3 (4D5B4J1e), Duganur-1 (4D5B4J2d), Bilkal-2 (4D5B4J1f), Nachawar-1 (4D5B4J1d), Bhimsagar (4D5B4J2c), Nachawar-2 (4D5B4J1c), Devarapalli-2 (4D5B4J1b), Sudapur-1 (4D5B4J2b), Sudapur-2 (4D5B4J2a) and Devarapalli-1 (4D5B4J1a) micro watersheds. Land Resource Inventory (LRI) was generated for five among the twelve micro-watersheds.

2.1. Location and Extent

LOCATION MAP OF DUGANUR SUB-WATERSHED







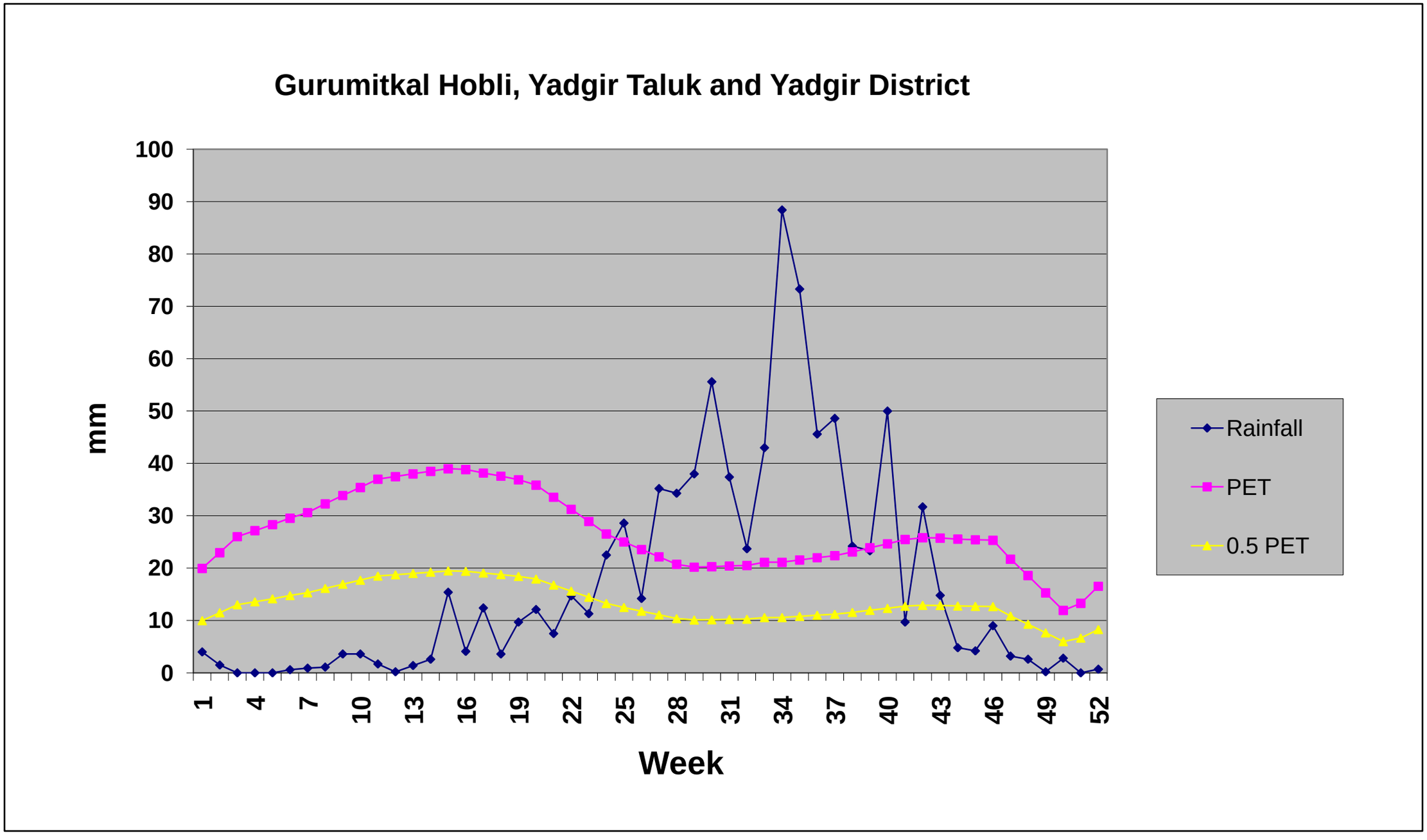
Duganur sub-watershed (Yadgir taluk, Yadgir district) is located between $16^0$52'39''– 16^0 57'21'' North latitudes and $77^0$15'19''– 77^0 20'24'' East longitudes, covering an area of about 5872.74 ha., bounded by Duganura, Siddhapura.B, Nachawara, Gajarakota villages.

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 five among the twelve micro-watersheds

Climate

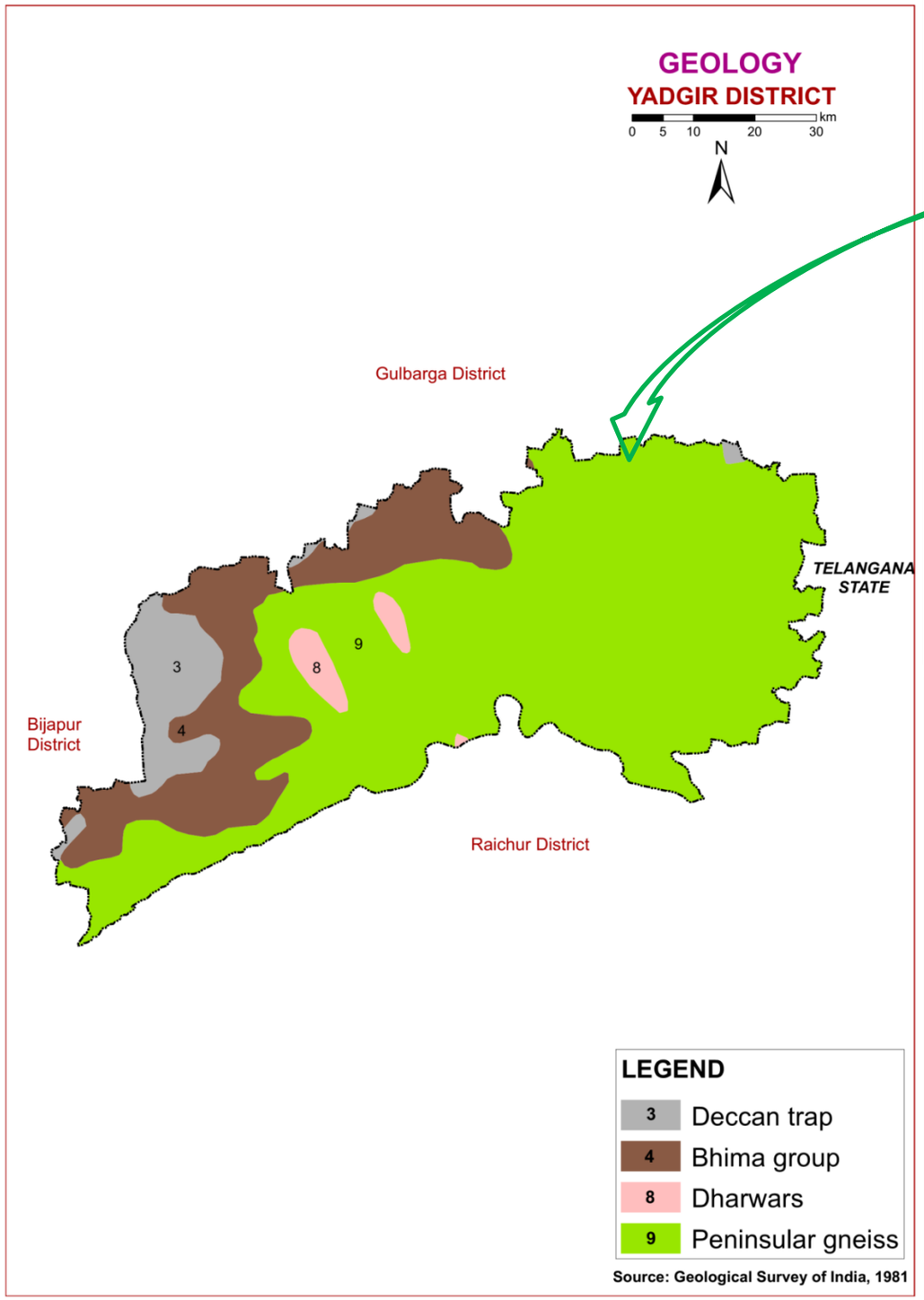


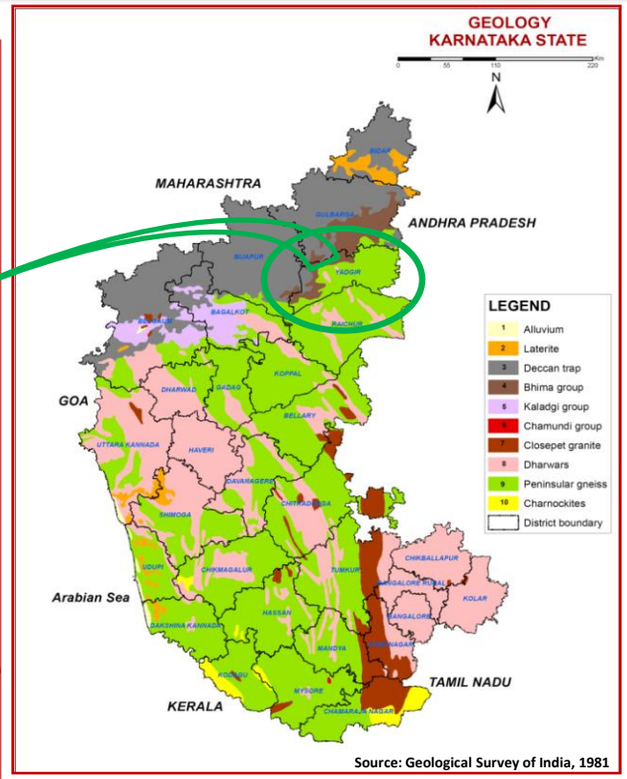
Length of Growing Period (LGP) is varying from June 4th week to 3rd week of October (120 - 150 days)

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, lete Creteceous 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 visicular 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.

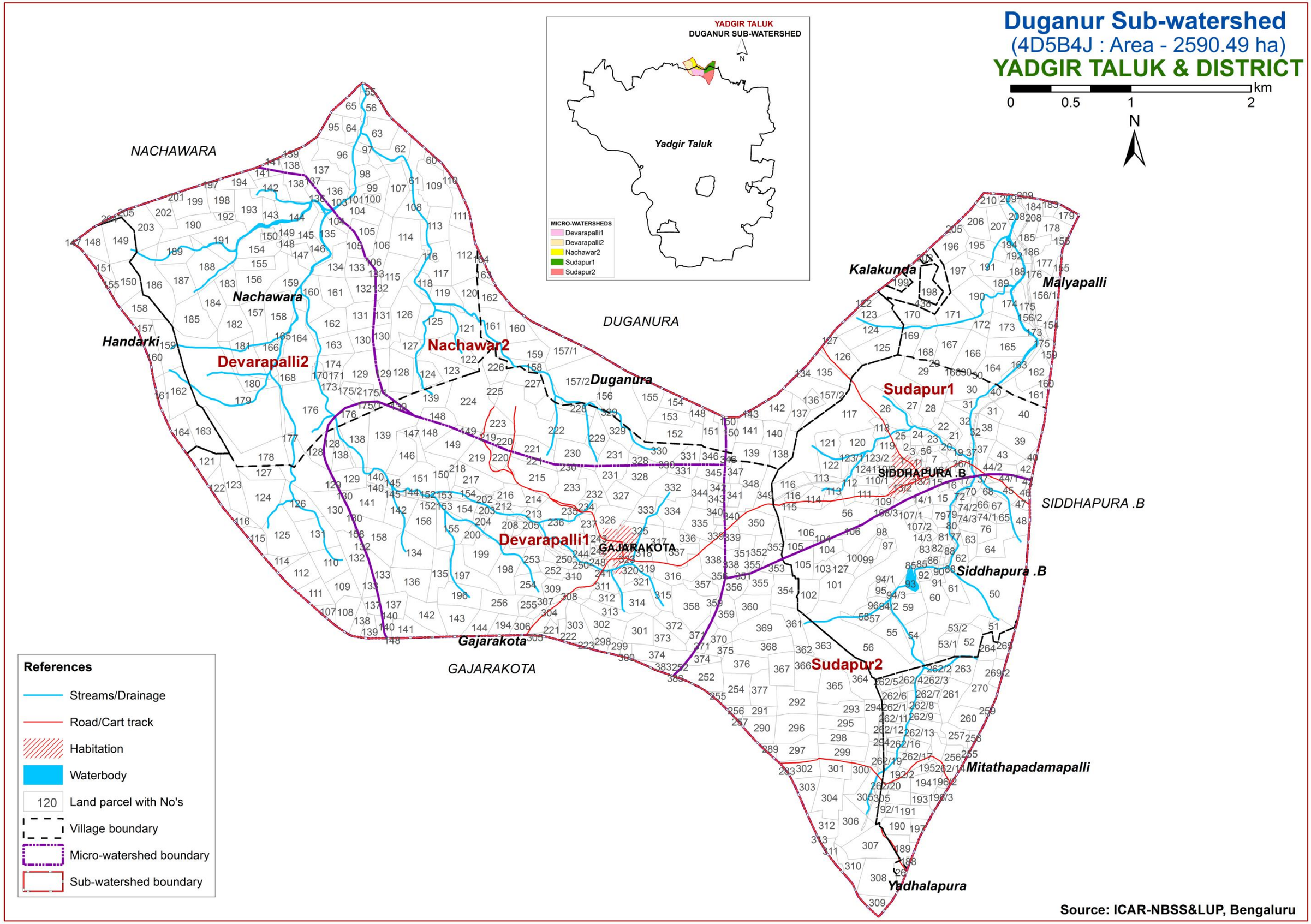
3. Survey Methodology

Sequence of activities in generation of LRI

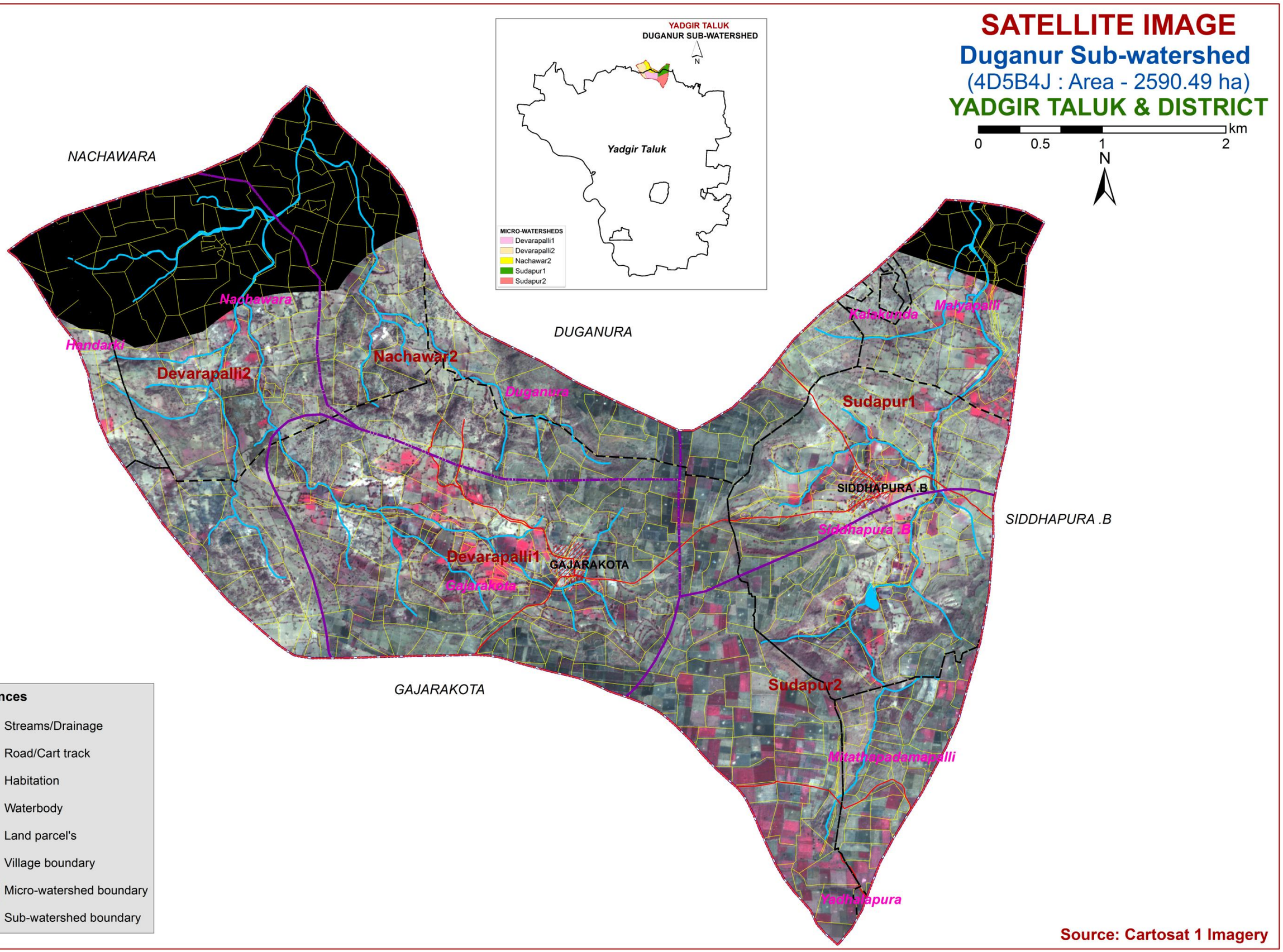
- Traversing the watershed using cadastral maps and imagery as base
- Identifying landforms, geology, land use and other features
- Selecting fields representing land units
- Opening profiles to 2 m depth
- Studying soil and site characteristics
- Grouping similar areas based on their soil-site characteristics 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.

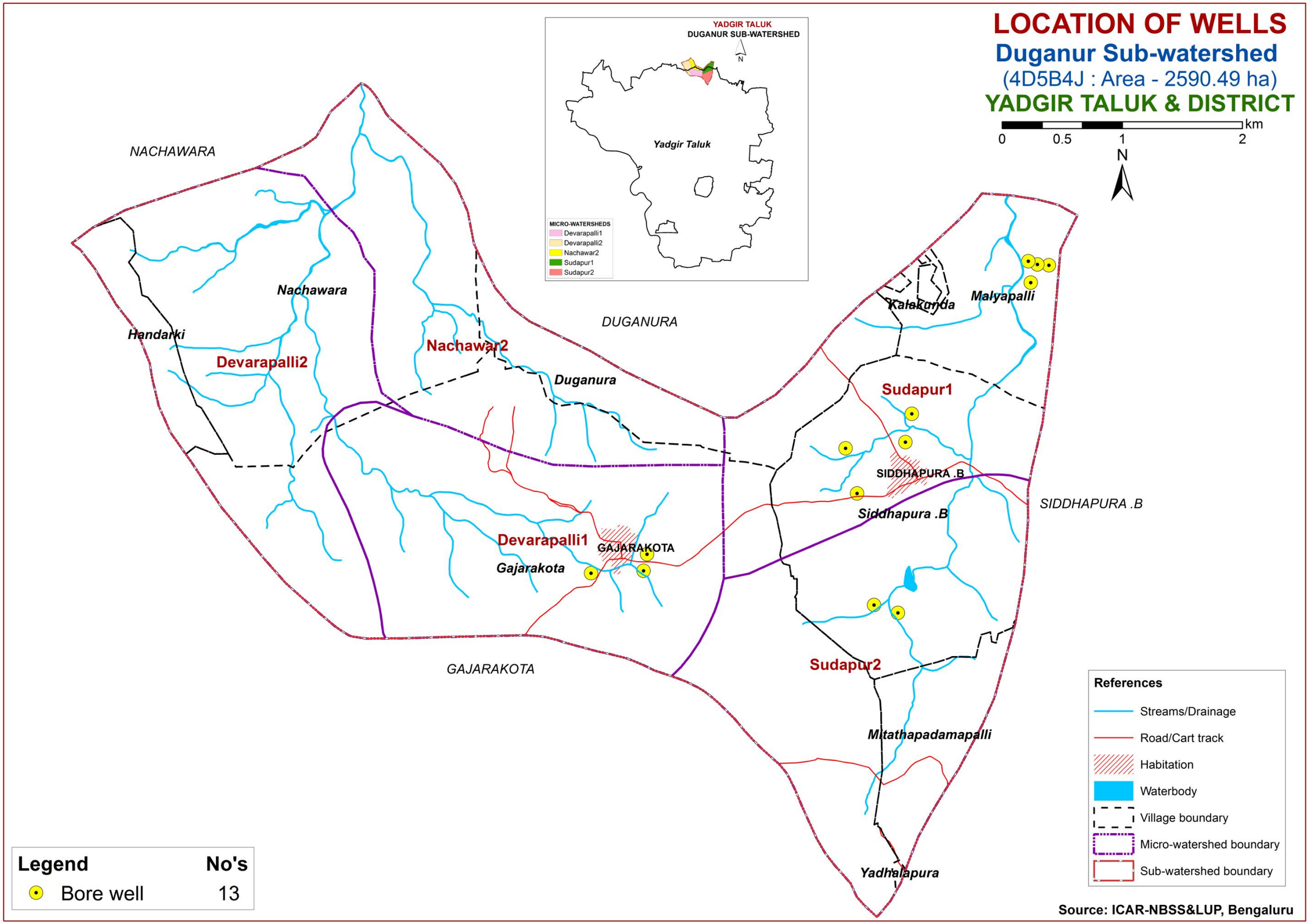
3.1. Database Used - Cadastral map



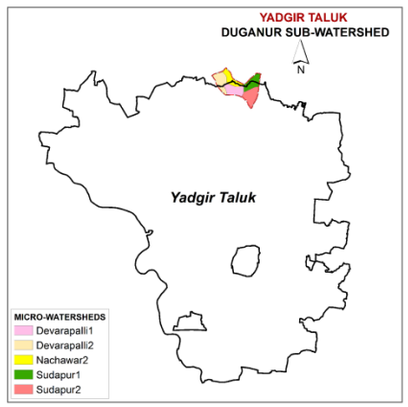
3.2. Database Used - Satellite Image



3.3. Location of Wells



4. The Soils

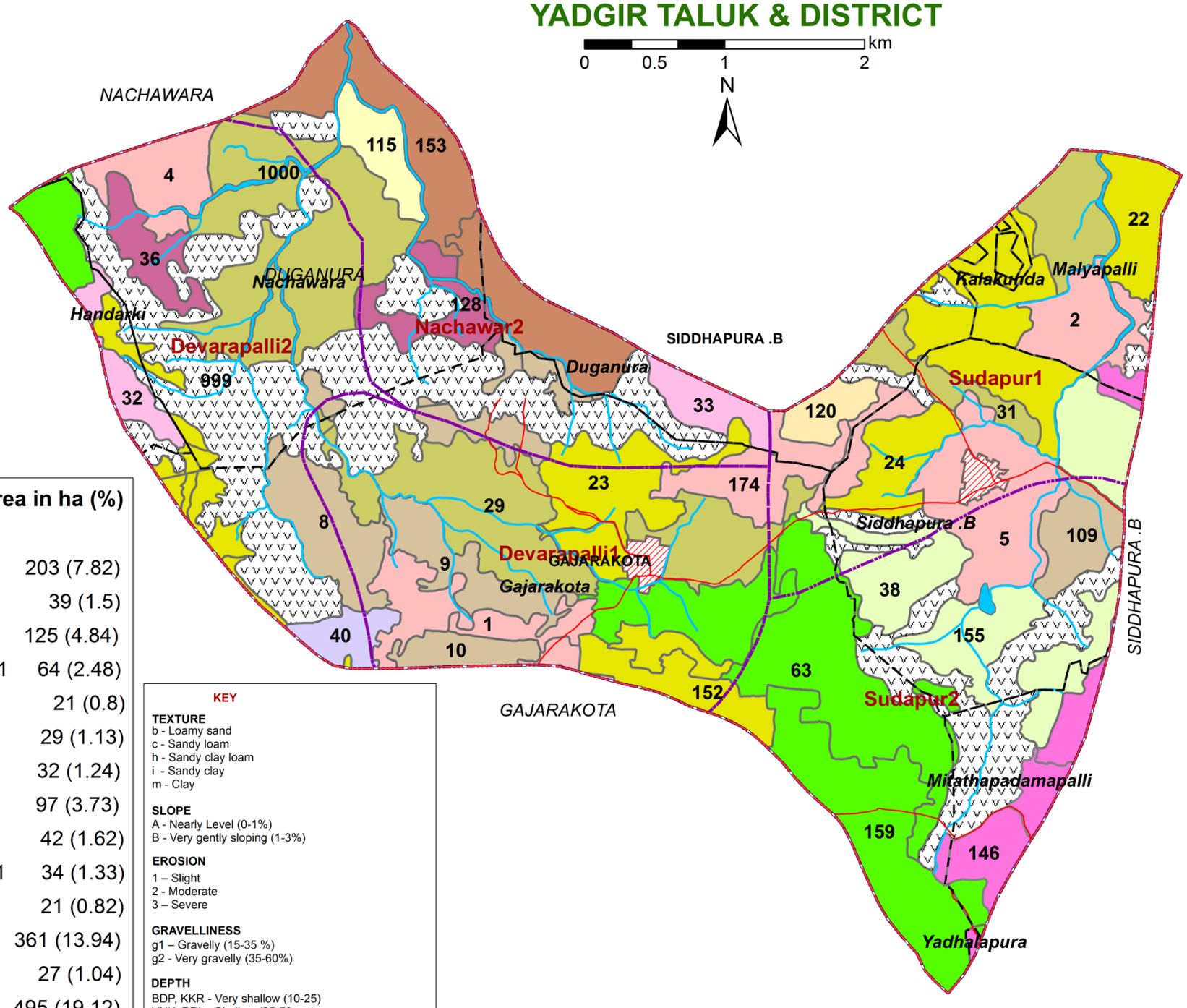


References

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

Texture — Gravelliness
NGP m B 2 g1
Soil Series — Slope — Erosion

SOILS
Duganur Sub-watershed
(4D5B4J : Area - 2590.49 ha)
YADGIR TALUK & DISTRICT



Soil Phase	Area in ha (%)	Soil Phase	Area in ha (%)
Soil of Granite and Granite Gneiss Landscape			
1, BDPiB2	43 (1.65)	23, JNKiB2g1	203 (7.82)
2, BDLbB2	45 (1.75)	24, JNKiB3g1	39 (1.5)
4, BDLhB2	41 (1.6)	153, KKRbB2g1	125 (4.84)
5, BDLiB2	113 (4.38)	146, NGPmB2g1	64 (2.48)
174, BDLcB2g2	45 (1.73)	40, PGPcB2	21 (0.8)
120, BDPhB2	20 (0.78)	36, SHThB2	29 (1.13)
115, BGDmB2	28 (1.09)	128, SHTcB2	32 (1.24)
155, BLCcB2g1	111 (4.29)	8, VNKbB2g1	97 (3.73)
38, BLCiB2	46 (1.78)	9, VNKcB2	42 (1.62)
159, BMNmA1	113 (4.37)	109, VNKmB2g1	34 (1.33)
63, BMNmB2g1	213 (8.24)	10, VNKiB2	21 (0.82)
32, HSLcB2	22 (0.85)	29, YLRcB2g1	361 (13.94)
33, HSLiB2	25 (0.97)	31, YLRiB2	27 (1.04)
152, JNKmB2	49 (1.89)	Rock outcrops	495 (19.12)
22, JNKiB2	49 (1.89)	Others*	35 (1.34)

* - Habitation & Waterbody

KEY

TEXTURE
b - Loamy sand
c - Sandy loam
h - Sandy clay loam
i - Sandy clay
m - Clay

SLOPE
A - Nearly Level (0-1%)
B - Very gently sloping (1-3%)

EROSION
1 – Slight
2 - Moderate
3 – Severe

GRAVELLINESS
g1 – Gravelly (15-35 %)
g2 - Very gravelly (35-60%)

DEPTH
BDP, KKR - Very shallow (10-25)
VNK, BDL - Shallow (25-50 cm)
JNK, YLR - Moderately shallow (50-75 cm)
BLC, HSL, SHT, PGP - Moderately deep (75-100 cm)
NGP, BGD - Deep (100-150 cm)
BMN - Very deep (>150 cm)

Source: ICAR-NBSS&LUP, Bengaluru

4.1 Mapping unit description of Duganur (4D5B4J) 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		**63 (2.43)**
120		BDPhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	20 (0.78)
1		BDPiB2	Sandy clay surface, slope 1-3%, moderate erosion	43 (1.65)
	KKR	Kakalawar soils are very shallow (<25 cm), well drained, have dark brown sandy loam soils occurring on very gently sloping uplands under cultivation		**125 (4.84)**
153		KKRbB2g1	Loamy sand surface, slope 1-3%, moderate erosion, gravelly (15-35%)	125 (4.84)
	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		**244 (9.46)**
2		BDLbB2	Sandy loam surface, slope 1-3%, moderate erosion	45 (1.75)
174		BDLcB2g2	Sandy loam surface, slope 1-3%, moderate erosion, very gravelly (35-60%)	45 (1.73)
4		BDLhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	41 (1.6)
5		BDLiB2	Sandy clay surface, slope 1-3%, moderate erosion	113 (4.38)
	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		**194 (7.5)**
8		VNKbB2g1	Loamy sand surface, slope 1-3%, moderate erosion, gravelly (15-35%)	97 (3.73)
9		VNKcB2	Sandy loam surface, slope 1-3%, moderate erosion,	42 (1.62)
10		VNKiB2	Sandy clay surface, slope 1-3%, moderate erosion	21 (0.82)
109		VNKmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	34 (1.33)
	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		**340 (13.1)**
22		JNKiB2	Sandy clay surface, slope 1-3%, moderate erosion	49 (1.89)
23		JNKiB2g1	Sandy clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	203 (7.82)
24		JNKiB3g1	Sandy clay surface, slope 1-3%, severe erosion, gravelly (15-35%)	39 (1.5)
152		JNKmB2	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	49 (1.89)

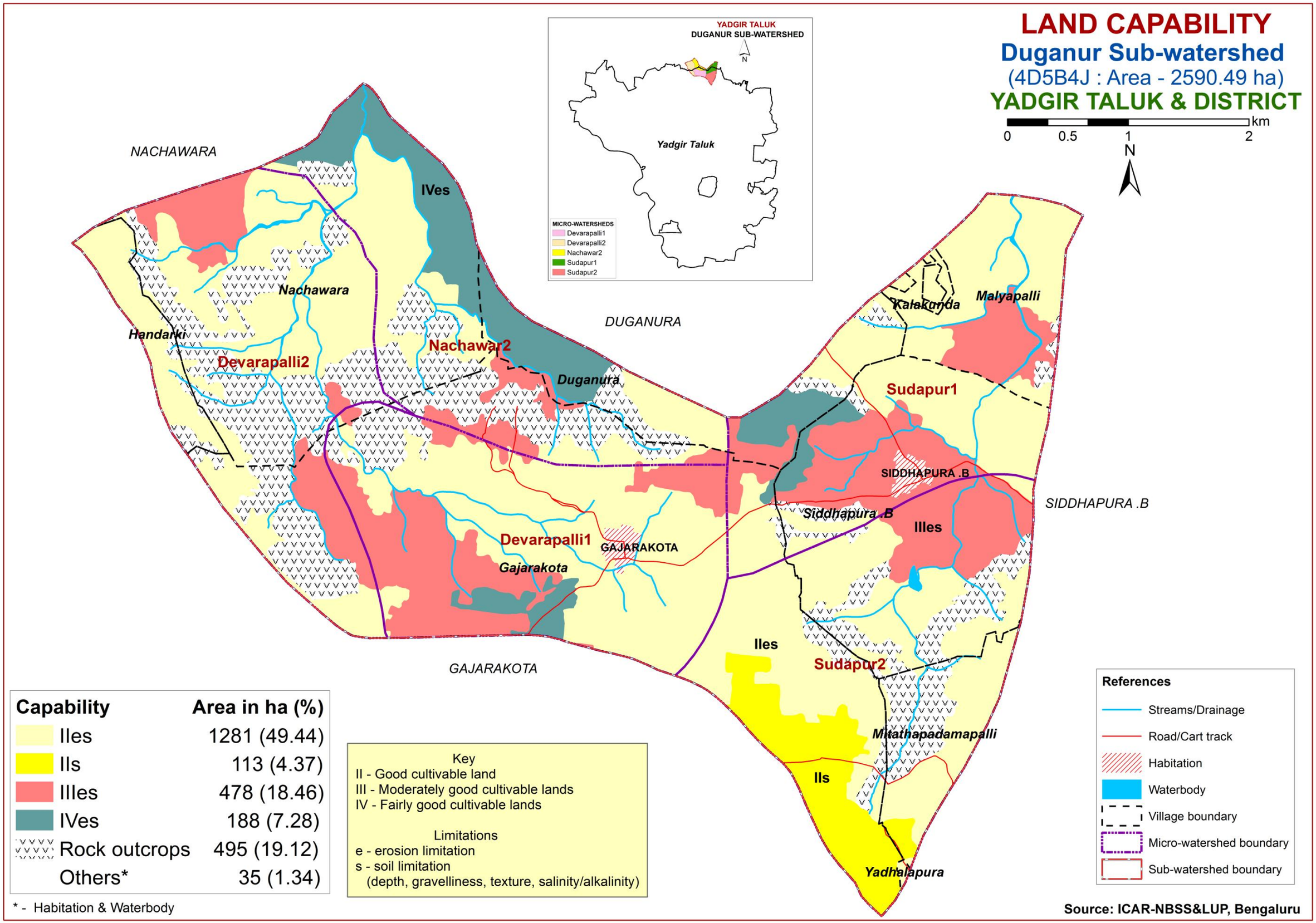
To be continued….

Soil map unit No*	Soil Series	Soil Phase Symbol	Mapping Unit Description	Area in ha (%)
Soils of Granite and Granite gneiss Landscape				
	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		**388 (14.98)**
29		YLRcB2g1	Sandy loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	361 (13.94)
31		YLRiB2	Sandy clay surface, slope 1-3%, moderate erosion	27 (1.04)
	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		**157 (6.07)**
155		BLCcB2g1	Sandy loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	111 (4.29)
38		BLCiB2	Sandy clay surface, slope 1-3%, moderate erosion	46 (1.78)
	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		**47 (1.85)**
32		HSLcB2	Sandy loam surface, slope 1-3%, moderate erosion,	22 (0.85)
33		HSLiB2	Sandy clay surface, slope 1-3%, moderate erosion	25 (0.97)
	PGP	Poglapur soils are moderately deep (75-100 cm), well drained, have dark brown, dark reddish brown to yellowish red sandy clay soils occurring on very gently sloping uplands under cultivation		**21 (0.8)**
40		PGPcB2	Sandy loam surface, slope 1-3%, moderate erosion,	21 (0.8)
	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		**61 (2.37)**
128		SHTcB2	Sandy loam surface, slope 1-3%, moderate erosion,	32 (1.24)
36		SHThB2	Sandy clay loam surface, slope 1-3%, moderate erosion	29 (1.13)
	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		**28 (1.09)**
115		BGDmB2	Clay surface, slope 1-3%, moderate erosion	28 (1.09)
	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		**64 (2.48)**
146		NGPmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	64 (2.48)
	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		**326 (12.61)**
159		BMNmA1	Clay surface, slope 0-1%, slight erosion	113 (4.37)
63		BMNmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	213 (8.24)
999		Rock outcrops	Rock lands, both massive and bouldery with little or no soil	**495 (19.12)**
1000		Others	Habitation & Waterbody	**35 (1.34)**

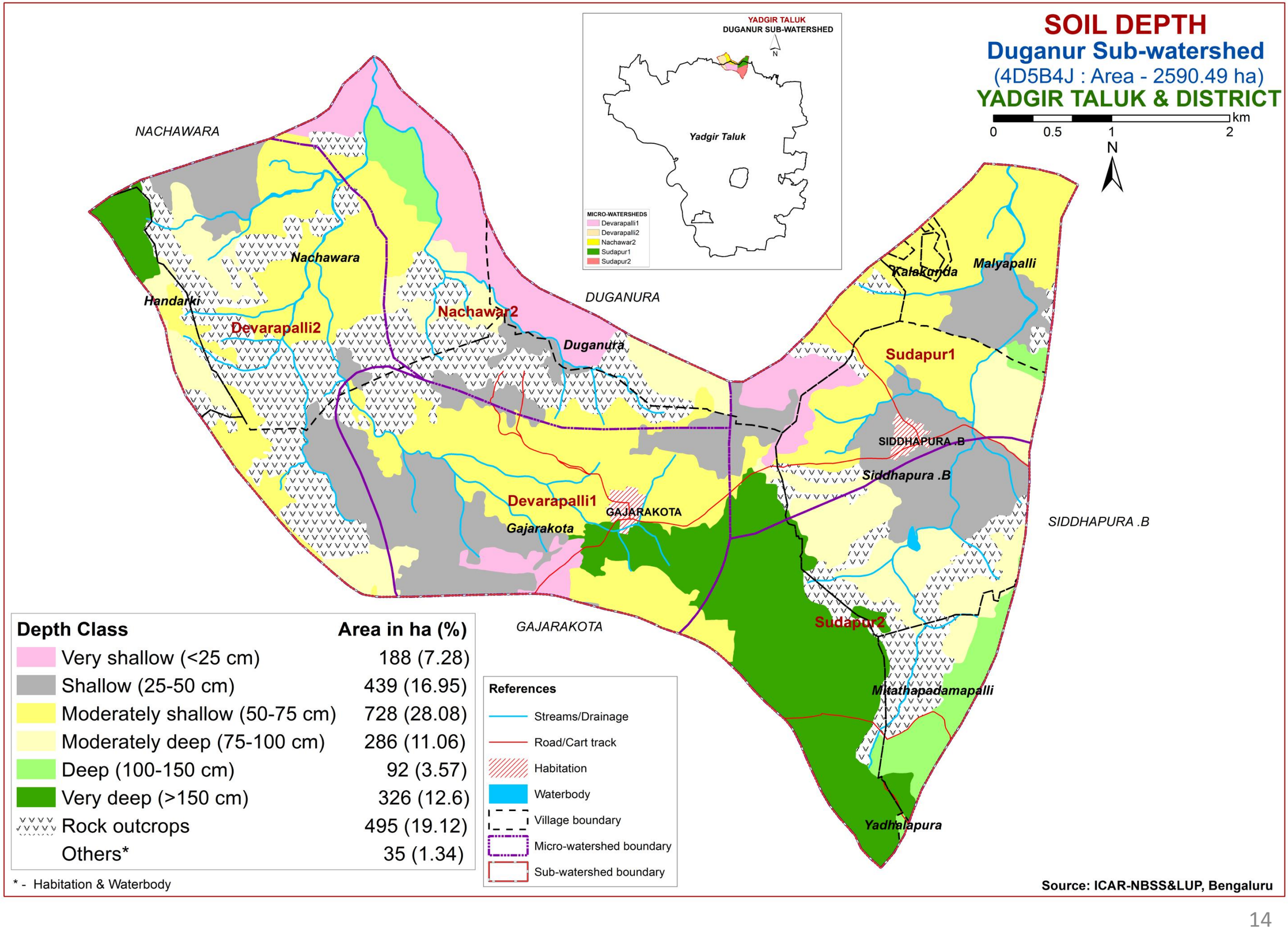
* Soil map unit numbers are continuous for the taluk, not for the sub-watershed

5. Soil Survey Interpretations

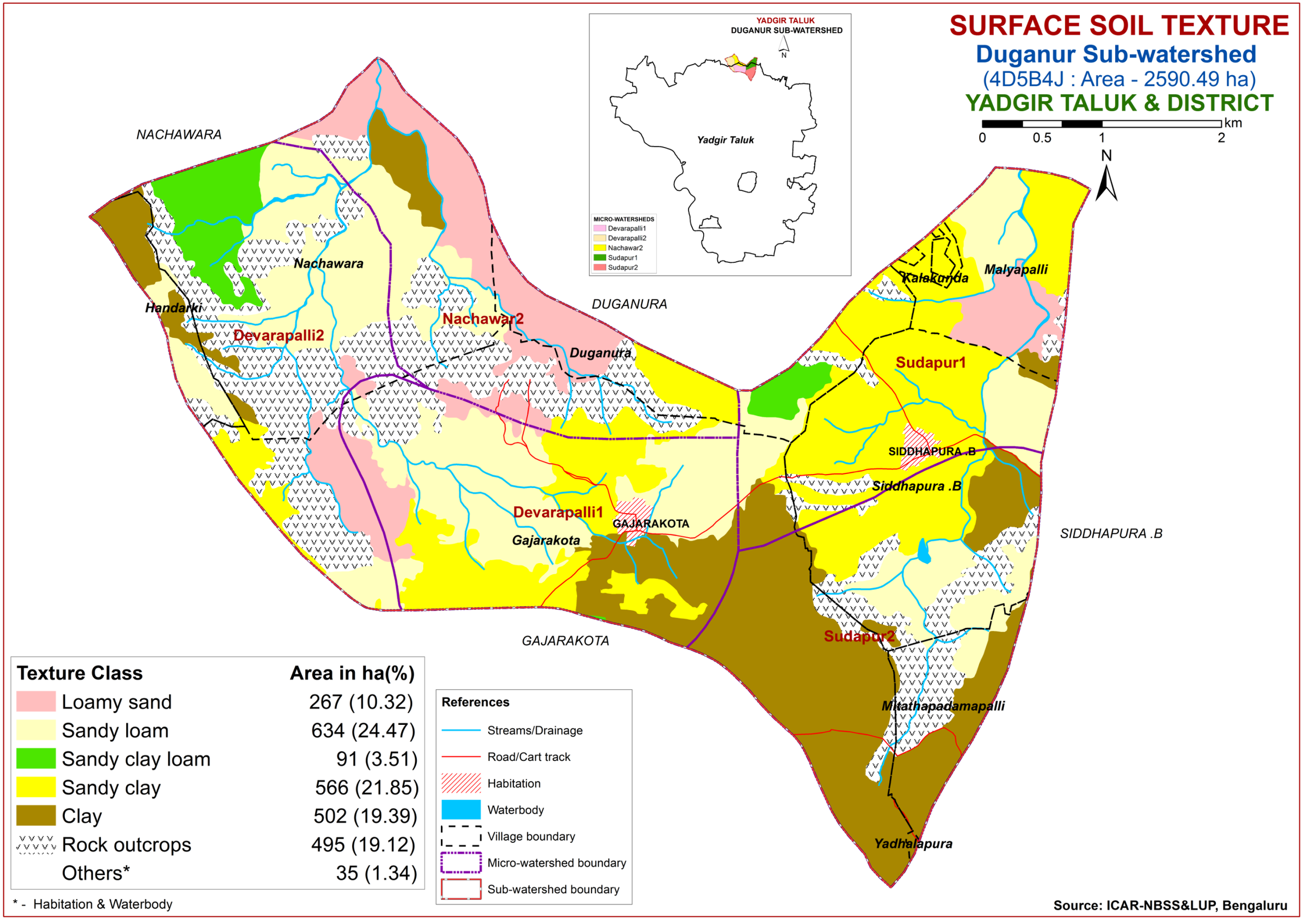
5.1. Land Capability Classification



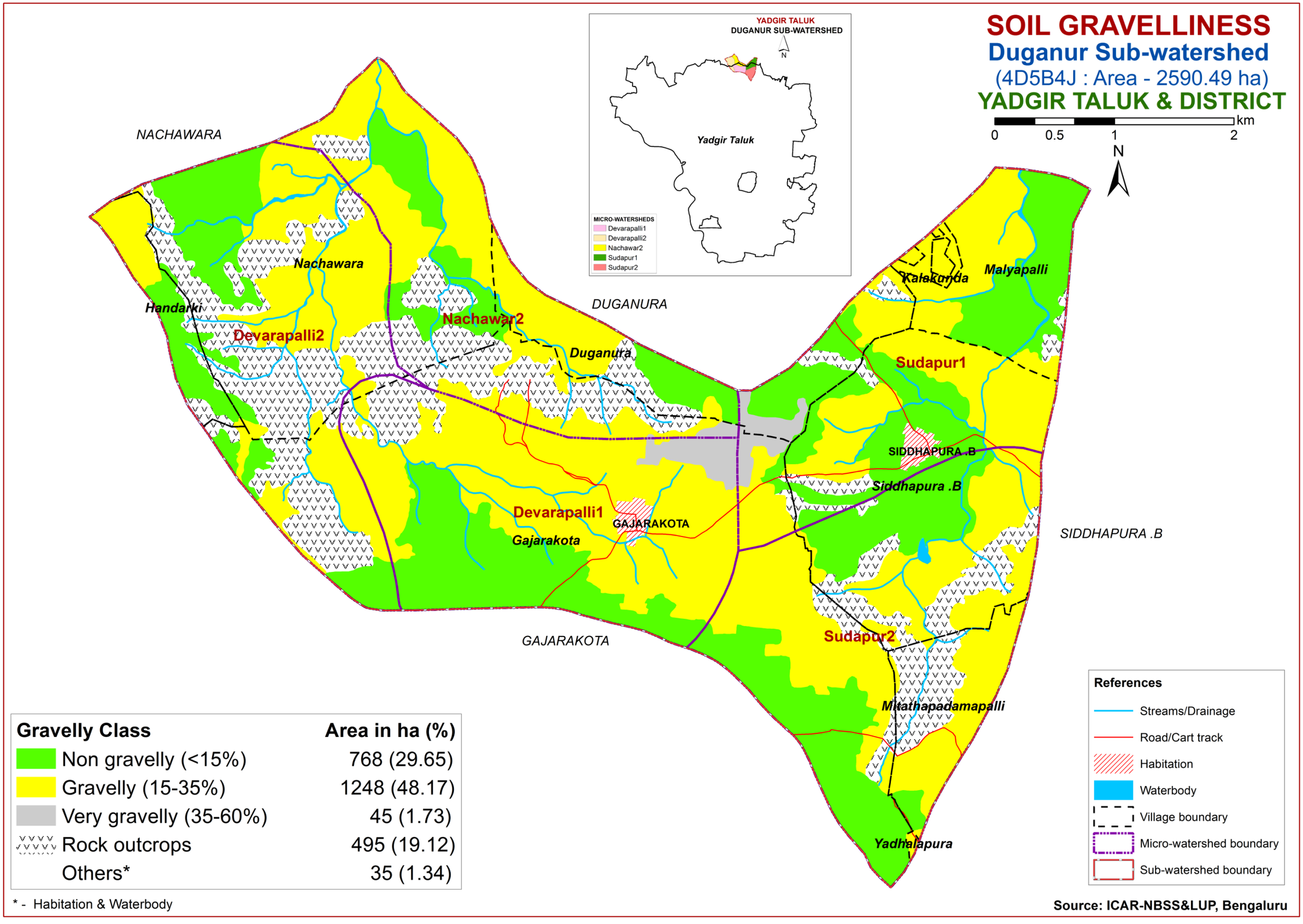
5.2. Soil Depth



5.3. Surface Soil Texture



5.4. Surface Soil Gravelliness



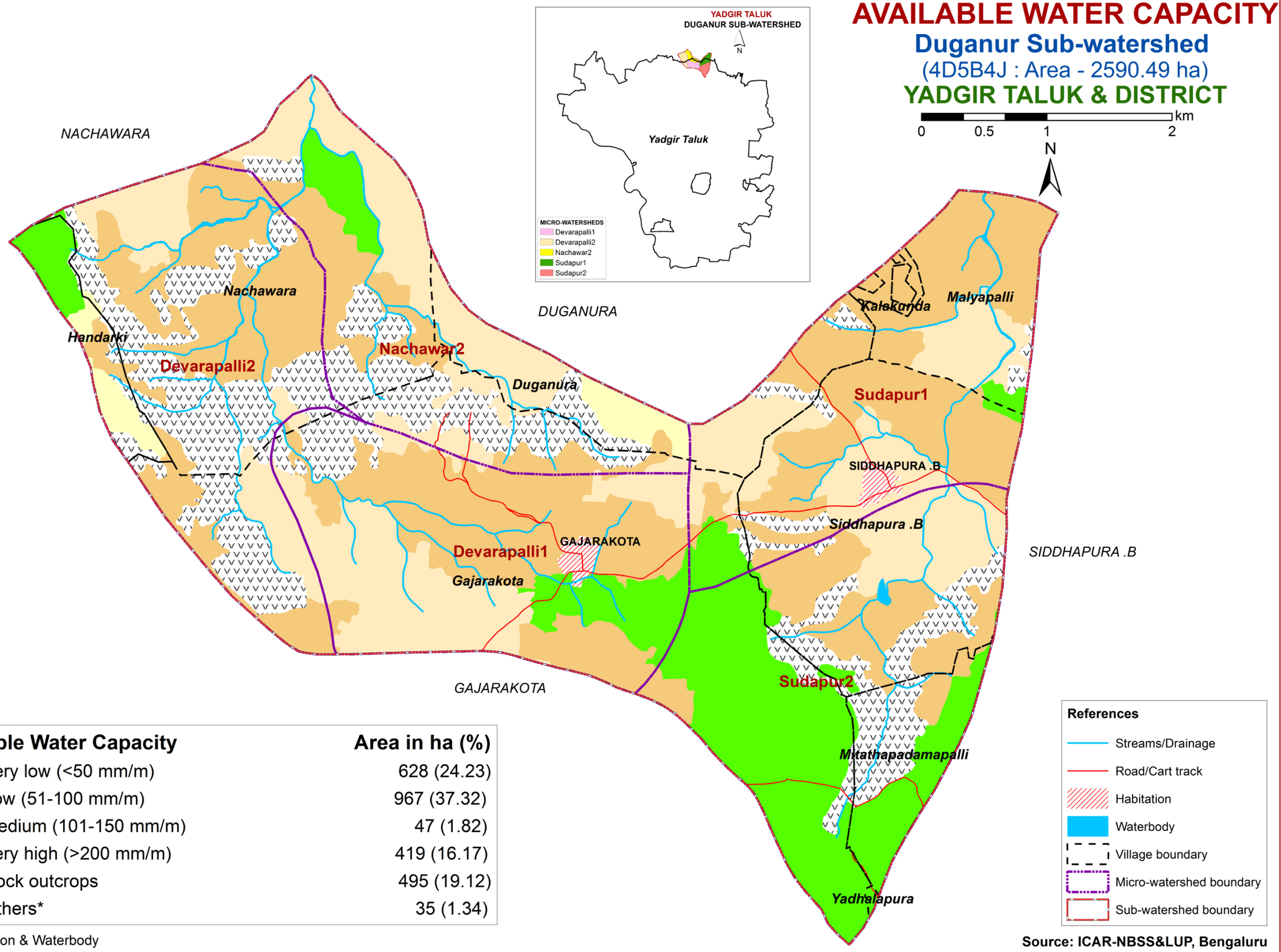
5.5. Available Water Capacity

AVAILABLE WATER CAPACITY

Duganur Sub-watershed

(4D5B4J : Area - 2590.49 ha)

YADGIR TALUK & DISTRICT



Available Water Capacity	Area in ha (%)
Very low (<50 mm/m)	628 (24.23)
Low (51-100 mm/m)	967 (37.32)
Medium (101-150 mm/m)	47 (1.82)
Very high (>200 mm/m)	419 (16.17)
Rock outcrops	495 (19.12)
Others*	35 (1.34)

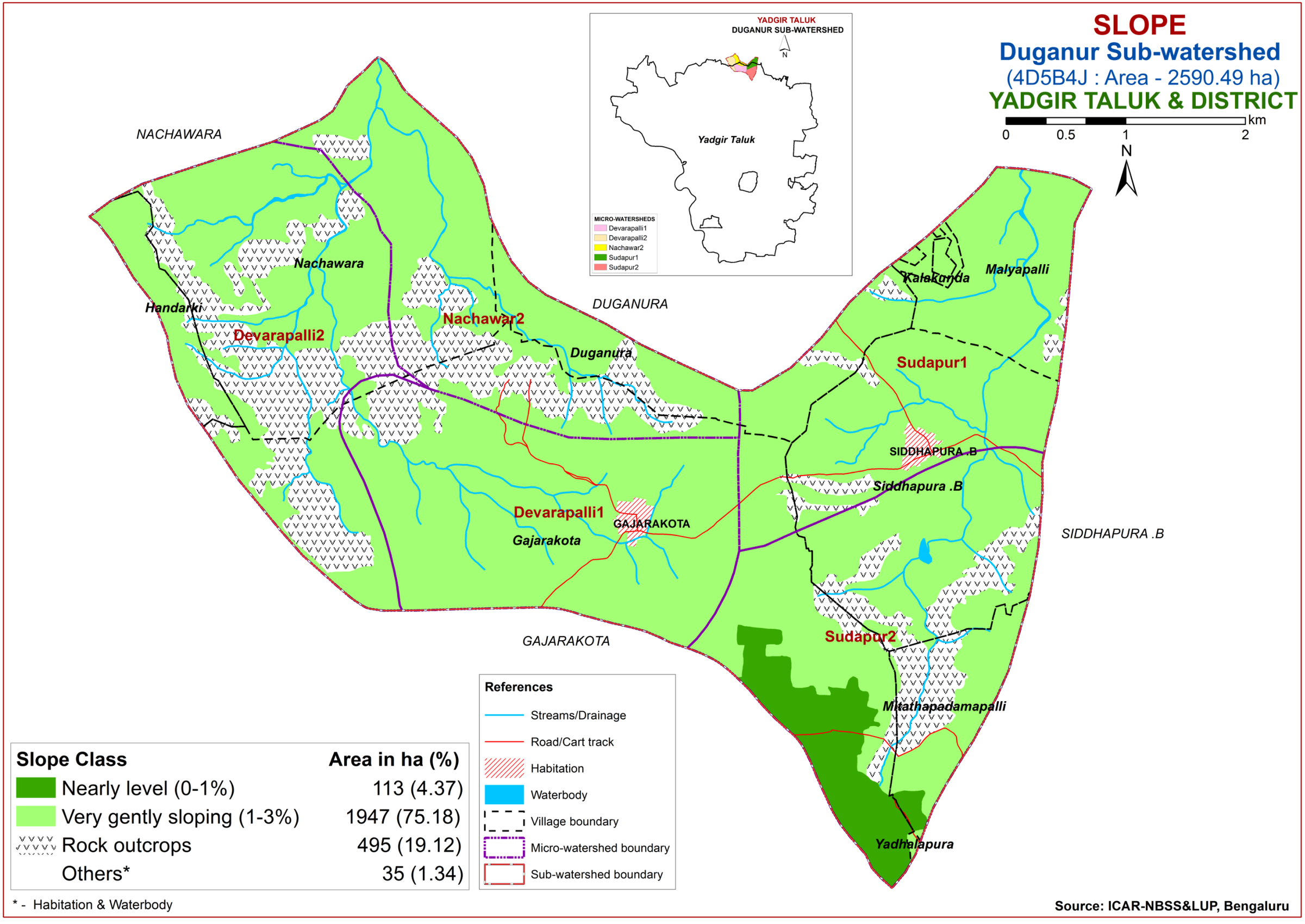
* - Habitation & Waterbody

References

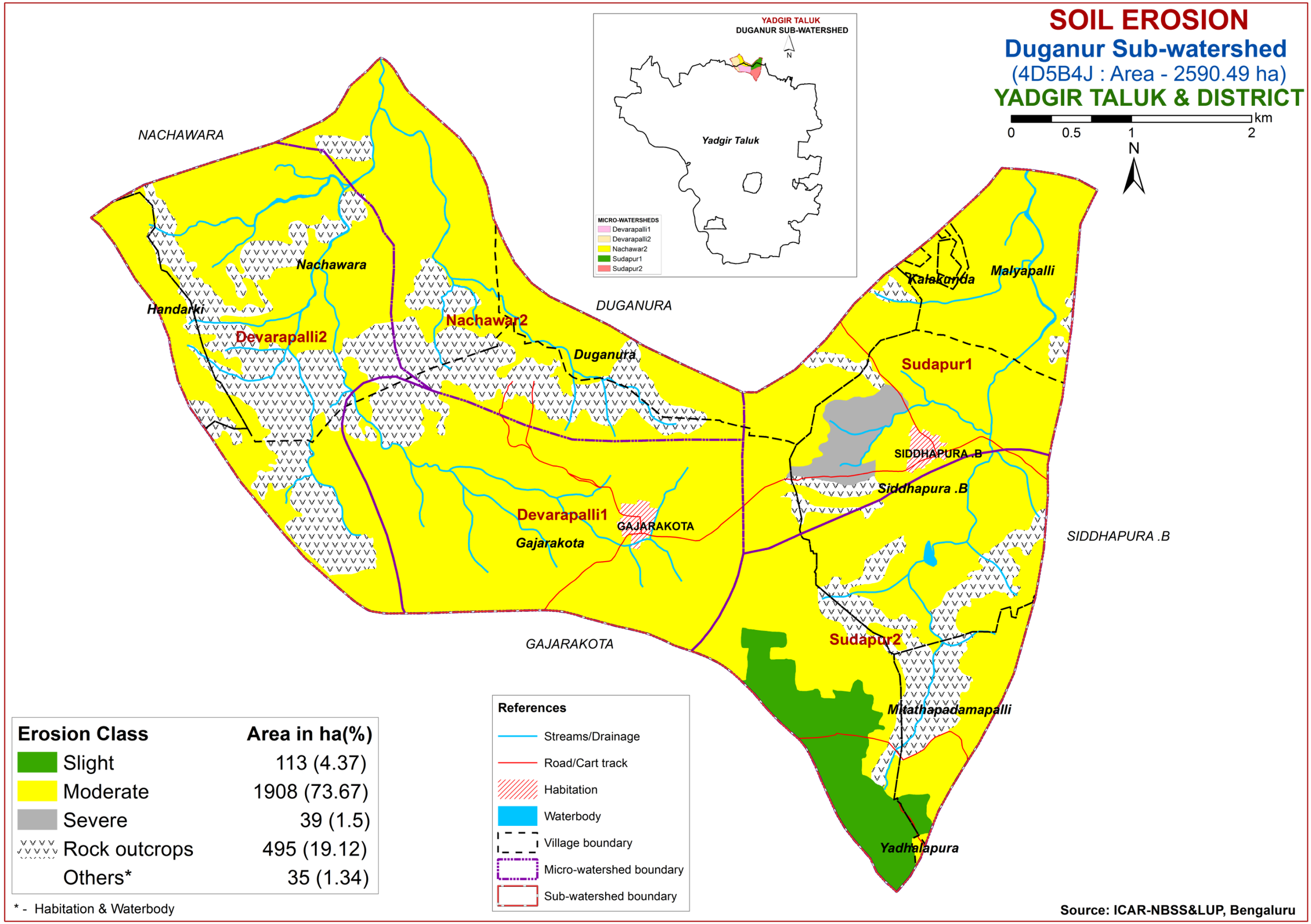
- Streams/Drainage
- Road/Cart track
- Habitation
- Waterbody
- Village boundary
- Micro-watershed boundary
- Sub-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

5.6.Slope

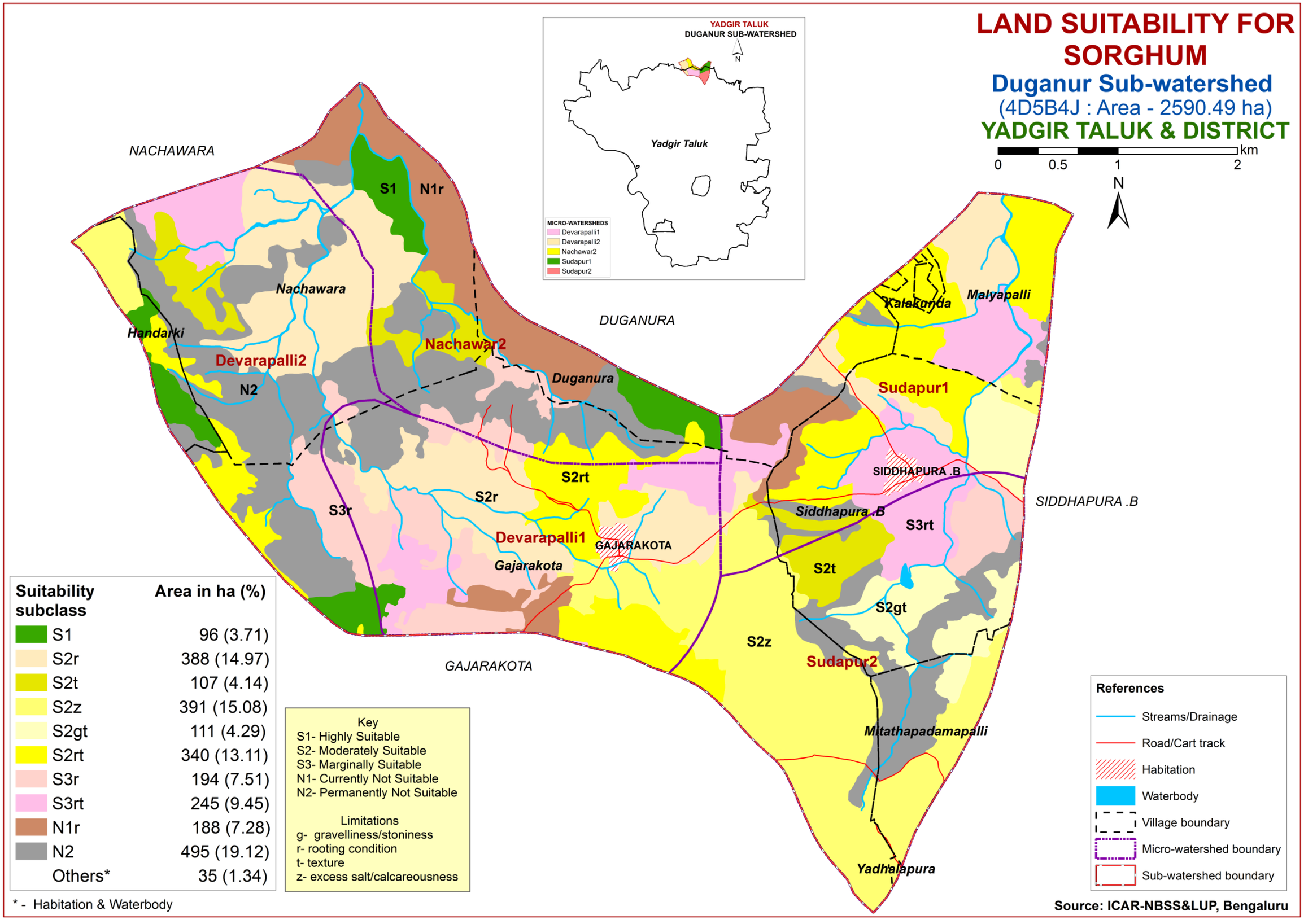

SLOPE
Duganur Sub-watershed
(4D5B4J : Area - 2590.49 ha)
YADGIR TALUK & DISTRICT
0 0.5 1 2 km
N
YADGIR TALUK
DUGANUR SUB-WATERSHED
Yadgir Taluk
MICRO-WATERSHEDS
Devarapalli1
Devarapalli2
Nachawar2
Sudapur1
Sudapur2
NACHAWARA
DUGANURA
SIDDHAPURA .B
GAJARAKOTA
Nachawara
Handarki
Devarapalli2
Nachawar2
Duganura
Kalakunda
Malyapalli
Sudapur1
SIDDHAPURA .B
Siddhapura .B
Devarapalli1
GAJARAKOTA
Gajarakota
Sudapur2
Mitathapadamapalli
Yadhalapura
References
Streams/Drainage
Road/Cart track
Habitation
Waterbody
Village boundary
Micro-watershed boundary
Sub-watershed boundary
Slope Class
Area in ha (%)
Nearly level (0-1%) 113 (4.37)
Very gently sloping (1-3%) 1947 (75.18)
Rock outcrops 495 (19.12)
Others* 35 (1.34)
* - Habitation & Waterbody
Source: ICAR-NBSS&LUP, Bengaluru

5.7.Soil Erosion



6. Land Suitability for Major Crops

6.1. Land Suitability for Sorghum



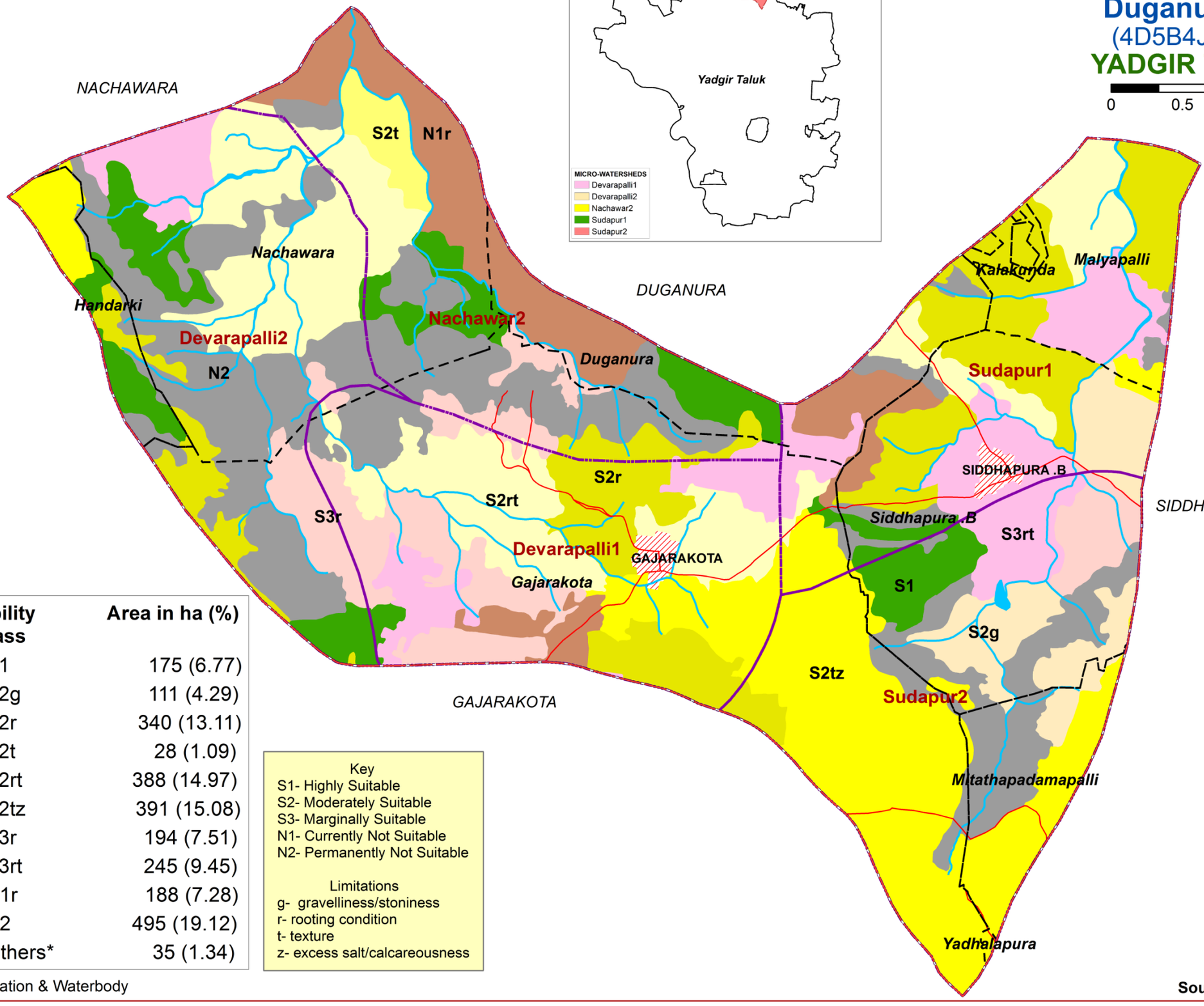
6.2. Land Suitability for Maize

LAND SUITABILITY FOR MAIZE

Duganur Sub-watershed

(4D5B4J : Area - 2590.49 ha)

YADGIR TALUK & DISTRICT



Suitability subclass	Area in ha (%)
S1	175 (6.77)
S2g	111 (4.29)
S2r	340 (13.11)
S2t	28 (1.09)
S2rt	388 (14.97)
S2tz	391 (15.08)
S3r	194 (7.51)
S3rt	245 (9.45)
N1r	188 (7.28)
N2	495 (19.12)
Others*	35 (1.34)

* - Habitation & Waterbody

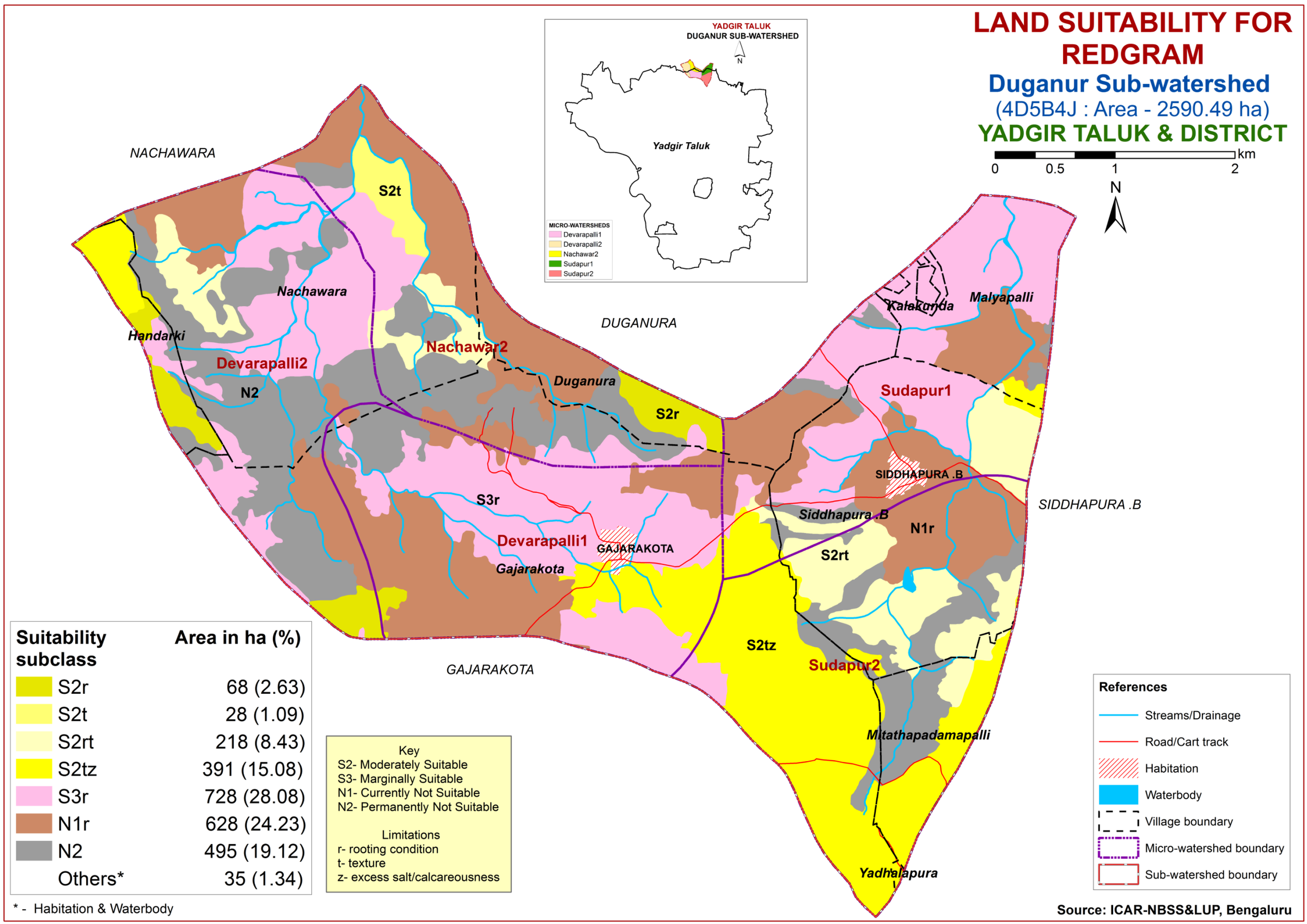
Key
S1- Highly Suitable
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable
N2- Permanently Not Suitable

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

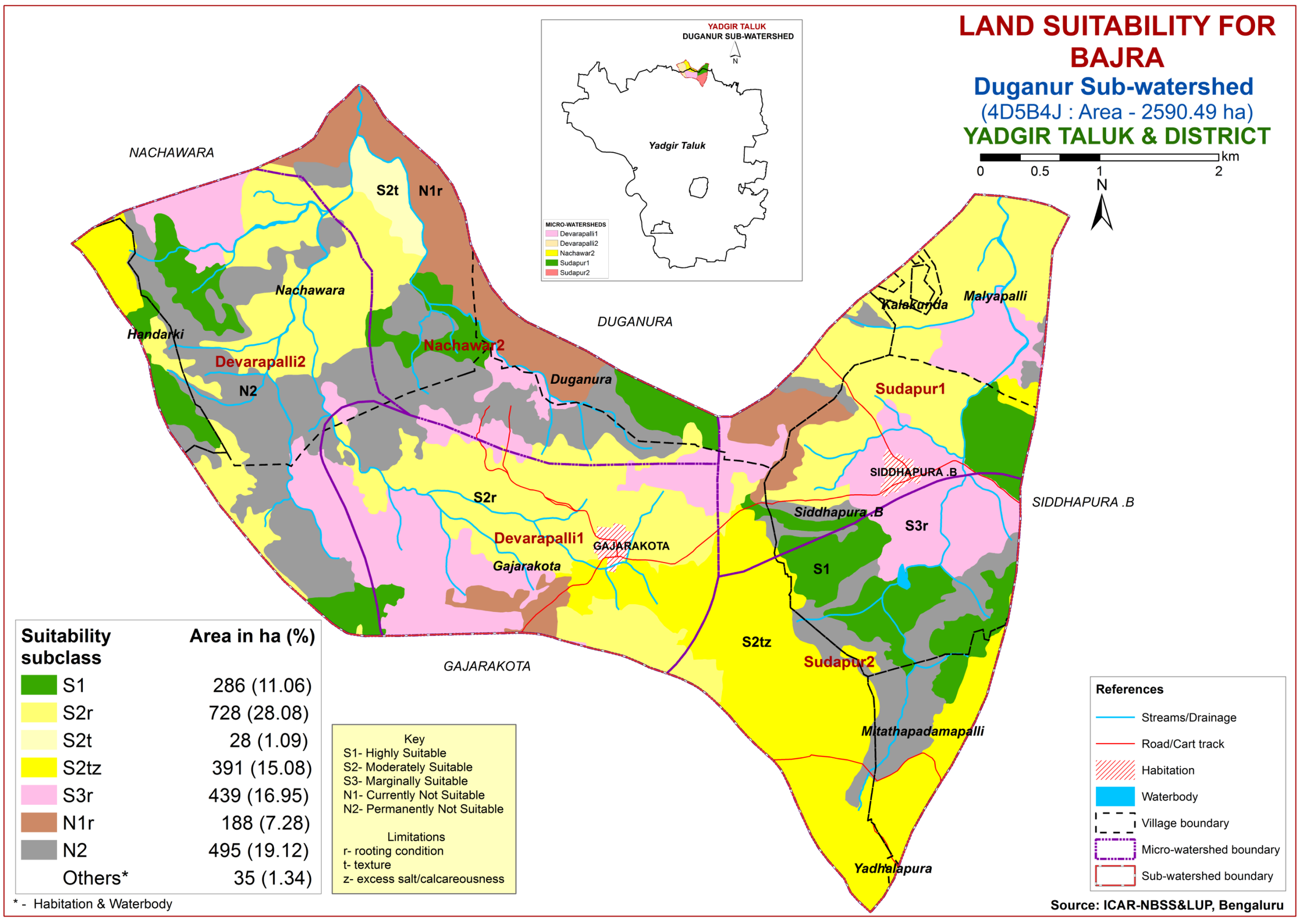
References
- Streams/Drainage
- Road/Cart track
- Habitation
- Waterbody
- Village boundary
- Micro-watershed boundary
- Sub-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

6.3. Land Suitability for Redgram



6.4. Land Suitability for Bajra



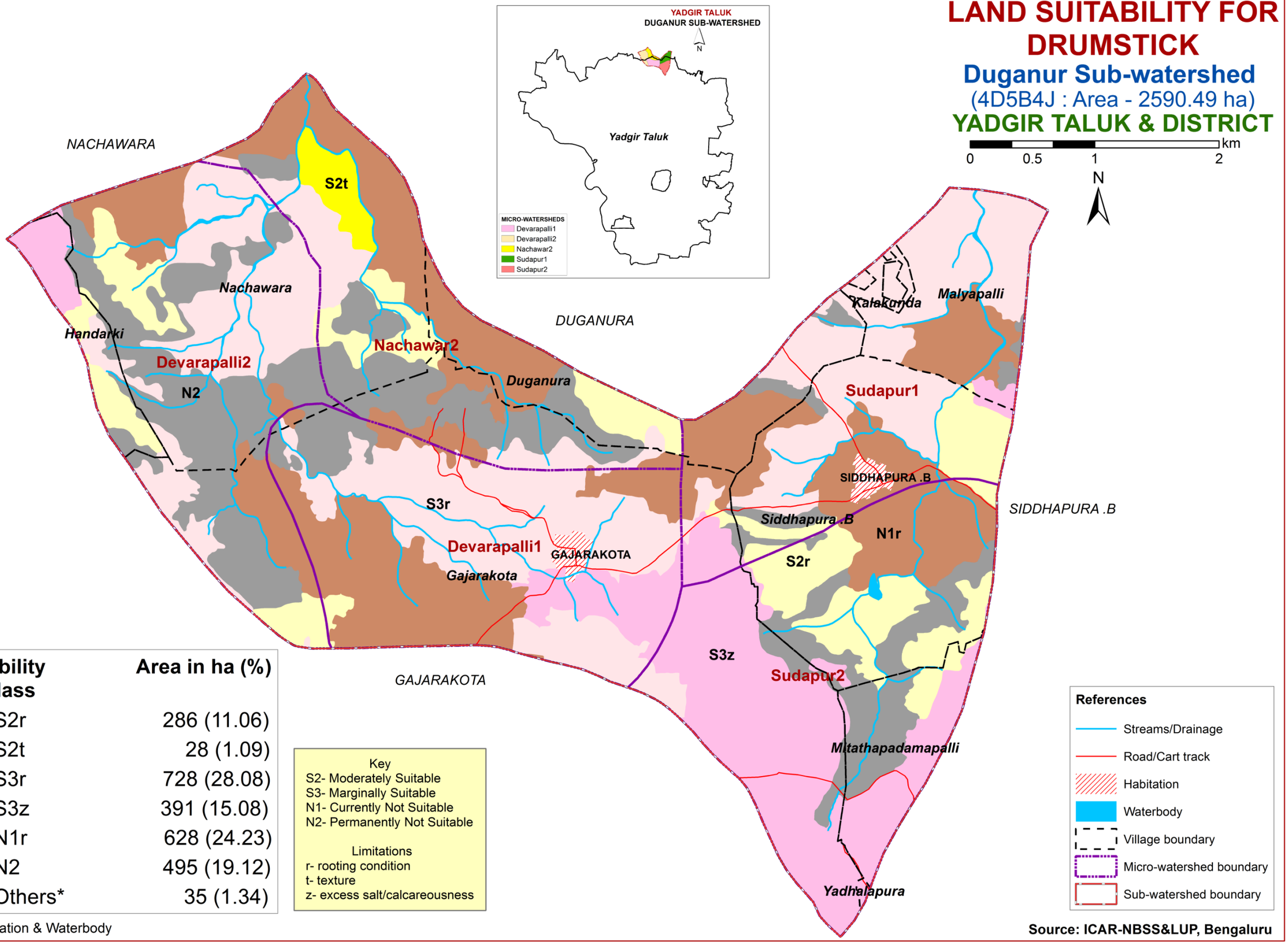
6.5. Land Suitability for Drumstick

LAND SUITABILITY FOR DRUMSTICK

Duganur Sub-watershed

(4D5B4J : Area - 2590.49 ha)

YADGIR TALUK & DISTRICT



Suitability subclass	Area in ha (%)
S2r	286 (11.06)
S2t	28 (1.09)
S3r	728 (28.08)
S3z	391 (15.08)
N1r	628 (24.23)
N2	495 (19.12)
Others*	35 (1.34)

* - Habitation & Waterbody

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

Limitations
r- rooting condition
t- texture
z- excess salt/calcareousness

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

Source: ICAR-NBSS&LUP, Bengaluru

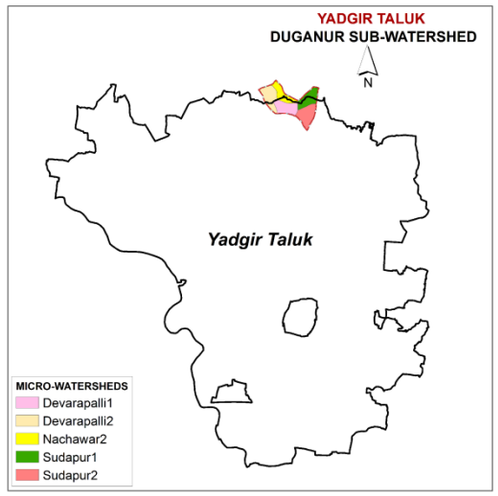
6.6. Land Suitability for Sunflower

LAND SUITABILITY FOR SUNFLOWER

Duganur Sub-watershed

(4D5B4J : Area - 2590.49 ha)

YADGIR TALUK & DISTRICT



km 0 0.5 1 2

N

Suitability subclass	Area in ha (%)
S1	28 (1.09)
S2r	68 (2.63)
S2z	391 (15.08)
S2rt	218 (8.43)
S3r	728 (28.08)
N1r	628 (24.23)
N2	495 (19.12)
Others*	35 (1.34)

* - Habitation & Waterbody

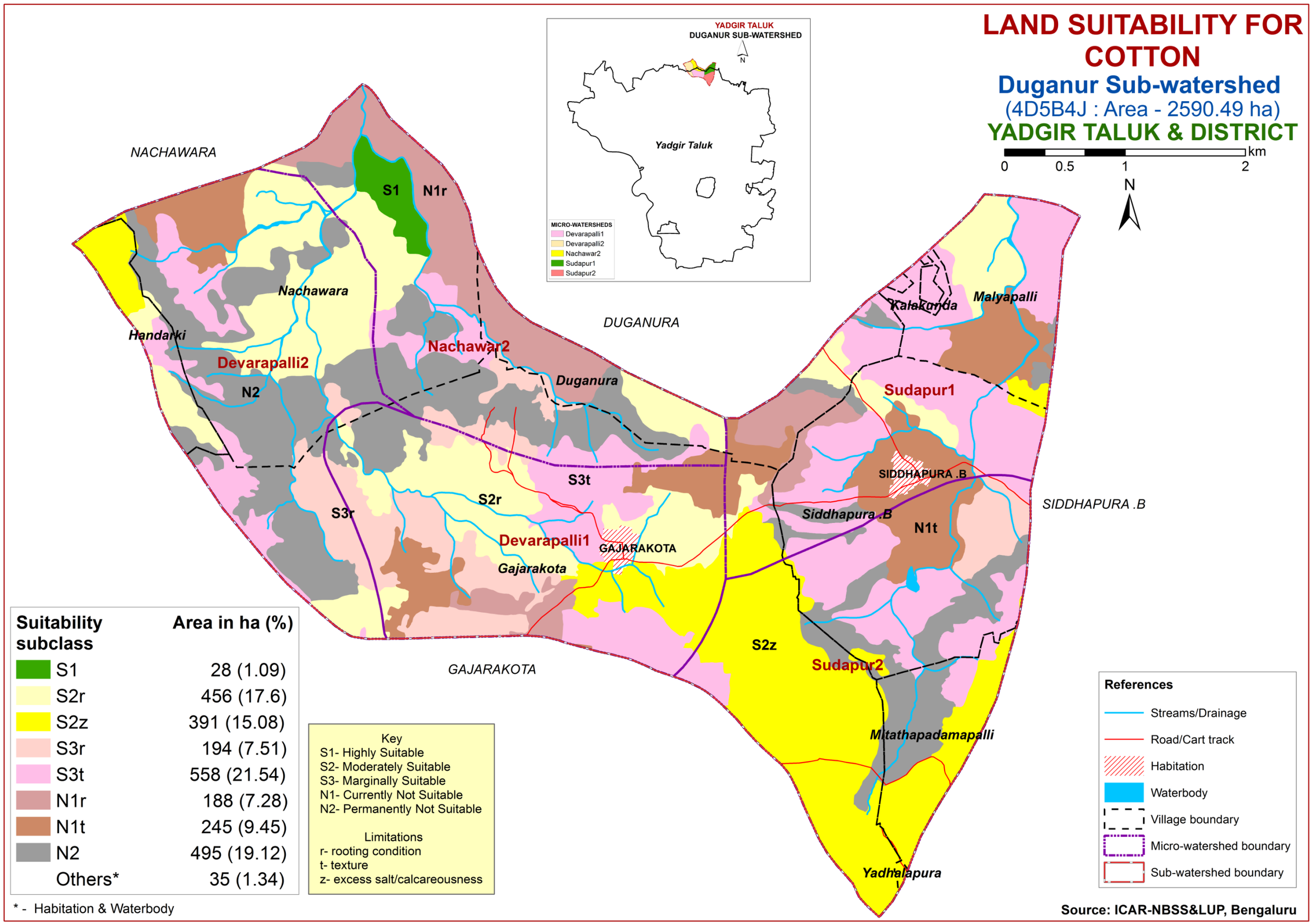
Key
S1- Highly Suitable
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable
N2- Permanently Not Suitable

Limitations
r- rooting condition
t- texture
z- excess salt/calcareousness

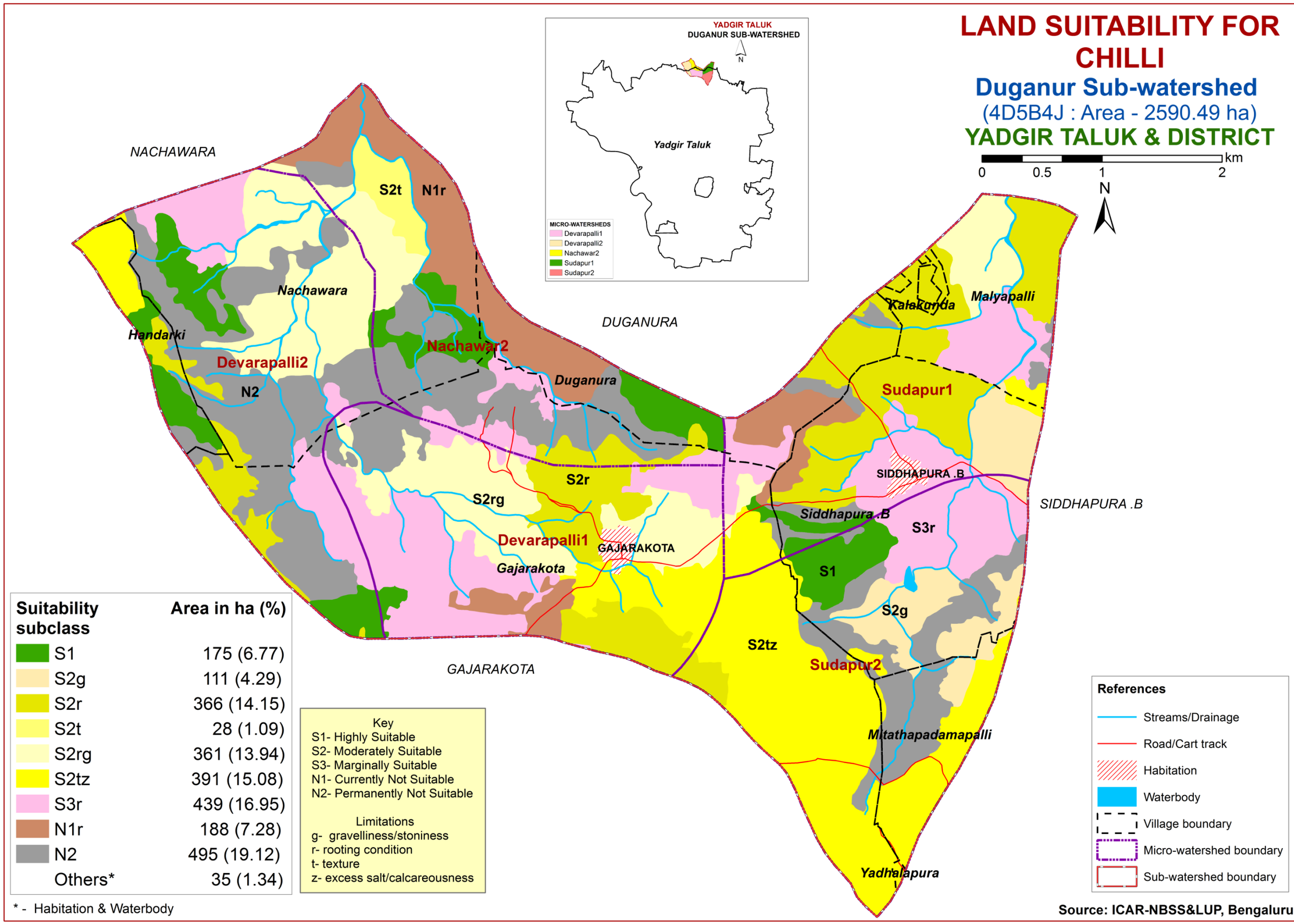
References
- Streams/Drainage
- Road/Cart track
- Habitation
- Waterbody
- Village boundary
- Micro-watershed boundary
- Sub-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

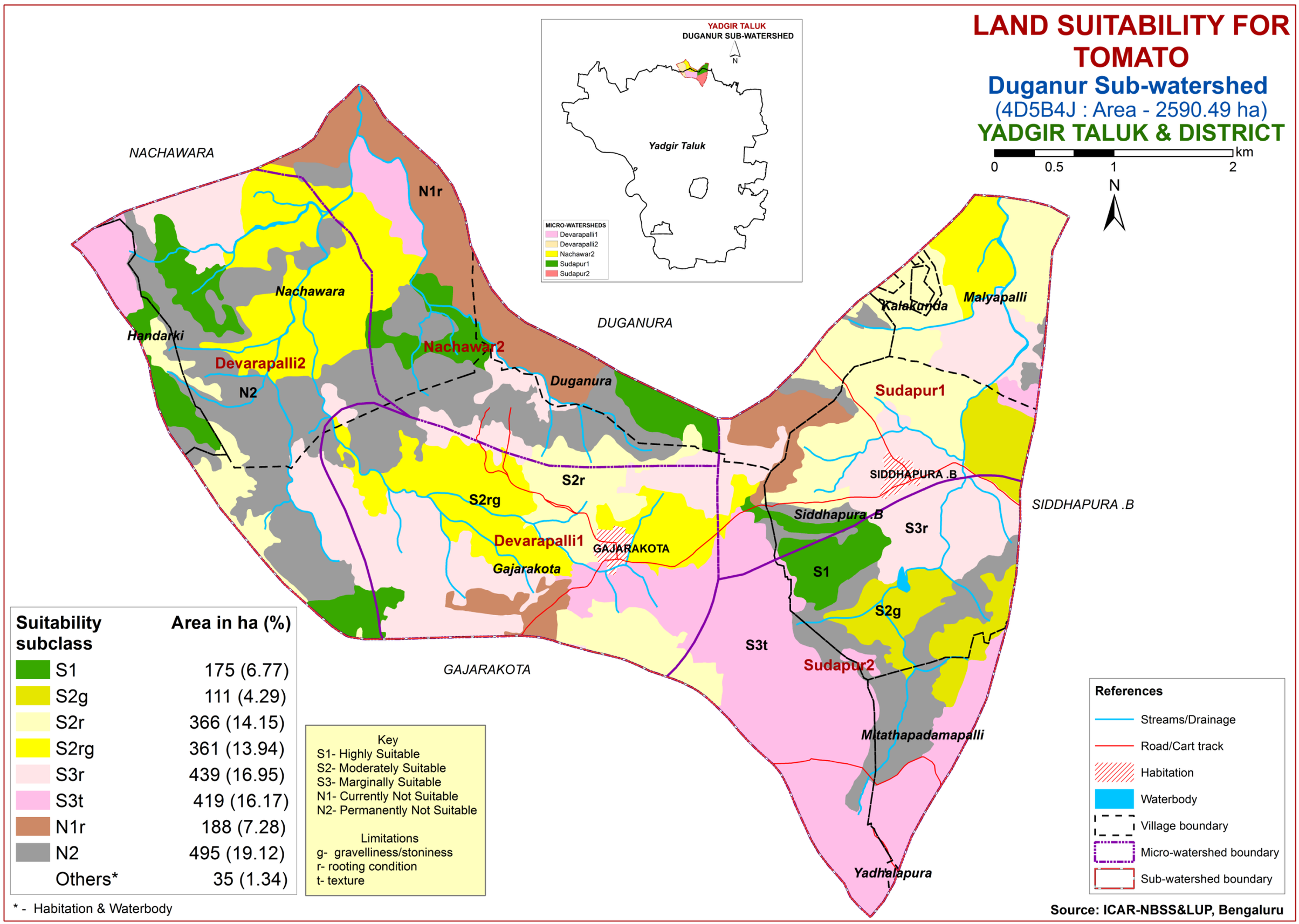
6.7. Land Suitability for Cotton



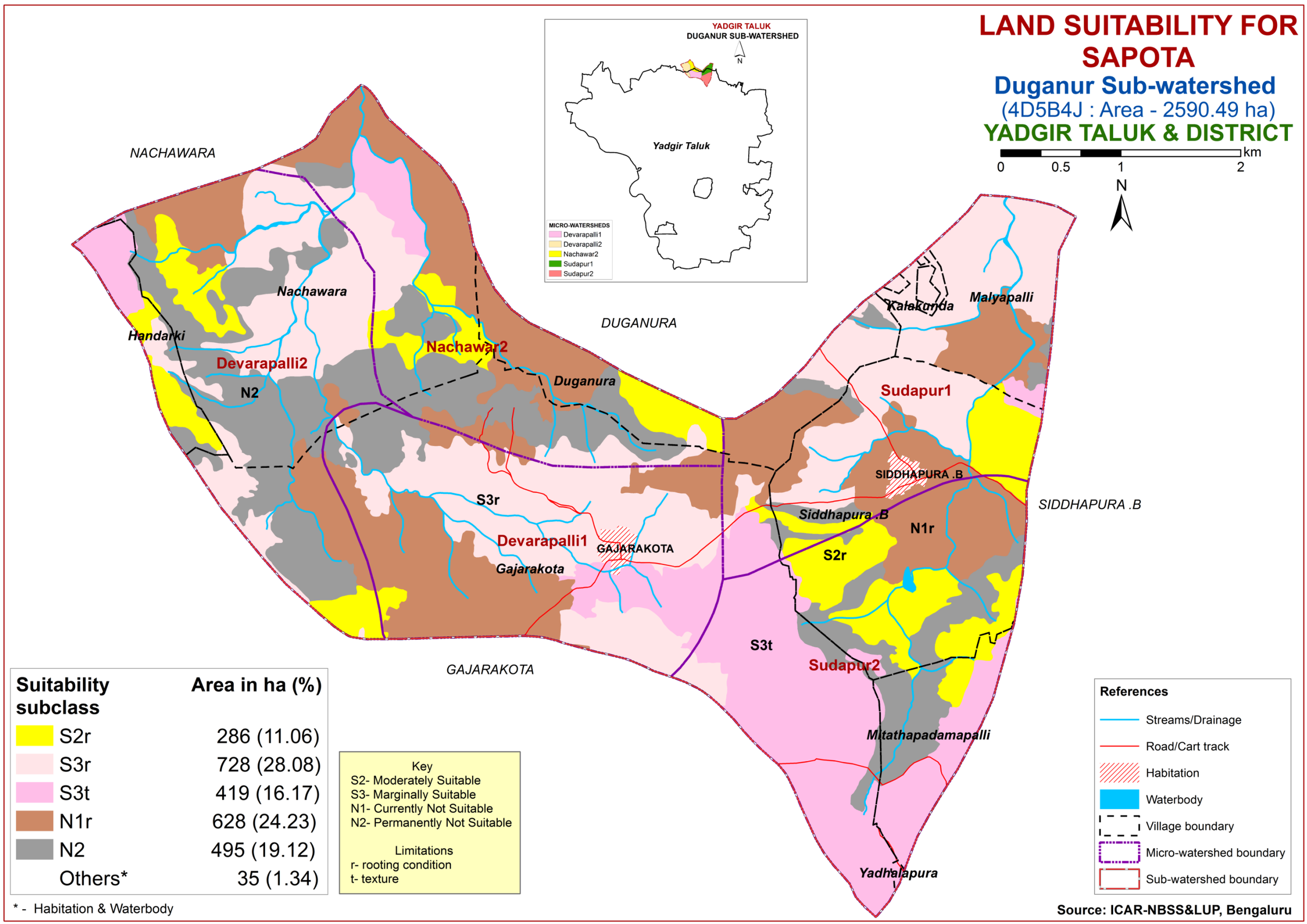
6.8. Land Suitability for Chilli



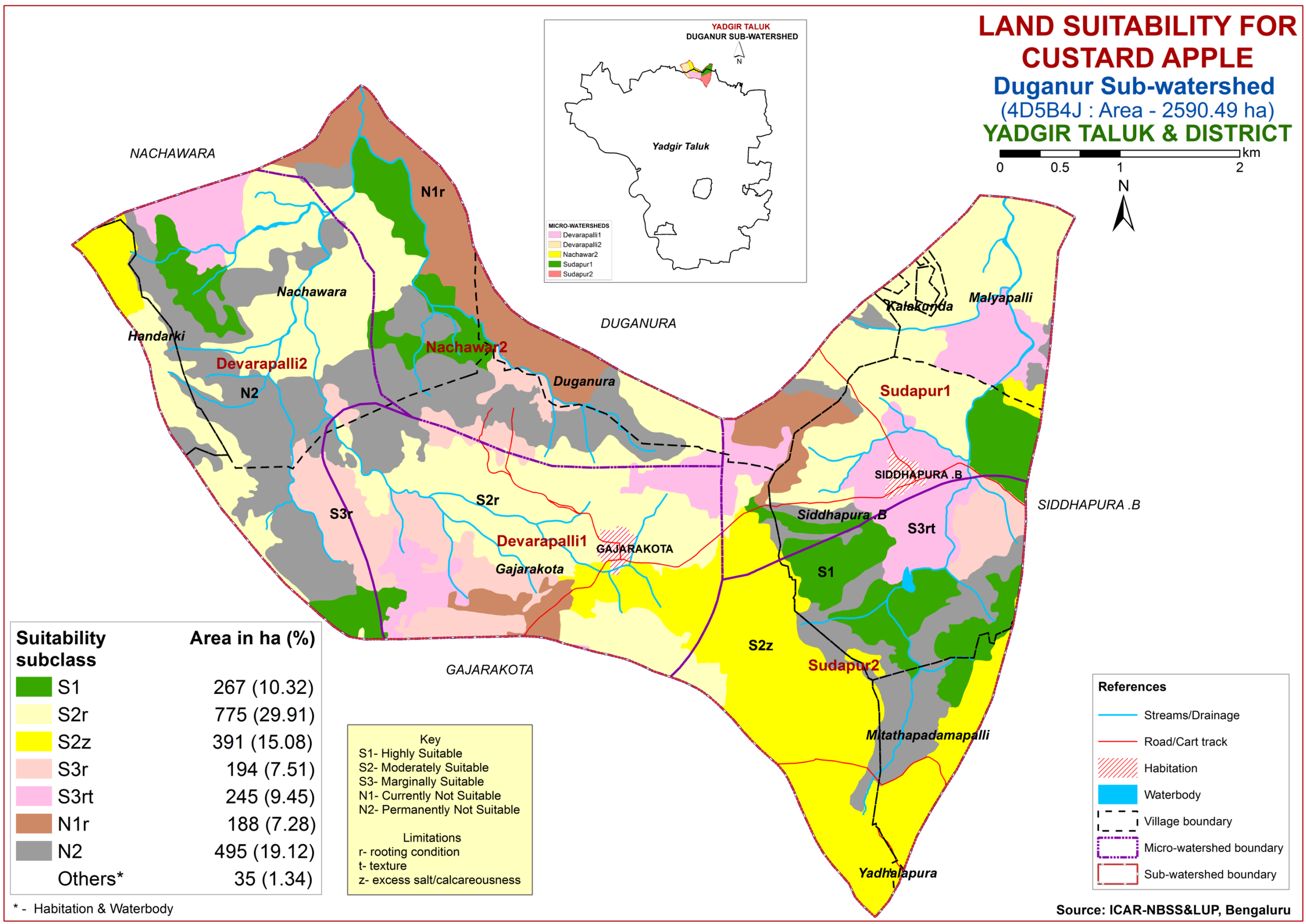
6.9. Land Suitability for Tomato



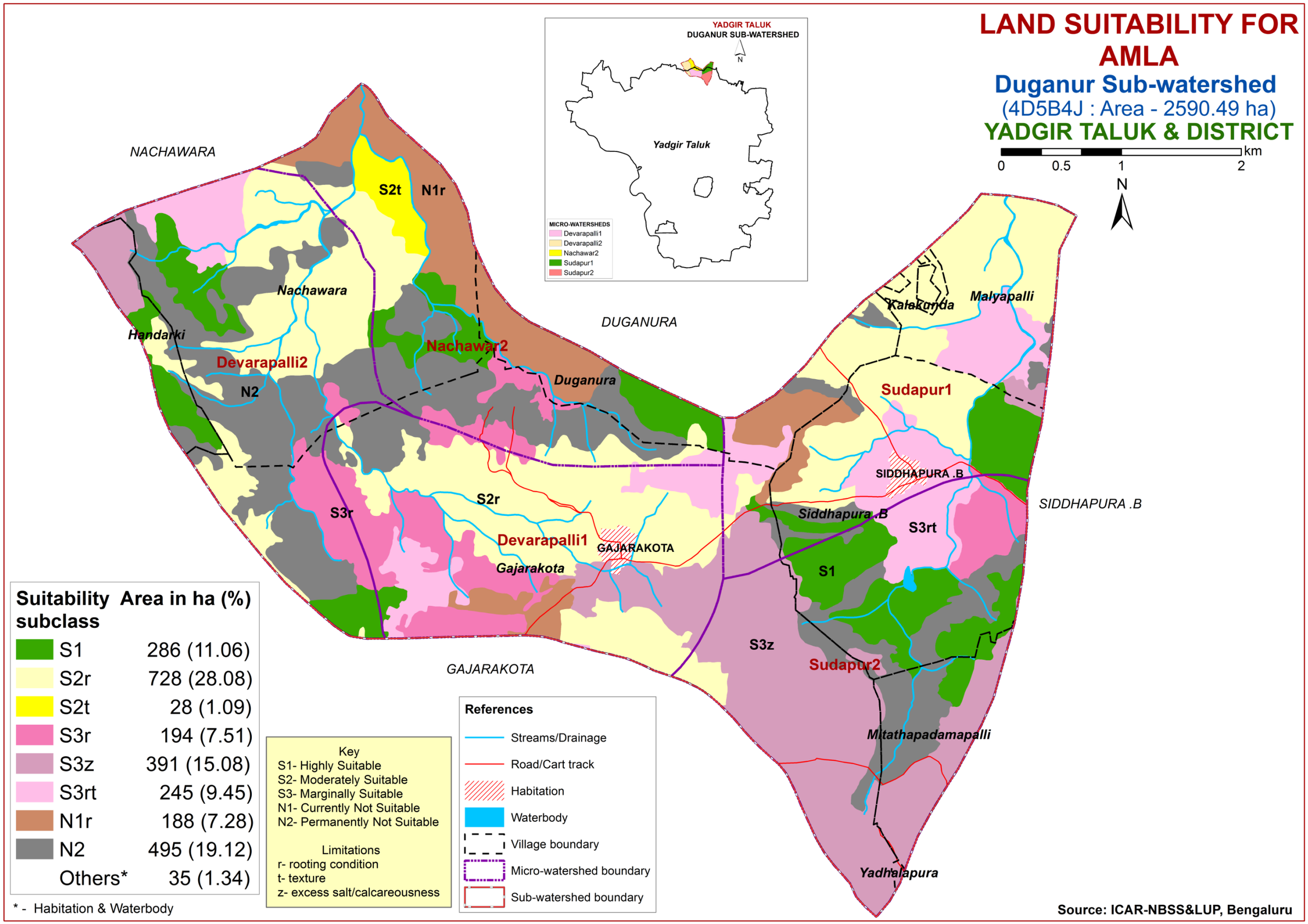
6.10. Land Suitability for Sapota



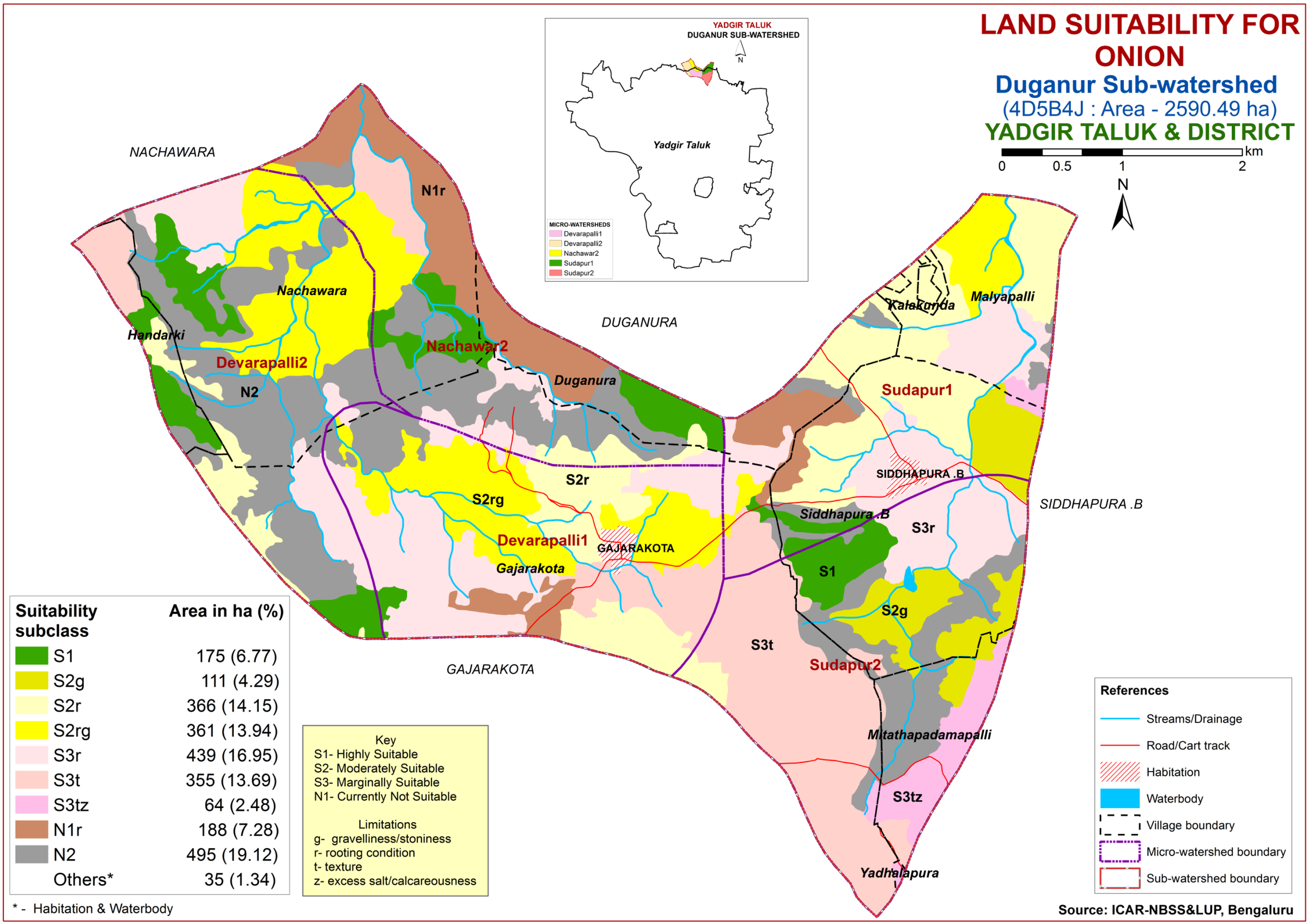
6.11. Land Suitability for Custard Apple



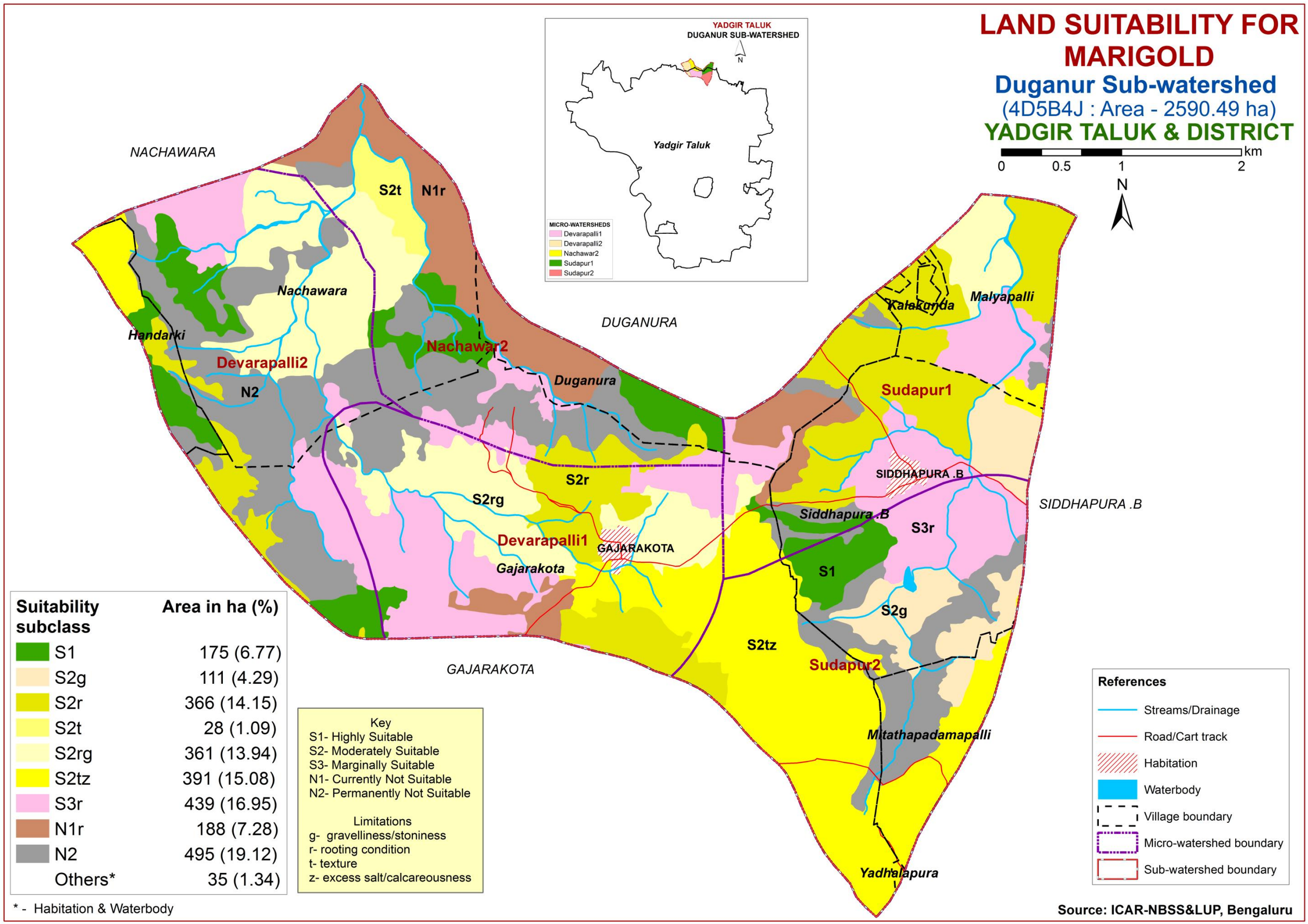
6.12. Land Suitability for Amla



6.13. Land Suitability for Onion



6.14. Land Suitability for Marigold



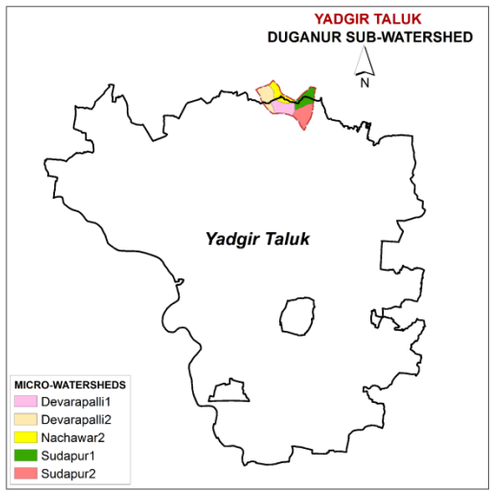
6.15. Land Suitability for Chrysanthemum

LAND SUITABILITY FOR CHRYSANTHEMUM

Duganur Sub-watershed

(4D5B4J : Area - 2590.49 ha)

YADGIR TALUK & DISTRICT



0 0.5 1 2 km

N

Suitability subclass	Area in ha (%)
S1	175 (6.77)
S2g	111 (4.29)
S2r	366 (14.15)
S2t	28 (1.09)
S2rg	361 (13.94)
S2tz	391 (15.08)
S3r	439 (16.95)
N1r	188 (7.28)
N2	495 (19.12)
Others*	35 (1.34)

* - Habitation & Waterbody

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

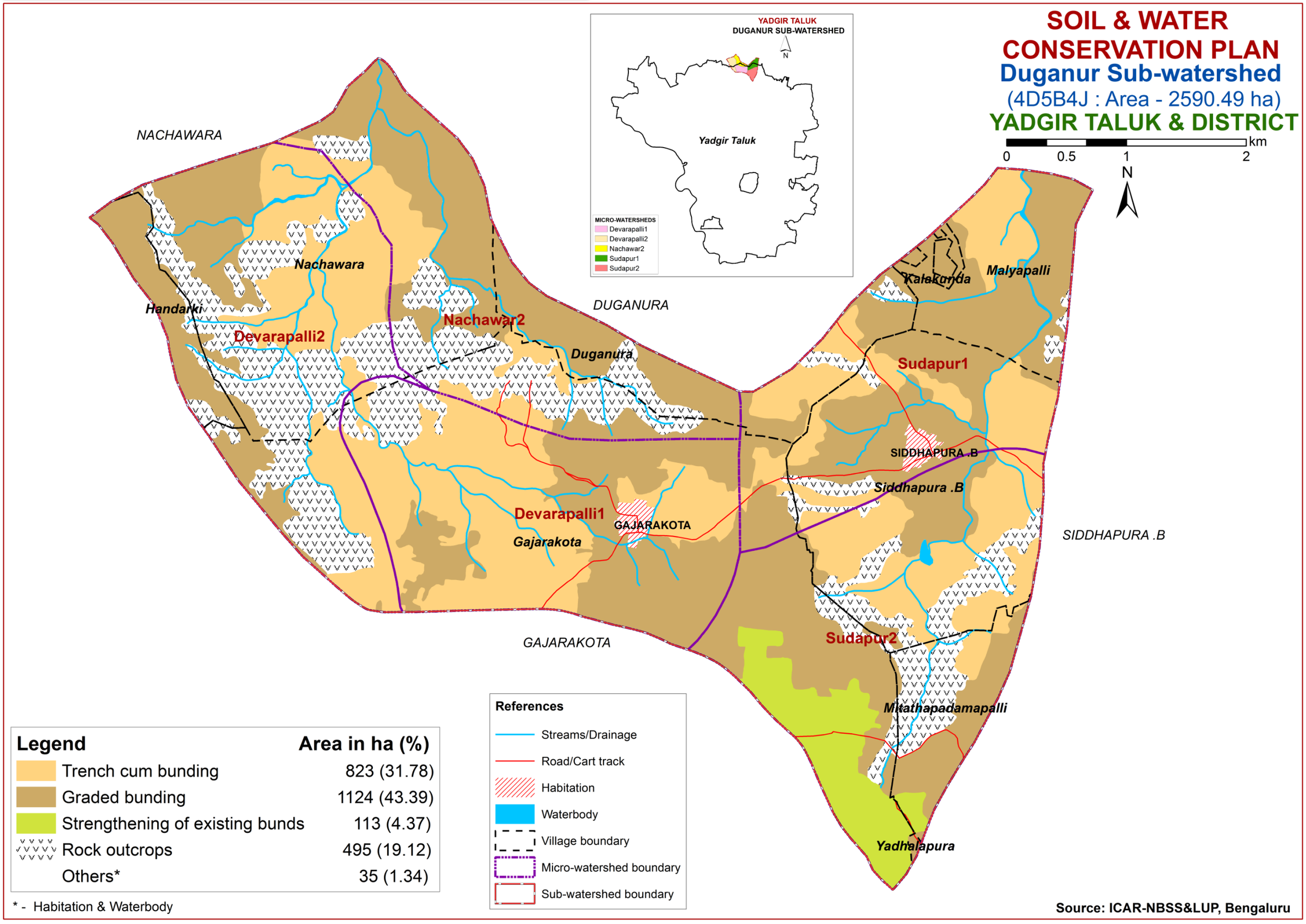
Limitations
g- gravelliness/stoniness
r- rooting condition
t- texture
z- excess salt/calcareousness

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

Source: ICAR-NBSS&LUP, Bengaluru

7. Soil and Water Conservation Measures

7.1. Soil & Water Conservation Plan



8. Table. Proposed Crop Plan for Duganur 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	155.BLCcB2g1 38.BLCiB2 40.PGPcB2 (Moderately deep red sandy clay to 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
2	159.BMNmA1 63.BMNmB2g1 32.HSLcB2 33.HSLiB2 146.NGPmB2g1 128.SHTcB2 36.SHThB2 115.BGDmB2 (Moderately deep to very deep, black calcareous sandy clay to 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	22.JNKiB2 23.JNKiB2g1 24.JNKiB3g1 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

To be continued….

LMU No.	Soil Map Units	Field Crops/ Commercial crops	Horticulture Crops (Rainfed/Irrigated)	Suitable Interventions
4	29.YLRcB2g1 31.YLRiB2 (Moderately shallow, sandy clay soils)	Maize, sorghum Groundnut, Bajra, Cotton	**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
5	2.BDLbB2 174.BDLcB2g2 4.BDLhB2 5.BDLiB2 120.BDPhB2 1.BDPiB2 153.KKRbB2g1 8.VNKbB2g1 9.VNKcB2 10.VNKiB2 109.VNKmB2g1 (Shallow to very shallow soils)	-	**Agri-Silvi-Pasture**:s Hybrid Napier, *Styloxanthes hamata, Styloxanthes scabra*	Use of short duration varieties, sowing across the slope, drip irrigation is recommended

PART - B

Hydrological Inventory of Duganur 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

THE WORLD BANK

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

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

ICAR - NBSS & LUP

Phone:080-23412242

E-mail: hd_rcb.nbsslup@icar.gov.in
nbssrcb@gmail.com

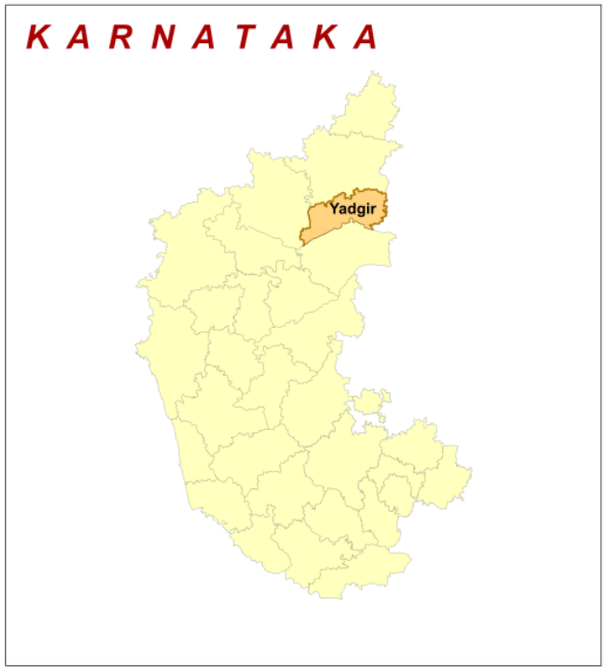
Details of Hydrology Team of LRI Partner Responsible for Preparation of Atlas

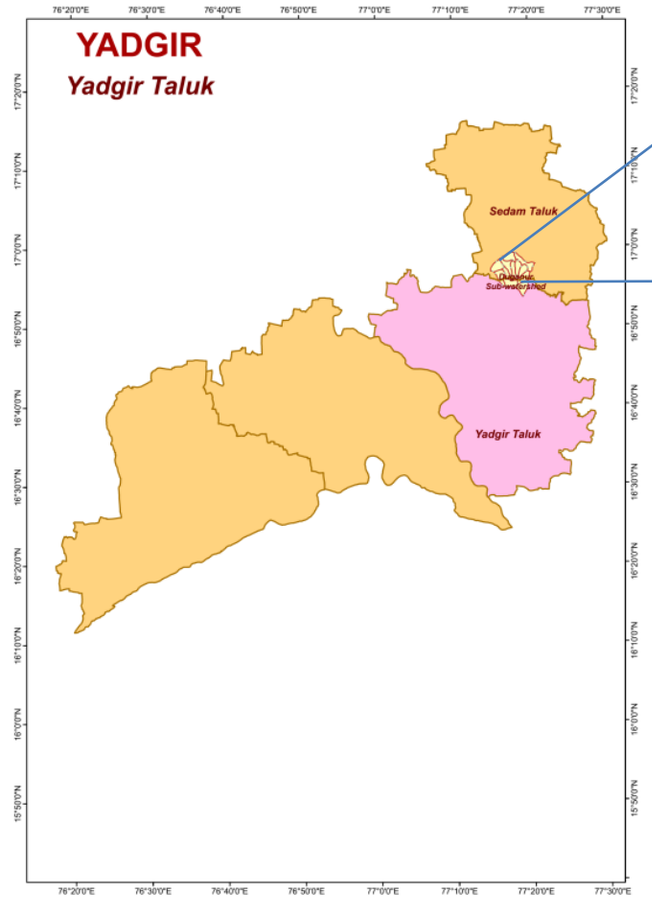
Name	Designation
Dr. Rajendra Hegde	Principal Scientist & Head Coordinator
Dr. S. Srinivas	Principal Scientist
Dr. K .V. Niranjana	Chief Technical Officer
Sh. R. S. Reddy	Consultant
Sh. A.G.Devendra Prasad	Consultant
Smt. K.Karunya Lakshmi	Research Associate
Ms. Seema, K.V.	Senior Research Fellow
Dr. Sekhar Muddu (Reviewed and approved)	Professor & Lead Scientist, Dept. of Civil Engineering & ICWaR, IISc, Bangalore
	Email: hd_rcb.nbsslup@icar.gov.in nbssrcb@gmail.com **Phone: Office:** 080-23412242,23410993 **Fax:** 080-23510350

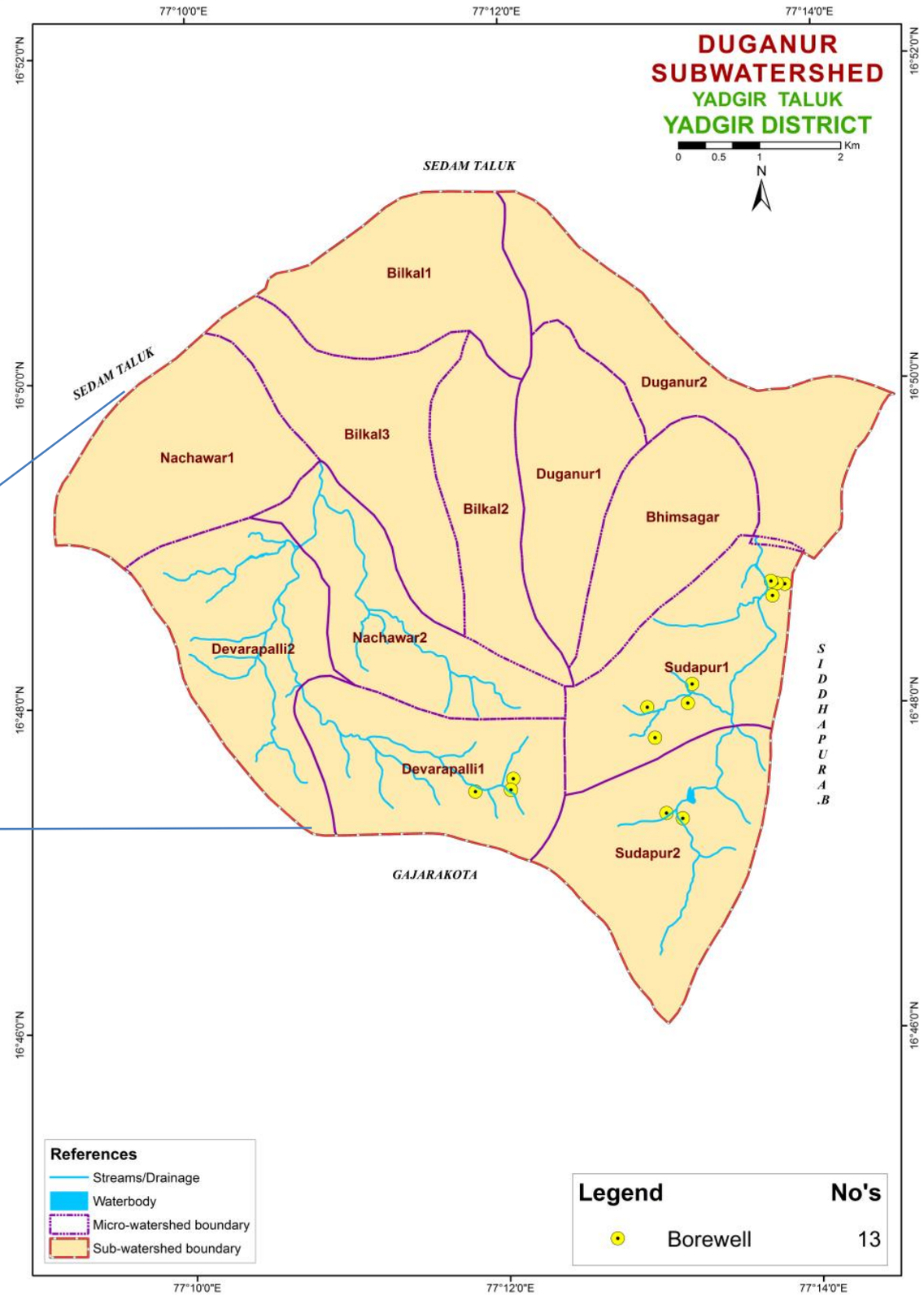
INTRODUCTION

- The inventory and documentation of spatial and temporal changes in hydrological components of Duganur sub-watershed (4D5B4J) in Yadgir taluk, Yadgir district, has been undertaken for integrated planning, development and management at the level of soil mapping units.
- Duganur sub-watershed (Yadgir taluk, Yadgir district) is located between $16^0$52'39''– 16^0 57'21'' North latitudes and $77^0$15'19''– 77^0 20'24'' East longitudes, covering an area of about 5872.74 ha.
- This sub-watershed encompasses of 12 MWs namely, Bilkal-1 (4D5B4J1g), Duganur-2 (4D5B4J2e), Bilkal-3 (4D5B4J1e), Duganur-1 (4D5B4J2d), Bilkal-2 (4D5B4J1f), Nachawar-1 (4D5B4J1d), Bhimsagar (4D5B4J2c), Nachawar-2 (4D5B4J1c), Devarapalli-2 (4D5B4J1b), Sudapur-1 (4D5B4J2b), Sudapur-2 (4D5B4J2a) and Devarapalli-1 (4D5B4J1a) micro watersheds. Land Resource Inventory (LRI) was generated for five among the twelve 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, Redgram, Chilli, Soybean , Paddy and major *rabi* crops are Sorghum, Bengal gram and 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 DUGANUR SUB-WATERSHED

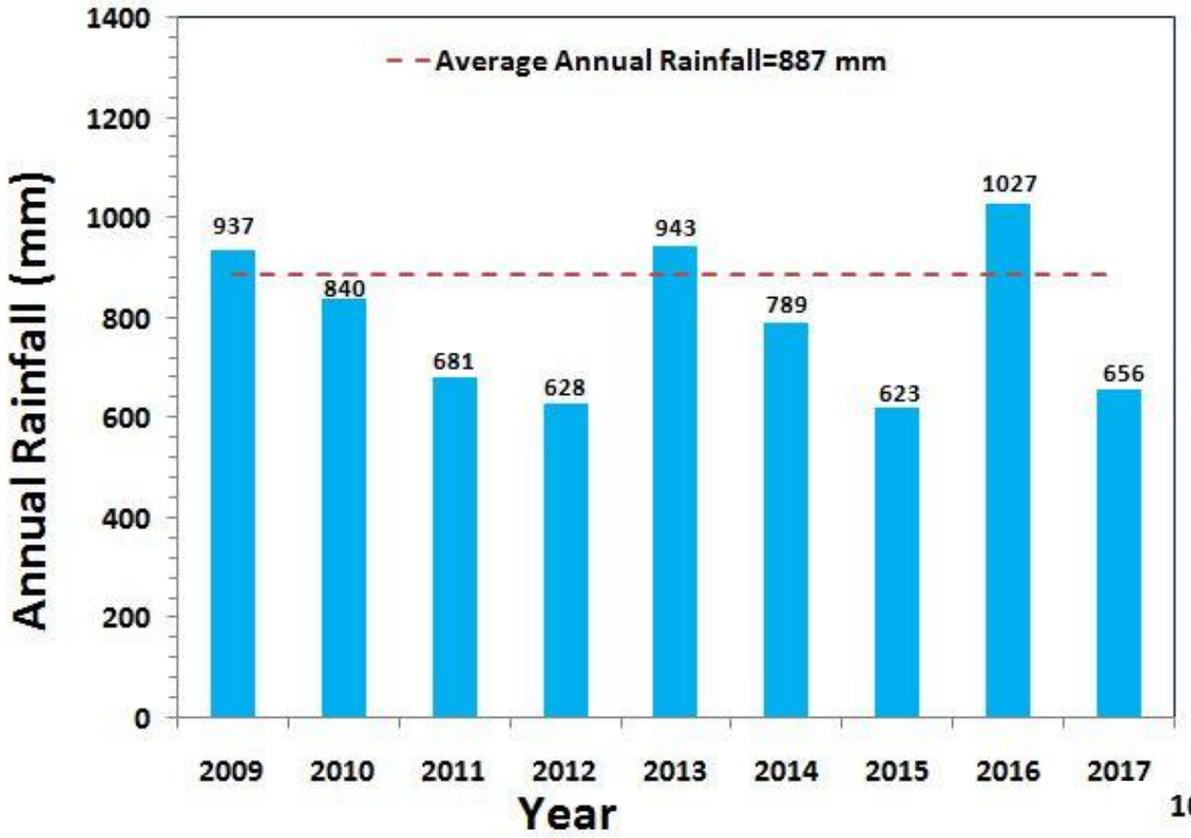






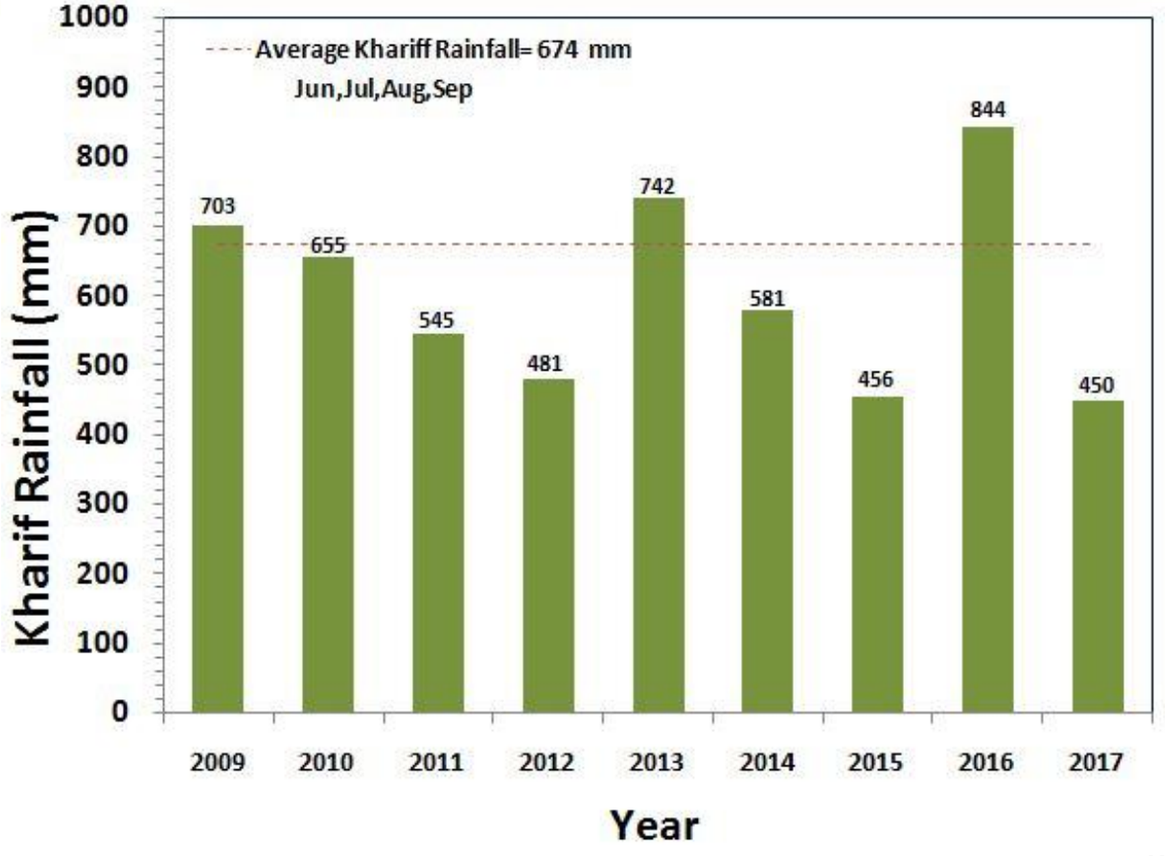
Soil & Water Conservation Structures in Duganur Sub-watershed, Yadgir taluk, Yadgir district

RAINFALL INDEX

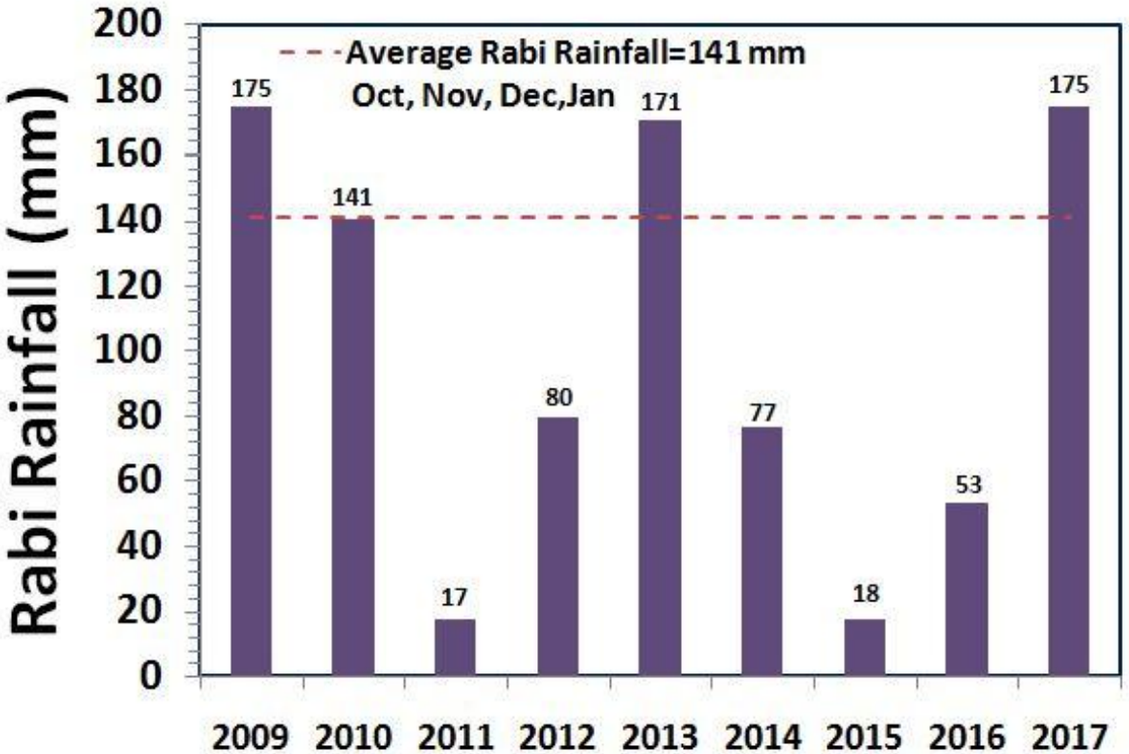


The average annual rainfall (1960-2014) recorded at the Yadgir station in Yadgir taluk of Yadgir district is 887 mm. The annual rainfall at Kodla station (Hobli H.Q.) is presented. During the years 2010, 2011, 2012, 2014, 2015 and 2017 the annual rainfall was deficient by 5%, 23%, 29%, 11%, 30% and 26% respectively.

The *kharif* rainfall (Jun–Sep) is an average about 76% of the annual rainfall and it typically follows the annual rainfall patterns. During the years 2010, 2011, 2012, 2014, 2015 and 2017 the *kharif* rainfall was deficient by 3%, 19%, 29%, 14%, 32% and 33% respectively.

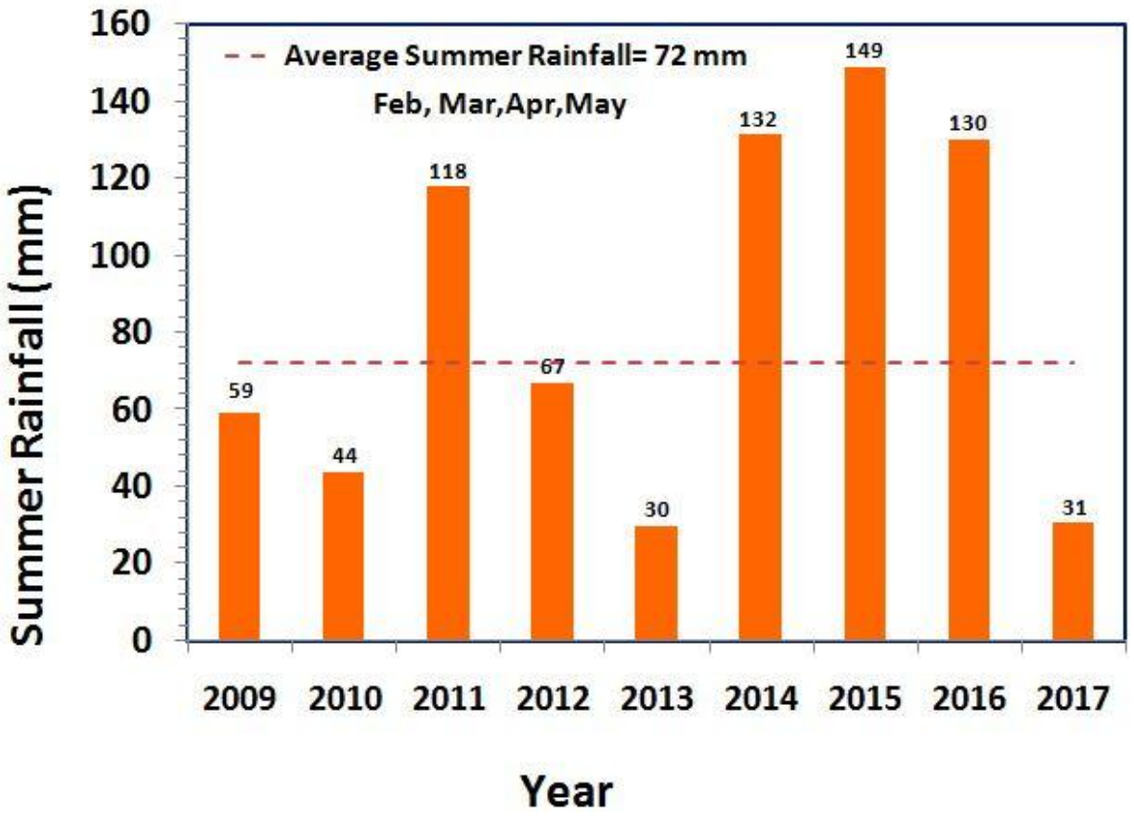


RAINFALL INDEX

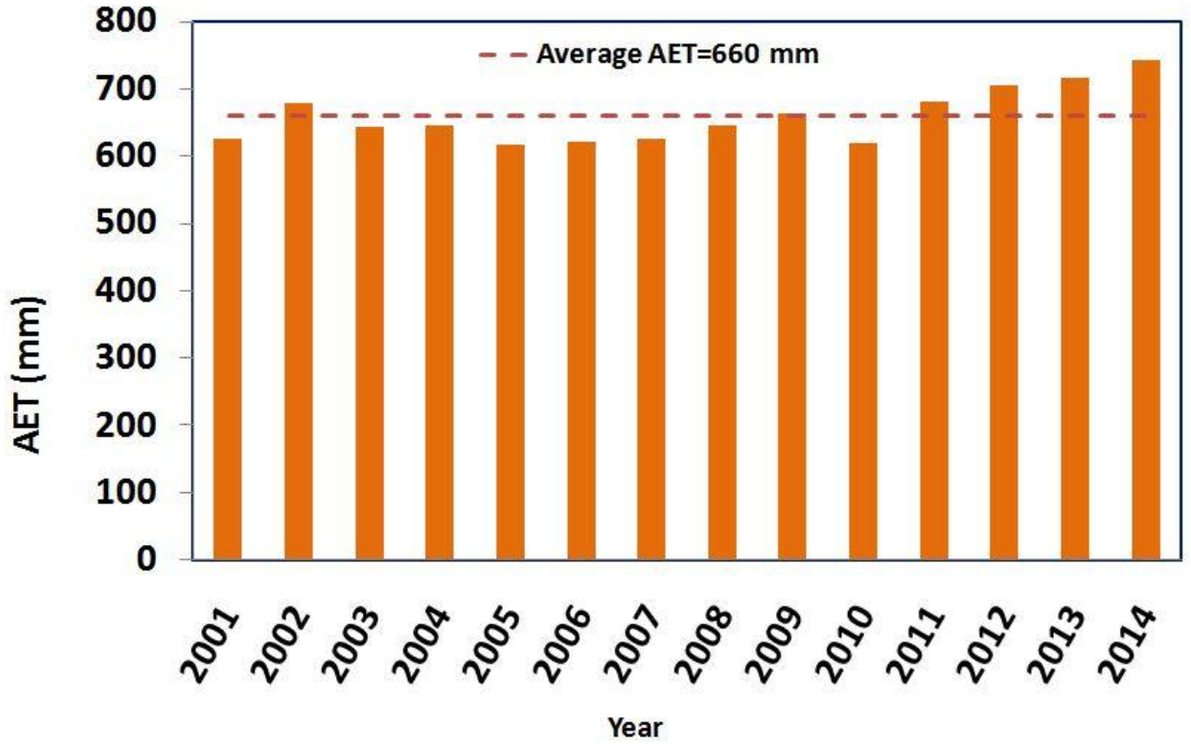


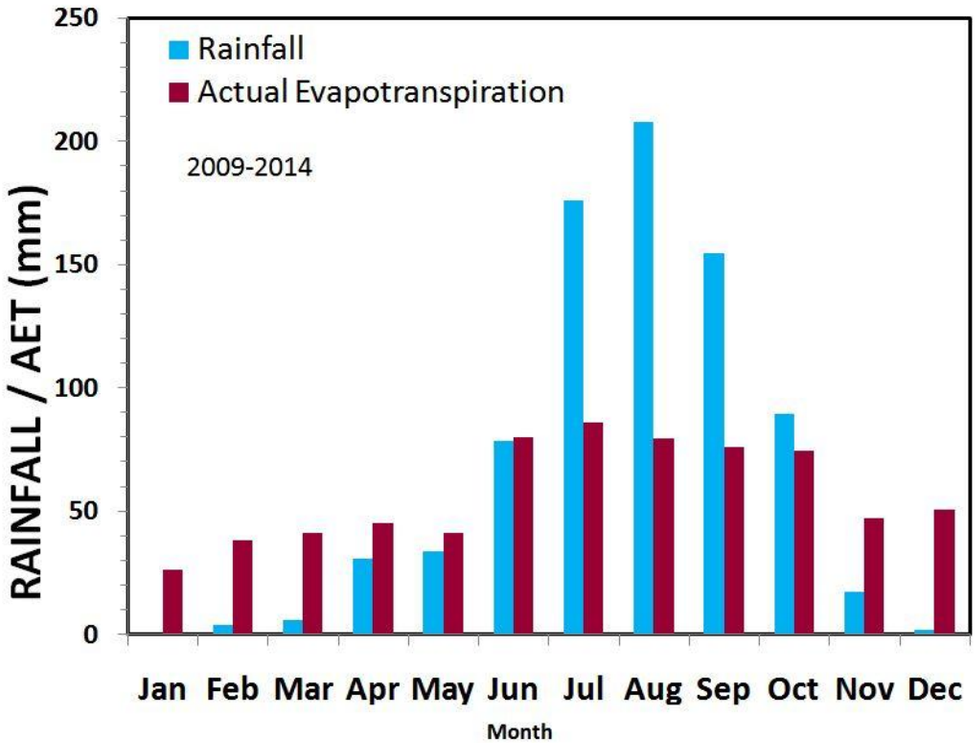
The average *rabi* rainfall (Oct-Jan) is about 13% of the average annual rainfall. During the years 2011, 2012, 2014, 2015 and 2016 the *rabi* rainfall was deficient by 88%, 43%, 45%, 87% and 62% respectively.

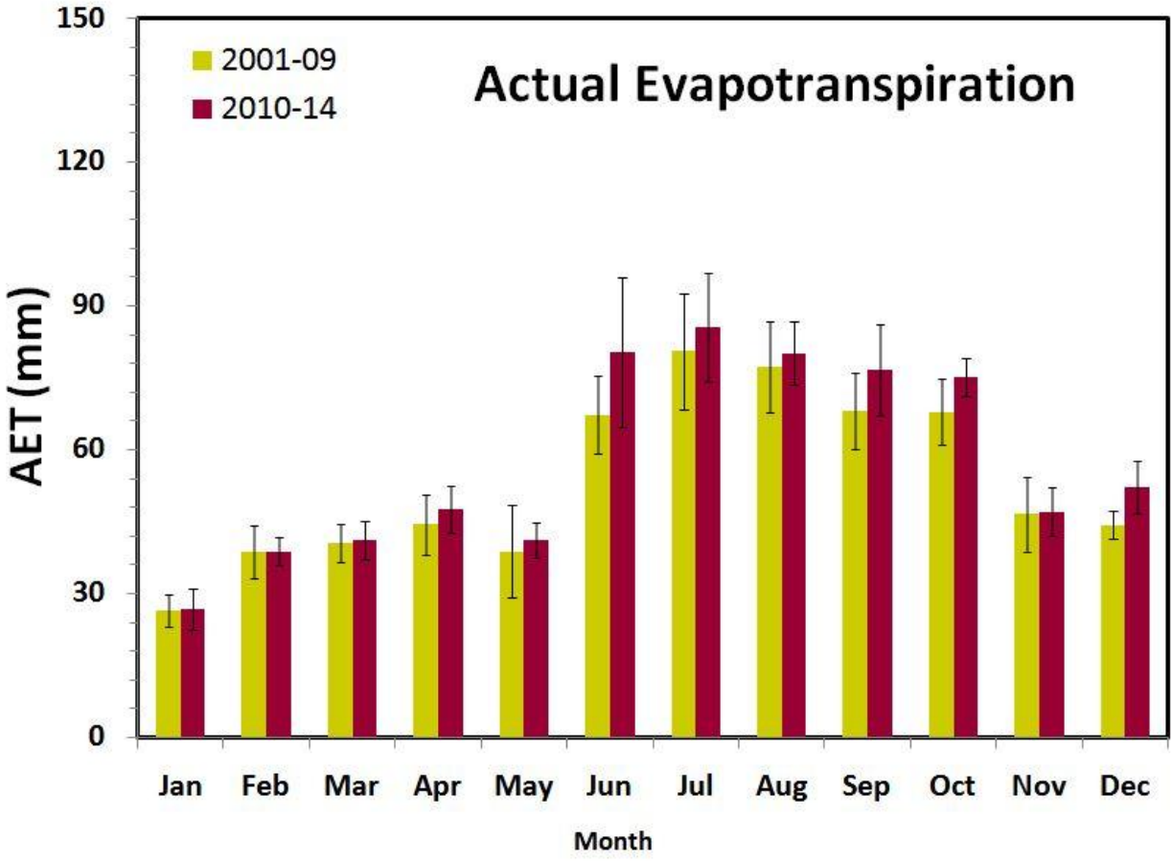
The average summer rainfall (Feb-May) is about 11% of the average annual rainfall.



EVAPOTRANSPIRATION

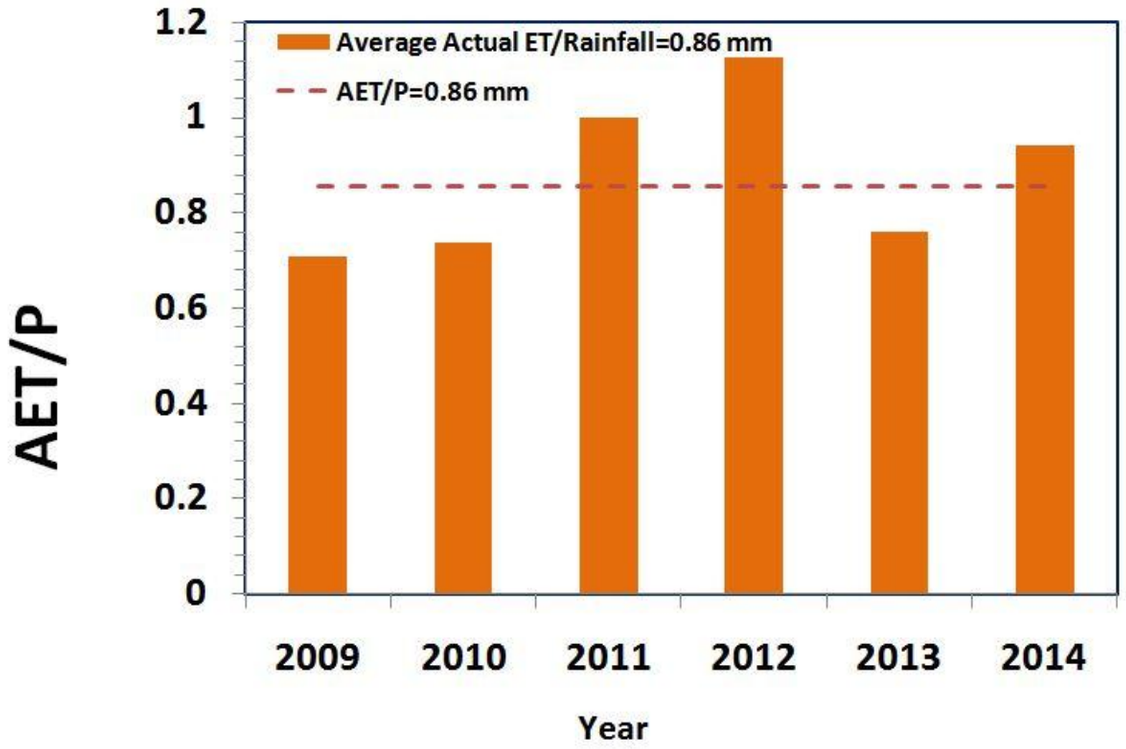


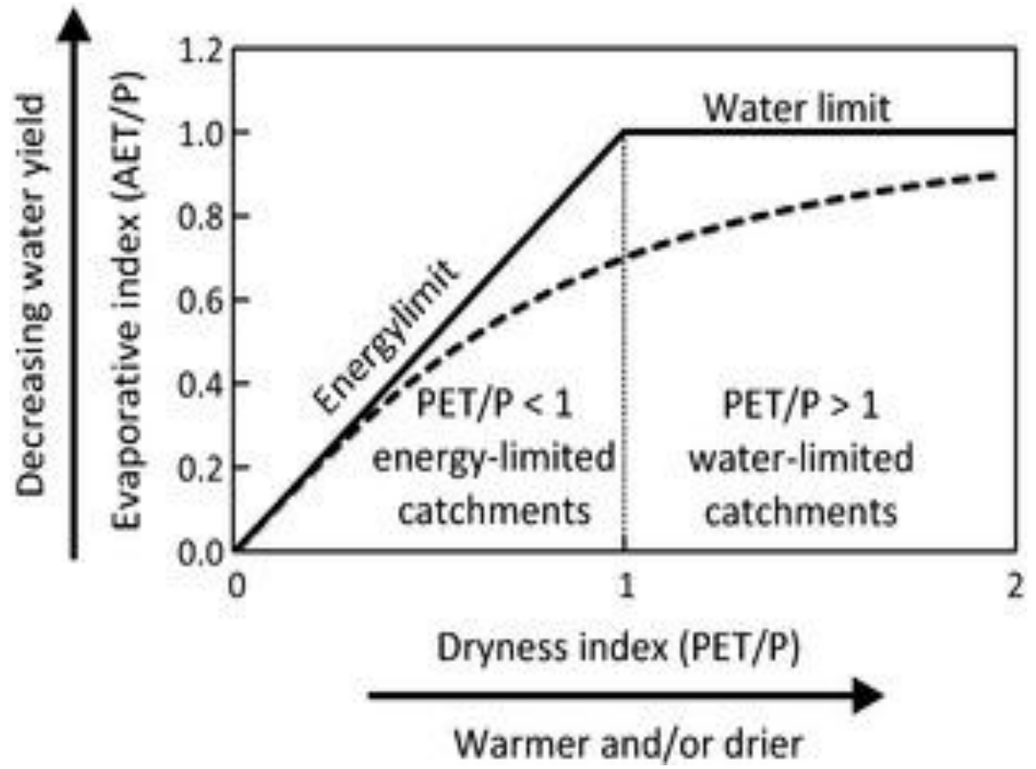




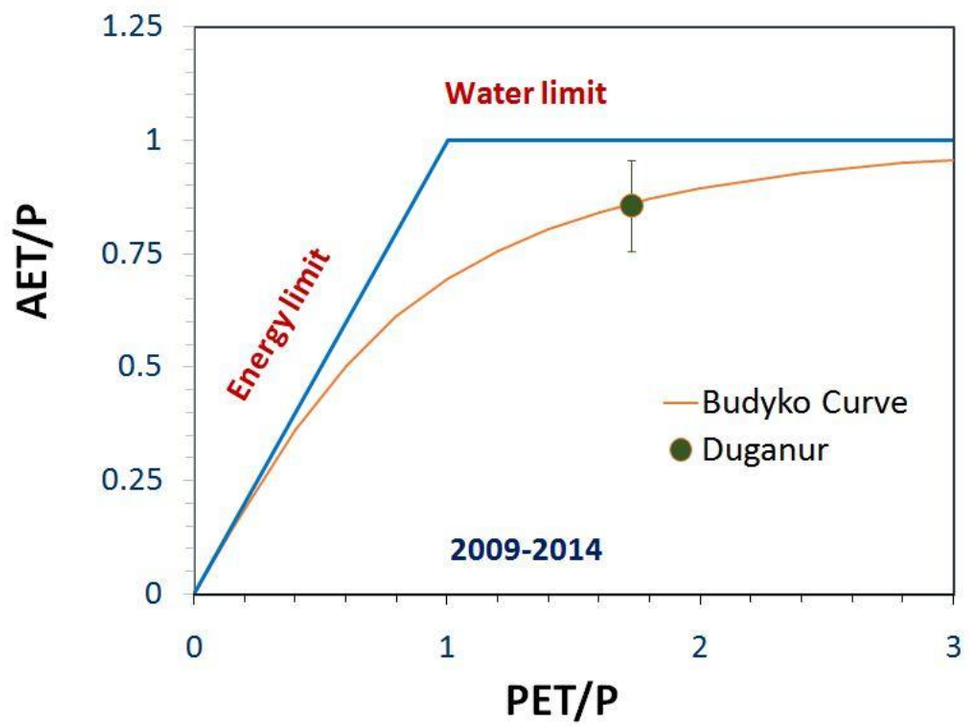
The average annual actual ET is lower than the average rainfall. During *kharif*, average rainfall and ET was found to be 606 mm and 322 mm respectively, whereas in *rabi* it was about 101 mm and 199 mm. In comparison to the 2001-2009, the annual ET increased by 8% during 2010-2014.

EVAPOTRANSPIRATION INDEX

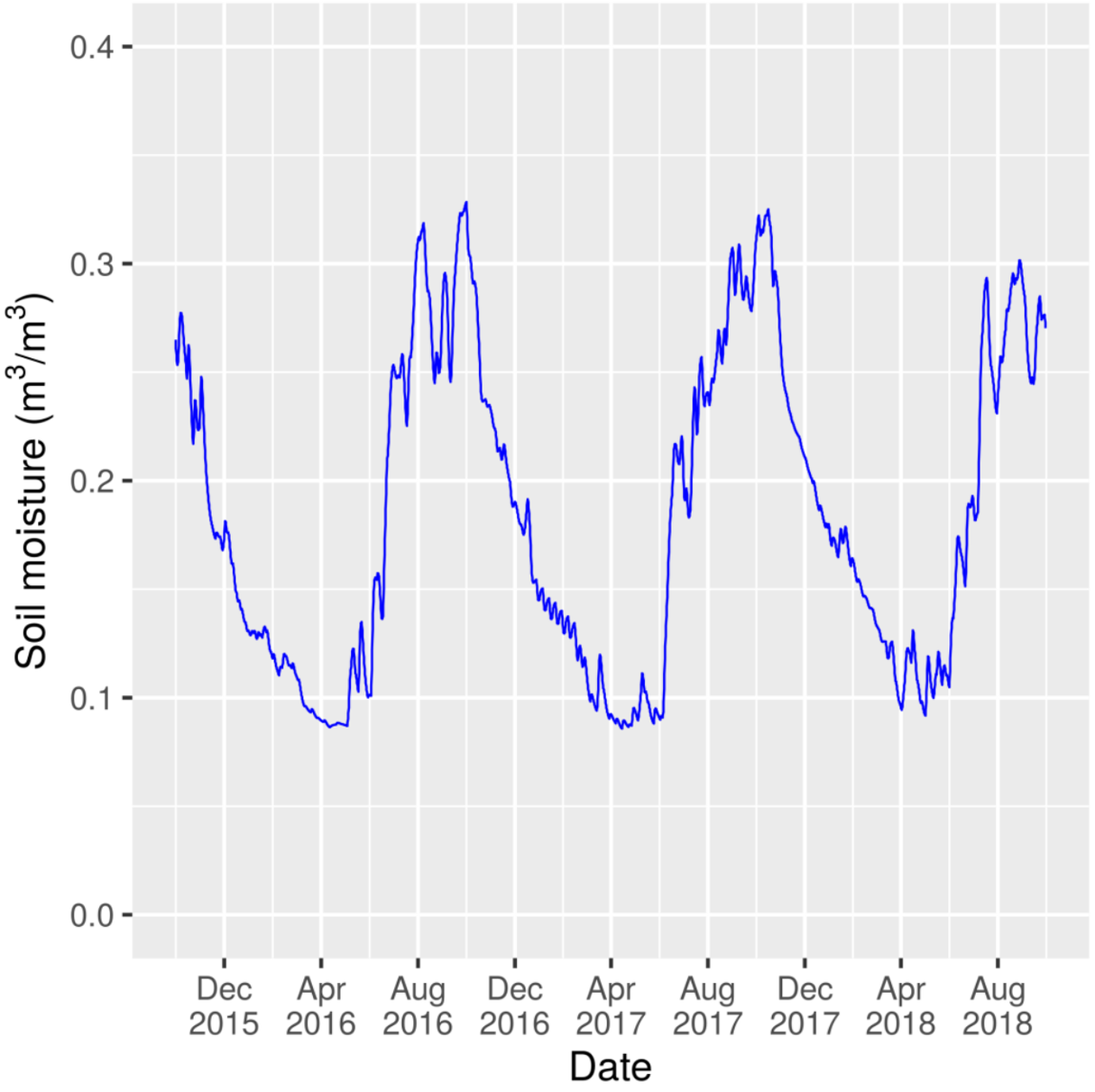




The average AET/P ratio was about 86%, which is slightly higher than the sustainable limit of about 80%. Even during extremely lower rainfall year of 2012, AET was 660 mm. This suggests the presence of water storage and utilization from other sources such as groundwater, which buffered the lower rainfall.

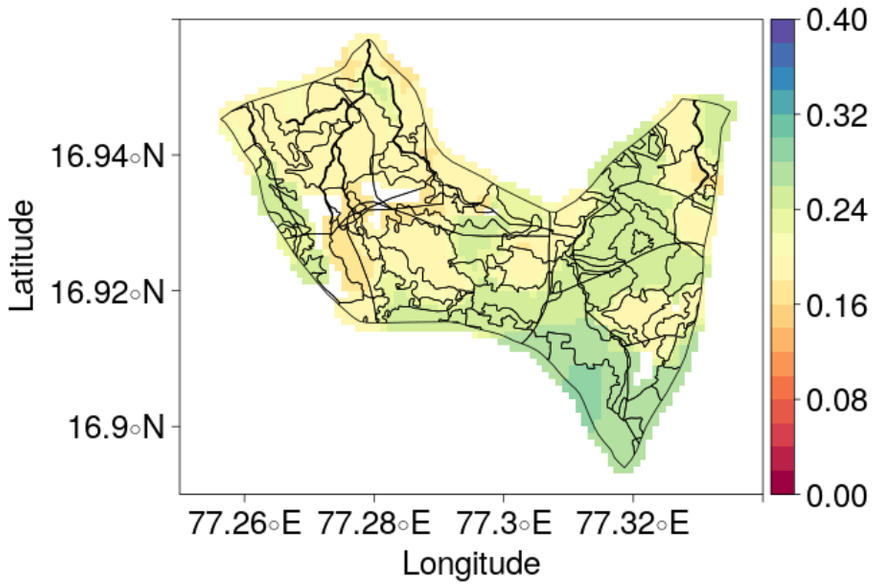


SATELLITE RETRIEVED SOIL MOISTURE

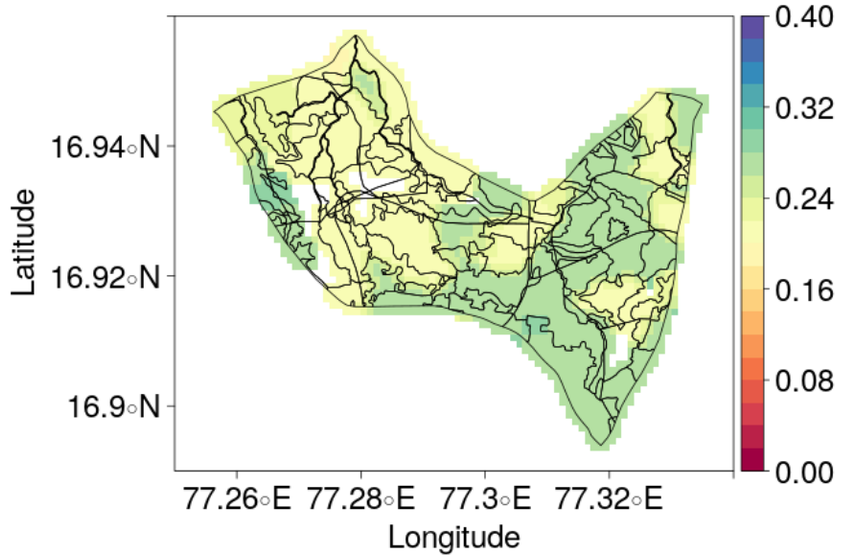


The method developed for retrieving soil moisture from multi-satellite observations allowed to map surface soil moisture behavior in the micro-watershed. The available surface moisture was varied in the range of 10-29 % in *kharif* and 15-33 % in *rabi* seasons of 2016, 19-32 % in *kharif* and 18-33% in *rabi* seasons of 2017.

Duganur– *rabi* Soil Moisture



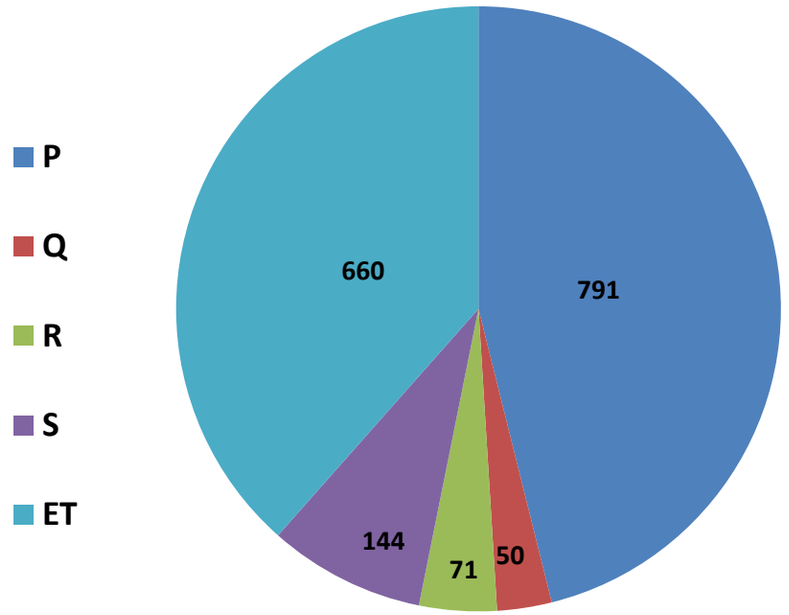
Duganur– *kharif* Soil Moisture



WATER BALANCE

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

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

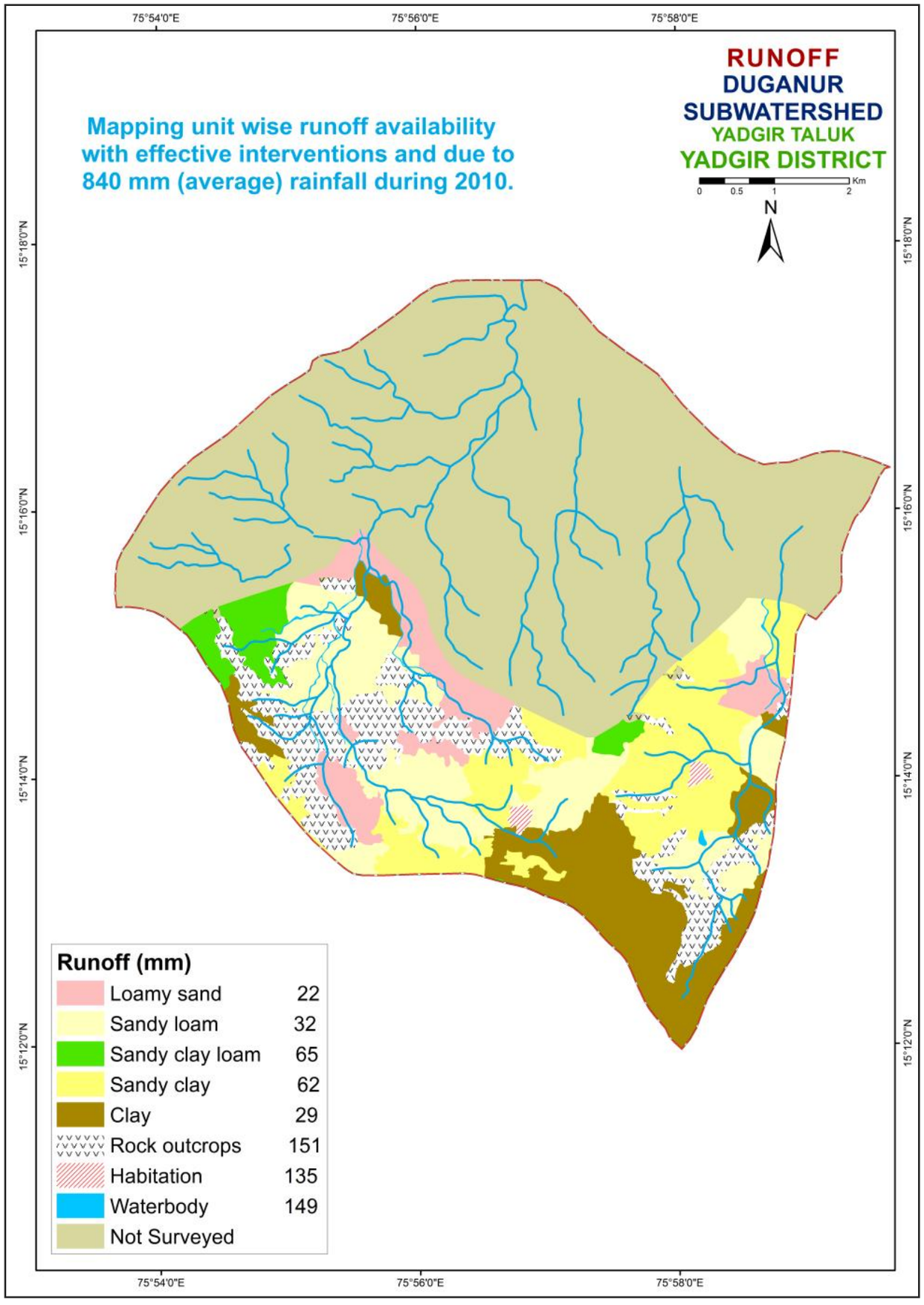


During June-October months, Precipitation is higher than Evapotranspiration, hence Runoff can occur in the watershed.

P = 791 mm (average of 2009-2017) ET = 660 mm R = 71 mm S = 144 mm Q = 50 mm

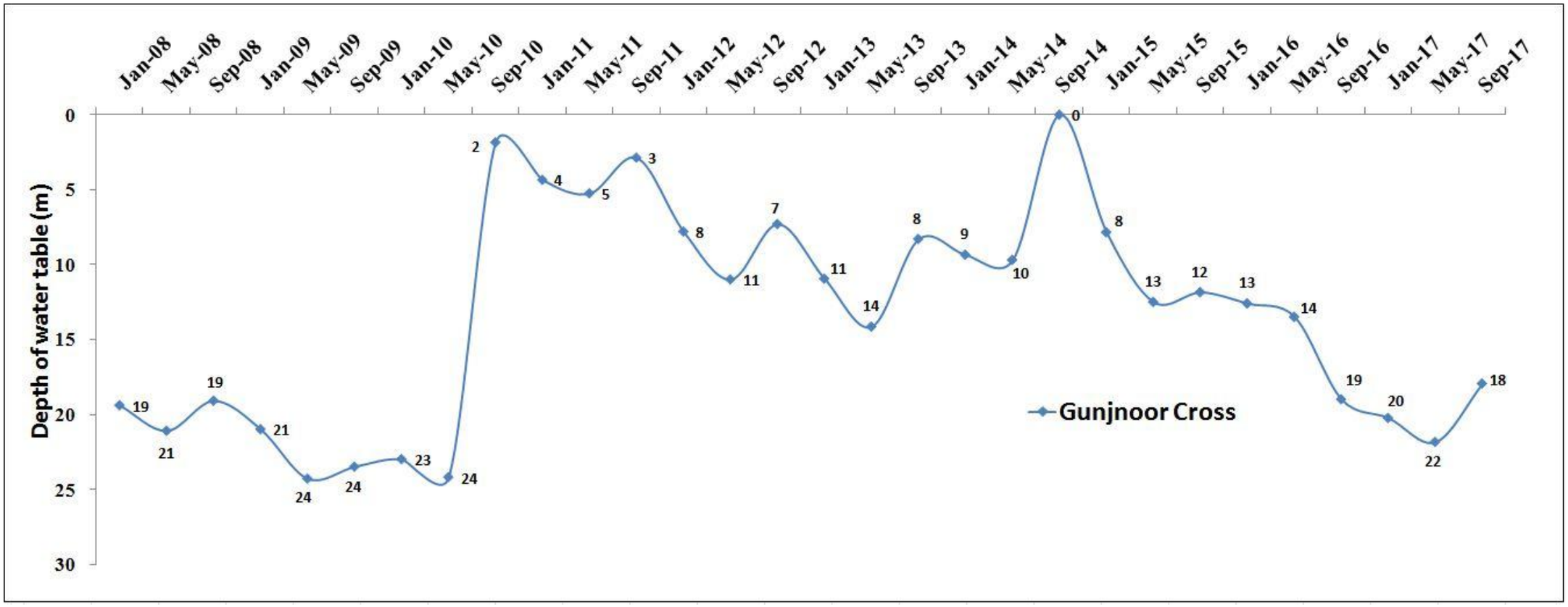
Sl. No.	Parameters	Average_ 2010 (mm)
1.	Rainfall	840
2.	Runoff availability with existing conditions	102
3.	Runoff availability with effective interventions	62
4.	Runoff allowed as environmental flow at the outlet	12
5.	Runoff excess for harvesting by construction of structures	50

RUNOFF


RUNOFF
DUGANUR
SUBWATERSHED
YADGIR TALUK
YADGIR DISTRICT
Mapping unit wise runoff availability with effective interventions and due to 840 mm (average) rainfall during 2010.
0 0.5 1 2 Km
N
75°54'0"E
75°56'0"E
75°58'0"E
15°18'0"N
15°16'0"N
15°14'0"N
15°12'0"N
Runoff (mm)
Loamy sand 22
Sandy loam 32
Sandy clay loam 65
Sandy clay 62
Clay 29
Rock outcrops 151
Habitation 135
Waterbody 149
Not Surveyed

GROUND WATER STATUS

GUNJNOOR STATION



The total number of wells present in Duganur Sub-watershed as per LRI data is 13 (13-Borewells). The groundwater level was found from the data obtained from KSNDMC for the nearest station Gunjnoor . Deeper levels were observed during the years 2008-2010 except September 2010 (viz.GWL level suddenly inclined). Whereas groundwater levels during the years 2011-2016 was slightly varying and during the year 2017 the levels were declined . Deepest levels were found in 2010.

SUMMARY

- The average annual rainfall of 862 mm in the Duganur sub-watershed as recorded from the Kodla station data by KSNDMC.

- 76%, 13% 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 deficit. The cropping & irrigation choices are not appropriate and need to be altered to shift the deficit water balance.

- The estimated runoff available to use is 50 mm for an average annual rainfall of 791 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 (144 mm) and utilizable runoff plus recharge is 244 (=144+50+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 521 mm. Hence the amount of water use for kharif and rabi seasons may be estimated as 651 mm (i.e 125% of AET). This demand for the two seasons is higher by 407 mm, i.e. (651-244). The AET in June-Sept months is only 52% 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 Duganur Sub-watershed as per LRI data is 13 (13-Borewells). The groundwater level was found from the data obtained from KSNDMC for the nearest station Gunjnoor. Deepest levels were found in 2010.