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Land Resource and Hydrological Inventory of Hadagimadara 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 Hadagimadara 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 Hadagimadara 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.

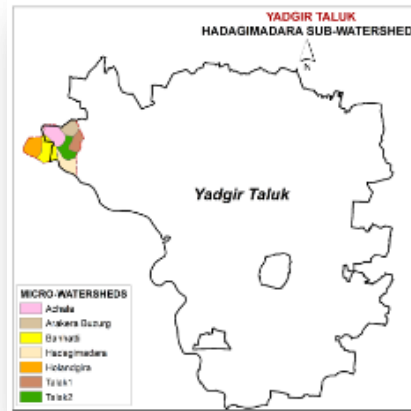
For easy map reading and understanding the information contain in different maps, the physical, cultural and scientific symbols used in the maps are illustrated in the form of colors, graphics and tables.

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.

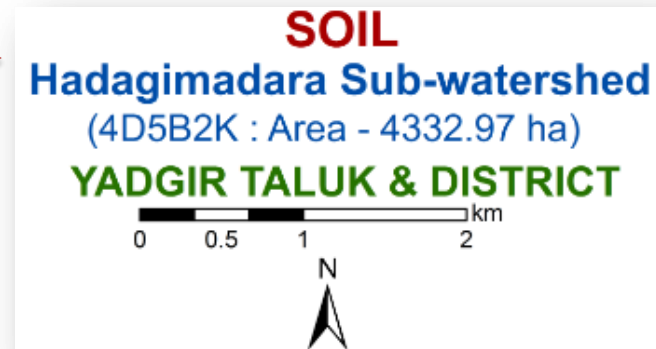
Inset map

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



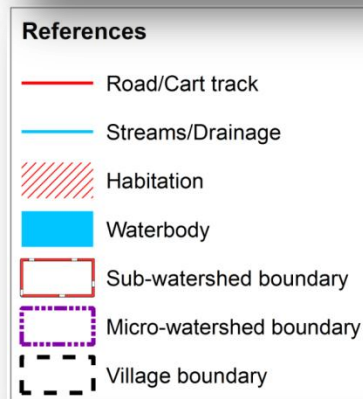
Map title

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



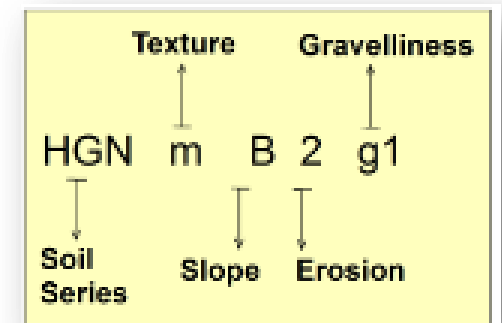
Legends and symbols

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.



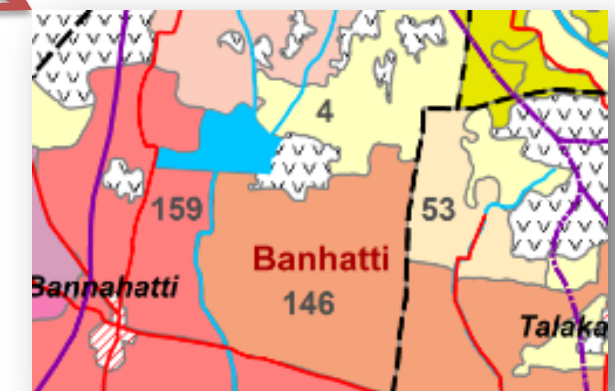
Map colours

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

SoilPhase	Area in ha(%)	SoilPhase	Area in ha(%)
2. BDLbB2	150 (3.47)	146. NGPmB2g1	92 (2.12)
4. BDLhb2	79 (1.81)	53. ANRhB2	63 (1.46)
5. BDLiB2	30 (0.68)	55. ANRiB2	39 (0.9)
162. BDLhb2g1	68 (1.56)	57. MDGcB2	139 (3.22)
8. VNKcb2g1	108 (2.49)	60. MDRiA1	54 (1.25)
9. VNKcb2	108 (2.5)	61. MDRmB2	67 (1.54)
10. VNKiB2	135 (3.11)	132. MDRhb2	12 (0.29)
11. SBRcb2	34 (0.78)	133. MDRiB2	45 (1.04)
20. JNKcb2	272 (6.28)	62. BMNmB2	102 (2.35)
21. JNKcb2g1	95 (2.2)	63. BMNmB2g1	91 (2.11)
110. JNKhb2	41 (0.96)	159. BMNmA1	127 (2.94)
27. YLRhb2	56 (1.29)	118. BDPcb2	28 (0.64)
29. YLRcb2g1	207 (4.78)	125. SBRhb2	46 (1.07)
31. YLRiB2	26 (0.61)	127. GWDmB2	136 (3.15)
34. GWDcb2	163 (3.76)	130. KBDhb2	32 (0.75)
35. GWDiB2	150 (3.47)	151. BGDmB2g1	50 (1.14)
49. NGPmB2	319 (7.37)	173. HSLiB2g1	66 (1.52)
163. NGPmA1	44 (1.01)		
		82. MGLmB2	57 (1.32)
		95. HGNmB2	84 (1.94)
		139. HGNmB2g1	188 (4.35)
		104. TMKiB2	95 (2.19)
		Rock outcrops	245 (5.66)
		Others*	324 (7.48)

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	b- Loamy sand
	c- Sandy loam
	i- Sandy clay
	h- Sandy clay loam
	m- Clay
SLOPE	A- Nearly level (0-1%)
	B- Very gently sloping (1-3%)
EROSION	1- Slight
	2- Moderate
GRAVELLINESS	g1- Gravely (15-35%)
DEPTH	BDP- Very shallow (<25 cm)
	BDL, VNK, - Shallow (25-50 cm)
	YLR, SBR, JNK, - Moderately shallow (50-75 cm)
	GWD, HSL, KBD, MGL - Moderately deep (75-100 cm)
	ANR, BCO, MDG, NGP, MKS - Deep (100-150 cm)
	BMN, HGN, MDR, TMK - Very deep (>150 cm)

Key	
S1- Highly Suitable	
S2- Moderately Suitable	
S3- Marginally Suitable	
N1- Currently Not Suitable	
Limitations	
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 Hadagimadara Sub-watershed covering an area of 4332.97 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.

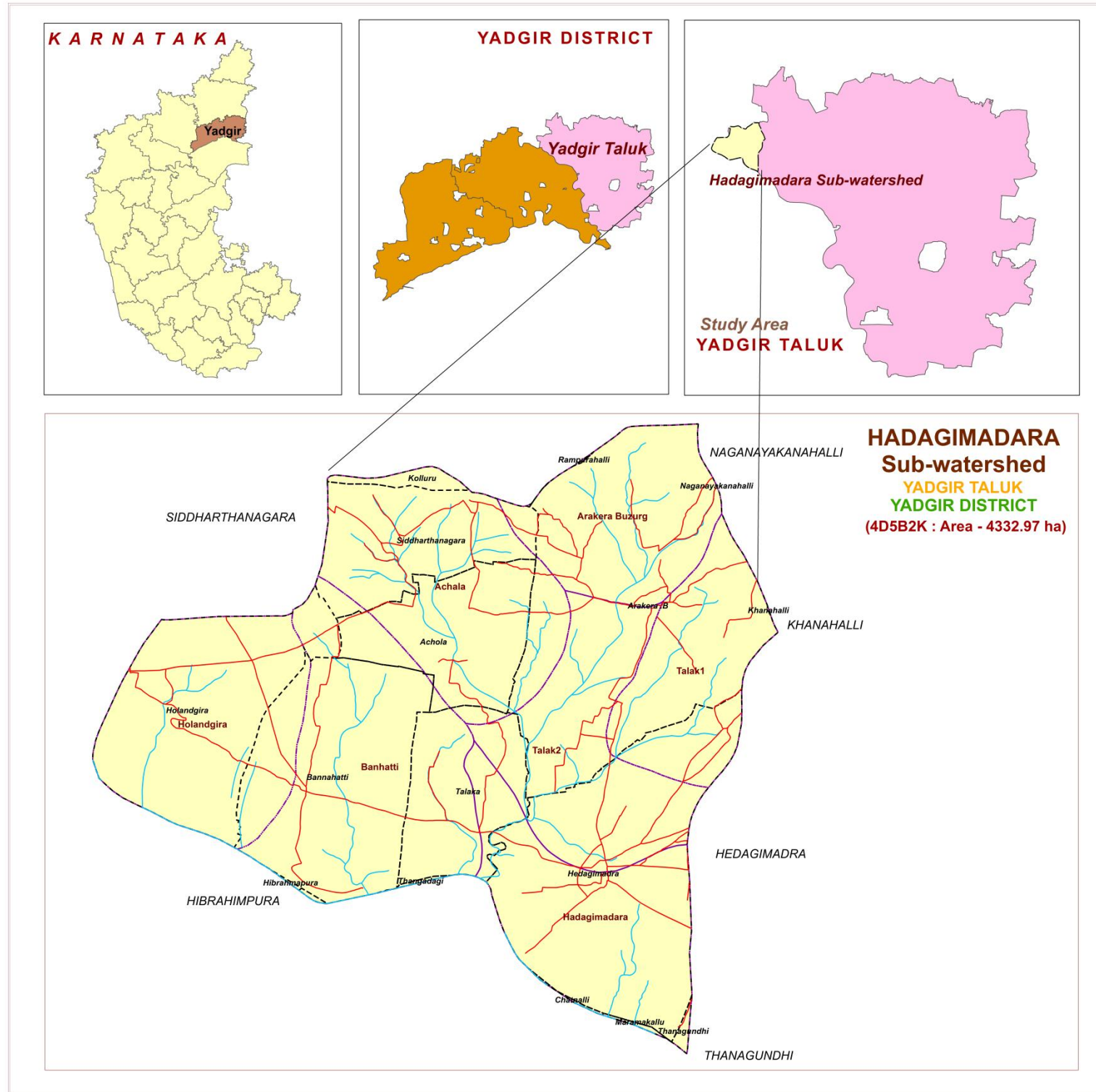
2. General Description of Sub-watershed

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' 17⁰0' – 16⁰55' and east longitudes 77⁰7' – 77⁰0'. 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 SWs-LRI for the HadagimadaraSub-watershed in Yadgir taluk, Yadgir district. It was selected for data base generation under Sujala III project. Hadagimadarai Sub-watershed (code– 4D5B2K) is covering an area of 4332.97 ha and spread across Siddharthanagara, Hibrahimpura, Naganayakanahalli, Thanagundhi, Hedagimadra and Khanahalli villages.

2.1. Location and Extent

LOCATION MAP OF HADAGIMADARA SUB-WATERSHED

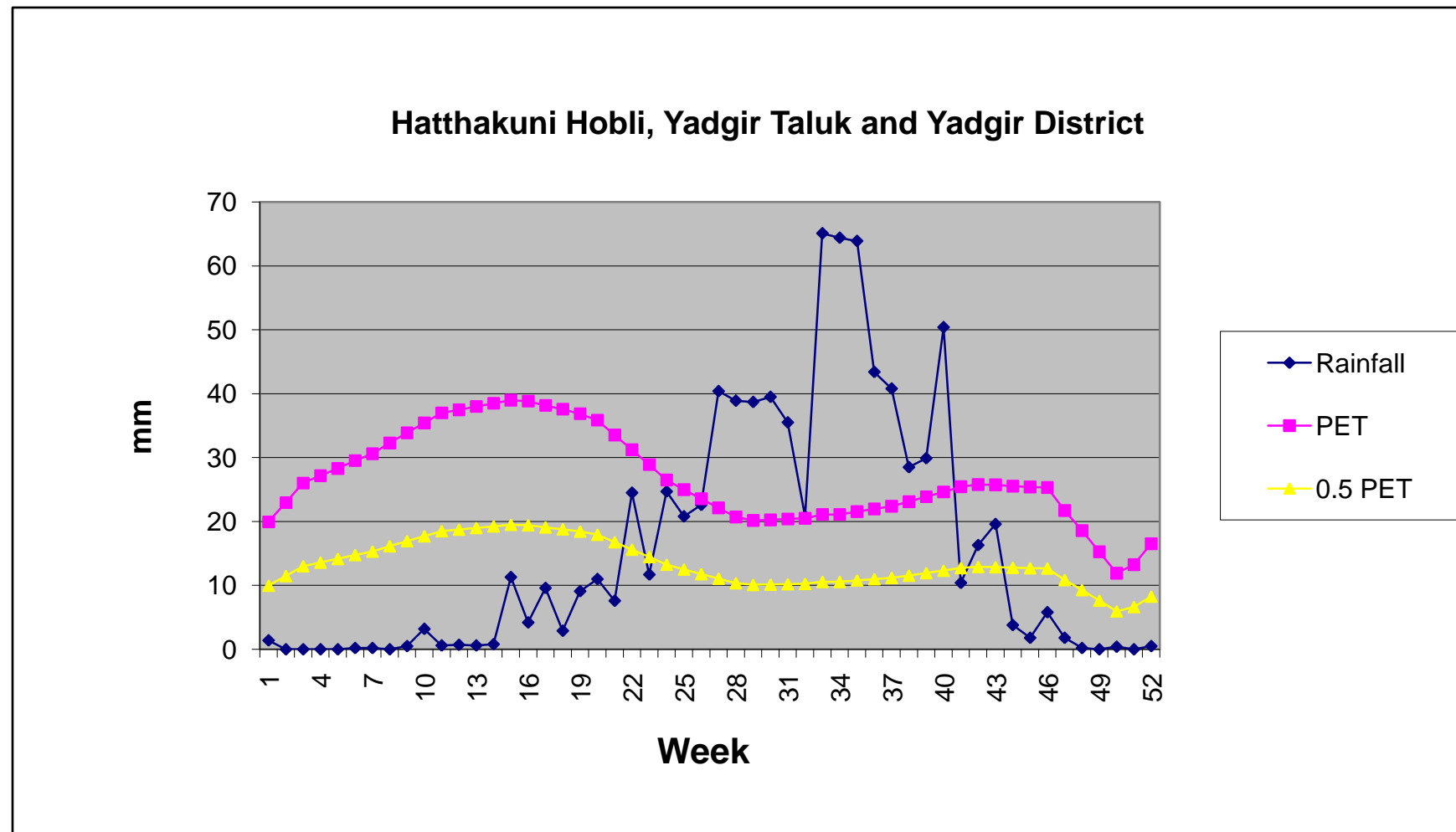


The Hadagimadara Sub-watershed (Yadgir taluk, Yadgir district) is located in between 16^o42' – 16^o46' North latitudes and 77^o10' – 77^o16' East longitudes, covering an area of about 4332.97 ha, bounded by Siddharthanagara, Hibrampura, Naganayakanahalli, Thanagundhi, Hedagimadra and Khanahalli villages.

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.

Climate

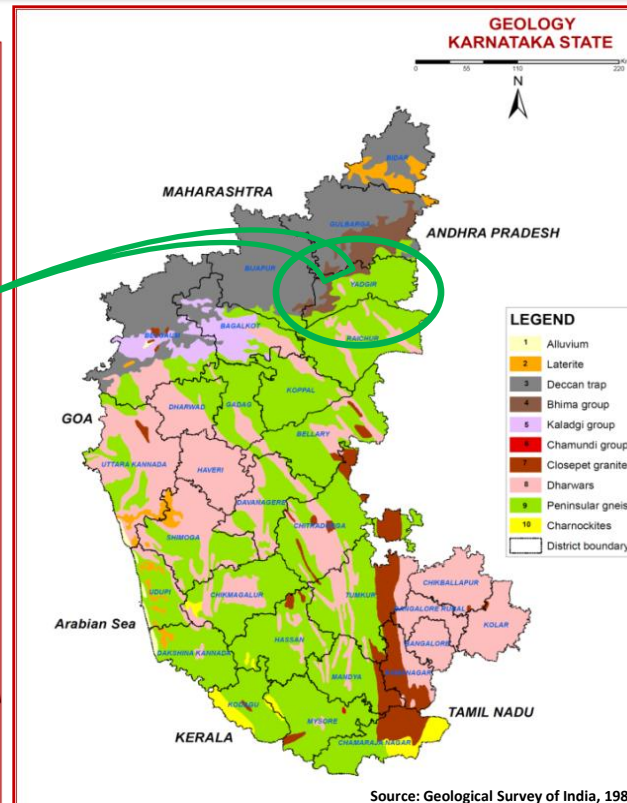
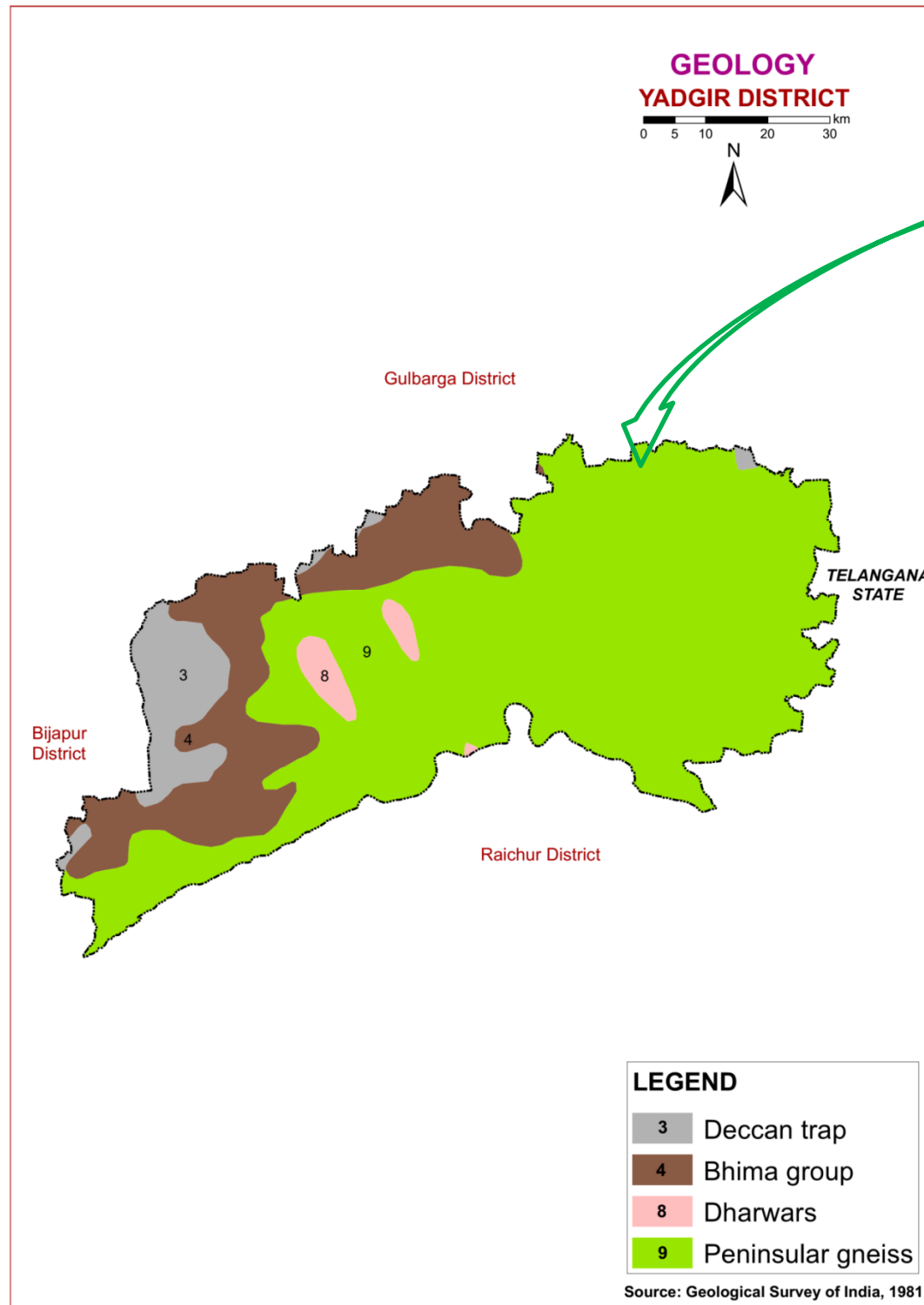


Length of Growing Period (LGP) is varying from June 1st week to 3rd week of October (120 - 150 days)

Annual Rainfall : 829 mm. in the Hatthakuni 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.

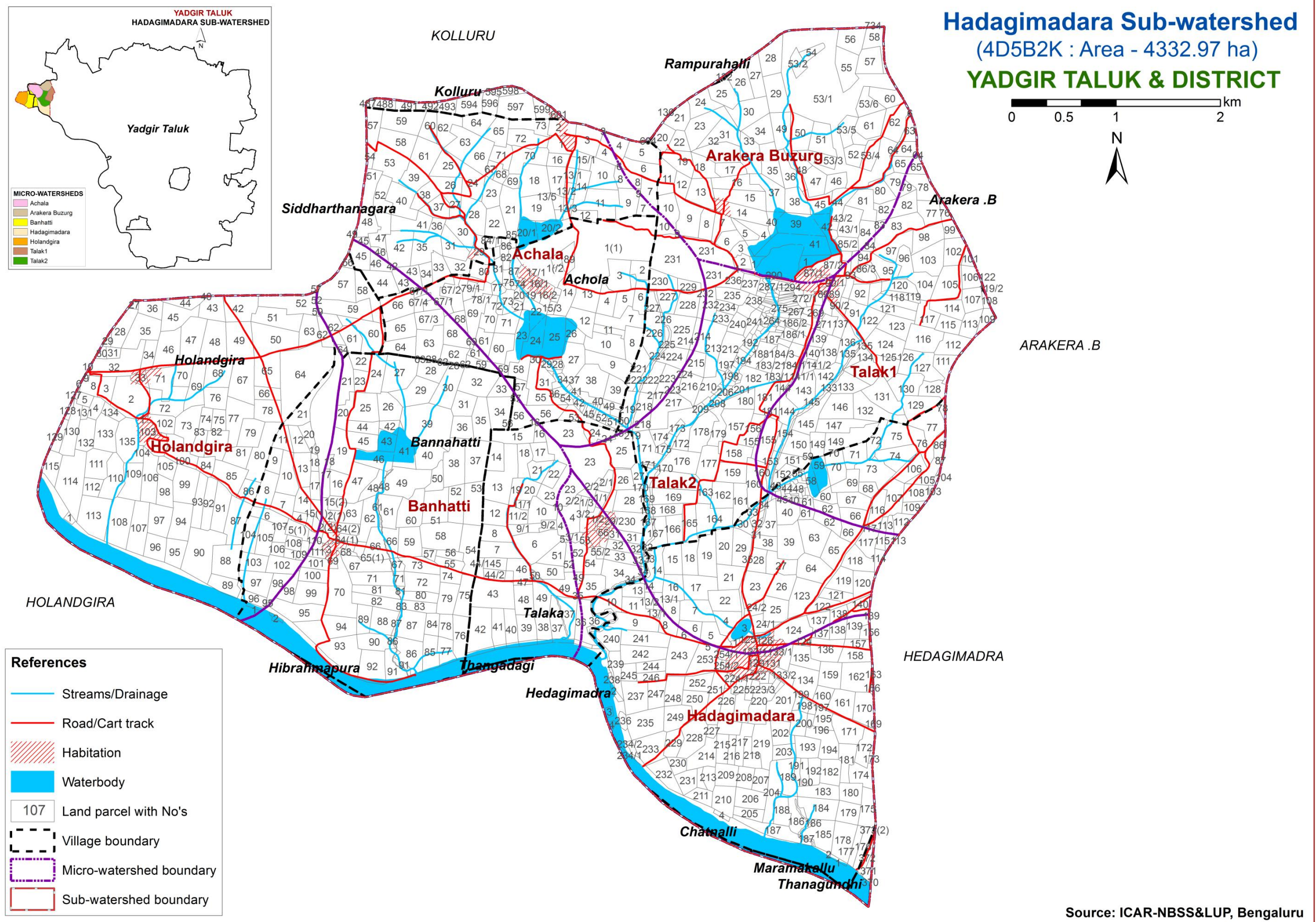
3. Survey Methodology

Sequence of activities in generation of LRI

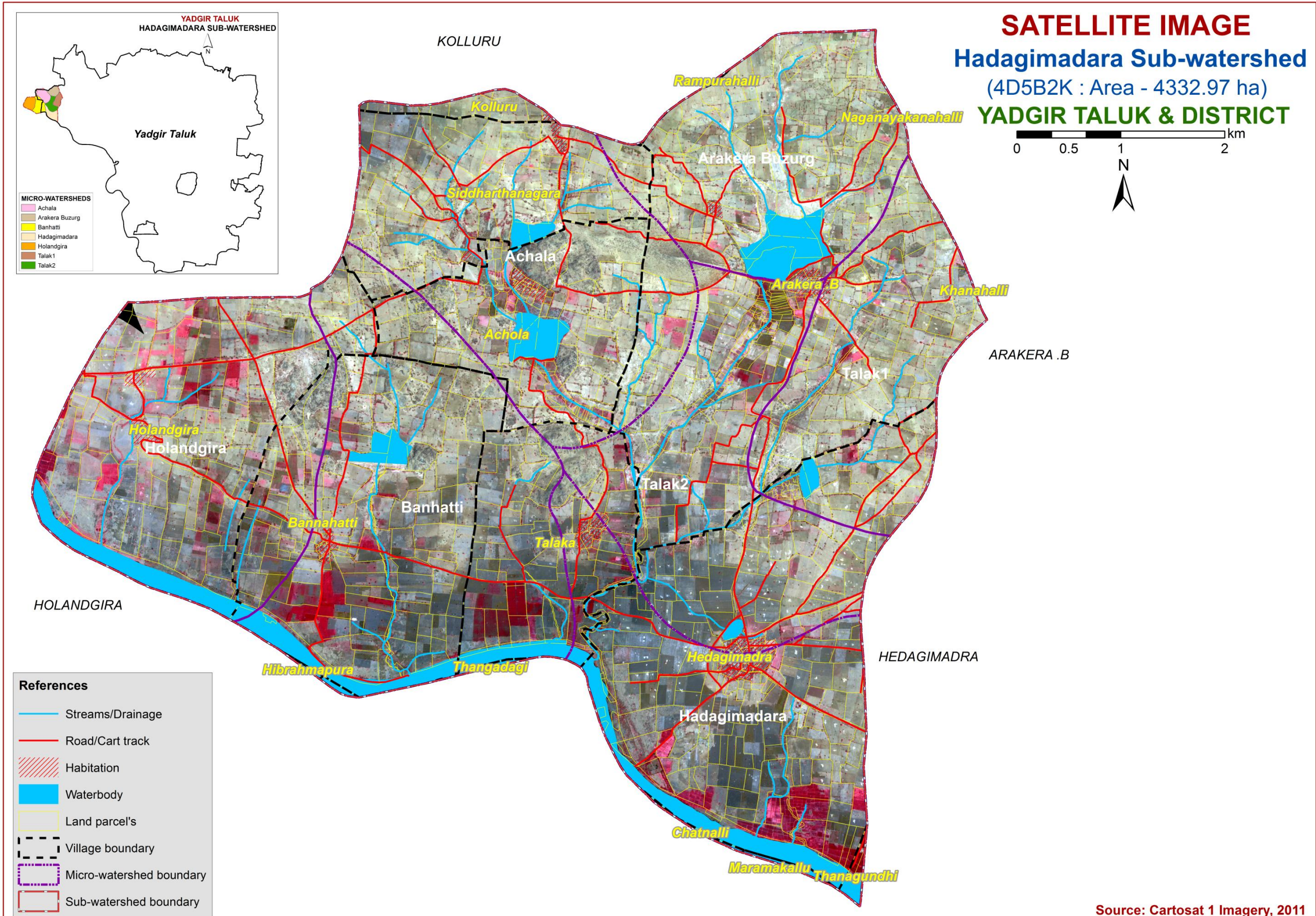
- Traversing the watershed using cadastral maps and imagery as base
- Identifying landforms, geology, land use and other features
- Selecting fields representing land units
- Opening profiles to 2 m depth
- Studying soil and site characteristics
- Grouping similar areas based on their soil-site characteristics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



Source: Cartosat 1 Imagery, 2011

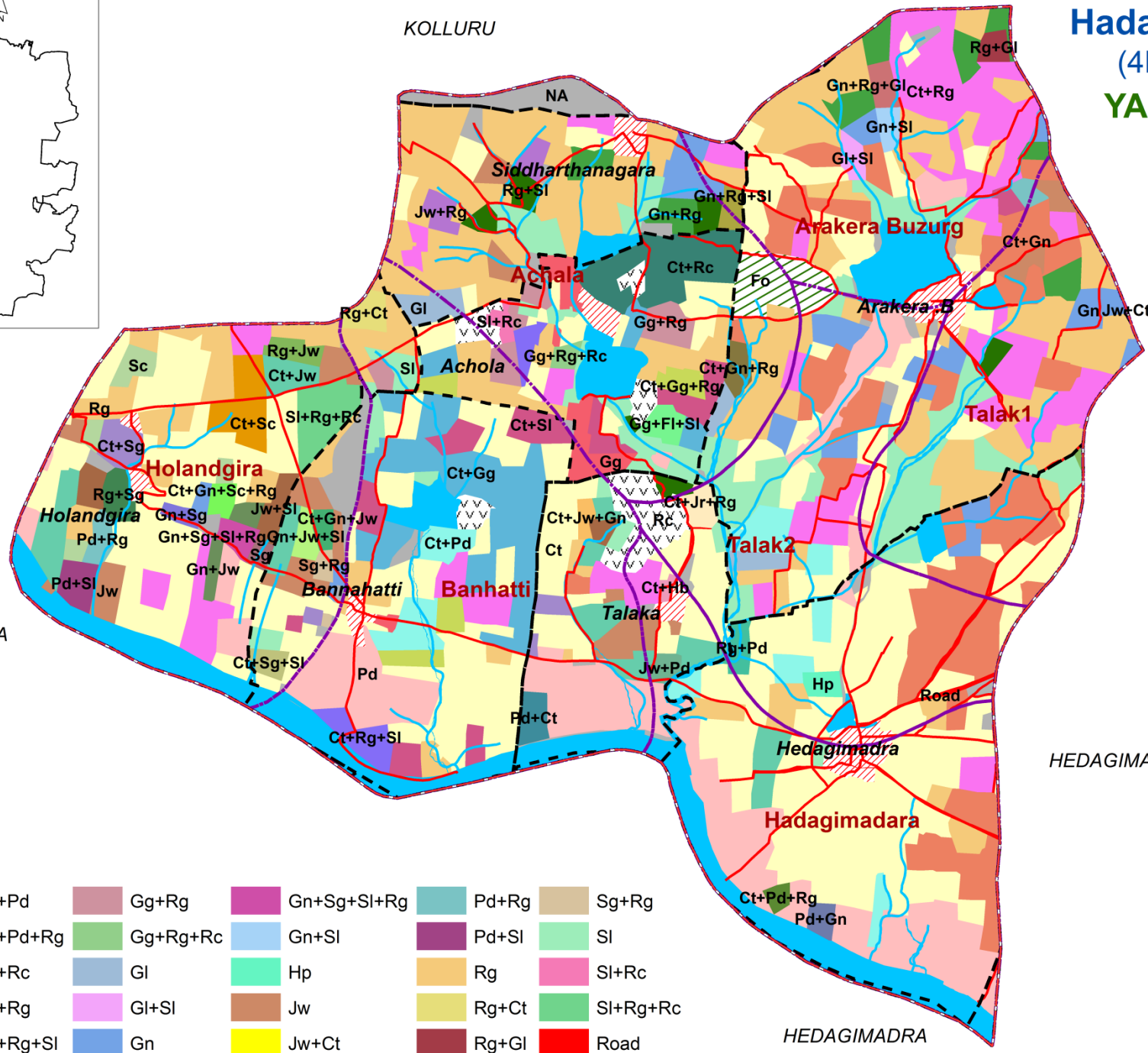
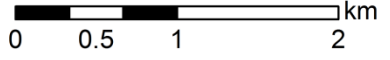
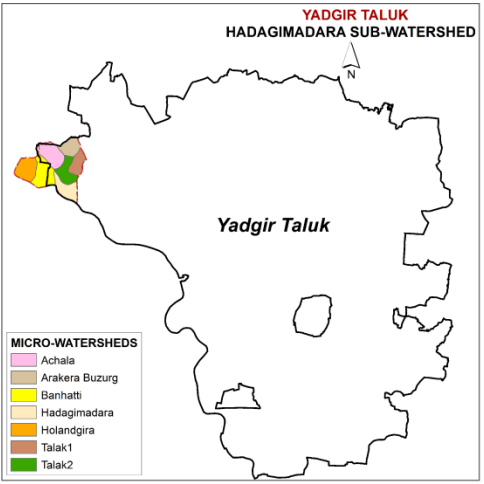
3.3. Current Landuse

CURRENT LANDUSE (2018)

Hadagimadara Sub-watershed

(4D5B2K : Area - 4332.97 ha)

YADGIR TALUK & DISTRICT



Current LandUse

Ct	Ct+Pd	Gg+Rg	Gn+Sg+Sl+Rg	Pd+Rg	Sg+Rg
Ct+Gg	Ct+Pd+Rg	Gg+Rg+Rc	Gn+Sl	Pd+Sl	Sl
Ct+Gg+Rg	Ct+Rc	Gl	Hp	Rg	Sl+Rc
Ct+Gn	Ct+Rg	Gl+Sl	Jw	Rg+Ct	Sl+Rg+Rc
Ct+Gn+Jw	Ct+Rg+Sl	Gn	Jw+Ct	Rg+Gl	Road
Ct+Gn+Rg	Ct+Sc	Gn+Jw	Jw+Pd	Rg+Jw	NA
Ct+Gn+Sc+Rg	Ct+Sg	Gn+Jw+Sl	Jw+Rg	Rg+Pd	Forest
Ct+Hb	Ct+Sg+Sl	Gn+Rg	Jw+Sl	Rg+Sg	Rock outcrops
Ct+Jr+Rg	Ct+Sl	Gn+Rg+Gl	Pd	Rg+Sl	Habitation
Ct+Jw	Gg	Gn+Rg+Sl	Pd+Ct	Sc	Waterbody
Ct+Jw+Gn	Gg+Fl+Sl	Gn+Sg	Pd+Gn	Sg	

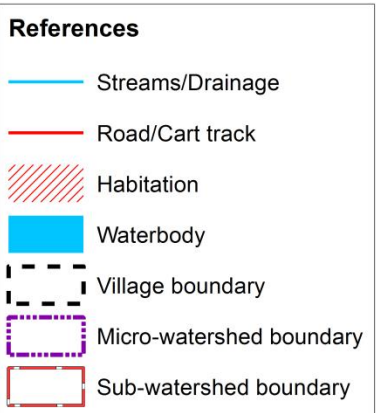
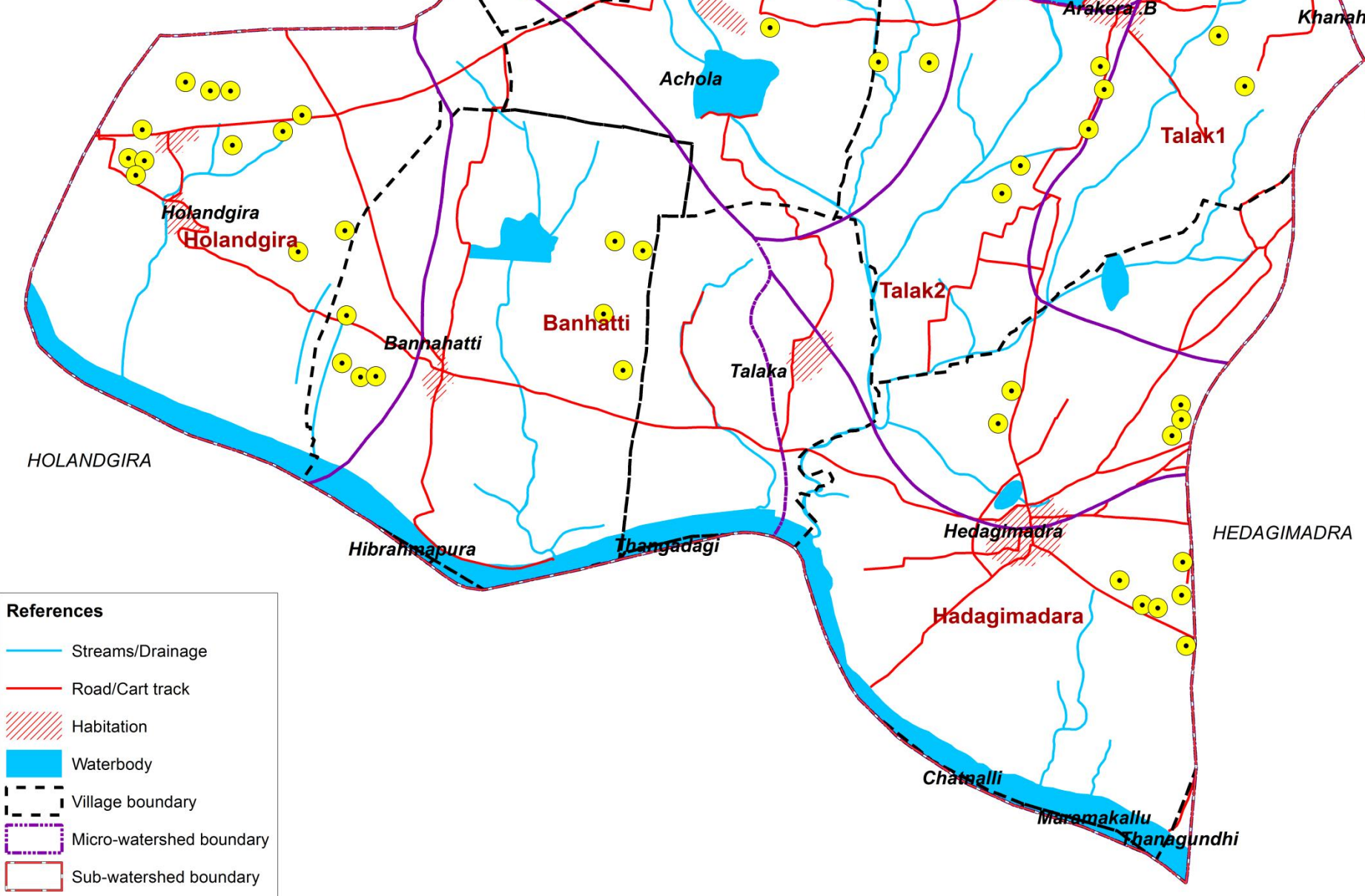
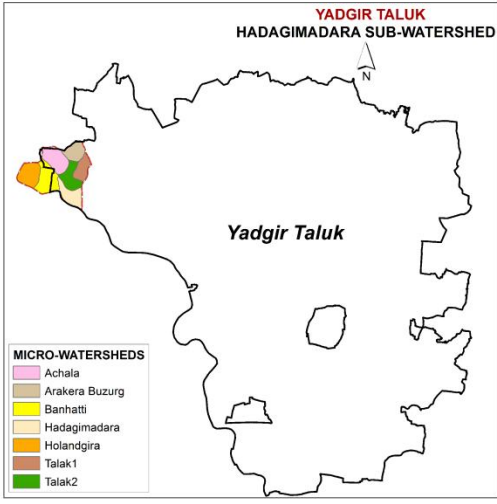
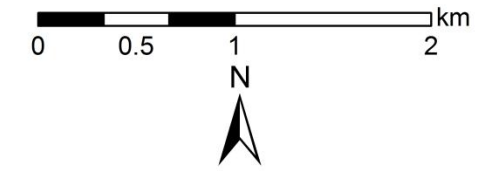
References

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

Source: ICAR-NBSS&LUP, Bengaluru

3.4. Location of Wells

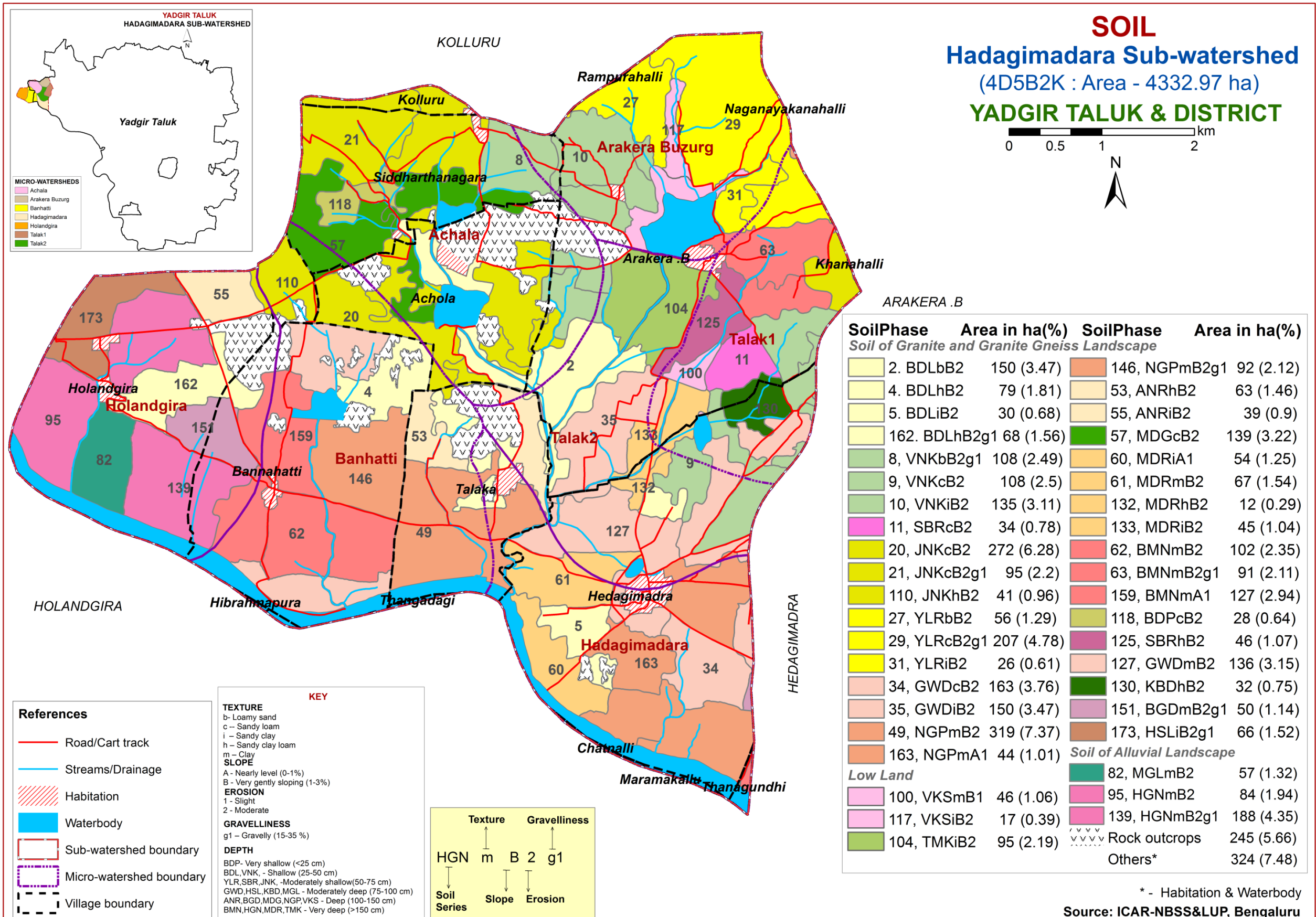
LOCATION OF WELLS Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha) YADGIR TALUK & DISTRICT



Legend		No's
	Borewell	46

Source: ICAR-NBSS&LUP, Bengaluru

4. The Soils



4.1 Mapping unit description of Hadagimadara (4D5B2K) 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				
	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	320 (7.4)
159		BMNmA1	Clay surface, slope 0-1%, slight erosion	127 (2.94)
62		BMNmB2	Clay surface, slope 1-3%, moderate erosion	102 (2.35)
63		BMNmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	91 (2.11)
	MDR		Madhwara soils are very deep (>150 cm), well drained, have very dark gray to very dark brown, slightly calcareous sandy clay loam soils occurring on nearly level to very gently sloping uplands under cultivation	178 (4.12)
132		MDRhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	12 (0.29)
60		MDRiA1	Sandy clay surface, slope 0-1%, slight erosion	54 (1.25)
133		MDRiB2	Sandy clay surface, slope 1-3%, moderate erosion	45 (1.04)
61		MDRmB2	Clay surface, slope 1-3%, moderate erosion	67 (1.54)
	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	102 (2.36)
53		ANRhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	63 (1.46)
55		ANRiB2	Sandy clay surface, slope 1-3%, moderate erosion	39 (0.9)
	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	50 (1.14)
151		BGDmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	50 (1.14)
	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	139 (3.22)
57		MDGcB2	Sandy loam surface, slope 1-3%, moderate erosion	139 (3.22)
	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	455 (10.5)
163		NGPmA1	Clay surface, slope 0-1%, slight erosion	44 (1.01)
49		NGPmB2	Clay surface, slope 1-3%, moderate erosion	319 (7.37)
146		NGPmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	92 (2.12)
	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	449 (10.38)

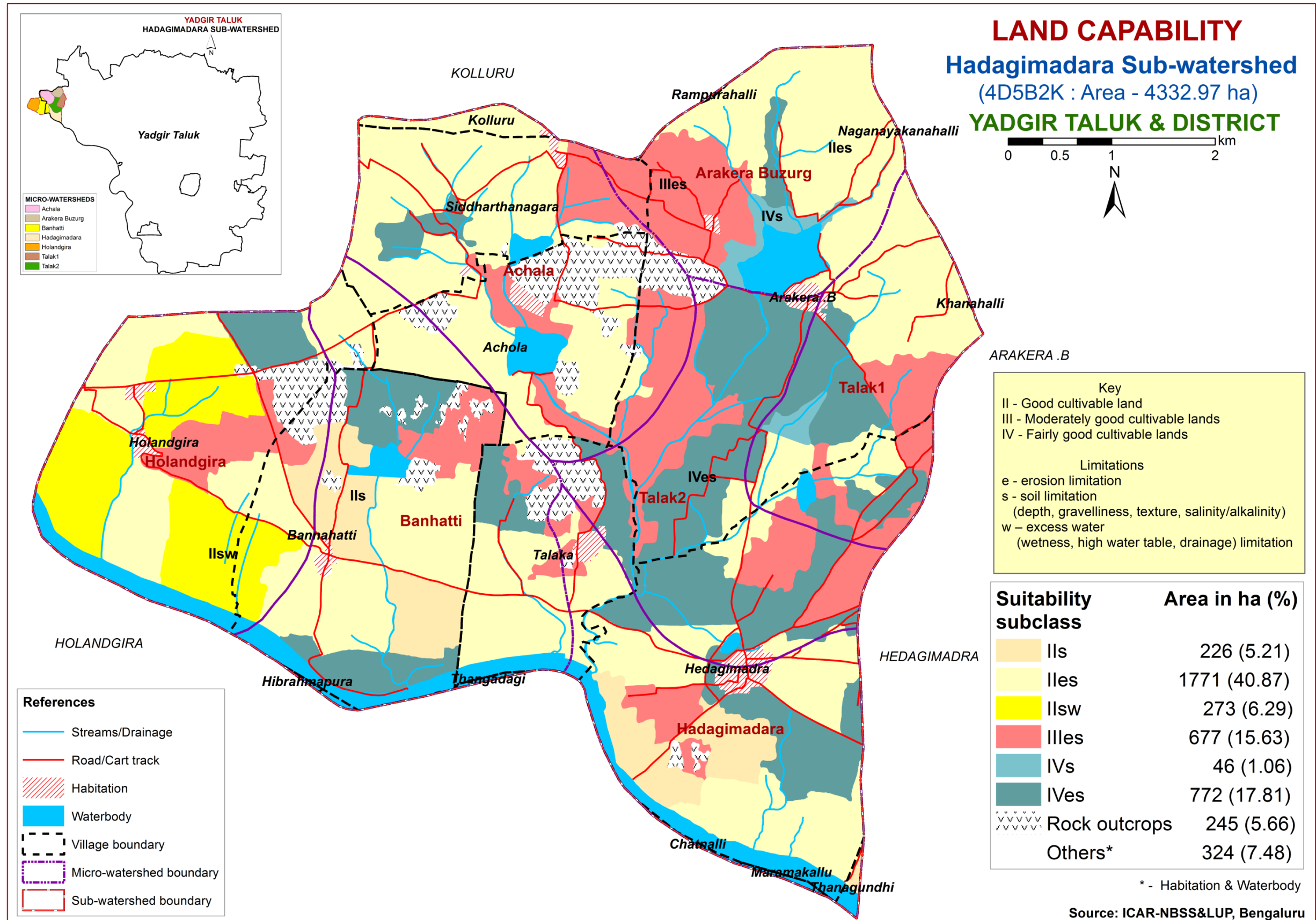
Soil map unit No*	Soil Series	Soil Phase Symbol	Mapping Unit Description	Area in ha (%)
Soils of Granite and Granite gneiss Landscape				
34		GWDcB2	Sandy loam surface, slope 1-3%, moderate erosion	163 (3.76)
35		GWDiB2	Sandy clay surface, slope 1-3%, moderate erosion	150 (3.47)
127		GWDmB2	Clay surface, slope 1-3%, moderate erosion	136 (3.15)
	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		66 (1.52)
173		HSLiB2g1	Sandy clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	66 (1.52)
	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		32 (0.75)
130		KBDhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	32 (0.75)
	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		408 (9.44)
20		JNKcB2	Sandy loam surface, slope 1-3%, moderate erosion	272 (6.28)
21		JNKcB2g1	Sandy loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	95 (2.2)
110		JNKhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	41 (0.96)
	SBR	Sambara soils are moderately shallow (50-75 cm), somewhat excessively drained, have light gray to pink, loamy sand soils occurring on very gently to gently sloping uplands under cultivation		80 (1.85)
11		SBRcB2	Sandy loam surface, slope 1-3%, moderate erosion	34 (0.78)
125		SBRhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	46 (1.07)
	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		289 (6.68)
27		YLRbB2	Loamy sand surface, slope 1-3%, moderate erosion	56 (1.29)
29		YLRcB2g1	Sandy loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	207 (4.78)
31		YLRiB2	Sandy clay surface, slope 1-3%, moderate erosion	26 (0.61)
	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		259 (5.96)
2		BDLbB2	Loamy sand surface, slope 1-3%, moderate erosion	150 (3.47)
4		BDLhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	79 (1.81)

Soil map unit No*	Soil Series	Soil Phase Symbol	Mapping Unit Description	Area in ha (%)
Soils of Granite and Granite gneiss Landscape				
5		BDLiB2	Sandy clay surface, slope 1-3%, moderate erosion	30 (0.68)
	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		351 (8.1)
8		VNKbB2g1	Loamy sand surface, slope 1-3%, moderate erosion, gravelly (15-35%)	108 (2.49)
9		VNKcB2	Sandy loam surface, slope 1-3%, moderate erosion	108 (2.5)
10		VNKiB2	Sandy clay surface, slope 1-3%, moderate erosion	135 (3.11)
	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		68 (1.56)
162		BDLhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	68 (1.56)
	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		28 (0.64)
118		BDPcB2	Sandy loam surface, slope 1-3%, moderate erosion	28 (0.64)
	TMK	Thumakur soils are very deep (>150 cm), moderately well drained, have very dark gray to dark brown, slightly calcareous sodic clay soils occurring on nearly level to very gently sloping low lands under cultivation		95 (2.19)
104		TMKiB2	Sandy clay surface, slope 1-3%, moderate erosion	95 (2.19)
	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		63 (1.45)
117		VKSiB2	Sandy clay surface, slope 1-3%, moderate erosion	17 (0.39)
100		VKSmB1	Clay surface, slope 1-3%, slight erosion	46 (1.06)
Soils of Alluvial Landscape				
	HGN	Hegganakera soils are very deep (>150 cm), moderately well drained, have very dark gray to dark grayish brown, slightly calcareous cracking clay soils occurring on very gently sloping plains under cultivation		272 (6.29)
95		HGNmB2	Clay surface, slope 1-3%, moderate erosion	84 (1.94)
139		HGNmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	188 (4.35)
	MGL	Mungala soils are moderately deep (75-100 cm), moderately well drained, very dark gray to dark gray, slightly calcareous cracking clay soils occurring on very gently sloping plains under cultivation		57 (1.32)
82		MGLmB2	Clay surface, slope 1-3%, moderate erosion	57 (1.32)
999		Rock outcrops	Rock lands, both massive and bouldery with little or no soil	245 (5.66)
1000		Others	Habitation and Waterbody	324 (7.48)

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

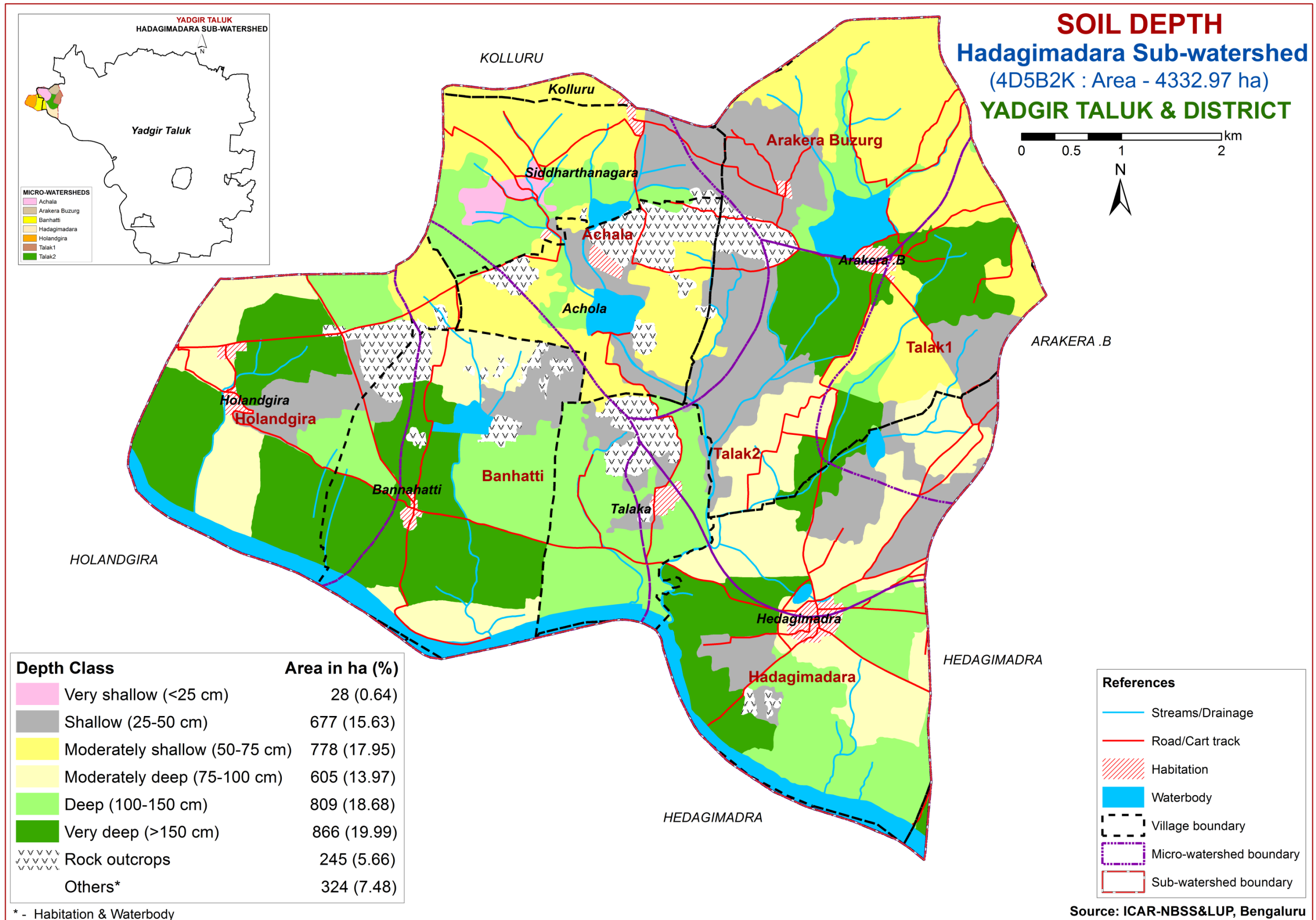
5. Soil Survey Interpretations

5.1. Land Capability Classification



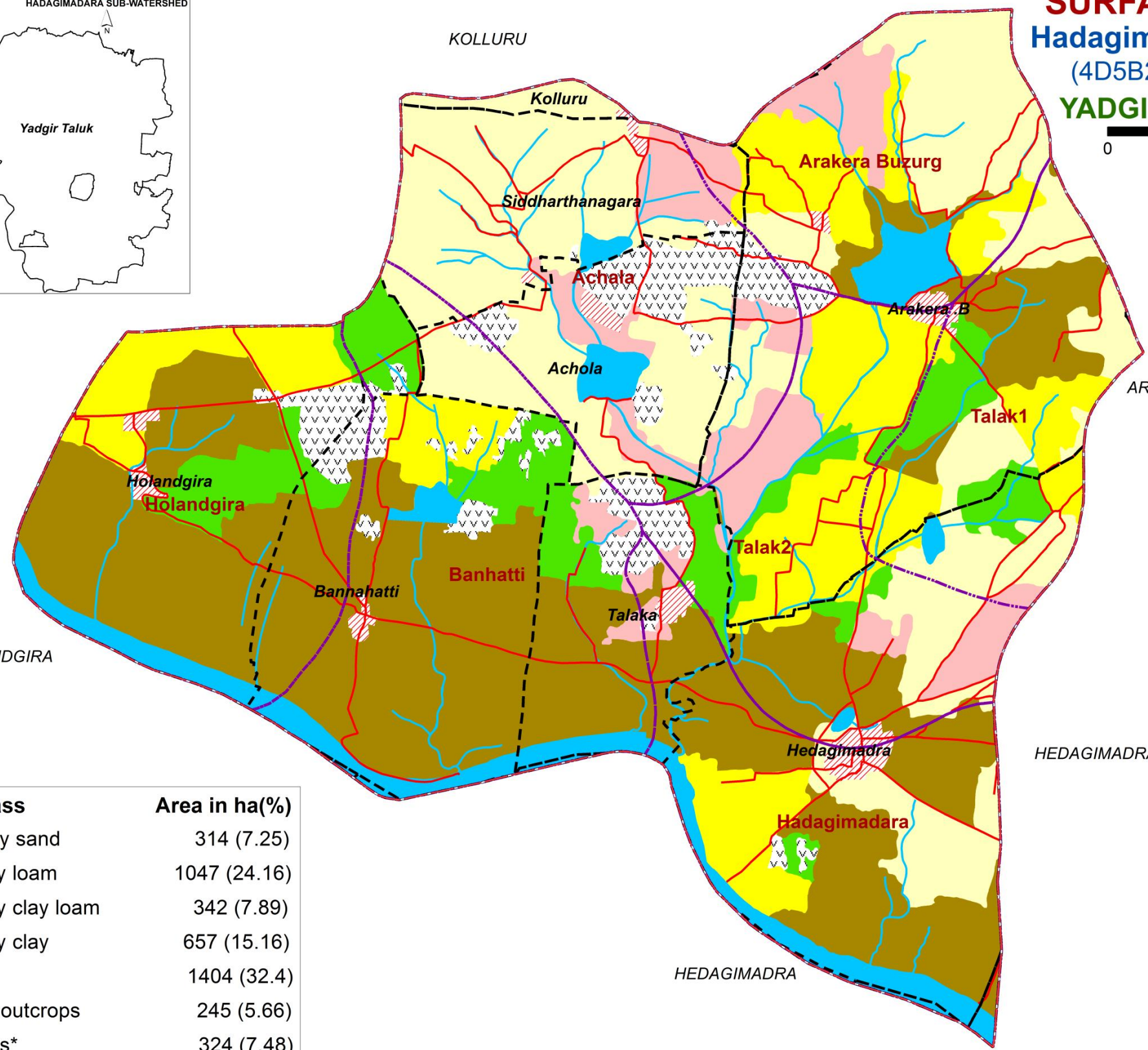
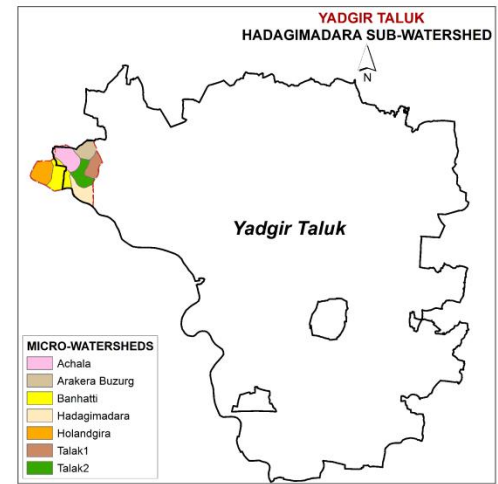
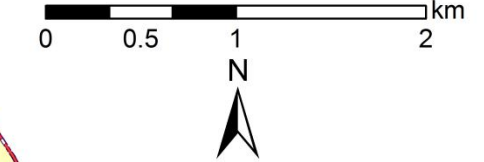
Source: ICAR-NBSS&LUP, Bengaluru

5.2. Soil Depth



5.3. Surface Soil Texture

SURFACE SOIL TEXTURE Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha) YADGIR TALUK & DISTRICT



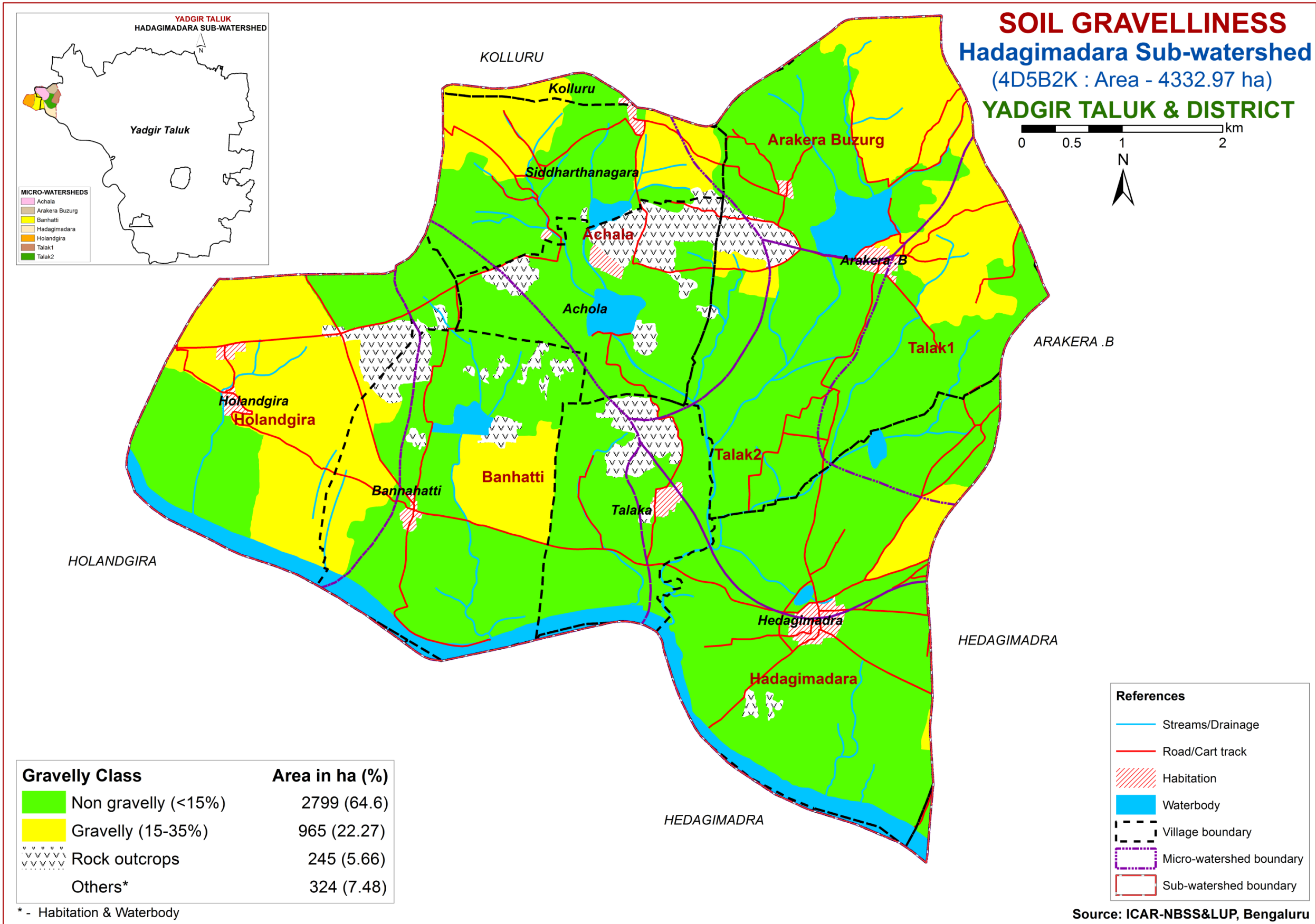
Texture Class	Area in ha(%)
Loamy sand	314 (7.25)
Sandy loam	1047 (24.16)
Sandy clay loam	342 (7.89)
Sandy clay	657 (15.16)
Clay	1404 (32.4)
Rock outcrops	245 (5.66)
Others*	324 (7.48)

* - Habitation & Waterbody

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

Source: ICAR-NBSS&LUP, Bengaluru

5.4. Surface Soil Gravelliness



Source: ICAR-NBSS&LUP, Bengaluru

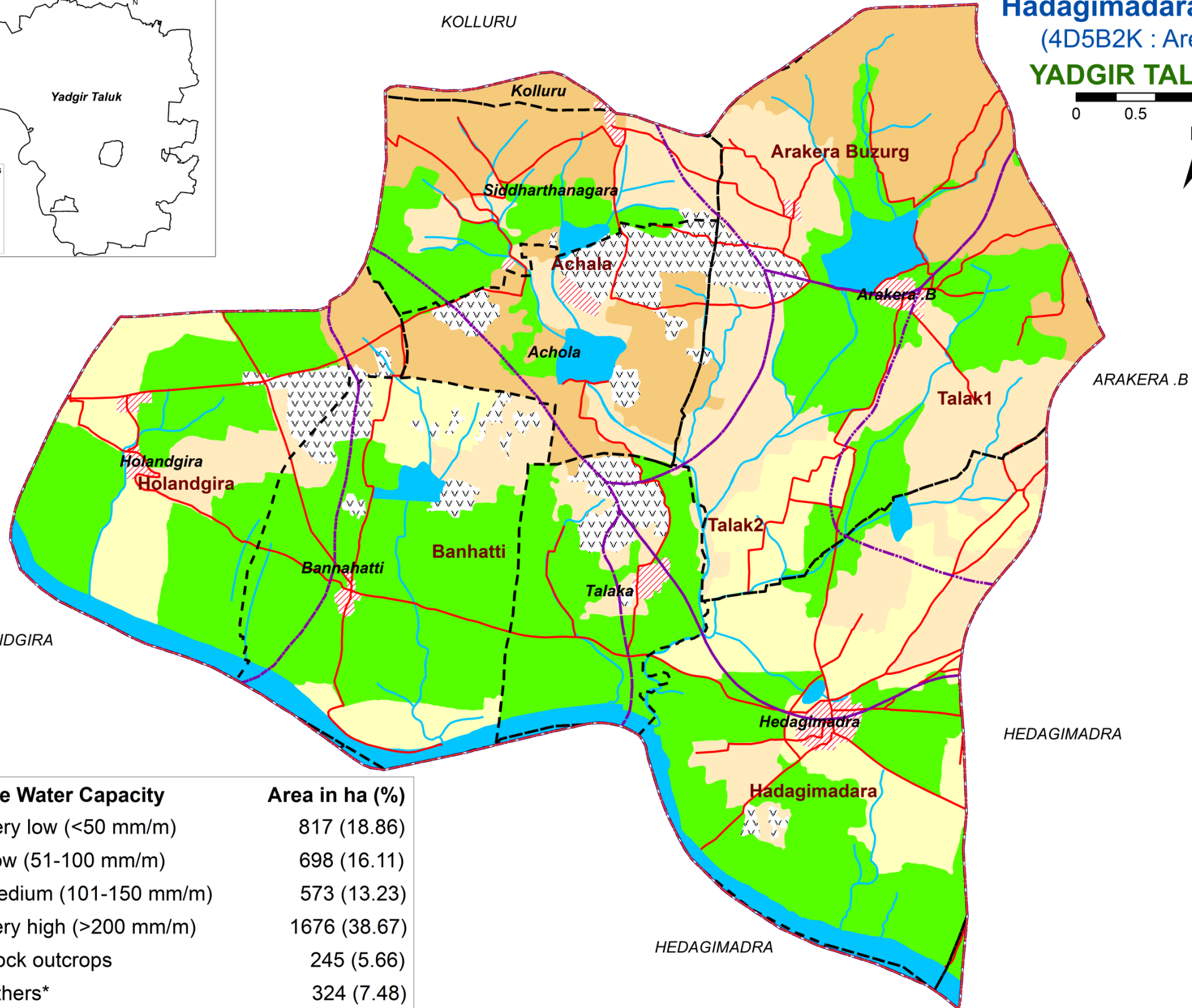
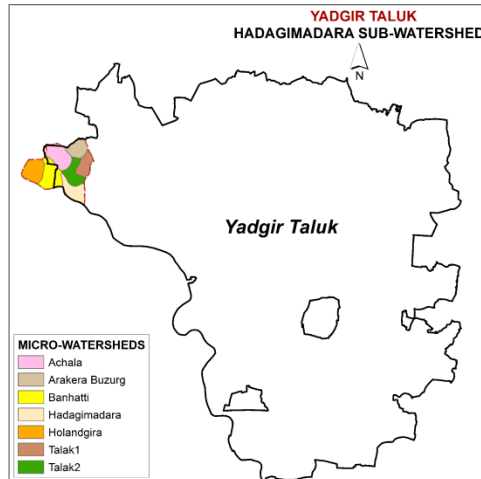
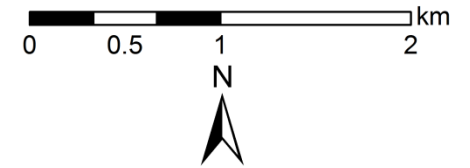
5.5. Available Water Capacity

AVAILABLE WATER CAPACITY

Hadagimadara Sub-watershed

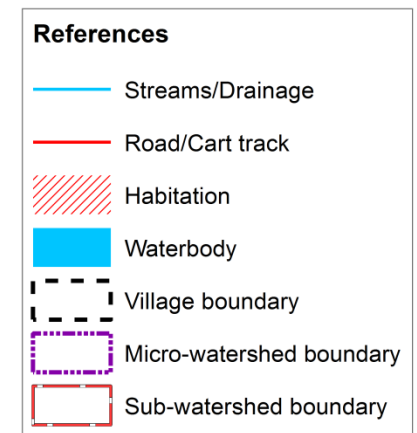
(4D5B2K : Area - 4332.97 ha)

YADGIR TALUK & DISTRICT



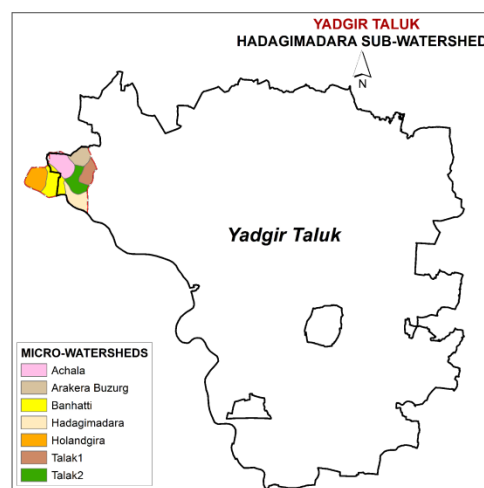
Available Water Capacity	Area in ha (%)
Very low (<50 mm/m)	817 (18.86)
Low (51-100 mm/m)	698 (16.11)
Medium (101-150 mm/m)	573 (13.23)
Very high (>200 mm/m)	1676 (38.67)
Rock outcrops	245 (5.66)
Others*	324 (7.48)

* - Habitation & Waterbody



Source: ICAR-NBSS&LUP, Bengaluru

5.6.Slope

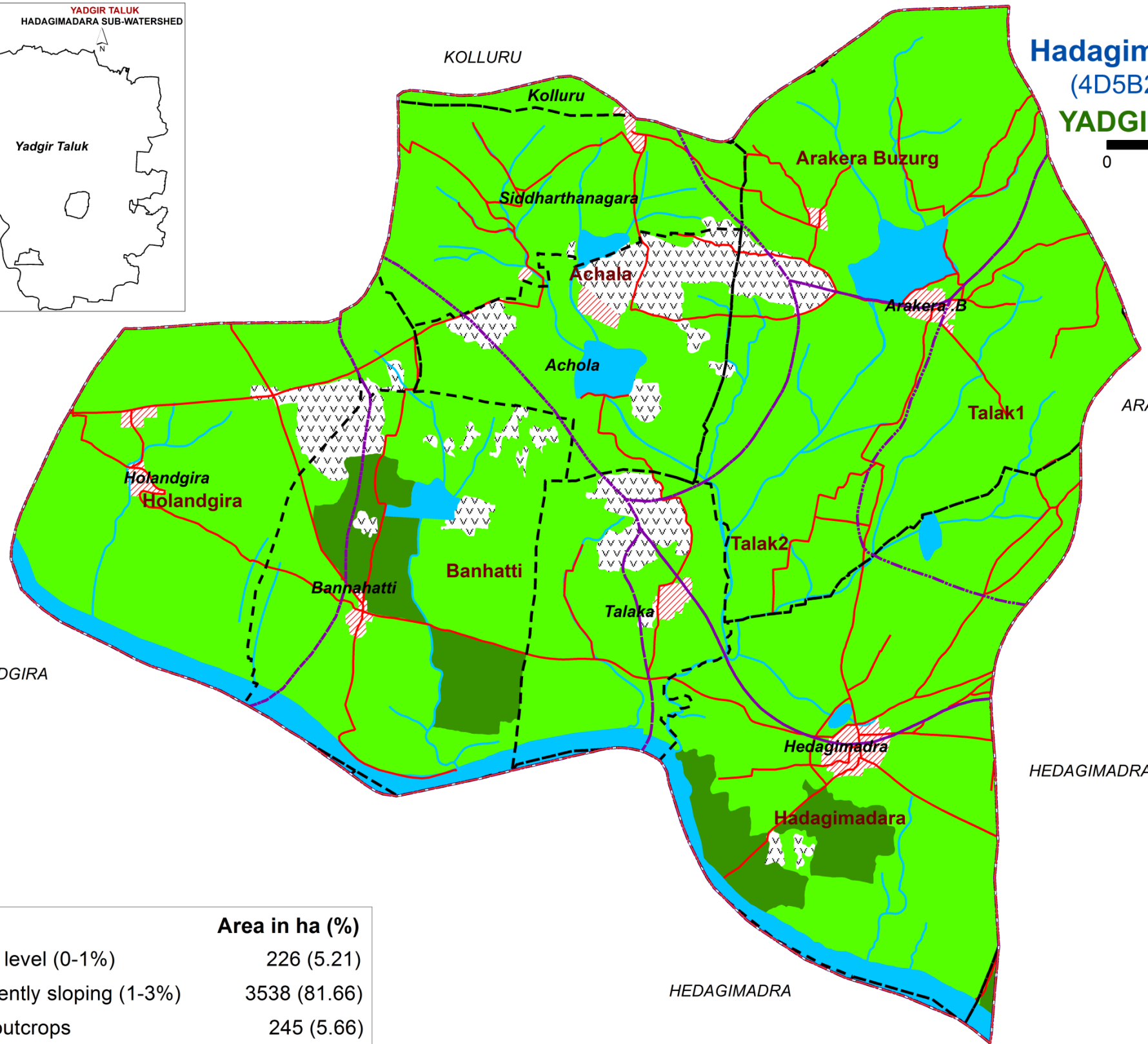


SLOPE

Hadagimadara Sub-watershed

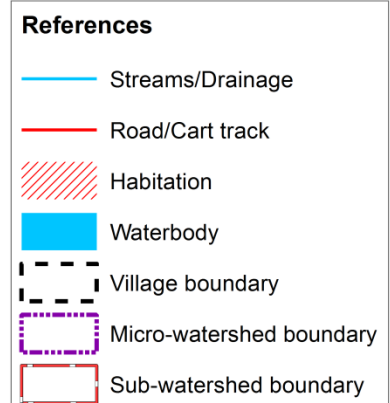
(4D5B2K : Area - 4332.97 ha)

YADGIR TALUK & DISTRICT



Slope Class	Area in ha (%)
Nearly level (0-1%)	226 (5.21)
Very gently sloping (1-3%)	3538 (81.66)
Rock outcrops	245 (5.66)
Others*	324 (7.48)

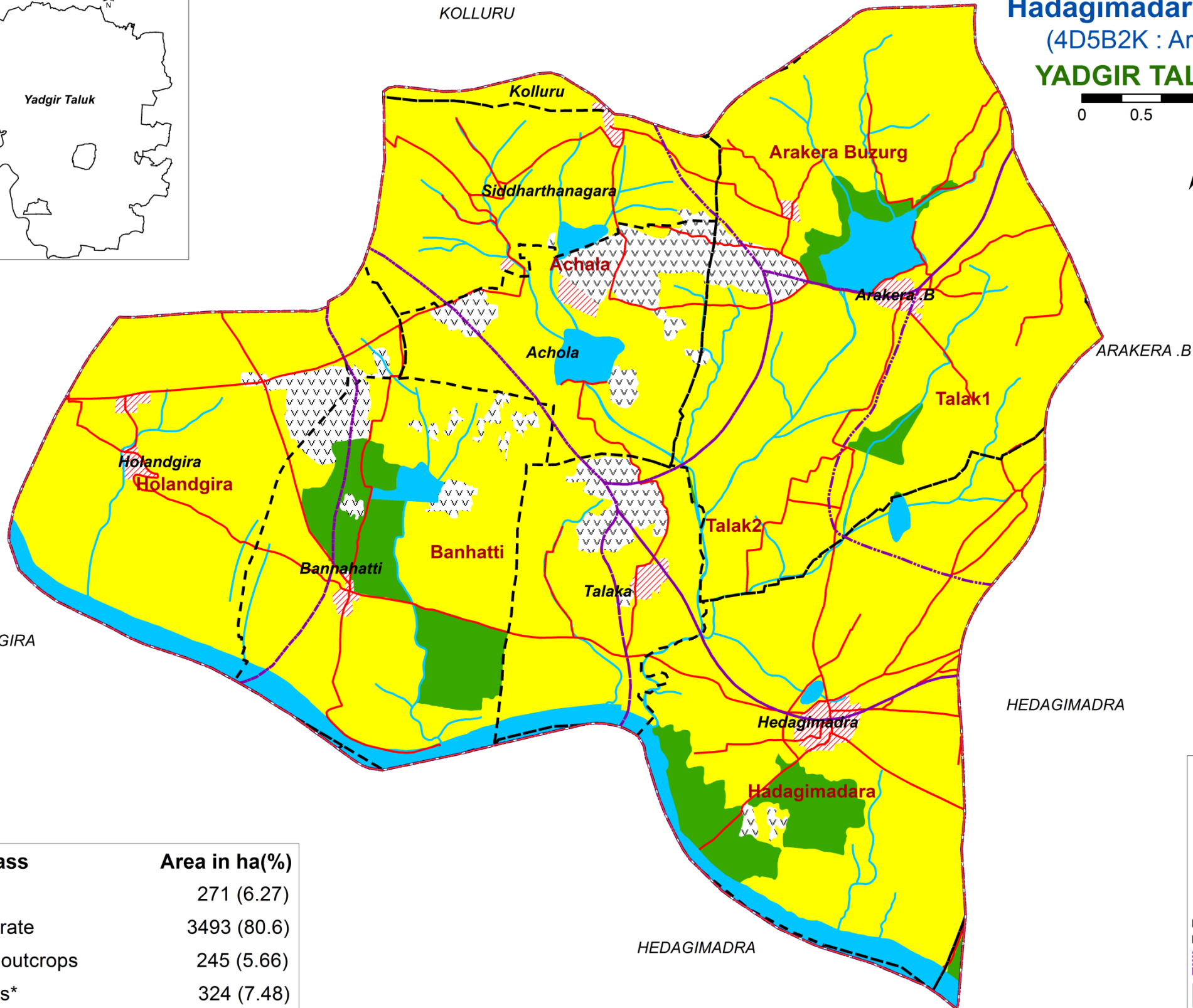
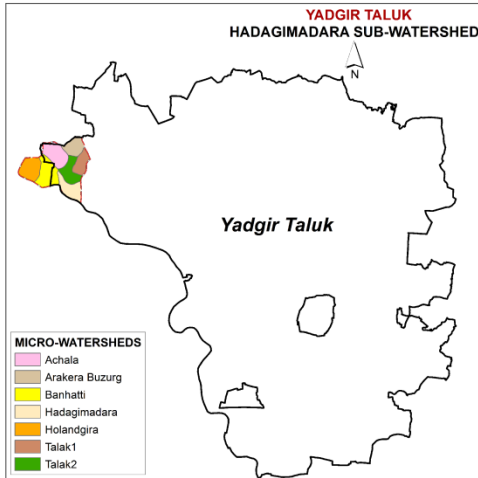
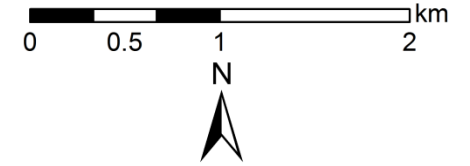
* - Habitation & Waterbody



Source: ICAR-NBSS&LUP, Bengaluru

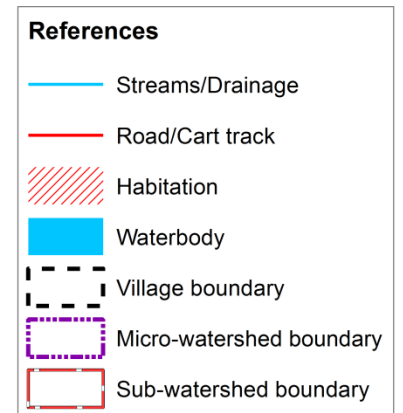
5.7. Soil Erosion

SOIL EROSION Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha) YADGIR TALUK & DISTRICT



Erosion Class	Area in ha(%)
Slight	271 (6.27)
Moderate	3493 (80.6)
Rock outcrops	245 (5.66)
Others*	324 (7.48)

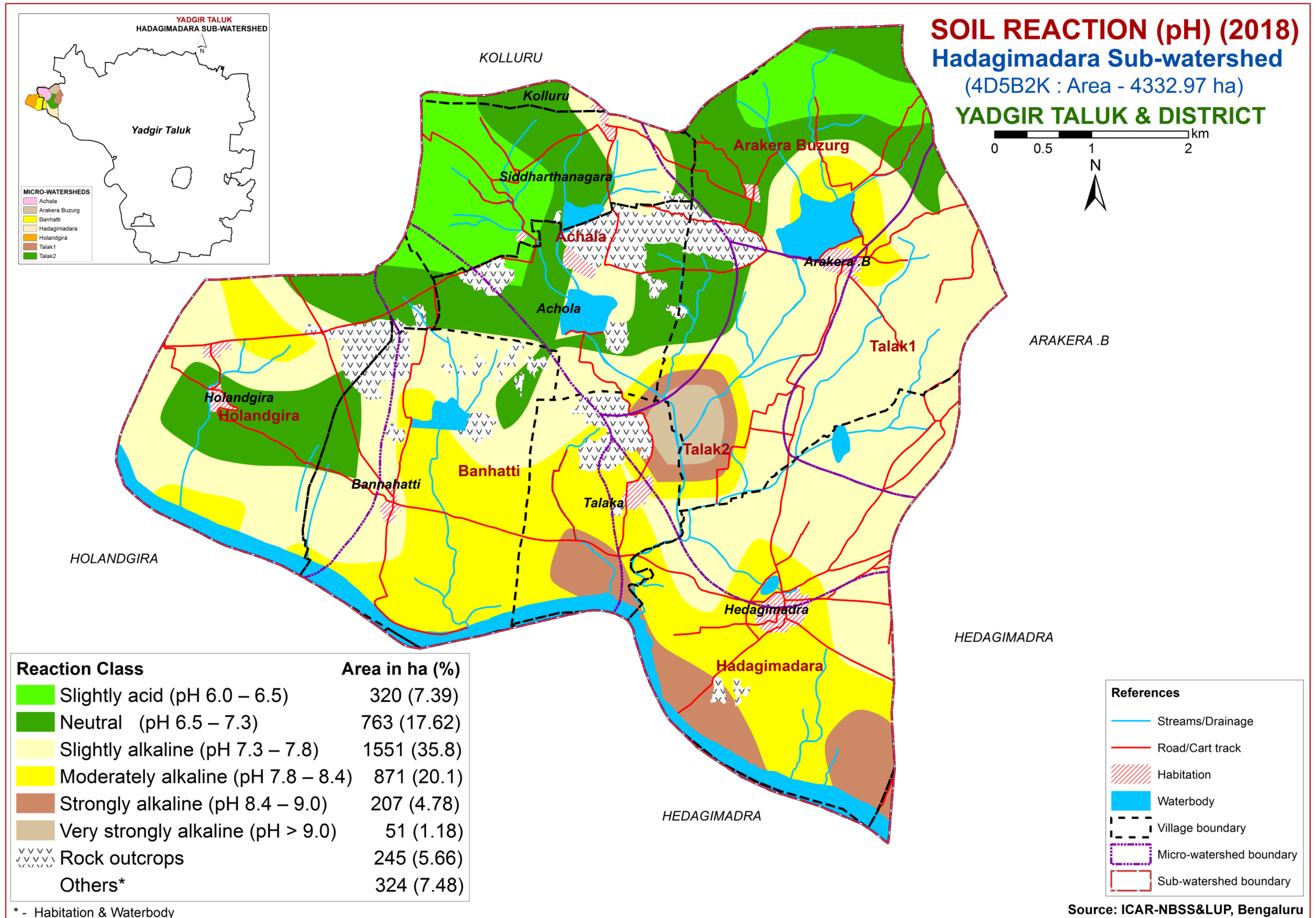
* - Habitation & Waterbody



Source: ICAR-NBSS&LUP, Bengaluru

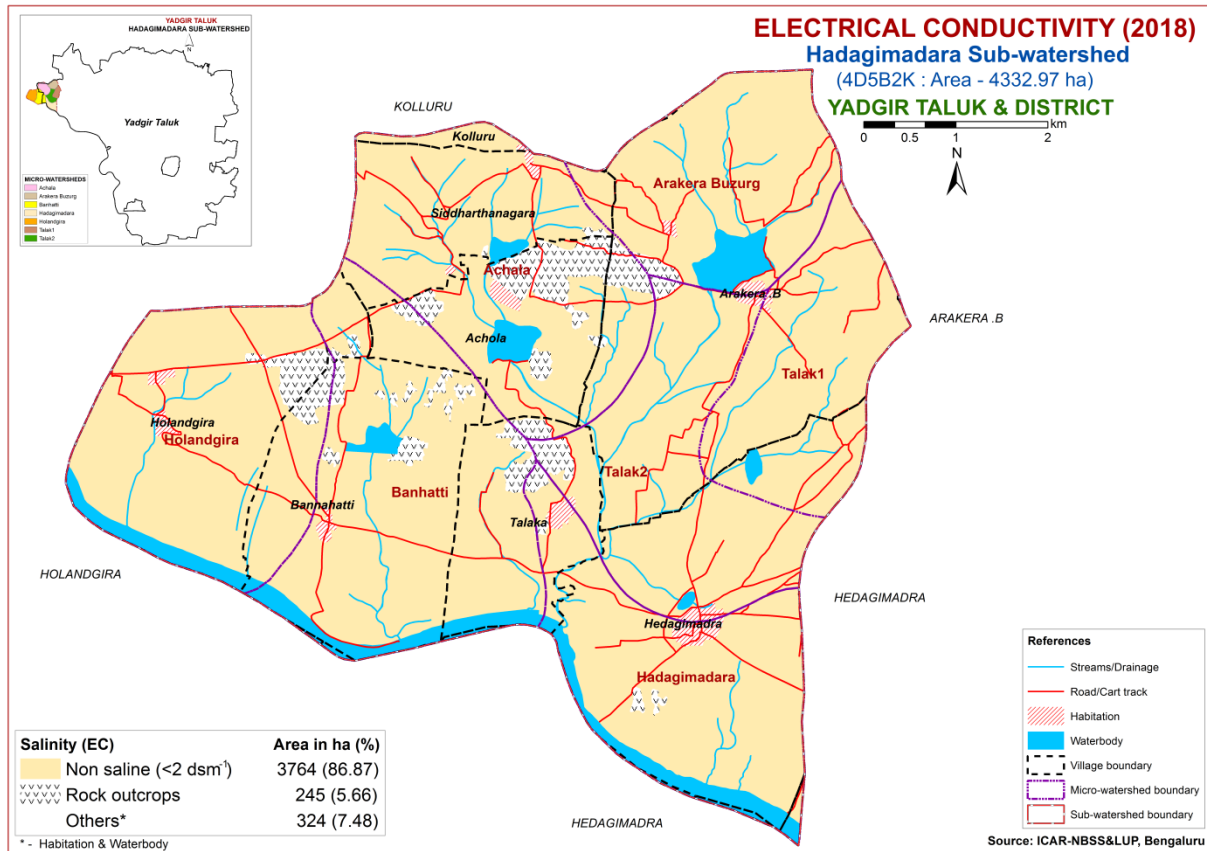
6. Soil Fertility Status

6.1. Soil Reaction (pH)

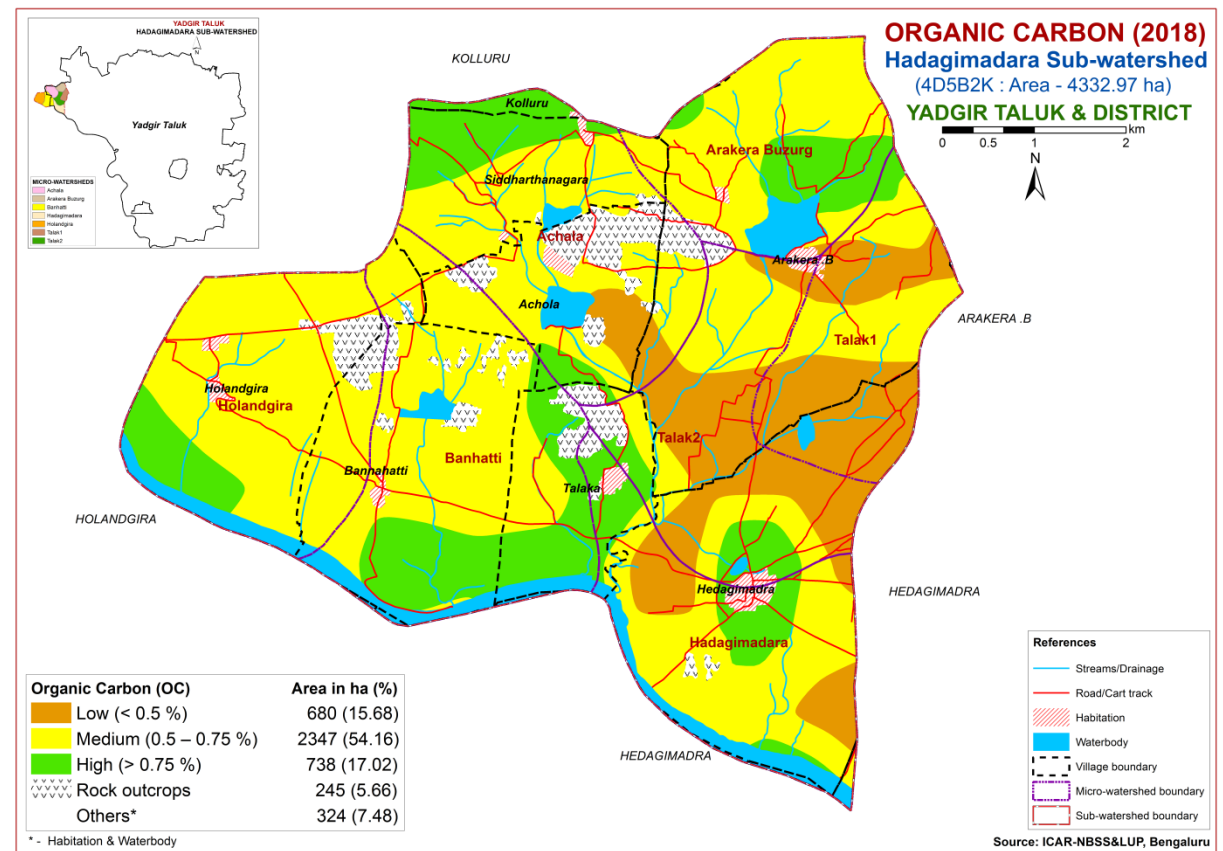


Source: ICAR-NBSS&LUP, Bengaluru

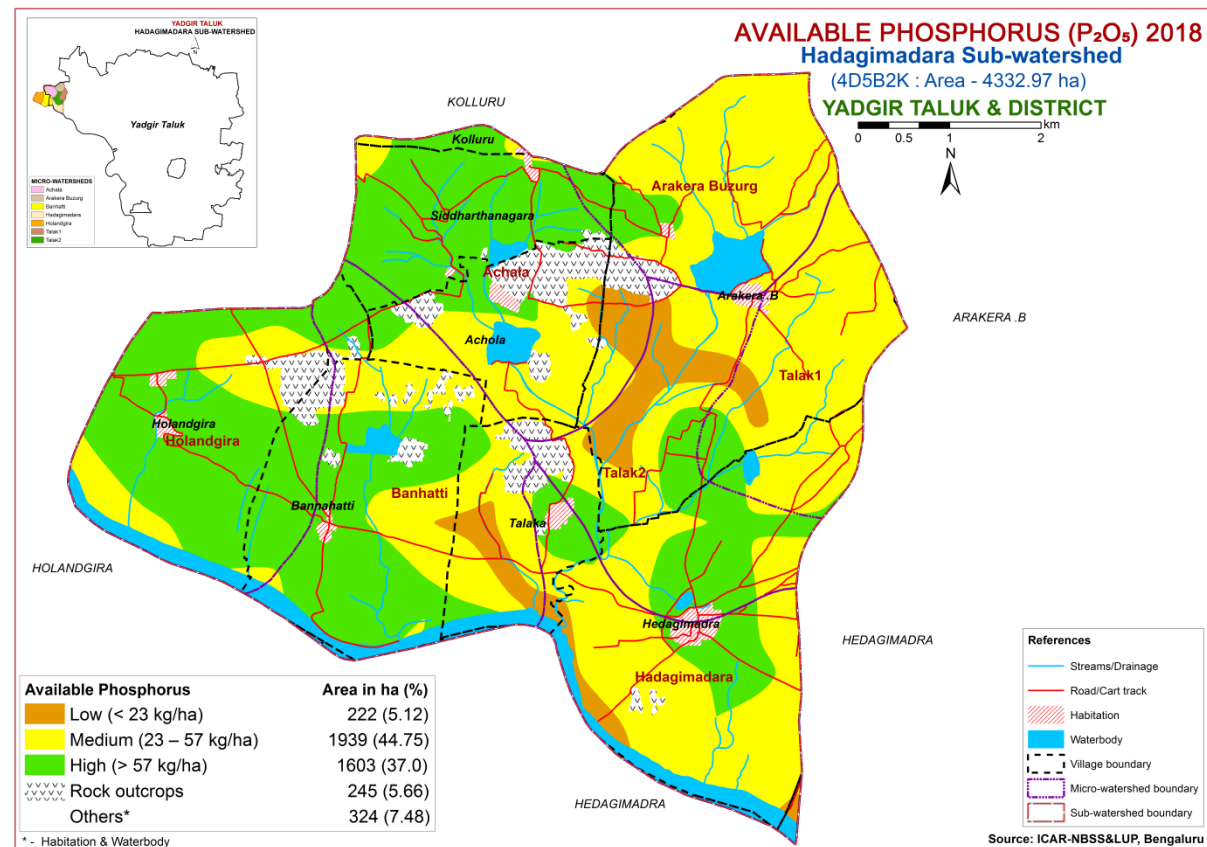
6.2 Electrical Conductivity (EC)



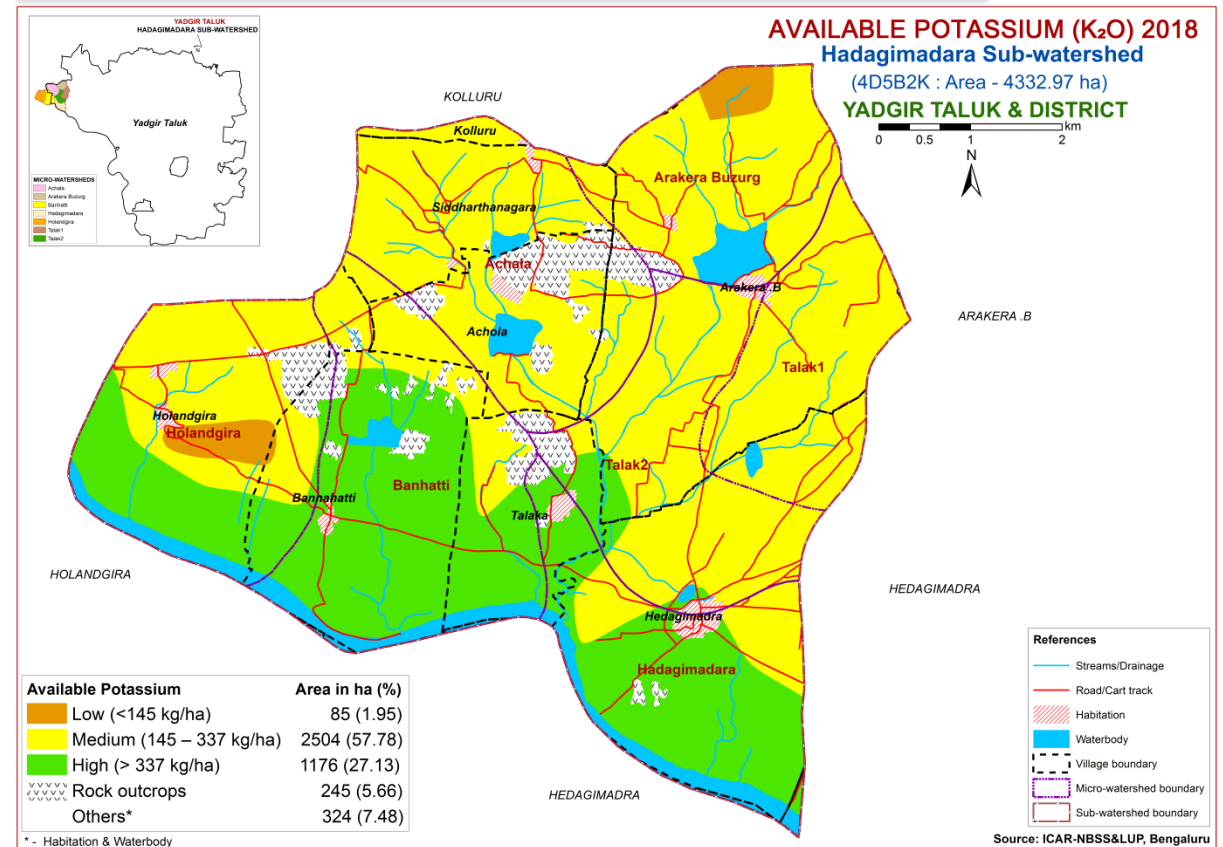
6.3. Organic Carbon



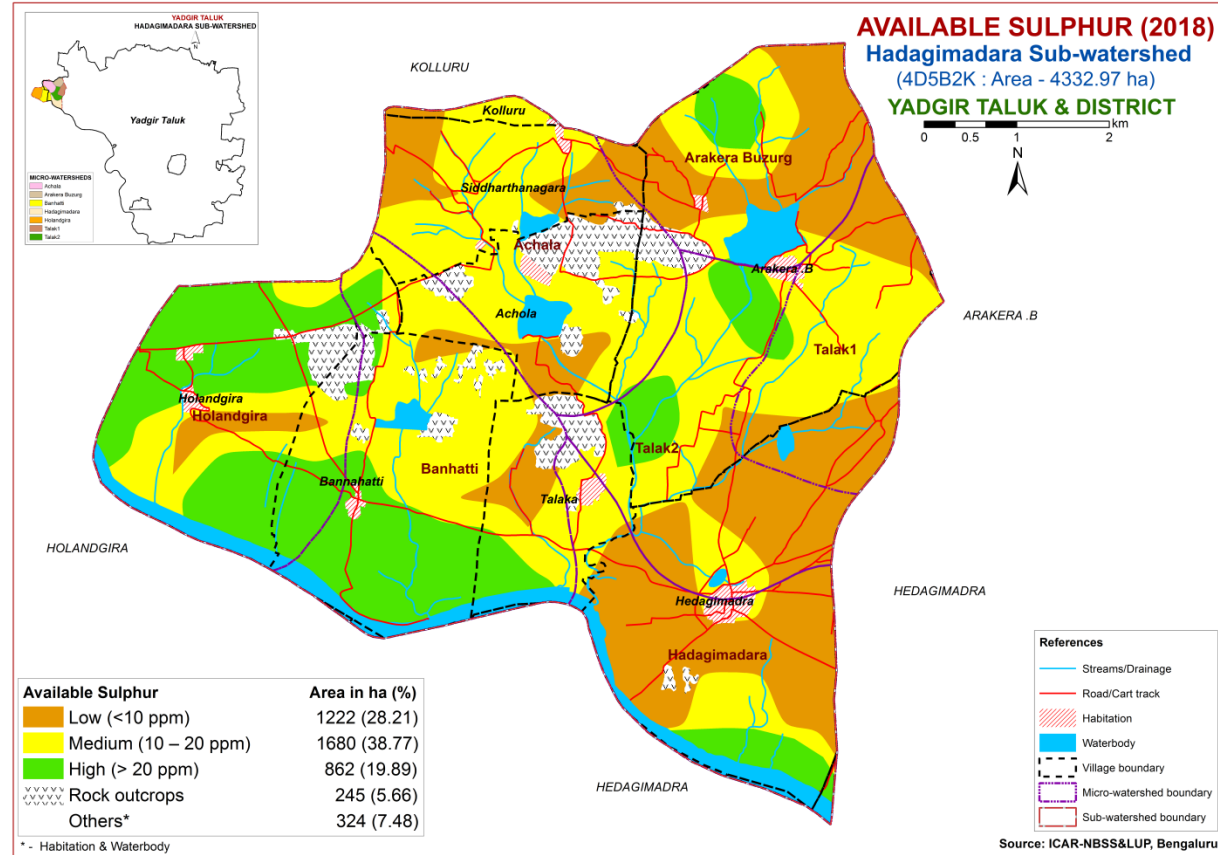
6.4. Available Phosphorus (P₂O₅)



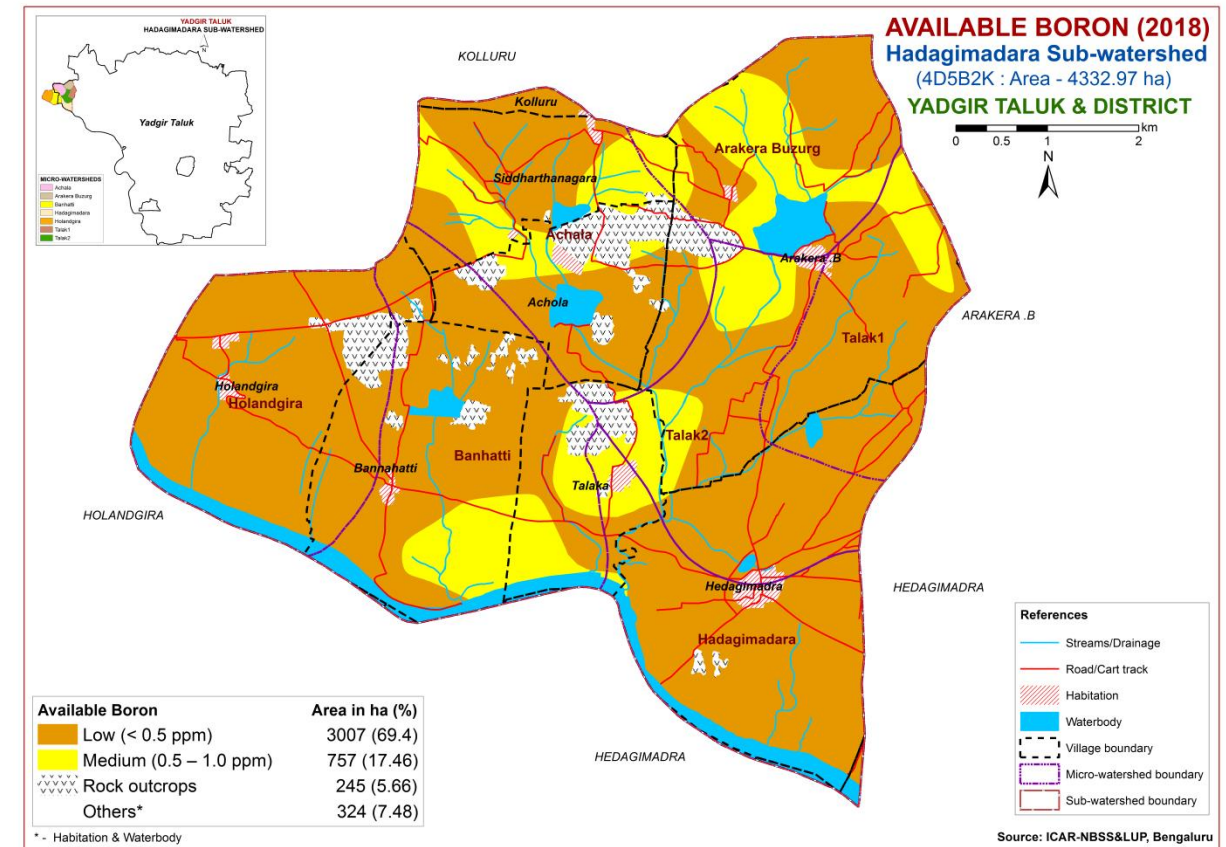
6.5. Available Potassium (K₂O)



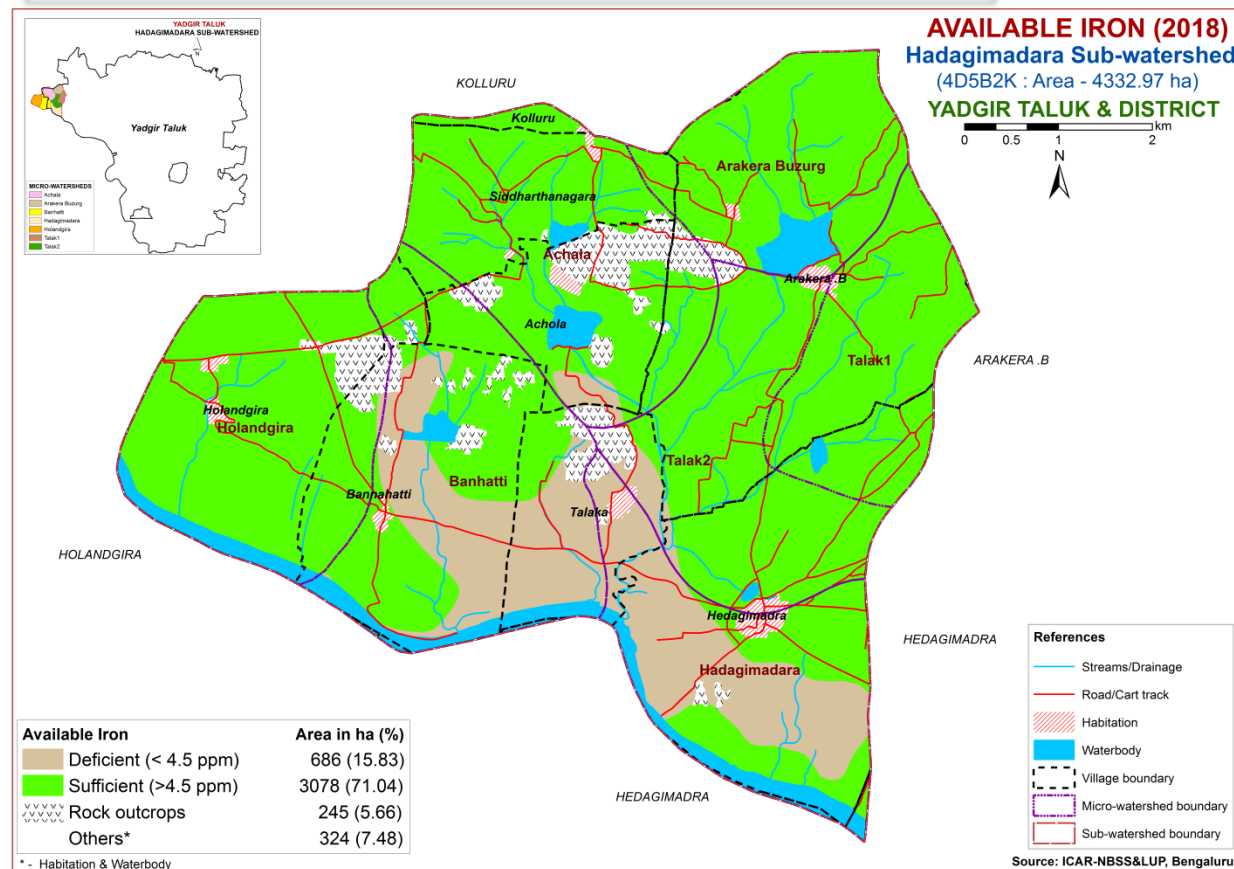
6.6. Available Sulphur



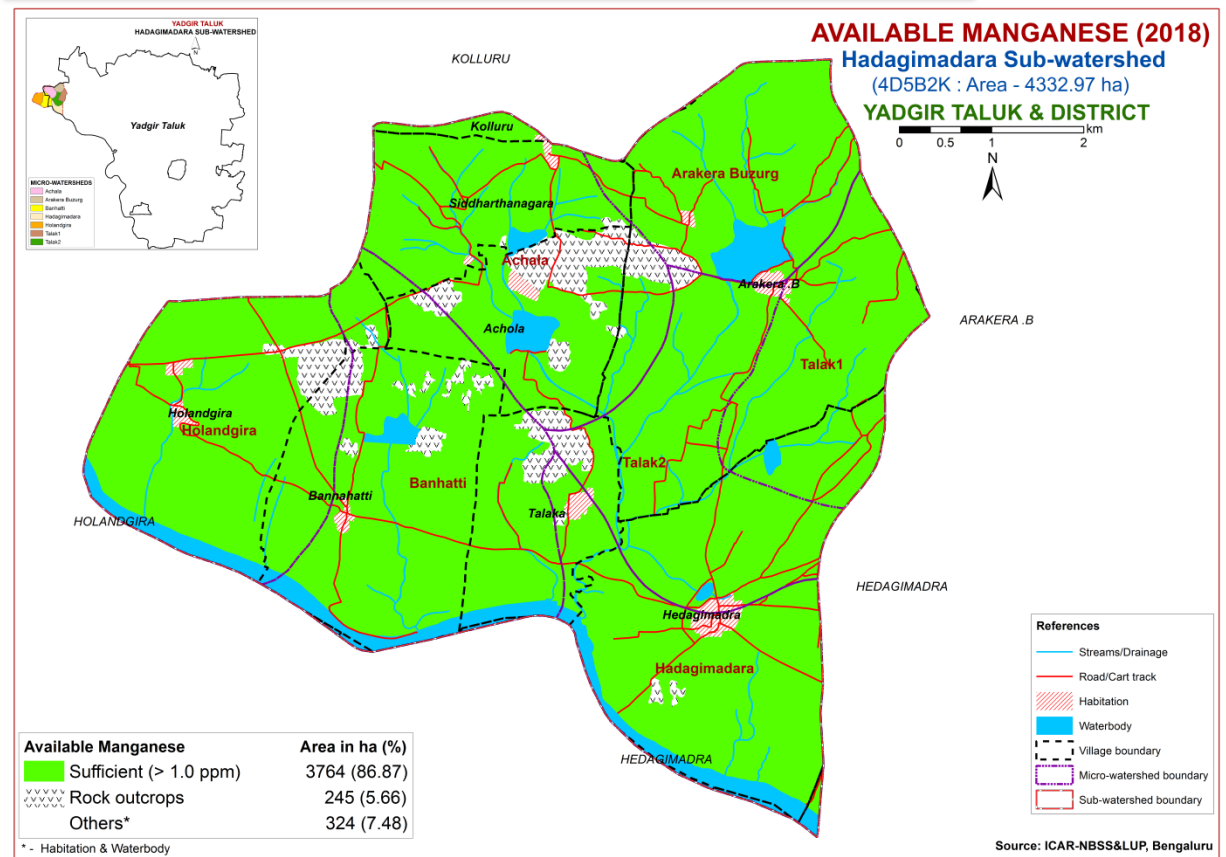
6.7. Available Boron



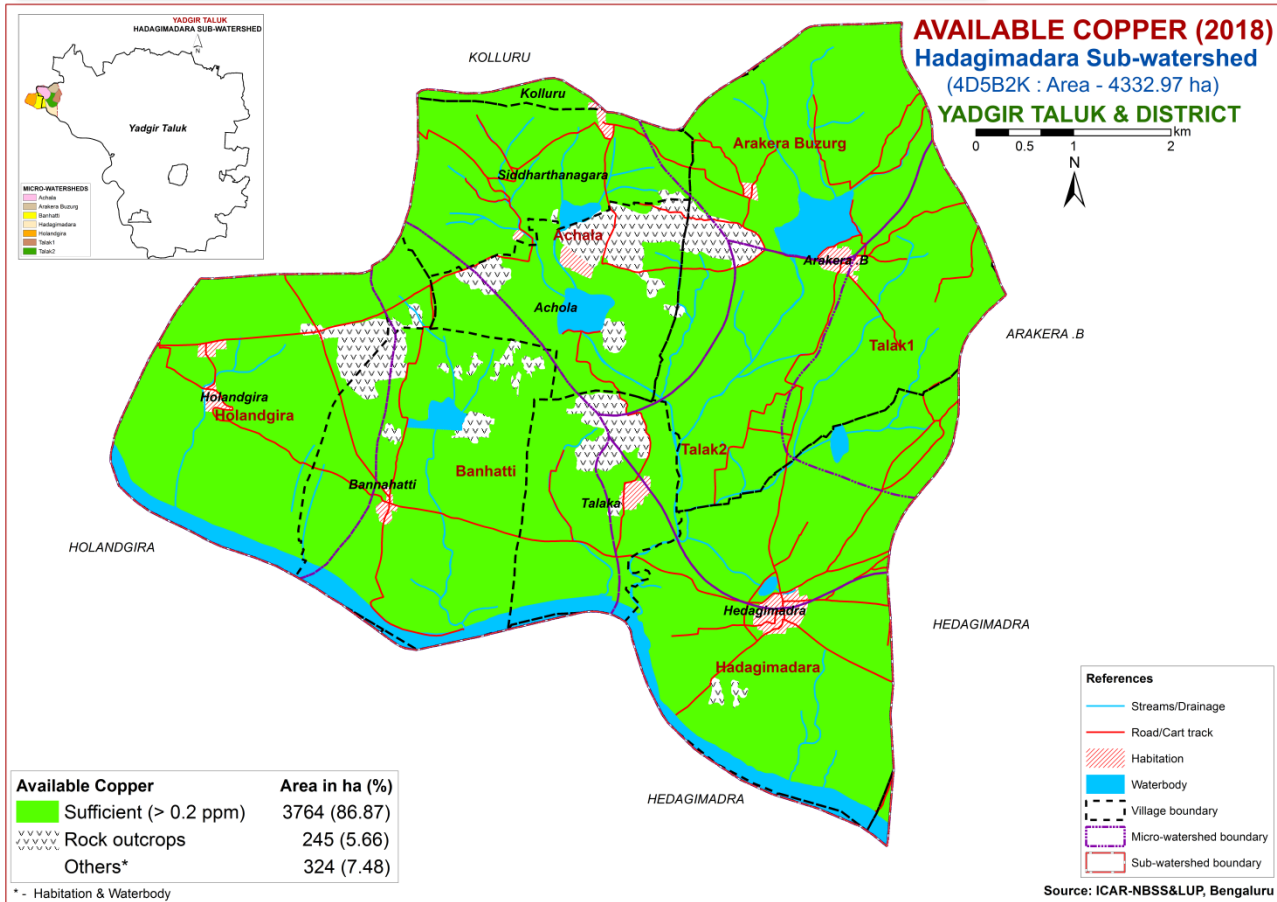
6.8. Available Iron



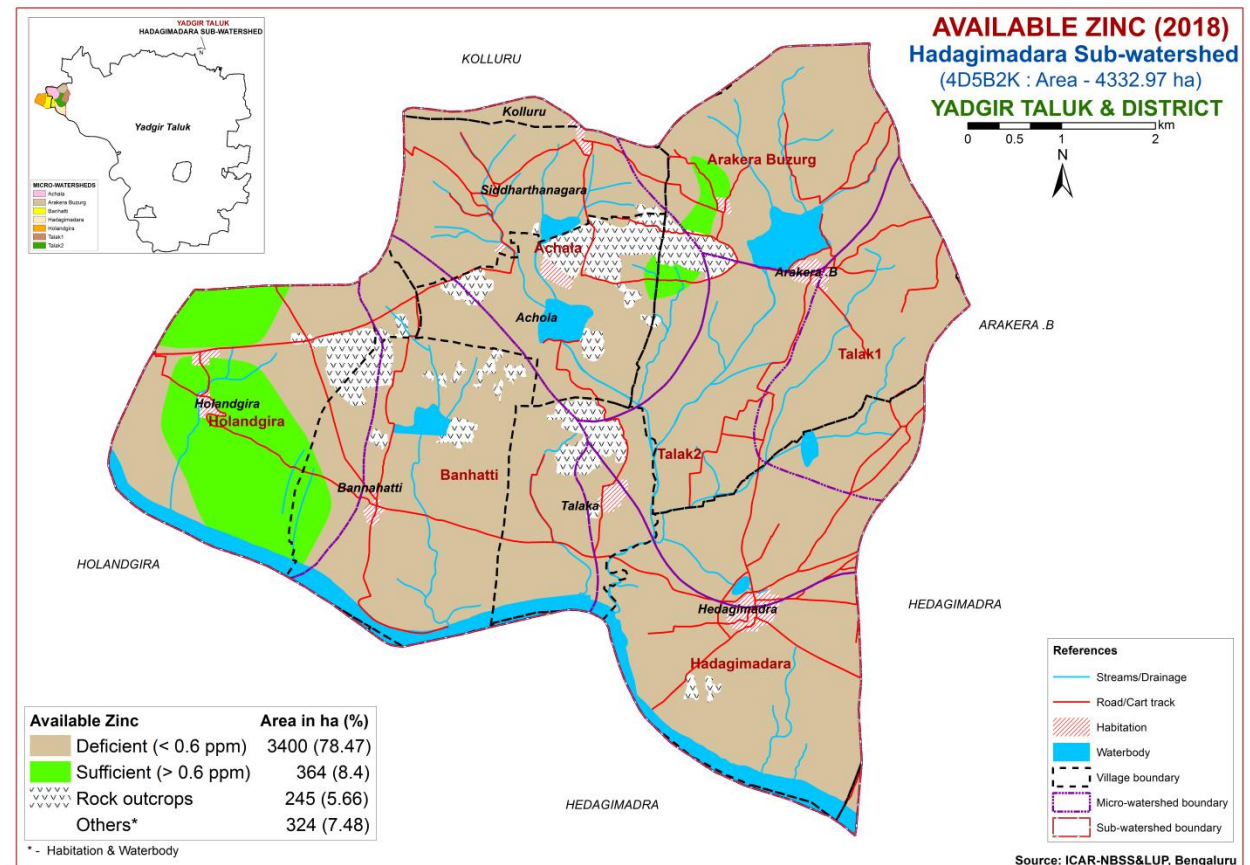
6.9. Available Manganese



6.10. Available Copper



6.11. Available Zinc

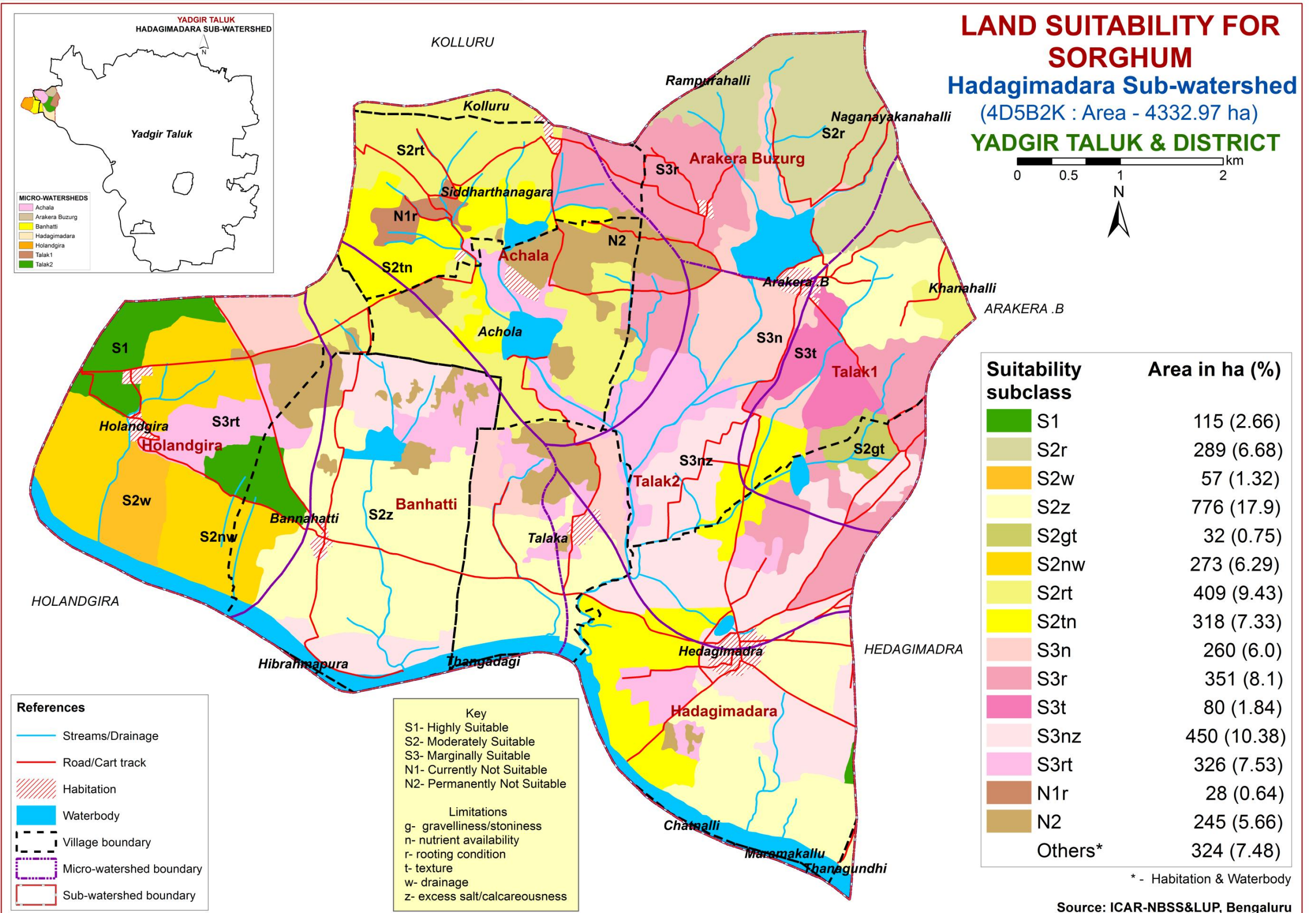


6.12. Correcting the Soil Nutrient Deficiencies

1. Reclamation of Salt affected soils
 - a) When the soil is having neutral pH (6.5-7.5), no need of adding amendments (lime or gypsum)
 - b) If the soil pH is <6.5, apply burnt lime to soil as per specifically recommended dosage and again after 2 years proper change has to be made based on soil test results.
 - c) If the soil pH is 7.5-8.5 due to excess calcium content, drain out the excess calcium from the soil with good quality irrigation water.
 - d) If the soil pH is more than 8.5 due to higher sodium content in soil, apply specifically recommended dose of gypsum & drain out the excess salts with good quality irrigation water.
2. In case of low & high content of major nutrients in the soil, follow the modifications as given below:
 - N: P: K (N: P₂O₅: K₂O) **For low N content**, add 25 % extra to the Recommended Dose of Fertilisers (RDF).
For high N content, reduce 25% from the RDF and apply to soil.
Eg:- if 100kg N, then we have to apply
 - 100+25% for deficient soil.
 - 100% for medium available N content soil.
 - 100-25% for higher N content soil.
 - Follow the same in case of P & K.
3. Use or Incorporation of biofertilizers like Rhizobium, Azotobacter, Azospirillum, Phosphate Solubilizing Bacteria and mycorrhiza enhances normal available nutrients in soil to the plants and also reduce the input cost of cultivation.
4. For calcium deficient soil, apply N-fertilizers like calcium ammonium nitrate; Gypsum can also supply calcium (CaSO₄ · 2H₂O)
5. Apply 405kg MgSO₄ per ha to the magnesium deficient soil. In case of perennial horticulture crops apply 150-200g/ plant.
6. In sulphur deficient acid soils (Humid region) apply phosphorus (in the form of) through SSP & use sulphur coated urea to the crops.
7. Apply 30-50kg ferrous sulfate (FeSO₄) per ha to the iron deficient soils. In case of perennial Horticulture crops apply 3-5g/ litre FeSO₄/plant as foliar spray.
8. Apply 30-40kg/ha – manganese sulfate (MnSO₄) as soil application to the manganese deficient soils. In case of perennial Horticulture crops apply 3-5 g/litre MnSO₄/plant as foilar application.
9. Apply Zinc – 10-25 kg/ha –ZnSO₄ – soil application to the Zinc deficient soils. In case of perennial Horticulture crops apply 3-5g/ litre – foliar application.
10. Apply Copper – 5-10 kg /ha – copper sulfate (CuSO₄) soil application for the copper deficient soils and for Perennial horticultural crops 3-5g/ litre – CuSO₄/plant as foliar application.
11. Apply borax 8-10 kg/ha in boron deficient soils and for Perennial horticultural crops as foliar application – 1g / litre.
12. Apply molybdenum – ammonium molybdate 200-250 gm/ha for Molybdenum deficient soils or dissolve 1g / litre ammonium molybdate for Foliar spray.
13. Soil sampling and testing needs to be done at every 2-3 years interval.

7. Land Suitability for Major Crops

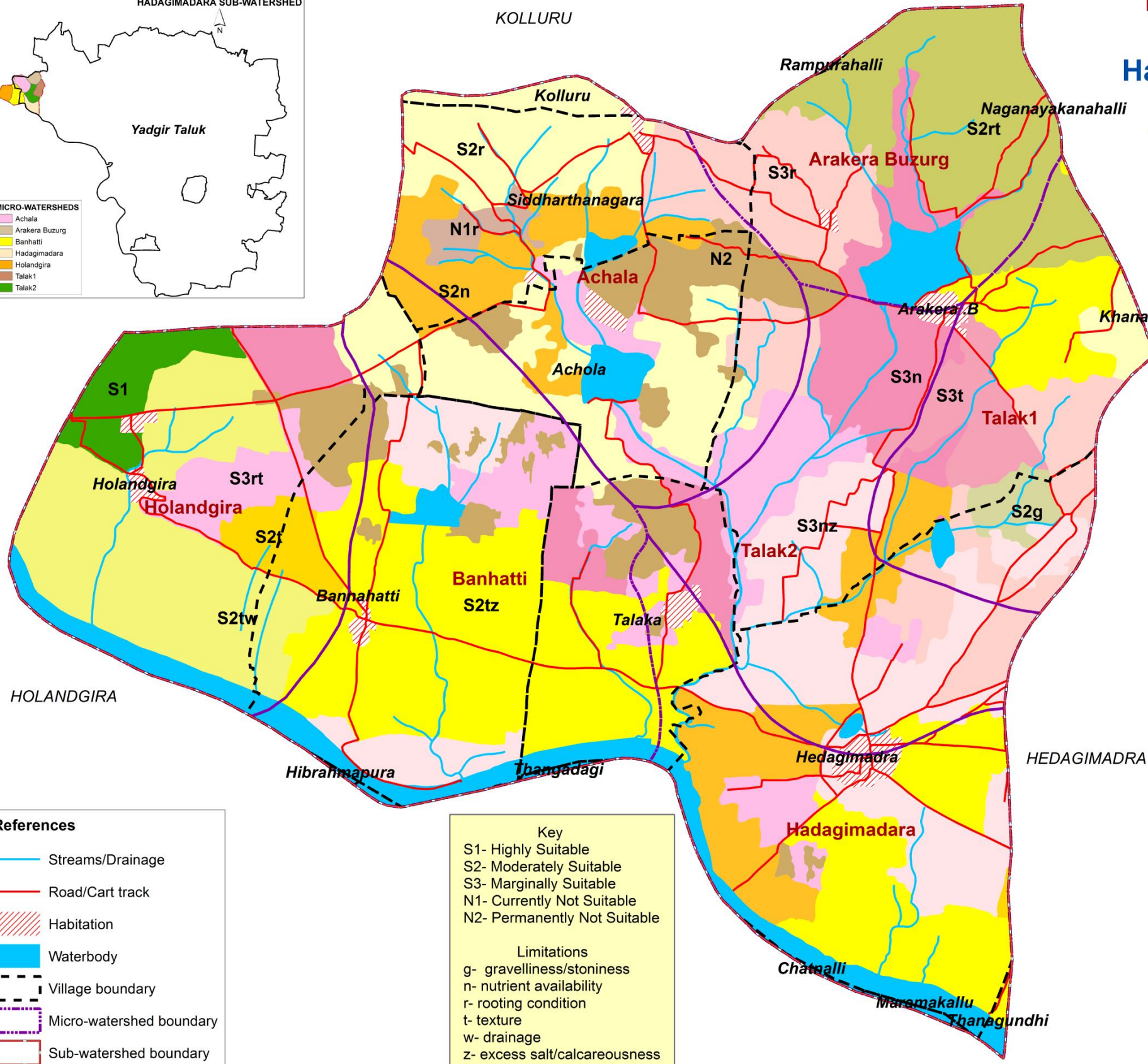
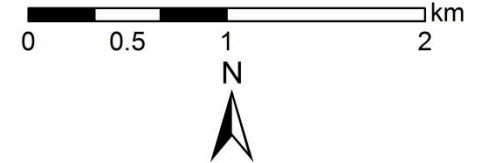
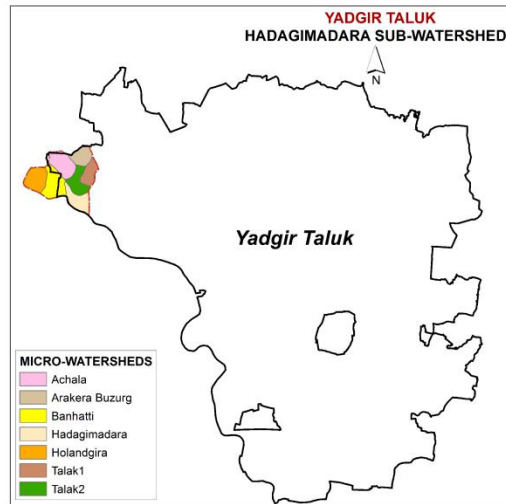
7.1. Land Suitability for Sorghum



Source: ICAR-NBSS&LUP, Bengaluru

7.2. Land Suitability for Maize

LAND SUITABILITY FOR MAIZE Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha) YADGIR TALUK & DISTRICT



ARAKERA .B

Suitability subclass	Area in ha (%)
S1	66 (1.52)
S2g	32 (0.75)
S2n	318 (7.33)
S2r	409 (9.43)
S2t	50 (1.14)
S2rt	289 (6.68)
S2tw	330 (7.61)
S2tz	776 (17.9)
S3n	260 (6.0)
S3r	351 (8.1)
S3t	80 (1.84)
S3nz	450 (10.38)
S3rt	326 (7.53)
N1r	28 (0.64)
N2	245 (5.66)
Others*	324 (7.48)

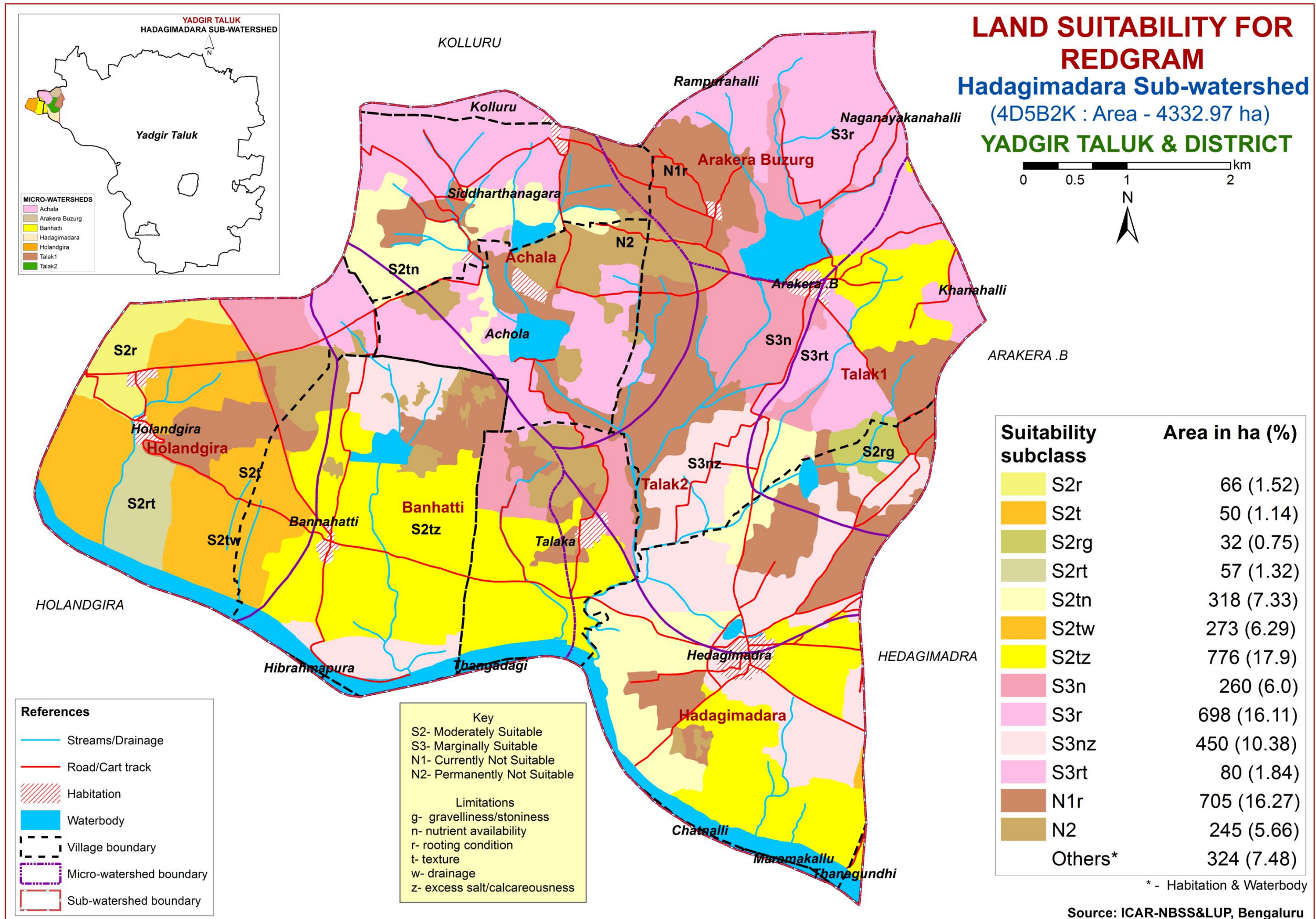
- References**
- Streams/Drainage
 - Road/Cart track
 - Habitation
 - Waterbody
 - Village boundary
 - Micro-watershed boundary
 - Sub-watershed boundary

- 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
 - w- drainage
 - z- excess salt/calcareousness

* - Habitation & Waterbody

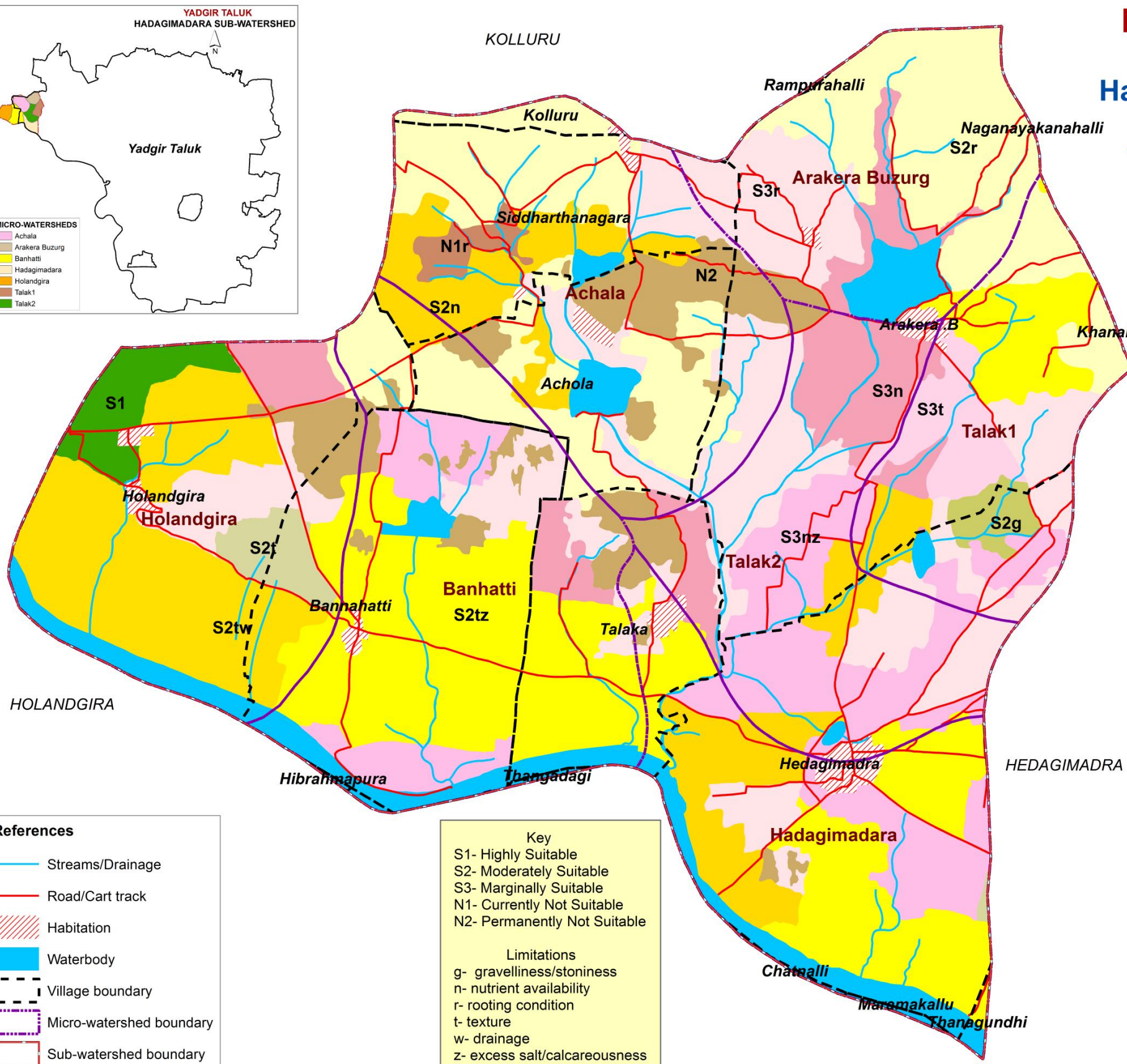
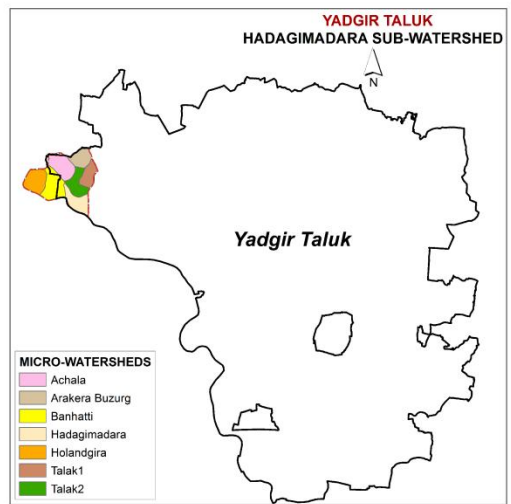
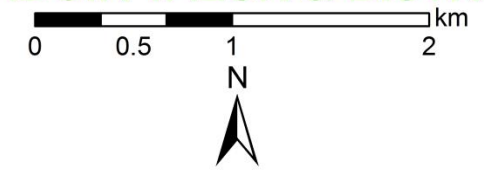
Source: ICAR-NBSS&LUP, Bengaluru

7.3. Land Suitability for Redgram



7.4. Land Suitability for Bajra

LAND SUITABILITY FOR BAJRA Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha) YADGIR TALUK & DISTRICT



Suitability subclass	Area in ha (%)
S1	66 (1.52)
S2g	32 (0.75)
S2n	318 (7.33)
S2r	698 (16.11)
S2t	50 (1.14)
S2tw	330 (7.61)
S2tz	776 (17.9)
S3n	260 (6.0)
S3r	677 (15.63)
S3t	80 (1.84)
S3nz	450 (10.38)
N1r	28 (0.64)
N2	245 (5.66)
Others*	324 (7.48)

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

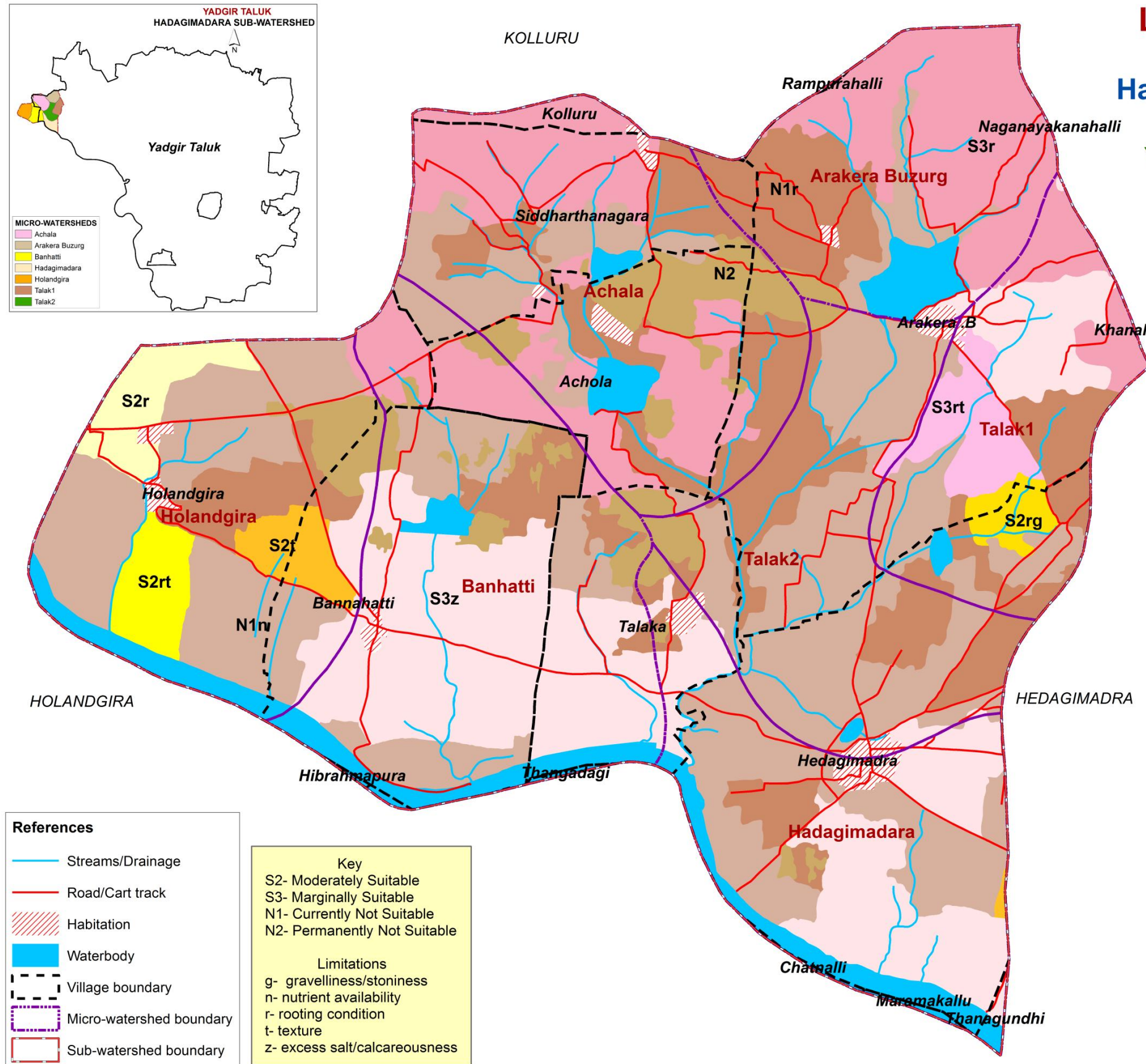
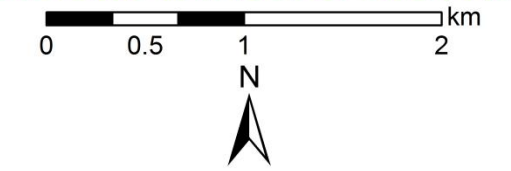
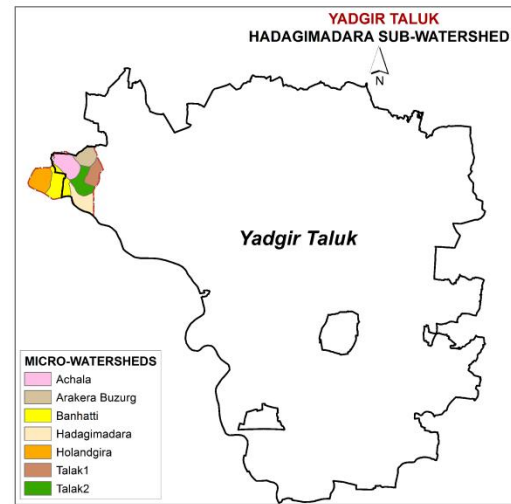
- Key**
- S1- Highly Suitable
 - S2- Moderately Suitable
 - S3- Marginally Suitable
 - N1- Currently Not Suitable
 - N2- Permanently Not Suitable
- Limitations**
- g- gravelliness/stoniness
 - n- nutrient availability
 - r- rooting condition
 - t- texture
 - w- drainage
 - z- excess salt/calcareousness

* - Habitation & Waterbody

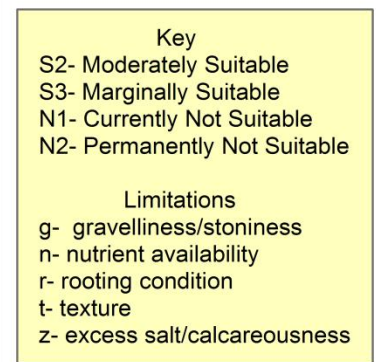
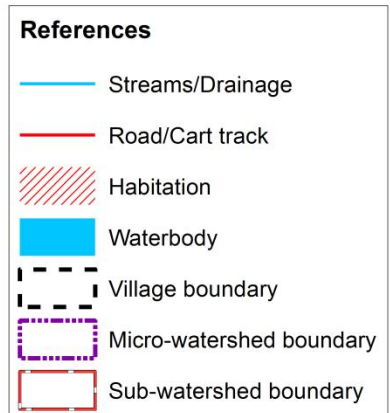
Source: ICAR-NBSS&LUP, Bengaluru

7.5. Land Suitability for Drumstick

LAND SUITABILITY FOR DRUMSTICK Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha) YADGIR TALUK & DISTRICT



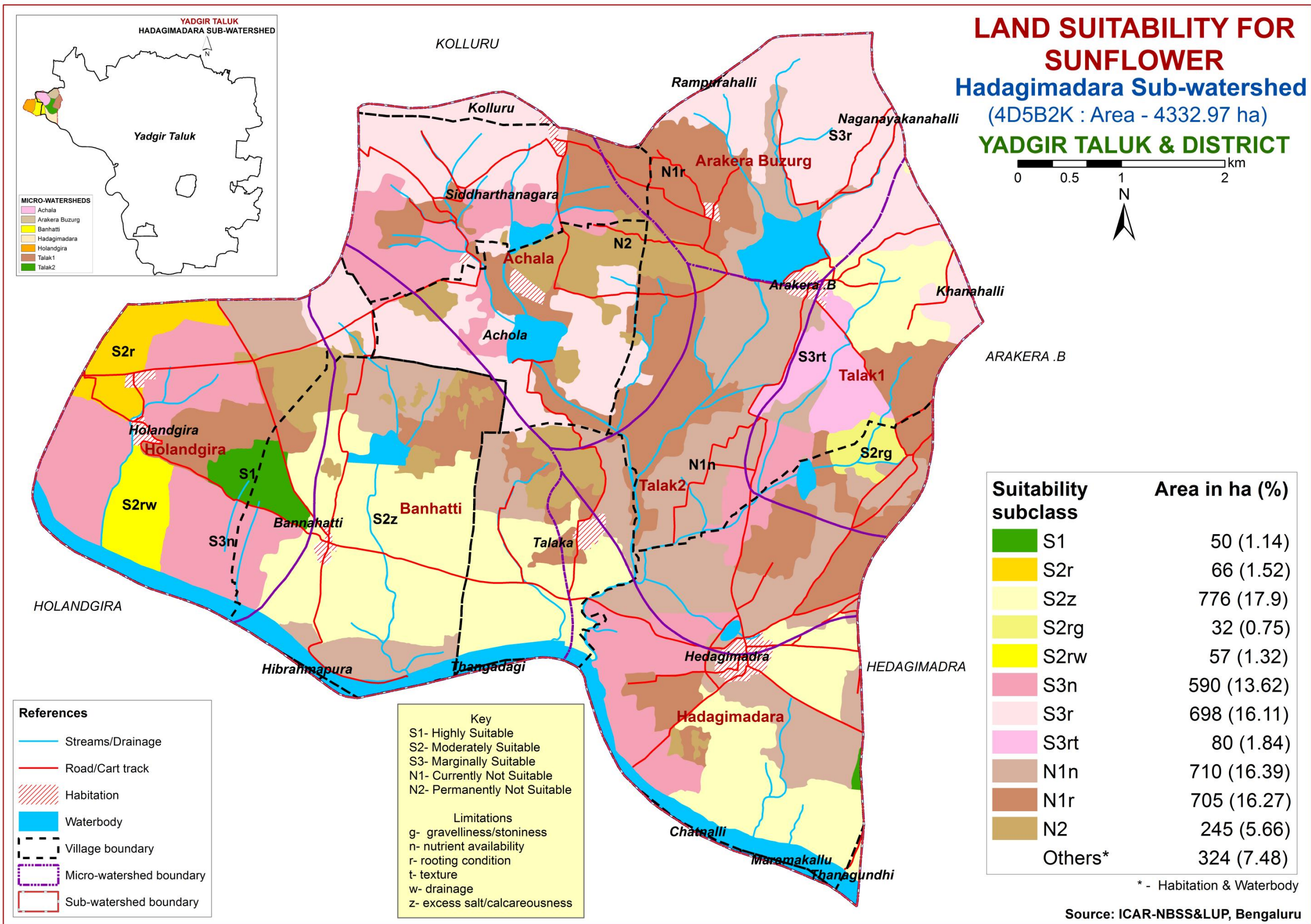
Suitability subclass	Area in ha (%)
S2r	66 (1.52)
S2t	50 (1.14)
S2rg	32 (0.75)
S2rt	57 (1.32)
S3r	698 (16.11)
S3z	776 (17.9)
S3rt	80 (1.84)
N1n	1300 (30.01)
N1r	705 (16.27)
N2	245 (5.66)
Others*	324 (7.48)



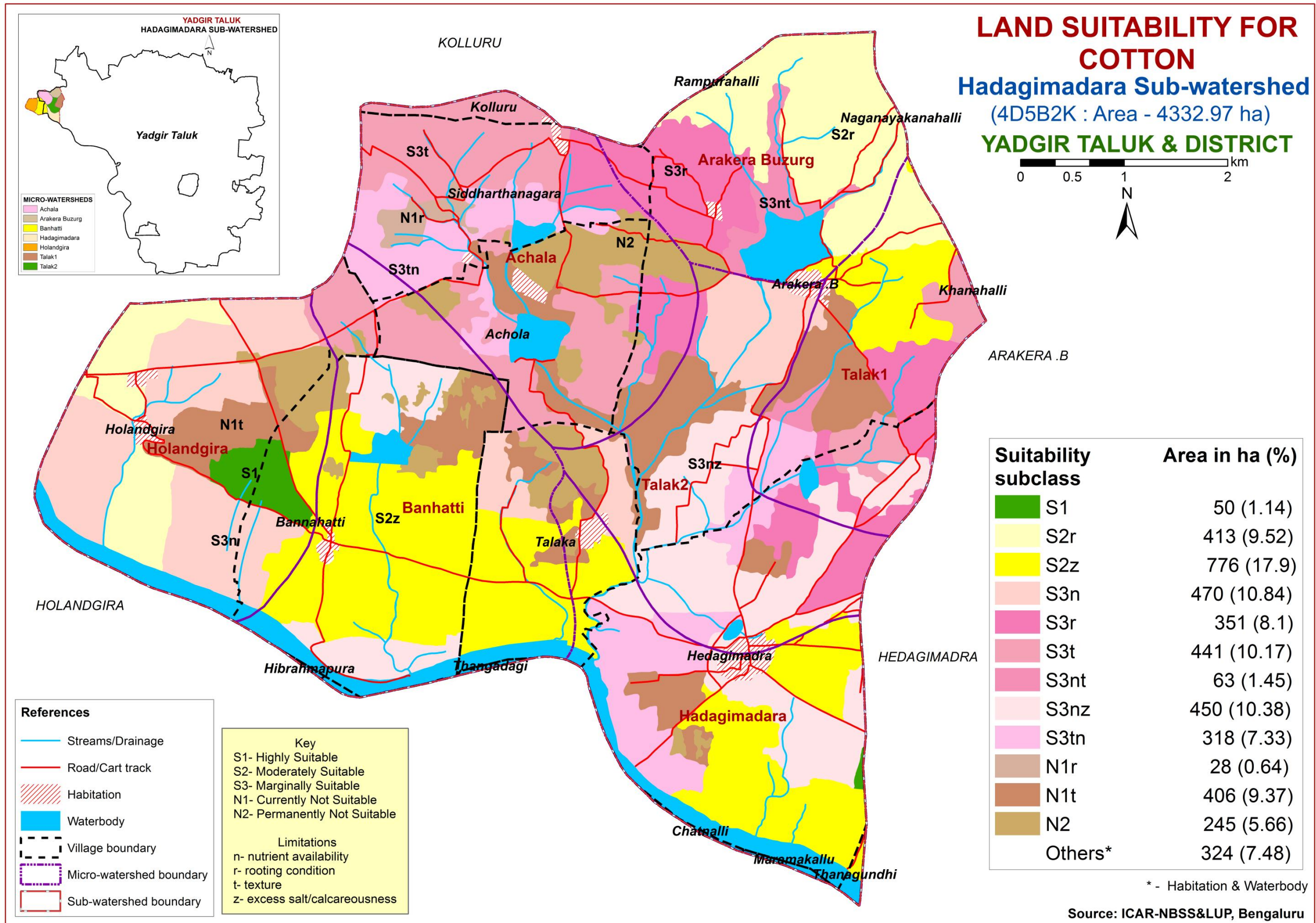
* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

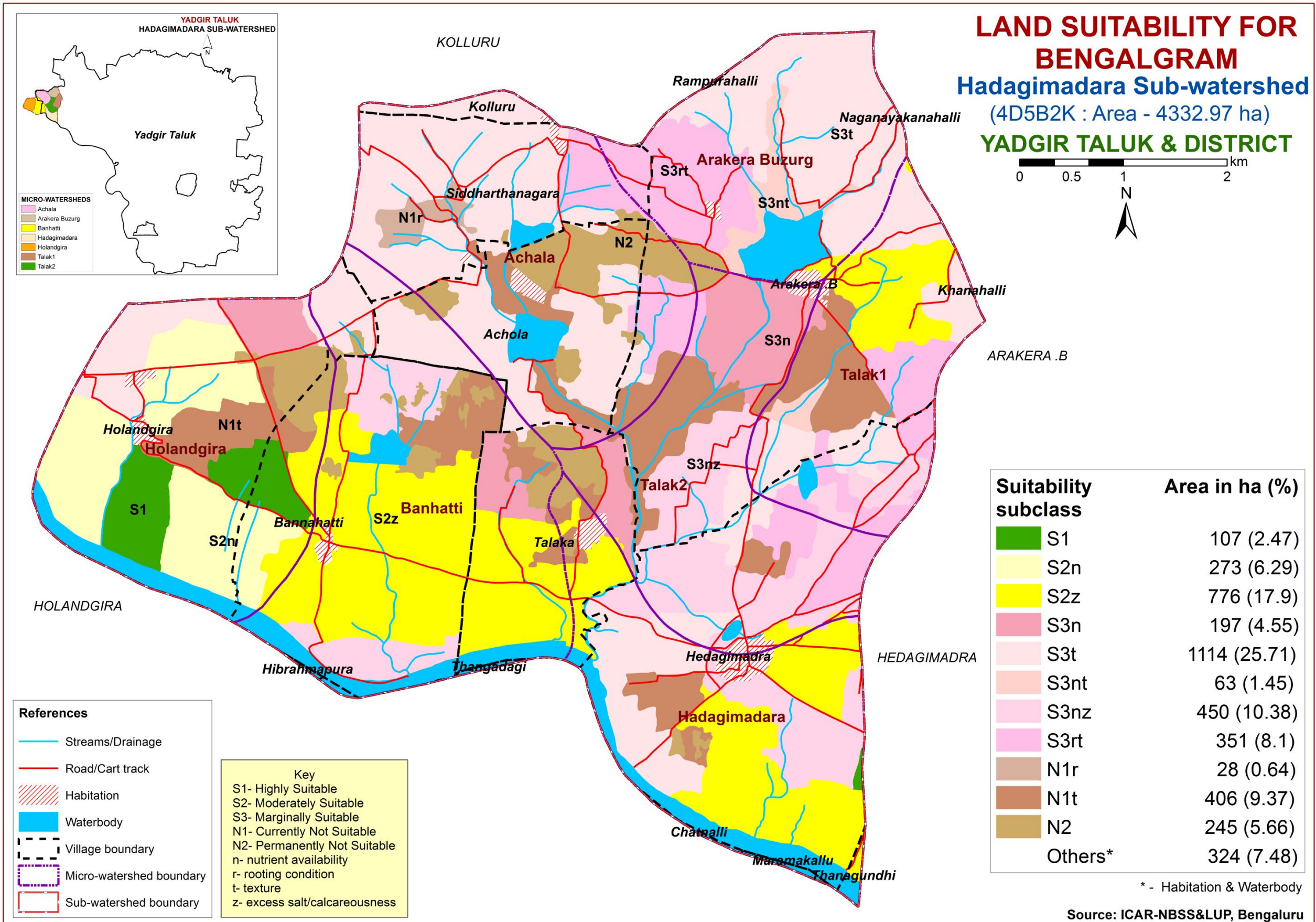
7.6. Land Suitability for Sunflower



7.7. Land Suitability for Cotton

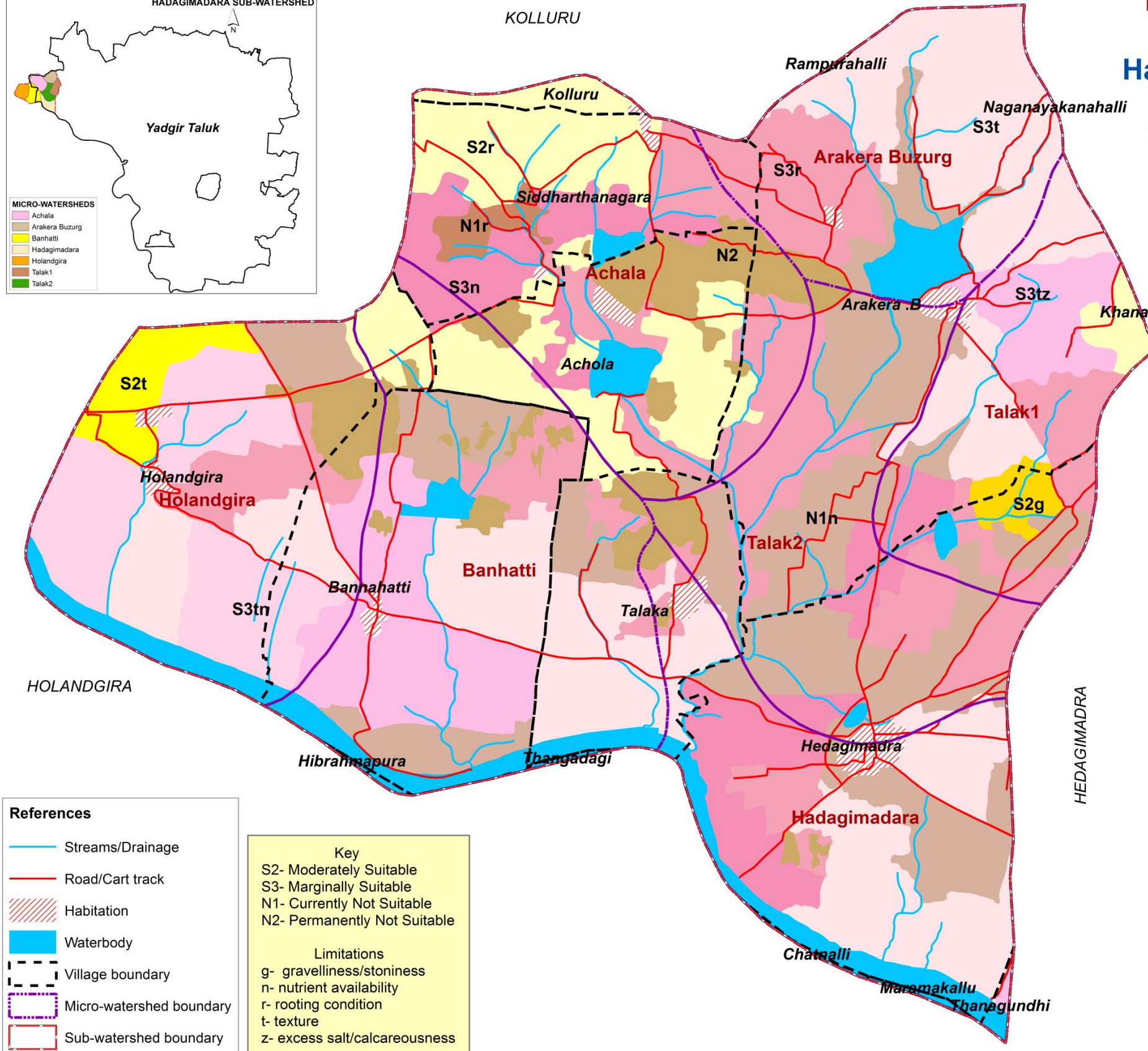
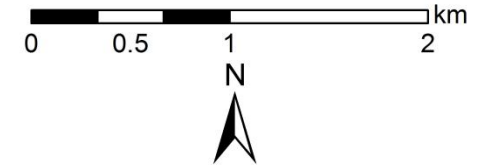
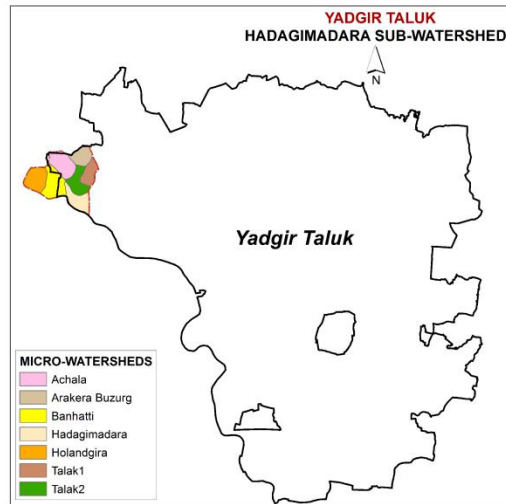


7.8. Land Suitability for Bengalgram

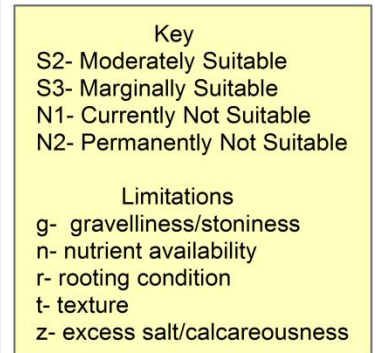
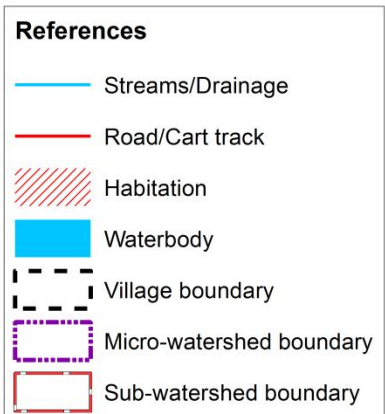


7.9. Land Suitability for Groundnut

LAND SUITABILITY FOR GROUNDNUT Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha) YADGIR TALUK & DISTRICT



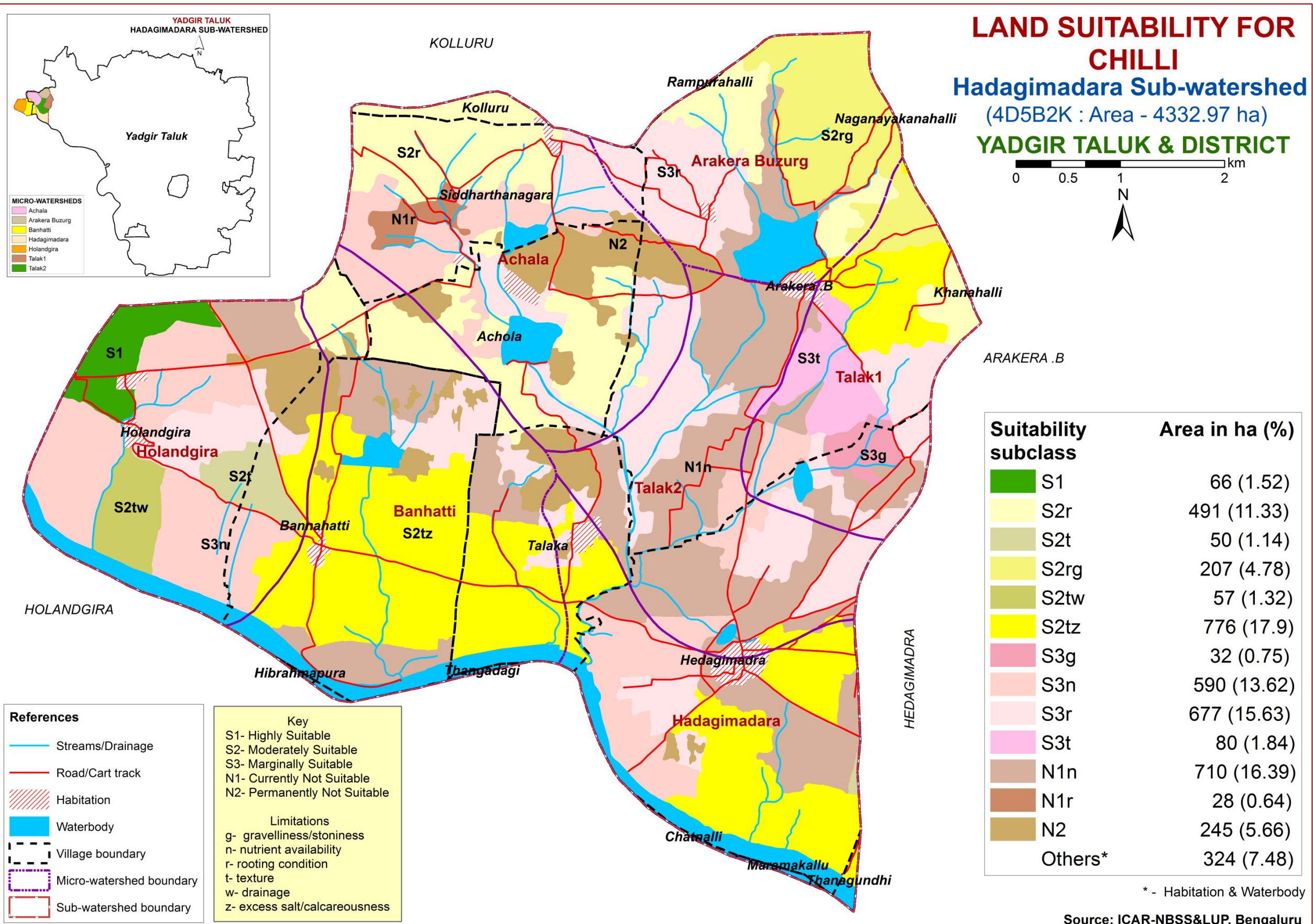
Suitability subclass	Area in ha (%)
S2g	32 (0.75)
S2r	409 (9.43)
S2t	66 (1.52)
S3n	318 (7.33)
S3r	677 (15.63)
S3t	931 (21.49)
S3tn	273 (6.29)
S3tz	320 (7.4)
N1n	710 (16.39)
N1r	28 (0.64)
N2	245 (5.66)
Others*	324 (7.48)



* - Habitation & Waterbody

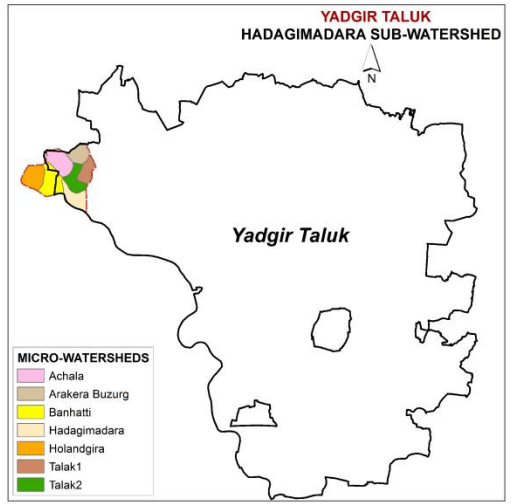
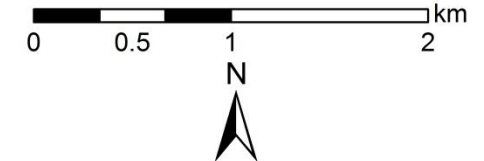
Source: ICAR-NBSS&LUP, Bengaluru

7.10. Land Suitability for Chilli

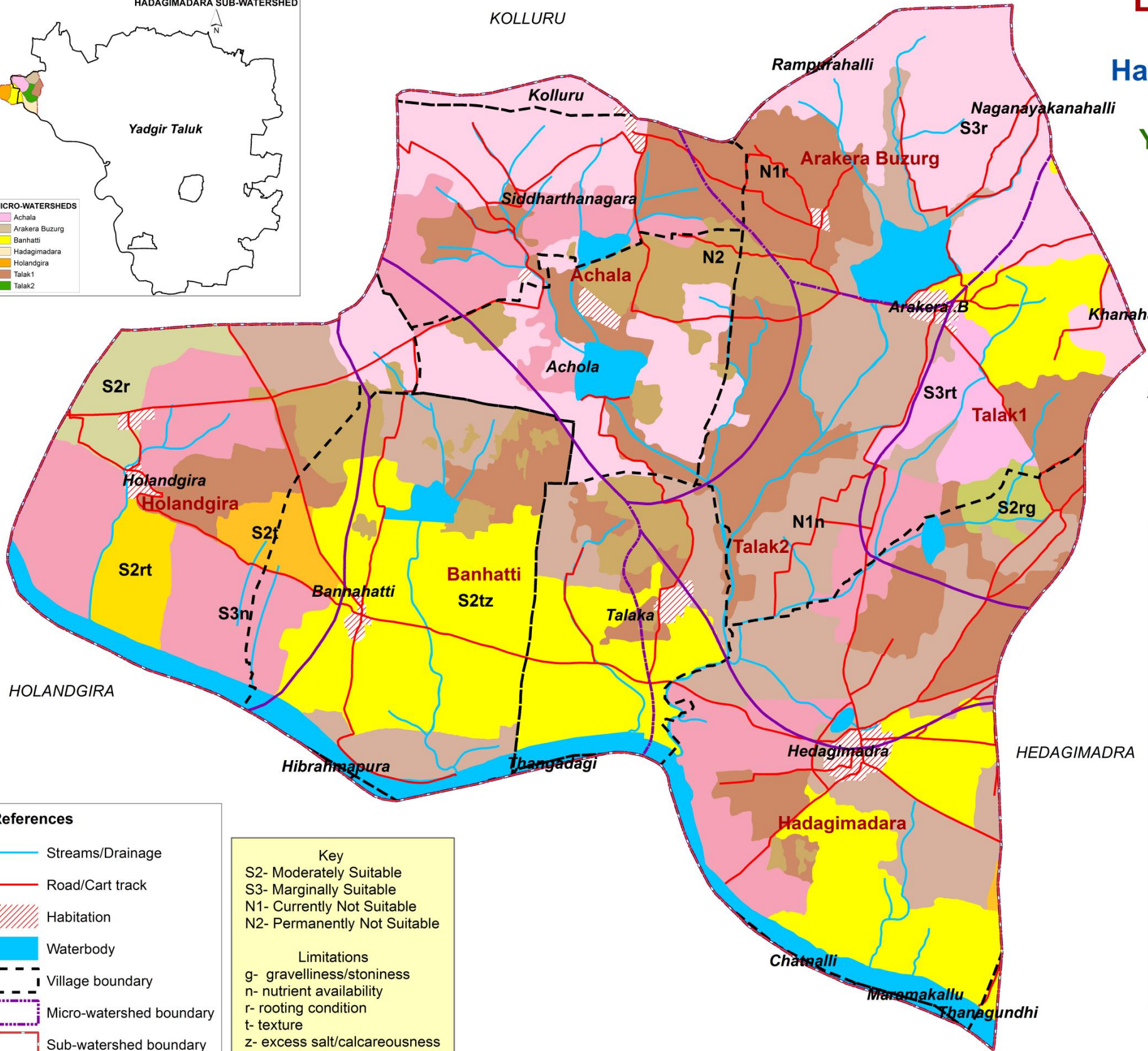


7.11. Land Suitability for Pomegranate

LAND SUITABILITY FOR POMEGRANATE Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha) YADGIR TALUK & DISTRICT



- MICRO-WATERSHEDS**
- Achala
 - Arakera Buzurg
 - Banhatti
 - Hadagimadara
 - Holandgira
 - Talak1
 - Talak2



Suitability subclass	Area in ha (%)
S2r	66 (1.52)
S2t	50 (1.14)
S2rg	32 (0.75)
S2rt	57 (1.32)
S2tz	776 (17.9)
S3n	590 (13.62)
S3r	698 (16.11)
S3rt	80 (1.84)
N1n	710 (16.39)
N1r	705 (16.27)
N2	245 (5.66)
Others*	324 (7.48)

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

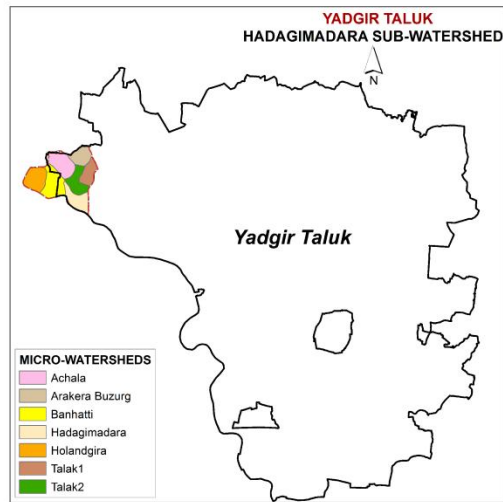
- Key**
- S2- Moderately Suitable
 - S3- Marginally Suitable
 - N1- Currently Not Suitable
 - N2- Permanently Not Suitable
- Limitations**
- g- gravelliness/stoniness
 - n- nutrient availability
 - r- rooting condition
 - t- texture
 - z- excess salt/calcareousness

* - Habitation & Waterbody

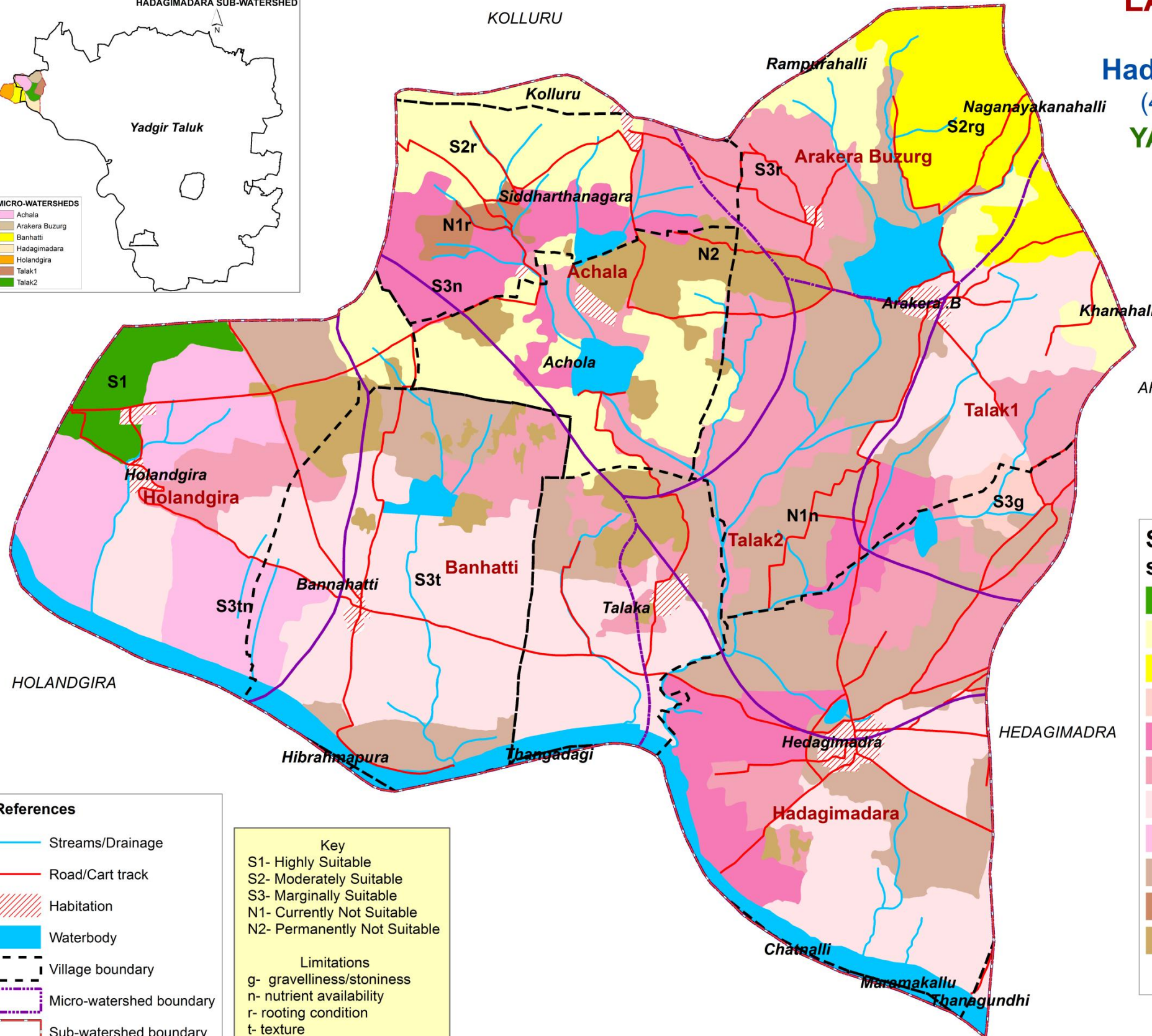
Source: ICAR-NBSS&LUP, Bengaluru

7.12. Land Suitability for Tomato

LAND SUITABILITY FOR TOMATO Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha) YADGIR TALUK & DISTRICT



- MICRO-WATERSHEDS**
- Achala
 - Arakera Buzurg
 - Banhatti
 - Hadagimadara
 - Holandgira
 - Talak1
 - Talak2



Suitability subclass	Area in ha (%)
S1	66 (1.52)
S2r	491 (11.33)
S2rg	207 (4.78)
S3g	32 (0.75)
S3n	318 (7.33)
S3r	677 (15.63)
S3t	962 (22.21)
S3tn	273 (6.29)
N1n	710 (16.39)
N1r	28 (0.64)
N2	245 (5.66)
Others*	324 (7.48)

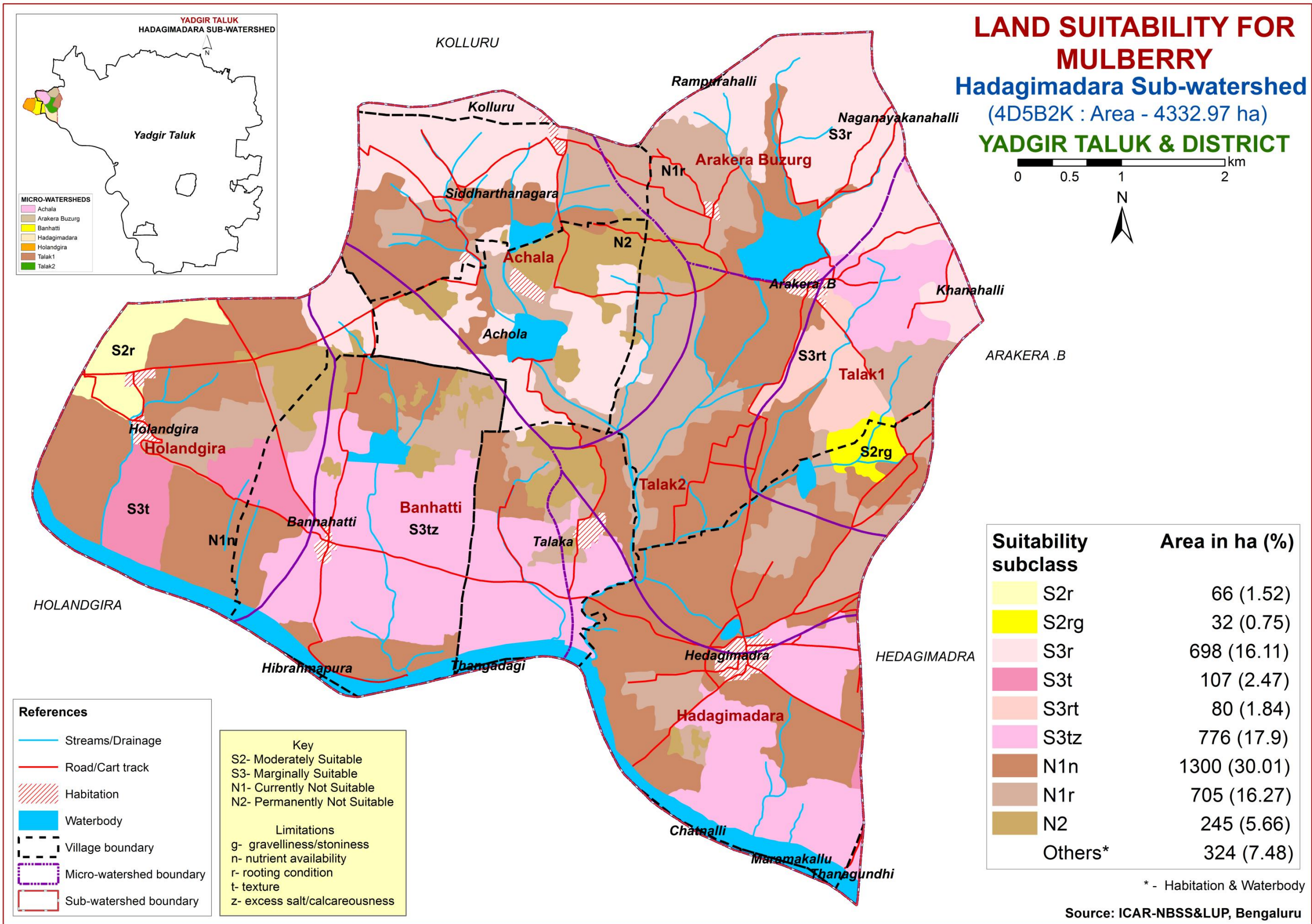
- References**
- Streams/Drainage
 - Road/Cart track
 - Habitation
 - Waterbody
 - Village boundary
 - Micro-watershed boundary
 - Sub-watershed boundary

- 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

* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

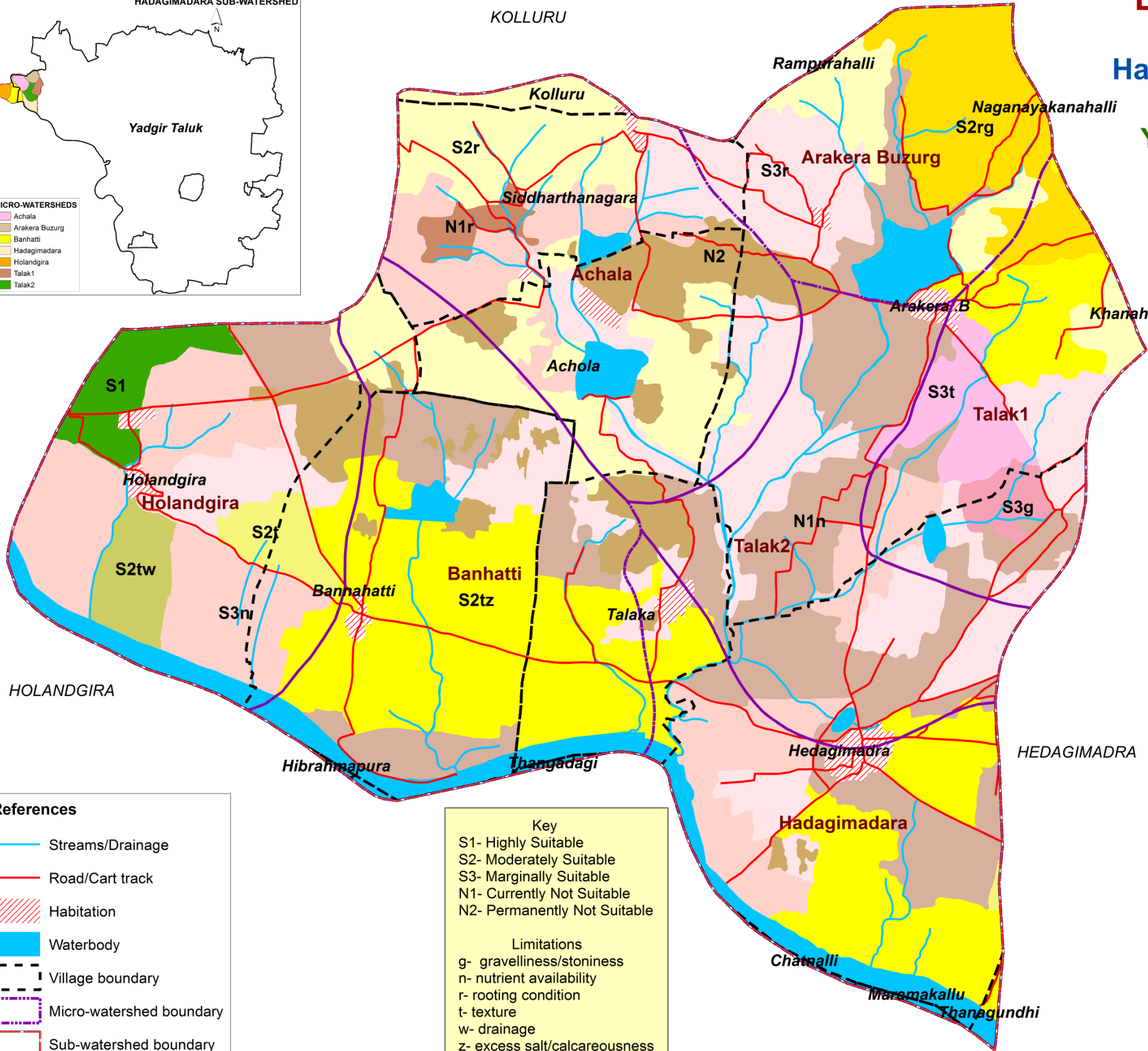
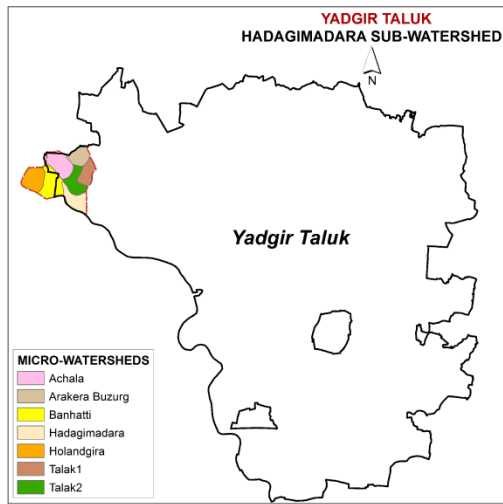
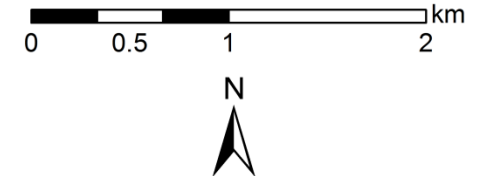
7.13. Land Suitability for Mulberry



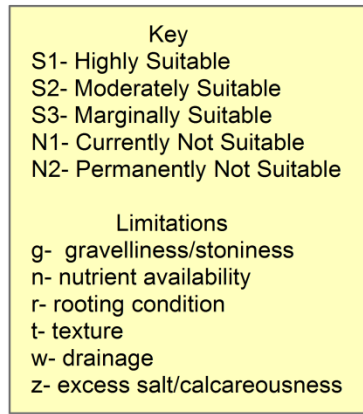
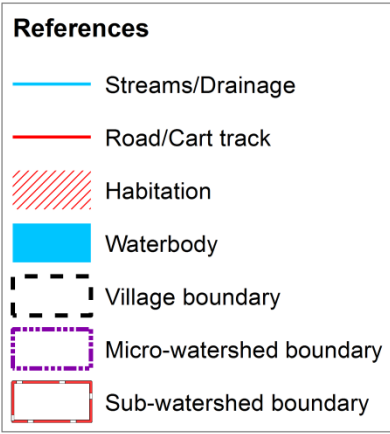
NOTE: Mulberry suitability evaluation only for mulberry leaf, not for silkworm rearing

7.14. Land Suitability for Bhendi

LAND SUITABILITY FOR BHENDI Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha) YADGIR TALUK & DISTRICT



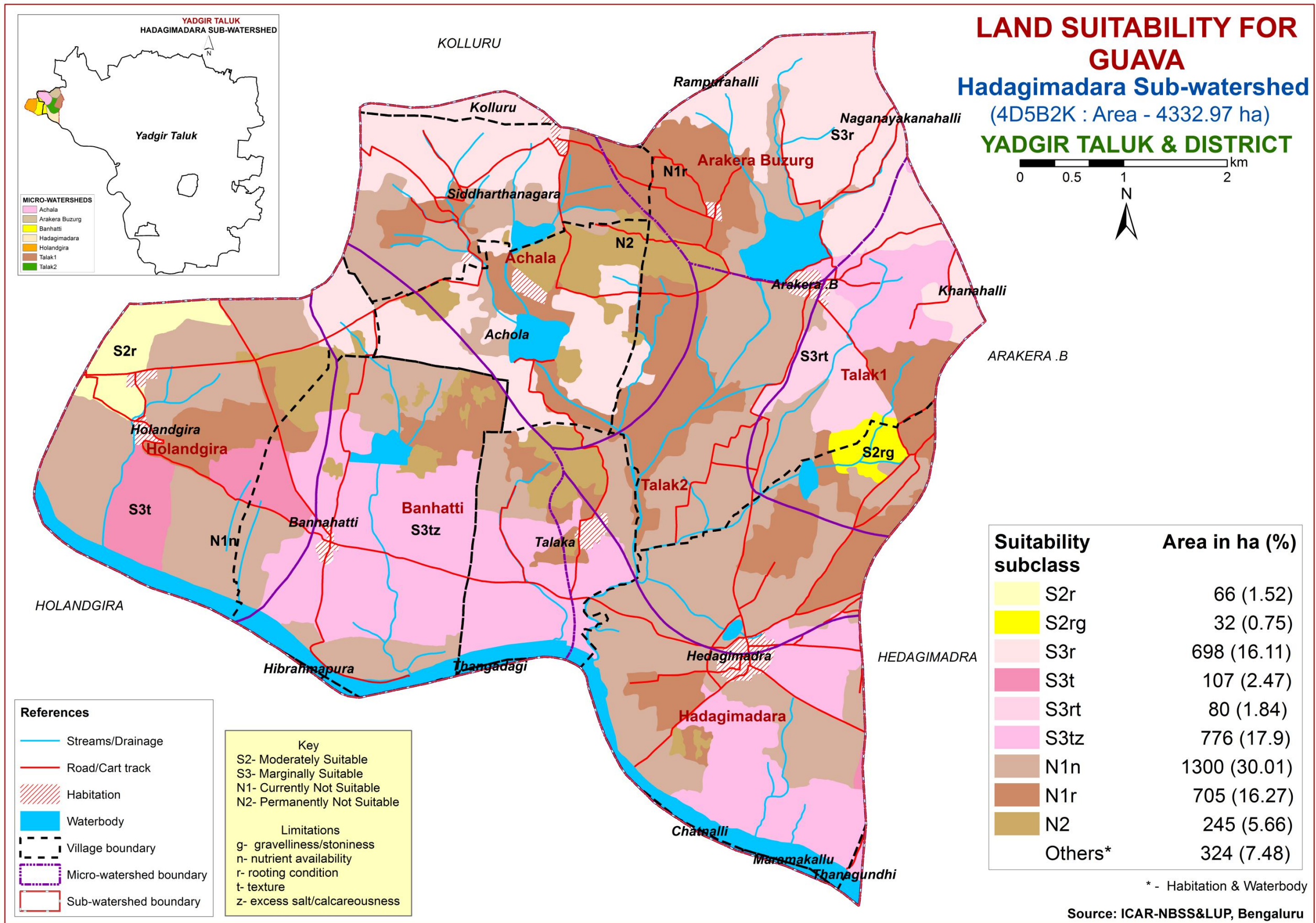
Suitability subclass	Area in ha (%)
S1	66 (1.52)
S2r	491 (11.33)
S2t	50 (1.14)
S2rg	207 (4.78)
S2tw	57 (1.32)
S2tz	776 (17.9)
S3g	32 (0.75)
S3n	590 (13.62)
S3r	677 (15.63)
S3t	80 (1.84)
N1n	710 (16.39)
N1r	28 (0.64)
N2	245 (5.66)
Others*	324 (7.48)



* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

7.15. Land Suitability for Guava

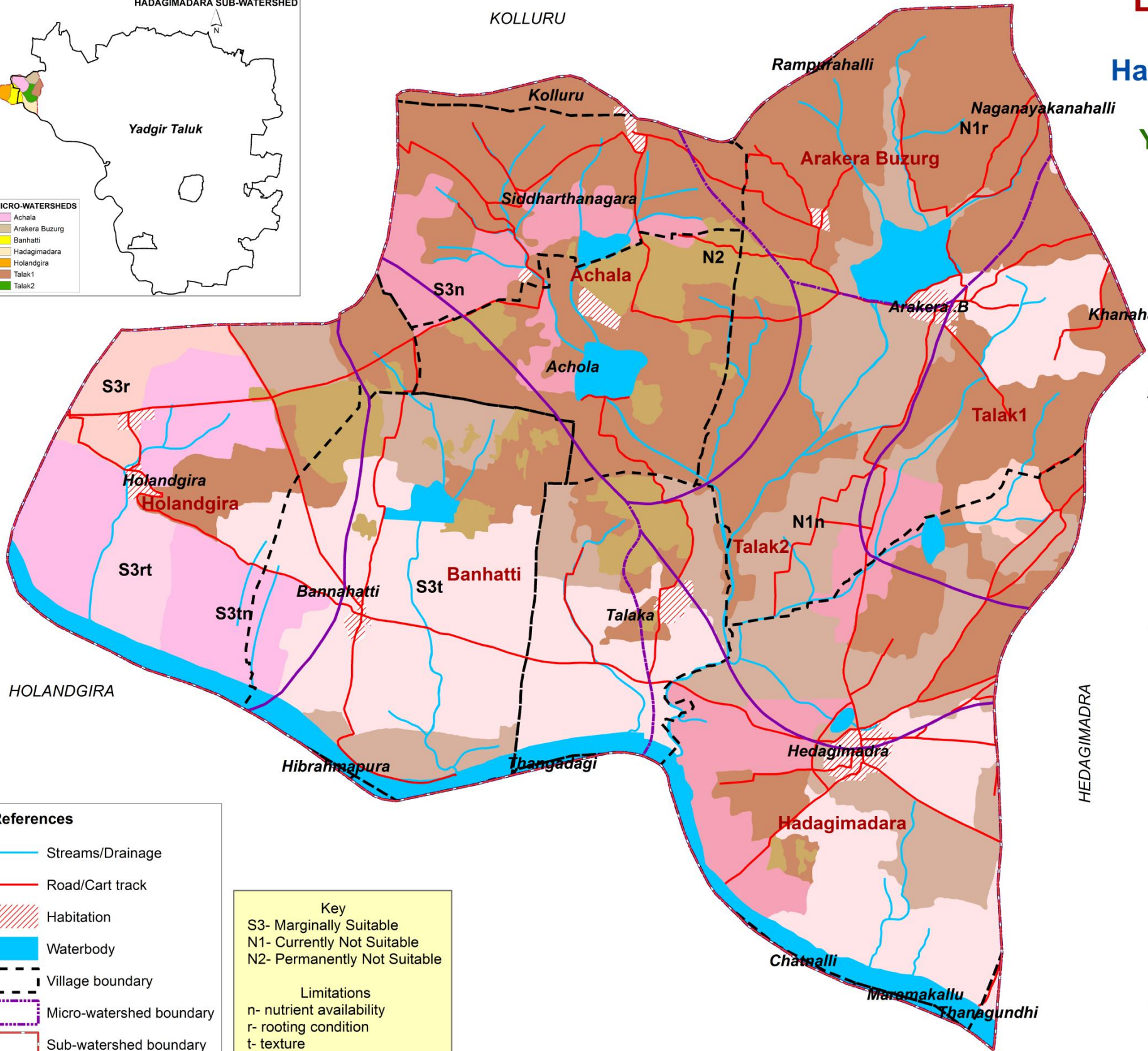
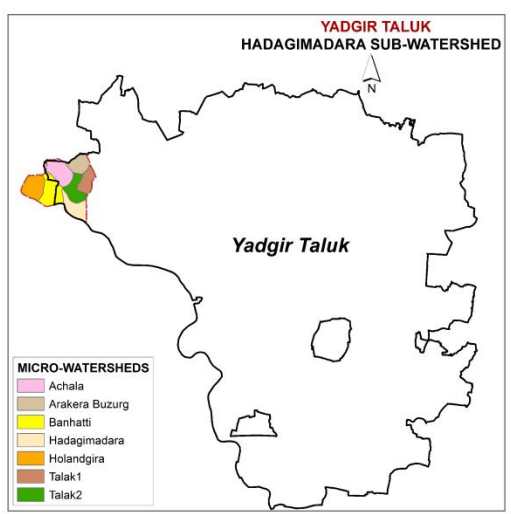
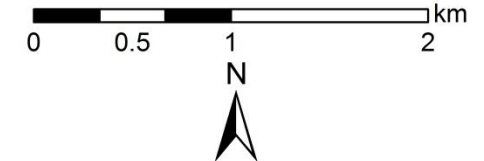


* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

7.16. Land Suitability for Mango

LAND SUITABILITY FOR MANGO Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha) YADGIR TALUK & DISTRICT



Suitability subclass	Area in ha (%)
S3n	318 (7.33)
S3r	98 (2.27)
S3t	825 (19.04)
S3rt	57 (1.32)
S3tn	273 (6.29)
N1n	710 (16.39)
N1r	1483 (34.23)
N2	245 (5.66)
Others*	324 (7.48)

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

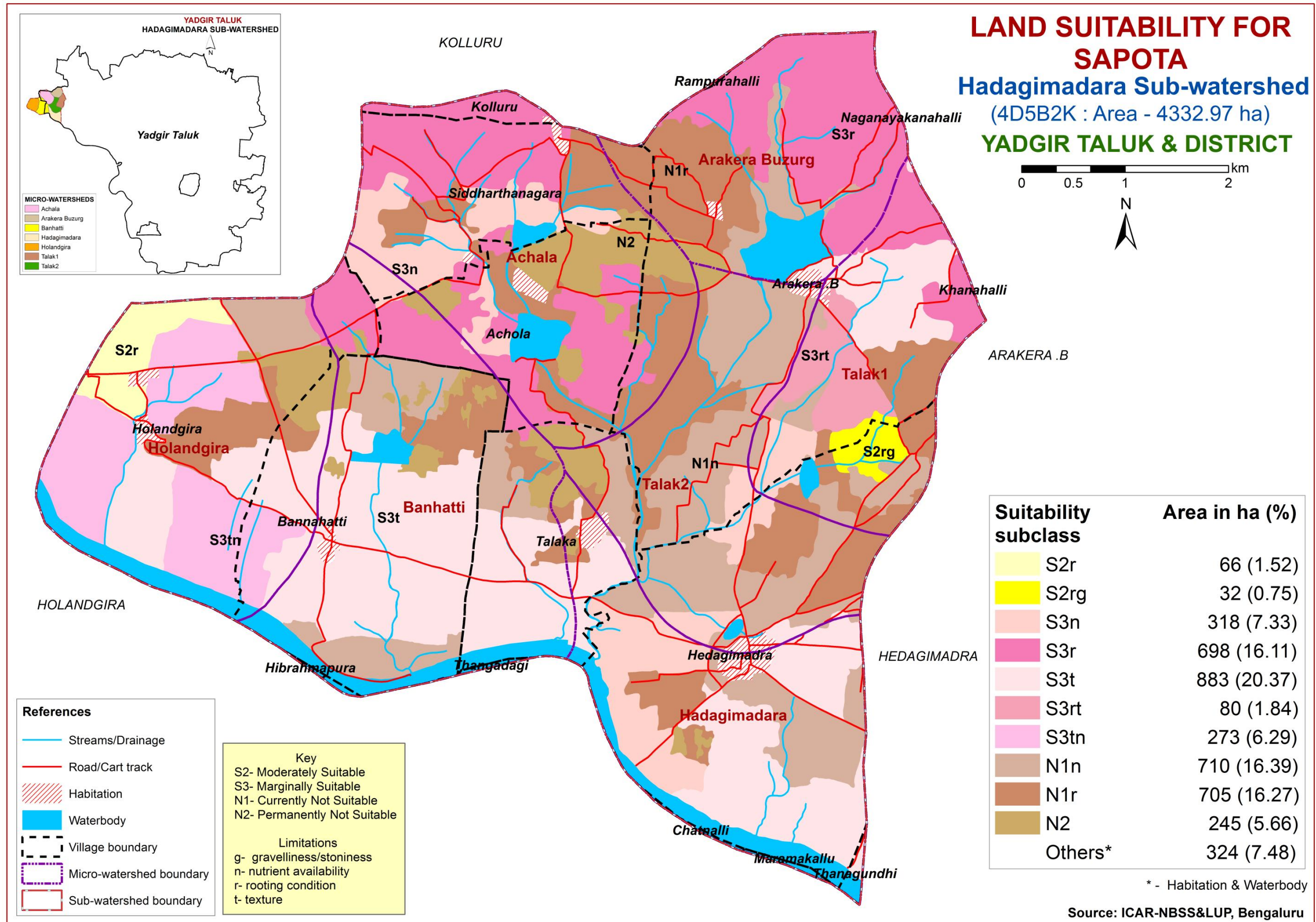
Key
 S3- Marginally Suitable
 N1- Currently Not Suitable
 N2- Permanently Not Suitable

Limitations
 n- nutrient availability
 r- rooting condition
 t- texture

* - Habitation & Waterbody

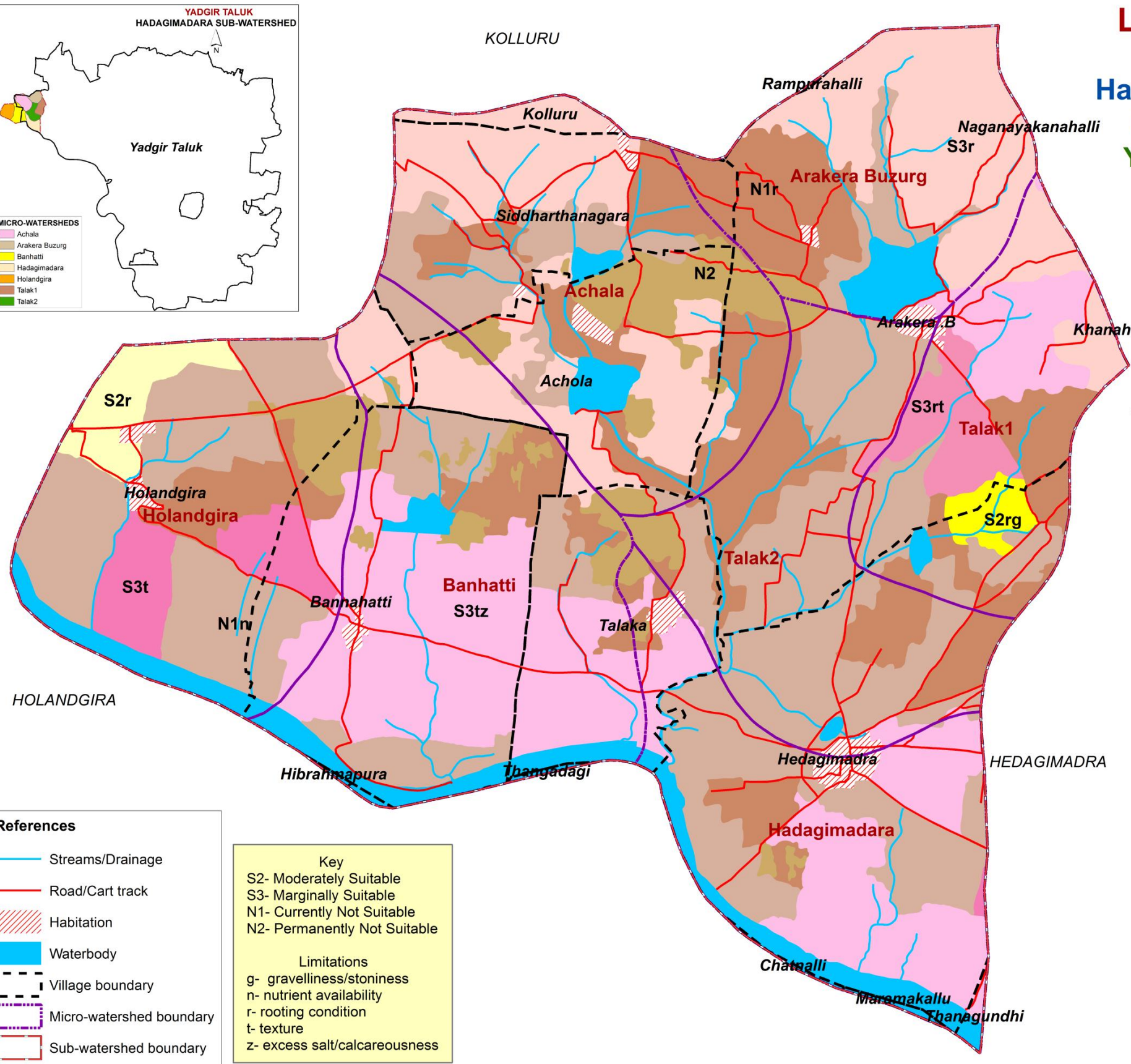
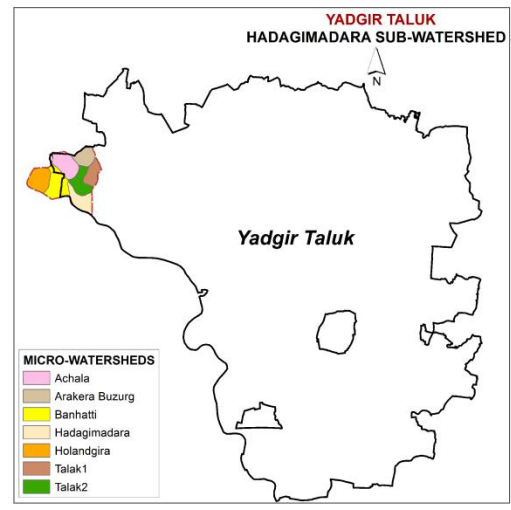
Source: ICAR-NBSS&LUP, Bengaluru

7.2. Land Suitability for Sapota



7.18. Land Suitability for Jackfruit

LAND SUITABILITY FOR JACKFRUIT Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha) YADGIR TALUK & DISTRICT



Suitability subclass	Area in ha (%)
S2r	66 (1.52)
S2rg	32 (0.75)
S3r	698 (16.11)
S3t	107 (2.47)
S3rt	80 (1.84)
S3tz	776 (17.9)
N1n	1300 (30.01)
N1r	705 (16.27)
N2	245 (5.66)
Others*	324 (7.48)

* - Habitation & Waterbody

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

- Key**
- 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

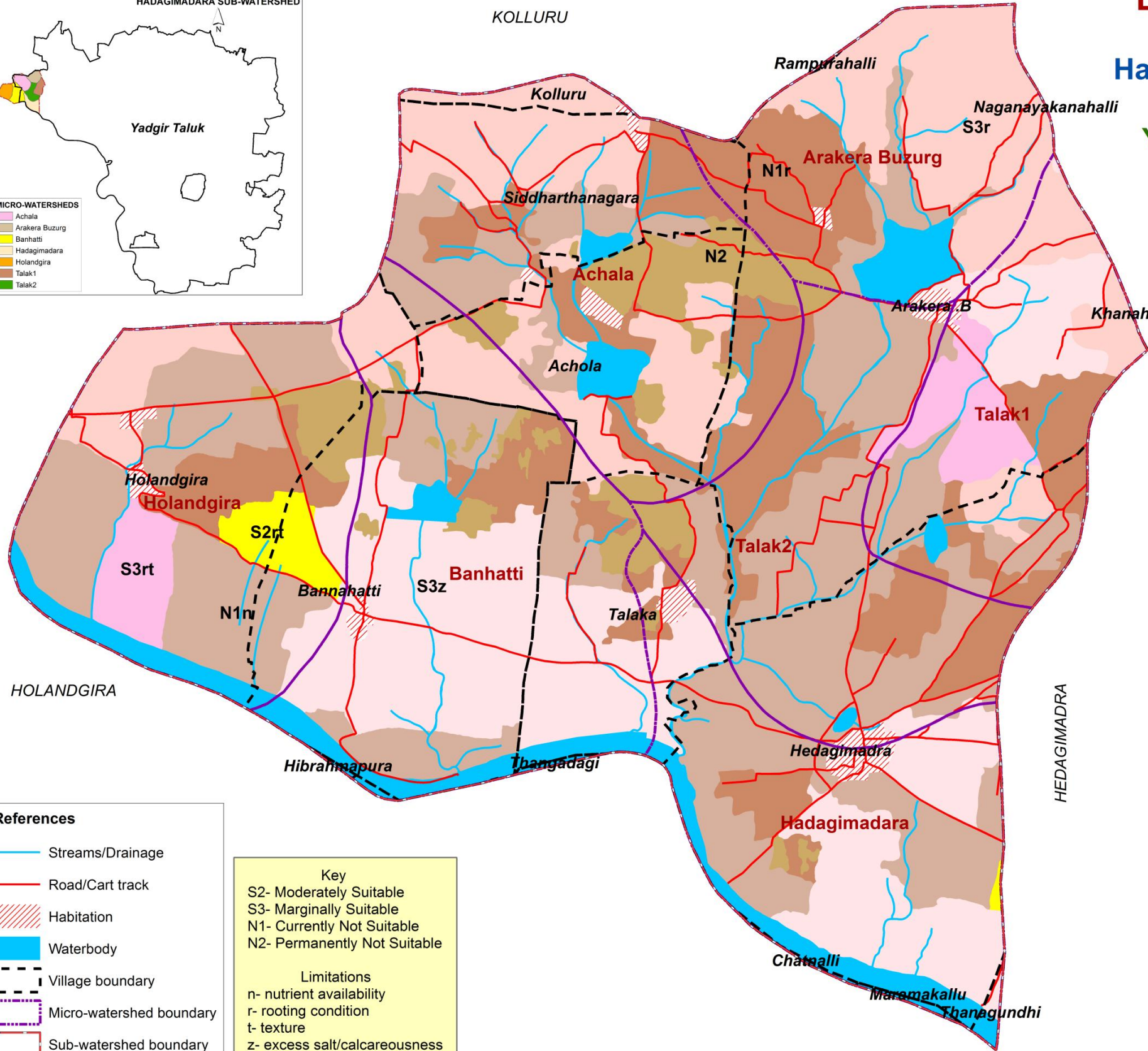
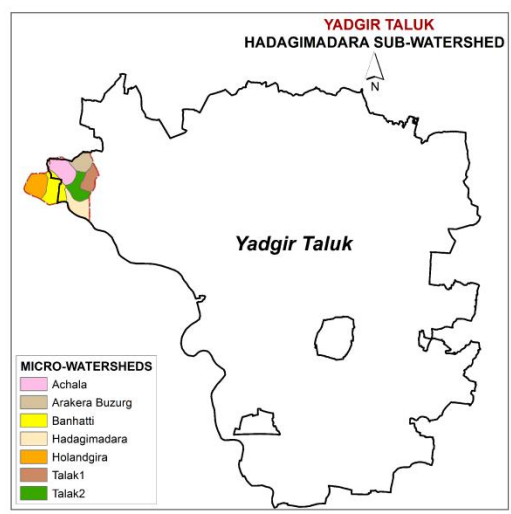
Source: ICAR-NBSS&LUP, Bengaluru

7.19. Land Suitability for Jamun

LAND SUITABILITY FOR JAMUN

Hadagimadara Sub-watershed
(4D5B2K : Area - 4332.97 ha)

YADGIR TALUK & DISTRICT



Suitability subclass	Area in ha (%)
S2rt	50 (1.14)
S3r	796 (18.37)
S3z	776 (17.9)
S3rt	137 (3.17)
N1n	1300 (30.01)
N1r	705 (16.27)
N2	245 (5.66)
Others*	324 (7.48)

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

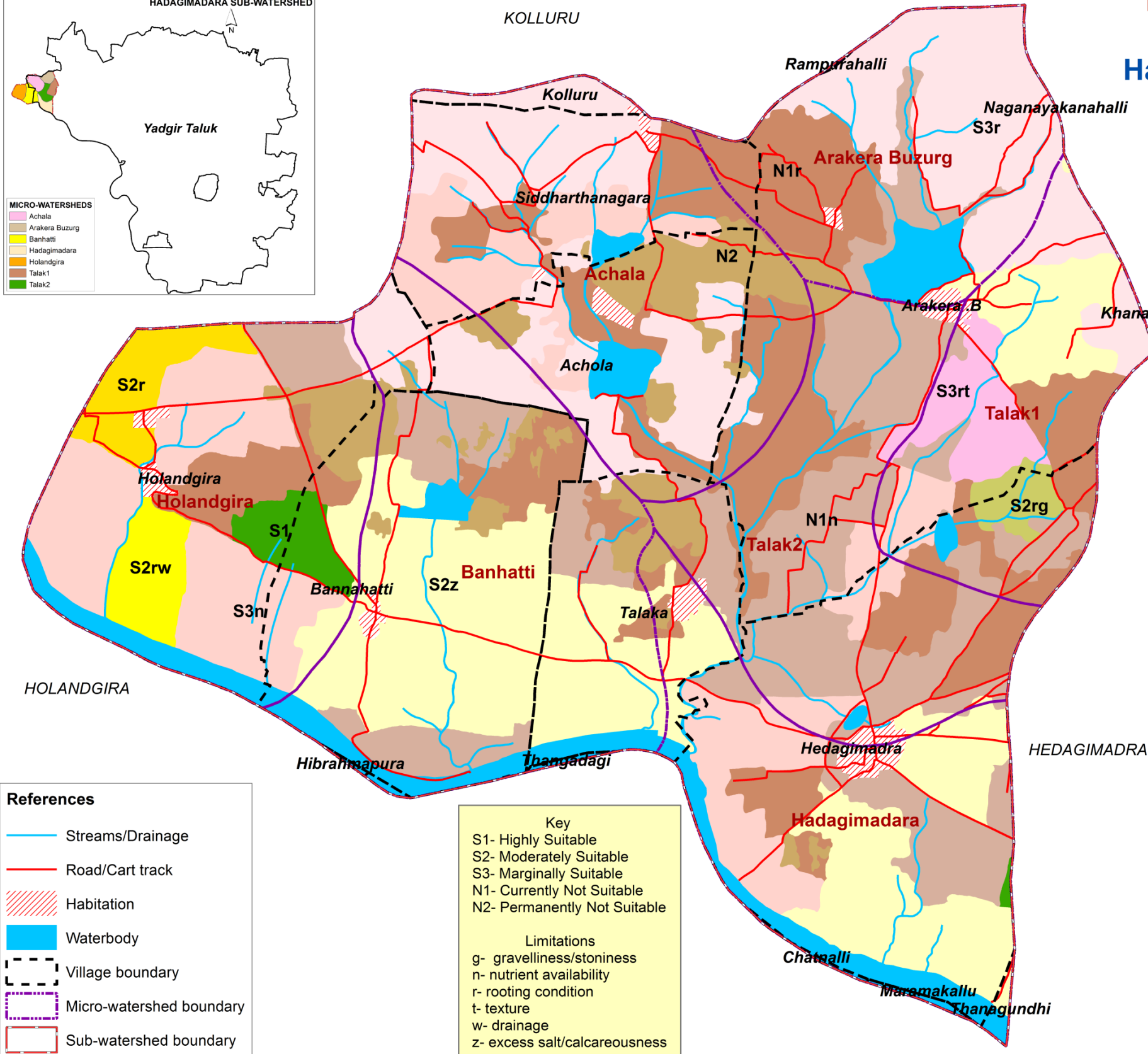
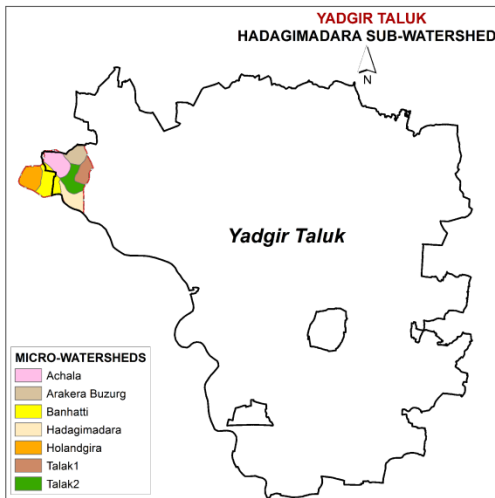
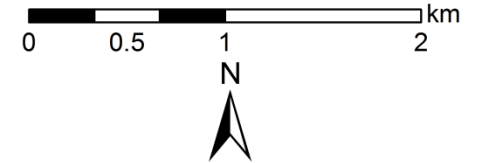
- Key**
- S2- Moderately Suitable
 - S3- Marginally Suitable
 - N1- Currently Not Suitable
 - N2- Permanently Not Suitable
- Limitations**
- n- nutrient availability
 - r- rooting condition
 - t- texture
 - z- excess salt/calcareousness

* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

7.20. Land Suitability for Musambi

LAND SUITABILITY FOR MUSAMBI Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha) YADGIR TALUK & DISTRICT



Suitability subclass	Area in ha (%)
S1	50 (1.14)
S2r	66 (1.52)
S2z	776 (17.9)
S2rg	32 (0.75)
S2rw	57 (1.32)
S3n	590 (13.62)
S3r	698 (16.11)
S3rt	80 (1.84)
N1n	710 (16.39)
N1r	705 (16.27)
N2	245 (5.66)
Others*	324 (7.48)

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

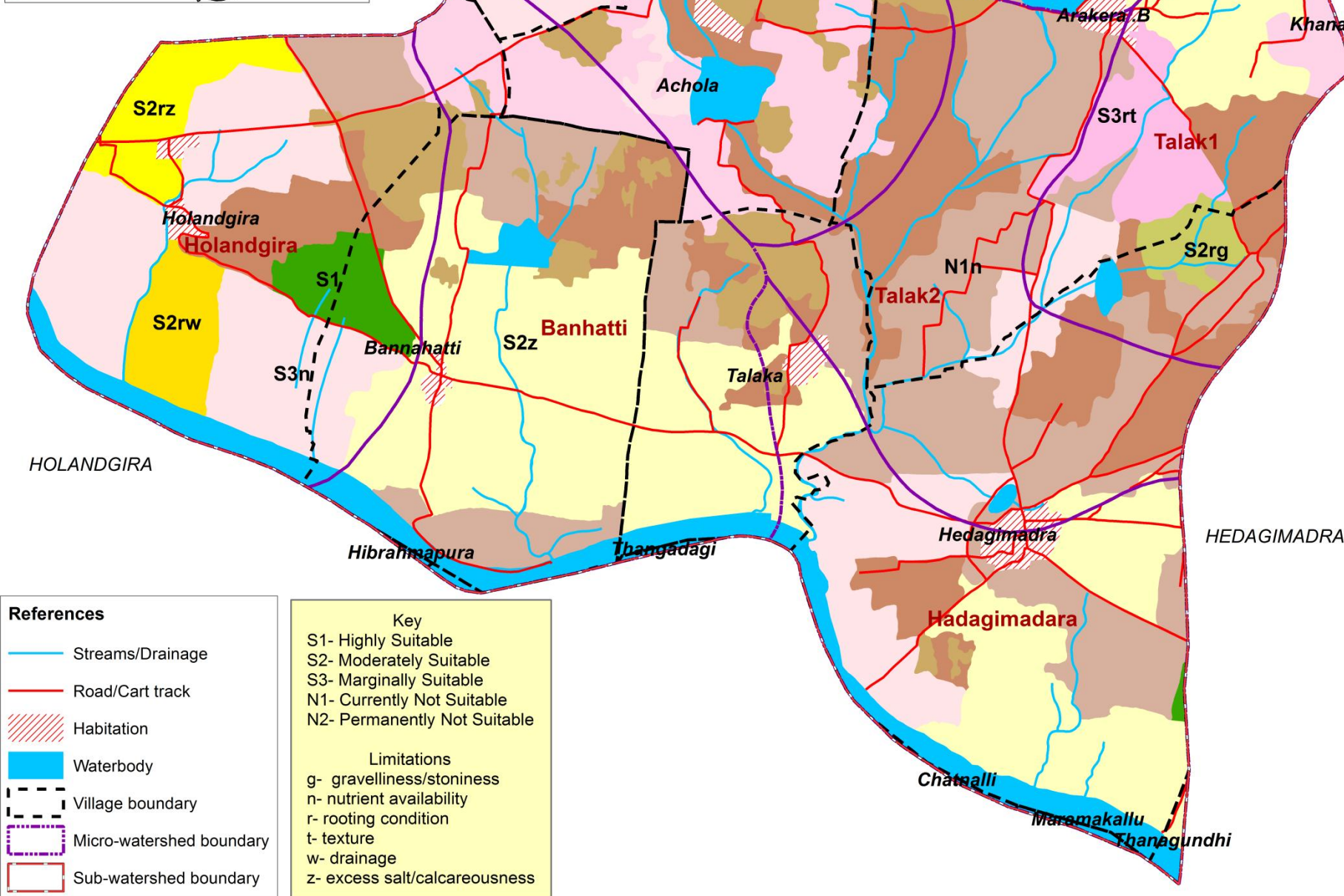
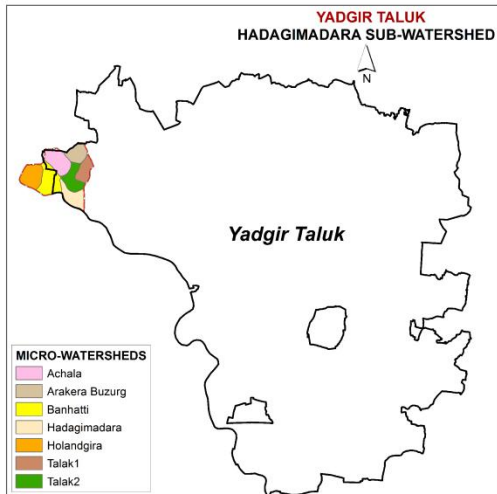
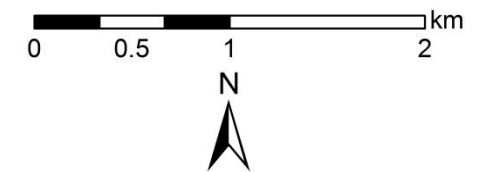
- Key**
- S1- Highly Suitable
 - S2- Moderately Suitable
 - S3- Marginally Suitable
 - N1- Currently Not Suitable
 - N2- Permanently Not Suitable
- Limitations**
- g- gravelliness/stoniness
 - n- nutrient availability
 - r- rooting condition
 - t- texture
 - w- drainage
 - z- excess salt/calcareousness

* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

7.21. Land Suitability for Lime

LAND SUITABILITY FOR LIME Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha) YADGIR TALUK & DISTRICT



Suitability subclass	Area in ha (%)
S1	50 (1.14)
S2z	776 (17.9)
S2rg	32 (0.75)
S2rw	57 (1.32)
S2rz	66 (1.52)
S3n	590 (13.62)
S3r	698 (16.11)
S3rt	80 (1.84)
N1n	710 (16.39)
N1r	705 (16.27)
N2	245 (5.66)
Others*	324 (7.48)

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

- 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
 - w- drainage
 - z- excess salt/calcareousness

* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

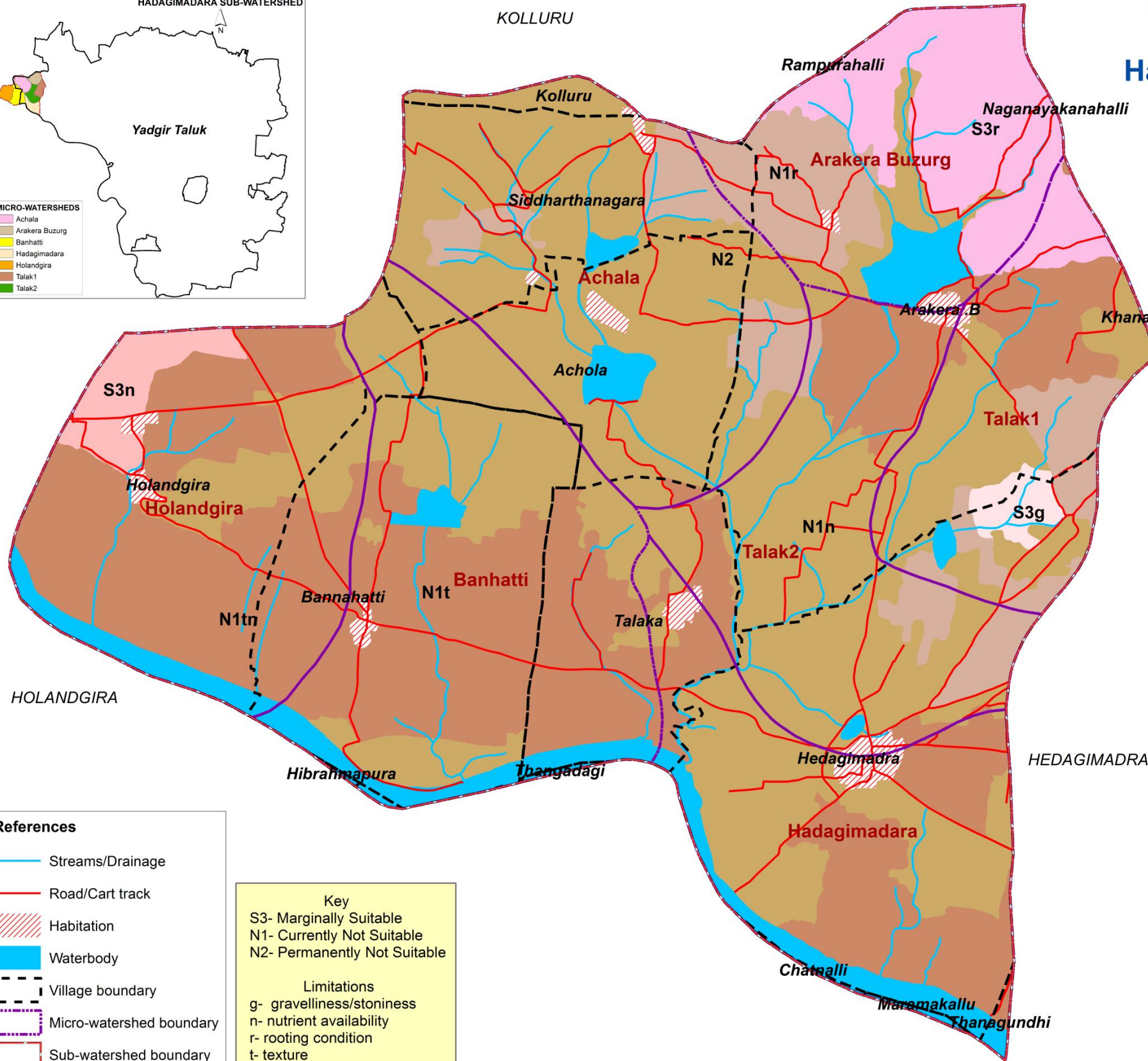
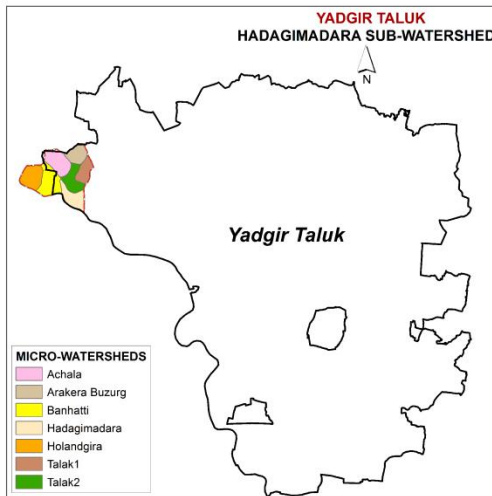
7.22. Land Suitability for Cashew

LAND SUITABILITY FOR CASHEW

Hadagimadara Sub-watershed

(4D5B2K : Area - 4332.97 ha)

YADGIR TALUK & DISTRICT



Suitability subclass	Area in ha (%)
S3g	32 (0.75)
S3n	66 (1.52)
S3r	289 (6.68)
N1n	1645 (37.97)
N1r	379 (8.75)
N1t	825 (19.04)
N1tn	527 (12.16)
N2	245 (5.66)
Others*	324 (7.48)

* - Habitation & Waterbody

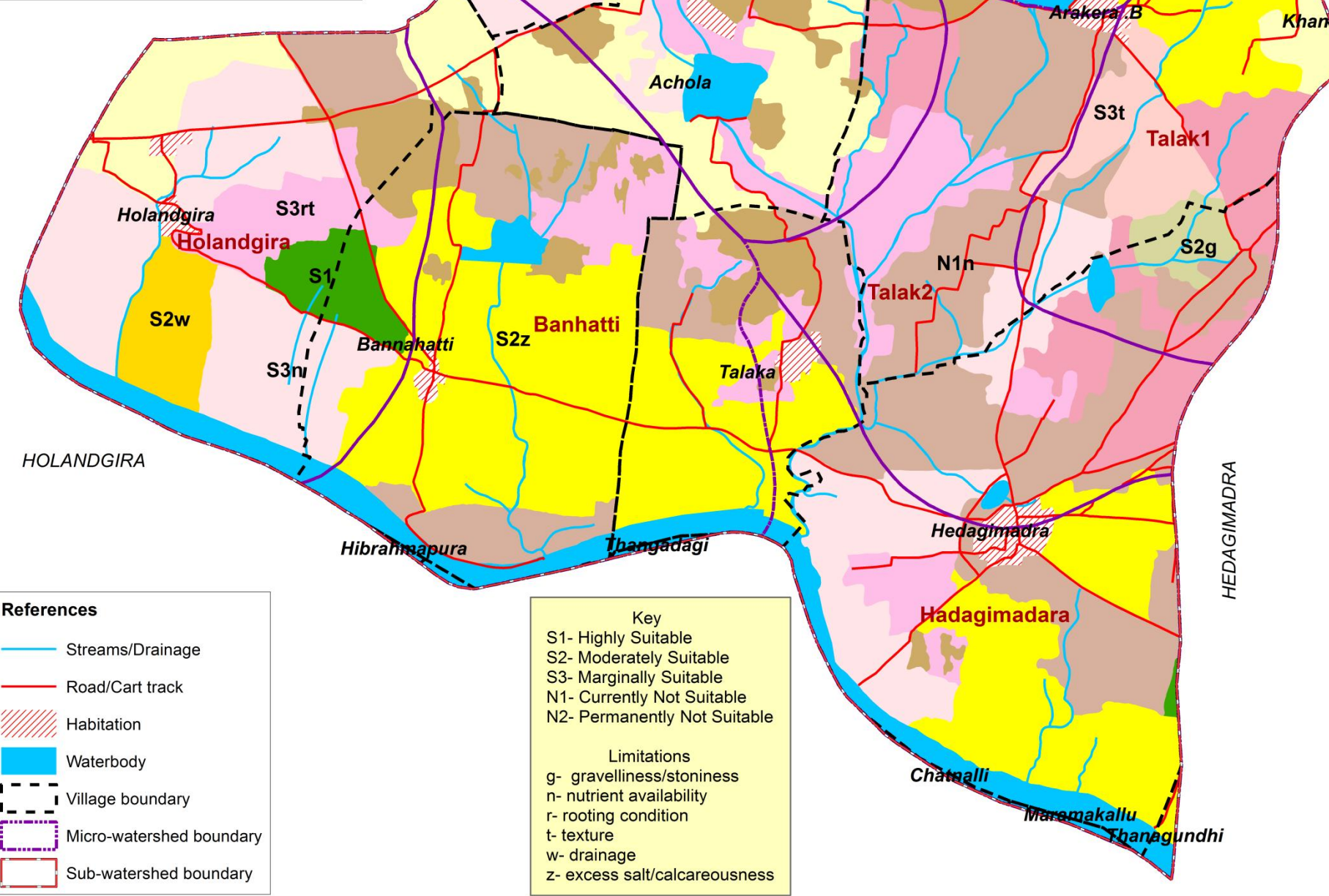
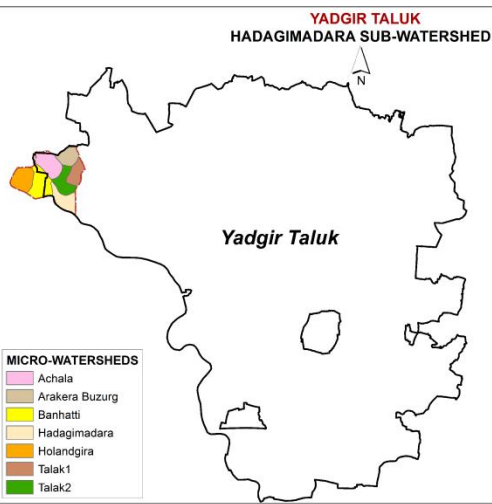
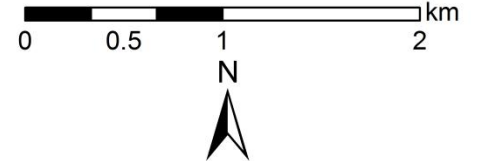
- References**
- Streams/Drainage
 - Road/Cart track
 - Habitation
 - Waterbody
 - Village boundary
 - Micro-watershed boundary
 - Sub-watershed boundary

- Key**
- S3- Marginally Suitable
 - N1- Currently Not Suitable
 - N2- Permanently Not Suitable
- Limitations**
- g- gravelliness/stoniness
 - n- nutrient availability
 - r- rooting condition
 - t- texture

Source: ICAR-NBSS&LUP, Bengaluru

7.23. Land Suitability for Custard Apple

LAND SUITABILITY FOR CUSTARD APPLE Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha) YADGIR TALUK & DISTRICT



Suitability subclass	Area in ha (%)
S1	50 (1.14)
S2g	32 (0.75)
S2r	764 (17.63)
S2w	57 (1.32)
S2z	776 (17.9)
S3n	590 (13.62)
S3r	351 (8.1)
S3t	80 (1.84)
S3rt	326 (7.53)
N1n	710 (16.39)
N1r	28 (0.64)
N2	245 (5.66)
Others*	324 (7.48)

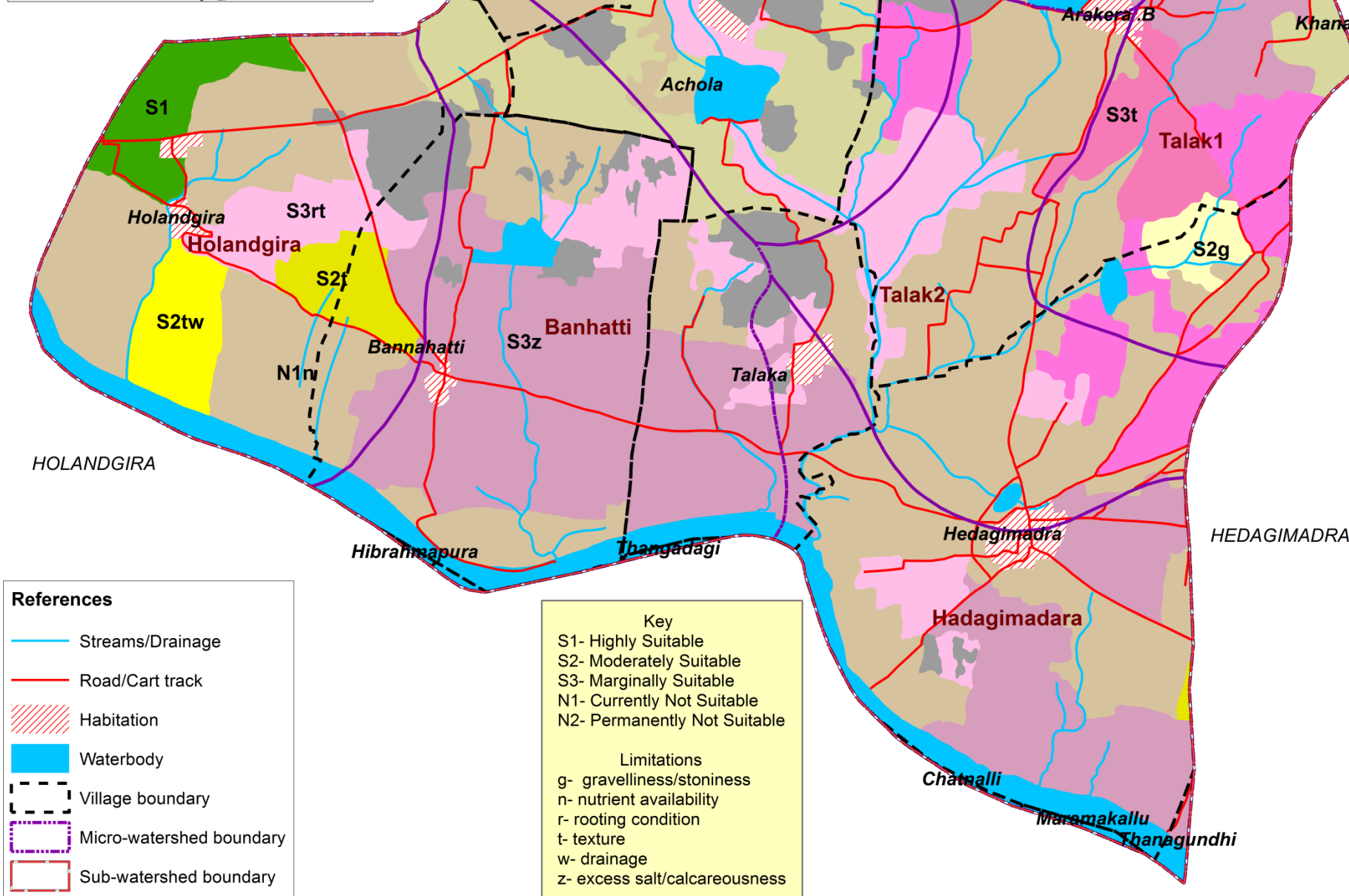
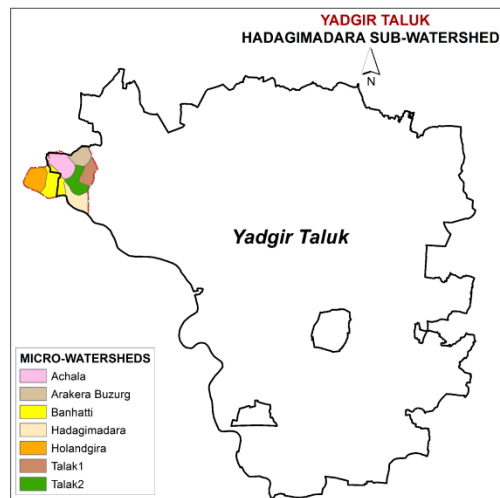
- References**
- Streams/Drainage
 - Road/Cart track
 - Habitation
 - Waterbody
 - Village boundary
 - Micro-watershed boundary
 - Sub-watershed boundary

- 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
 - w- drainage
 - z- excess salt/calcareousness

* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

7.24. Land Suitability for Amla



References

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

Key

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

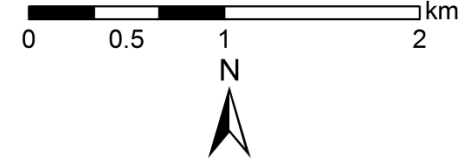
Limitations

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

LAND SUITABILITY FOR AMLA

Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha)

YADGIR TALUK & DISTRICT

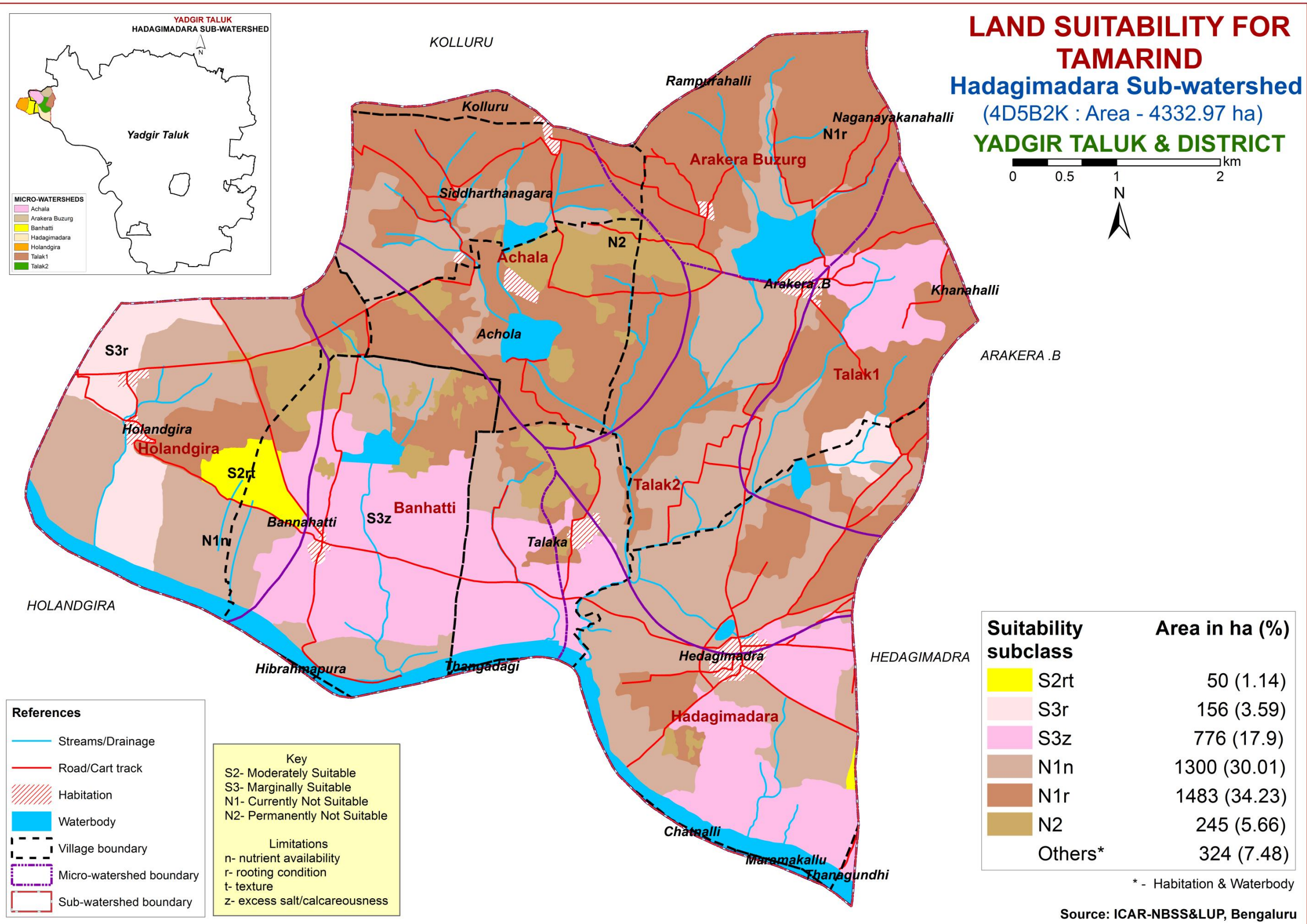


Suitability subclass	Area in ha (%)
S1	66 (1.52)
S2g	32 (0.75)
S2r	698 (16.11)
S2t	50 (1.14)
S2tw	57 (1.32)
S3r	351 (8.1)
S3t	80 (1.84)
S3z	776 (17.9)
S3rt	326 (7.53)
N1n	1300 (30.01)
N1r	28 (0.64)
N2	245 (5.66)
Others*	324 (7.48)

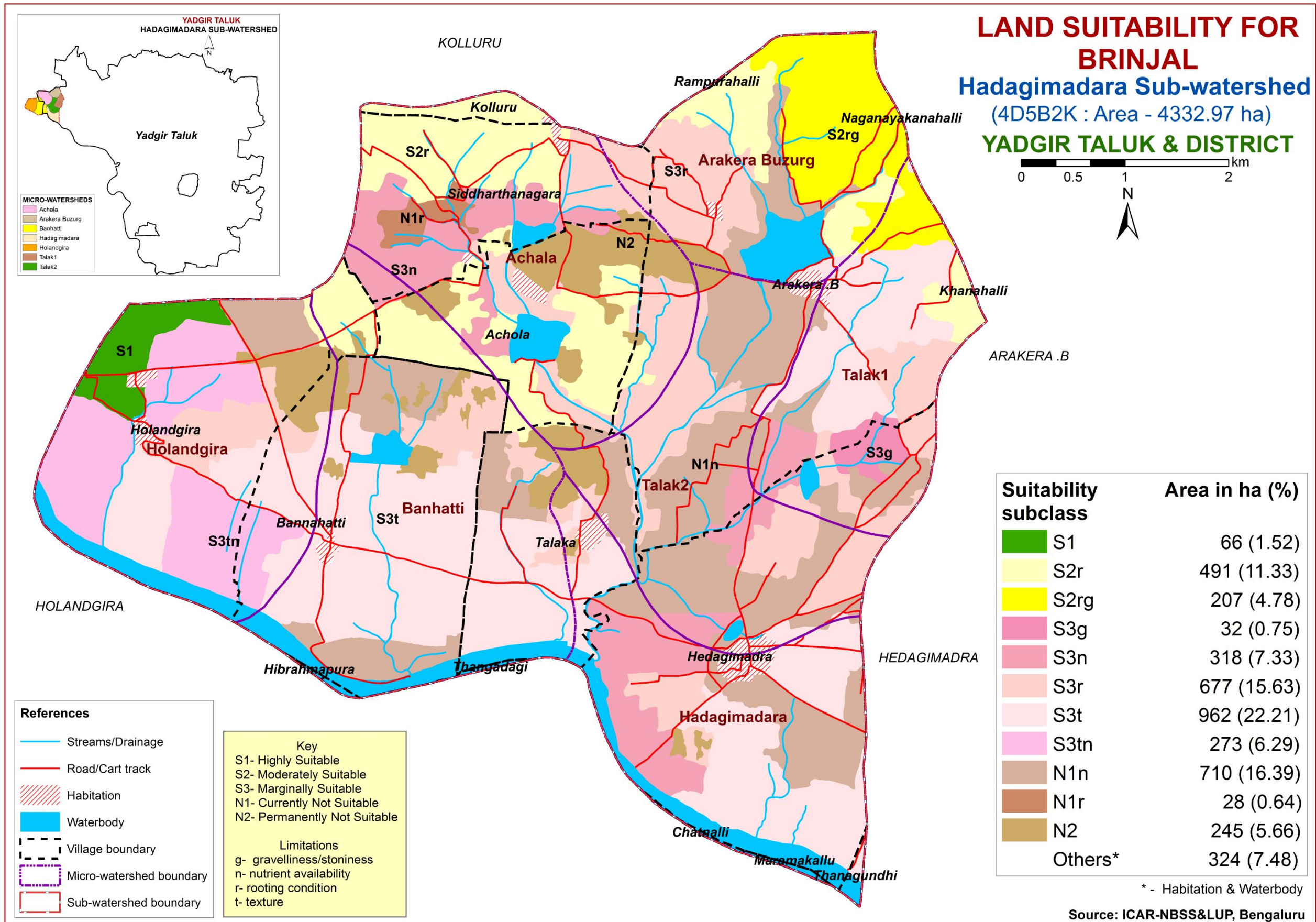
* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

7.25. Land Suitability for Tamarind



7.26. Land Suitability for Brinjal



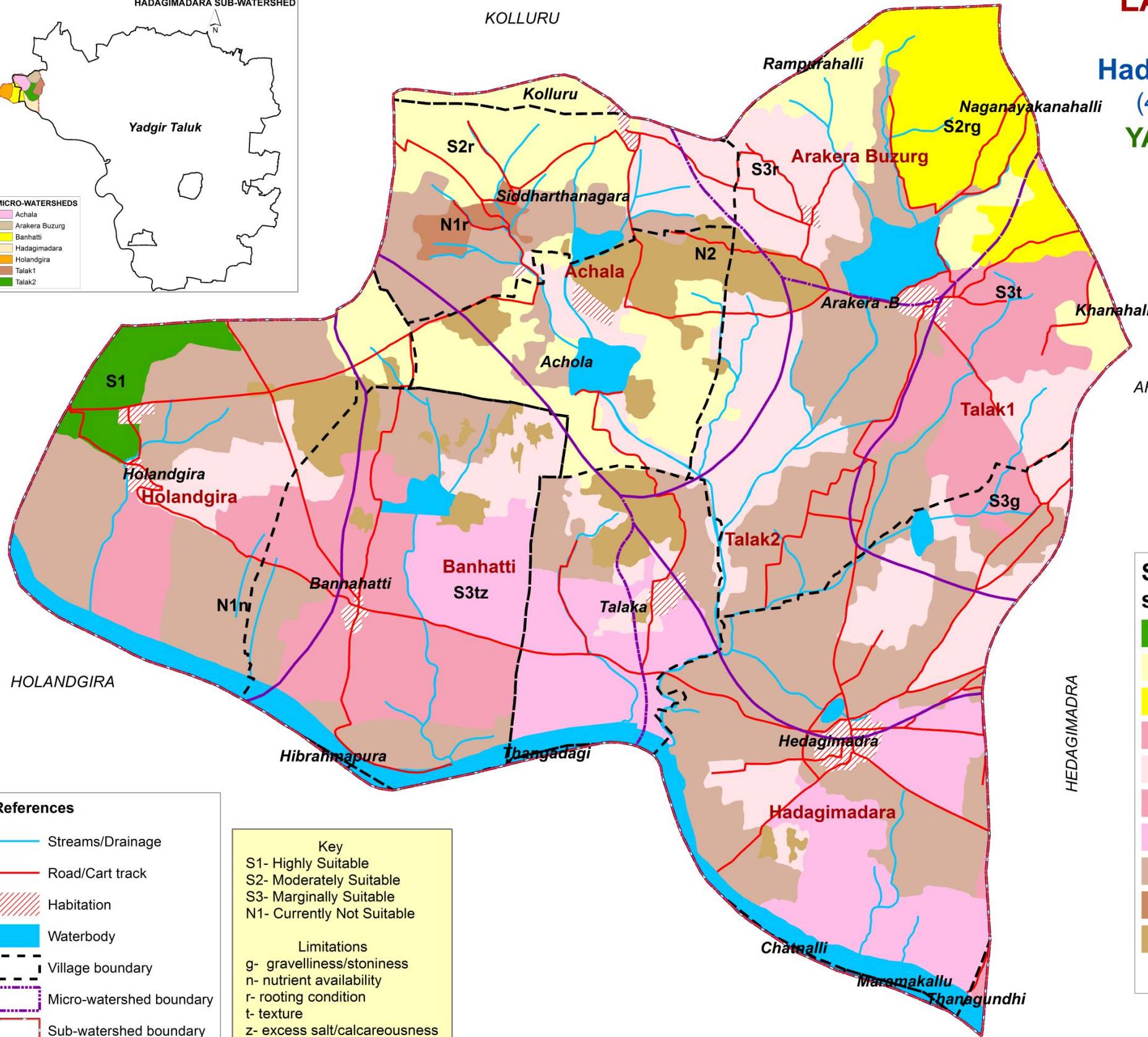
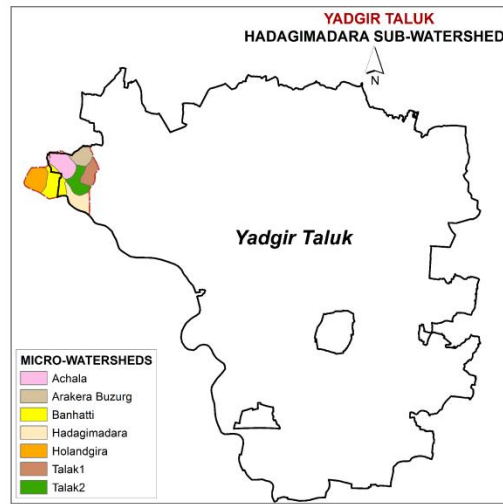
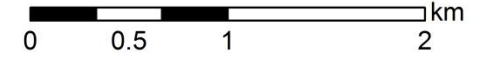
7.27. Land Suitability for Onion

LAND SUITABILITY FOR ONION

Hadagimadara Sub-watershed

(4D5B2K : Area - 4332.97 ha)

YADGIR TALUK & DISTRICT



Suitability subclass	Area in ha (%)
S1	66 (1.52)
S2r	491 (11.33)
S2rg	207 (4.78)
S3g	32 (0.75)
S3r	677 (15.63)
S3t	507 (11.7)
S3tz	455 (10.51)
N1n	1300 (30.01)
N1r	28 (0.64)
N2	245 (5.66)
Others*	324 (7.48)

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

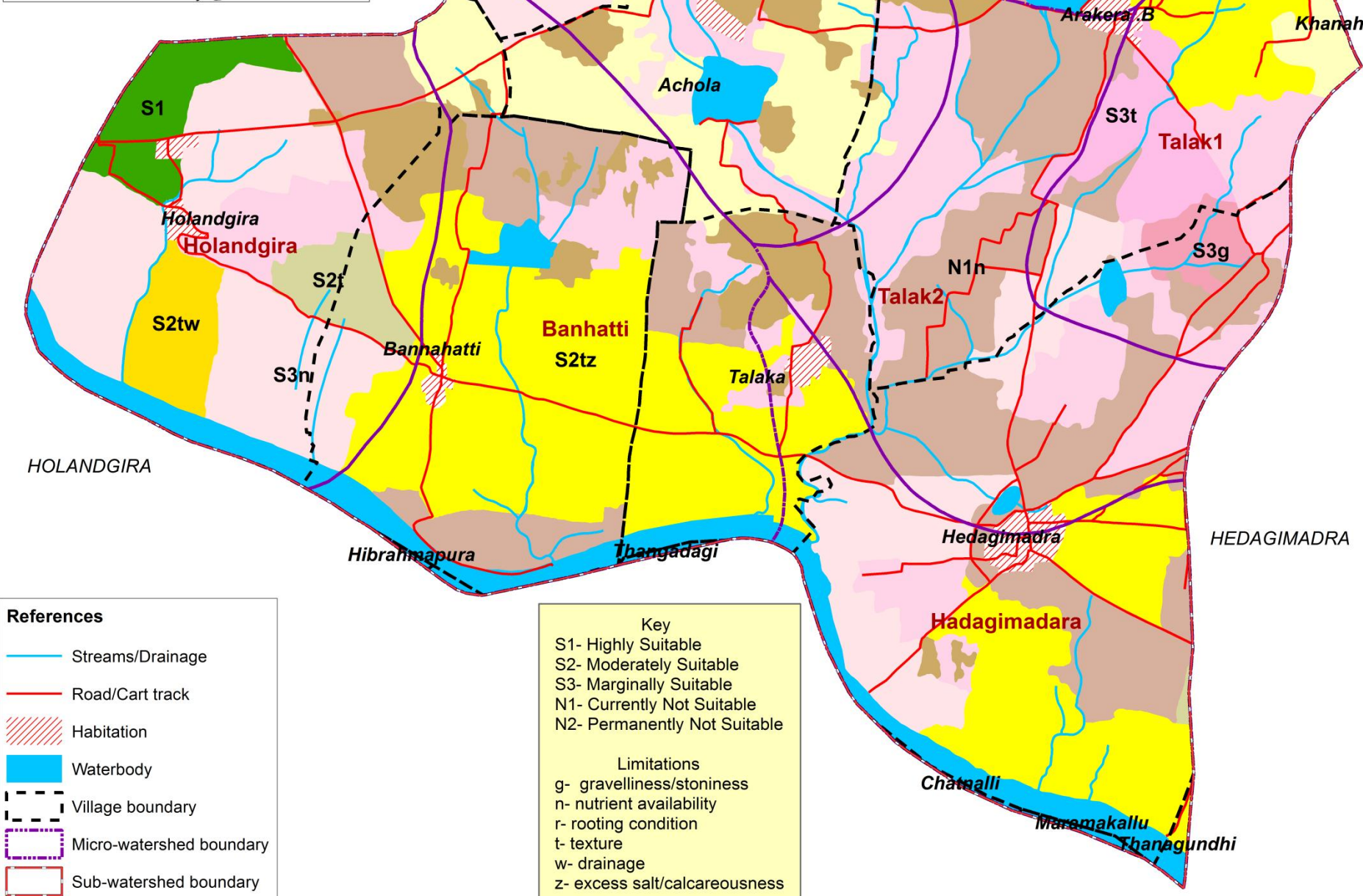
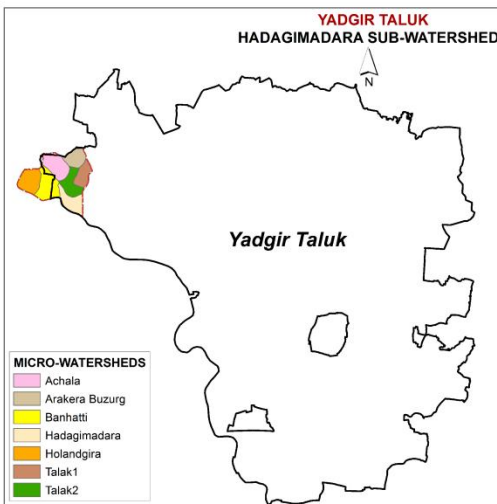
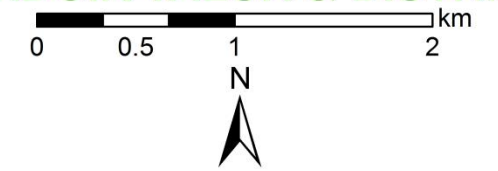
- Key**
- S1- Highly Suitable
 - S2- Moderately Suitable
 - S3- Marginally Suitable
 - N1- Currently Not Suitable
- Limitations**
- g- gravelliness/stoniness
 - n- nutrient availability
 - r- rooting condition
 - t- texture
 - z- excess salt/calcareousness

* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

7.28. Land Suitability for Marigold

LAND SUITABILITY FOR MARIGOLD Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha) YADGIR TALUK & DISTRICT



Suitability subclass	Area in ha (%)
S1	66 (1.52)
S2r	491 (11.33)
S2t	50 (1.14)
S2rg	207 (4.78)
S2tw	57 (1.32)
S2tz	776 (17.9)
S3g	32 (0.75)
S3n	590 (13.62)
S3r	677 (15.63)
S3t	80 (1.84)
N1n	710 (16.39)
N1r	28 (0.64)
N2	245 (5.66)
Others*	324 (7.48)

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

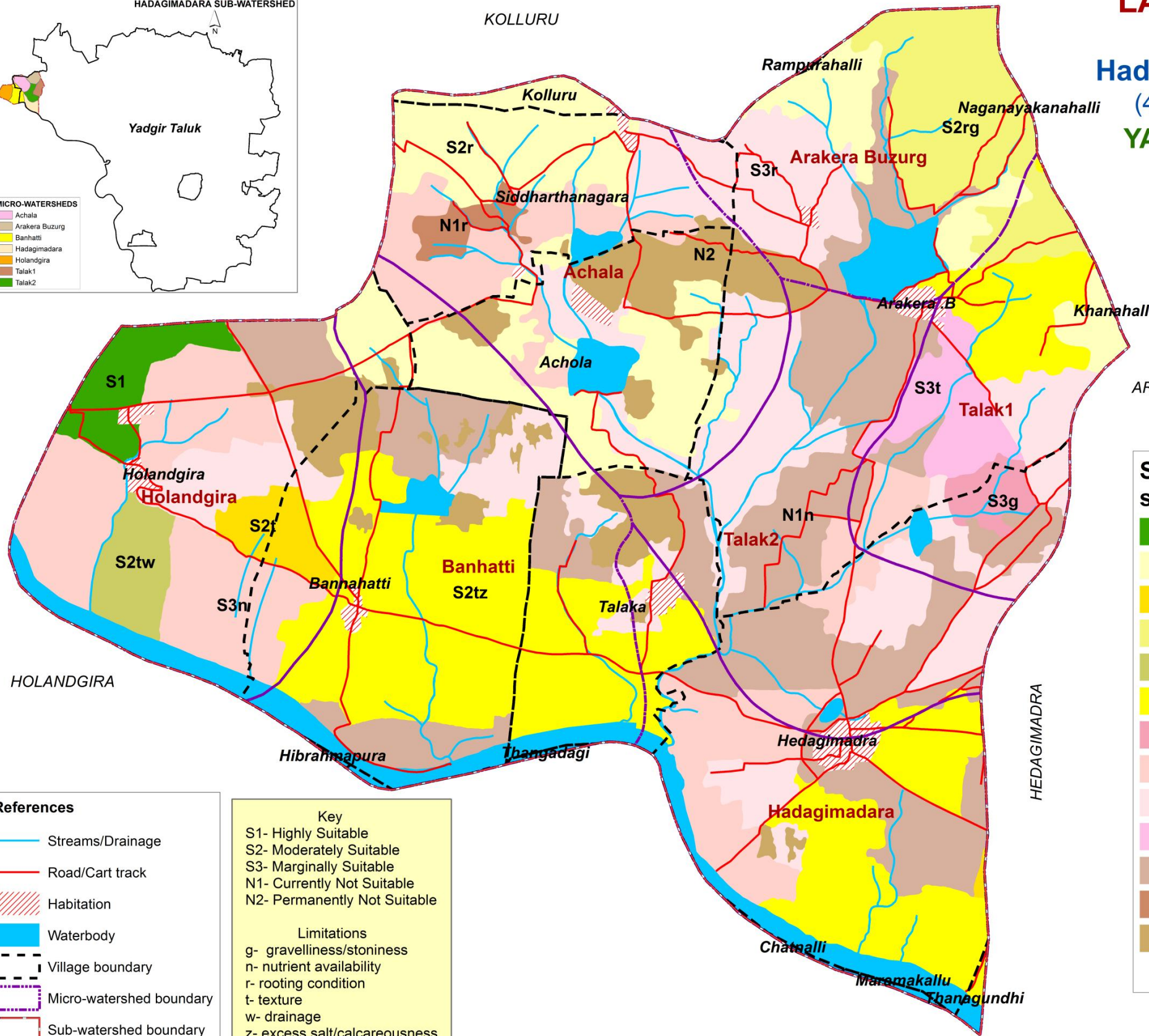
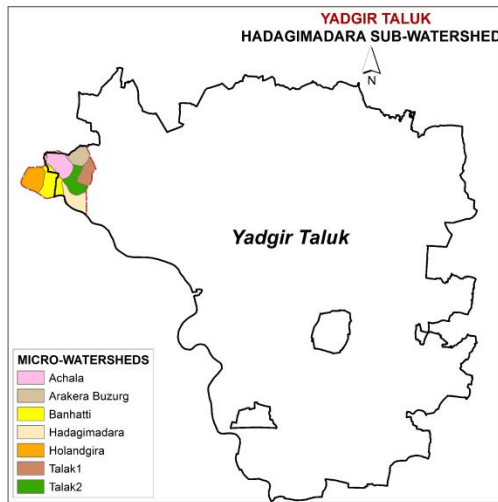
- Key**
- S1- Highly Suitable
 - S2- Moderately Suitable
 - S3- Marginally Suitable
 - N1- Currently Not Suitable
 - N2- Permanently Not Suitable
- Limitations**
- g- gravelliness/stoniness
 - n- nutrient availability
 - r- rooting condition
 - t- texture
 - w- drainage
 - z- excess salt/calcareousness

* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

7.29. Land Suitability for Chrysanthemum

LAND SUITABILITY FOR CHRYSANTHEMUM Hadagimadara Sub-watershed (4D5B2K : Area - 4332.97 ha) YADGIR TALUK & DISTRICT



Suitability subclass	Area in ha (%)
S1	66 (1.52)
S2r	491 (11.33)
S2t	50 (1.14)
S2rg	207 (4.78)
S2tw	57 (1.32)
S2tz	776 (17.9)
S3g	32 (0.75)
S3n	590 (13.62)
S3r	677 (15.63)
S3t	80 (1.84)
N1n	710 (16.39)
N1r	28 (0.64)
N2	245 (5.66)
Others*	324 (7.48)

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

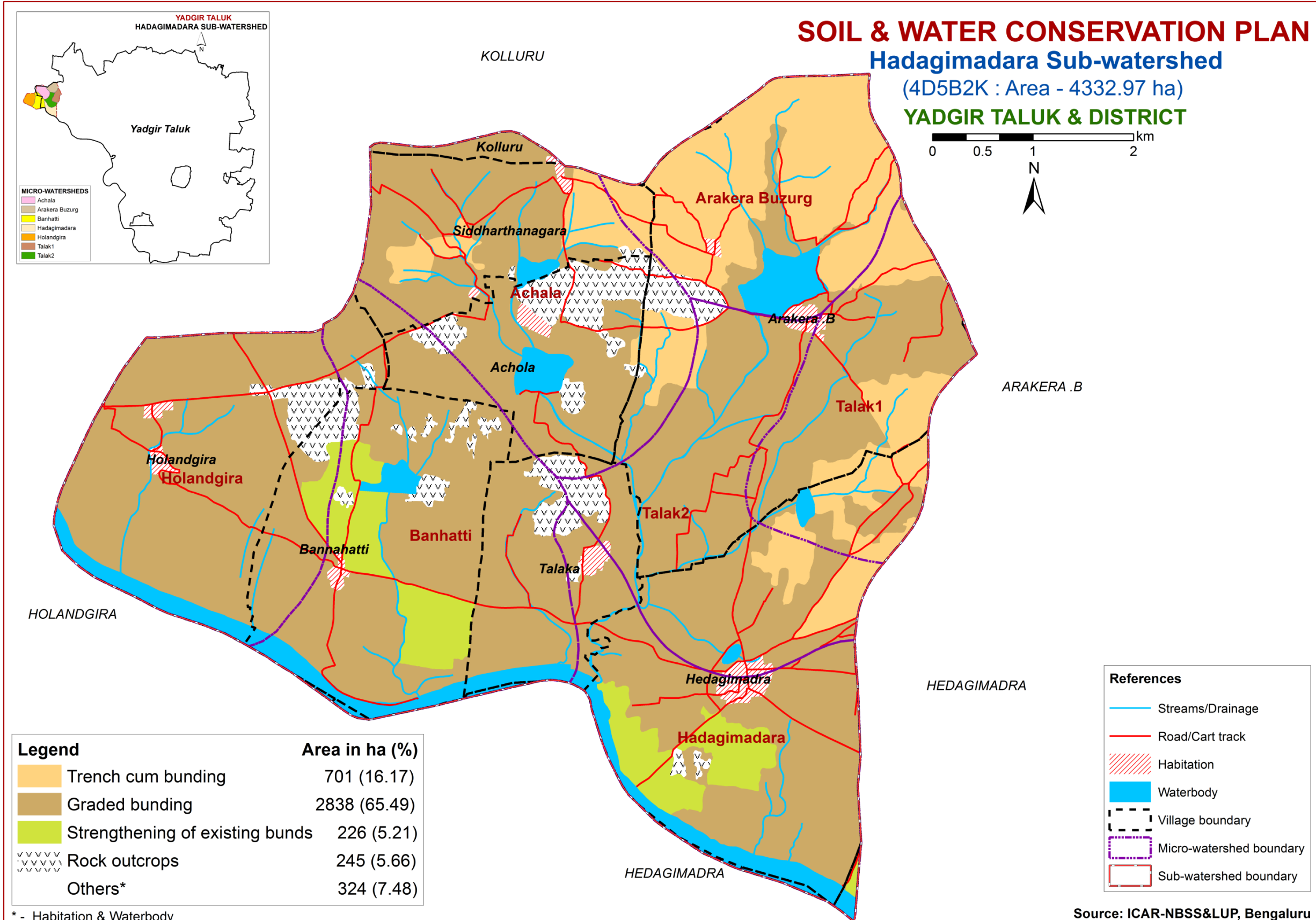
- Key**
- S1- Highly Suitable
 - S2- Moderately Suitable
 - S3- Marginally Suitable
 - N1- Currently Not Suitable
 - N2- Permanently Not Suitable
- Limitations**
- g- gravelliness/stoniness
 - n- nutrient availability
 - r- rooting condition
 - t- texture
 - w- drainage
 - z- excess salt/calcareousness

* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

8. Soil and Water Conservation Measures

8.1. Soil & Water Conservation Plan



Source: ICAR-NBSS&LUP, Bengaluru

9. Table. Proposed Crop Plan for Hadagimadara Sub-watershed, Yadgir 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	95.HGNmB2,139.HGNmB2g1 57.MDGcB2,132.MDRhB2 60.MDRiA1,133.MDRiB2 61.MDRmB2 (Deep to very 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
2	53.ANRhB2,55.ANRiB2 34.GWDcB2,35.GWDiB2 127.GWDmB2,117.VKSiB2 100.VKSmB1,104 TMKiB2 (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
3	151 BGDmB2g1,159 BMNmA1 62 BMNmB2, 63 BMNmB2g1 82 MGLmB2,163 NGPmA1 49 NGPmB2,146 NGPmB2g1 173HSLiB2g1 (Moderately deep to very deep, black calcareous clay soils)	Maize, Sorghum, Sunflower, Groundnut, Red gram, Bajra, Bengal gram, safflower, linseed	Fruit crops: Musambi, Sapota, Pomegranate, Amla, Custard apple, Guava, Jackfruit, 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
5	130 KBDhB2 (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)
6	20.JNKcB2,21.JNKcB2g1 110.JNKhB2 (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

LMU. No	Soil Map Units	Field Crops/Commercial crops	Horticulture Crops (Rainfed/Irrigated)	Suitable Interventions
7	11.SBRcB2 125.SBRhB2 (Moderately shallow, loamy sand soils)	-	Agri-Silvi-Pasture: Hybrid Napier, <i>Styloxanthes hamata</i> , <i>Styloxanthes scabra</i>	Application of FYM, Biofertilizers and micronutrients, drip irrigation, Mulching, suitable soil and water conservation practices
8	27.YLRbB2,29.YLRcB2g1 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
9	2.BDLbB2,4.BDLhB2 162.BDLhB2g1,5BDLiB2 8 VNKbB2g1,9 VNKcB2 10 VNKiB2 (Shallow soils)	-	Custard apple, Hybrid Napier, <i>Styloxanthes hamata</i> , <i>Styloxanthes scabra</i>	Use of short duration varieties, sowing across the slope

PART-B

Hydrological Inventory of Hadagimadara 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 Hadagimadara 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

Phone:080-23412242

E-mail:nbssrcb@gmail.com



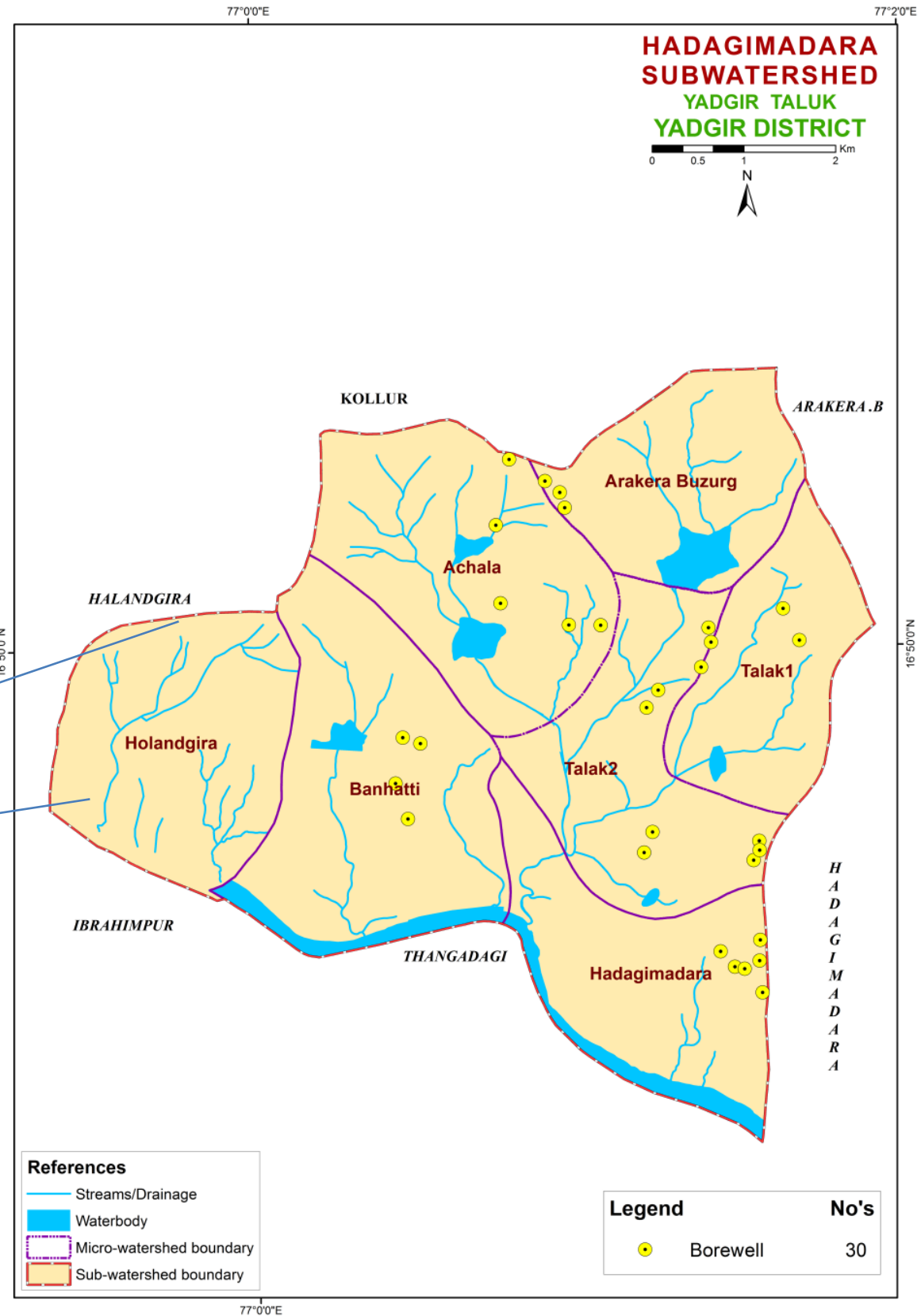
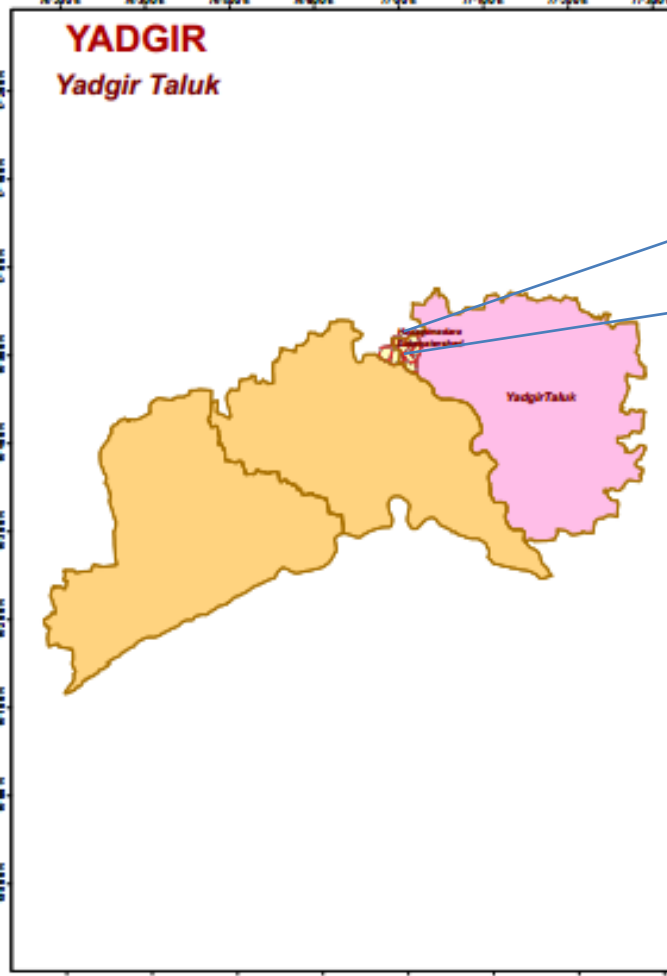
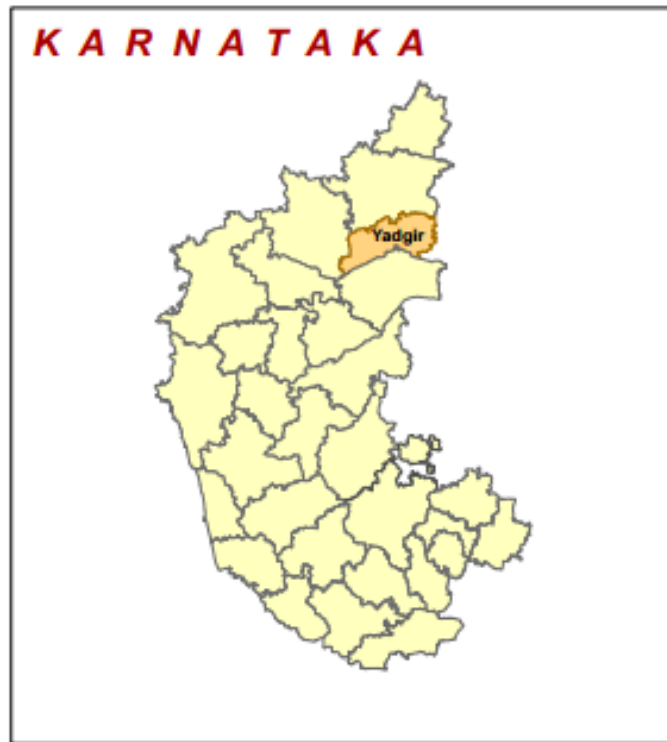
Details of Hydrology Team of LRI Partner Responsible for Preparation of Atlas

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
<p style="text-align: right;">Email: hd_rcb.nbsslup@icar.gov.in nbssrcb@gmail.com Phone: Office: 080-23412242,23410993 Fax: 080-23510350</p>	

INTRODUCTION

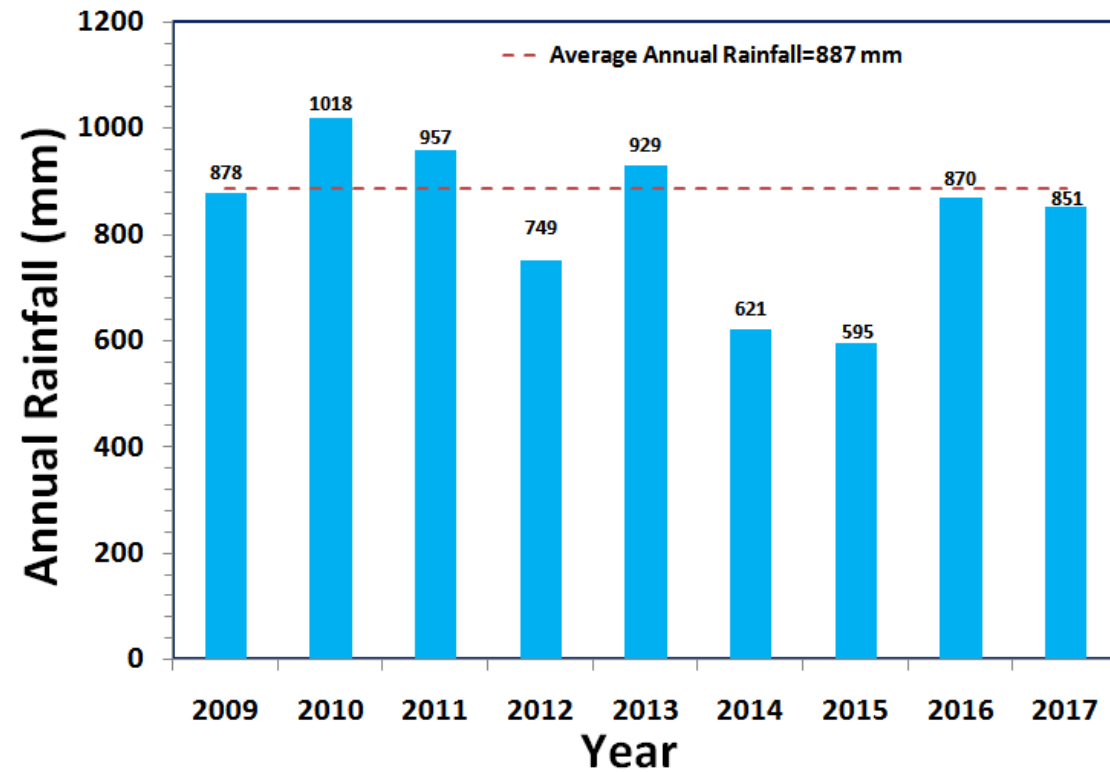
- The inventory and documentation of spatial and temporal changes in hydrological components of Hadagimadara sub-watershed (4D5B2K) in Yadgir Taluk, Yadgir District, has been undertaken for integrated planning, development and management.
- Hadagimadara sub-watershed (Yadgir Taluk, Yadgir District) is located between $16^{\circ}47'29''$ - $16^{\circ}52'6''$ North latitudes and $76^{\circ}57'12''$ - $77^{\circ} 2'20''$ East longitudes, covering an area of about 4320 ha.
- This sub-watershed encompasses of 7 MWs namely Achala (4D5B2K1b), Arakera Buzurg (4D5B2K1a), Banhatti (4D5B2K2b), Hadagimadara (4D5B2K2b), Holandgira (4D5B2K2a) Talak-1 (4D5B2K1c) and Talak-2 (4D5B2K1d). Land Resource Inventory (LRI) was generated for all the seven 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 HADAGIMADARA SUB-WATERSHED



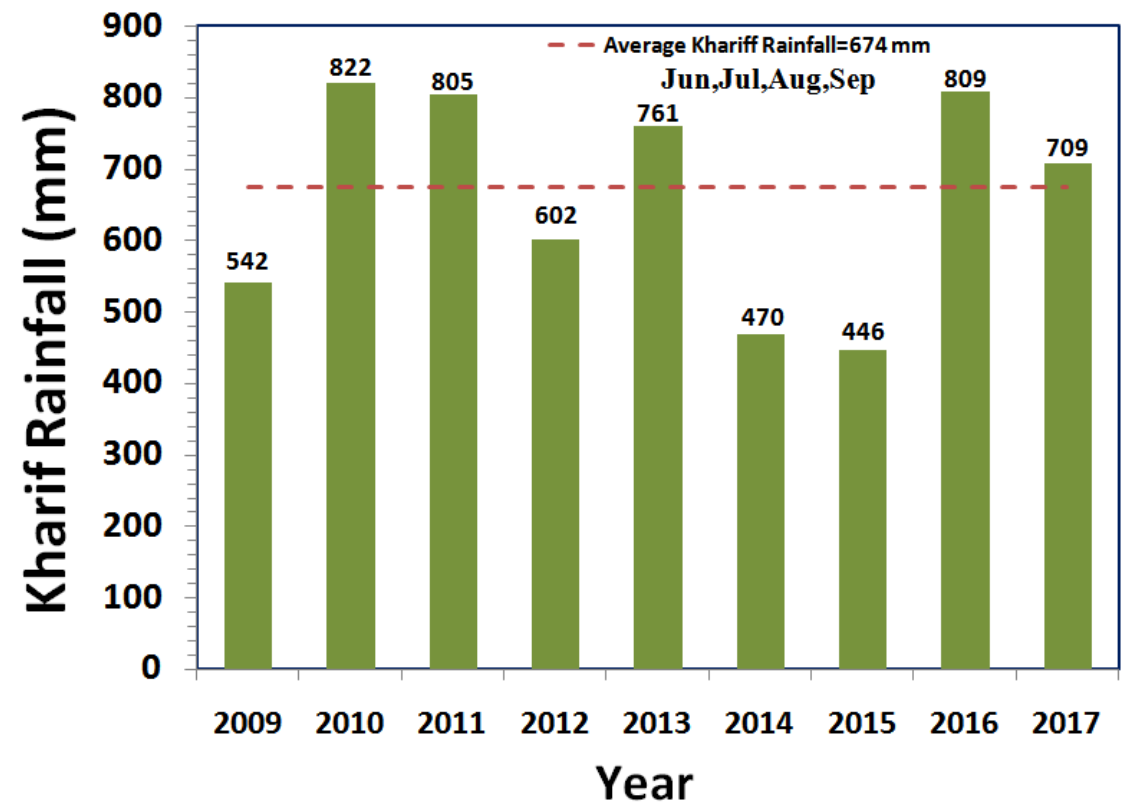
Soil & Water Conservation Structures in Hadagimadara Sub-watershed, Yadgir Taluk, Yadgir District

RAINFALL INDEX

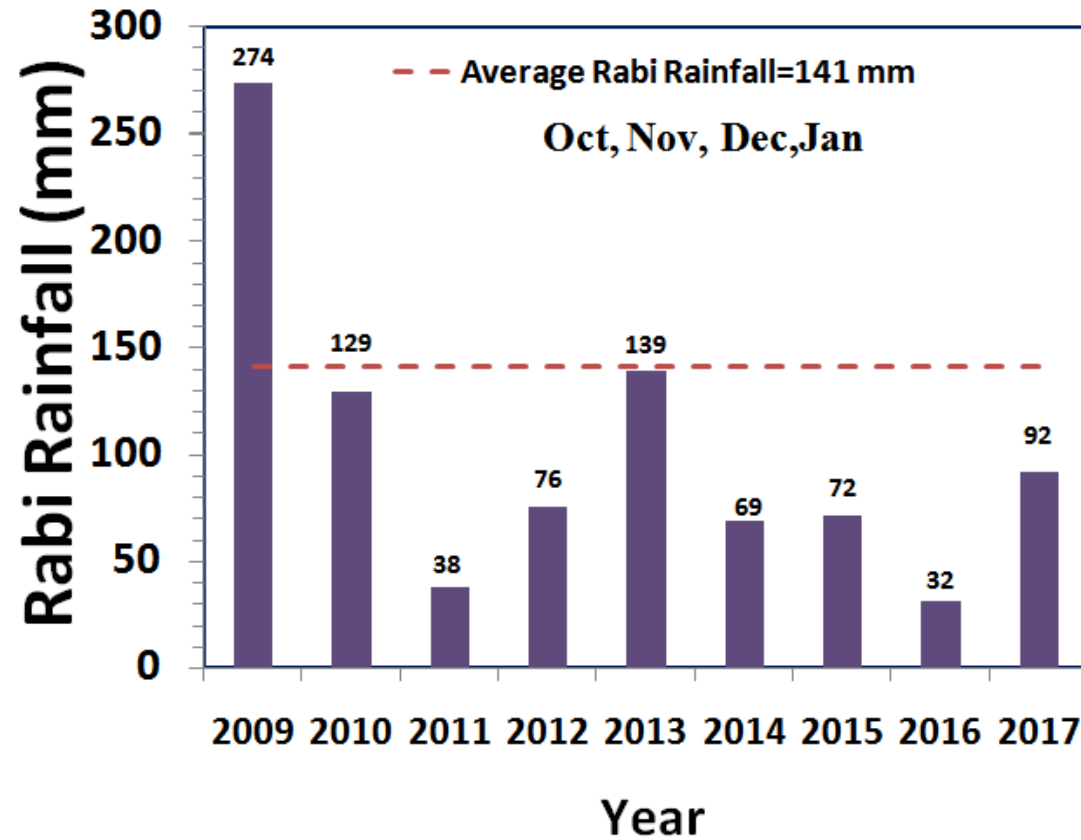


The average annual rainfall (1960-2014) recorded at the Yadgir station in Yadgir taluk of Yadgir district is 887 mm. The annual rainfall at Hathakuni station (Hobli H.Q.) is presented. During the years 2009, 2012, 2014, 2015, 2016 and 2017 the annual rainfall was deficient by 1%, 22%, 42%, 46%, 3% and 6% respectively.

The *kharif* rainfall (Jun–Sep) is an average about 80% of the annual rainfall and it typically follows the annual rainfall patterns.

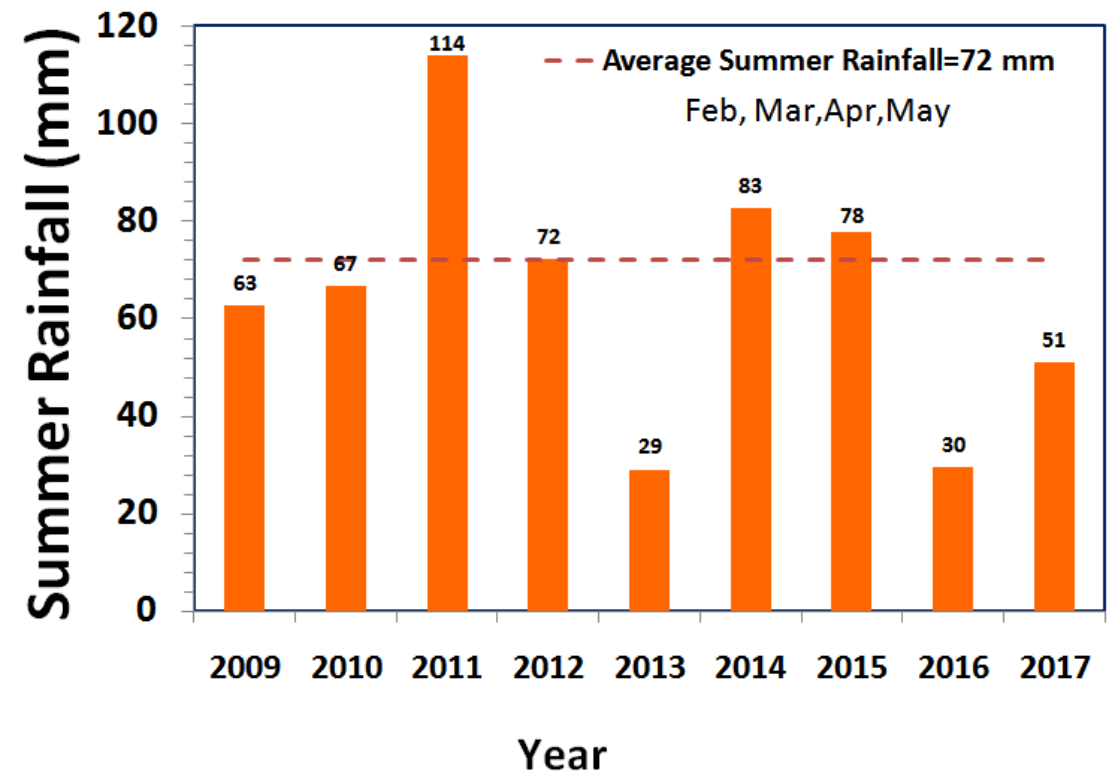


RAINFALL INDEX

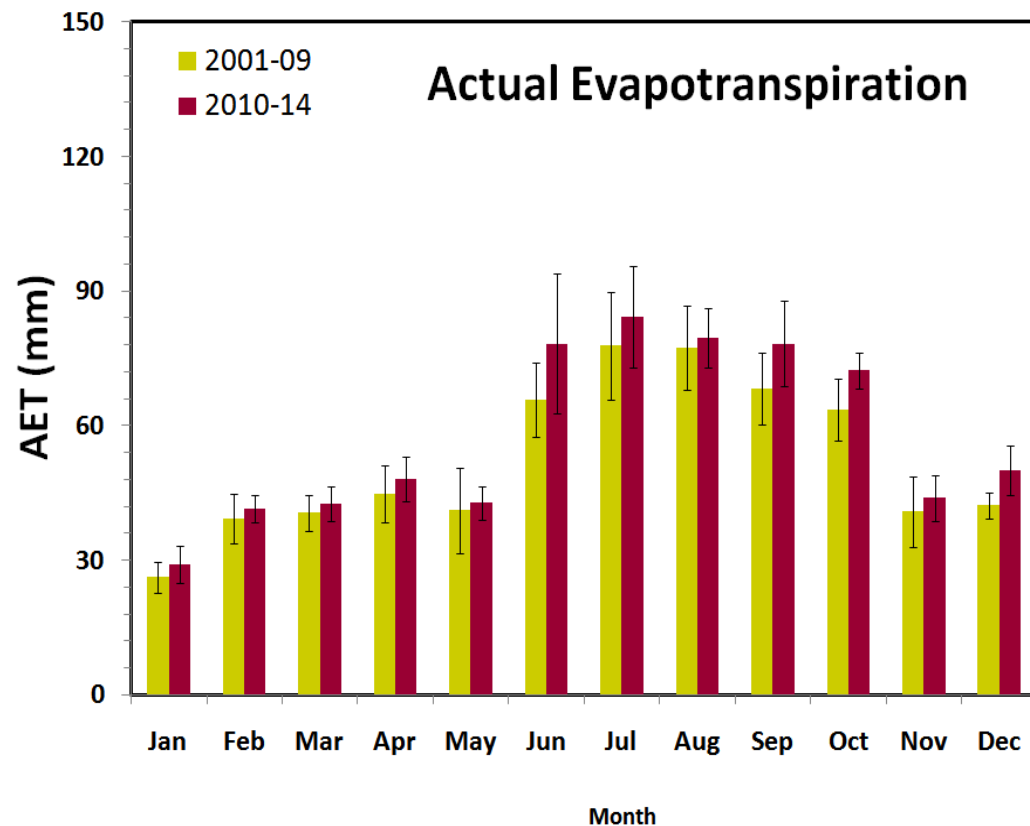
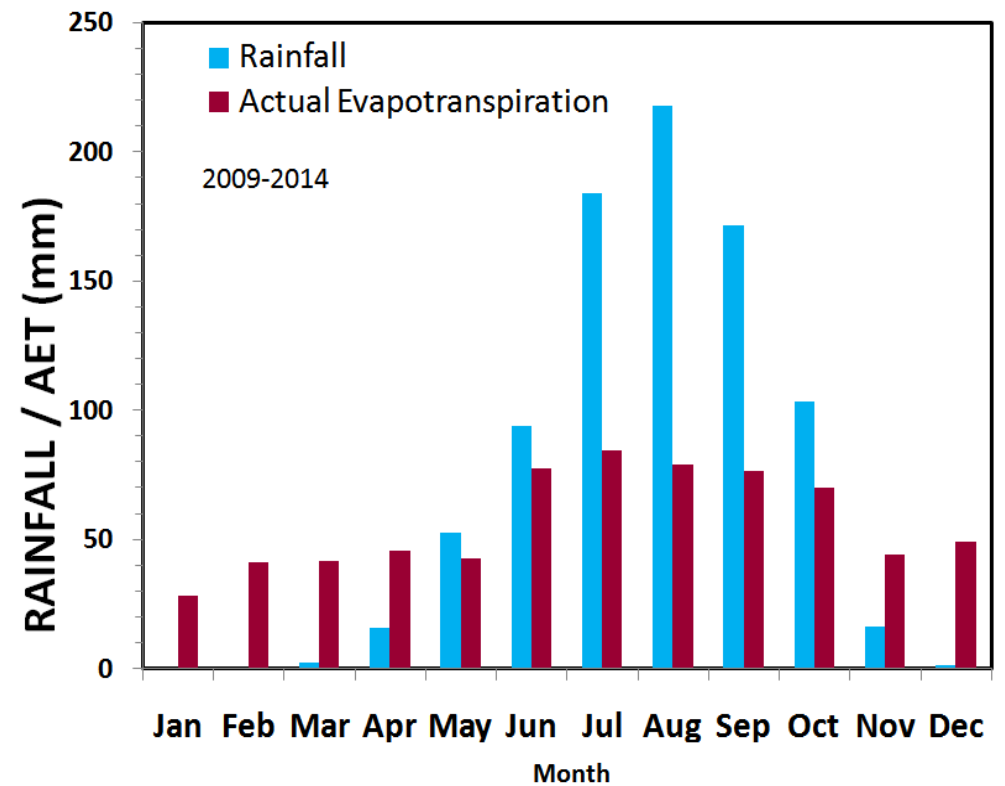
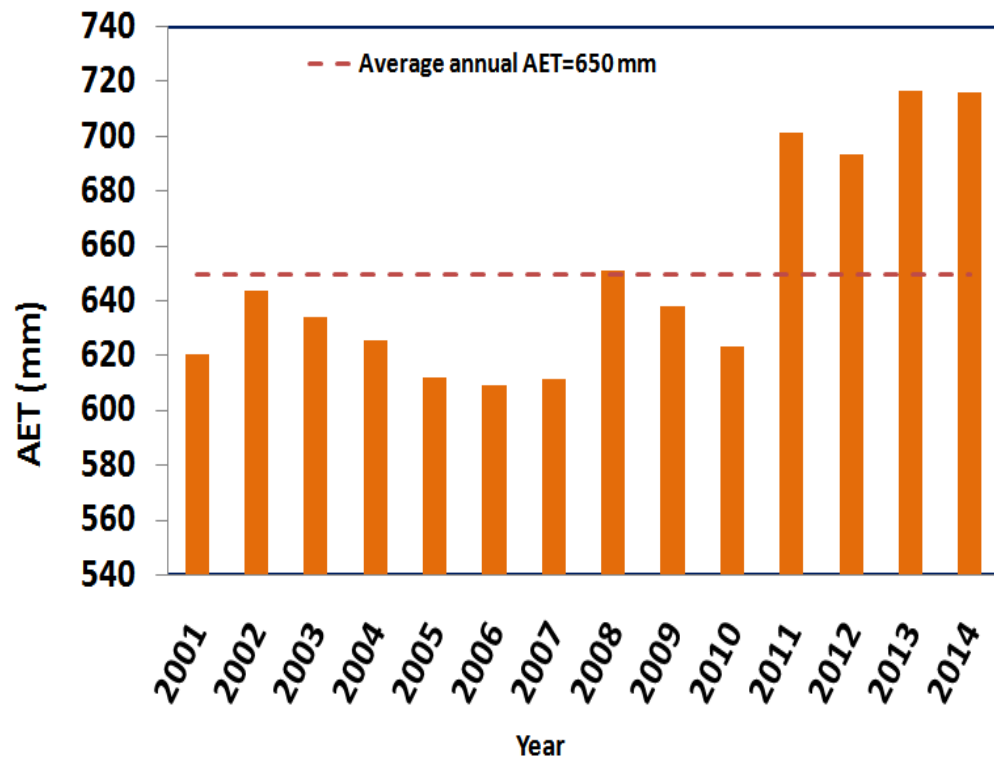


The average *rabi* rainfall (Oct-Jan) is about 12% of the Average annual rainfall. During the year 2009 highest *rabi* rainfall was received, where as other years showed deficient rainfall.

The average summer rainfall (Feb-May) is about 8% of the average annual rainfall.

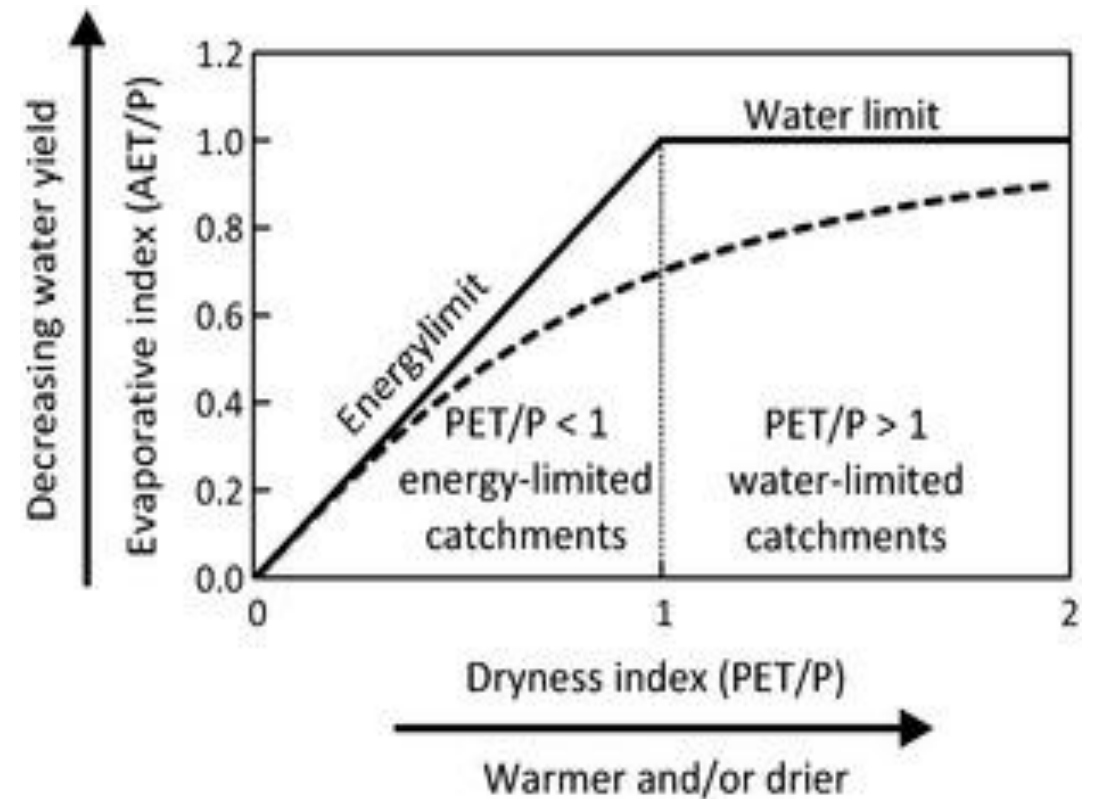
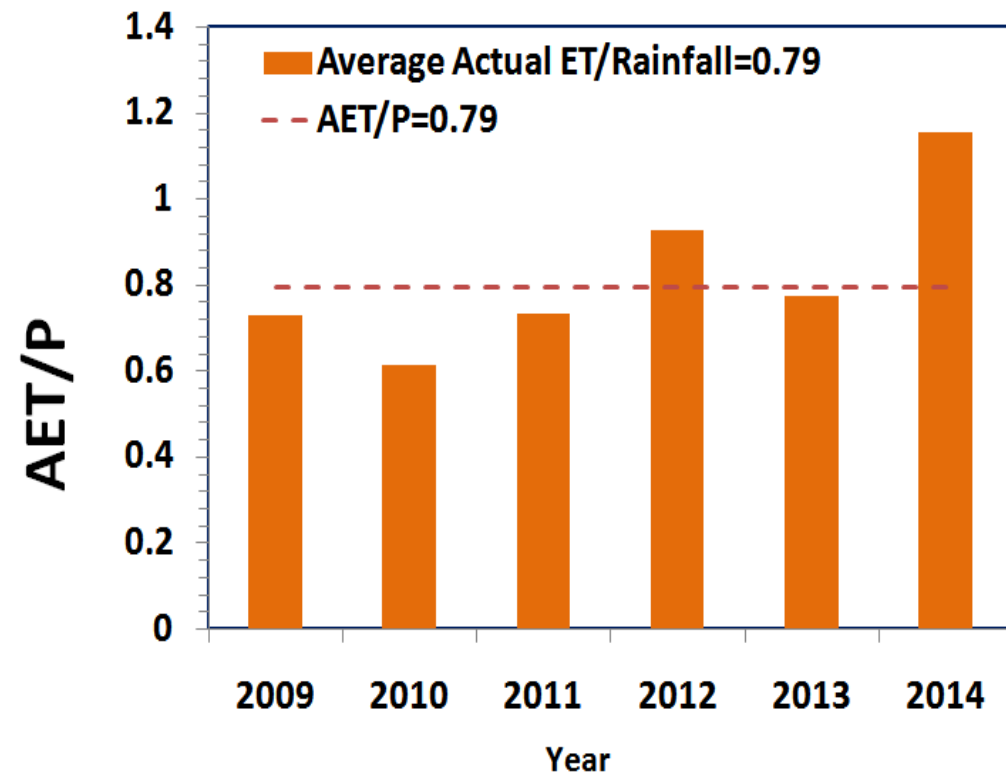


EVAPOTRANSPIRATION

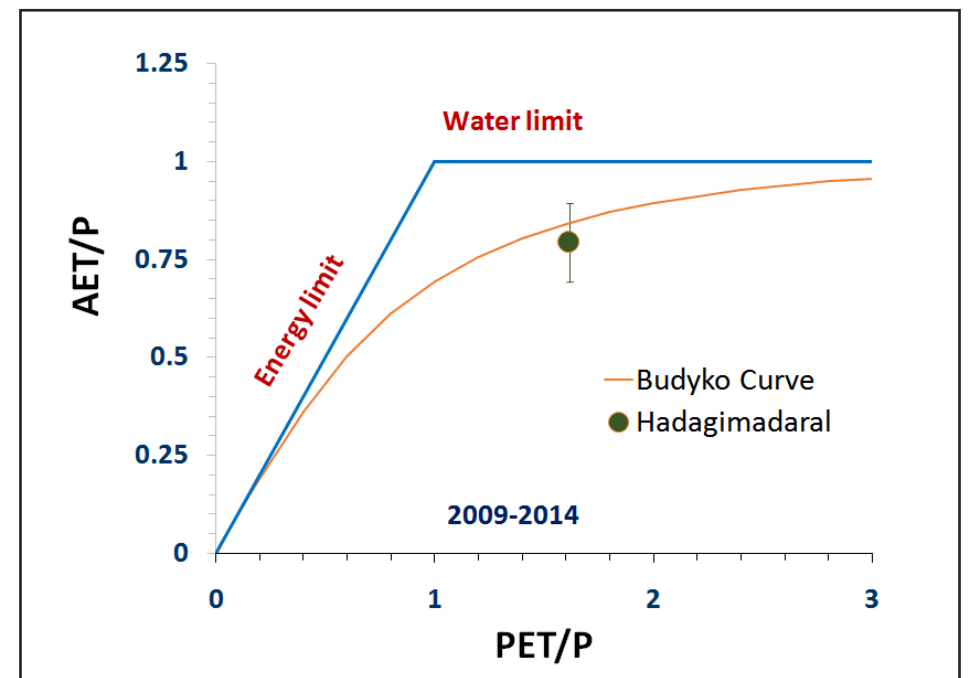


The average annual actual ET is lower than the average rainfall. During *kharif*, average rainfall and AET was found to be 674 mm and 317 mm respectively, whereas in *rabi* it was about 141 mm and 192 mm. The annual ET increased by 9% during 2010-2014 compared to 2001-2009 .

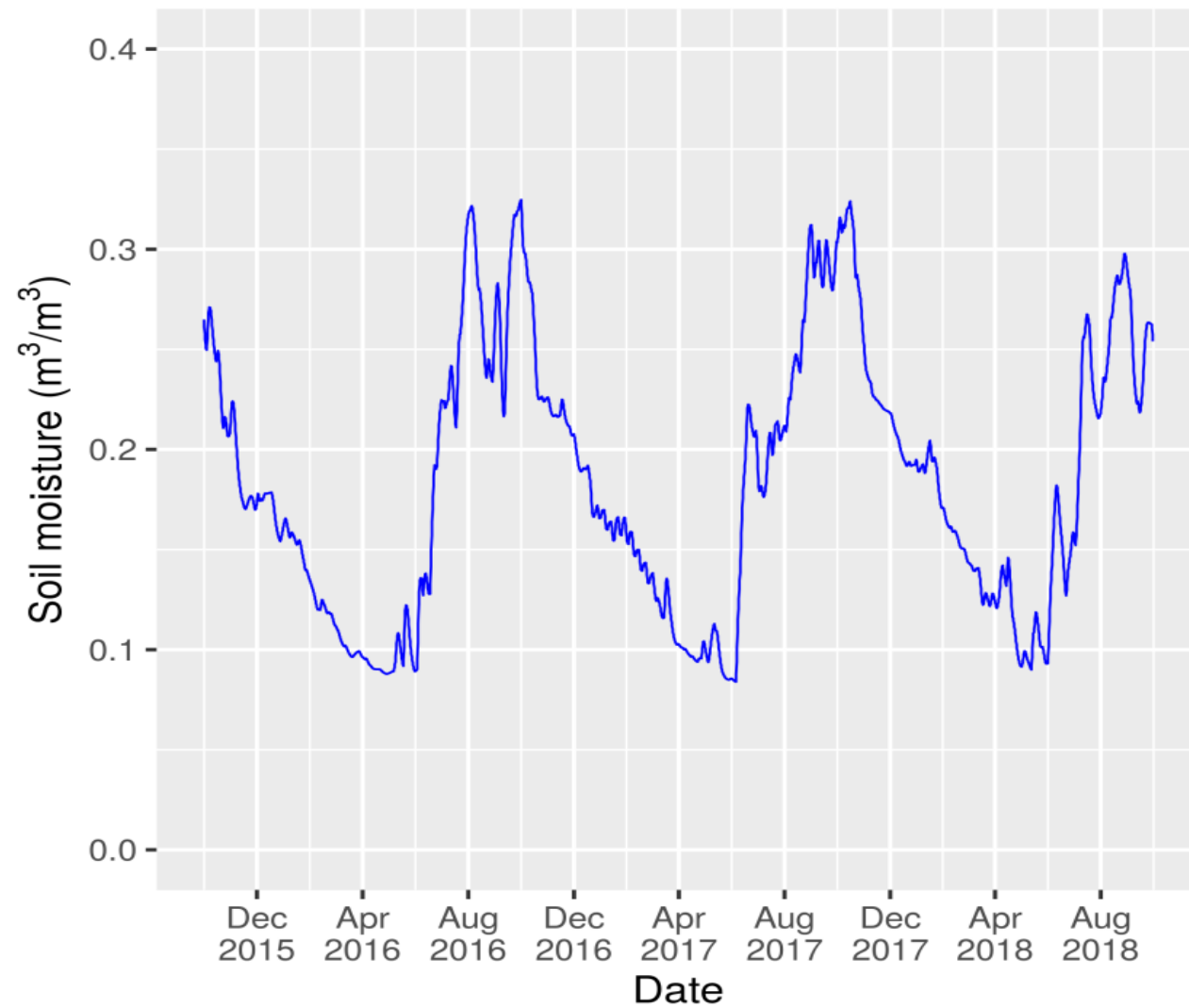
EVAPOTRANSPIRATION INDEX



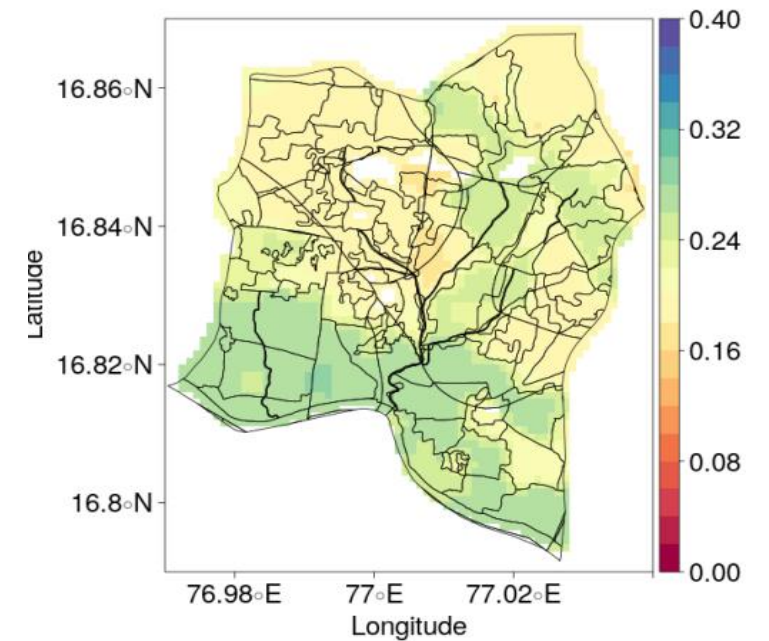
The average AET/P ratio was about 79%, which is lower than the sustainable limit of about 80%. Watershed water balance is sustainable due to higher rainfall during the *kharif* season.



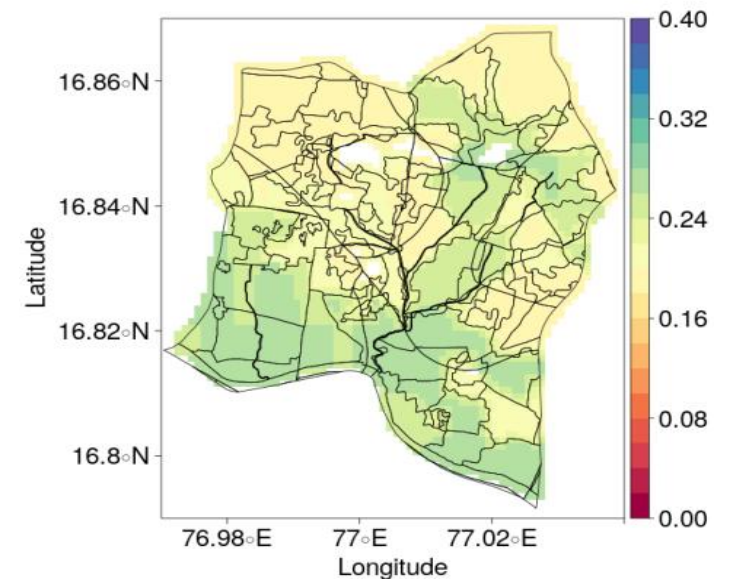
SATELLITE RETRIEVED SOIL MOISTURE



Hadagimadara – *rabi* Soil Moisture



Hadagimadara – *kharif* Soil Moisture

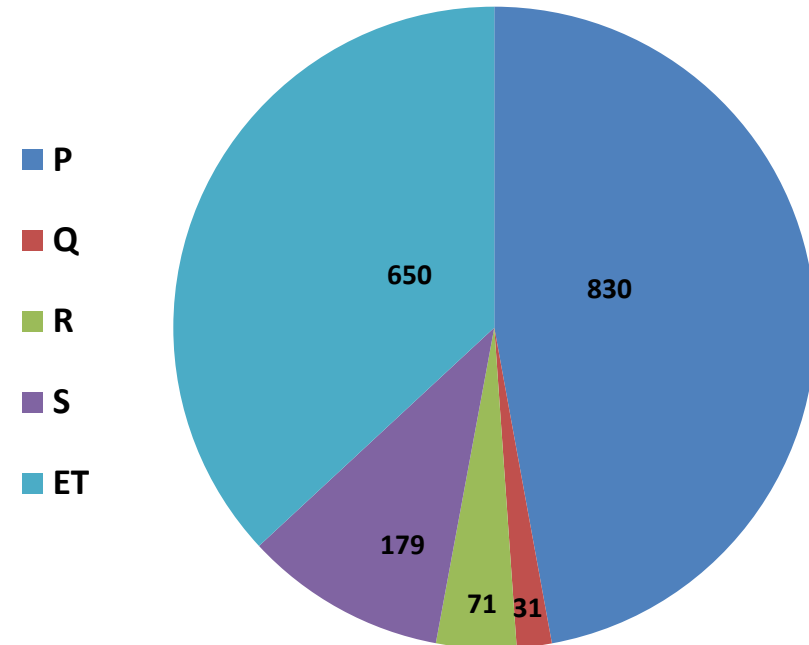


The method developed for retrieving soil moisture from multi-satellite observations allowed to map surface soil moisture behavior in the micro-watershed. The available surface moisture was varied in the range of 13-28 % in *kharif* and 16-33% in *rabi* seasons of 2016 and 10-31% in *kharif* and 19-32% in *rabi* seasons of 2017.

WATER BALANCE

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

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

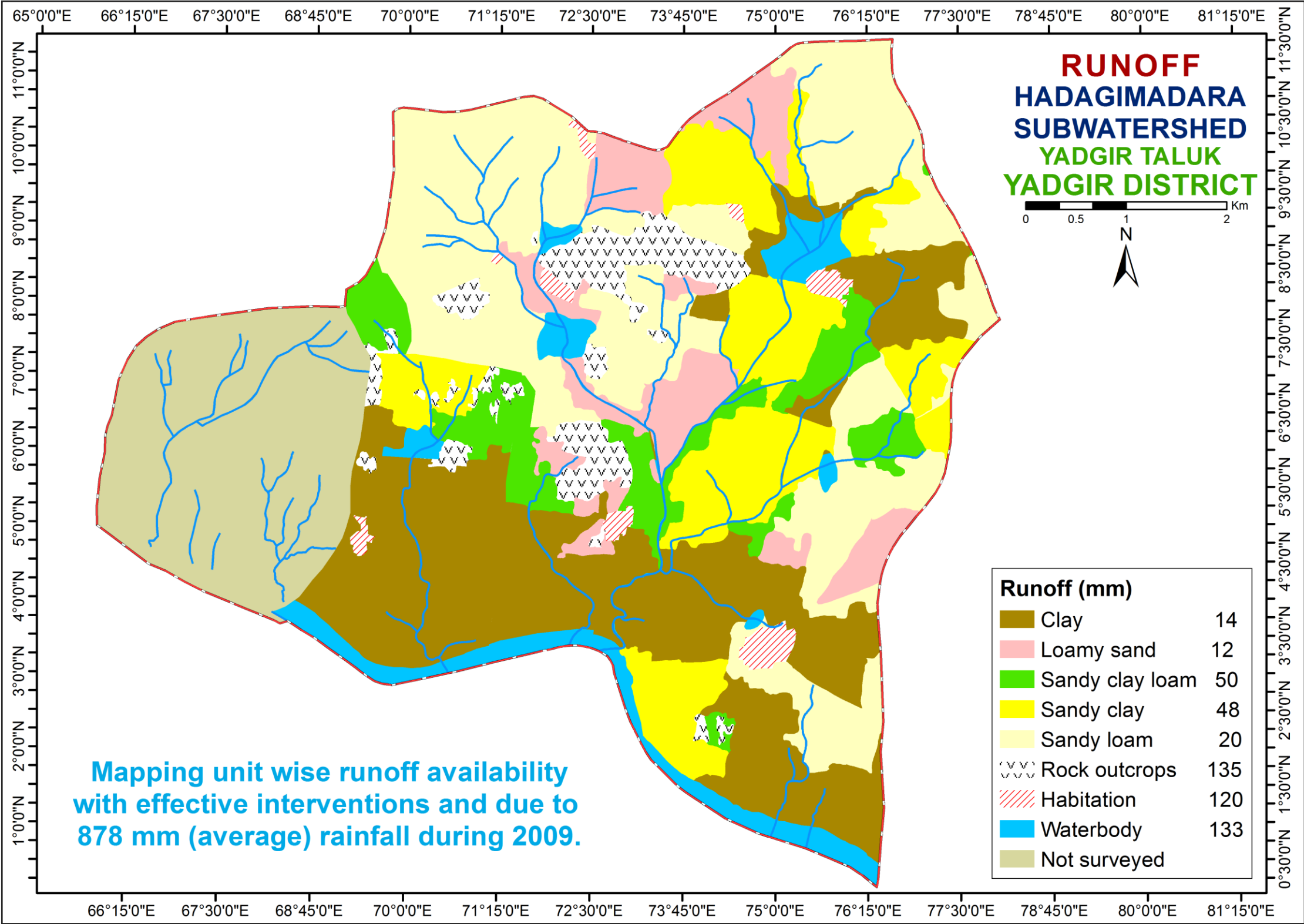


During May-October months, Precipitation is higher than Evapotranspiration, hence Runoff can occur in the watershed.

P = 830 mm (average of 2009-2017) ET = 650 mm R = 71 mm S = 179 mm Q = 31 mm

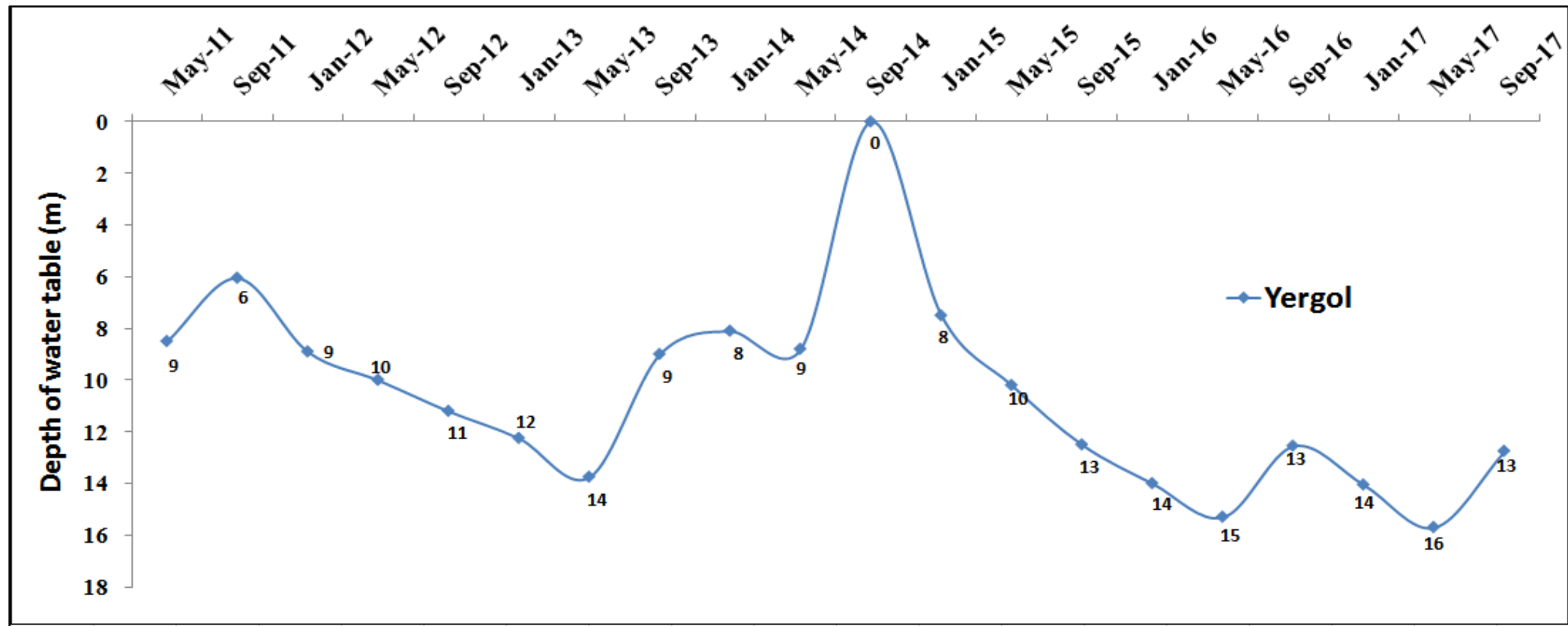
Sl. No.	Parameters	Average_2009 (mm)
1.	Rainfall	878
2.	Runoff availability with existing conditions	85
3.	Runoff availability with effective interventions	39
4.	Runoff allowed as environmental flow at the outlet	8
5.	Runoff excess for harvesting by construction of structures	31

RUNOFF



GROUND WATER STATUS

YERGOL STATION



The total number of wells present in Hadagimadara Sub-watershed as per LRI data is 30 (Borewell). The groundwater level shown above is from the data obtained from Dept. of Mines & Geology for the nearest station Yergol. The graph depicts the groundwater levels during the years 2011-2017 were slightly varying, where as during the year 2014 was found constant.

SUMMARY

- The average annual rainfall of 887 mm in the Hadagimadara sub-watershed as recorded from the Hathakuni station data.
- 80%, 12% and 8% 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 31 mm for an average annual rainfall of 830 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 (179 mm) and utilizable runoff plus recharge is 260 (=179+31+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 510 mm. Hence the amount of water use for kharif and rabi seasons may be estimated as 638 mm (i.e. 125% of AET). This demand for the two seasons is higher by 378 mm, i.e. (638-260). 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 Hadagimadara Sub-watershed as per LRI data is 30 Borewell. The groundwater level data obtained from Dept. of Mines & Geology for the nearest station Yergol.