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किसानों का हमसफर
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Land Resource and Hydrological Inventory of Gopalapur 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 Gopalapur Sub-watershed for Watershed Planning and Development

Yadgir Taluk, Yadgir District, Karnataka (AESR 6.2)

CONTENTS

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How to read and use the Atlas

The Land Resource Inventory of Gopalapur 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.

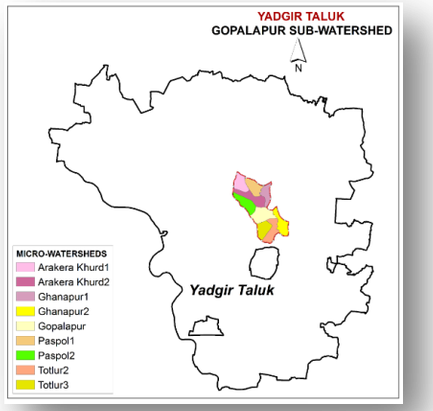
For easy map reading and understanding the information contain in different maps, the physical, cultural and scientific symbols used in the maps are illustrated in the form of colors, graphics and tables.

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.

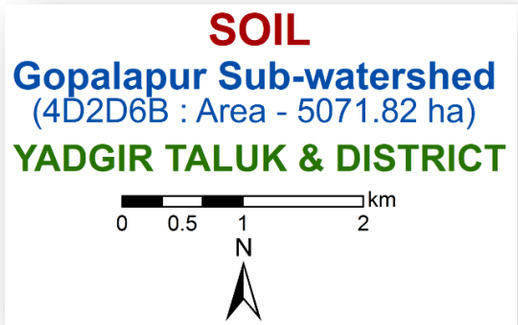
Inset map

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



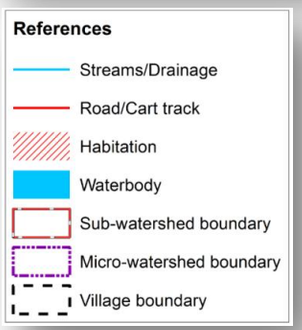
Map title

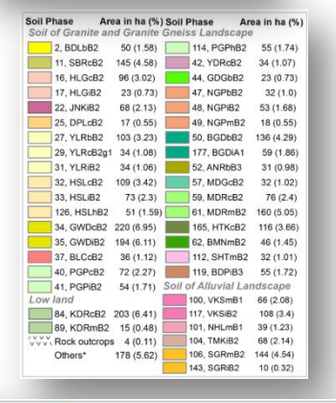
Map title conveys the relevance of thematic information presented along with a graphical scale, geographical location and watershed details in text form.



Legends and symbols

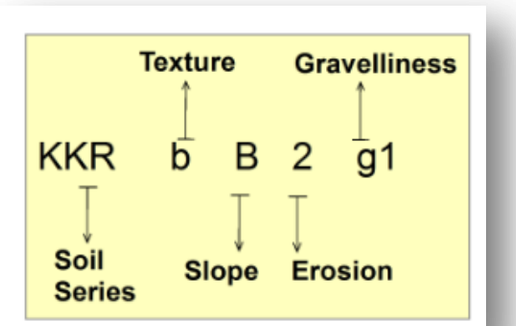
*Two legends accompany each map, a **map reference**, which depicts geographic features and a **thematic legend** which portrays spatial information. Picking up the symbol and colour of a particular enables one to go to the legends to obtain the required information.*





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.

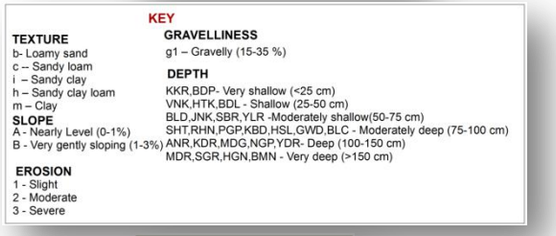


Map colours

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

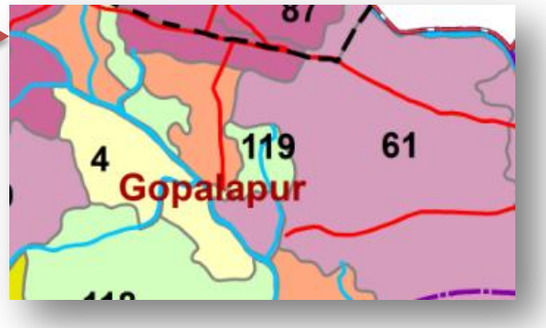
Map key

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.



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.



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 Gopalapur Sub-watershed covering an area of 5071.82ha 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.

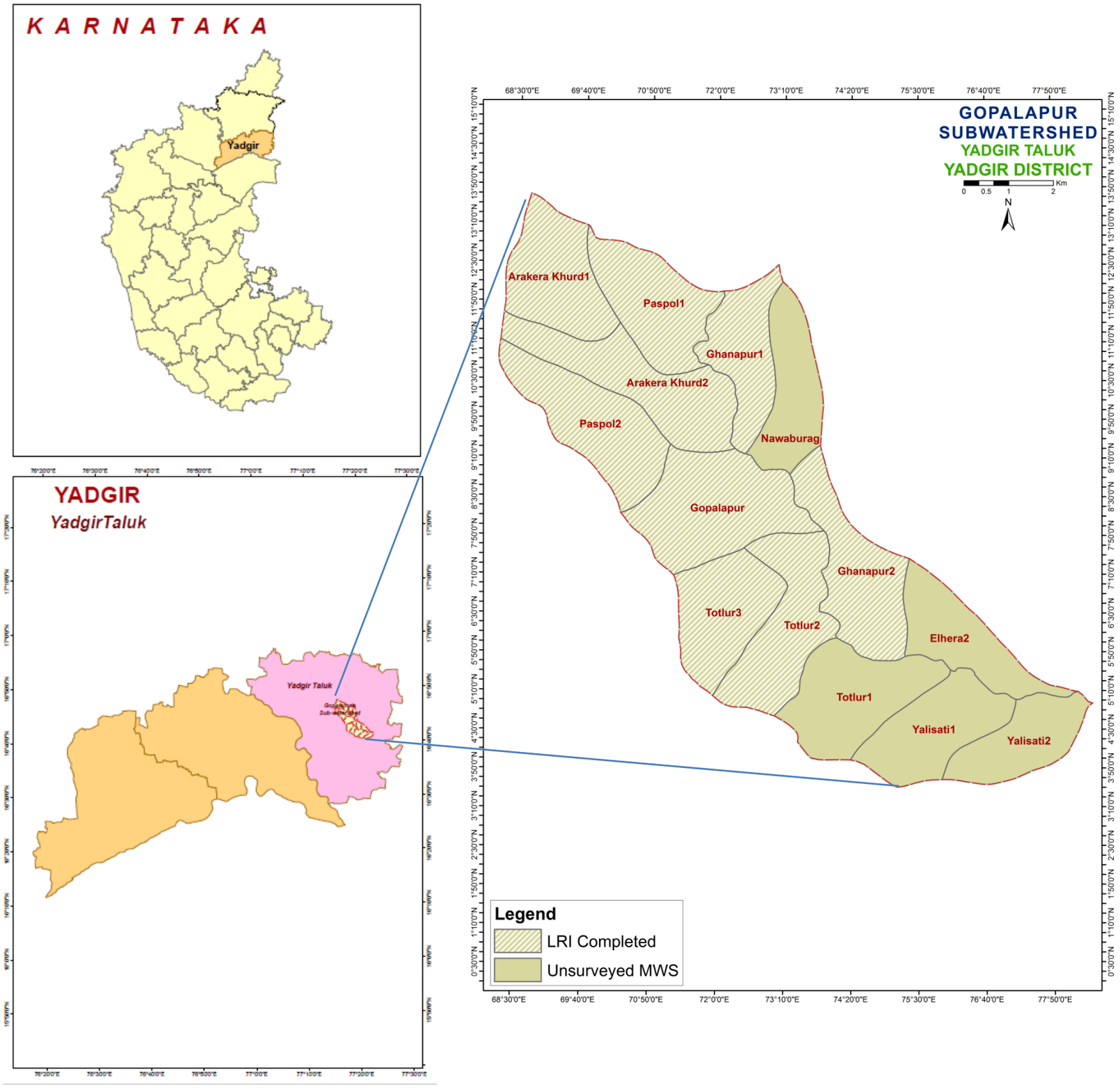
2. General Description of Sub-watershed

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’ $17^0$0’ – $16^0$55’ and east longitudes 77^0 7’ – 77^0 0’. 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 Gopalapur SWs (code– 4D2D6B) in Yadgir taluk, Yadgir district covering an area of 7369 ha. It was selected for data base generation under Sujala III project. This sub-watershed encompasses of 14 MWs namely, Elhera-2 (4D2D6B2d), Gopalapur (4D2D6B1e), Ghanapur-2 (4D2D6B2c), Arakera Khurd-1 (4D2D6B1a), Paspol-1 (4D2D6B1b), Ghanapur-1 (4D2D6B2a), Nawaburag (4D2D6B2b), Arakera Khurd-2 (4D2D6B1c), Paspol-2 (4D2D6B1d), Totlur-2 (4D2D6B3b), Totlur-3 (4D2D6B3a), Totlur-1 (4D2D6B3c), Yalisati-1 (4D2D6B3d) and Yalisati-2 (4D2D6B3e) micro watersheds. Land Resource Inventory (LRI) was generated for nine among the fourteen micro-watersheds.

2.1. Location and Extent

LOCATION MAP OF GOPALAPUR SUB-WATERSHED



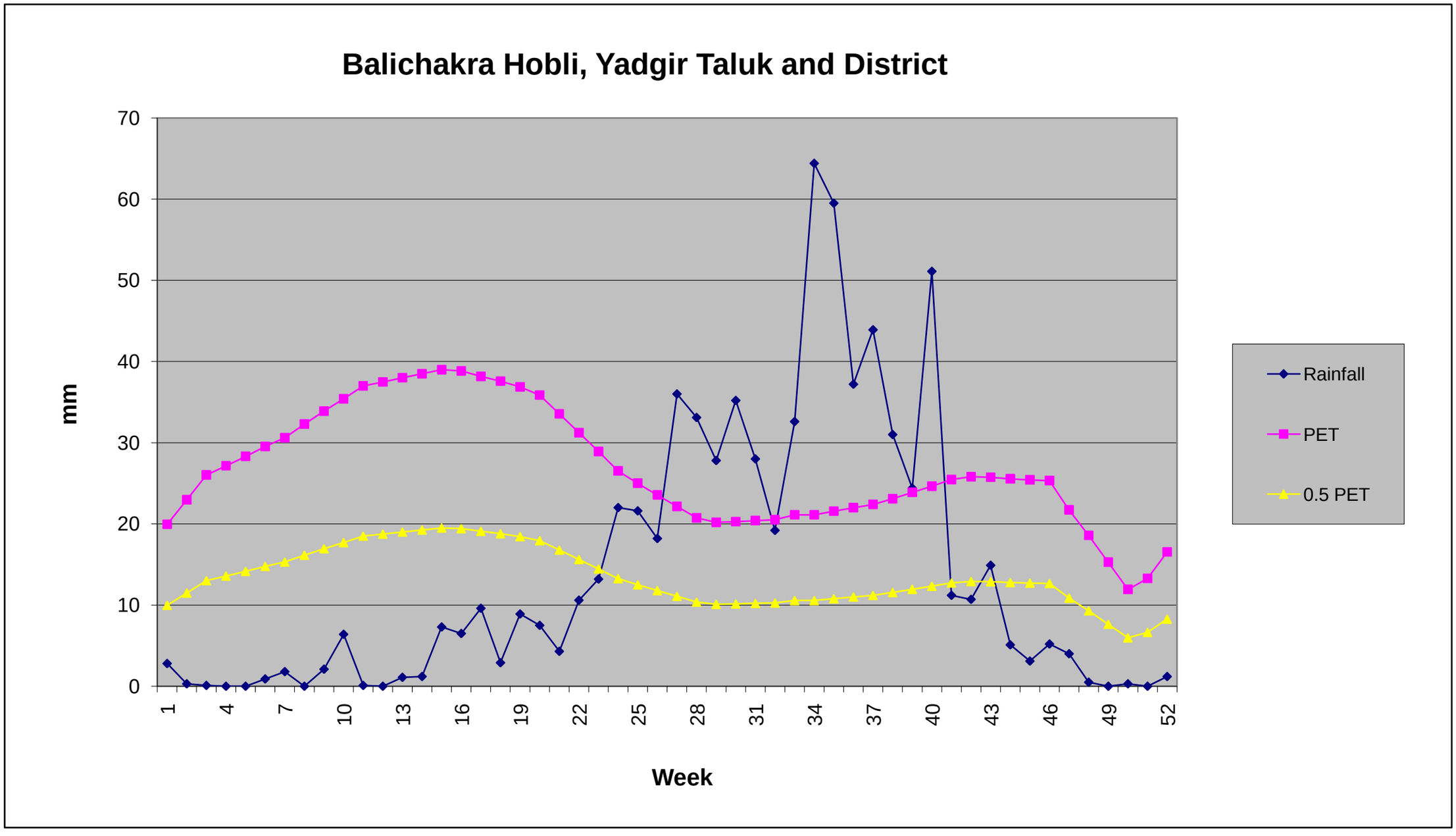
Gopalapur sub-watershed (Yadgir taluk, Yadgir district) is located between $16^0$41'23''– $16^0$47'26'' North latitudes and $77^0$15'36''–$77^0$20'39'' East longitudes, covering an area of about 7369 ha.

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

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

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

Climate

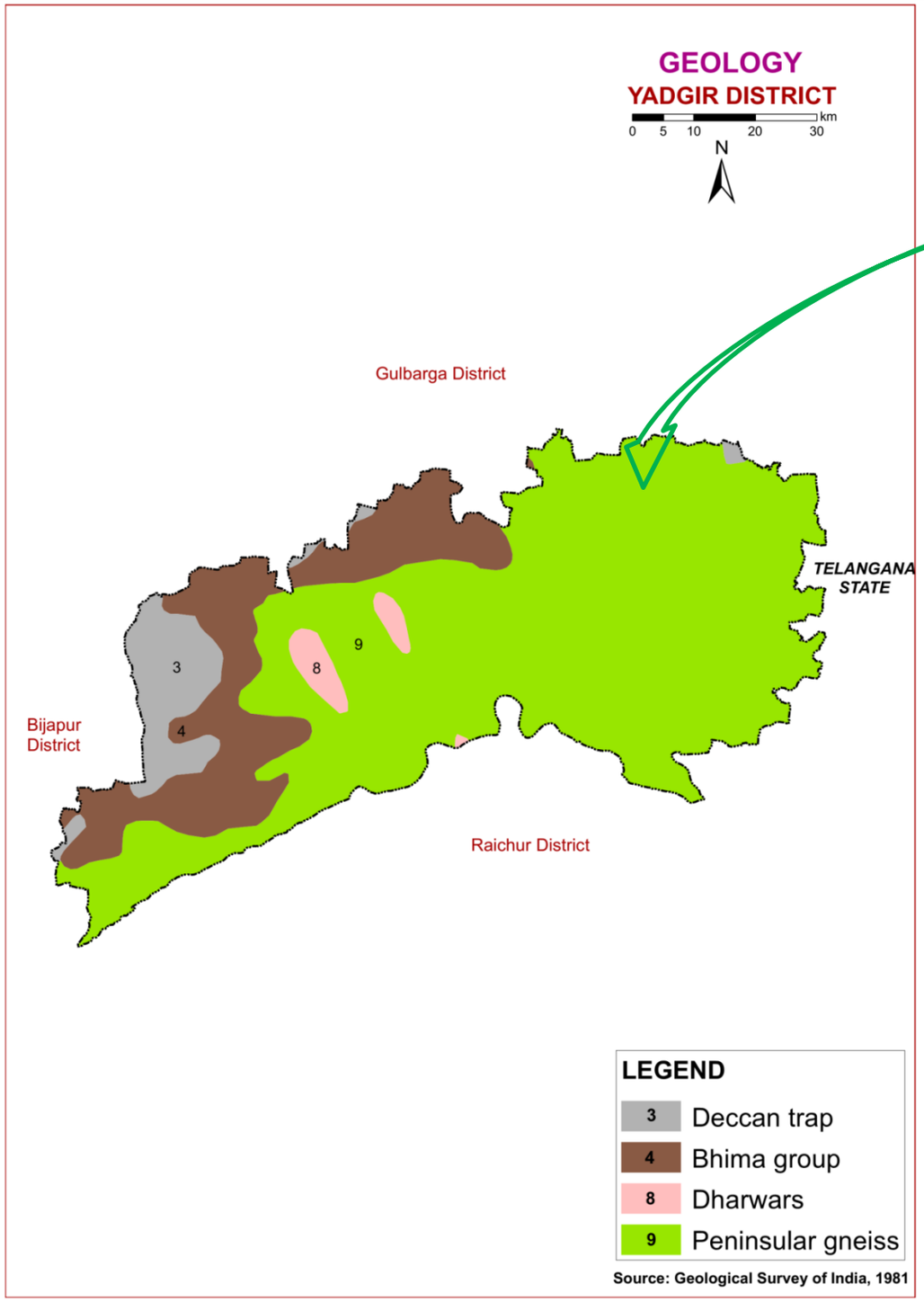


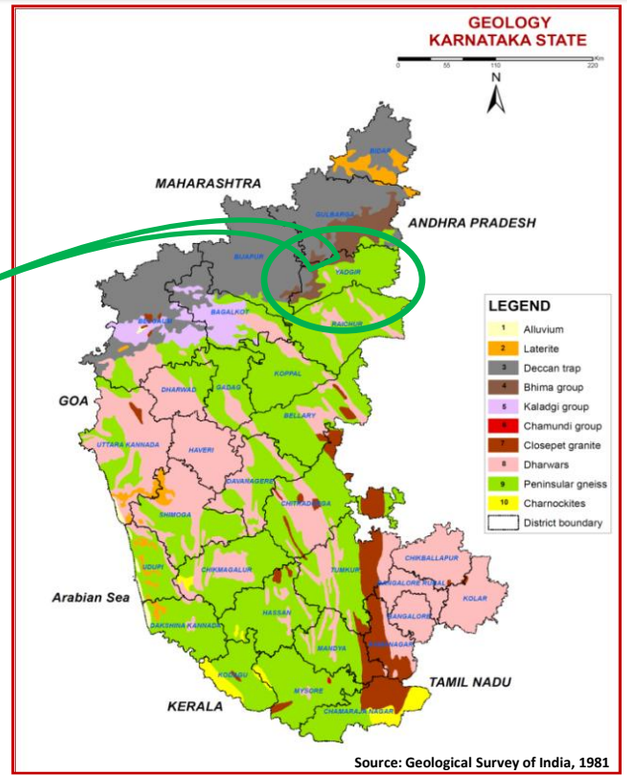
Length of Growing Period (LGP) is varying from June 2nd week to Last week of October (120 - 150 days)

Annual Rainfall : 729 mm. in the Balichakra Hobli, Yadgir Taluk & District

Source: KSNMDC (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.

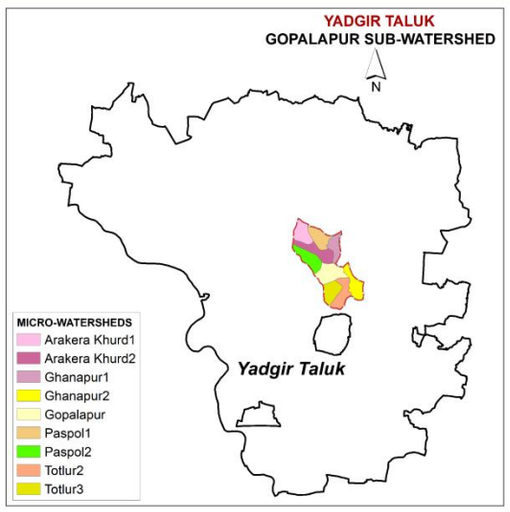
3. Survey Methodology

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



Gopalapur Sub-watershed
(4D2D6B : Area - 5071.82 ha)
YADGIR TALUK & DISTRICT

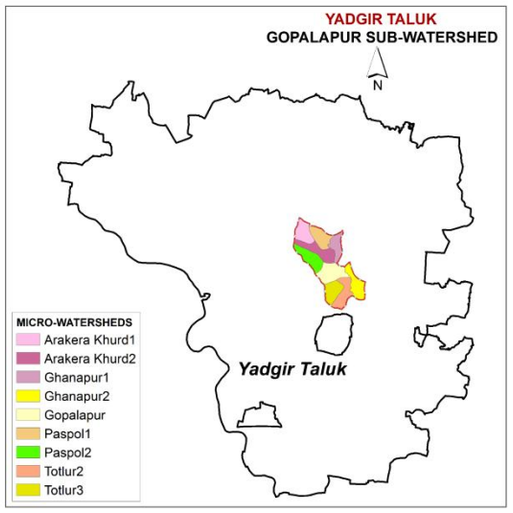
0 0.5 1 2 km
N

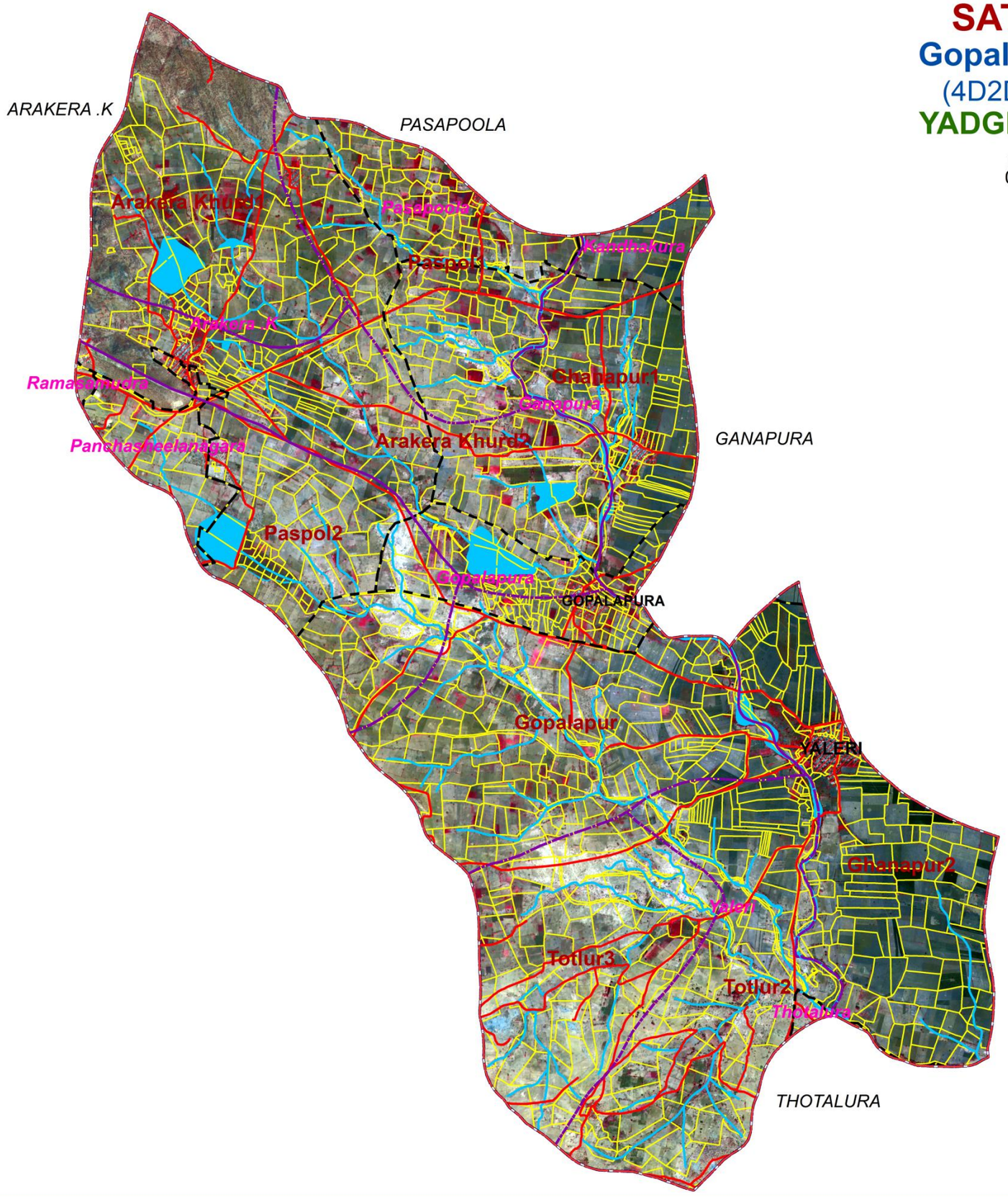
ARAKERA .K
PASAPOOLA
Pasapoola
Arakera Khurd1
Kandhakura
Paspol1
Arakera .K
Ganapura
Ghanapur1
Ramasamudra
Arakera Khurd2
GANAPURA
Panchasheelanagara
Paspol2
Gopalapura
GOPALAPURA
Gopalapur
YALERI
Ghanapur2
Totlur3
Totlur2
Yaleri
THOTALURA

References
- Streams/Drainage
- Road/Cart track
- Habitation
- Waterbody
- 306 Land parcel with No's
- Village boundary
- Micro-watershed boundary
- Sub-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

3.2. Database Used - Satellite Image





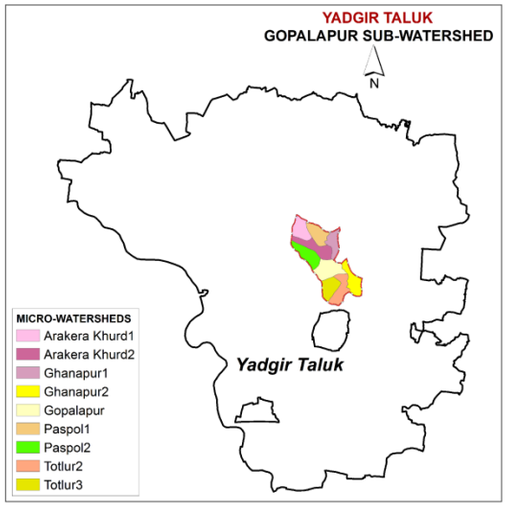
SATELLITE IMAGE
Gopalapur Sub-watershed
(4D2D6B : Area - 5071.82 ha)
YADGIR TALUK & DISTRICT

km
0 0.5 1 2
N

References
- Streams/Drainage
- Road/Cart track
- Habitation
- Waterbody
- Land parcel with No's
- Village boundary
- Micro-watershed boundary
- Sub-watershed boundary

Source: Cartosat 1 Imagery, 2011

3.3. Location of Wells



LOCATION OF WELLS

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

km
0 0.5 1 2
N

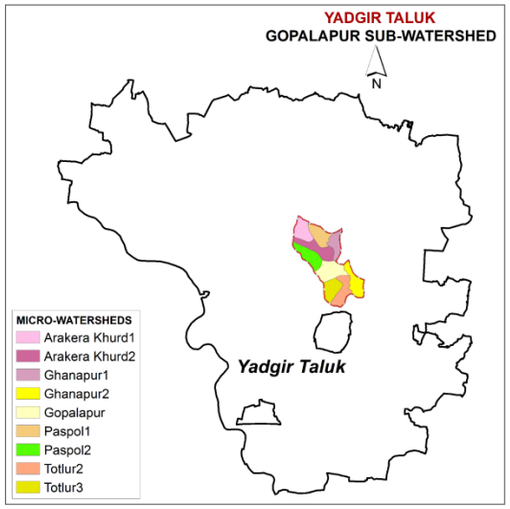
ARAKERA .K
PASAPOOLA
Arakera Khurd1
Pasapoola
Paspol1
Kandhakura
Arakera .K
Ramasamudra
Ghanapur1
Ganapura
Panchasheelanagara
Arakera Khurd2
GANAPURA
Paspol2
Gopalapura
GOPALAPURA
Gopalapur
YALERI
Ghanapur2
Yaleri
Totlur3
Totlur2
Thotalura
THOTALURA

Legend **No's**
Borewell 37

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

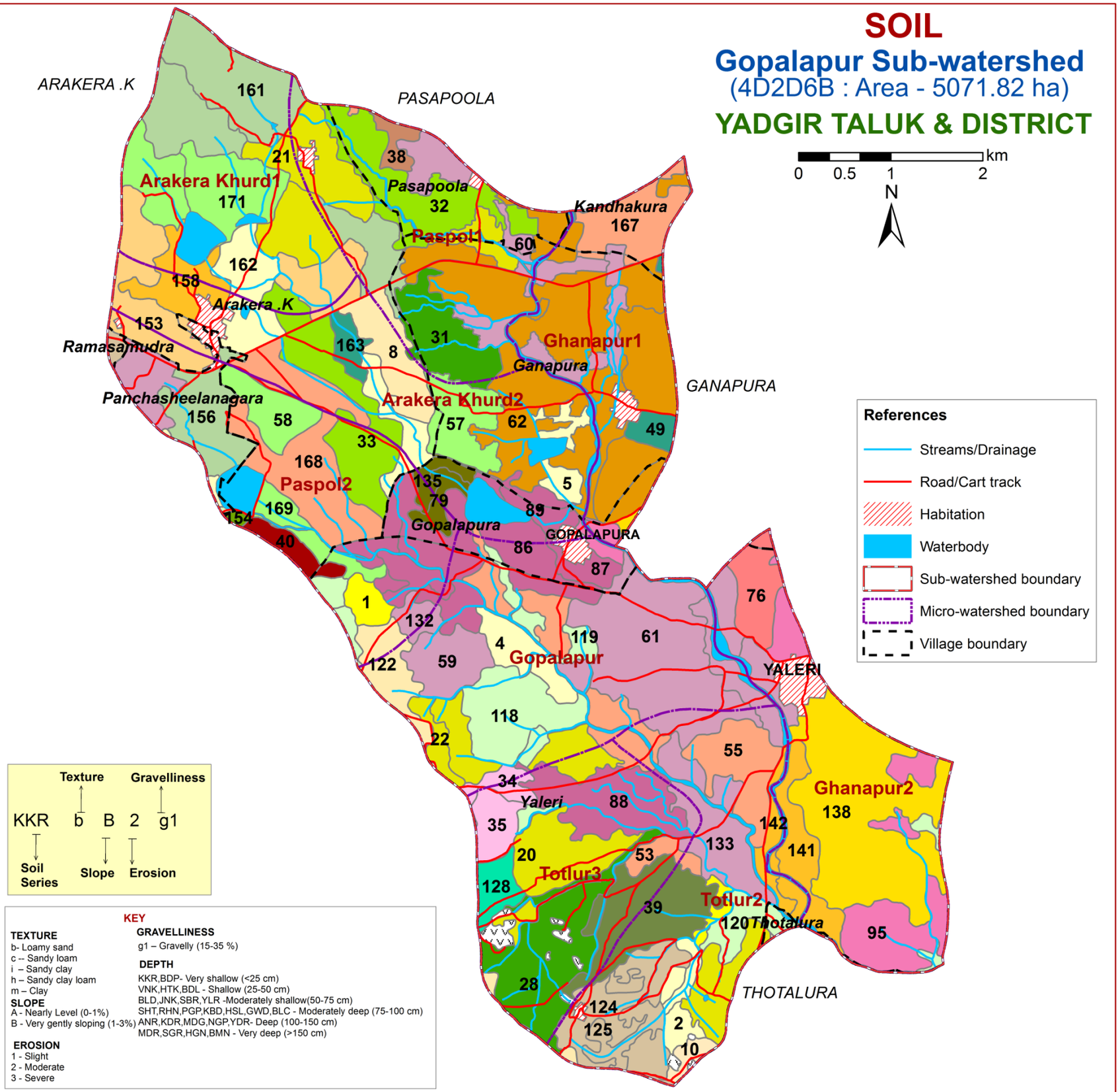
Source: ICAR-NBSS&LUP, Bengaluru

4. The Soils



Soil Phase	Area in ha (%)	Soil Phase	Area in ha (%)
Soil of Granite and Granite Gneiss Landscape			
1, BDPiB2	30 (0.59)	168, ANRcB2	150 (2.96)
2, BDLbB2	28 (0.55)	57, MDGcB2	112 (2.21)
4, BDLhB2	37 (0.73)	58, MDGiB2	45 (0.88)
5, BDLiB2	38 (0.75)	171, MDGhA1	74 (1.46)
162, BDLhB2g1	101 (2.0)	169, MDGcA1	35 (0.68)
8, VNKbB2g1	66 (1.31)	59, MDRcB2	92 (1.81)
10, VNKiB2	12 (0.23)	133, MDRiB2	211 (4.15)
122, VNKcB3	50 (0.99)	60, MDRiA1	10 (0.21)
20, JNKcB2	191 (3.77)	61, MDRmB2	259 (5.11)
21, JNKcB2g1	147 (2.9)	132, MDRhB2	28 (0.54)
22, JNKiB2	18 (0.36)	62, BMNmB2	442 (8.71)
28, YLRbB3	127 (2.5)	118, BDPcB2	104 (2.06)
31, YLRiB2	84 (1.66)	119, BDPiB3	43 (0.84)
32, HSLcB2	114 (2.24)	120, BDPhB2	41 (0.81)
33, HSLiB2	116 (2.29)	124, SBRbB3	98 (1.92)
34, GWDcB2	19 (0.38)	125, SBRhB2	34 (0.66)
35, GWDiB2	32 (0.63)	128, SHTcB2	27 (0.54)
38, BLCiB2	16 (0.31)	153, KKRbB2g1	141 (2.78)
39, KBDbB3	116 (2.29)	154, YDRcB2g1	3 (0.06)
40, PGPcB2	23 (0.46)	156, HTKbB2	71 (1.4)
53, ANRhB2	19 (0.37)	161, HTKbB2g1	224 (4.43)
55, ANRiB2	156 (3.08)	49, NGPmB2	18 (0.36)
167, ANRcA1	69 (1.37)	163, NGPmA1	20 (0.39)
Low Land		Soil of Alluvial Landscape	
141, SGRcB2	62 (1.23)	76, BLDmB2	48 (0.95)
142, SGRhB2	22 (0.43)	86, KDRhA1	55 (1.08)
158, SGRiA1	52 (1.02)	87, KDRiB2	76 (1.49)
Rock outcrops	17 (0.33)	88, KDRiB3	181 (3.57)
Others*	215 (4.24)	89, KDRmB2	21 (0.41)
		95, HGNmB2	132 (2.61)
		79, RHNmB2	18 (0.36)
		135, RHNhB2	16 (0.32)
		138, HGNmB1	265 (5.23)

* - Habitation & Waterbody



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
3 - Severe

GRAVELLINESS
g1 – Gravelly (15-35 %)

DEPTH
KKR,BDP- Very shallow (<25 cm)
VNK,HTK,BDL - Shallow (25-50 cm)
BLD,JNK,SBR,YLR -Moderately shallow(50-75 cm)
SHT,RHN,PGP,KBD,HSL,GWD,BLC - Moderately deep (75-100 cm)
ANR,KDR,MDG,NGP,YDR- Deep (100-150 cm)
MDR,SGR,HGN,BMN - Very deep (>150 cm)

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

Source: ICAR-NBSS&LUP, Bengaluru

4.1 Mapping unit description of Gopalapur (4D2D6B) 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		**218 (4.3)**
118		BDPcB2	Sandy loam surface, slope 1-3%, moderate erosion	104 (2.06)
120		BDPhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	41 (0.81)
1		BDPiB2	Sandy clay surface, slope 1-3%, moderate erosion	30 (0.59)
119		BDPiB3	Sandy clay surface, slope 1-3%, severe erosion	43 (0.84)
	KKR	Kakalawar soils are very shallow (<25 cm), well drained, have dark brown sandy loam soils occurring on very gently sloping uplands under cultivation		**141 (2.78)**
153		KKRbB2g1	Loamy sand surface, slope 1-3%, moderate erosion, gravelly (15-35%)	141 (2.78)
	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		**204 (4.03)**
2		BDLbB2	Loamy sand surface, slope 1-3%, moderate erosion	28 (0.55)
4		BDLhB2	Sandy clay loam surface, slope 1-3%, moderate erosion,	37 (0.73)
162		BDLhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	101 (2.0)
5		BDLiB2	Sandy clay surface, slope 1-3, moderate erosion	38 (0.75)
	HTK	Hattikuni soils are shallow (25-50 cm), well drained, have dark yellowish brown sandy loam soils occurring on very gently sloping uplands under cultivation		**295 (5.83)**
156		HTKbB2	Loamy sand surface, slope 1-3%, moderate erosion	71 (1.4)
161		HTKbB2g1	Loamy sand surface, slope 1-3%, moderate erosion, gravelly (15-35%)	224 (4.43)
	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		**128 (2.53)**
8		VNKbB2g1	Loamy sand surface, slope 1-3%, moderate erosion, gravelly (15-35%)	66 (1.31)
122		VNKcB3	Sandy loam surface, slope 1-3%, severe erosion	50 (0.99)
10		VNKiB2	Sandy clay surface, slope 1-3%, moderate erosion	12 (0.23)
	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		**356 (7.03)**
20		JNKcB2	Sandy loam surface, slope 1-3%, moderate erosion	191 (3.77)
21		JNKcB2g1	Sandy loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	147 (2.9)
22		JNKiB2	Sandy clay surface, slope 1-3, moderate erosion	18 (0.36)

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				
	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		**132 (2.58)**
124		SBRbB3	Loamy sand surface, slope 1-3%, severe erosion	98 (1.92)
125		SBRhB2	Sandy clay loam surface, slope 1-3%, moderate erosion,	34 (0.66)
	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		**211 (4.16)**
28		YLRbB3	Loamy sand surface, slope 1-3%, severe erosion	127 (2.5)
31		YLRiB2	Sandy clay surface, slope 1-3%, moderate erosion	84 (1.66)
	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		**16 (0.31)**
38		BLCiB2	Sandy clay surface, slope 1-3%, moderate erosion	16 (0.31)
	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		**51 (1.01)**
34		GWDcB2	Sandy loam surface, slope 1-3%, moderate erosion	19 (0.38)
35		GWDiB2	Sandy clay surface, slope 1-3%, moderate erosion	32 (0.63)
	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		**230 (4.53)**
32		HSLcB2	Sandy loam surface, slope 1-3%, moderate erosion	114 (2.24)
33		HSLiB2	Sandy clay surface, slope 1-3%, moderate erosion	116 (2.29)
	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		**116 (2.29)**
39		KBDbB3	Loamy sand surface, slope 1-3%, severe erosion	116 (2.29)
	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		**23 (0.46)**
40		PGPcB2	Sandy loam surface, slope 1-3%, moderate erosion	23 (0.46)
	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		**27 (0.54)**
128		SHTcB2	Sandy loam surface, slope 1-3%, moderate erosion	27 (0.54)

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				
	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		**394 (7.78)**
167		ANRcA1	Sandy loam surface, slope 0-1%, slight erosion	69 (1.37)
168		ANRcB2	Sandy loam surface, slope 1-3%, moderate erosion	150 (2.96)
53		ANRhB2	Sandy clay loam surface, slope 1-3%, moderate erosion,	19 (0.37)
55		ANRiB2	Sandy clay surface, slope 1-3%, moderate erosion	156 (3.08)
	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		**266 (5.23)**
169		MDGcA1	Sandy loam surface, slope 0-1%, slight erosion	35 (0.68)
57		MDGcB2	Sandy loam surface, slope 1-3%, moderate erosion	112 (2.21)
171		MDGhA1	Sandy clay loam surface, slope 0-1%, slight erosion	74 (1.46)
58		MDGiB2	Sandy clay surface, slope 1-3%, moderate erosion	45 (0.88)
	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		**38 (0.75)**
163		NGPmA1	Clay surface, slope 1-3%, slight erosion	20 (0.39)
49		NGPmB2	Clay surface, slope 1-3%, moderate erosion	18 (0.36)
	YDR	Yadgir soils are deep (100-150 cm), well drained, have brown to dark yellowish brown and olive brown, sodic sandy loam soils occurring on very gently sloping uplands under cultivation		**3 (0.06)**
154		YDRcB2g1	Sandy loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	3 (0.06)
	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		**442 (8.71)**
62		BMNmB2	Clay surface, slope 1-3%, moderate erosion	442 (8.71)
	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		**600 (11.82)**
59		MDRcB2	Sandy loam surface, slope 1-3%, moderate erosion	92 (1.81)
132		MDRhB2	Sandy clay loam surface, slope 1-3%, moderate erosion,	28 (0.54)
60		MDRiA1	Sandy clay surface, slope 0-1%, slight erosion	10 (0.21)
133		MDRiB2	Sandy clay surface, slope 1-3%, moderate erosion	211 (4.15)
61		MDRmB2	Clay surface, slope 1-3%, moderate erosion	259 (5.11)

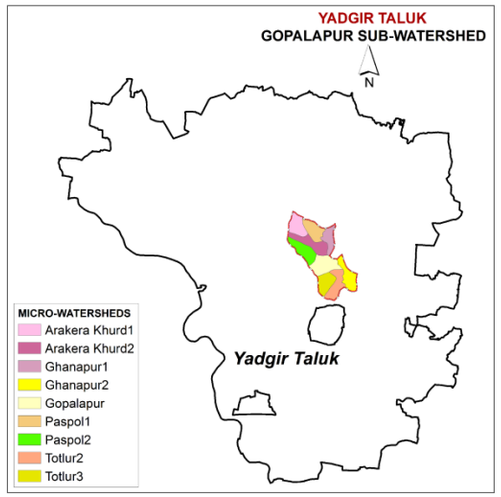
To be continued….

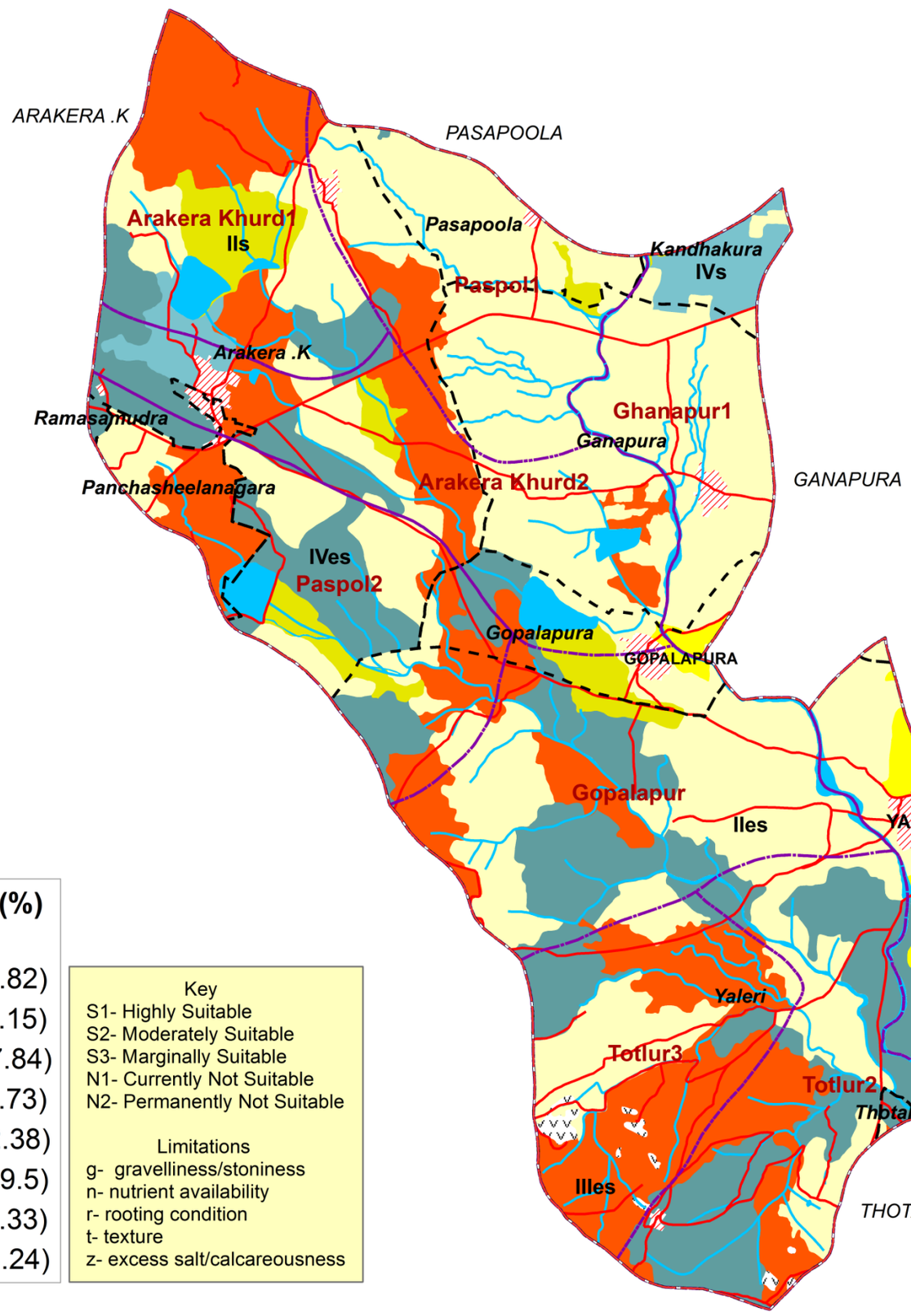
Soil map unit No*	Soil Series	Soil Phase Symbol	Mapping Unit Description	Area in ha (%)
Soils of Granite and Granite gneiss Landscape				
	SGR	Sangwar soils are very deep (>150 cm), moderately well drained, have dark gray to very dark gray, calcareous sodic cracking clay soils occurring on nearly level to very gently sloping lowlands under cultivation		**136 (2.68)**
141		SGRcB2	Sandy loam surface, slope 1-3%, moderate erosion	62 (1.23)
142		SGRhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	22 (0.43)
158		SGRiA1	Sandy clay surface, slope 0-1%, slight erosion	52 (1.02)
Soils of Alluvial Landscape				
	BLD	Balched soils are moderately shallow (50-75 cm), moderately well drained, have black to very dark grayish brown, slightly calcareous clay loam soils. occurring on very gently to gently sloping plains under cultivation		**48 (0.95)**
76		BLDmB2	Clay surface, slope 1-3%, moderate erosion	48 (0.95)
	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		**397 (7.84)**
138		HGNmB1	Clay surface, slope 1-3%, slight erosion	265 (5.23)
95		HGNmB2	Clay surface, slope 1-3%, moderate erosion	132 (2.61)
	RHN	Rachanalli soils are moderately deep (75-100 cm), well drained, have very dark grayish brown to dark brown, slightly calcareous sodic sandy clay loam soils occurring on very gently sloping plains under cultivation.		**34 (0.68)**
135		RHNhB2	Sandy clay loam surface, slope 1-3%, moderate erosion,	16 (0.32)
79		RHNmB2	Clay surface, slope 1-3%, moderate erosion	18 (0.36)
	KDR	Kudlura soils are deep (100-150 cm), moderately well drained, have very dark gray to grayish brown, calcareous cracking clay soils occurring on nearly level to very gently sloping plains under cultivation		**333 (6.55)**
86		KDRhA1	Sandy clay loam surface, slope 0-1%, slight erosion	55 (1.08)
87		KDRiB2	Sandy clay surface, slope 1-3%, moderate erosion	76 (1.49)
88		KDRiB3	Sandy clay surface, slope 1-3%, severe erosion	181 (3.57)
89		KDRmB2	Clay surface, slope 1-3%, moderate erosion	21 (0.41)
999		Rock outcrops	Rock lands, both massive and bouldery with little or no soil	**17 (0.33)**
1000		Others		**215 (4.24)**

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

5. Soil Survey Interpretations

5.1. Land Capability Classification





LAND CAPABILITY
Gopalapur Sub-watershed
(4D2D6B : Area - 5071.82 ha)
YADGIR TALUK & DISTRICT

0 0.5 1 2 km
N

Capability subclass	Area in ha (%)
IIs	194 (3.82)
IIes	2087 (41.15)
IIsw	398 (7.84)
IIIes	1051 (20.73)
IVs	121 (2.38)
IVes	989 (19.5)
Rock outcrops	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

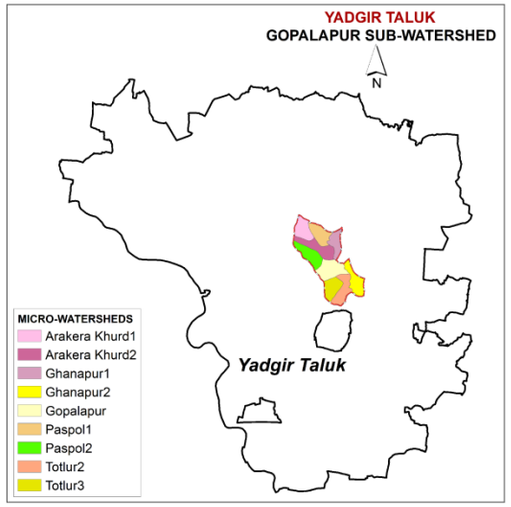
Key
S1- Highly Suitable
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable
N2- Permanently Not Suitable

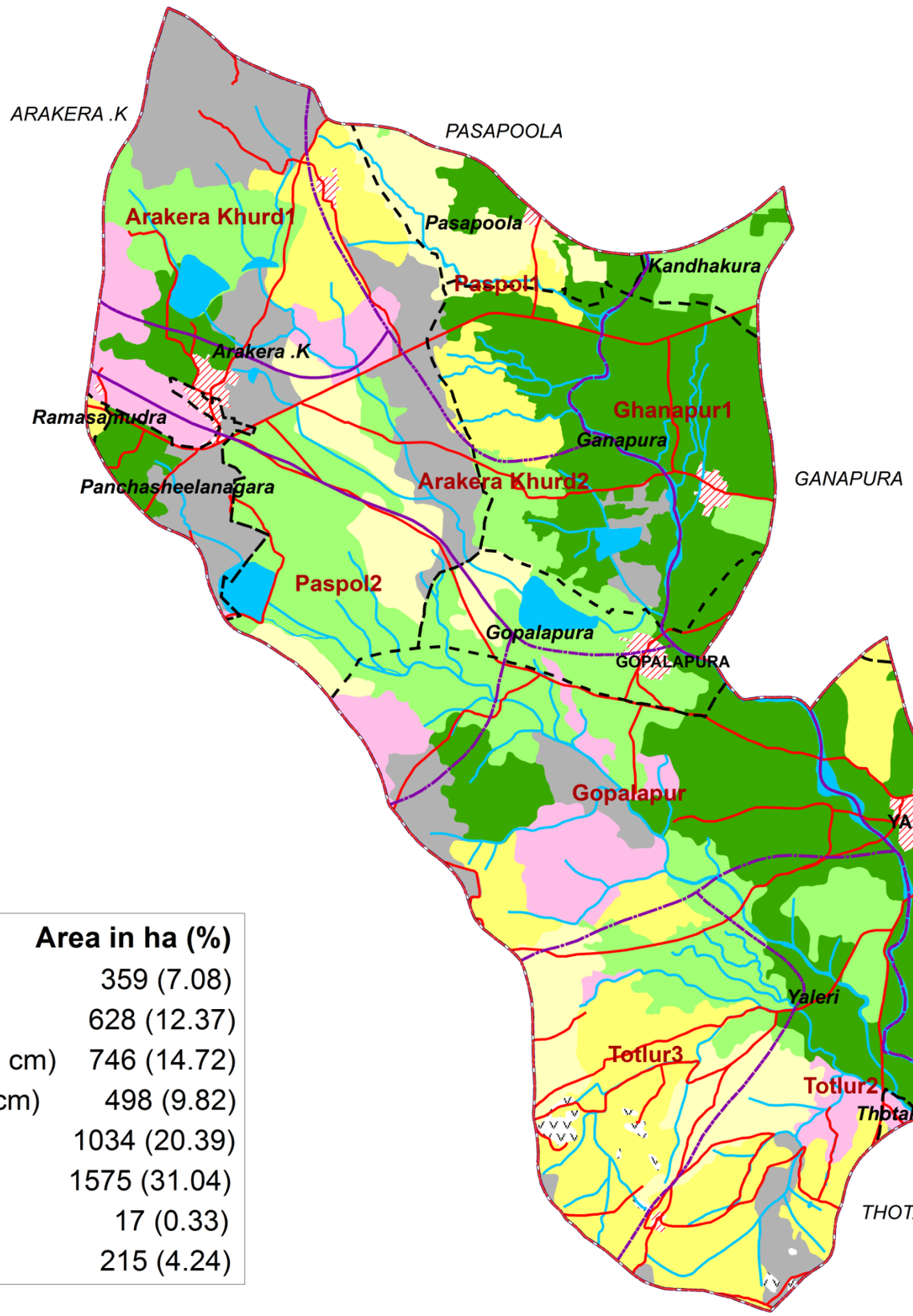
Limitations
g- gravelliness/stoniness
n- nutrient availability
r- rooting condition
t- texture
z- excess salt/calcareousness

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

Source: ICAR-NBSS&LUP, Bengaluru

5.2. Soil Depth





SOIL DEPTH

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

km
0 0.5 1 2
N

Depth Class	Area in ha (%)
Very shallow (<25 cm)	359 (7.08)
Shallow (25-50 cm)	628 (12.37)
Moderately shallow (50-75 cm)	746 (14.72)
Moderately deep (75-100 cm)	498 (9.82)
Deep (100-150 cm)	1034 (20.39)
Very deep (>150 cm)	1575 (31.04)
Rock outcrops	17 (0.33)
Others*	215 (4.24)

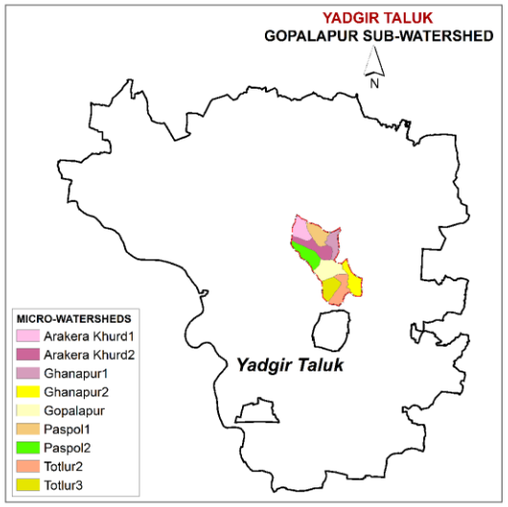
* - Habitation & Waterbody

References

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

Source: ICAR-NBSS&LUP, Bengaluru

5.3. Surface Soil Texture



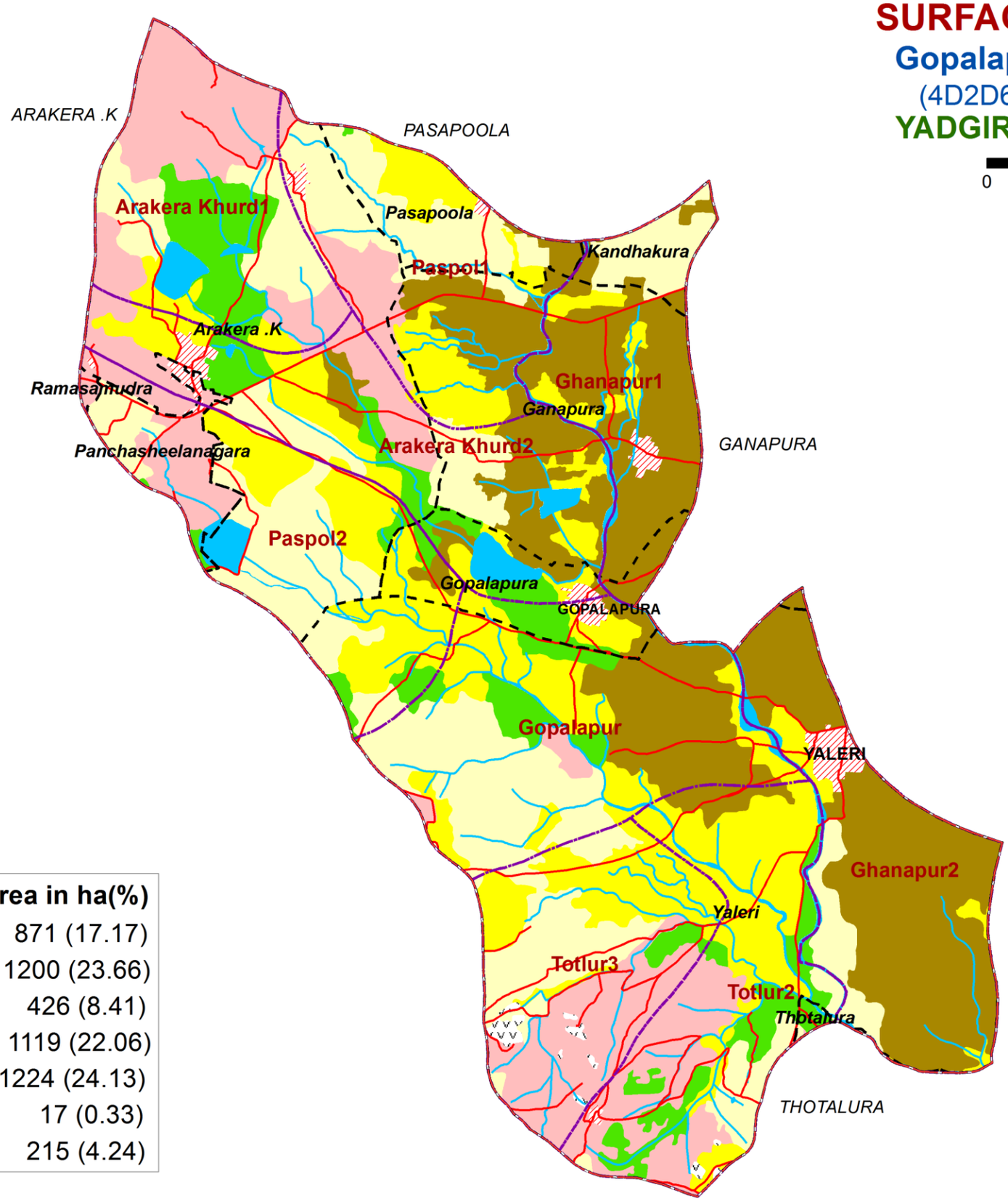
SURFACE SOIL TEXTURE

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

km
0 0.5 1 2
N



Texture Class	Area in ha(%)
Loamy sand	871 (17.17)
Sandy loam	1200 (23.66)
Sandy clay loam	426 (8.41)
Sandy clay	1119 (22.06)
Clay	1224 (24.13)
Rock outcrops	17 (0.33)
Others*	215 (4.24)

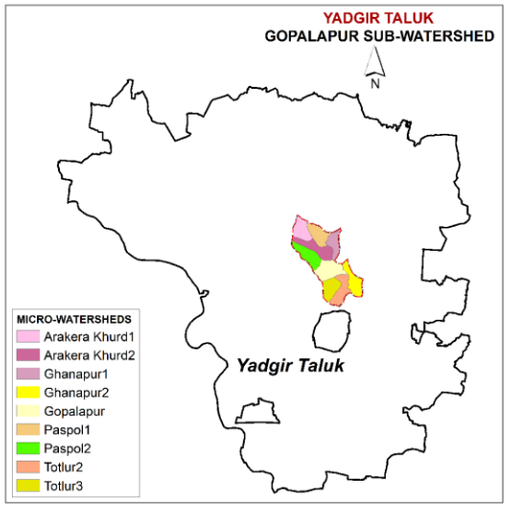
* - Habitation & Waterbody

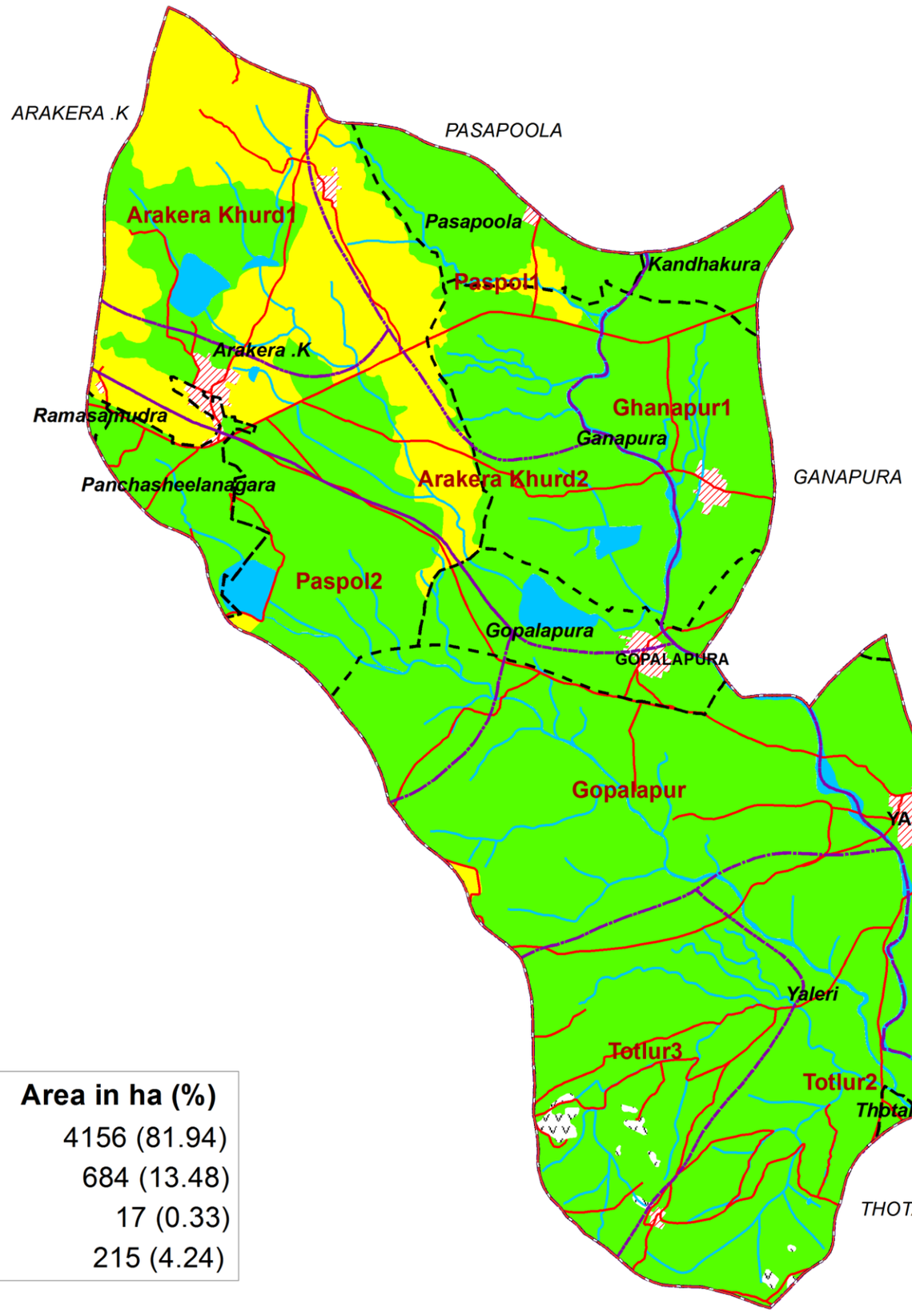
References

- 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





SOIL GRAVELLINESS

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

km
0 0.5 1 2
N

Gravelly Class	Area in ha (%)
Non gravelly (<15%)	4156 (81.94)
Gravelly (15-35%)	684 (13.48)
Rock outcrops	17 (0.33)
Others*	215 (4.24)

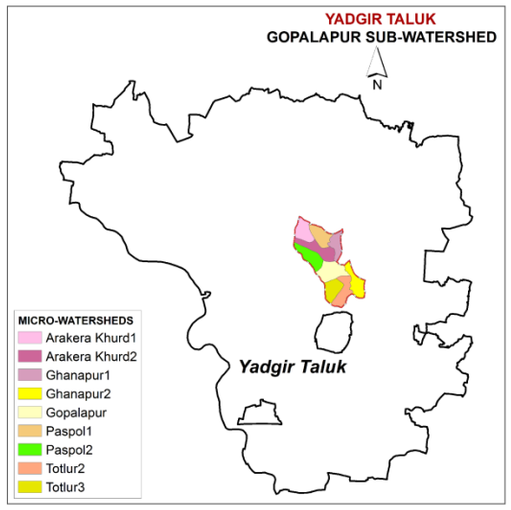
* - Habitation & Waterbody

References

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

Source: ICAR-NBSS&LUP, Bengaluru

5.5. Available Water Capacity



AVAILABLE WATER CAPACITY

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

0 0.5 1 2 km

N

ARAKERA .K
PASAPOOLA
Arakera Khurd1
Pasapoola
Kandhakura
Paspol1
Arakera .K
Ramasamudra
Ghanapur1
Ganapura
GANAPURA
Panchasheelanagara
Arakera Khurd2
Paspol2
Gopalapura
GOPALAPURA
Gopalapur
YALERI
Ghanapur2
Yaleri
Totlur3
Totlur2
Thotalura
THOTALURA

Available Water Capacity	Area in ha (%)
Very low (<50 mm/m)	1234 (24.33)
Low (51-100 mm/m)	685 (13.5)
Medium (101-150 mm/m)	316 (6.23)
Very high (>200 mm/m)	2605 (51.37)
Rock outcrops	17 (0.33)
Others*	215 (4.24)

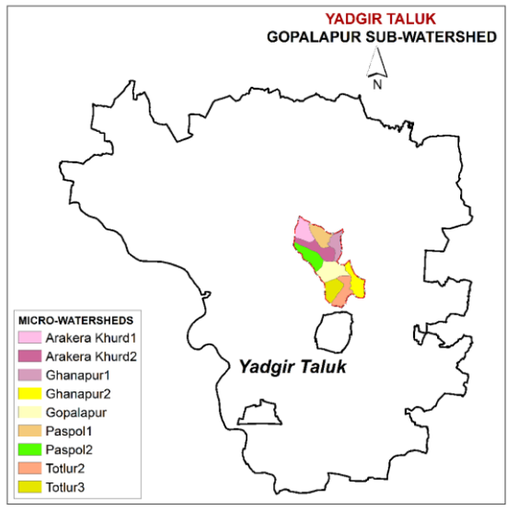
* - Habitation & Waterbody

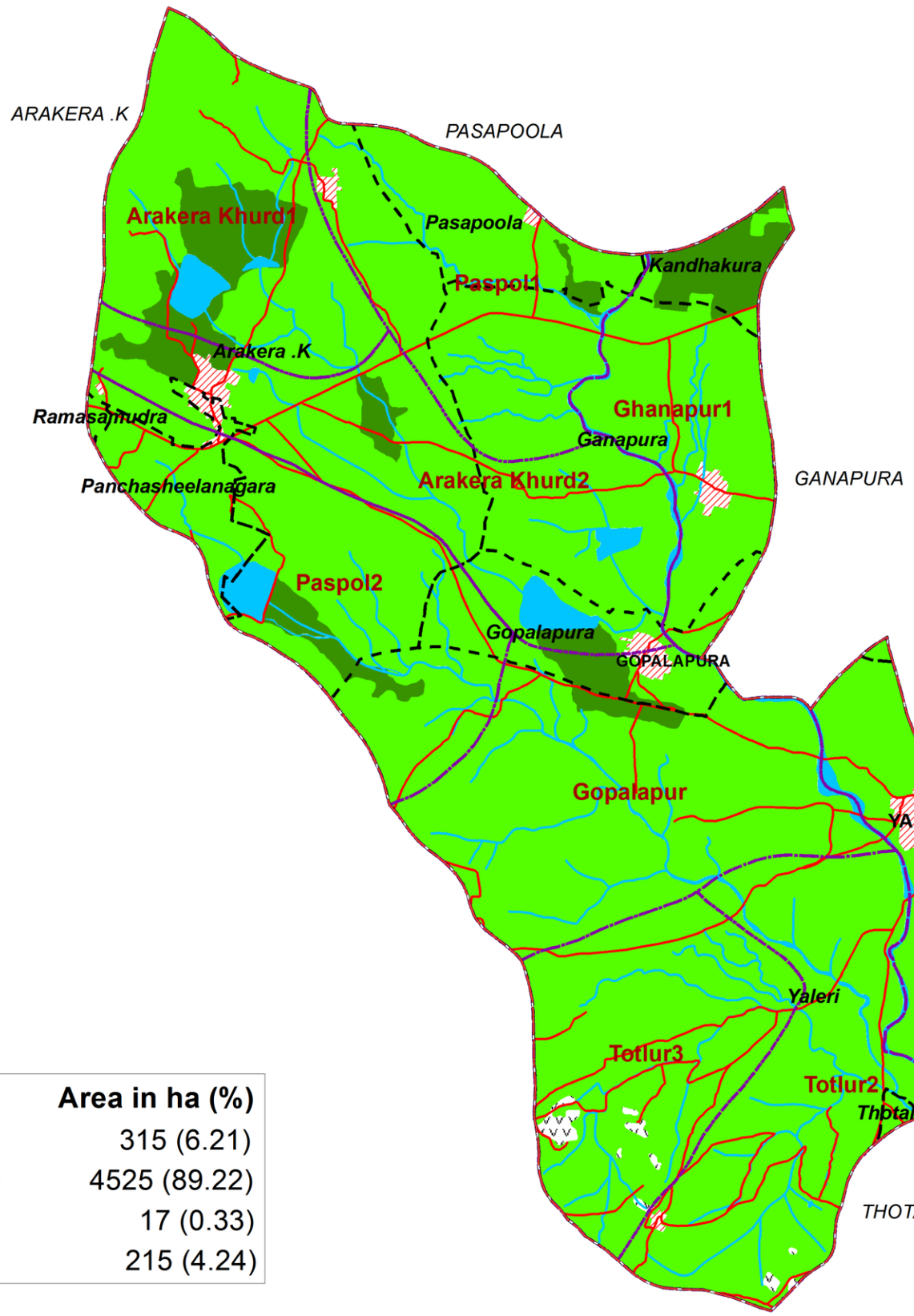
References

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

Source: ICAR-NBSS&LUP, Bengaluru

5.6.Slope





SLOPE

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

km
0 0.5 1 2
N

Slope Class	Area in ha (%)
Nearly level (0-1%)	315 (6.21)
Very gently sloping (1-3%)	4525 (89.22)
Rock outcrops	17 (0.33)
Others*	215 (4.24)

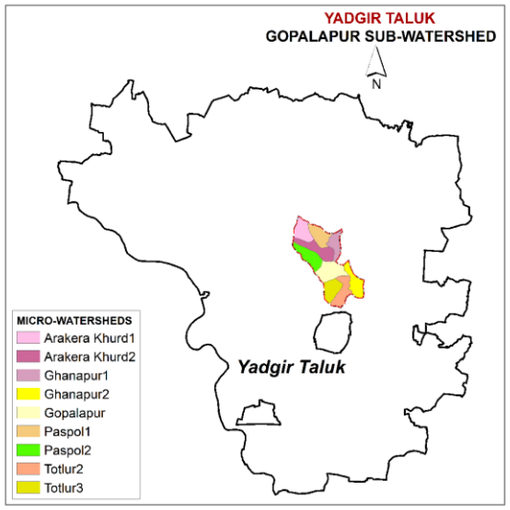
* - Habitation & Waterbody

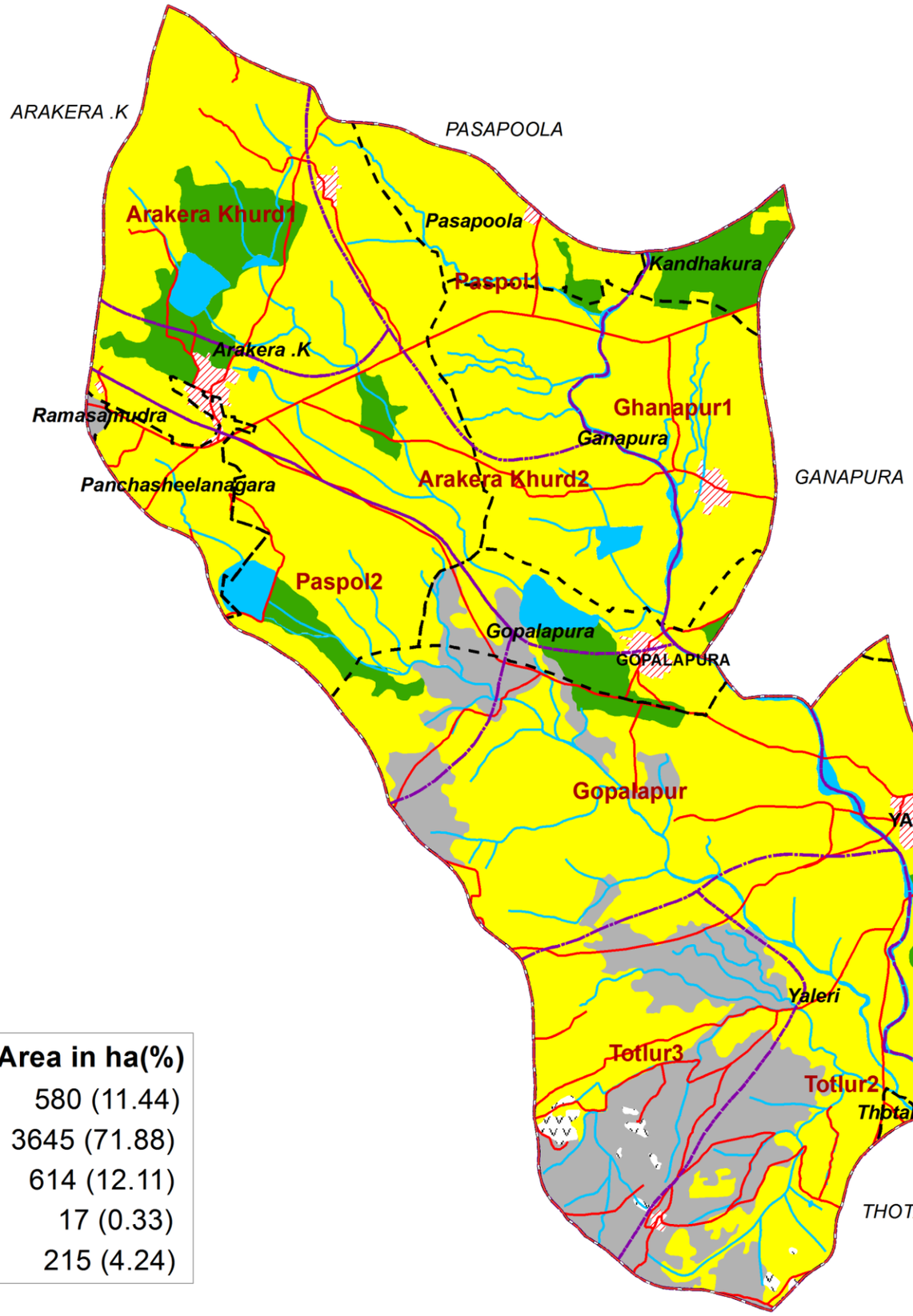
References

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

Source: ICAR-NBSS&LUP, Bengaluru

5.7.Soil Erosion





SOIL EROSION

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

km
0 0.5 1 2
N

Erosion Class	Area in ha(%)
Slight	580 (11.44)
Moderate	3645 (71.88)
Severe	614 (12.11)
Rock outcrops	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

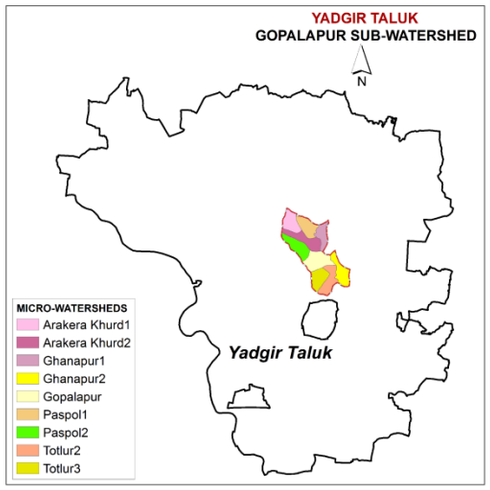
References

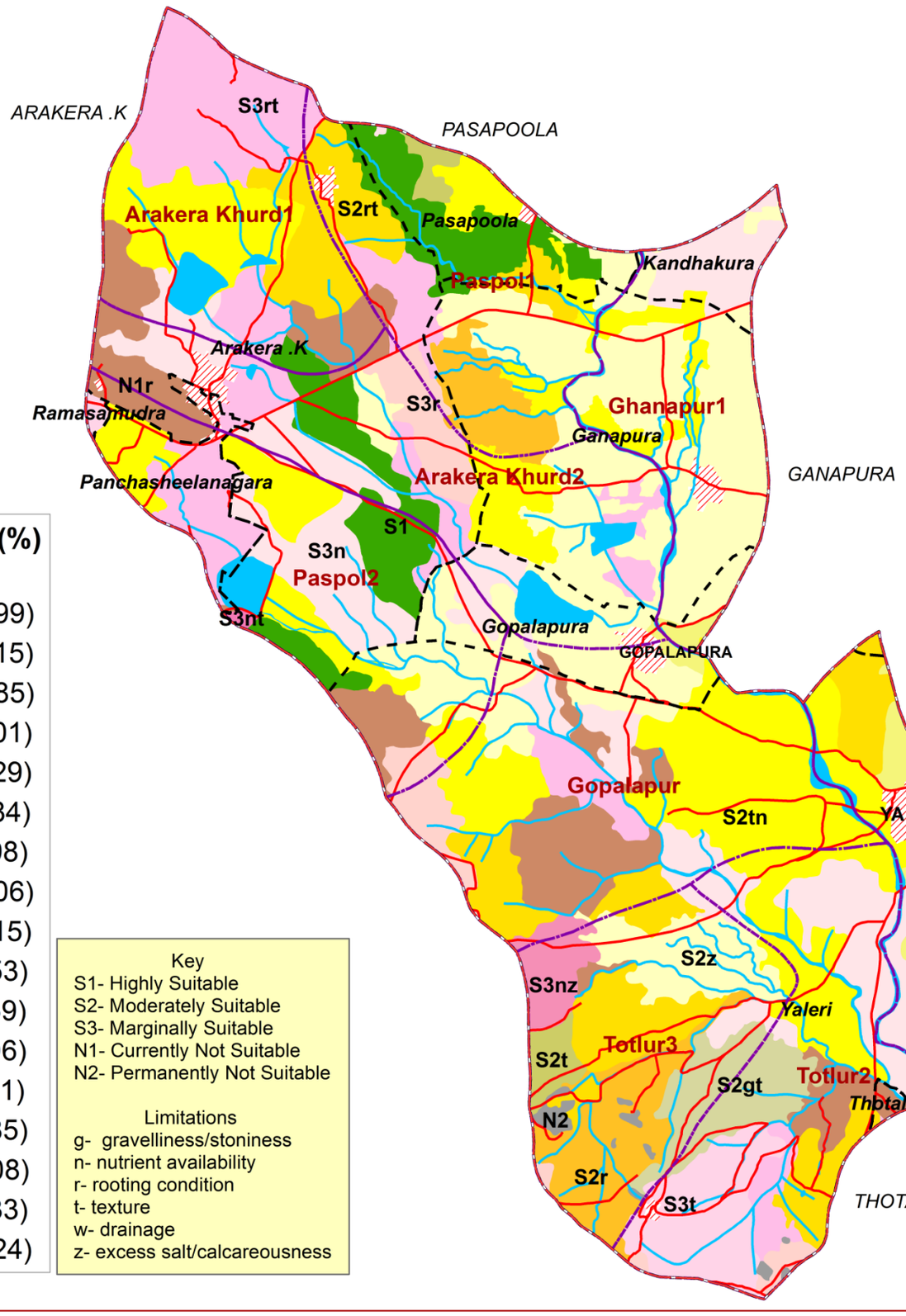
- Streams/Drainage
- Road/Cart track
- Habitation
- Waterbody
- Village boundary
- Micro-watershed boundary
- Sub-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

6. Land Suitability for Major Crops

6.1. Land Suitability for Sorghum





LAND SUITABILITY FOR SORGHUM

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

0 0.5 1 2 km

N

Suitability subclass	Area in ha (%)
S1	253 (4.99)
S2r	211 (4.15)
S2t	43 (0.85)
S2z	812 (16.01)
S2gt	116 (2.29)
S2nw	398 (7.84)
S2rt	405 (7.98)
S2tn	865 (17.06)
S3n	565 (11.15)
S3r	128 (2.53)
S3t	131 (2.59)
S3nt	3 (0.06)
S3nz	51 (1.01)
S3rt	499 (9.85)
N1r	359 (7.08)
N2	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

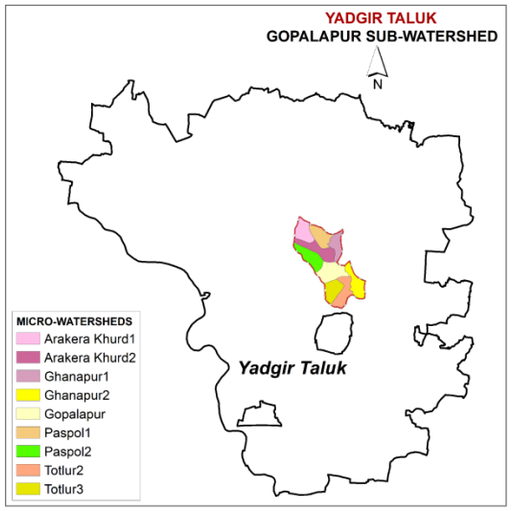
Key
S1- Highly Suitable
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable
N2- Permanently Not Suitable

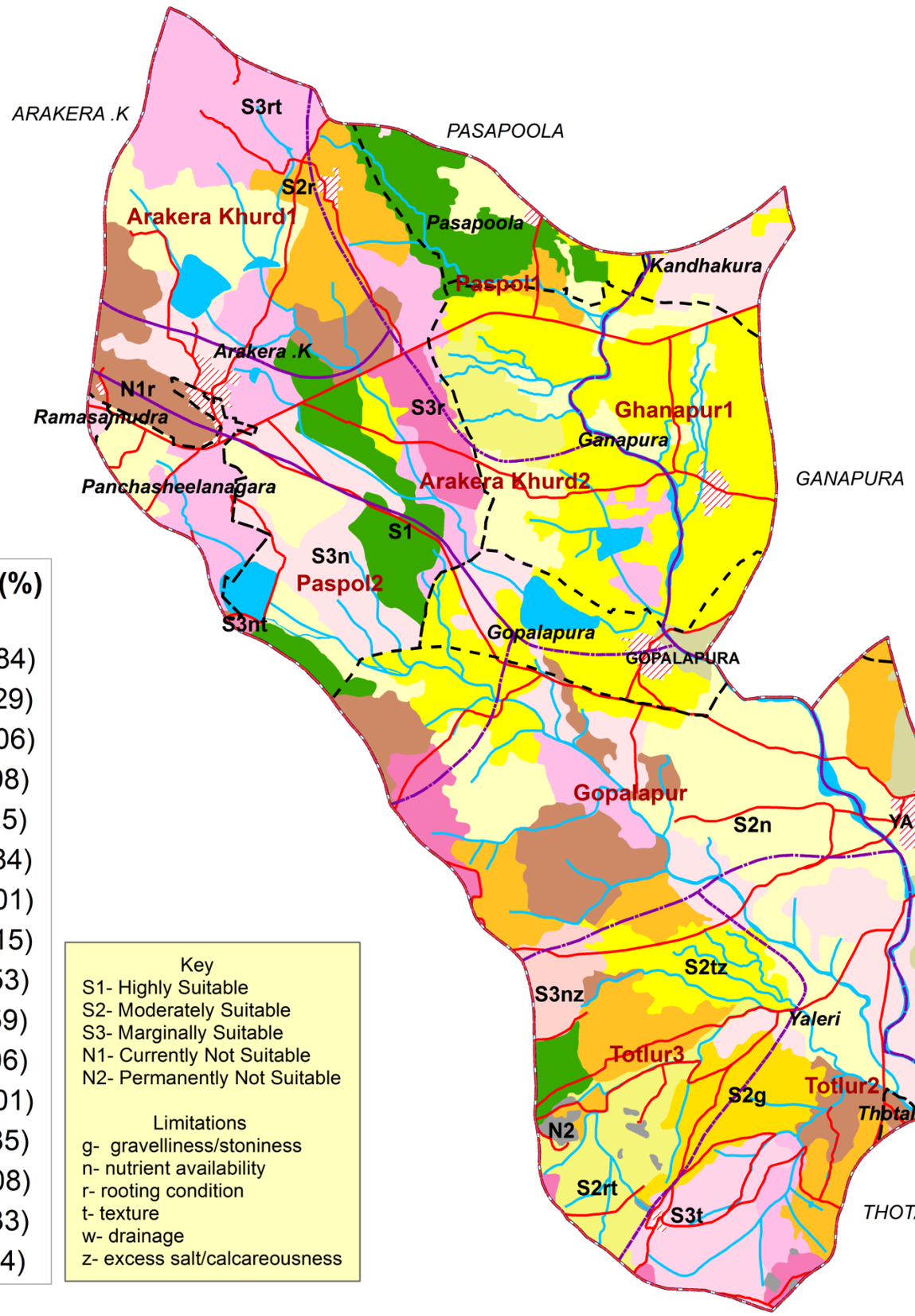
Limitations
g- gravelliness/stoniness
n- nutrient availability
r- rooting condition
t- texture
w- drainage
z- excess salt/calcareousness

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

Source: ICAR-NBSS&LUP, Bengaluru

6.2. Land Suitability for Maize





LAND SUITABILITY FOR MAIZE

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

0 0.5 1 2 km

N

Suitability subclass	Area in ha (%)
S1	296 (5.84)
S2g	116 (2.29)
S2n	865 (17.06)
S2r	405 (7.98)
S2rt	211 (4.15)
S2tw	398 (7.84)
S2tz	812 (16.01)
S3n	565 (11.15)
S3r	128 (2.53)
S3t	131 (2.59)
S3nt	3 (0.06)
S3nz	51 (1.01)
S3rt	499 (9.85)
N1r	359 (7.08)
N2	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

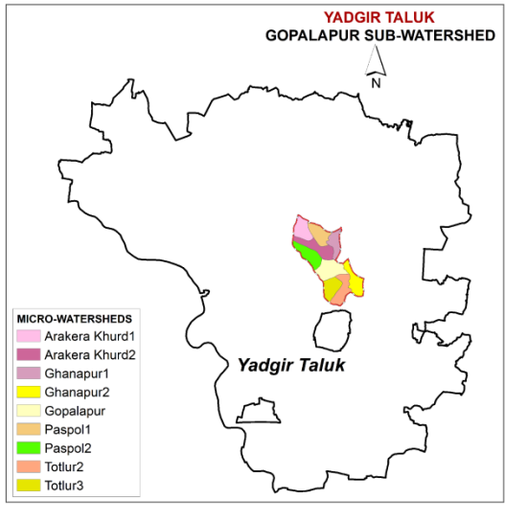
Key
S1- Highly Suitable
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable
N2- Permanently Not Suitable

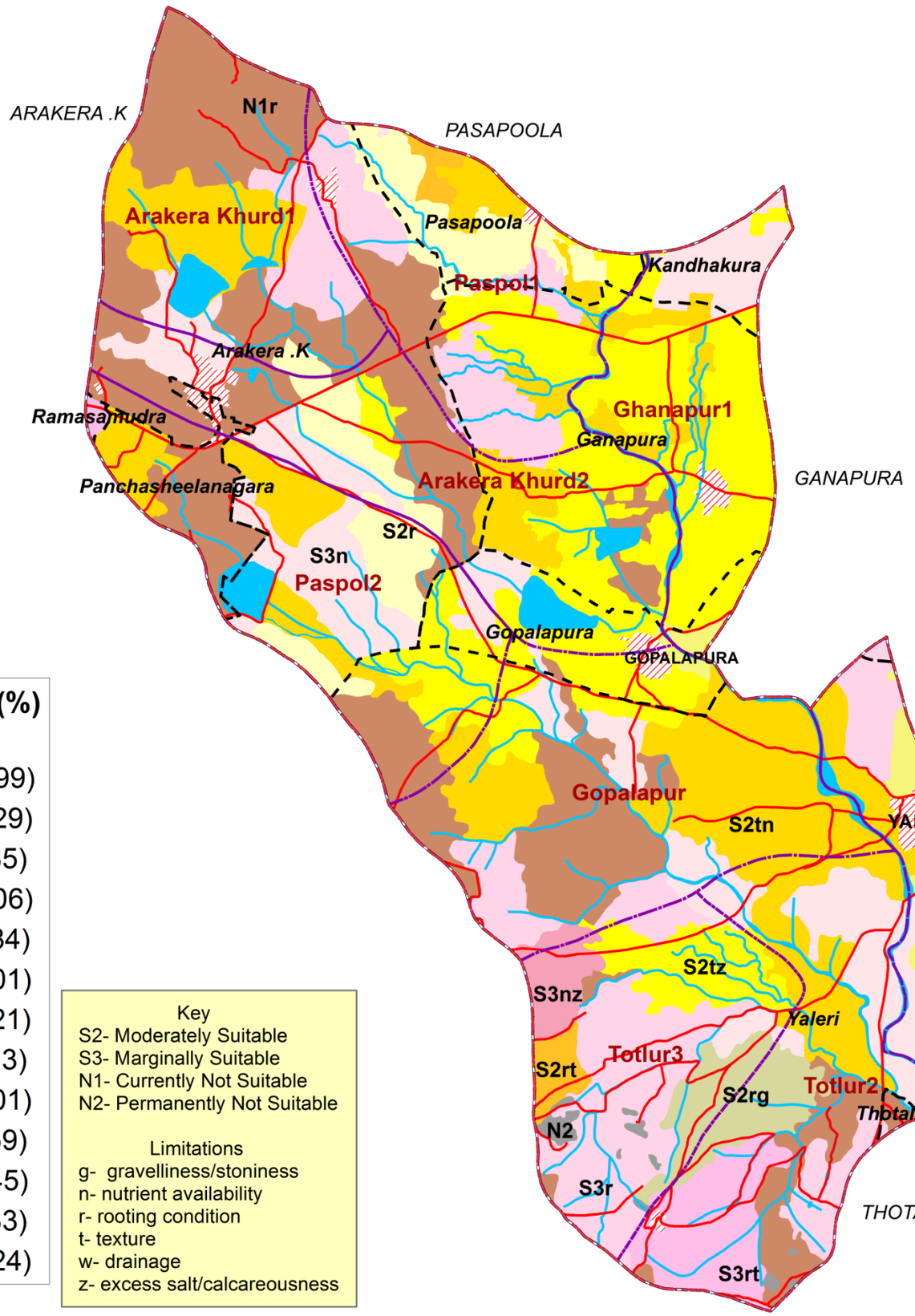
Limitations
g- gravelliness/stoniness
n- nutrient availability
r- rooting condition
t- texture
w- drainage
z- excess salt/calcareousness

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





LAND SUITABILITY FOR REDGRAM

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

0 0.5 1 2 km

N

Suitability subclass	Area in ha (%)
S2r	253 (4.99)
S2rg	116 (2.29)
S2rt	43 (0.85)
S2tn	865 (17.06)
S2tw	398 (7.84)
S2tz	812 (16.01)
S3n	568 (11.21)
S3r	615 (12.13)
S3nz	51 (1.01)
S3rt	131 (2.59)
N1r	987 (19.45)
N2	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

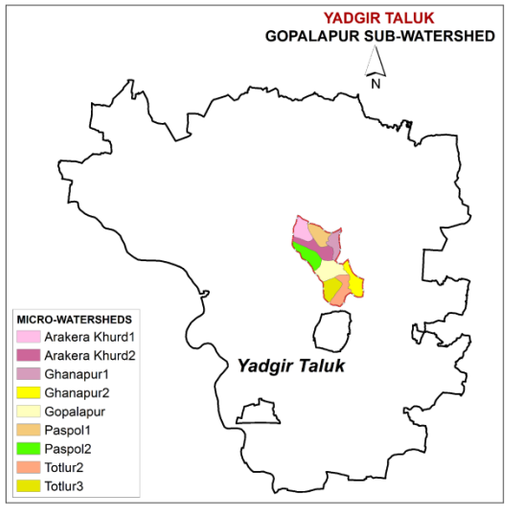
Key
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable
N2- Permanently Not Suitable

Limitations
g- gravelliness/stoniness
n- nutrient availability
r- rooting condition
t- texture
w- drainage
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

6.4. Land Suitability for Bajra



LAND SUITABILITY FOR BAJRA

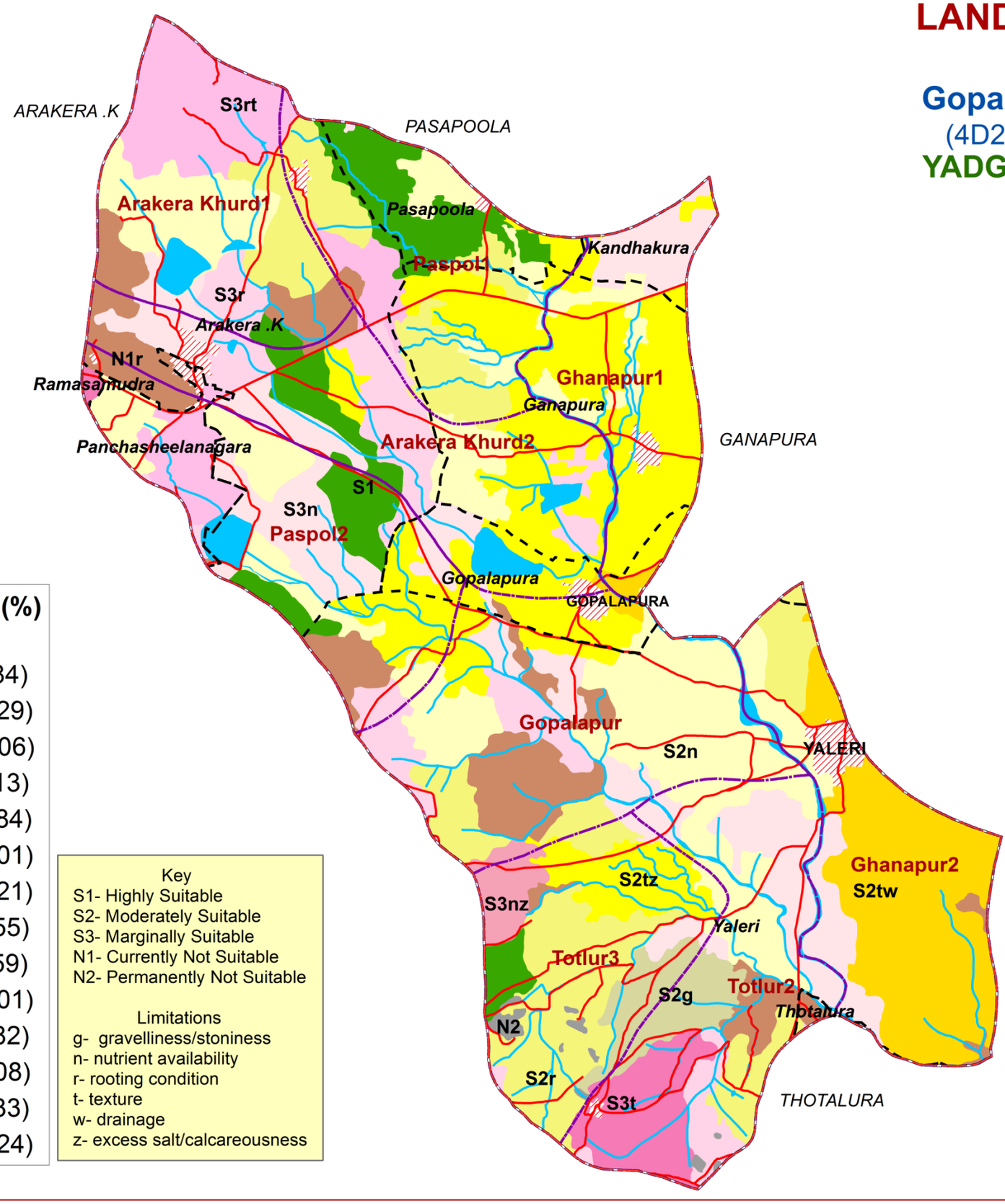
Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

0 0.5 1 2 km

N



Suitability subclass	Area in ha (%)
S1	296 (5.84)
S2g	116 (2.29)
S2n	865 (17.06)
S2r	615 (12.13)
S2tw	398 (7.84)
S2tz	812 (16.01)
S3n	568 (11.21)
S3r	332 (6.55)
S3t	131 (2.59)
S3nz	51 (1.01)
S3rt	295 (5.82)
N1r	359 (7.08)
N2	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

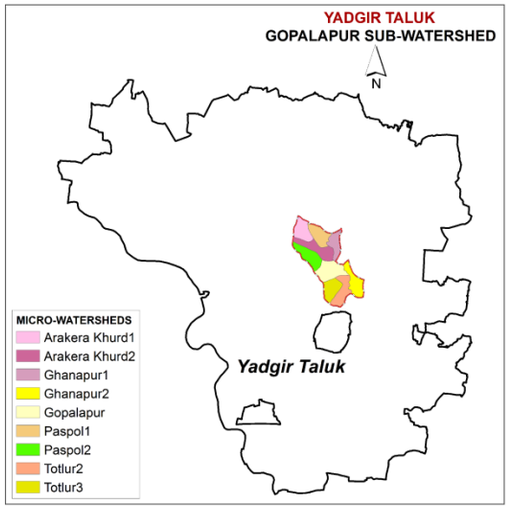
Key
S1- Highly Suitable
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable
N2- Permanently Not Suitable

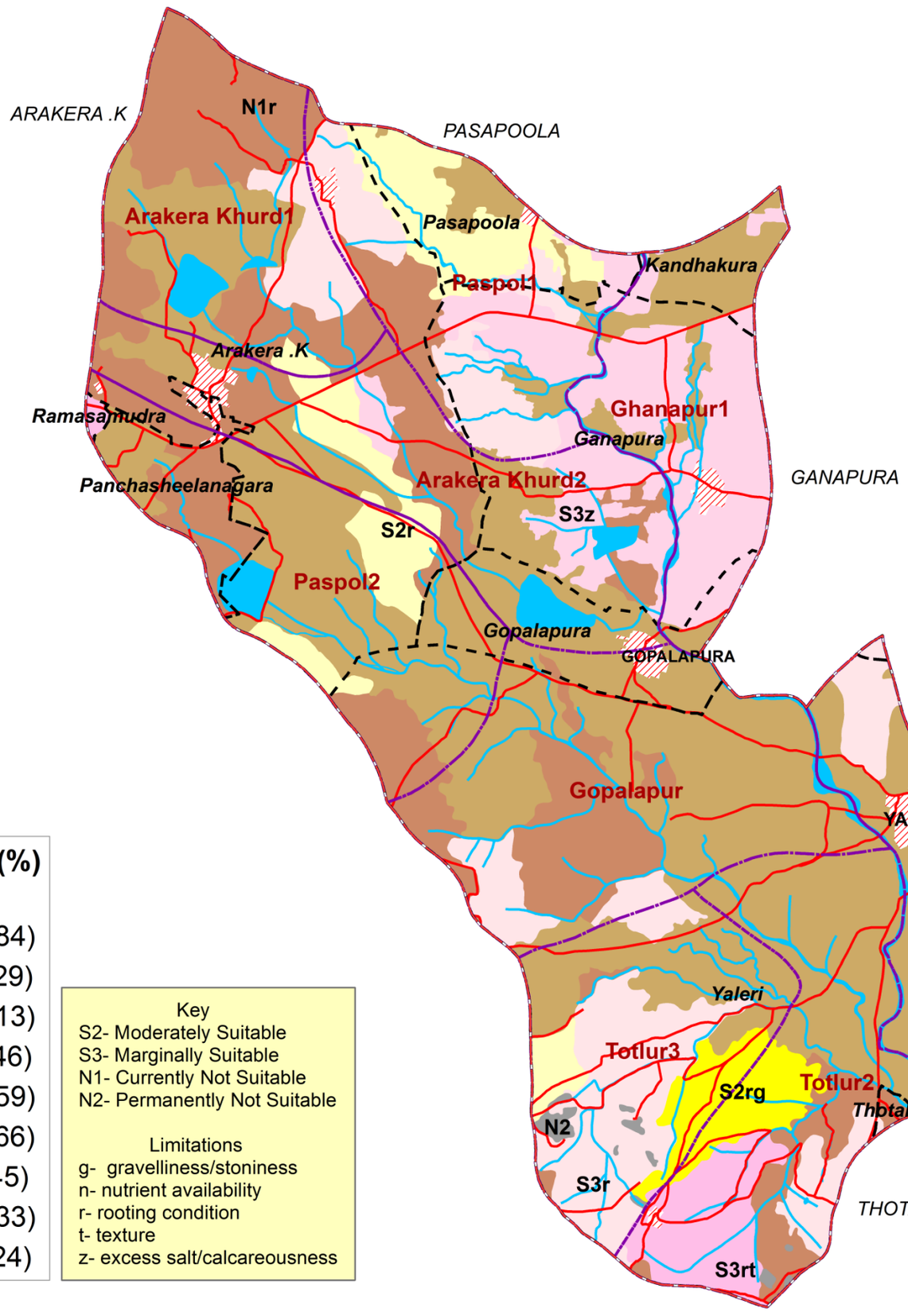
Limitations
g- gravelliness/stoniness
n- nutrient availability
r- rooting condition
t- texture
w- drainage
z- excess salt/calcareousness

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

Source: ICAR-NBSS&LUP, Bengaluru

6.5. Land Suitability for Drumstick





LAND SUITABILITY FOR DRUMSTICK

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

km
0 0.5 1 2
N

Suitability subclass	Area in ha (%)
S2r	296 (5.84)
S2rg	116 (2.29)
S3r	615 (12.13)
S3z	480 (9.46)
S3rt	131 (2.59)
N1n	2215 (43.66)
N1r	987 (19.45)
N2	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

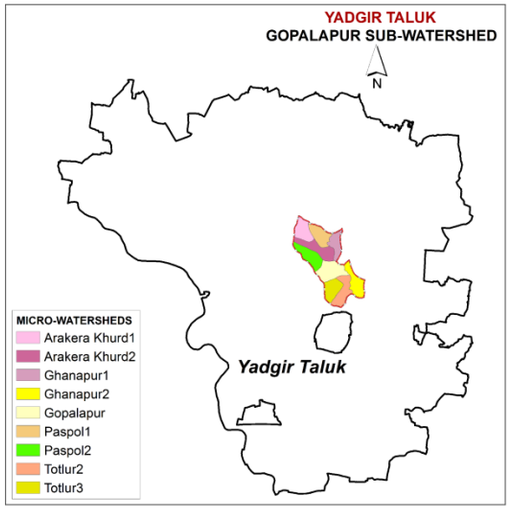
Key
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable
N2- Permanently Not Suitable

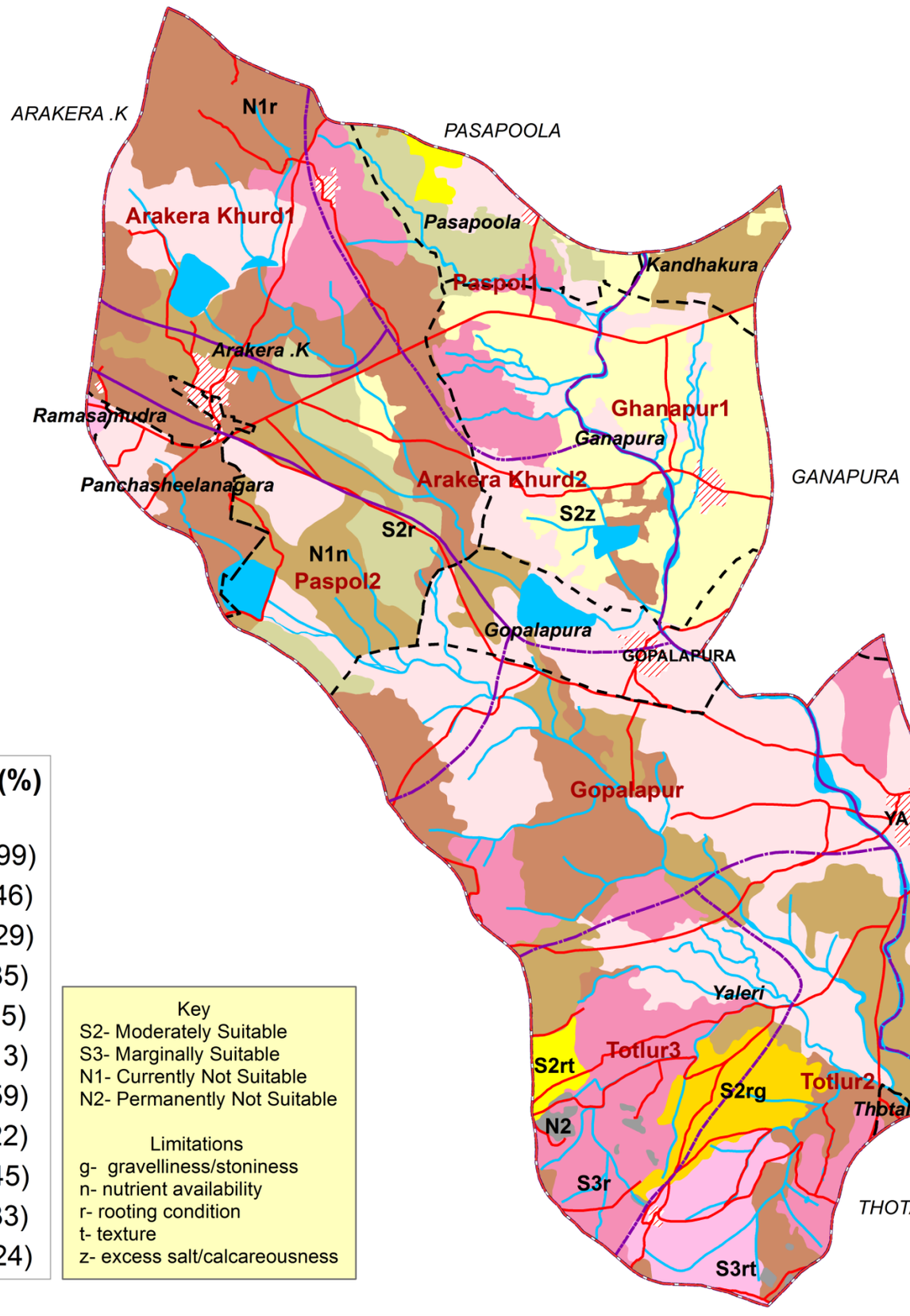
Limitations
g- gravelliness/stoniness
n- nutrient availability
r- rooting condition
t- texture
z- excess salt/calcareousness

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

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

km
0 0.5 1 2
N

Suitability subclass	Area in ha (%)
S2r	253 (4.99)
S2z	480 (9.46)
S2rg	116 (2.29)
S2rt	43 (0.85)
S3n	1595 (31.45)
S3r	615 (12.13)
S3rt	131 (2.59)
N1n	620 (12.22)
N1r	987 (19.45)
N2	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

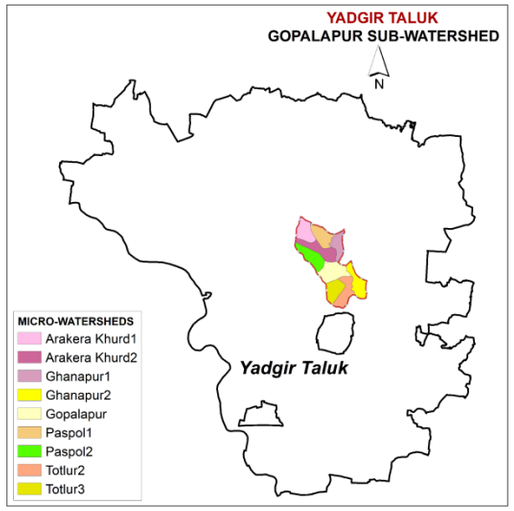
Key
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable
N2- Permanently Not Suitable

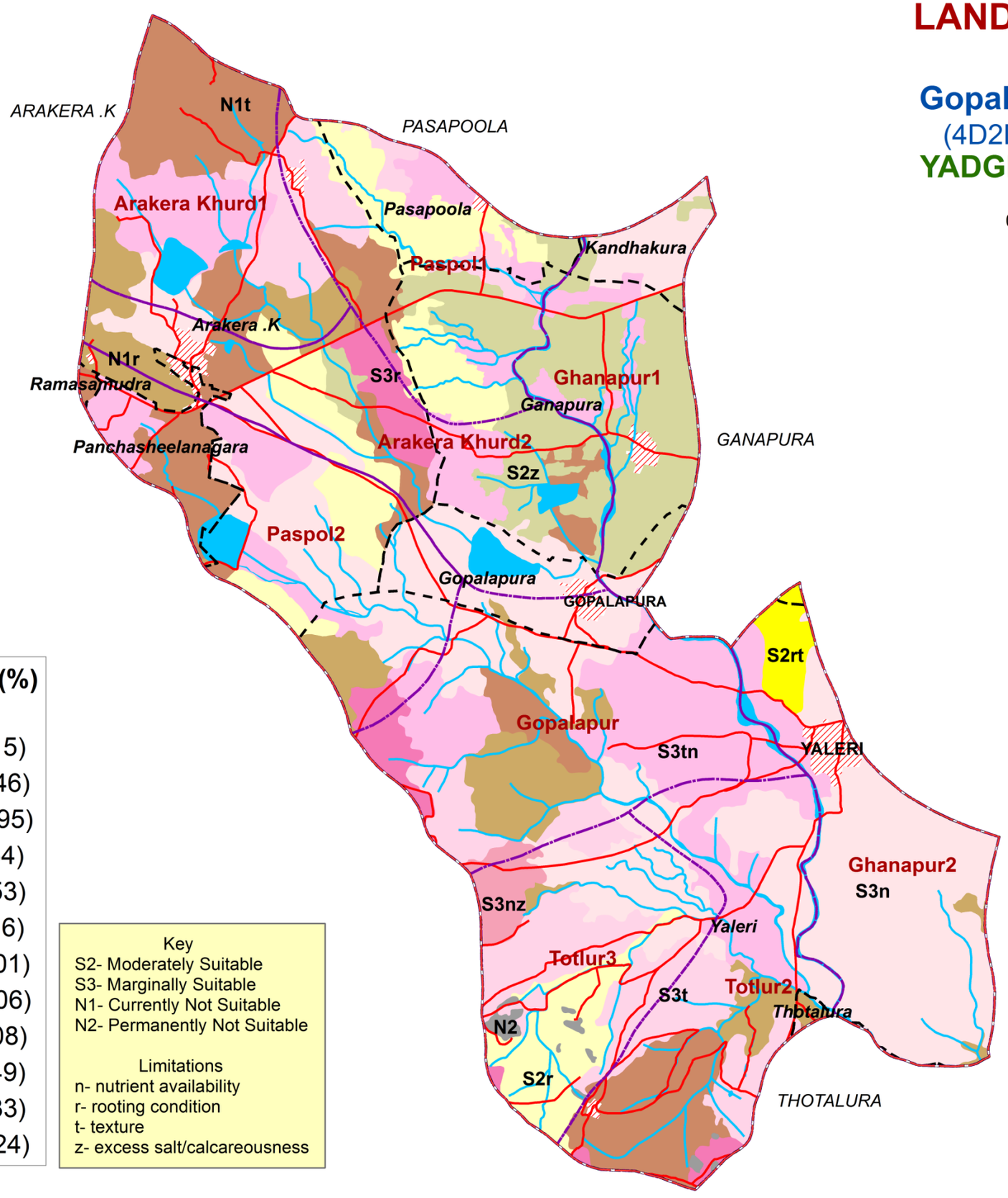
Limitations
g- gravelliness/stoniness
n- nutrient availability
r- rooting condition
t- texture
z- excess salt/calcareousness

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





LAND SUITABILITY FOR COTTON

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

km
0 0.5 1 2
N

Suitability subclass	Area in ha (%)
S2r	464 (9.15)
S2z	480 (9.46)
S2rt	48 (0.95)
S3n	1295 (25.54)
S3r	128 (2.53)
S3t	516 (10.16)
S3nz	51 (1.01)
S3tn	865 (17.06)
N1r	359 (7.08)
N1t	634 (12.49)
N2	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

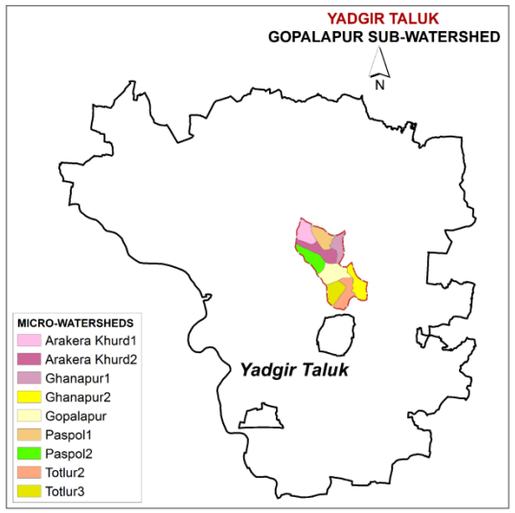
Key
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable
N2- Permanently Not Suitable

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

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

Source: ICAR-NBSS&LUP, Bengaluru

6.8. Land Suitability for Chilli

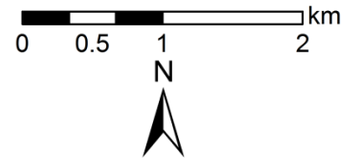


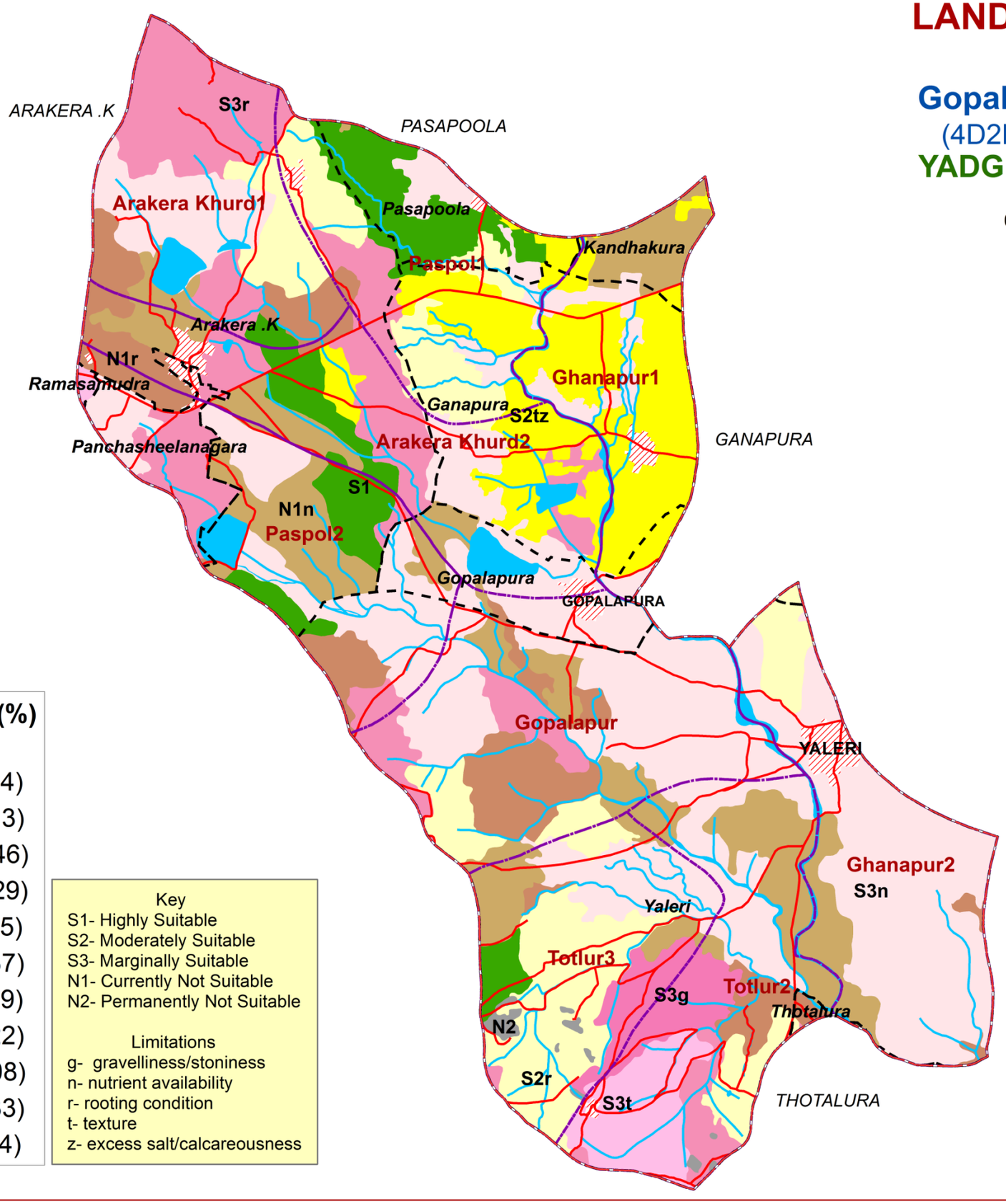
LAND SUITABILITY FOR CHILLI

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT





Suitability subclass	Area in ha (%)
S1	296 (5.84)
S2r	615 (12.13)
S2tz	480 (9.46)
S3g	116 (2.29)
S3n	1595 (31.45)
S3r	628 (12.37)
S3t	131 (2.59)
N1n	620 (12.22)
N1r	359 (7.08)
N2	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

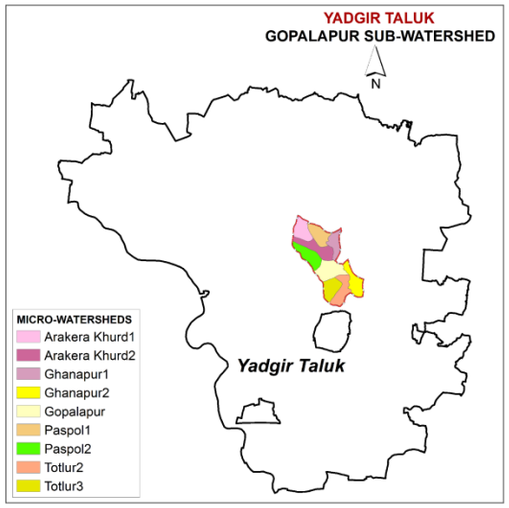
Key
S1- Highly Suitable
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable
N2- Permanently Not Suitable

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

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

Source: ICAR-NBSS&LUP, Bengaluru

6.9. Land Suitability for Tomato



LAND SUITABILITY FOR TOMATO

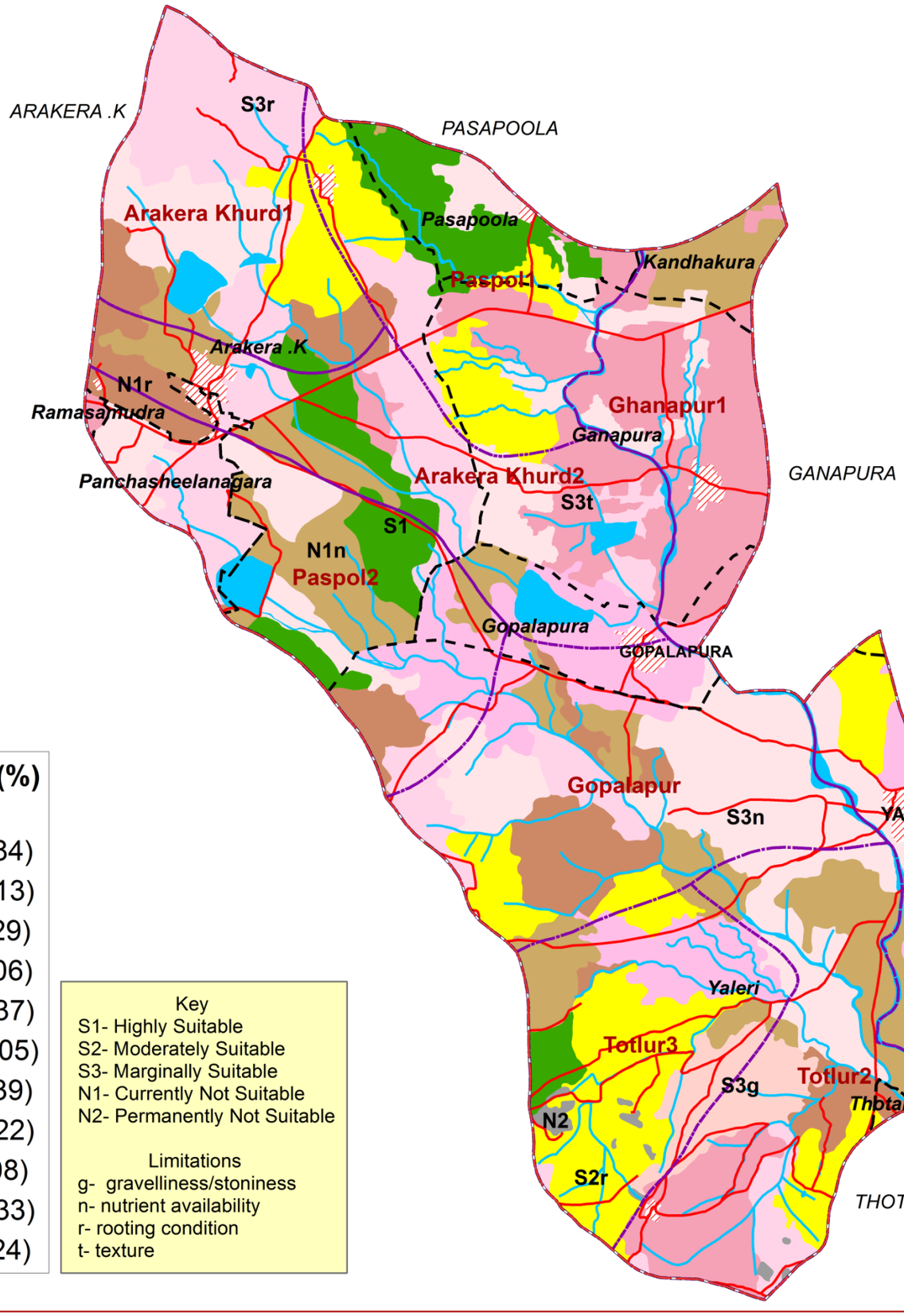
Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

0 0.5 1 2 km

N



Suitability subclass	Area in ha (%)
S1	296 (5.84)
S2r	615 (12.13)
S3g	116 (2.29)
S3n	865 (17.06)
S3r	628 (12.37)
S3t	611 (12.05)
S3tn	730 (14.39)
N1n	620 (12.22)
N1r	359 (7.08)
N2	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

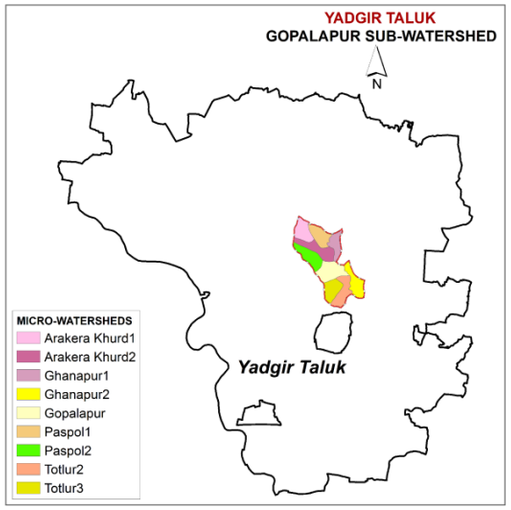
Key
S1- Highly Suitable
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable
N2- Permanently Not Suitable

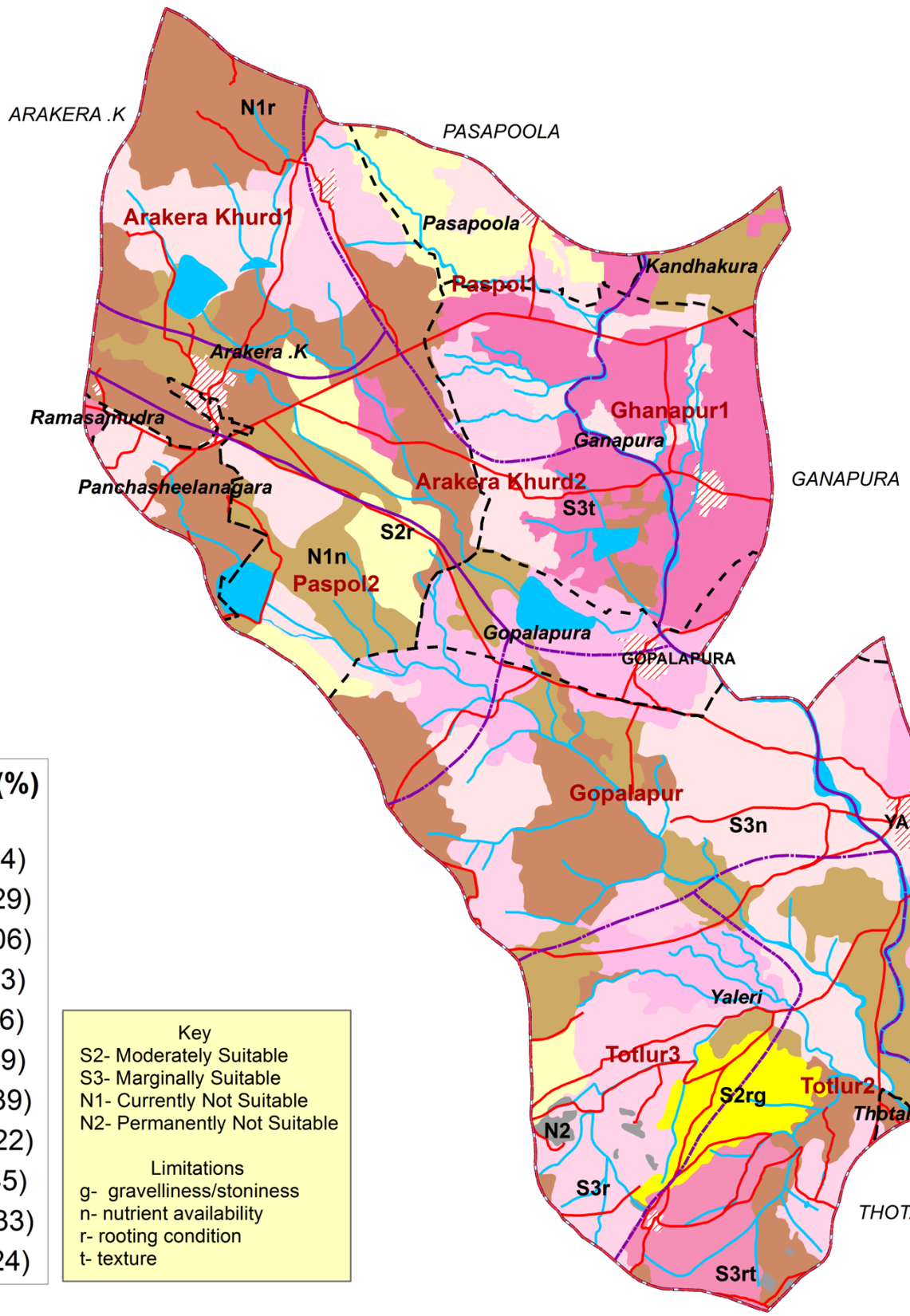
Limitations
g- gravelliness/stoniness
n- nutrient availability
r- rooting condition
t- texture

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

Source: ICAR-NBSS&LUP, Bengaluru

6.10. Land Suitability for Sapota





LAND SUITABILITY FOR SAPOTA

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

km
0 0.5 1 2
N

Suitability subclass	Area in ha (%)
S2r	296 (5.84)
S2rg	116 (2.29)
S3n	865 (17.06)
S3r	615 (12.13)
S3t	480 (9.46)
S3rt	131 (2.59)
S3tn	730 (14.39)
N1n	620 (12.22)
N1r	987 (19.45)
N2	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

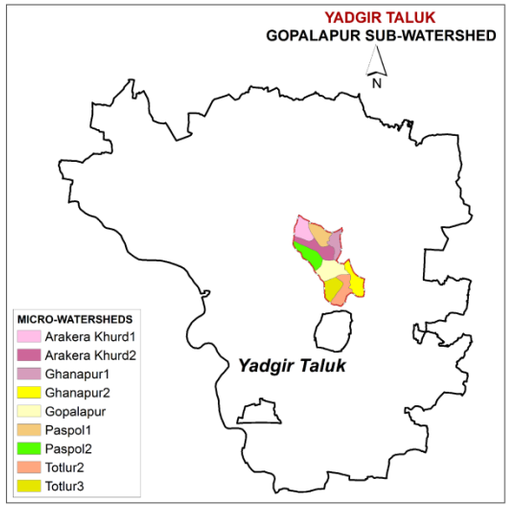
Key
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable
N2- Permanently Not Suitable

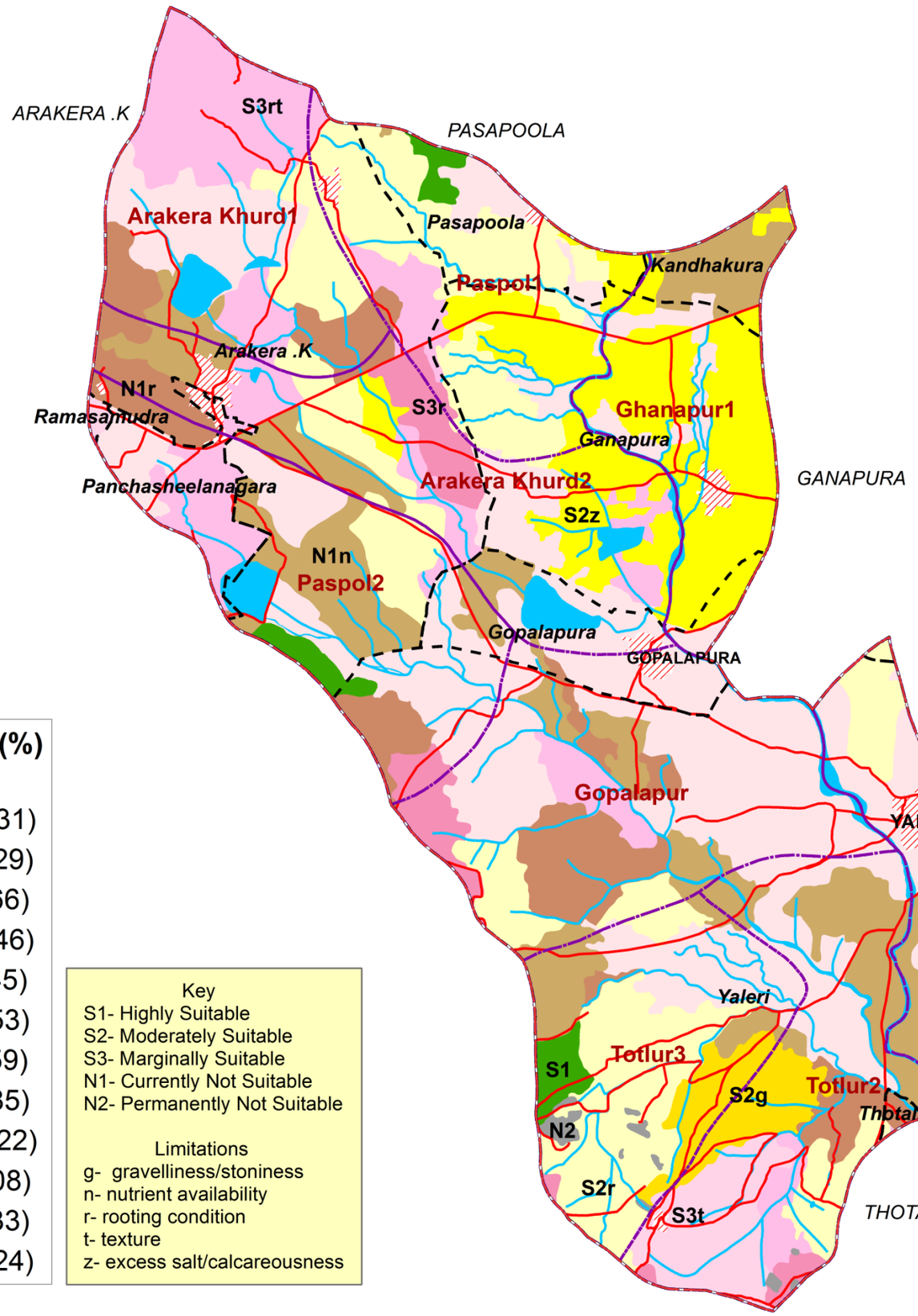
Limitations
g- gravelliness/stoniness
n- nutrient availability
r- rooting condition
t- texture

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

Source: ICAR-NBSS&LUP, Bengaluru

6.11. Land Suitability for Custard Apple





LAND SUITABILITY FOR CUSTARD APPLE

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

km
0 0.5 1 2
N

Suitability subclass	Area in ha (%)
S1	66 (1.31)
S2g	116 (2.29)
S2r	845 (16.66)
S2z	480 (9.46)
S3n	1595 (31.45)
S3r	128 (2.53)
S3t	131 (2.59)
S3rt	499 (9.85)
N1n	620 (12.22)
N1r	359 (7.08)
N2	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

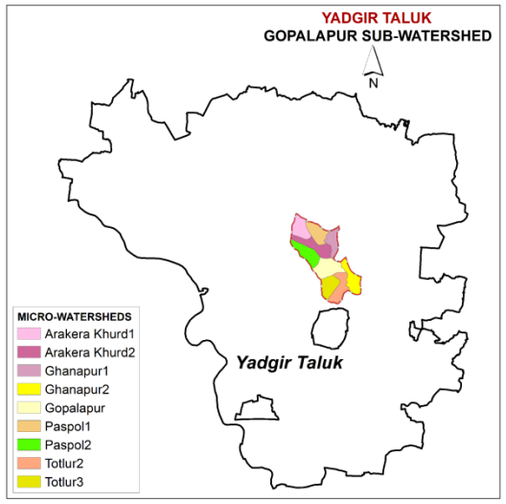
Key
S1- Highly Suitable
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable
N2- Permanently Not Suitable

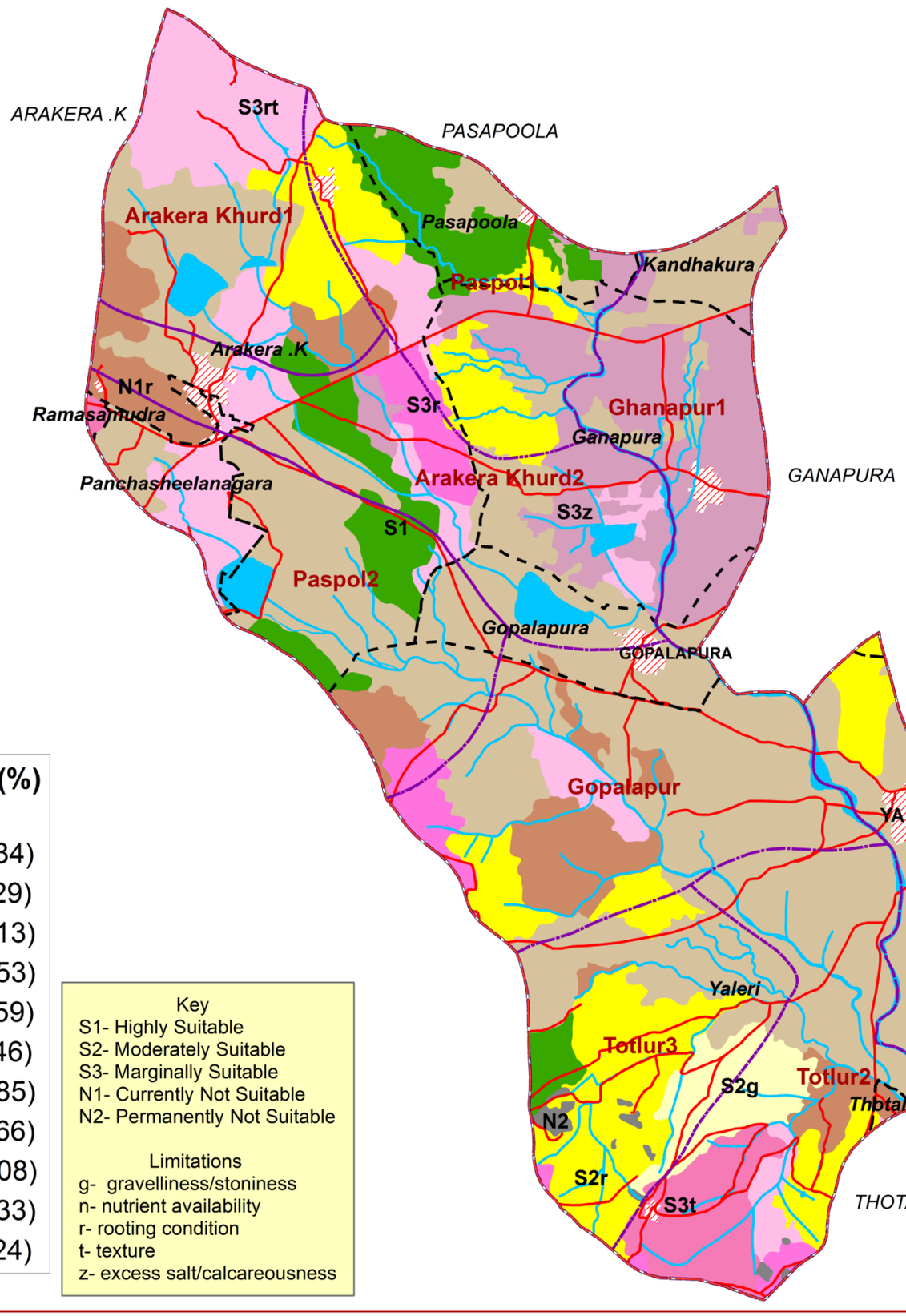
Limitations
g- gravelliness/stoniness
n- nutrient availability
r- rooting condition
t- texture
z- excess salt/calcareousness

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

Source: ICAR-NBSS&LUP, Bengaluru

6.12. Land Suitability for Amla





LAND SUITABILITY FOR AMLA

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

0 0.5 1 2 km

N

Suitability subclass	Area in ha (%)
S1	296 (5.84)
S2g	116 (2.29)
S2r	615 (12.13)
S3r	128 (2.53)
S3t	131 (2.59)
S3z	480 (9.46)
S3rt	499 (9.85)
N1n	2215 (43.66)
N1r	359 (7.08)
N2	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

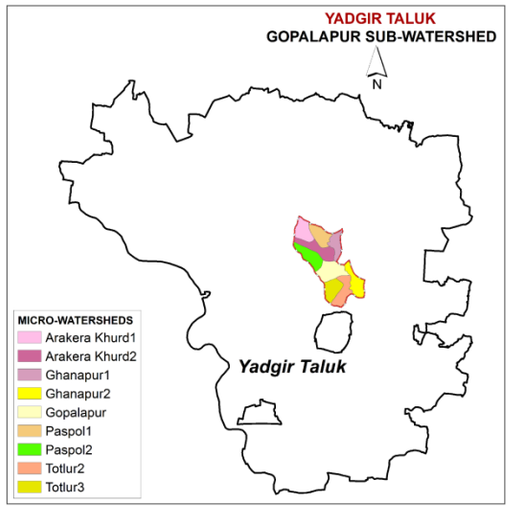
Key
S1- Highly Suitable
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable
N2- Permanently Not Suitable

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

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

Source: ICAR-NBSS&LUP, Bengaluru

6.13. Land Suitability for Onion



LAND SUITABILITY FOR ONION

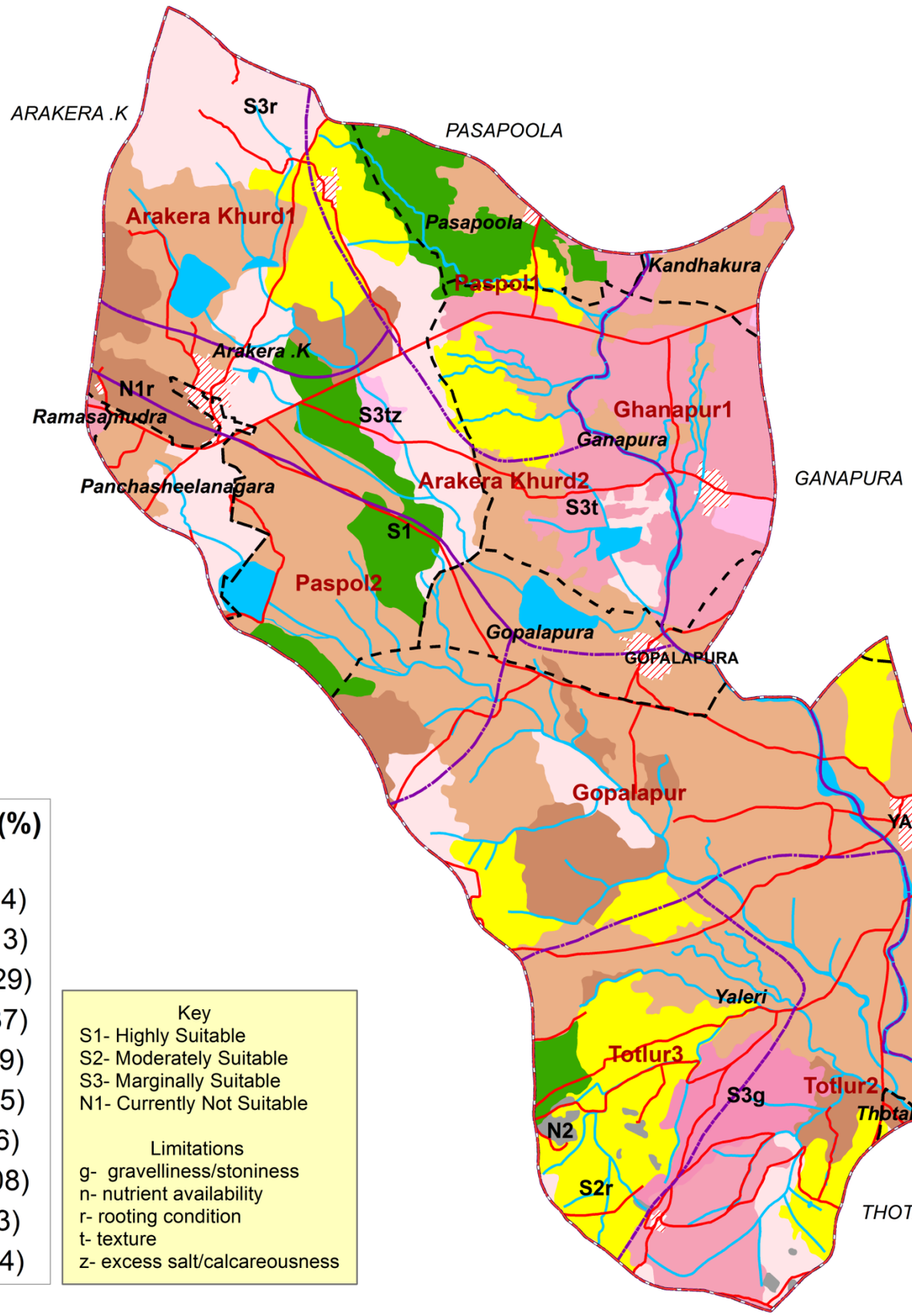
Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

km 0 0.5 1 2

N



Suitability subclass	Area in ha (%)
S1	296 (5.84)
S2r	615 (12.13)
S3g	116 (2.29)
S3r	628 (12.37)
S3t	573 (11.29)
S3tz	38 (0.75)
N1n	2215 (43.66)
N1r	359 (7.08)
N2	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

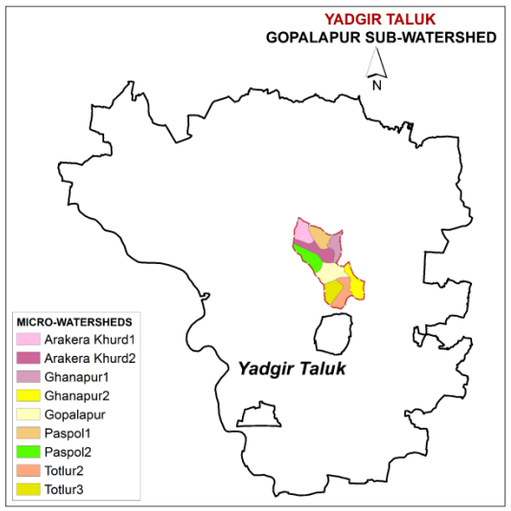
Key
S1- Highly Suitable
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable

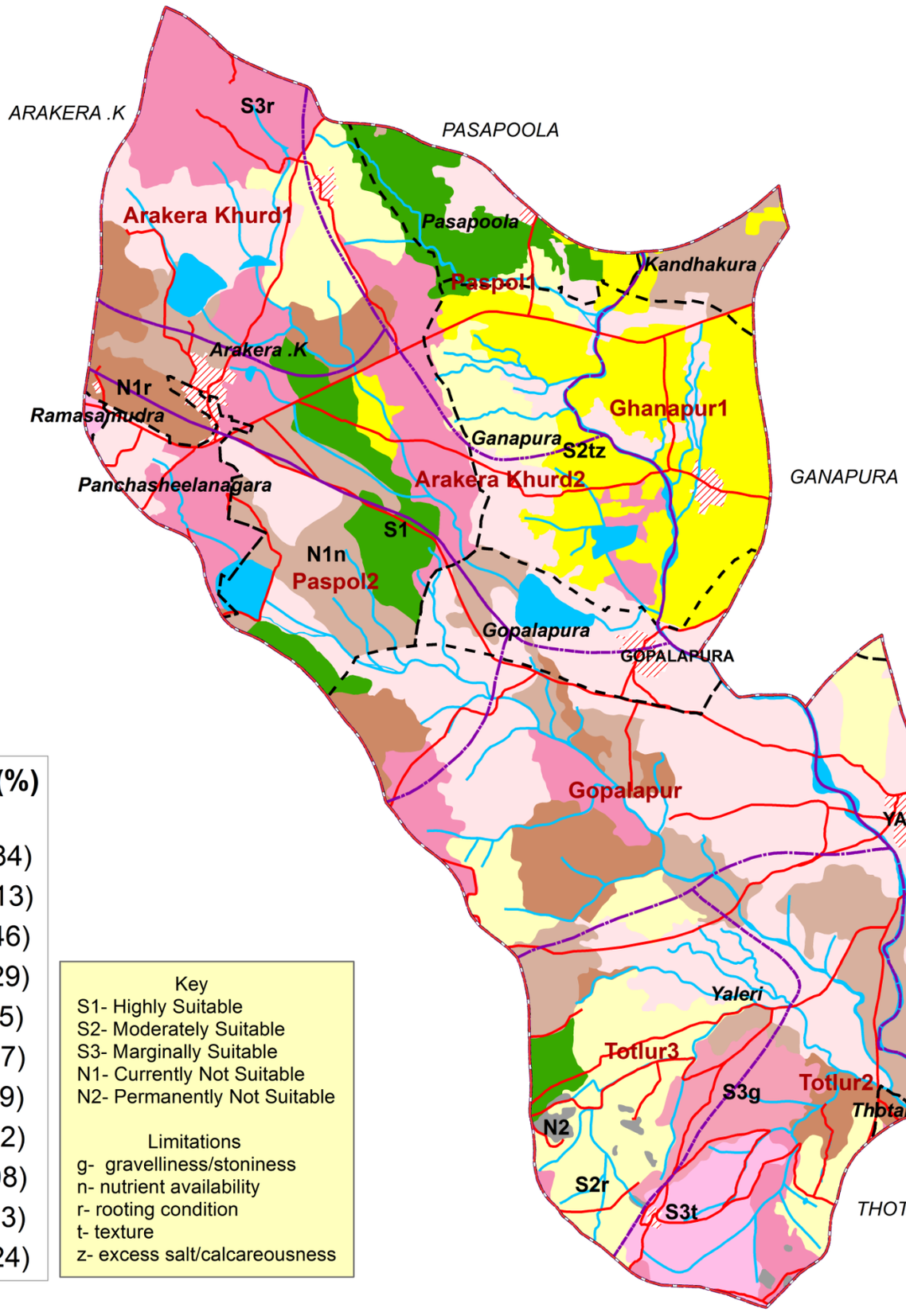
Limitations
g- gravelliness/stoniness
n- nutrient availability
r- rooting condition
t- texture
z- excess salt/calcareousness

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

Source: ICAR-NBSS&LUP, Bengaluru

6. 14.Land Suitability for Marigold





LAND SUITABILITY FOR MARIGOLD

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

0 0.5 1 2 km

N

Suitability subclass	Area in ha (%)
S1	296 (5.84)
S2r	615 (12.13)
S2tz	480 (9.46)
S3g	116 (2.29)
S3n	1595 (31.45)
S3r	628 (12.37)
S3t	131 (2.59)
N1n	620 (12.22)
N1r	359 (7.08)
N2	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

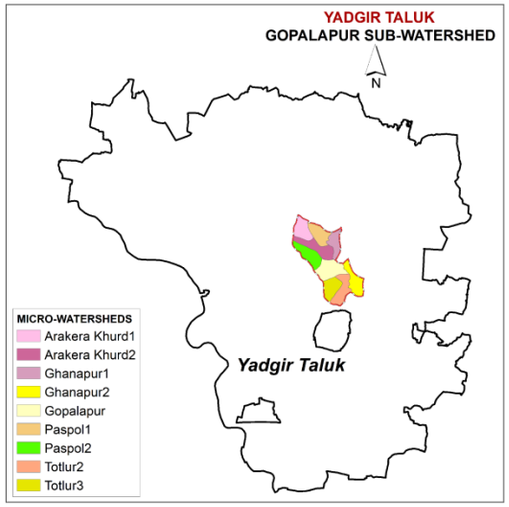
Key
S1- Highly Suitable
S2- Moderately Suitable
S3- Marginally Suitable
N1- Currently Not Suitable
N2- Permanently Not Suitable

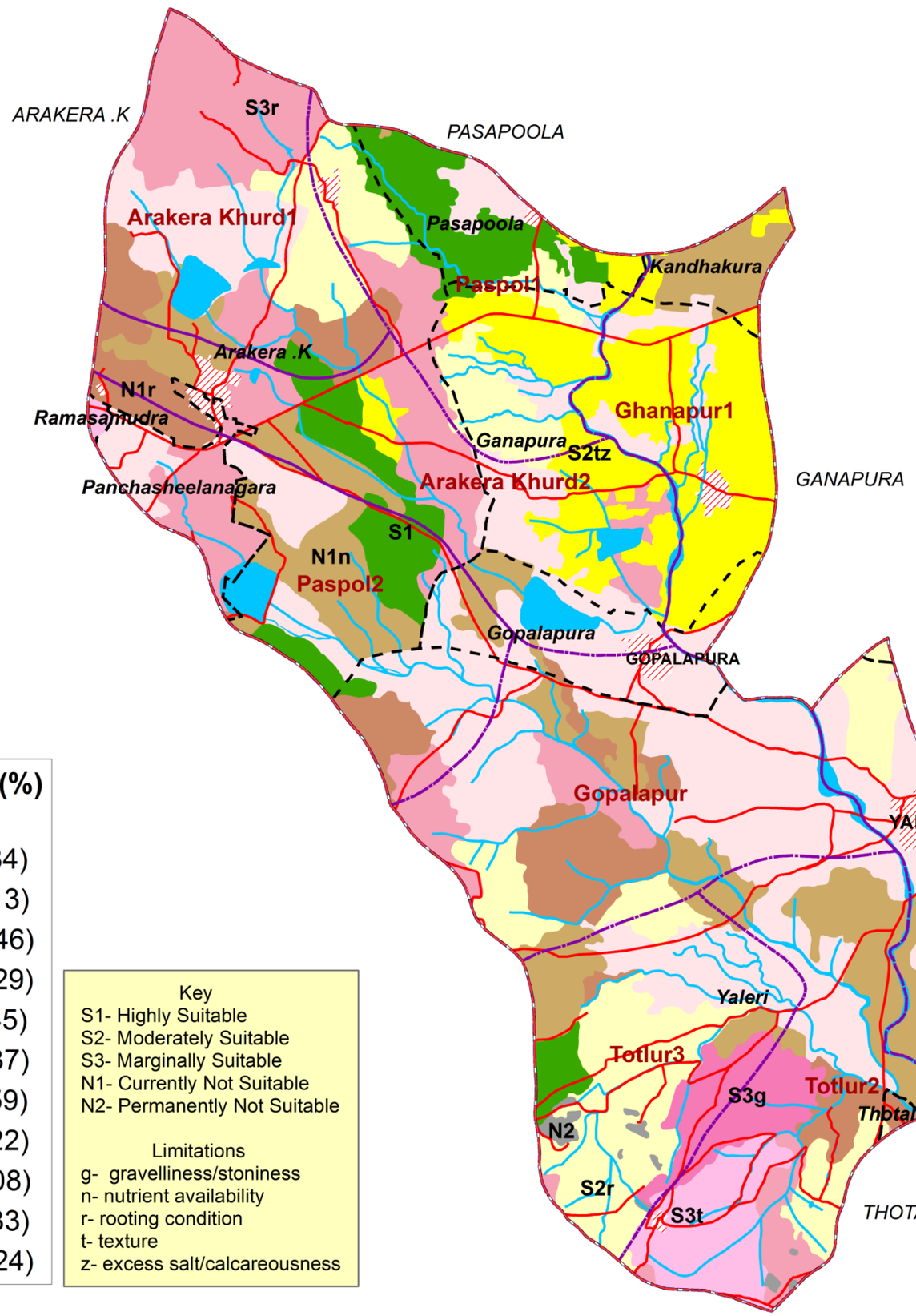
Limitations
g- gravelliness/stoniness
n- nutrient availability
r- rooting condition
t- texture
z- excess salt/calcareousness

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

Source: ICAR-NBSS&LUP, Bengaluru

6.15. Land Suitability for Chrysanthemum





LAND SUITABILITY FOR CHRYSANTHEMUM

Gopalapur Sub-watershed

(4D2D6B : Area - 5071.82 ha)

YADGIR TALUK & DISTRICT

0 0.5 1 2 km

N

Suitability subclass	Area in ha (%)
S1	296 (5.84)
S2r	615 (12.13)
S2tz	480 (9.46)
S3g	116 (2.29)
S3n	1595 (31.45)
S3r	628 (12.37)
S3t	131 (2.59)
N1n	620 (12.22)
N1r	359 (7.08)
N2	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

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

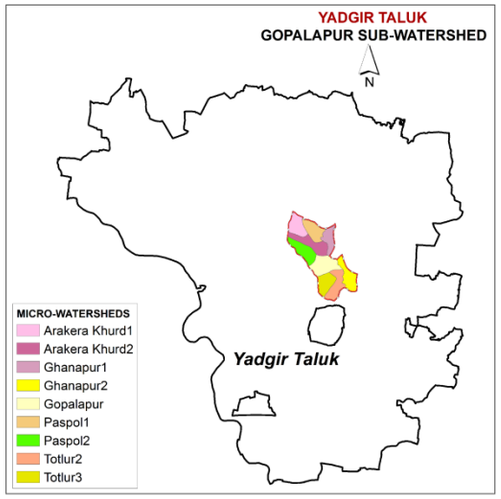
Limitations
g- gravelliness/stoniness
n- nutrient availability
r- rooting condition
t- texture
z- excess salt/calcareousness

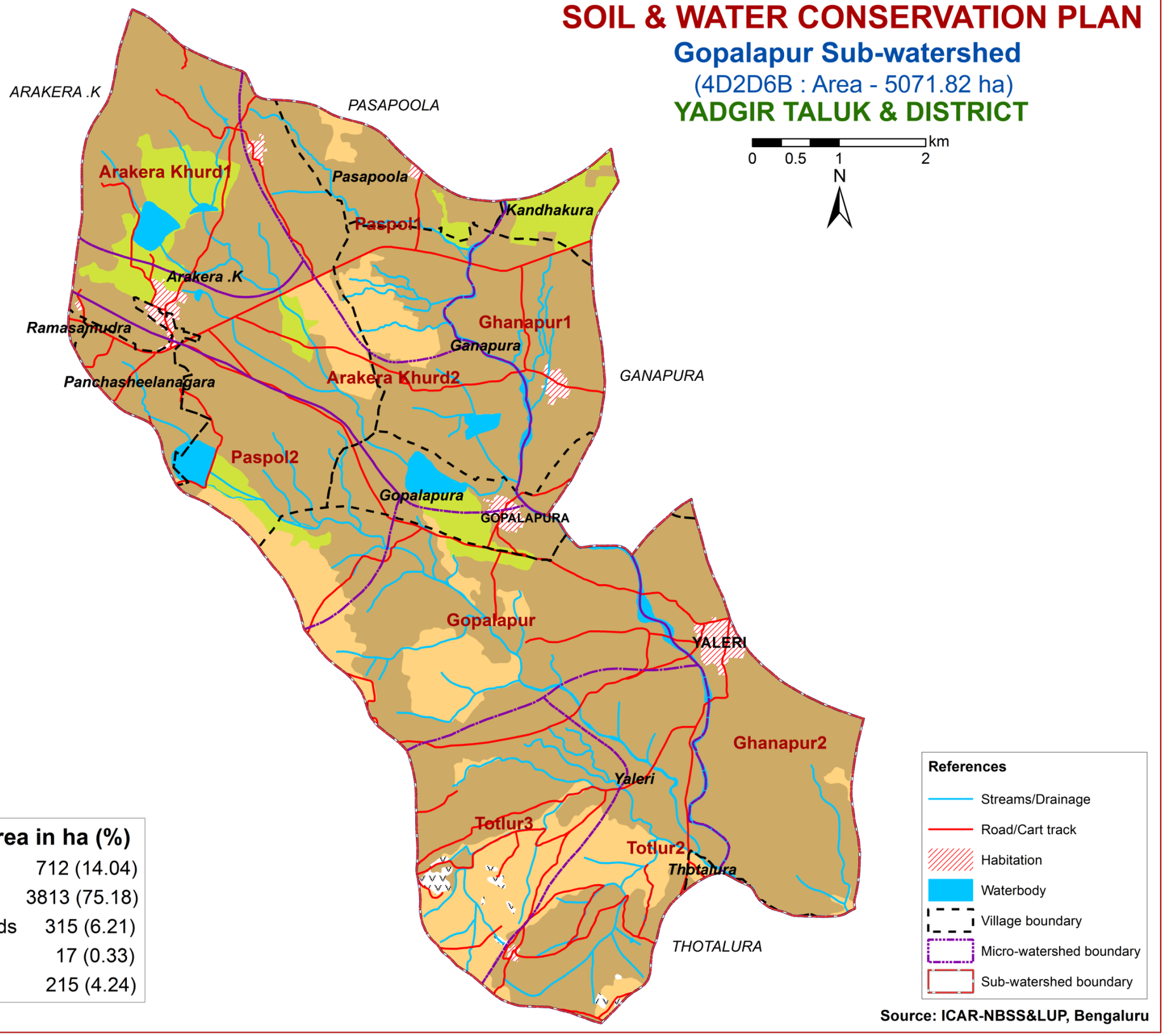
References
- Streams/Drainage
- Road/Cart track
- Habitation
- Waterbody
- Village boundary
- Micro-watershed boundary
- Sub-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

7. Soil and Water Conservation Measures

7.1. Soil & Water Conservation Plan





Legend	Area in ha (%)
Trench cum bunding	712 (14.04)
Graded bunding	3813 (75.18)
Strengthening of existing bunds	315 (6.21)
Rock outcrops	17 (0.33)
Others*	215 (4.24)

* - Habitation & Waterbody

8. Table. Proposed Crop Plan for Gopalapur Sub-watershed, Balichakra 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	167.ANRcA1 168.ANRcB2 53.ANRhB2 55.ANRiB2 34.GWDcB2 35.GWDiB2 135.RHNhB2 79.RHNmB2 141.SGRcB2 142.SGRhB2 158.SGRiA1 154.YDRcB2g1 (Sodic soils)	-	**Agri-Silvi-Pasture** Ber, Aonla, Acacia sp. Dhaincha, Rhodes grass, Para grass ,Bermuda grass	Application of gypsum, iron pyrites and elemental sulphur. Addition of farm yard manures, green manures and providing subsurface drainage
2	38.BLCiB2 40.PGPcB2 (Moderately deep, red sandy clay 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
3	138.HGNmB1 95.HGNmB2 86.KDRhA1 87.KDRiB2 88.KDRiB3 89.KDRmB2 169MDGcA1 57.MDGcB2 171.MDGhA1 58.MDGiB2 59.MDRcB2 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

To be continued….

LMU.No	Soil Map Units	Field Crops/ Commercial crops	Horticulture Crops (Rainfed/Irrigated)	Suitable Interventions
4	62.BMNmB2 32HSLcB2 33.HSLiB2 163.NGPmA1 49.NGPmB2 128.SHTcB2 (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
5	39.KBDbB3 (Moderately deep, red gravelly sandy clay loam 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 22.JNKiB2 (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
7	124.SBRbB3,125.SBRhB2 (Moderately shallow, loamy sand soils)	-	**Agri-Silvi-Pasture:** Hybrid Napier, *Styloxanthes hamata*, *Styloxanthes scabra*	Application of FYM, Bio fertilizers and micronutrients, drip irrigation, Mulching, suitable soil and water conservation practices
8	28.YLRbB3 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

To be continued….

LMU.No	Soil Map Units	Field Crops /Commercial crops	Horticulture Crops (Rainfed/Irrigated)	Suitable Interventions
9	76.BLDmB2 (Moderately shallow, clay loam soils)	Maize, sorghum, Groundnut, Cotton, Bajra	**Fruit crops:** Amla, Custard apple **Vegetables:** Tomato, Chilli, Onion, Bhendi **Flowers:** Marigold, Chrysanthemum	Application of FYM, Biofertilizers and micronutrients, drip irrigation, Mulching, suitable soil and water conservation practices
10	2.BDLbB2,4.BDLhB2 162.BDLhB2g1,5.BDLiB2 118.BDPcB2,120.BDPhB2 1.BDPiB2 119.BDPiB3 156.HTKbB2 161HTKbB2g1 153.KKRbB2g1 8.VNKbB2g1 122VNKcB3 10.VNKiB2 (Shallow to very shallow soils)	-	**Agri-Silvi-Pasture:** Hybrid Napier, *Styloxanthes hamata,* Glyricidia, *Styloxanthes scabra*	Use of short duration varieties, sowing across the slope and split application of nitrogen fertilizers

PART - B

Hydrological Inventory of Gopalapur 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 Gopalapur 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

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Sh. R.S.Reddy	Consultant
Sh. A.G.Devendra Prasad	Consultant
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Ms. Seema, K.V.	Senior Research Fellow
Dr. Sekhar Muddu (Reviewed and approved)	Professor & Lead Scientist, Dept. of Civil Engineering & ICWaR, IISc, Bangalore
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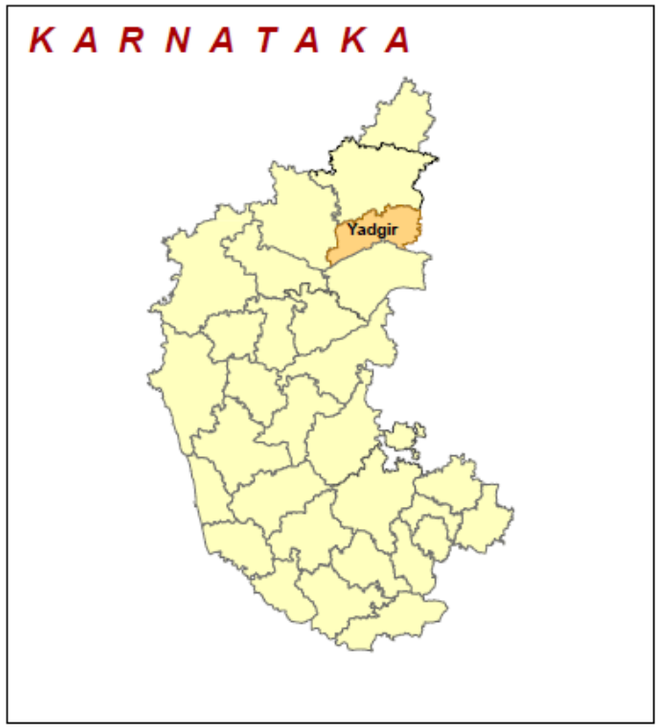
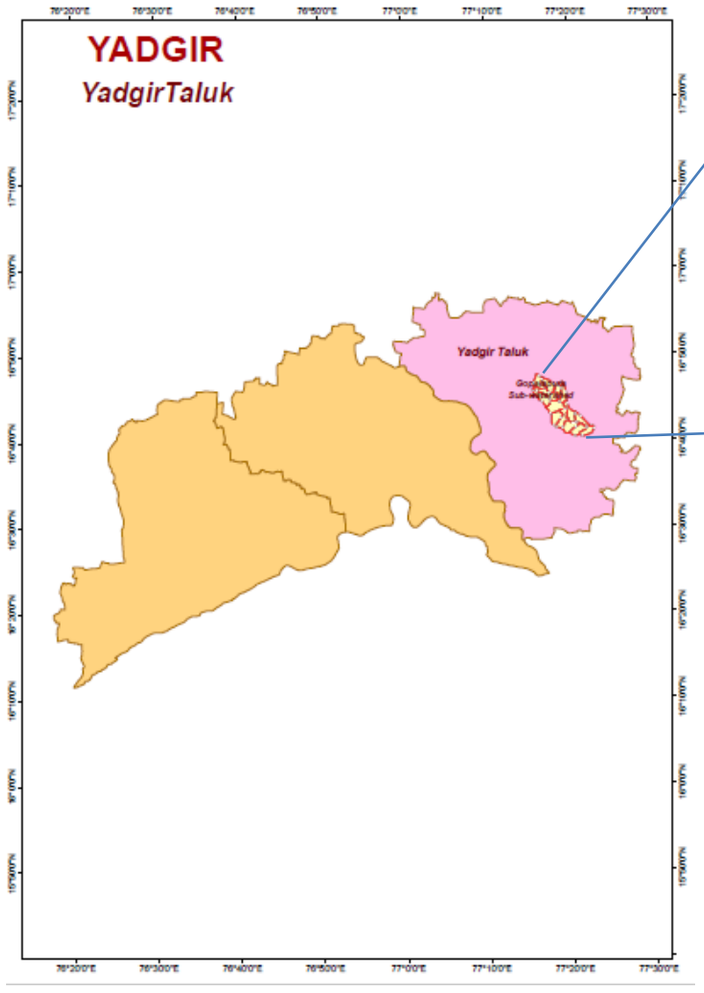
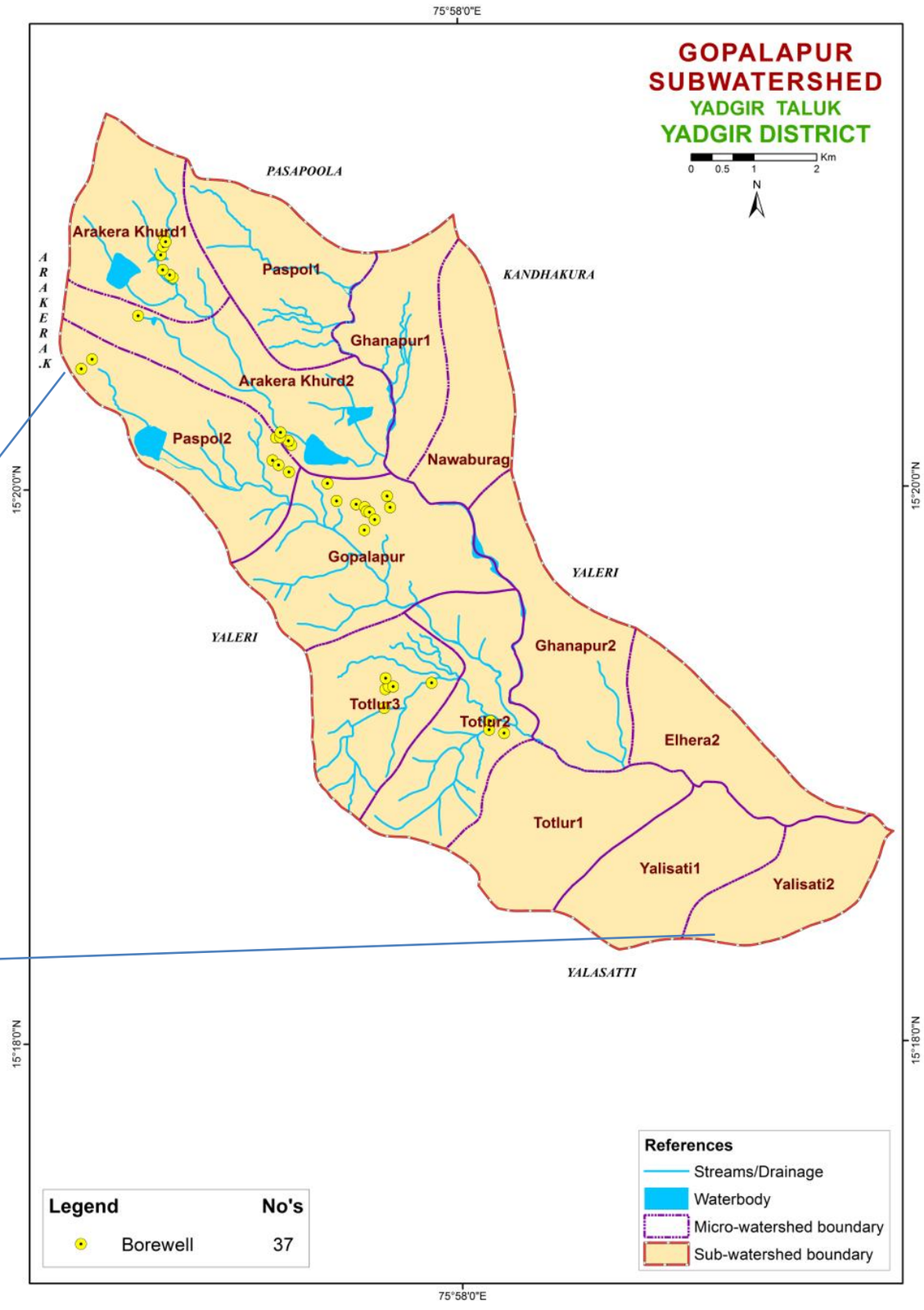
INTRODUCTION

- The inventory and documentation of spatial and temporal changes in hydrological components of Gopalapur sub-watershed (4D2D6B) in Yadgir taluk, Yadgir district, has been undertaken for integrated planning, development and management at the level of soil mapping units.
- Gopalapur sub-watershed (Yadgir taluk, Yadgir district) is located between $16^0$41’23”– $16^0$47’26” North latitudes and $77^0$15’ 36”–$77^0$20’39” East longitudes, covering an area of about 7369 ha.
- This sub-watershed encompasses of 14 MWs namely, Elhera-2 (4D2D6B2d), Gopalapur (4D2D6B1e), Ghanapur-2 (4D2D6B2c), Arakera Khurd-1 (4D2D6B1a), Paspol-1 (4D2D6B1b), Ghanapur-1 (4D2D6B2a), Nawaburag (4D2D6B2b), Arakera Khurd-2 (4D2D6B1c), Paspol-2 (4D2D6B1d), Totlur-2 (4D2D6B3b), Totlur-3 (4D2D6B3a), Totlur-1 (4D2D6B3c), Yalisati-1 (4D2D6B3d) and Yalisati-2 (4D2D6B3e) micro watersheds. Land Resource Inventory (LRI) was generated for nine among the fourteen 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 GOPALAPUR SUB-WATERSHED

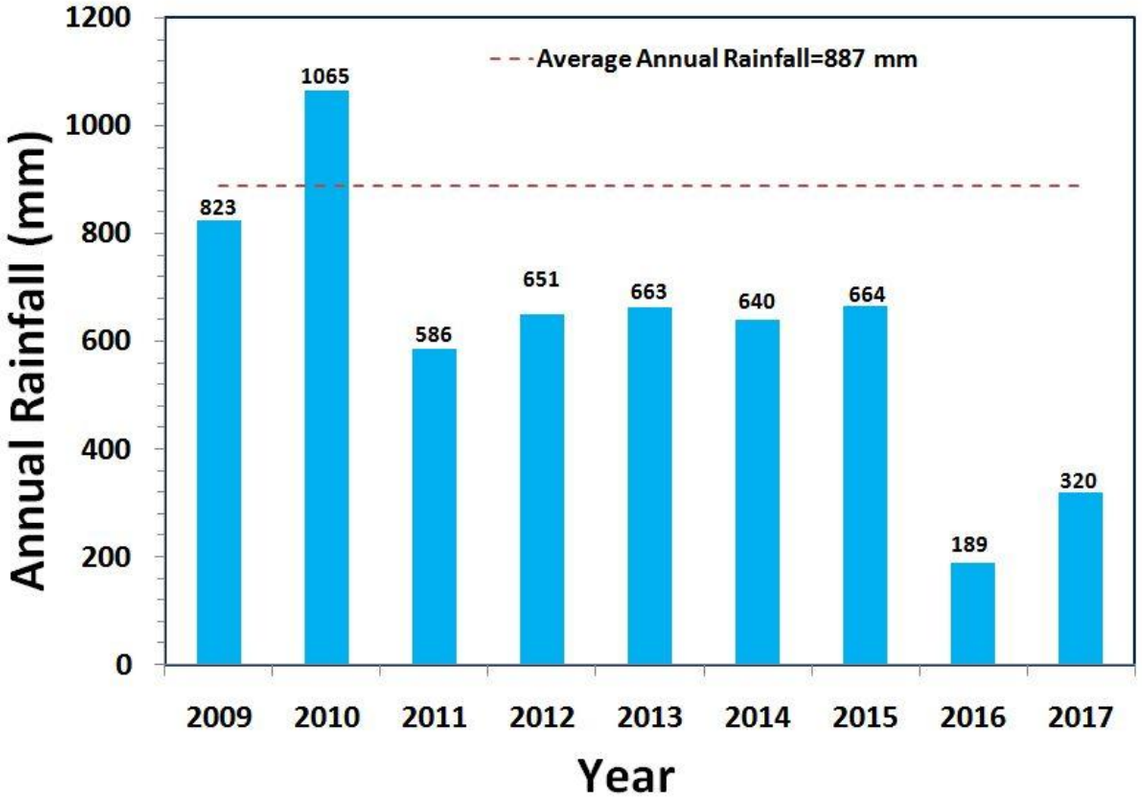






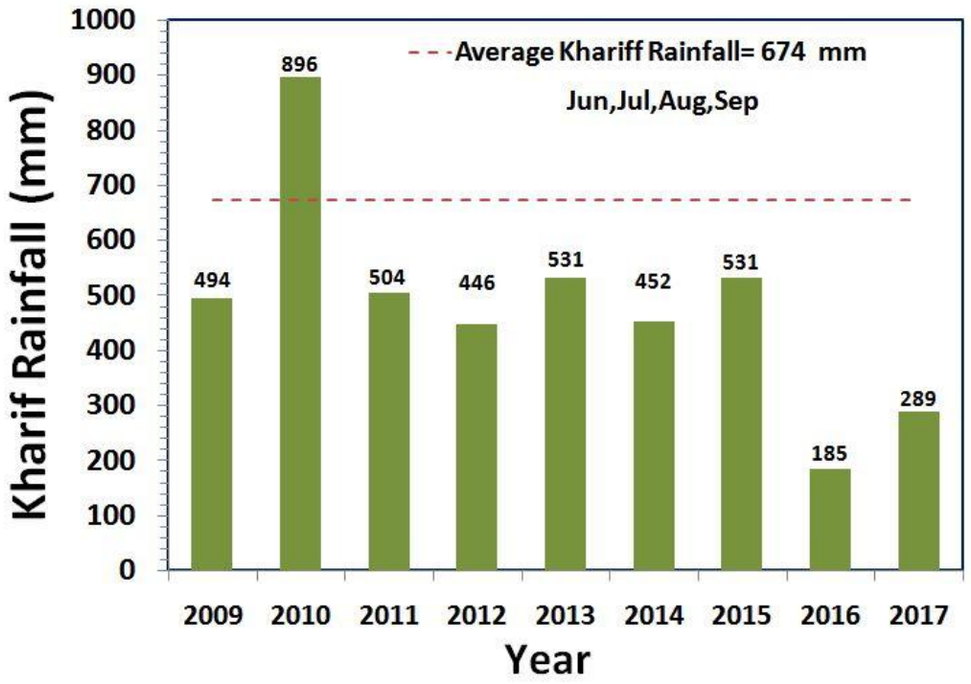
Soil & Water Conservation Structures in Gopalapur Sub-watershed, Yadgir taluk, Yadgir district

RAINFALL INDEX

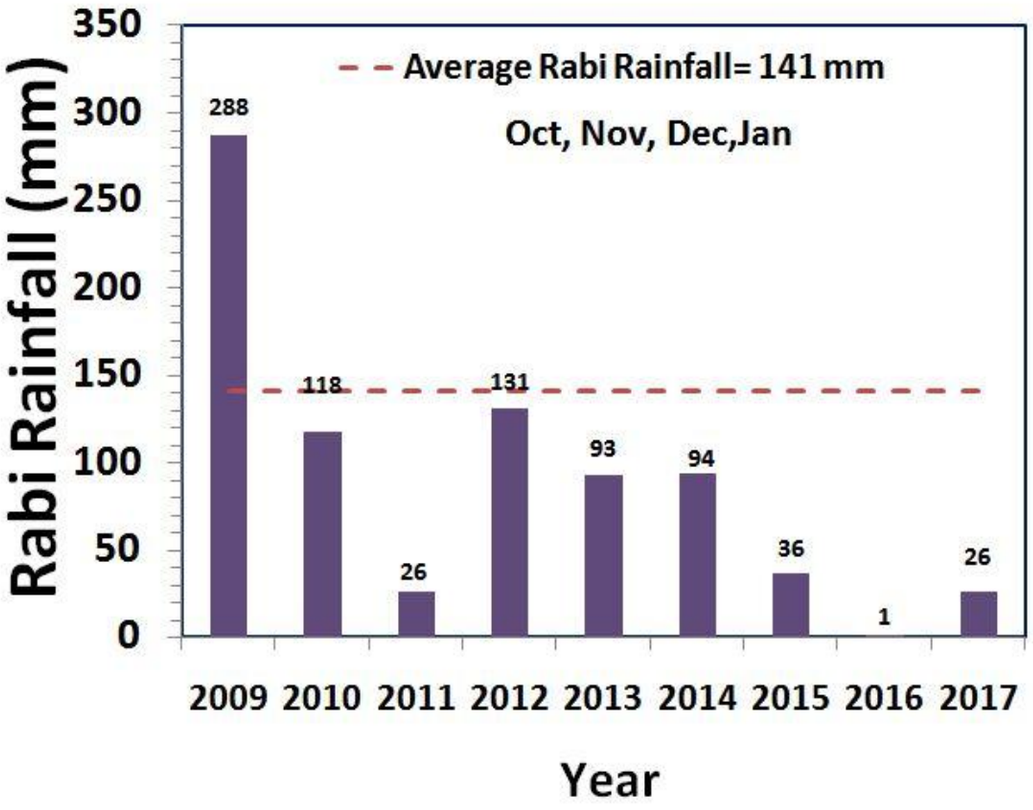


The average annual rainfall (1960-2014) recorded at the Yadgir station in Yadgir taluk of Yadgir district is 887 mm. The annual rainfall at Balichakra station (Hobli H.Q.) is presented. During the years 2009, 2011, 2012, 2013, 2014, 2015, 2016 and 2017 the annual rainfall was deficient by 7%, 34%, 27%, 25%, 28%, 25%, 79% and 64% respectively.

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

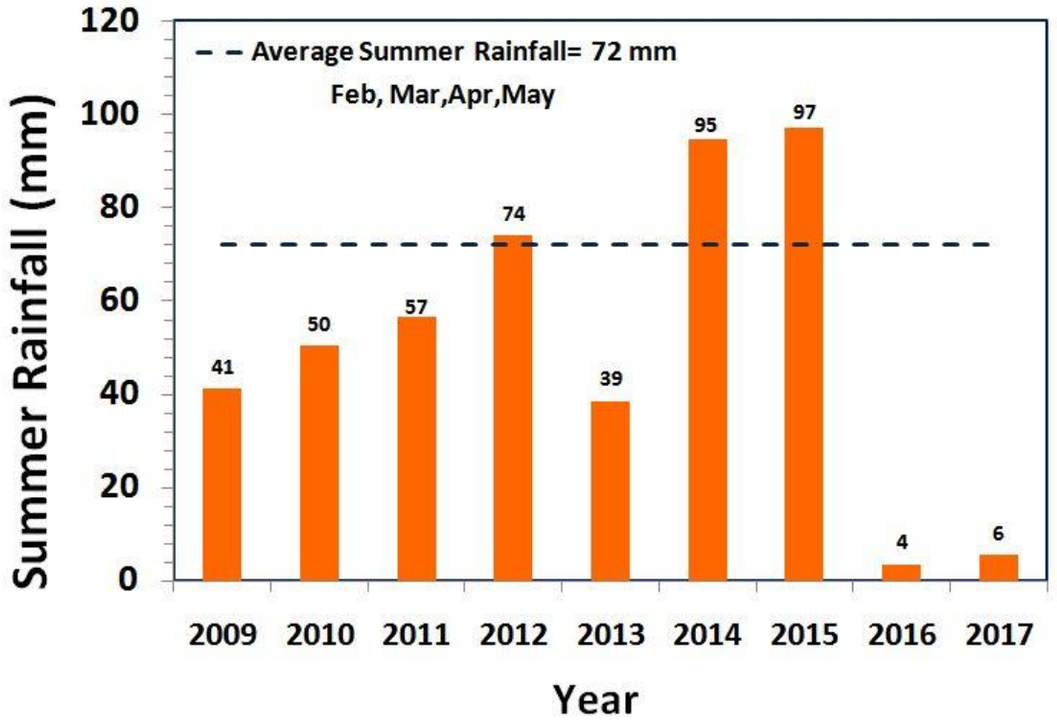


RAINFALL INDEX

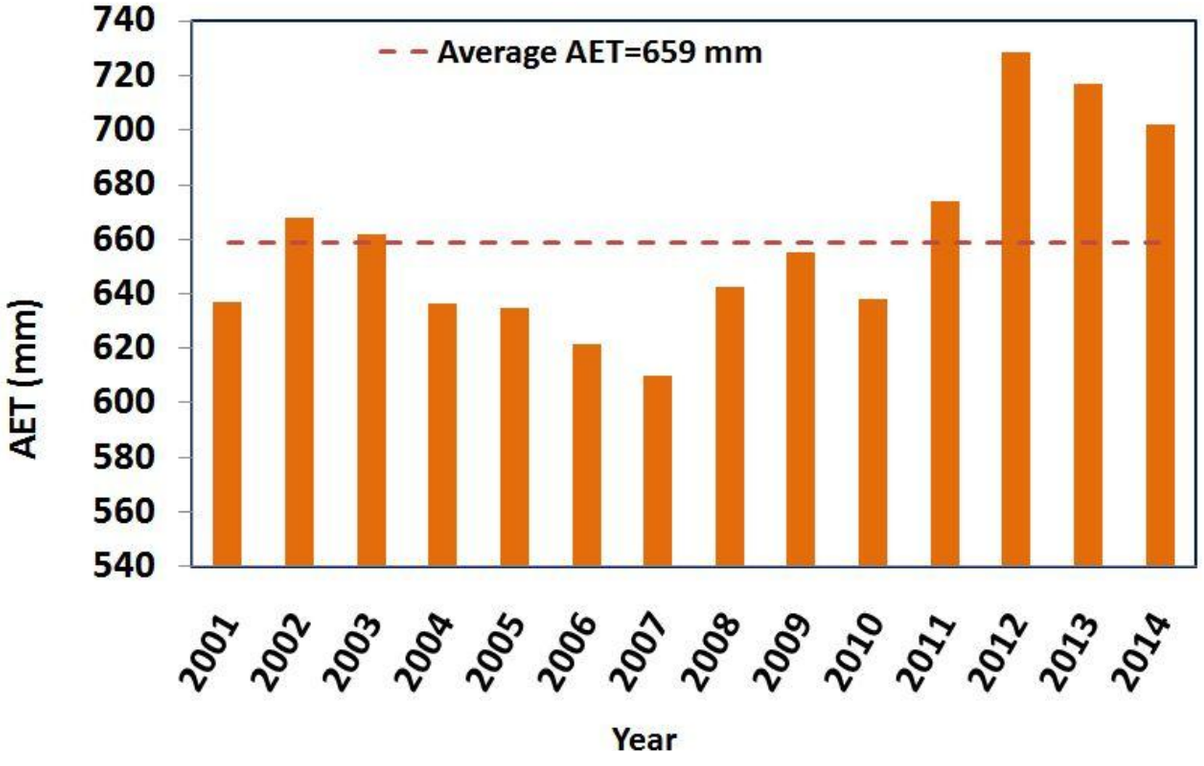


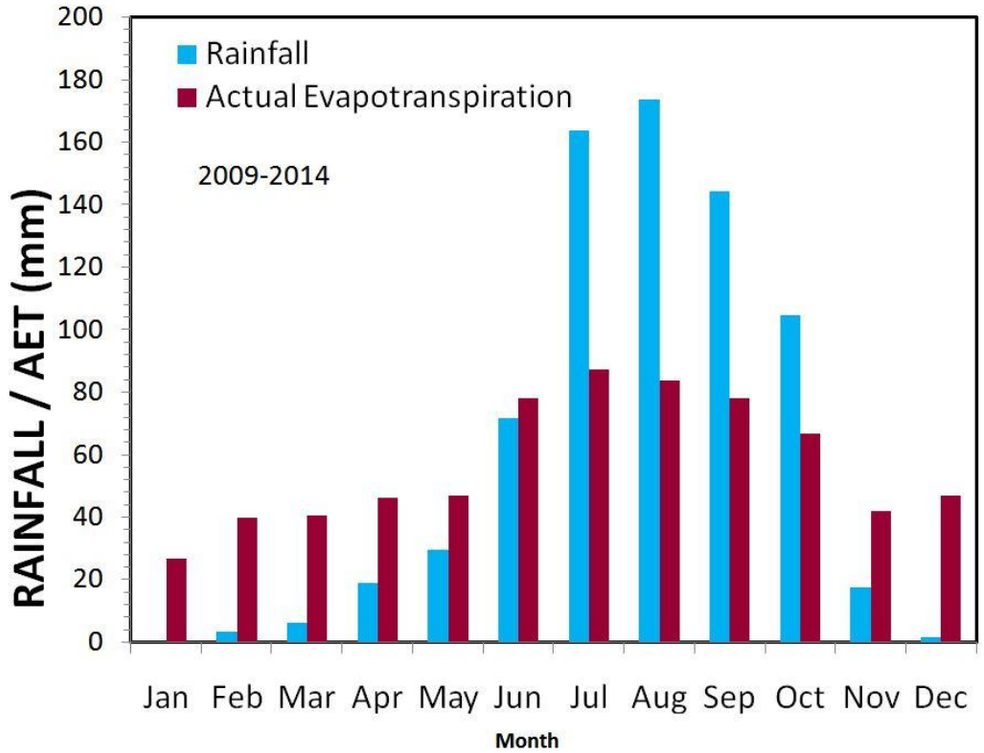
The average Rabi rainfall (Oct-Jan) is about 13% of the Average annual rainfall. During the years 2009 high *rabi* rainfall was received, where as other years showed deficient rainfall.

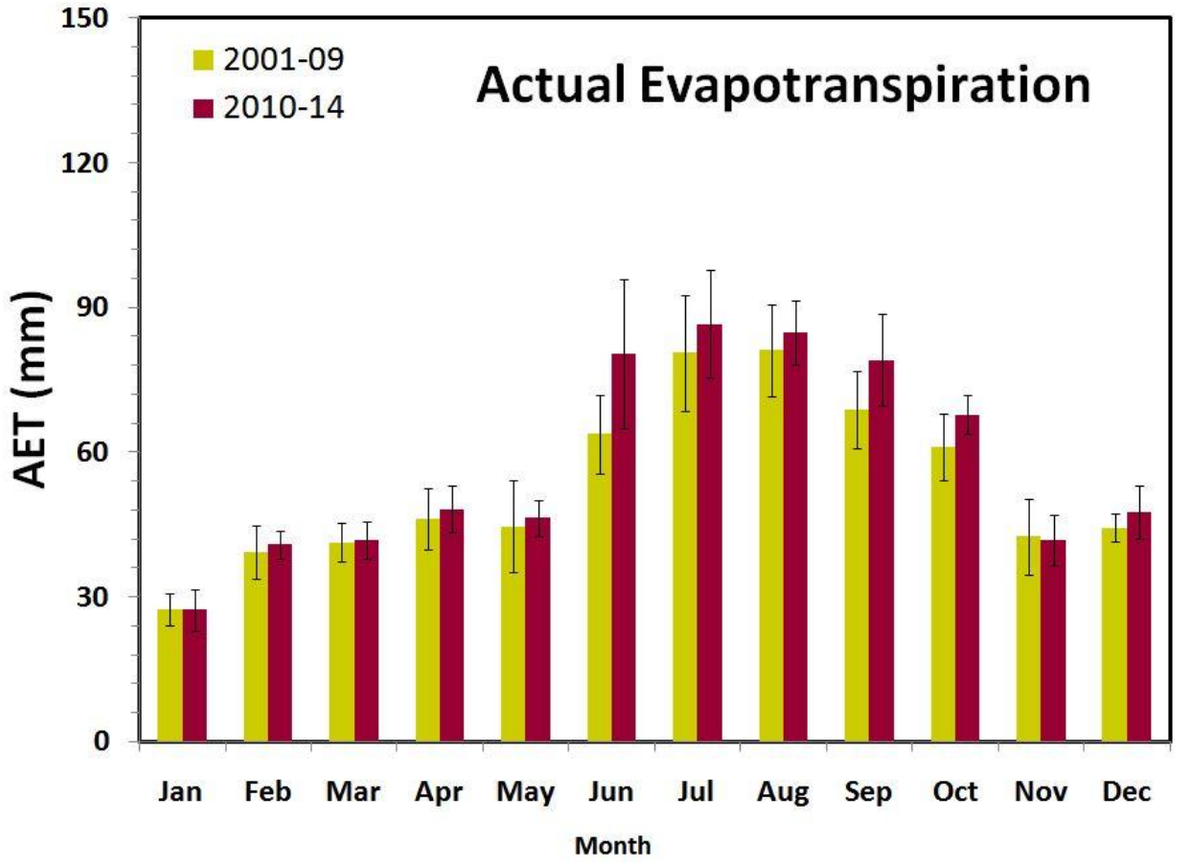
The average summer rainfall (Feb-May) is about 7% of the average annual rainfall.



EVAPOTRANSPIRATION

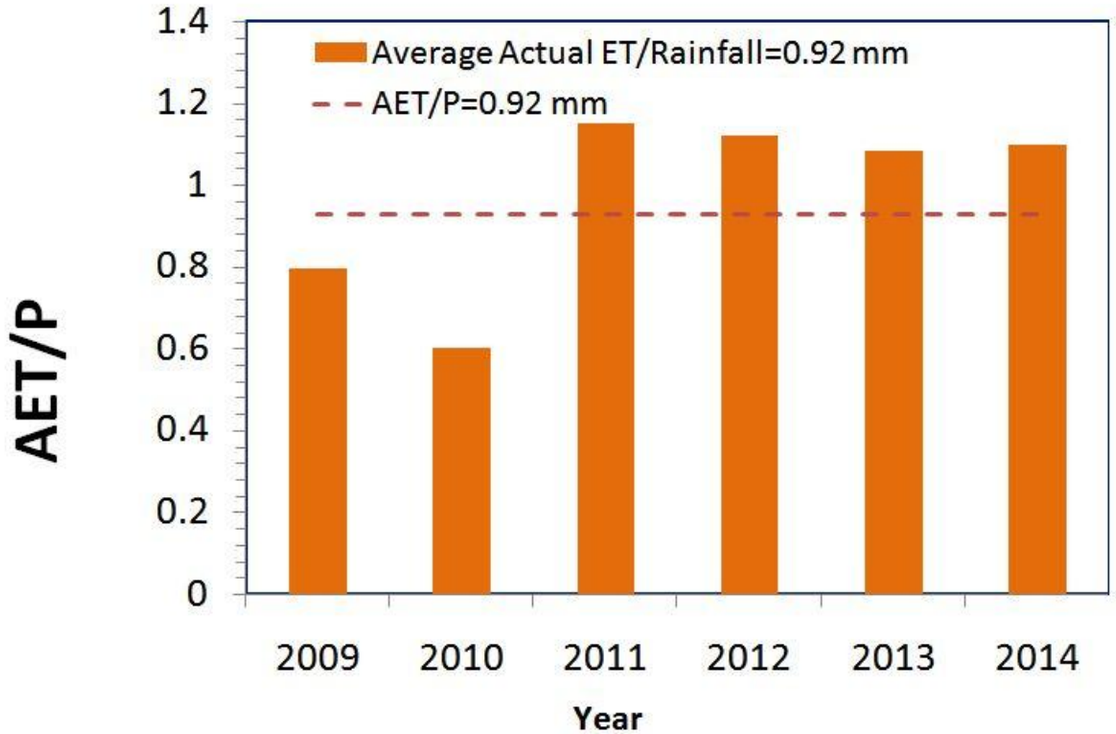


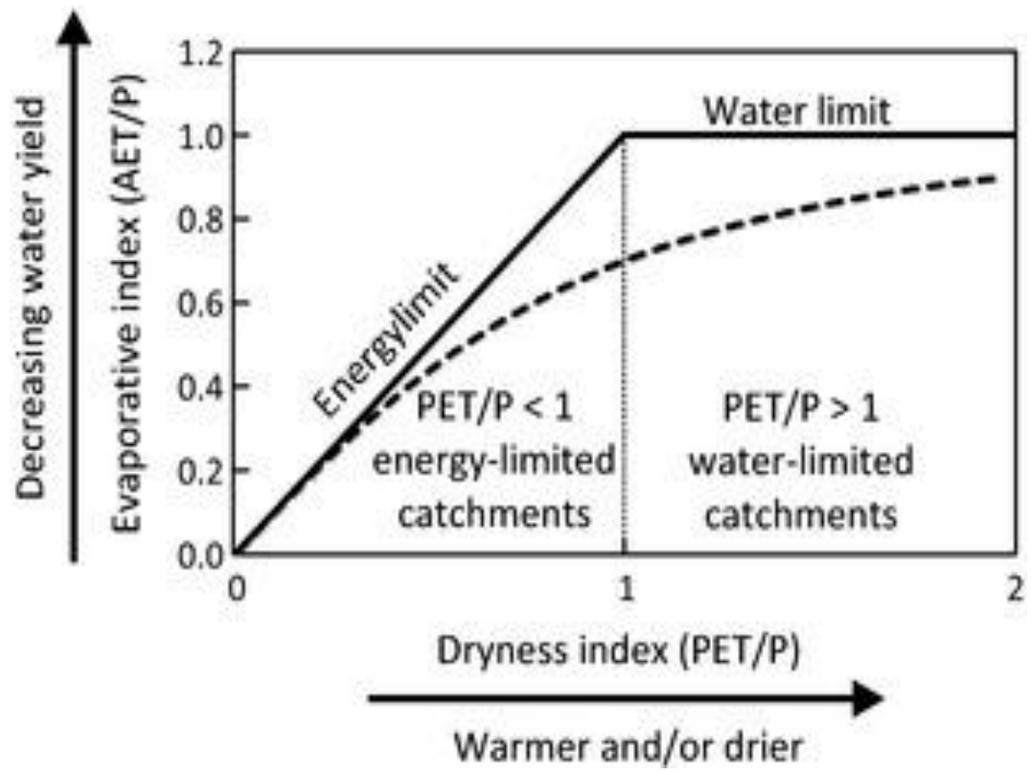




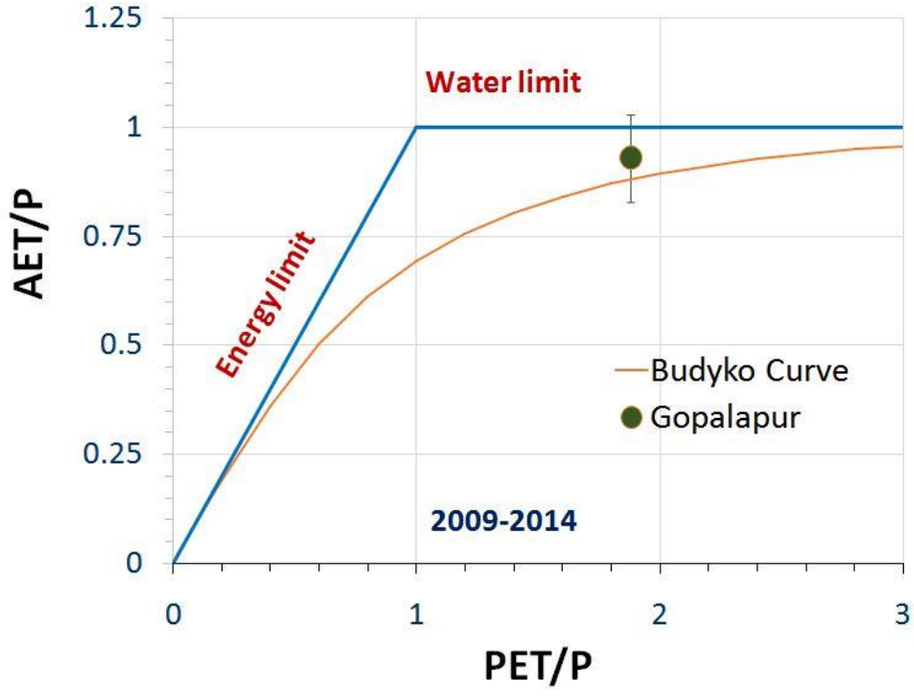
The average annual actual ET is lower than the average annual rainfall. During *kharif*, average rainfall and ET was found to be 481 mm and 328 mm respectively, whereas in *rabi* it was about 90 mm and 183 mm. In comparison to the 2001-2009, the annual ET increased by 7% during 2010-2014.

EVAPOTRANSPIRATION INDEX

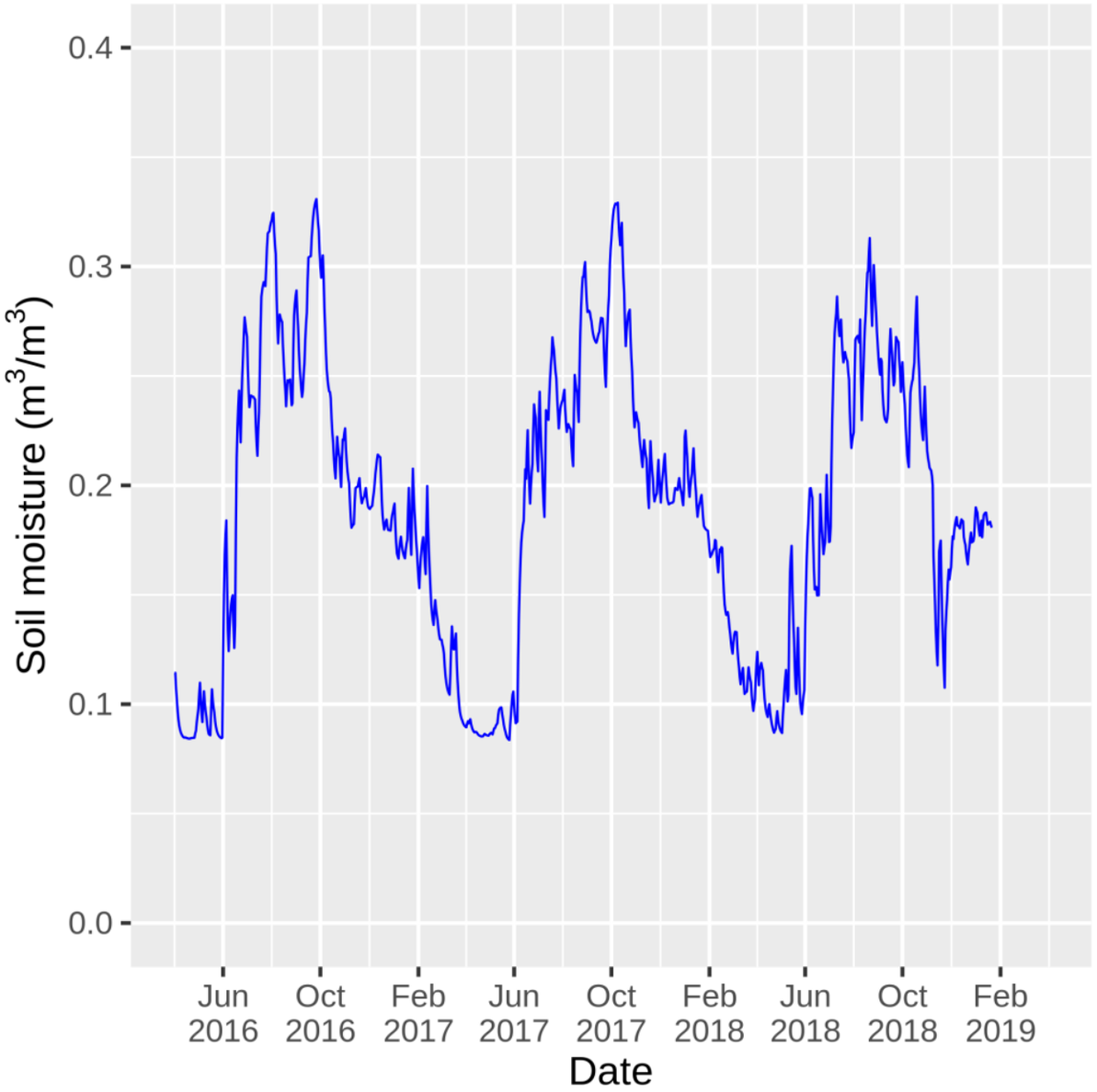


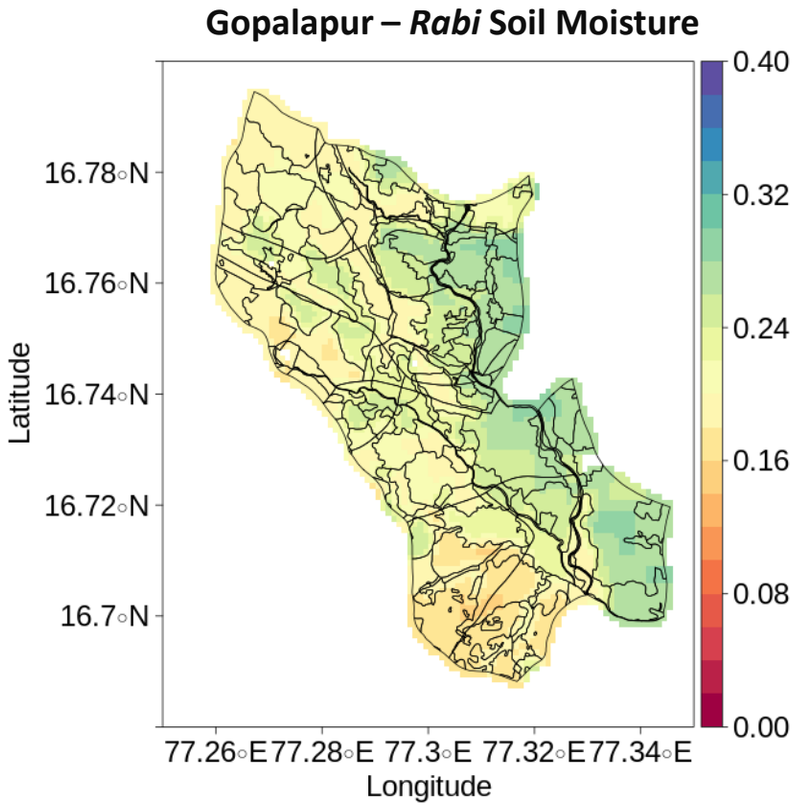


The average AET/P ratio was about 92%, which is slightly higher than the sustainable limit of about 80%. Even during extremely lower rainfall year of 2011, AET was 660 mm. This suggests the presence of water storage and utilization from other sources such as groundwater, which buffered the lower rainfall.

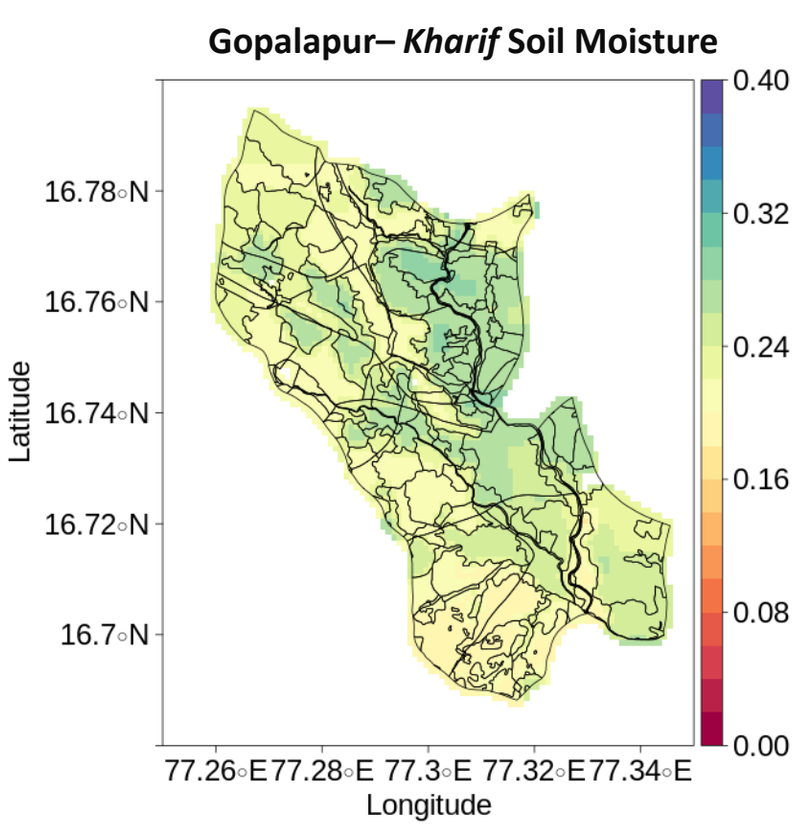


SATELLITE RETRIEVED SOIL MOISTURE





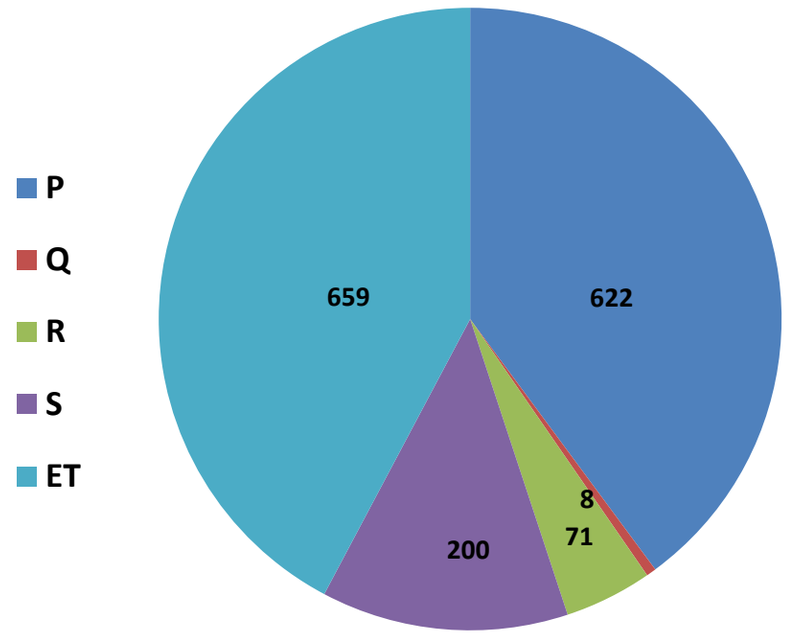
The method developed for retrieving soil moisture from multi-satellite observations allowed to map surface soil moisture behavior in the micro-watershed. The available surface moisture was varied in the range of 8-29 % in *kharif* and 18-33 % in *rabi* seasons of 2016, 11-30% in *kharif* and 23-33% in *rabi* seasons of 2017 and 31-20% in *kharif* and 19-21% in *rabi* seasons of 2018.



WATER BALANCE

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

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

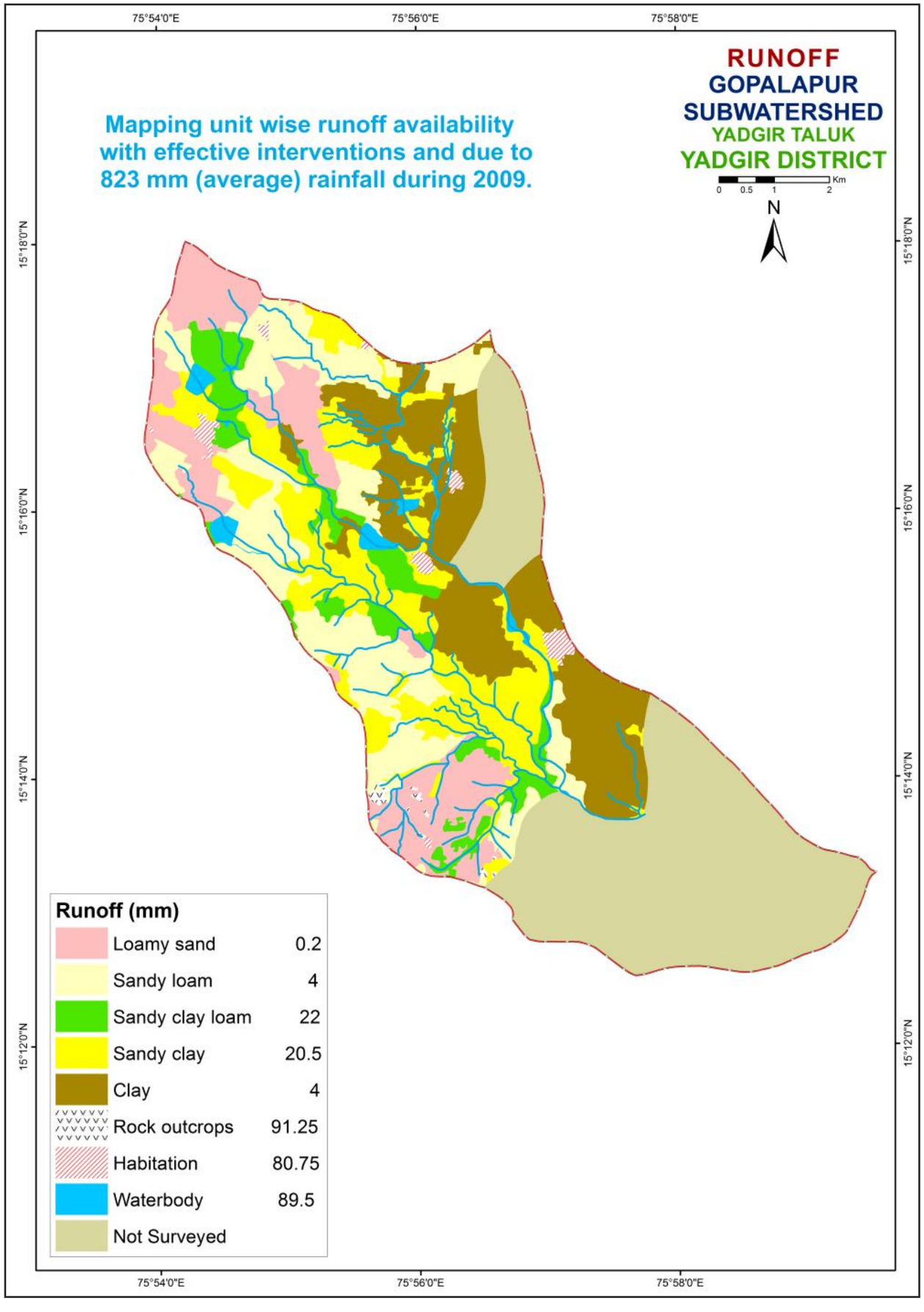


During July-September months, Precipitation is lower than Evapotranspiration, hence slight Runoff can occur in the watershed.

P = 622 mm (average of 2009-2017) ET = 659 mm R = 71 mm S = 200 mm Q = 8 mm

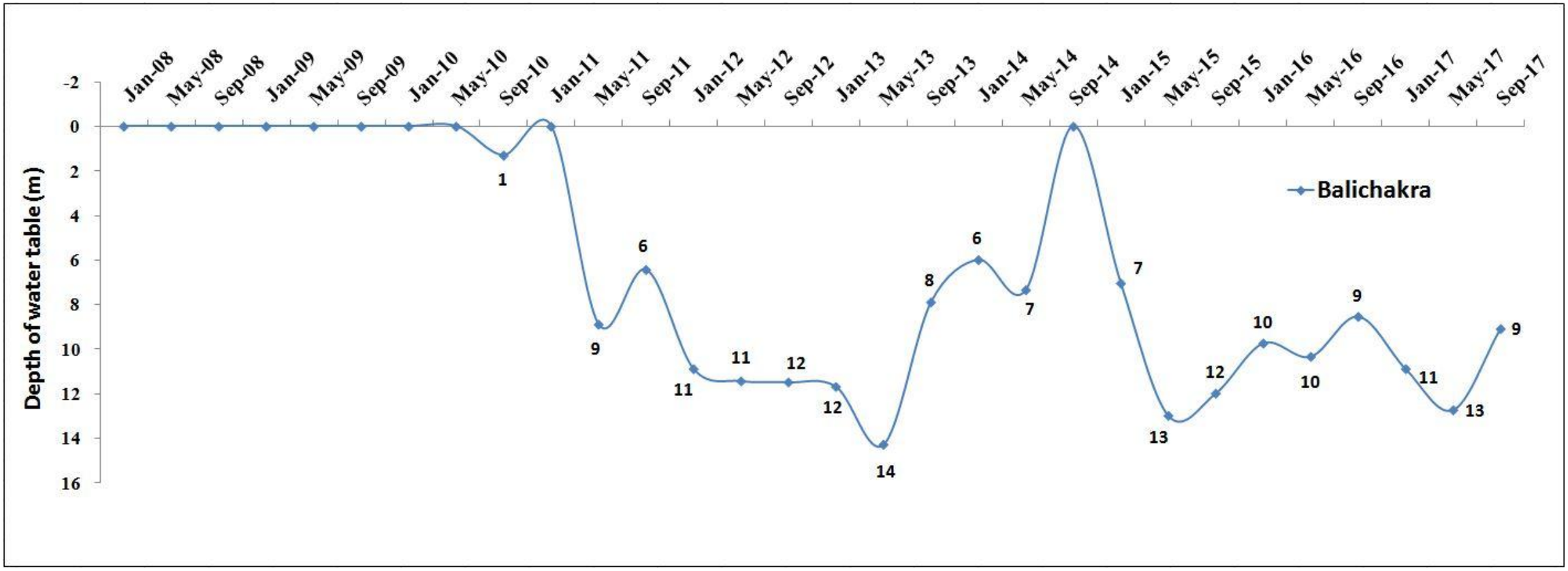
Sl. No.	Parameters	Average_ 2009 (mm)
1.	Rainfall	823
2.	Runoff availability with existing conditions	29
3.	Runoff availability with effective interventions	10
4.	Runoff allowed as environmental flow at the outlet	2
5.	Runoff excess for harvesting by construction of structures	8

RUNOFF


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
GOPALAPUR
SUBWATERSHED
YADGIR TALUK
YADGIR DISTRICT
0 0.5 1 2 Km
N
Mapping unit wise runoff availability with effective interventions and due to 823 mm (average) rainfall during 2009.
Runoff (mm)
Loamy sand 0.2
Sandy loam 4
Sandy clay loam 22
Sandy clay 20.5
Clay 4
Rock outcrops 91.25
Habitation 80.75
Waterbody 89.5
Not Surveyed

GROUND WATER STATUS

BALICHAKRA STATION



The total number of wells present in Gopalapur Sub-watershed as per LRI data is 37 Borewells. The groundwater level was found from the data obtained from KSNDMC for the nearest station Balichakra. The above graph depicts the groundwater levels during the years 2011-2017 was slightly varying, except September (2014)- May (2015). Deepest levels were found in 2013.

SUMMARY

- The average annual rainfall of 887 mm in the Gopalapur sub-watershed as recorded from the Balichakra station data by KSNDMC.

- 80 percent, 13 percent and 7 percent 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 8 mm for an average annual rainfall of 622 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 (200 mm) and utilizable runoff plus recharge is 258 (=200+8+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 511 mm. Hence the amount of water use for kharif and rabi seasons may be estimated as 639 mm (i.e 125% of AET). This demand for the two seasons is higher by 381 mm, i.e. (639-258). The AET in June-Sept months is only 59% 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 Gopalapur Sub-watershed as per LRI data is 37 (37-Borewells). The groundwater level was found from the data obtained from KSNDMC for the nearest station Balichakra. Deepest levels were found in 2013.