हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

Agrisearch with a human touch

Land Resource and Hydrological Inventory of Kerehalli Sub-watershed for Watershed Planning and Development Koppal Taluk, Koppal District, Karnataka (AESR 3.0)

Sujala – III

Karnataka Watershed Development Project- II

Funded by World Bank

ICAR - NBSS & LUP

THE WORLD BANK

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 Kerehalli Sub-watershed for Watershed Planning and Development Koppal Taluk, Koppal District Karnataka (AESR 3.0)

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How to read and use the Atlas

The Land Resource Inventory of Kerehalli Sub-watershed (Koppal Taluk, Koppal District) for Watershed Planning (AESR 3.0) was undertaken to provide comprehensive site- specific cadastral level information useful for farm level planning and integrated development of the area under Sujala – III, Karnataka Watershed Development Project- II.

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

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

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

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

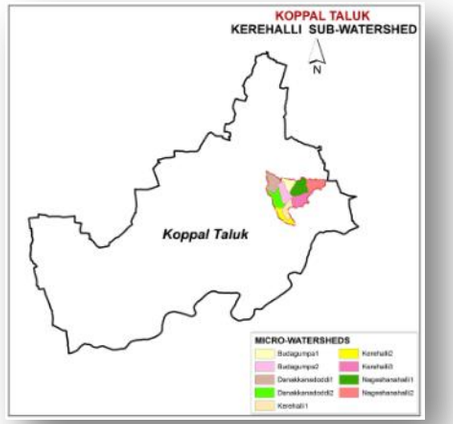
For easy map reading and understanding the information contain in different maps, the physical, cultural and scientific symbols used in the maps are illustrated in the form of colors, graphics and tables.

Physical, Cultural and Scientific symbols used in the Atlas

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

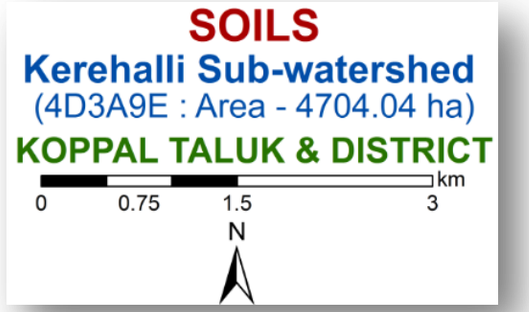
Inset map

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



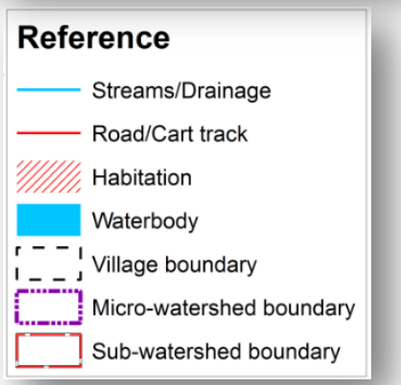
Map title

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



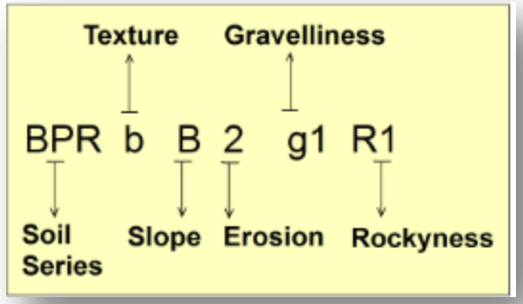
Legends and symbols

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



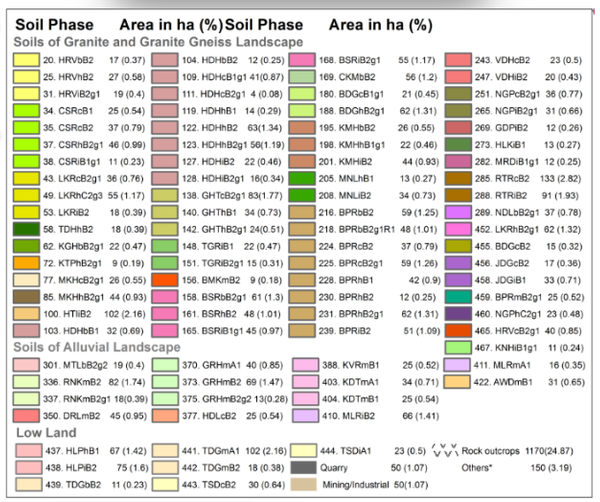
Soil Units

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



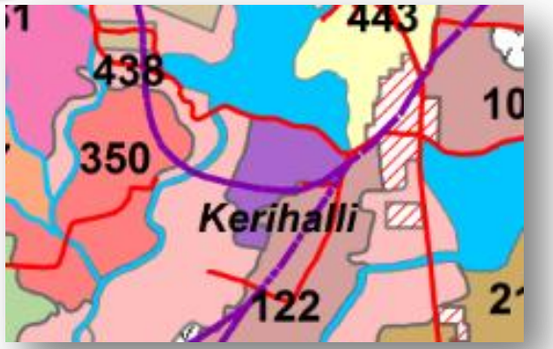
Map colours

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



Soil 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.

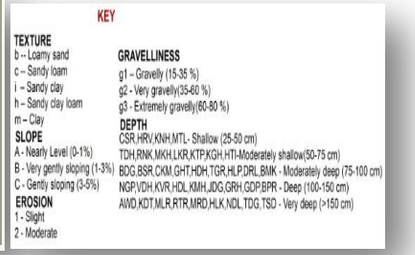


Map key

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

Limitations
g- gravelliness/stoniness
n- nutrient availability
r- rooting condition
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 Kerehalli Sub-watershed covering an area of 4704.04 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.

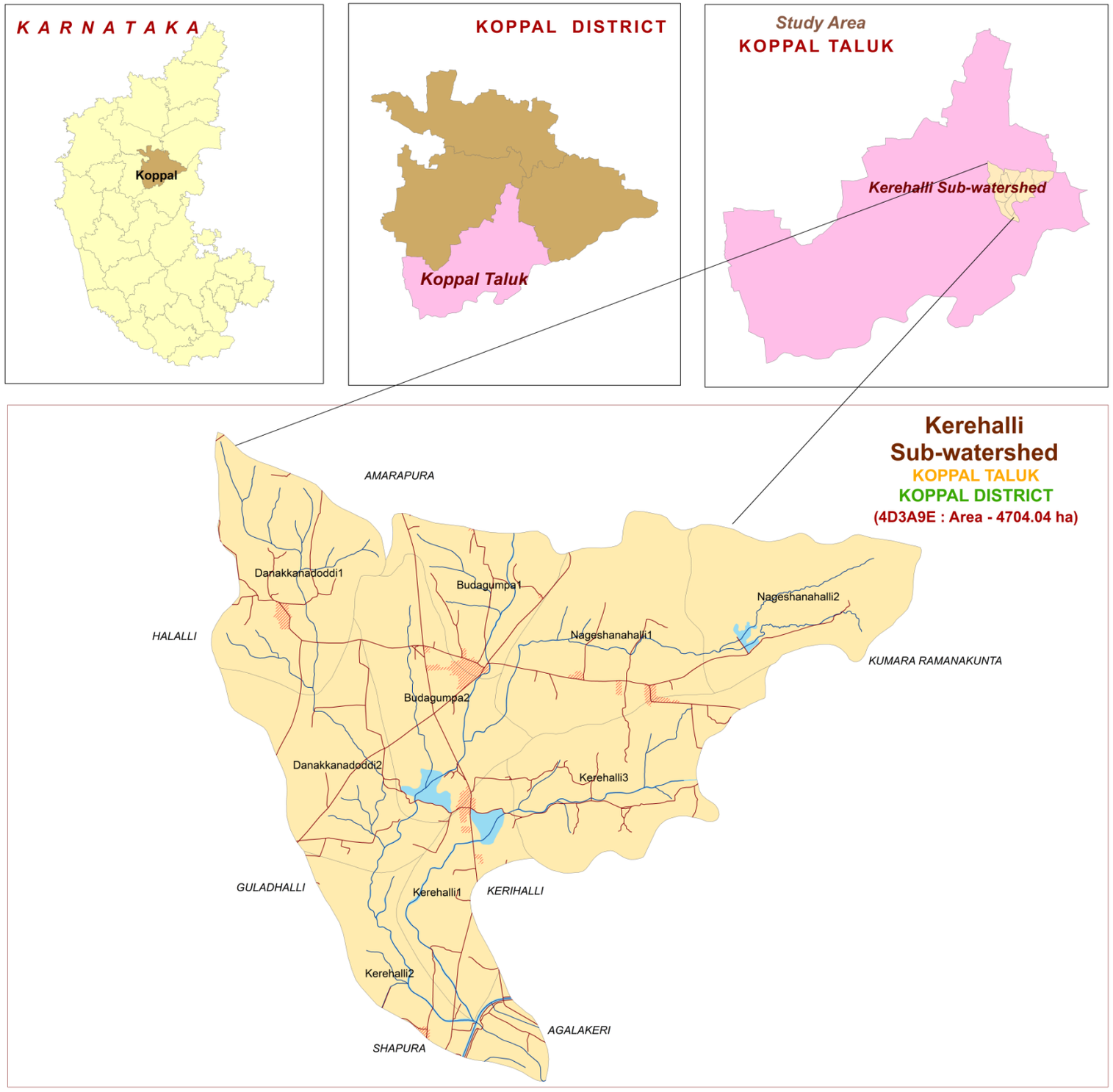
2. General Description of Sub-watershed

The Koppal district came to existence on 1st April 1998 by carving out of erst-while Raichur district of Karnataka with a geographical area of 552495 ha out of which forest area is 29451 ha, located in the northern part of the state. It lies between north latitudes 15˚ 09′ and 16˚ 01′ and east longitudes 75˚ 46′ and 76˚ 48′. The area falls in the Tungabhadra sub-basin of the Krishna basin. Tungabhadra river flows in the southern boundary of the district in north – easterly direction. The climate of the district is very hot and dry. The district has an average annual rainfall of 572 mm. Soils are well drained red sandy loam to medium deep black soils. This may be the weathering product of schistose, gneissic and granite terrain. Agriculture in Koppal district is dependent upon rainfall, irrigation tanks, wells, streams etc. The major agricultural crops grown are Jawar, Bajra, Wheat, Maize, Paddy, Horsegram, Greengram, Cowpea, Groundnut, Cotton, Niger seeds, Castor, Sunflower, Sugarcane etc. The major fruit crops include Pomegranates, Mango, Sapota, Citrus, Guava, Papaya. The major vegetable crops are leafy vegetables, Tomato, Onion, Brinjal *etc*.

As a pilot study, **ICAR-NBSS&LUP, Bangalore** carried out the generation of LRI for the Kerehalli Sub-watershed in Koppal taluk, Koppal district. It was selected for data base generation under Sujala III project. Kerehalli Sub-watershed (code - (4D3A9E) is covering an area of 4704.04 ha and spread across Guladhalli, Kerihalli, Budhagumpa, Dhanakanadoddi, Halalli, Agalakeri, Shapura, Balebavi, Nageshanahalli, Sulthanapura, Amarapura, Jabbaragudda, Kumara Ramanakunta, Kukanapalli, Tavarageri, Shivapura, Chandragiri and Hitnala villages.

LOCATION AND EXTENT

LOCATION MAP OF KEREHALLI SUB-WATERSHED



The Kerehalli Sub-watershed (Koppal taluk, Koppal district) is located in between 15^0 20' – 15^0 25' North latitudes and 75^0 16' – 75^0 22' East longitudes, covering an area of about 4704.04 ha. bounded by across Guladhalli, Kerihalli, Budhagumpa, Dhanakanadoddi, Halalli, Agalakeri, Shapura, Balebavi, Nageshanahalli, Sulthanapura, Amarapura, Jabbaragudda, KumaraRamanakunta, Kukanapalli, Tavarageri, Shivapura, Chandragiri and Hitnala villages.

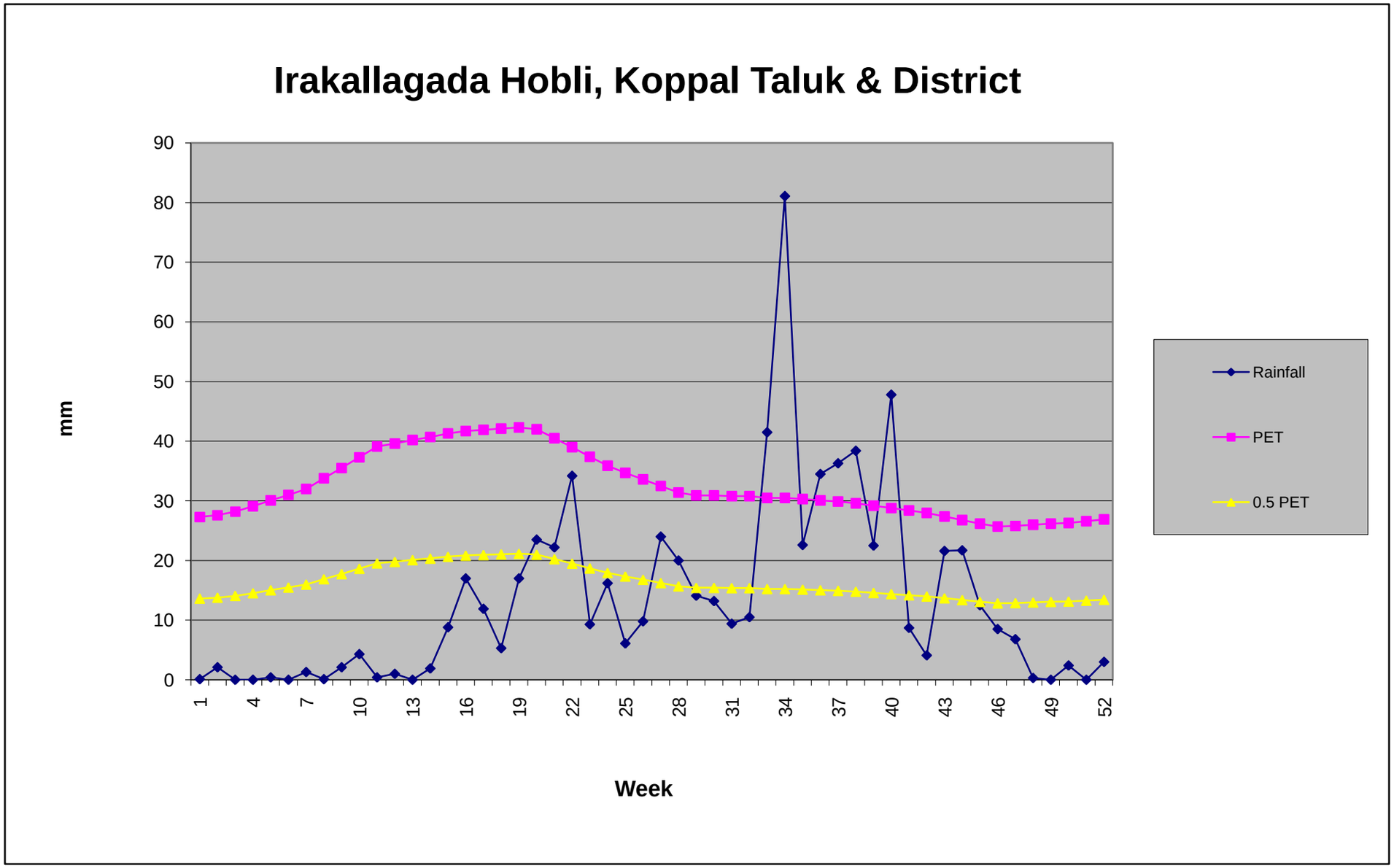
Agro Ecological Region (AER) – 3: (Deccan plateau, hot arid ecosubregion)

Karnataka Plateau (Rayalseema as inclusion), hot arid ESR with deep loamy and clayey mixed Red and Black soils, low to medium AWC and LGP 60-90 days

Agro-climatic Zone 3: Northern Dry Zone:

This zone is the largest in the state with a geographical area of 5.04 M ha, of which about 3.55 M ha is under cultivation. Irrigation is available to about 0.49 M ha. The zone encompasses the entire districts of Bijapur and Bellary, 6 taluks of Koppal, 5 taluks of Dharwad and 5 taluks of Belgaum. Of the 35 taluks in the zone, 9 taluks have a mean elevation of 800-900 m MSL while the rest have an elevation of 450-800 m. The rainfall is similar to that of the northeastern dry zone, ranging between 465 and 785 mm. Black soils are predominant in the zone with depth ranging from shallow to deep. General cropping season is *kharif* in shallow black soils and *rabi* in medium and deep black soils. Important crops of the zone are jowar, maize, bajra, groundnut, pulses, sunflower, cotton and sugarcane.

Climate

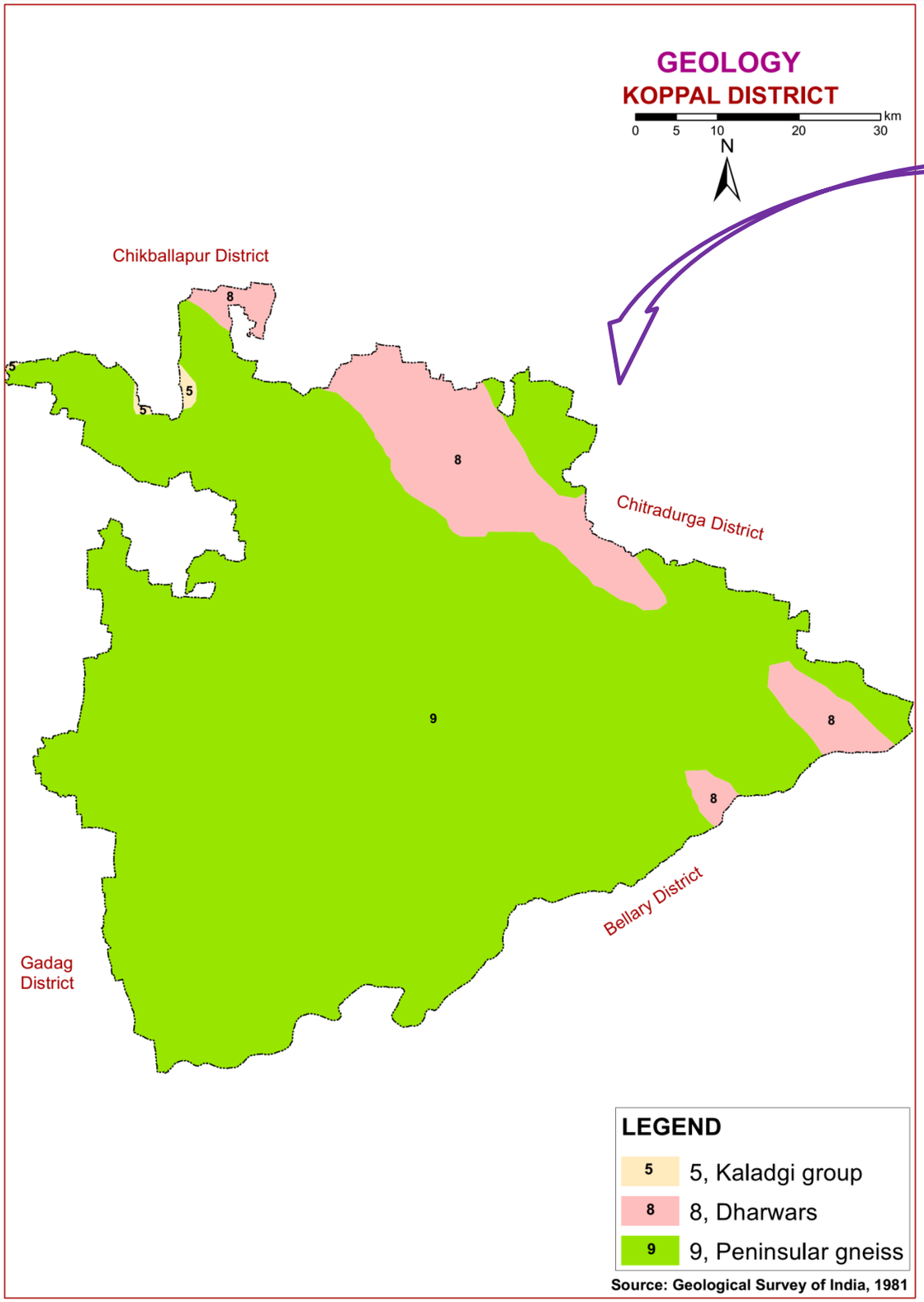


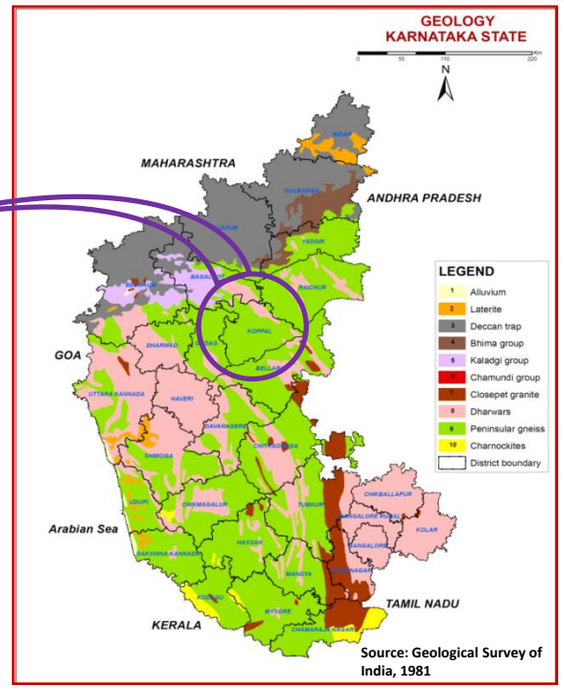
Length of Growing Period (LGP) is varying from July 1st week to last week of September (< 90 days)

Annual Rainfall : 701 mm. in the Irakallagada Hobli, Koppal Taluk & District

Source: KSNMDC (1980-2011)

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 - KOPPAL DISTRICT

Kaladgi group

It consists of nearly horizontal sedimentary rocks 3000 to 5000m thick overlying the Archaeans. The component rocks are sandstones, shales, limestone, dolomite and schists.

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 (comprises banded ferruginous quartzites, pyroxenite, gabbro, serpentinite, acid volcanic, phyllites, metabasalt, and quartz-chlorite schist) and Chitradurga groups (includes quartzite, limestone, dolomite, chlorite-schist, and manganese and iron ores with phyllite, metabasalt and conglomerates).

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

Peninsular Gneiss

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

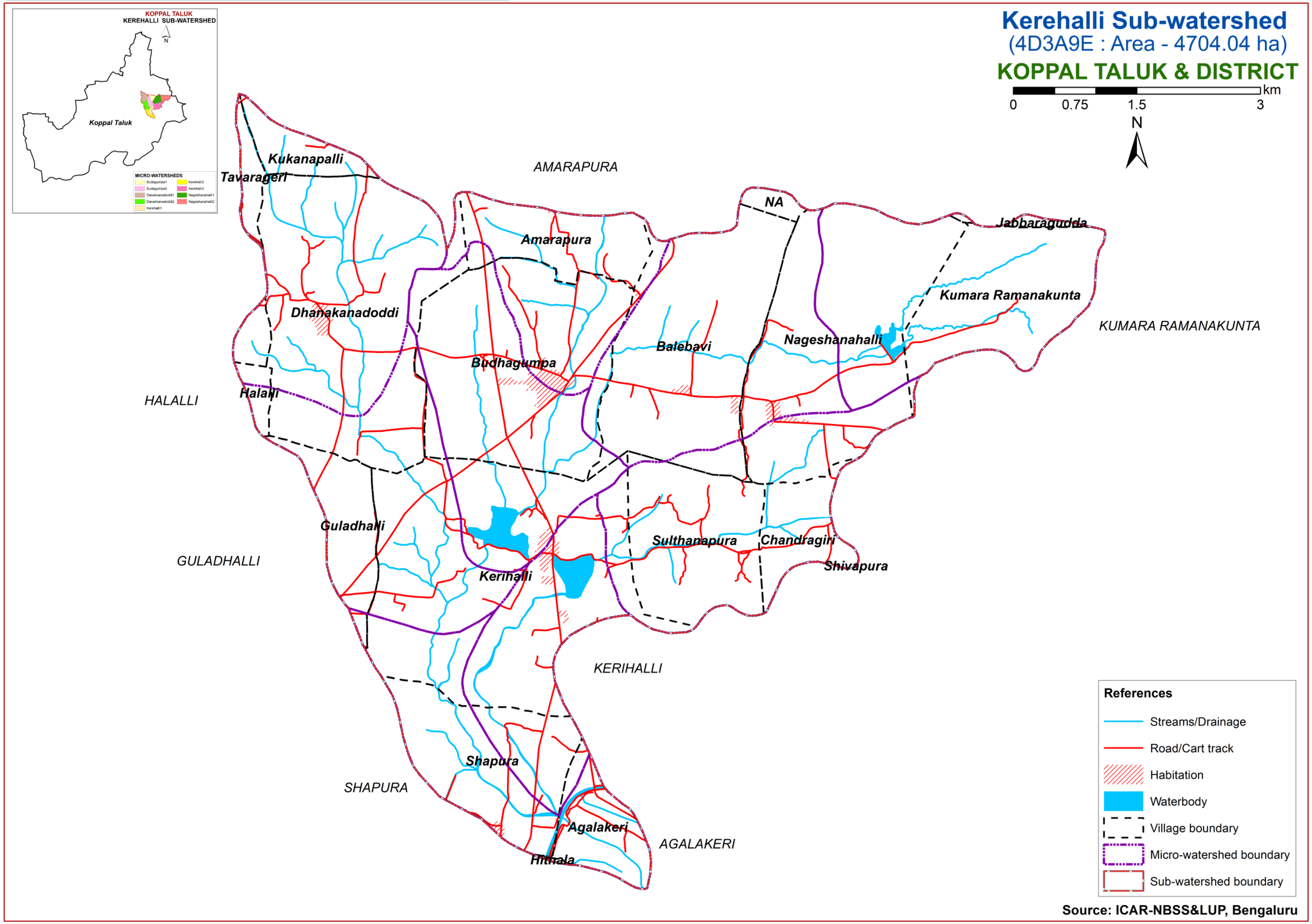
3. SURVEY METHODOLOGY

Sequence of activities in generation of LRI

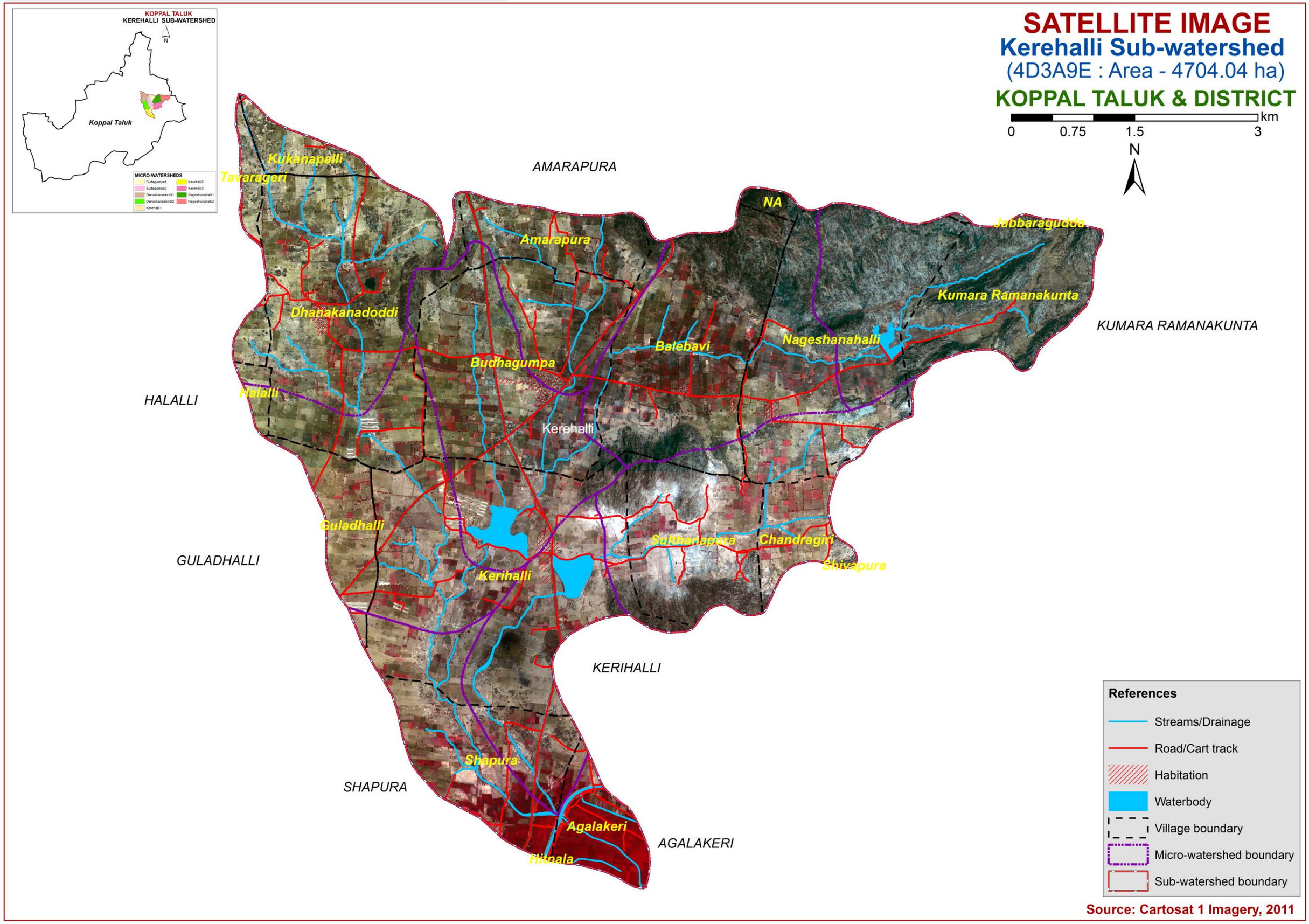
- Traversing the watershed using cadastral maps and imagery as base
- Identifying landforms, geology, land use and other features
- Selecting fields representing land units
- Opening profiles to 2 m depth
- Studying soil and site characteristics
- Grouping similar areas based on their soil-site characteristics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

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

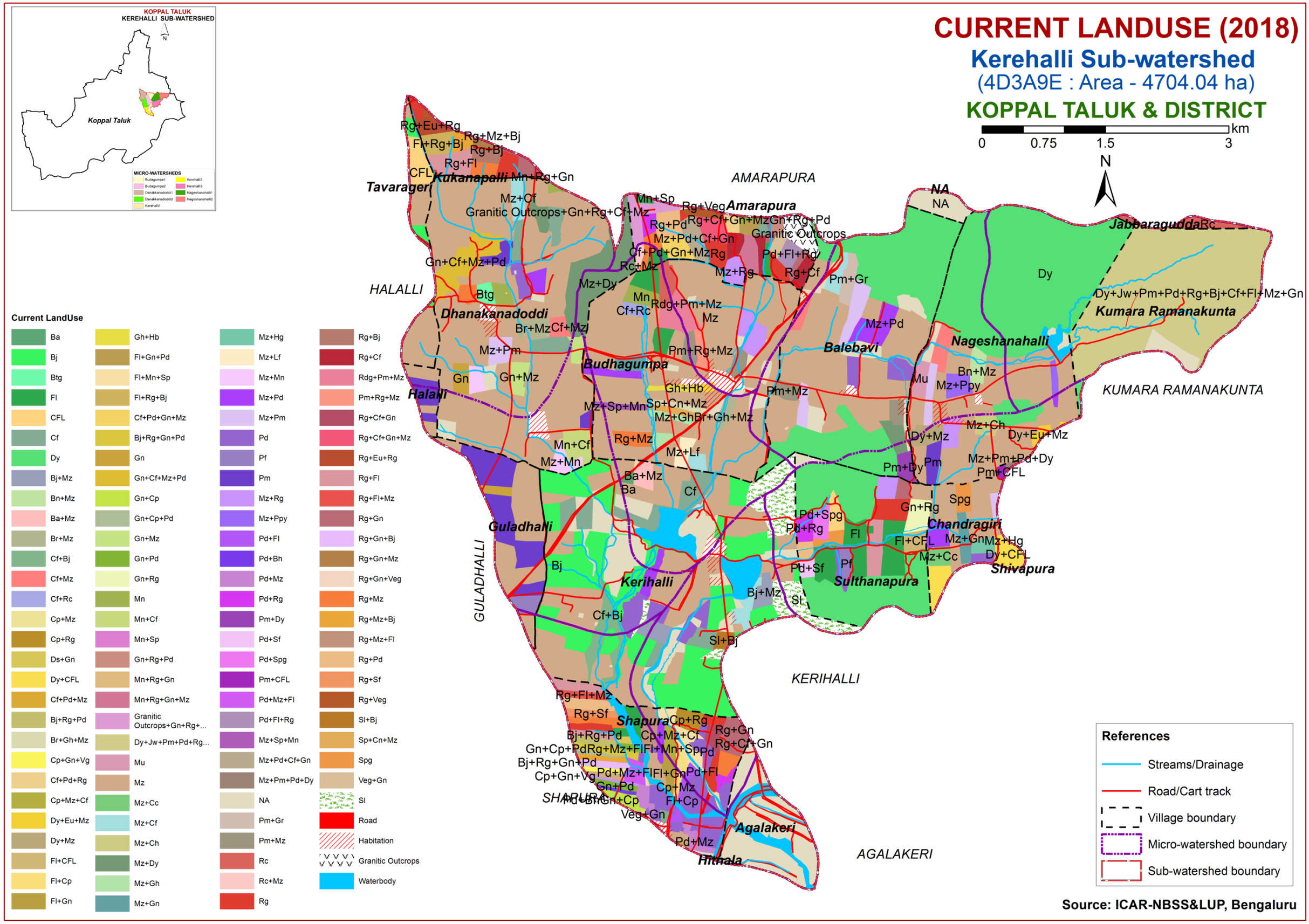
3.1. Database Used - Cadastral map



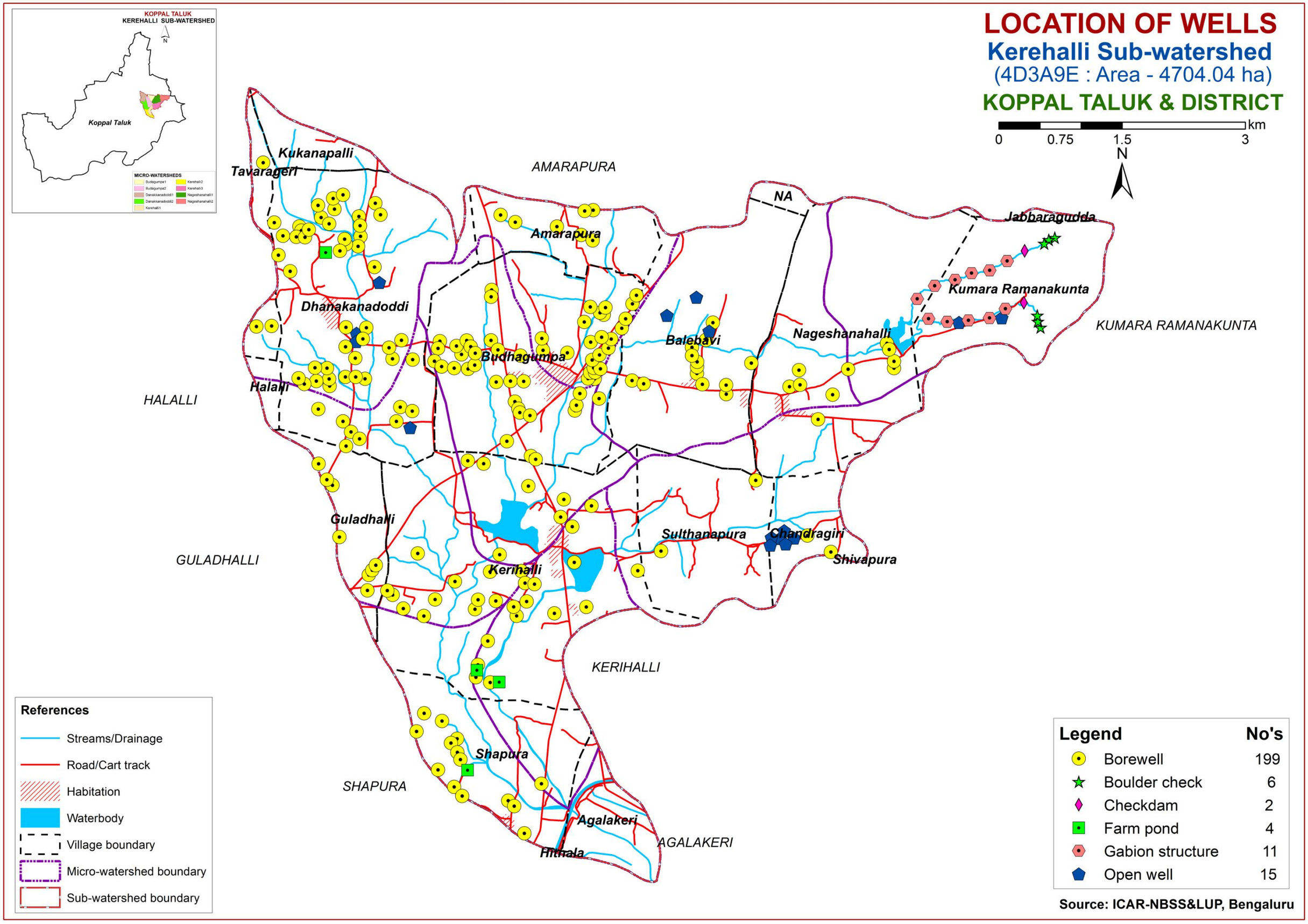
3.2. Database Used - Satellite Image



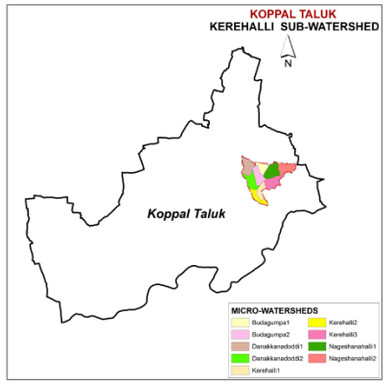
3.3. Current LandUse



3.4. Location of Wells



4. The Soils



SOILS

Kerehalli Sub-watershed

(4D3A9E : Area - 4704.04 ha)

KOPPAL TALUK & DISTRICT

0 0.75 1.5 3 km

N

KEY

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

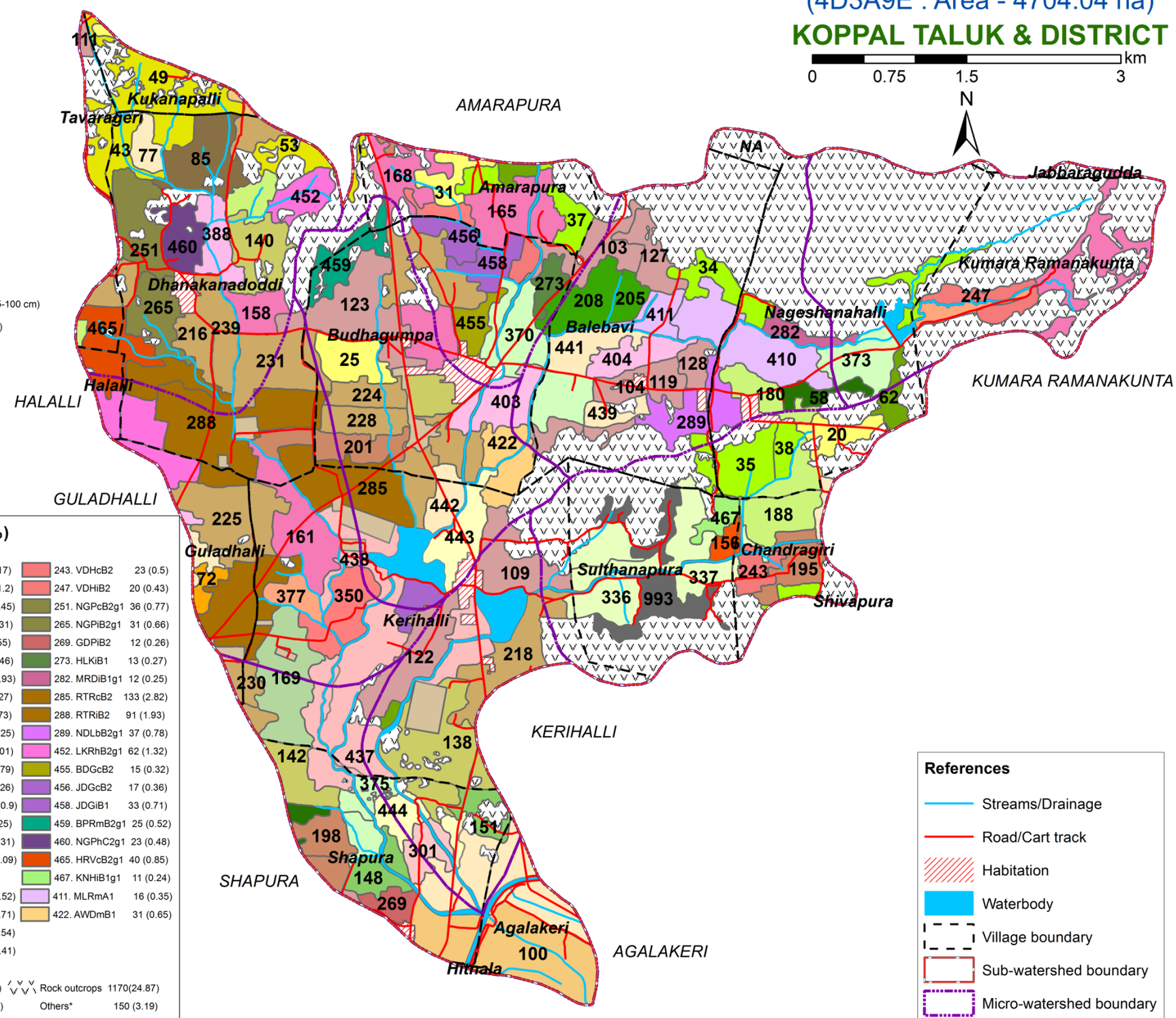
SLOPE
A - Nearly Level (0-1%)
B - Very gently sloping (1-3%)
C - Gently sloping (3-5%)

EROSION
1 - Slight
2 - Moderate

GRAVELLINESS
g1 – Gravelly (15-35 %)
g2 - Very gravelly(35-60 %)
g3 - Extremely gravelly(60-80 %)

DEPTH
CSR,HRV,KNH,MTL- Shallow (25-50 cm)
TDH,RNK,MKH,LKR,KTP,KGH,HTI-Moderately shallow(50-75 cm)
BDG,BSR,CKM,GHT,HDH,TGR,HLP,DRL,BMK - Moderately deep (75-100 cm)
NGP,VDH,KVR,HDL,KMH,JDG,GRH,GDP,BPR - Deep (100-150 cm)
AWD,KDT,MLR,RTR,MRD,HLK,NDL,TDG,TSD - Very deep (>150 cm)

Texture Gravelliness
BPR b B 2 g1 R1
Soil Series Slope Erosion Rockyness



Soil Phase	Area in ha (%)	Soil Phase	Area in ha (%)				
Soils of Granite and Granite Gneiss Landscape							
20. HRVbB2	17 (0.37)	104. HDHbB2	12 (0.25)	168. BSRiB2g1	55 (1.17)	243. VDHcB2	23 (0.5)
25. HRVhB2	27 (0.58)	109. HDHcB1g1	41(0.87)	169. CKMbB2	56 (1.2)	247. VDHiB2	20 (0.43)
31. HRViB2g1	19 (0.4)	111. HDHcB2g1	4 (0.08)	180. BDGcB1g1	21 (0.45)	251. NGPcB2g1	36 (0.77)
34. CSRcB1	25 (0.54)	119. HDHhB1	14 (0.29)	188. BDGhB2g1	62 (1.31)	265. NGPiB2g1	31 (0.66)
35. CSRcB2	37 (0.79)	122. HDHhB2	63(1.34)	195. KMHbB2	26 (0.55)	269. GDPiB2	12 (0.26)
37. CSRhB2g1	46 (0.99)	123. HDHhB2g1	56(1.19)	198. KMHhB1g1	22 (0.46)	273. HLKiB1	13 (0.27)
38. CSRiB1g1	11 (0.23)	127. HDHiB2	22 (0.46)	201. KMHiB2	44 (0.93)	282. MRDiB1g1	12 (0.25)
43. LKRcB2g1	36 (0.76)	128. HDHiB2g1	16(0.34)	205. MNLhB1	13 (0.27)	285. RTRcB2	133 (2.82)
49. LKRhC2g3	55 (1.17)	138. GHTcB2g1	83(1.77)	208. MNLiB2	34 (0.73)	288. RTRiB2	91 (1.93)
53. LKRiB2	18 (0.39)	140. GHThB1	34 (0.73)	216. BPRbB2	59 (1.25)	289. NDLbB2g1	37 (0.78)
58. TDHhB2	18 (0.39)	142. GHThB2g1	24(0.51)	218. BPRbB2g1R1	48 (1.01)	452. LKRhB2g1	62 (1.32)
62. KGHbB2g1	22 (0.47)	148. TGRiB1	22 (0.47)	224. BPRcB2	37 (0.79)	455. BDGcB2	15 (0.32)
72. KTPhB2g1	9 (0.19)	151. TGRiB2g1	15 (0.31)	225. BPRcB2g1	59 (1.26)	456. JDGcB2	17 (0.36)
77. MKHcB2g1	26 (0.55)	156. BMKmB2	9 (0.18)	228. BPRhB1	42 (0.9)	458. JDGiB1	33 (0.71)
85. MKHhB2g1	44 (0.93)	158. BSRbB2g1	61 (1.3)	230. BPRhB2	12 (0.25)	459. BPRmB2g1	25 (0.52)
100. HTIiB2	102 (2.16)	161. BSRhB2	48 (1.01)	231. BPRhB2g1	62 (1.31)	460. NGPhC2g1	23 (0.48)
103. HDHbB1	32 (0.69)	165. BSRiB1g1	45 (0.97)	239. BPRiB2	51 (1.09)	465. HRVcB2g1	40 (0.85)
						467. KNHiB1g1	11 (0.24)
Soils of Alluvial Landscape							
301. MTLbB2g2	19 (0.4)	370. GRHmA1	40 (0.85)	388. KVRmB1	25 (0.52)	411. MLRmA1	16 (0.35)
336. RNKmB2	82 (1.74)	373. GRHmB2	69 (1.47)	403. KDTmA1	34 (0.71)	422. AWDmB1	31 (0.65)
337. RNKmB2g1	18(0.39)	375. GRHmB2g2	13(0.28)	404. KDTmB1	25 (0.54)		
350. DRLmB2	45 (0.95)	377. HDLcB2	25 (0.54)	410. MLRiB2	66 (1.41)		
Low Land							
437. HLPhB1	67 (1.42)	441. TDGmA1	102 (2.16)	444. TSDiA1	23 (0.5)	Rock outcrops	1170(24.87)
438. HLPiB2	75 (1.6)	442. TDGmB2	18 (0.38)	Quarry	50 (1.07)	Others*	150 (3.19)
439. TDGbB2	11 (0.23)	443. TSDcB2	30 (0.64)	Mining/Industrial	50(1.07)		

* - Habitation & Waterbody

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

Source: ICAR-NBSS&LUP, Bengaluru

4.1 Mapping unit description of Kerehalli (4D3A9E) Sub-watershed in Koppal taluk, Koppal district

Soil map unit No*	Soil Series	Soil phase	Mapping Unit Description	Area in ha (%)
Soils of Granite and Granite Gneiss Landscape				
	HLK	Hallikere soils are very deep (>150 cm), well drained, have dark brown to dark reddish brown clayey soils occurring on nearly level to very gently sloping uplands under cultivation		**13 (0.27)**
273		HLKiB1	Sandy clay surface, slope 1-3% slight erosion	13 (0.27)
	MRD	Muradi soils are very deep (>150 cm), well drained, have red to dark red sandy clay loam soils occurring on nearly level to gently sloping uplands under cultivation		**12 (0.25)**
282		MRDiB1g1	Sandy clay surface, slope 1-3% slight erosion, gravelly (15-35%)	12 (0.25)
	RTR	Ranatur soils are very deep (>150 cm), well drained, have dark reddish brown to dark red clay soils occurring on nearly level to very gently sloping uplands under cultivation		**224 (4.75)**
285		RTRcB2	Sandy loam surface, slope 1-3%, moderate erosion	133 (2.82)
288		RTRiB2	Sandy clay surface, slope 1-3% moderate erosion	91 (1.93)
	NDL	Niduvalalu soils are very deep (>150 cm), well drained, have red to dark reddish brown red gravelly sandy clay soils occurring on nearly level to very gently sloping uplands under cultivation		**37 (0.78)**
289		NDLbB2g1	Loamy sand surface, slope 1-3%, moderate erosion, gravelly (15-35%)	37 (0.78)
	KMH	Kumchahalli soils are deep (100-150cm), well drained, have dark reddish brown to dark red sandy clay soils occurring on nearly level to very gently sloping uplands under cultivation		**92 (1.94)**
195		KMHbB2	Loamy sand surface, slope 1-3%, moderate erosion	26 (0.55)
198		KMHhB1g1	Loamy sand surface, slope 1-3%, slight erosion, gravelly (15-35%)	22 (0.46)
201		KMHiB2	Sandy clay surface, slope 1-3%, moderate erosion	44 (0.93)
	MNL	Mornal soils are deep (100-150 cm), well drained, have dark reddish brown to red gravelly sandy clay soils occurring on very gently sloping uplands under cultivation		**47 (1.0)**
205		MNLhB1	Loamy sand surface, slope 1-3%, slight erosion	13 (0.27)
208		MNLiB2	Sandy clay surface, slope 1-3%, moderate erosion	34 (0.73)
	BPR	Balapur soils are deep (100-150 cm), well drained, have dark reddish brown to dark red gravelly sandy clay to clay soils occurring on nearly level to gently sloping uplands under cultivation		**395 (8.38)**
216		BPRbB2	Loamy sand surface, slope 1-3%, moderate erosion	59 (1.25)
218		BPRbB2g1R1	Loamy sand surface, slope 1-3%, moderate erosion, gravelly (15-35%), fairly rocky (2-10%)	48 (1.01)
224		BPRcB2	Sandy loam surface, slope 1-3%, moderate erosion	37 (0.79)
225		BPRcB2g1	Sandy loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	59 (1.26)
228		BPRhB1	Sandy clay loam surface, slope 1-3%, slight erosion	42 (0.9)
230		BPRhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	12 (0.25)

To be continued...

Soil map unit No*	Soil Series	Soil phase	Mapping Unit Description	Area in ha (%)
Soils of Granite and Granite Gneiss Landscape				
231		BPRhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	62 (1.31)
239		BPRiB2	Sandy clay surface, slope 1-3%, moderate erosion	51 (1.09)
459		BPRmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	25 (0.52)
	VDH	Vaddarahalli soils are deep (100-150 cm), moderately well drained, have dark brown sandy clay to clay soils occurring on nearly level to very gently sloping uplands under cultivation		**43 (0.93)**
243		VDHcB2	Sandy loam surface, slope 1-3%, moderate erosion	23 (0.5)
247		VDHiB2	Sandy clay surface, slope 1-3%, moderate erosion	20 (0.43)
	NGP	Nagalapur soils are deep (100-150 cm), well drained, have dark reddish brown to dark red gravelly sandy clay soils occurring on nearly level to gently sloping uplands under cultivation		**90 (1.91)**
251		NGPcB2g1	Sandy loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	36 (0.77)
265		NGPiB2g1	Sandy clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	31 (0.66)
460		NGPhC2g1	Sandy clay loam surface, slope 3-5%, moderate erosion, gravelly (15-35%)	23 (0.48)
	GDP	Giddadapalya soils are deep (100-150 cm), well drained, have dark reddish brown to dark red gravelly sandy clay to clay soils occurring on very gently sloping uplands under cultivation		**12 (0.26)**
269		GDPiB2	Sandy clay surface, slope 1-3%, moderate erosion	12 (0.26)
	JDG	Jedigere soils are deep (100-150 cm), well drained, have dark brown to dark reddish brown red sandy clay to clay soils occurring on nearly level to very gently sloping uplands under cultivation		**50 (1.07)**
456		JDGcB2	Sandy loam surface, slope 1-3%, moderate erosion	17 (0.36)
458		JDGiB1	Sandy clay loam surface, slight erosion	33 (0.71)
	HDH	Hooradhahalli soils are moderately deep (75-100 cm), well drained, dark red to dark reddish brown, red gravelly sandy clay to clay soils occurring on nearly level to moderately sloping uplands under cultivation		**260 (5.51)**
103		HDHbB1	Loamy sand surface, slope 1-3%, slight erosion	32 (0.69)
104		HDHbB2	Loamy sand surface, slope 1-3%, moderate erosion	12 (0.25)
109		HDHcB1g1	Sandy loam surface, slope 1-3%, slight erosion, gravelly (15-35%)	41 (0.87)
111		HDHcB2g1	Sandy loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	4 (0.08)
119		HDHhB1	Sandy clay loam, surface, slope 1-3%, slight erosion	14 (0.29)
122		HDHhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	63 (1.34)
123		HDHhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	56 (1.19)
127		HDHiB2	Sandy clay surface, slope 1-3%, moderate erosion	22 (0.46)
128		HDHiB2g1	Sandy clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	16 (0.34)

To be continued...

Soil map unit No*	Soil Series	Soil phase	Mapping Unit Description	Area in ha (%)
Soils of Granite and Granite Gneiss Landscape				
	GHT	Gollarahatti soils are moderately deep (75-100 cm), well drained, have dark reddish brown to dark red gravelly sandy clay loam soils occurring on nearly level very gently sloping uplands under cultivation		**127 (2.5)**
138		GHTcB2g1	Sandy loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	83 (1.77)
140		GHThB1	Sandy clay loam surface, slope 1-3%, slight erosion	34 (0.73)
142		GHThB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	24 (0.51)
	TGR	Tigari soils are moderately deep (75-100 cm), well drained, have dark reddish brown to reddish brown, calcareous gravelly sandy clay loam soils occurring on very gently sloping uplands		**37 (0.78)**
148		TGRiB1	Sandy clay surface, slope 1-3%, slight erosion	22 (0.47)
151		TGRiB2g1	Sandy clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	15 (0.31)
	BMK	Bhimanakunte soils are moderately deep (75-100 cm), well drained, have very dark reddish brown to yellowish red gravelly, calcareous sandy clay to clay soils occurring on nearly level to very gently sloping uplands under cultivation		**9 (0.18)**
156		BMKmB2	Clay surface, slope 1-3%, moderate erosion	9 (0.18)
	BSR	Bisarahalli soils are moderately deep (75-100 cm), well drained, have dark reddish brown red gravelly sandy clay soils occurring on very gently sloping uplands under cultivation		**209 (4.45)**
158		BSRbB2g1	Loamy sand surface, slope 1-3%, moderate erosion, gravelly (15-35%)	61 (1.3)
161		BSRhB2	Sandy clay loam surface, slope 1-3%, moderate erosion,	48 (1.01)
165		BSRiB1g1	Sandy clay surface, slope 1-3%, slight erosion, gravelly (15-35%)	45 (0.97)
168		BSRiB2g1	Sandy clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	55 (1.17)
	CKM	Chikkamegheri soils are moderately deep (75-100 cm), well drained, have dark brown to dark reddish brown red sandy clay soils occurring on nearly level to very gently sloping uplands under cultivation		**56 (1.2)**
169		CKMbB2	Loamy sand surface, slope 1-3%, moderate erosion	56 (1.2)
	BDG	Bidanagere soils are moderately deep (75-100 cm), well drained, have dark reddish brown gravelly red clay soils occurring on nearly level to gently sloping uplands under cultivation		**98 (2.08)**
180		BDGcB1g1	Sandy loams surface, slope 1-3%, slope 1-3%, gravelly (15-35%)	21 (0.45)
188		BDGhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	62 (1.31)
455		BDGcB2	Sandy loam surface, slope 1-3%, moderate erosion	15 (0.32)
	LKR	Lakkur soils are moderately shallow (50-75 cm), well drained, have dark reddish brown to dark red, red gravelly sandy clay soils occurring on very gently to moderately sloping uplands under cultivation		**171 (3.64)**
43		LKRcB2g1	Sandy loams surface, slope 1-3%, moderate erosion, gravelly (15-35%)	36 (0.76)
49		LKRhC2g3	Sandy clay loam surface, slope 3-5%, moderate erosion, extremely gravelly (35-60%)	55 (1.17)

To be continued...

Soil map unit No*	Soil Series	Soil phase	Mapping Unit Description	Area in ha (%)
Soils of Granite and Granite Gneiss Landscape				
53		LKRiB2	Sandy clay surface, slope 1-3%, moderate erosion	18 (0.39)
452		LKRhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	62 (1.32)
	TDH	Thammadahalli soils are moderately shallow (50-75cm), well drained, have brown to very dark brown and dark reddish brown sandy clay to clay soils occurring on nearly level to gently sloping uplands		**18 (0.39)**
58		TDHhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	18 (0.39)
	KGH	Kutegoudanahundi soils are moderately shallow (50-75 cm), well drained, have brown to dark brown gravelly red sandy clay loam soils occurring on nearly level to very gently to gently sloping uplands under cultivation		**22 (0.47)**
62		KGHbB2g1	Loamy sand surface, slope 1-3%, moderate erosion, gravelly (15-35%)	22 (0.47)
	KTP	Kethanapura soils are moderately shallow (50-75 cm), well drained, have dark reddish brown red gravelly sandy clay soils occurring on very gently sloping uplands under cultivation		**9 (0.19)**
72		KTPhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	9 (0.19)
	MKH	Mukhadahalli soils are moderately shallow (50-75 cm), well drained, have dark brown to reddish brown gravelly red sandy clay soils occurring on gently very gently to gently sloping uplands under cultivation		**70 (1.48)**
77		MKHcB2g1	Sandy loams surface, slope 1-3%, moderate erosion, gravelly (15-35%)	26 (0.55)
85		MKHhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	44 (0.93)
	HTI	Hatti soils are moderately shallow (50-75 cm), well drained, have dark reddish brown red gravelly sandy clay soils occurring on nearly level to very gently sloping uplands under cultivation		**102 (2.16)**
100		HTIiB2	Sandy clay surface, slope 1-3%, moderate erosion	102 (2.16)
	HRV	Harve soils are shallow (25-50 cm), well drained, dark red to dark red dish brown, red gravelly sandy clay loam soils occurring on nearly level to gently sloping uplands under cultivation		**103 (2.2)**
20		HRVbB2	Loamy sand surface, slope 1-3%, moderate erosion	17 (0.37)
25		HRVhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	27 (0.58)
31		HRViB2g1	Sandy clay surface, slope 1-3%, moderate erosion	19 (0.4)
465		HRVcB2g1	Sandy loams surface, slope 1-3%, moderate erosion, gravelly (15-35%)	40 (0.85)
	CSR	Chikkasavanur soils are shallow (25-50 cm), well drained, have dark brown to light yellowish brown, sandy clay loam soils occurring on nearly level to very gently sloping uplands under cultivation		**119 (2.55)**
34		CSRcB1	Sandy loam surface, slope 1-3%, slight erosion	25 (0.54)
35		CSRcB2	Sandy loam surface, slope 1-3%, moderate erosion	37 (0.79)
37		CSRhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	46 (0.99)

To be continued...

Soil map unit No*	Soil Series	Soil phase	Mapping Unit Description	Area in ha (%)
Soils of Granite and Granite Gneiss Landscape				
38		CSRiB1g1	Sandy clay surface, slope 1-3%, gravelly (15-35%)	11 (0.23)
	KNH	Kanchanahallisoils are shallow (25 -50 cm), well drained, have dark reddish brown sandy clay soils occurring on very gently sloping uplands		**11 (0.24)**
467		KNHiB1g1	Sandy clay surface, slope 1-3%, slight erosion, gravelly (15-35%)	11 (0.24)
	TDG	Thondigere soils are very deep (>150 cm), well drained, have dark brown to dark yellowish brown, sandy clay loam soils occurring on nearly level to very gently sloping lowlands under cultivation		**131 (2.77)**
439		TDGbB2	Loamy sand surface, slope 1-3%, moderate erosion	11 (0.23)
441		TDGmA1	Clay surface, slope 0-1%, slight erosion	102 (2.16)
442		TDGmB2	Clay surface, slope 1-3%, moderate erosion	18 (0.38)
	TSD	Thimmasandra soils are very deep (>150 cm), moderately well drained, have very dark brown to very dark grayish brown, clay soils occurring on nearly level to very gently sloping lowlands under cultivation		**53 (1.14)**
443		TSDcB2	Sandy loam surface, slope 1-3%, moderate erosion	30 (0.64)
444		TSDiA1	Sandy clay surface, slope 0-1%, slight erosion	23 (0.5)
	HLP	Huliyapura soils are moderately deep (75-100 cm), well drained, have dark- strong brown to dark yellowish brown sandy clay loam soils occurring on very gently sloping low lands under cultivation		**142 (3.02)**
437		HLPhB1	Sandy clay loam surface, slope 1-3%, slight erosion	67 (1.42)
438		HLPiB2	Sandy clay surface, slope 1-3%, moderate erosion	75 (1.6)
Soils of Alluvial Landscape				
	KDT	Kadagathur soils are very deep (>150 cm), moderately well drained, have dark brown to very dark grayish brown, black sandy clay to clay soils occurring on nearly level to very gently sloping plains under cultivation		**59 (1.25)**
403		KDTmA1	Clay surface, slope 0-1%, slight erosion	34 (0.71)
404		KDTmB1	Clay surface, slope 1-3%, slight erosion	25 (0.54)
	MLR	Murlapur soils are very deep (>150 cm), moderately well drained, have very dark grayish brown to very dark gray, calcareous black cracking clay soils occurring on nearly level to very gently sloping plains under cultivation		**82 (1.76)**
410		MLRiB2	Sandy clay surface, slope 1-3%, moderate erosion	66 (1.41)
411		MLRmA1	Clay surface, slope 0-1%, slight erosion	16 (0.35)

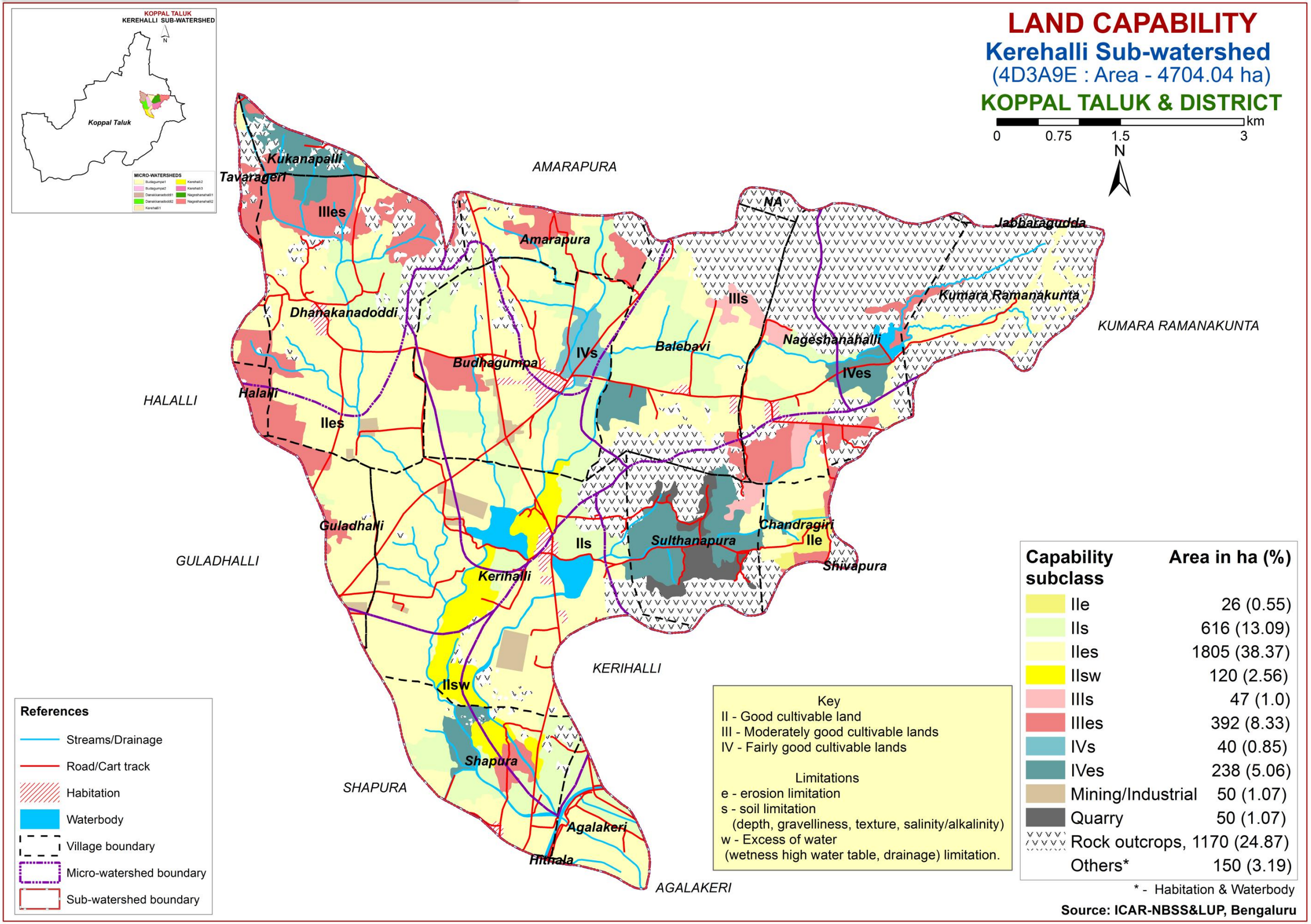
To be continued...

Soil map unit No*	Soil Series	Soil phase	Mapping Unit Description	Area in ha (%)
Soils of Alluvial Landscape				
	AWD	Alawandi soils are very deep (>150 cm), moderately well drained, have very dark grayish brown to black , calcareous black cracking clay soils occurring on nearly level to very gently sloping plains under cultivation		**31 (0.65)**
422		AWDmB1	Clay surface, slope 1-3%, slight erosion	31 (0.65)
	GRH	Gatareddihal soils are deep (100-150 cm), moderately well drained, have light olive brown to very dark gray, calcareous black cracking clay soils occurring on nearly level to very gently sloping plains under cultivation		**82 (2.6)**
370		GRHmA1	Clay surface, slope 0-1%, slight erosion	40 (0.85)
373		GRHmB2	Clay surface, slope 1-3%, moderate erosion	69 (1.47)
375		GRHmB2g2	Clay surface, slope 1-3%, moderate erosion, very gravelly (35-60%)	13 (0.28)
	HDL	Handrala soils are deep (100-150 cm), moderately well drained, have dark gray to very dark gray, black calcareous cracking clay soils occurring on very gently sloping plains under cultivation		**25 (0.54)**
377		HDLcB2	Sandy loam surface, slope 1-3%, moderate erosion	25 (0.54)
	KVR	Kavalur soils are deep (100-150 cm), moderately well drained, have dark yellowish brown to very dark grayish brown, calcareous cracking black clay soils occurring on nearly level to very gently sloping plains under cultivation		**25 (0.52)**
388		KVRmB1	Clay surface, slope 1-3%, slight erosion	25 (0.52)
	DRL	Dambarahalli soils are moderately deep (75-100 cm), moderately well drained, have dark brown to very dark gray, calcareous black cracking clay soils occurring on nearly level to very gently sloping plains under cultivation		**45 (0.95)**
350		DRLmB2	Clay surface, slope 1-3%, moderate erosion	45 (0.95)
	RNK	Ravanaki soils are moderately shallow (50-75 cm), moderately well drained, have dark brown to very dark grayish brown and dark gray, sodic black clay soils occurring on nearly level to very gently sloping plains under cultivation		**100 (2.13)**
336		RNKmB2	Clay surface, slope 1-3%, moderate erosion	82 (1.74)
337		RNKmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	18 (0.39)
301		MTLbB2g2	Loamy sand surface, slope 1-3%, moderate erosion, very gravelly (35-60%)	19 (0.4)
993		Quarry		50 (1.07)
994		Mining/Industrial	Mining/Industrial area	50 (1.07)
999		Rock outcrops	Rock lands, both massive and bouldery with little or no soil	1170 (24.87)
1000		Others	Habitation and waterbody	**150 (3.19)**

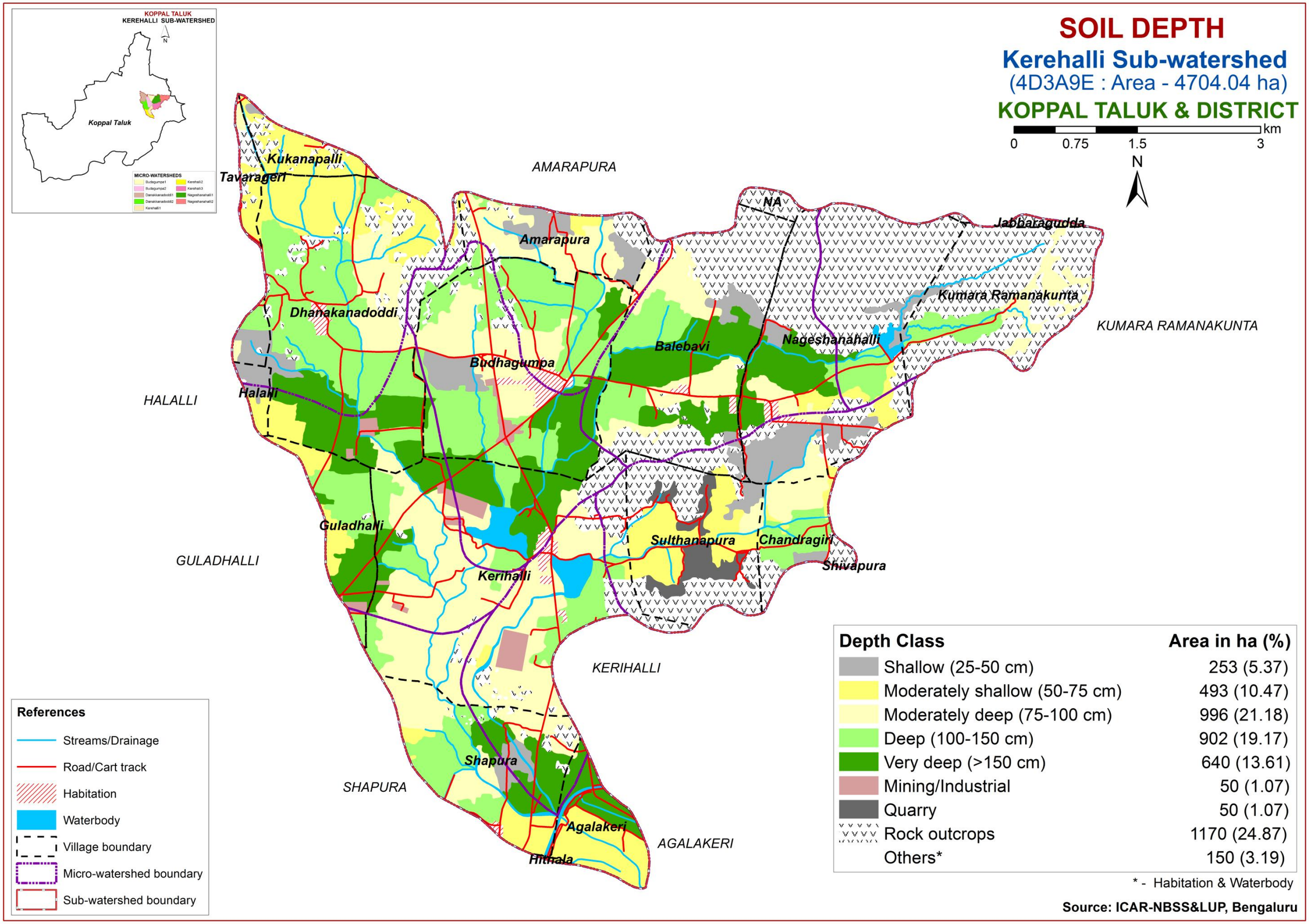
*Soil map unit numbers are continuous for the taluk, not for the Sub-watershed

5. Soil Survey Interpretations

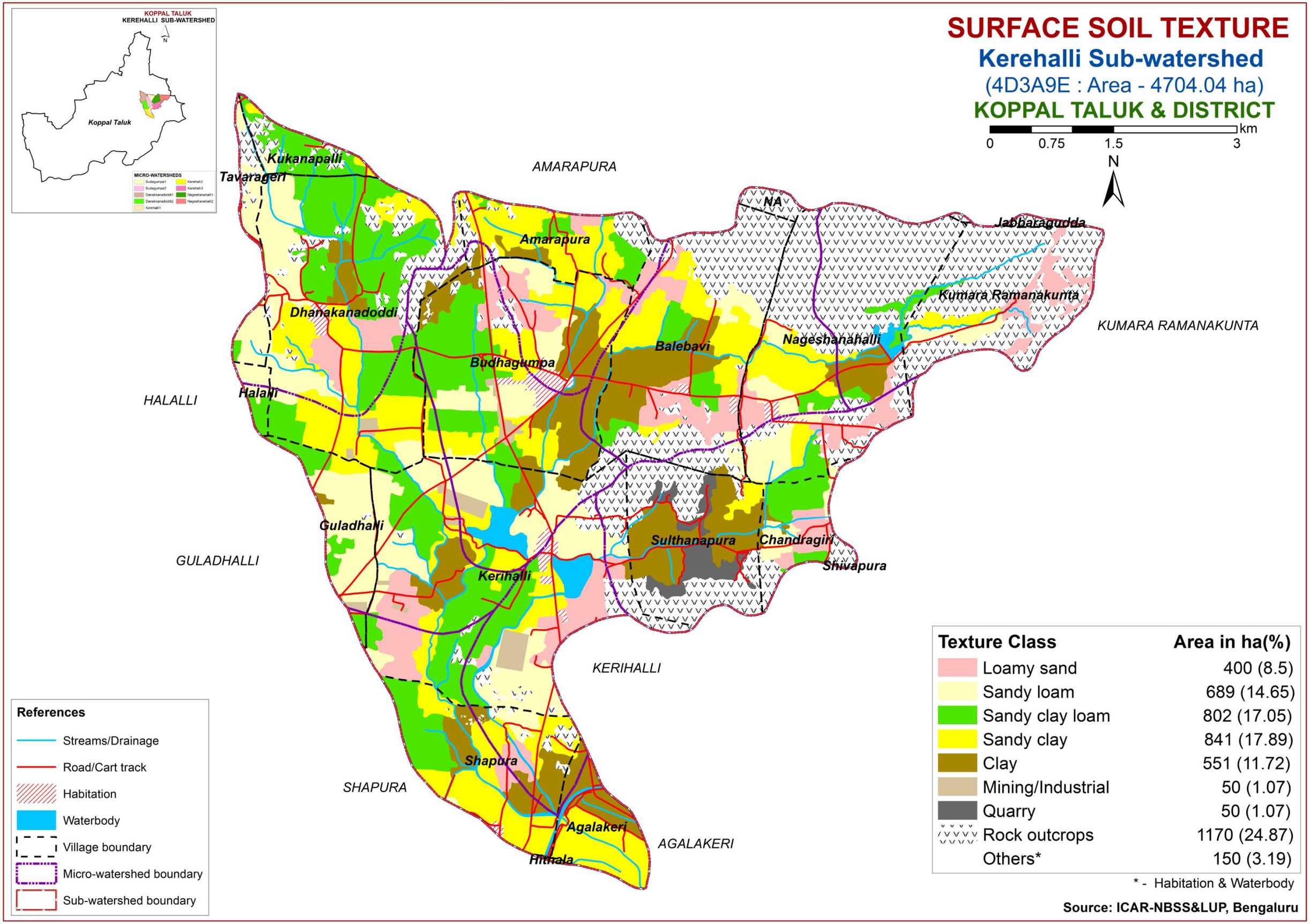
5.1. Land Capability Classification



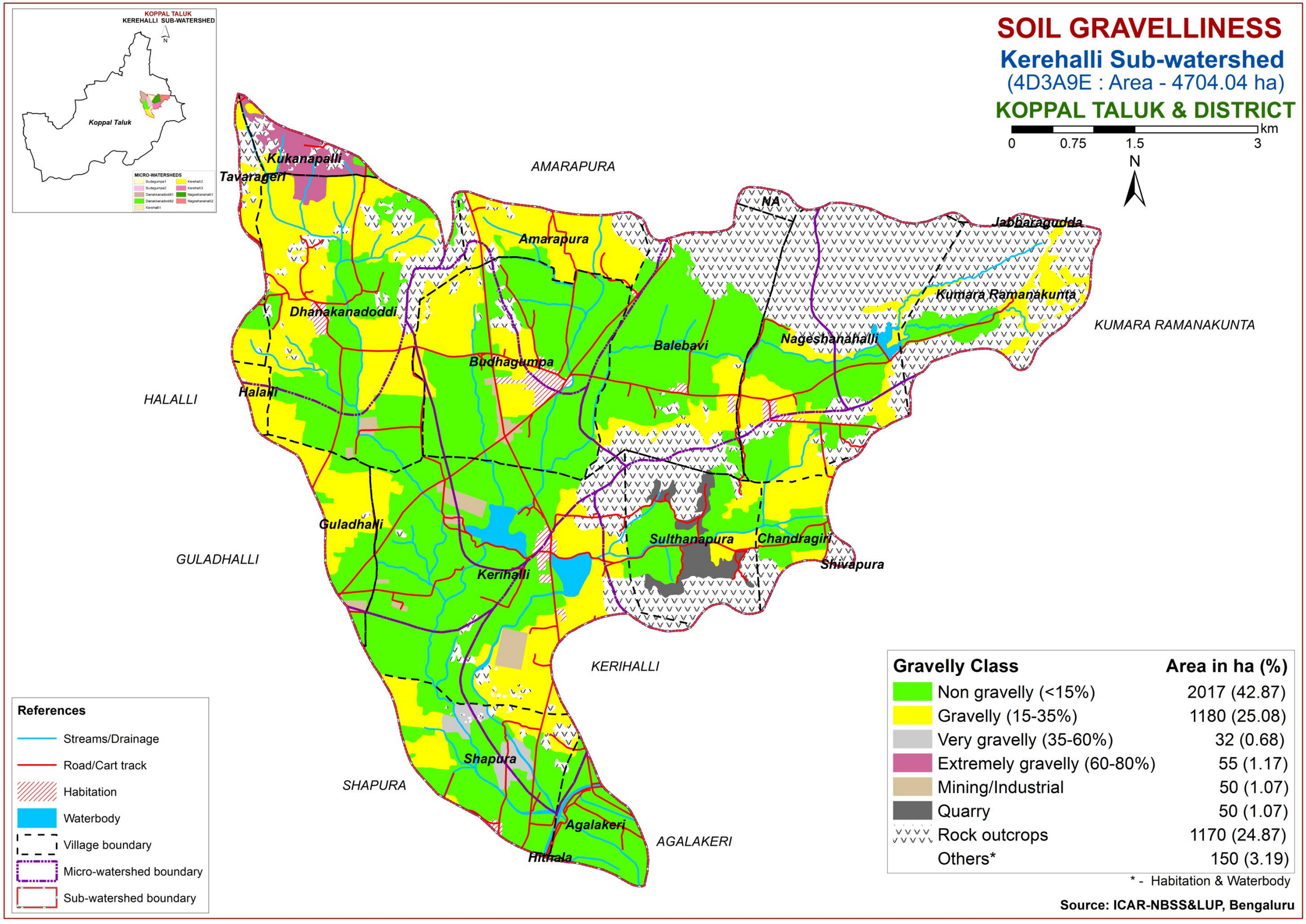
5.2. Soil Depth



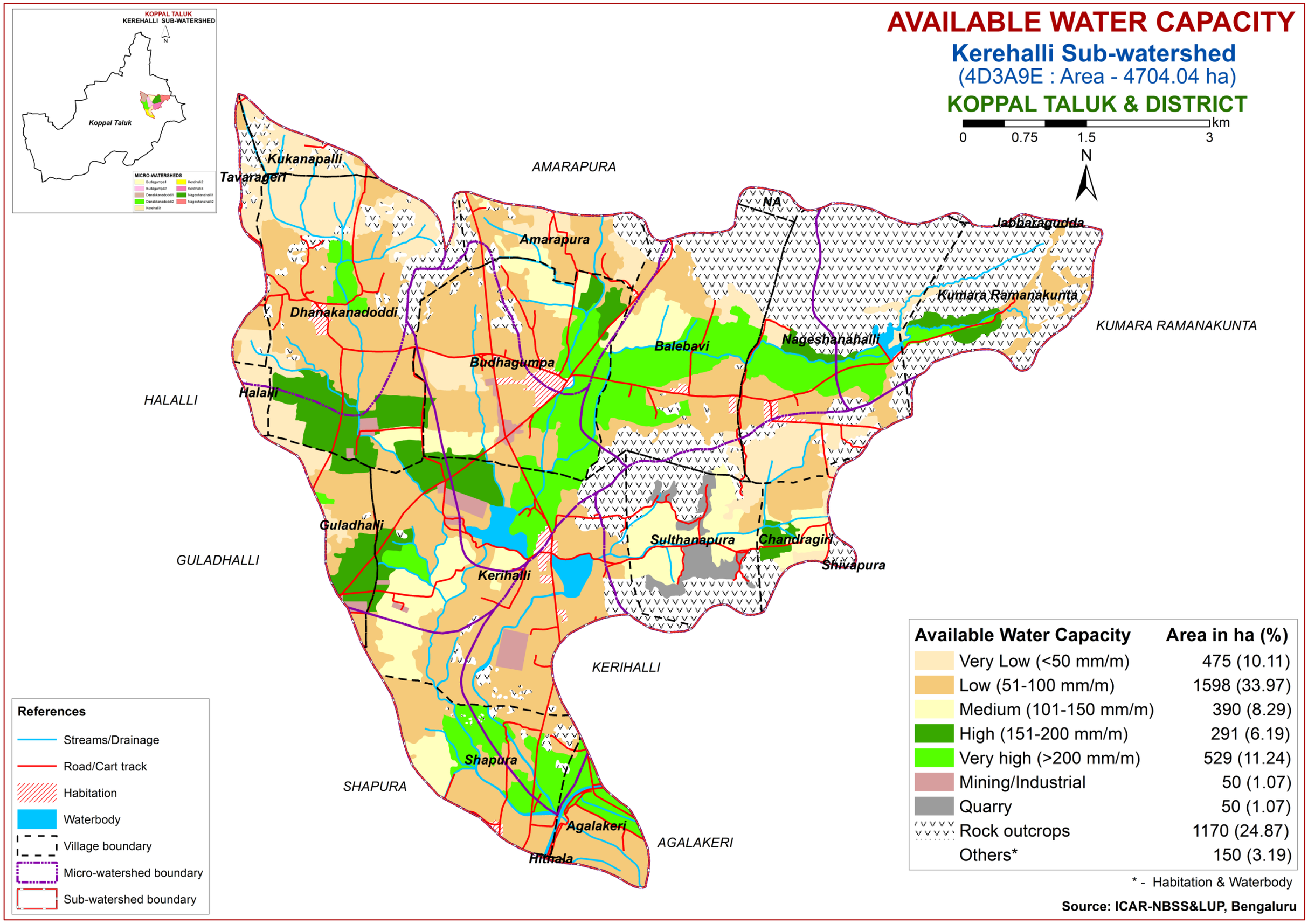
5.3. Surface Soil Texture



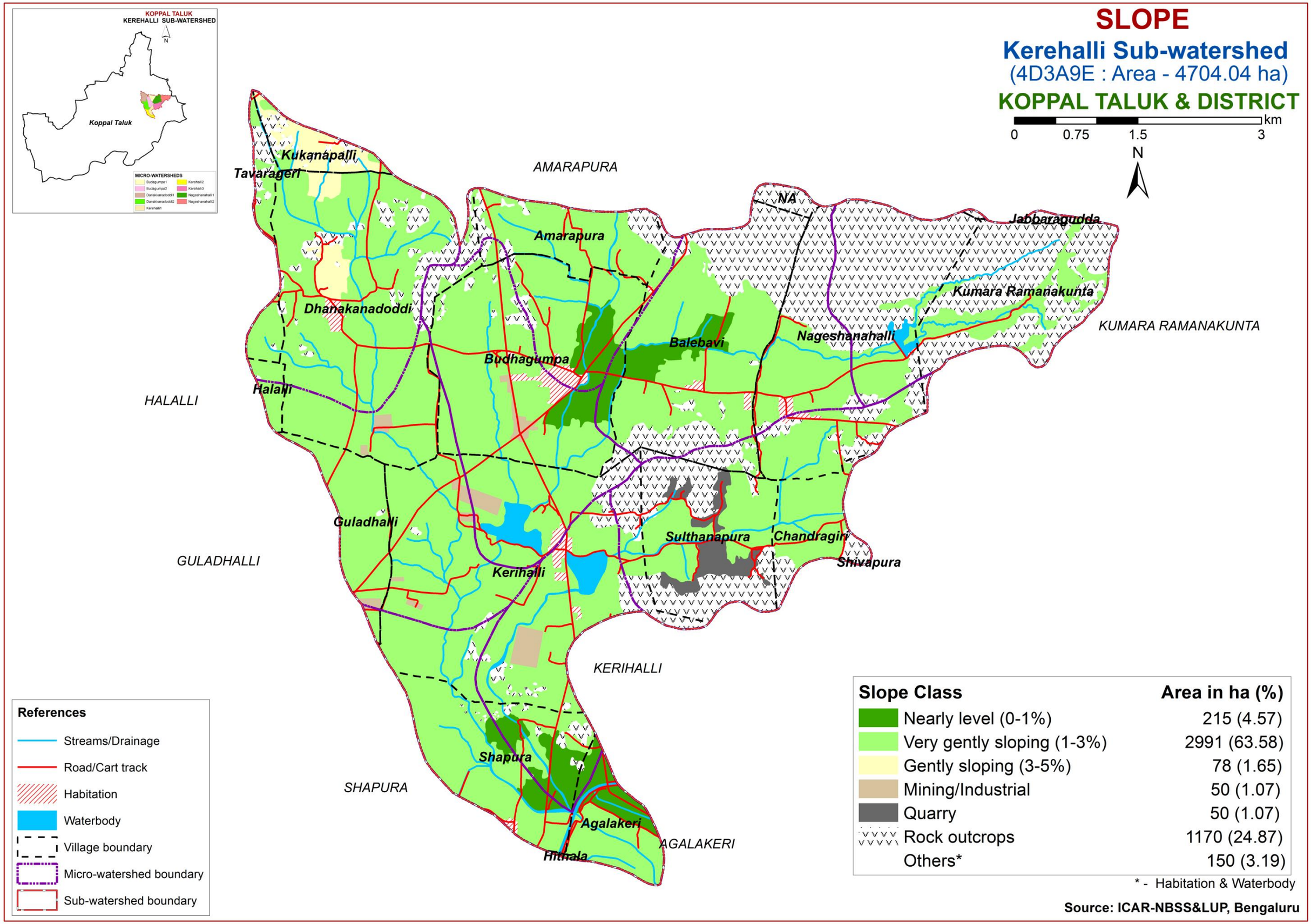
5.4. Surface Soil Gravelliness



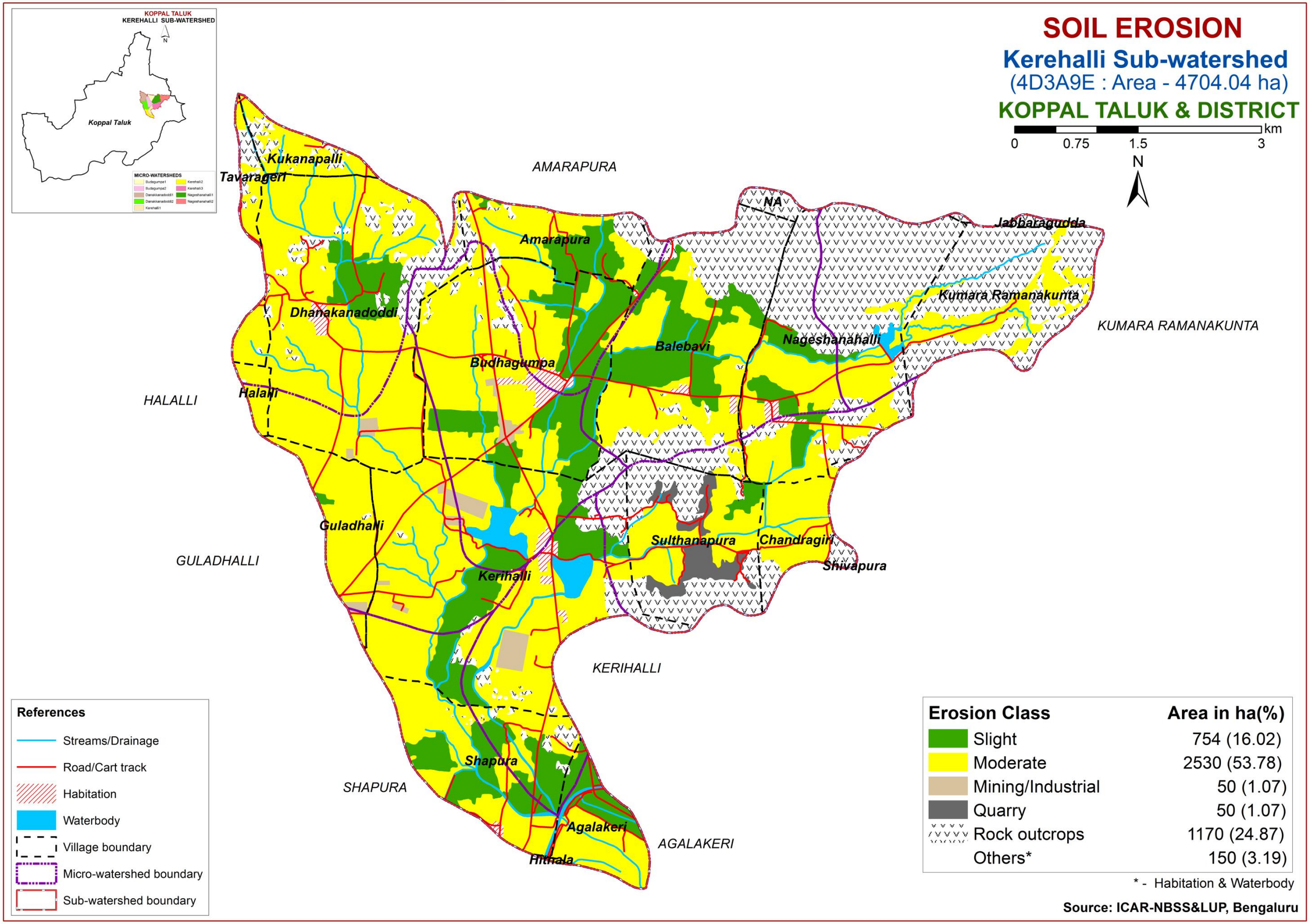
5.5. Available Water Capacity



5.6.Slope

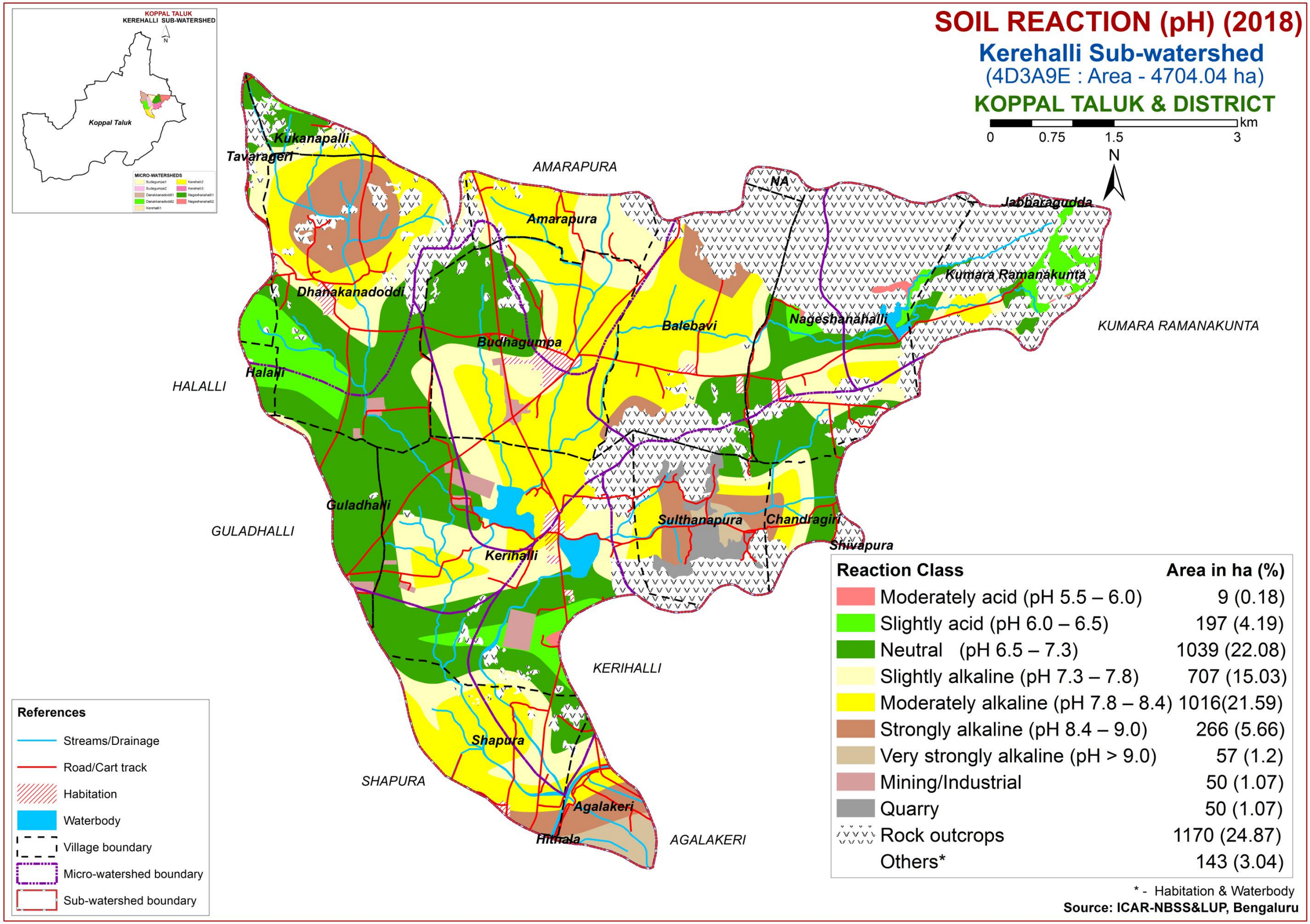

SLOPE
Kerehalli Sub-watershed
(4D3A9E : Area - 4704.04 ha)
KOPPAL TALUK & DISTRICT
0 0.75 1.5 3 km
N
KOPPAL TALUK
KEREHALLI SUB-WATERSHED
Koppal Taluk
MICRO-WATERSHEDS
Kukanapalli
Tavarageri
AMARAPURA
NA
Jabbaragudda
Amarapura
Kumara Ramanakunta
KUMARA RAMANAKUNTA
Dhanakanadoddi
Balebavi
Nageshanahalli
Budhagumpa
Halalli
HALALLI
Guladhalli
GULADHALLI
Sulthanapura
Chandragiri
Shivapura
Kerihalli
KERIHALLI
Shapura
SHAPURA
Agalakeri
AGALAKERI
Hithala
References
Streams/Drainage
Road/Cart track
Habitation
Waterbody
Village boundary
Micro-watershed boundary
Sub-watershed boundary
Slope Class
Area in ha (%)
Nearly level (0-1%) 215 (4.57)
Very gently sloping (1-3%) 2991 (63.58)
Gently sloping (3-5%) 78 (1.65)
Mining/Industrial 50 (1.07)
Quarry 50 (1.07)
Rock outcrops 1170 (24.87)
Others* 150 (3.19)
* - Habitation & Waterbody
Source: ICAR-NBSS&LUP, Bengaluru

5.7.Soil Erosion

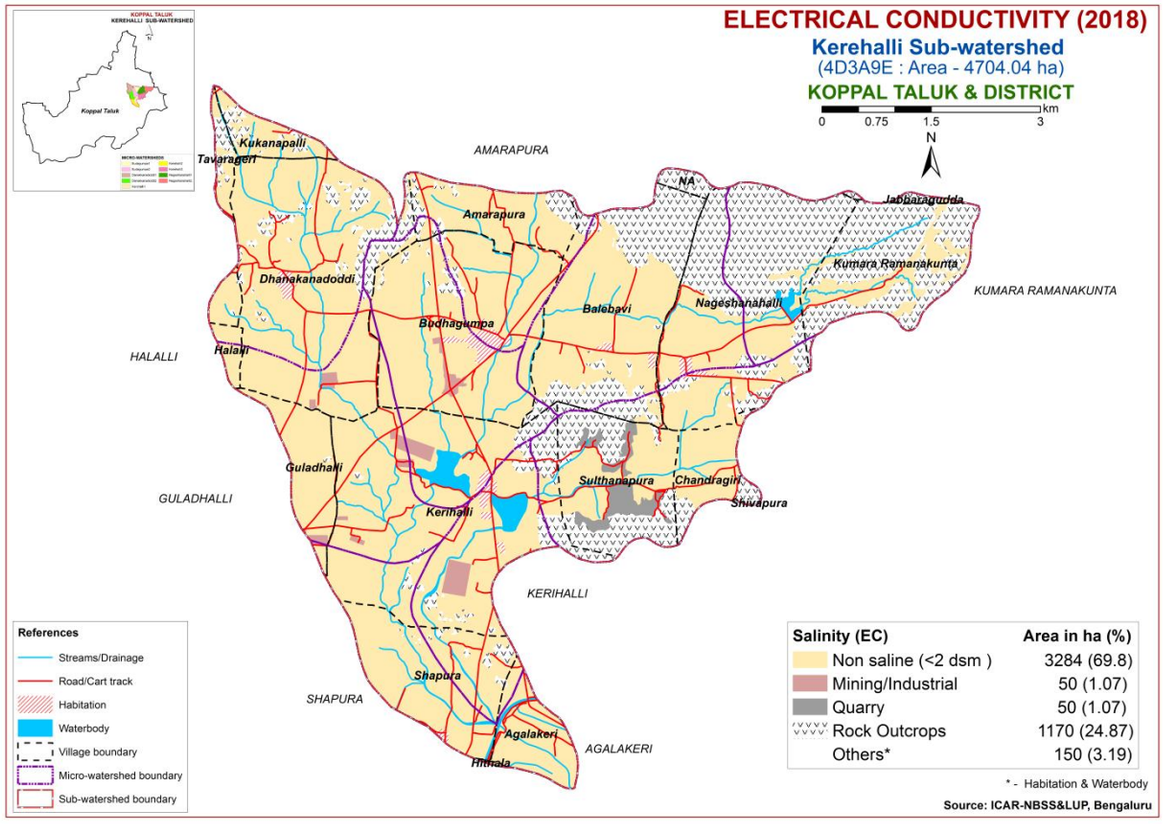


6. Soil Fertility Status

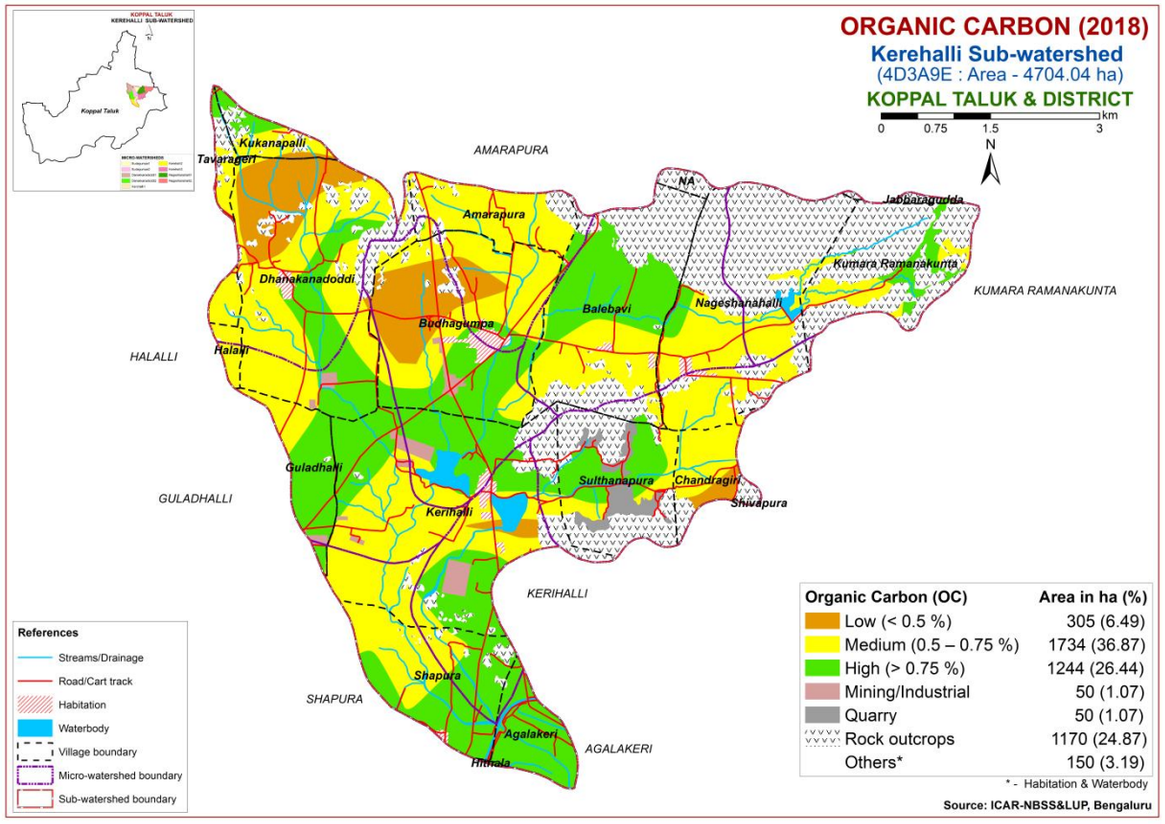
6.1. Soil Reaction (pH)



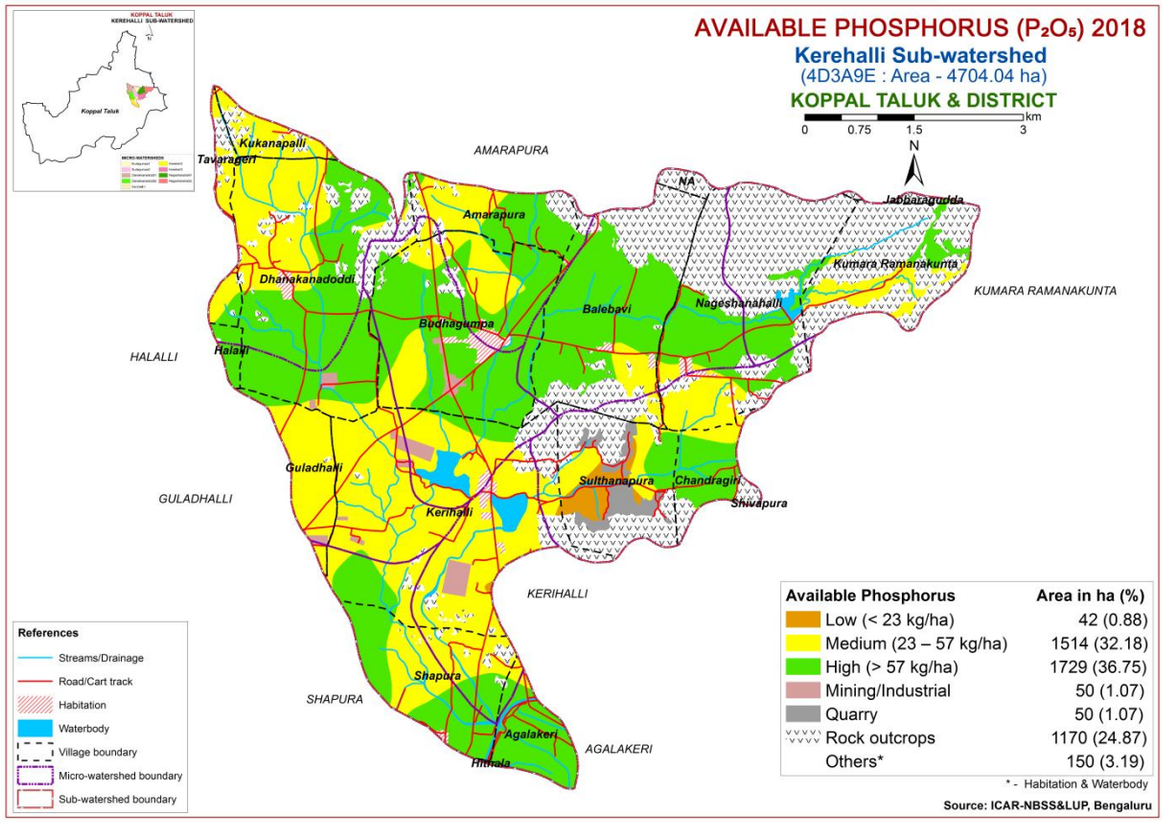
6.2. Electrical Conductivity (EC)



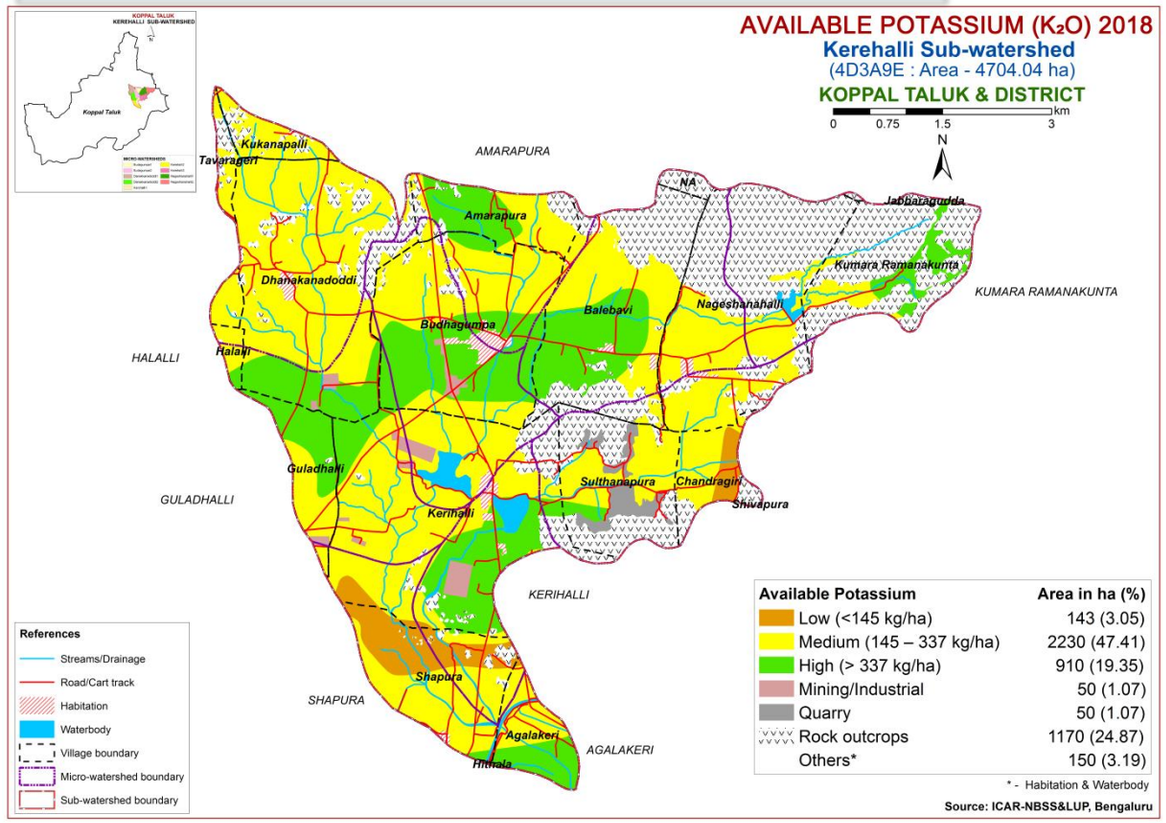
6.3. Organic Carbon



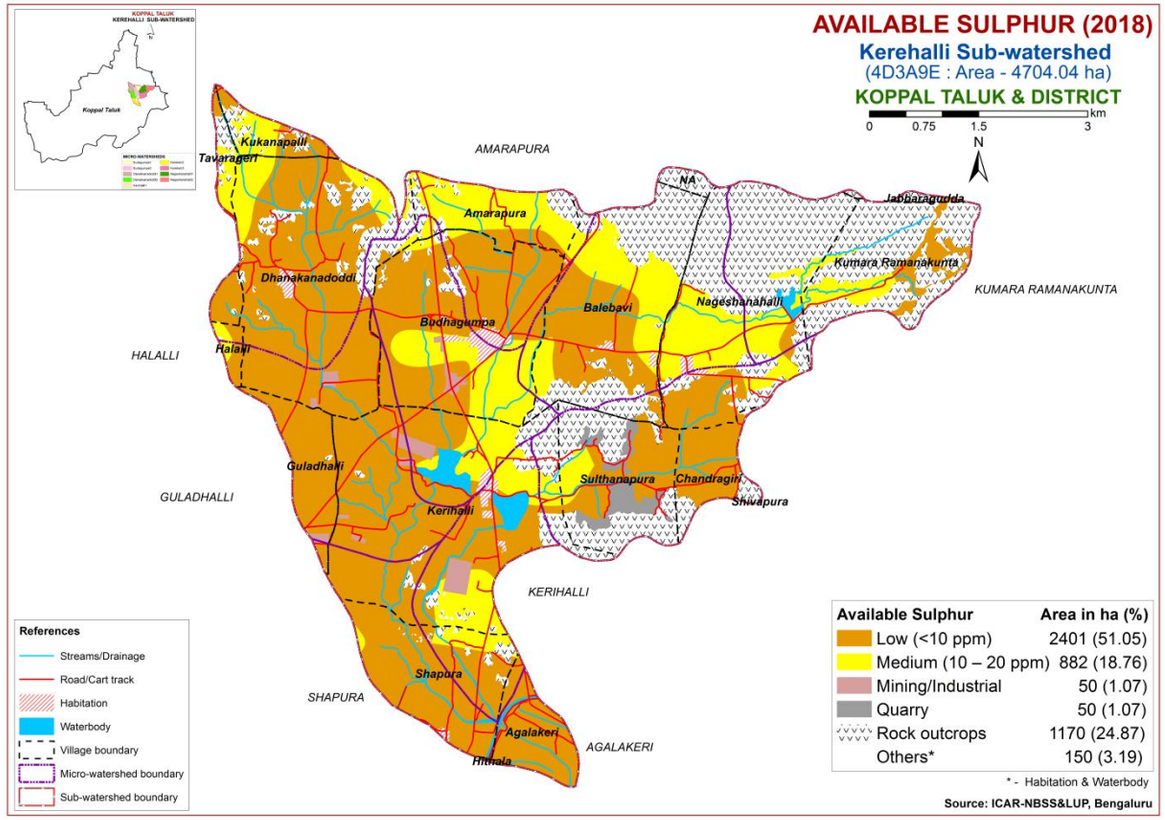
6.4. Available Phosphorus



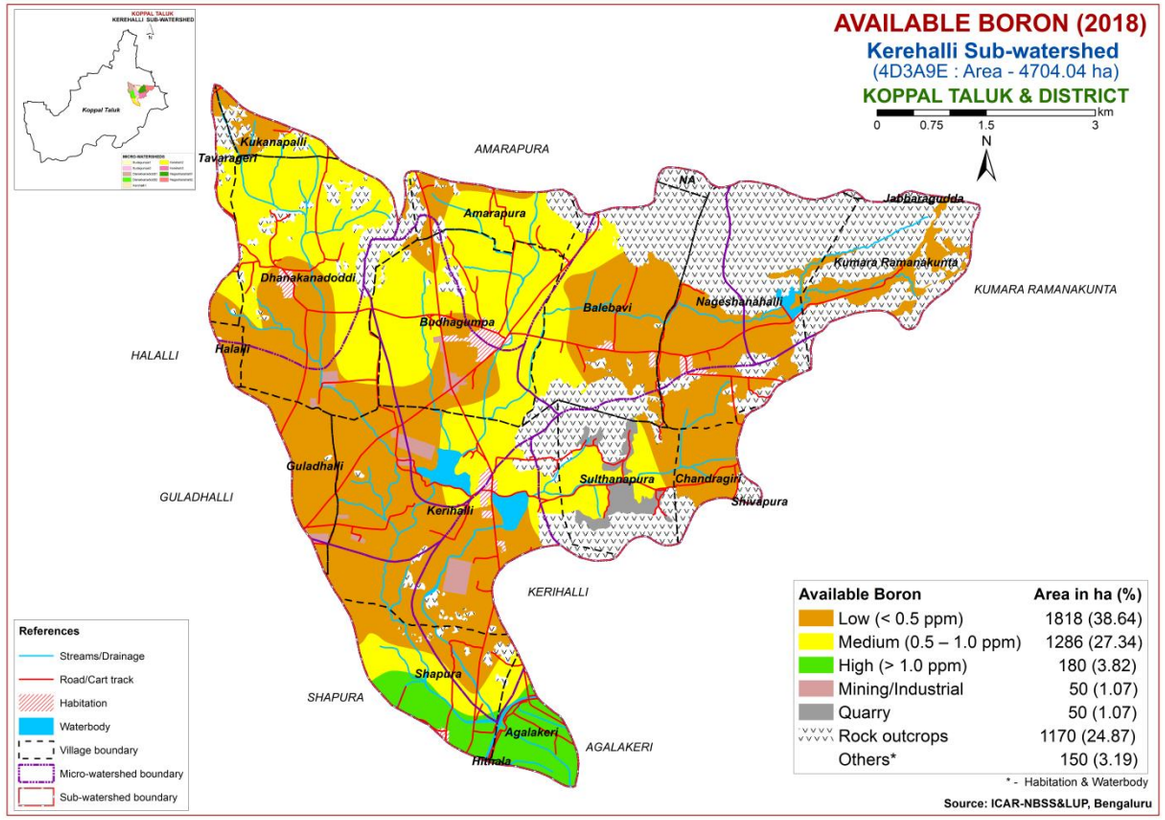
6.5. Available Potassium



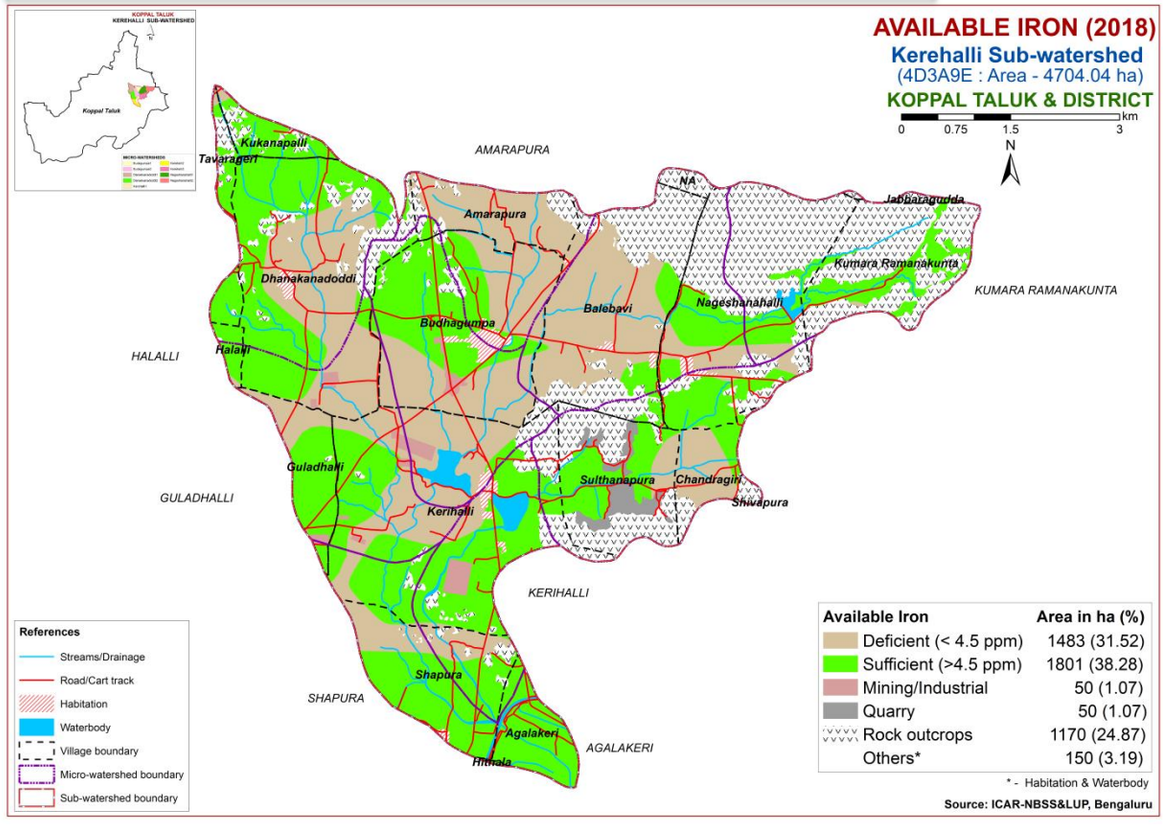
6.6. Available Sulphur



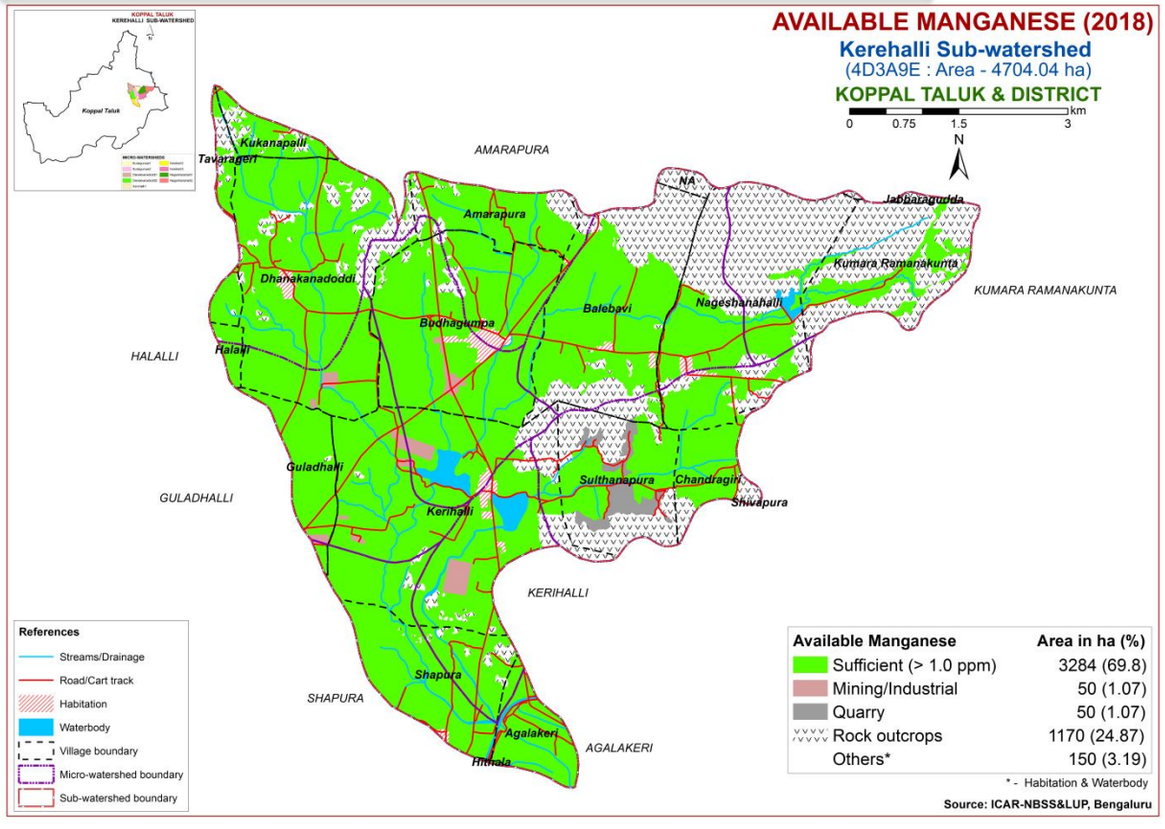
6.7. Available Boron



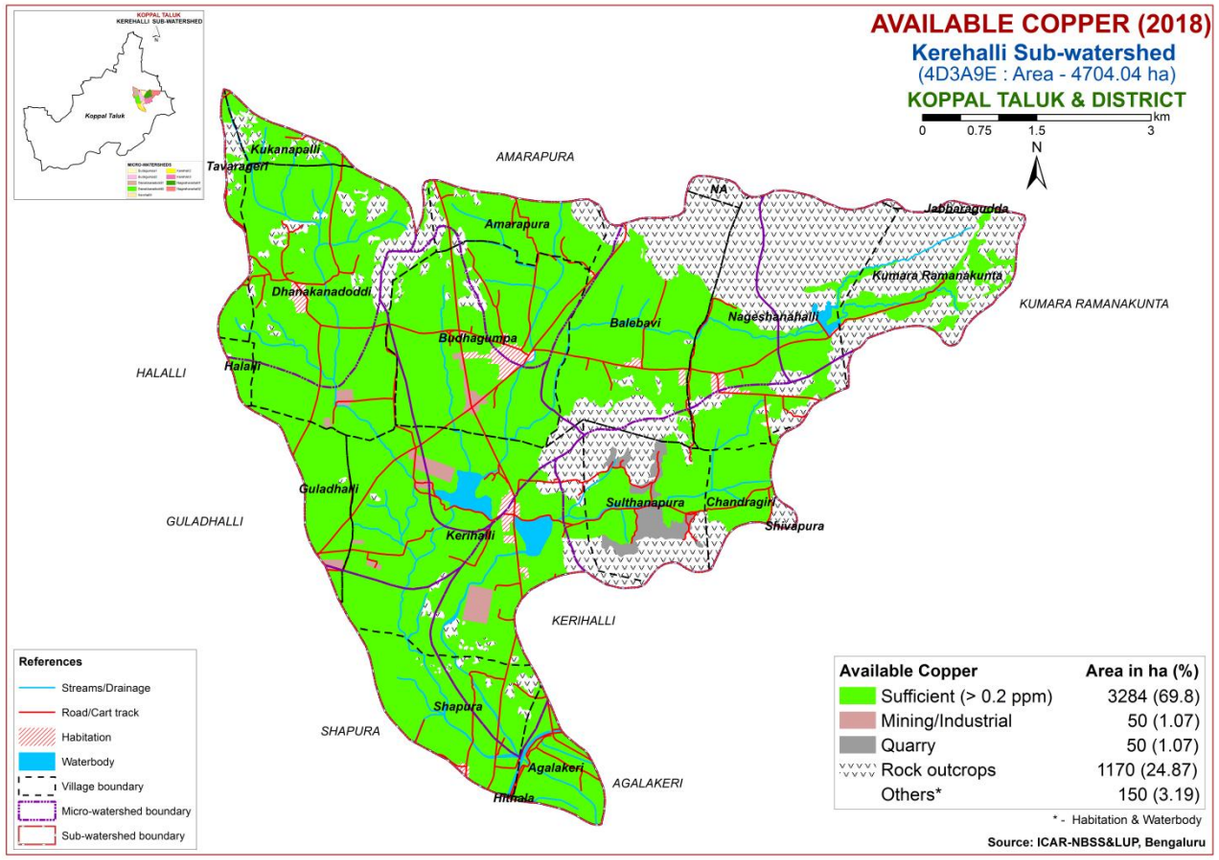
6.8. Available Iron



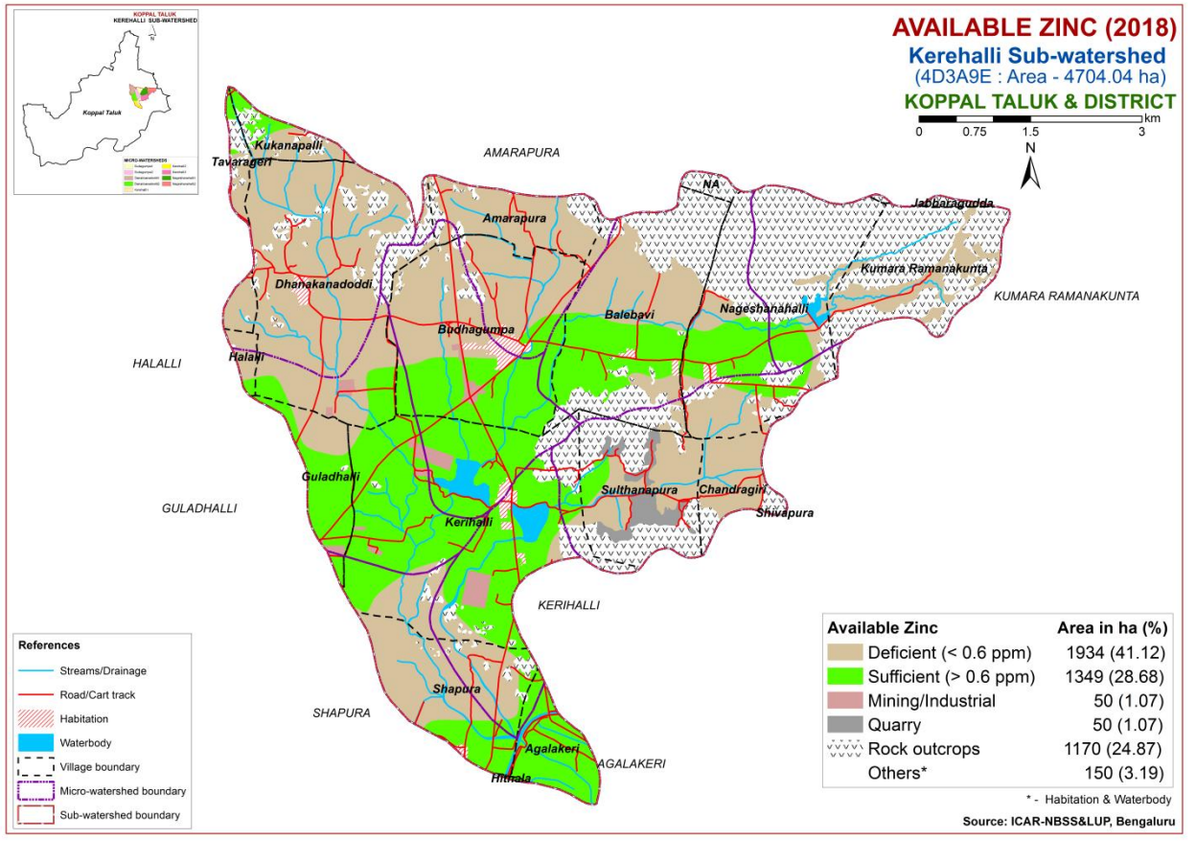
6.9. Available Manganese



6.10. Available Copper



6.11. Available Zinc



6.12. Correcting the Soil Nutrient Deficiencies

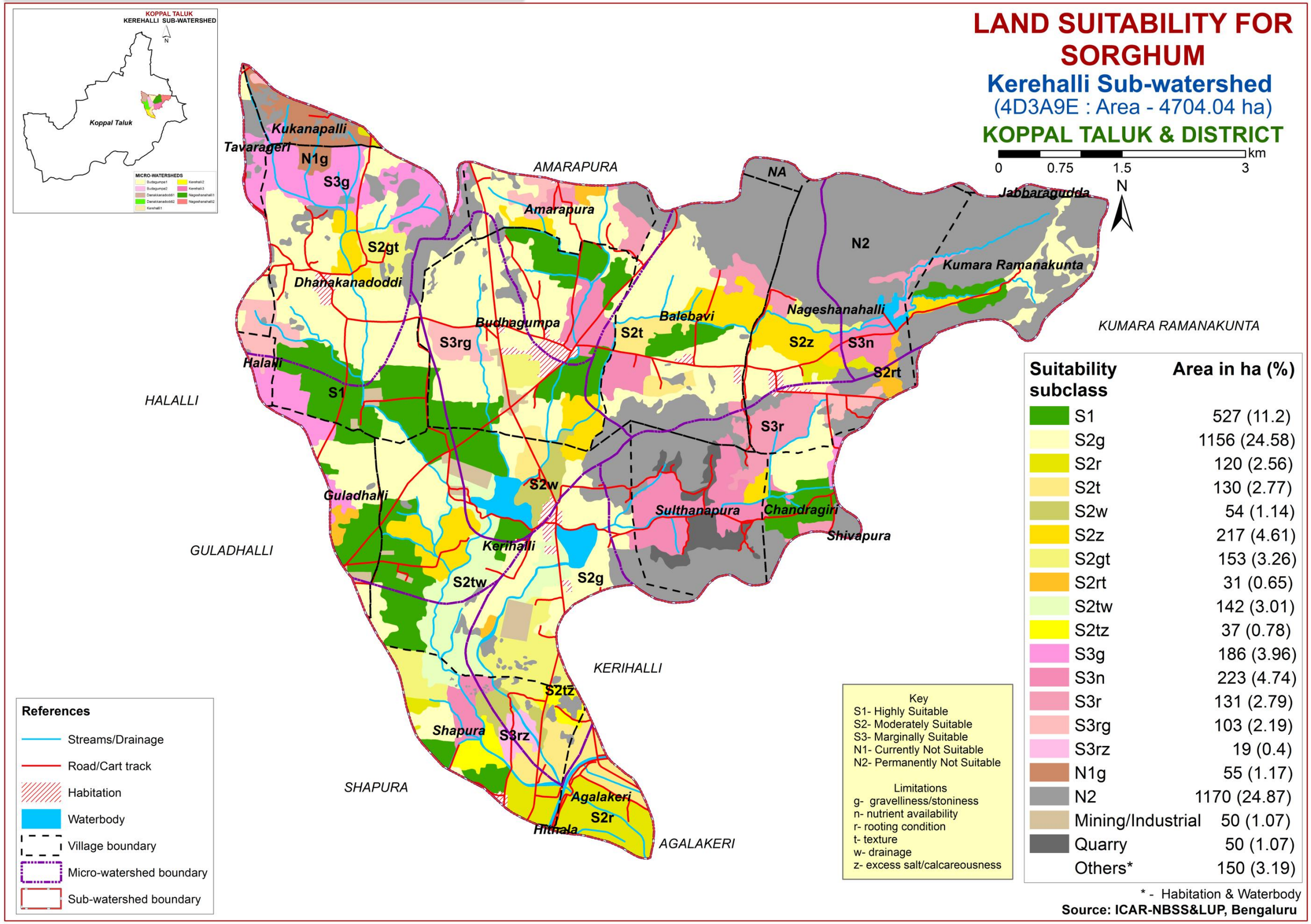
1. Reclamation of Salt affected soils
   a) When the soil is having neutral pH (6.5-7.5), no need of adding amendments (lime or gypsum)
   b) If the soil pH is <6.5, apply burnt lime to soil as per specifically recommended dosage and again after 2 years proper change has to be made based on soil test results.
   c) If the soil pH is 7.5-8.5 due to excess calcium content, drain out the excess calcium form 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 bellow:
   - N: P: K (N: P_2O_5: K_2O) **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.

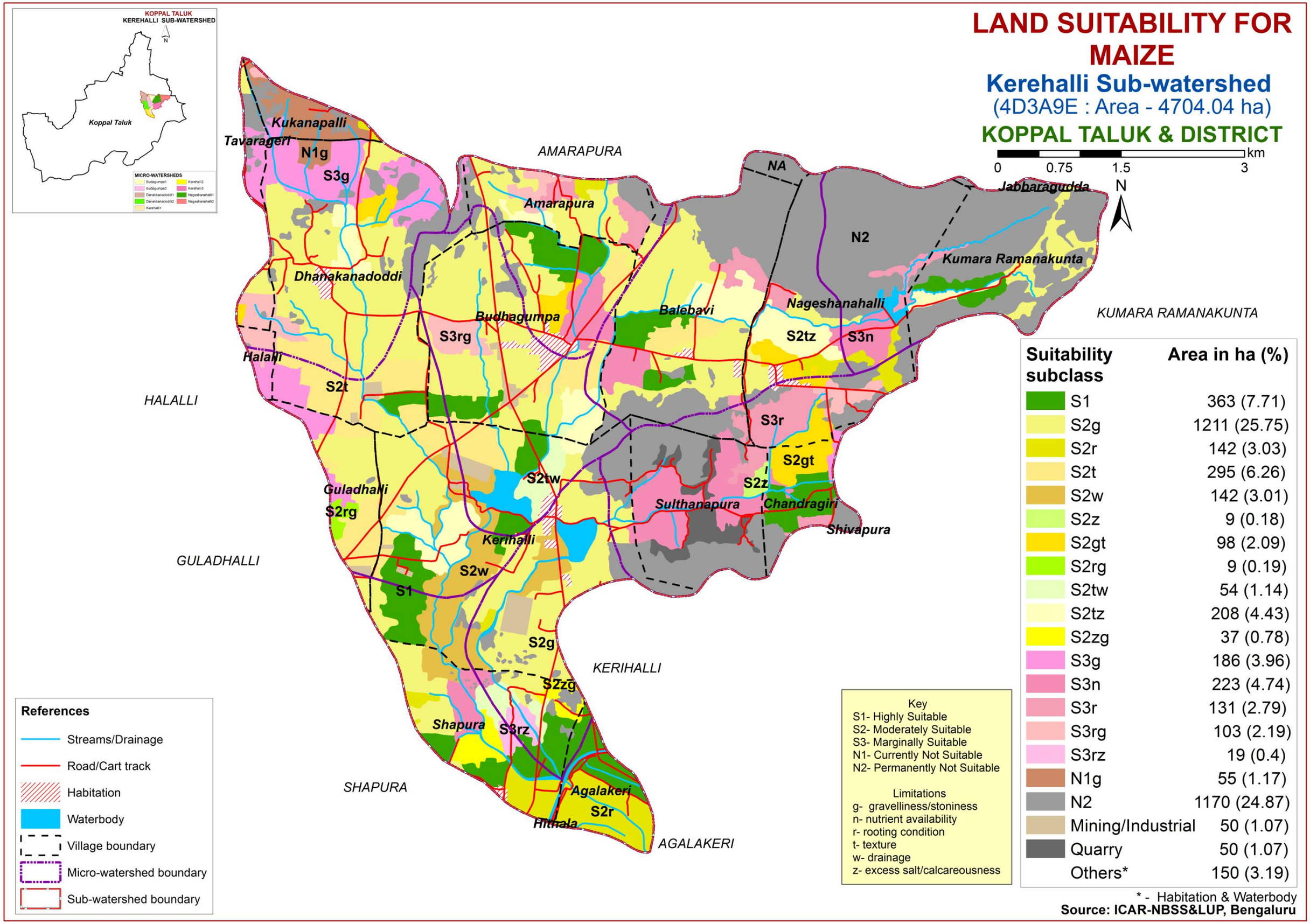
3. Use or Incorporation of biofertilizers like Rhizobium, Azotobacter, Azospirillum, Phosphate Solubilizing Bacteria and mycorrhiza enhances normal available nutrients in soil to the plants and also reduce the input cost of cultivation.
4. For calcium deficient soil, apply N-fertilizers like calcium ammonium nitrate; Gypsum can also supply calcium ($CaSO_4$. $2H_2O$)
5. Apply 405kg $MgSO_4$ 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 ($FeSO_4$) per ha to the iron deficient soils. In case of perennial Horticulture crops apply 3-5g/ litre $FeSo_4$ /plant as foliar spray.
8. Apply 30-40kg/ha – manganese sulfate ($MnSO_4$) as soil application to the manganese deficient soils. In case of perennial Horticulture crops apply 3-5 g/litre $MnSO_4$ /plant as foilar application.
9. Apply Zinc – 10-25 kg/ha –$ZnSO_4$ – 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 ($CuSO_4$) soil application for the copper deficient soils and for Perennial horticultural crops 3-5g/ litre – $CuSO_4$/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

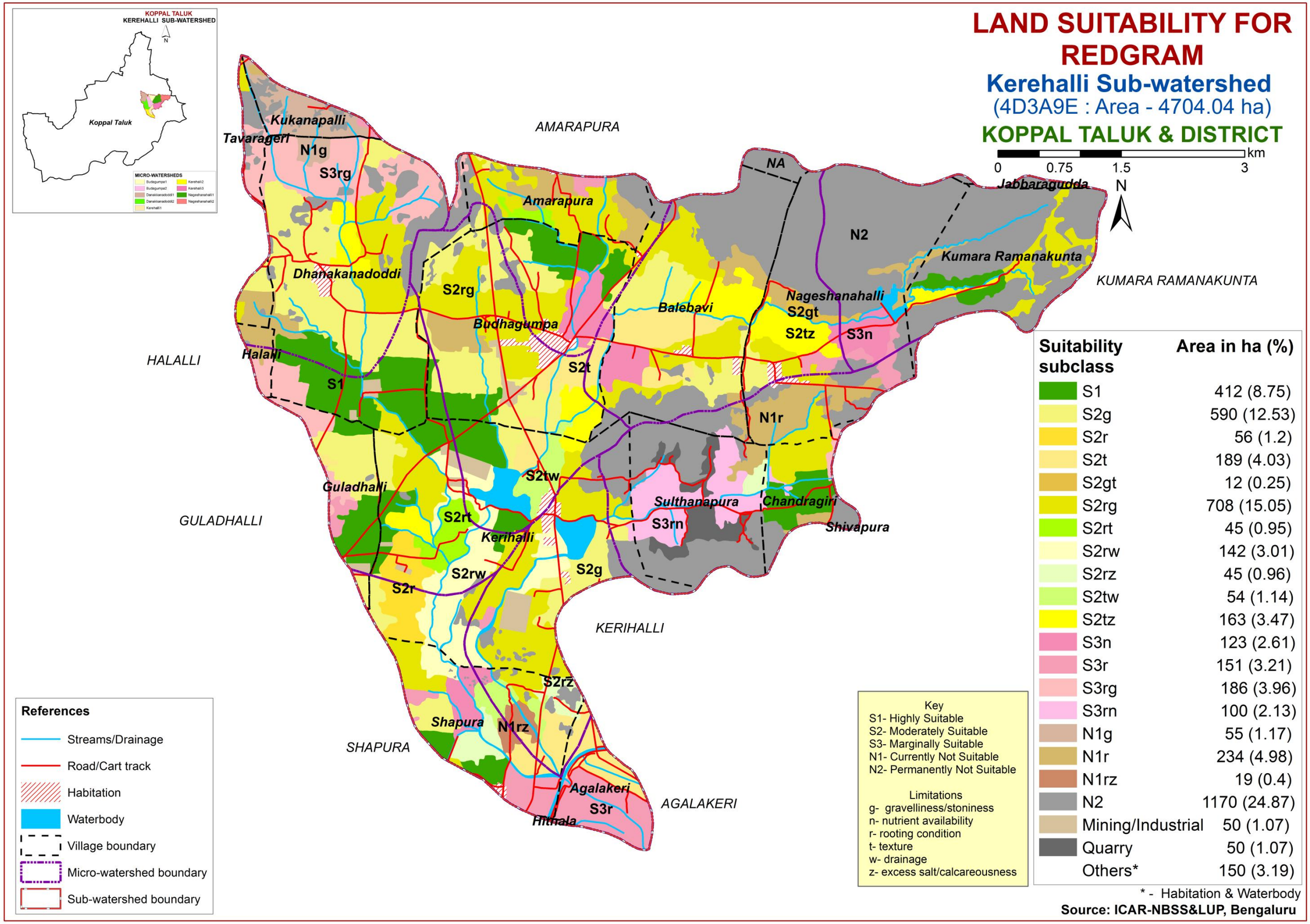
7.1. Land Suitability for Sorghum



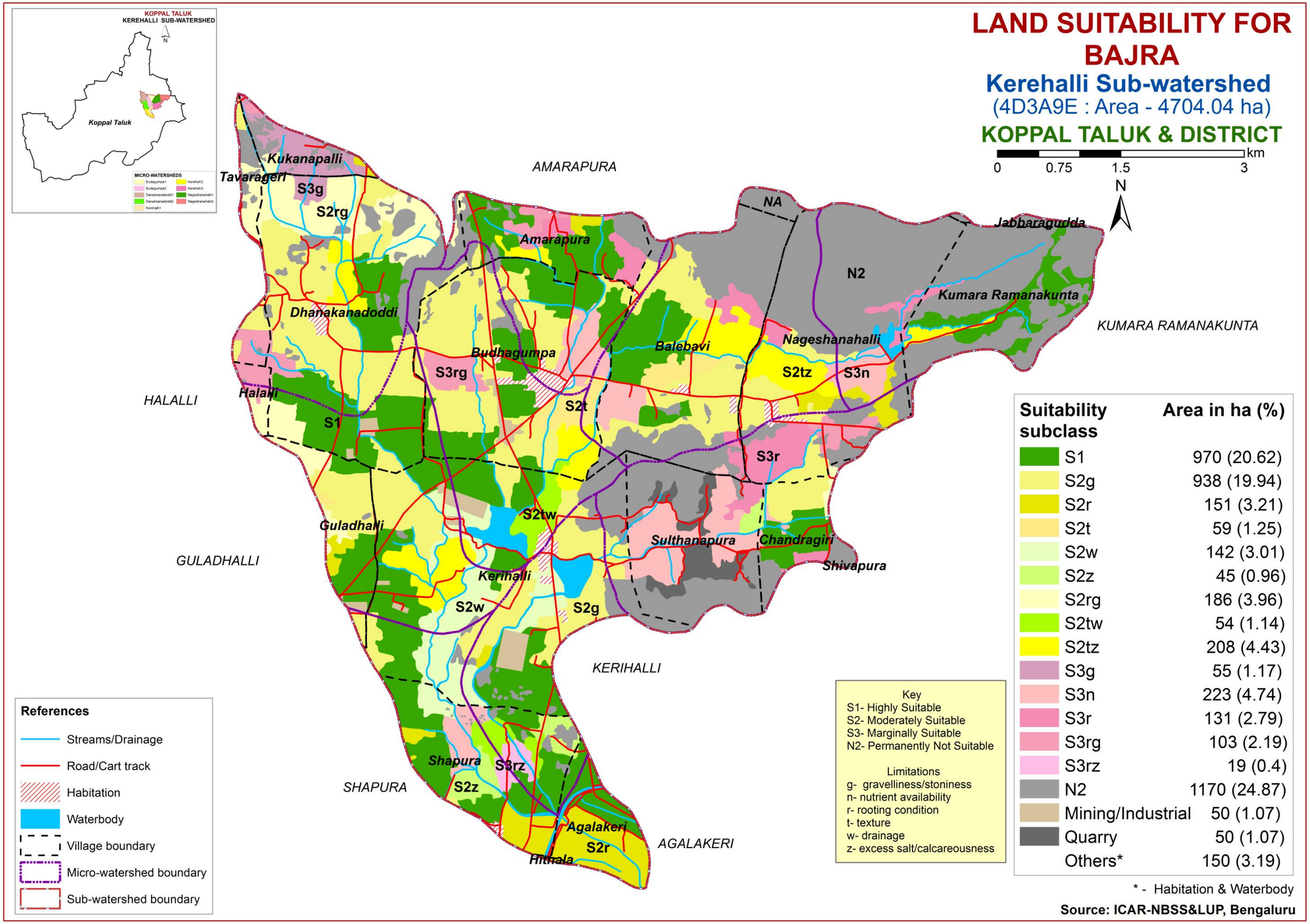
7.2. Land Suitability for Maize



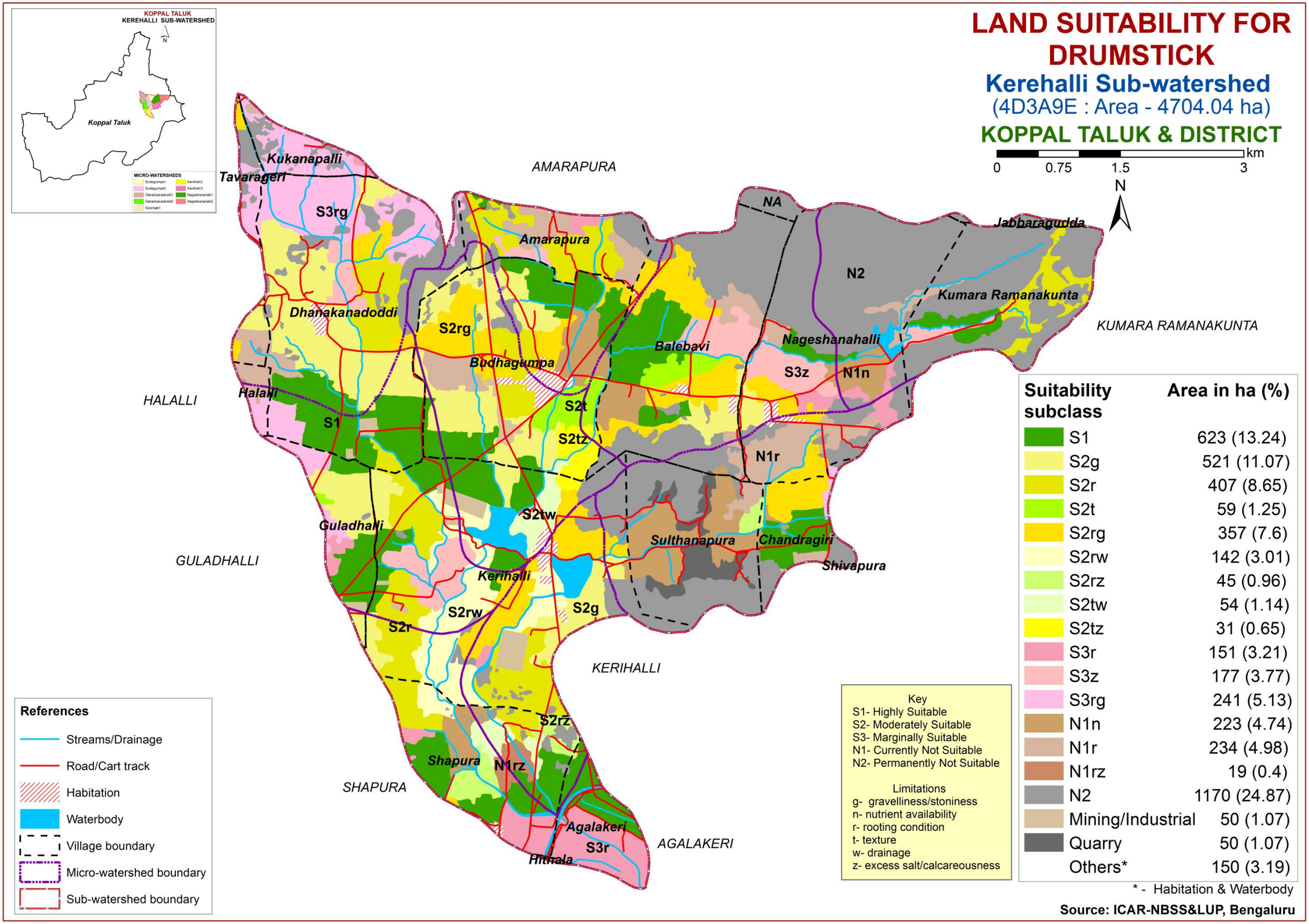
7.3. Land Suitability for Redgram



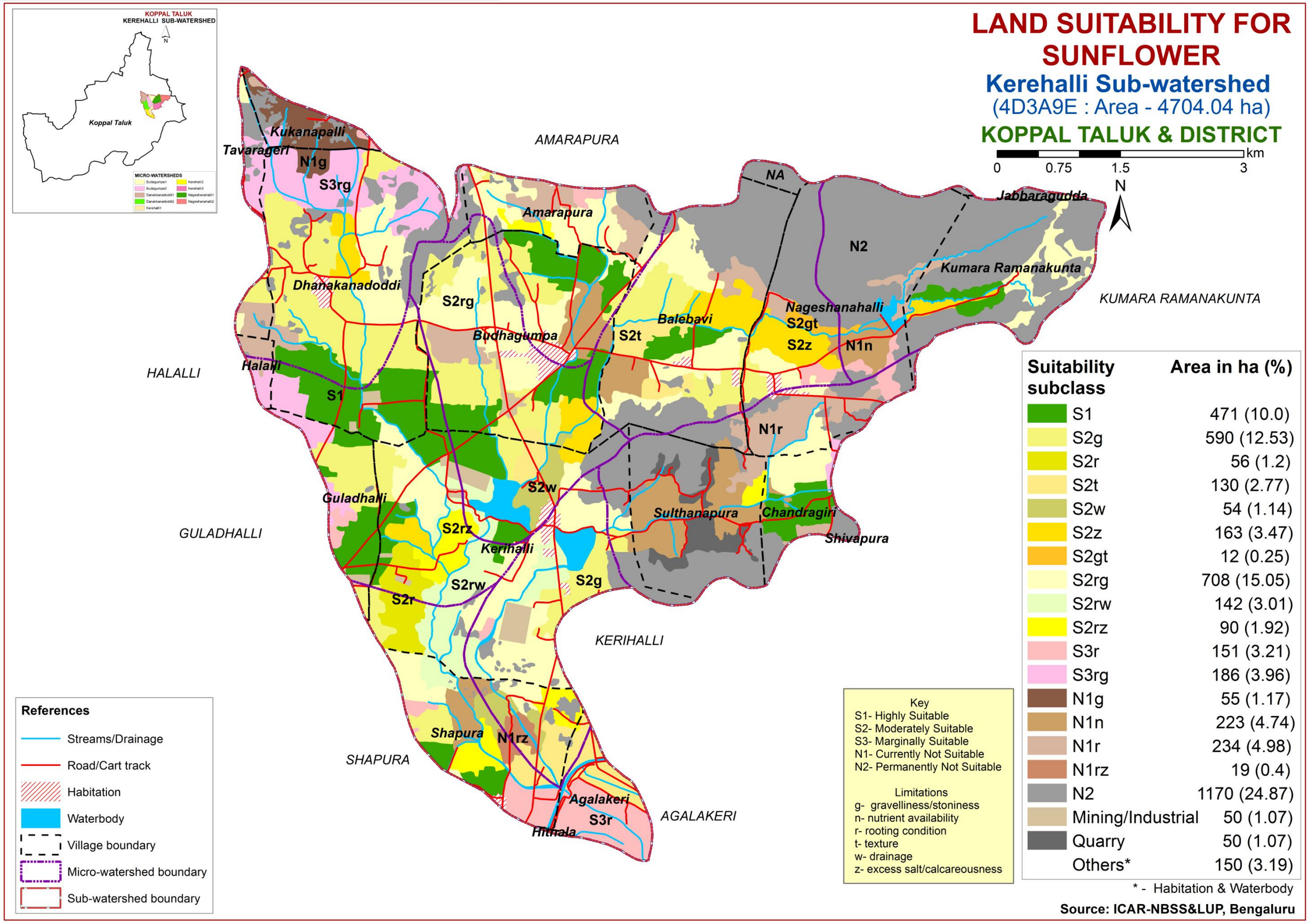
7.4. Land Suitability for Bajra



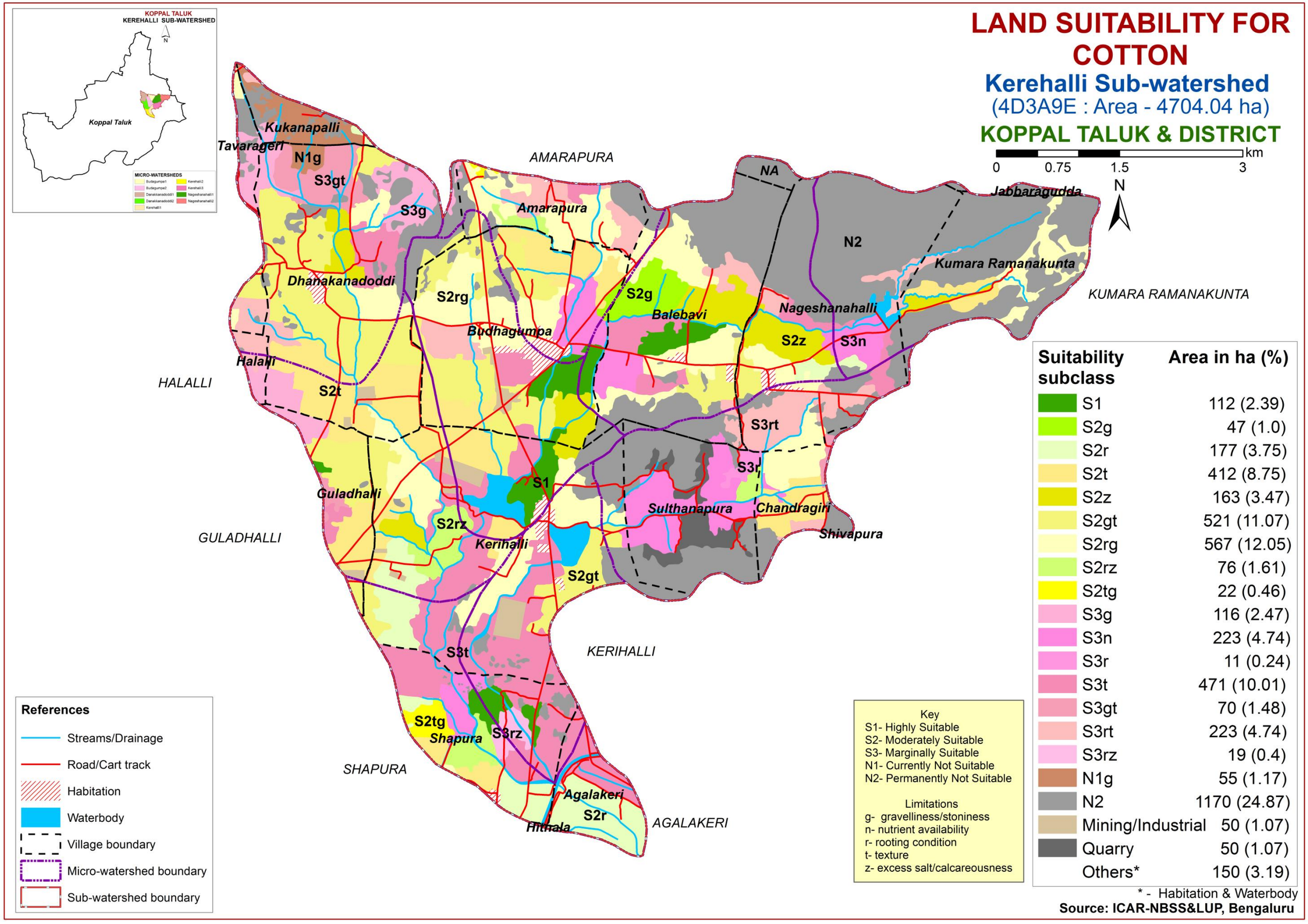
7.5. Land Suitability for Drumstick



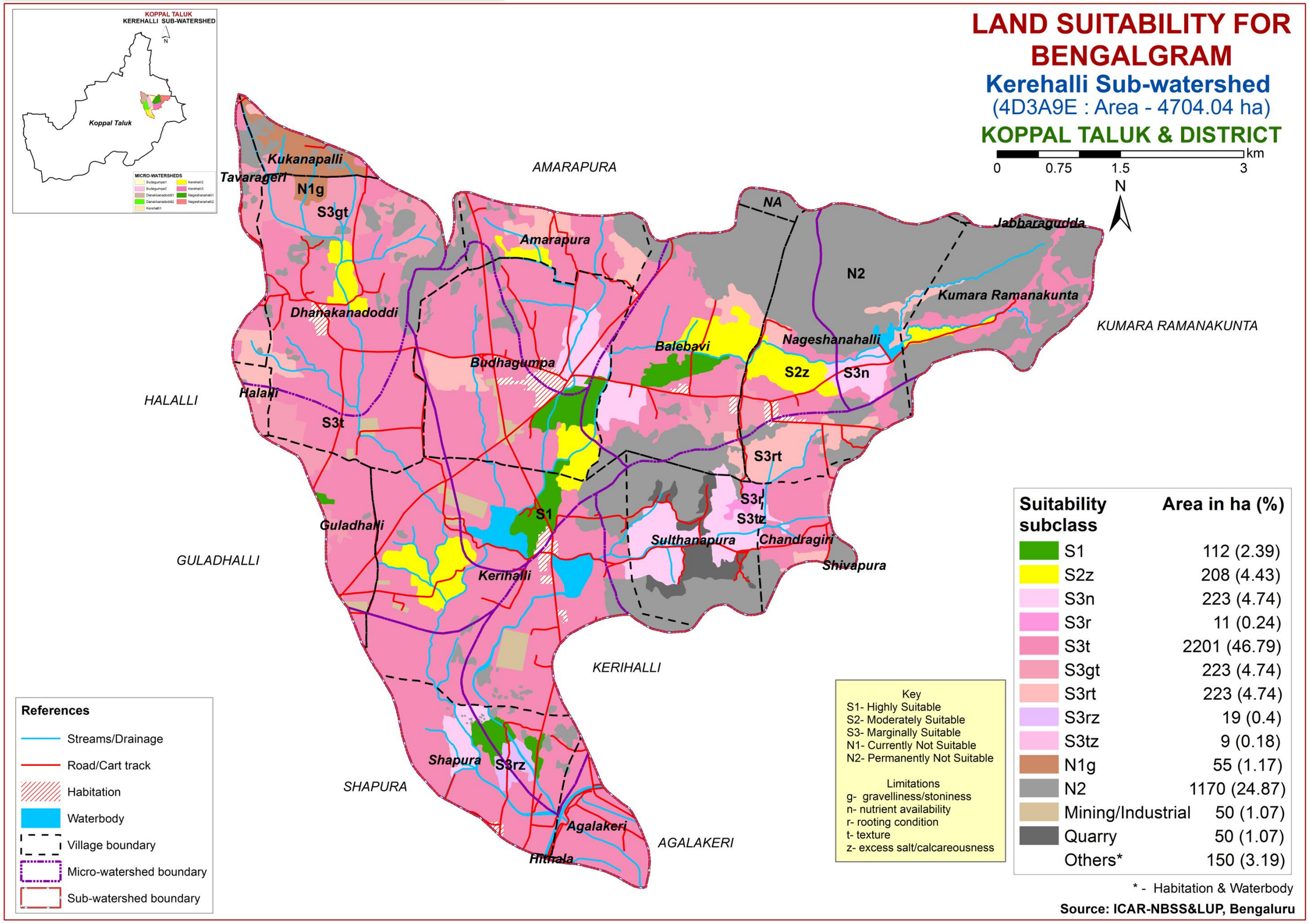
7.6. Land Suitability for Sunflower



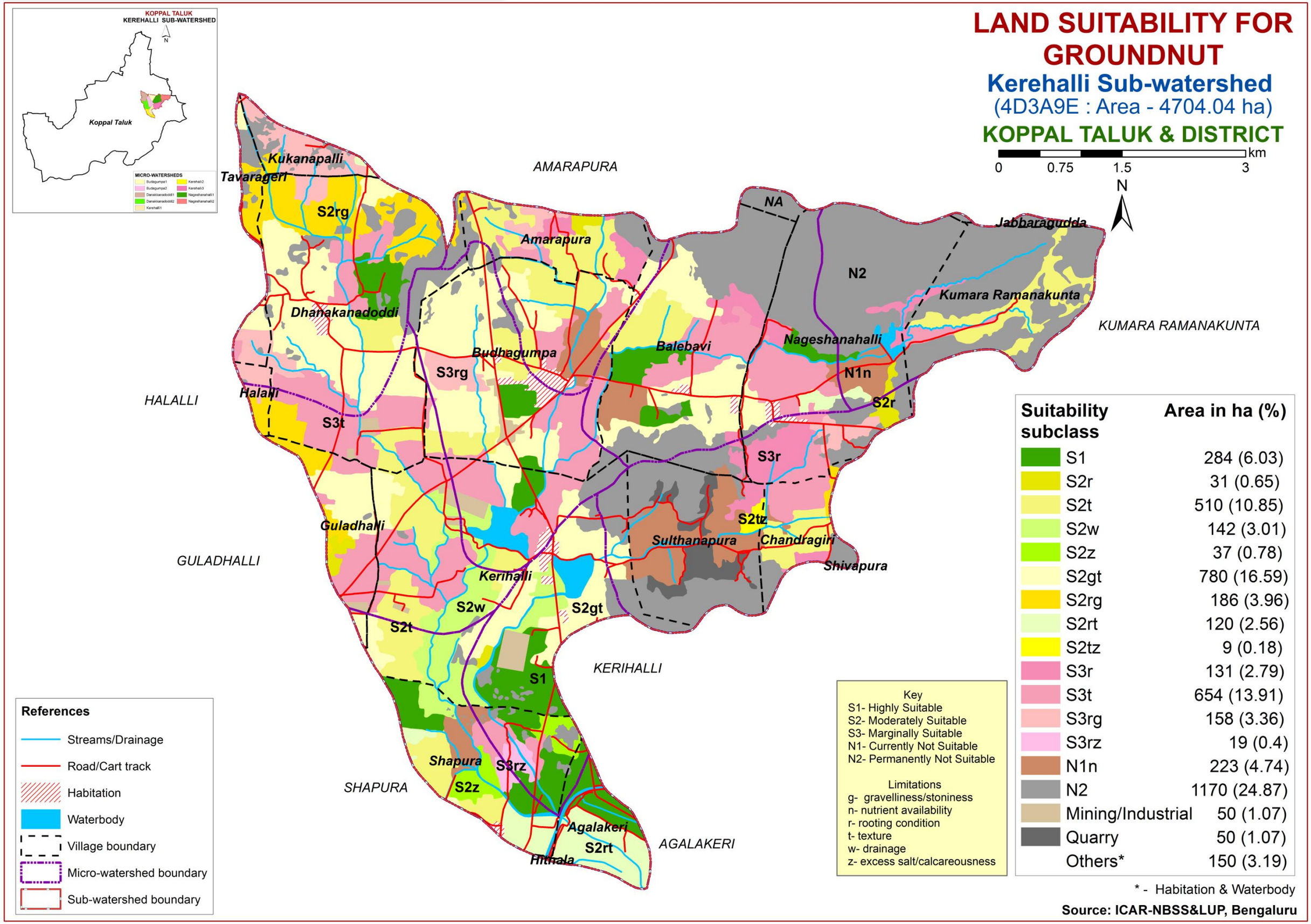
7.7. Land Suitability for Cotton



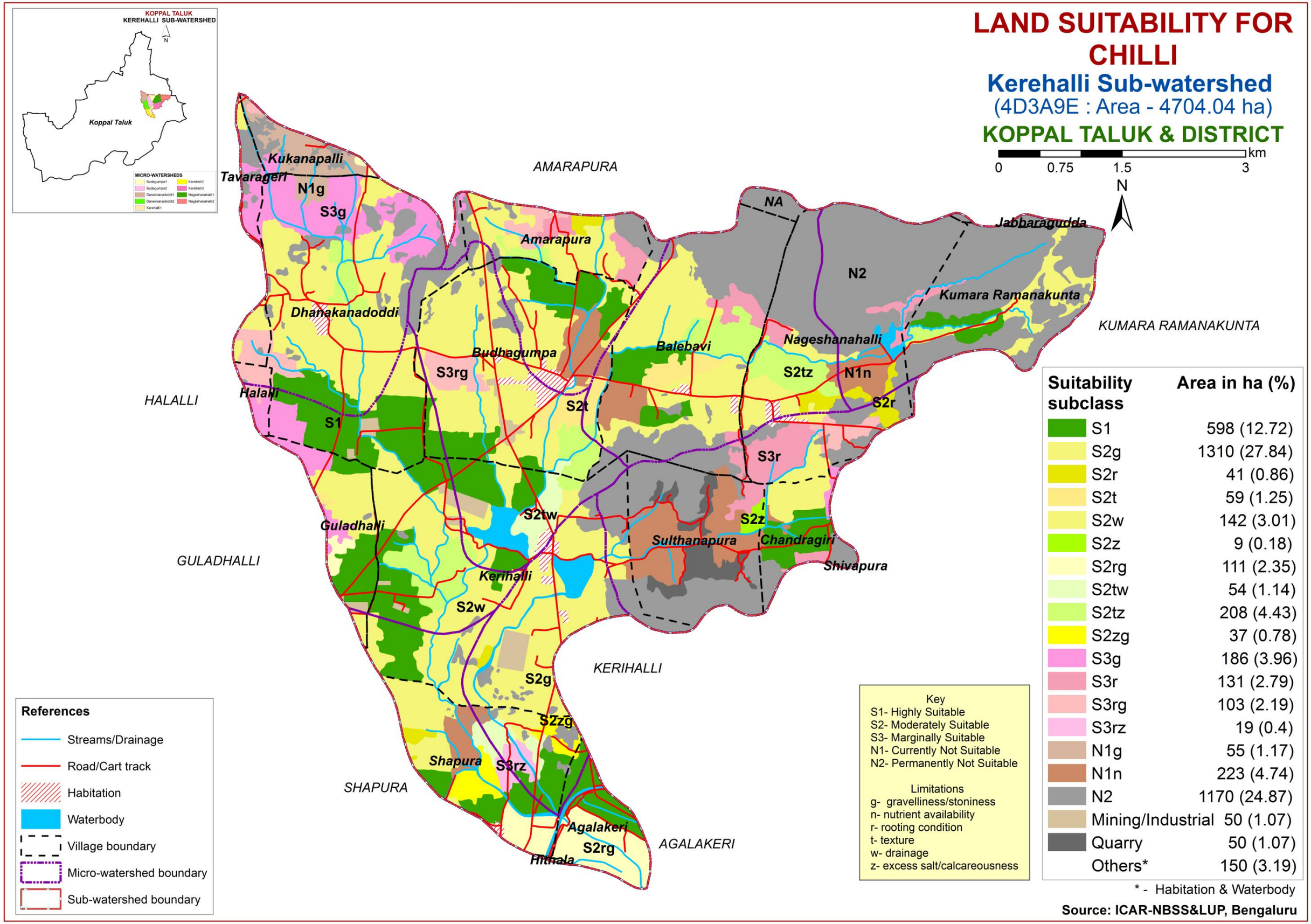
7.8. Land Suitability for Bengalgram



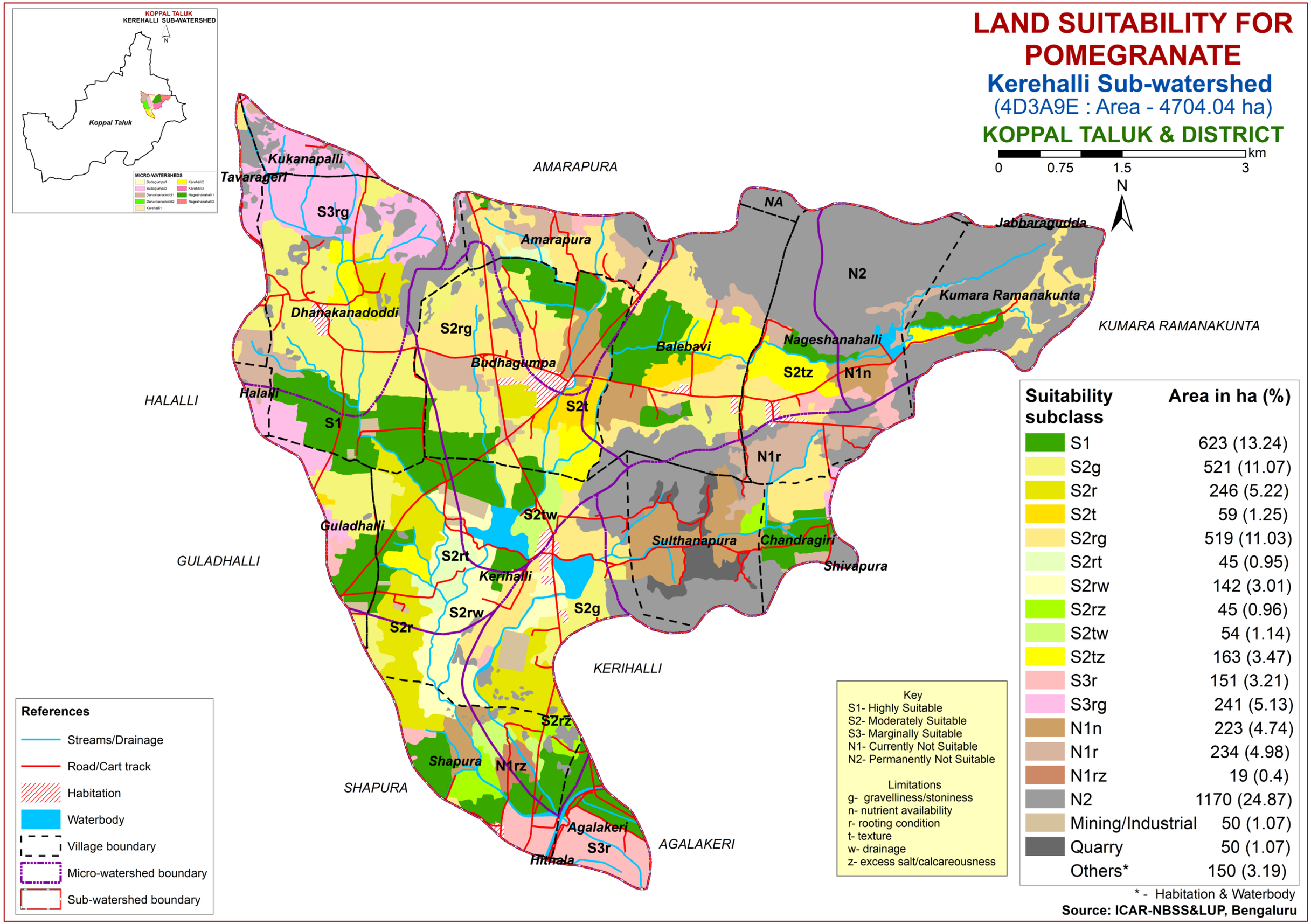
7.9. Land Suitability for Groundnut



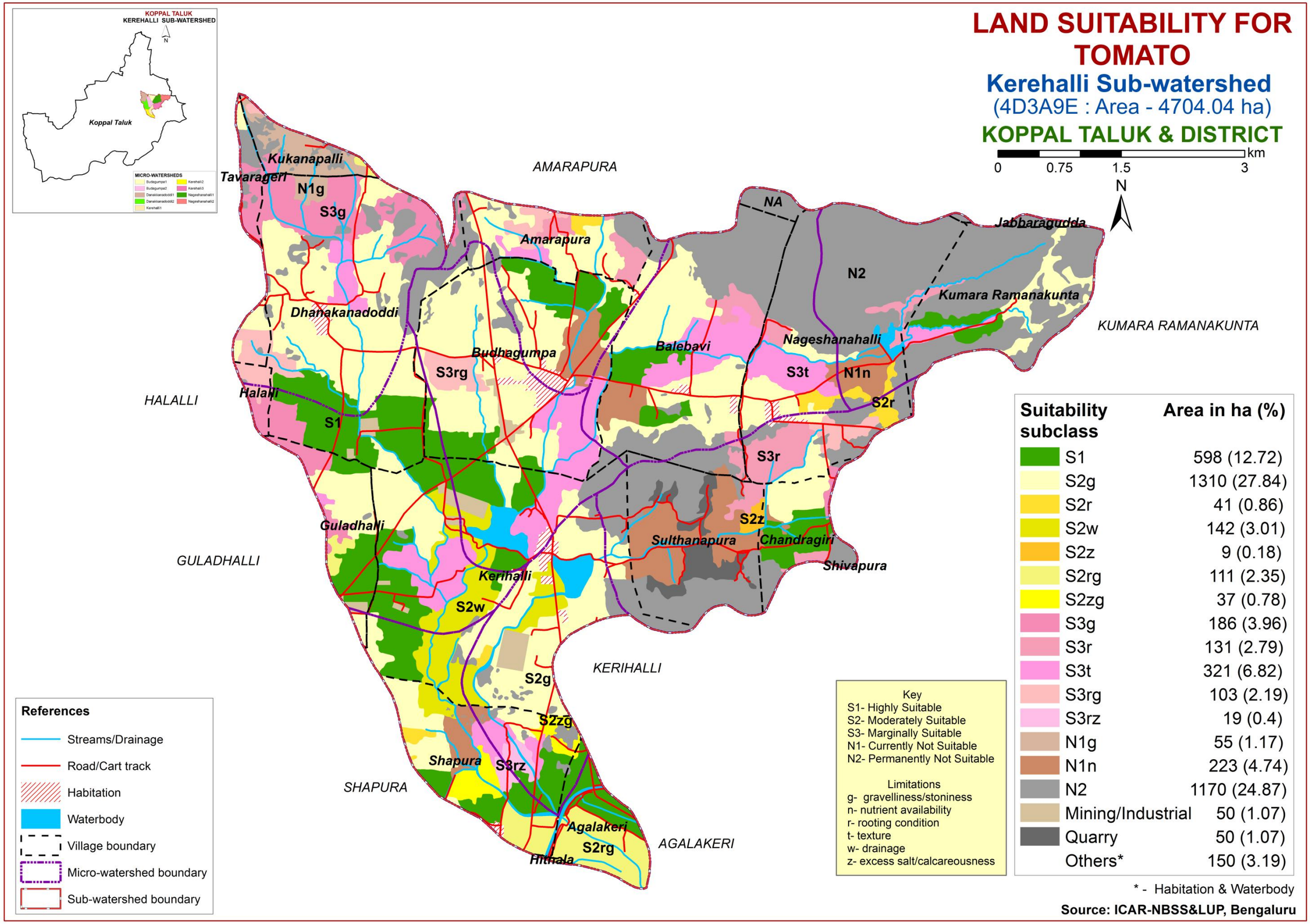
7.10. Land Suitability for Chilli



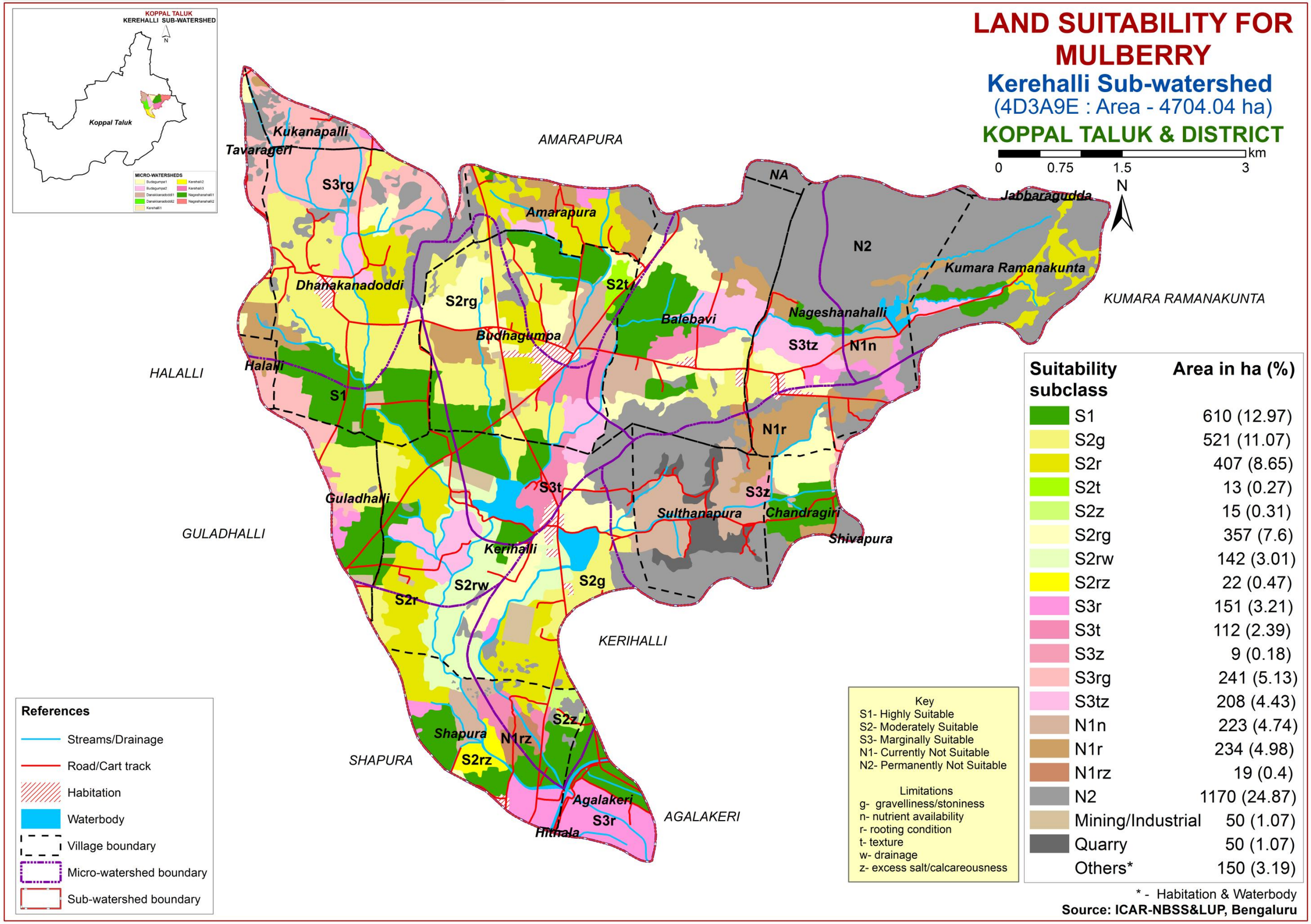
7.11. Land Suitability for Pomegranate



7.12. Land Suitability for Tomato

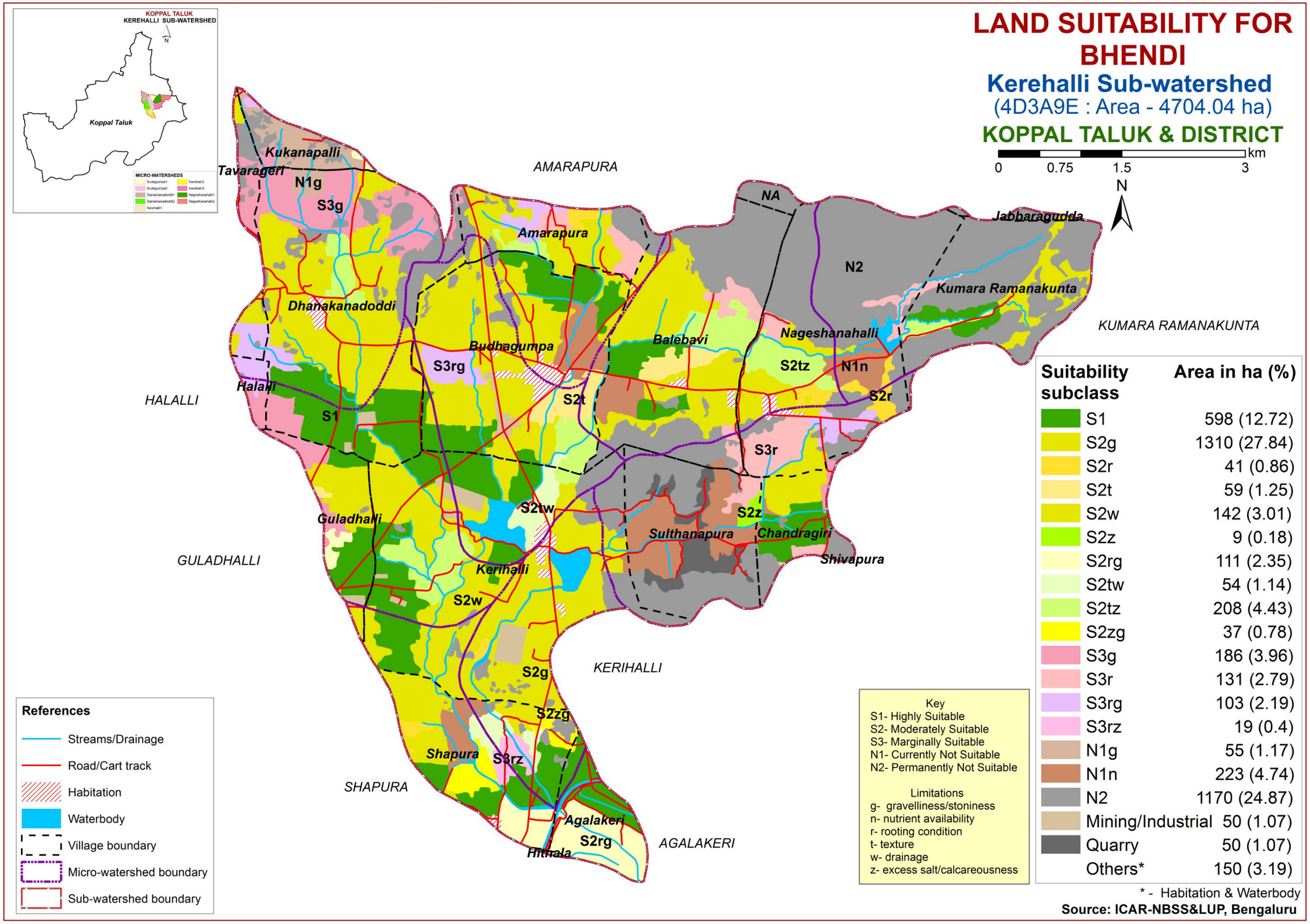


7.13. Land Suitability for Mulberry

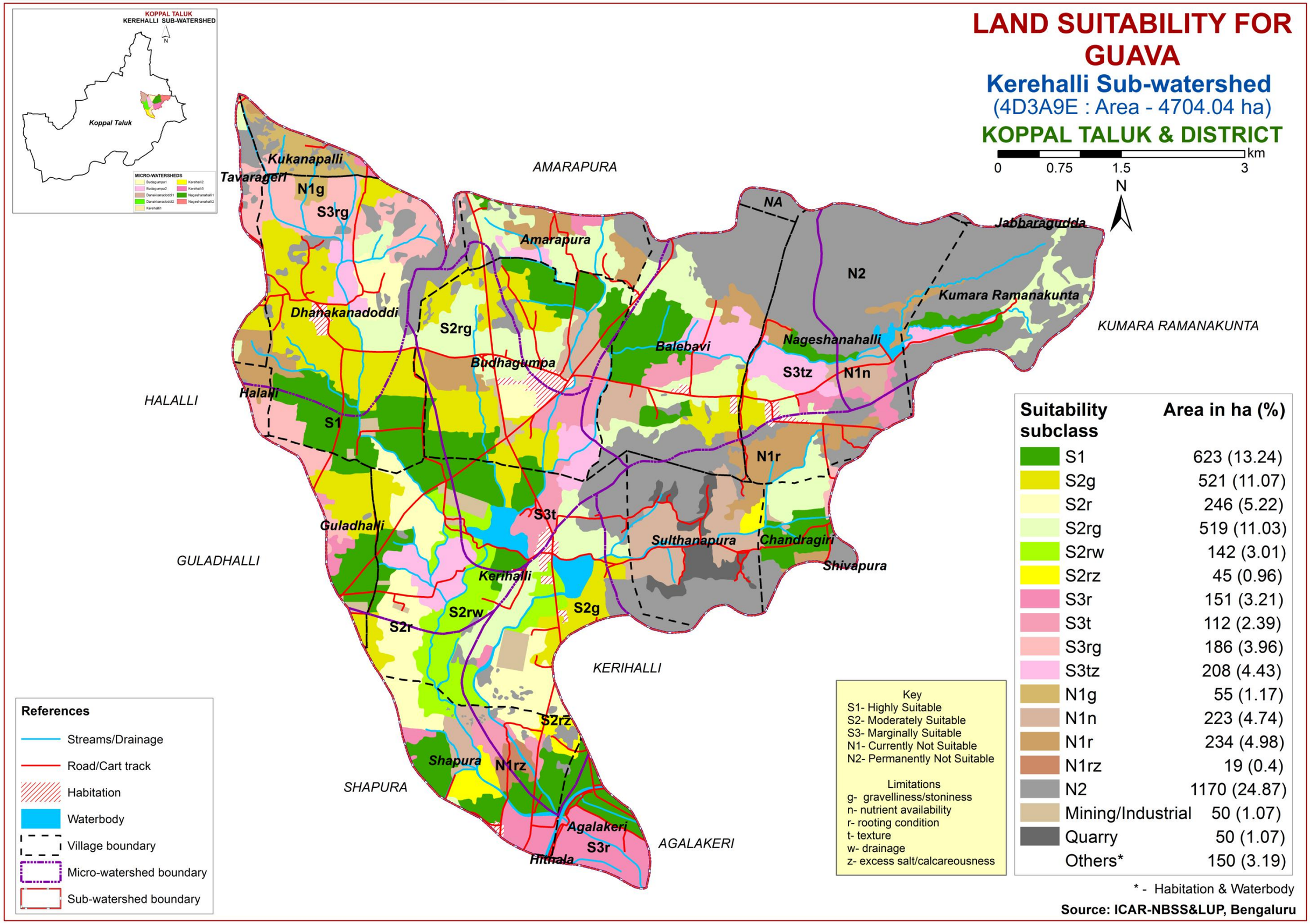


NOTE: Mulberry suitability evaluation only for mulberry leaf, not for silkworm rearing

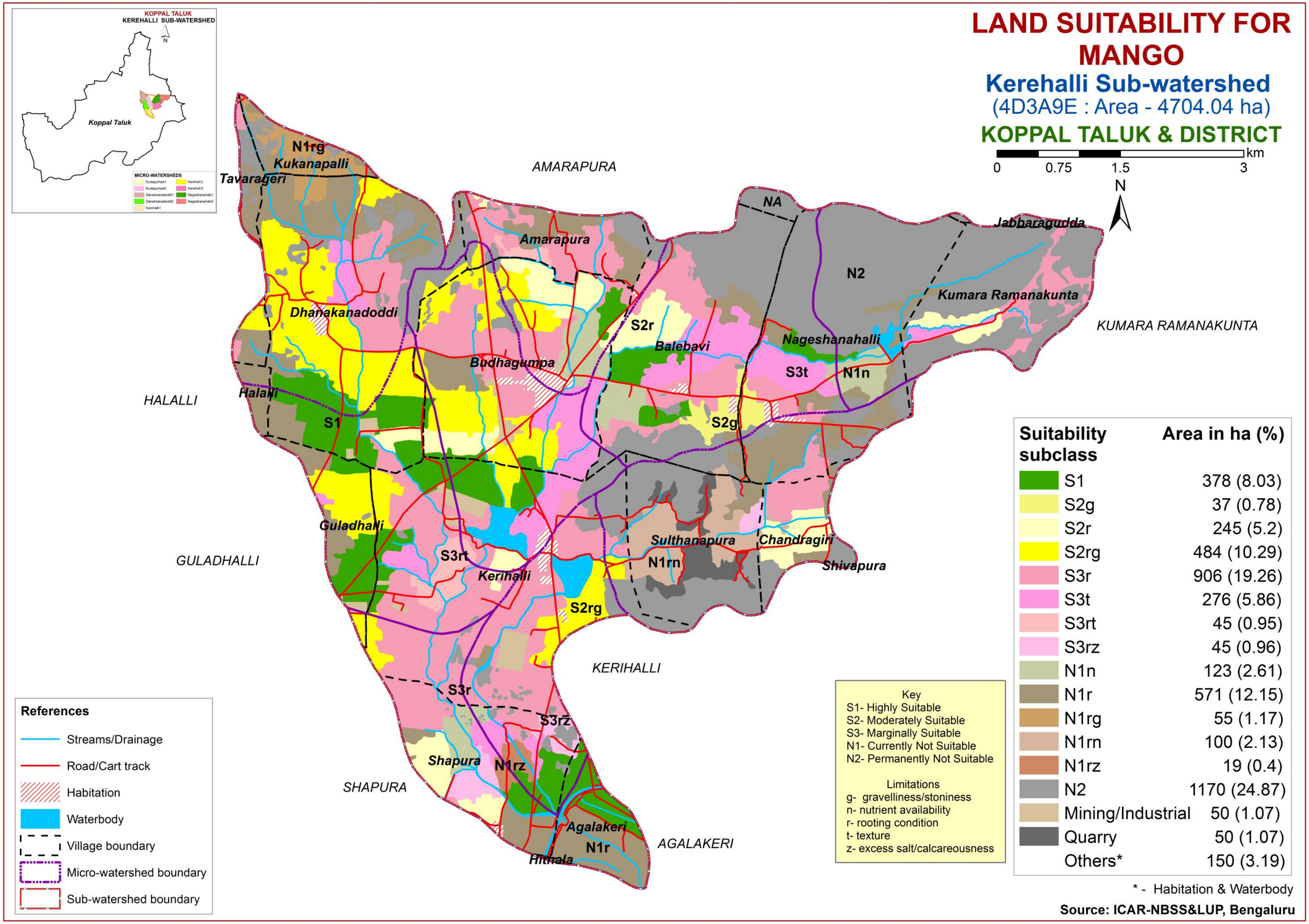
7.14. Land Suitability for Bhendi



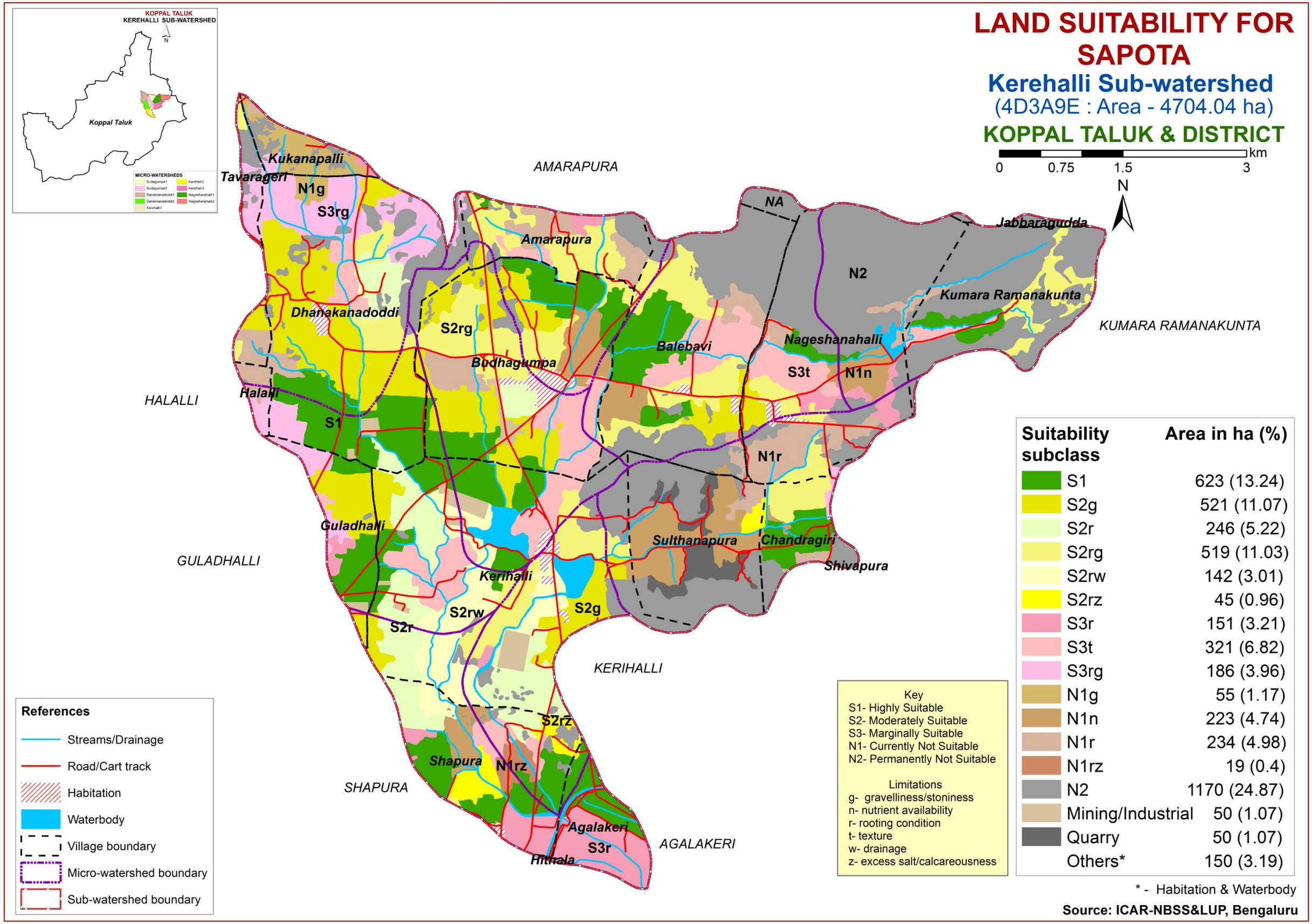
7.15. Land Suitability for Guava



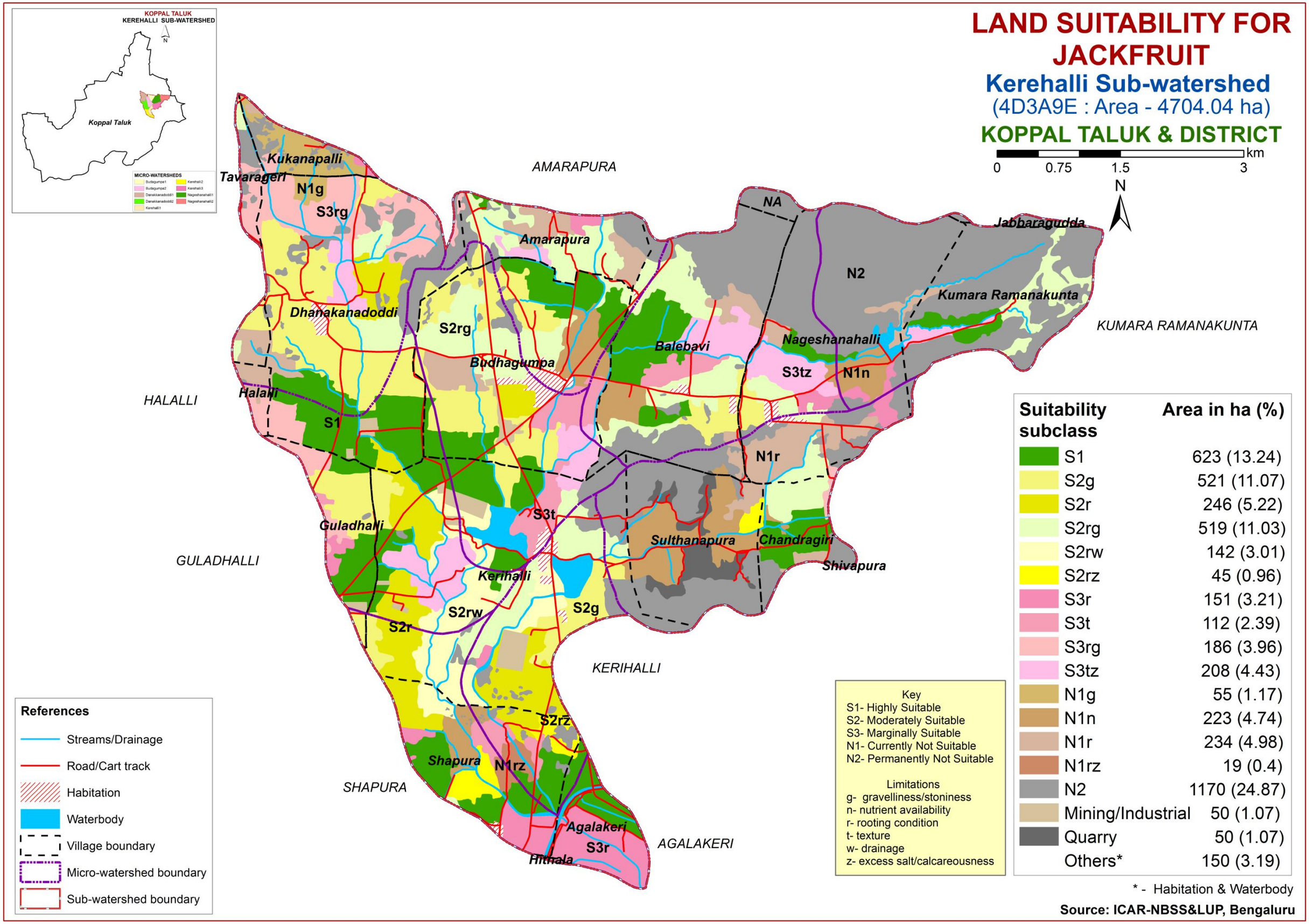
7.16. Land Suitability for Mango



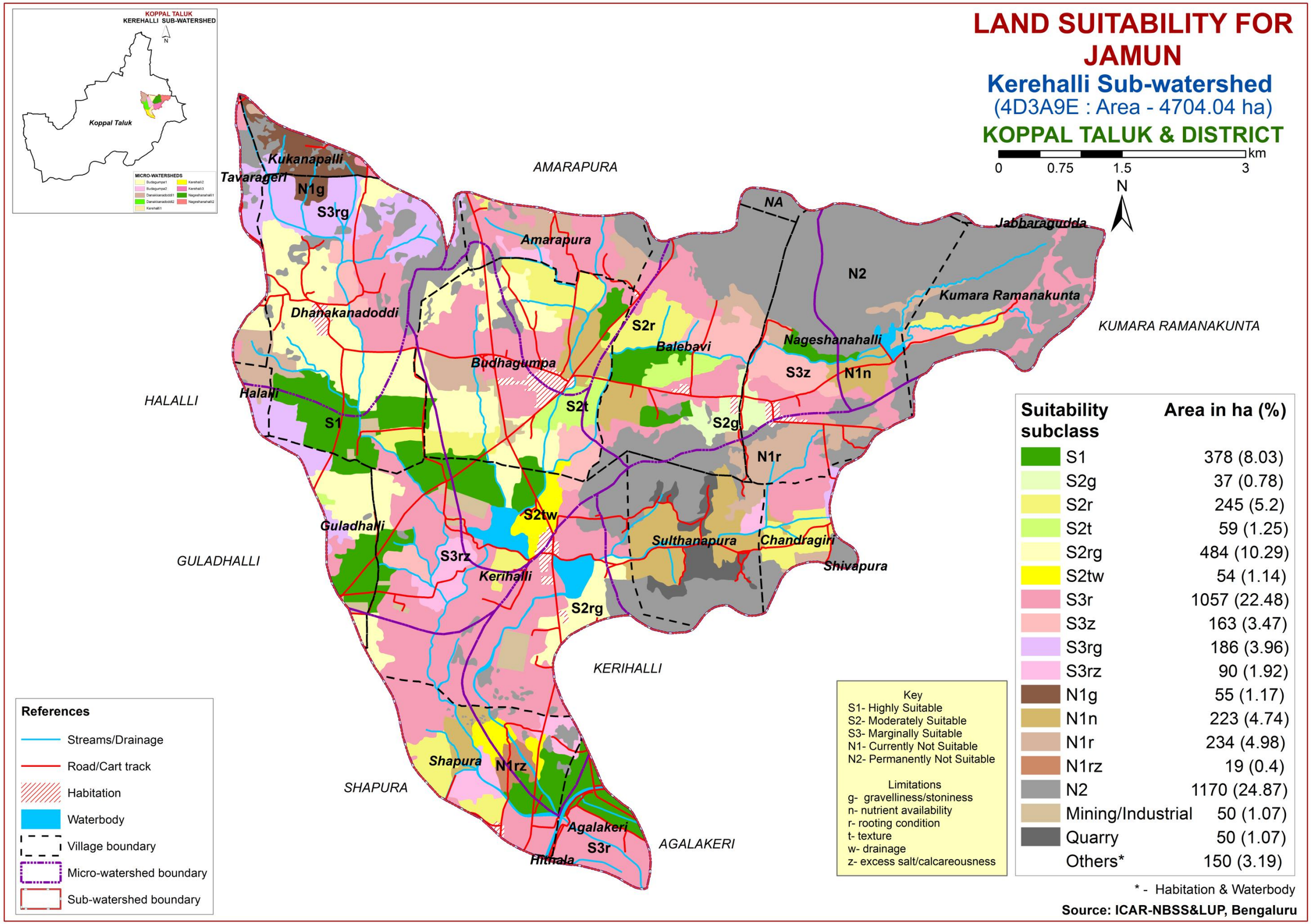
7.17. Land Suitability for Sapota



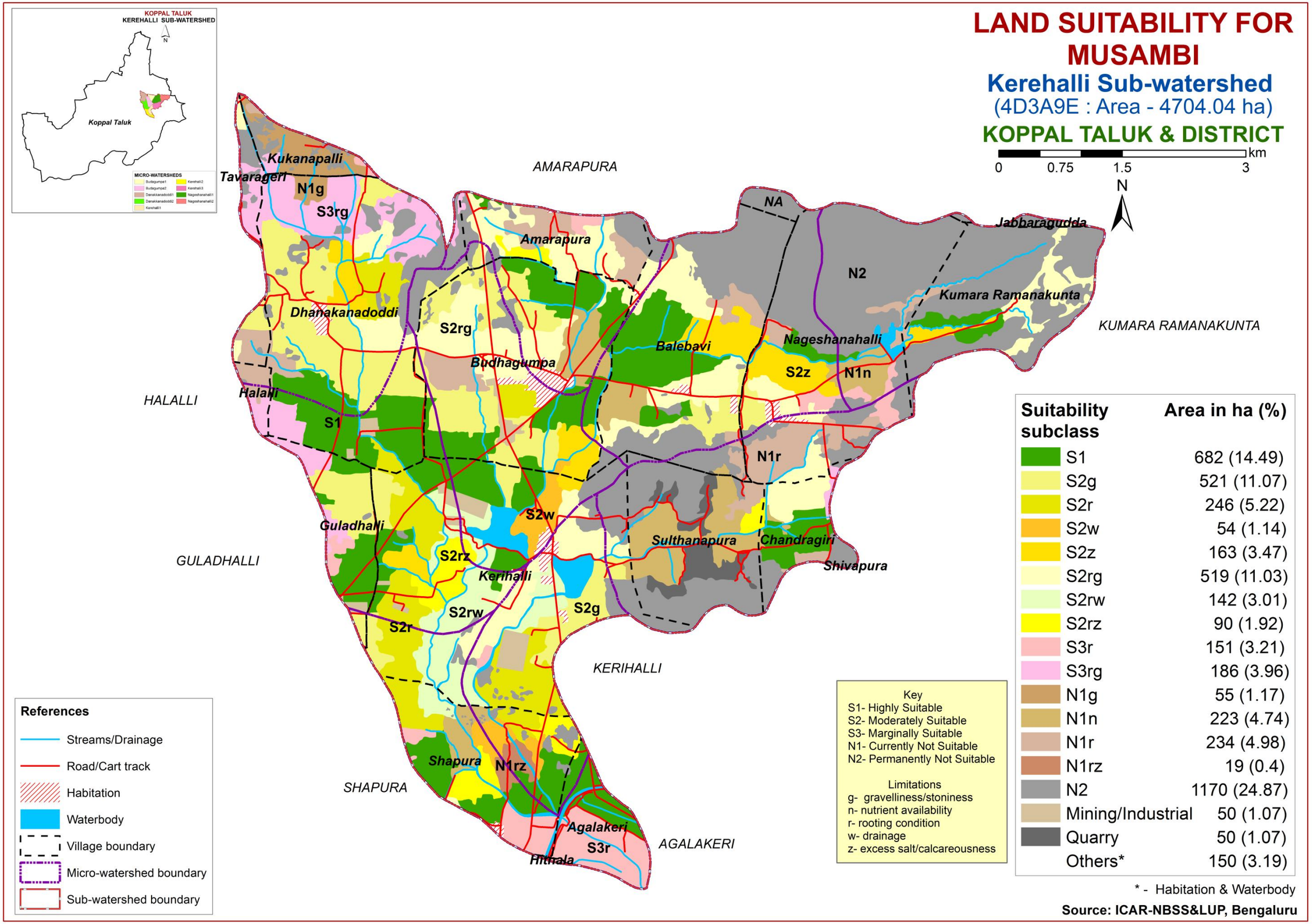
7.18. Land Suitability for Jackfruit



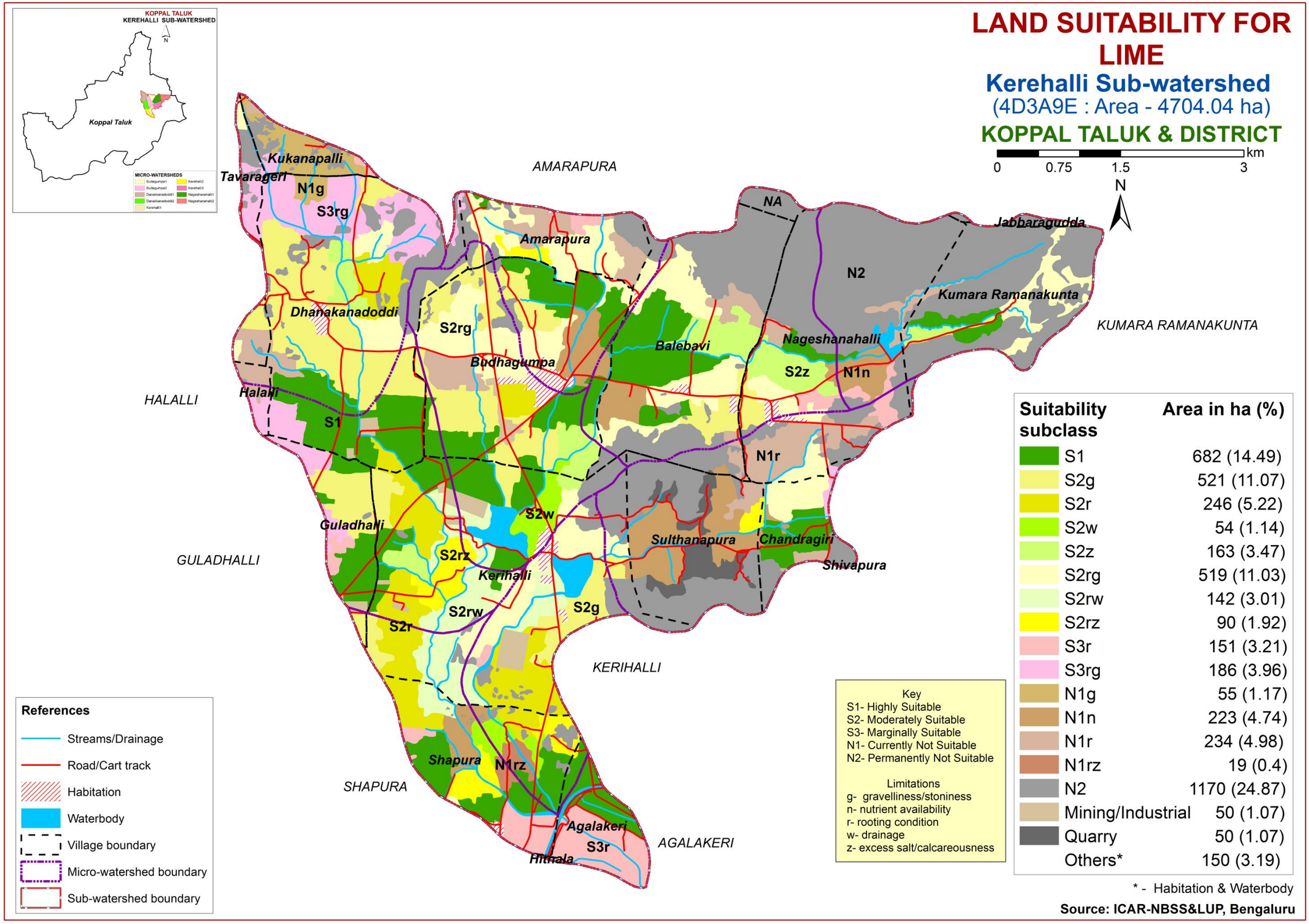
7.19. Land Suitability for Jamun



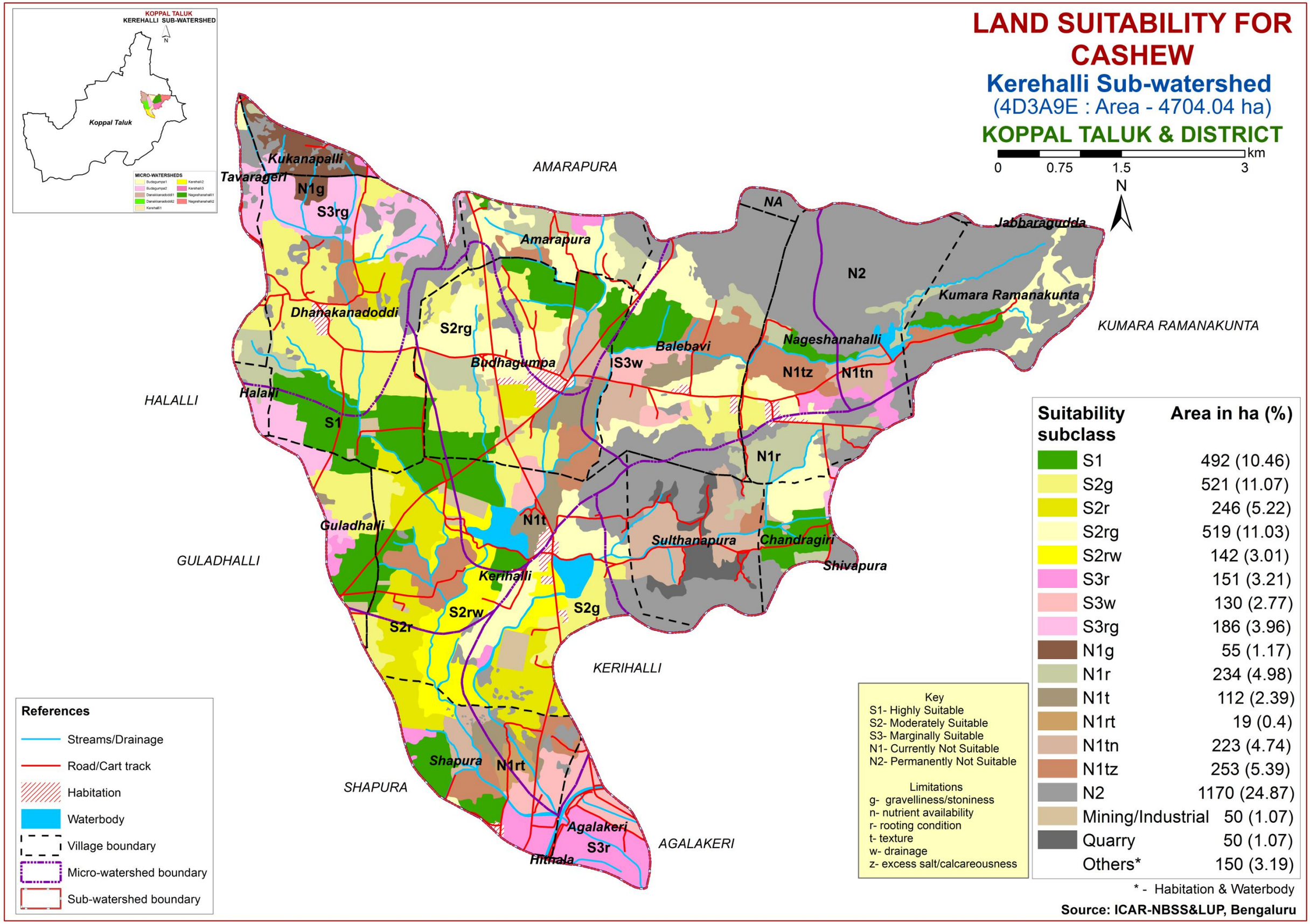
7.20. Land Suitability for Musambi



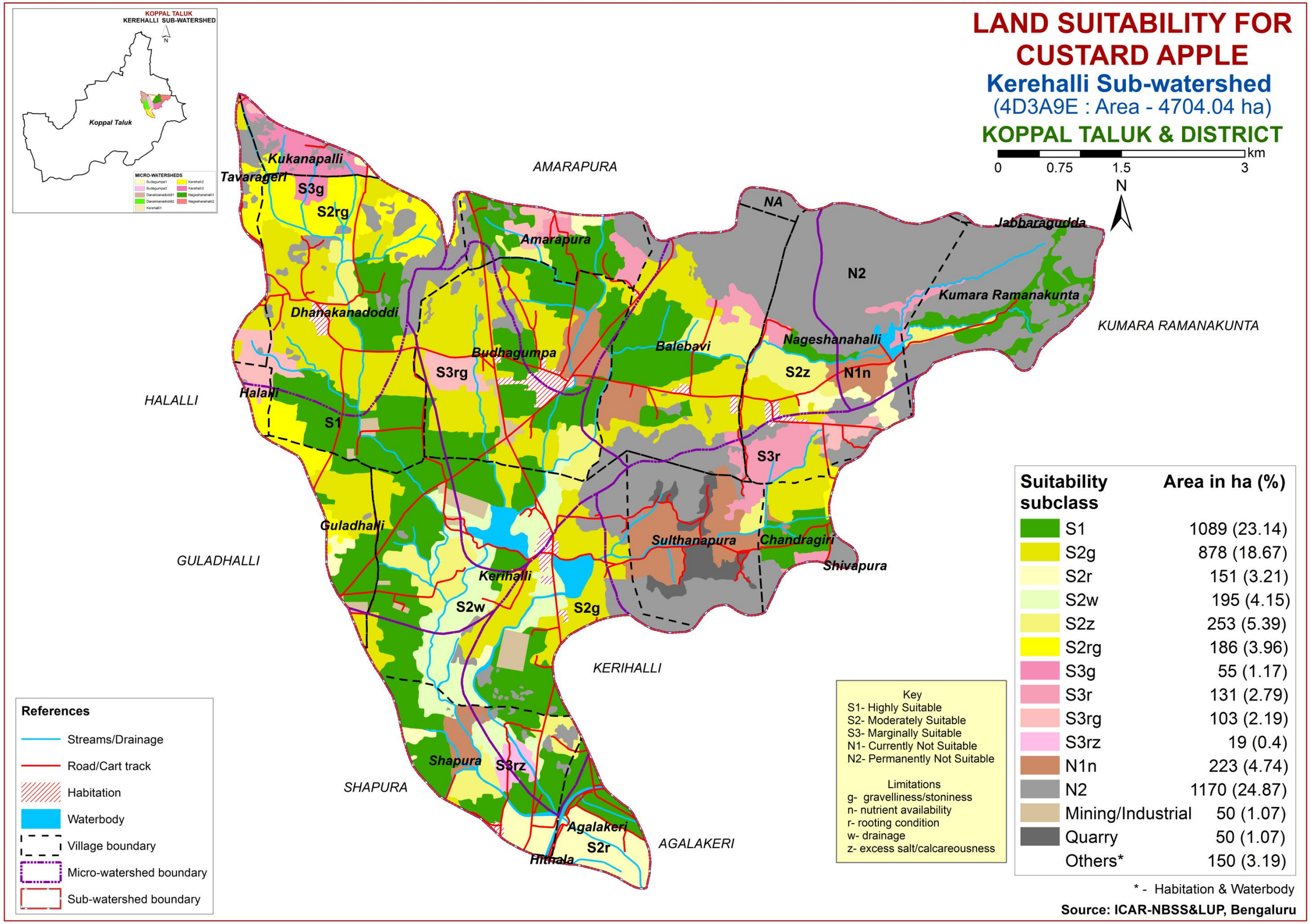
7.21. Land Suitability for Lime



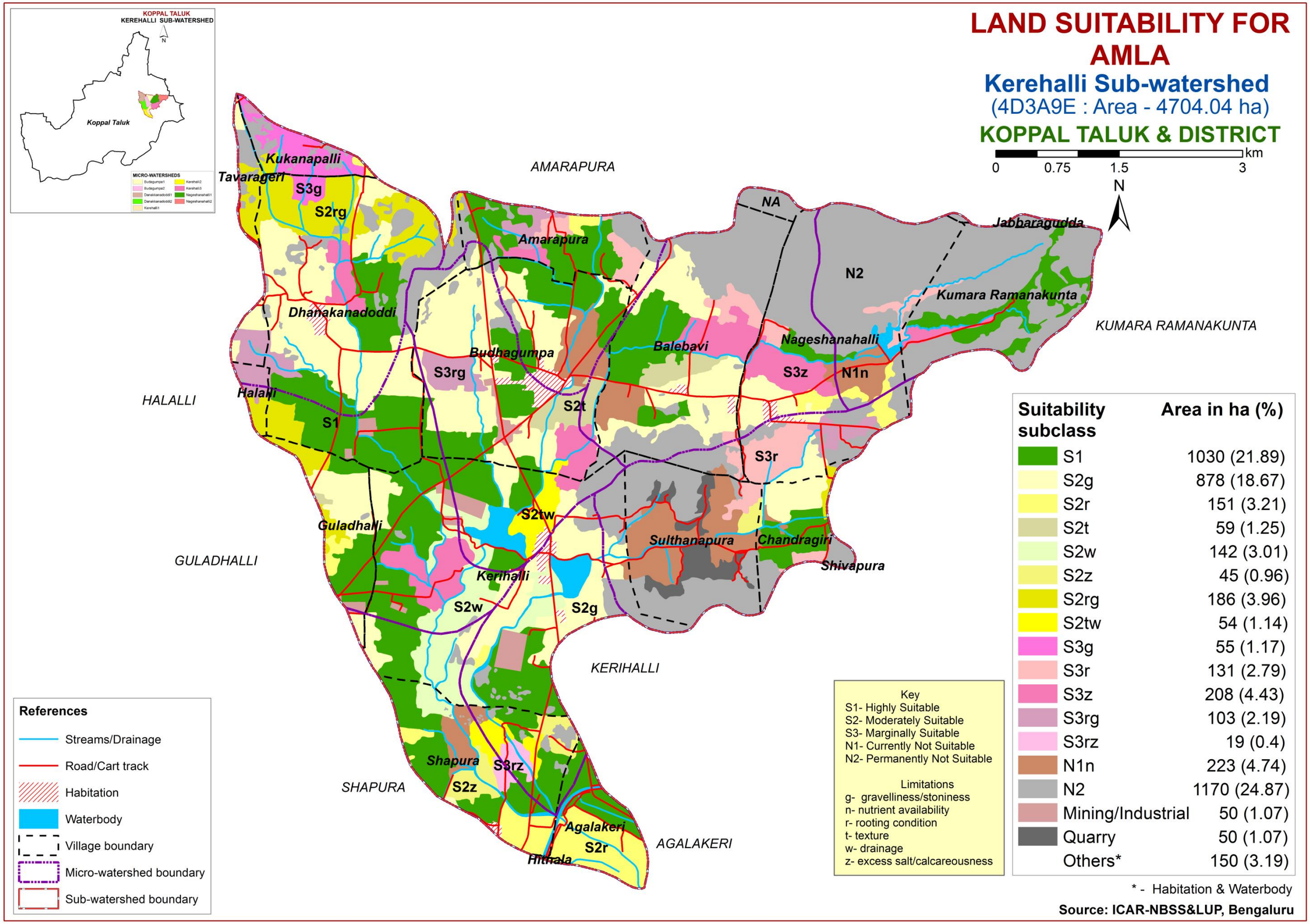
7.22. Land Suitability for Cashew



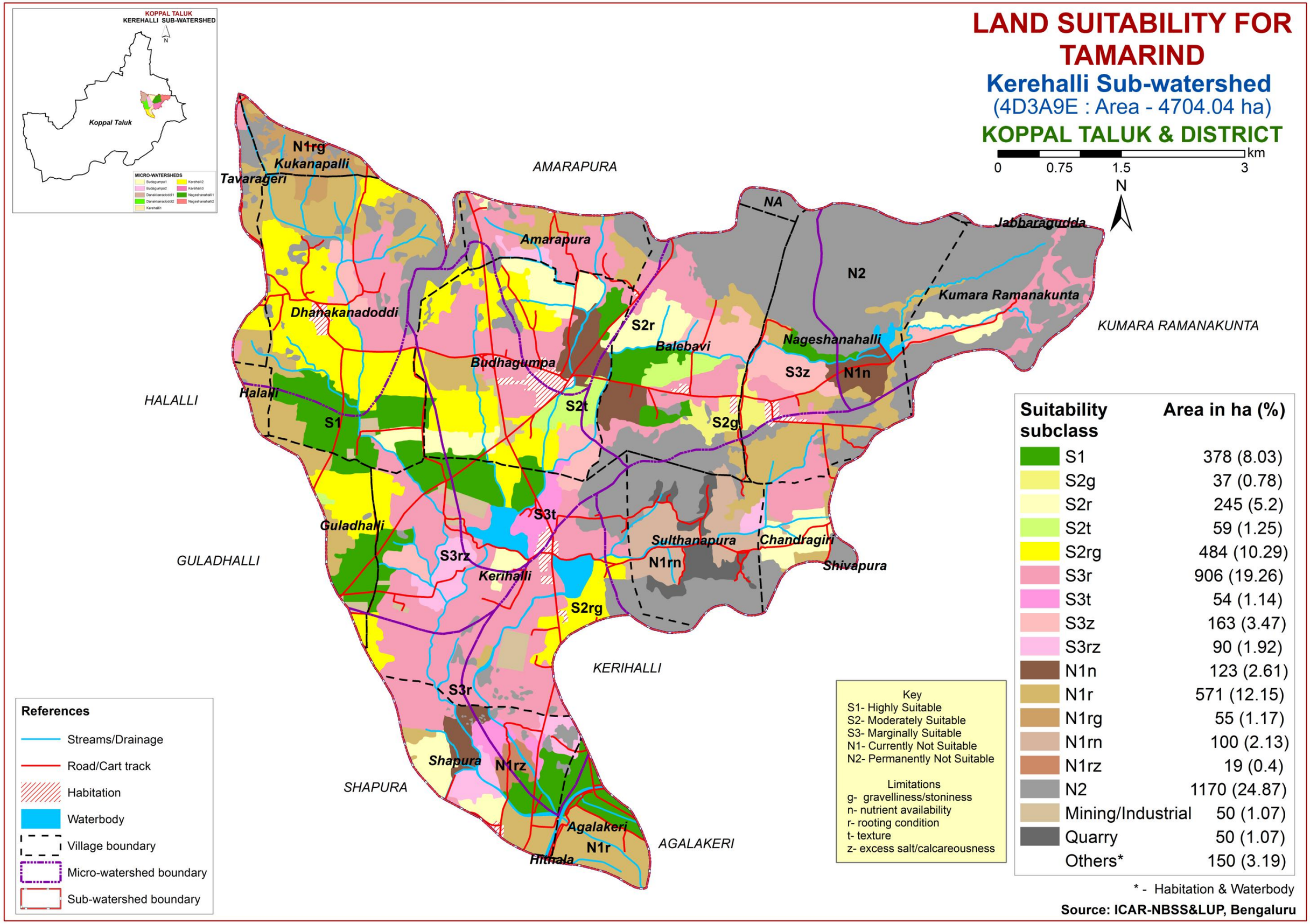
7.23. Land Suitability for Custard Apple



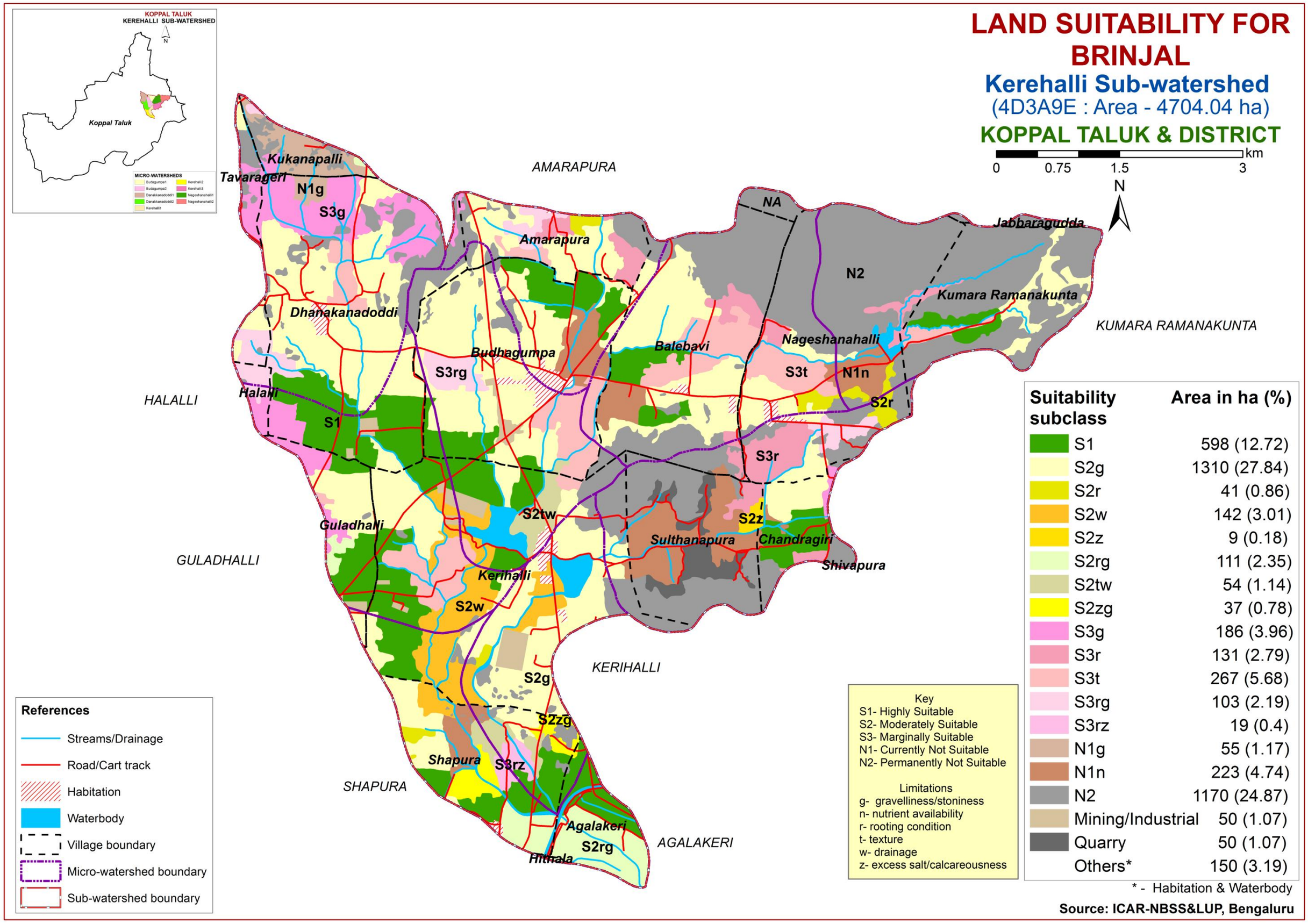
7.24. Land Suitability for Amla



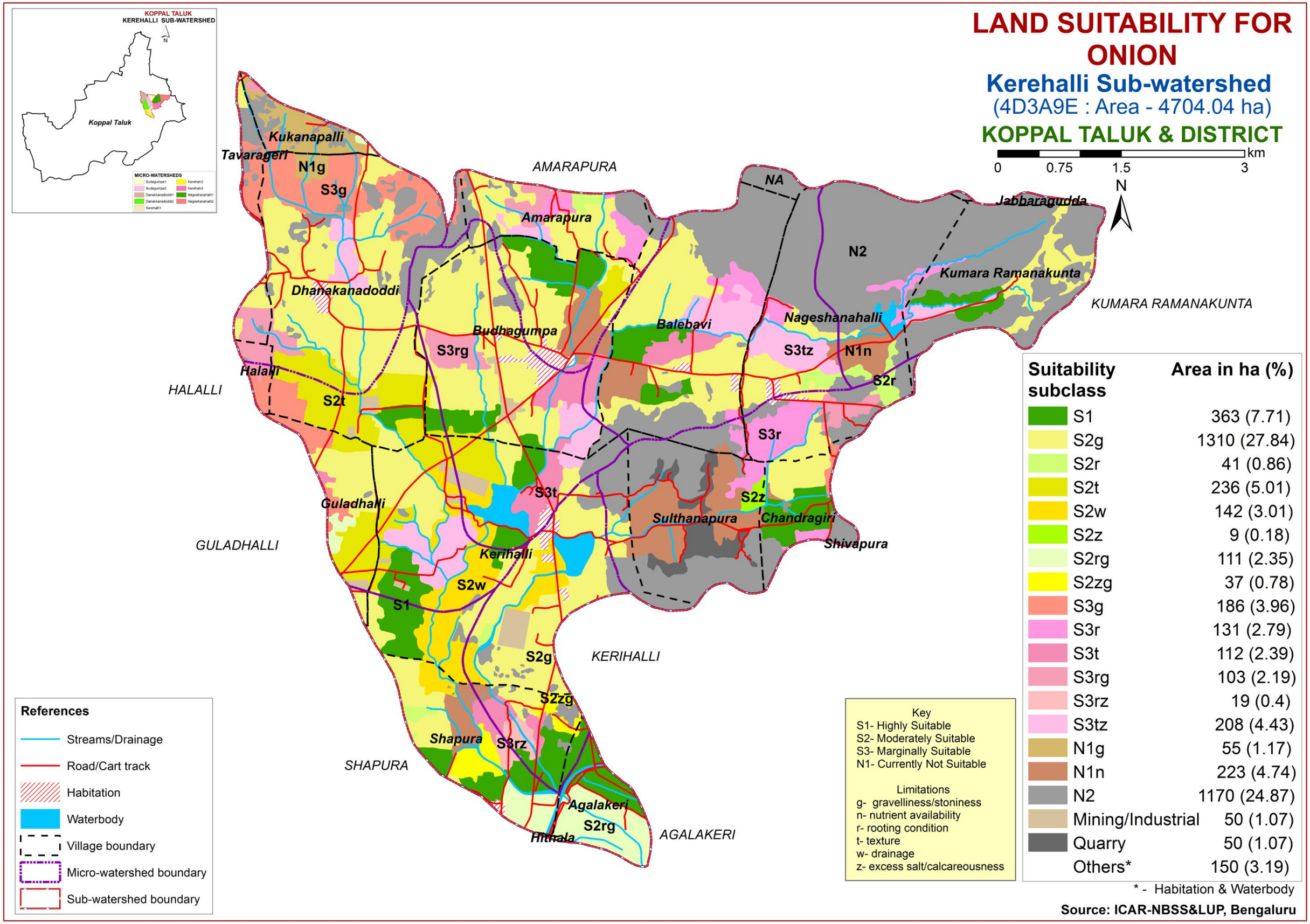
7.25. Land Suitability for Tamarind



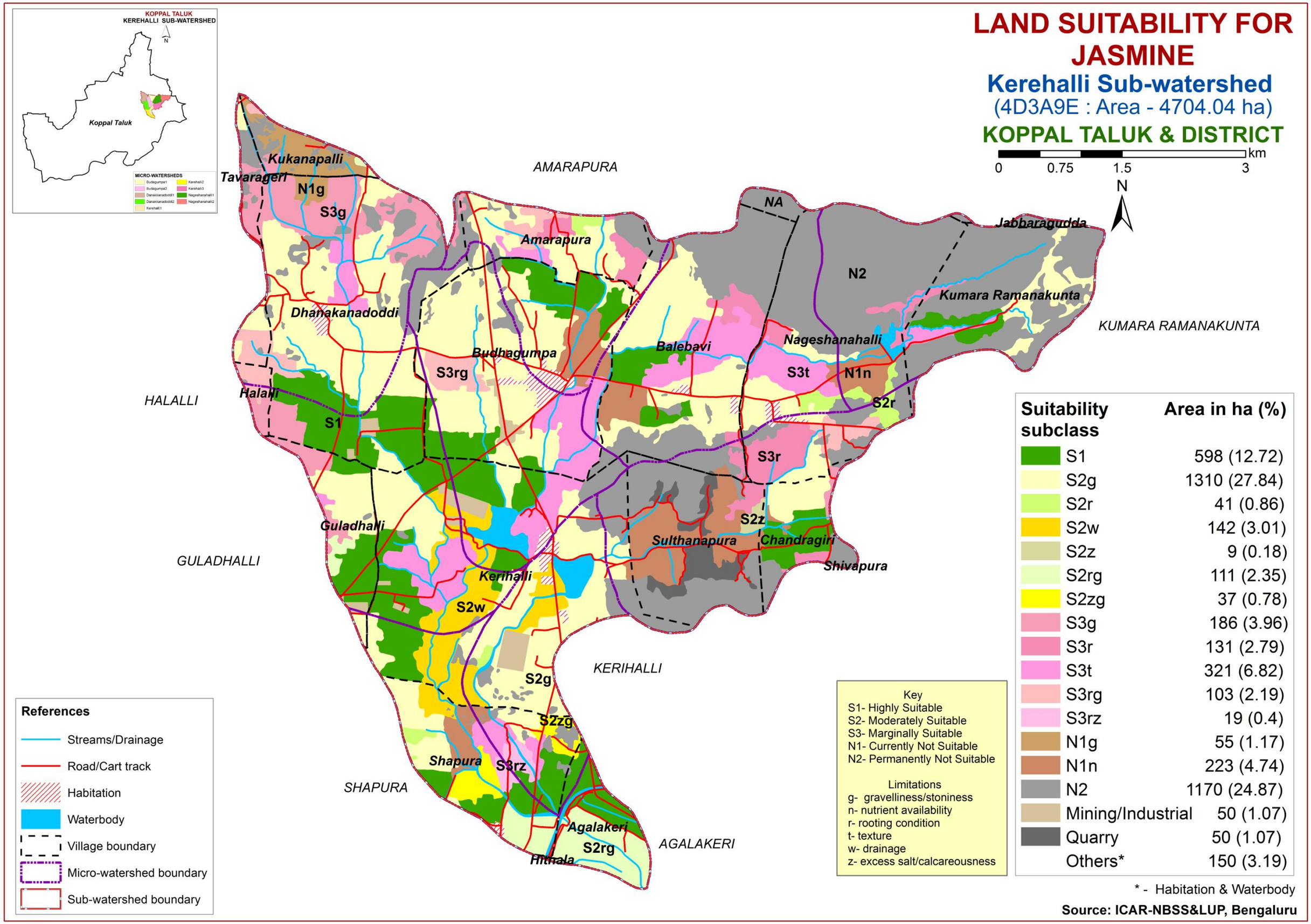
7.26. Land Suitability for Brinjal



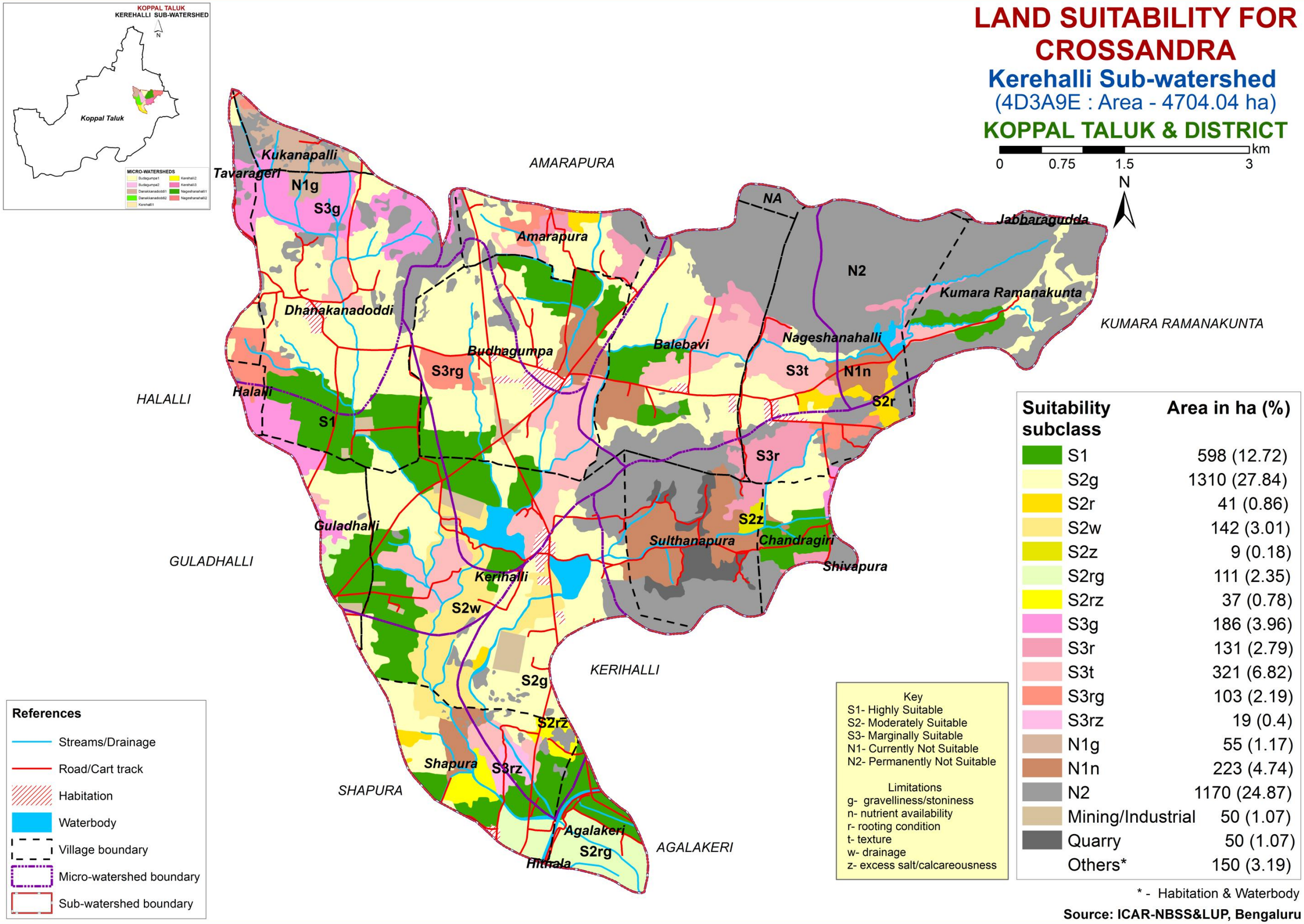
7.27. Land Suitability for Onion



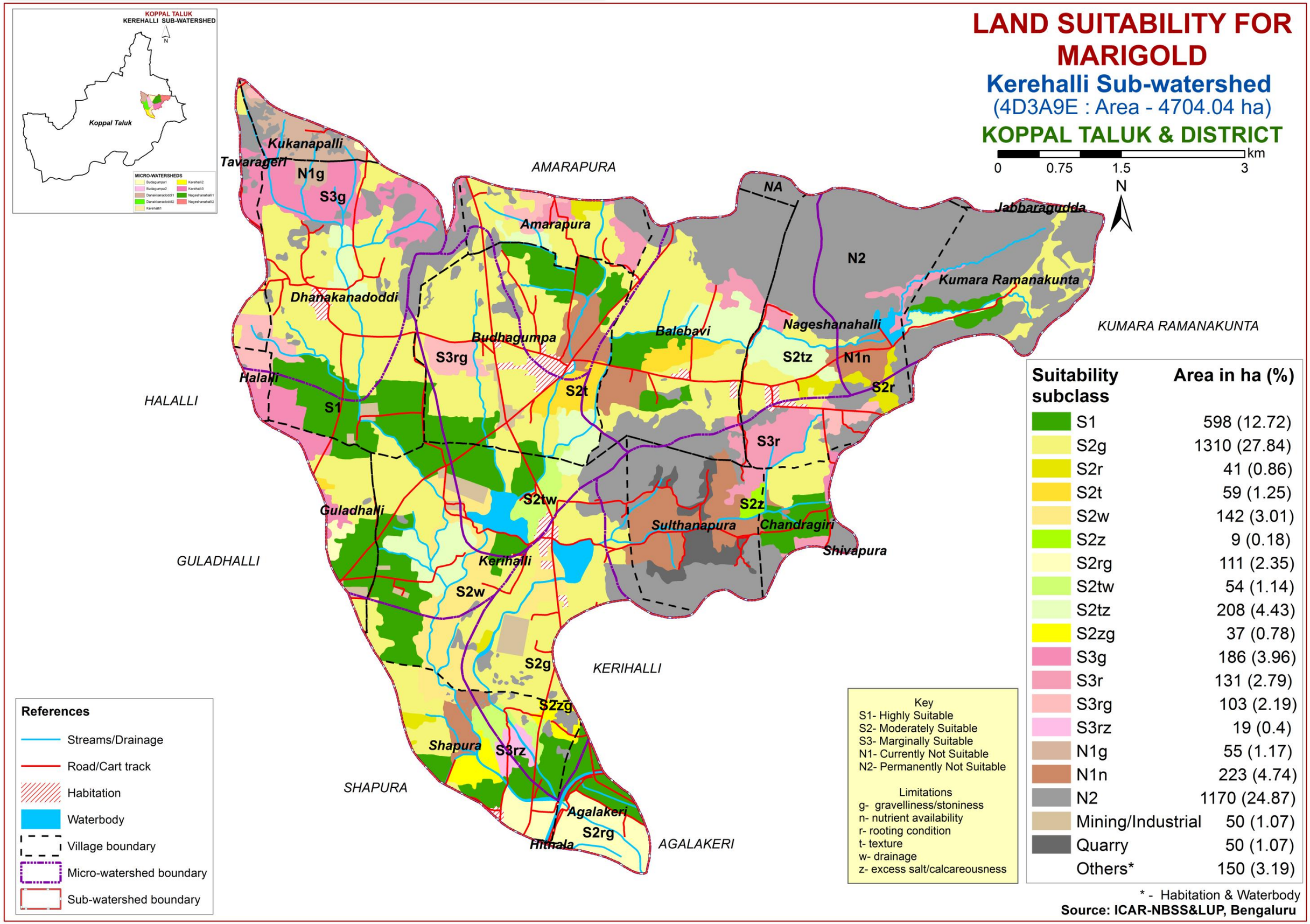
7.28. Land Suitability for Jasmine



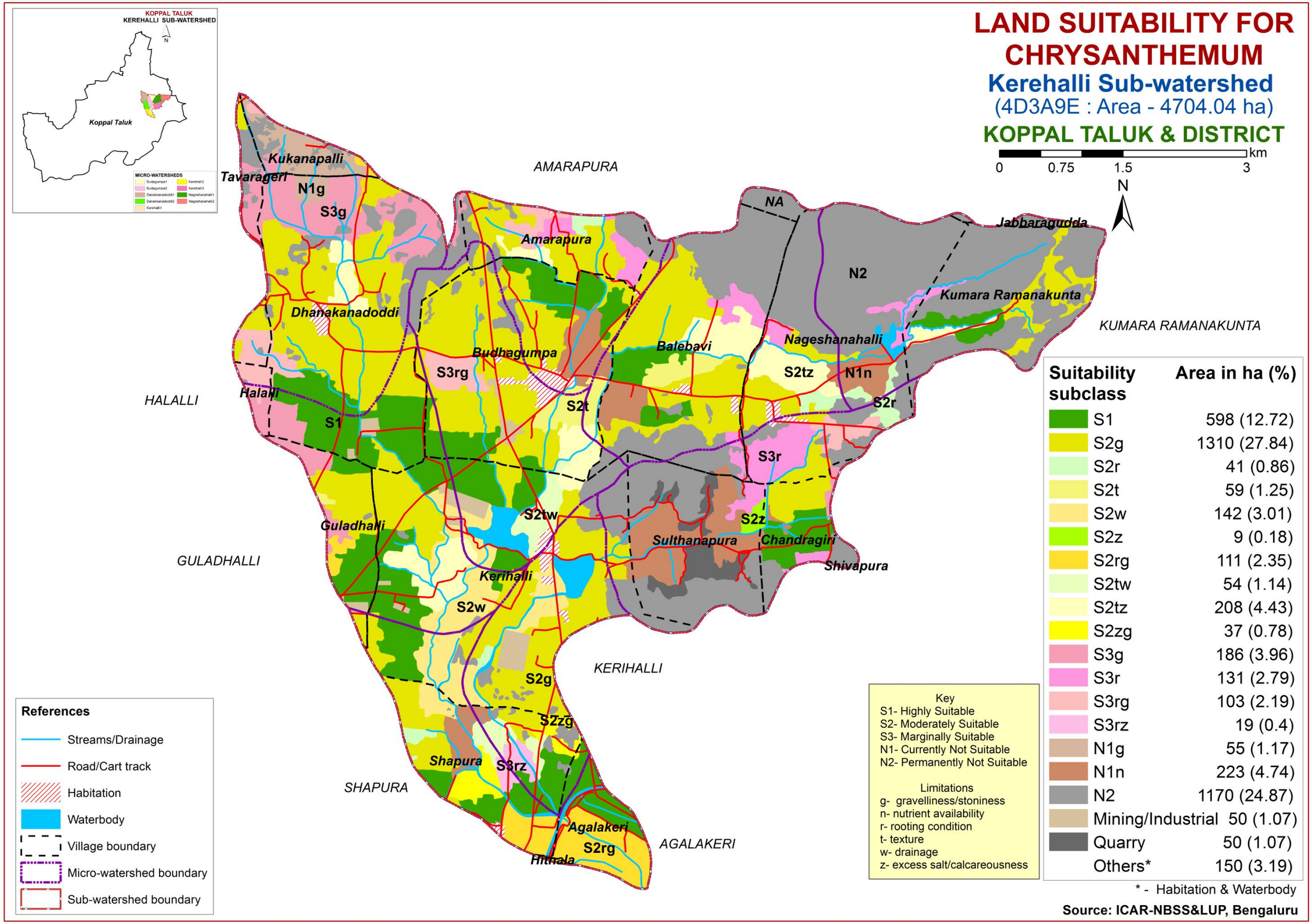
7.29. Land Suitability for Crossandra



7.30. Land Suitability for Marigold

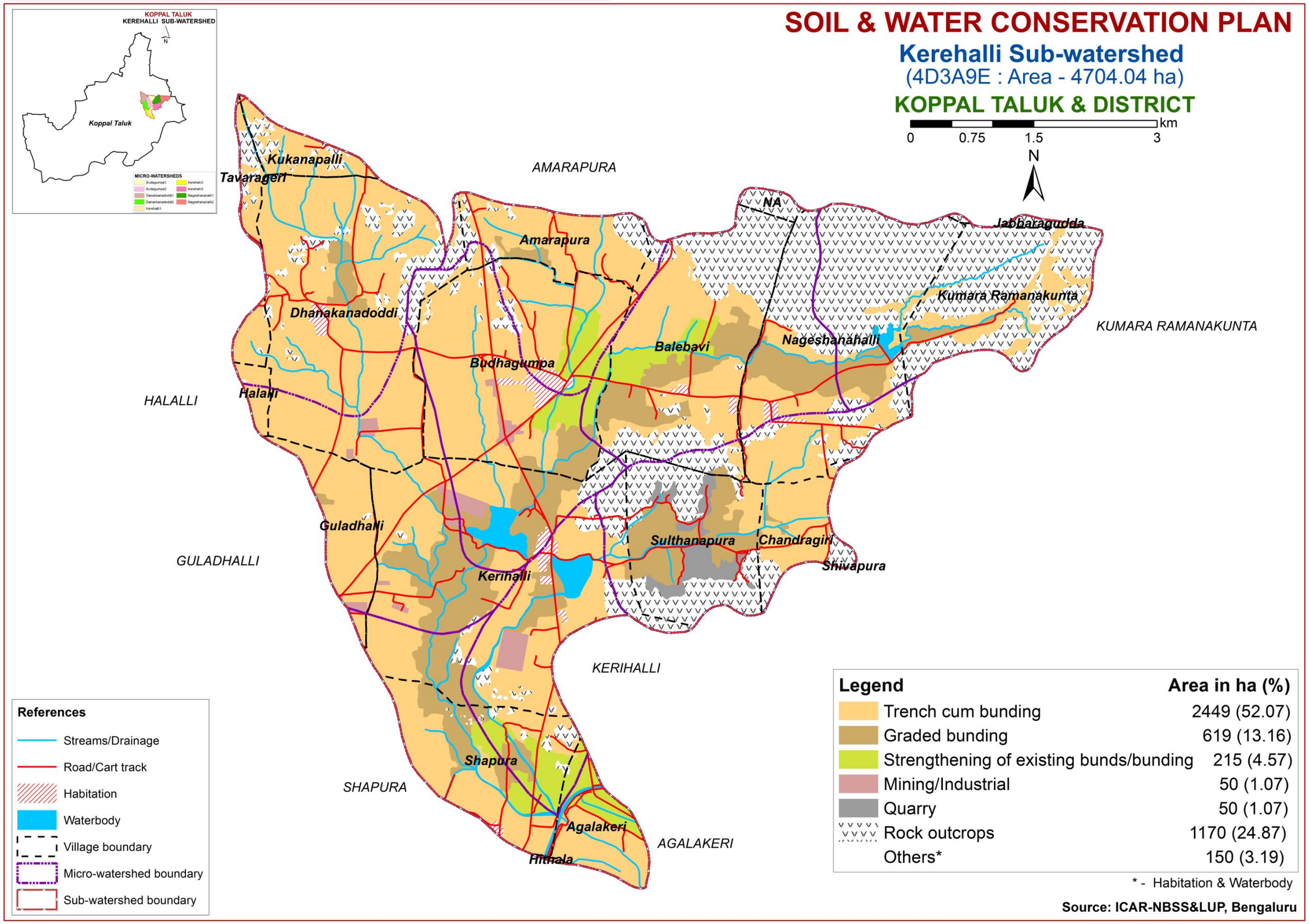


7.31. Land Suitability for Chrysanthemum



8. Soil and Water Conservation Measures

8.1. Soil & Water Conservation Plan



9.Table. Proposed Crop Plan for Kerehalli Sub-watershed, Irakallagada hobli, Koppal taluk, Koppal district based on soil-site–crop suitability assessment

LMU. No	Soil Map Units	Field Crops/Commercial crops	Horticulture Crops (Rainfed/Irrigated)	Suitable Interventions
1	350 DRLmB2 377.HDLcB2 388.KVRmB1 403.KDTmA1 404.KDTmB1 410.MLRiB2 411.MLRmA1 422.AWDmB1 (Moderately deep to very deep, black calcareous clay soils)	Maize, Sorghum, Sunflower, Bajra, Cotton, Red gram, Bengal gram, Soybean, Safflower, Linseed	**Fruit crops**: Pomegranate, Lime, Musambi, Custard apple **Vegetables:** Drumstick, Chillies, Bhendi, Coriander **Flowers:**Marigold, Chrysanthemum,	Application of FYM, Biofertilizers and micronutrients, drip irrigation, mulching, suitable soil and water conservation practices
2	437.HLPhB1 438.HLPiB2 439.TDGbB2 441.TDGmA1 442.TDGmB2 443.TSDcB2 444.TSDiA1 (Moderately deep to very deep, lowland sandy clay loam to clay soils)	Maize, Sorghum, Groundnut, Sunflower, Bajra, Red gram, Mulberry	**Fruit crops**: Amla, Tamarind **Vegetables:** Tomato, Chillies, Drumstick, Onion, Bhendi, Brinjal **Flowers:**Marigold, Chrysanthemum**,** Jasmine, Crossandra	Providing proper drainage, addition of organic manures, green leaf manuring, suitable conservation practices
3	336.RNKmB2 337.RNKmB2g1 370.GRHmA1 373.GRHmB2 375.GRHmB2g2 (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
4	289 NDLbB2g1 (Very deep, red gravelly sandy clay soils)	Maize, Sorghum, Sunflower, Groundnut, Bajra, Cotton, Red gram	**Fruit crops** : Mango, Tamarind, Sapota, Pomegranate, Amla, Cashew, Guava, Custard apple, Jack fruit, Jamun, Lime, Musambi **Vegetables:** Tomato, Chilli, Drumstick, Onion, Bhendi, Brinjal, Curry leaves **Flowers:**Marigold, Chrysanthemum, Jasmine, Crossandra	Drip irrigation, mulching, suitable soil and water conservation practices (Crescent Bunding with Catch Pit etc)

To be continued…

LMU. No	Soil Map Units	Field Crops/Commercial crops	Horticulture Crops (Rainfed/Irrigated)	Suitable Interventions
5	273 HLKiB1 285 RTRcB2 288 RTRiB2 (Very deep, red clay soils)	Maize, Sorghum, Sunflower, Bajra, Mulberry, Cotton, Red gram, Horse gram, Field bean	**Fruit crops** :Mango, Sapota, Guava, Tamarind, Pomegranate, Lime, Musambi Cashew, Jackfruit, Jamun Custard apple, Amla **Vegetables:** Tomato, Chillies, Drumstick, Onion, Bhendi, Brinjal, Curry leaves **Flowers:**Marigold, Chrysanthemum, Jasmine, Crossandra	Drip irrigation, mulching, suitable soil and water conservation practices (Crescent Bunding with Catch Pit etc)
6	138 GHTcB2g1 140 GHThB1 142 GHThB2g1 148 TGRiB1 151 TGRiB2g1 156 BMKmB2 158 BSRbB2g1 161 BSRhB2 165 BSRiB1g1 168 BSRiB2g1 169 CKMbB2 195 KMHbB2 198 KMHhB1g1 201 KMHiB2 205 MNLhB1 208 MNLiB2 243 VDHcB2 247 VDHiB2 282 MRDiB1g1 456 JDGcB2 458 JDGiB1 (Moderately deep to very deep, red sandy clay to sandy clay loam soils)	Maize, Sorghum, Groundnut, Sunflower, Bajra, Mulberry, Cotton, Red gram	**Fruit crops**: Mango, Sapota, Pomegranate, Amla, Cashew, Custard apple, Guava, Jackfruit, Jamun, Lime, Musambi, Tamarind **Vegetables:** Tomato, Chillies, Drumstick, Onion, Bhendi, Brinjal, Curry leaves **Flowers:** Marigold, Chrysanthemum**,** Jasmine, Crossandra	Drip irrigation, mulching, suitable soil and water conservation practices (Crescent Bunding with Catch Pit etc)

To be continued…

LMU. No	Soil Map Units	Field Crops/Commercial crops	Horticulture Crops (Rainfed/Irrigated)	Suitable Interventions
7	103 HDHbB1 104 HDHbB2 109HDHcB1g1 111 HDHcB2g1 119 HDHhB1 122 HDHhB2 123 HDHhB2g1 127 HDHiB2 128 HDHiB2g1 180 BDGcB1g1 188 BDGhB2g1 216 BPRbB2 218 BPRbB2g1R1 224 BPRcB2 225 BPRcB2g1 228 BPRhB1 230 BPRhB2 231 BPRhB2g1 239 BPRiB2 251 NGPcB2g1 265 NGPiB2g1 269 GDPiB2 455 BDGcB2 459 BPRmB2g1 460 NGPhC2g1 (Moderately deep to deep, red gravelly sandy clay soils)	Maize, Sorghum, Sunflower, Groundnut, Bajra, Cotton, Red gram	**Fruit crops** : Sapota, Pomegranate, Amla, Cashew, Guava, Custard apple, Jack fruit, Jamun, Lime, Musambi **Vegetables:** Tomato, Chilli, Drumstick, Onion, Bhendi, Brinjal, Curry leaves **Flowers:** Marigold, Chrysanthemum, Jasmine, Crossandra	Drip irrigation, mulching, suitable soil and water conservation practices (Crescent Bunding with Catch Pit etc)
8	58.TDHhB2 62.KGHbB2g1 72.KTPhB2g1 100.HTIiB2 (Moderately shallow, red sandy clay to clay soils)	Maize, Sorghum, Groundnut, Bajra, Cotton, Horse gram, Castor	**Fruit crops** : Amla, Custard apple **Vegetables:** Tomato, Chilli, Onion, Bhendi, Brinjal ,Curry leaves **Flowers:**Marigold, Chrysanthemum, Jasmine, Crossandra	Drip irrigation, mulching, suitable soil and water conservation practices (Crescent Bunding with Catch Pit etc)

To be continued…

LMU. No	Soil Map Units	Survey Number	Field Crops/Commercial crops	Horticulture Crops (Rainfed/Irrigated)	Suitable Interventions
9	43 LKRcB2g1 49 LKRhC2g3 53.LKRiB2 77 MKHcB2g1 85 MKHhB2g1 452.LKRhB2g1 (Moderately shallow, red gravelly sandy clay soils)		Bajra, Groundnut, Horse gram, Castor	**Fruit crops** : Amla, Custard apple **Vegetables:** Curry leaves **Flowers:** Marigold, Chrysanthemum	Drip irrigation, mulching, suitable soil and water conservation practices (Crescent Bunding with Catch Pit etc)
10	20 HRVbB2 25.HRVhB2 31.HRViB2g1 34.CSRcB1 35.CSRcB2 37CSRhB2g1 38 CSRiB1g1 465 HRVcB2g1 467 KNHiB1g1 (Shallow red soils)		-	Hybrid Napier, Glyricidia, Simaruba, Dhaincha, Sunhemp, *Styloxanthes scabra*, *Styloxanthes hamata*	Use of short duration varieties, sowing across the slope and split application of nitrogen fertilizers
11	301.MTLbB2g2 (Shallow black gravelly clay soils)		-	Hybrid Napier, *Styloxanthes hamata*, *Styloxanthes scabra*	Use of short duration varieties, sowing across the slope

PART-B

Hydrological Inventory of Kerehalli Sub-watershed, Koppal Taluk, Koppal 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 Kerehalli Sub-watershed, Koppal Taluk, Koppal 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

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Ms. Seema, K.V.	Senior Research Fellow
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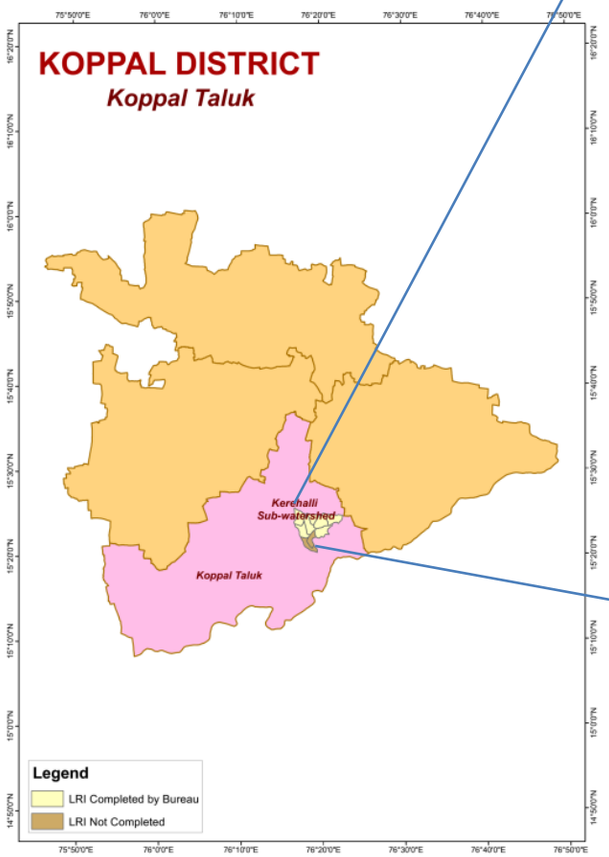
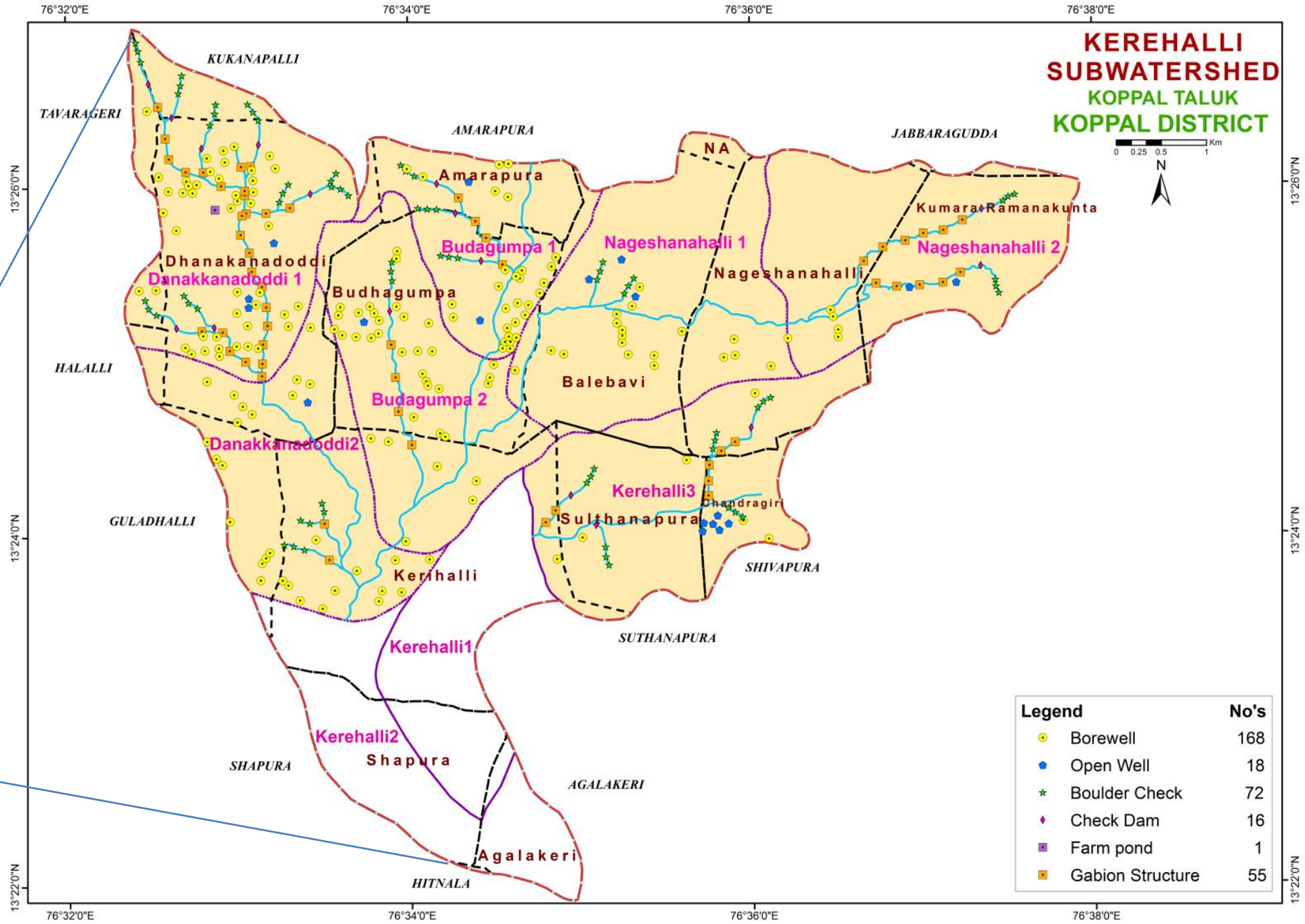
INTRODUCTION

- The inventory and documentation of spatial and temporal changes in hydrological components of Kerehalli sub-watershed (4D3A9E) in Koppal taluk, Koppal district, has been undertaken for integrated planning, development and management at the level of soil mapping units.
- Kerehalli sub-watershed (Koppal taluk & district) is located in between $15^0$20’4.59’’–$15^0$25’41.11’’ North latitudes and $76^0$16’8.62’’–$76^0$23’3.28’’ East longitudes, covering an area of about 4716 ha.
- This sub watershed encompasses of 9 MWs namely, Budagumpa-1 (4D3A9E1c), Budagumpa-2 (4D3A9E1d), Danakkanadoddi-1 (4D3A9E2a), Danakkanadoddi-2 (4D3A9E2b), Nageshanahalli-1 (4D3A9E1b), Nageshanahalli-2 (4D3A9E1a), Kerehalli-3 (4D3A9E2c), Kerehalli-1 (4D3A9E2d) and Kerehalli-2 (4D3A9E2e) micro watersheds. Land Resource Inventory (LRI) was generated for all the nine micro-watersheds.
- Average annual rainfall (1960-2014) of the Hobli (Block) pertaining to the sub-watershed is 631 mm.
- In this sub-watershed major *kharif* crops grown are Maize, Cotton, Sunflower, Bajra, Groundnut, Red gram and major *rabi* crops are Sorghum, Bengal gram, Safflower.
- Hydrological components namely rainfall (annual, *kharif*, *rabi* and summer), PET, AET, runoff, surface soil moisture, ground water status and water balance are presented.

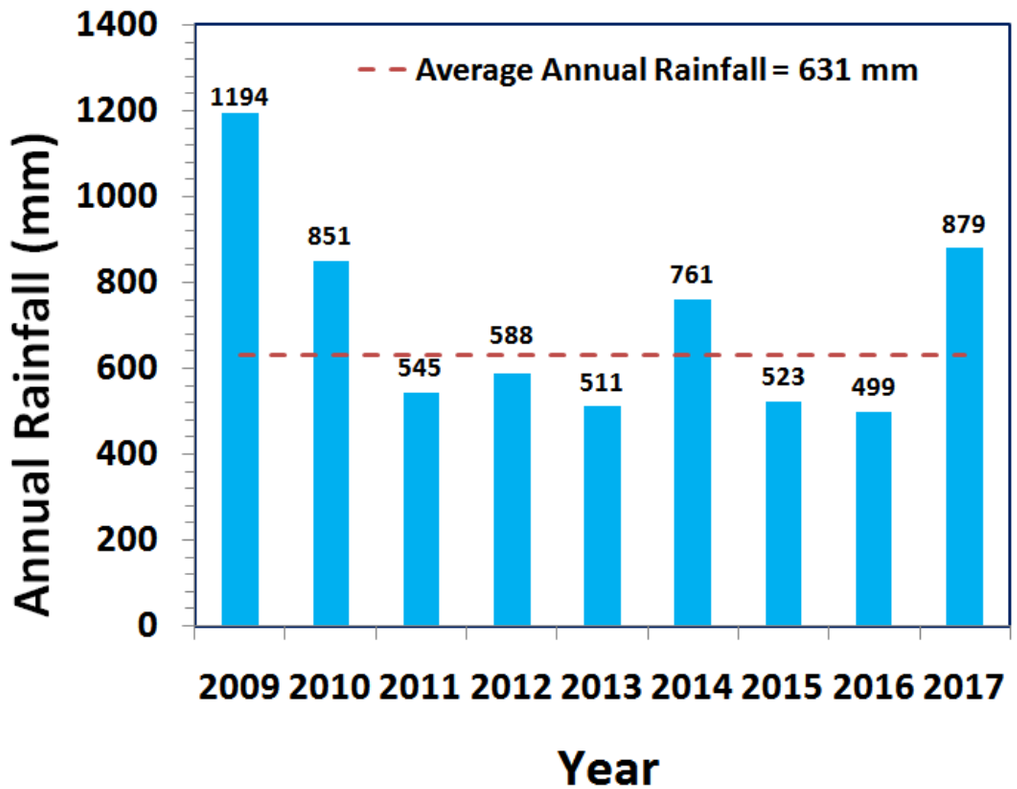
LOCATION MAP OF KEREHALLI SUB-WATERSHED





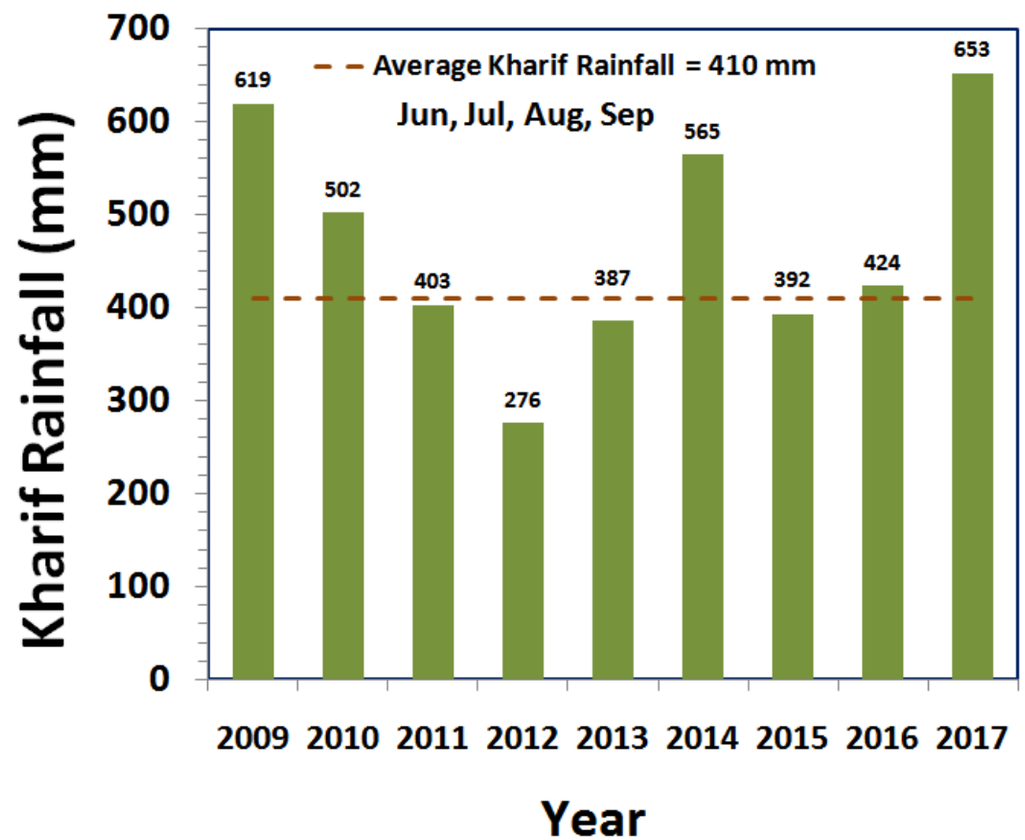
Soil & Water Conservation Structures in Kerehalli Sub-watershed,
Koppal taluk, Koppal district

RAINFALL INDEX

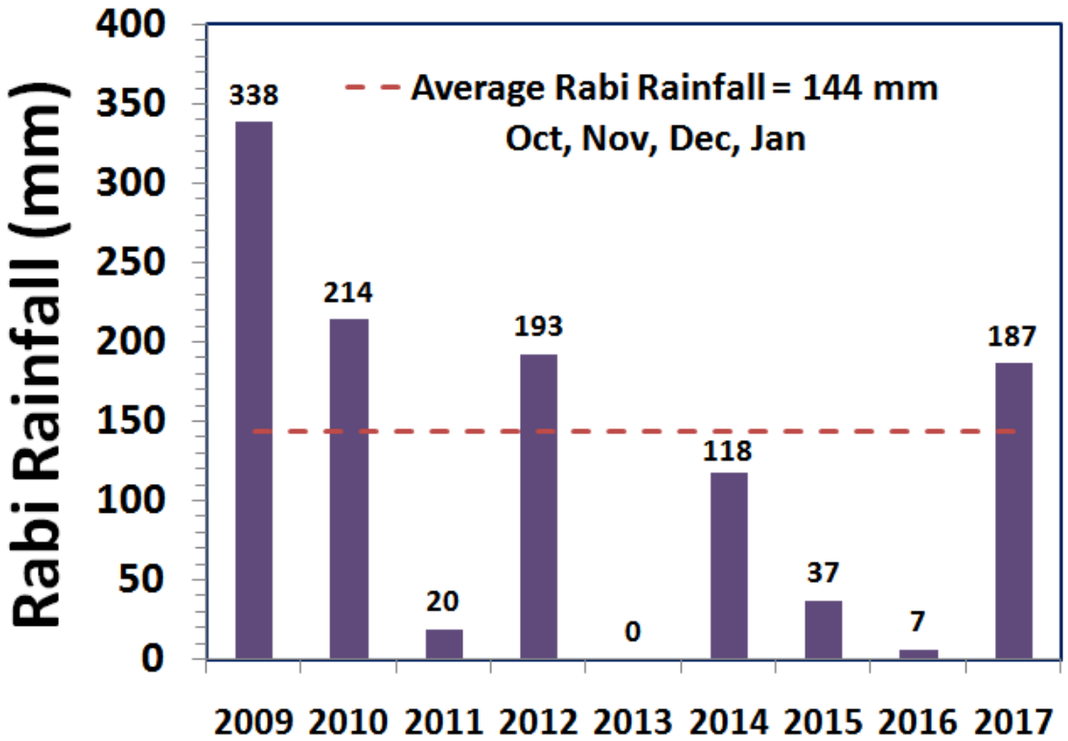


The average annual rainfall (1960-2014) recorded at the Koppal station in Koppal taluk of Koppal district is 631 mm. The annual rainfall at Irakallagada station (Hobli H.Q.) is presented. During the years 2011, 2012, 2013, 2015 and 2016 the annual rainfall was deficient by 14%, 7%, 19 %, 17% and 21% respectively.

The *kharif* rainfall (Jun–Sep) is an average about 68% of the annual rainfall and it typically follows the annual rainfall patterns. During the years 2011, 2012, 2013 and 2015 the *kharif* rainfall was deficient by 2%, 33%, 6% and 4% respectively.

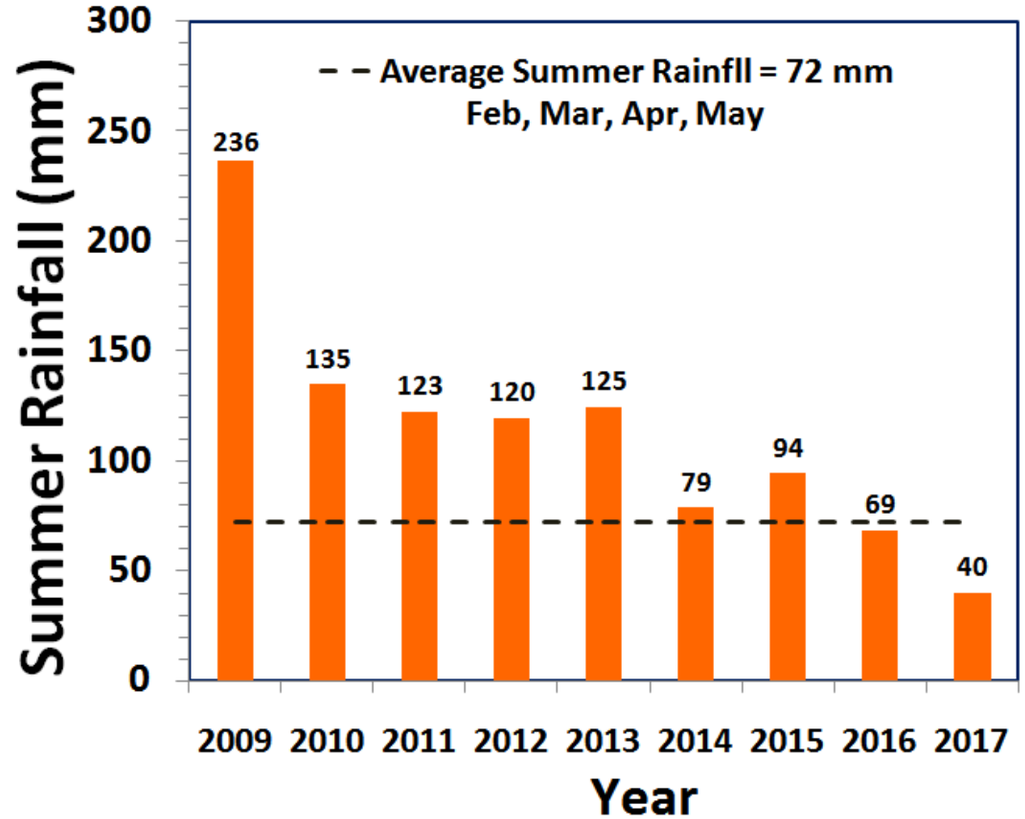


RAINFALL INDEX

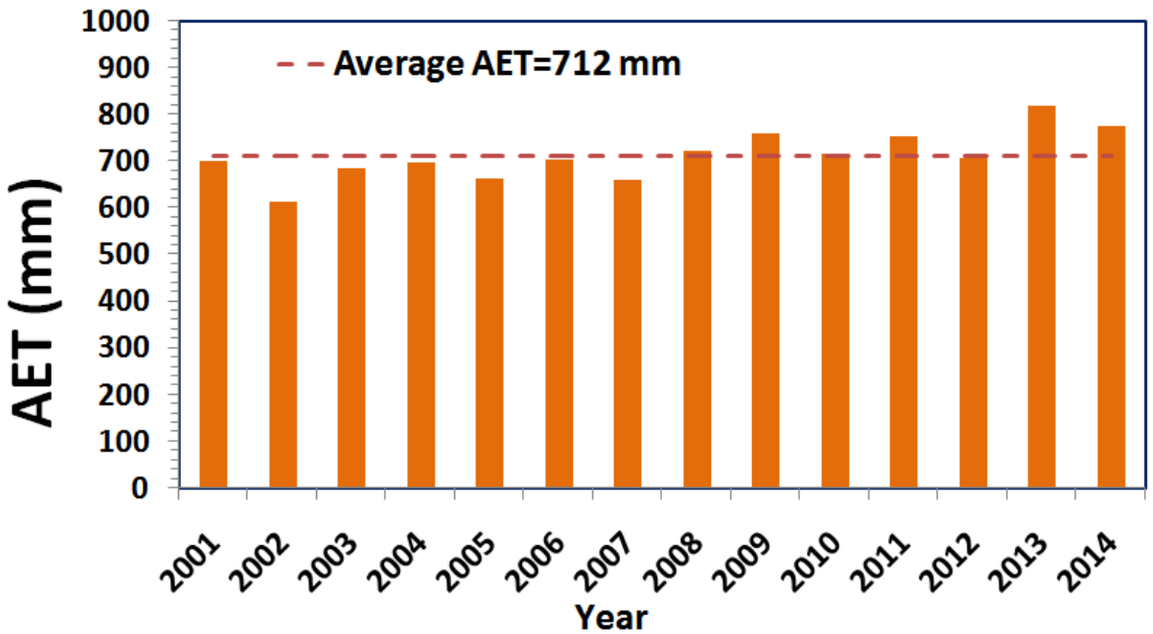


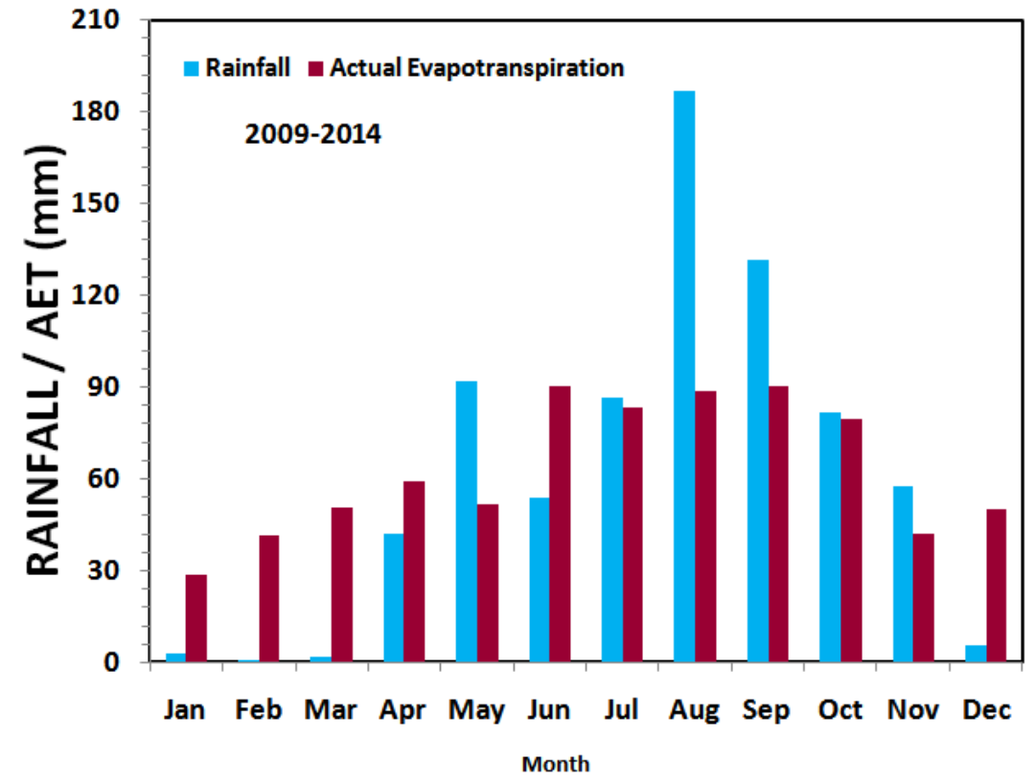
The average *rabi* rainfall (Oct-Jan) is about 15% of the average annual rainfall. During the years 2011, 2013, 2014, 2015 and 2016 the *rabi* rainfall was deficient by 86%, 100%, 18%, 74% and 95% respectively.

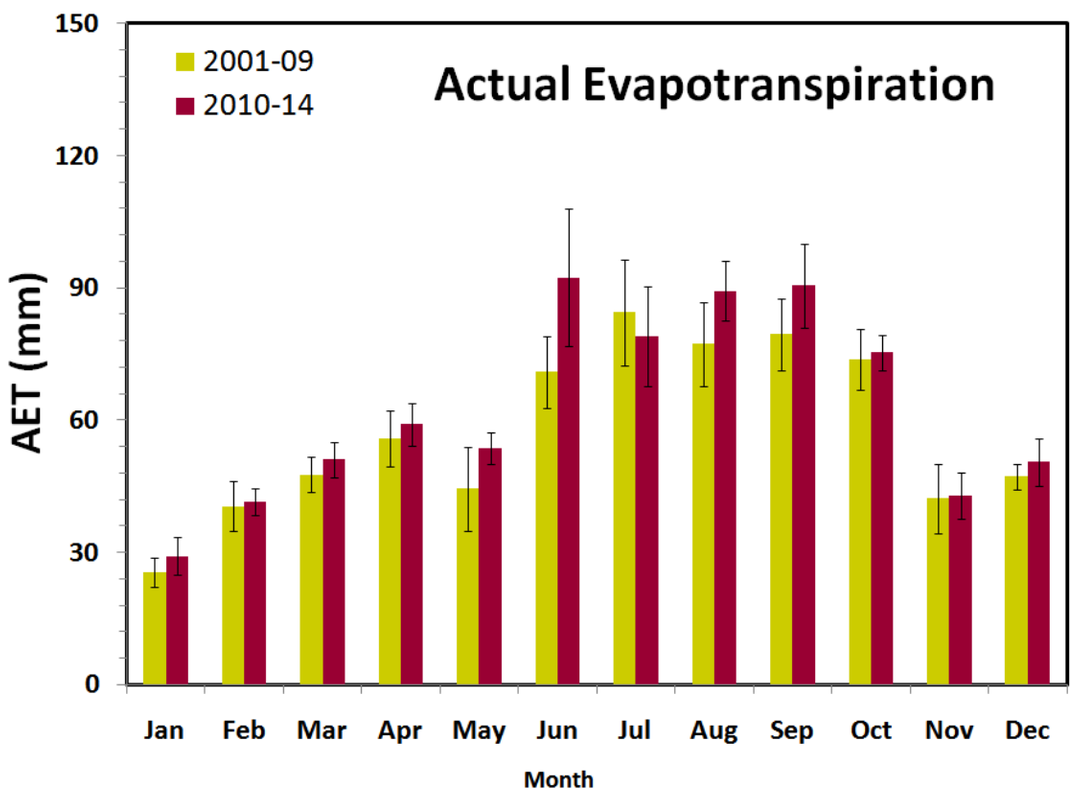
The average summer rainfall (Feb-May) is about 17% of the average annual rainfall.



EVAPOTRANSPIRATION

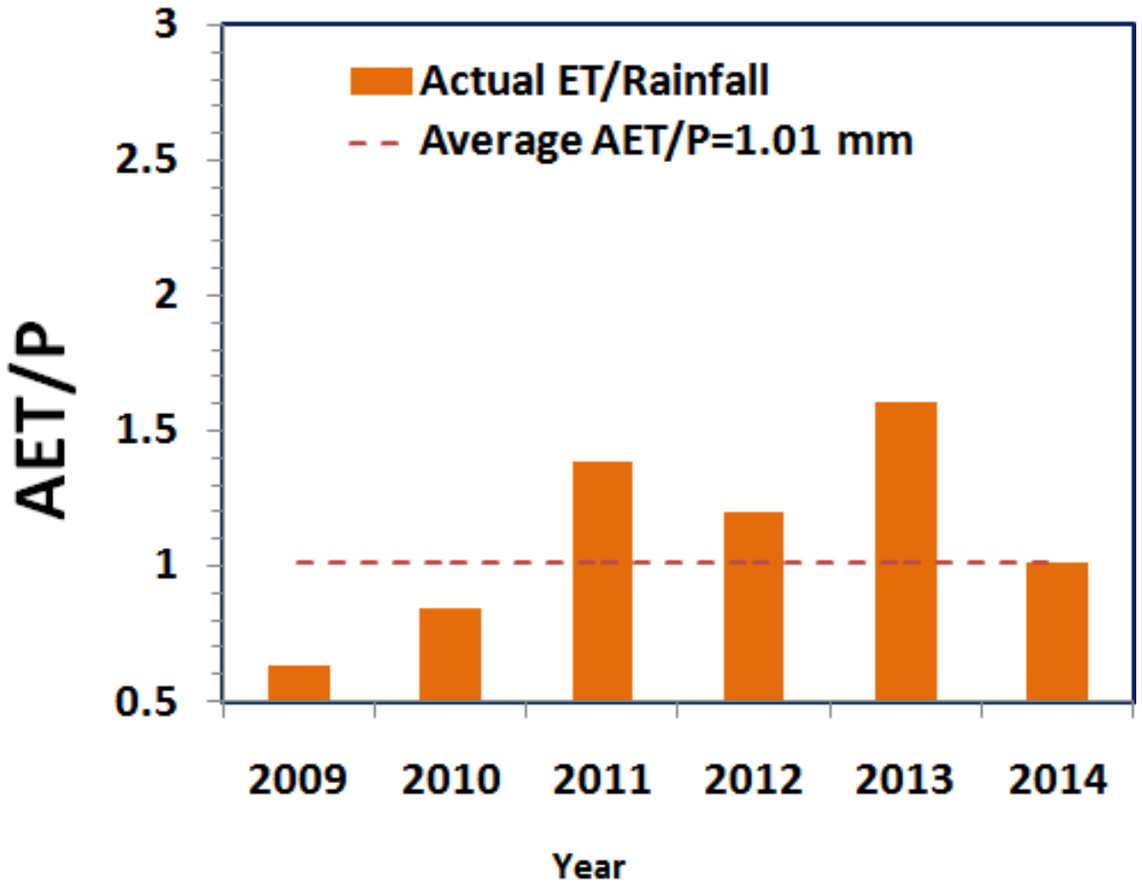


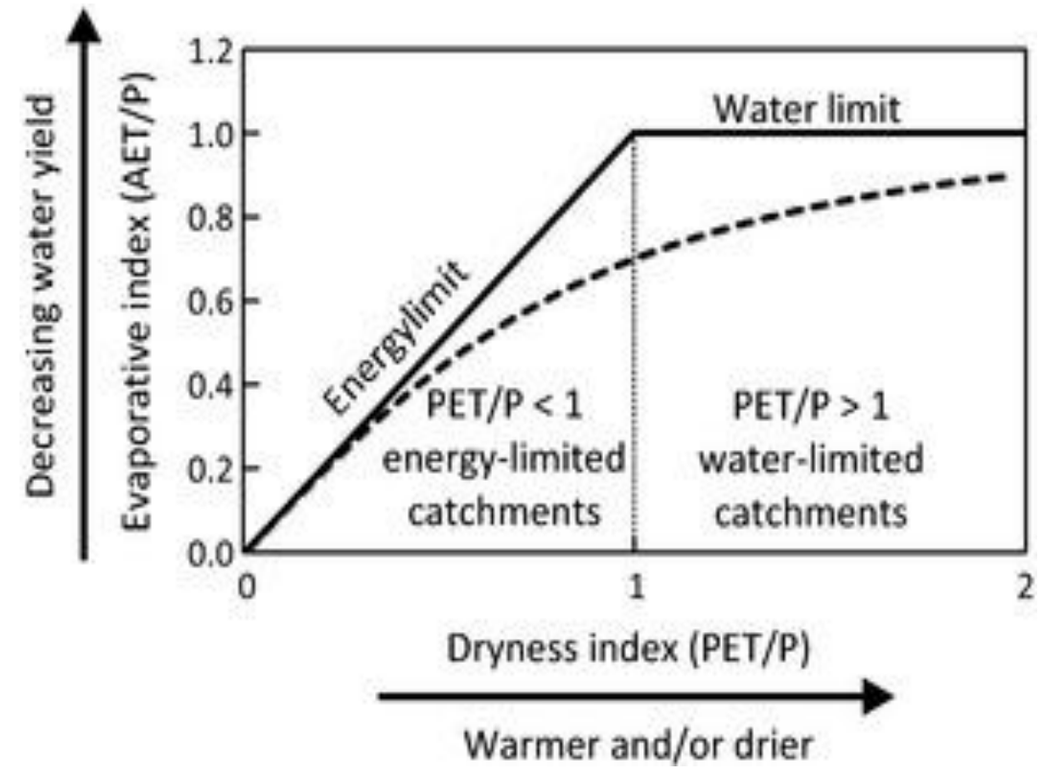




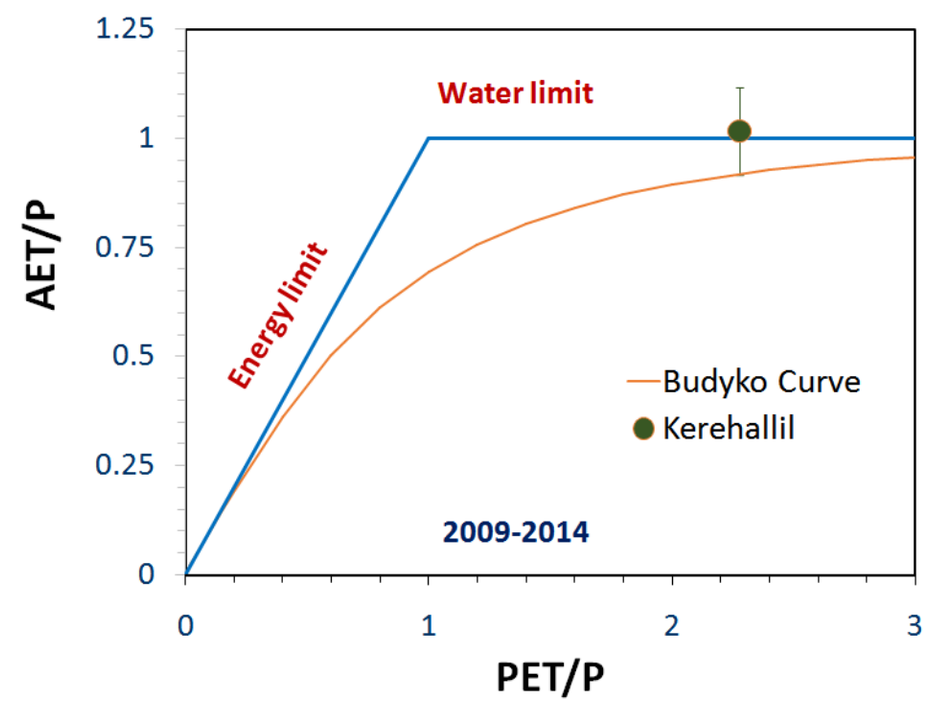
The average annual actual ET is higher than average annual rainfall. During *kharif*, average rainfall and ET was found to be 469 mm and 353 mm respectively, whereas in *rabi* it was about 124 mm and 200 mm. In comparison to the 2001-2009, the annual ET increased by 9% during 2010-2014.

EVAPOTRANSPIRATION INDEX

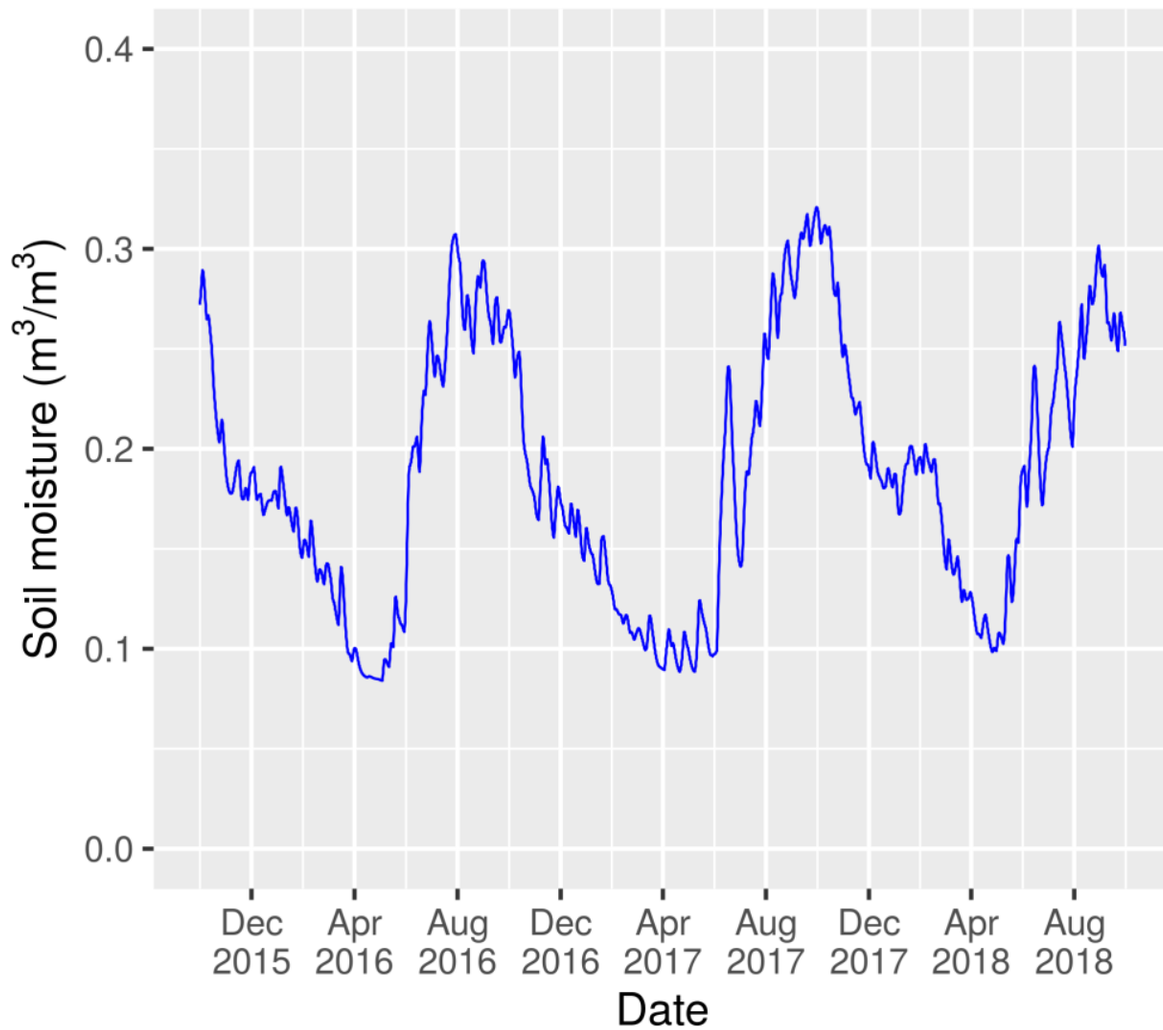




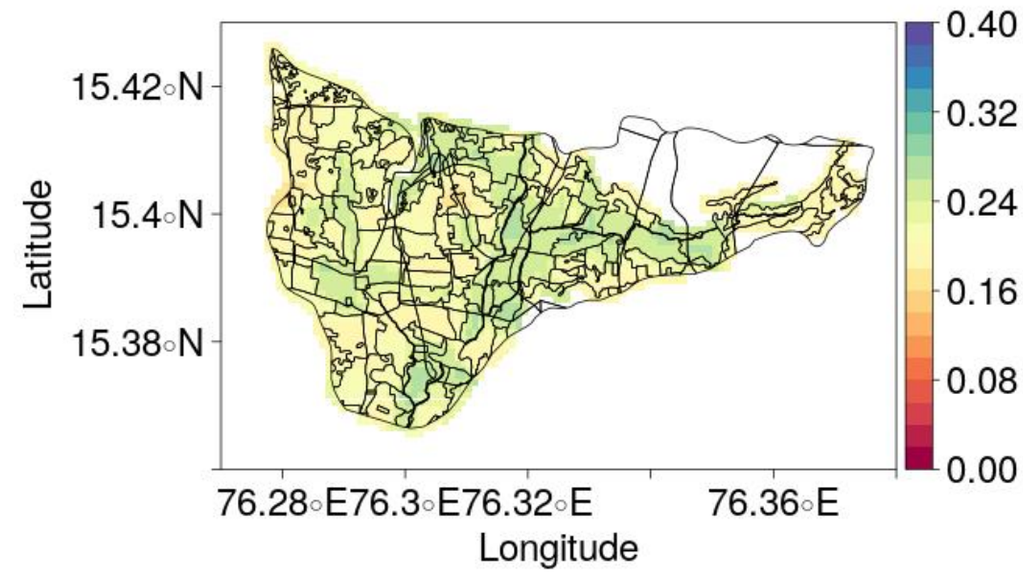
The average AET/P ratio was about 101%, which is higher than the sustainable limit of about 80%. Even during extremely lower rainfall year of 2013, AET was 712 mm. This suggests the presence of water storage and utilization from other sources such as groundwater, which buffered the lower rainfall.



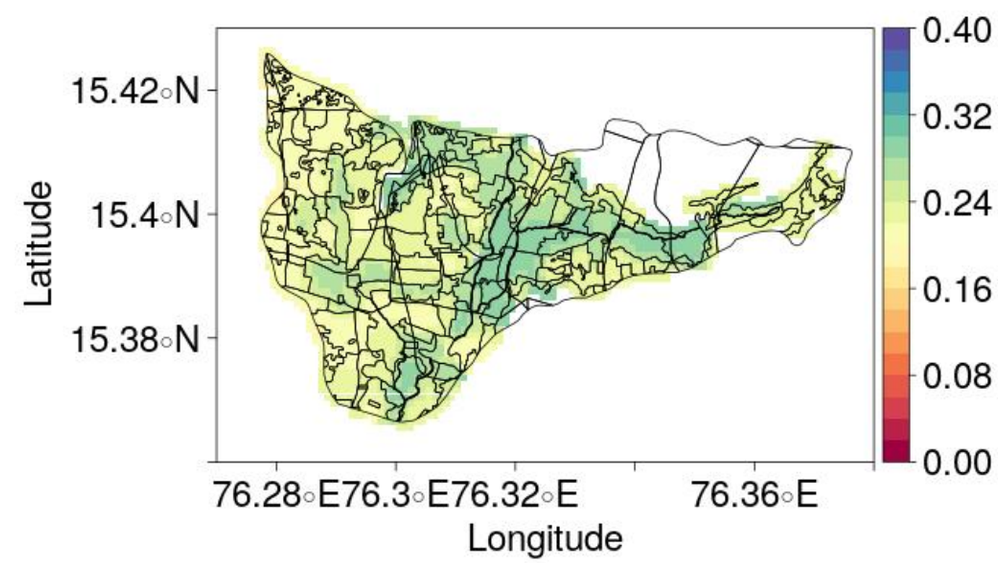
SATELLITE RETRIEVED SOIL MOISTURE



Kerehalli – Rabi Soil Moisture



Kerehalli – Kharif Soil Moisture

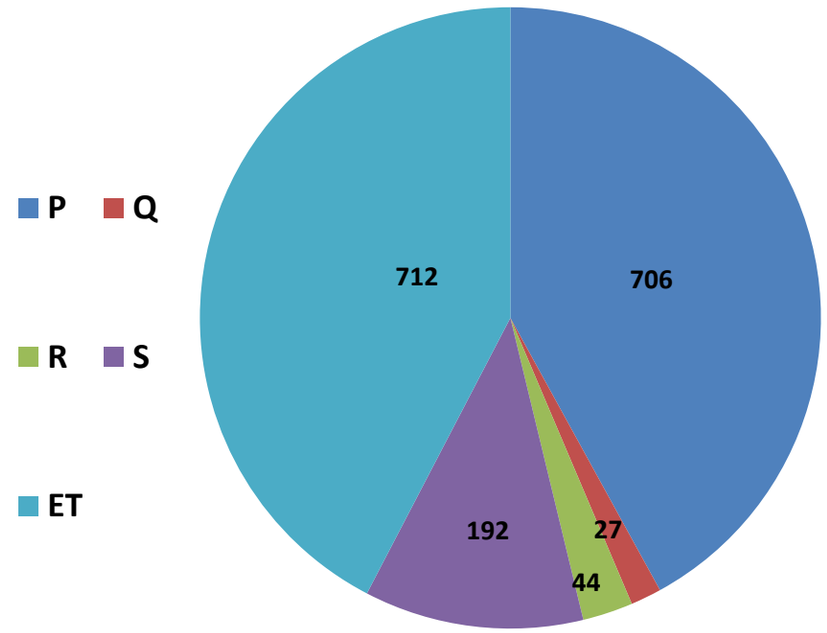


The method developed for retrieving soil moisture from multi-satellite observations allowed to map surface soil moisture behavior in the micro-watershed. The available surface moisture was varied in the range of 19-30 % in *kharif* and 16-27 % in *rabi* seasons of 2016, 10-30 % in *kharif* and 27-31% 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

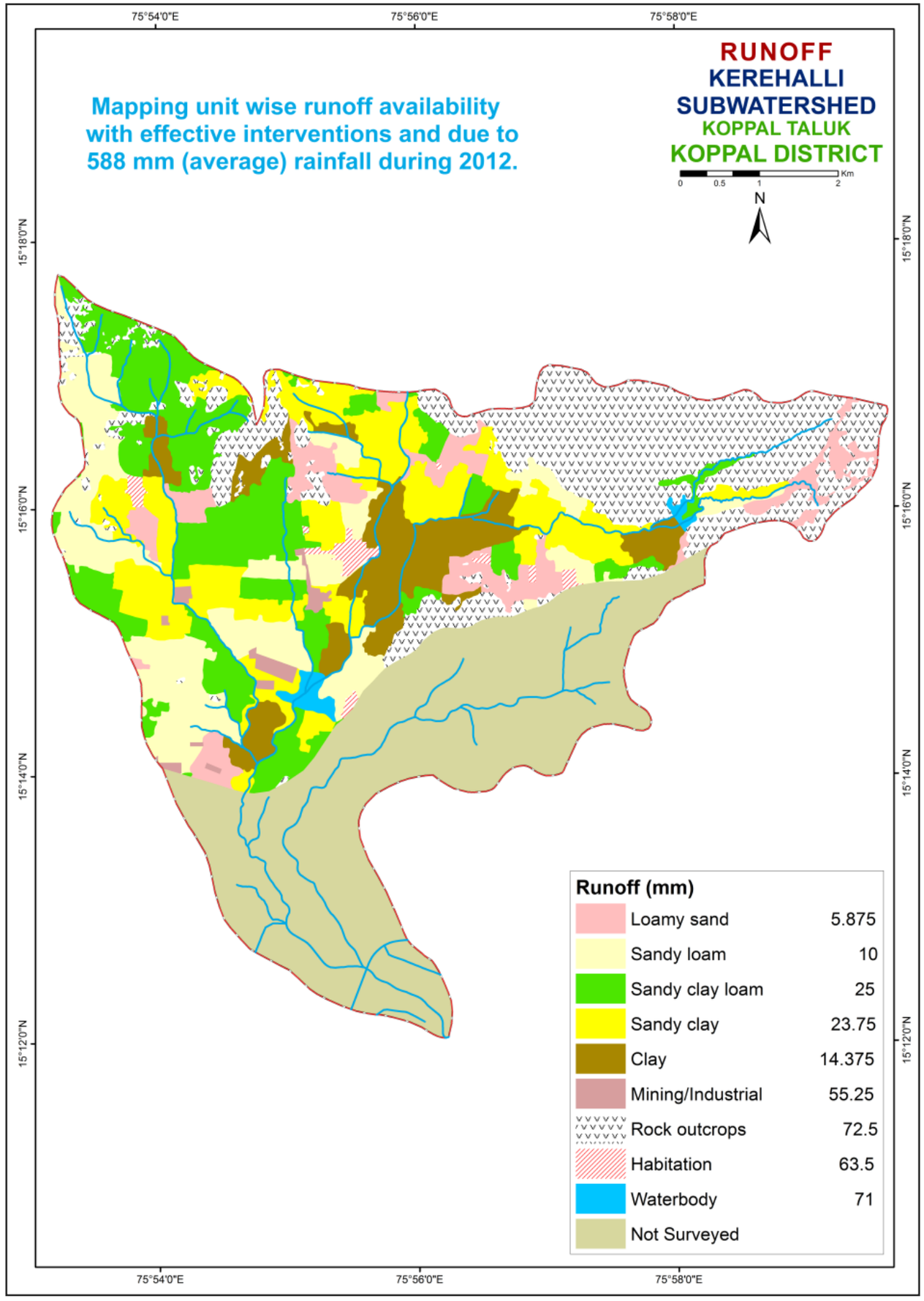


During August-September months, Precipitation is slightly higher than Evapotranspiration, hence Slight Runoff can occur in the watershed.

P = 706 mm (average of 2009-2017) ET = 712 mm R = 44 mm S = 192 mm Q = 27 mm

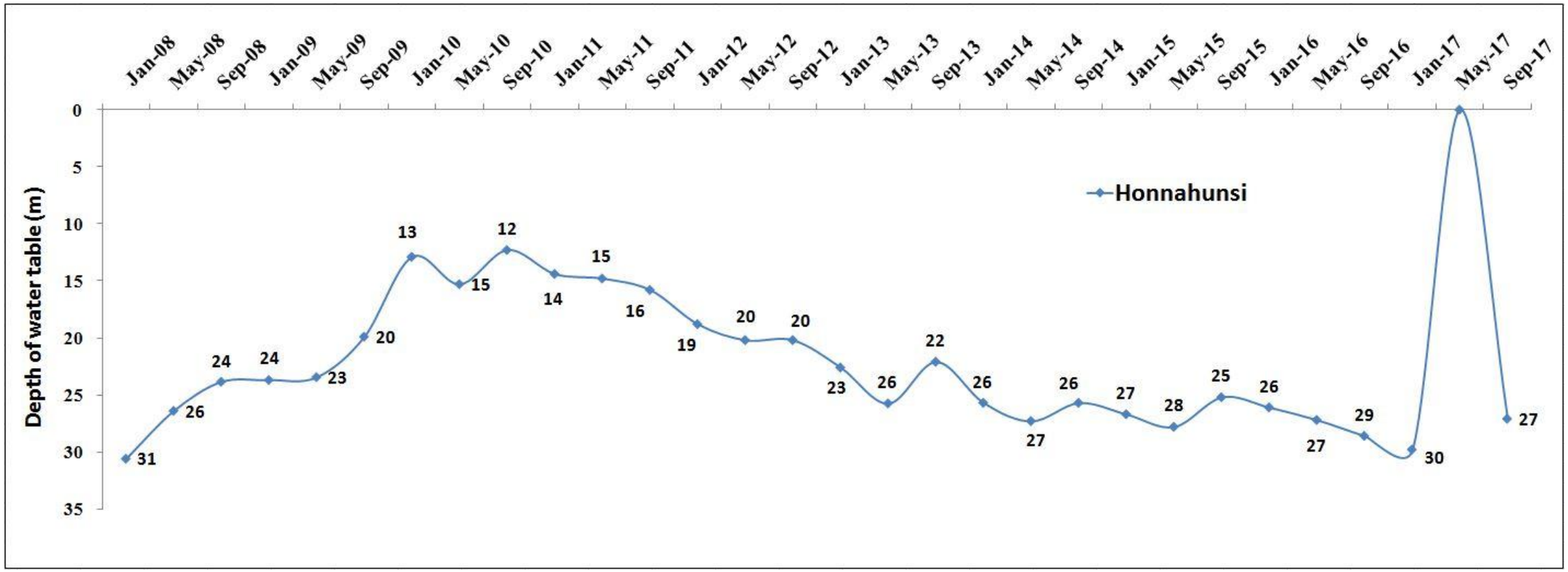
Sl. No.	Parameters	Average_ 2012 (mm)
1.	Rainfall	588
2.	Runoff availability with existing conditions	48
3.	Runoff availability with effective interventions	34
4.	Runoff allowed as environmental flow at the outlet	7
5.	Runoff excess for harvesting by construction of structures	27

RUNOFF


RUNOFF
KEREHALLI
SUBWATERSHED
KOPPAL TALUK
KOPPAL DISTRICT
Mapping unit wise runoff availability with effective interventions and due to 588 mm (average) rainfall during 2012.
0 0.5 1 2 Km
N
75°54'0"E
75°56'0"E
75°58'0"E
15°18'0"N
15°16'0"N
15°14'0"N
15°12'0"N
Runoff (mm)
Loamy sand 5.875
Sandy loam 10
Sandy clay loam 25
Sandy clay 23.75
Clay 14.375
Mining/Industrial 55.25
Rock outcrops 72.5
Habitation 63.5
Waterbody 71
Not Surveyed

GROUND WATER STATUS

HONNAHUNSI STATION



The total number of wells present in Kerehalli Sub-watershed as per LRI data are 186 (168-Borewells and 18-Openwells). The groundwater level was found from the data obtained from KSNDMC for the nearest station Honnahunsi. The above graph depicts the groundwater levels during the years 2008-2017 were slightly varying except for the year 2017. Deepest level was found in 2008.

SUMMARY

- The average annual rainfall of 631 mm in the Kerehalli sub-watershed as recorded from the Irakallagada station data by KSNDMC.

- 68 percent, 15 percent and 17 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 27 mm for an average annual rainfall of 706 mm (2009-2017). The utilizable groundwater is 31 mm (70% of 44 mm recharge estimated). This means the total available water resource combining the soil moisture store for kharif & rabi (192 mm) and utilizable runoff plus recharge is 250 (=192+31+27)

- The average actual evapotranspiration estimated in the watershed based on the current land use and irrigation practices for the kharif and rabi seasons is 553 mm. Hence the amount of water use for kharif and rabi seasons may be estimated as 691 mm (i.e 125% of AET). This demand for the two seasons is higher by 441 mm, i.e. (691-250). The AET in June-Sept months is 77% 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 Kerehalli Sub-watershed as per LRI data are 186 (168-Borewells and 18-Openwells). The groundwater level was found from the data obtained from KSNDMC for the nearest station Honnahunsi. Deepest level was found in 2008.