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ICAR - NBSS & LUP

ICAR-NBSS&LUP Sujala SWs-LRI Atlas No. 73

Land Resource and Hydrological Inventory of Hangala Sub-watershed for Watershed Planning and Development Gundlupet Taluk, Chamarajanagar District, Karnataka (AESR 8.2)

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



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

About ICAR - NBSS&LUP

The ICAR - 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 optimising 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 Hangala Sub-watershed for Watershed Planning and Development Gundlupet Taluk, Chamarajanagar District, Karnataka (AESR 8.2)

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How to read and use the Atlas

The Land Resource Inventory of Hangala sub-watershed (Gundlupet taluk, Chamarajanagar district) for Watershed Planning (AESR 8.2) 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 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 watershed.

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.

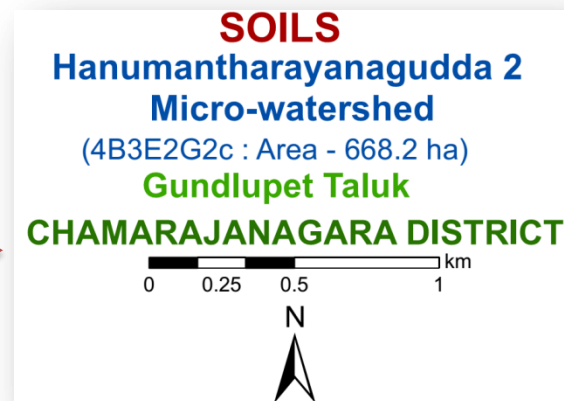
Inset map

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



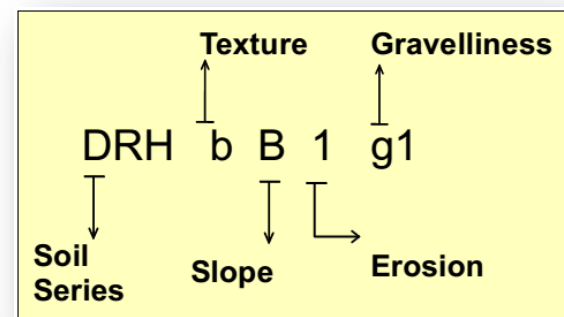
Legends and symbols

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.

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

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 Phases	Area in ha (%)
1, ARKiB1	10 (1.53)
2, ARKmB1	16 (2.42)
3, BMBmA1	34 (5.05)
4, DRHbB1g1	6 (0.96)
5, DRHbc2g1	2 (0.32)
6, DRHhb1g1	5 (0.7)
7, HGHmB1	32 (4.84)
8, KLPcB1g1	6 (0.95)
9, KNGmB1	14 (2.08)
10, MGHbB1g2	6 (0.86)
11, Forest	509 (76.11)
12, Others*	28 (4.18)

Land Management Units (LMU)

Grouping of similar soil areas based on their soil-site characteristics into management units that respond similarly for a given level of management are designated as land management units

LMU	Area in ha (%)
LMU-1	26 (3.95)
LMU-2	32 (4.84)
LMU-3	34 (5.05)
LMU-4	6 (0.95)
LMU-5	27 (4.06)
LMU-6	6 (0.86)
Forest	509 (76.11)
Others*	28 (4.18)

* - Waterbody

Map key

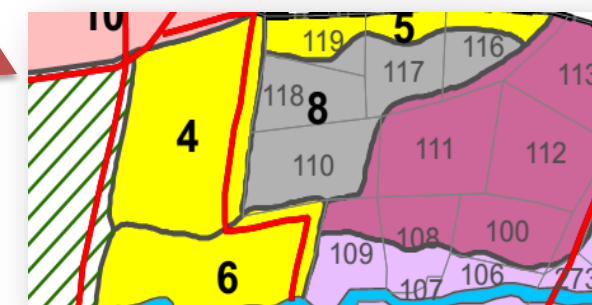
There are many thematic types to be differentiated on the map solely based on colour. Therefore soils and suitability types and their limitations are distinguished by colours with a combination of alpha-numeric characters.

KEY	
TEXTURE	
b	Loamy sand
c	Sandy loam
h	Sandy clay loam
i	Sandy clay
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 %)
DEPTH	
MGH,DRH	Moderately shallow (50-75 cm)
KNG	Moderately deep (75-100 cm)
KLP	Deep (100-150 cm)
HGH, BMB, ARK	Very deep (>150 cm)

Key	
S1	Highly Suitable
S2	Moderately Suitable
Limitations	
g	gravelliness
r	rooting condition
t	texture

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.



LAND RESOURCE INVENTORY OF HANAGALA SUB-WATERSHED FOR PLANNING

GUNDLUPET TALUK, CHAMARAJANAGAR DISTRICT

A pilot study by ICAR-NBSS&LUP, Bangalore

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.

Chamarajanagar district is located about 200 km away from the capital city of Karnataka. The district is located in the southern tip of Karnataka state. It is carved out of the original Mysore district and covers an area of about 510100 ha. Majority of the population is dependent on agriculture in the district. The geology of the district consists of Granite gneiss, Schist and Charnockite. The average annual rainfall in the district is 751 mm. The major crops grown are Maize, Sorghum, Groundnut, Sunflower, Cotton, Sugarcane, Greengram, Blackgram and Tomato etc.

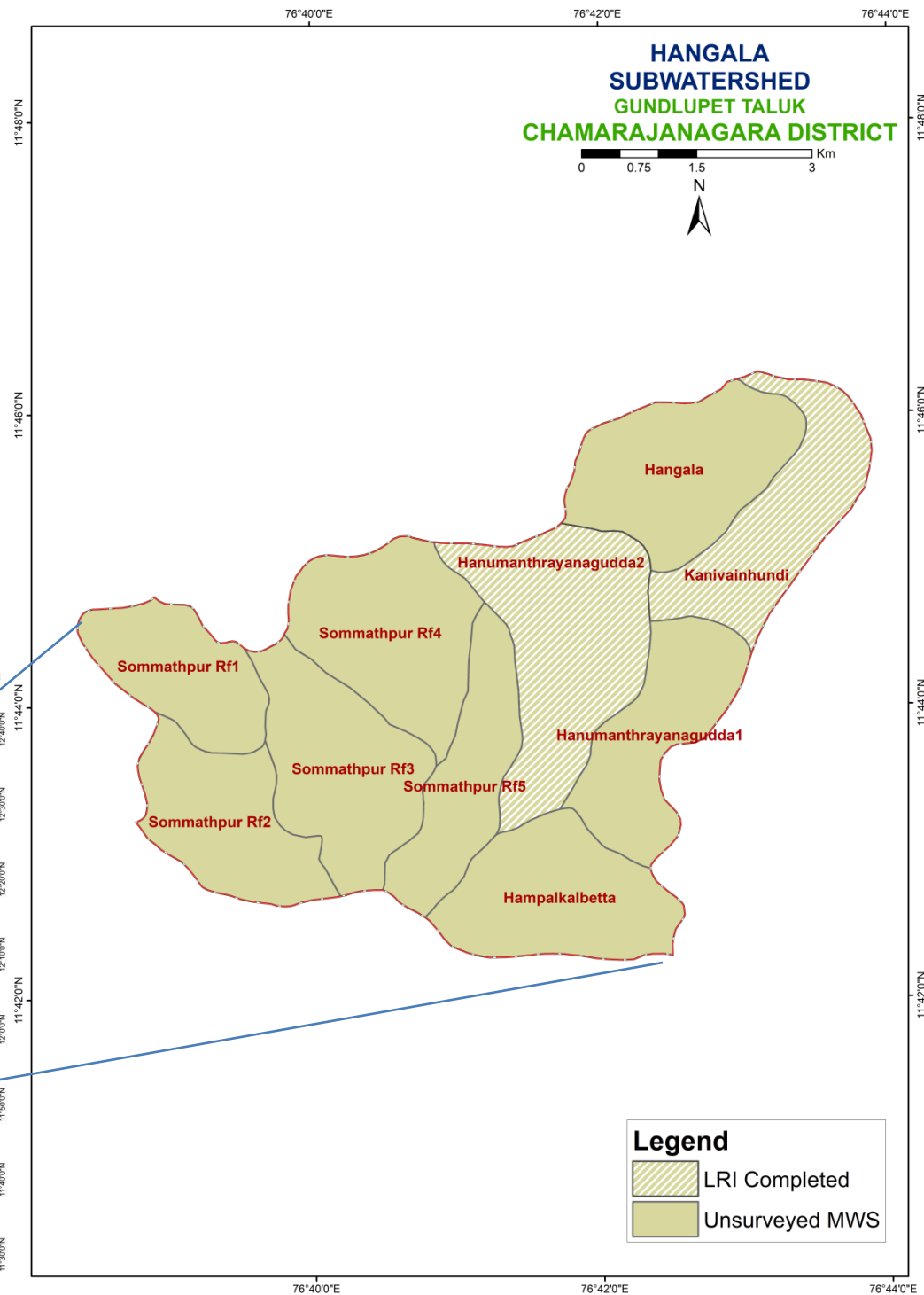
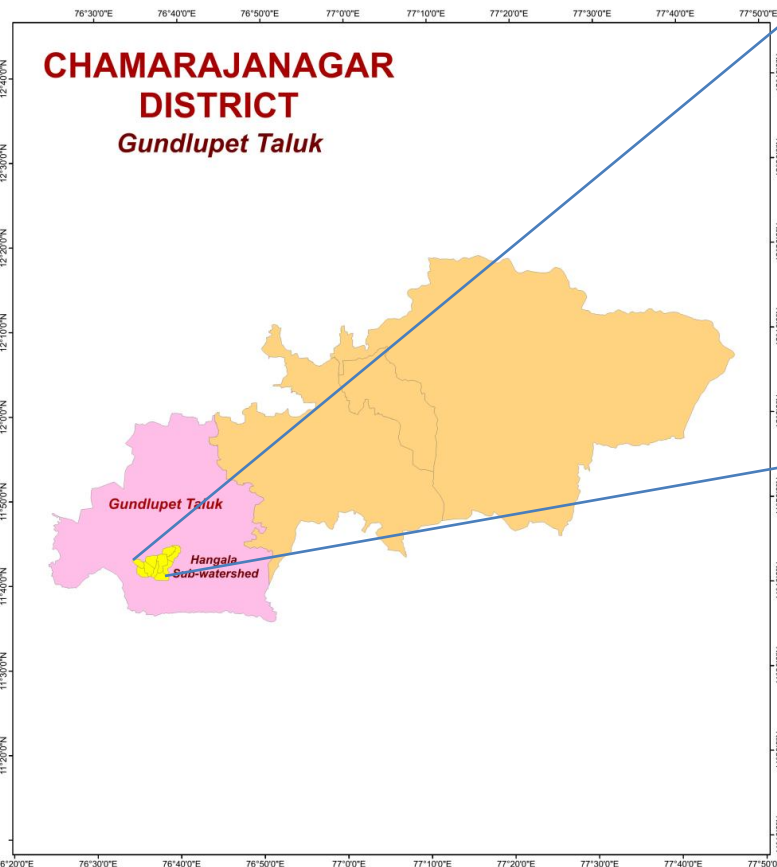
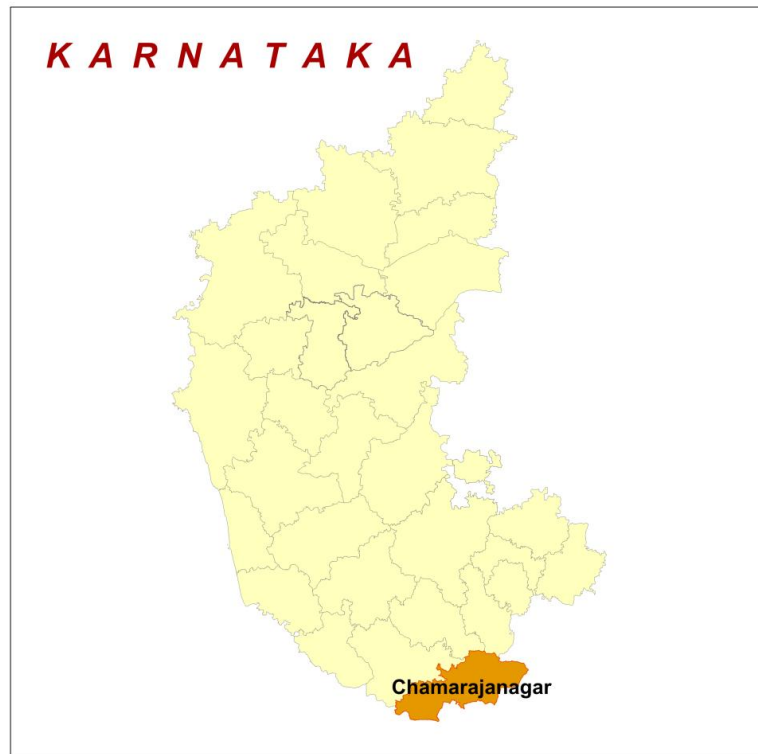
As a pilot study, **ICAR-NBSS&LUP, Bangalore** carried out the generation of LRI for the Hanagala sub-watershed in Gundlupet Taluk, Chamarajanagar District. It was selected for data base generation under batch V of Sujala III project. This sub-watershed encompasses of 10 MWs namely Kanivainhundi (4B3E2G2e), Hangala (4B3E2G2d), Hanumanthrayanagudda-1(4B3E2G2b), Hanumanthrayanagudda-2 (4B3E2G2c), Sommathpur Rf-4 (4B3E2G1d), Sommathpur Rf-1 (4B3E2G1a), Sommathpur Rf-5 (4B3E2G1e), Sommathpur Rf-3 (4B3E2G1c), Sommathpur Rf-2 (4B3E2G1b) and Hampalkalbeta (4B3E2G2a) micro watersheds. Land Resource Inventory (LRI) was generated for two (Hanumanthrayanagudda2-4B3E2G2c, Kanivainhundi-4B3E2G2e) among the ten micro-watersheds.

The major landforms identified in the micro-watersheds (Hanumantharayannagudda2 – 4B3E2G2c and Kanivaihundi - 4B3E2G2e) 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 Hangala Sub- watershed during February-March 2015 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.

LOCATION AND EXTENT

LOCATION MAP OF HANGALA SUB WATERSHED



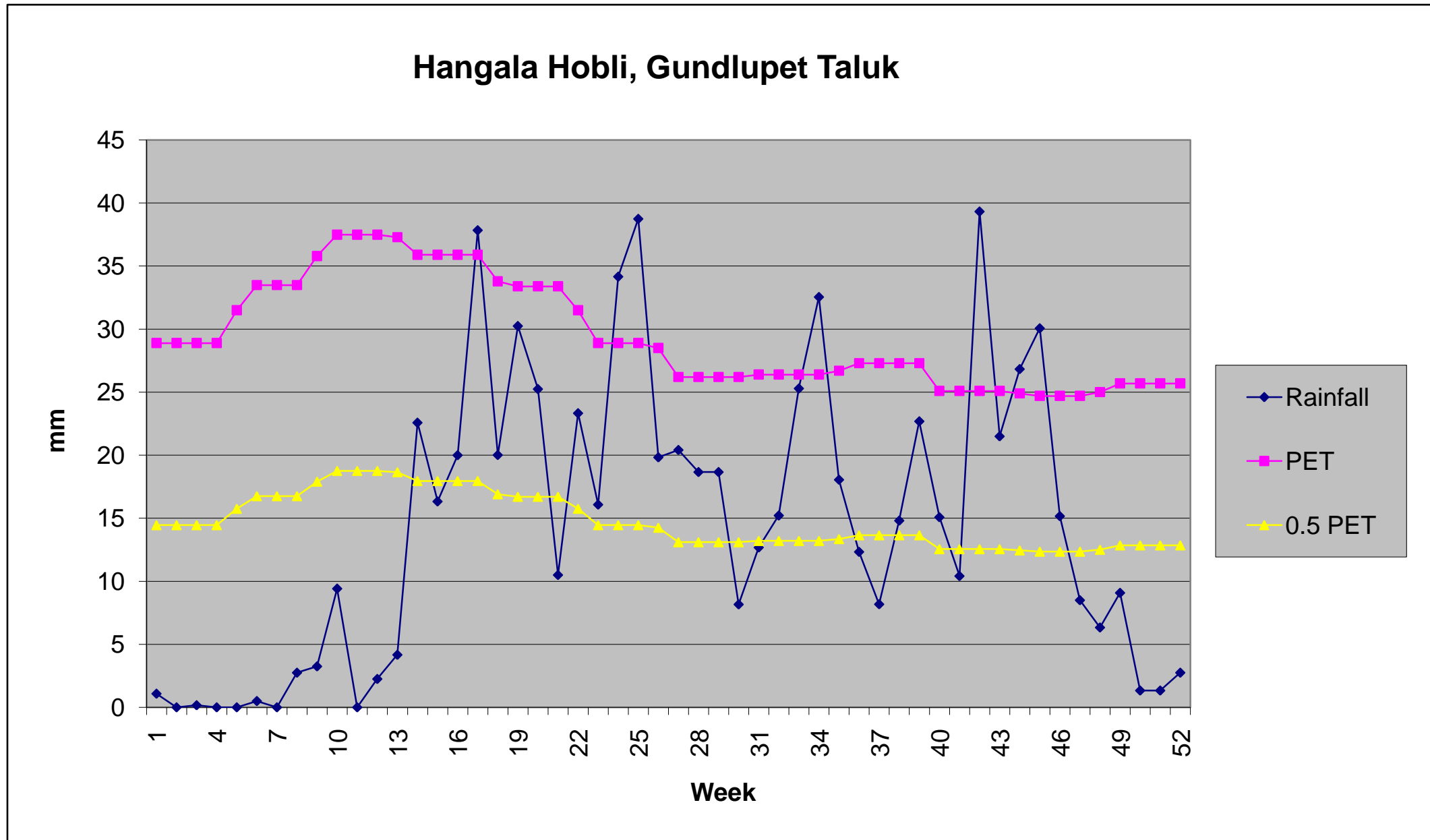
Hangala sub-watershed (Gundlupet taluk, Chamarajanagar district) is located between 11^o44'48"–11^o41'25" North latitudes and 76^o40'11"–76^o37'4" East longitudes, covering an area of about 4209 ha.

Agro Ecological Sub Region (AESR) 8.2: Central Karnataka Plateau, hot moist semi-arid ESR with medium to deep Red loamy soils, low AWC and LGP 120-150 days.

Agro-climatic Zone 6: Southern Dry Zone
It has a total geographical area of 1.56 M ha with 0.74 M ha under cultivation of which 0.22 M ha is irrigated. The mean elevation ranges from 450 to 900 m MSL; most part of the zone is situated at 800-900m. The major soils are red loams with pockets of black soils in Kollegal, Yalandur and T.N. Pura taluks of Mysore district. The average annual rainfall ranges from 670 to 890 mm, of which about 55 to 75 per cent is received during the kharif season. The major crops of the zone are rice, ragi, sugarcane, pulses and minor millets.

NOTE: In this Sub-Watershed, Land Resource Inventory (LRI) was generated for two micro-watersheds Hanumanthrayanagudda-2(4B3E2G2c) and Kanivainhundi (4B3E2G2e), among the ten micro-watersheds.

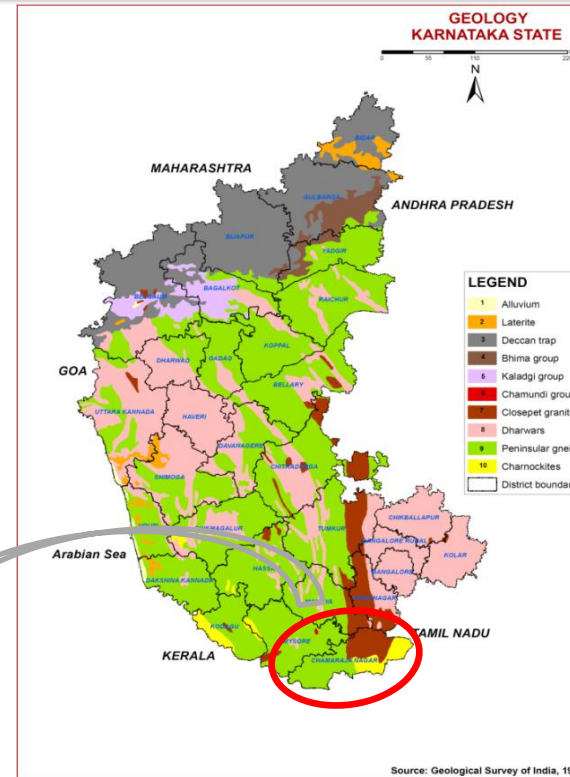
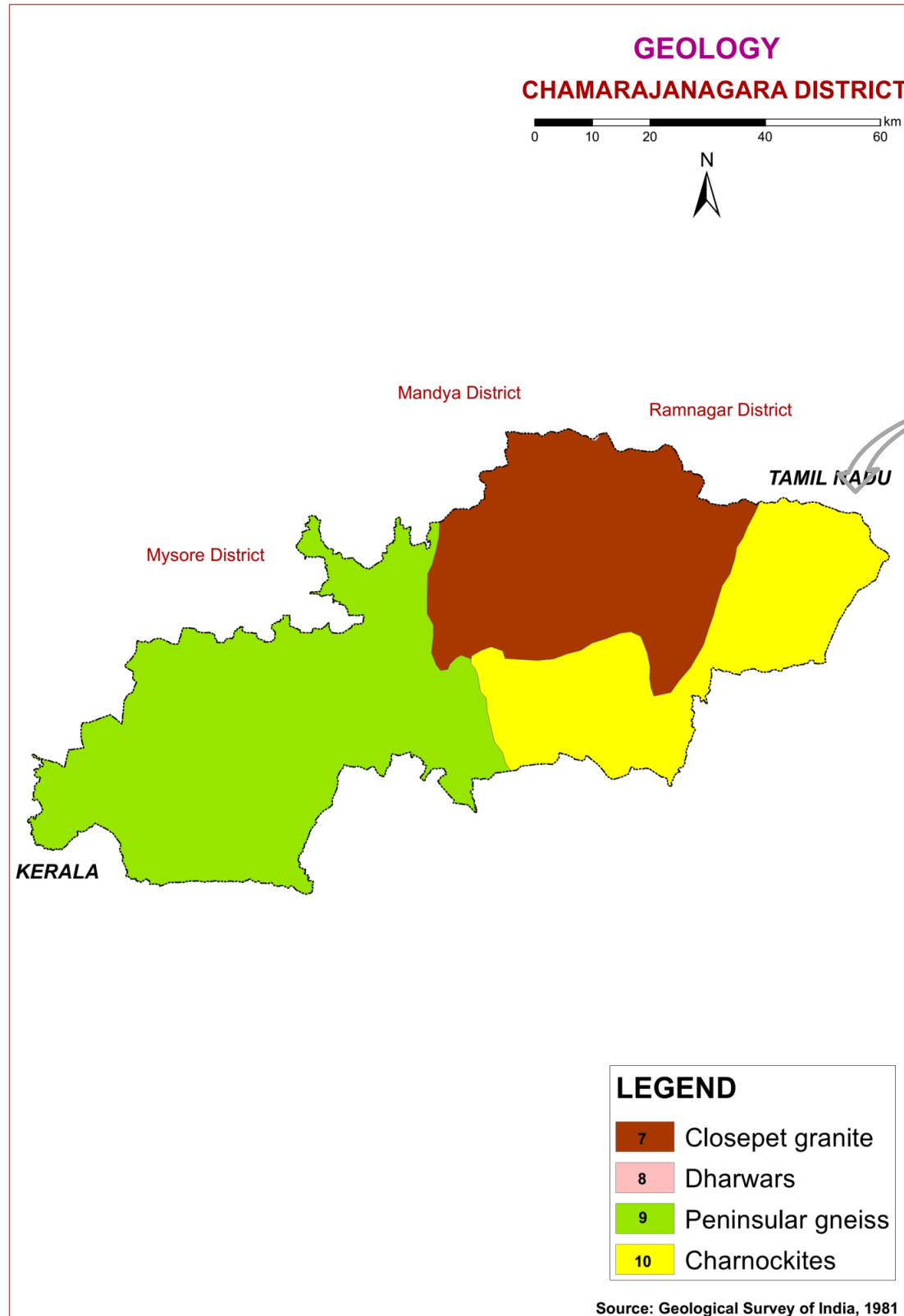
Climate



Length of Growing Period (LGP) is varying from May 2nd week to 1st week of October about 120-150 days and surplus occurs during November which may go either as run off or recharge of ground water.

Annual Rainfall : 754 mm. in the Hangala hobli, Gundlupet taluk

Geology



GEOLOGY - KARNATAKA STATE

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

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

GEOLOGY - CHAMARAJANAGARA DISTRICT

Upper Proterozoic group: Formations of the Upper Proterozoic in Karnataka are closepet granites, Chamundi granites, Kaladgi series and Bhima series. Out of these ChamaraJanagara district consists of Closepet granites.

Closepet granites

Closepet granites are also known as Ramanagaram granites, constitute a well-defined range of hills and composed of various types of granite, granodiorite and granite porphyry

Archaean group: The Archaean group of rocks of Karnataka are the oldest formations (> 3000 million years) of the earth's crust. They are unfossiliferous, thoroughly crystalline, extremely contorted and faulted rocks, with well-defined foliated structure. They are intruded by plutonic rocks. The important formations of this group are Peninsular Gneiss, Dharwar schists, and Charnockites.

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.

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.

Charnockites

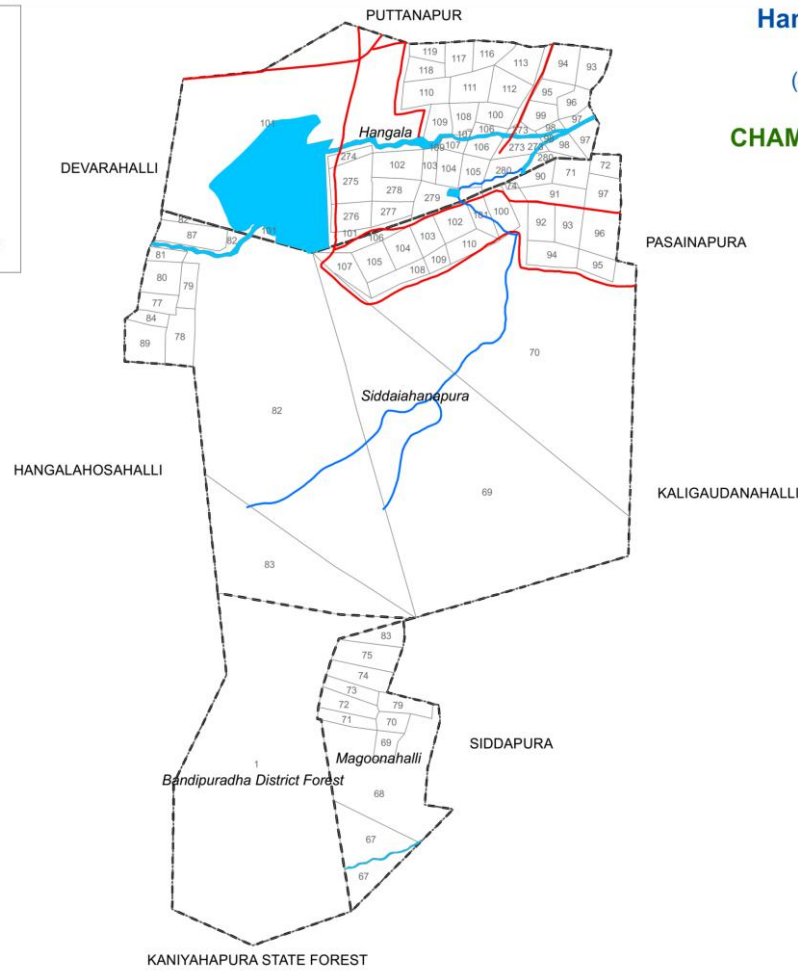
These are considered to be rocks of plutonic origin that have undergone recrystallization. The group includes a wide variety of rocks ranging in composition from acid to ultramafic, characterized by the presence of orthopyroxene (hypersthene) and blue quartz. They are generally black in colour, and banding is common.

SURVEY METHODOLOGY

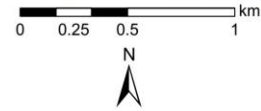
Sequence of activities in generation of LRI

- 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 (250m 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.

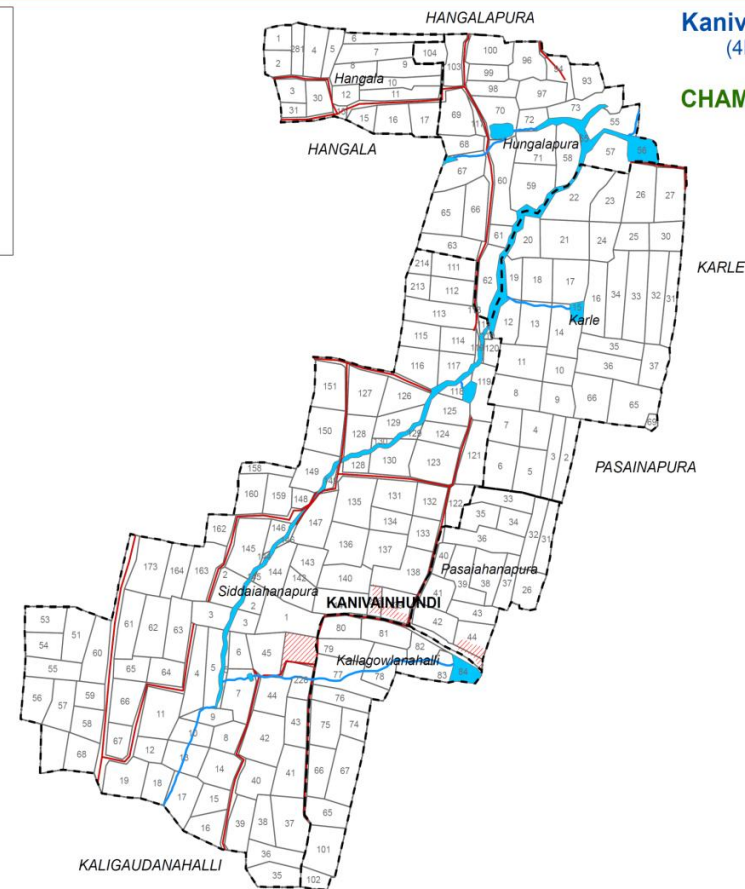


**Hanumantharayanagudda 2
Micro-watershed**
(4B3E2G2c : Area - 668.2 ha)
Gundlupet Taluk
CHAMARAJANAGARA DISTRICT

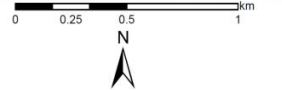


- References**
- Streams/Drainage
 - Road/Cart track
 - Water body
 - Land parcel with No's
 - Village boundary
 - Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

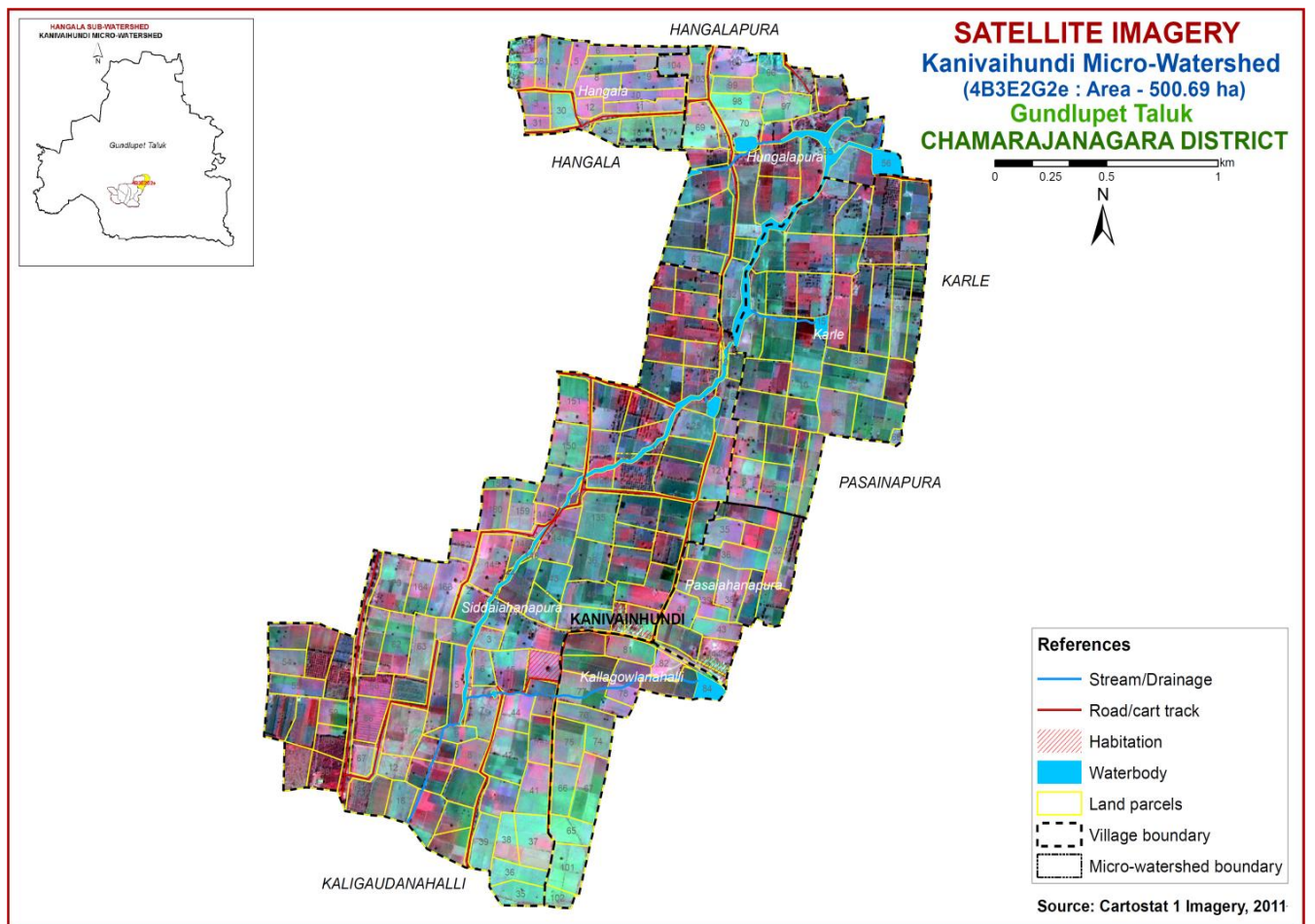
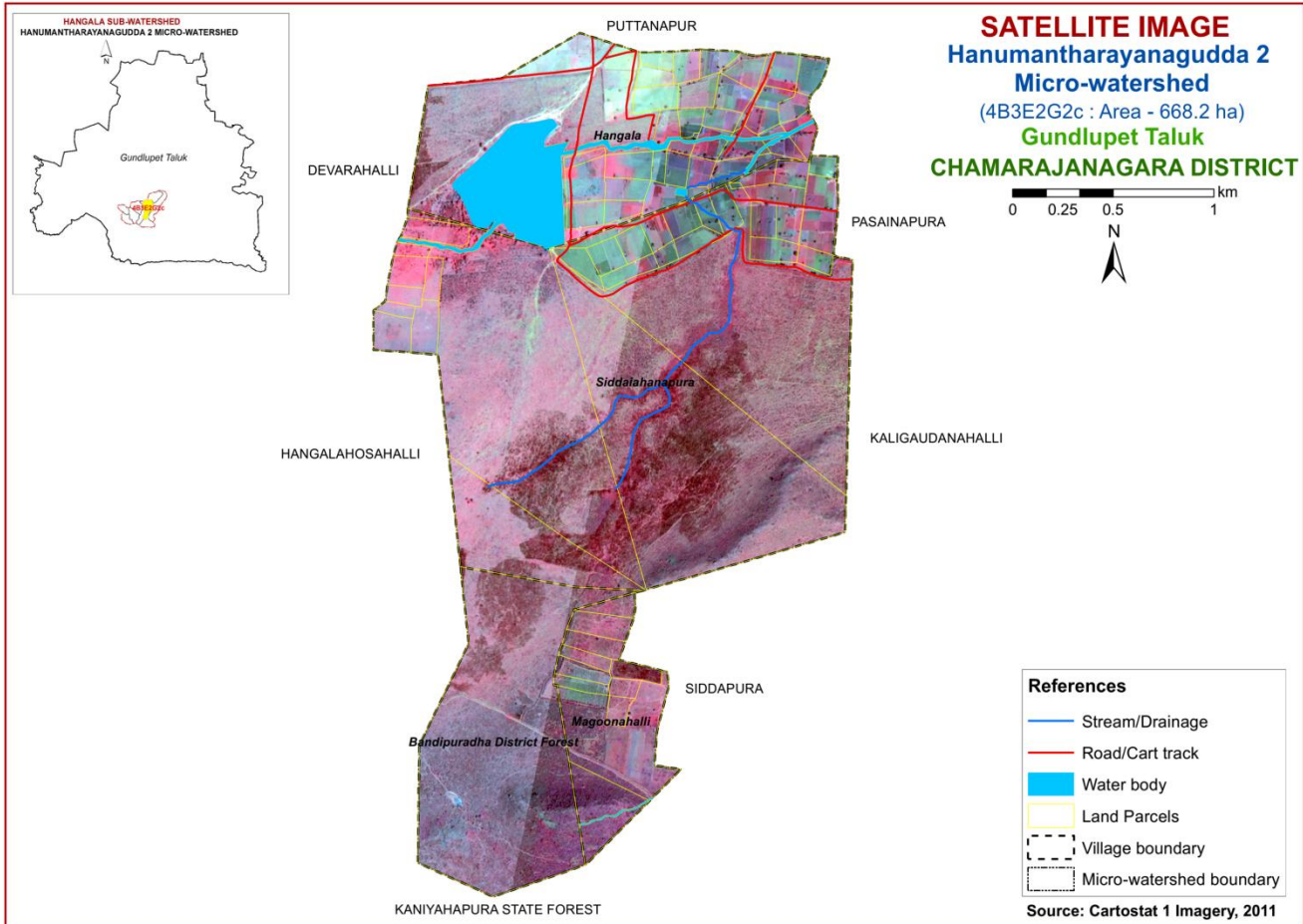


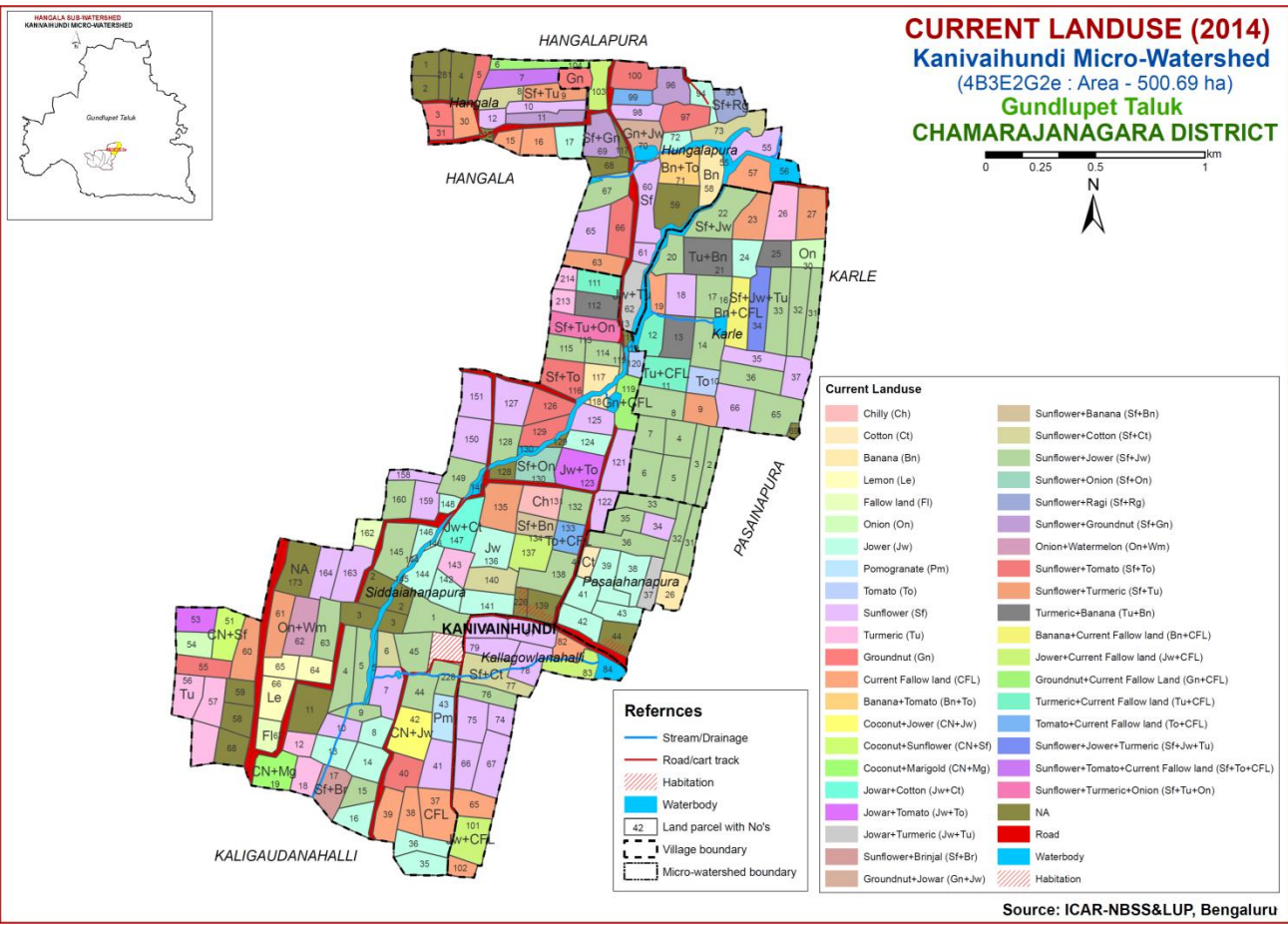
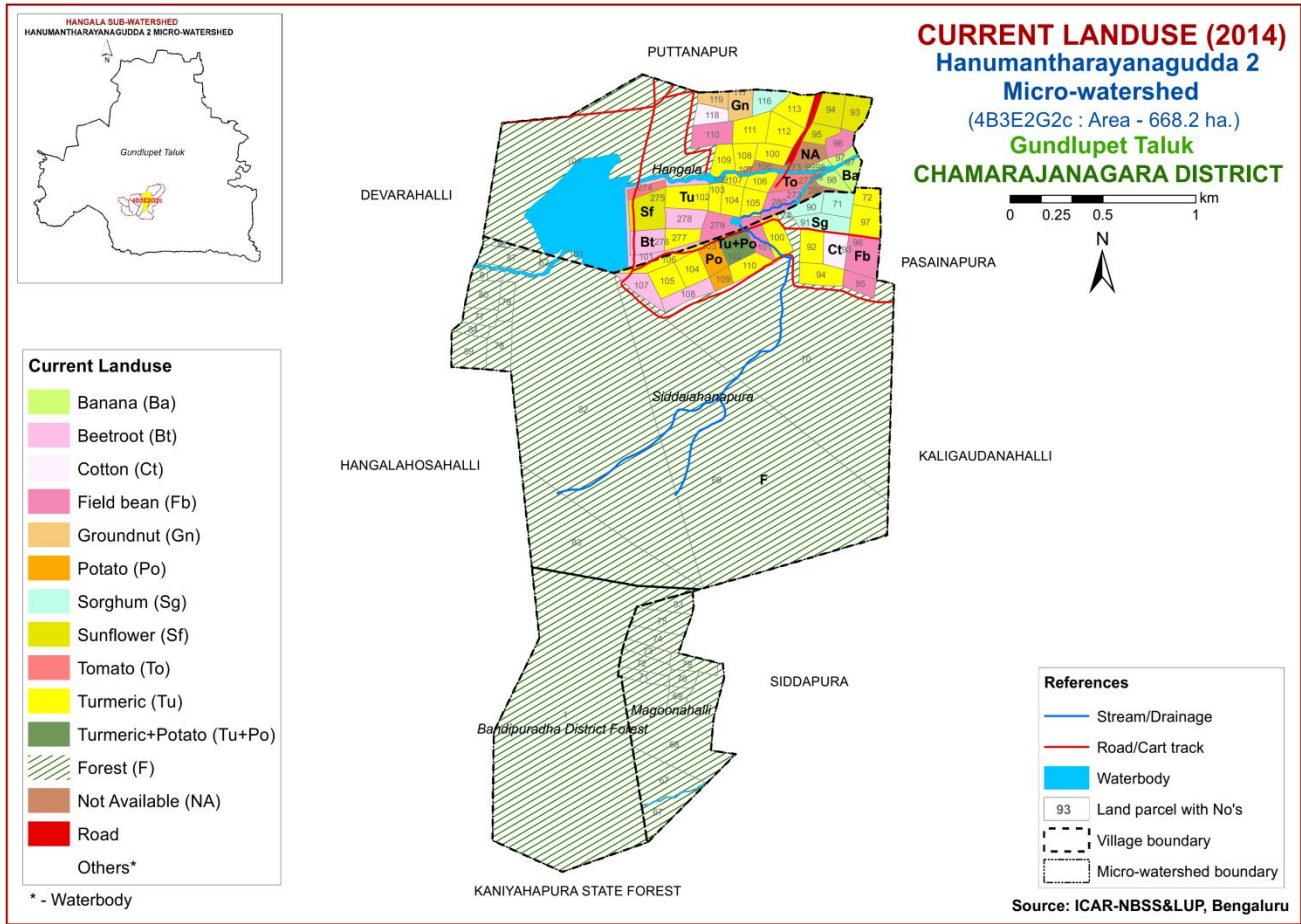
Kanivaihundi Micro-Watershed
(4B3E2G2e : Area - 500.69 ha)
Gundlupet Taluk
CHAMARAJANAGARA DISTRICT

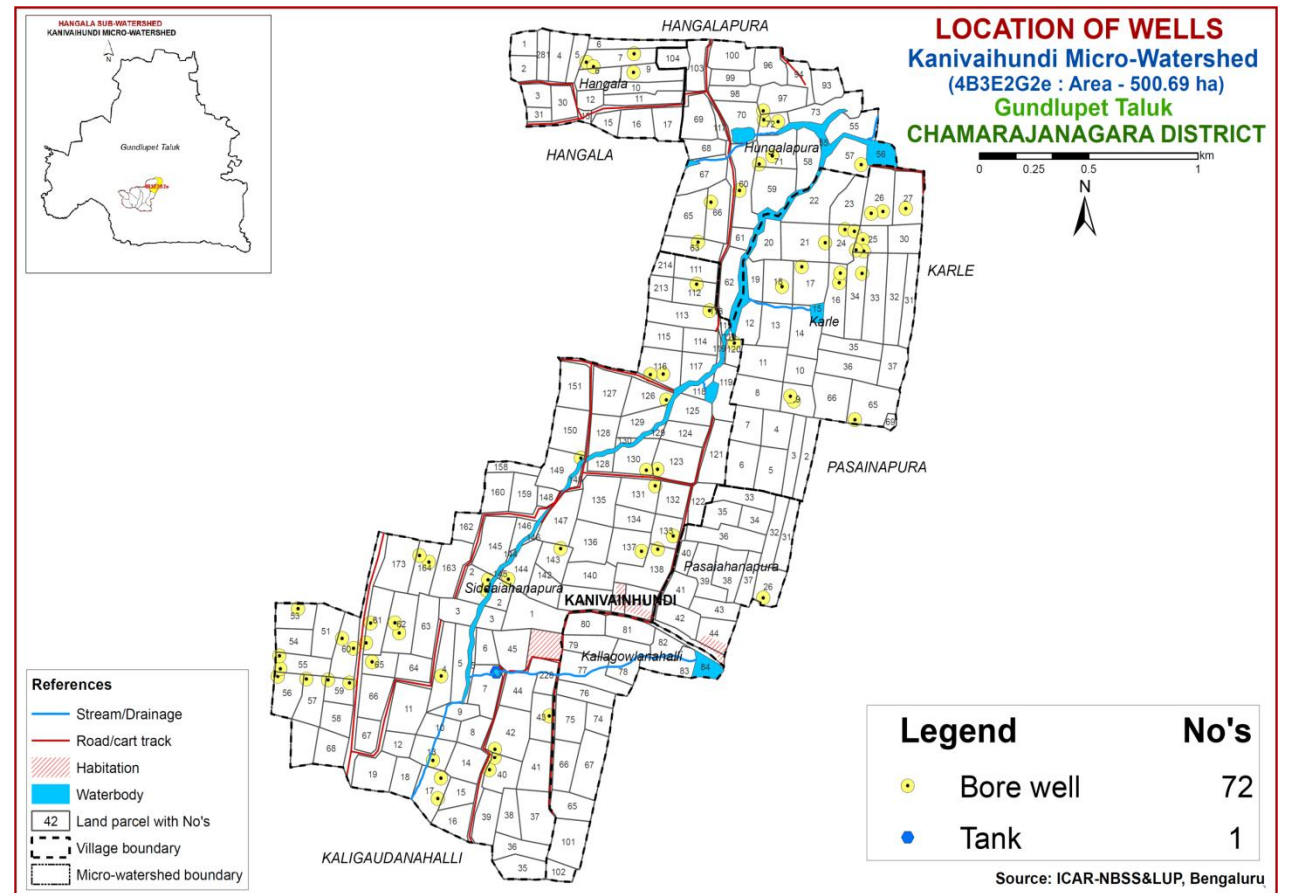
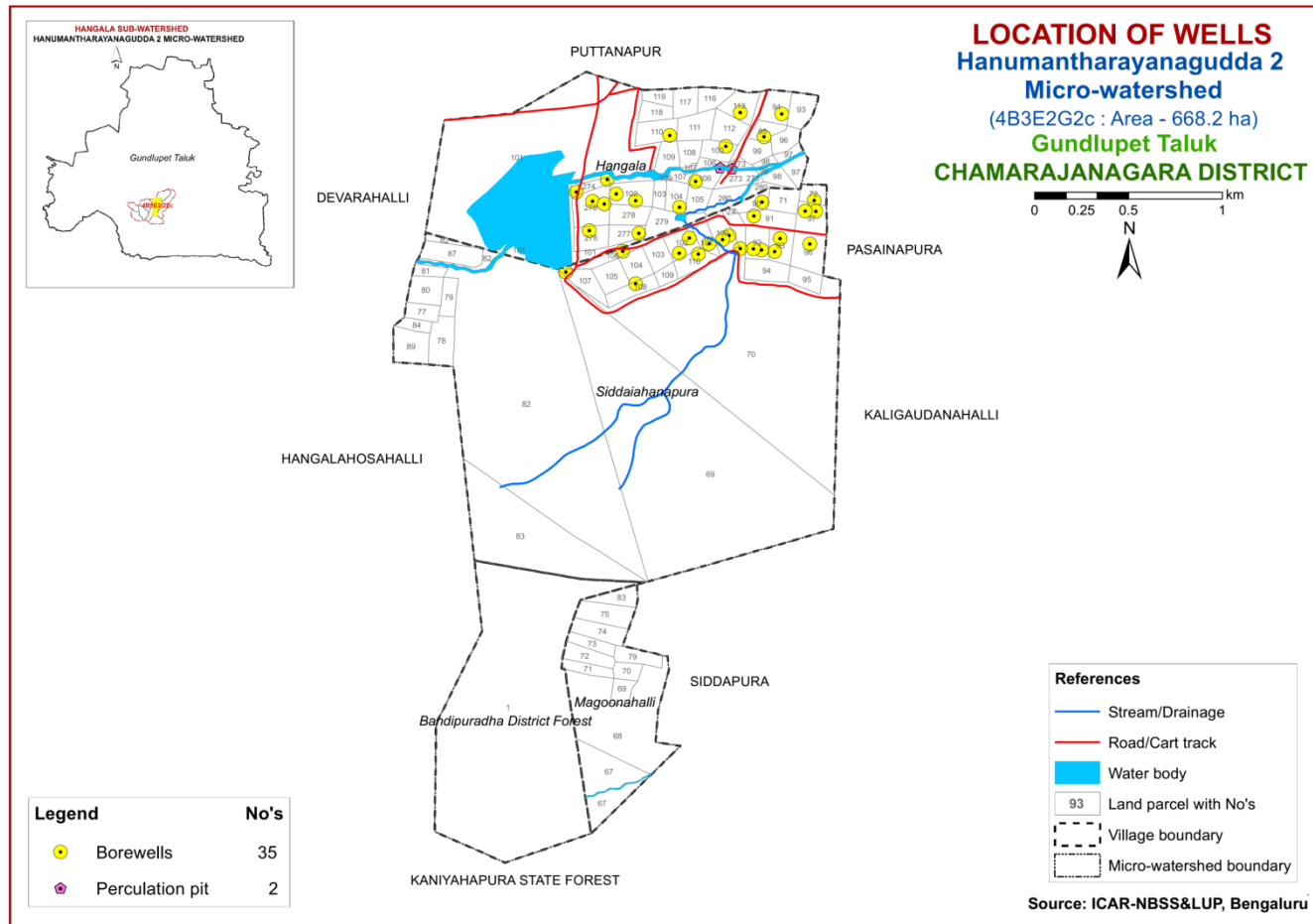


- References**
- Stream/Drainage
 - Road/cart track
 - Habitation
 - Waterbody
 - Land parcel with No's
 - Village boundary
 - Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru



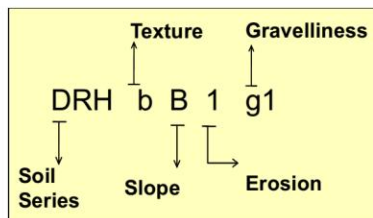
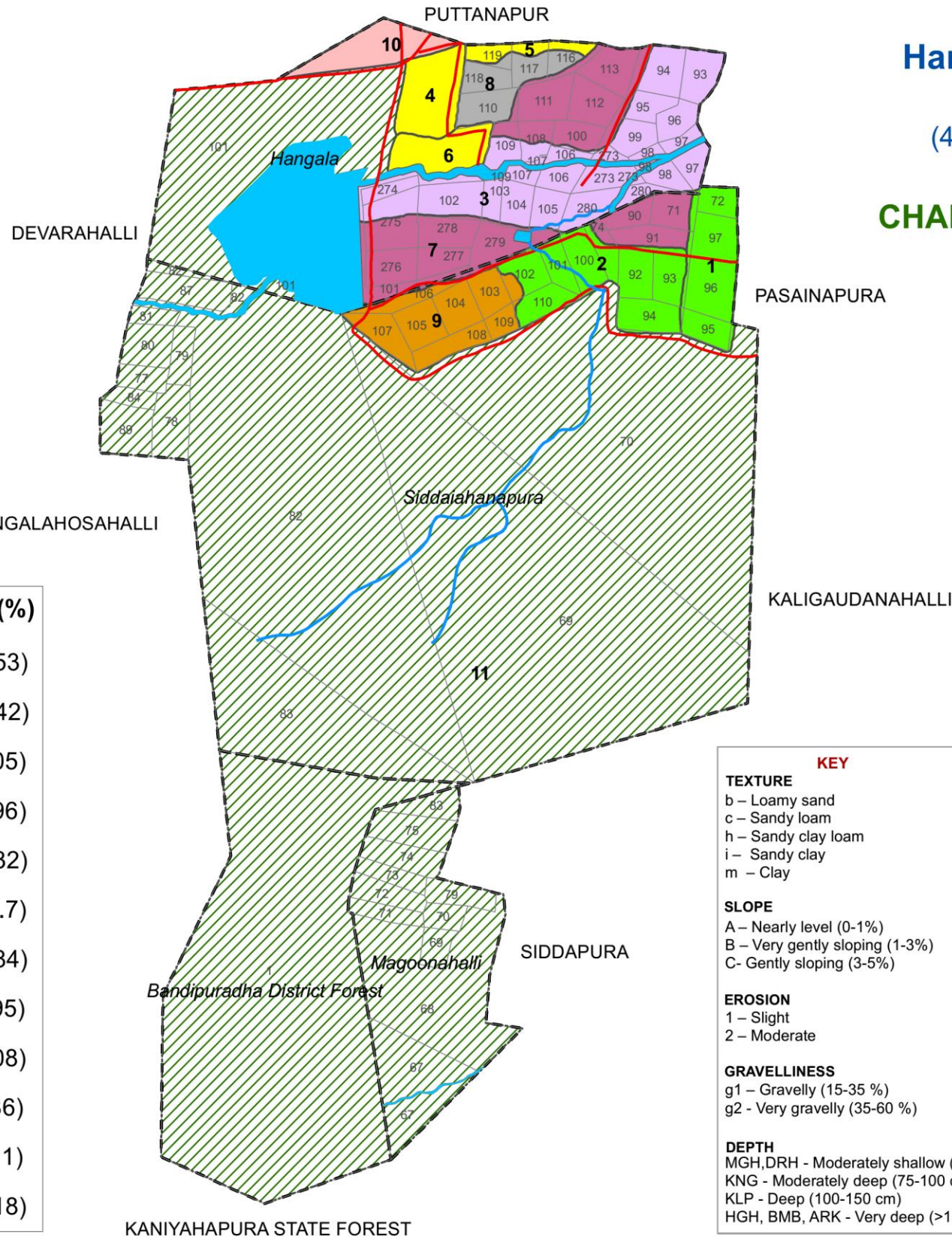
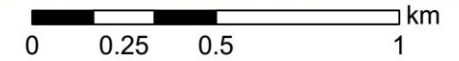




SOILS

Hanumantharayanagudda 2 Micro-watershed

(4B3E2G2c : Area - 668.2 ha)
Gundlupet Taluk
CHAMARAJANAGARA DISTRICT



Soil Phases	Area in ha (%)
1, ARKiB1	10 (1.53)
2, ARKmB1	16 (2.42)
3, BMBmA1	34 (5.05)
4, DRHbB1g1	6 (0.96)
5, DRHbC2g1	2 (0.32)
6, DRHhB1g1	5 (0.7)
7, HGHmB1	32 (4.84)
8, KLPcB1g1	6 (0.95)
9, KNGmB1	14 (2.08)
10, MGHbB1g2	6 (0.86)
11, Forest	509 (76.11)
12, Others*	28 (4.18)

* - Waterbody

KEY

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

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

EROSION
 1 - Slight
 2 - Moderate

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

DEPTH
 MGH, DRH - Moderately shallow (50-75 cm)
 KNG - Moderately deep (75-100 cm)
 KLP - Deep (100-150 cm)
 HGH, BMB, ARK - Very deep (>150 cm)

References

- Stream/Drainage
- Road/Cart track
- Water body
- Land parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

Table 1.Mapping unit description of Hanumantharayanagudda-2 Micro-watershed in Gundlupet Taluk, Chamarajanagara District

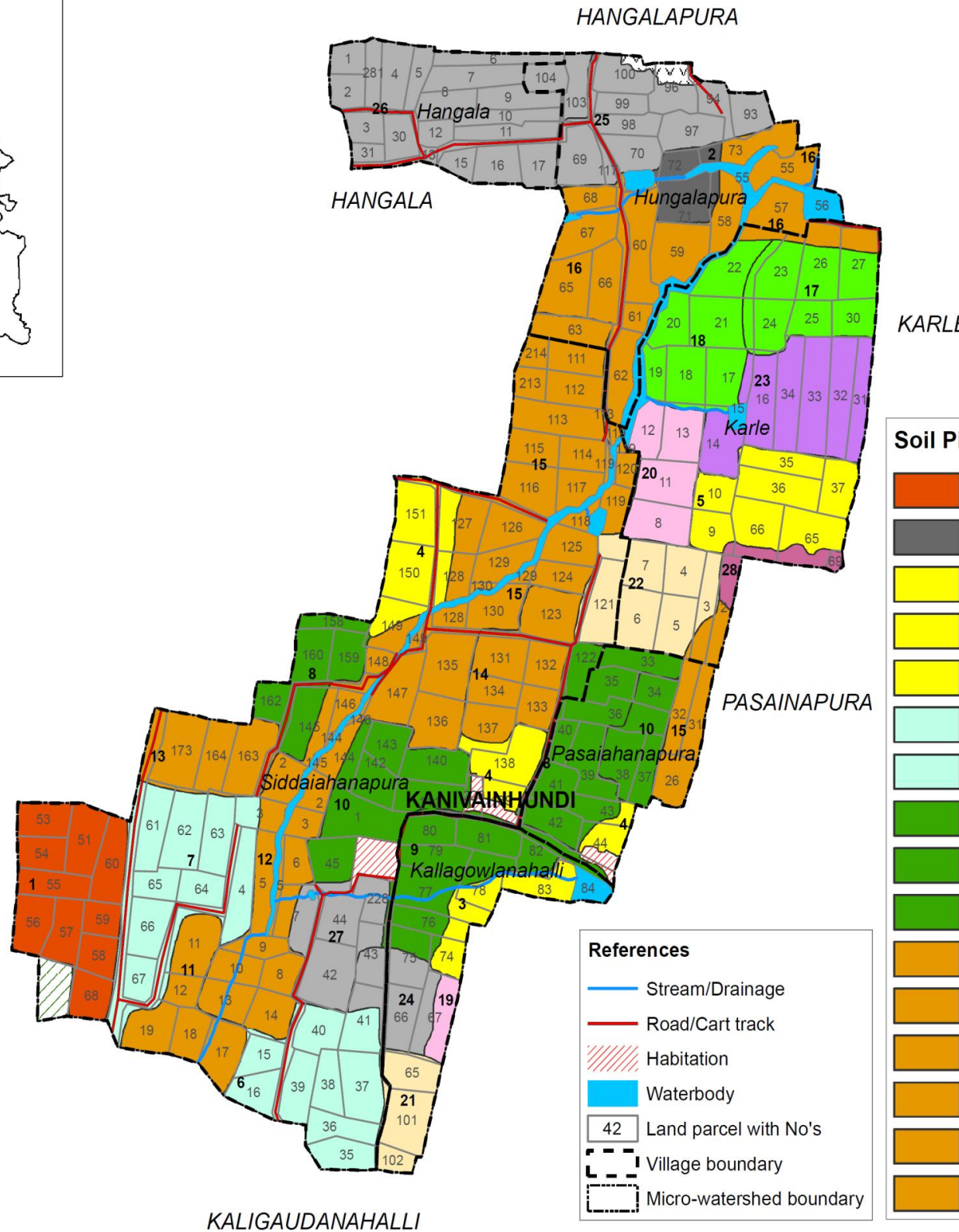
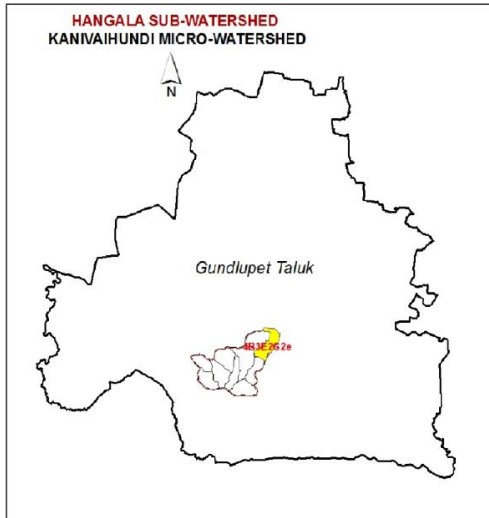
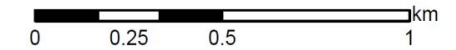
Soil No*	Soil Series	Soil Phases	Mapping unit description	Area in ha (%)
	ARK		Annurkeri soils are very deep (>150 cm), well drained, have dark reddish brown to very dusky red sandy clay to clay soils occurring on very gently sloping uplands under cultivation.	26.36 (3.95)
1		ARKiB1	Sandy clay surface, slope 1-3%, slight erosion	10.19 (1.53)
2		ARKmB1	Clay surface, slope 1-3%, slight erosion	16.17 (2.42)
	BMB		Beemanabeedu soils are very deep (>150 cm), moderately well drained, have very dark greyish brown to dark grey and very dark brown clayey soils occurring on nearly level to very gently sloping lowlands under cultivation	33.77 (5.05)
3		BMBmA1	Clay surface, slope 0-1%, slight erosion	33.77 (5.05)
	DRH		Devarahalli soils are moderately shallow (50-75 cm), well drained, have dark red to reddish brown and dusky red gravelly sandy clay loam to sandy clay soils occurring on very gently to gently sloping uplands under cultivation	13.25 (1.98)
4		DRHbB1g1	Loamy sand surface, slope 1-3%, slight erosion, gravelly (15-35%)	6.44 (0.96)
5		DRHbC2g1	Loamy sand surface, slope 3-5%, moderate erosion, gravelly (15-35%)	2.13 (0.32)
6		DRHhB1g1	Sandy clay loam surface, slope 1-3%, slight erosion, gravelly (15-35%)	4.68 (0.70)
	HGH		Honnegaudanahalli soils are very deep (>150 cm), well drained, have very dark brown to brown and dark reddish brown sandy clay loam soils occurring on very gently sloping uplands under cultivation.	32.36 (4.84)
7		HGHmB1	Clay surface, slope 1-3%, slight erosion	32.36 (4.84)
	KLP		Kallipura soils are deep (100-150 cm), well drained, have dark reddish brown to dark red gravelly sandy clay loam to sandy clay soils occurring on very gently sloping uplands under cultivation.	6.35 (0.95)
8		KLPcB1g1	Sandy loam surface, slope 1-3%, slight erosion, gravelly (15-35%)	6.35 (0.95)
	KNG		Kannigala soils are moderately deep (75-100 cm), well drained, have dark reddish brown to dark red gravelly sandy clay loam to sandy clay soils occurring on very gently sloping uplands and strongly sloping mounds and ridges.	13.87 (2.08)

Soil No*	Soil Series	Soil Phases	Mapping unit description	Area in ha (%)
9		KNGmB1	Clay surface, slope 1-3%, slight erosion	13.87 (2.08)
	MGH	Magoonahalli soils are moderately shallow (50-75 cm), well drained, have very dark brown to dark brown gravelly sandy clay loam soils occurring on very gently sloping uplands and moderately sloping mounds and ridges		5.72 (0.86)
10		MGHbB1g2	Loamy sand surface, slope 1-3%, slight erosion, very gravelly (35-60%)	5.72 (0.86)
11		Forest		508.59 (76.11)
12		Others	Others – Habitation & Waterbody	27.93 (4.18)

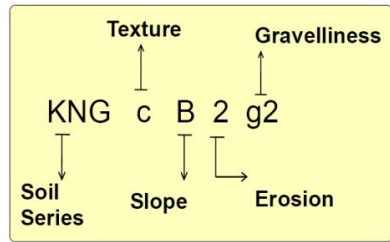
*Soil map unit numbers are continuous for the taluk, not the micro-watershed

SOILS

Kanivaihundi Micro-Watershed (4B3E2G2e : Area - 500.69 ha) Gundlupet Taluk CHAMARAJANAGARA DISTRICT



Soil Phases	Area in ha (%)	Soil Phases	Area in ha (%)
1, ARKiB1	21 (4.23)	17, HPRiB1	14 (2.78)
2, BMBmB1	5 (0.95)	18, HPRmB2	15 (2.9)
3, DRHhB1	6 (1.2)	19, KLPbB1	2 (0.38)
4, DRHhB1g1	17 (3.36)	20, KLPiB2	10 (1.99)
5, DRHiA1	16 (3.2)	21, KNGcB2g2	7 (1.36)
6, GPRcB1g1	20 (4.03)	22, KNGhB2g2	15 (3.06)
7, GPRhB1	25 (5.06)	23, MDHiB1	18 (3.65)
8, HDRhB1g1	27 (5.37)	24, MGHcB1	8 (1.54)
9, HDRiB1	16 (3.29)	25, MGHcB2g1	18 (3.67)
10, HDRiB1g1	23 (4.51)	26, MGHcB2g2	34 (6.69)
11, HGHhB2	11 (2.2)	27, MGHhB1g1	11 (2.13)
12, HGHiB1	25 (4.95)	28, SPRiB1g1	3 (0.59)
13, HGHiB2	11 (2.16)	29, Forest	2 (0.42)
14, HGHiA1	13 (2.7)	30, Rock outcrops	1(0.26)
15, HGHiB1	57 (11.32)	31, Others*	16 (3.1)
16, HGHiB2	35 (6.94)		



KEY

TEXTURE
 c - Sandy loam
 h - Sandy clay loam
 m - Clay
 i - Sandy clay

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

EROSION
 1 - Slight
 2 - Moderate

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

DEPTH
 HDR,SPR - Shallow (25-50 cm)
 DRH,HPR,MGH- Moderately shallow (50-75 cm)
 GPR,KNG- Moderately deep (75-100 cm)
 KLP,MDH- Deep (100-150 cm)
 AKR,BMB,HGH- Very deep (>150 cm)

References

- Stream/Drainage
- Road/Cart track
- Habitation
- Waterbody
- 42 Land parcel with No's
- Village boundary
- Micro-watershed boundary

* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

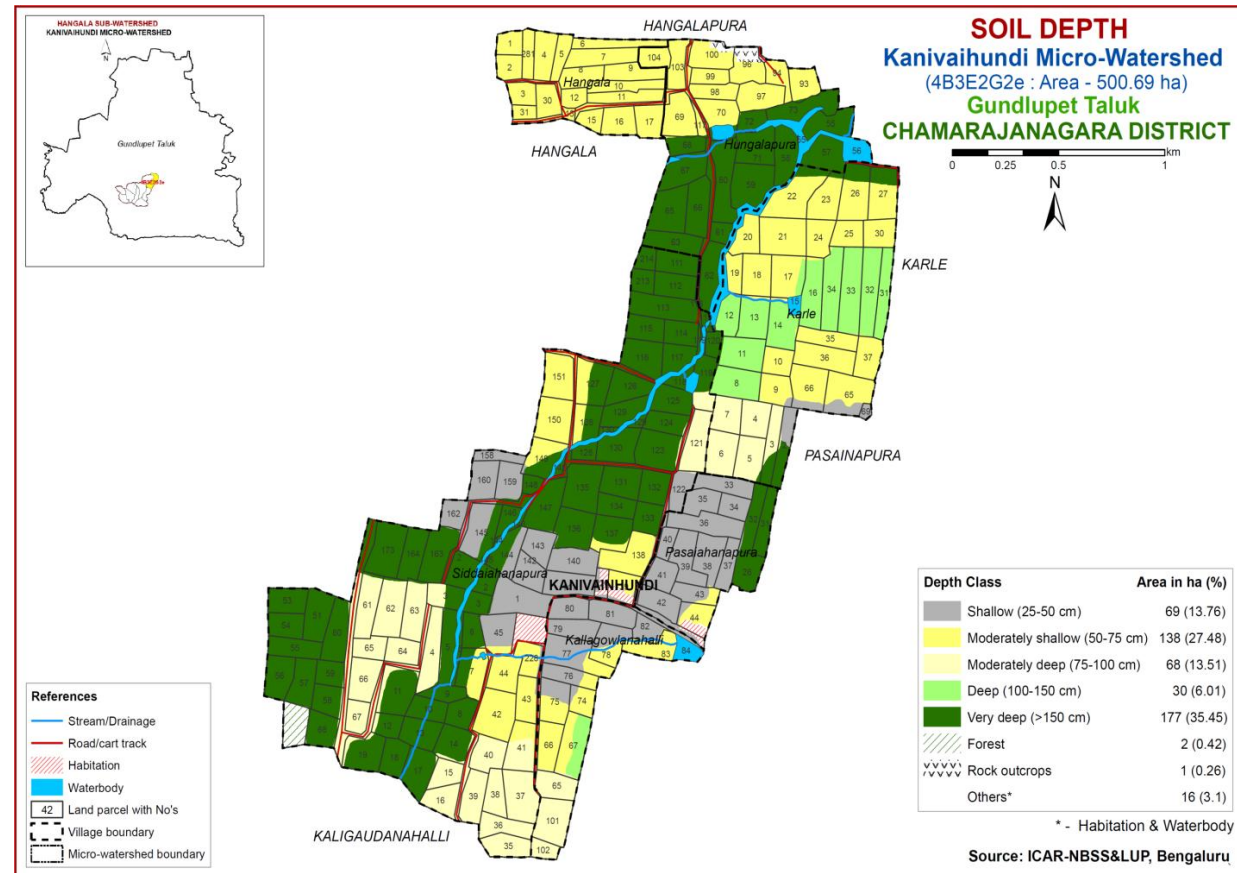
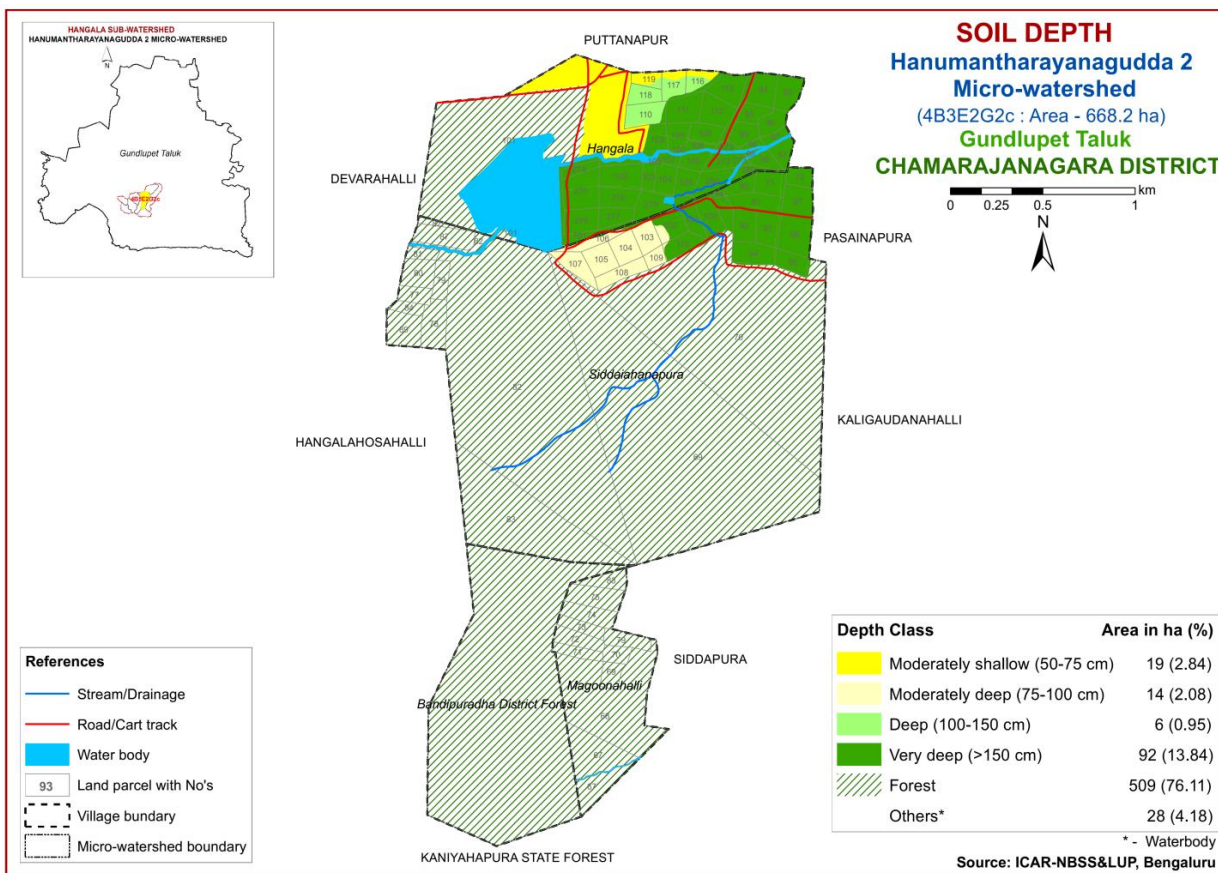
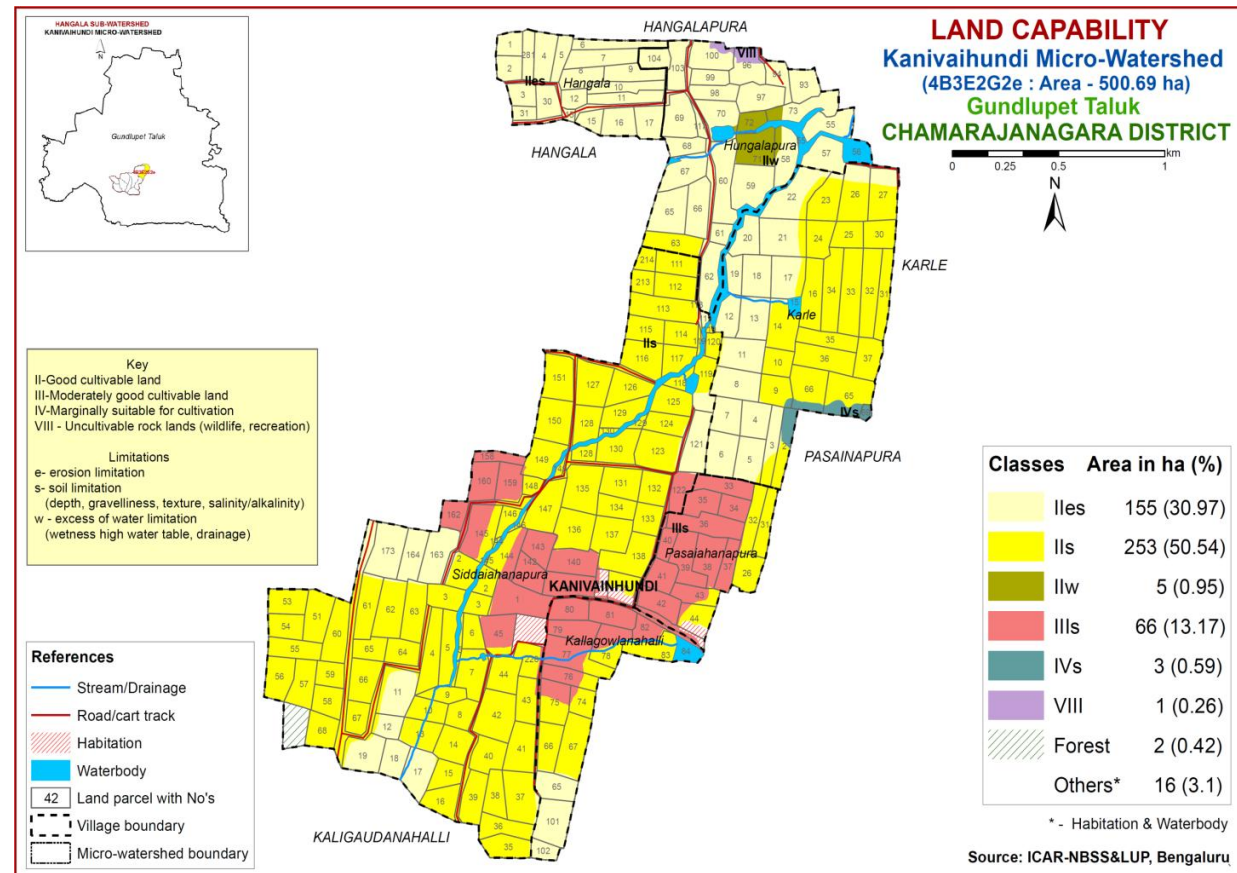
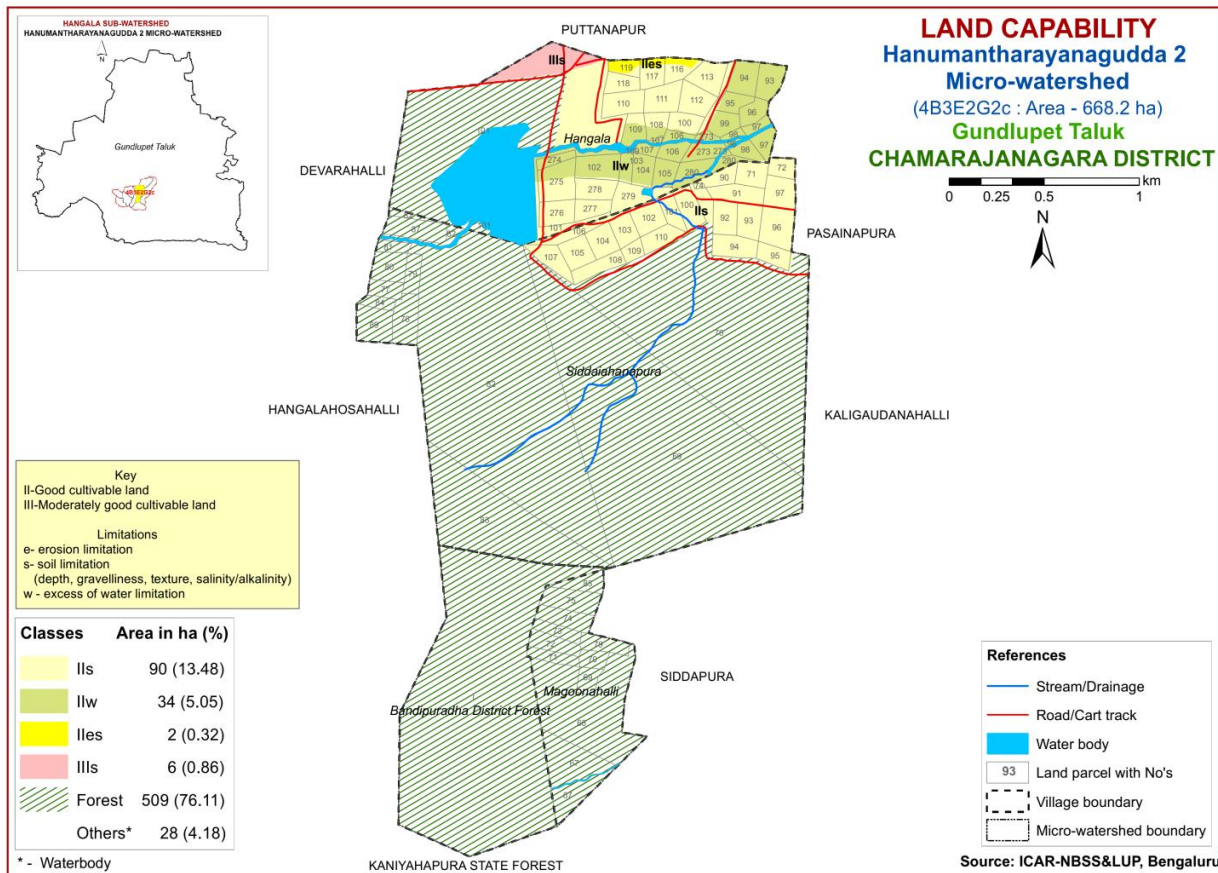
Table 2. Mapping unit description of Kanivaihundi Micro-watershed in Gundlupet Taluk, Chamarajanagara District

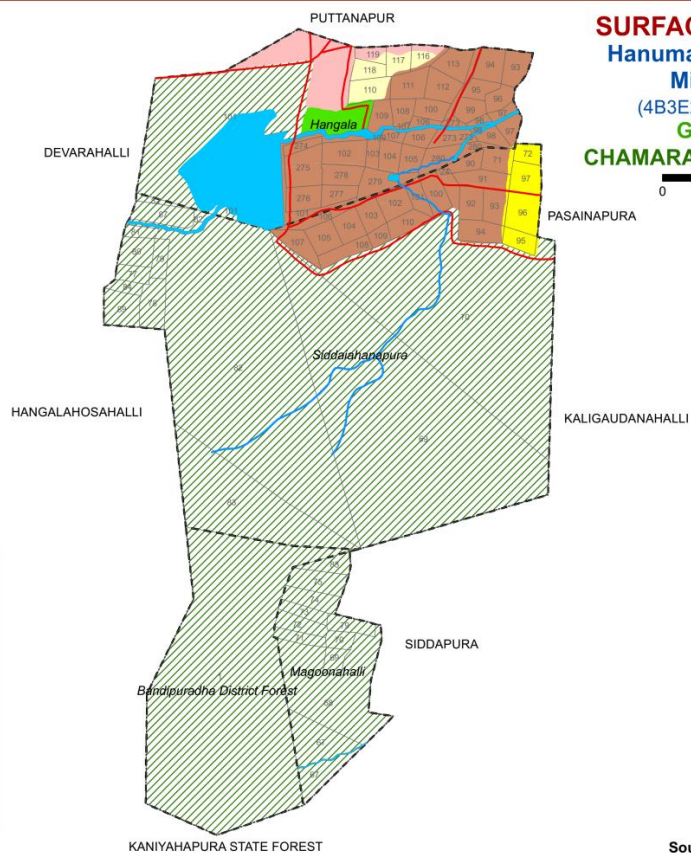
Soil No*	Soil Series	Soil Phase	Mapping Unit Description	Area in ha (%)
	ARK	Annurkeri soils are very deep (>150 cm), well drained, have dark reddish brown to very dusky red sandy clay to clay soils occurring on very gently sloping uplands under cultivation.		21.16 (4.23)
1		ARKiB1	Sandy clay surface, slope 1-3%, slight erosion	21.16 (4.23)
	BMB	Beemanabeedu soils are very deep (>150 cm), moderately well drained, have very dark greyish brown to dark grey and very dark brown clayey soils occurring on nearly level to very gently sloping lowlands under cultivation		4.74 (0.95)
2		BMBmB1	Clay surface, slope 1-3%, slight erosion	4.74 (0.95)
	DRH	Devarahalli soils are moderately shallow (50-75 cm), well drained, have dark red to reddish brown and dusky red gravelly sandy clay loam to sandy clay soils occurring on very gently to gently sloping uplands under cultivation		38.86 (7.76)
3		DRHhB1	Sandy clay loam surface, slope 1-3%, slight erosion	6.02 (1.20)
4		DRHhB1g1	Sandy clay loam surface, slope 1-3%, slight erosion, gravelly (15-35%)	16.82 (3.36)
5		DRHiA1	Sandy clay surface, slope 0-1%, slight erosion	16.02 (3.20)
	GPR	Gopalapura soils are moderately deep (75-100 cm), well drained, have dark brown to dark reddish brown and reddish brown gravelly sandy clay loam to sandy clay soils occurring on very gently to gently sloping uplands under cultivation		45.51 (9.09)
6		GPRcB1g1	Sandy loam surface, slope 1-3%, slight erosion, gravelly (15-35%)	20.16 (4.03)
7		GPRhB1	Sandy clay loam surface, slope 1-3%, slight erosion	25.35 (5.06)
	HDR	Hindupur soils are shallow (25-50 cm), well drained, have dark reddish brown to dusky red sandy clay loam to sandy clay soils occurring on very gently sloping uplands and moderately sloping mounds and ridges		65.93 (13.17)
8		HDRhB1g1	Sandy clay loam surface, slope 1-3 %, slight erosion, gravelly (15-35%)	26.89 (5.37)
9		HDRiB1	Sandy clay surface, slope 1-3%, slight erosion	16.48 (3.29)
10		HDRiB1g1	Sandy clay surface, slope 1-3 %, slight erosion, gravelly (15-35%)	22.56 (4.51)

Soil No*	Soil Series	Soil Phase	Mapping Unit Description	Area in ha (%)
	HGH		Honnegaudanahalli soils are very deep (>150 cm), well drained, have very dark brown to brown and dark reddish brown sandy clay loam soils occurring on very gently sloping uplands under cultivation.	151.57 (30.27)
11		HGHhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	11.00 (2.20)
12		HGHiB1	Sandy clay surface, slope 1-3%, slight erosion	24.80 (4.95)
13		HGHiB2	Sandy clay surface, slope 1-3%, moderate erosion	10.81 (2.16)
14		HGHmA1	Clay surface, slope 0-1%, slight erosion	13.50 (2.70)
15		HGHmB1	Clay surface, slope 1-3%, slight erosion	56.70 (11.32)
16		HGHmB2	Clay surface, slope 1-3%, moderate erosion	34.76 (6.94)
	HPR		Hullipura soils are moderately shallow (50-75 cm), well drained, have dark brown to very dark brown gravelly sandy clay loam to sandy clay soils occurring on very gently to gently sloping uplands under cultivation	28.45 (5.68)
17		HPRiB1	Sandy clay surface, slope 1-3%, slight erosion	13.94 (2.78)
18		HPRmB2	Clay surface, slope 1-3%, moderate erosion	14.51 (2.90)
	KLP		Kallipura soils are deep (100-150 cm), well drained, have dark reddish brown to dark red gravelly sandy clay loam to sandy clay soils occurring on very gently sloping uplands under cultivation.	11.85 (2.37)
19		KLPbB1	Loamy sand surface, slope 1-3%, slight erosion	1.91 (0.38)
20		KLPiB2	Sandy clay surface, slope 1-3%, moderate erosion	9.94 (1.99)
	KNG		Kannigala soils are moderately deep (75-100 cm), well drained, have dark reddish brown to dark red gravelly sandy clay loam to sandy clay soils occurring on very gently sloping uplands and strongly sloping mounds and ridges.	22.14 (16.71)
21		KNGcB2g2	Sandy loam surface, slope 1-3%, moderate erosion, very gravelly (35-60%)	6.79 (1.36)
22		KNGhB2g2	Sandy clay loam surface, slope 1-3%, moderate erosion, very gravelly (35-60%)	15.35 (3.06)

Soil No*	Soil Series	Soil Phase	Mapping Unit Description	Area in ha (%)
	MDH	Maddinahundi soils are deep (100-150 cm), well drained, have dark reddish brown gravelly sandy clay soils occurring on very gently to gently sloping uplands under cultivation.		18.26 (3.65)
23		MDHiB1	Sandy clay surface, slope 1-3%, slight erosion	18.26 (3.65)
	MGH	Magoonahalli soils are moderately shallow (50-75 cm), well drained, have very dark brown to dark brown gravelly sandy clay loam soils occurring on very gently sloping uplands and moderately sloping mounds and ridges		70.31 (14.03)
24		MGHcB1	Sandy loam surface, slope 1-3%, slight erosion	7.70 (1.54)
25		MGHcB2g1	Sandy loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	18.40 (3.67)
26		MGHcB2g2	Sandy loam surface, slope 1-3%, moderate erosion, very gravelly (35-60%)	33.52 (6.69)
27		MGHhB1g1	Sandy clay loam surface, slope 1-3%, slight erosion, gravelly (15-35%)	10.69 (2.13)
	SPR	Shivapura soils are shallow (25-50 cm), well drained, have dark reddish brown gravelly sandy clay loam to sandy clay soils occurring on very gently sloping uplands and very strongly sloping hills, mounds and ridges.		2.98 (0.59)
28		SPRiB1g1	Sandy clay surface, slope 1-3%, slight erosion, gravelly (15-35%)	2.98 (0.59)
29		Forest		2.12 (0.42)
30		Rock outcrop		1.28 (0.26)
31		Others	Others– Habitation & Waterbody	15.53 (3.10)

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





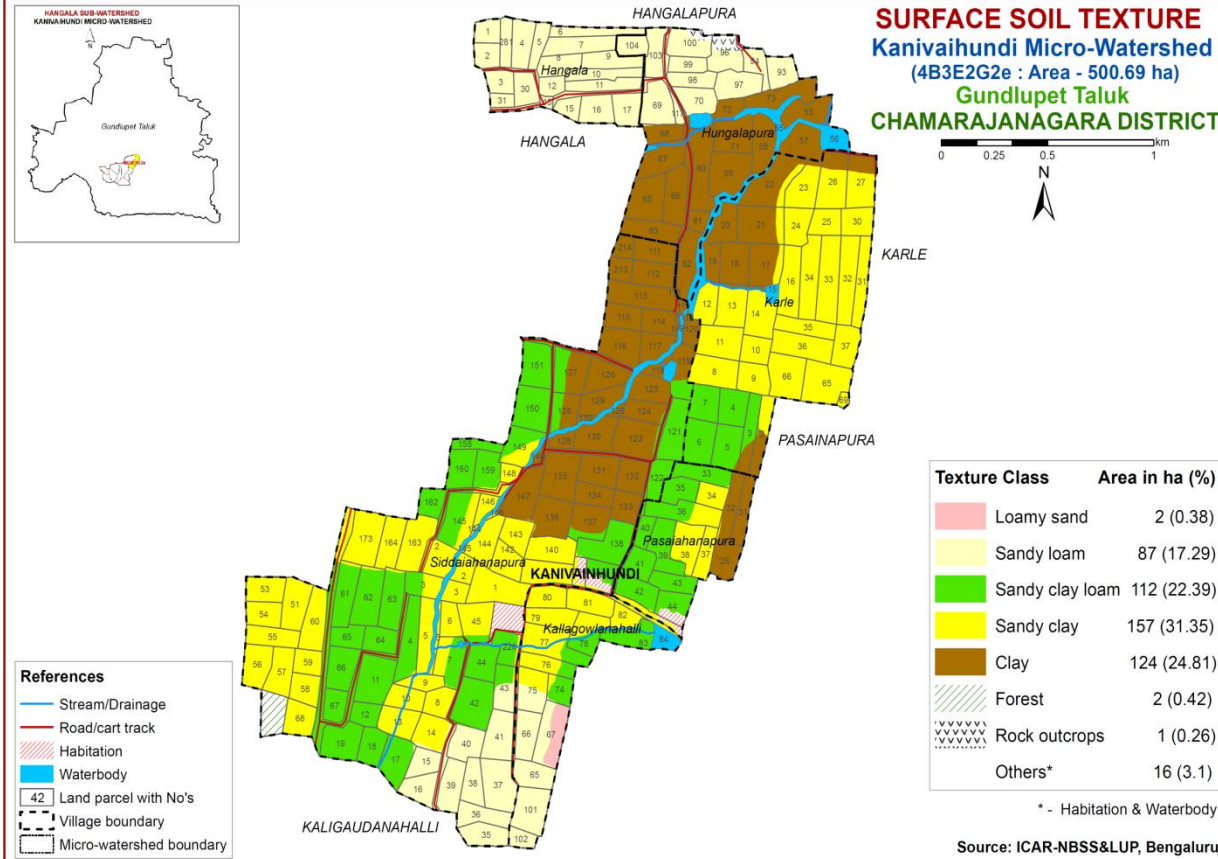
SURFACE SOIL TEXTURE
Hanumantharayanagudda 2
Micro-watershed
 (4B3E2G2c : Area - 668.2 ha)
Gundlupet Taluk
CHAMARAJANAGARA DISTRICT

Texture Class	Area in ha (%)
Loamy sand	14 (2.14)
Sandy loam	6 (0.95)
Sandy clay loam	5 (0.7)
Sandy clay	10 (1.53)
Clay	96 (14.39)
Forest	509 (76.11)
Others*	28 (4.18)

* - Waterbody

- References**
- Stream/Drainage
 - Road/Cart track
 - Water body
 - Land parcel with No's
 - Village boundary
 - Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru



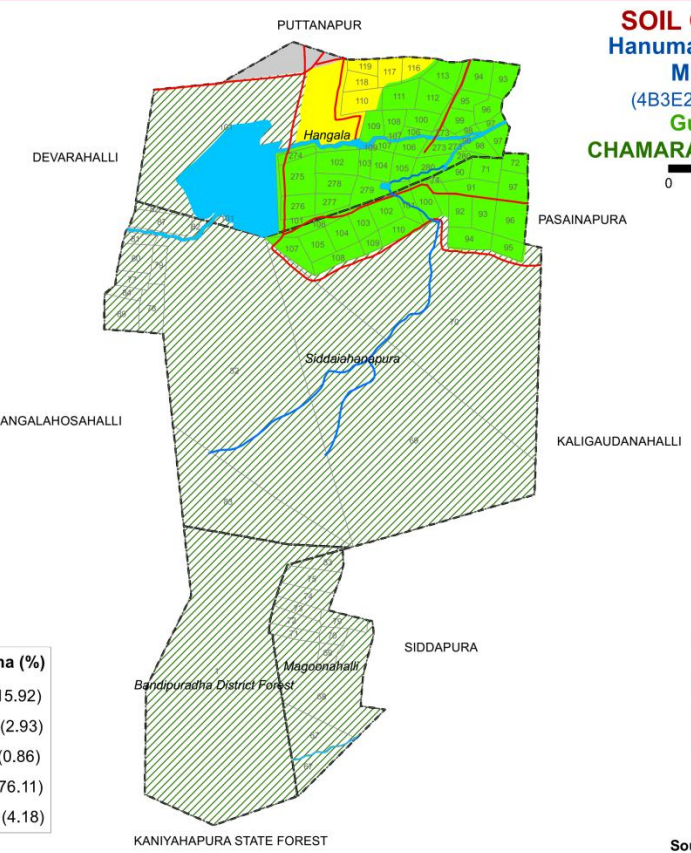
SURFACE SOIL TEXTURE
Kanivaihundi Micro-Watershed
 (4B3E2G2e : Area - 500.69 ha)
Gundlupet Taluk
CHAMARAJANAGARA DISTRICT

Texture Class	Area in ha (%)
Loamy sand	2 (0.38)
Sandy loam	87 (17.29)
Sandy clay loam	112 (22.39)
Sandy clay	157 (31.35)
Clay	124 (24.81)
Forest	2 (0.42)
Rock outcrops	1 (0.26)
Others*	16 (3.1)

* - Habitation & Waterbody

- References**
- Stream/Drainage
 - Road/cart track
 - Habitation
 - Waterbody
 - Land parcel with No's
 - Village boundary
 - Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru



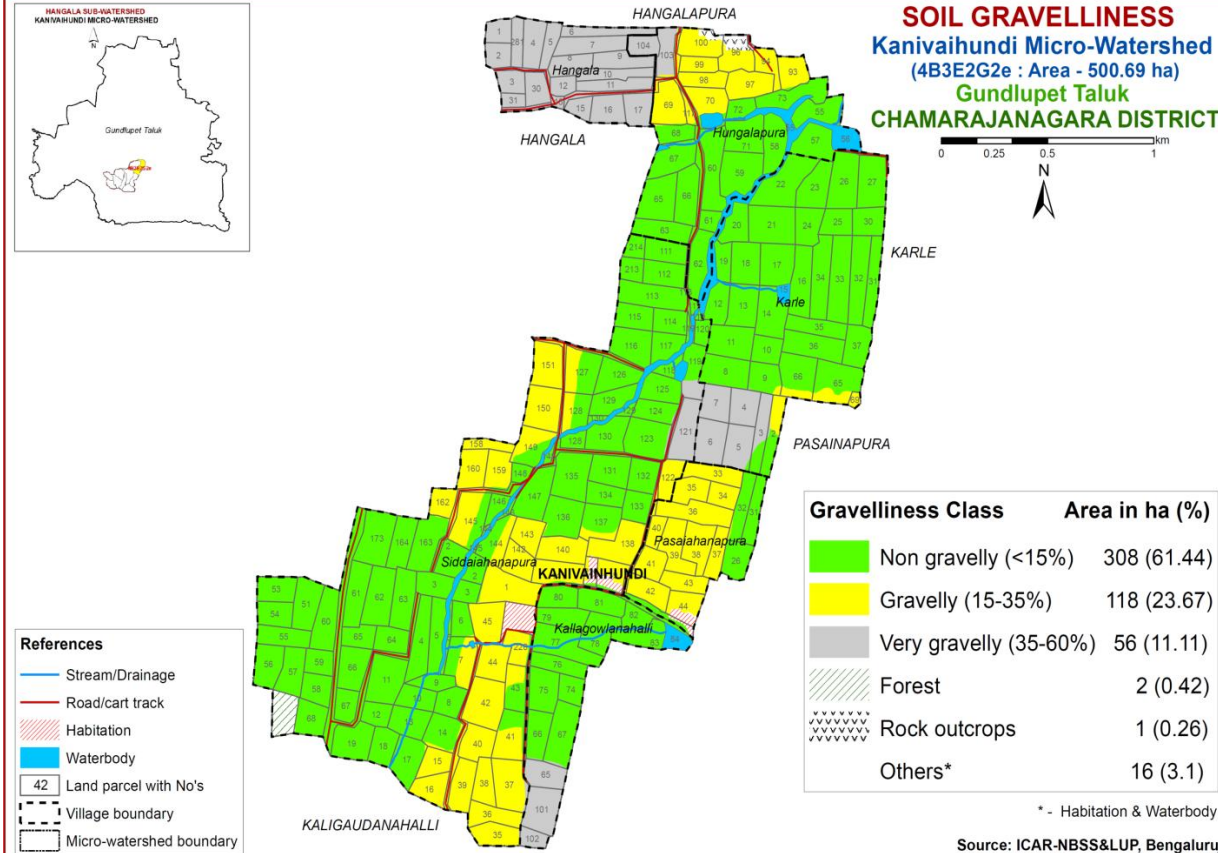
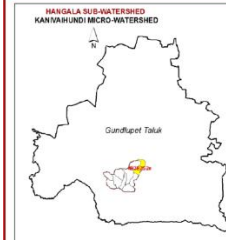
SOIL GRAVELLINESS
Hanumantharayanagudda 2
Micro-watershed
 (4B3E2G2c : Area - 668.2 ha)
Gundlupet Taluk
CHAMARAJANAGARA DISTRICT

Graveliness Class	Area in ha (%)
Non gravelly (<15%)	106 (15.92)
Gravelly (15-35%)	20 (2.93)
Very gravelly (35-60%)	6 (0.86)
Forest	509 (76.11)
Others*	28 (4.18)

* - Waterbody

- References**
- Stream/Drainage
 - Road/Cart track
 - Water body
 - Land parcel with No's
 - Village boundary
 - Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru



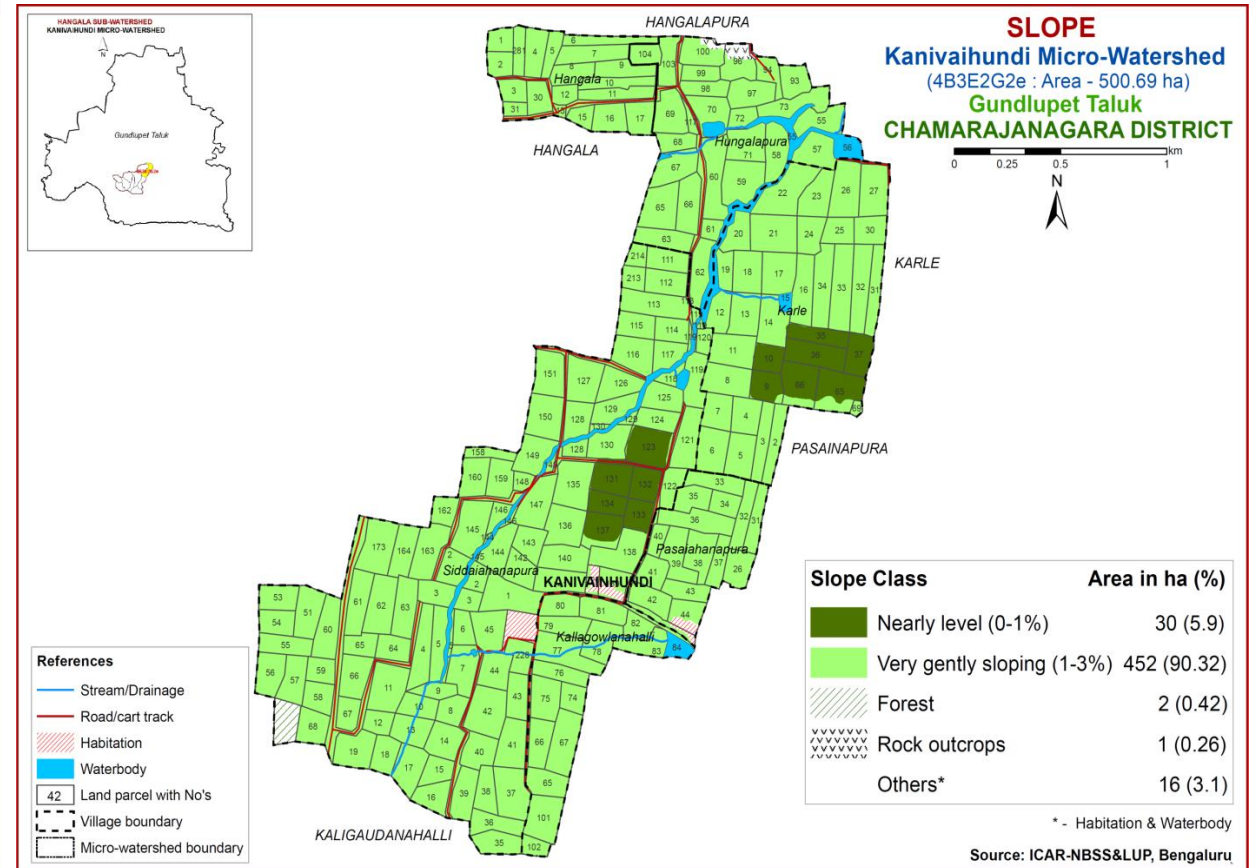
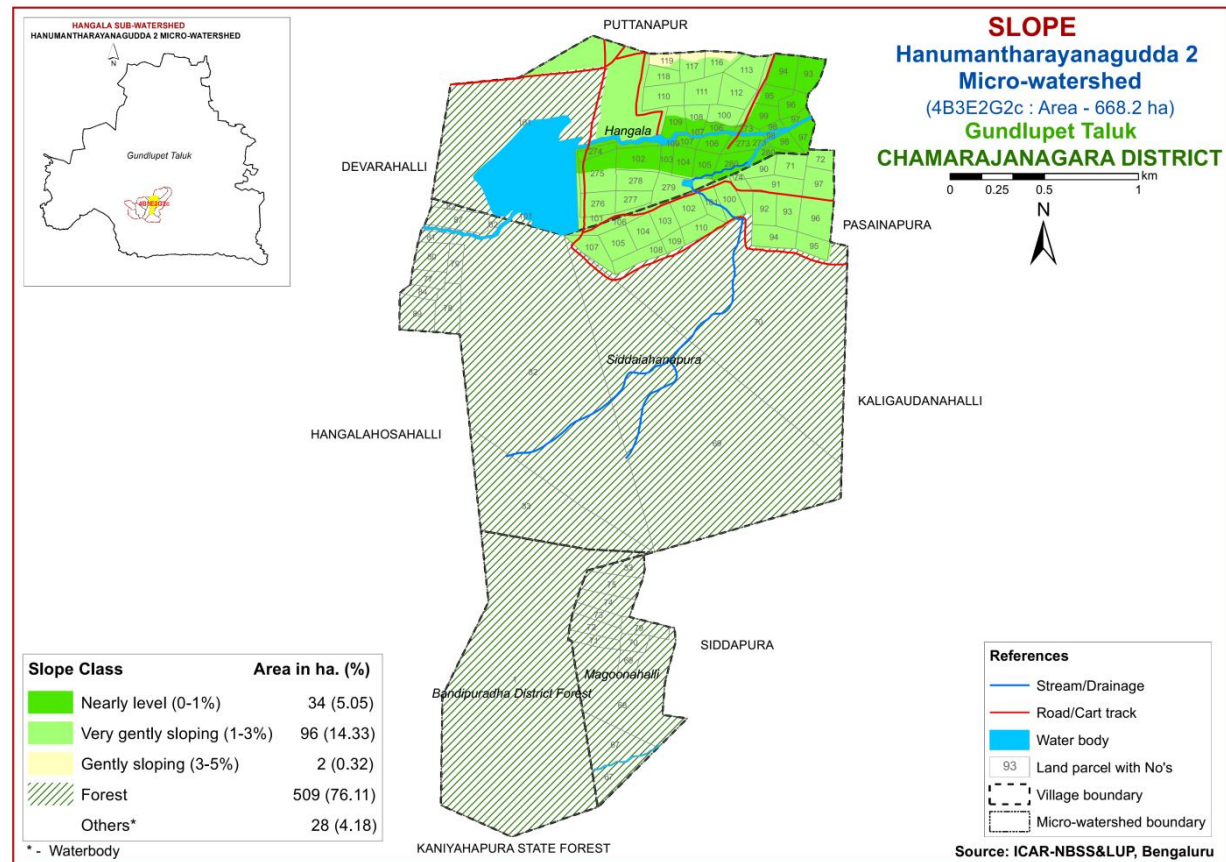
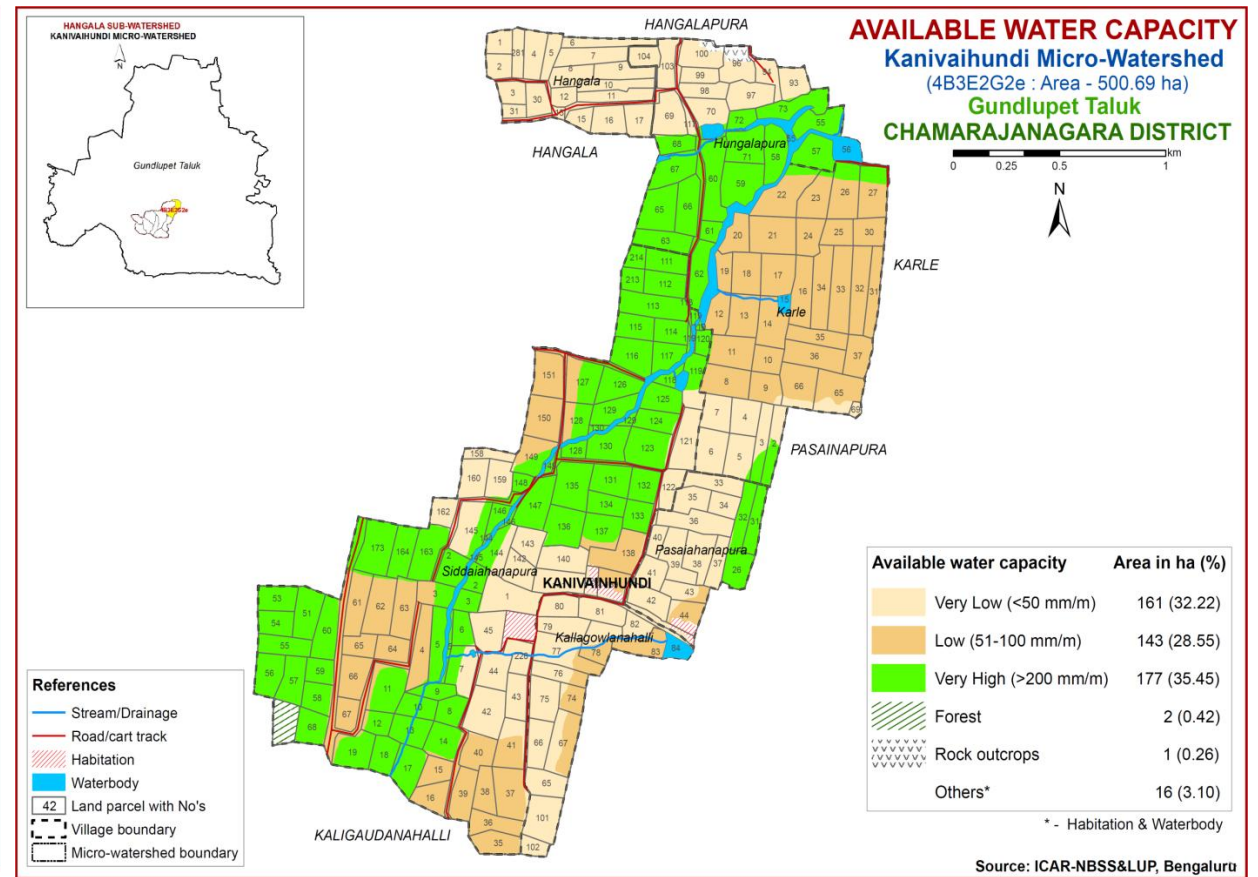
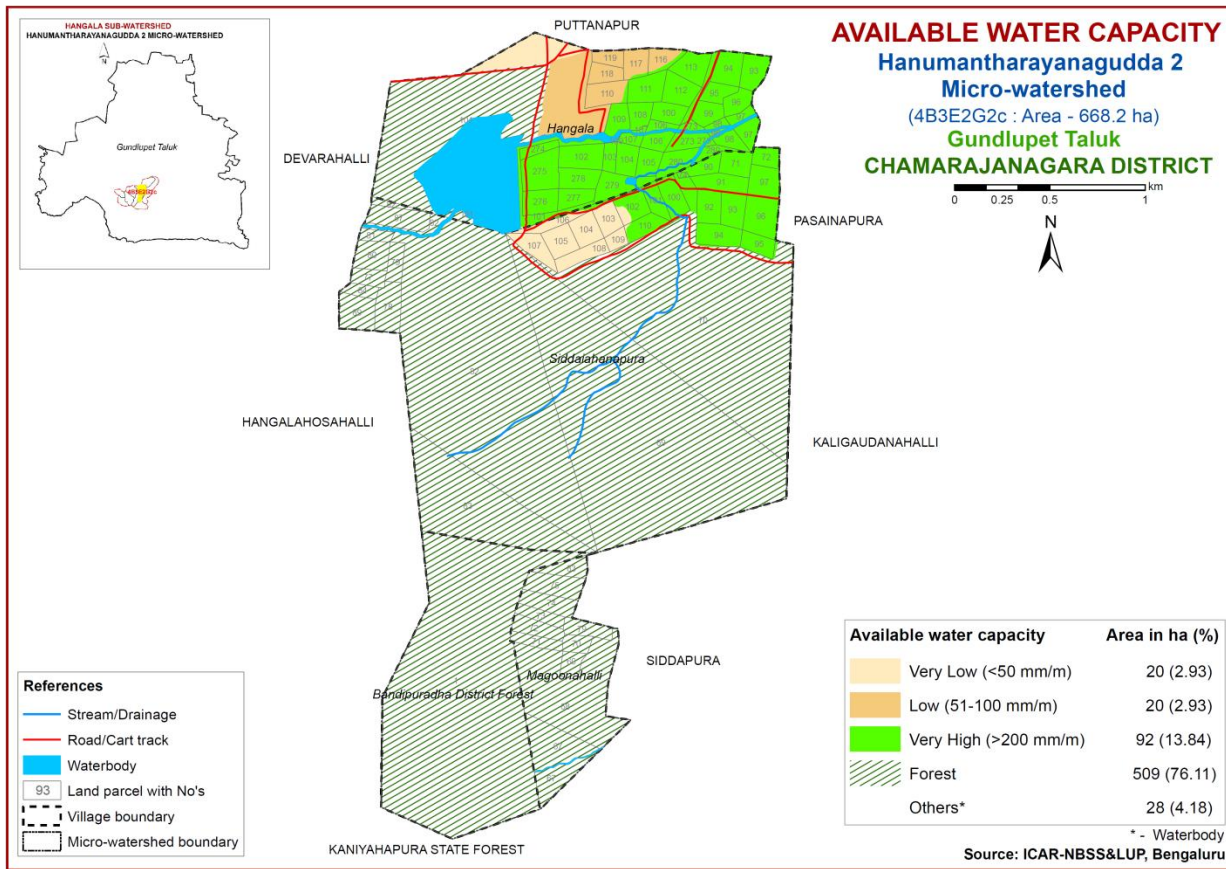
SOIL GRAVELLINESS
Kanivaihundi Micro-Watershed
 (4B3E2G2e : Area - 500.69 ha)
Gundlupet Taluk
CHAMARAJANAGARA DISTRICT

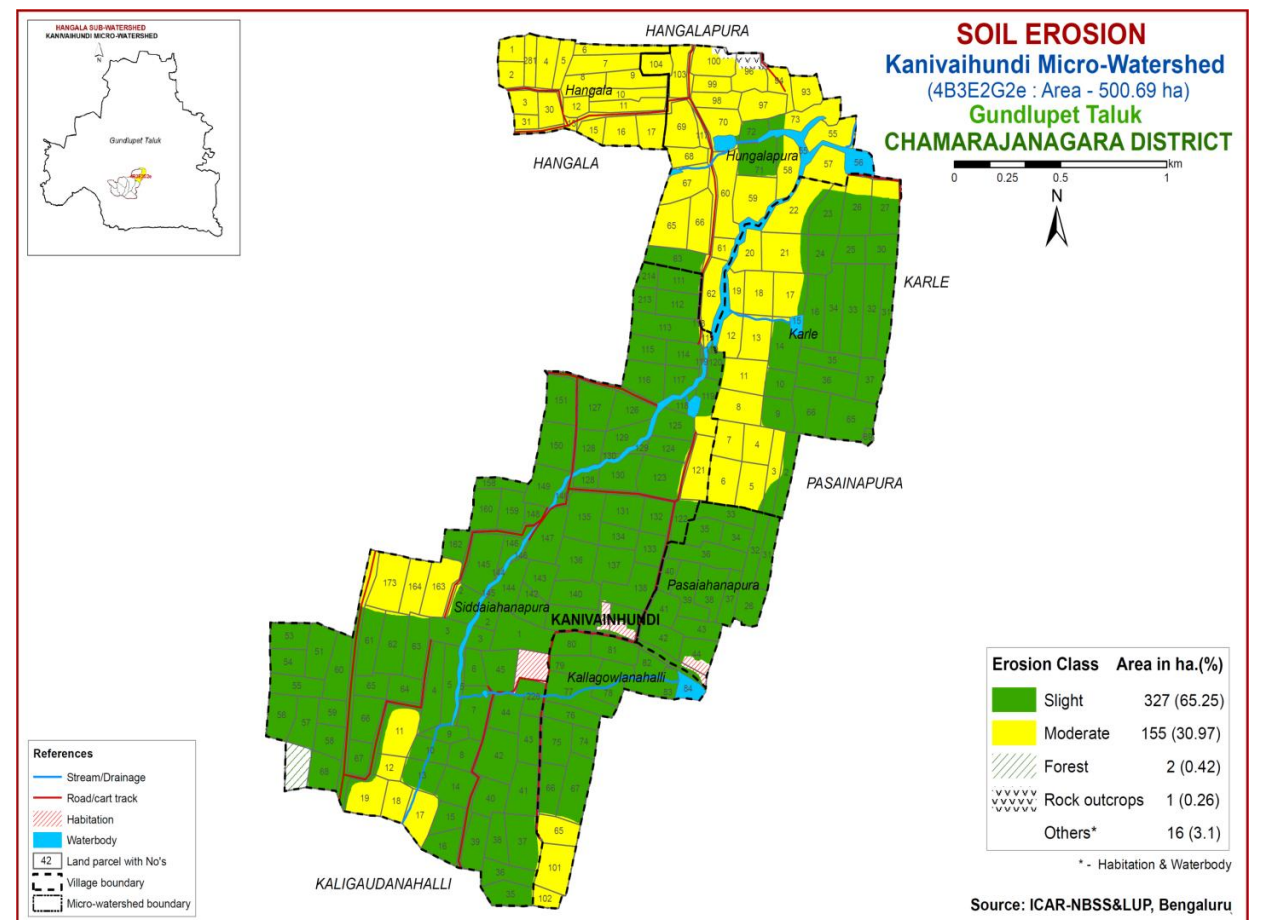
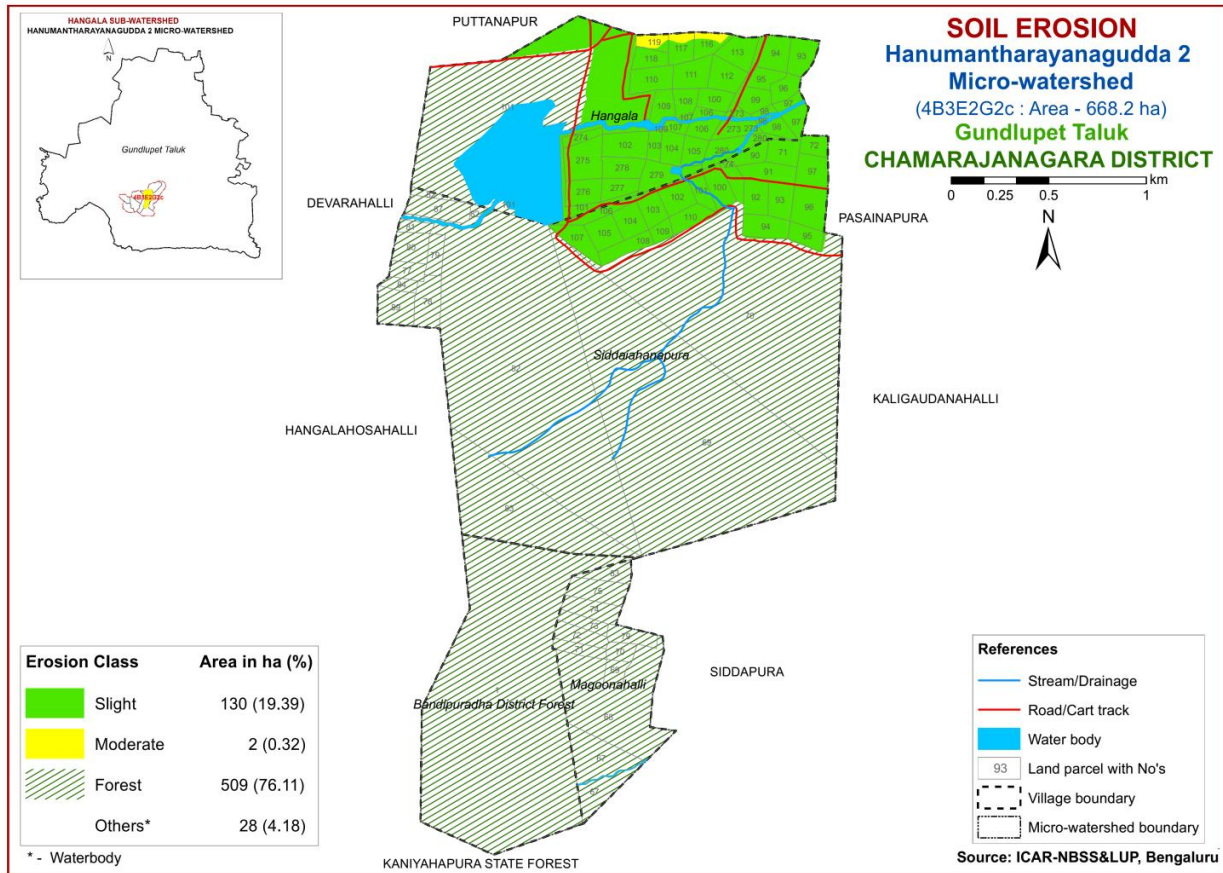
Graveliness Class	Area in ha (%)
Non gravelly (<15%)	308 (61.44)
Gravelly (15-35%)	118 (23.67)
Very gravelly (35-60%)	56 (11.11)
Forest	2 (0.42)
Rock outcrops	1 (0.26)
Others*	16 (3.1)

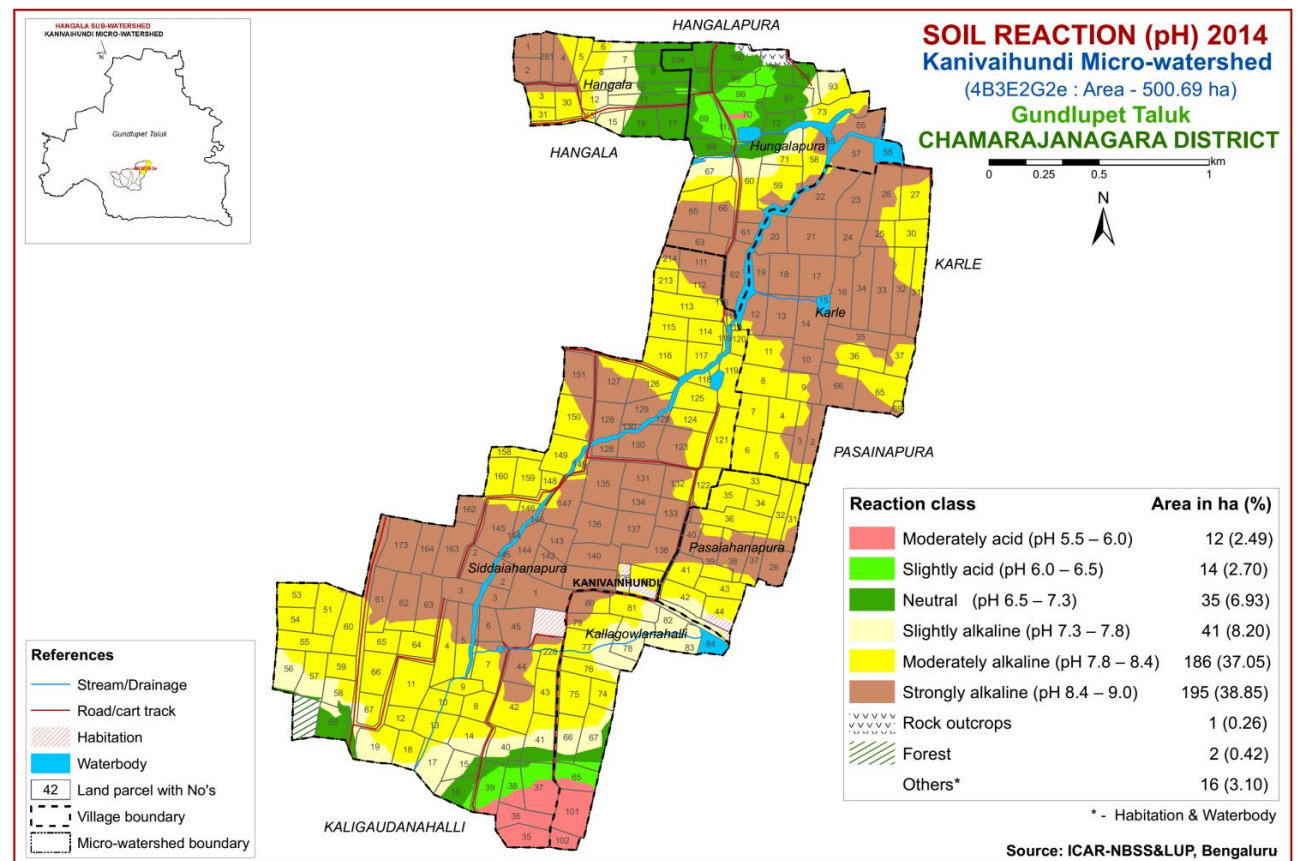
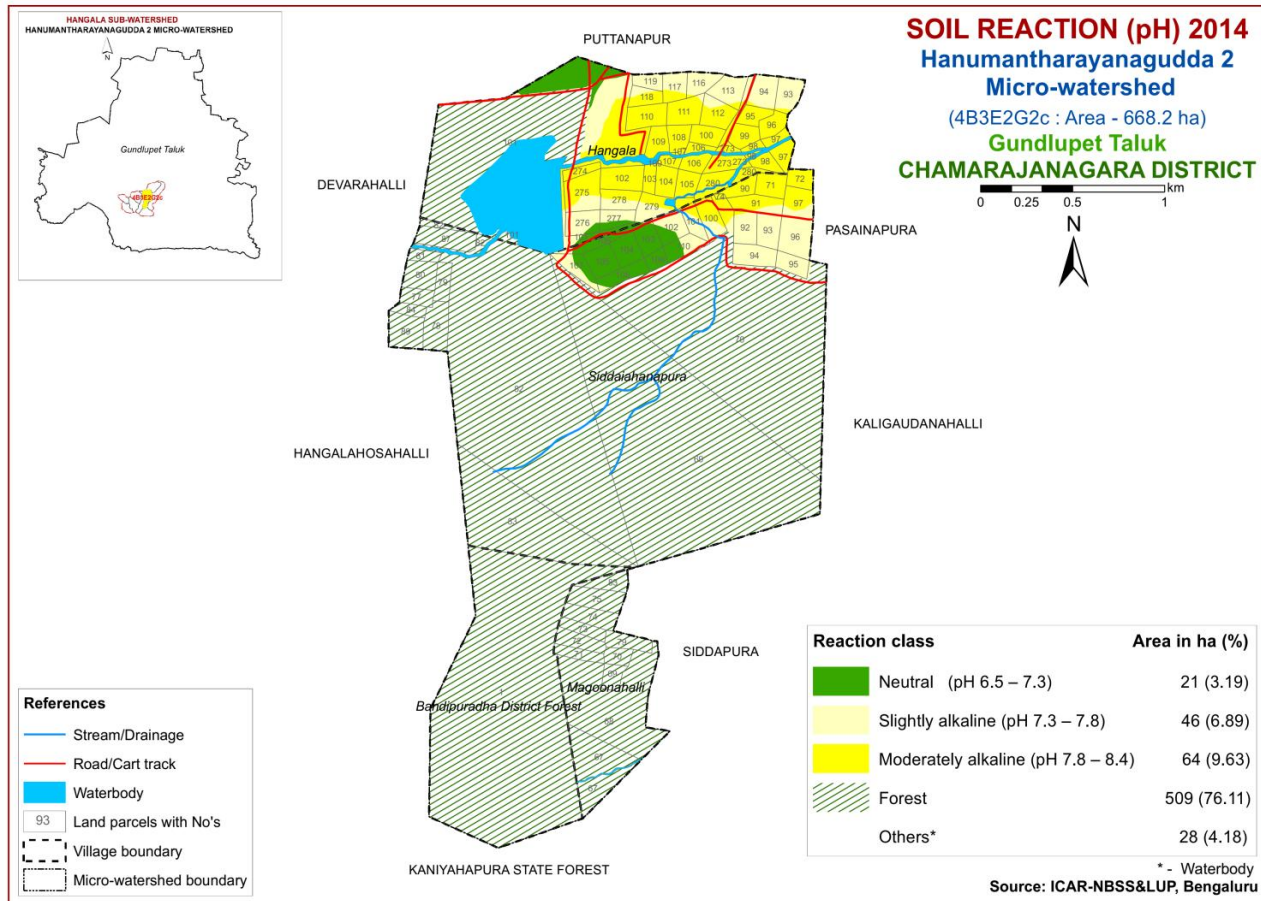
* - Habitation & Waterbody

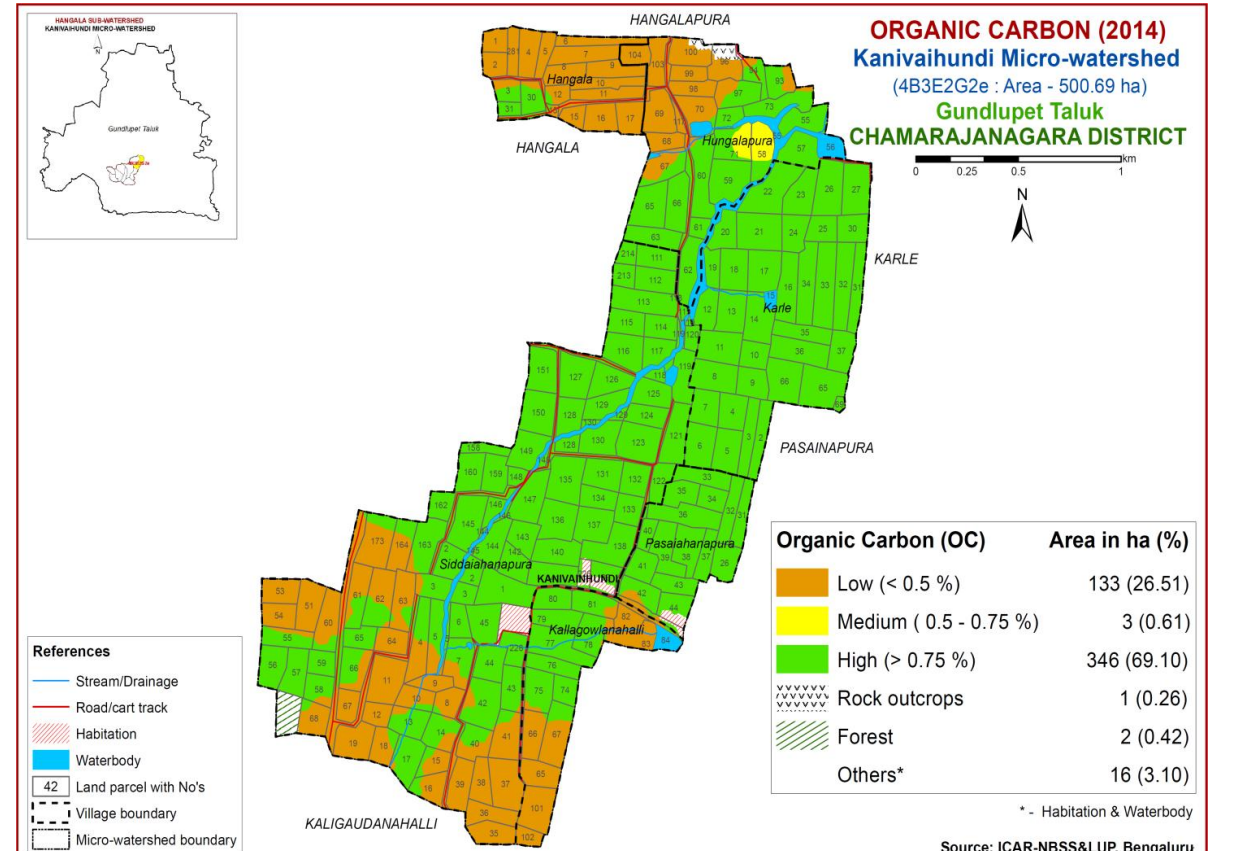
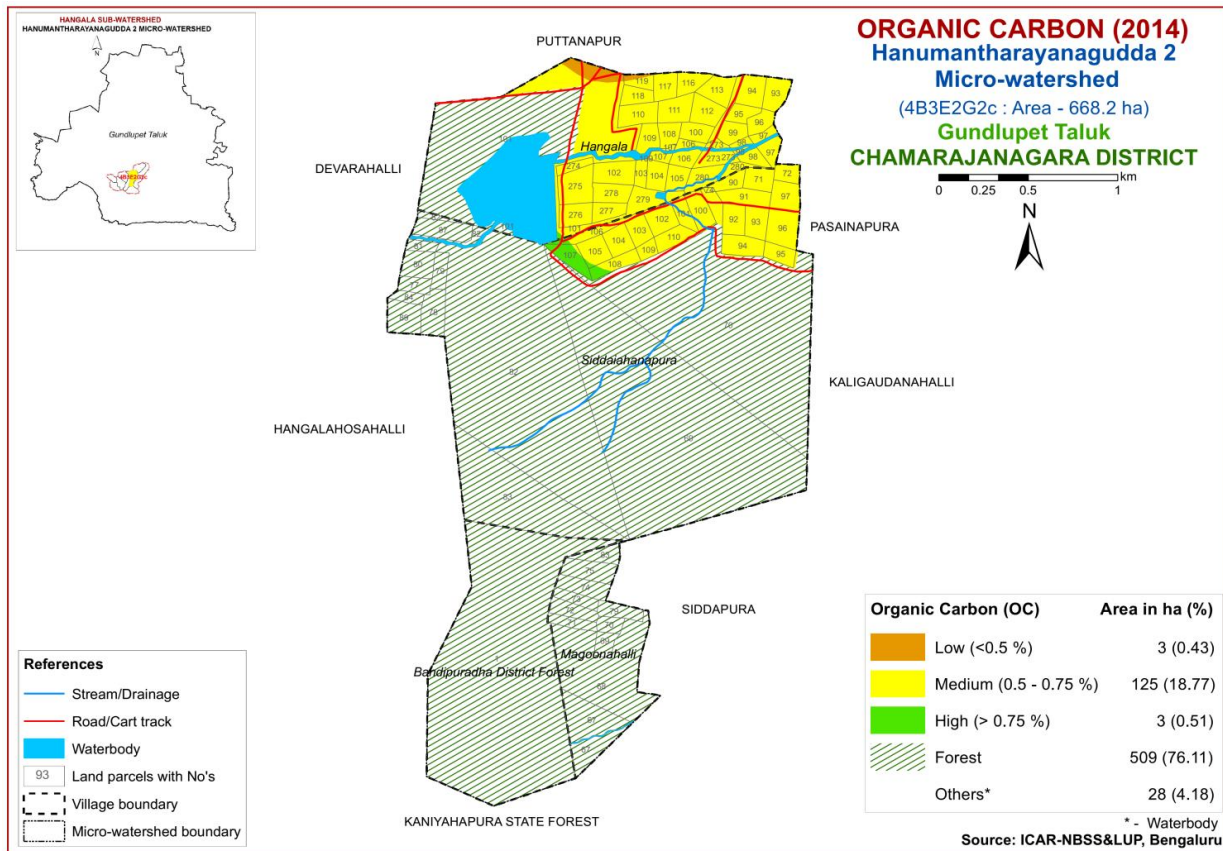
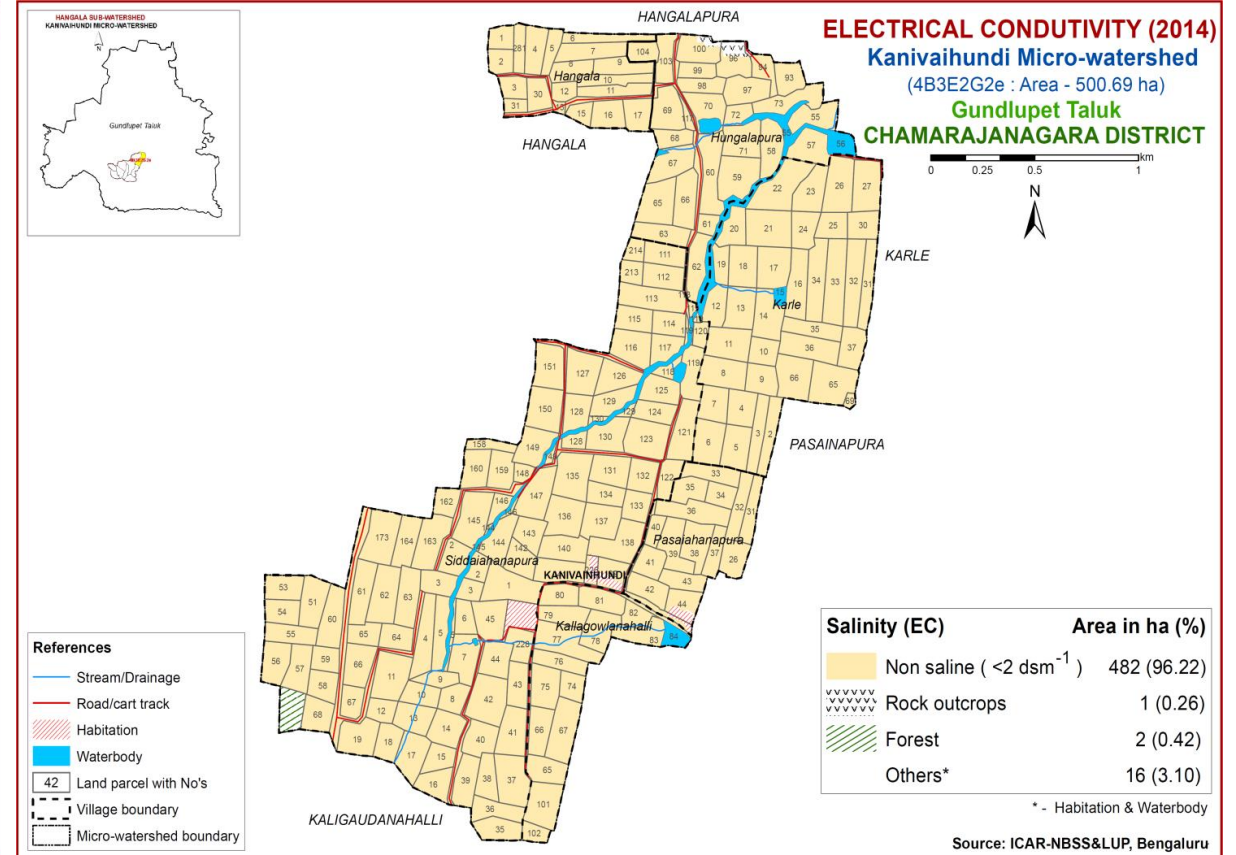
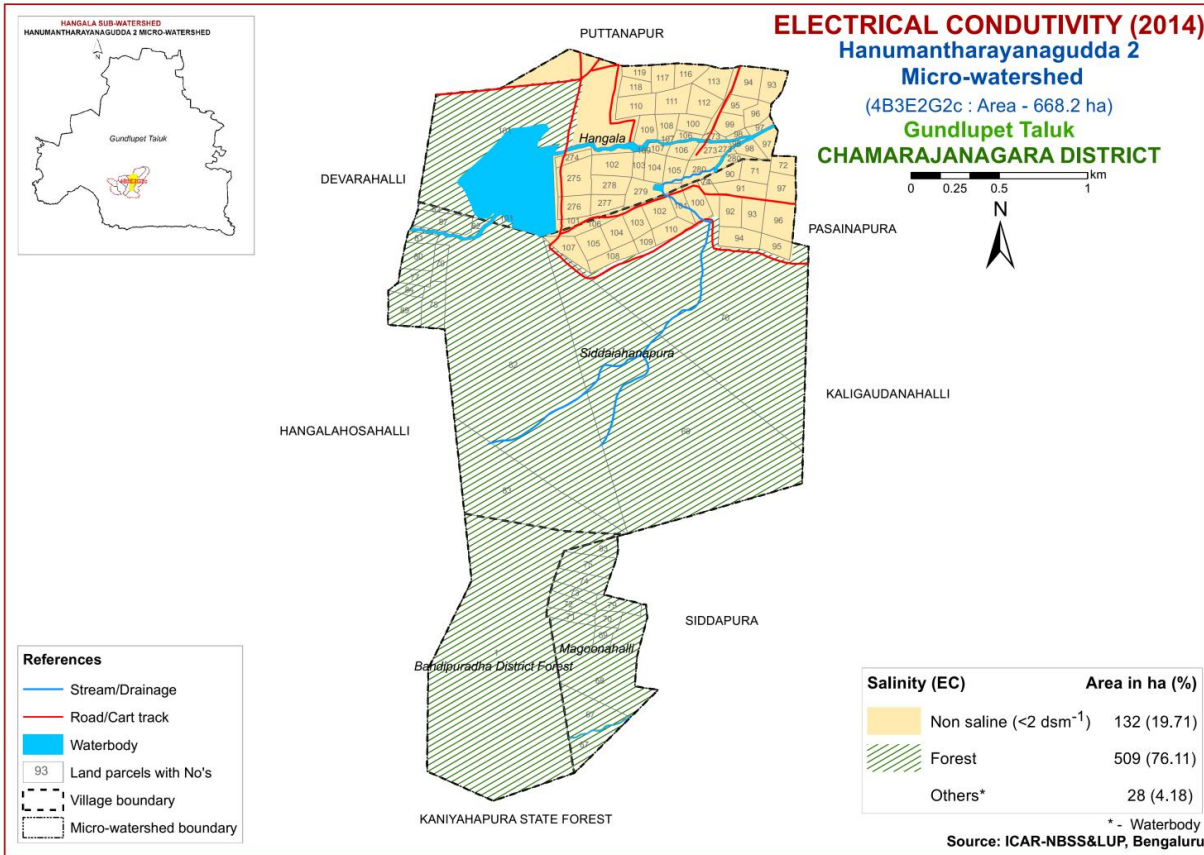
- References**
- Stream/Drainage
 - Road/cart track
 - Waterbody
 - Habitation
 - Land parcel with No's
 - Village boundary
 - Micro-watershed boundary

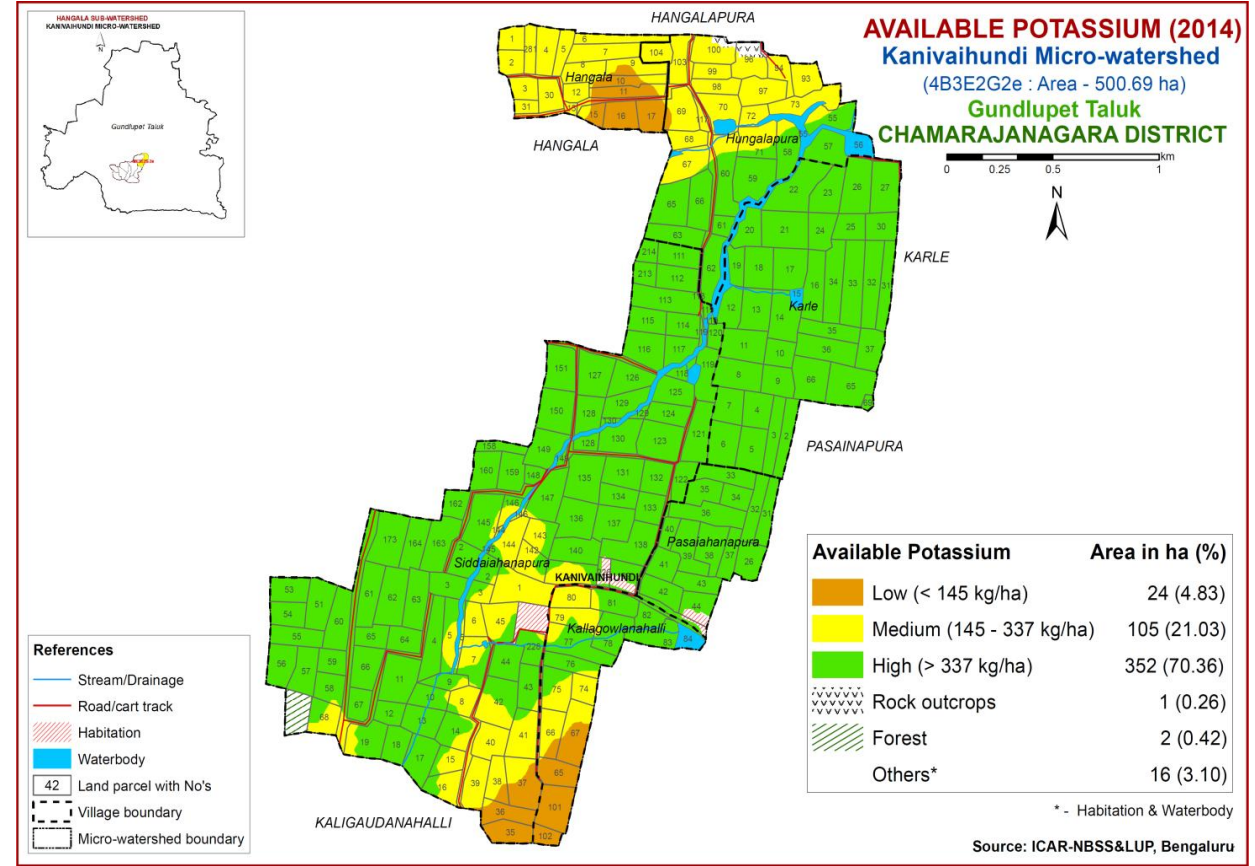
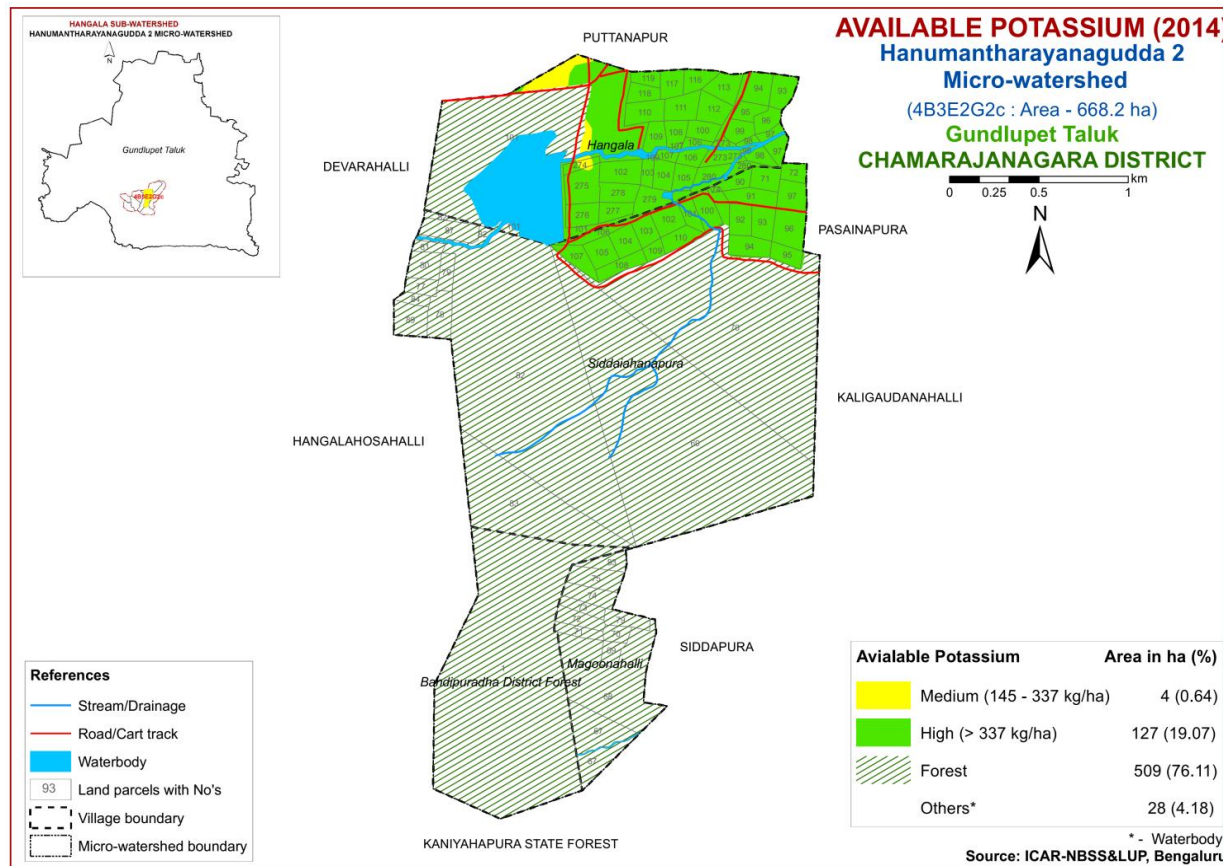
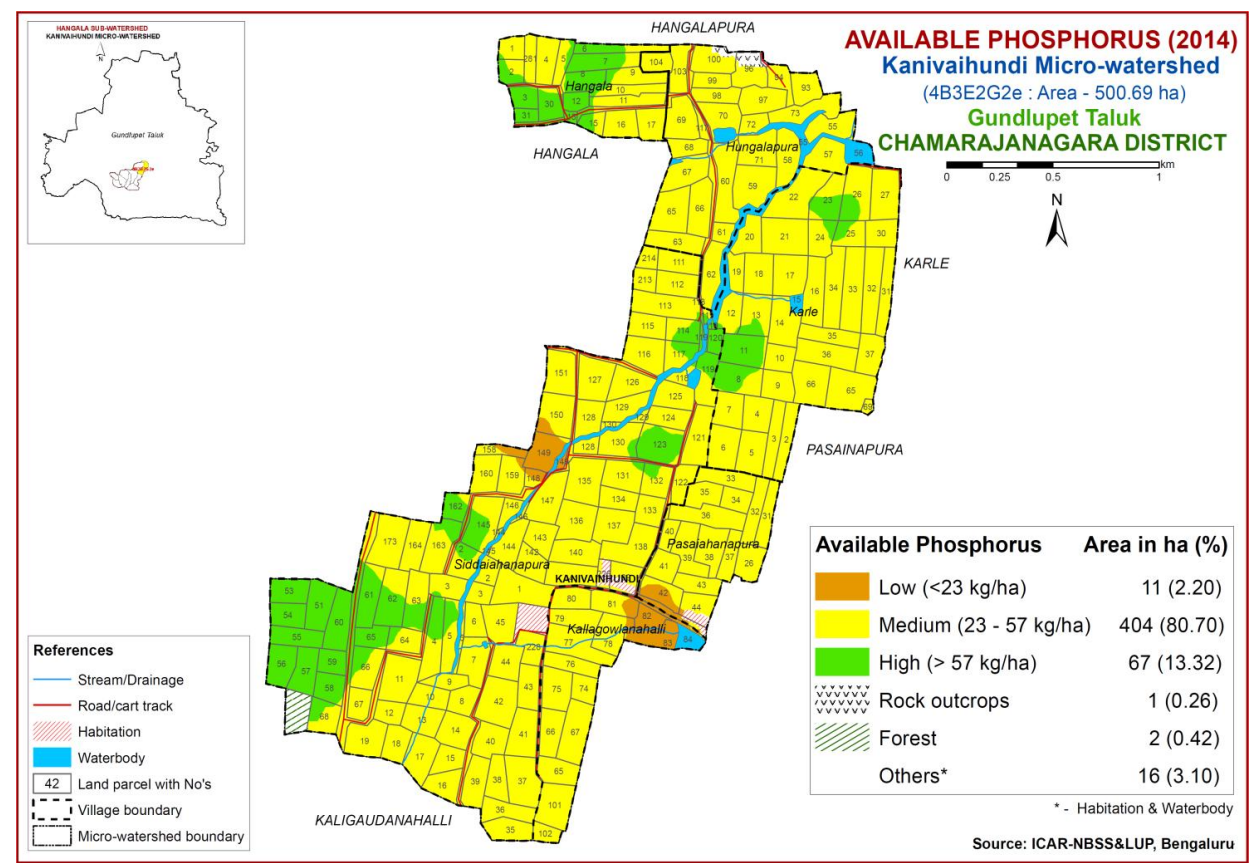
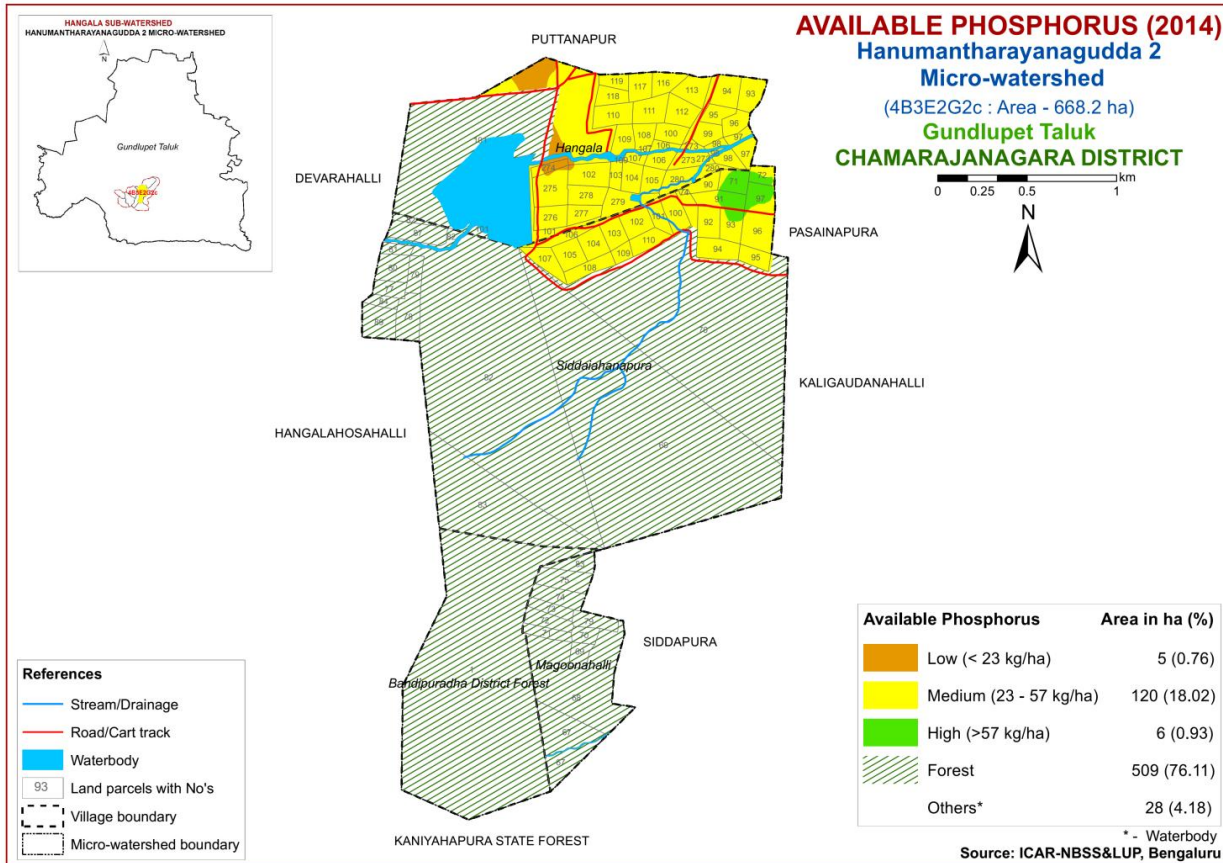
Source: ICAR-NBSS&LUP, Bengaluru

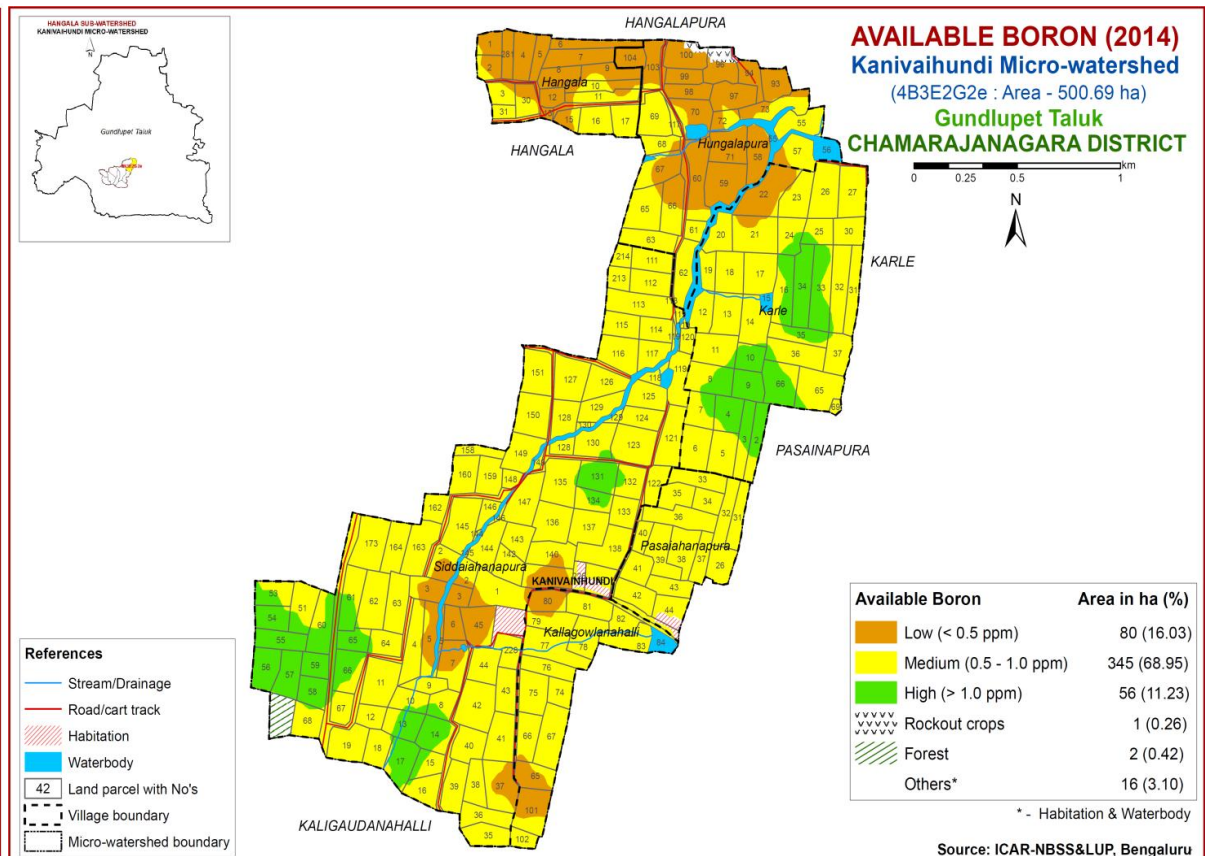
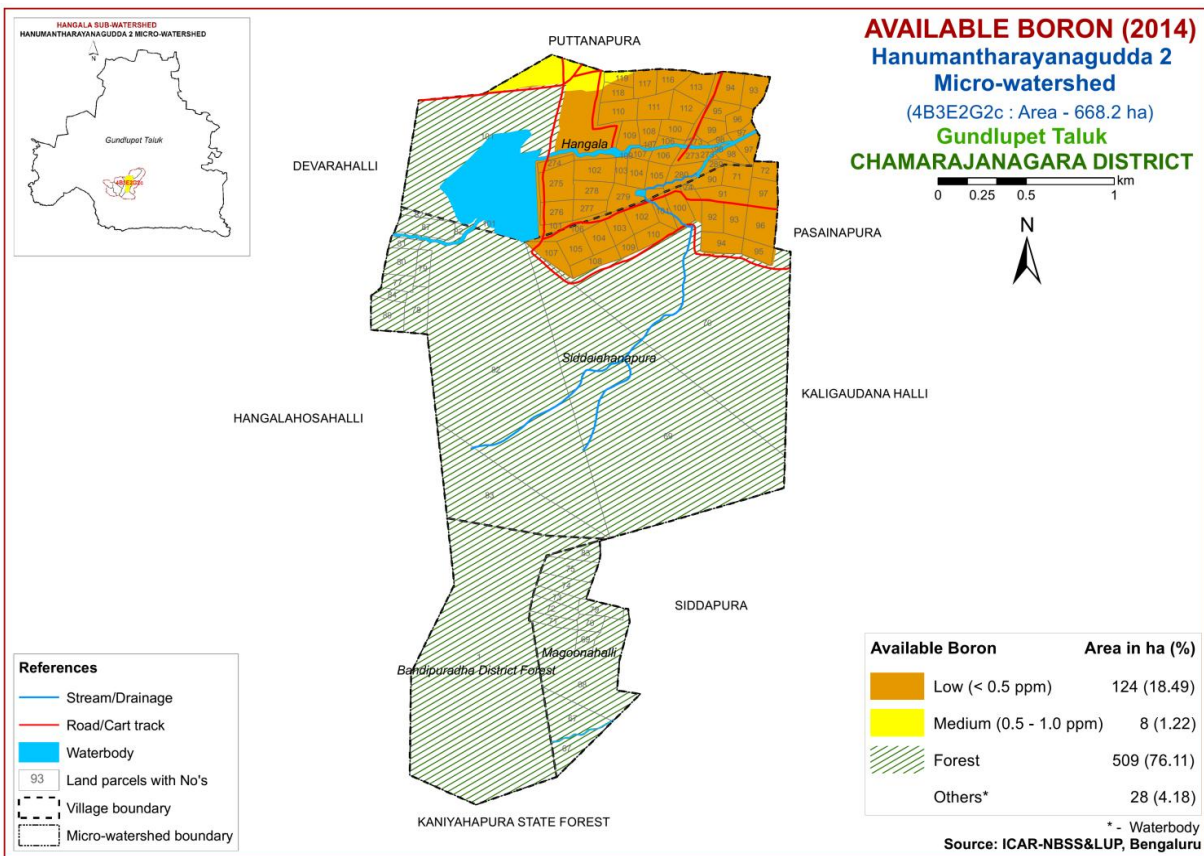
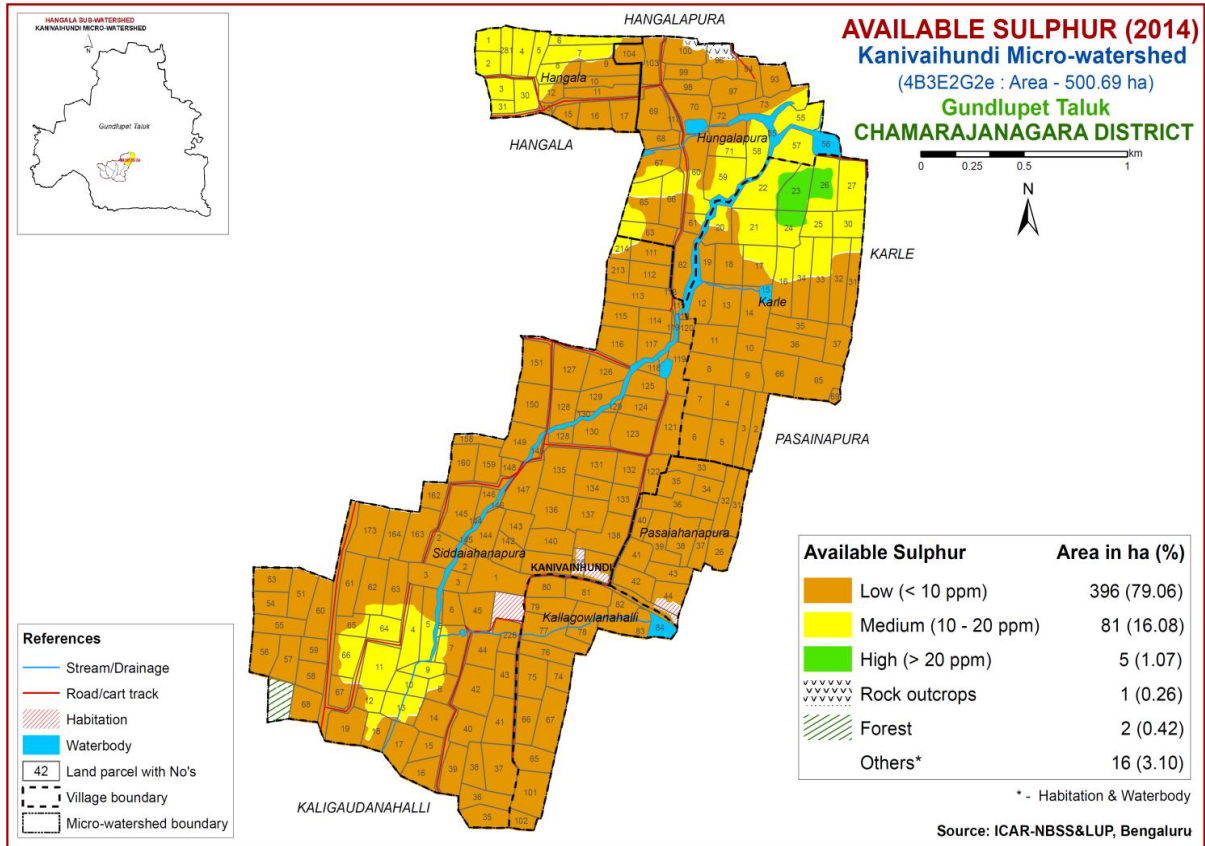
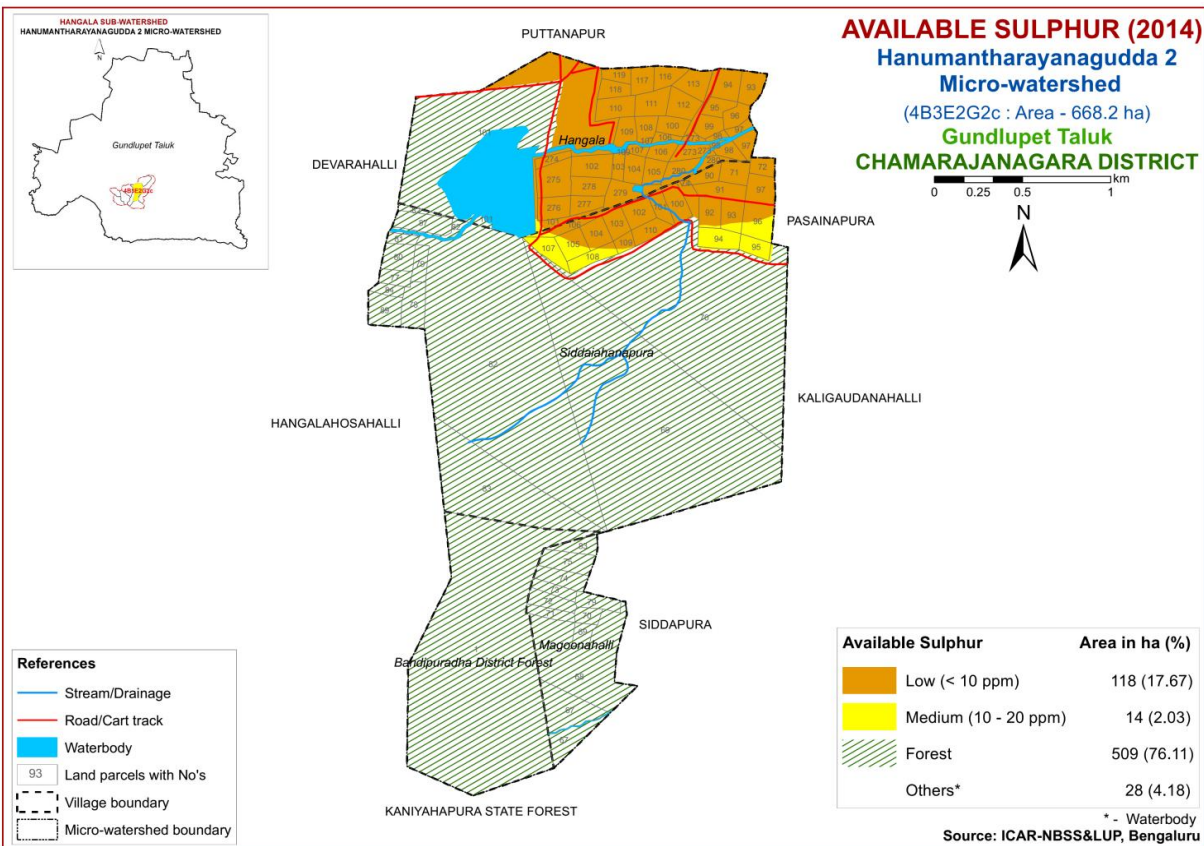


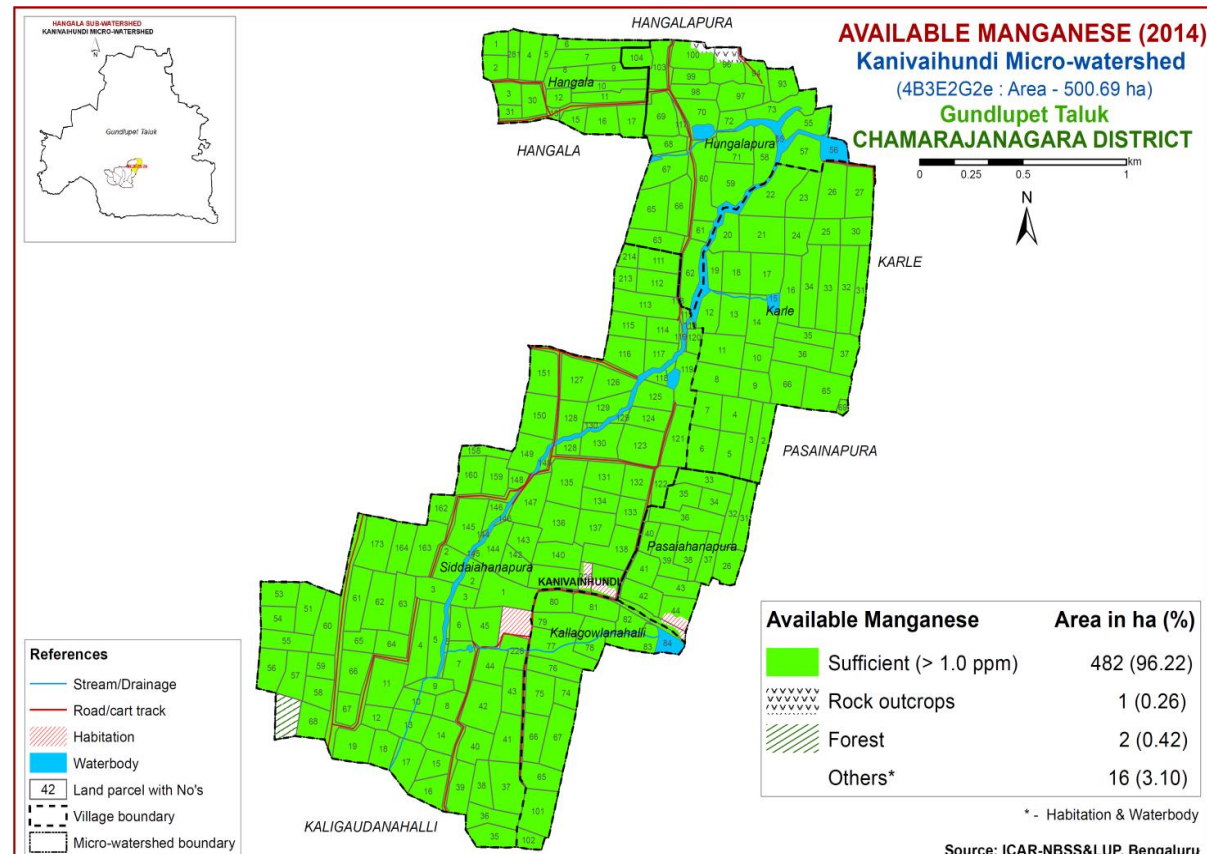
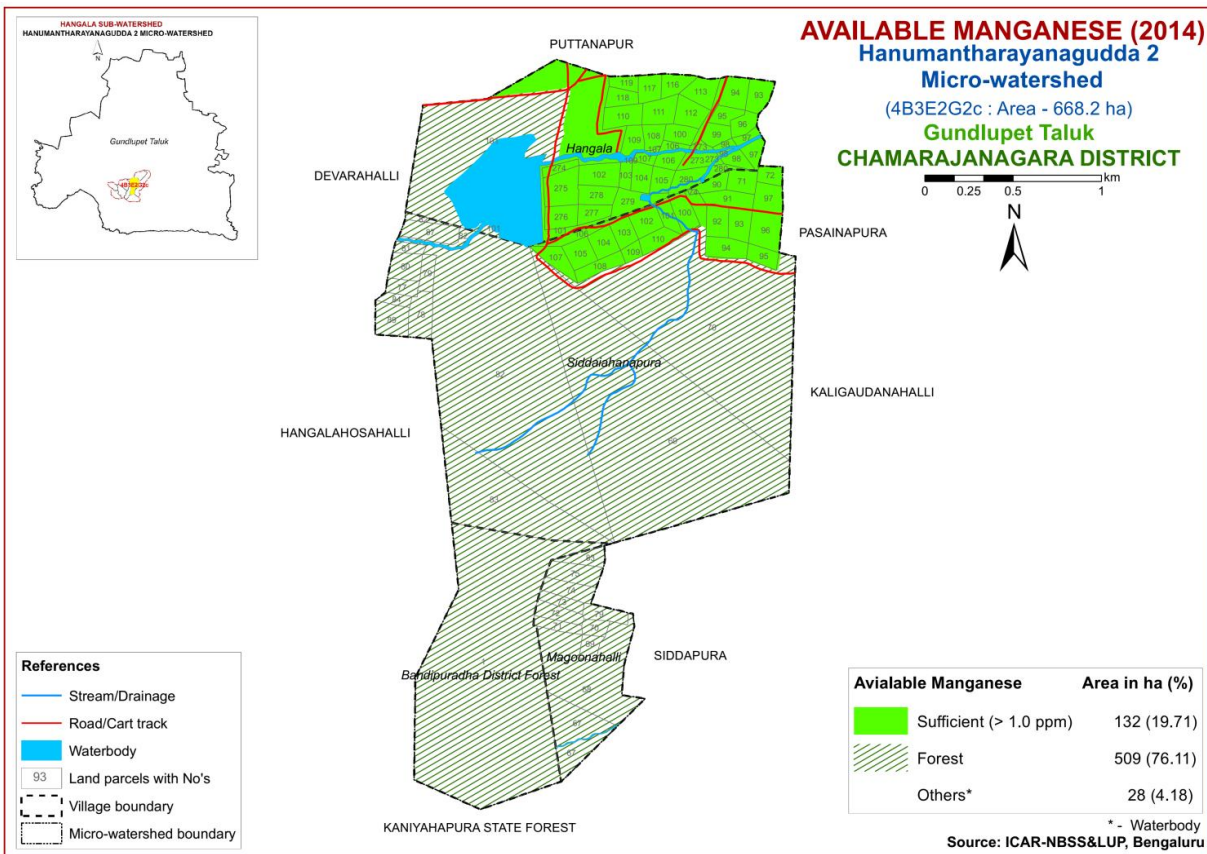
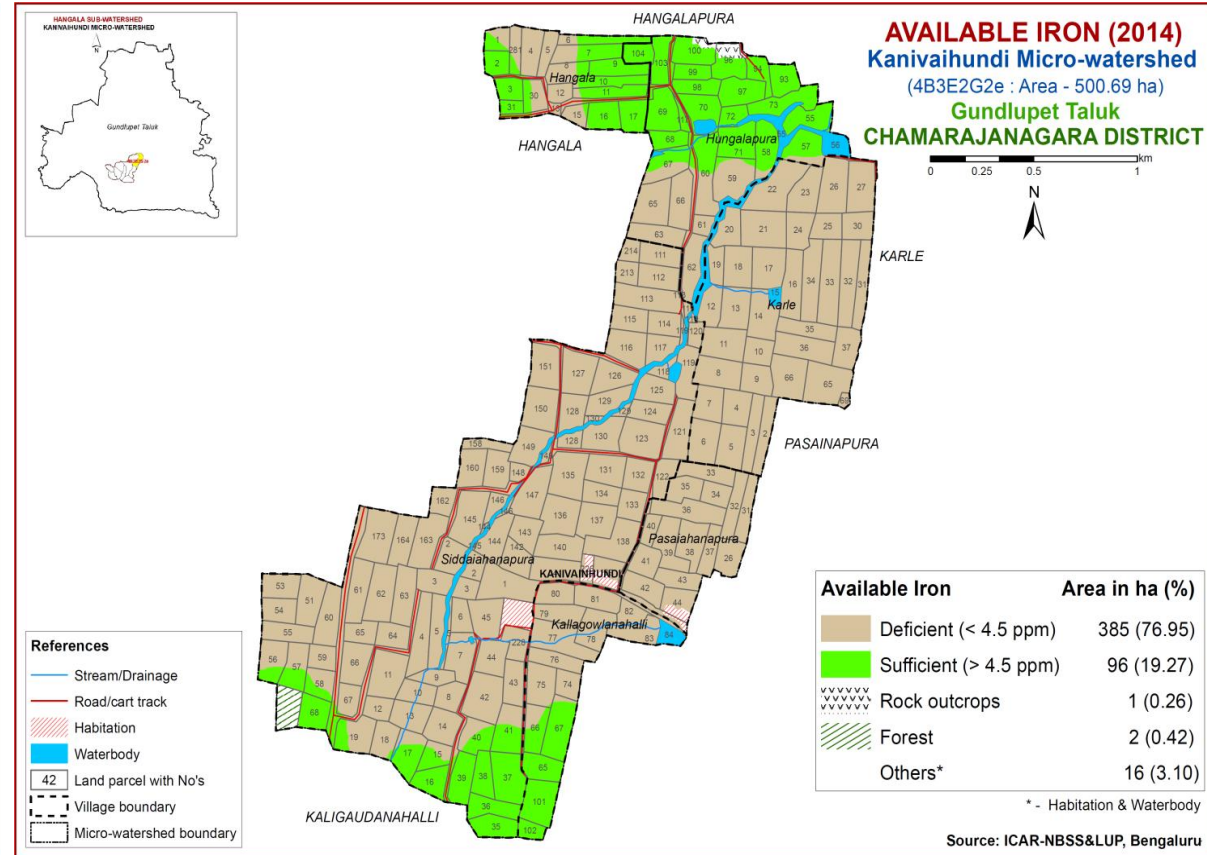
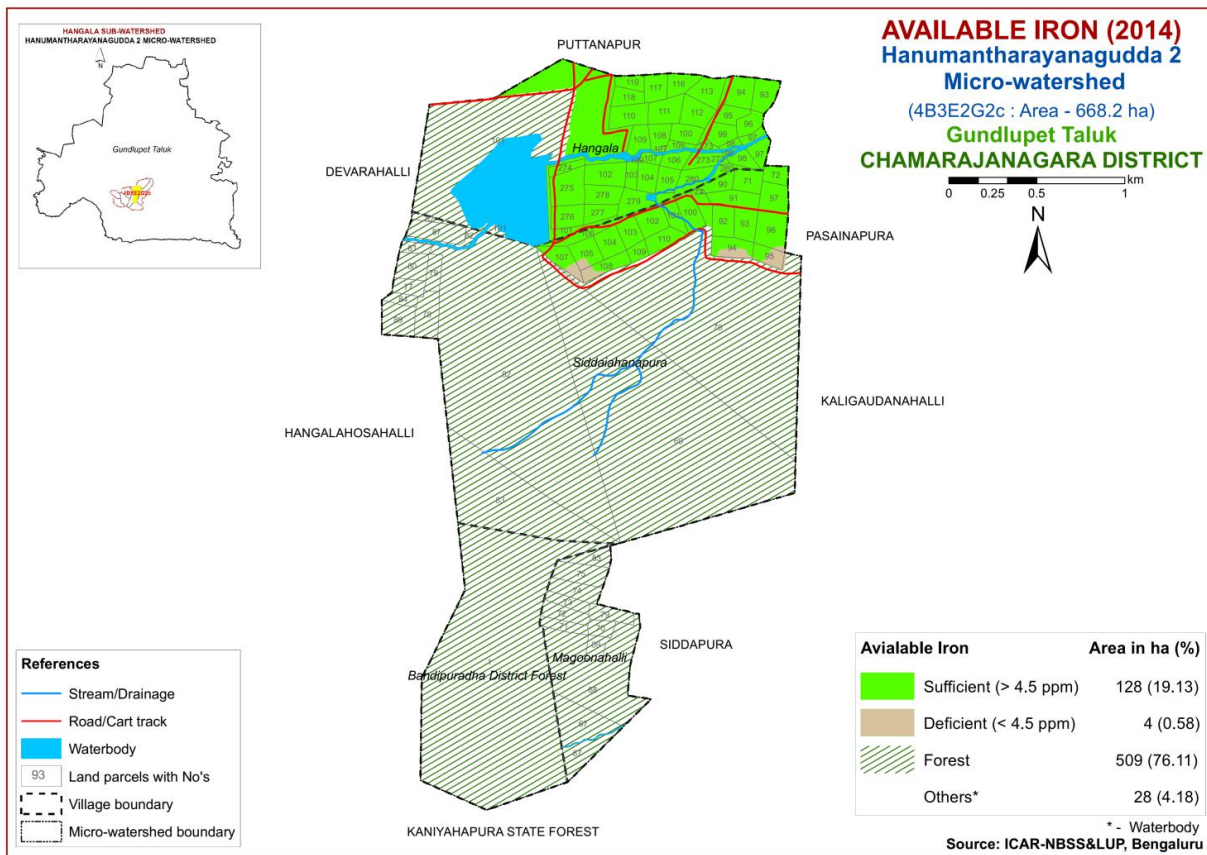


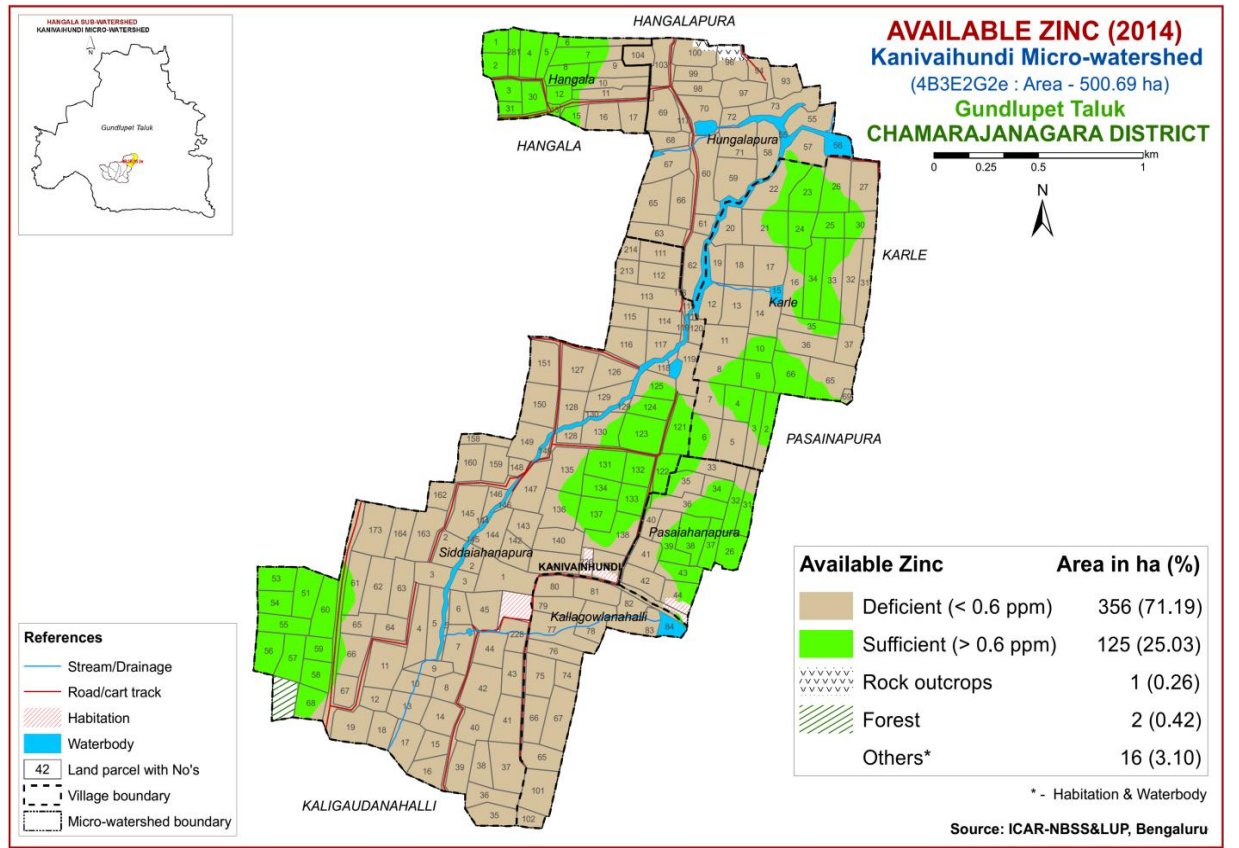
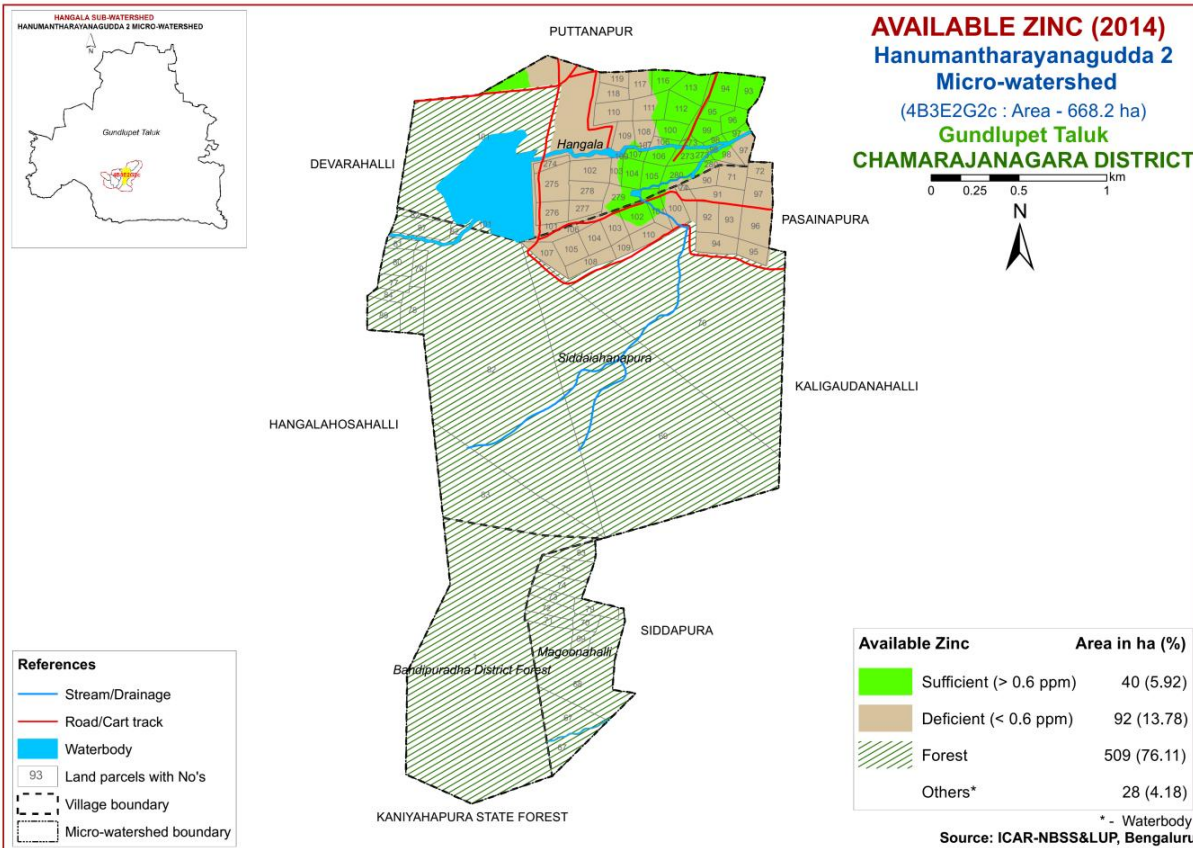
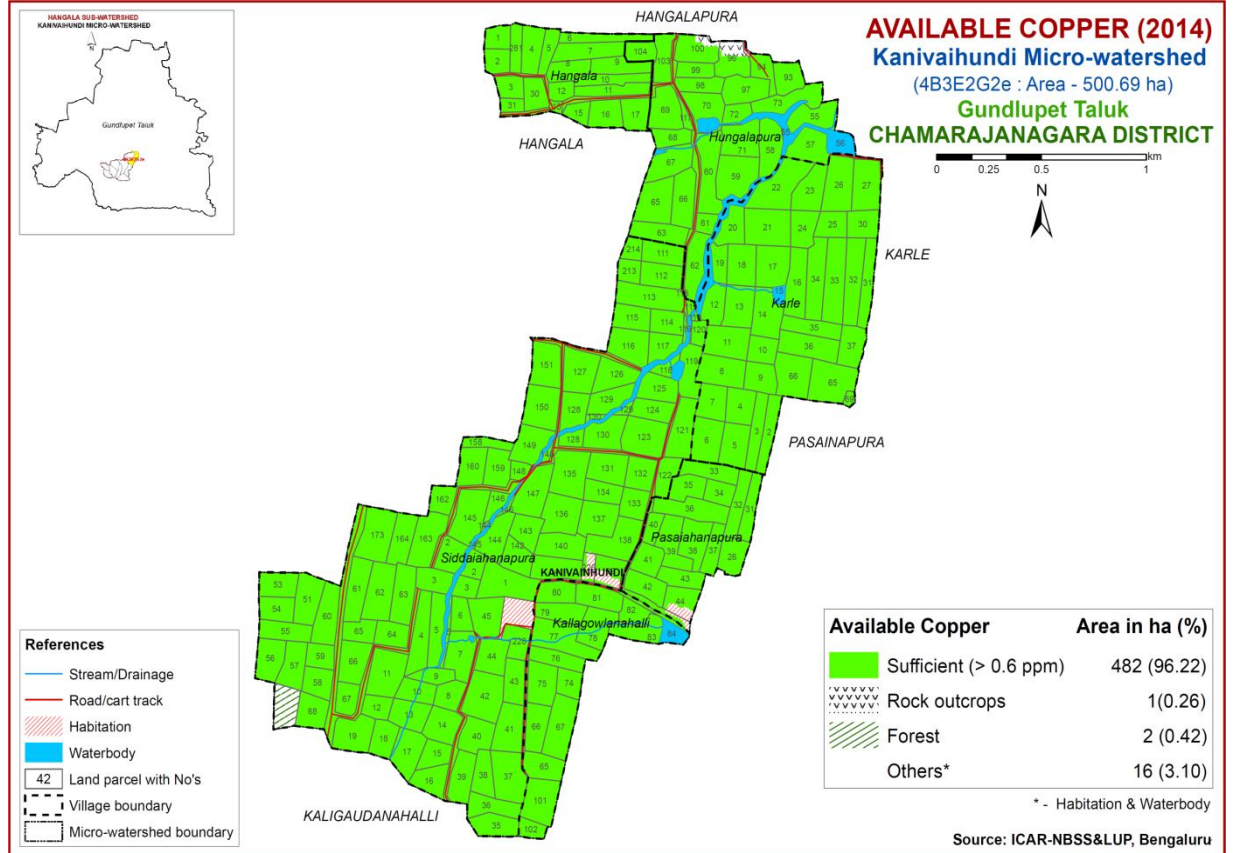
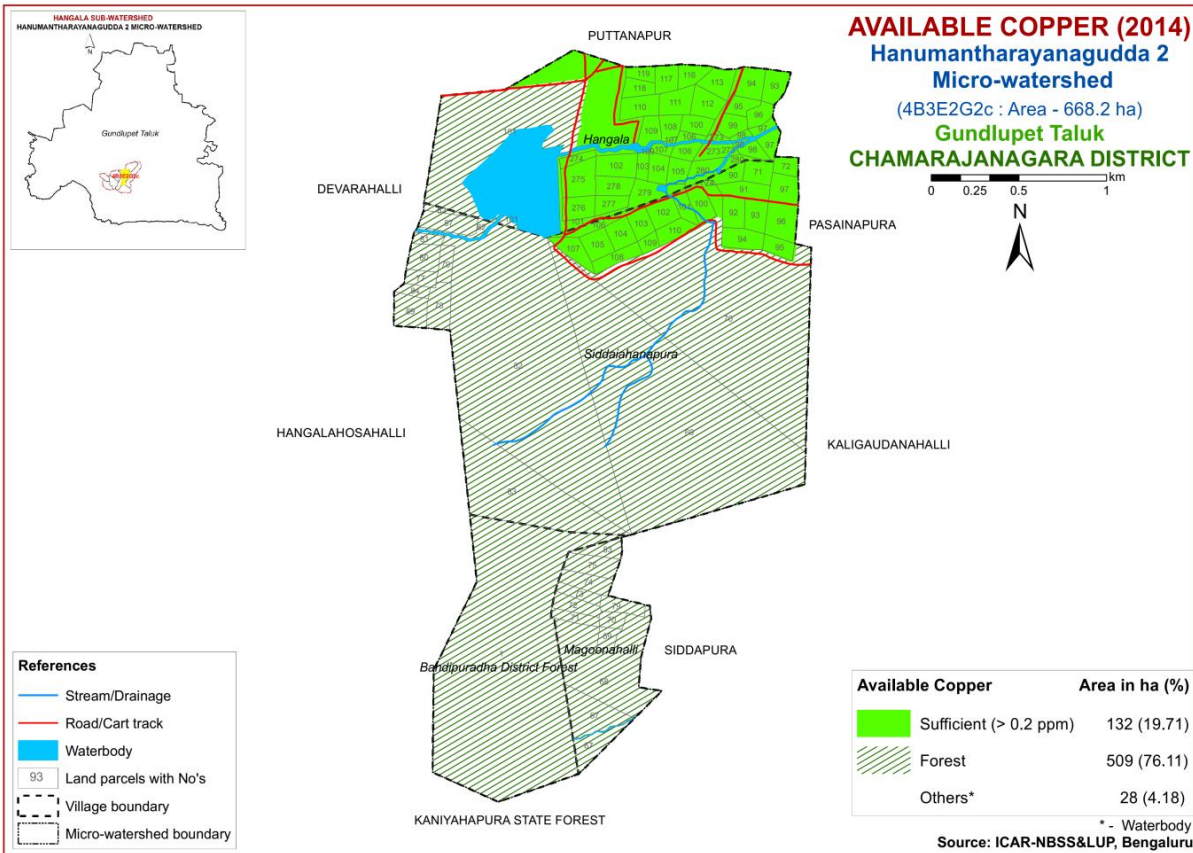


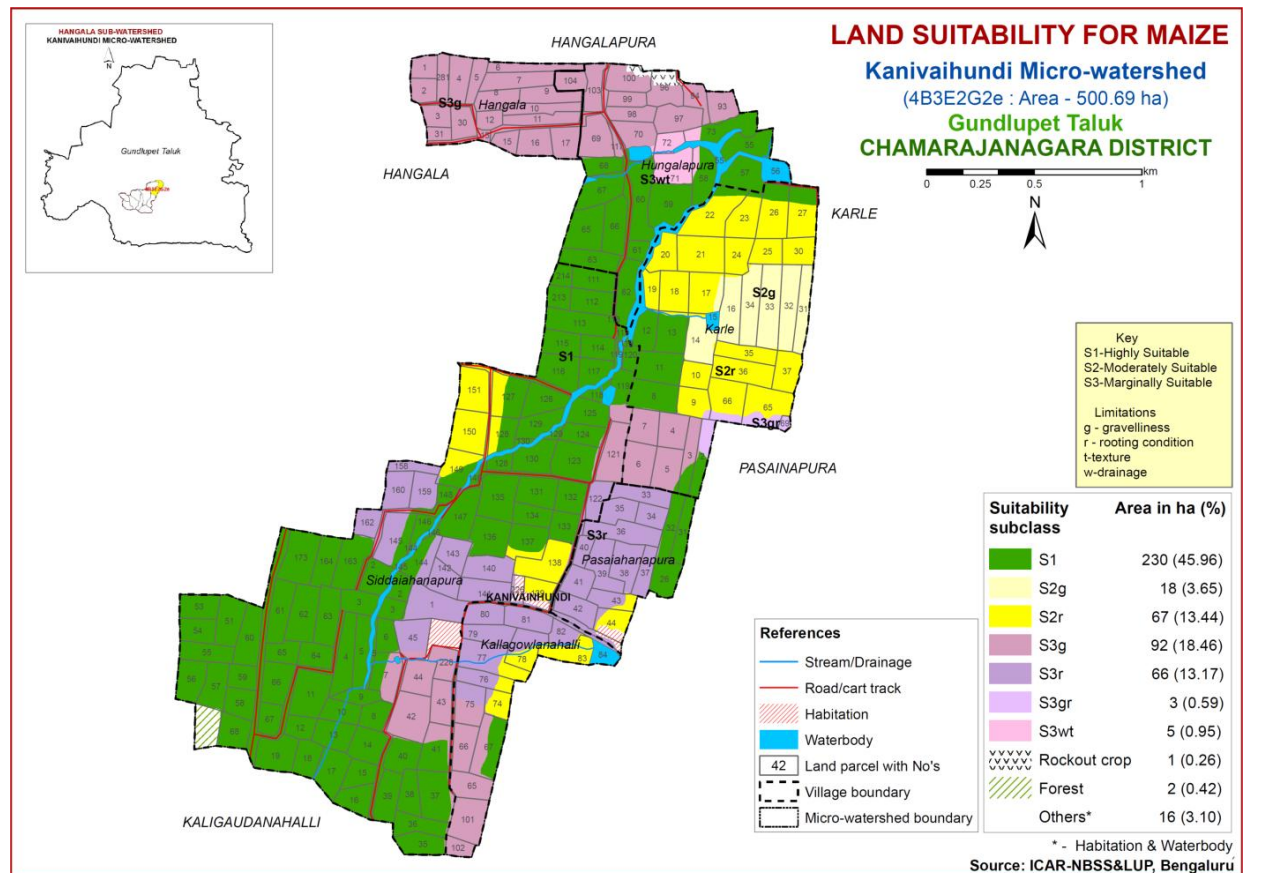
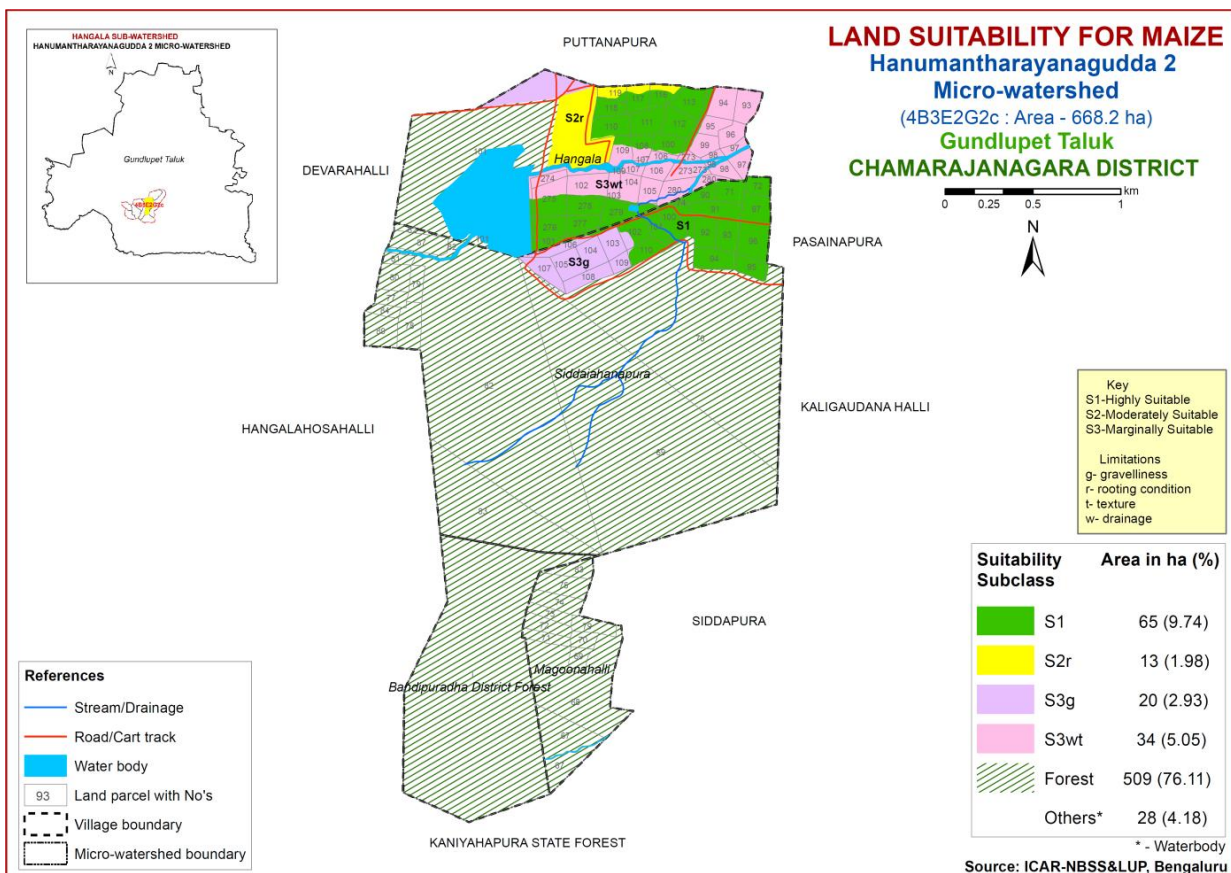
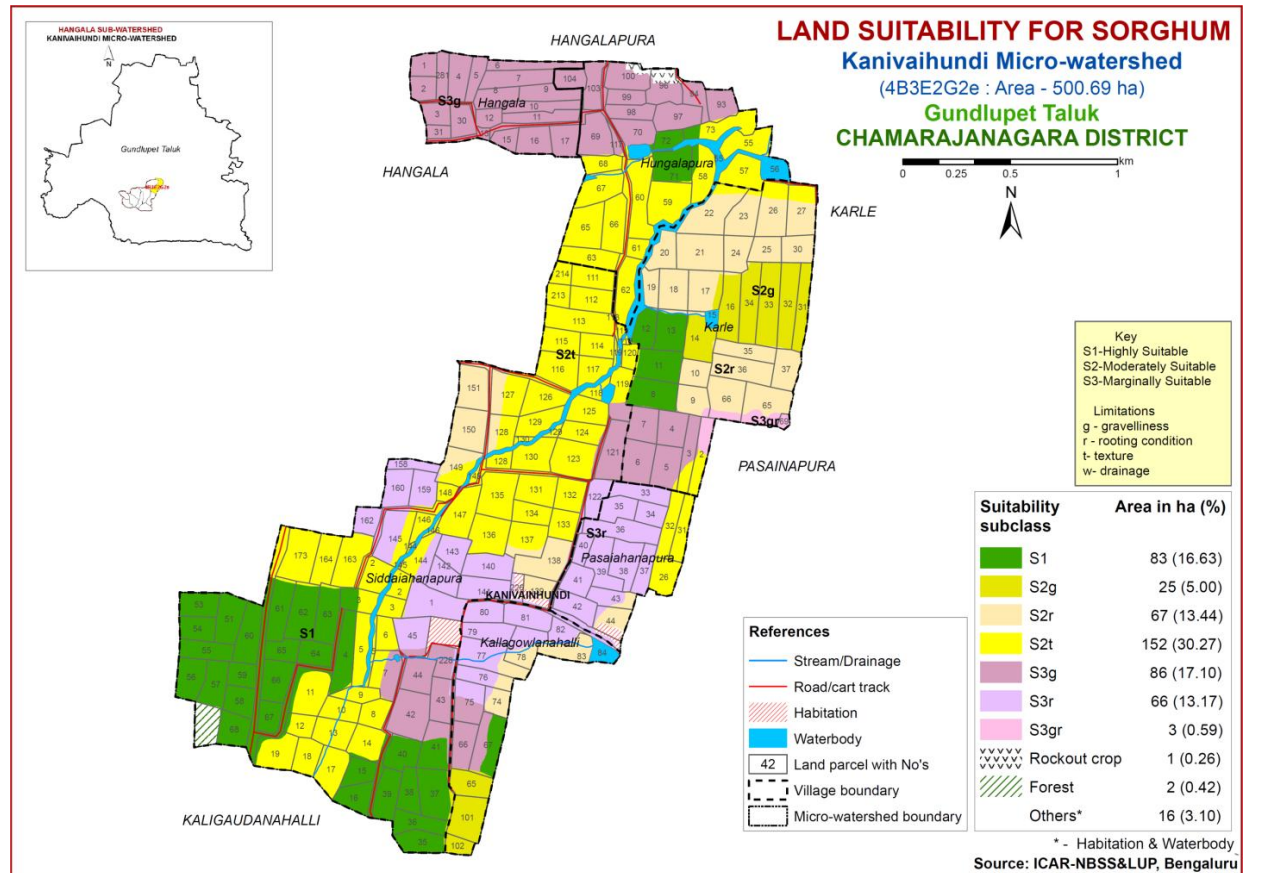
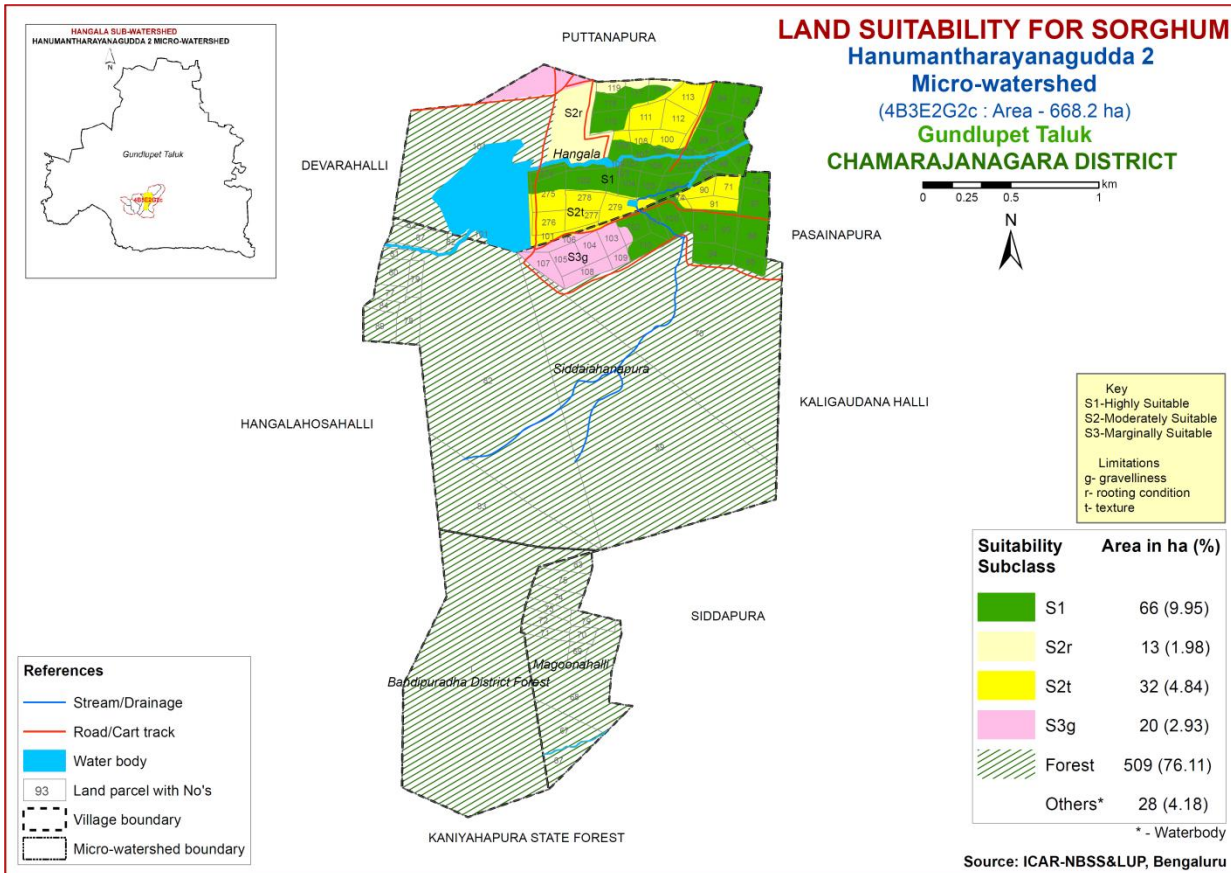


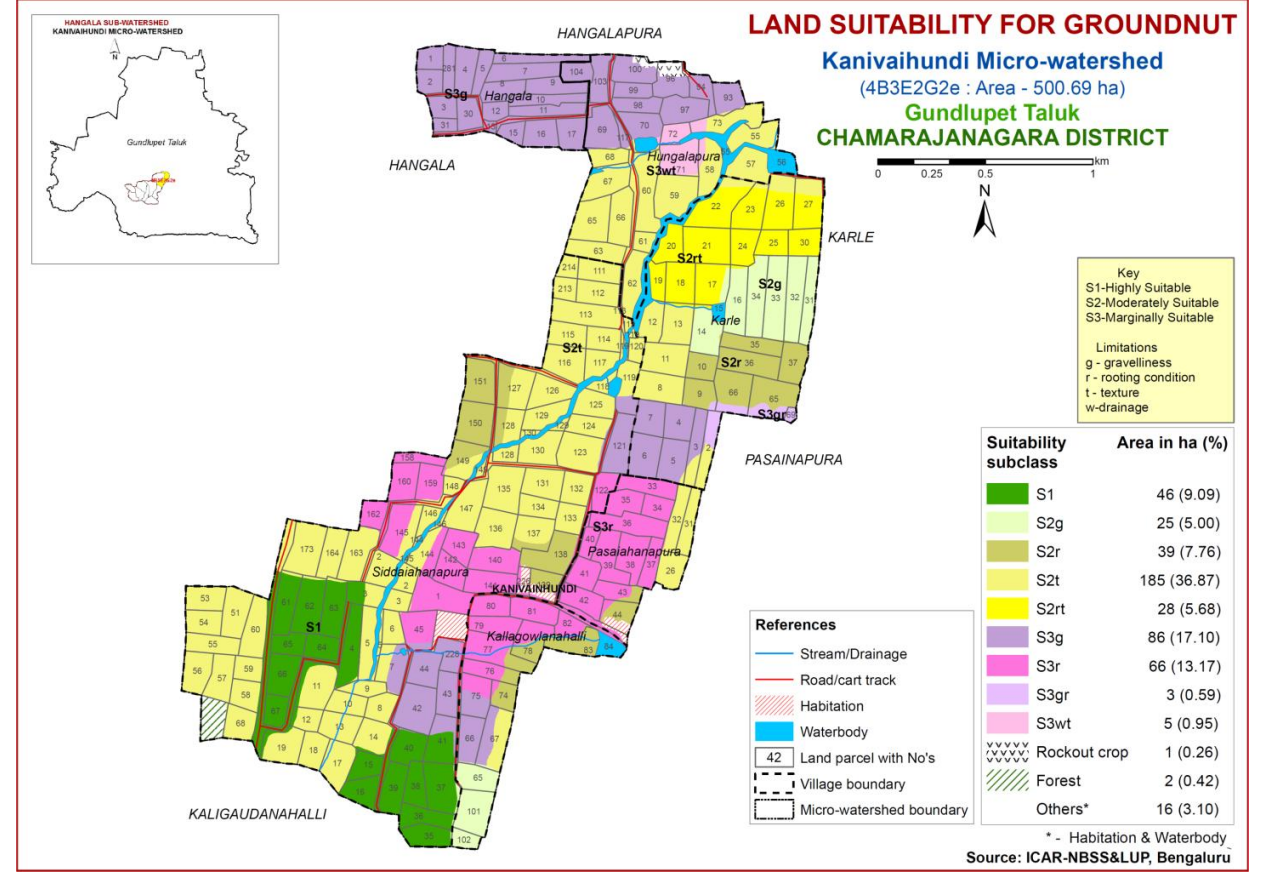
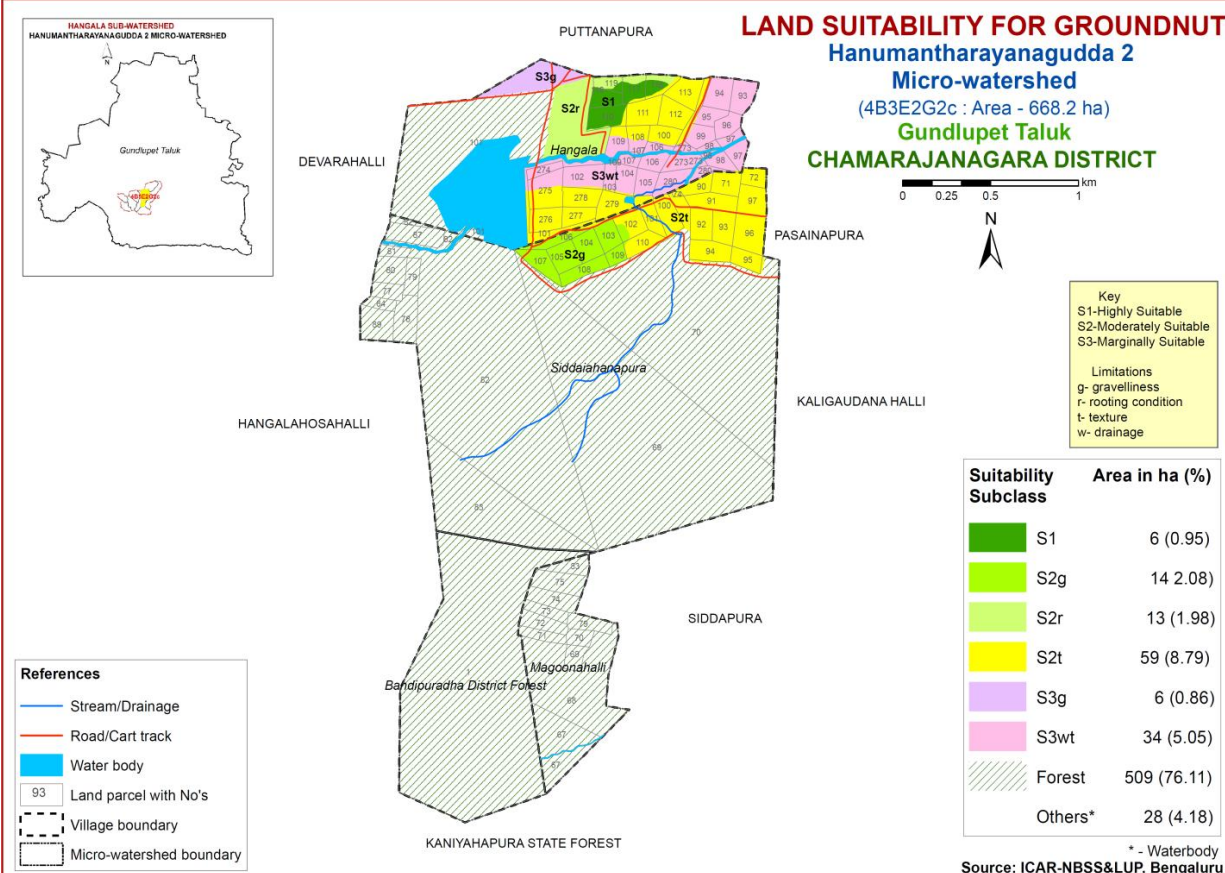
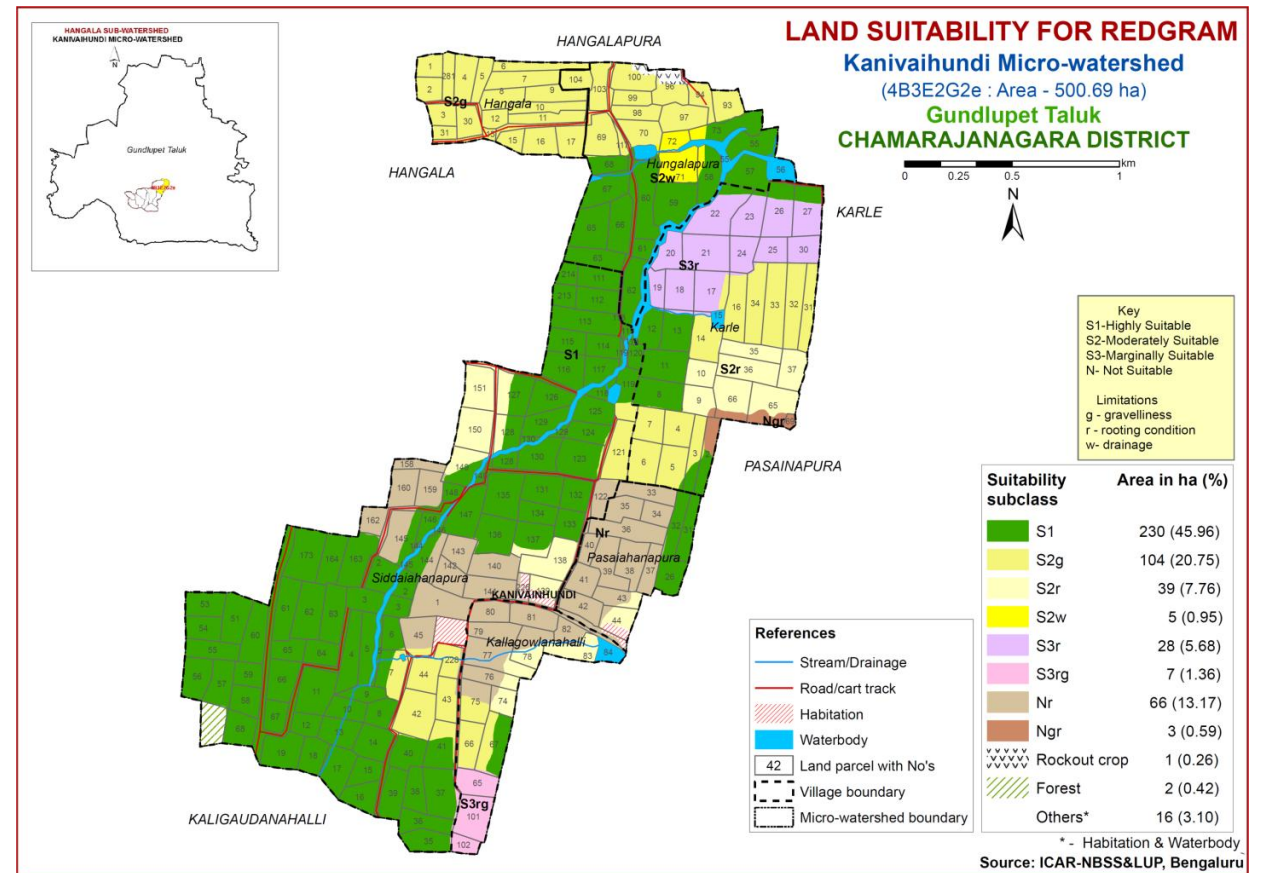
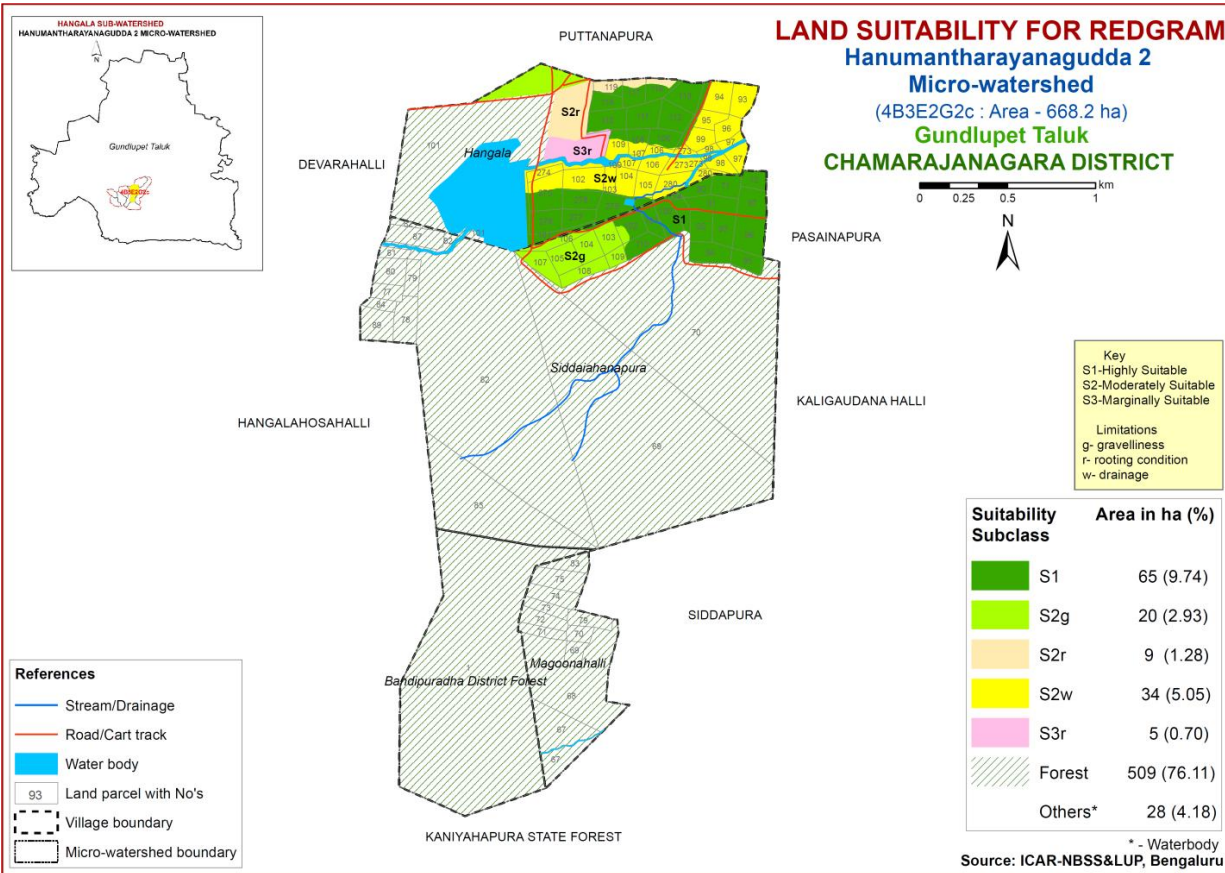


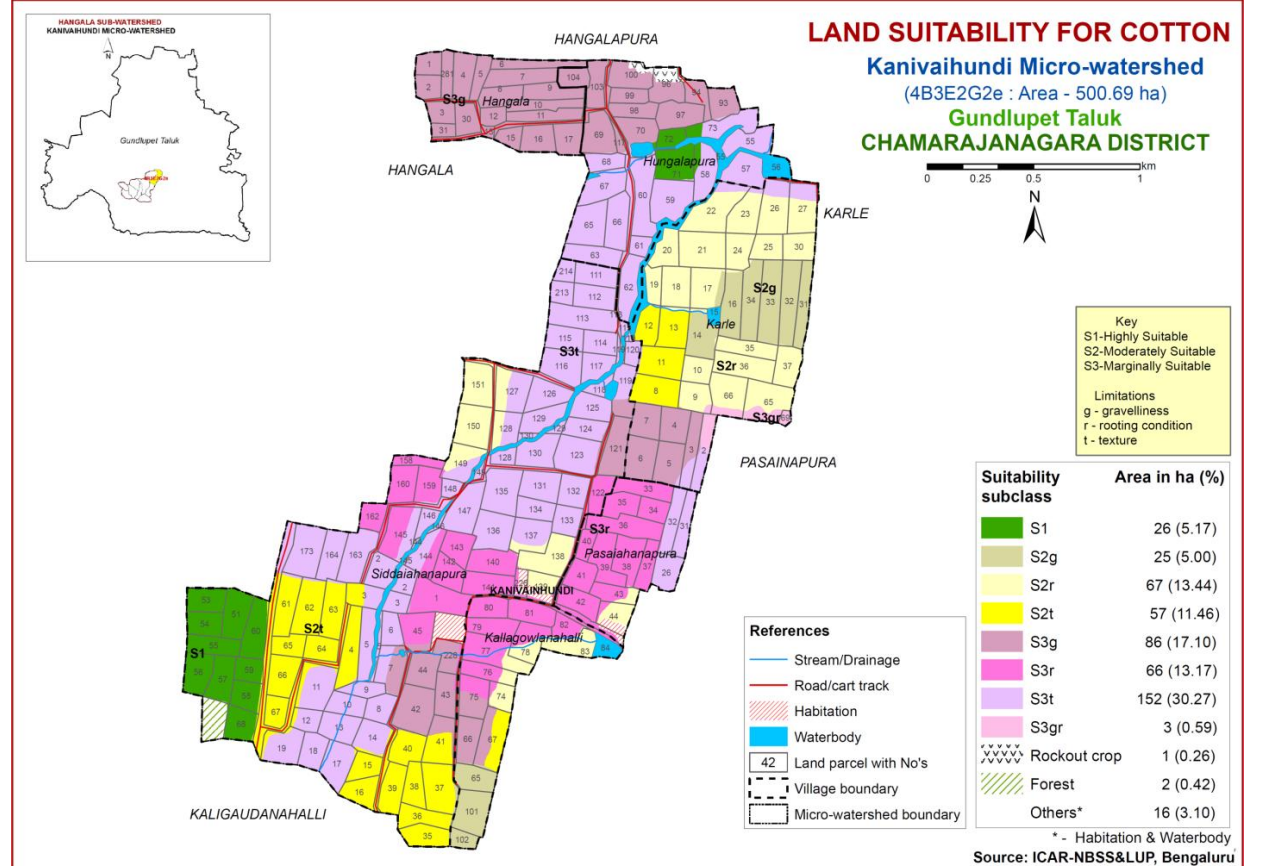
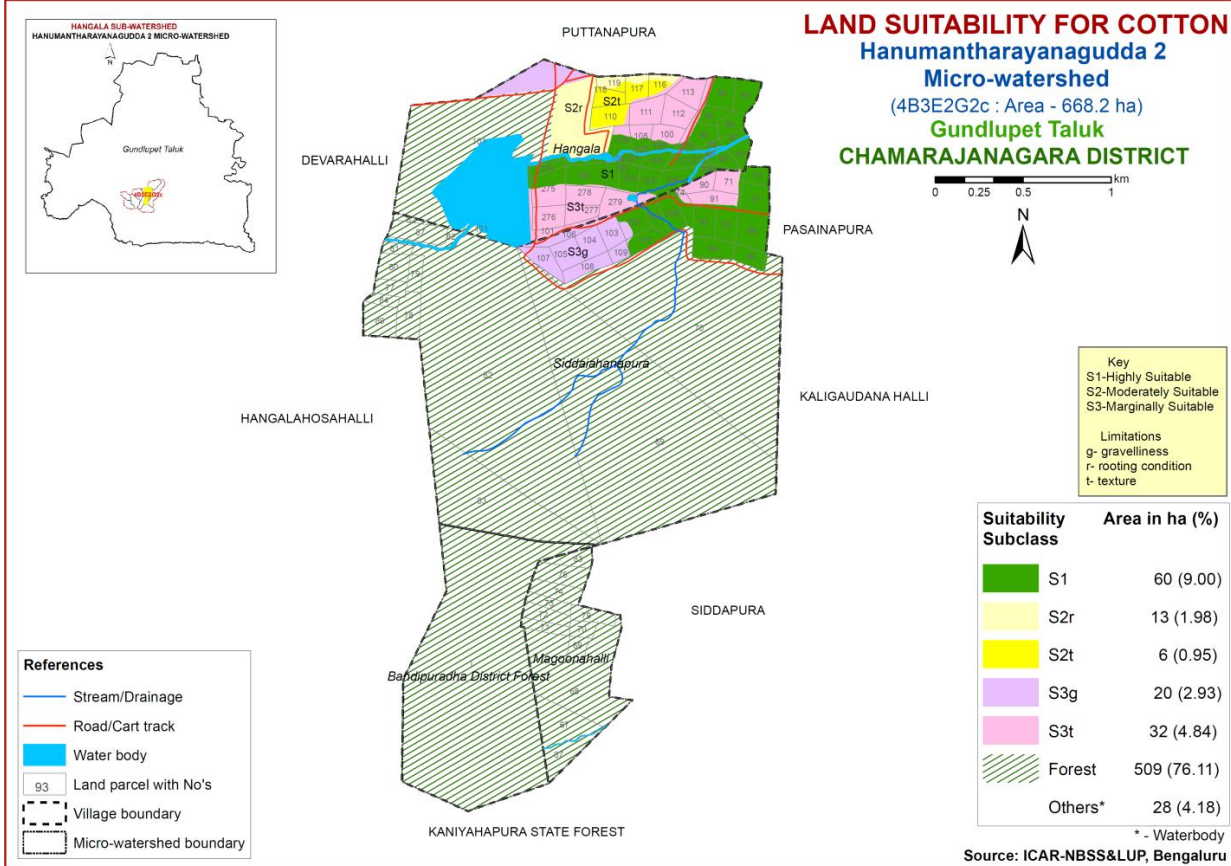
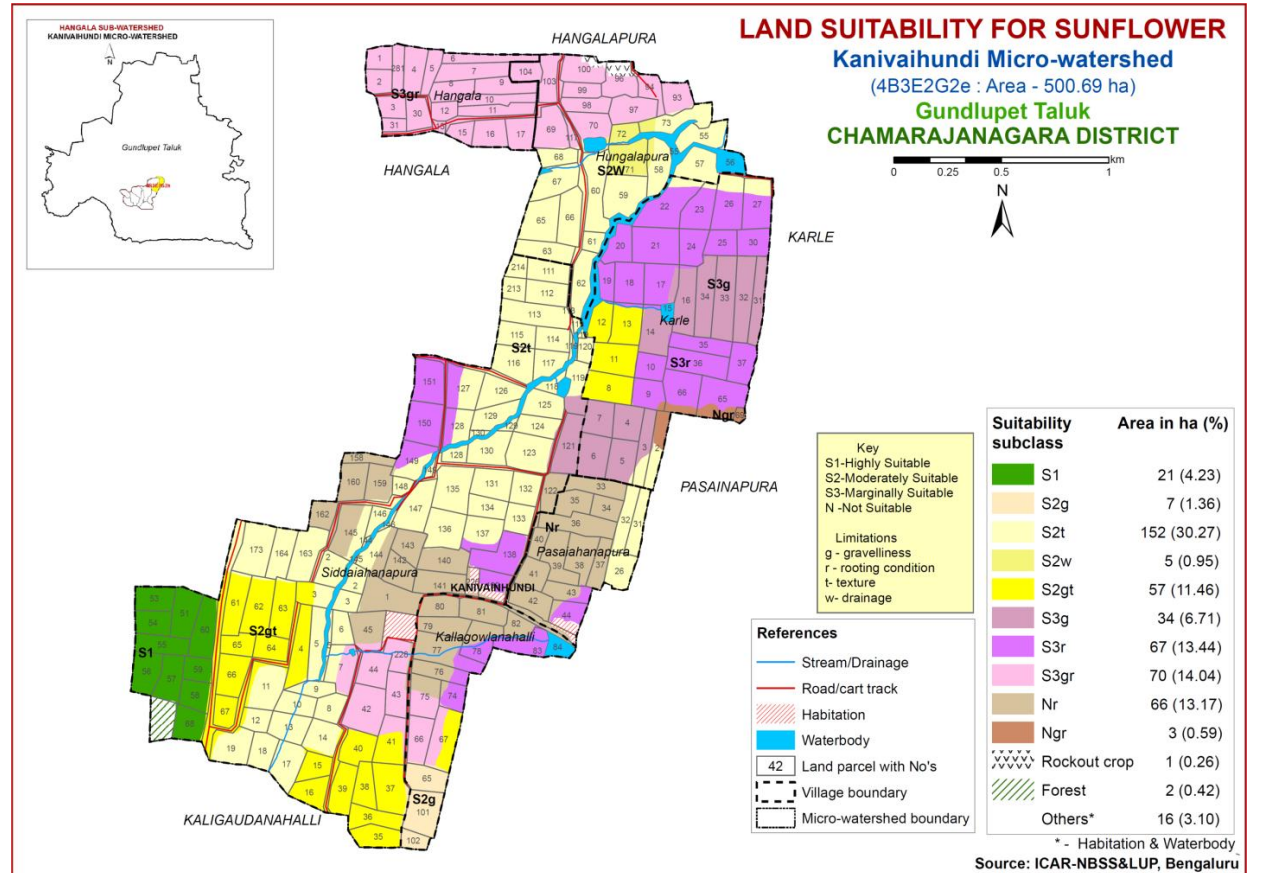
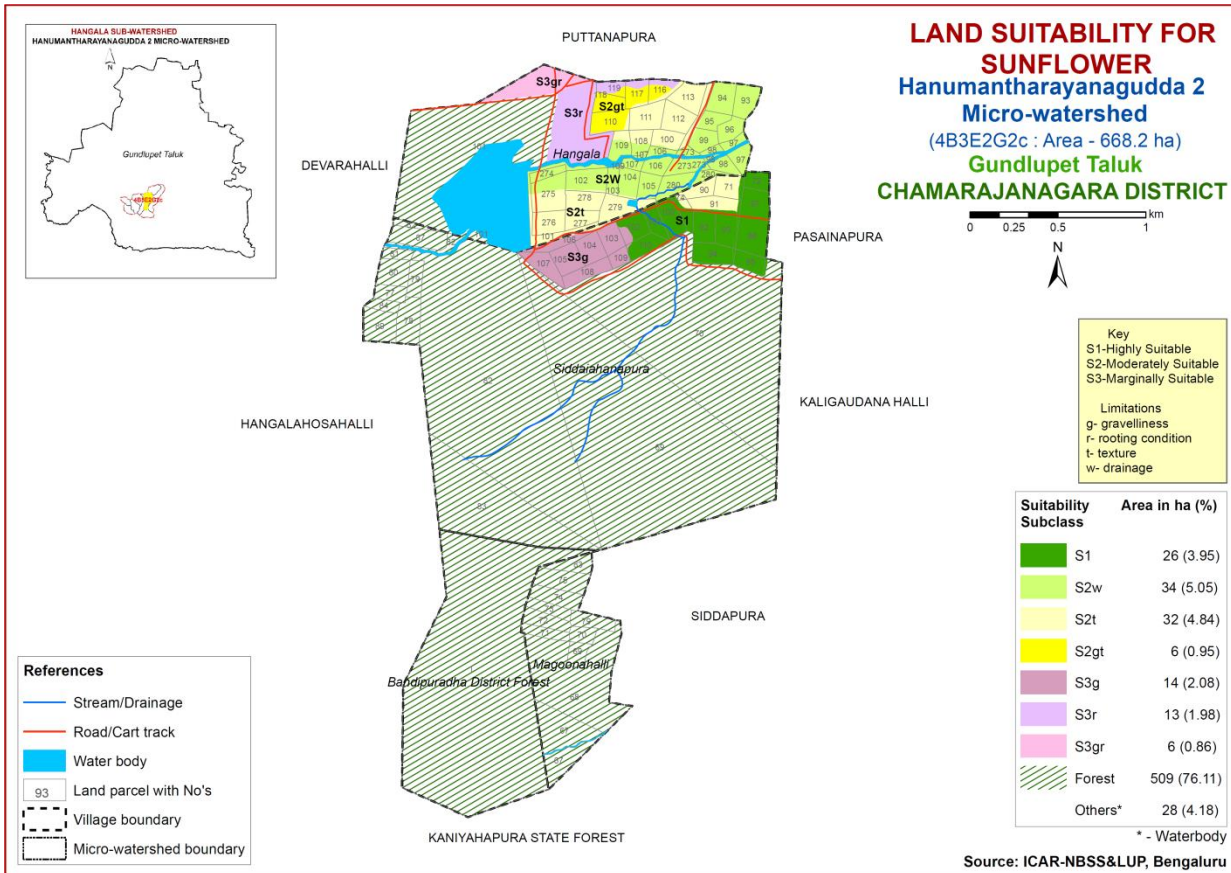


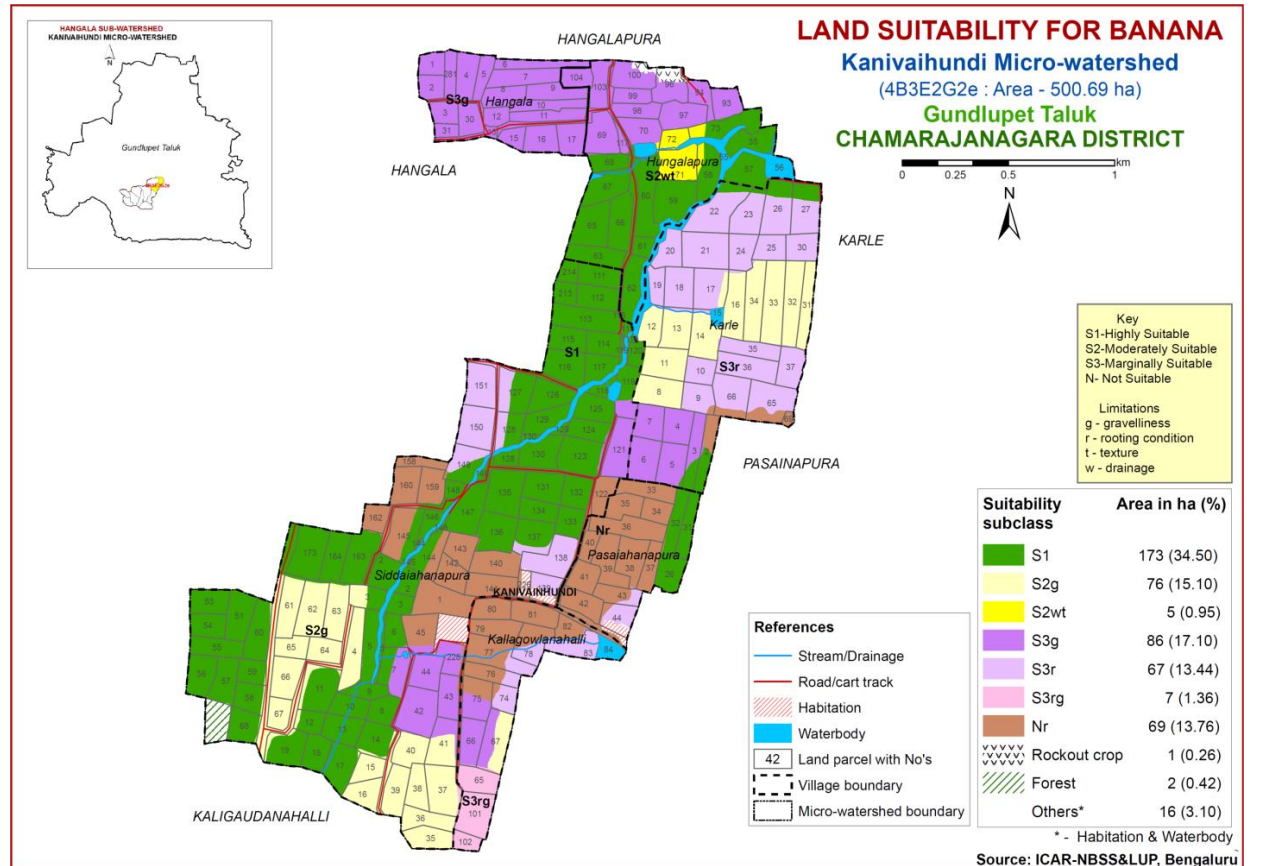
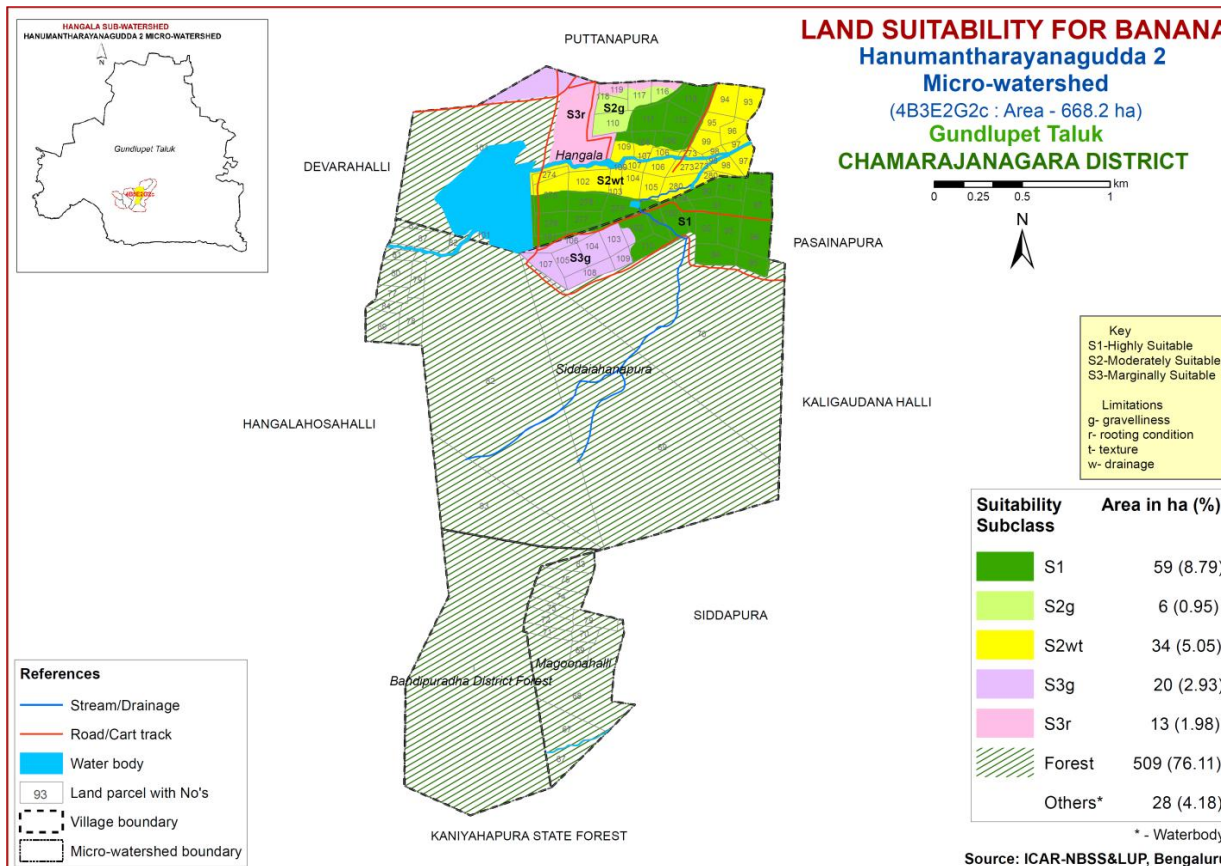
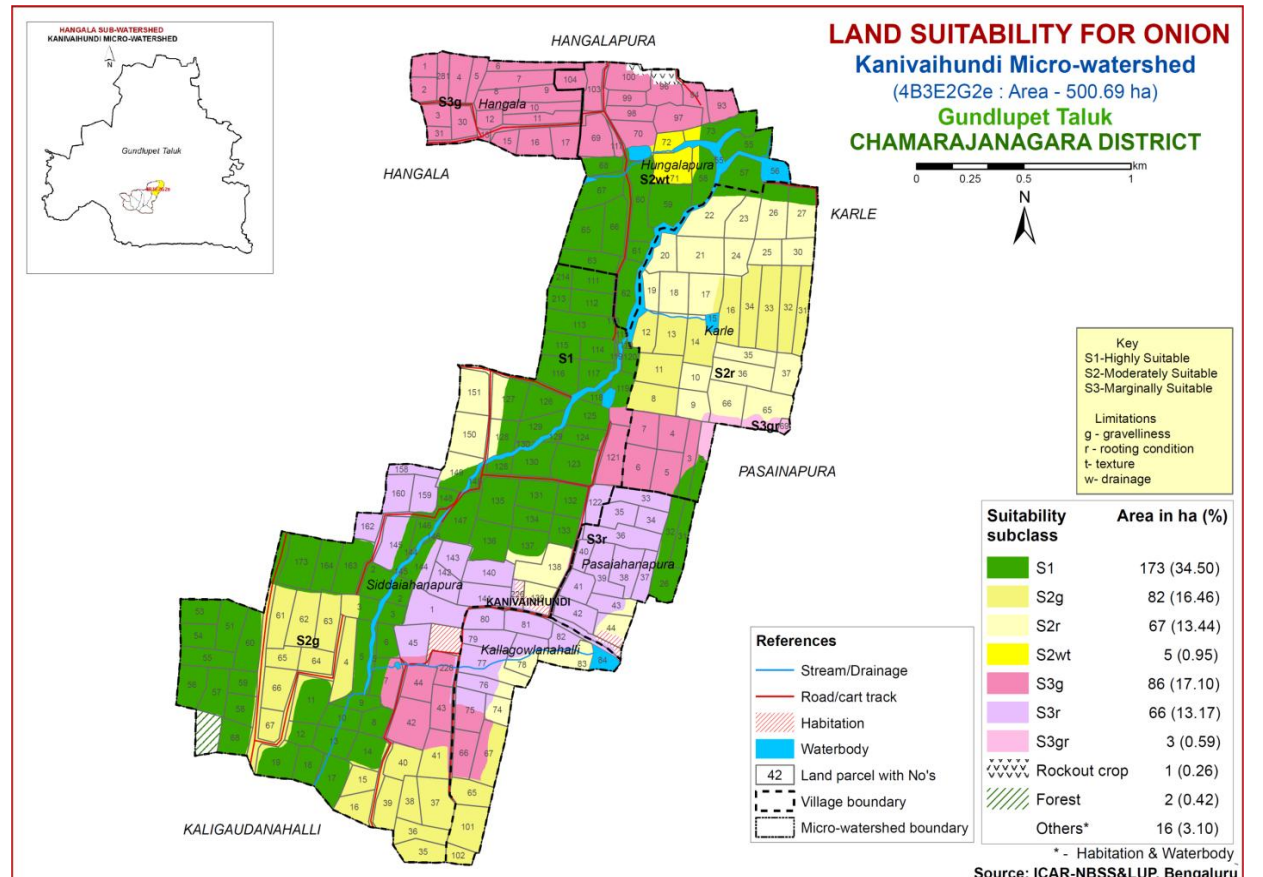
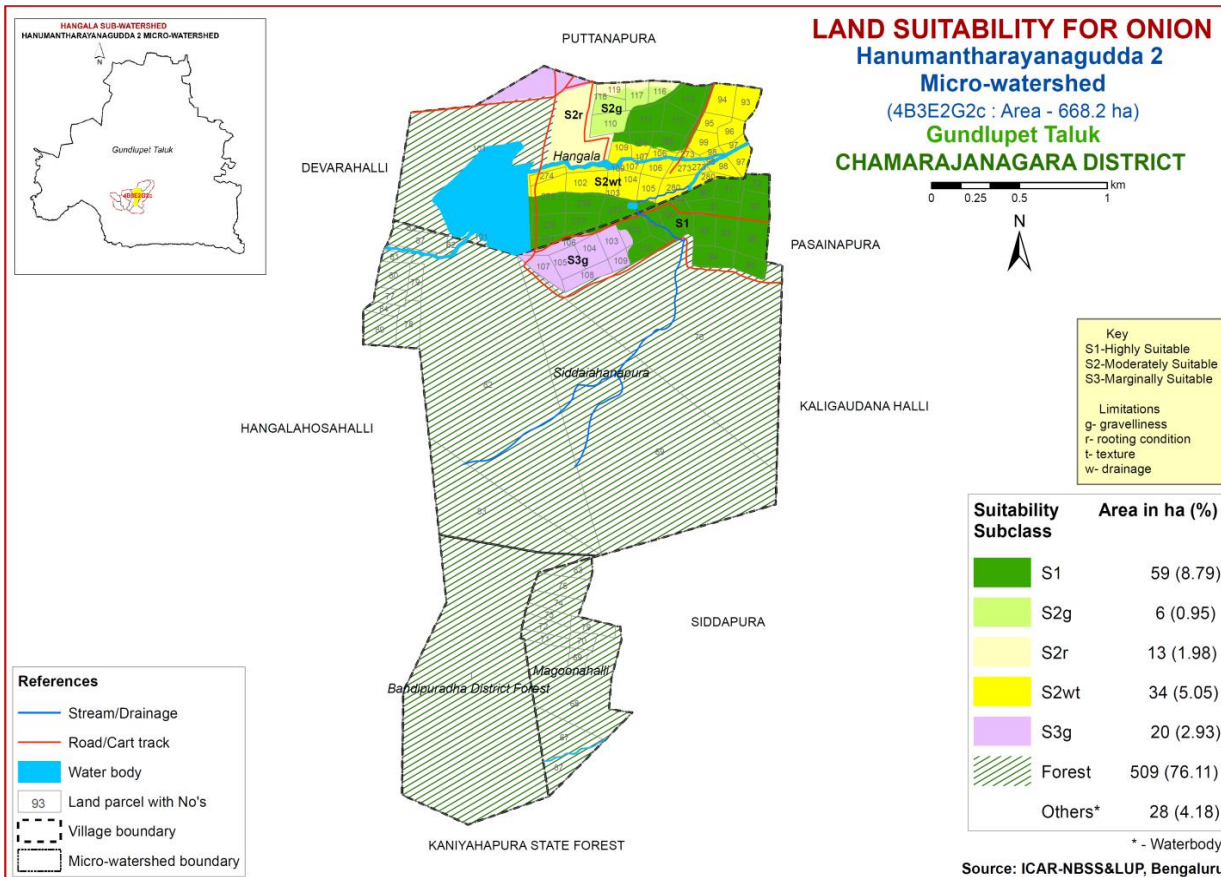


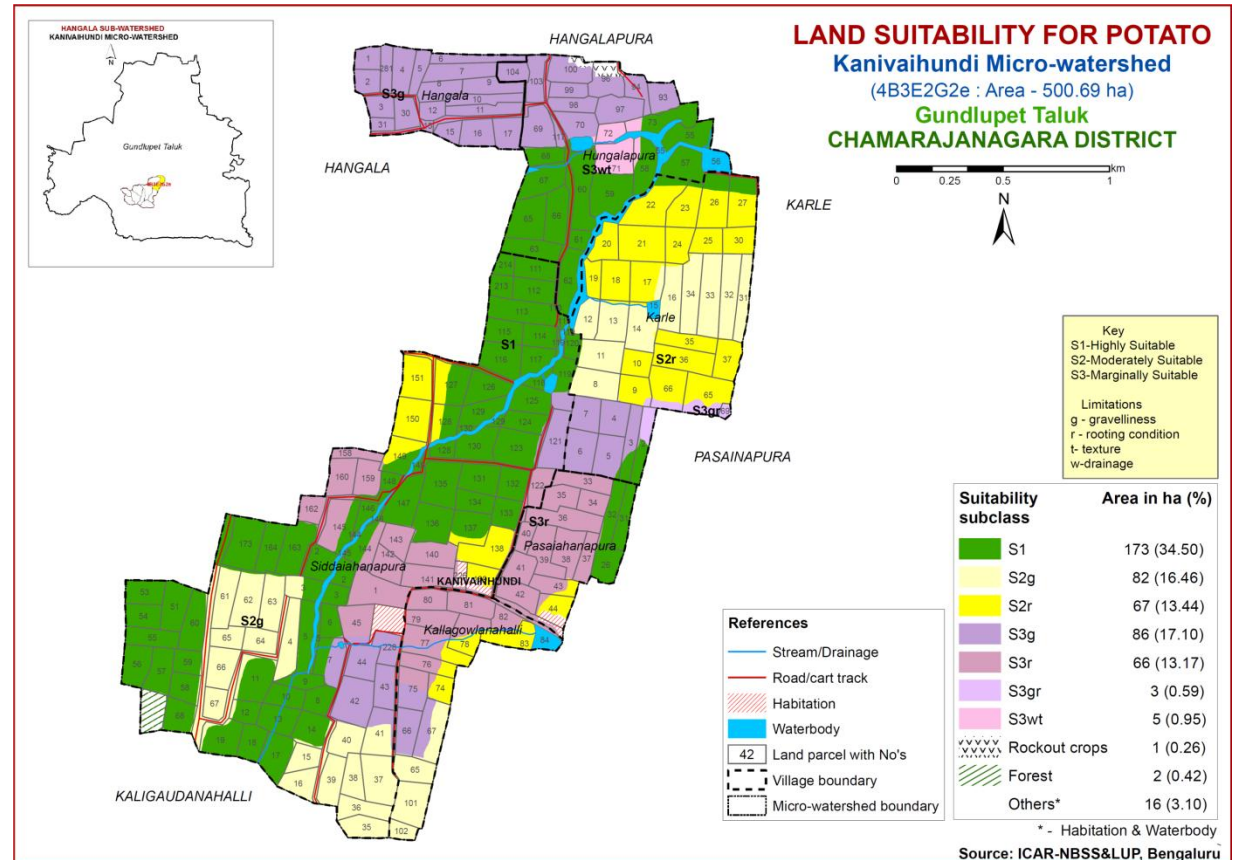
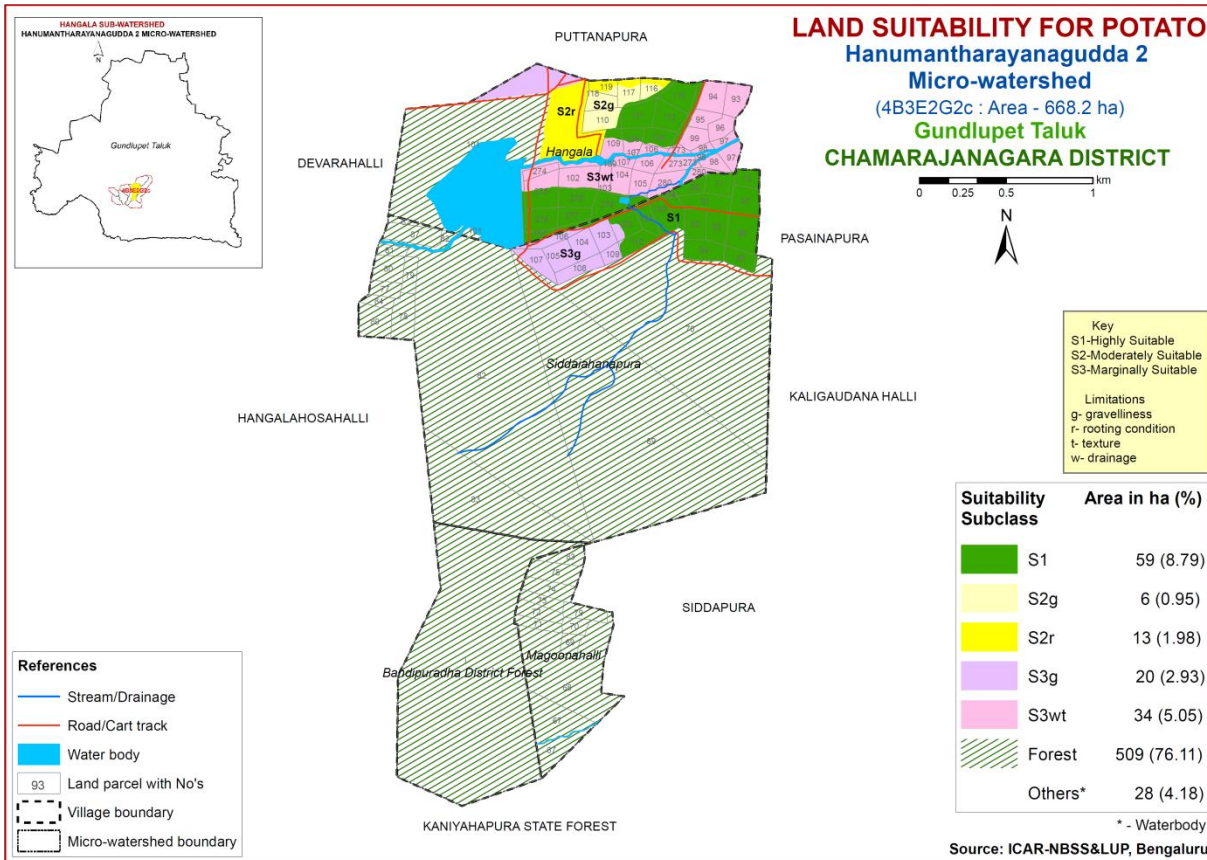
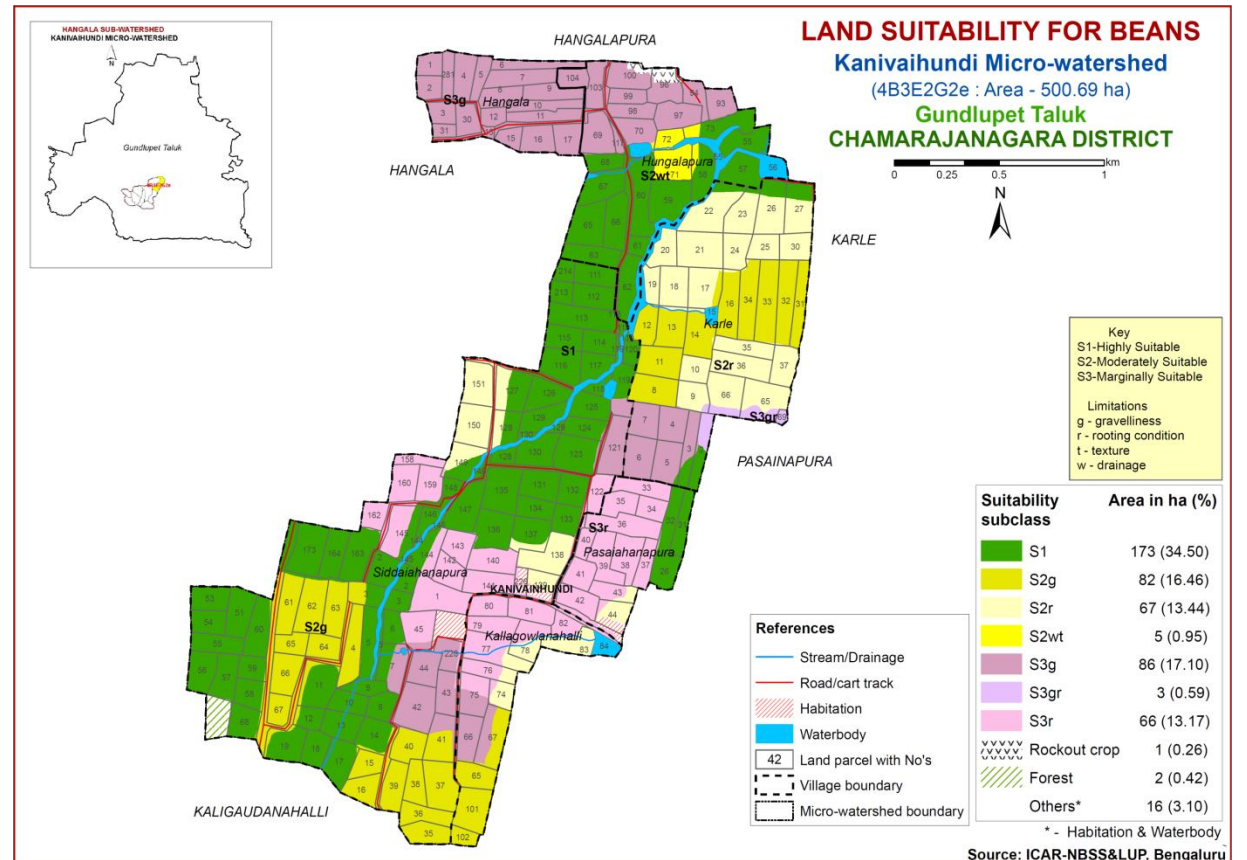
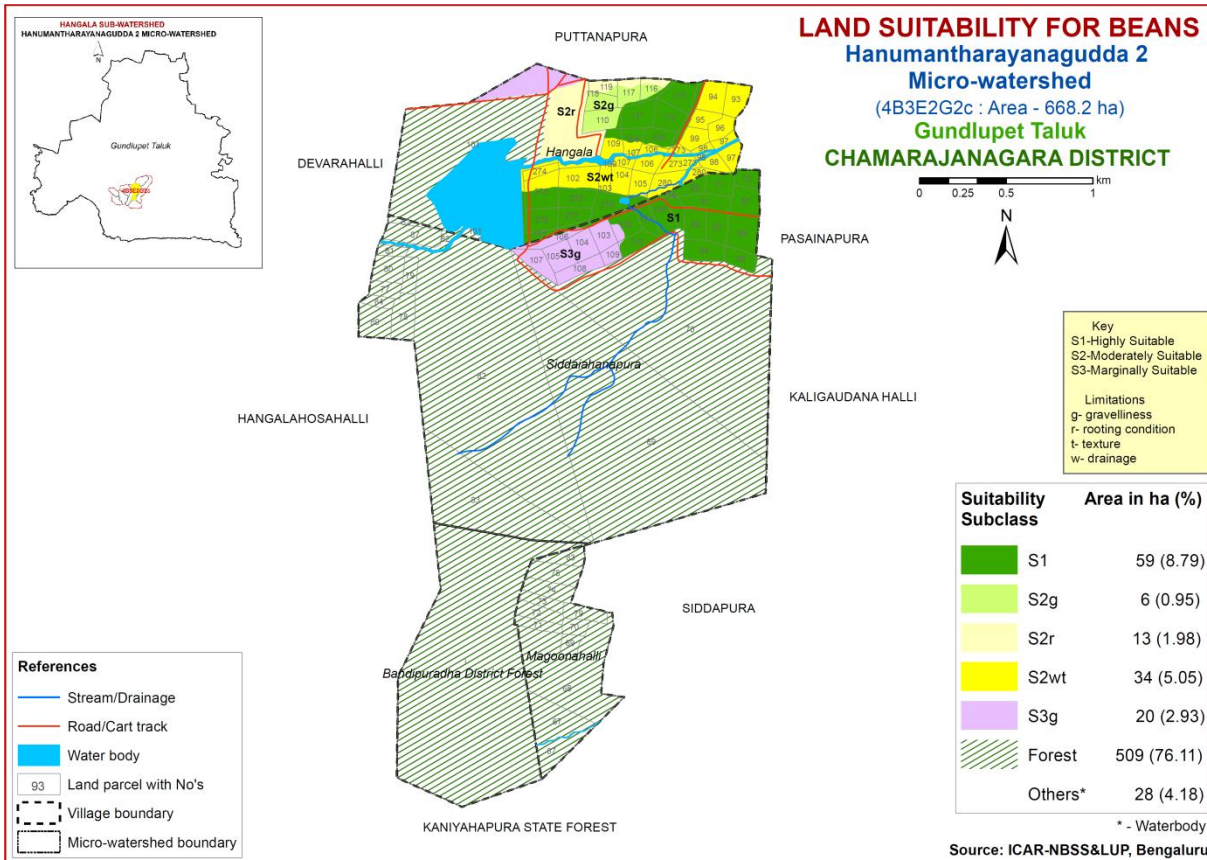


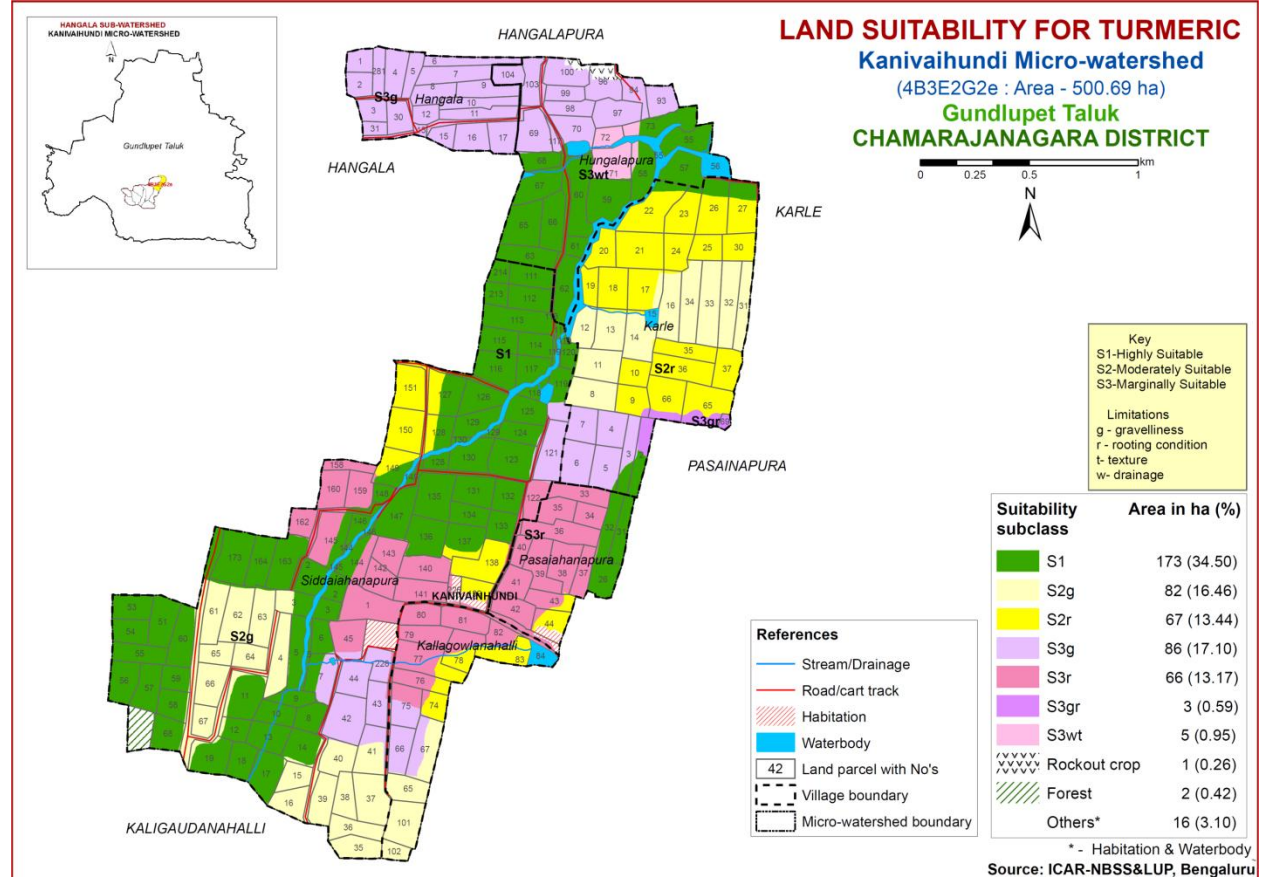
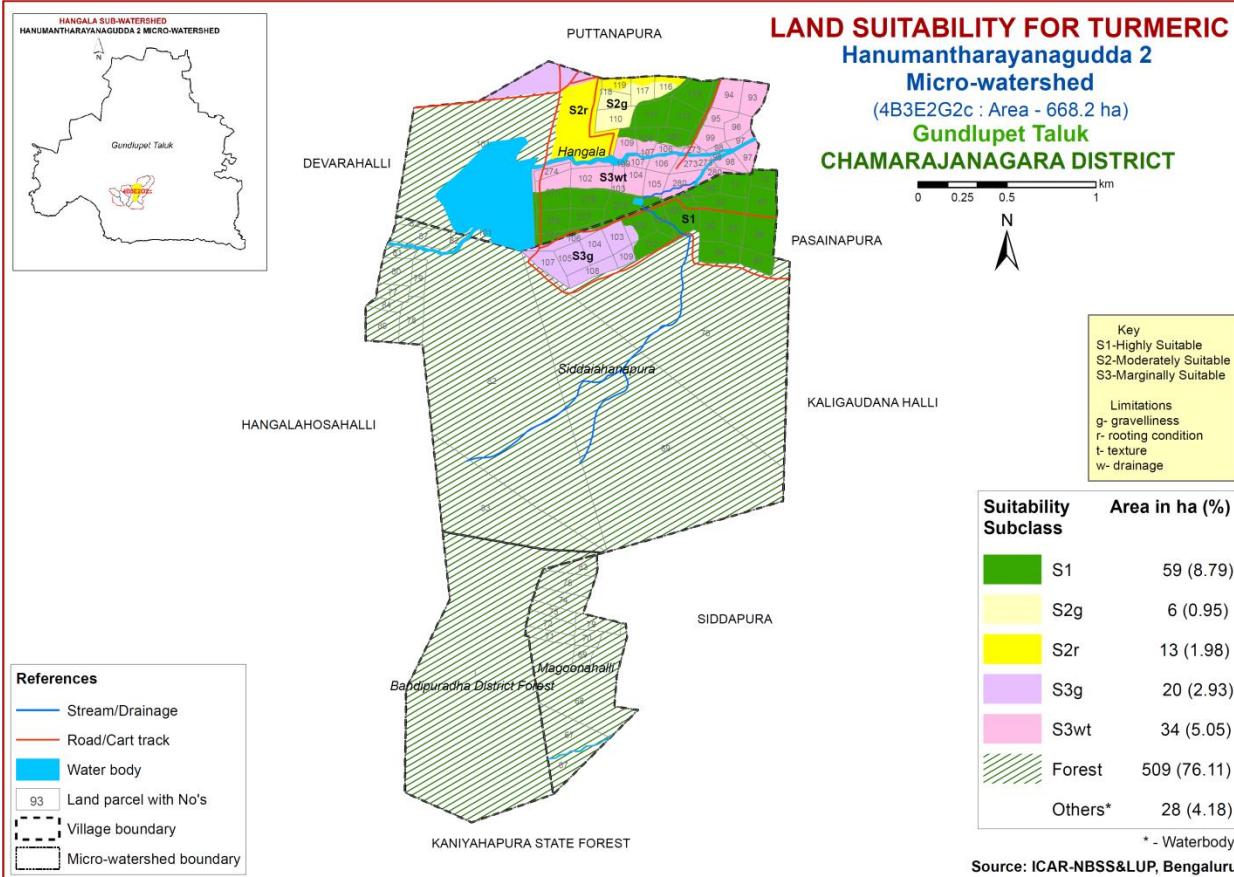
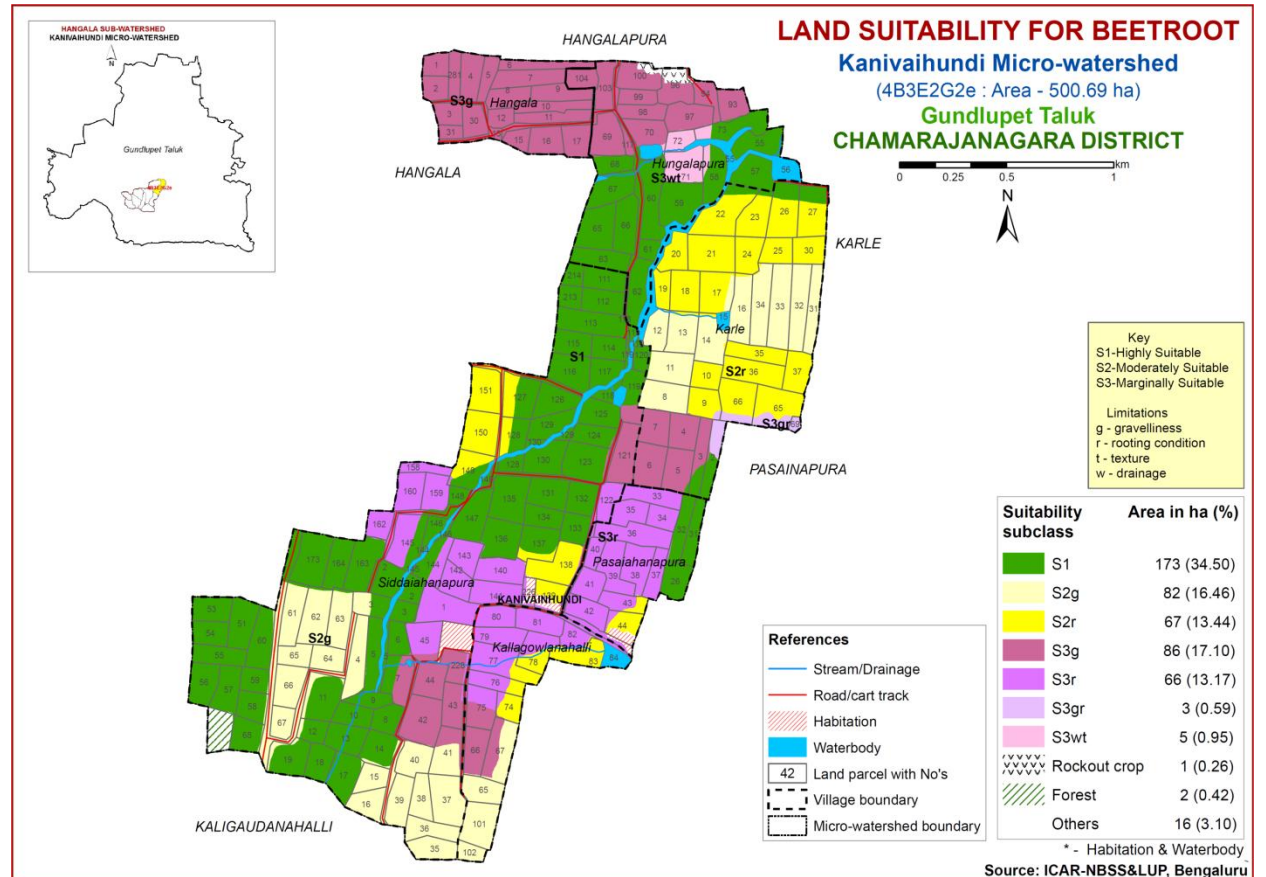
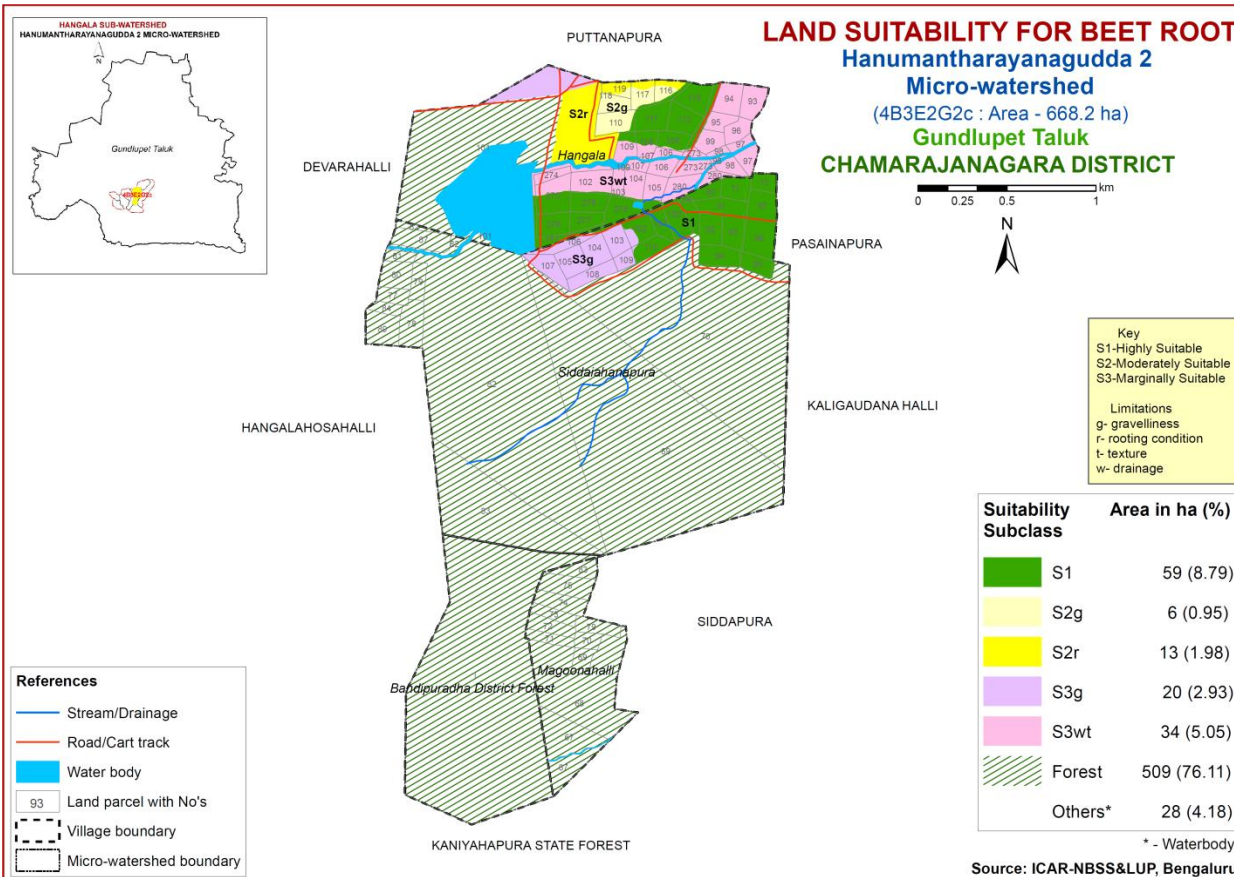


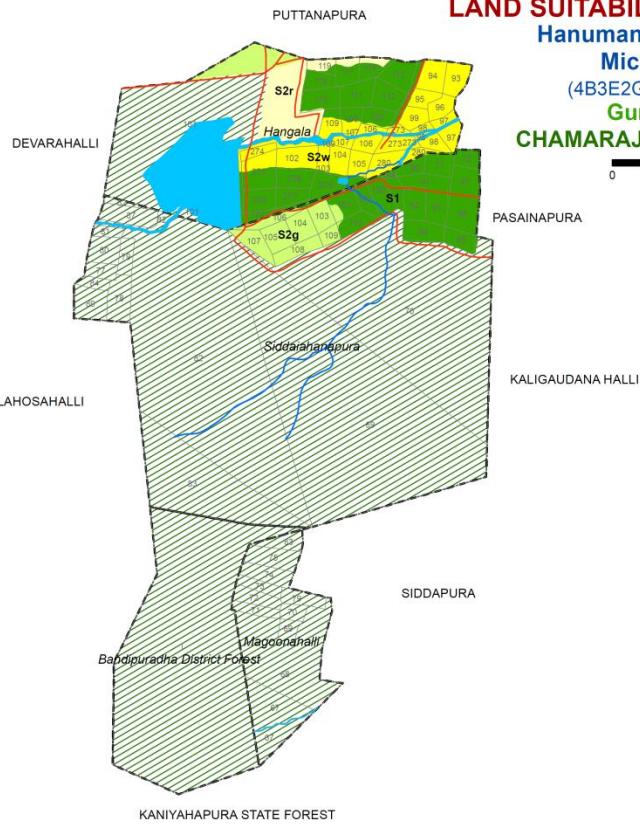
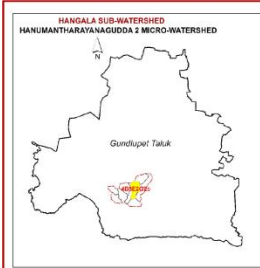












LAND SUITABILITY FOR HORSEGRAM
Hanumantharayanagudda 2
Micro-watershed
 (4B3E2G2c : Area - 668.2 ha)
Gundlupet Taluk
CHAMARAJANAGARA DISTRICT

0 0.25 0.5 1 km



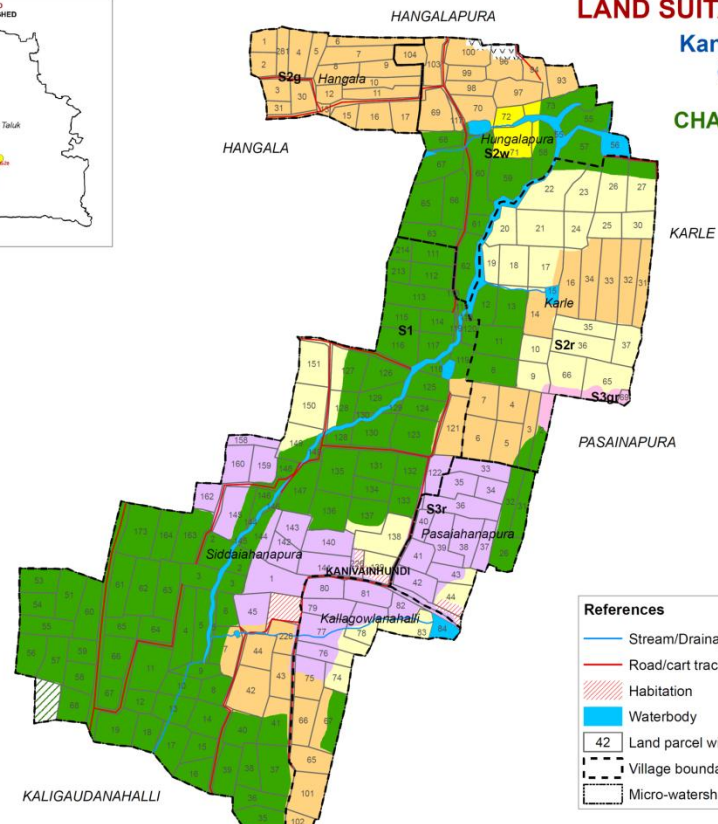
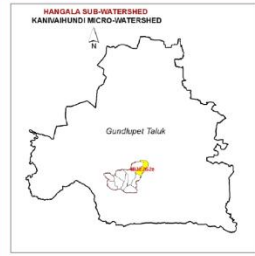
Key
 S1-Highly Suitable
 S2-Moderately Suitable
 Limitations
 g - graveliness
 r - rooting condition
 w- drainage

Suitability Subclass	Area in ha (%)
S1	65 (9.74)
S2g	20 (2.93)
S2r	13 (1.98)
S2w	34 (5.05)
Forest	509 (76.11)
Others*	28 (4.18)

* - Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

- References**
- Stream/Drainage
 - Road/Cart track
 - Water body
 - Land parcel with No's
 - Village boundary
 - Micro-watershed boundary



LAND SUITABILITY FOR HORSEGRAM
Kanivaihundi Micro-watershed
 (4B3E2G2e : Area - 500.69 ha)
Gundlupet Taluk
CHAMARAJANAGARA DISTRICT

0 0.25 0.5 1 km



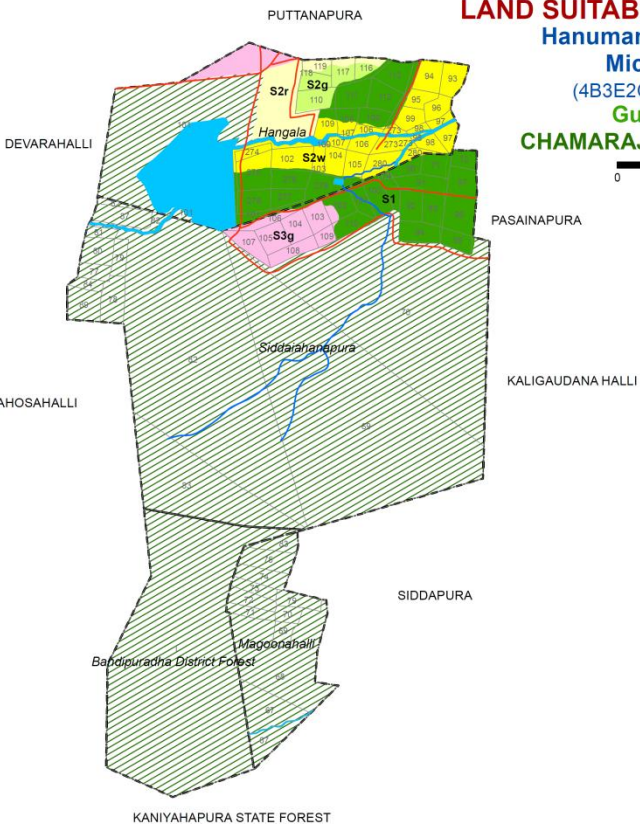
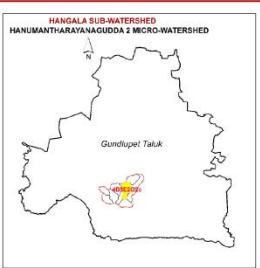
Key
 S1-Highly Suitable
 S2-Moderately Suitable
 S3-Marginally Suitable
 Limitations
 g - graveliness
 r - rooting condition
 w-drainage

Suitability subclass	Area in ha (%)
S1	230 (45.96)
S2g	111 (22.11)
S2r	67 (13.44)
S2w	5 (0.95)
S3r	66 (13.17)
S3gr	3 (0.59)
Rockout crop	1 (0.26)
Forest	2 (0.42)
Others*	16 (3.10)

* - Habitation & Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

- References**
- Stream/Drainage
 - Road/cart track
 - Habitation
 - Waterbody
 - Land parcel with No's
 - Village boundary
 - Micro-watershed boundary



LAND SUITABILITY FOR FIELD BEAN
Hanumantharayanagudda 2
Micro-watershed
 (4B3E2G2c : Area - 668.2 ha)
Gundlupet Taluk
CHAMARAJANAGARA DISTRICT

0 0.25 0.5 1 km



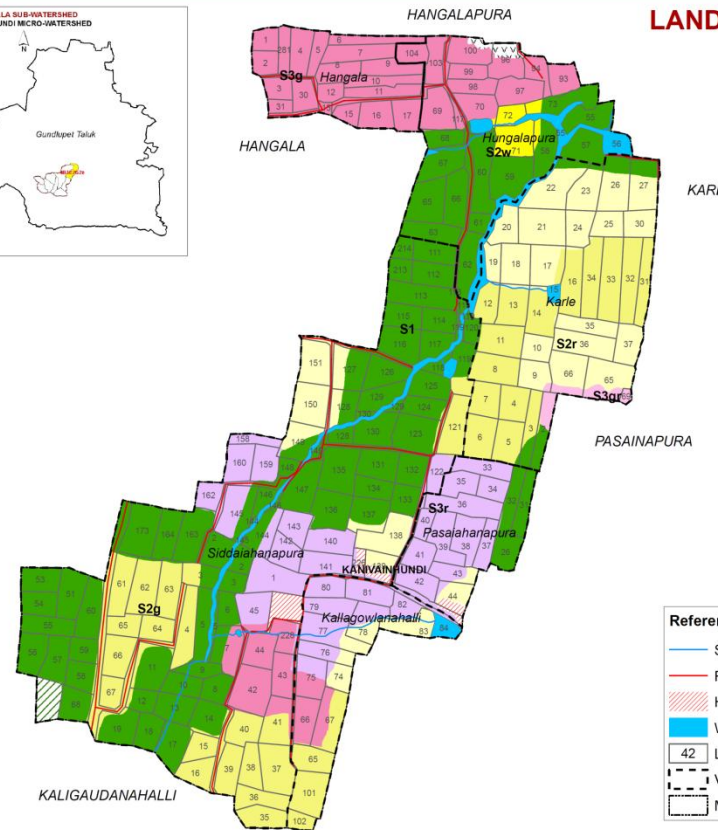
Key
 S1-Highly Suitable
 S2-Moderately Suitable
 S3-Marginally Suitable
 Limitations
 g- graveliness
 r- rooting condition
 w- drainage

Suitability Subclass	Area in ha (%)
S1	59 (8.79)
S2g	6 (0.95)
S2r	13 (1.98)
S2w	34 (5.05)
S3g	20 (2.93)
Forest	509 (76.11)
Others*	28 (4.18)

* - Waterbody

Source: ICAR-NBSS&LUP, Bengaluru

- References**
- Stream/Drainage
 - Road/Cart track
 - Water body
 - Land parcel with No's
 - Village boundary
 - Micro-watershed boundary



LAND SUITABILITY FOR FIELD BEANS
Kanivaihundi Micro-watershed
 (4B3E2G2e : Area - 500.69 ha)
Gundlupet Taluk
CHAMARAJANAGARA DISTRICT

0 0.25 0.5 1 km



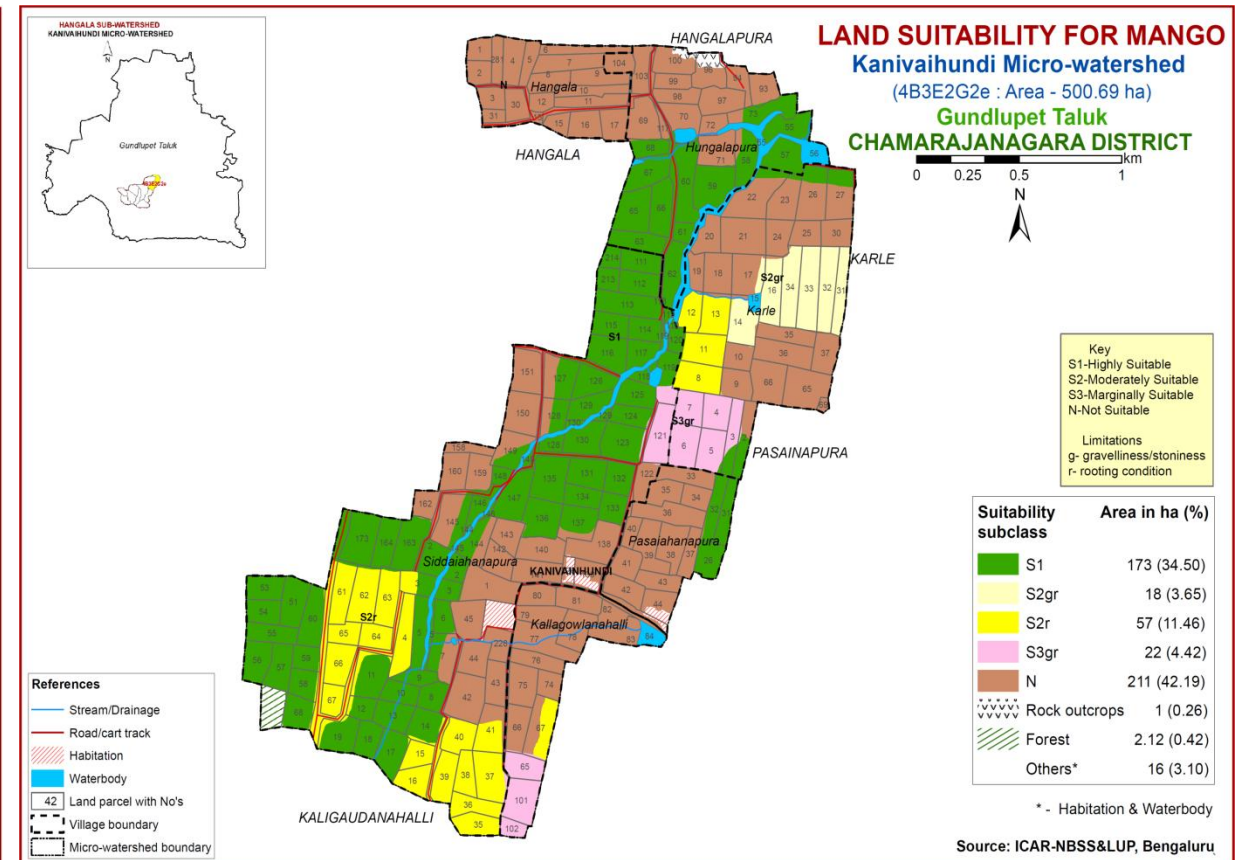
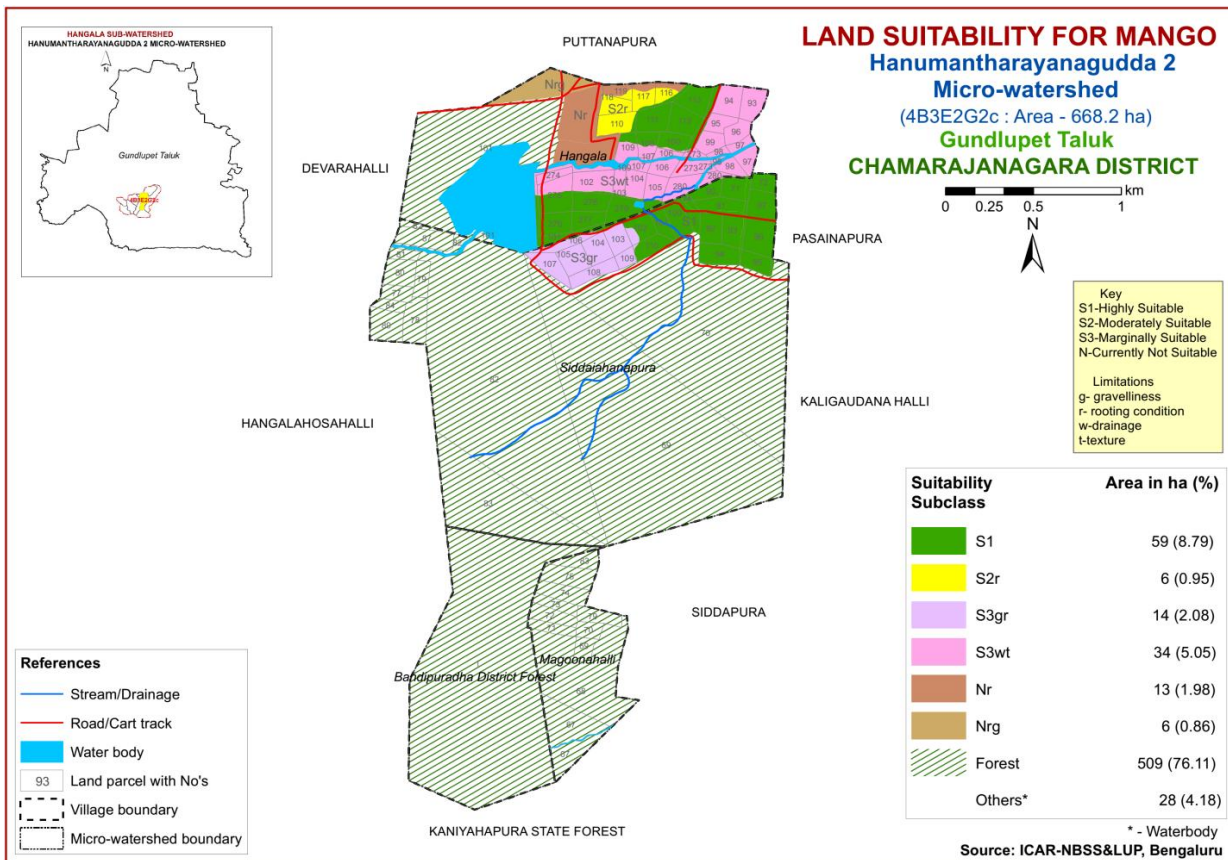
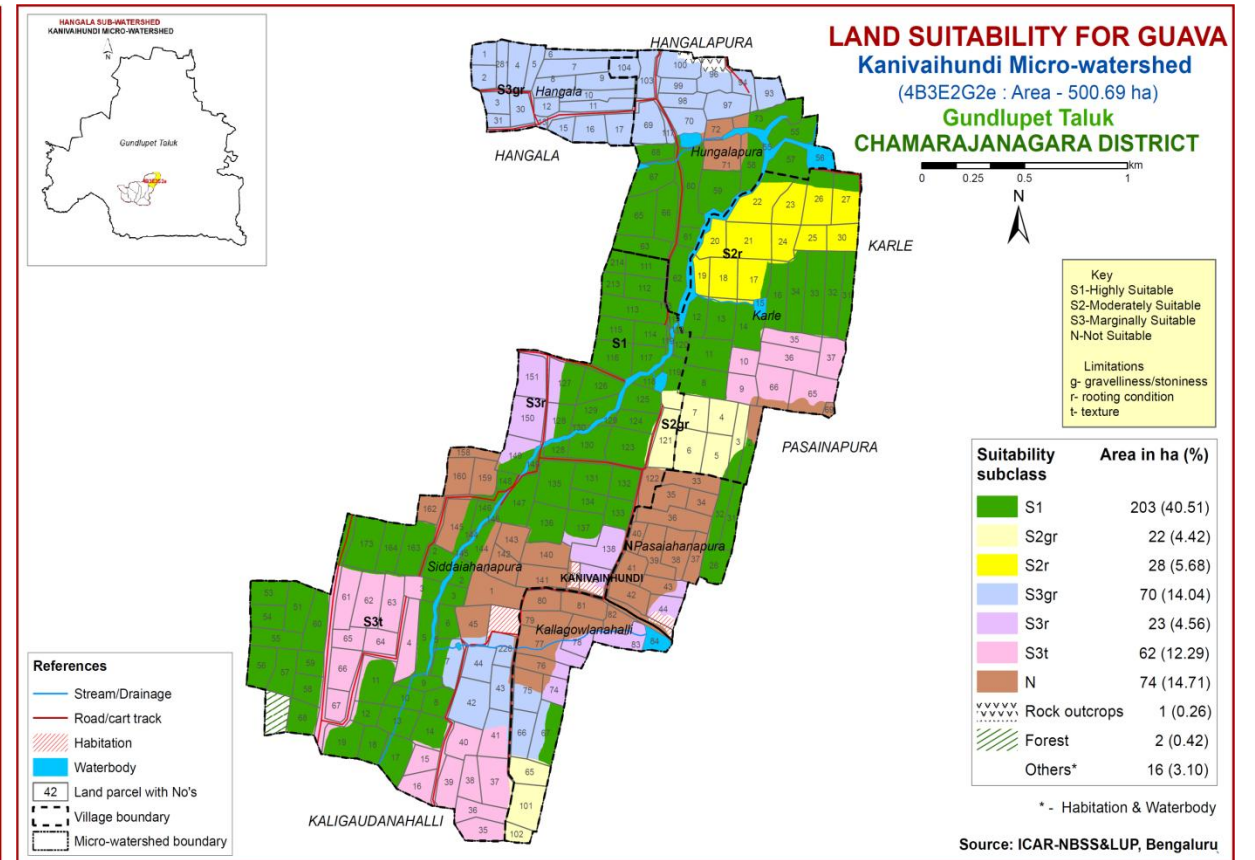
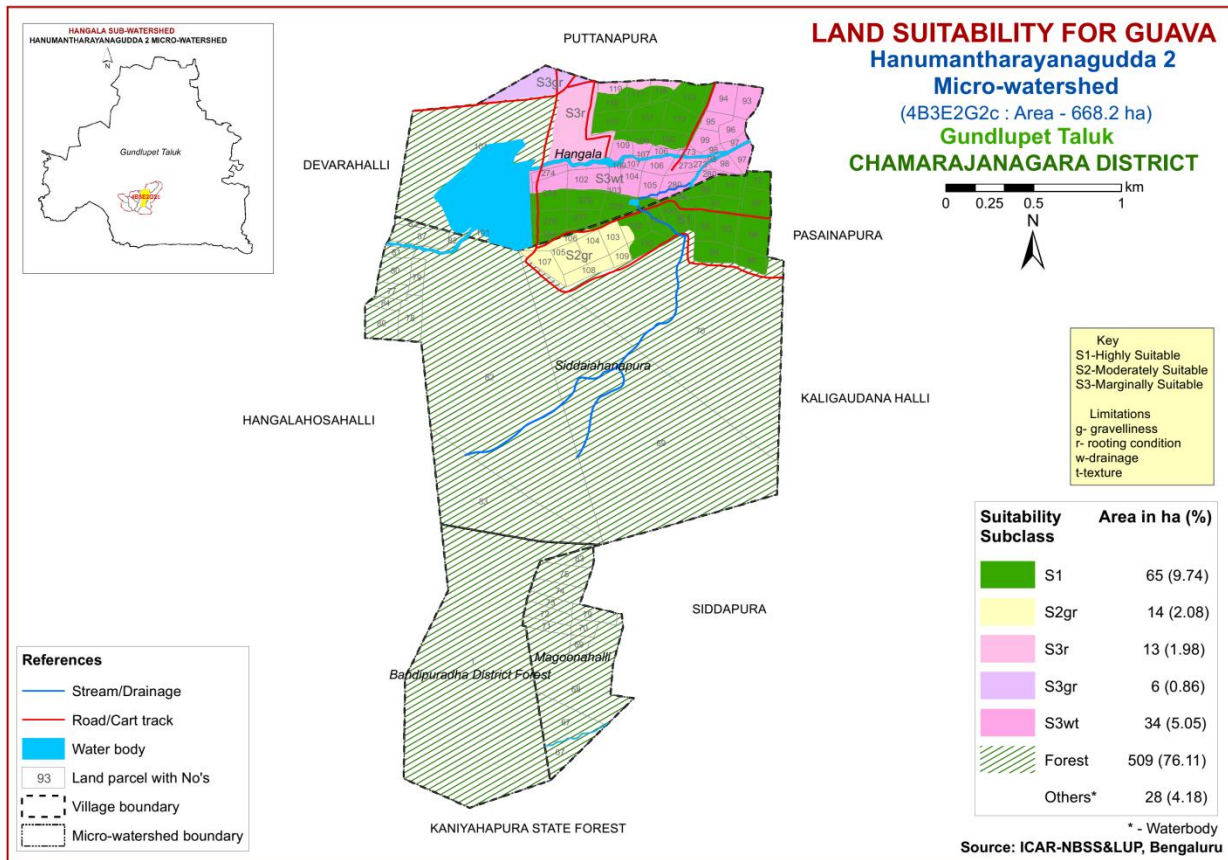
Key
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 S2-Moderately Suitable
 S3-Marginally Suitable
 Limitations
 g - graveliness
 r - rooting condition
 w-drainage

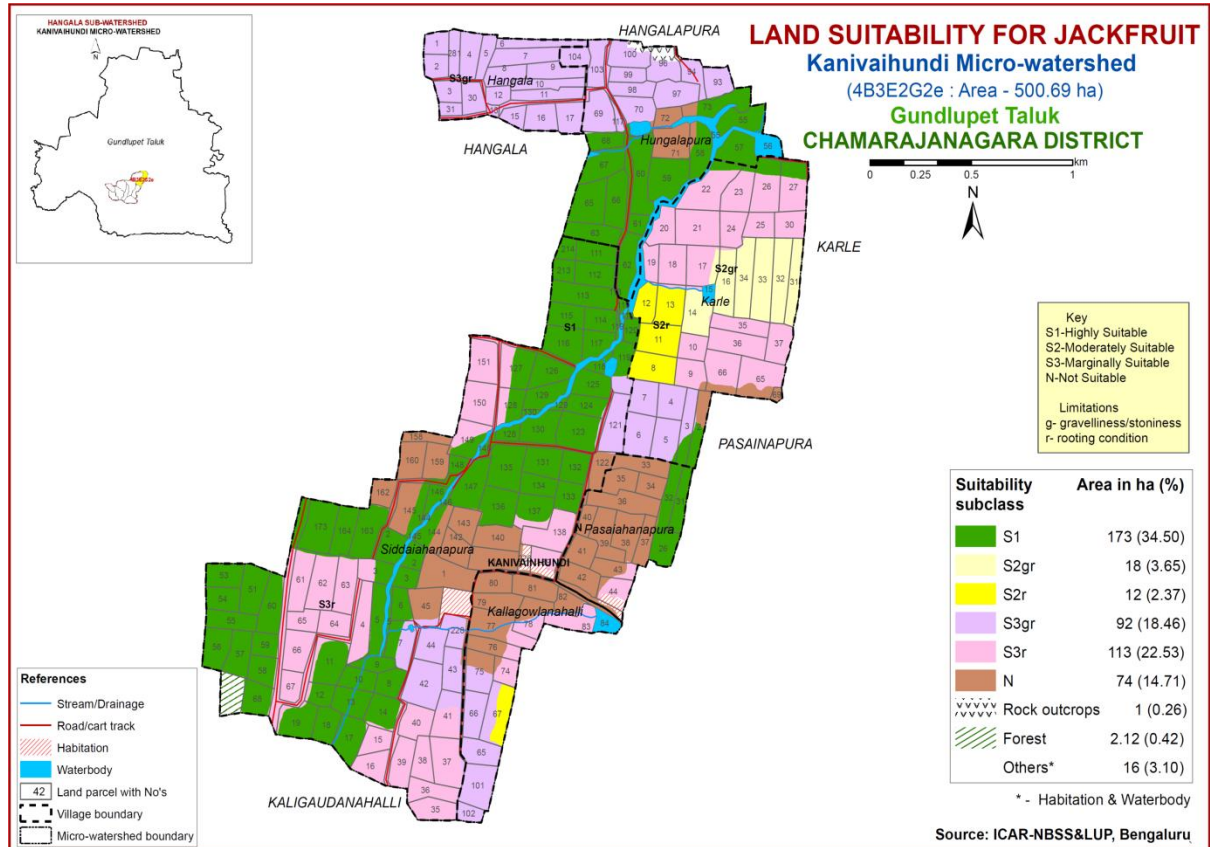
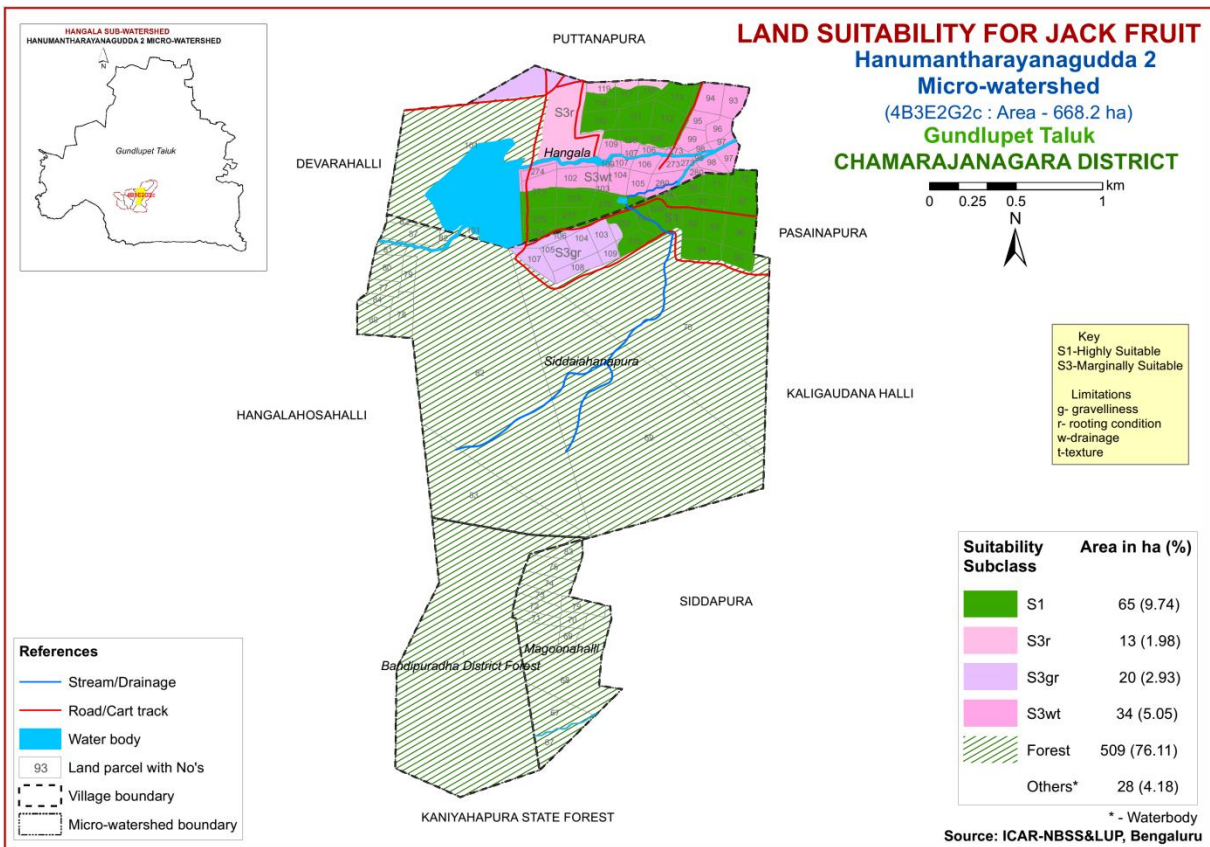
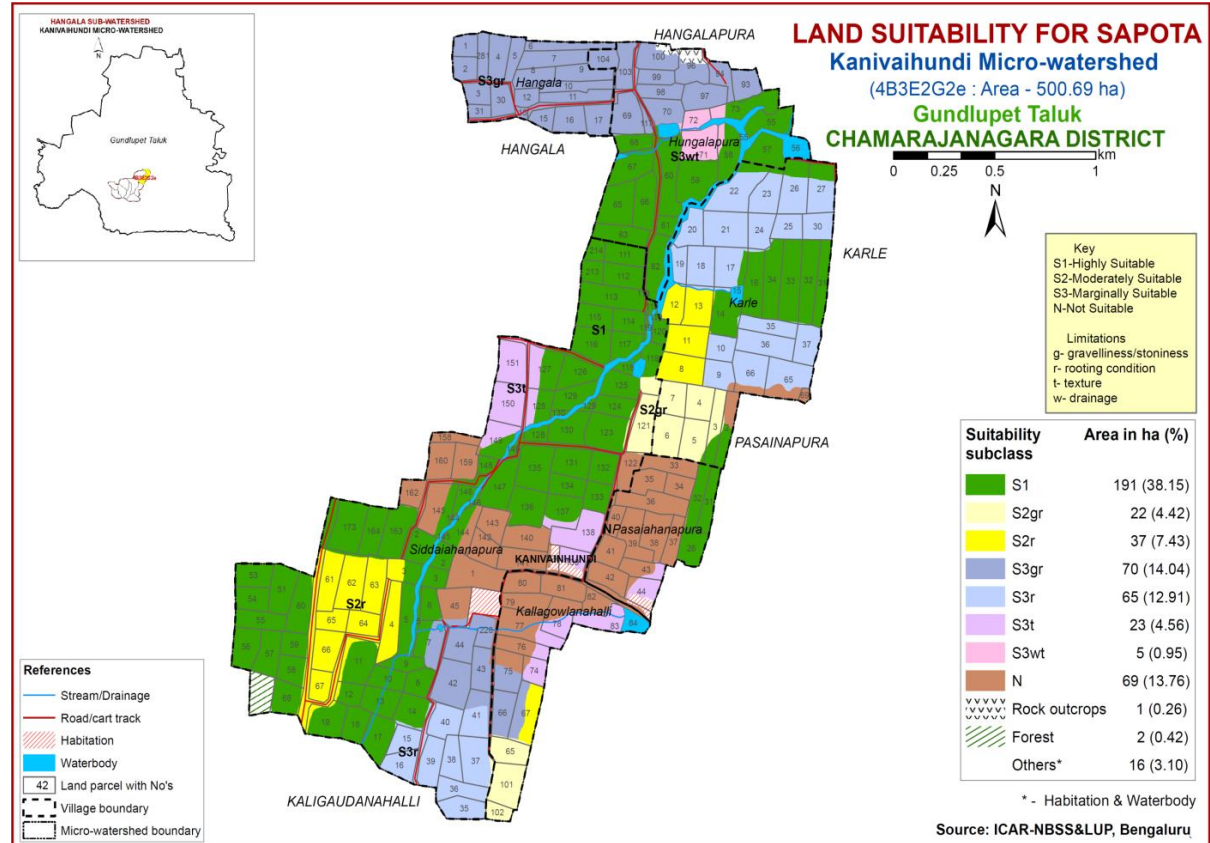
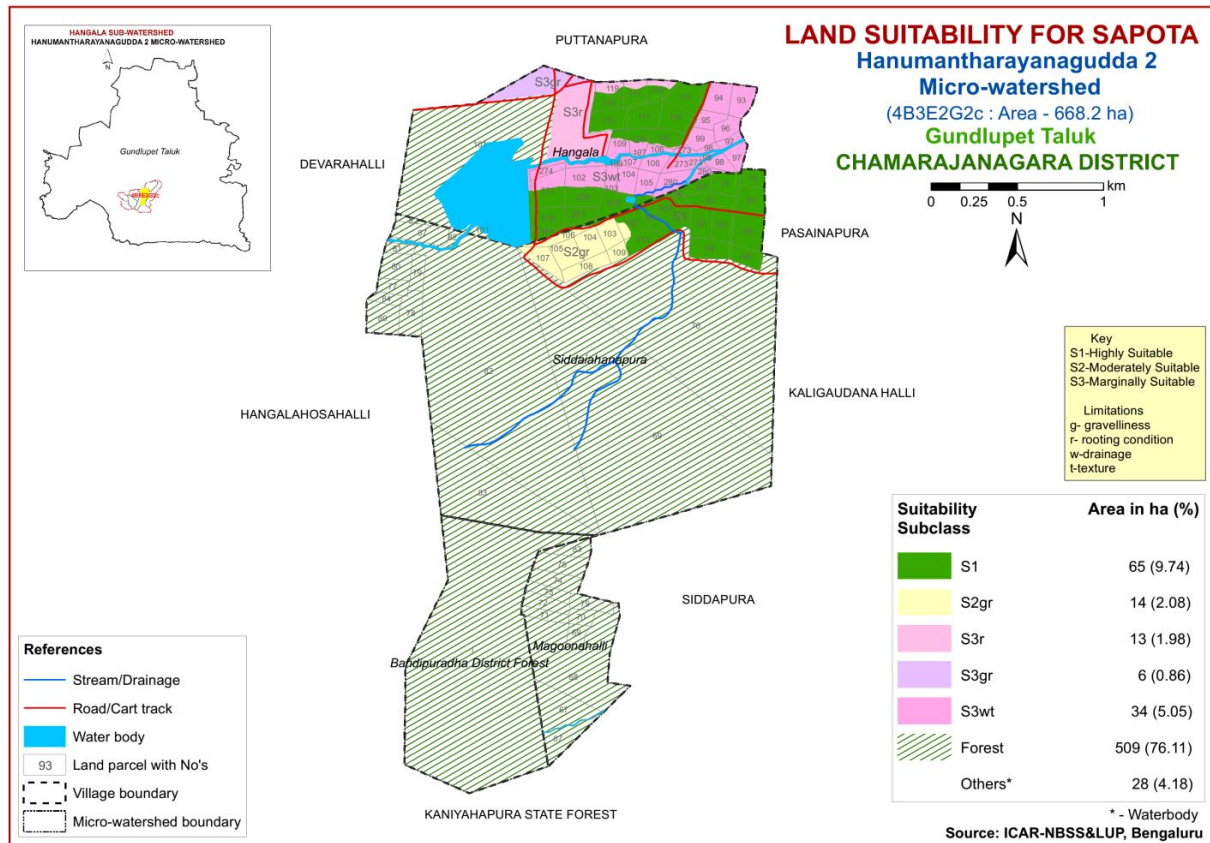
Suitability subclass	Area in ha (%)
S1	173 (34.50)
S2g	98 (19.52)
S2r	67 (13.44)
S2w	5 (0.95)
S3g	70 (14.04)
S3r	66 (13.17)
S3gr	3 (0.59)
Rockout crop	1 (0.26)
Forest	2 (0.42)
Others*	16 (3.10)

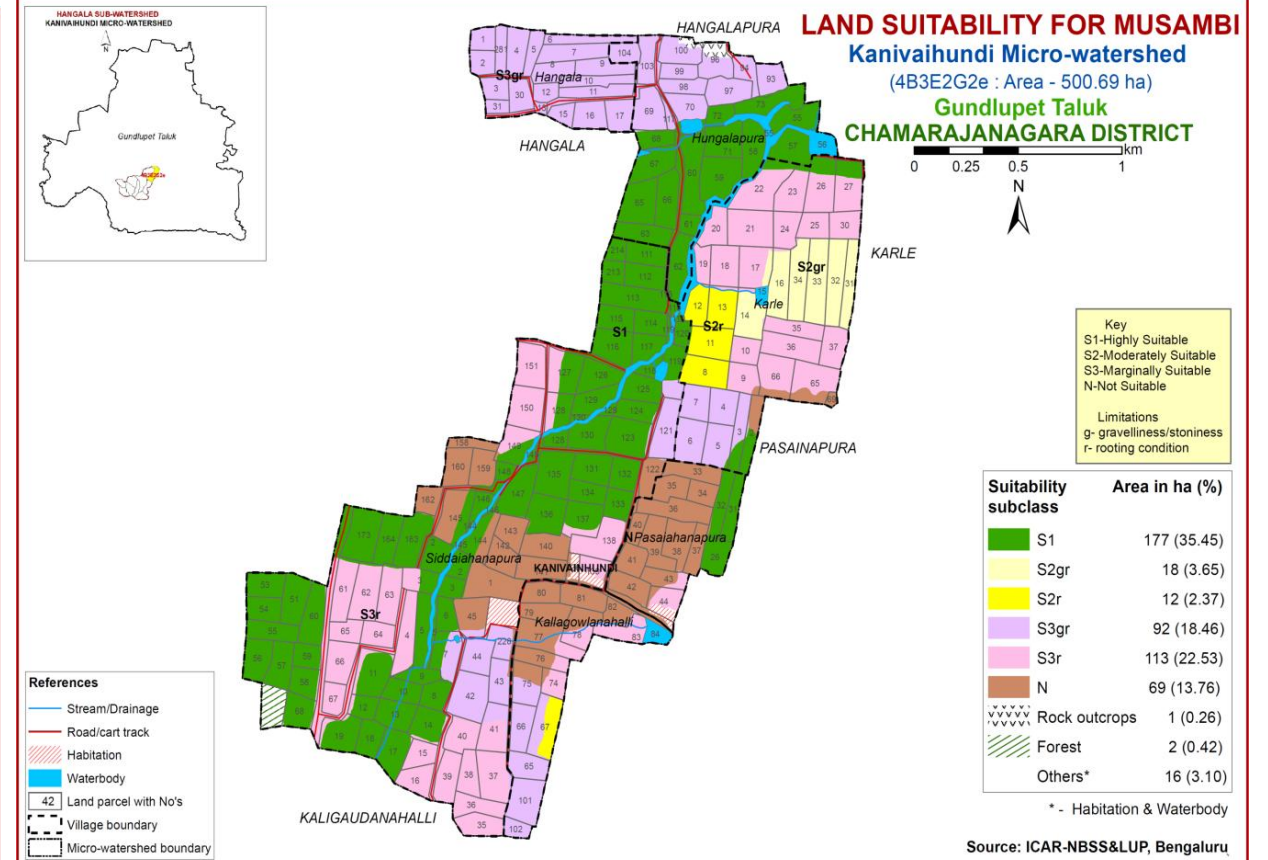
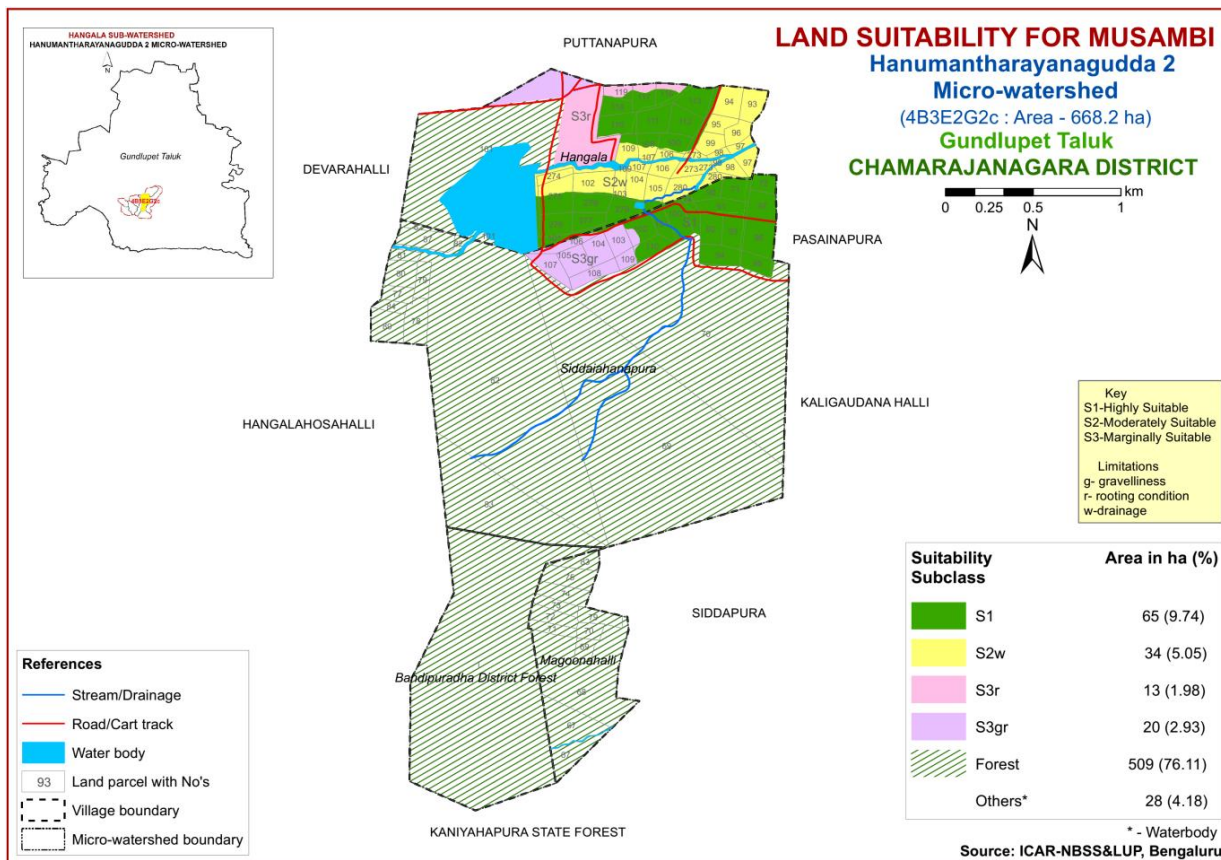
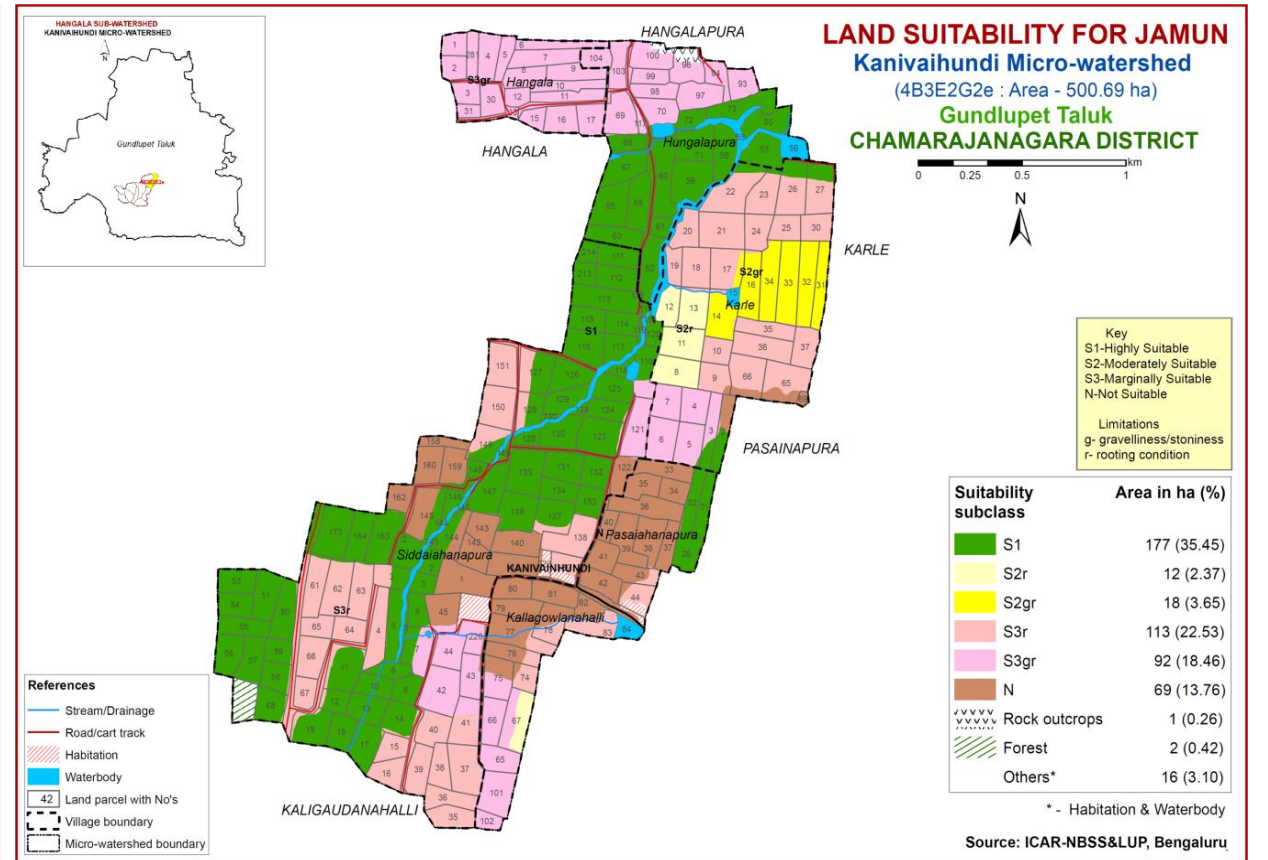
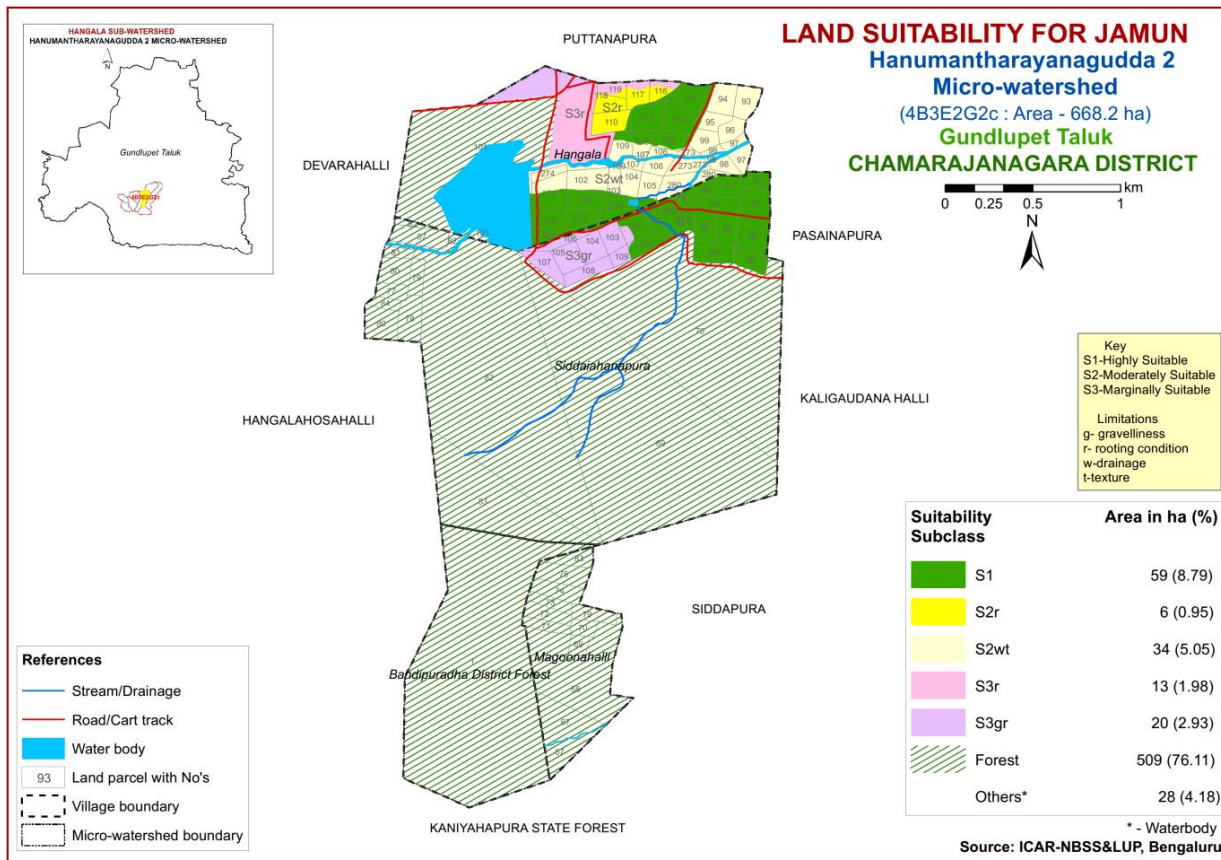
* - Habitation & Waterbody

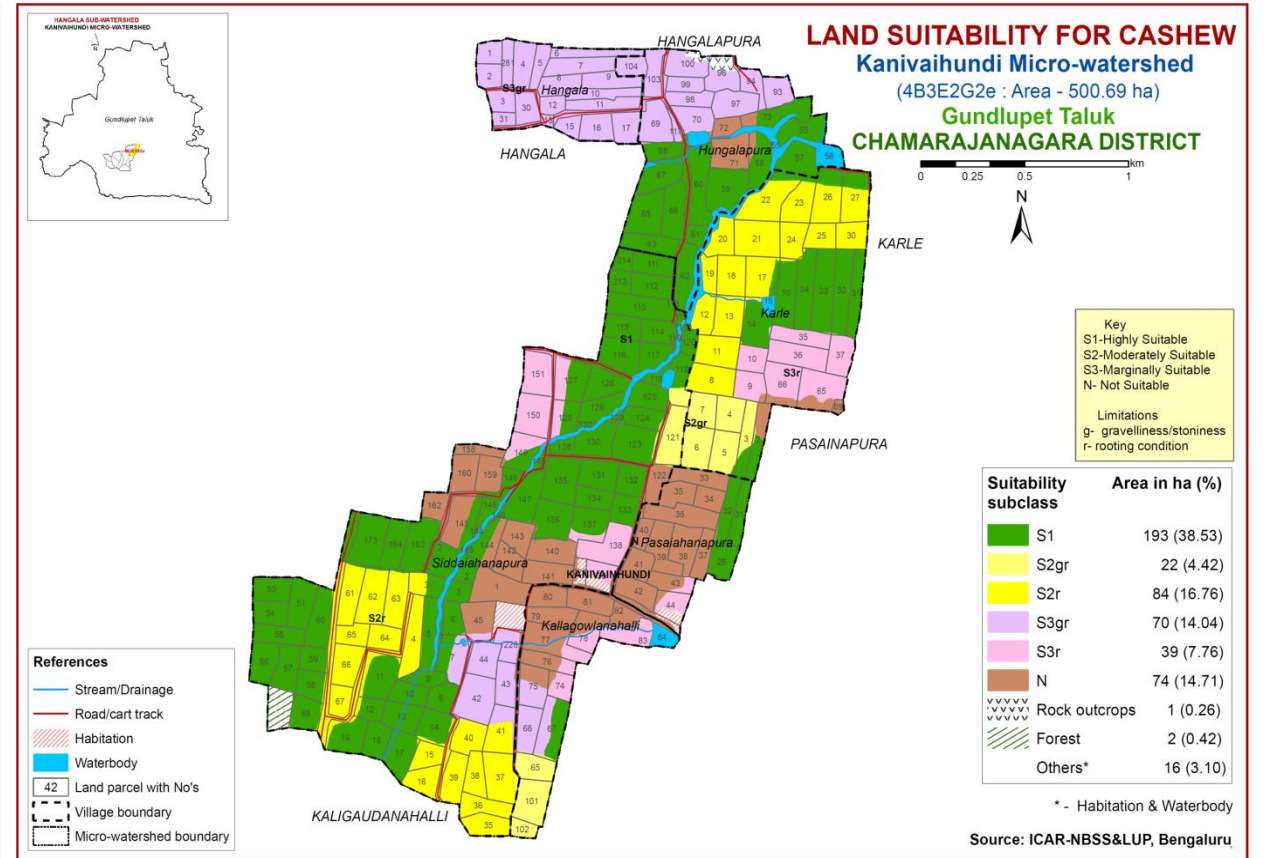
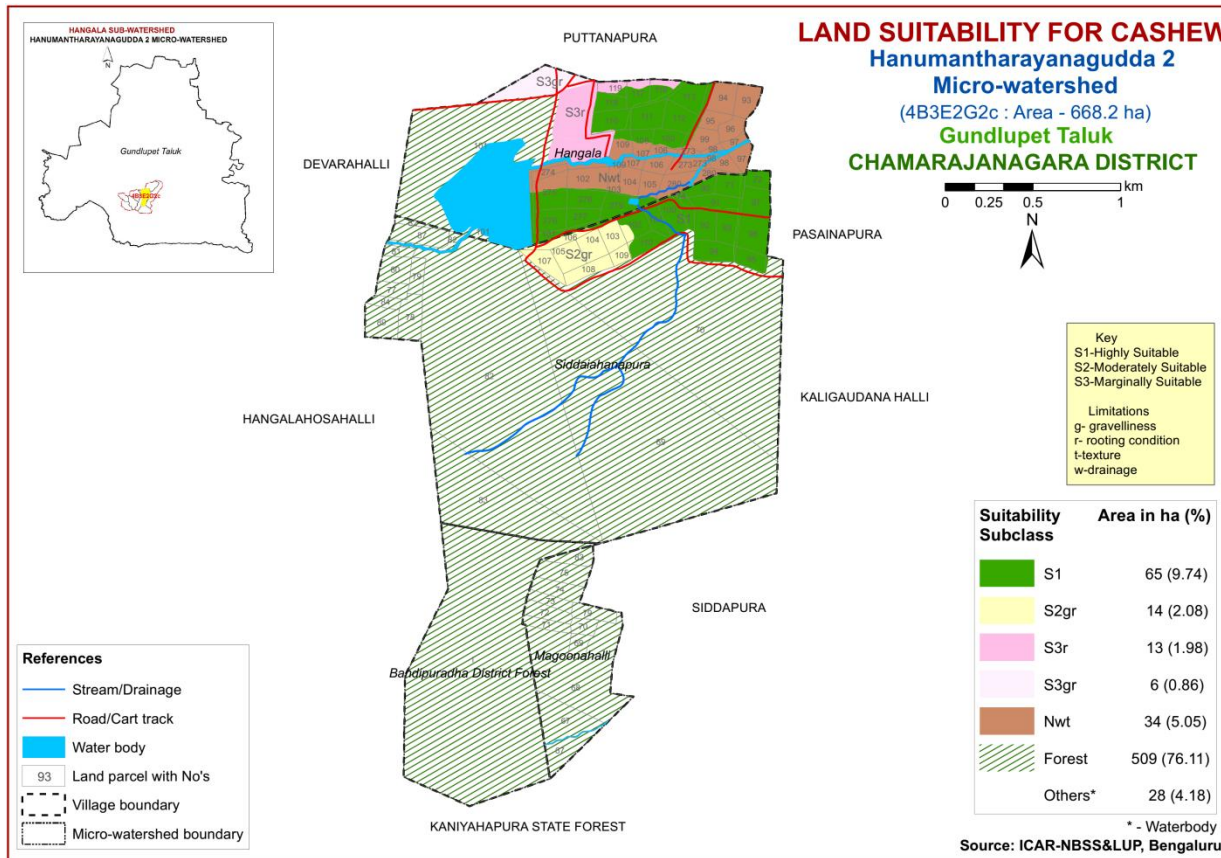
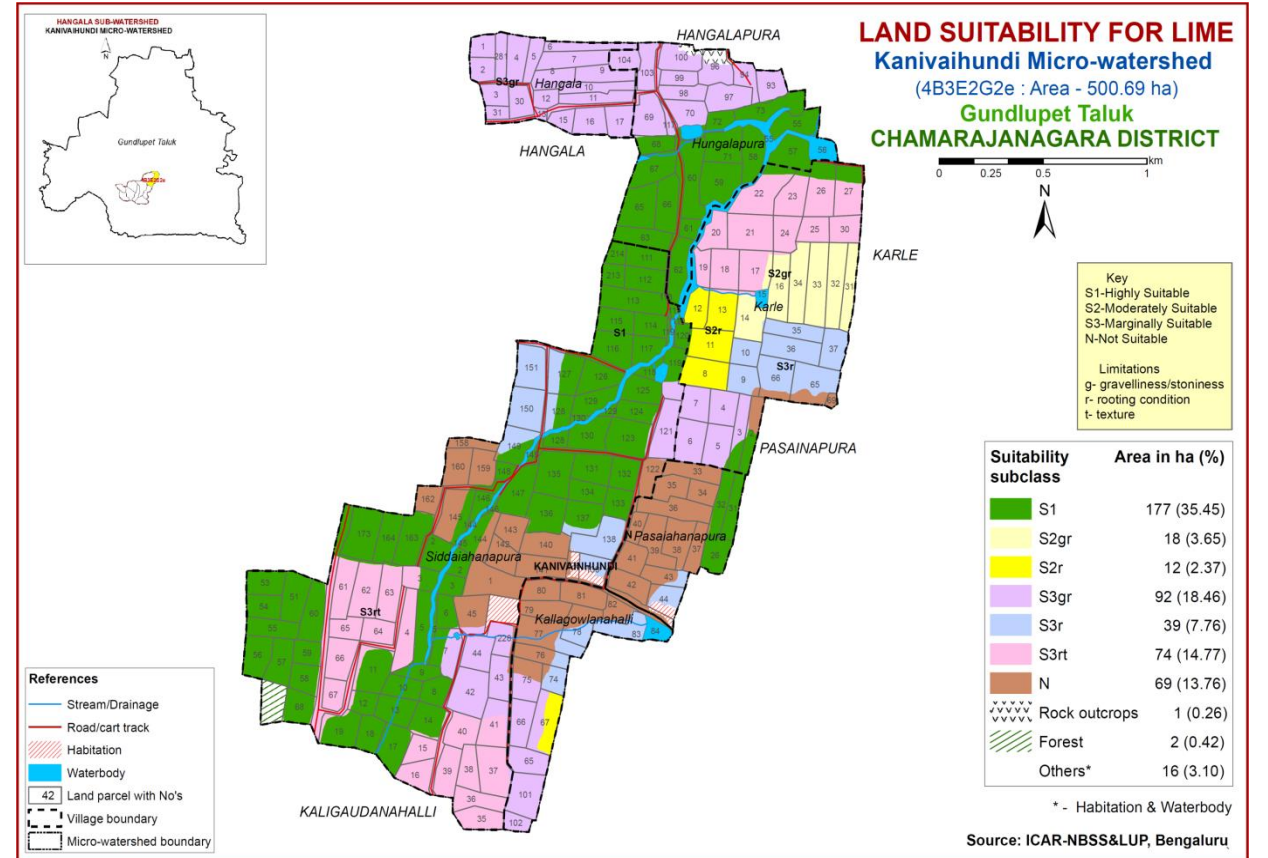
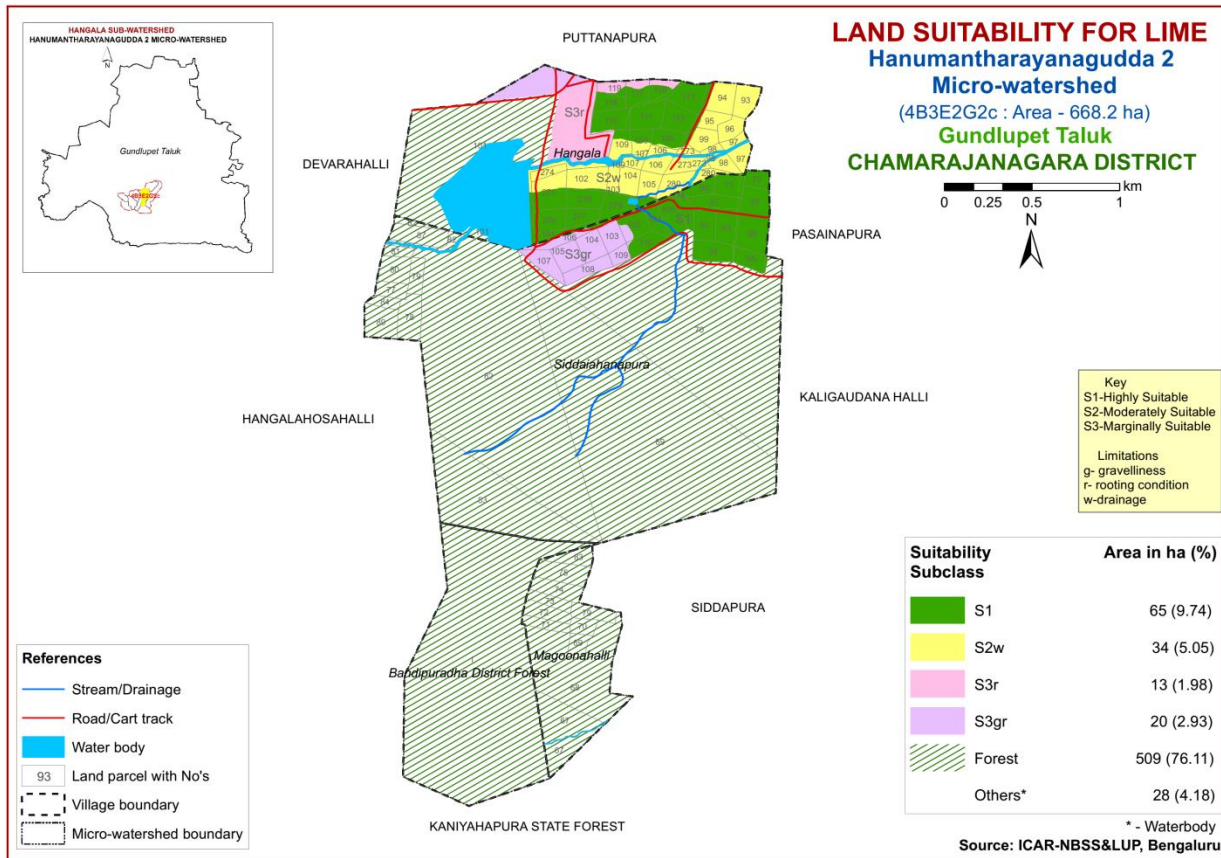
Source: ICAR-NBSS&LUP, Bengaluru

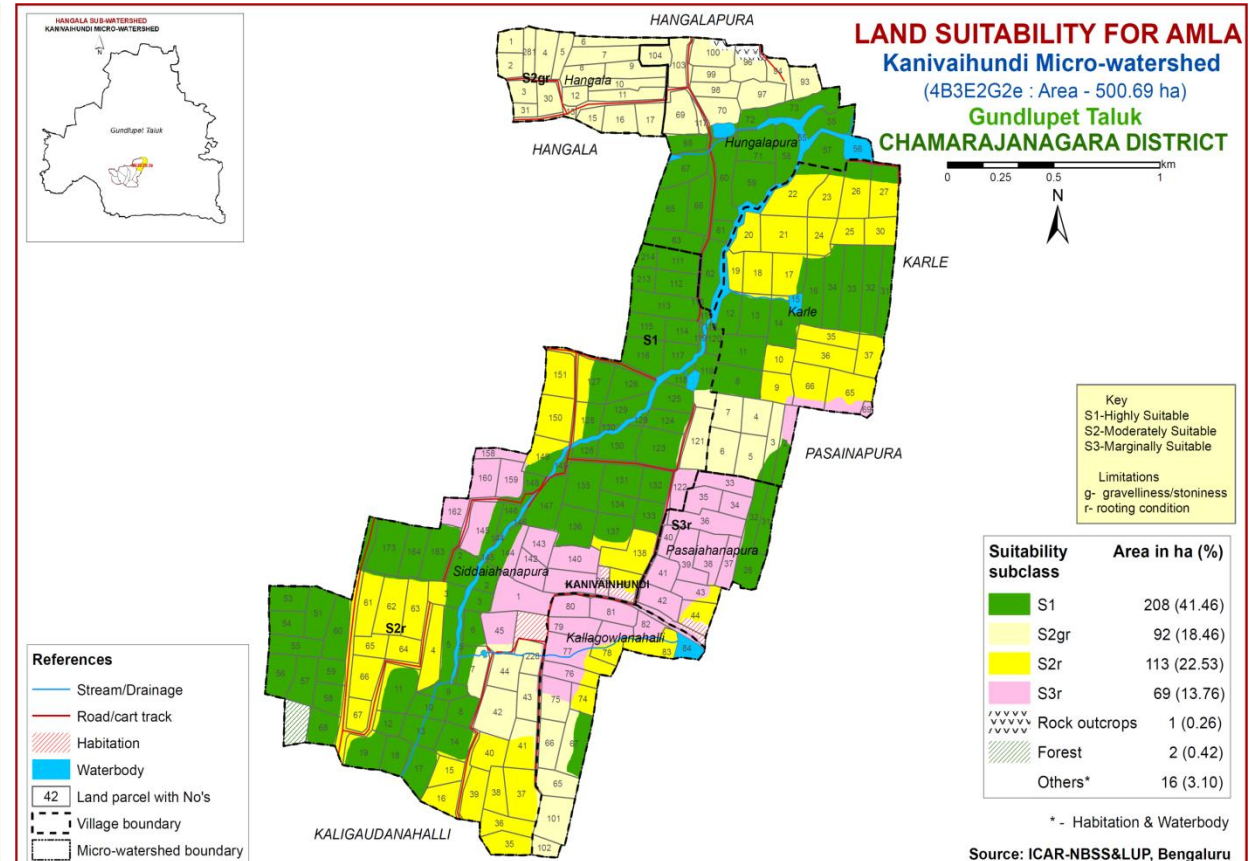
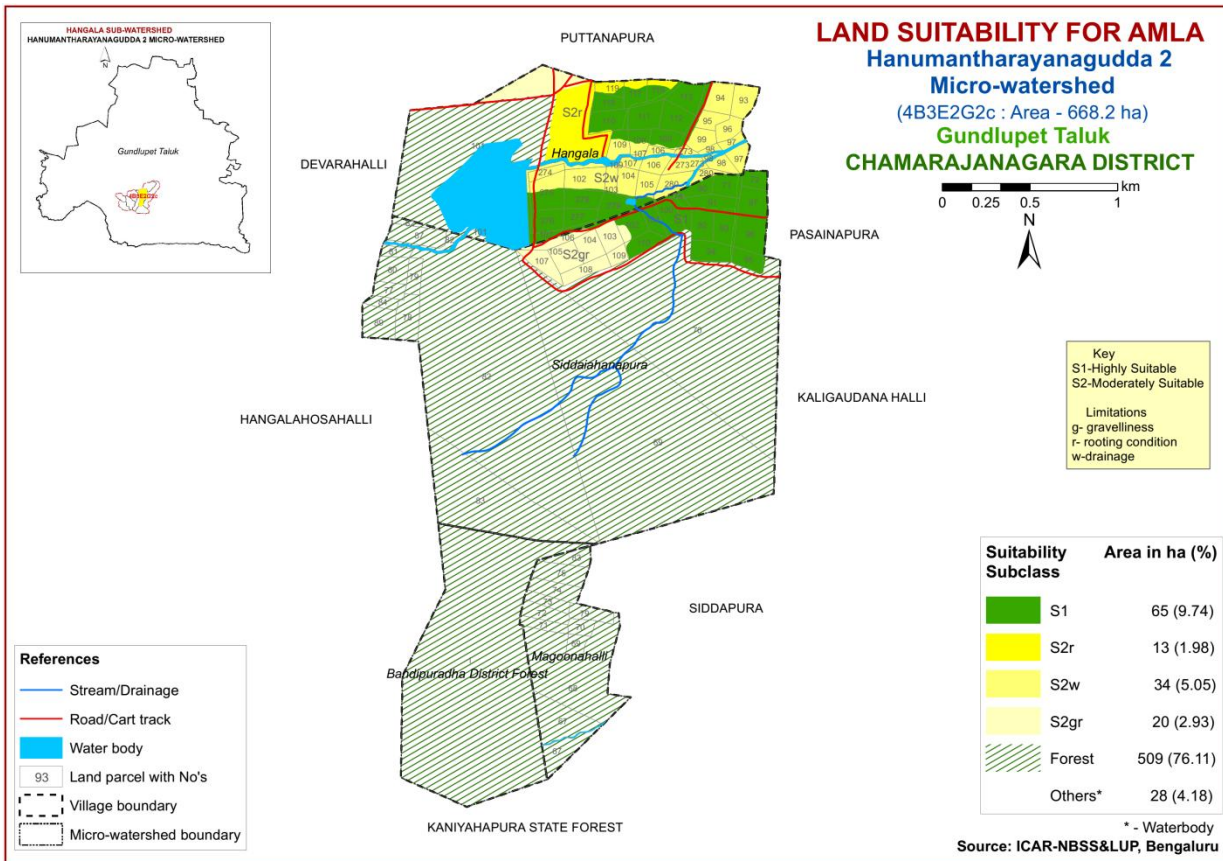
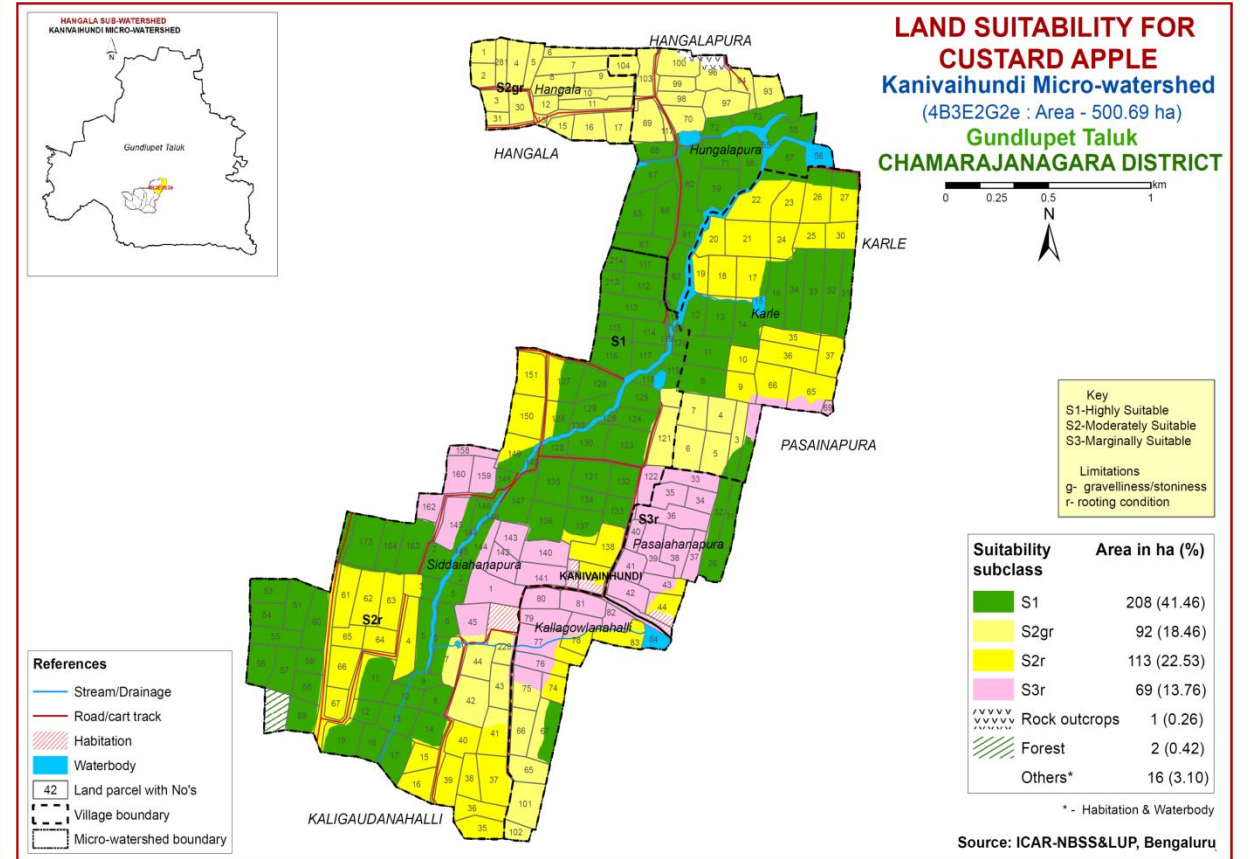
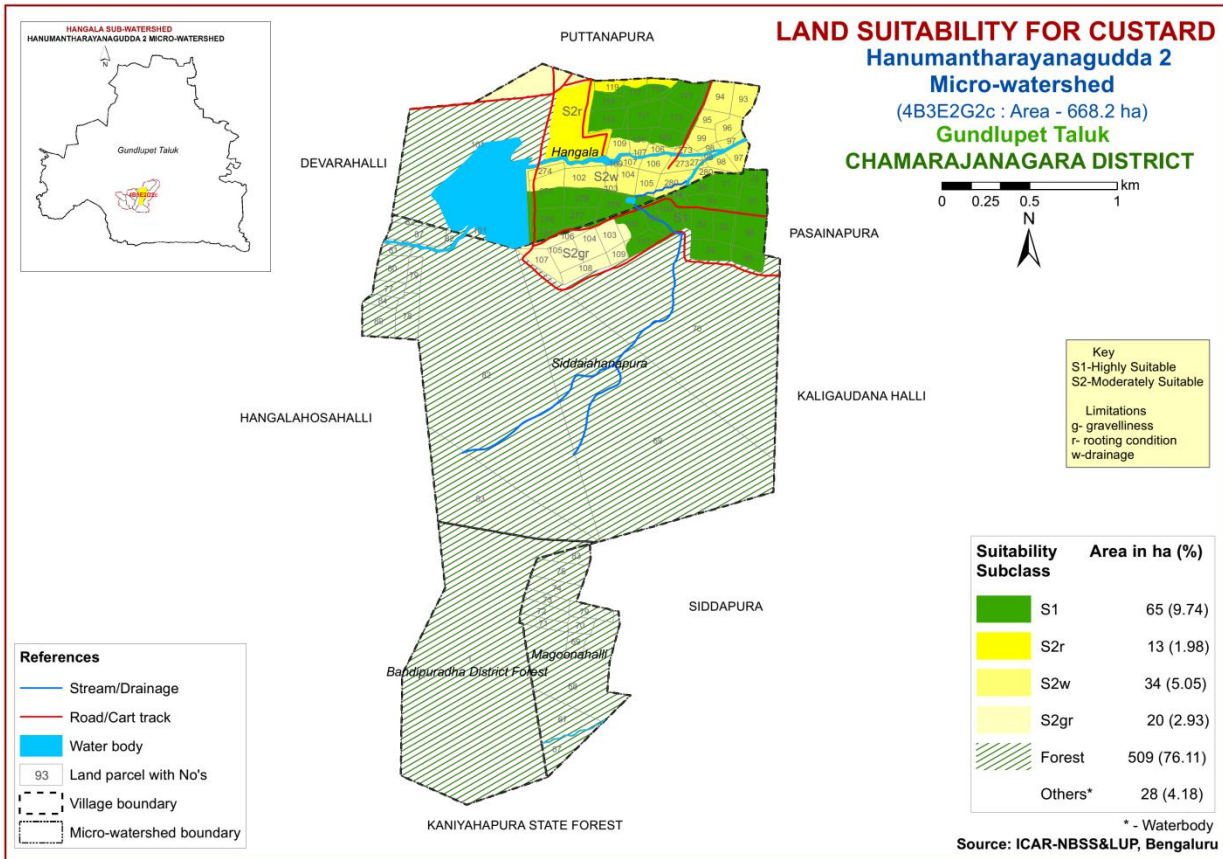
- References**
- Stream/Drainage
 - Road/cart track
 - Habitation
 - Waterbody
 - Land parcel with No's
 - Village boundary
 - Micro-watershed boundary

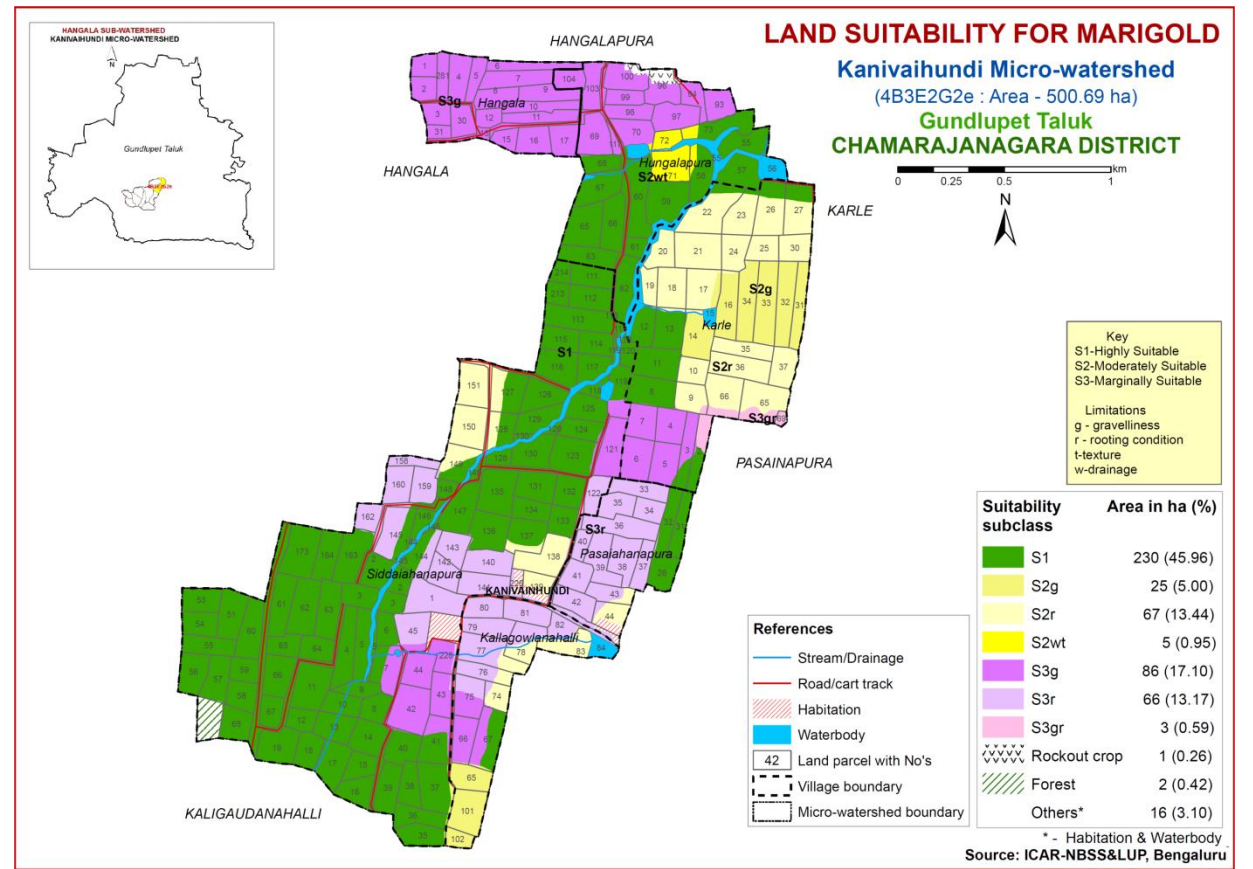
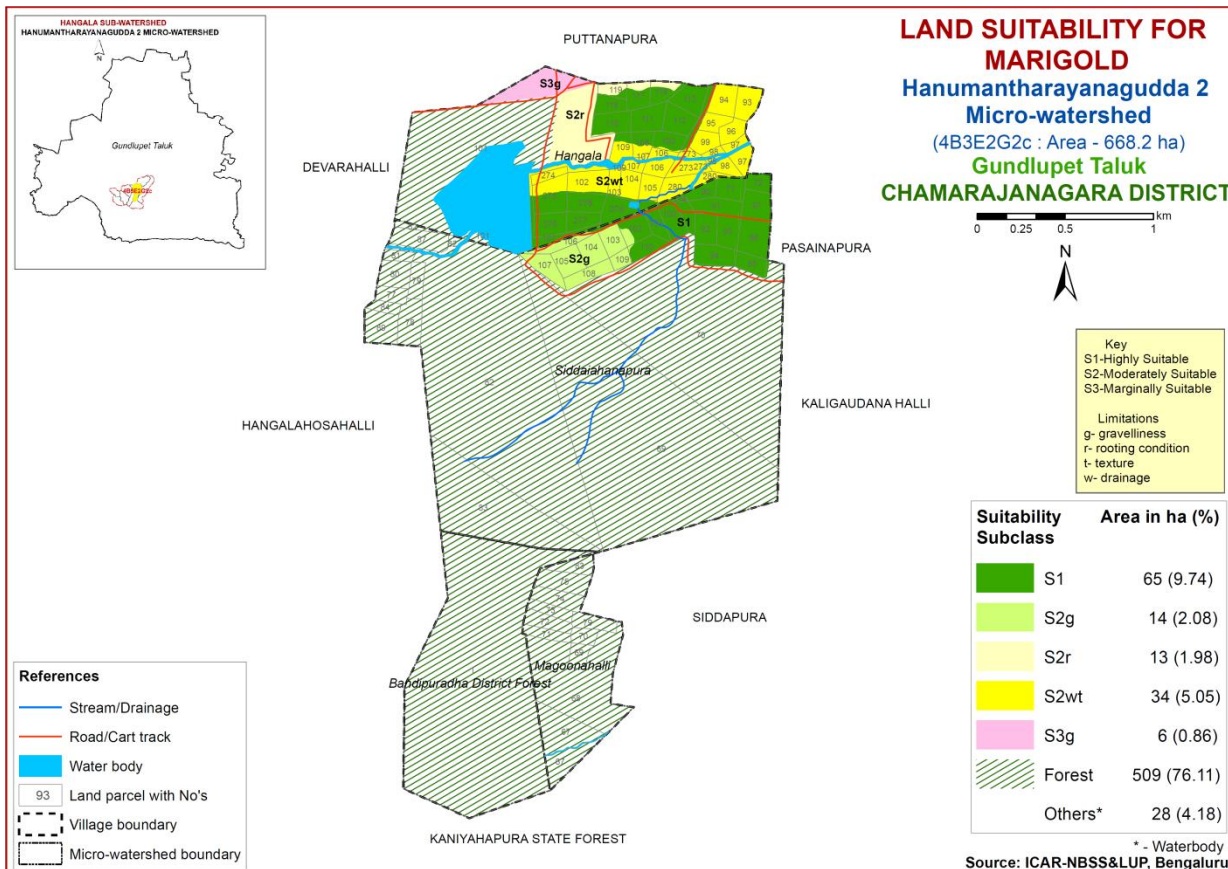
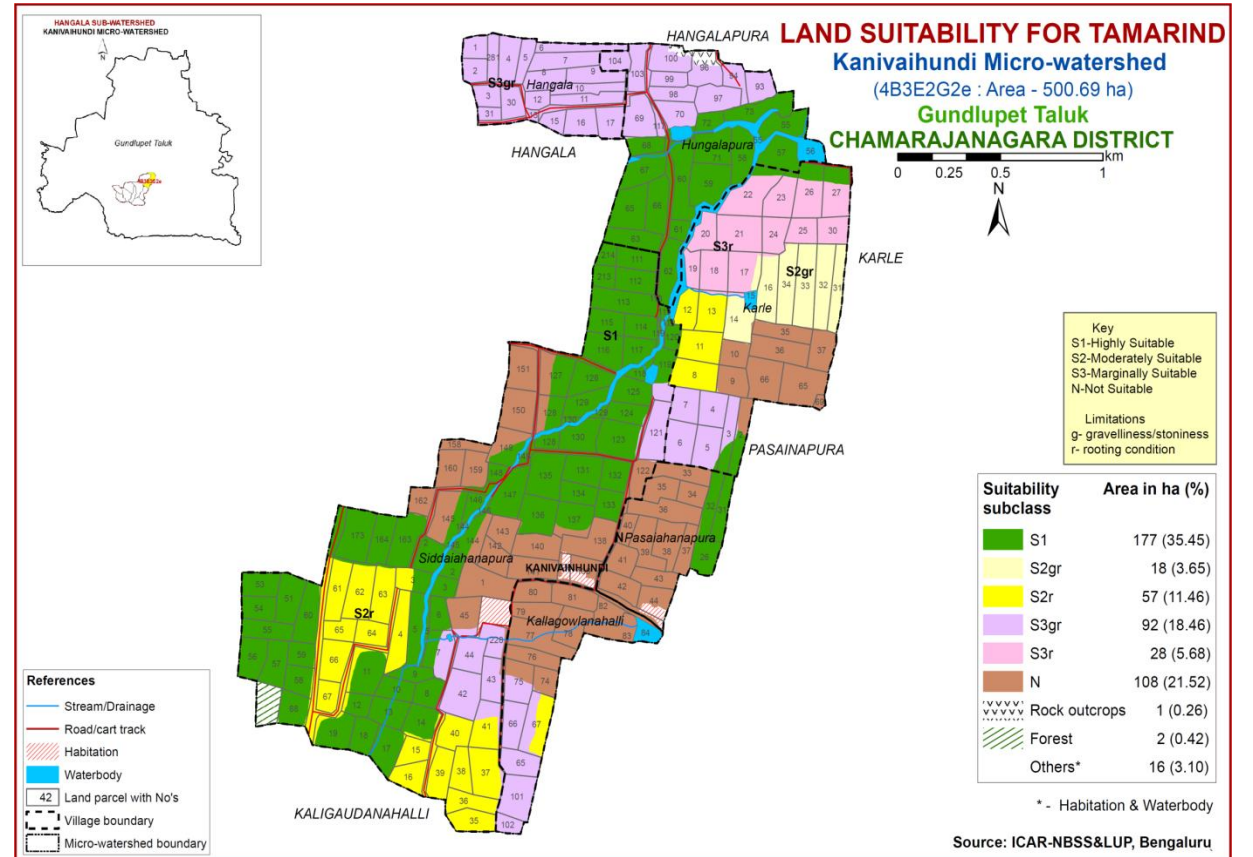
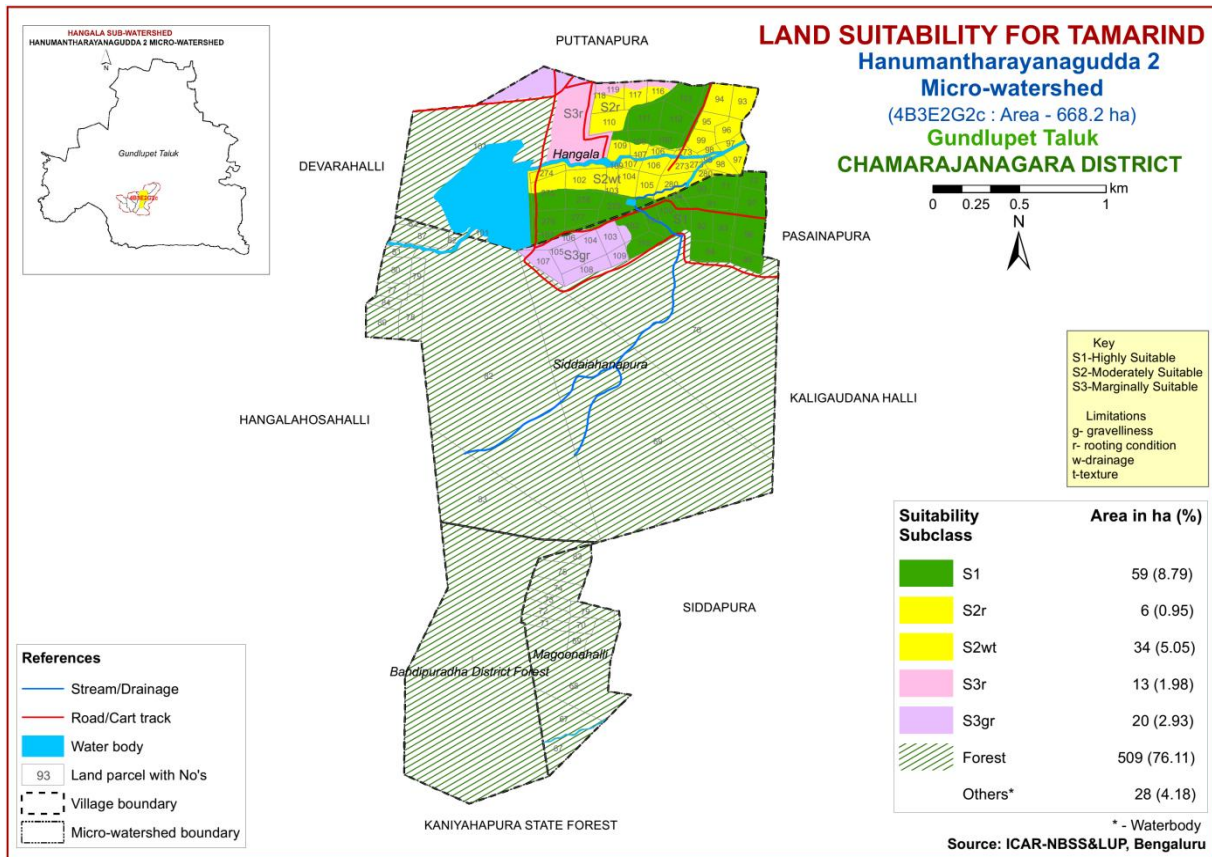


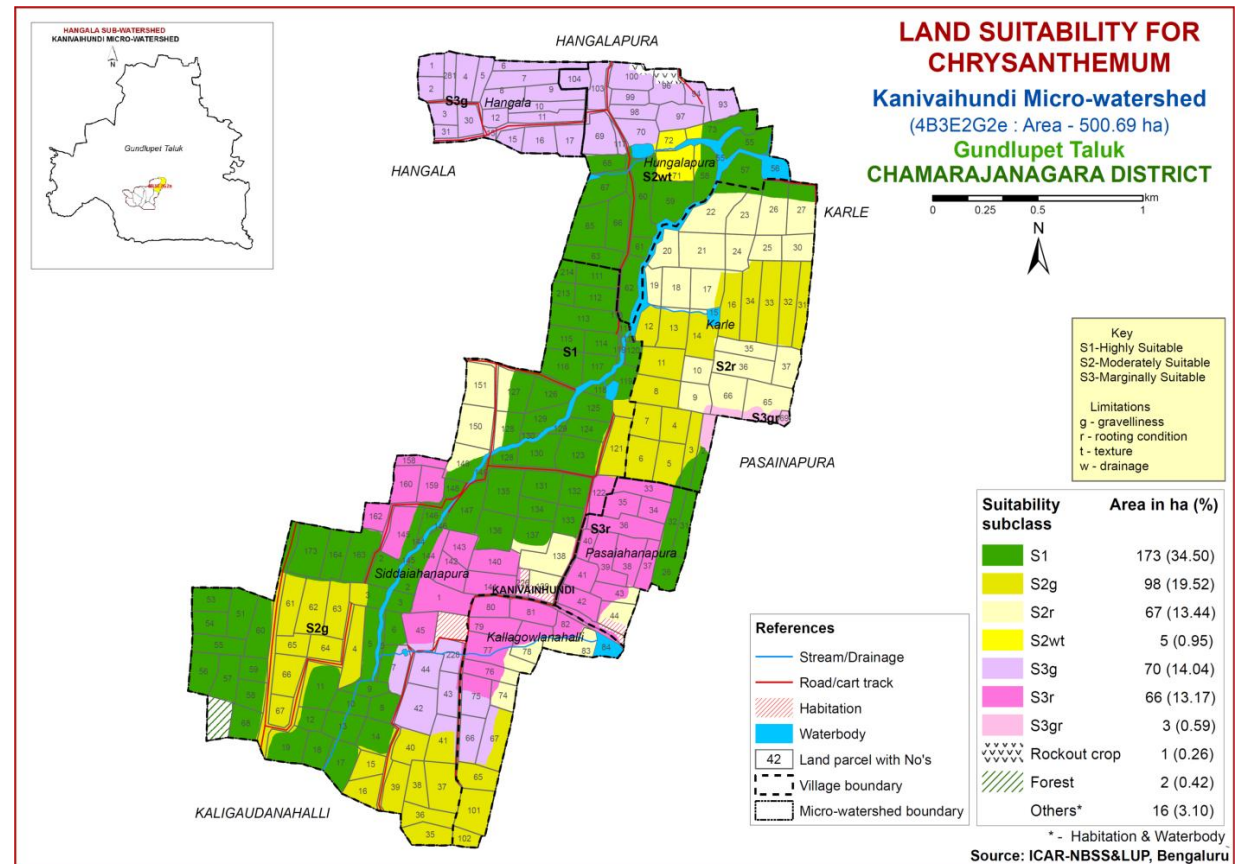
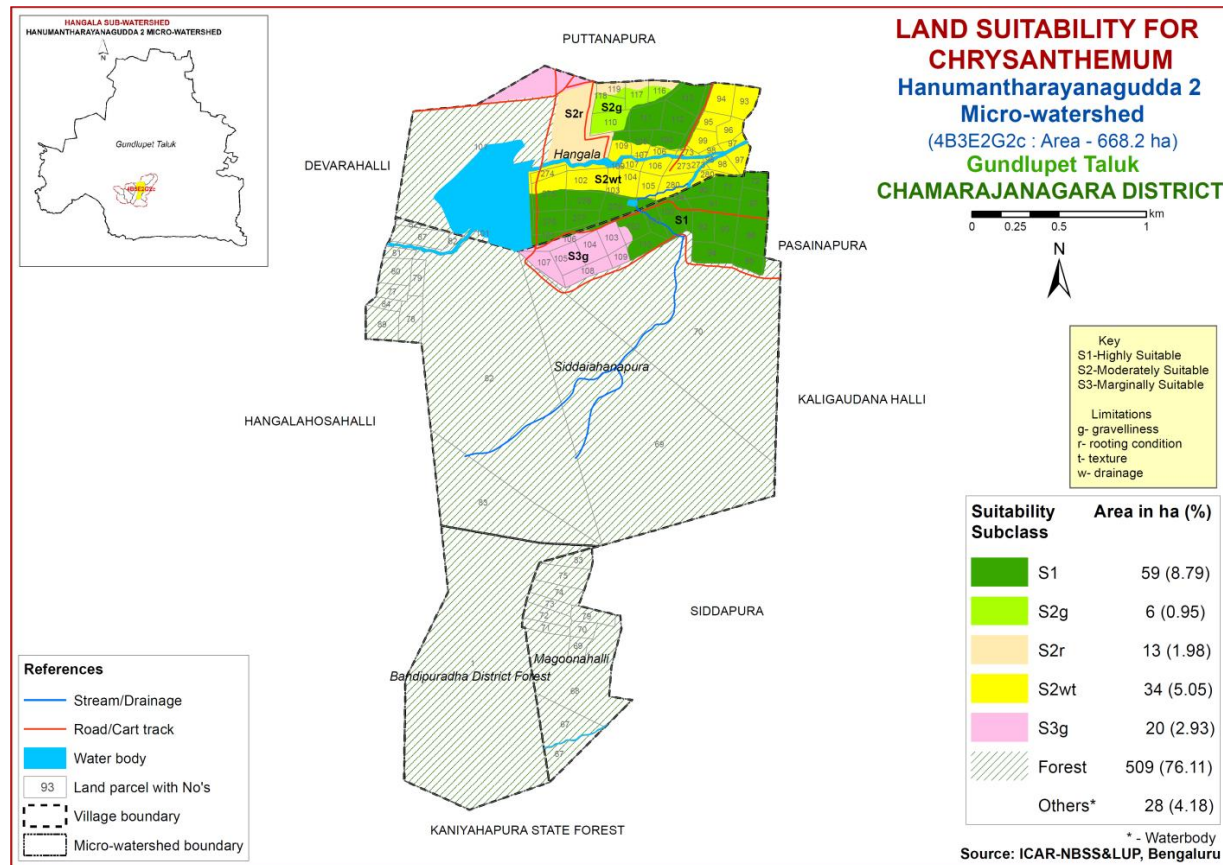


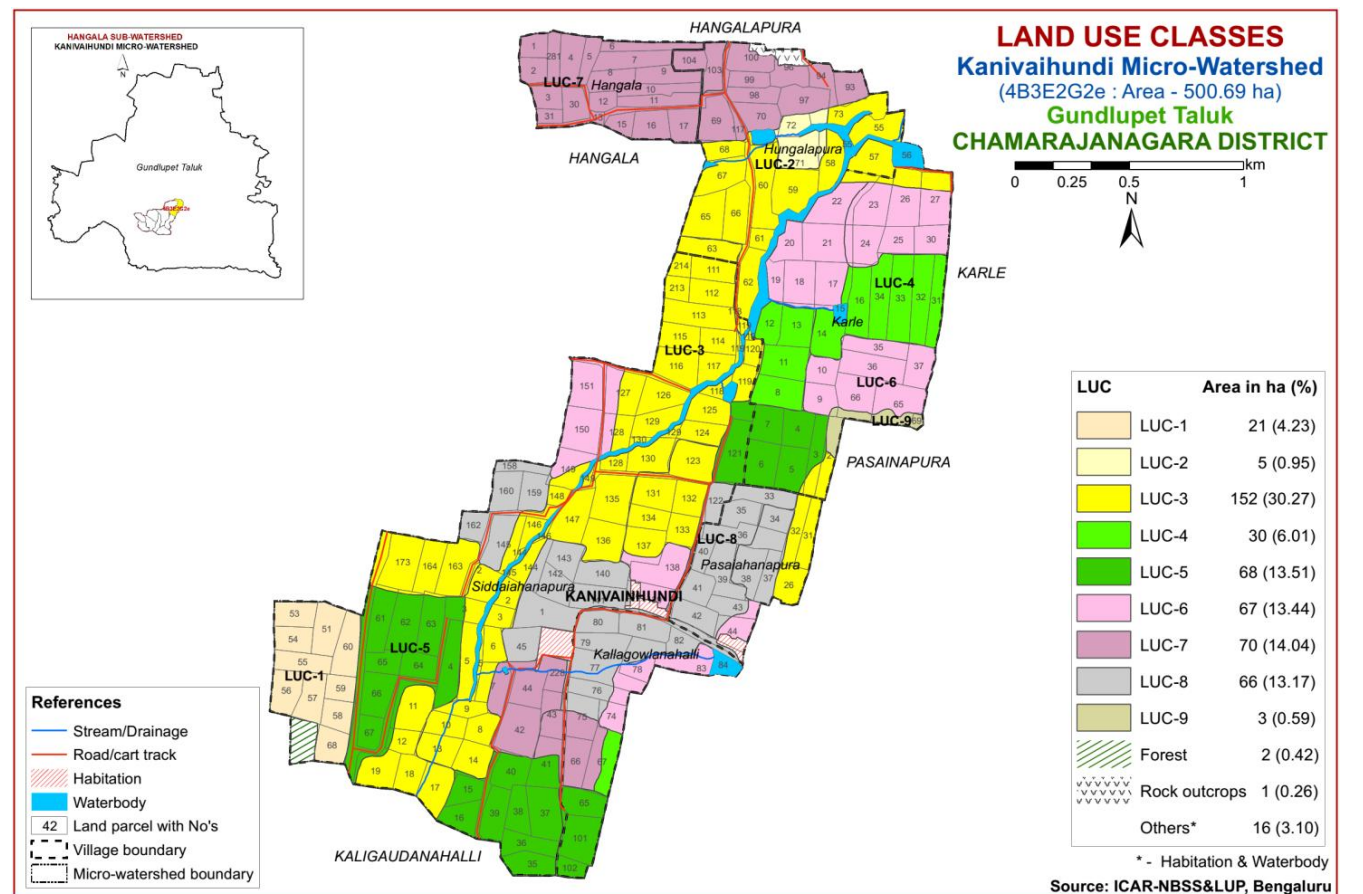
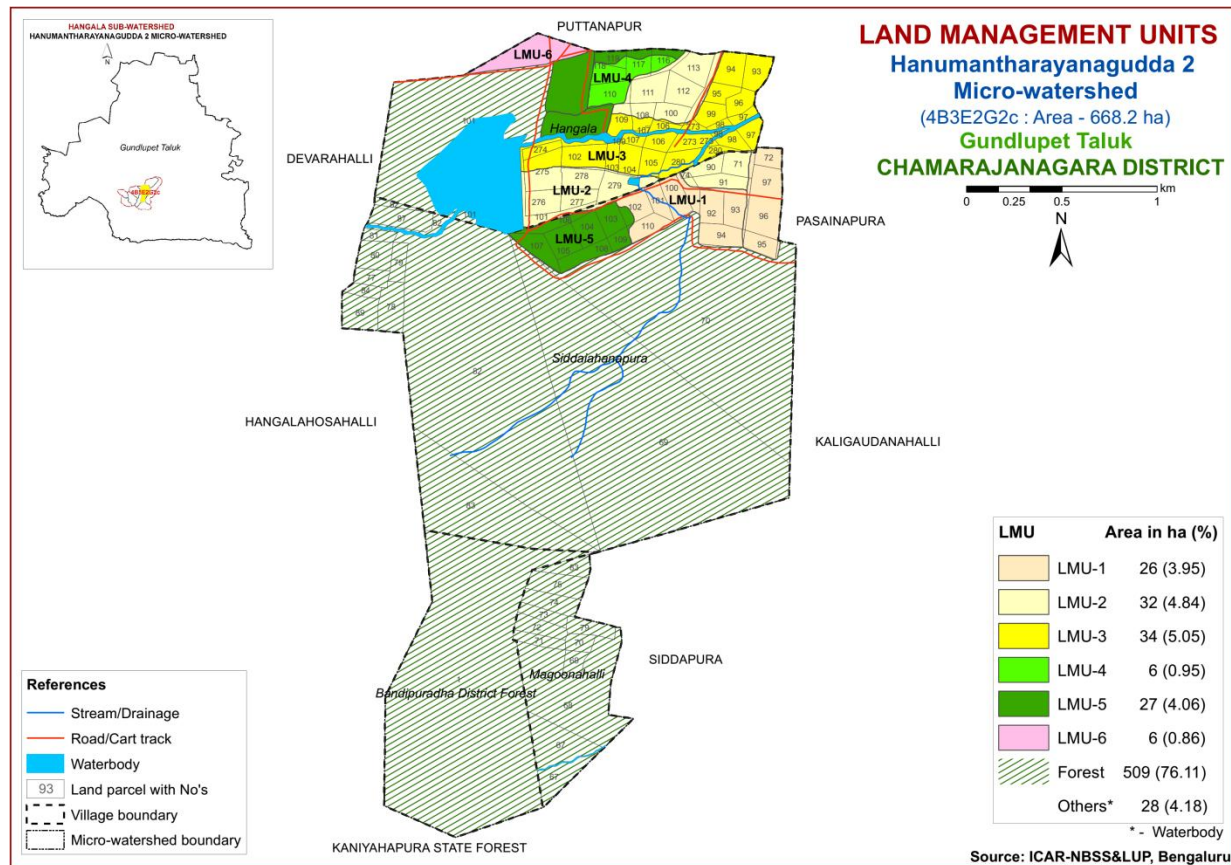












NOTE: Proposed Crop Plan for LMU's are given in Table

**Table3. Proposed Crop Plan for Hanumantharayanagudda-2 Micro-watershed, Hangala Sub-watershed
Gundlupet Taluk, Chamarajanagar District based on soil-site–crop suitability Assessment**

LMU NO	Mapping Units	Survey Number	Field crops/Forestry crops	Suitable Horticulture crops under irrigation	Horticulture crops with interventions	Suitable interventions
LMU1	1,2 (26 ha) (>150 cm) (Very deep, red clay soils)	Siddaiahnapura: 72,92,93,94,95,96, 97,100,101,102,110	Maize, Sorghum, Cotton, Sunflower, Redgram, Sugarcane Multiple crop rotation: Redgram+Maize Redgram+Groundnut Pulses+Ragi Pulses+Sorghum	Turmeric, Banana, Lime, Tomato, Beans, Bhendi	Perennial components: Mango, Sapota, Lime Flower crops: Marigold, Chrysanthemum Annual vegetables: Chillies, Bhendi	Drip irrigation, mulching, crop suitable conservation practices
LMU 2	7 (32 ha) (>150 cm) (Very deep, red loam soils)	Hangala: 100,108,111,112, 113,275,276,277, 278,279 Siddaiahnapura: 71,74,90,91	Maize, Sorghum, Sunflower, Redgram, Sugarcane Multiple crop rotation: Redgram+Maize Redgram+Groundnut Pulses+Ragi Pulses+Sorghum	Turmeric, Banana, Lime, Tomato, Beans, Bhendi	Perennial components: Mango, Sapota, Lime Flower crops: Marigold, Chrysanthemum Annual vegetables: Chillies, Bhendi	Drip irrigation, mulching, crop suitable conservation practices
LMU 3	3 (34 ha) (>150 cm) (Very deep, lowland clay soils)	Hangala: 93,94,95,96,97, 98,99,102,103,104, 105,106,107,109,27 3,274,280	Cotton, Sorghum, Sunflower, Redgram, Sugarcane Multiple crop rotation: Reg gram+Fodder Sorghum Pulses+ Sorghum	Beetroot, Banana, Lime, Tomato, Beans, Bhendi	Flower crops: Marigold, Chrysanthemum Perennial components: Custard apple, Amla, Lime Annual vegetables: Chillies, Bhendi	Drip Irrigation, mulching, crop suitable conservation practices

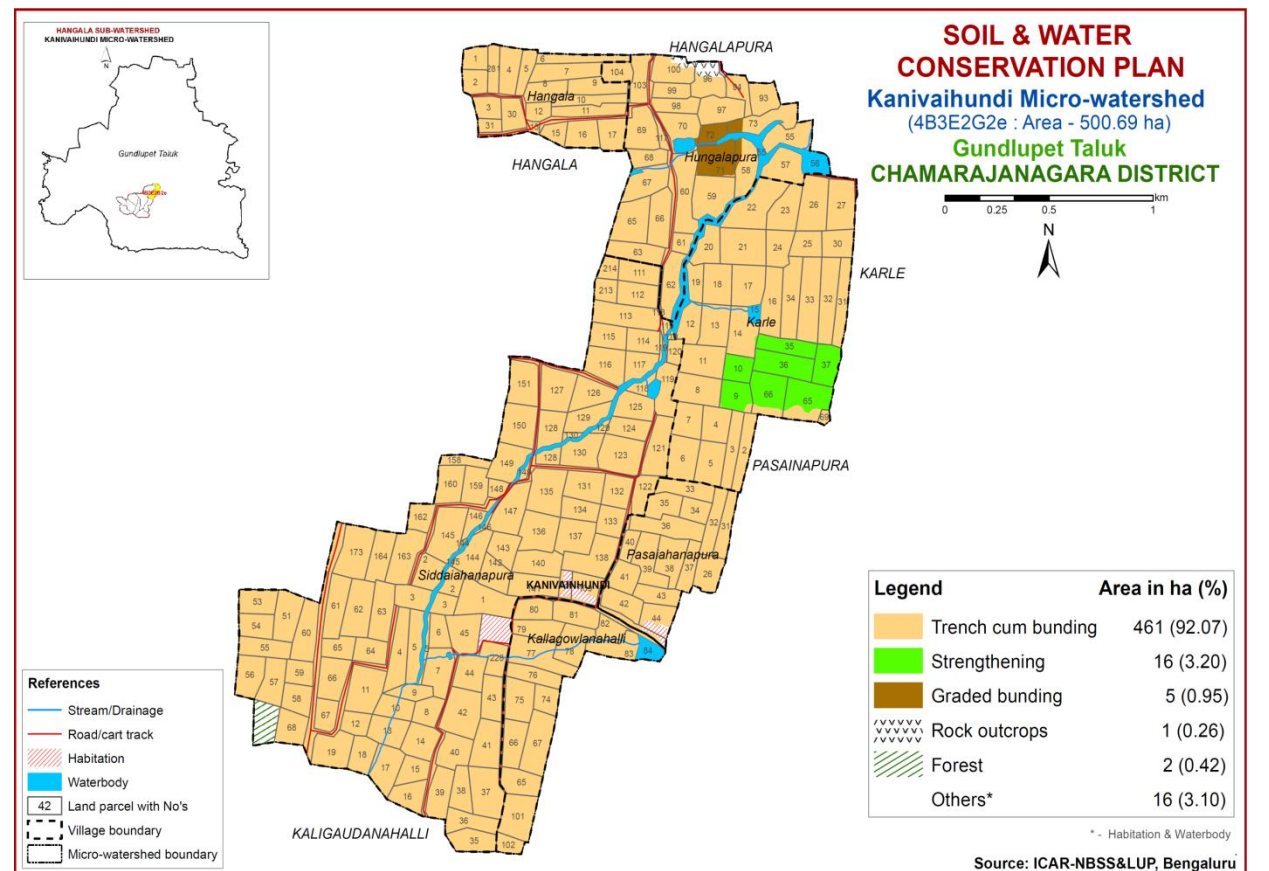
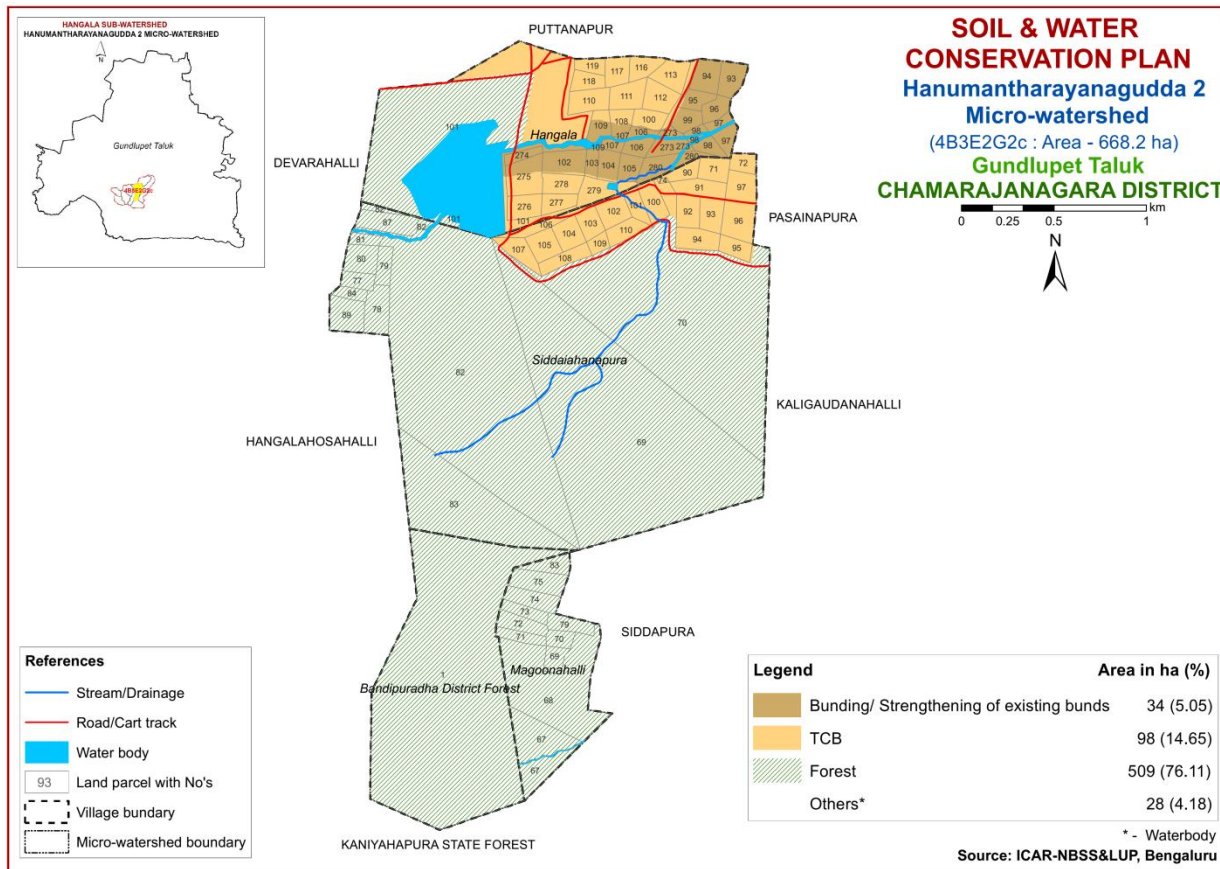
LMU NO	Mapping Units	Survey Number	Field crops/ Forestry crops	Suitable Horticulture crops under irrigation	Horticulture crops with interventions	Suitable interventions
LMU 4	8 (6 ha) (100-150 cm) Deep, gravelly red clay soils	Hangala: 110,116,117,118	Maize, Sorghum, Cotton, Sunflower, Redgram Multiple crop rotation: Redgram+Maize Redgram+Groundnut Pulses+Sorghum	Tomato, Beetroot, Potato, Mango, Banana, Beans, Bhendi, Turmeric	Perennial components: Mango, Sapota, Lime Flower crops: Marigold, Chrysanthemum Annual vegetables: Chillies, Bhendi	Drip irrigation, mulching, crop suitable conservation practices
LMU 5	9, 4, 5, 6 (27 ha) (50-100 cm) Moderately shallow to moderately deep, gravelly red clayey soils	Hangala: 119 Siddaiahnapura: 103,104,105,106, 107,108,109	Maize, Sorghum, Groundnut, Cotton, Ragi, Sunflower Pulses+Sorghum	Fieldbean, Tomato, Beetroot, Onion, Banana, Turmeric	Perennial components: Sapota, Guava Flower crops: Marigold, Chrysanthemum Annual vegetables: Chillies, Bhendi	Drip irrigation, mulching, Crop suitable conservation practices
LMU 6	10 (6 ha) (50-75 cm) Moderately shallow, gravelly red loam soils	Hangala: 101	Groundnut, Ragi, Horsegram	Custard apple, Amla	Custard apple, Amla, Drumstick, Fig	Drip irrigation, mulching, Crop suitable conservation practices

Table 4. Proposed Crop Plan for Kanivaihundi Micro-watershed, Hangala Sub-watershed Gundlupet Taluk, Chamarajanagar District based on soil-site–crop suitability Assessment

LMU NO	Mapping Units	Survey Number	Field crops/Forestry crops	Suitable Horticulture crops under irrigation	Horticulture crops with interventions	Suitable interventions
LUC-1	1 (21 ha) (>150 cm) (Very deep, red clay soils)	Siddaiahapura: 51,53,54,55,56,57,58,59,60,68	Maize, Sorghum, Cotton, Sunflower, Redgram, Sugarcane Multiple crop rotation: Redgram+Maize Redgram+Groundnut Pulses+Ragi Pulses+Sorghum	Turmeric, Banana, Lime, Tomato, Beans, Bhendi	Perennial components: Mango, Sapota, Lime Flower crops: Marigold, Chrysanthemum Annual vegetables: Chillies, Bhendi	Drip irrigation, mulching, crop suitable conservation practices
LUC-2	2 (5 ha) (>150 cm) (Very deep, lowland clayey soils)	Hungalapura: 71,72	Cotton, Sorghum, Sunflower, Redgram, Sugarcane Multiple crop rotation: Reg gram+Fodder Sorghum Pulses+ Sorghum	Beetroot, Banana, Lime, Tomato, Beans, Bhendi	Flower crops: Marigold, Chrysanthemum Perennial components: Custard apple, Amla, Lime Annual vegetables: Chillies, Bhendi	Drip Irrigation, mulching, crop suitable conservation practices
LUC-3	11, 12, 13, 14, 15, 16 (152 ha) (>150 cm) (Very deep, red loam soils)	Hungalapura: 55,57,58,59,60,61,62,63,65,66,67,68,73 Karle: 2 Pasaiahapura: 26,31,32 Siddaiahapura: 2,3,5,6,8,9,10,11,12,13,14,17,18,19,111,112,113,114,115,116,117,118,119,120,123,124,125,126,127,128,129,130,131,132,133,134,135,136,137,144,146,147,148,163,164,173,213, 214	Maize, Sorghum, Sunflower, Redgram, Sugarcane Multiple crop rotation: Redgram+Maize Redgram+Groundnut Pulses+Ragi Pulses+Sorghum	Turmeric, Banana, Lime, Tomato, Beans, Bhendi	Perennial components: Mango, Sapota, Lime Flower crops: Marigold, Chrysanthemum Annual vegetables: Chillies, Bhendi	Drip irrigation, mulching, crop suitable conservation practices

LMU NO	Mapping Units	Survey Number	Field crops/Forestry crops	Suitable Horticulture crops under irrigation	Horticulture crops with interventions	Suitable interventions
LUC-4	19, 20, 23 (30 ha) (100-150 cm) Deep, gravelly red clay soils	Kallagowlanahalli: 67 Karle: 8,11,12,13,14,16,31,32,33,34	Maize, Sorghum, Cotton, Sunflower, Redgram Multiple crop rotation: Redgram+Maize Redgram+Groundnut Pulses+Sorghum	Tomato, Beetroot, Potato, Mango, Banana, Beans, Bhendi, Turmeric	Perennial components: Mango, Sapota, Lime Flower crops: Marigold, Chrysanthemum Annual vegetables: Chillies, Bhendi	Drip irrigation, mulching, crop suitable conservation practices
LUC-5	6, 7, 21, 22 (68 ha) (75-100 cm) Moderately deep, gravelly red clay soils	Kallagowlanahalli: 65,101,102 Karle: 3,4,5,6,7 Siddaiahnapura: 4,15,16,35,36,37,38,39,40,41,61,62,63,64,65,66,67,121	Maize, Sorghum, Cotton, Ragi, Sunflower Pulses+Sorghum	Fieldbean, Tomato, Beetroot, Onion, Banana, Turmeric	Perennial components: Sapota, Guava Flower crops: Marigold, Chrysanthemum Annual vegetables: Chillies, Bhendi	Drip irrigation, mulching, Crop suitable conservation practices
LUC-6	3, 4, 5, 17, 18 (67 ha) (50-75 cm) Moderately shallow, gravelly red clay soils	Kallagowlanahalli: 74,83 Karle: 9,10,17,18,19,20,21,22,23,24,25,26,27,30,35,36,37,65,66 Pasaiahnapura: 44 Siddaiahnapura: 138,139,149,150,151	Ragi, Groundnut, Maize, Sorghum, Cotton Pulses+Sorghum	Fieldbean, Tomato, Beetroot, Onion, Banana, Turmeric	Custard apple, Ber, Aonla Vegetables: Clusterbean, Bhendi Flower crops: Marigold, Chrysanthemum, Gillardia	Drip irrigation, mulching, Crop suitable conservation practices

LMU NO	Mapping Units	Survey Number	Field crops/Forestry crops	Suitable Horticulture crops under irrigation	Horticulture crops with interventions	Suitable interventions
LUC-7	24, 25, 26, 27 (70 ha) (50-75 cm) Moderately shallow, gravelly red loam soils	Hangala: 1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,30,31,281 Hungalapura: 69,70,93,94,96,97,98,99,100,103,104,117 Kallagowlanahalli: 66,75 Siddaiahnapura: 7,42,43,44,228	Groundnut, Ragi, Horsegram	Custard apple, Amla	Custard apple, Amla, Drumstick, Fig	Drip irrigation, mulching, Crop suitable conservation practices
LUC-8	8, 9, 10 (66 ha) (25-50 cm) Shallow, red clay soils	Kallagowlanahalli: 76,77,78,79,80,81,82 Pasaiahnapura: 33,34,35,36,37,38,39,40,41,42,43 Siddaiahnapura: 1,45,122,140,141,142,143,145,158,159,160,162	Groundnut, Horsegram, Fieldbean, Ragi	Custard apple, Amla	Custard apple, Ber	Drip irrigation, mulching, Crop suitable conservation practices
LUC-9	28 (3 ha) (25-50 cm) Shallow gravelly, red clay soils (marginal lands)	Karle: 69	Groundnut, Horsegram	Custard apple, Amla	Custard apple, Ber	Drip irrigation, mulching, Crop suitable conservation practices



G. BALANCE OF RUNOFF WATER:

	QUANTITY OF RUNOFF		TOTAL QUANTITY OF WATER STORED IN THE PROPOSED STRUCTURES:.
=	WATER -	-	
=	306458.40	-	284966.40
=	21492.00m ³		

NOTE: QUANTITY OF RUNOFF TO BE SET APART FOR THE COMMITMENTS LIKE EXISTING WATER BODIES HAS TO BE TAKEN CARE OF BEFORE FINALISING THE NUMBER AND CAPACITY OF STORAGE/ RECHARGE STRUCTURES

H. ADDITIONAL STORAGE STRUCTURES:

= BALANCE OF RUNOFF WATER/ STORAGE CAPACITY OF PROPOSED STRUCTURE

			STORAGE CAPACITY (m ³)				
DIMENSION OF POND(m)			EXCAVATION BY SEGMENTAL METHOD		EXCAVATION BY MECHANICAL MEANS		
L x W x D			QUANTITY (m ³)	NOS.	QUANTITY(m ³)	NOS.	
21492.00	/	319.7	12 X 12 X 3	319.7	67	258	83
			OR				
21492.00	/	530.3	15 X 15 X 3	530.3	41	447	48
			OR				
21492.00	/	794.9	18 X 18 X 3	794.9	27	690	31
			OR				
21492.00	/	1113.5	21 X 21 X 3	1113.5	19	987	22

OR CHECK DAMS/NALA BUNDS ON DECIDING THE IDEAL SPOTS FOR RECHARGE

F. BALANCE OF RUNOFF WATER:

$$\begin{aligned}
 &= \text{QUANTITY OF RUNOFF WATER} - \text{TOTAL QUANTITY OF WATER STORED IN THE PROPOSED STRUCTURES:.} \\
 &= 243827.48 - 217895.60 \\
 &= 25931.88 \text{ m}^3
 \end{aligned}$$

NOTE: QUANTITY OF RUNOFF TO BE SET APART FOR THE COMMITMENTS LIKE EXISTING WATER BODIES HAS TO BE TAKEN CARE OF BEFORE FINALISING THE NUMBER AND CAPACITY OF STORAGE/ RECHARGE STRUCTURES

G. ADDITIONAL STORAGE STRUCTURES:

$$= \text{BALANCE OF RUNOFF WATER/ STORAGE CAPACITY OF PROPOSED STRUCTURE}$$

	STORAGE CAPACITY (m ³)				
	DIMENSION OF POND(m)	EXCAVATION BY SEGMENTAL METHOD		EXCAVATION BY MECHANICAL MEANS	
		L x W x D	QUANTITY (m ³)	NOS.	QUANTITY(m ³)
25931.88 / 319.7	12 X 12 X 3	319.7	81	258	101
	OR				
25931.88 / 530.3	15 X 15 X 3	530.3	49	447	58
	OR				
25931.88 / 794.9	18 X 18 X 3	794.9	33	690	38
	OR				
25931.88 / 1113.5	21 X 21 X 3	1113.5	23	987	26

OR CHECK DAMS/NALA BUNDS ON DECIDING THE IDEAL SPOTS FOR RECHARGE

PART - B

Hydrological Inventory of Hanagala Sub-watershed, Gundlupet Taluk, Chamarajanagara District, Karnataka for Watershed Planning and Development



Sujala - III
Karnataka Watershed Development Project-II
Watershed Development Department
Government of Karnataka



Hydrological Inventory of Hangala Sub-watershed, Gundlupet Taluk,
Chamarajanagar 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



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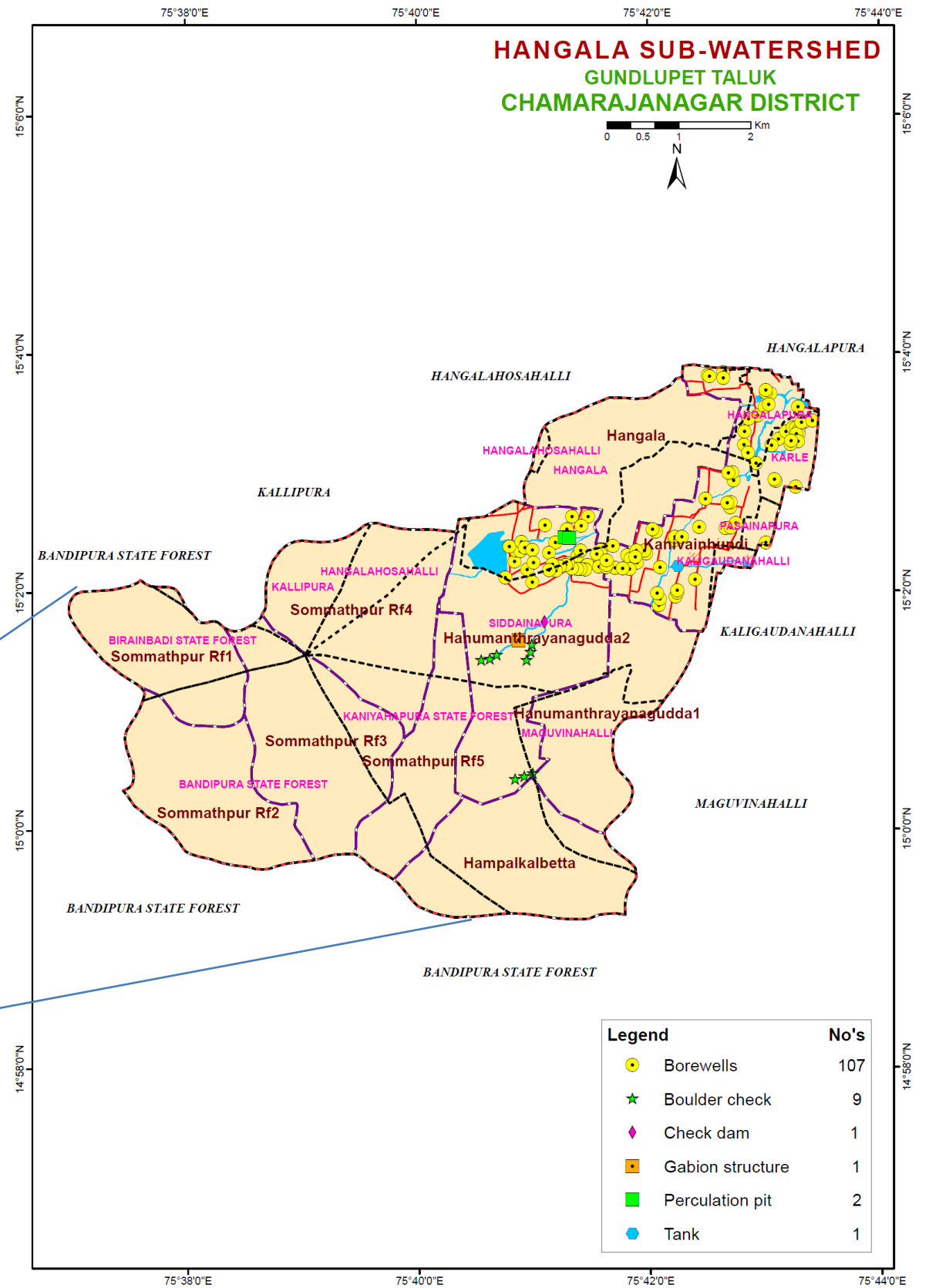
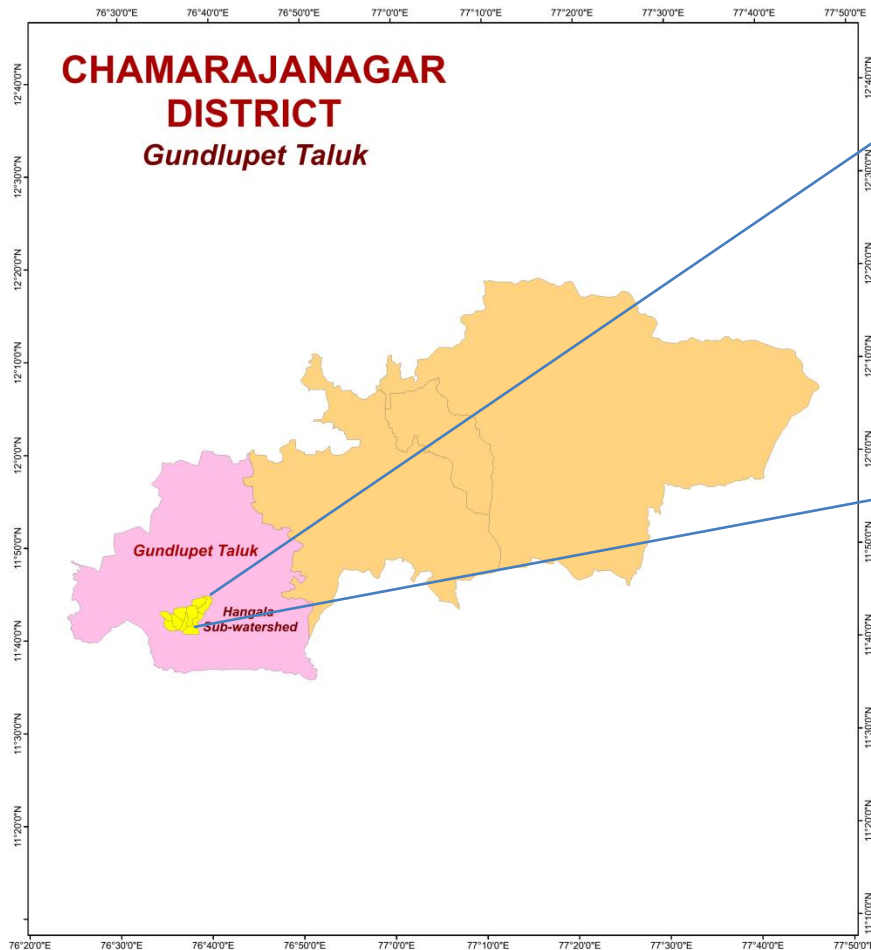
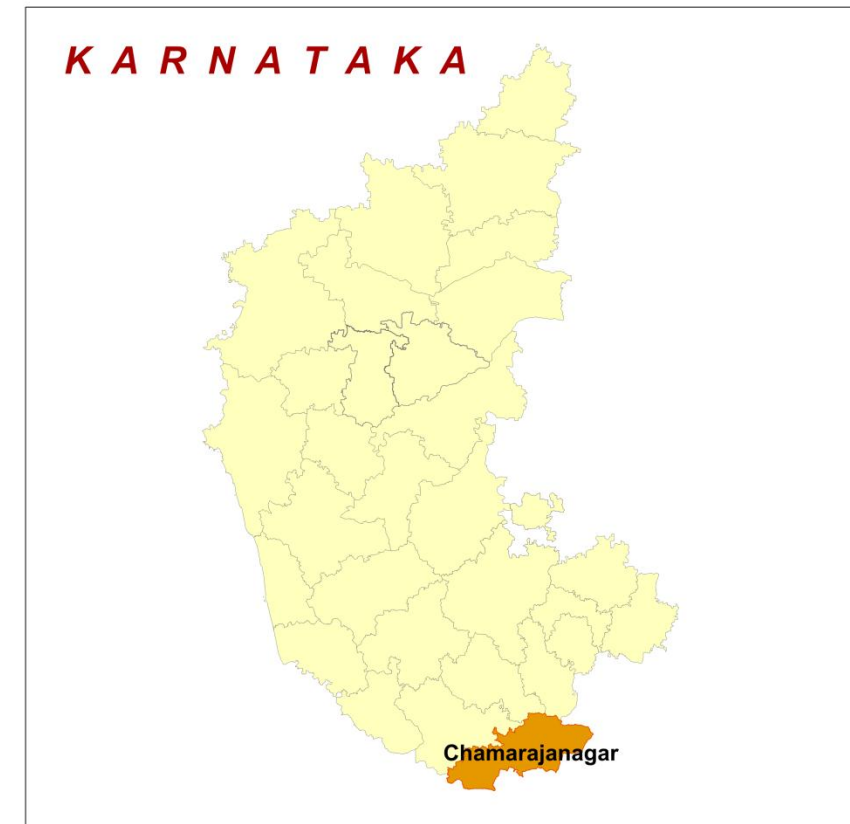
Details of Hydrology Team of LRI Partner Responsible for Preparation of Atlas

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

INTRODUCTION

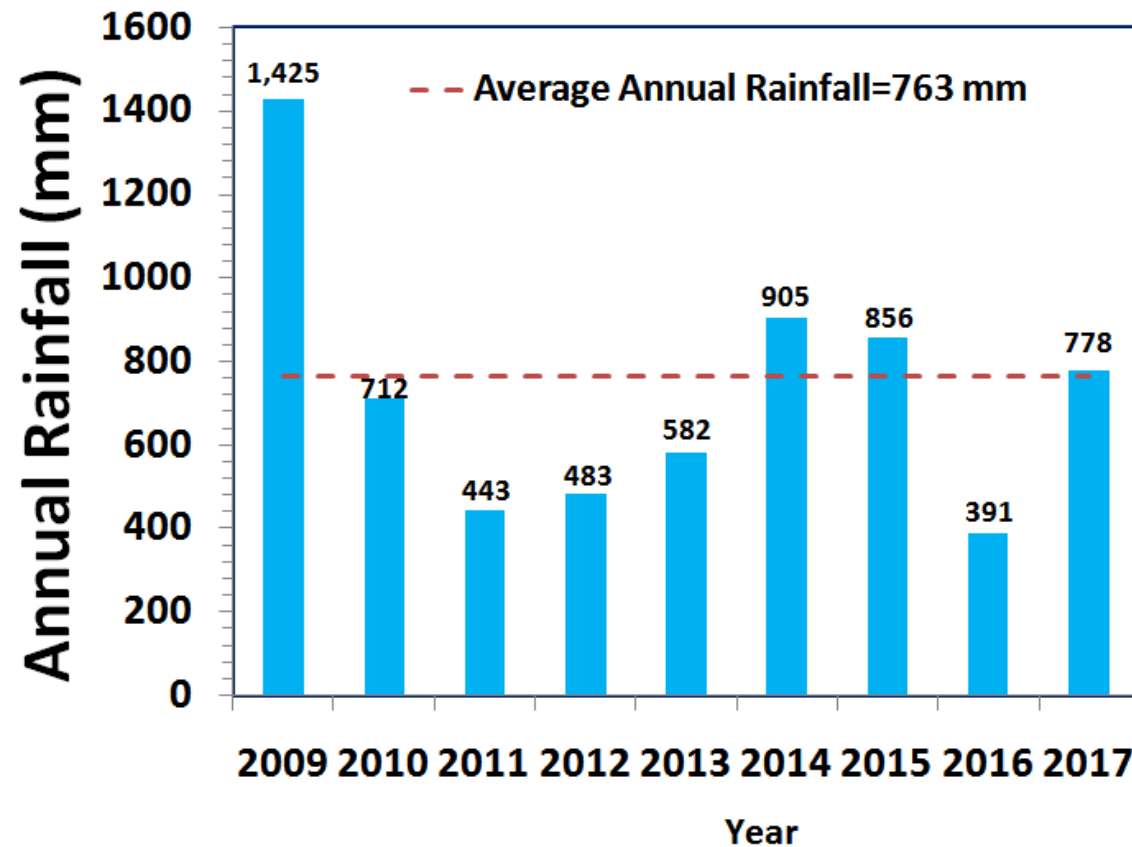
- The inventory and documentation of spatial and temporal changes in hydrological components of Hangala sub-watershed (4B3E2G) in Gundlupet taluk, Chamarajanagar district, has been undertaken for integrated planning, development and management at the level of soil mapping units.
- Hangala sub-watershed (Gundlupet taluk, Chamarajanagar district) is located between 11^o44'48"–11^o41'25" North latitudes and 76^o40'11"–76^o37'4" East longitudes, covering an area of about 4209 ha.
- This sub-watershed encompasses of 10 MWs namely Kanivainhundi (4B3E2G2e), Hangala (4B3E2G2d), Hanumanthrayanagudda-1(4B3E2G2b), Hanumanthrayanagudda-2 (4B3E2G2c), Sommathpur Rf-4 (4B3E2G1d), Sommathpur Rf-1 (4B3E2G1a), Sommathpur Rf-5 (4B3E2G1e), Sommathpur Rf-3 (4B3E2G1c), Sommathpur Rf-2 (4B3E2G1b) and Hampalkalbetta (4B3E2G2a) micro watersheds. Land Resource Inventory (LRI) was generated for two among the ten micro-watersheds.
- Average annual rainfall (1960-2014) of the Hobli (Block) pertaining to the sub-watershed is 763 mm.
- In this sub-watershed major *kharif* crops grown are Maize, Redgram, Sunflower, Groundnut, Cotton, Onion, Marigold and major *rabi* crop is Sorghum.
- 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 HANGALA SUB-WATERSHED



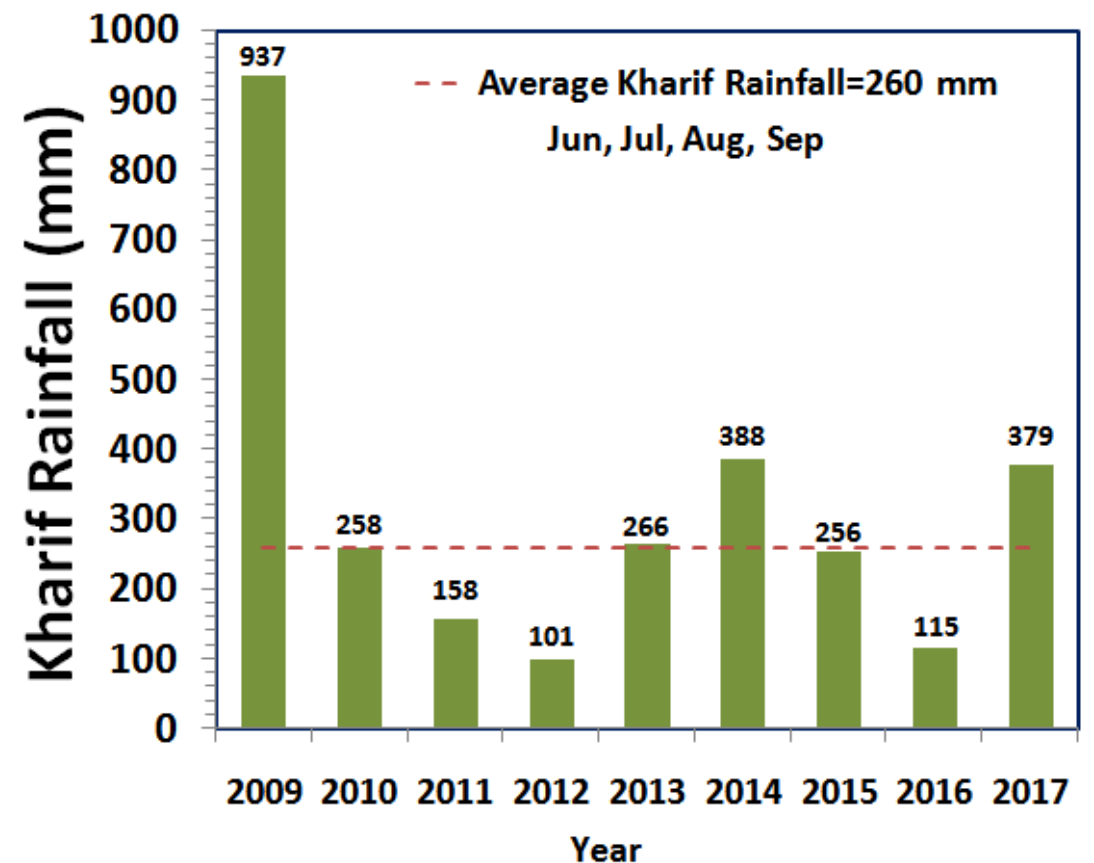
Soil & Water Conservation Structures in Hangala Sub-watershed, Gundlupet taluk, Chamarajanagar district

RAINFALL INDEX

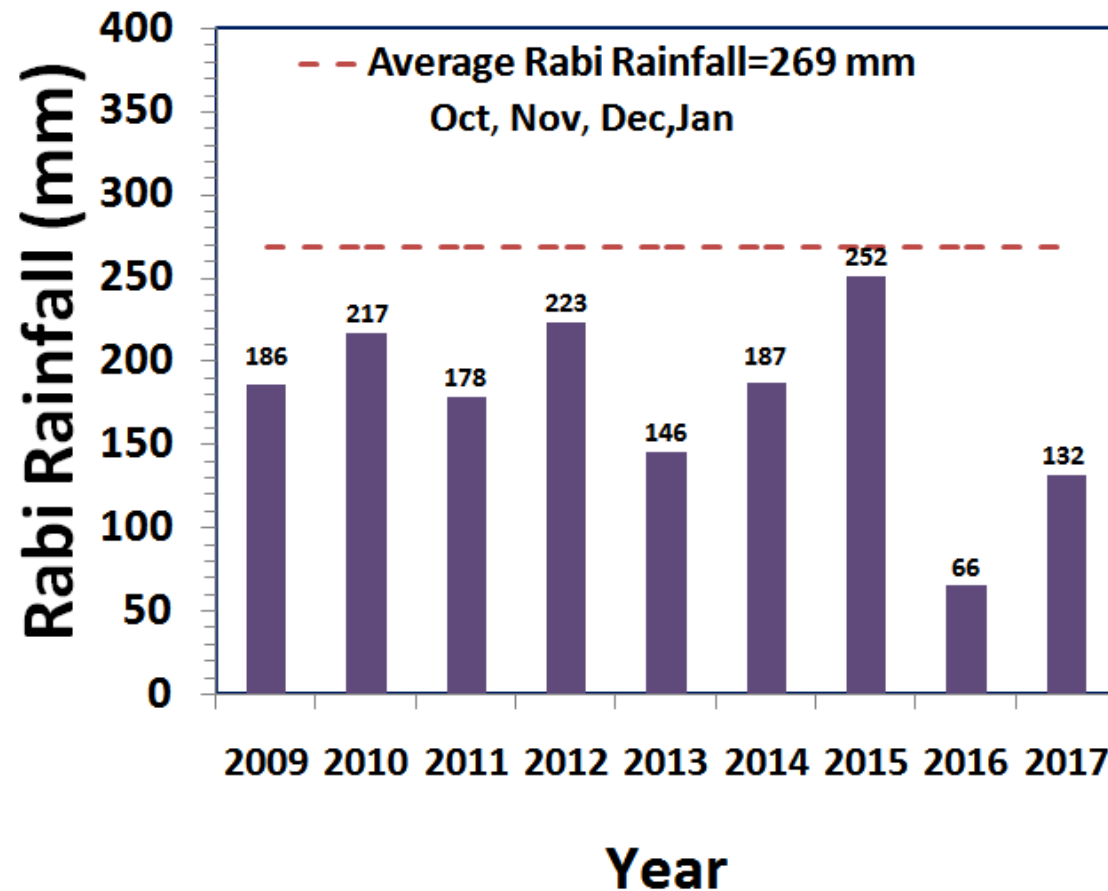


The average annual rainfall (1960-2014) recorded at the Gundlupet station in Gundlupet taluk of Chamarajanagar district is 763 mm. The annual rainfall at Hangala station (Hobli H.Q.) is presented. During the years 2010, 2011, 2012, 2013 and 2016 the annual rainfall was deficient by 10%, 11%, 12%, 13% and 16% respectively.

The *kharif* rainfall (Jun–Sep) is an average about 39% of the annual rainfall and it typically follows the annual rainfall patterns. During the years 2011, 2012, 2015 and 2016 the *kharif* rainfall was deficient by 39%, 61%, 2% and 56% respectively.

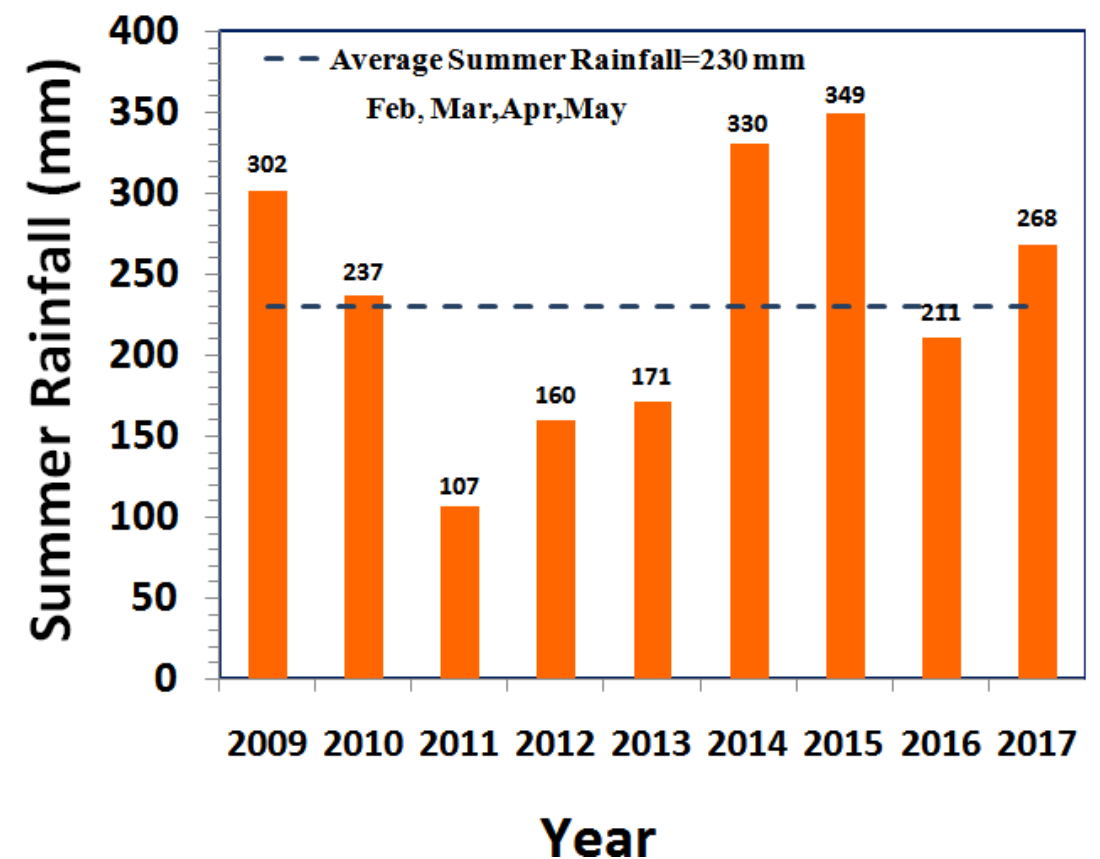


RAINFALL INDEX

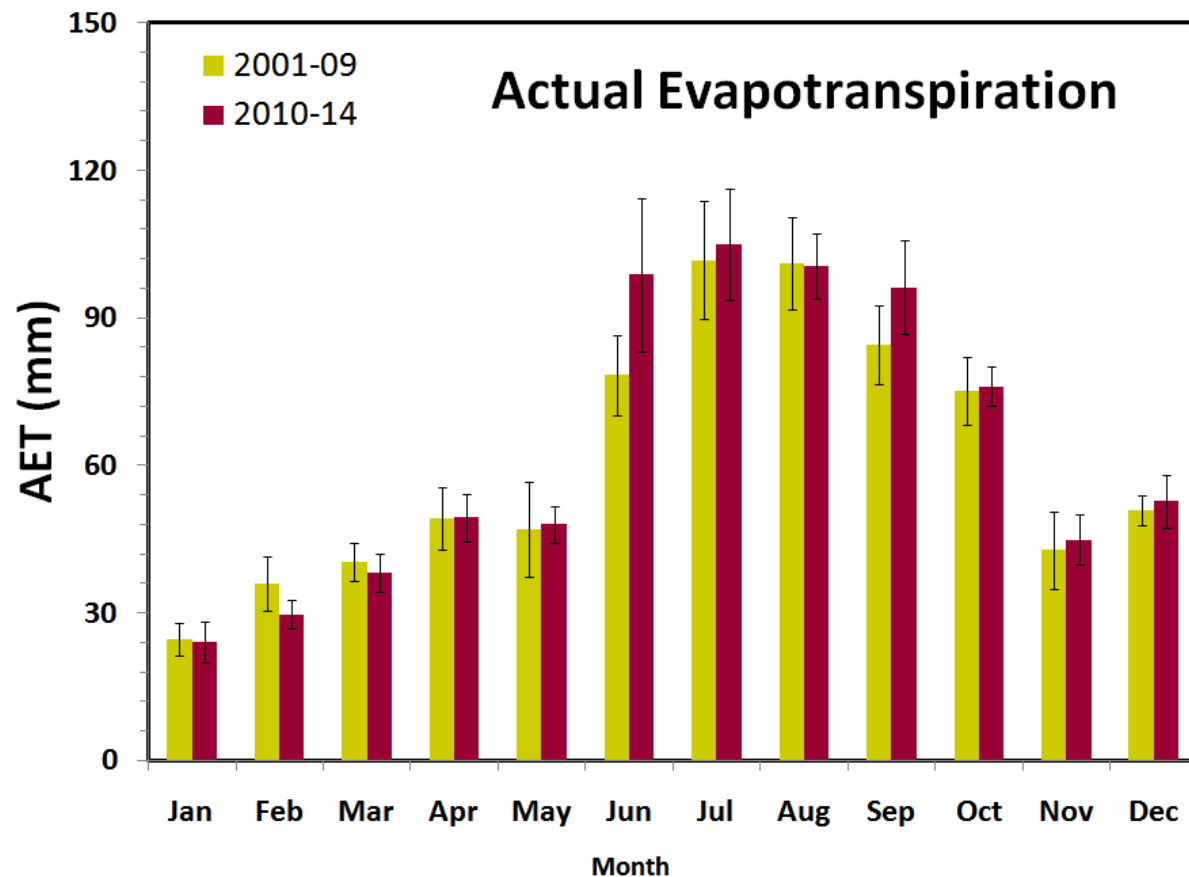
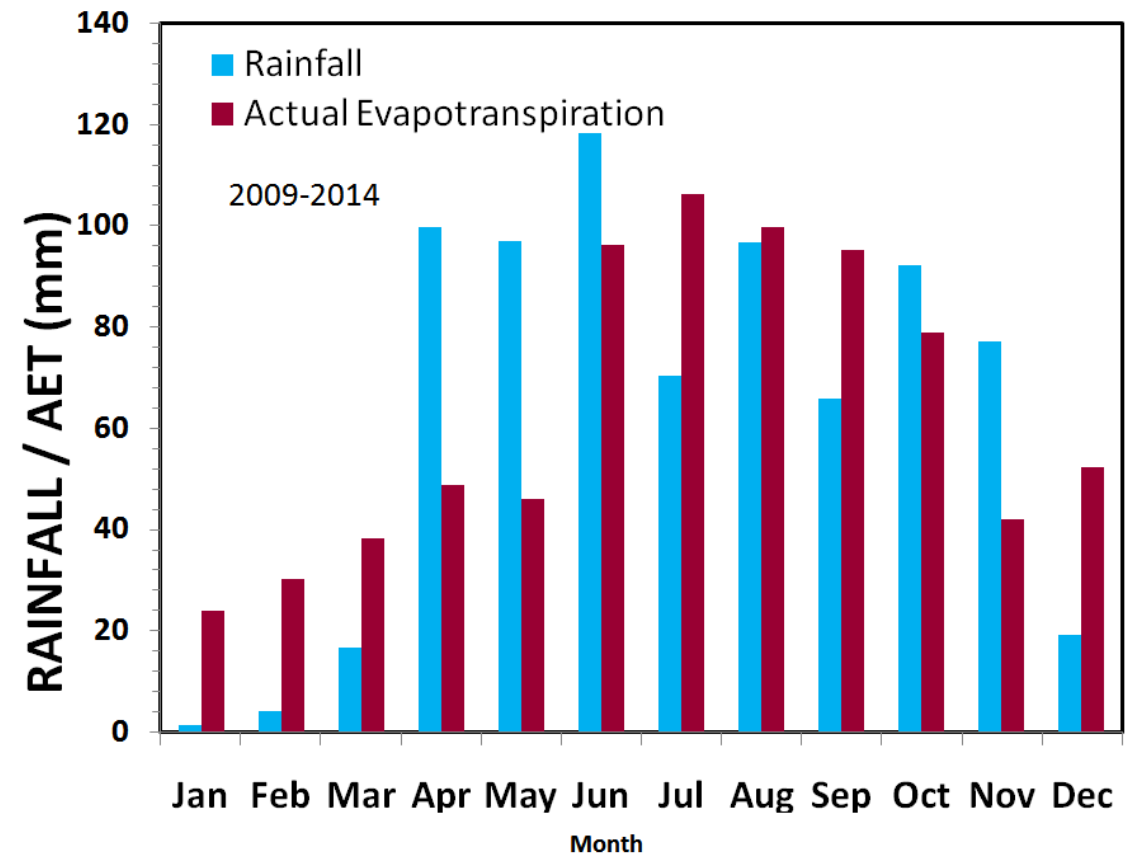
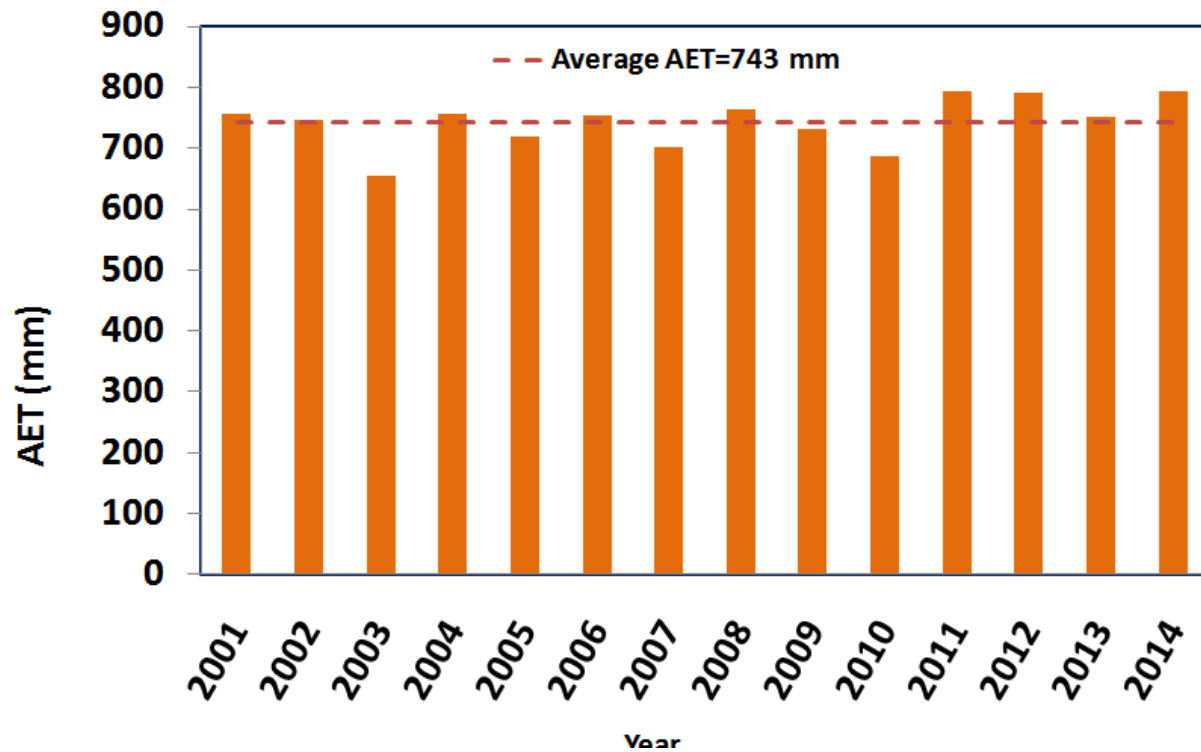


The average *rabi* rainfall (Oct-Jan) is about 26% of the average annual rainfall. During all the years showed deficient rainfall.

The average summer rainfall (Feb-May) is about 34% of the average annual rainfall.

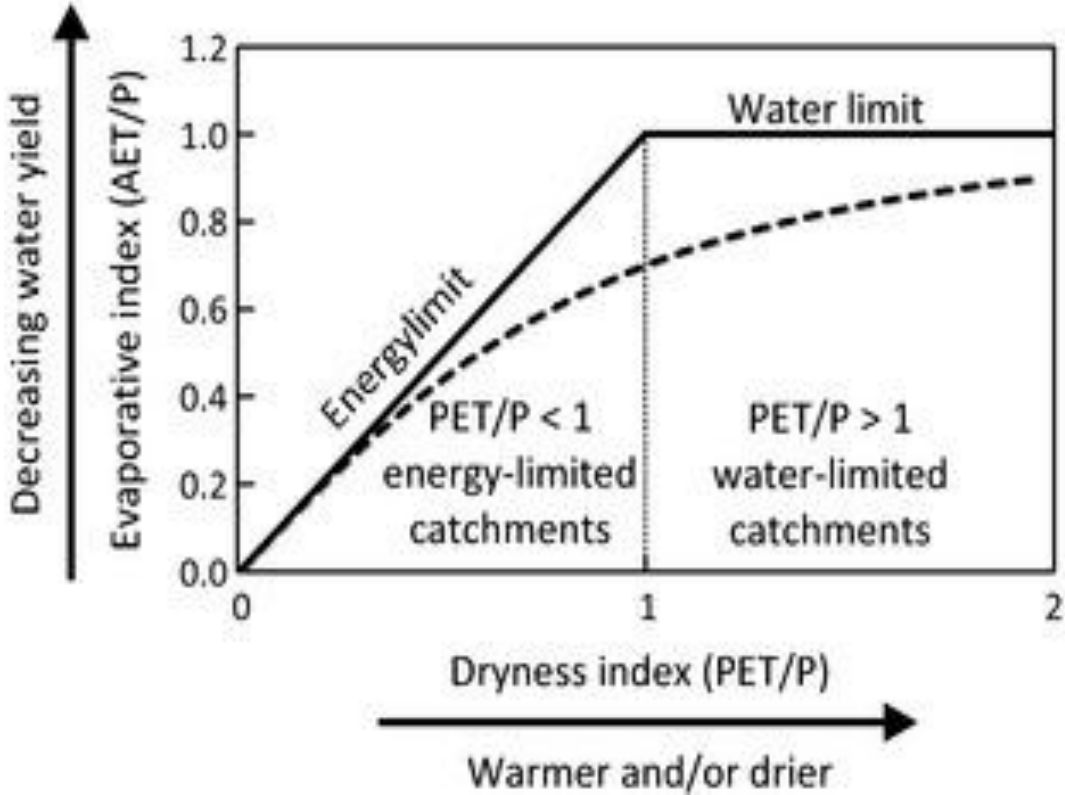
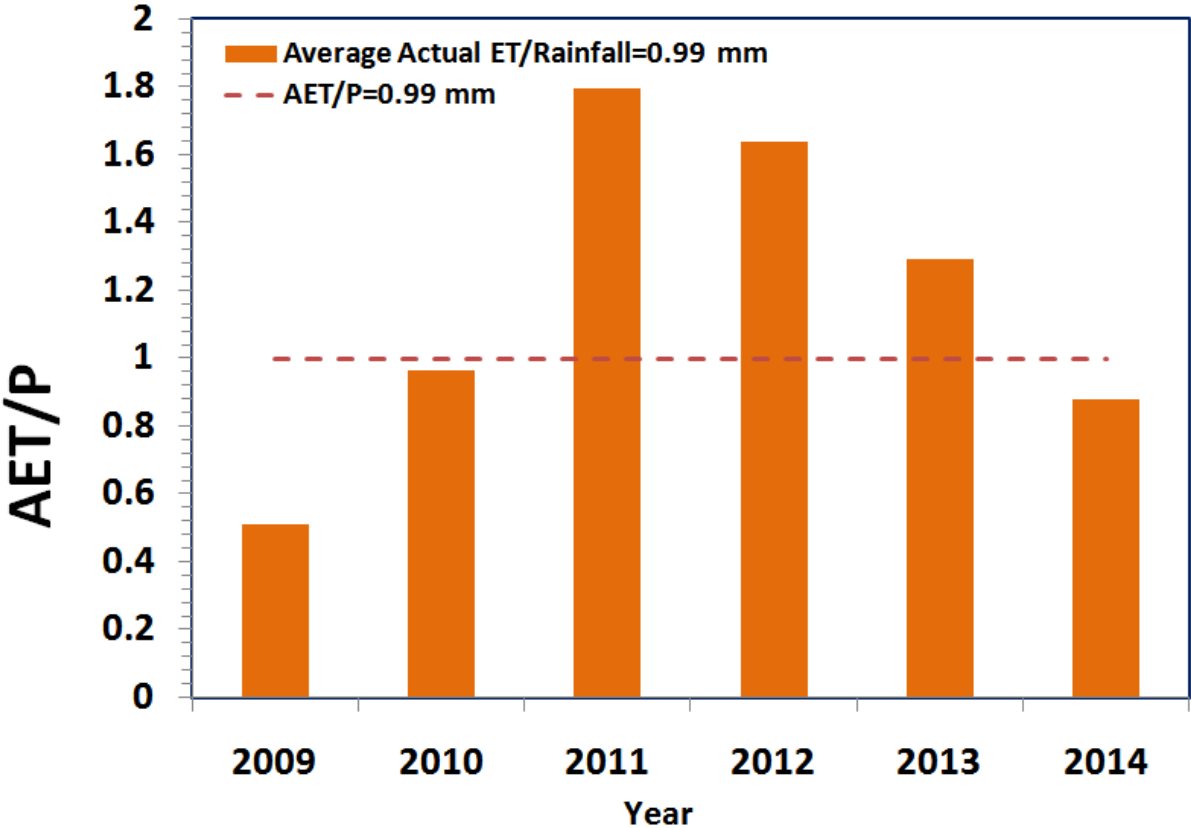


EVAPOTRANSPIRATION

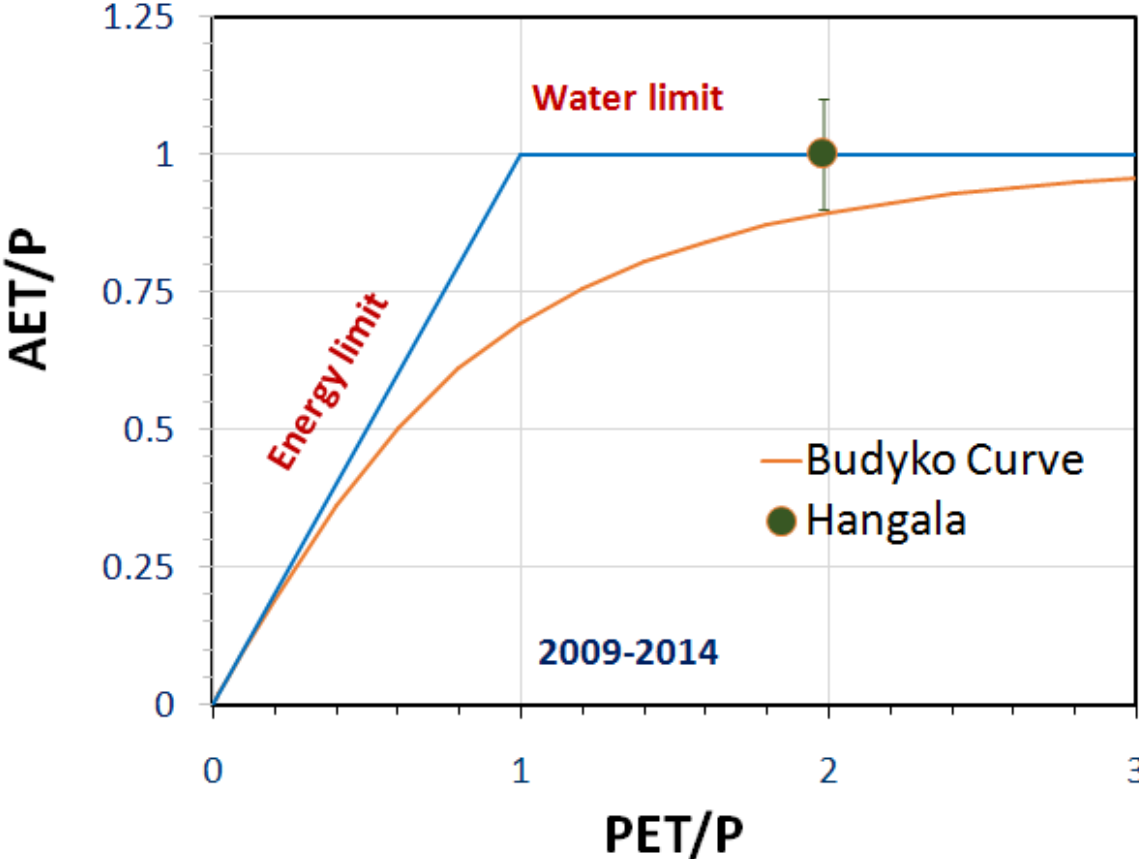


The average annual actual ET is lower than the average rainfall. During *kharif*, average rainfall and ET was found to be 317 mm and 398 mm respectively, whereas in *rabi* it was about 176 mm and 197 mm. In comparison to the 2001-2009, the annual ET increased by 4% during 2010-2014.

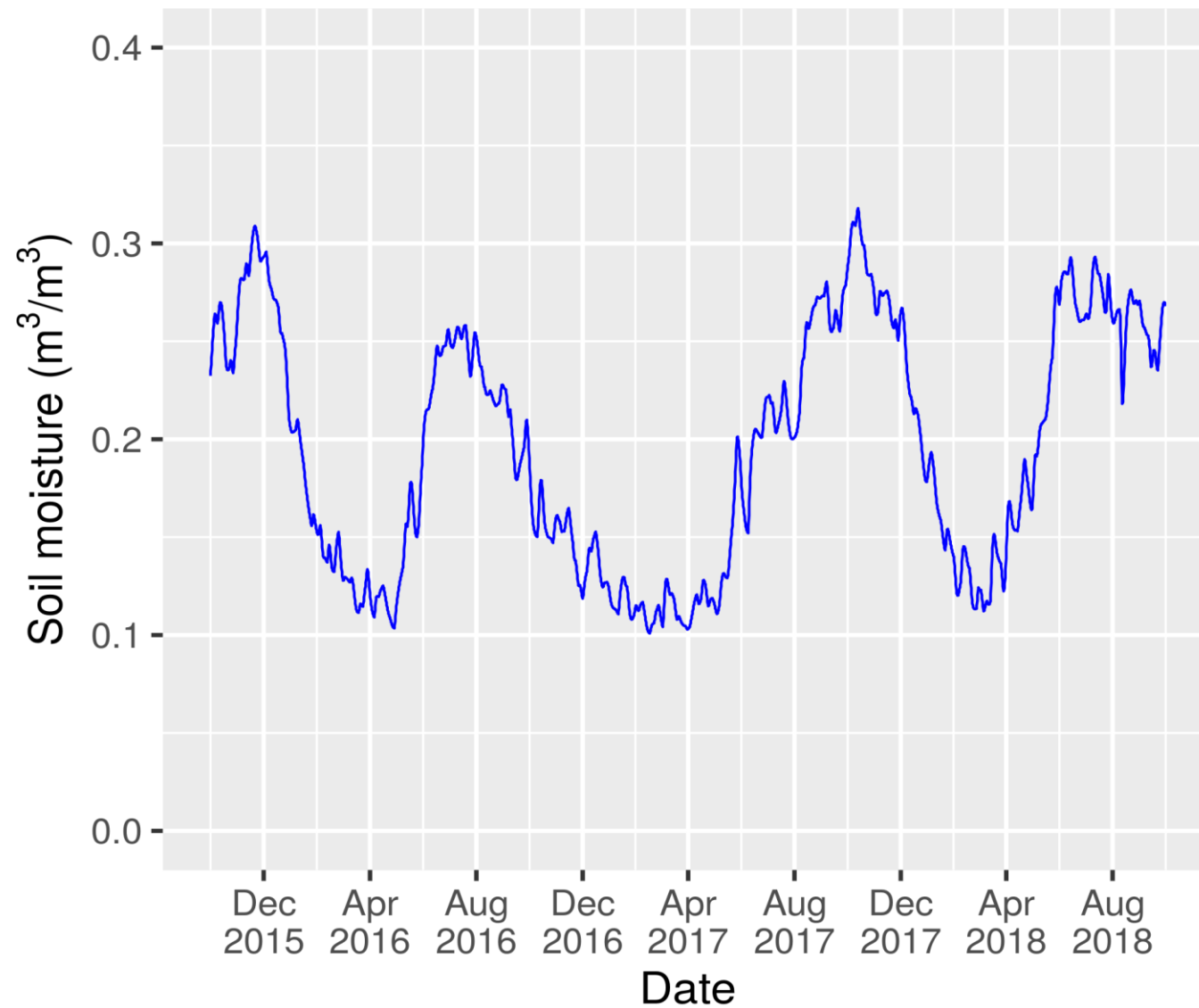
EVAPOTRANSPIRATION INDEX



The average AET/P ratio was about 99%, which is higher than the sustainable limit of about 80%. Even during extremely lower rainfall year of 2011, AET was 740 mm. This suggests the presence of water storage and utilization from other sources such as groundwater, which buffered the lower rainfall.

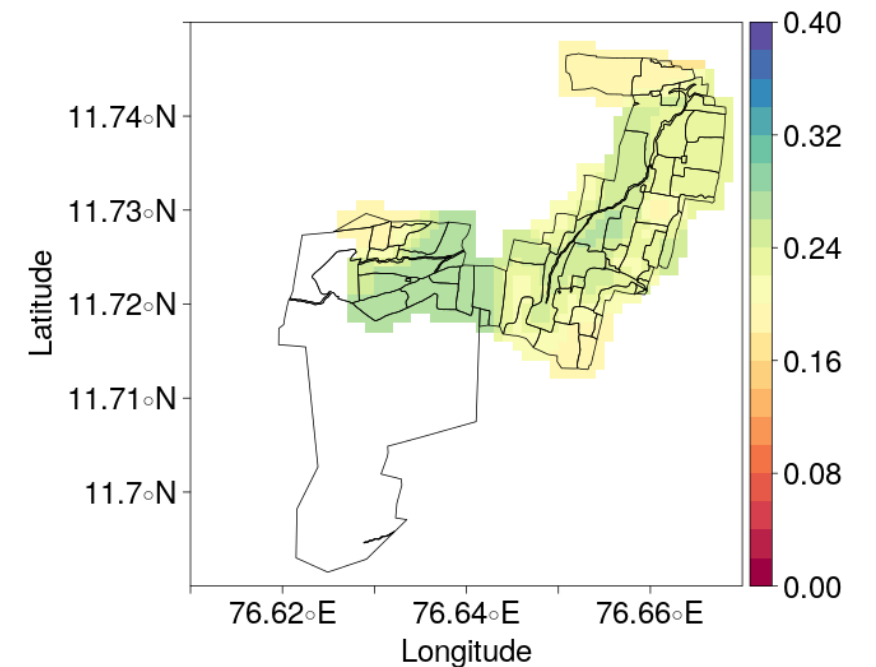


SATELLITE RETRIEVED SOIL MOISTURE

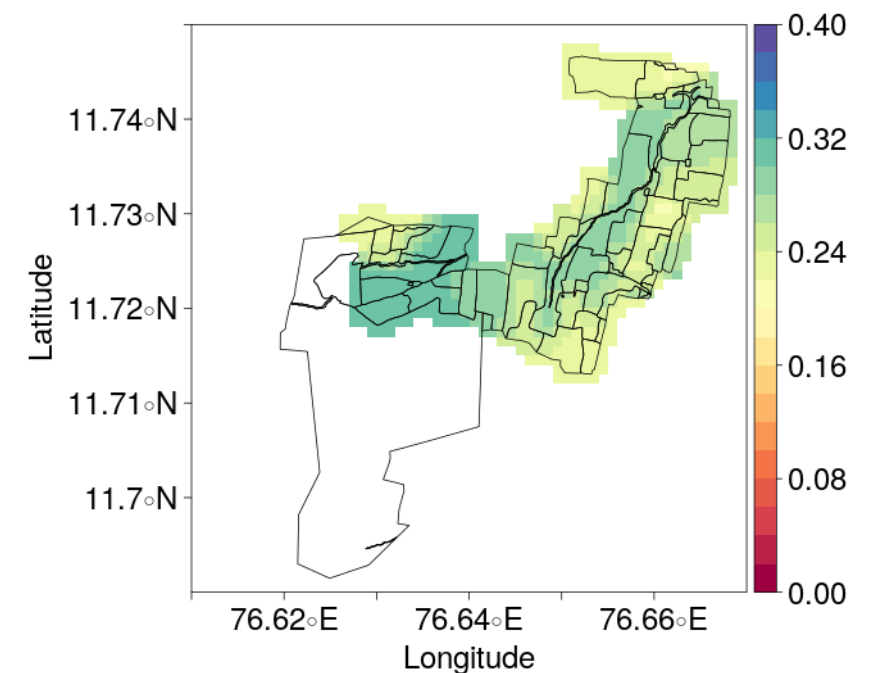


The method developed for retrieving soil moisture from multi-satellite observations allowed to map surface soil moisture behavior in the micro-watershed. The available surface moisture was varied in the range of 20-23% in *kharif* and 14-21% in *rabi* seasons of 2016 and 20-27% in *kharif* and 19-31% in *rabi* seasons of 2017.

Hangala-*rabi* Soil Moisture



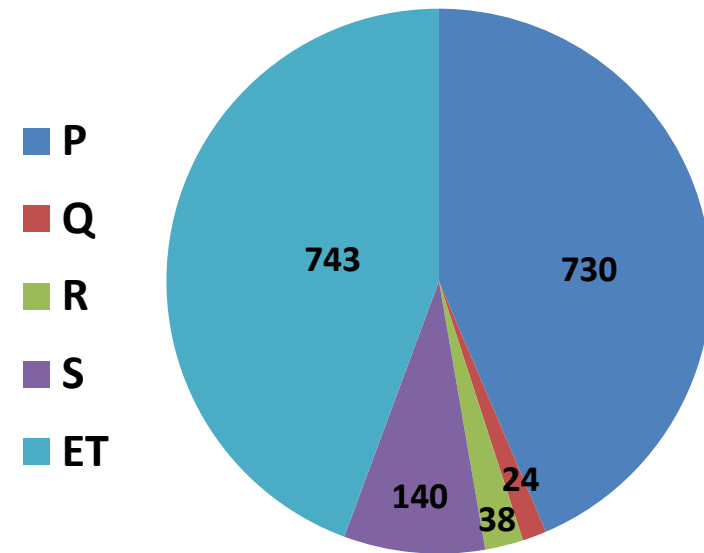
Hangala - *kharif* Soil Moisture



WATER BALANCE

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

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

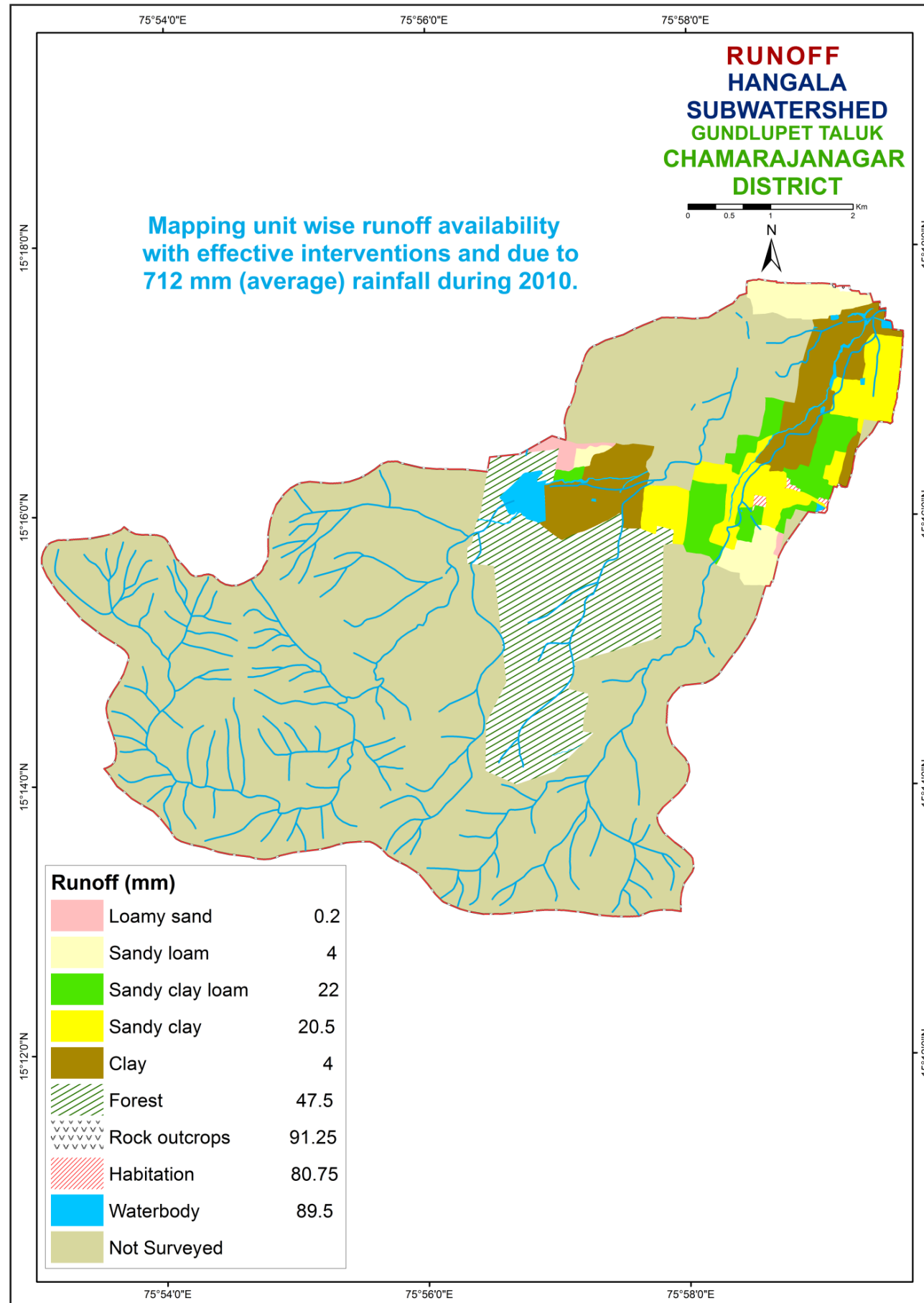


During June-September months, Precipitation is lower than Evapotranspiration, hence Slight Runoff can occur in the watershed.

P = 730 mm (average of 2009-2017) ET = 743 mm R = 38 mm S = 140 mm Q = 24 mm

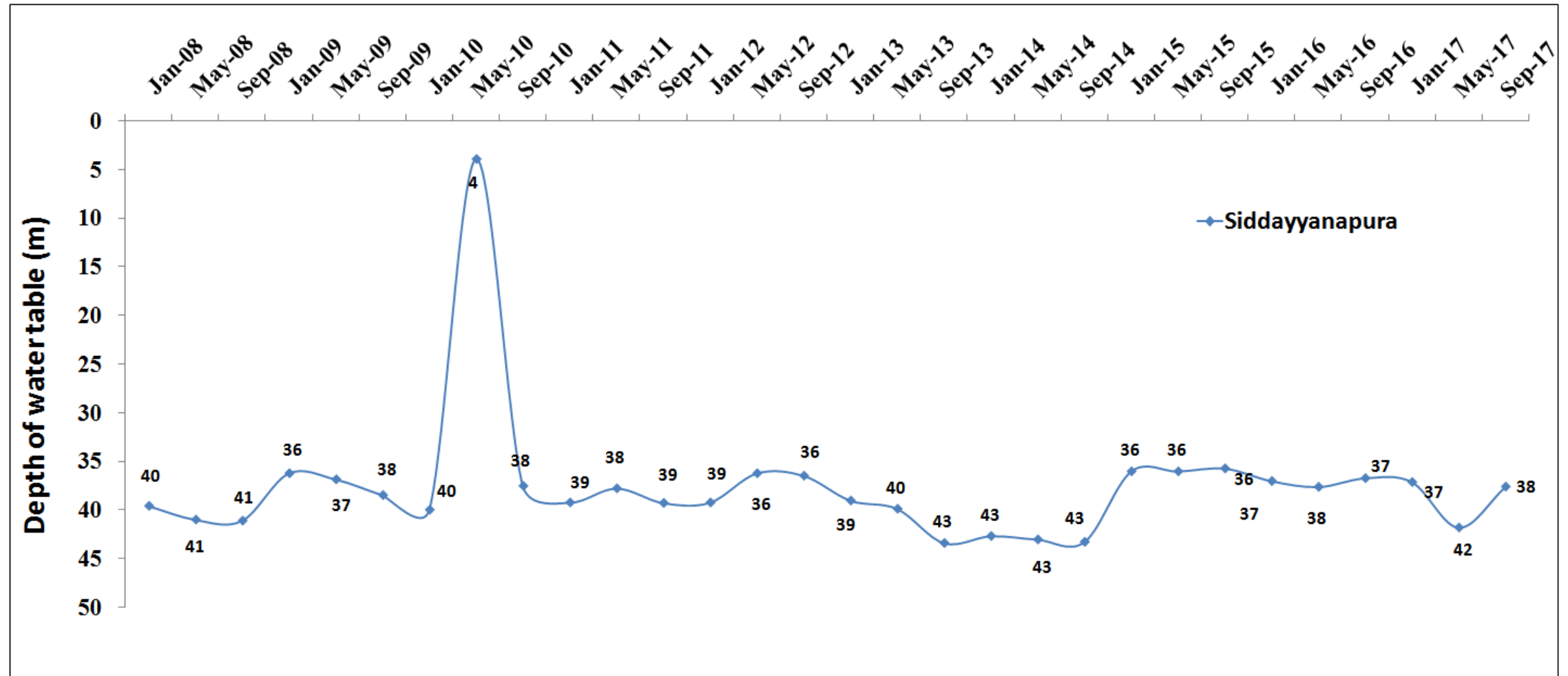
Sl. No.	Parameters	Average_ 2010 (mm)
1.	Rainfall	712
2.	Runoff availability with existing conditions	45
3.	Runoff availability with effective interventions	30
4.	Runoff allowed as environmental flow at the outlet	6
5.	Runoff excess for harvesting by construction of structures	24

RUNOFF



GROUND WATER STATUS

SIDDAYANAPURA STATION



The total number of wells present in Hangala Sub-watershed as per LRI data are 107(Bore wells). The groundwater level was found from the data obtained from KSNDMC for the nearest station Siddayyanapura. The above graph depicts the groundwater levels during the years 2008-2017 were slightly varying Except the year May 2010. Deepest level was found in 2014 year.

SUMMARY

- The average annual rainfall of 763 mm in the Hangala sub-watershed as recorded from the Hangala station data by KSNDMC.
- 39%, 26% and 34% 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 inappropriate and needed to be altered.
- The estimated runoff available to use is 24 mm for an average annual rainfall of 730 mm (2009-2017). The utilizable groundwater is 27 mm (70% of 38 mm recharge estimated). This means the total available water resource combining the soil moisture store for kharif & rabi (140 mm) and utilizable runoff plus recharge is 191 (=140+27+24)
- The average actual evapotranspiration estimated in the watershed based on the current land use and irrigation practices for the kharif and rabi seasons is 595 mm. Hence the amount of water use for kharif and rabi seasons may be estimated as 744 mm (i.e 125% of AET). This demand for the two seasons is higher by 553 mm, i.e. (744-191). The AET in June-Sept months is more than rainfall.
- The total number of wells present in Hangala Sub-watershed as per LRI data are 107 (Bore wells). The groundwater level was found from the data obtained from KSNDMC for the nearest station Siddayanapura. Deepest level was found in 2014 year.