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

Agrisearch with a human touch

ICAR - NBSS & LUP

Land Resource and Hydrological Inventory of Hadgali Sub-watershed for Watershed Planning and Development Shirahatti Taluk, Gadag District, Karnataka (AESR 6.4)

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

THE 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 National Bureau of Soil Survey and Land Use Planning (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 Hadgali Sub-watershed for Watershed Planning and Development

Shirahatti Taluk, Gadag District, Karnataka (AESR 6.4)

CONTENTS

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How to read and use the Atlas

The Land Resource Inventory of Hadgali Sub-watershed (Shirahatti Taluk, Gadag District) for Watershed Planning (AESR 6.4) 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.

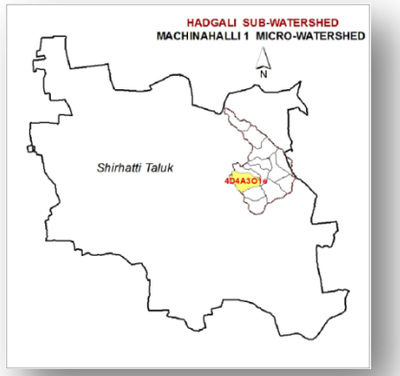
For easy map reading and understanding the information contain in different maps, the physical, cultural and scientific symbols used in the maps are illustrated in the form of colors, graphics and tables.

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.

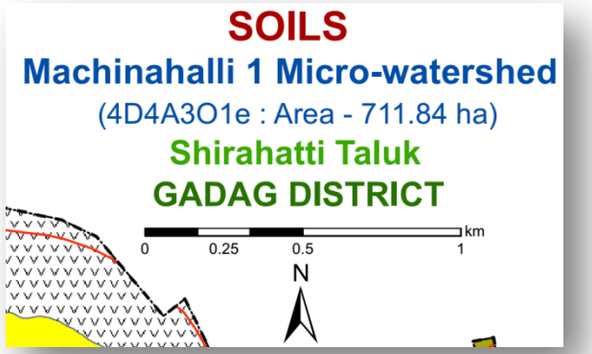
Inset map

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



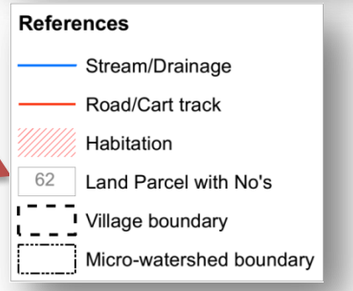
Map title

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



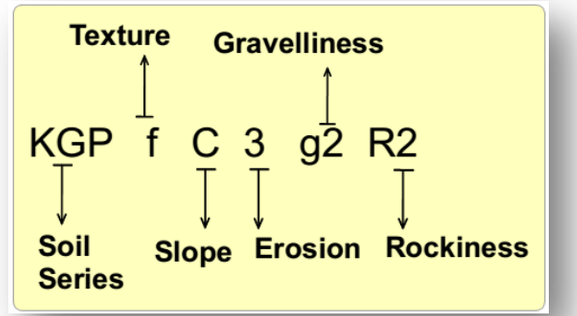
Legends and symbols

*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.*



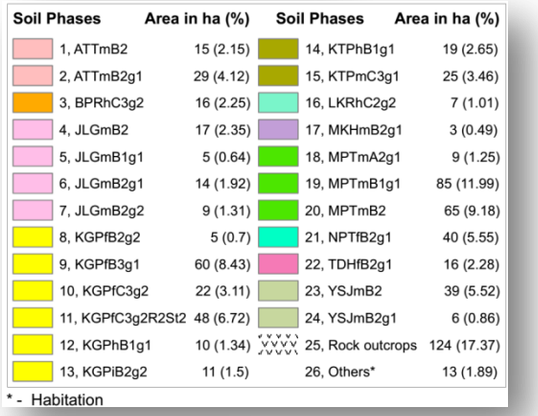
Soil Units

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 (%)	Soil Phases	Area in ha (%)
1, ATTmB2	15 (2.15)	14, KTPhB1g1	19 (2.65)
2, ATTmB2g1	29 (4.12)	15, KTPmC3g1	25 (3.46)
3, BPRhC3g2	16 (2.25)	16, LKRhC2g2	7 (1.01)
4, JLGmB2	17 (2.35)	17, MKHmB2g1	3 (0.49)
5, JLGmB1g1	5 (0.64)	18, MPTmA2g1	9 (1.25)
6, JLGmB2g1	14 (1.92)	19, MPTmB1g1	85 (11.99)
7, JLGmB2g2	9 (1.31)	20, MPTmB2	65 (9.18)
8, KGPfB2g2	5 (0.7)	21, NPTfB2g1	40 (5.55)
9, KGPfB3g1	60 (8.43)	22, TDHfB2g1	16 (2.28)
10, KGPfC3g2	22 (3.11)	23, YSJmB2	39 (5.52)
11, KGPfC3g2R2St2	48 (6.72)	24, YSJmB2g1	6 (0.86)
12, KGPhB1g1	10 (1.34)	25, Rock outcrops	124 (17.37)
13, KGPiB2g2	11 (1.5)	26, Others*	13 (1.89)

* - Habitation

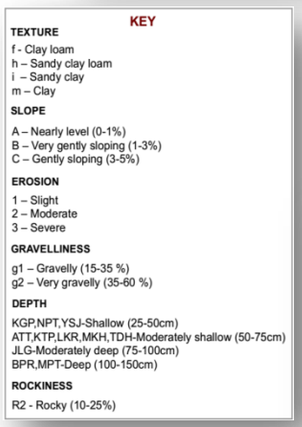
Land Management Units (LMU)

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

Legend	Area in ha (%)
LMU-1	16 (2.25)
LMU-2	160 (22.42)
LMU-3	44 (6.21)
LMU-4	45 (6.26)
LMU-5	70 (9.89)
LMU-6	155 (21.78)
LMU-7	85 (11.92)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

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.

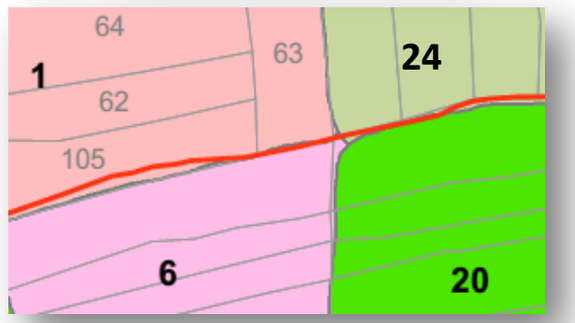


Key
S1-Highly Suitable
S2-Moderately Suitable
S3-Marginally Suitable
N- Not Suitable

Limitations
g- gravelliness
r- rooting condition

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 HADGALI SUB-WATERSHED FOR WATERSHED PLANNING AND DEVELOPMENT
SHIRAHATTI TALUK, GADAG 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.

Gadag district is located around 480 km North West Central part of the state capital Bangalore. The geographical area of the district is 4656 sq km. It is carved out of the original Dharwad district. Major part of population is dependant on agriculture in the district. The geology of the district consists of Granite gneiss, Gadag schists and Banded Ferruginous Quartzite. The major crops grown are maize, sorghum, wheat, groundnut, cotton, onion, greengram, blackgram and sunflower.

As a pilot study, **ICAR-NBSS&LUP, Bangalore** carried out the generation of LRI for the Machinahalli-1 micro-watershed. Hadgali sub-watershed in Shirahatti taluk, Gadag district was selected for database generation under batch-V of Sujala III project. This sub-watershed encompasses of 13 MWs namely, Hadgali-1 (4D4A3O2a), Hadgali-2 (4D4A3O2b), Hadgali-3 (4D4A3O2f), Hadgali-4 (4D4A3O2c), Kusalpur-1 (4D4A3O1c), Kusalpur-2 (4D4A3O1b), Kusalpur-3 (4D4A3O1a), Machinnalli-1 (4D4A3O1e), Machinnalli-2 (4D4A3O1f), Nave Barnur (4D4A3O1g), Suganhalli North-1 (4D4A3O2d), Suganhalli North-2 (4D4A3O2e) and Teggin Barnur (4D4A3O1d) micro watersheds. Land Resource Inventory (LRI) was generated for one Micro-watershed (Machinahalli1-4D4A3O1e) among the thirteen micro-watersheds.

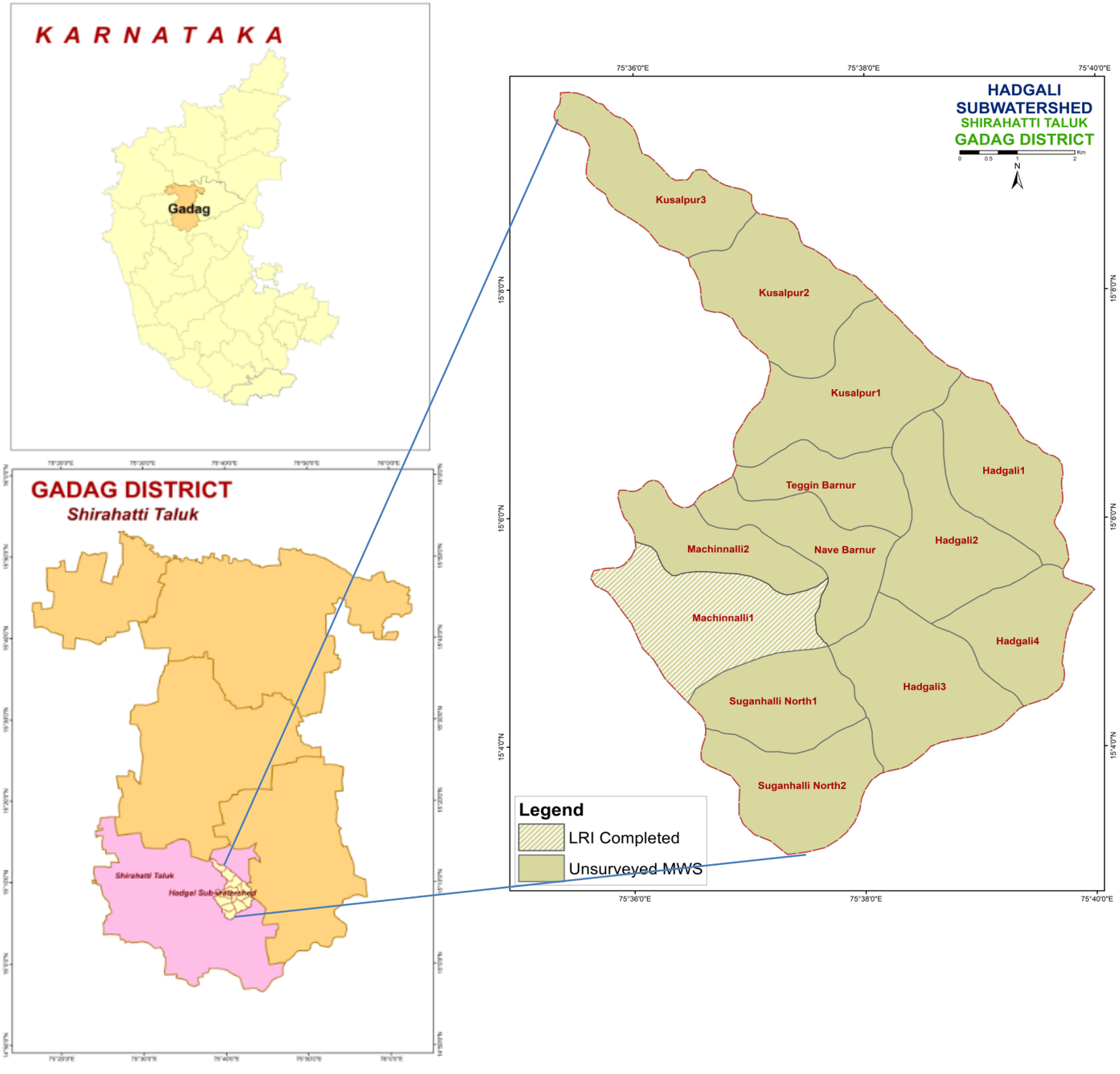
To be continued…

The major landforms identified in the micro-watershed (Machinahalli-1-4D4A3O1e) of Hadgali 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 Machinahalli1 (4D4A3O1e) micro-watershed of Hadgali 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 action plan for the integrated development of watershed.

LOCATION AND EXTENT

LOCATION MAP OF HADGALI SUB-WATERSHED



NOTE: In this Sub-Watershed, Land Resource Inventory (LRI) was generated for one micro-watershed (Machinahalli1-4D4A3O1e) among the Thirteen micro-watersheds.

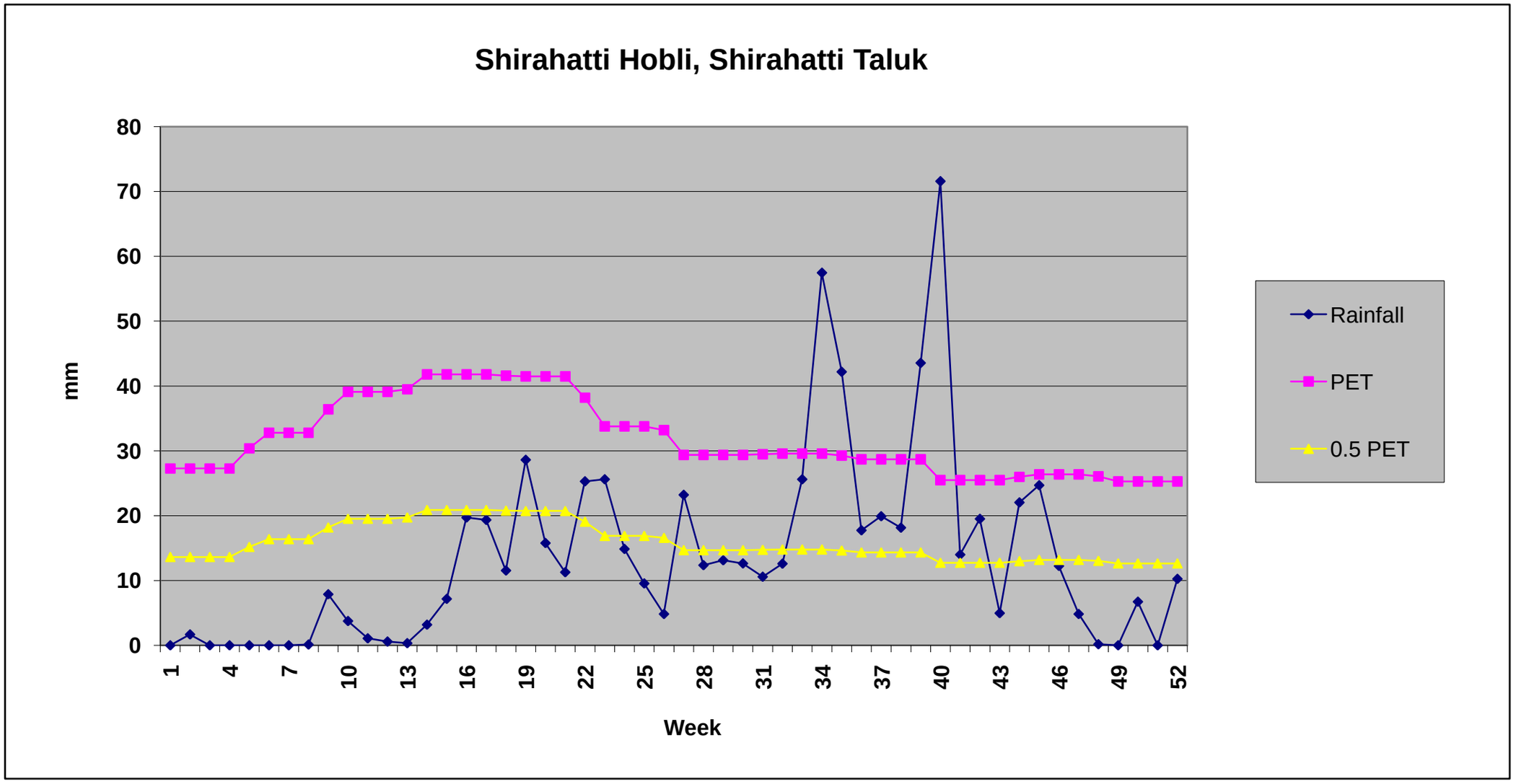
Hadgali sub-watershed (Shirahatti taluk, Gadag district) is located between $15^0$8'59''–$15^0$6'34'' North latitudes and $75^0$40'56''–$75^0$38'10'' East longitudes, covering an area of about 5896 ha.

Where, the Machinahalli-1 micro-watershed (Hadgali sub-watershed, Shirahatti Taluk, Gadag district) is located in between $15^0$8'59''–$15^0$6'34'' North latitudes and $75^0$40'56''–$75^0$38'10'' East longitudes, covering an area of about 712 ha, bounded by Majjur village on north, Rantur village on the west, Nave bavanur village on the south, and Machinahalli village on the east.

Agro Ecological Sub Region (AESR) 6.4: North Sahyadris and Western Karnataka Plateau, hot dry subhumid ESR - Deccan (Western Maharashtra and Karnataka), Plateau, hot dry subhumid eco system with shallow black soils (medium and deep black soils as inclusions), and GP 150-180 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.

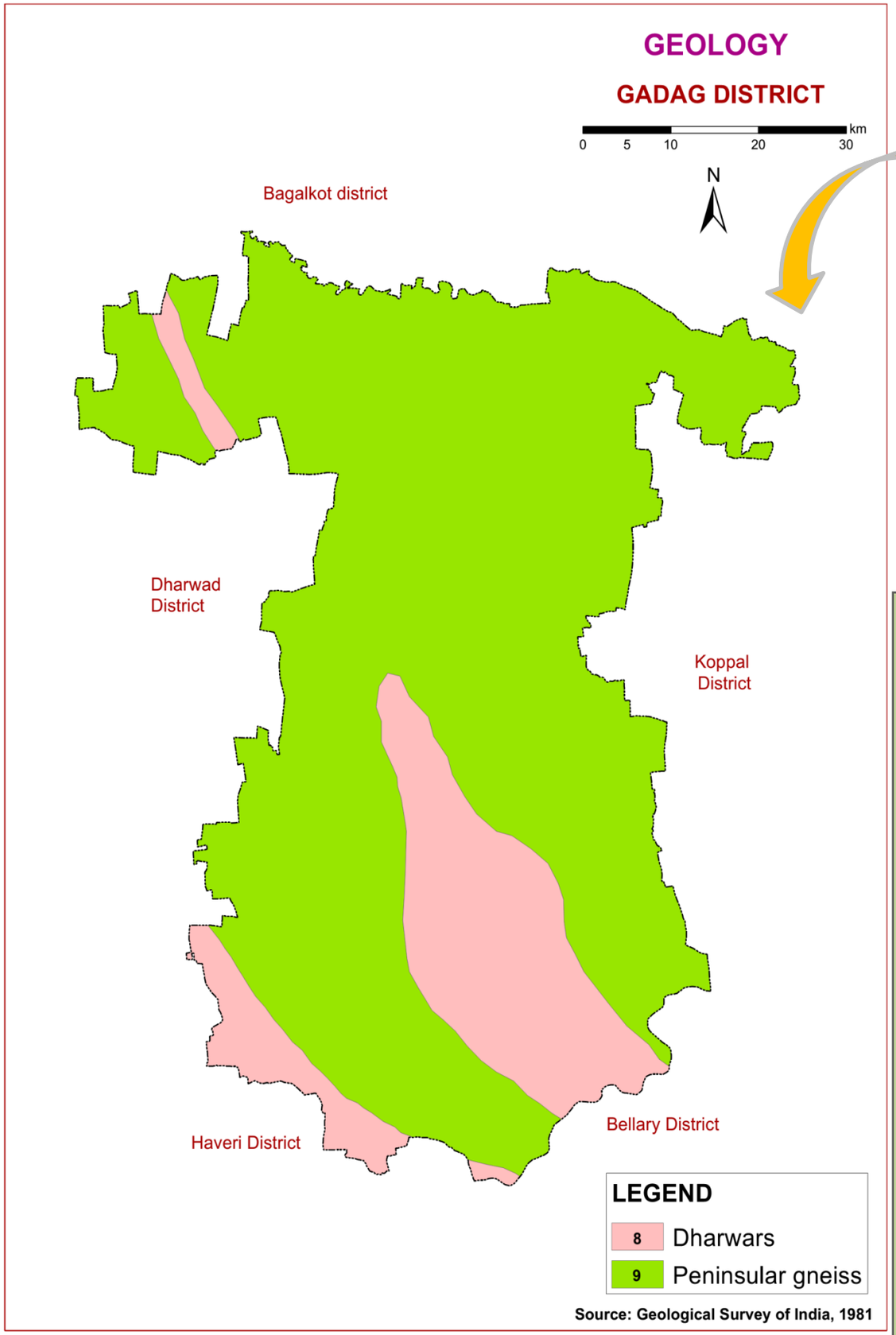
Climate

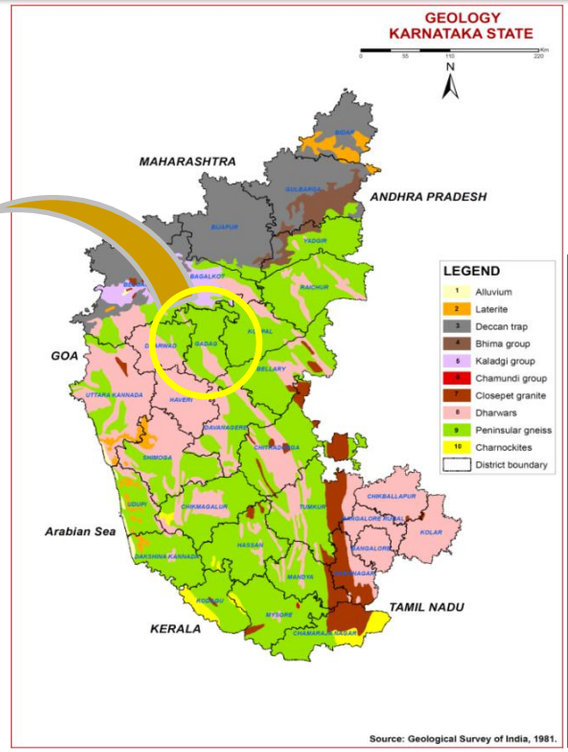


Length of Growing Period (LGP) is varying from June last week to 4th week of November (150-180 days)

Annual Rainfall : 712 mm. in the Shirahatti Hobli and Taluk, Gadag District

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 - GADAG DISTRICT

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 Archeans are also known as the Basement Complex or the Gneissic Complex. The important formations of this group are Peninsular Gneiss, Dharwar schists, and Charnockites.

Peninsular Gneiss

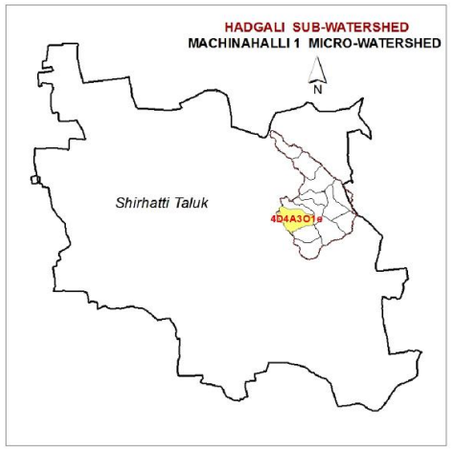
Exposed over a large area of Karnataka in all the districts except Bidar is the Peninsular Gneiss which is a heterogeneous mixture of several types of granitic rocks such as banded gneisses, granitic gneisses, granites and gneissic granites, granodiorites and diorites. The banded gneisses consist of 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. ***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.

Charnockites

These are considered to be rocks of plutonic origin that have undergone recrystallization. The group includes a wide variety ot 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.



SATELLITE IMAGE

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT

km
0 0.25 0.5 1

N

MAJJUR

RANTUR

Ranathura

Machenahalli

Machinahalli

Navebavanur

NAVE BAVANUR

References

- Stream/Drainage
- Road/Cart track
- Habitation
- Land parcels
- Village boundary
- Micro-watershed boundary

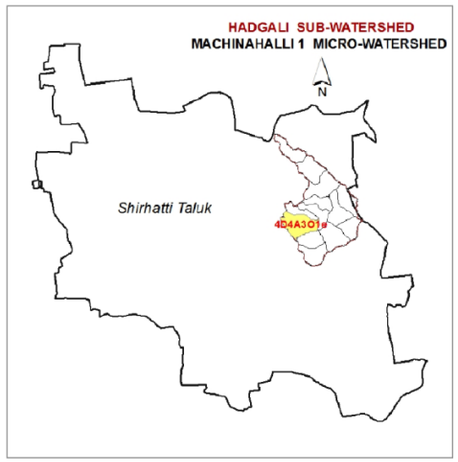
Source: Cartosat-1 Imagery, 2011

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



km
0 0.25 0.5 1

N

MAJJUR
RANTUR
Ranathura
Machenahalli
Machinahalli
Navebavanura
NAVE BAVANUR

References

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

Source: ICAR-NBSS&LUP, Bengaluru

CURRENT LANDUSE

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT

km
0 0.25 0.5 1

N

MAJJUR

RANTUR

NAVE BAVANUR

Machinahalli

Navebavanura

Machenahalli

Ranathura

64 Sl+F+Hill area
80 Sl+Hill area
65
66
67 F
68
70 Eu+F
71
72 Mz+Ct+Bn
69
74 Ranathura
73 Mz+Jw+Rg
75
Jw+Rg
82
76
77 Jw+Fl
78 Mz+Rg
79
80
97
98
99
101
102 Jw+Sf
105
106
110
68
106
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Mz+Ct+Jw
66
65
69 Ct+Gn
70 Ct+Rg
71 Ct+Mz+Rg
79
78/1
78/2 Mz+Fl
78/3 NA
77
76
75
74
73 Mz+Ct
72/1
72/2
9
8 Sc+Ct+On
7 Ct
6 Ct+Mz
5
64
62 Ct+On
105
63
61 Mz+Jw
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60/2
59
58
57 Ct+Jw
56 Jw
55
15
10 Ct+Rg+Gn
11/1
11/2
12
13 Jw+Ch+On+Gn
102
103
103/A
104
2
1
3/3
3/1
3/2
4
19/B
19/A Jw+Hill area
39 Mz
40
Sc+On
34
28
29
27

Current Landuse

- Jowar (Jw)
- Maize (Mz)
- Cotton (Ct)
- Cotton+Jowar (Ct+Jw)
- Cotton+Maize (Ct+Mz)
- Cotton+Onion (Ct+On)
- Cotton+Redgram (Ct+Rg)
- Cotton+Groundnut (Ct+Gn)
- Jowar+Redgram (Jw+Rg)
- Jowar+Sunflower (Jw+Sf)
- Maize+Cotton (Mz+Ct)
- Sugarcane+Onion (Sc+On)
- Maize+Fallow land (Mz+Fl)
- Maize+Jowar (Mz+Jw)
- Maize+Redgram (Mz+Rg)
- Jowar+Fallow land (Jw+Fl)
- Jowar+Hill area (Jw)
- Eucalyptous trees+Forest (Eu+F)
- Scrub land+Hill area (Sl)
- Maize+Cotton+Jowar (Mz+Ct+Jw)
- Cotton+Maize+Chilly (Ct+Mz+Ch)
- Cotton+Maize+Redgram (Ct+Mz+Rg)
- Cotton+Redgram+Groundnut (Ct+Rg+Gn)
- Maize+Cotton+Banana (Mz+Ct+Bn)
- Maize+Jowar+Redgram (Mz+Jw+Rg)
- Scrub land+Forest+Hill area (Sl+F)
- Sugarcane+Cotton+Onion (Sc+Ct+On)
- Jowar+Chilly+Onion+Groundnut (Jw+Ch+On+Gn)
- Forest (F)
- NA
- Others*

*- Habitation & Waterbody

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

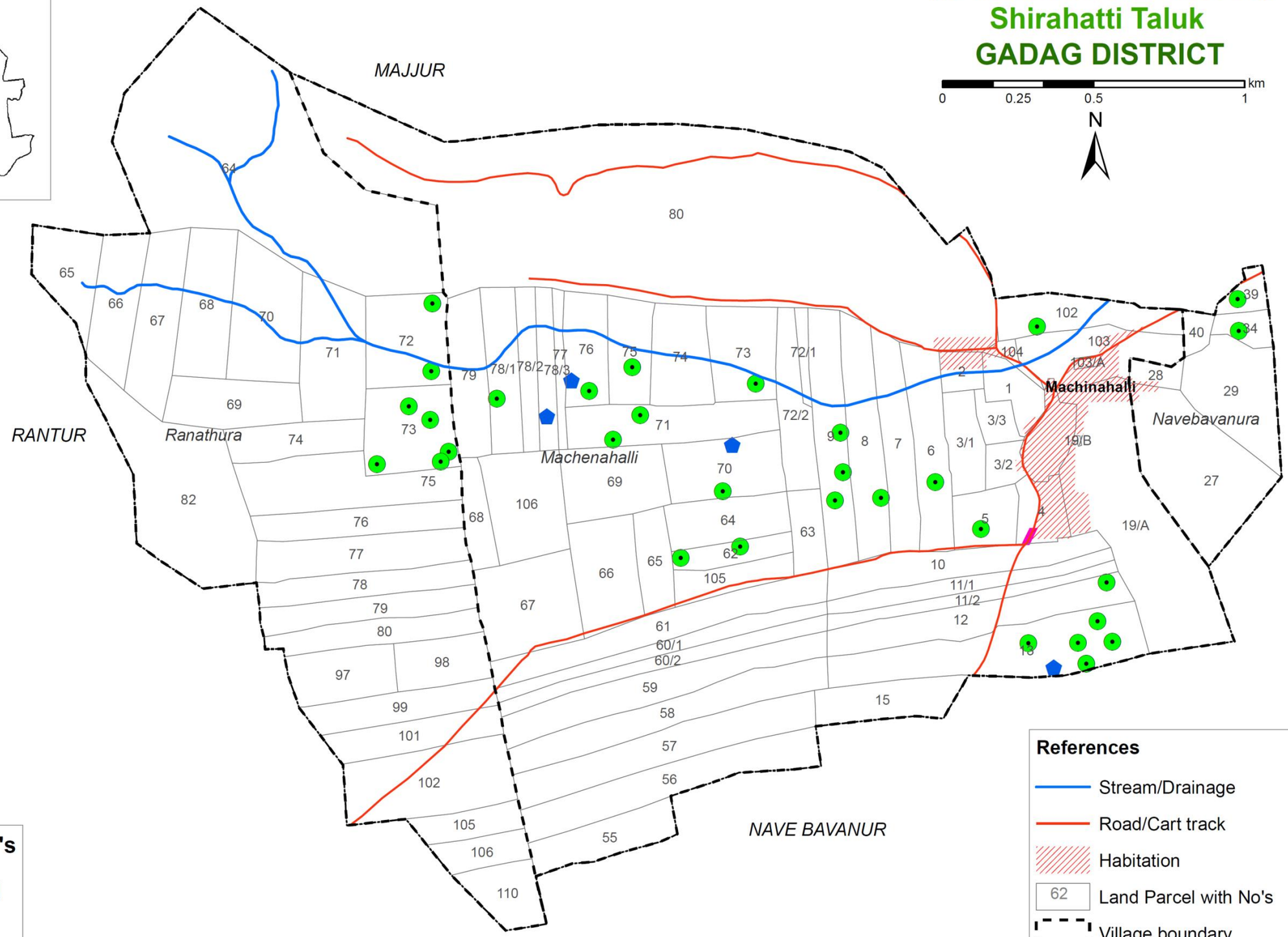
LOCATION OF WELLS

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



Legend	No's
Bore well	31
Hand bore	1
Open well	4

References

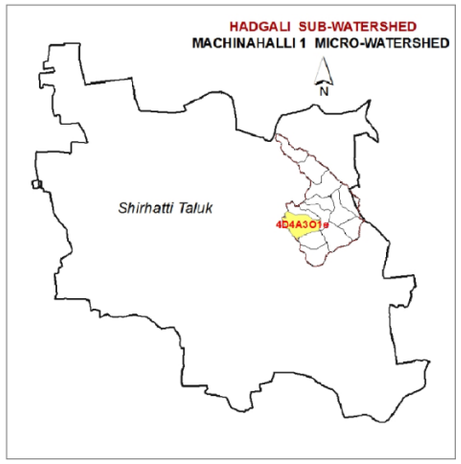
- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

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 transects 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.



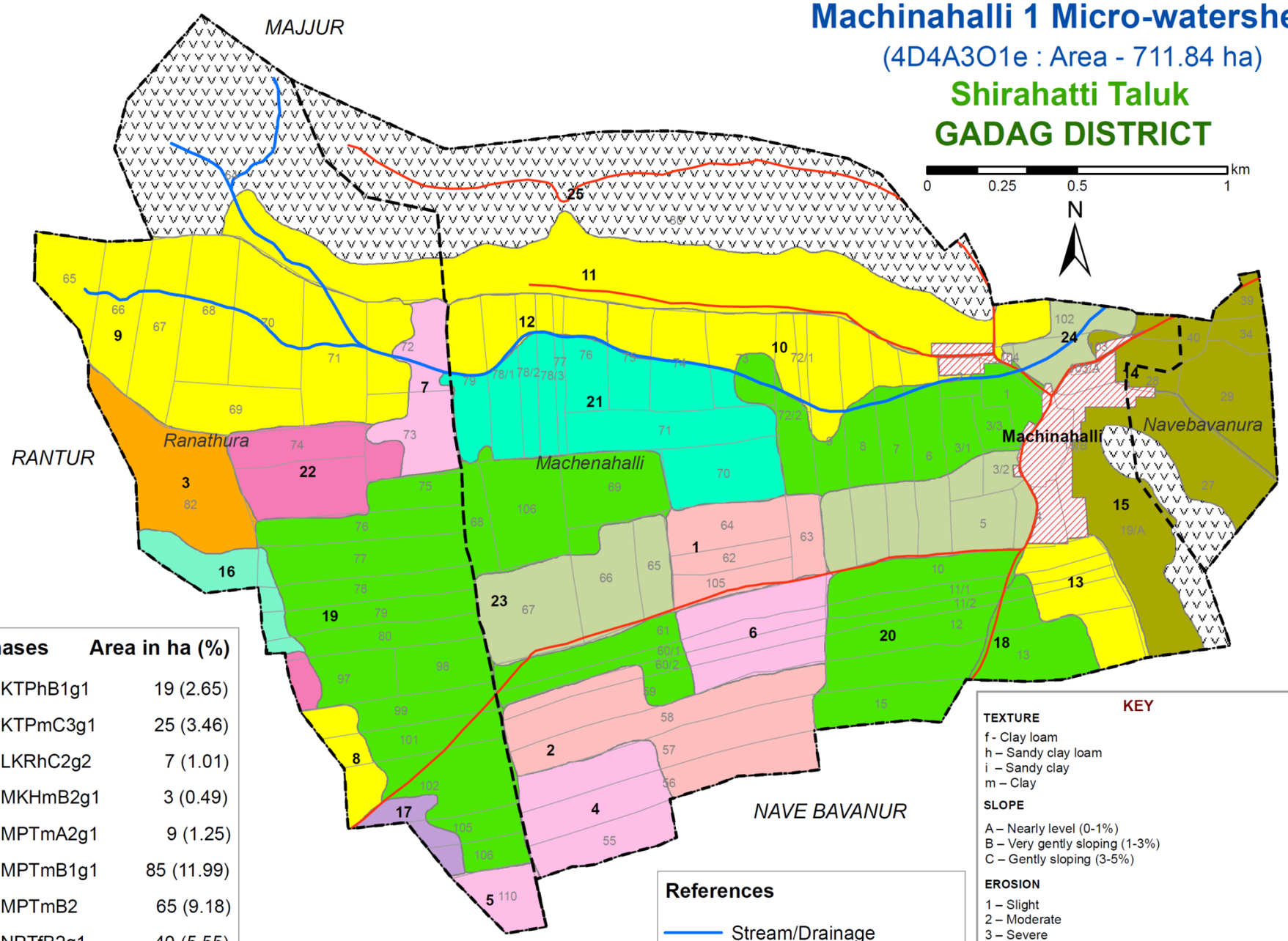
SOILS

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



Texture Gravelliness

KGP f C 3 g2 R2

Soil Series | Slope | Erosion | Rockiness

Soil Phases	Area in ha (%)	Soil Phases	Area in ha (%)
1, ATTmB2	15 (2.15)	14, KTPhB1g1	19 (2.65)
2, ATTmB2g1	29 (4.12)	15, KTPmC3g1	25 (3.46)
3, BPRhC3g2	16 (2.25)	16, LKRhC2g2	7 (1.01)
4, JLGmB2	17 (2.35)	17, MKHmB2g1	3 (0.49)
5, JLGmB1g1	5 (0.64)	18, MPTmA2g1	9 (1.25)
6, JLGmB2g1	14 (1.92)	19, MPTmB1g1	85 (11.99)
7, JLGmB2g2	9 (1.31)	20, MPTmB2	65 (9.18)
8, KGPfB2g2	5 (0.7)	21, NPTfB2g1	40 (5.55)
9, KGPfB3g1	60 (8.43)	22, TDHfB2g1	16 (2.28)
10, KGPfC3g2	22 (3.11)	23, YSJmB2	39 (5.52)
11, KGPfC3g2R2St2	48 (6.72)	24, YSJmB2g1	6 (0.86)
12, KGPhB1g1	10 (1.34)	25, Rock outcrops	124 (17.37)
13, KGPiB2g2	11 (1.5)	26, Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

KEY

TEXTURE

f - Clay 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
3 – Severe

GRAVELLINESS

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

DEPTH

KGP,NPT,YSJ-Shallow (25-50cm)
ATT,KTP,LKR,MKH,TDH-Moderately shallow (50-75cm)
JLG-Moderately deep (75-100cm)
BPR,MPT-Deep (100-150cm)

ROCKINESS

R2 - Rocky (10-25%)

Source: ICAR-NBSS&LUP, Bengaluru

Mapping unit description of Machinahalli 1 Micro-watershed (4D4A3O1e)
Shirahatti taluk, Gadag district

Soil No*	Soil Series	Soil Phases	Mapping unit description	Area in ha (%)
	ATT	Attikatti soils are moderately shallow (50-75 cm), well drained, have dark brown to very dark brown clayey soils occurring on very gently sloping uplands under cultivation		**44.59 (6.27)**
1		ATTmB2	Clay surface, slope 1-3%, moderate erosion	15.28 (2.15)
2		ATTmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	29.31 (4.12)
	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 very gently to gently sloping uplands under cultivation		**16.01 (2.25)**
3		BPRhC3g2	Sandy clay loam surface, slope 3-5%, severe erosion, very gravelly (35-60%)	16.01 (2.25)
	JLG	Jelligeri soils are moderately deep (75-100 cm), moderately well drained, very dark brown to dark brown and black cracking clay soils occurring on very gently sloping uplands under cultivation		**44.23 (6.22)**
4		JLGmB2	Clay surface, slope 1-3%, moderate erosion	16.69 (2.35)
5		JLGmB1g1	Clay surface, slope 1-3%, slight erosion, gravelly (15-35%)	4.54 (0.64)
6		JLGmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	13.69 (1.92)
7		JLGmB2g2	Clay surface, slope 1-3%, moderate erosion, very gravelly (35-60%)	9.31 (1.31)

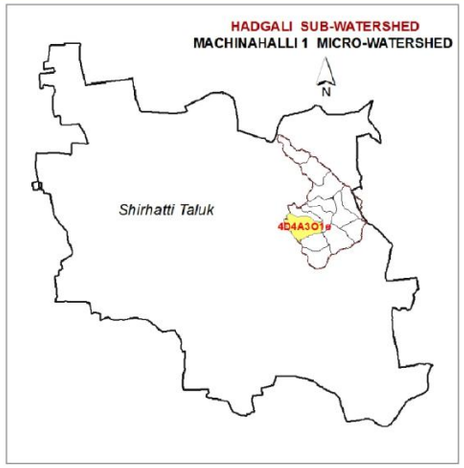
To be continued….

Soil No*	Soil Series	Soil Phases	Mapping unit description	Area in ha (%)
	KGP	Kaggalipura soils are shallow (25 - 50 cm), well drained, have brown to dark reddish brown sandy clay loam to sandy clay soils occurring on very gently sloping uplands under cultivation		**155.07 (21.80)**
8		KGPfB2g2	Clay loam surface, slope 1-3%, moderate erosion, very gravelly (35-60%)	4.95 (0.70)
9		KGPfB3g1	Clay loam surface, slope 1-3%, severe erosion, gravelly (15-35%)	59.97 (8.43)
10		KGPfC3g2	Clay loam surface, slope 3-5%, severe erosion, very gravelly (35-60%)	22.12 (3.11)
11		KGPfC3g2R2St2	Clay loam surface, slope 3-5%, severe erosion, very gravelly (35-60%), fairly rocky (2-10%), very stony (0.1-3%)	47.84 (6.72)
12		KGPhB1g1	Sandy clay loam surface, slope 1-3%, slight erosion, gravelly (15-35%)	9.53 (1.34)
13		KGPiB2g2	Sandy clay surface, slope 1-3%, moderate erosion, very gravelly (35-60%)	10.66 (1.50)
	KTP	Kethanapura soils are moderately shallow (50-75 cm), well drained, have dark reddish brown gravelly sandy loam soils occurring on very gently to gently sloping uplands under cultivation		**43.51 (6.11)**
14		KTPhB1g1	Sandy clay loam surface, slope 1-3%, slight erosion, gravelly (15-35%)	18.87 (2.65)
15		KTPmC3g1	Clay surface, slope 3-5%, severe erosion, gravelly (15-35%)	24.64 (3.46)
	LKR	Lakkur soils are moderately shallow (50-75 cm), well drained, have reddish brown to dark red gravelly sandy clay loam to sandy clay red soils occurring on nearly level to gently and moderately sloping uplands under cultivation		**7.19 (1.01)**
16		LKRhC2g2	Sandy clay loam surface, slope 3-5%, moderate erosion, very gravelly (35-60%)	7.19 (1.01)
	MKH	Mukhadahalli soils are moderately shallow (50-75 cm), well drained, have dark brown to reddish brown gravelly sandy clay loam soils occurring on very gently to gently sloping uplands under cultivation		**3.47 (0.49)**
17		MKHmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35 %)	3.47 (0.49)
	MPT	Mahalingapur Tanda soils are deep (100-150 cm), moderately well drained, have very dark brown to very dark greyish brown cracking clay soils occurring on very gently sloping uplands under cultivation		**159.63 (22.42)**
18		MPTmA2g1	Clay surface, slope 0-1%, moderate erosion, gravelly (15-35%)	8.93 (1.25)
19		MPTmB1g1	Clay surface, slope 1-3%, slight erosion, gravelly (15-35%)	85.36 (11.99)
20		MPTmB2	Clay surface, slope 1-3%, moderate erosion	65.34 (9.18)

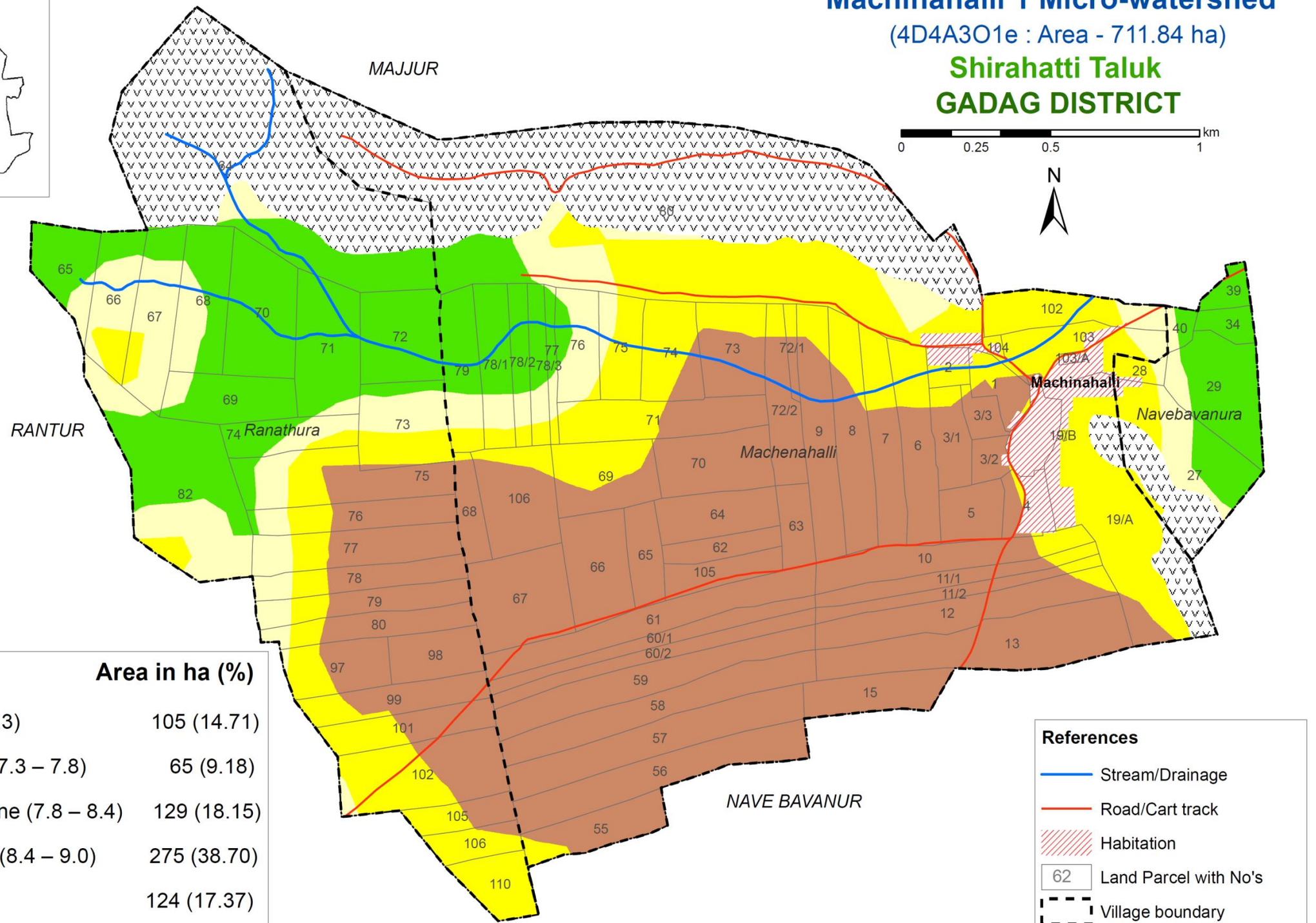
To be continued….

Soil No*	Soil Series	Soil Phases	Mapping unit description	Area in ha (%)
	NPT	Nabhapur Tanda soils are shallow (25-50 cm), well drained, have very dark brown to very dark gray calcareous clay soils occurring on very gently sloping uplands under cultivation		**39.51 (5.55)**
21		NPTfB2g1	Clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	39.51 (5.55)
	TDH	Thammadahalli soils are moderately shallow (50 – 75 cm), well drained, have brown to very dark brown and dark reddish brown sandy loam to clay loam soils occurring on nearly level to gently sloping uplands under cultivation		**16.20 (2.28)**
22		TDHfB2g1	Clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35 %)	16.20 (2.28)
	YSJ	Yelisirunj soils are shallow (25-50 cm), well drained, have very dark brown to very dark greyish brown clay soils occurring on very gently sloping uplands under cultivation		**45.38 (6.38)**
23		YSJmB2	Clay surface, slope 1-3%, moderate erosion	39.28 (5.52)
24		YSJmB2g1	Clay surface, slope 1-3 %, moderate erosion, gravelly (15-35 %)	6.10 (0.86)
25	Rock outcrops			123.62 (17.37)
26	Habitation			13.46 (1.89)

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



SOIL REACTION (pH)
2014
Machinahalli 1 Micro-watershed
(4D4A3O1e : Area - 711.84 ha)
Shirahatti Taluk
GADAG DISTRICT

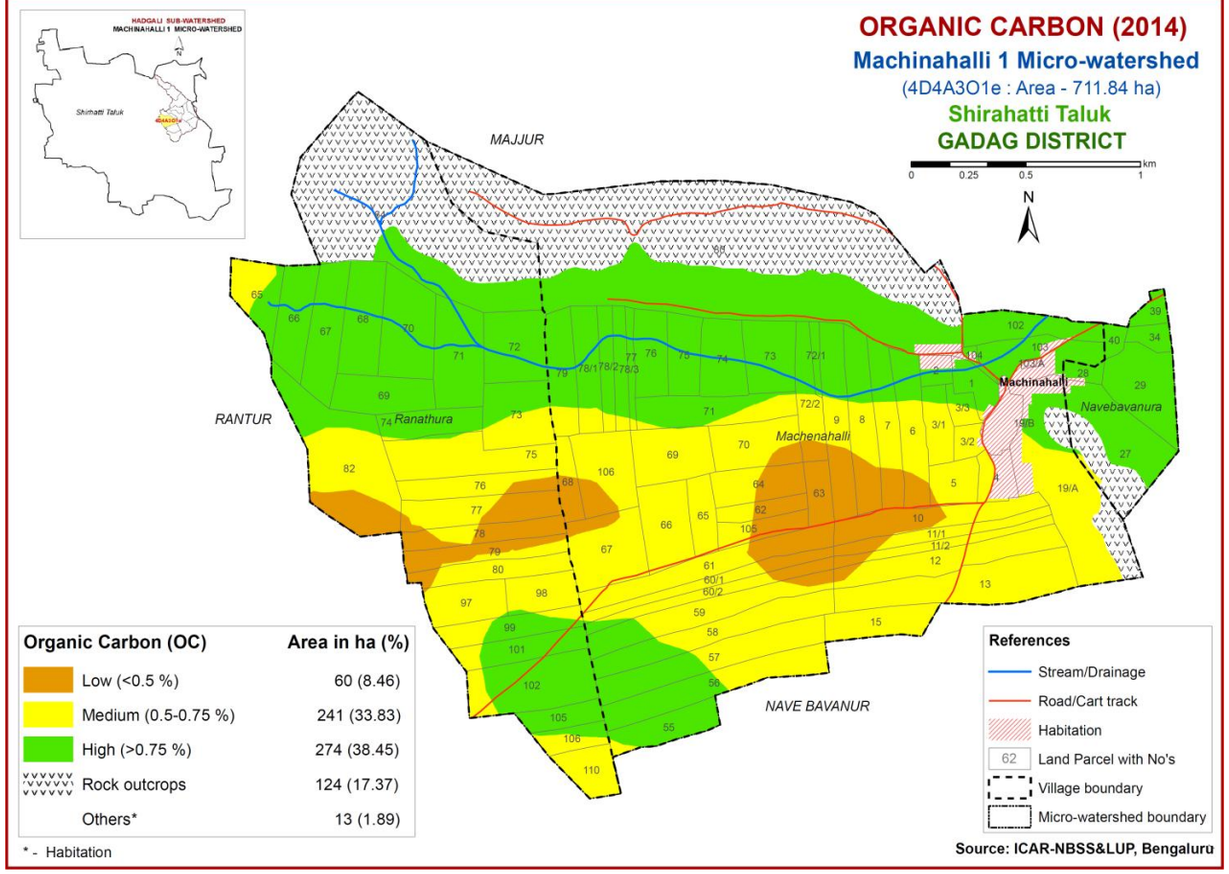


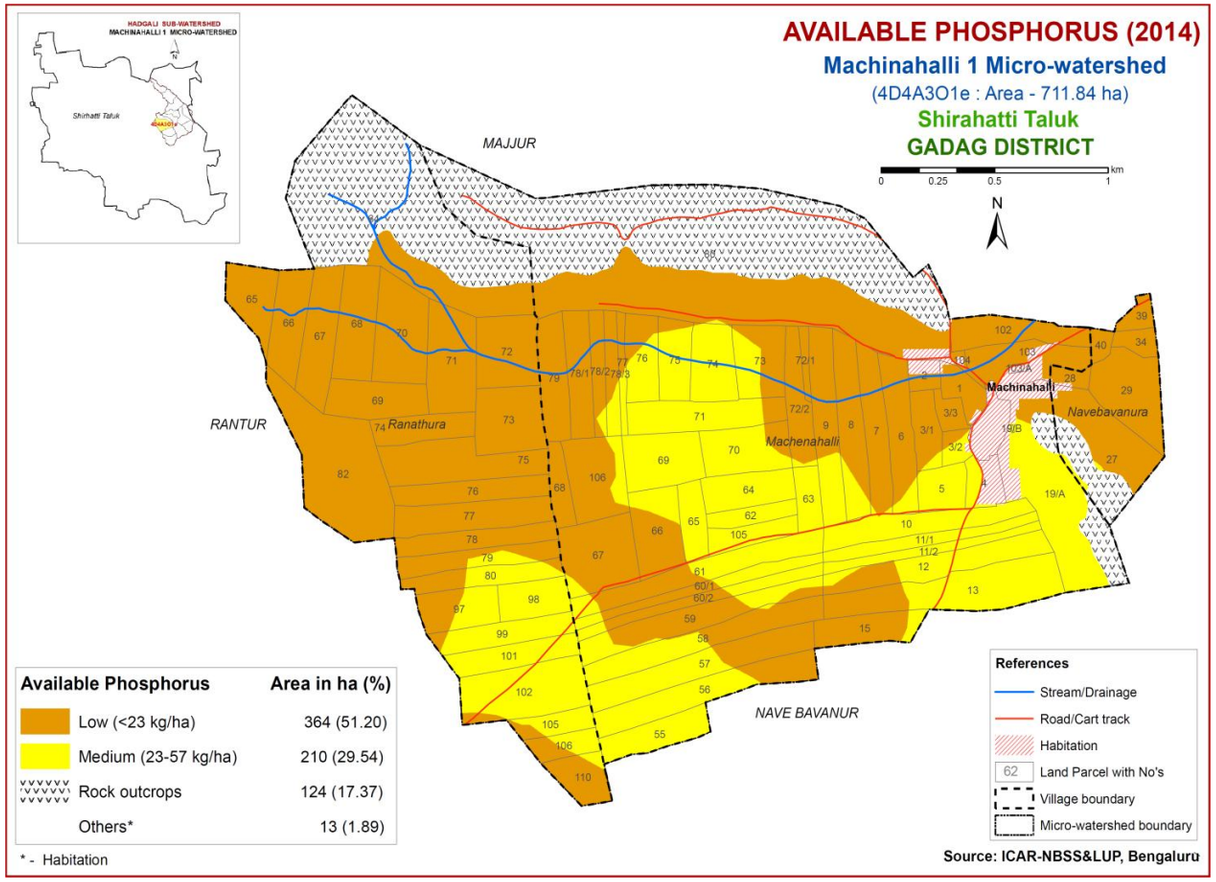
pH Status	Area in ha (%)
Neutral (6.5 – 7.3)	105 (14.71)
Slightly alkaline (7.3 – 7.8)	65 (9.18)
Moderately alkaline (7.8 – 8.4)	129 (18.15)
Strongly alkaline (8.4 – 9.0)	275 (38.70)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

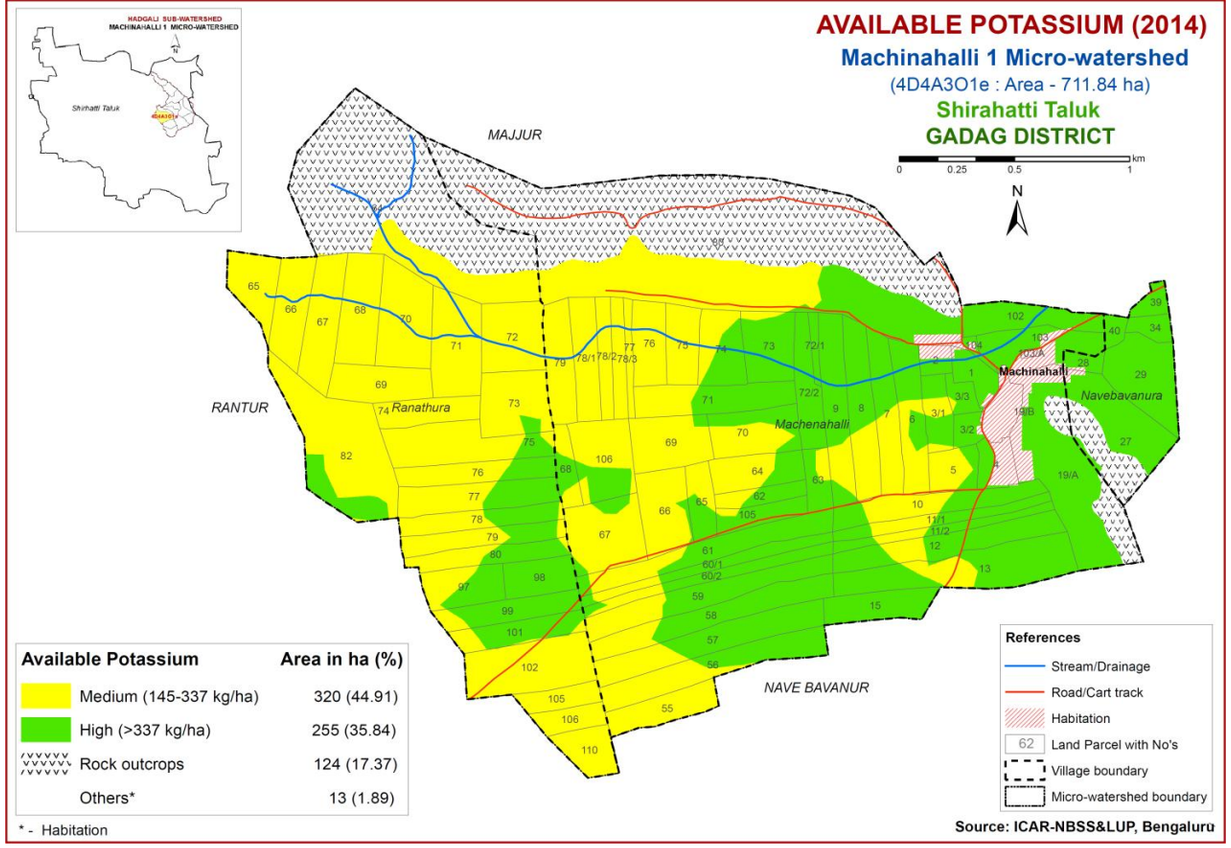
* - Habitation

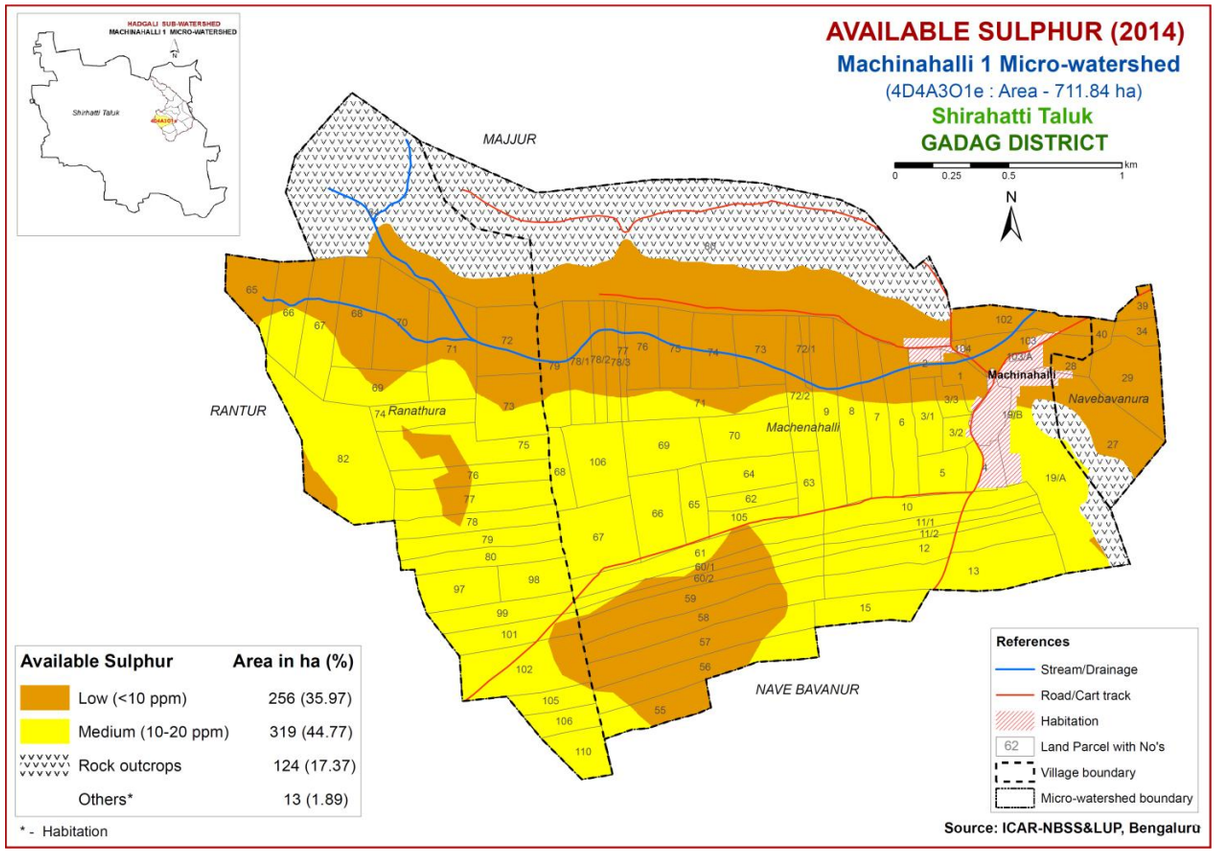
References
- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

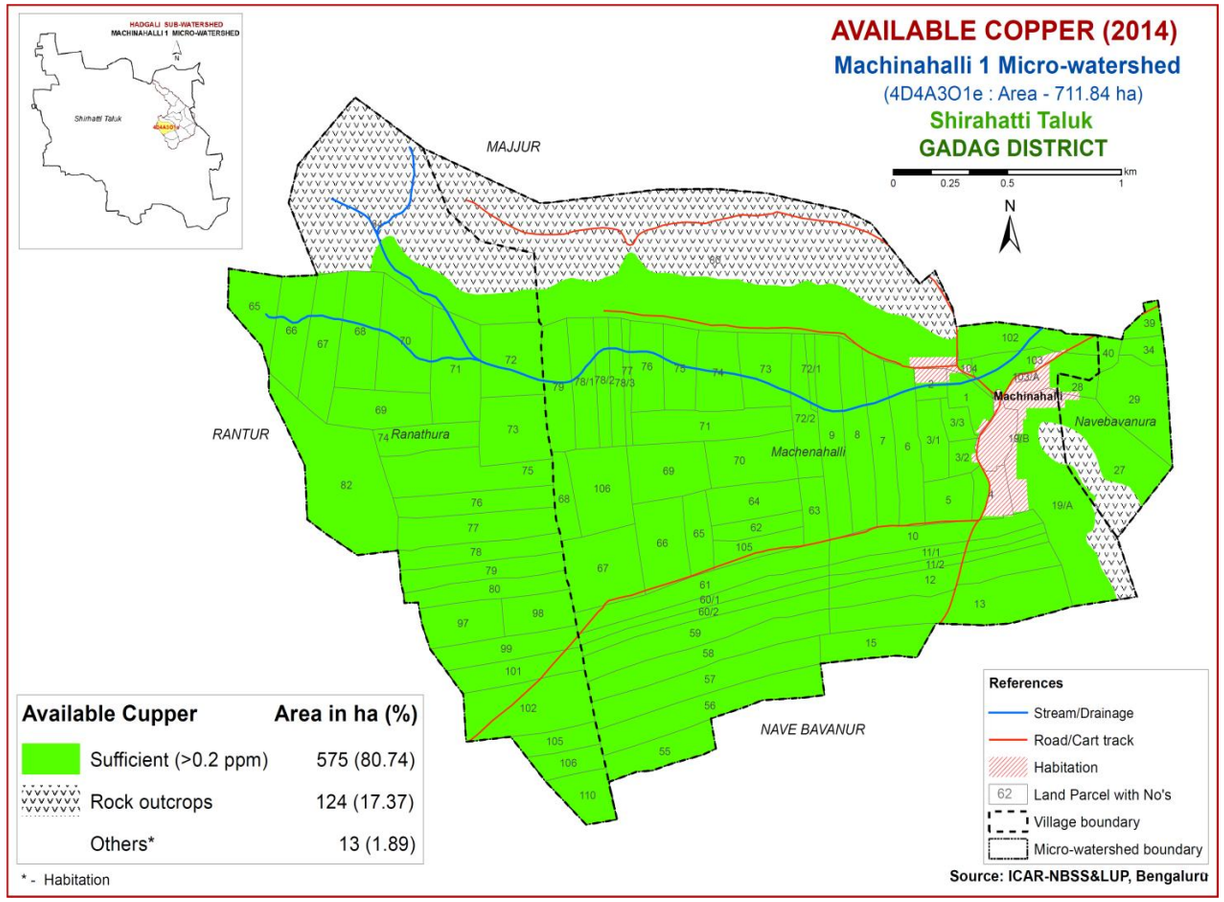
Source: ICAR-NBSS&LUP, Bengaluru

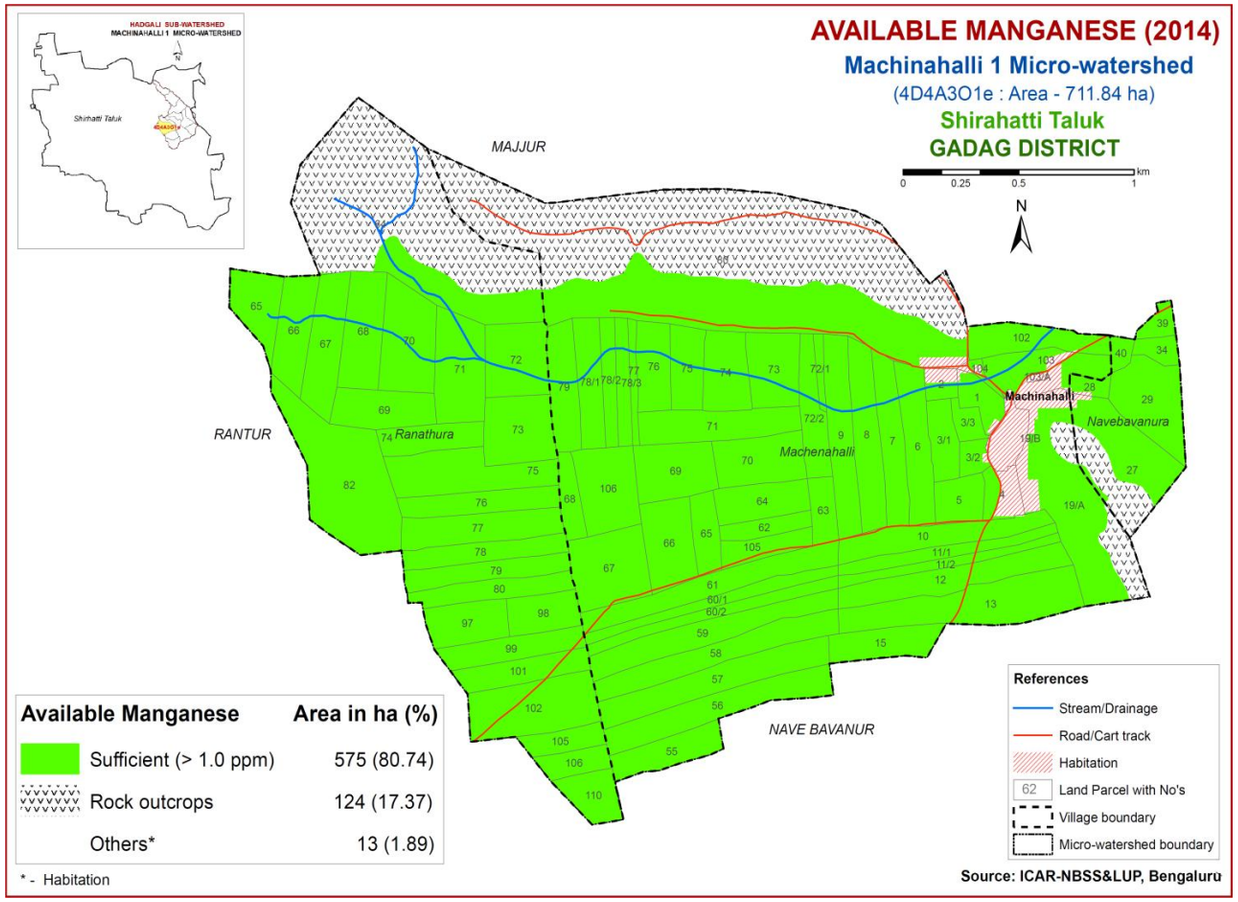

HADGALI SUB-WATERSHED
MACHINAHALLI 1 MICRO-WATERSHED
Shirhatti Taluk
ORGANIC CARBON (2014)
Machinahalli 1 Micro-watershed
(4D4A3O1e : Area - 711.84 ha)
Shirahatti Taluk
GADAG DISTRICT
0 0.25 0.5 1 km
N
MAJJUR
RANTUR
NAVE BAVANUR
Ranathura
Machenahalli
Machinahalli
Navebavanura
Organic Carbon (OC) | Area in ha (%)
Low (<0.5 %) | 60 (8.46)
Medium (0.5-0.75 %) | 241 (33.83)
High (>0.75 %) | 274 (38.45)
Rock outcrops | 124 (17.37)
Others* | 13 (1.89)
* - Habitation
References
Stream/Drainage
Road/Cart track
Habitation
62 Land Parcel with No's
Village boundary
Micro-watershed boundary
Source: ICAR-NBSS&LUP, Bengaluru

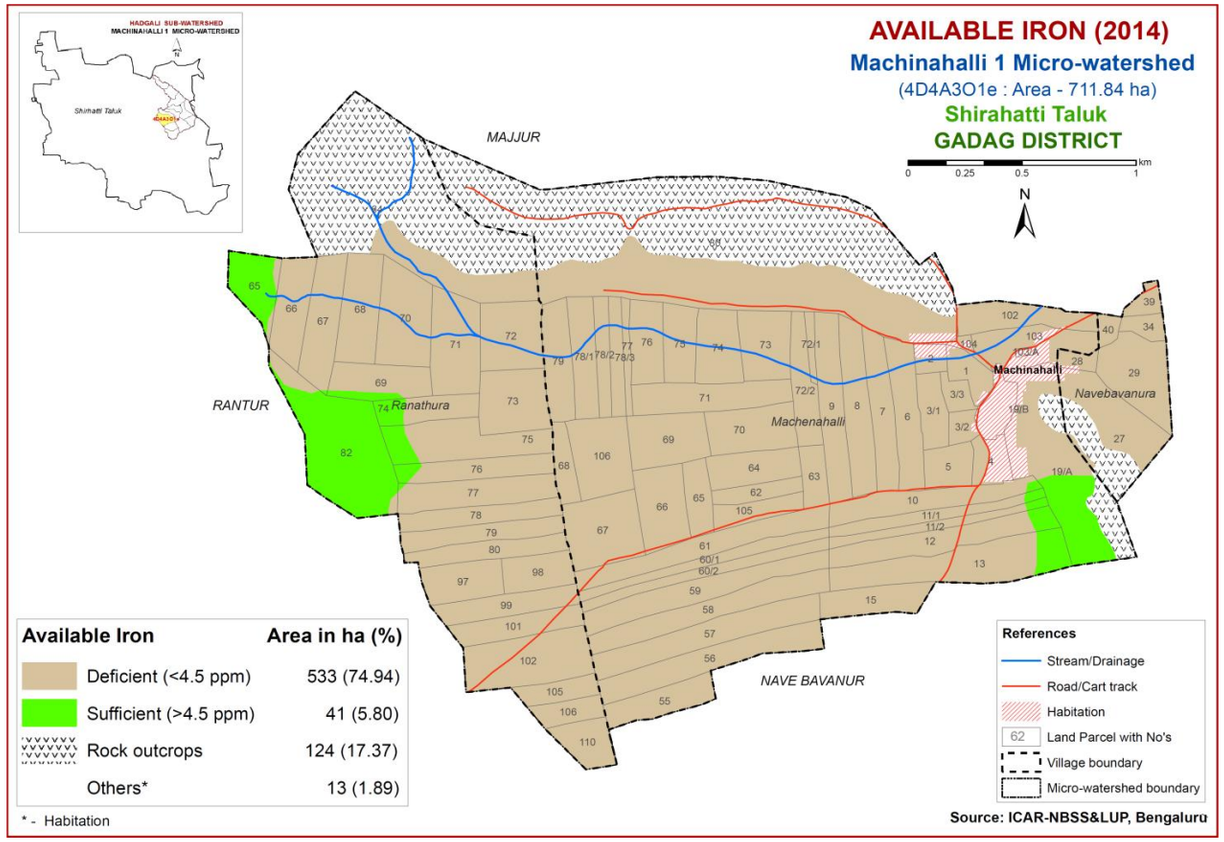

HADGALI SUB-WATERSHED
MACHINAHALLI 1 MICRO-WATERSHED
Shirhatti Taluk
AVAILABLE PHOSPHORUS (2014)
Machinahalli 1 Micro-watershed
(4D4A3O1e : Area - 711.84 ha)
Shirahatti Taluk
GADAG DISTRICT
0 0.25 0.5 1 km
N
MAJJUR
RANTUR
NAVE BAVANUR
Ranathura
Machenahalli
Machinahalli
Navebavanura
Available Phosphorus | Area in ha (%)
Low (<23 kg/ha) | 364 (51.20)
Medium (23-57 kg/ha) | 210 (29.54)
Rock outcrops | 124 (17.37)
Others* | 13 (1.89)
* - Habitation
References
Stream/Drainage
Road/Cart track
Habitation
62 Land Parcel with No's
Village boundary
Micro-watershed boundary
Source: ICAR-NBSS&LUP, Bengaluru

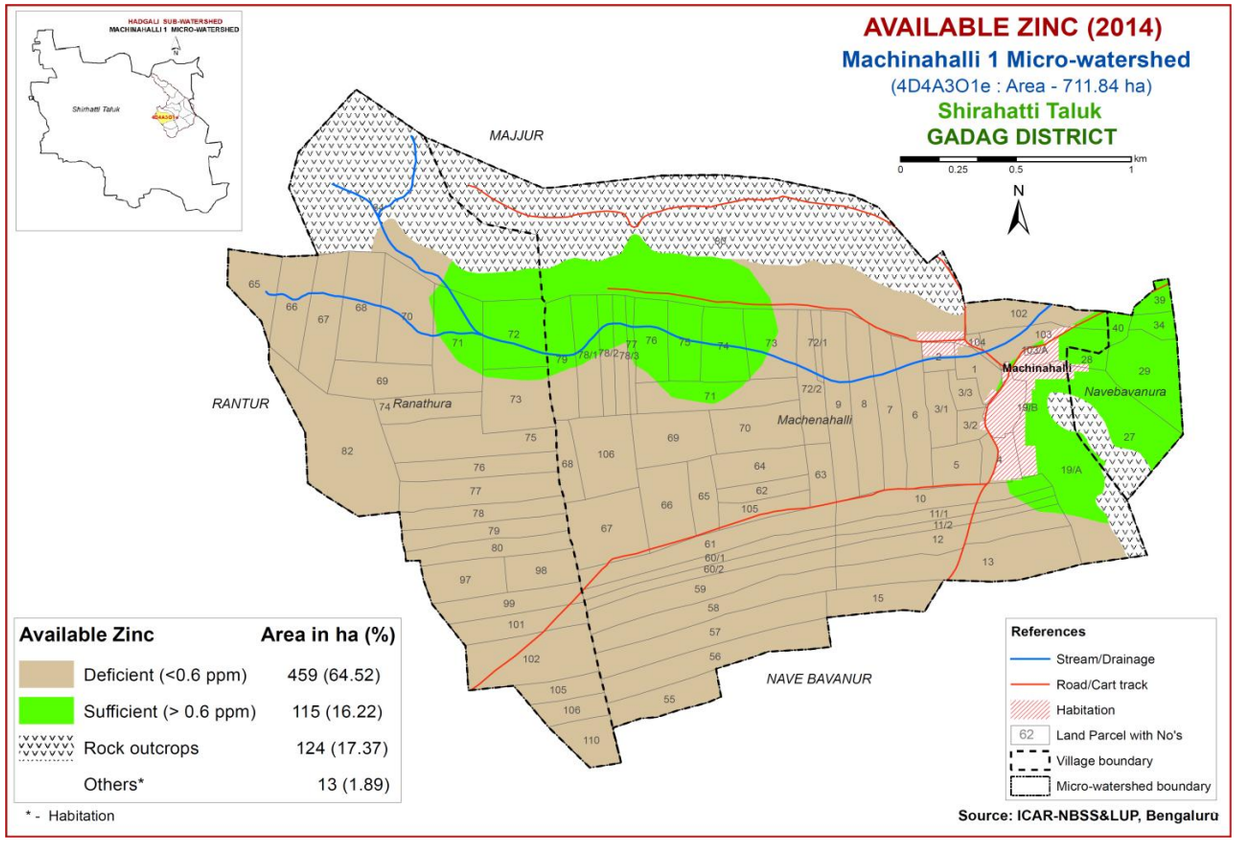

HADGALI SUB-WATERSHED
MACHINAHALLI 1 MICRO-WATERSHED
Shirhatti Taluk
AVAILABLE POTASSIUM (2014)
Machinahalli 1 Micro-watershed
(4D4A3O1e : Area - 711.84 ha)
Shirahatti Taluk
GADAG DISTRICT
0 0.25 0.5 1 km
N
MAJJUR
RANTUR
NAVE BAVANUR
Ranathura
Machenahalli
Machinahalli
Navebavanura
Available Potassium | Area in ha (%)
Medium (145-337 kg/ha) | 320 (44.91)
High (>337 kg/ha) | 255 (35.84)
Rock outcrops | 124 (17.37)
Others* | 13 (1.89)
* - Habitation
References
Stream/Drainage
Road/Cart track
Habitation
62 Land Parcel with No's
Village boundary
Micro-watershed boundary
Source: ICAR-NBSS&LUP, Bengaluru


HADGALI SUB-WATERSHED
MACHINAHALLI 1 MICRO-WATERSHED
Shirhatti Taluk
AVAILABLE SULPHUR (2014)
Machinahalli 1 Micro-watershed
(4D4A3O1e : Area - 711.84 ha)
Shirahatti Taluk
GADAG DISTRICT
0 0.25 0.5 1 km
N
MAJJUR
RANTUR
NAVE BAVANUR
Ranathura
Machenahalli
Machinahalli
Navebavanura
Available Sulphur | Area in ha (%)
Low (<10 ppm) | 256 (35.97)
Medium (10-20 ppm) | 319 (44.77)
Rock outcrops | 124 (17.37)
Others* | 13 (1.89)
* - Habitation
References
Stream/Drainage
Road/Cart track
Habitation
62 Land Parcel with No's
Village boundary
Micro-watershed boundary
Source: ICAR-NBSS&LUP, Bengaluru


AVAILABLE COPPER (2014)
Machinahalli 1 Micro-watershed
(4D4A3O1e : Area - 711.84 ha)
Shirahatti Taluk
GADAG DISTRICT
HADGALI SUB-WATERSHED
MACHINAHALLI 1 MICRO-WATERSHED
Shirahatti Taluk
4D4A3O1e
MAJJUR
RANTUR
NAVE BAVANUR
Ranathura
Machenahalli
Machinahalli
Navebavanura
0 0.25 0.5 1 km
N
Available Cupper
Area in ha (%)
Sufficient (>0.2 ppm) 575 (80.74)
Rock outcrops 124 (17.37)
Others* 13 (1.89)
* - Habitation
References
Stream/Drainage
Road/Cart track
Habitation
62 Land Parcel with No's
Village boundary
Micro-watershed boundary
Source: ICAR-NBSS&LUP, Bengaluru


AVAILABLE MANGANESE (2014)
Machinahalli 1 Micro-watershed
(4D4A3O1e : Area - 711.84 ha)
Shirahatti Taluk
GADAG DISTRICT
HADGALI SUB-WATERSHED
MACHINAHALLI 1 MICRO-WATERSHED
Shirahatti Taluk
4D4A3O1e
MAJJUR
RANTUR
NAVE BAVANUR
Ranathura
Machenahalli
Machinahalli
Navebavanura
0 0.25 0.5 1 km
N
Available Manganese
Area in ha (%)
Sufficient (> 1.0 ppm) 575 (80.74)
Rock outcrops 124 (17.37)
Others* 13 (1.89)
* - Habitation
References
Stream/Drainage
Road/Cart track
Habitation
62 Land Parcel with No's
Village boundary
Micro-watershed boundary
Source: ICAR-NBSS&LUP, Bengaluru


AVAILABLE IRON (2014)
Machinahalli 1 Micro-watershed
(4D4A3O1e : Area - 711.84 ha)
Shirahatti Taluk
GADAG DISTRICT
HADGALI SUB-WATERSHED
MACHINAHALLI 1 MICRO-WATERSHED
Shirahatti Taluk
4D4A3O1e
MAJJUR
RANTUR
NAVE BAVANUR
Ranathura
Machenahalli
Machinahalli
Navebavanura
0 0.25 0.5 1 km
N
Available Iron
Area in ha (%)
Deficient (<4.5 ppm) 533 (74.94)
Sufficient (>4.5 ppm) 41 (5.80)
Rock outcrops 124 (17.37)
Others* 13 (1.89)
* - Habitation
References
Stream/Drainage
Road/Cart track
Habitation
62 Land Parcel with No's
Village boundary
Micro-watershed boundary
Source: ICAR-NBSS&LUP, Bengaluru


AVAILABLE ZINC (2014)
Machinahalli 1 Micro-watershed
(4D4A3O1e : Area - 711.84 ha)
Shirahatti Taluk
GADAG DISTRICT
HADGALI SUB-WATERSHED
MACHINAHALLI 1 MICRO-WATERSHED
Shirahatti Taluk
4D4A3O1e
MAJJUR
RANTUR
NAVE BAVANUR
Ranathura
Machenahalli
Machinahalli
Navebavanura
0 0.25 0.5 1 km
N
Available Zinc
Area in ha (%)
Deficient (<0.6 ppm) 459 (64.52)
Sufficient (> 0.6 ppm) 115 (16.22)
Rock outcrops 124 (17.37)
Others* 13 (1.89)
* - Habitation
References
Stream/Drainage
Road/Cart track
Habitation
62 Land Parcel with No's
Village boundary
Micro-watershed boundary
Source: ICAR-NBSS&LUP, Bengaluru

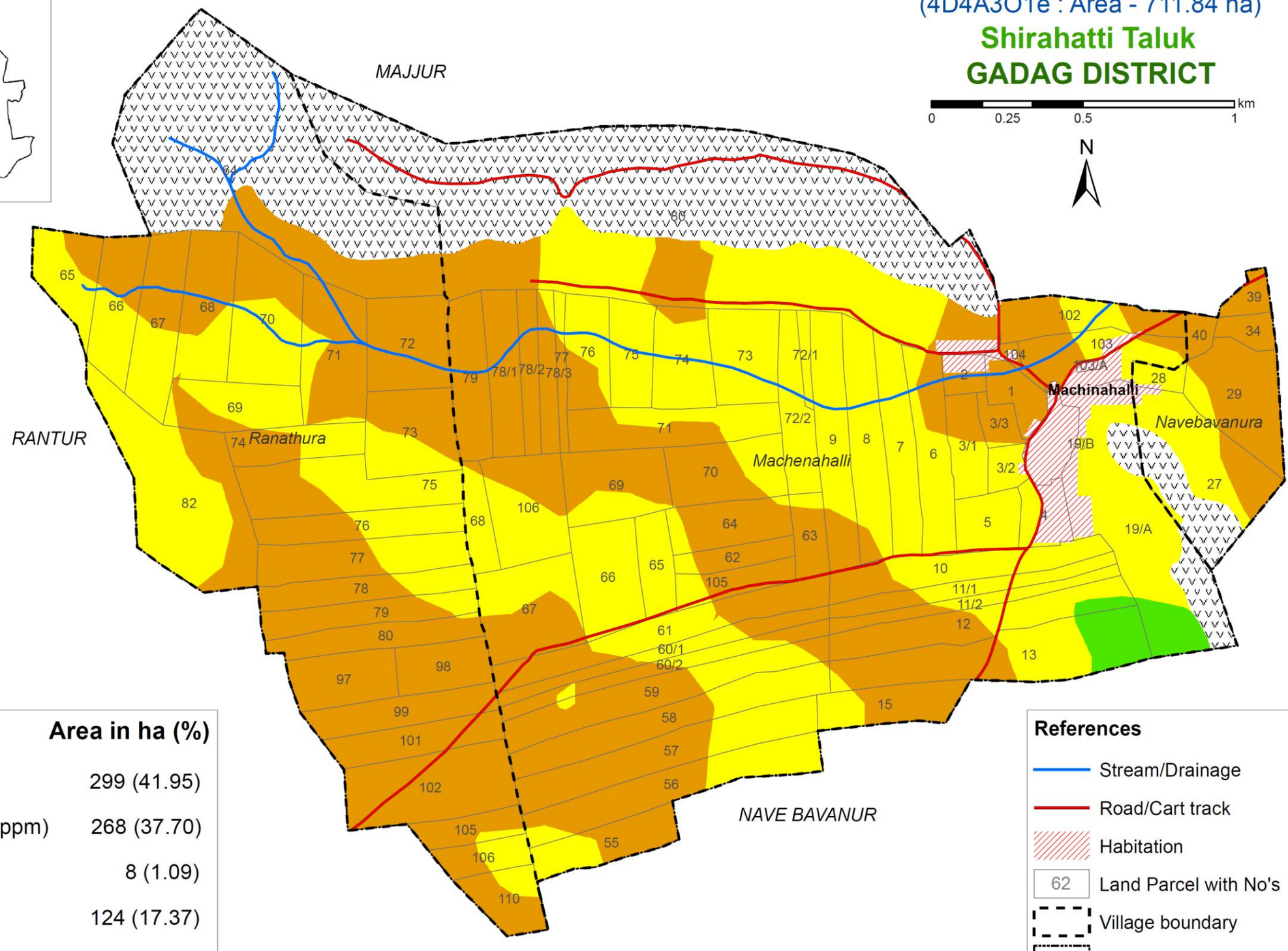
AVAILABLE BORON (2014)

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



Available Boron	Area in ha (%)
Low (<0.5 ppm)	299 (41.95)
Medium (0.5-1.0 ppm)	268 (37.70)
High (>1.0 ppm)	8 (1.09)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

SOIL DEPTH

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT

km
0 0.25 0.5 1

N

MAJJUR

RANTUR

NAVE BAVANUR

Ranathura

Machenahalli

Machinahalli

Navebavanura

Depth Class	Area in ha (%)
Shallow (25-50 cm)	240 (33.71)
Moderately shallow (50-75 cm)	115 (16.15)
Moderately deep (75-100 cm)	44 (6.21)
Deep (100-150 cm)	176 (24.67)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

HADGALI SUB-WATERSHED
MACHINAHALLI 1 MICRO-WATERSHED

SURFACE SOIL TEXTURE

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT

0 0.25 0.5 1 km

N

MAJJUR

RANTUR

Ranathura

Machenahalli

NAVE BAVANUR

Machinahalli

Navebavanura

Texture Class	Area in ha (%)
Clay loam	191 (26.78)
Sandy clay loam	52 (7.25)
Sandy clay	11 (1.5)
Clay	322 (45.22)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

SOIL GRAVELLINESS

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT

km
0 0.25 0.5 1
N

MAJJUR
RANTUR
NAVE BAVANUR
Ranathura
Machenahalli
Machinahalli
Navebavanura

Gravelliness Class	Area in ha (%)
Non gravelly (<15%)	137 (19.19)
Gravelly (15-35%)	320 (44.97)
Very gravelly (35-60%)	118 (16.59)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

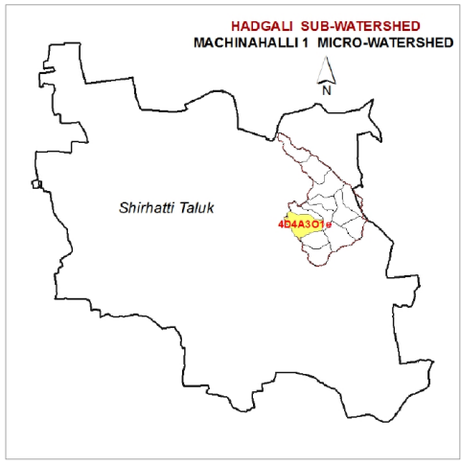
AVAILABLE WATER CAPACITY

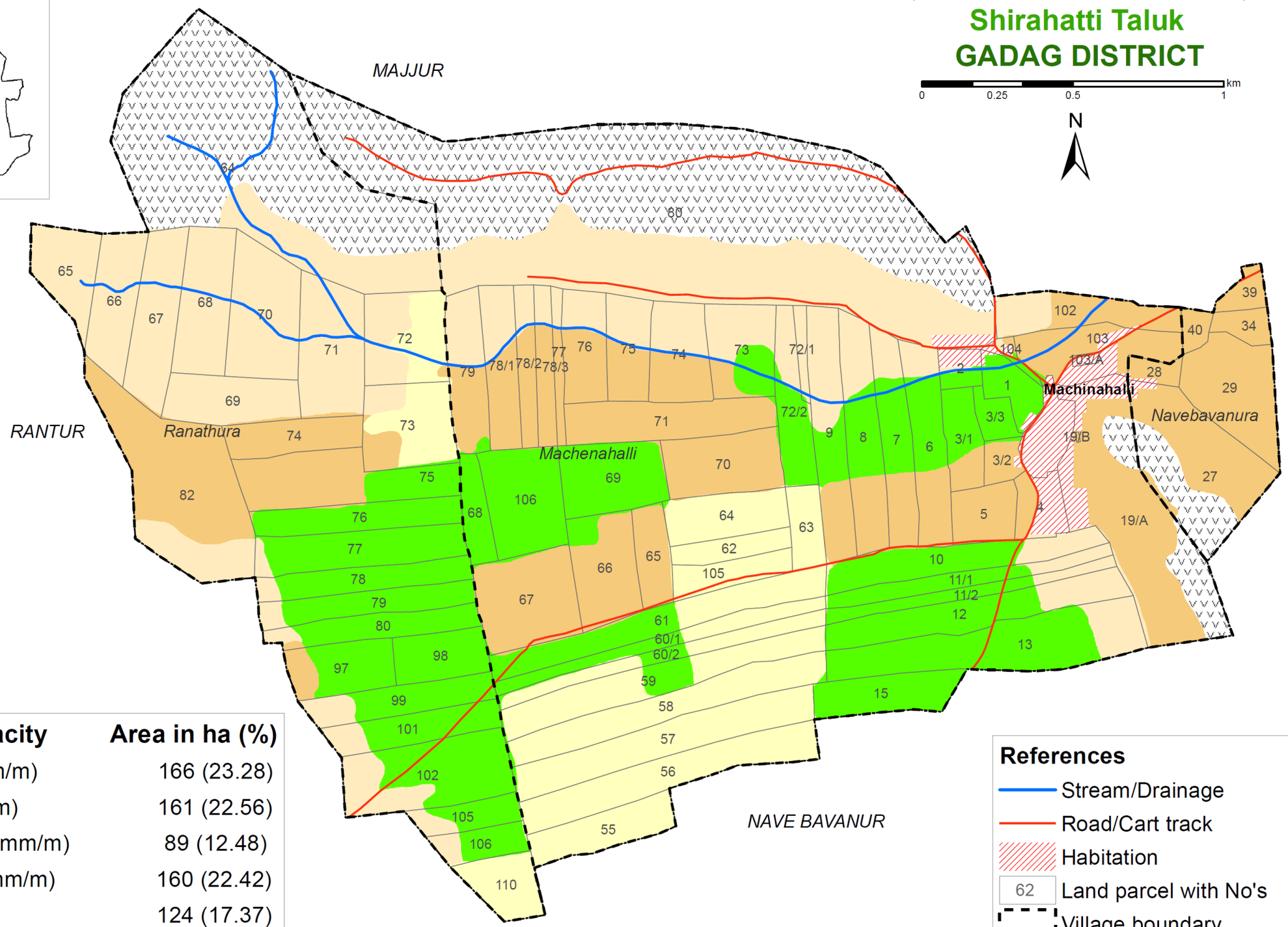
Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT





Available Water Capacity	Area in ha (%)
Very Low (<50 mm/m)	166 (23.28)
Low (51-100 mm/m)	161 (22.56)
Medium (101-150 mm/m)	89 (12.48)
Very High (>200 mm/m)	160 (22.42)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

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

Source: ICAR-NBSS&LUP, Bengaluru

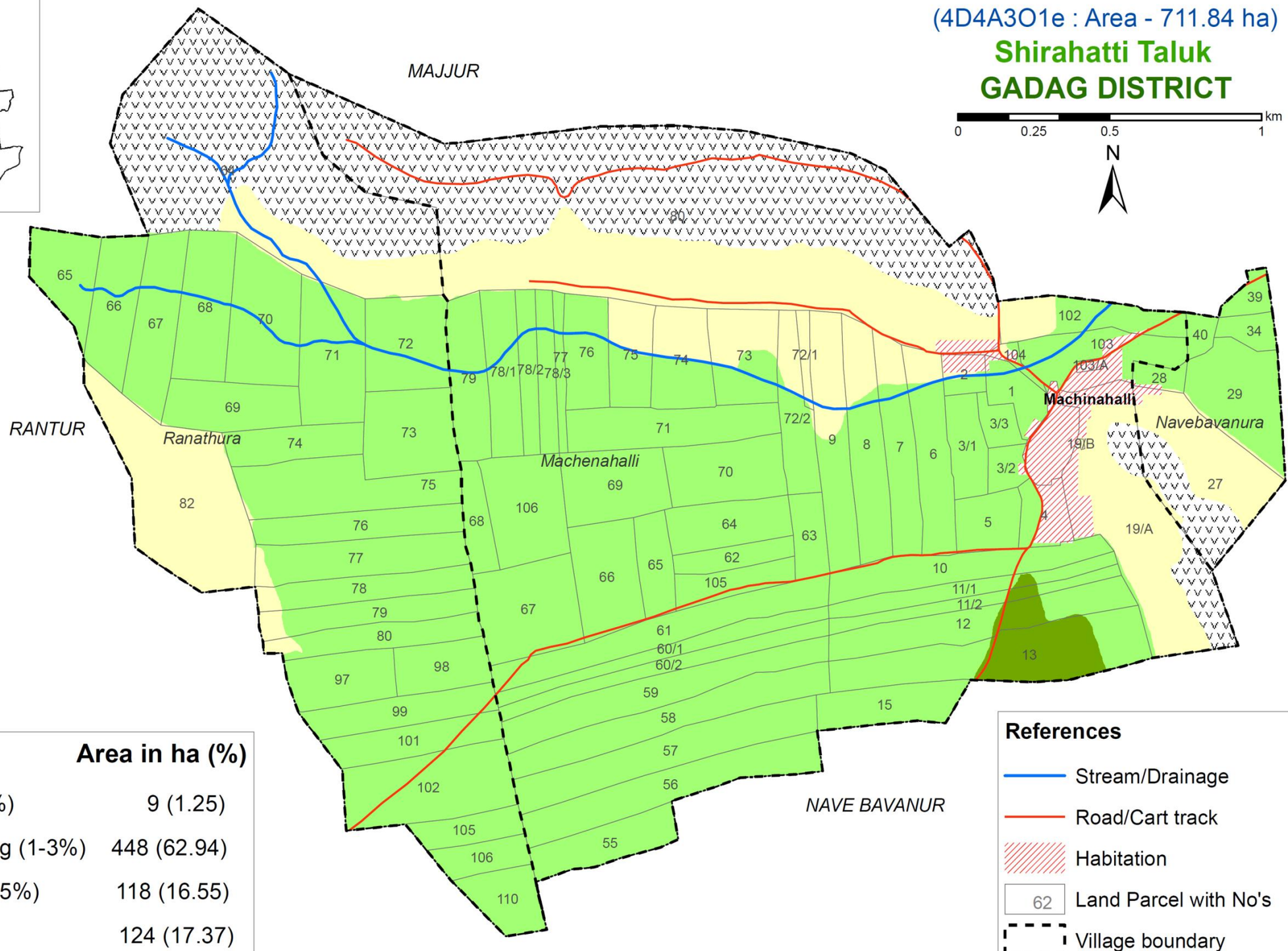
SLOPE

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



Slope Class	Area in ha (%)
Nearly level (0-1%)	9 (1.25)
Very gently sloping (1-3%)	448 (62.94)
Gently sloping (3-5%)	118 (16.55)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

SOIL EROSION

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT

0 0.25 0.5 1 km

N

MAJJUR

RANTUR

NAVE BAVANUR

Ranathura

Machenahalli

Machinahalli

Navebavanura

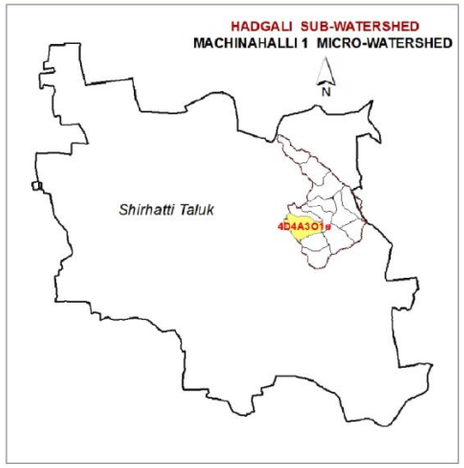
Erosion Class	Area in ha (%)
Slight	118 (16.62)
Moderate	286 (40.16)
Severe	171 (23.96)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru



SALINITY (2014)

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT

km
0 0.25 0.5 1

N

MAJJUR

RANTUR

NAVE BAVANUR

Ranathura

Machenahalli

Machinahalli

Navebavanura

Salinity	Area in ha (%)
Non saline (<2 dsm)	575 (80.74)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

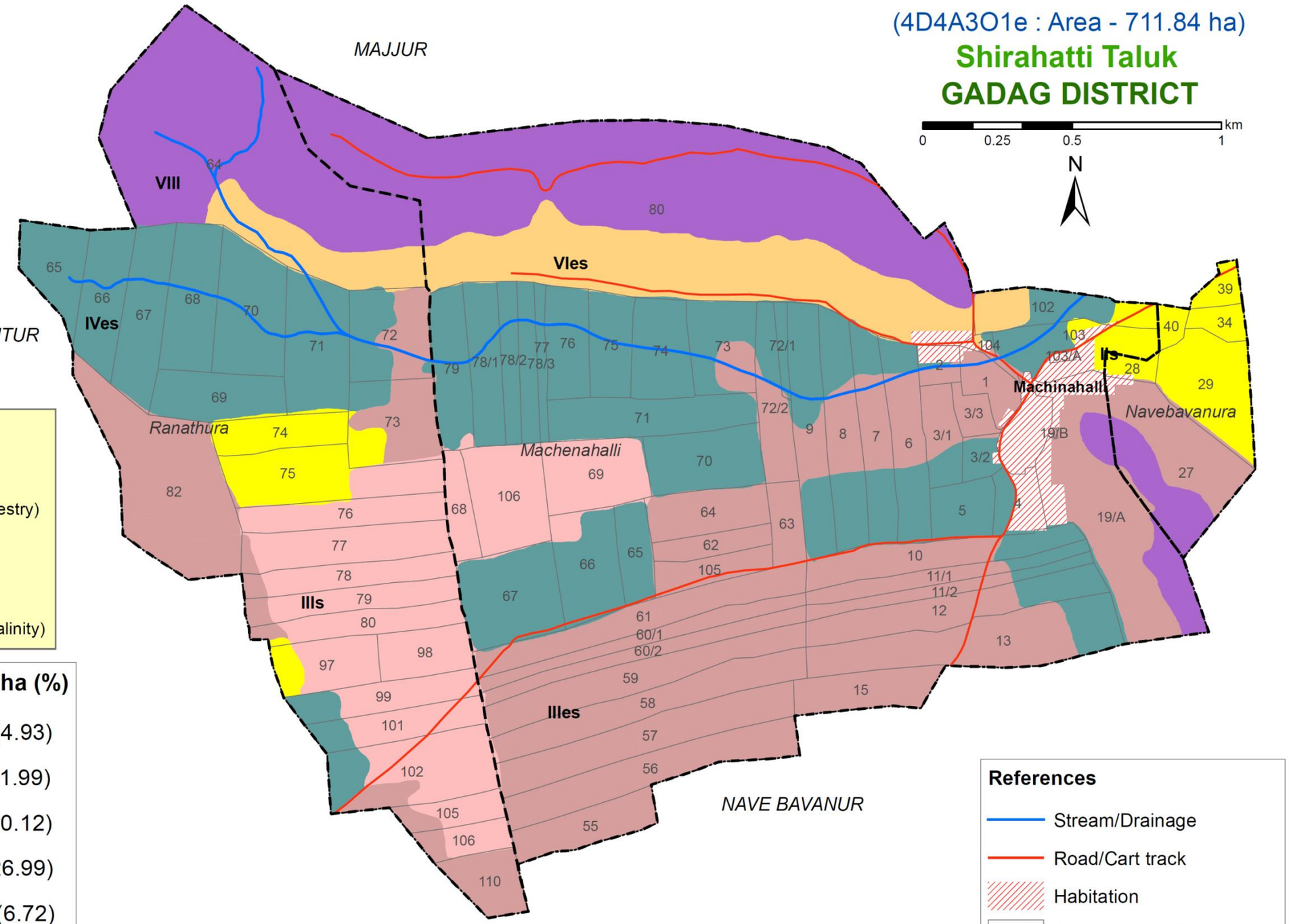
LAND CAPABILITY

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



Key

II-Good cultivable land
III-Moderately good cultivable land
IV-Marginally suitable for cultivation
VI- Not suitable for cultivation (grazing/forestry)
VIII-Rock land

Limitations

e- erosion limitation
s- soil limitation
(depth, gravelliness, texture, salinity/alkalinity)

Capability classes	Area in ha (%)
IIs	35 (4.93)
IIIs	85 (11.99)
IIIes	214 (30.12)
IVes	192 (26.99)
VIes	48 (6.72)
VIII	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

LAND SUITABILITY FOR SORGHUM

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT

km
0 0.25 0.5 1

N

MAJJUR
RANTUR
NAVE BAVANUR
Ranathura
Machenahalli
Machinahalli
Navebavanura
S3r
S3rg
S3z
S2g
S3g
S1
S2r
S2rg

Suitability Subclass	Area in ha (%)
S1	195 (27.33)
S2g	25 (3.56)
S2r	45 (6.26)
S2rg	60 (8.39)
S3g	11 (1.50)
S3r	115 (16.14)
S3rg	86 (12.02)
S3z	40 (5.55)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

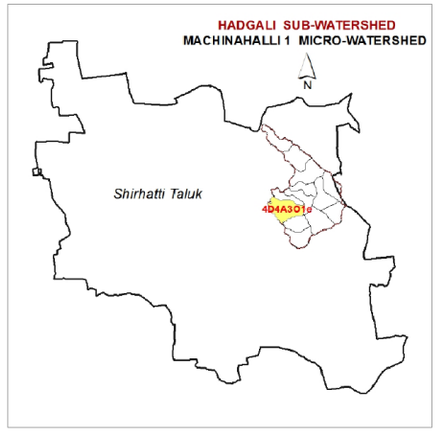
* - Habitation

Key
S1-Highly Suitable
S2-Moderately Suitable
S3-Marginally Suitable

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

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

Source: ICAR-NBSS&LUP, Bengaluru



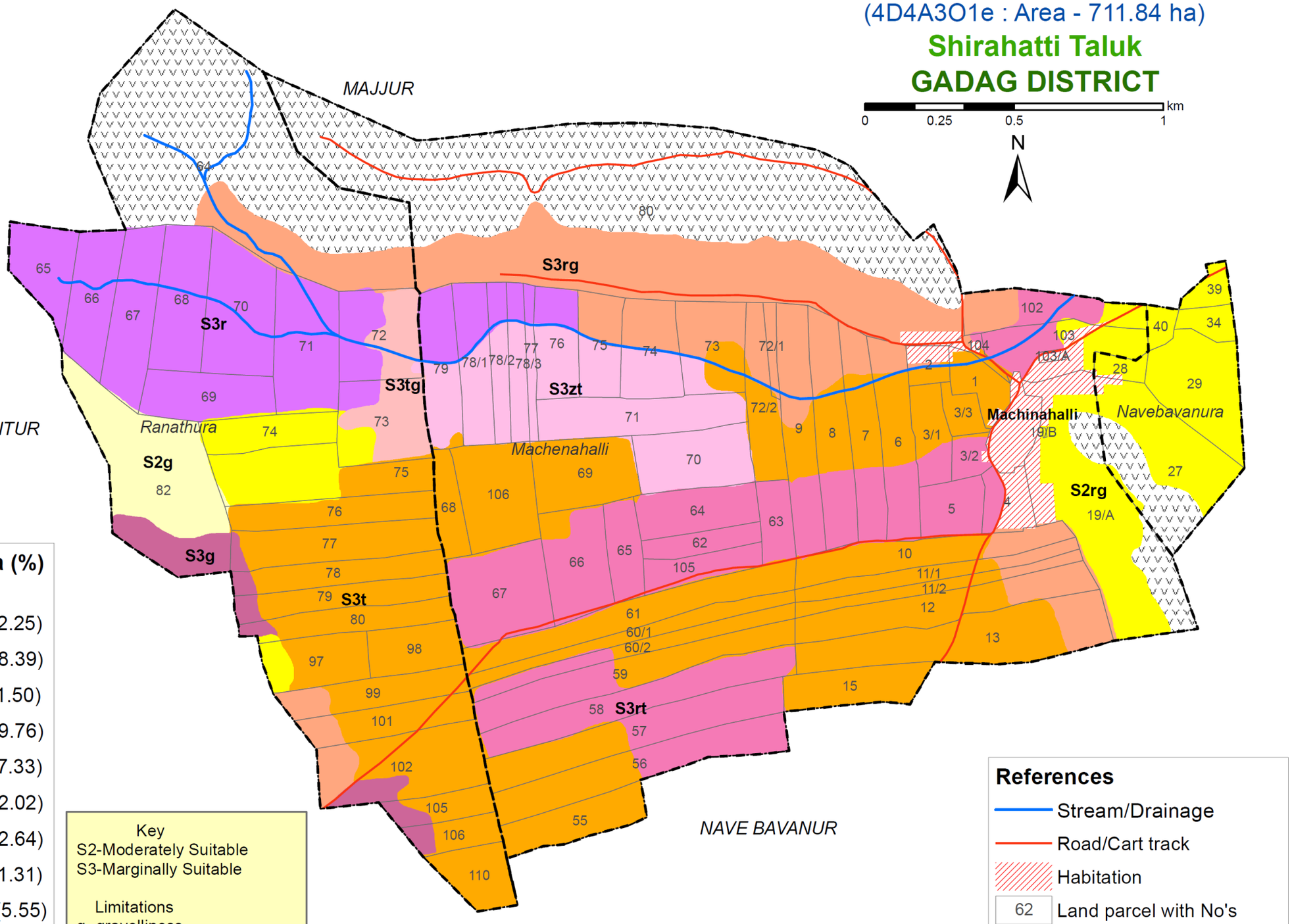
LAND SUITABILITY FOR MAIZE

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



Suitability Subclass	Area in ha (%)
S2g	16 (2.25)
S2rg	60 (8.39)
S3g	11 (1.50)
S3r	69 (9.76)
S3t	195 (27.33)
S3rg	86 (12.02)
S3rt	90 (12.64)
S3tg	9 (1.31)
S3zt	40 (5.55)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

Key
S2-Moderately Suitable
S3-Marginally Suitable

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

References

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

Source: ICAR-NBSS&LUP, Bengaluru

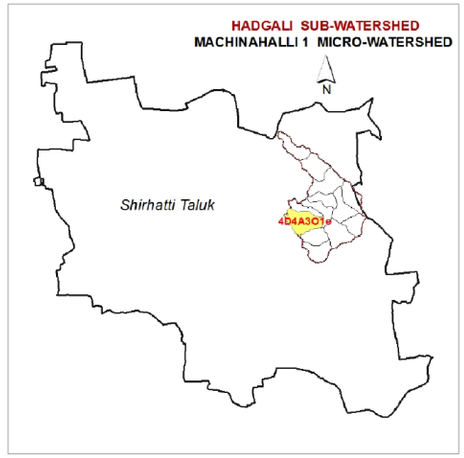
LAND SUITABILITY FOR COTTON

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



km
0 0.25 0.5 1

N

MAJJUR
RANTUR
NAVE BAVANUR
Ranathura
Machenahalli
Machinahalli
Navebavanura

S1
S2r
S2rg
S3g
S3r
S3z

Key
S1-Highly Suitable
S2-Moderately Suitable
S3-Marginally Suitable

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

Suitability Subclass	Area in ha (%)
S1	160 (22.42)
S2r	123 (17.28)
S2rg	42 (5.83)
S3g	96 (13.52)
S3r	115 (16.14)
S3z	40 (5.55)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

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

Source: ICAR-NBSS&LUP, Bengaluru

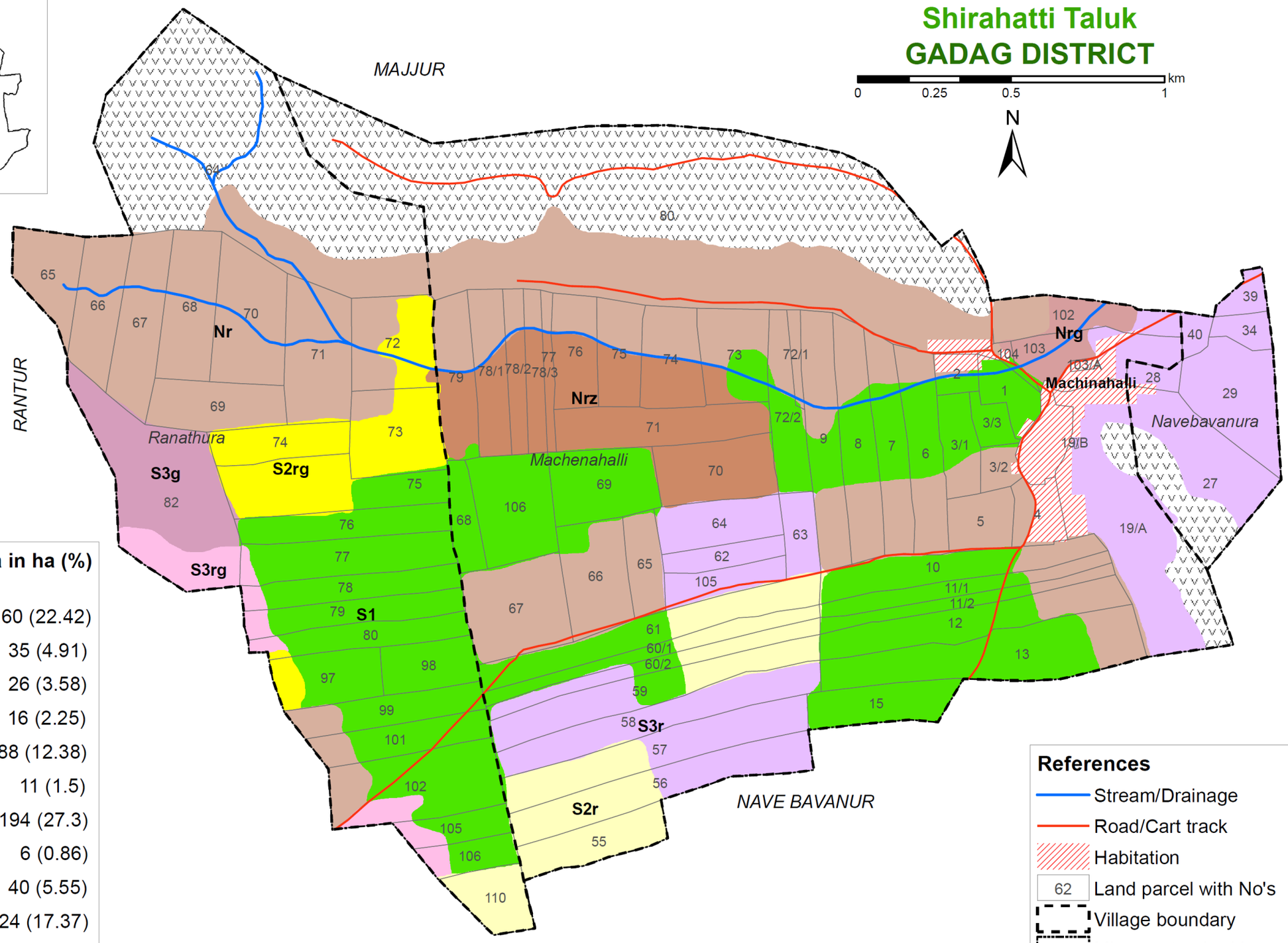
LAND SUITABILITY FOR SUNFLOWER

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



Key
S1-Highly Suitable
S2-Moderately Suitable
S3-Marginally Suitable
N-Not Suitable

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

Suitability Subclass	Area in ha (%)
S1	160 (22.42)
S2r	35 (4.91)
S2rg	26 (3.58)
S3g	16 (2.25)
S3r	88 (12.38)
S3rg	11 (1.5)
Nr	194 (27.3)
Nrg	6 (0.86)
Nrz	40 (5.55)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

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

Source: ICAR-NBSS&LUP, Bengaluru

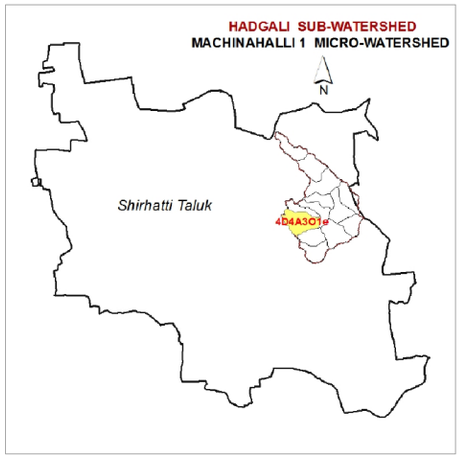
LAND SUITABILITY FOR ONION

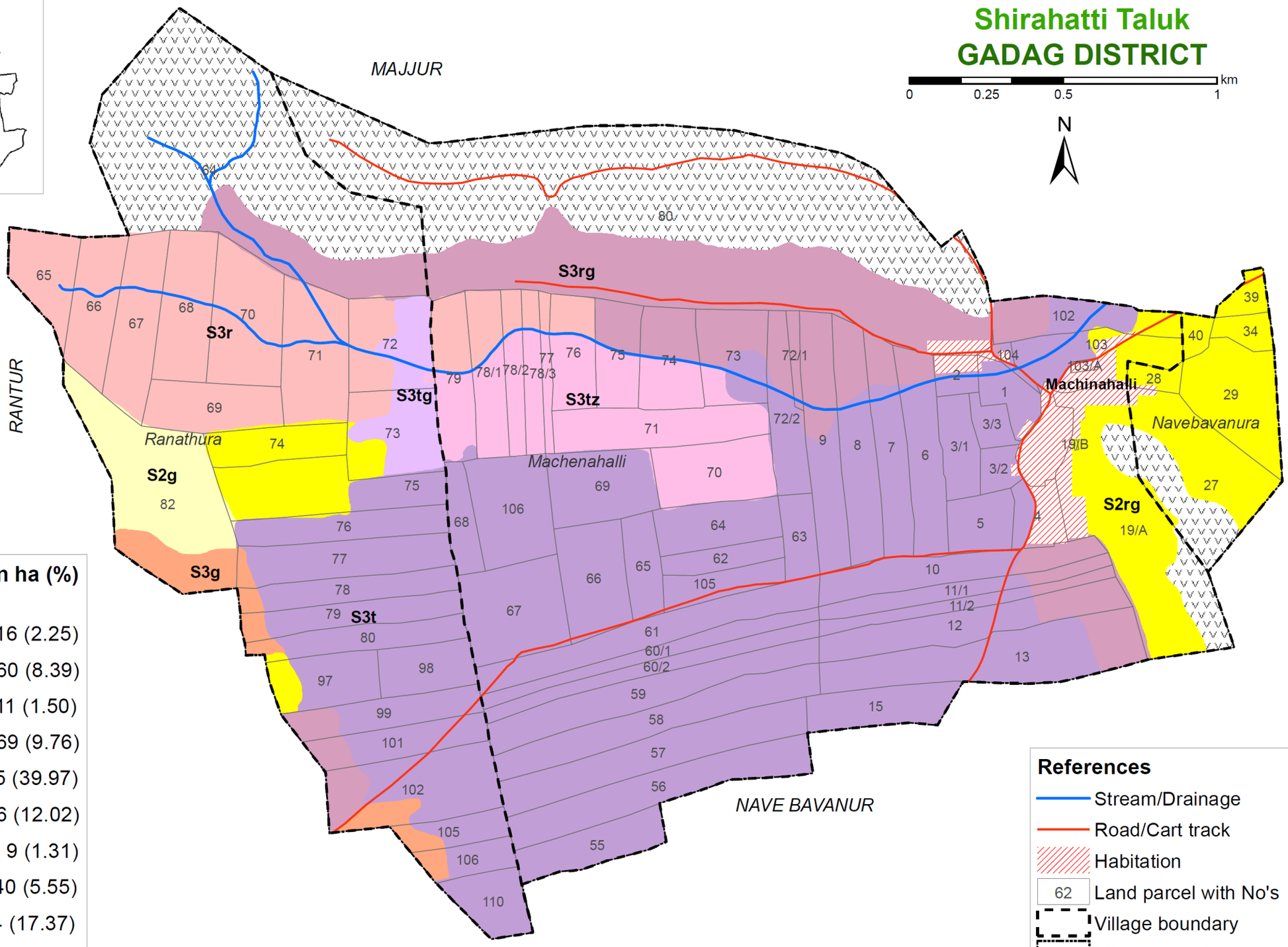
Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT





0 0.25 0.5 1 km

N

Key

S2-Moderately Suitable
S3-Marginally Suitable

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

Suitability Subclass	Area in ha (%)
S2g	16 (2.25)
S2rg	60 (8.39)
S3g	11 (1.50)
S3r	69 (9.76)
S3t	285 (39.97)
S3rg	86 (12.02)
S3tg	9 (1.31)
S3tz	40 (5.55)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

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

Source: ICAR-NBSS&LUP, Bengaluru

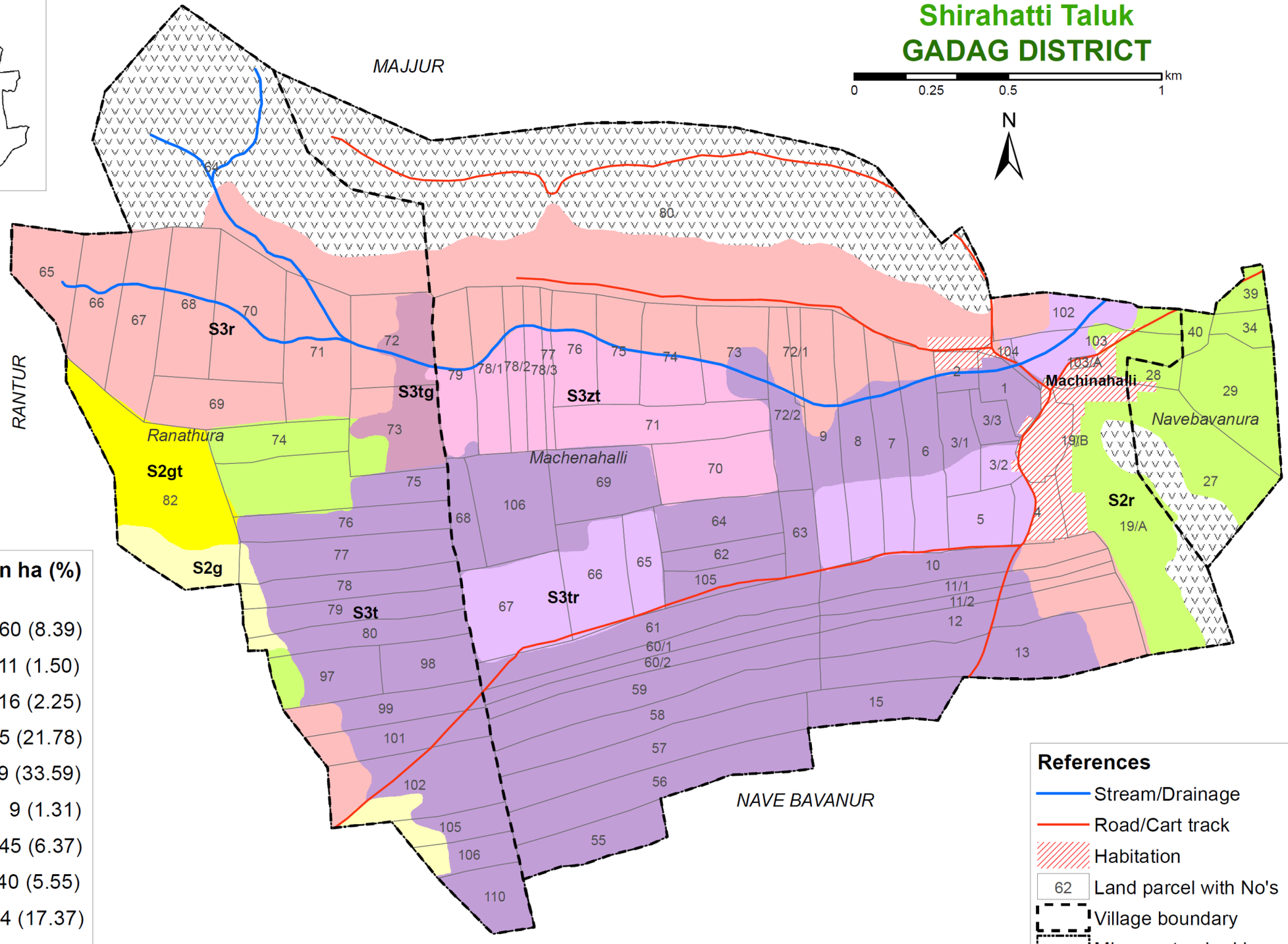
LAND SUITABILITY FOR GROUNDNUT

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



Key
S2-Moderately Suitable
S3-Marginally Suitable

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

Suitability Subclass	Area in ha (%)
S2r	60 (8.39)
S2g	11 (1.50)
S2gt	16 (2.25)
S3r	155 (21.78)
S3t	239 (33.59)
S3tg	9 (1.31)
S3tr	45 (6.37)
S3zt	40 (5.55)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

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

Source: ICAR-NBSS&LUP, Bengaluru

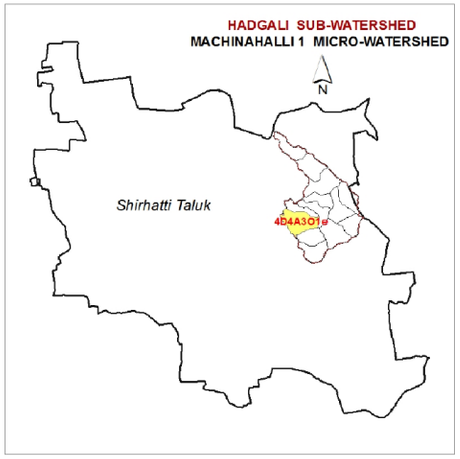
LAND SUITABILITY FOR CHILLY

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



km
0 0.25 0.5 1

N

MAJJUR

RANTUR

Ranathura

Machenahalli

Machinahalli

Navebavanura

NAVE BAVANUR

S3r

S3rg

S2gz

S2rg

S3g

S2g

S2r

Key
S2-Moderately Suitable
S3-Marginally Suitable

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

Suitability Subclass	Area in ha (%)
S2g	220 (30.89)
S2r	45 (6.26)
S2gz	40 (5.55)
S2rg	105 (14.76)
S3g	11 (1.50)
S3r	69 (9.76)
S3rg	86 (12.02)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

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

Source: ICAR-NBSS&LUP, Bengaluru

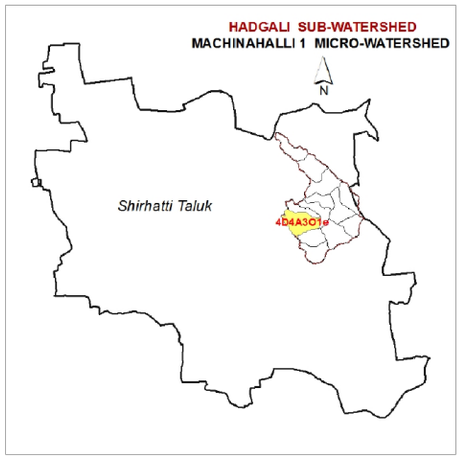
LAND SUITABILITY FOR SUGARCANE

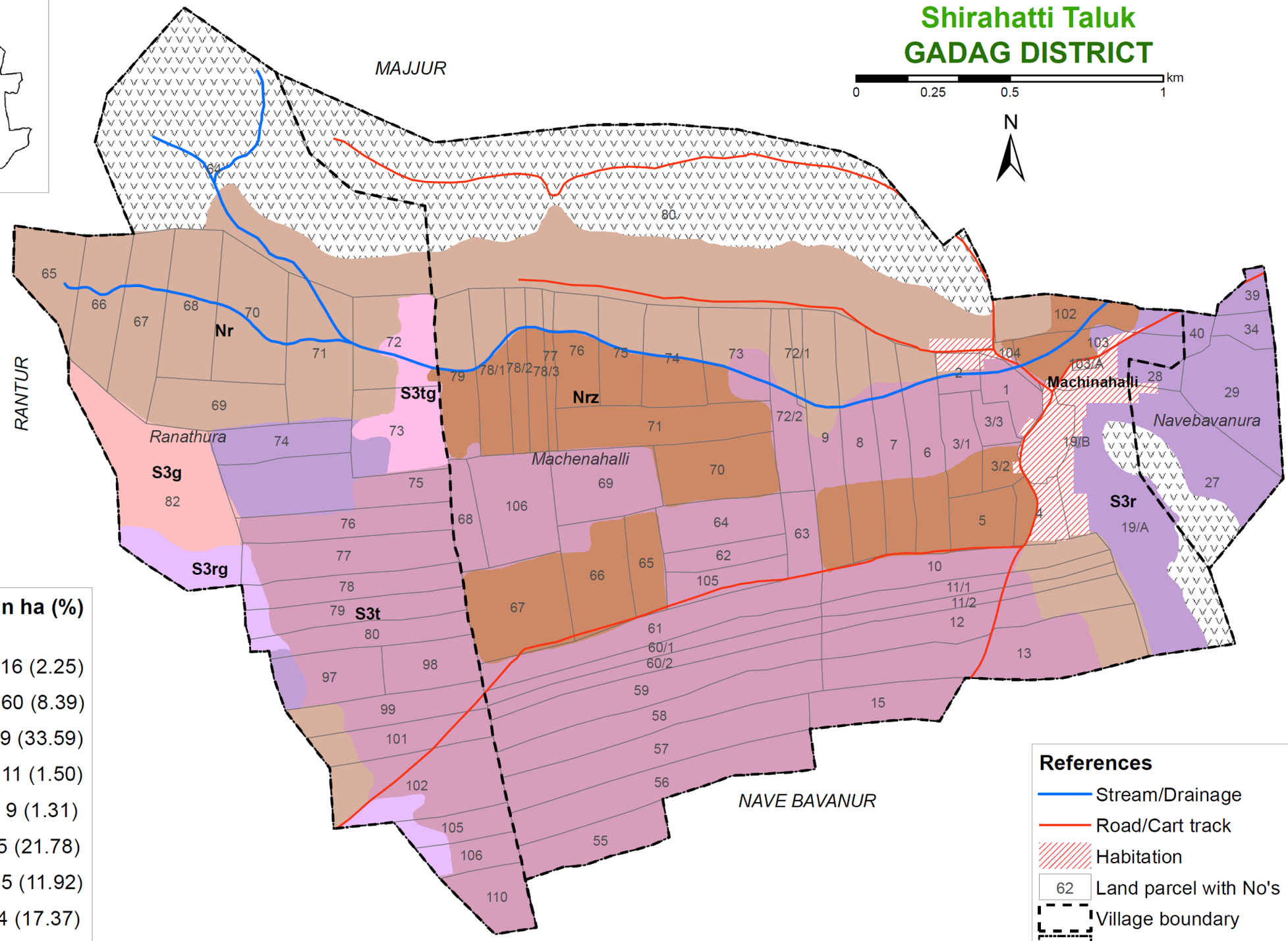
Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT





Key
S3-Marginally Suitable
N-Not Suitable

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

Suitability Subclass	Area in ha (%)
S3g	16 (2.25)
S3r	60 (8.39)
S3t	239 (33.59)
S3rg	11 (1.50)
S3tg	9 (1.31)
Nr	155 (21.78)
Nrz	85 (11.92)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

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

Source: ICAR-NBSS&LUP, Bengaluru

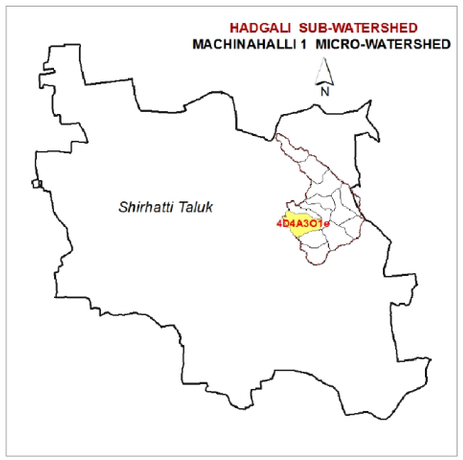
LAND SUITABILITY FOR POMEGRANATE

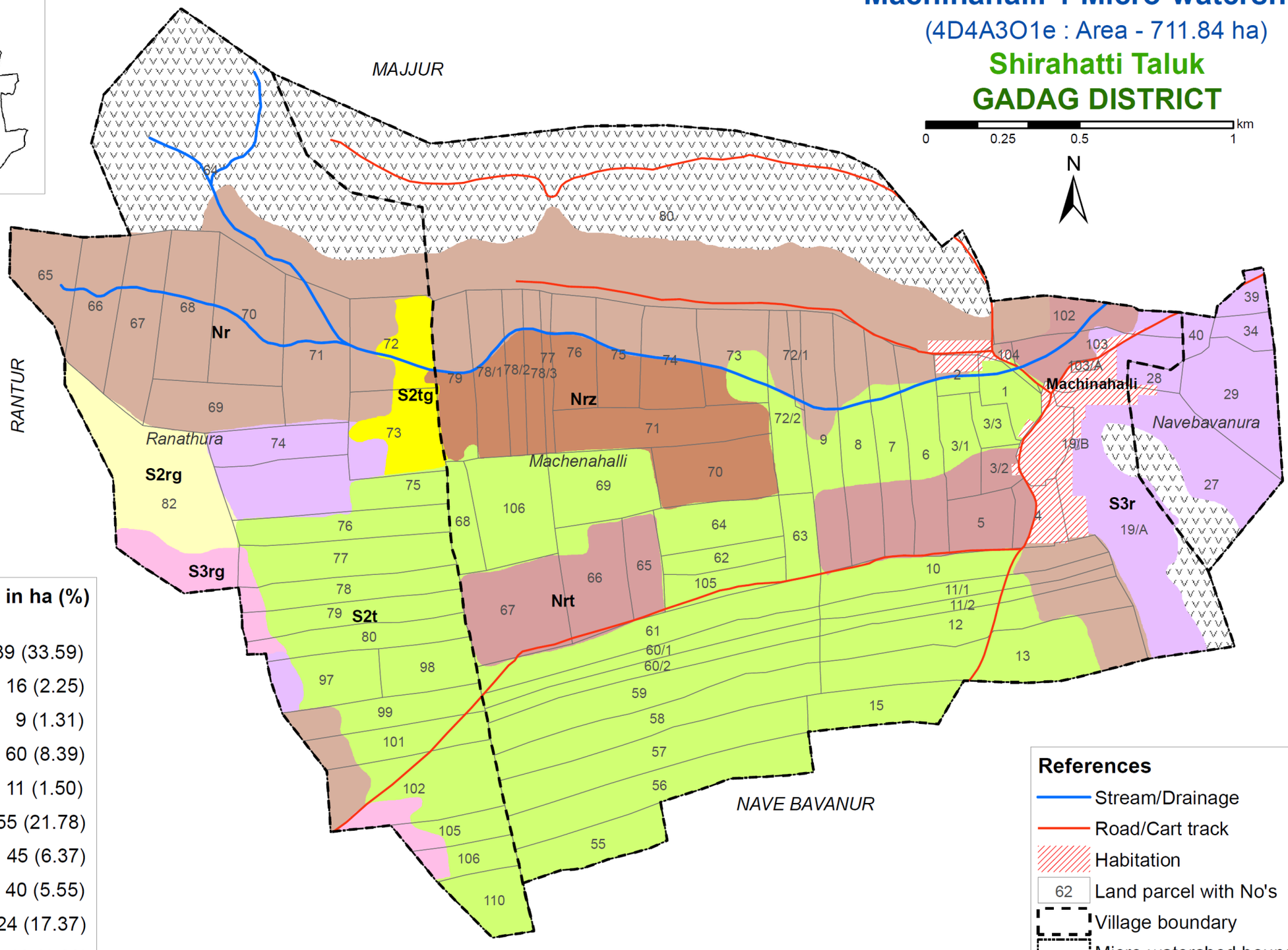
Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT





Key
S2-Moderately Suitable
S3-Marginally Suitable
N-Not Suitable

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

Suitability Subclass	Area in ha (%)
S2t	239 (33.59)
S2rg	16 (2.25)
S2tg	9 (1.31)
S3r	60 (8.39)
S3rg	11 (1.50)
Nr	155 (21.78)
Nrt	45 (6.37)
Nrz	40 (5.55)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

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

Source: ICAR-NBSS&LUP, Bengaluru

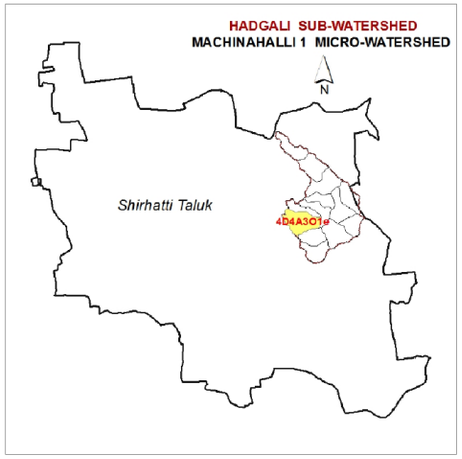
LAND SUITABILITY FOR TOMATO

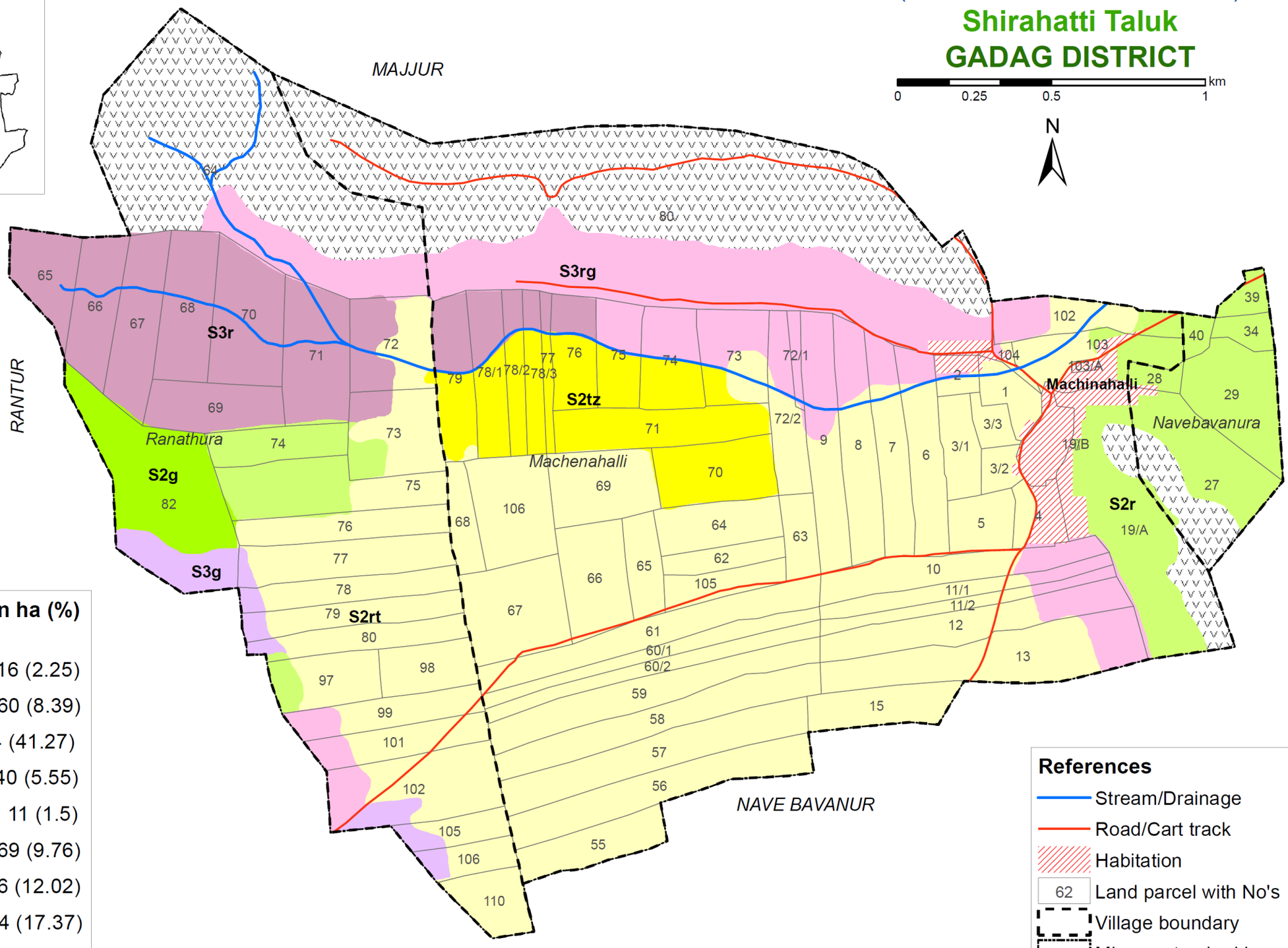
Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT





Key
S2-Moderately Suitable
S3-Marginally Suitable

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

Suitability Subclass	Area in ha (%)
S2g	16 (2.25)
S2r	60 (8.39)
S2rt	294 (41.27)
S2tz	40 (5.55)
S3g	11 (1.5)
S3r	69 (9.76)
S3rg	86 (12.02)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

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

Source: ICAR-NBSS&LUP, Bengaluru

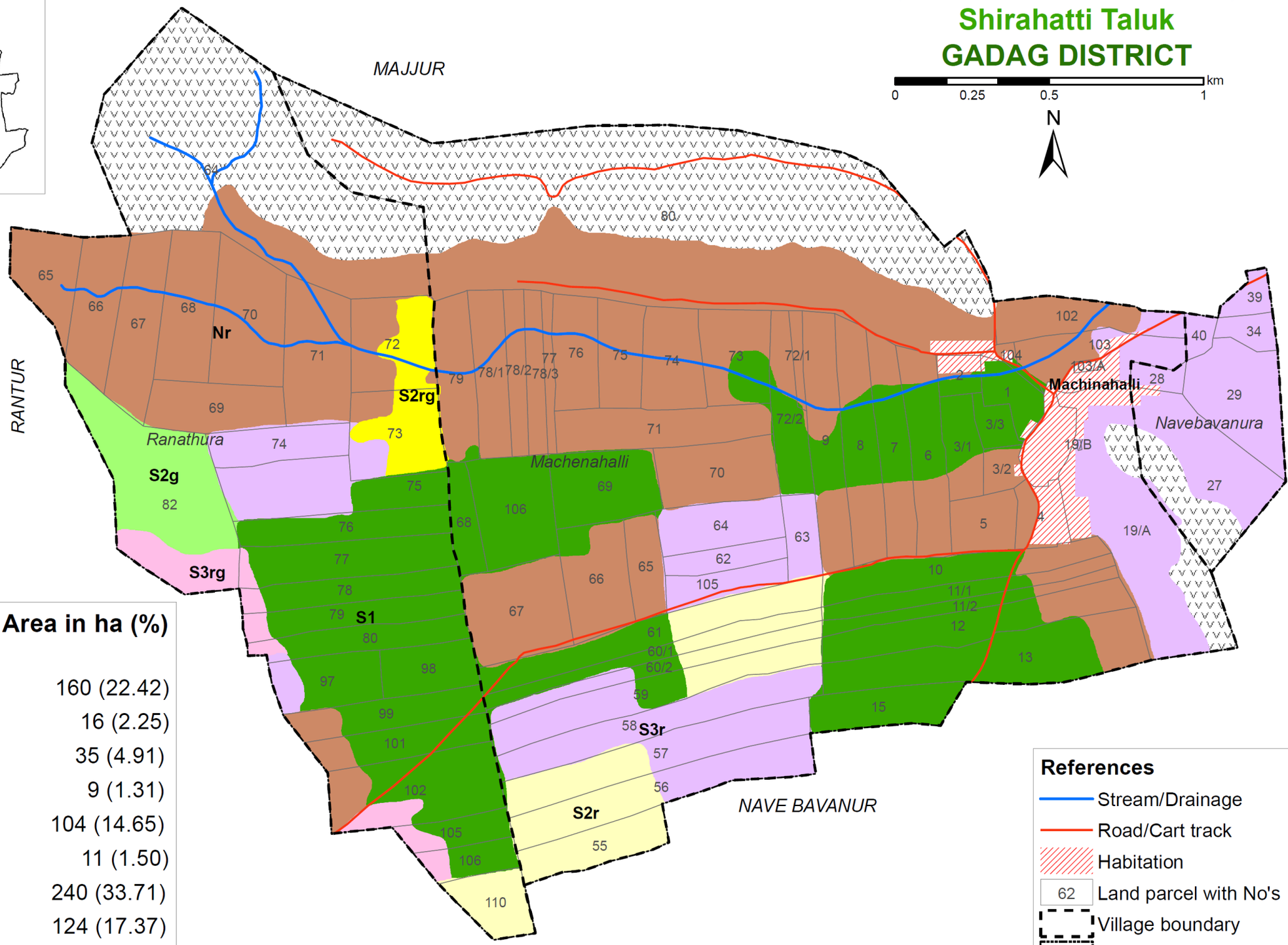
LAND SUITABILITY FOR CITRUS

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



Key
S1-Highly Suitable
S2-Moderately Suitable
S3-Marginally Suitable
N-Not Suitable

Limitations
g- gravelliness/stoniness
r- rooting condition

Suitability Subclass	Area in ha (%)
S1	160 (22.42)
S2g	16 (2.25)
S2r	35 (4.91)
S2rg	9 (1.31)
S3r	104 (14.65)
S3rg	11 (1.50)
Nr	240 (33.71)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

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

Source: ICAR-NBSS&LUP, Bengaluru

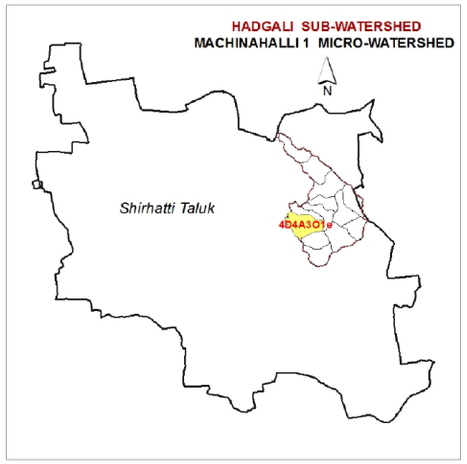
LAND SUITABILITY FOR GUAVA

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



km
0 0.25 0.5 1

N

MAJJUR
RANTUR
NAVE BAVANUR
Ranathura
Machenahalli
Machinahalli
Navebavanura

S2g
S3rg
S3t
S3tg
Nr
Ntr
S3r

Key
S2-Moderately Suitable
S3-Marginally Suitable
N-Not Suitable

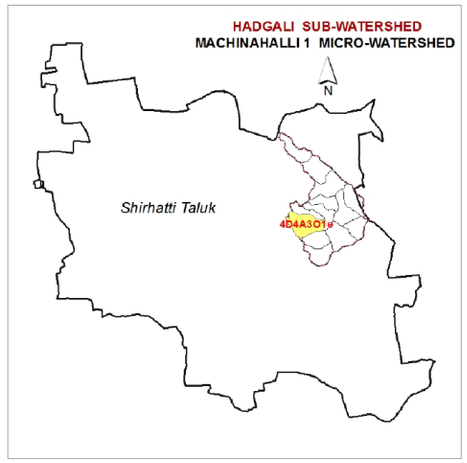
Limitations
g- gravelliness
r- rooting condition
t- texture

Suitability subclass	Area in ha (%)
S2g	16 (2.25)
S3r	104 (14.65)
S3t	195 (27.33)
S3rg	11 (1.50)
S3tg	9 (1.31)
Nr	195 (27.33)
Ntr	45 (6.37)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

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

Source: ICAR-NBSS&LUP, Bengaluru



LAND SUITABILITY FOR MANGO

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT

km
0 0.25 0.5 1
N

MAJJUR
RANTUR
NAVE BAVANUR
Ranathura
Machenahalli
Machinahalli
Navebavanura
S2gr
N

Key
S2-Moderately Suitable
N- Not Suitable

Limitations
g- gravelliness
r- rooting condition

Suitability	Area in ha(%)
S2gr	16 (2.25)
N	559 (78.5)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References
- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

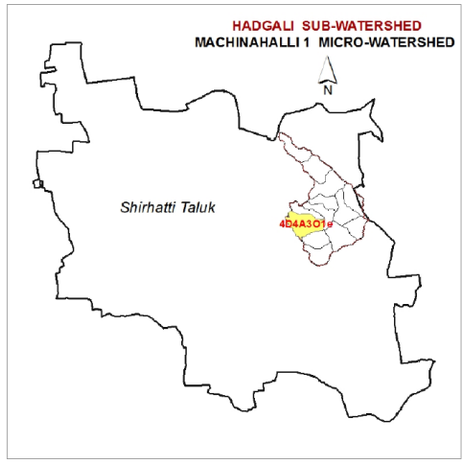
LAND SUITABILITY FOR SAPOTA

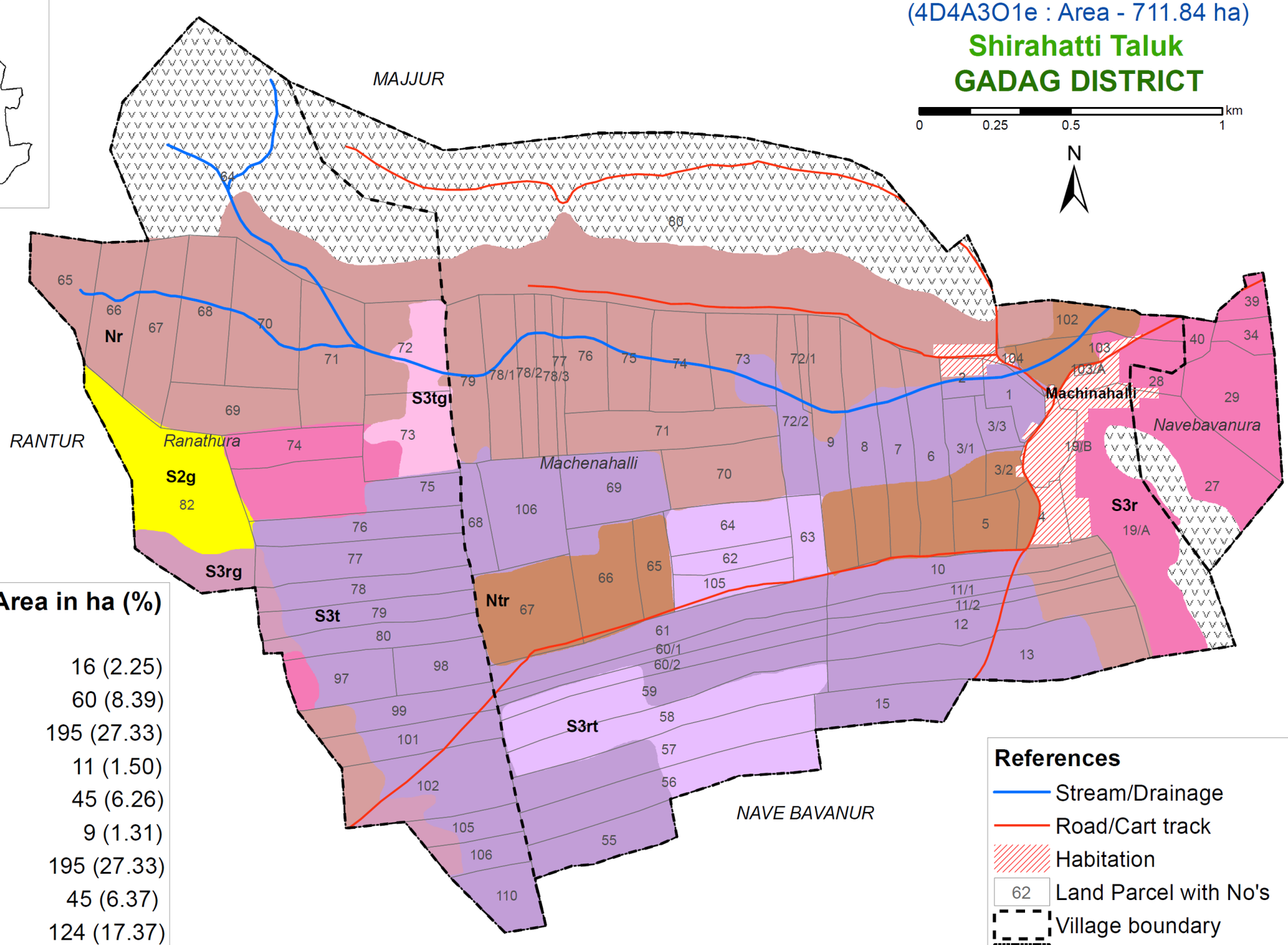
Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT





Key
S2-Moderately Suitable
S3-Marginally Suitable
N- Not Suitable

Limitations
g- gravelliness
r- rooting condition
t- texture

Suitability subclass	Area in ha (%)
S2g	16 (2.25)
S3r	60 (8.39)
S3t	195 (27.33)
S3rg	11 (1.50)
S3rt	45 (6.26)
S3tg	9 (1.31)
Nr	195 (27.33)
Ntr	45 (6.37)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References
- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

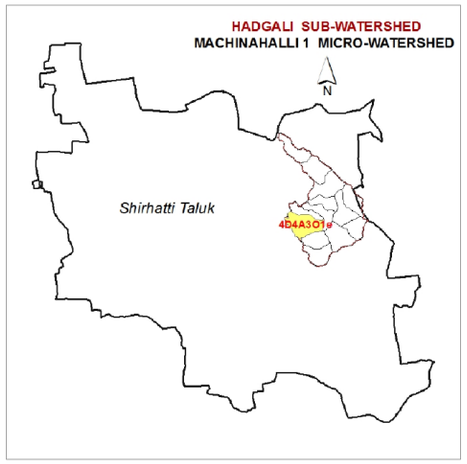
LAND SUITABILITY FOR JACKFRUIT

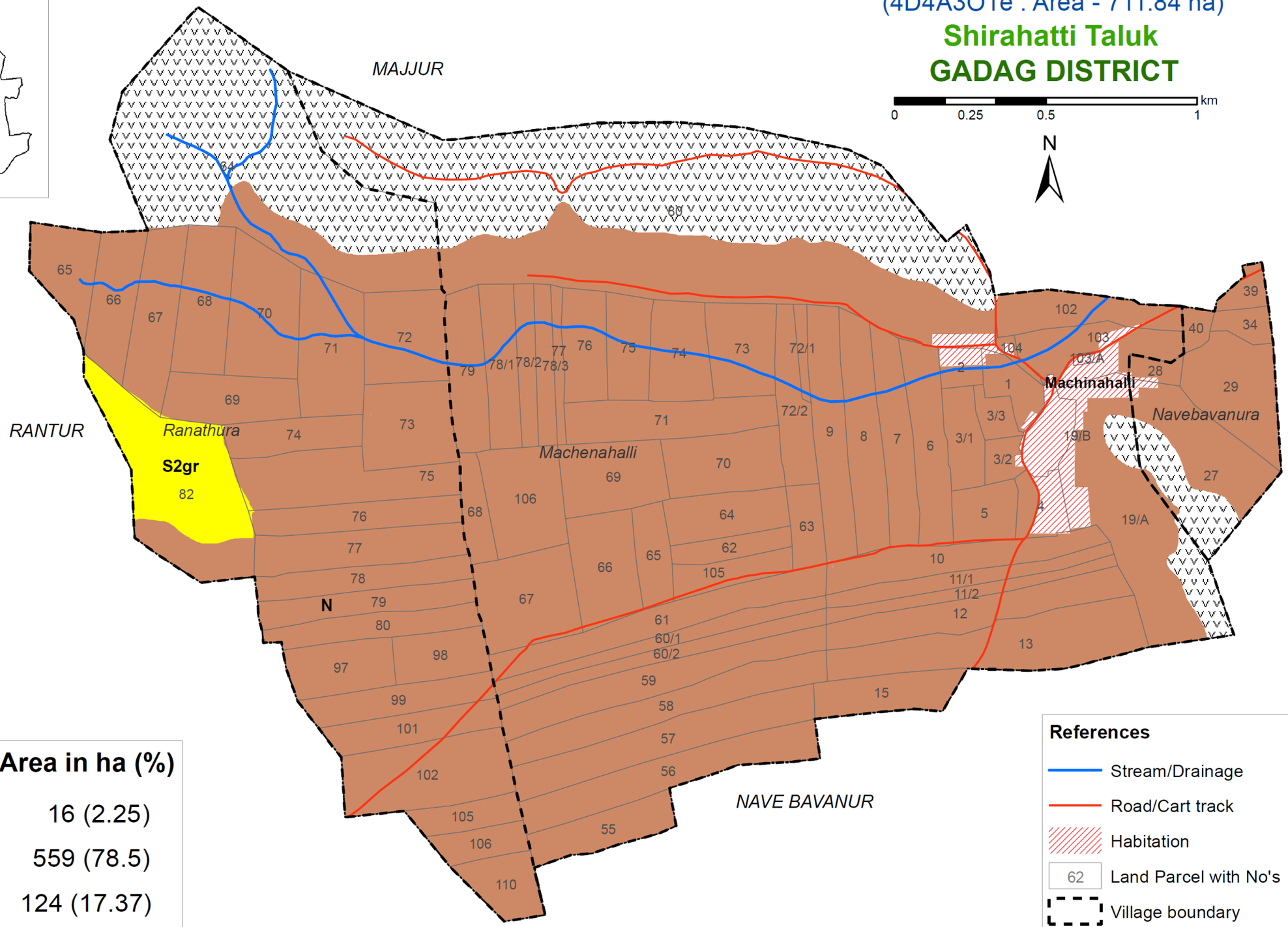
Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT





Key
S2-Moderately Suitable
N-Not Suitable

Limitations
g- gravelliness
r- rooting condition

Suitability	Area in ha (%)
S2gr	16 (2.25)
N	559 (78.5)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

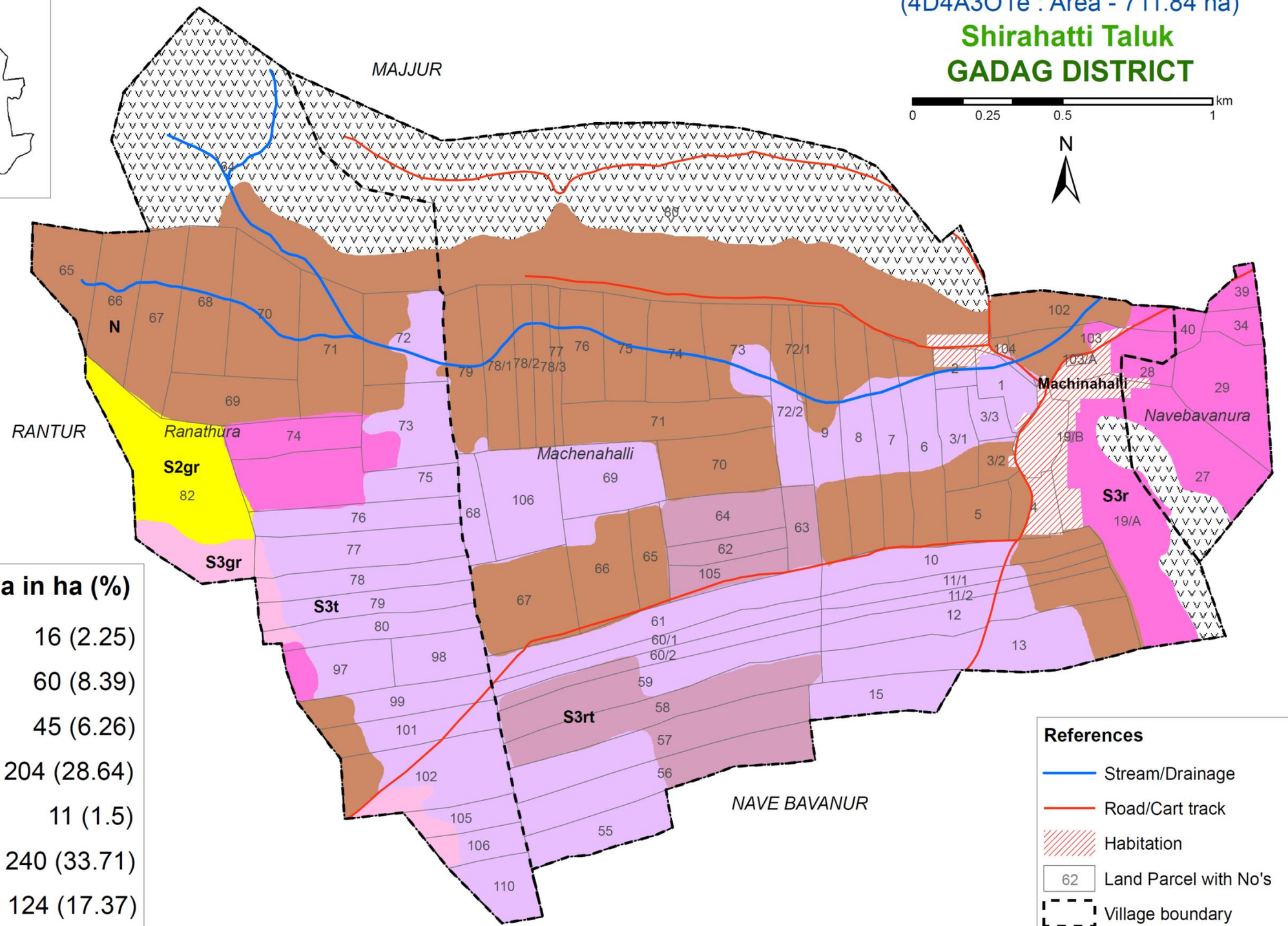
LAND SUITABILITY FOR JAMUN

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



Key
S2-Moderately Suitable
S3-Marginally Suitable
N-Not Suitable

Limitations
g- gravelliness
r- rooting condition
t- texture

Suitability	Area in ha (%)
S2gr	16 (2.25)
S3r	60 (8.39)
S3rt	45 (6.26)
S3t	204 (28.64)
S3gr	11 (1.5)
N	240 (33.71)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

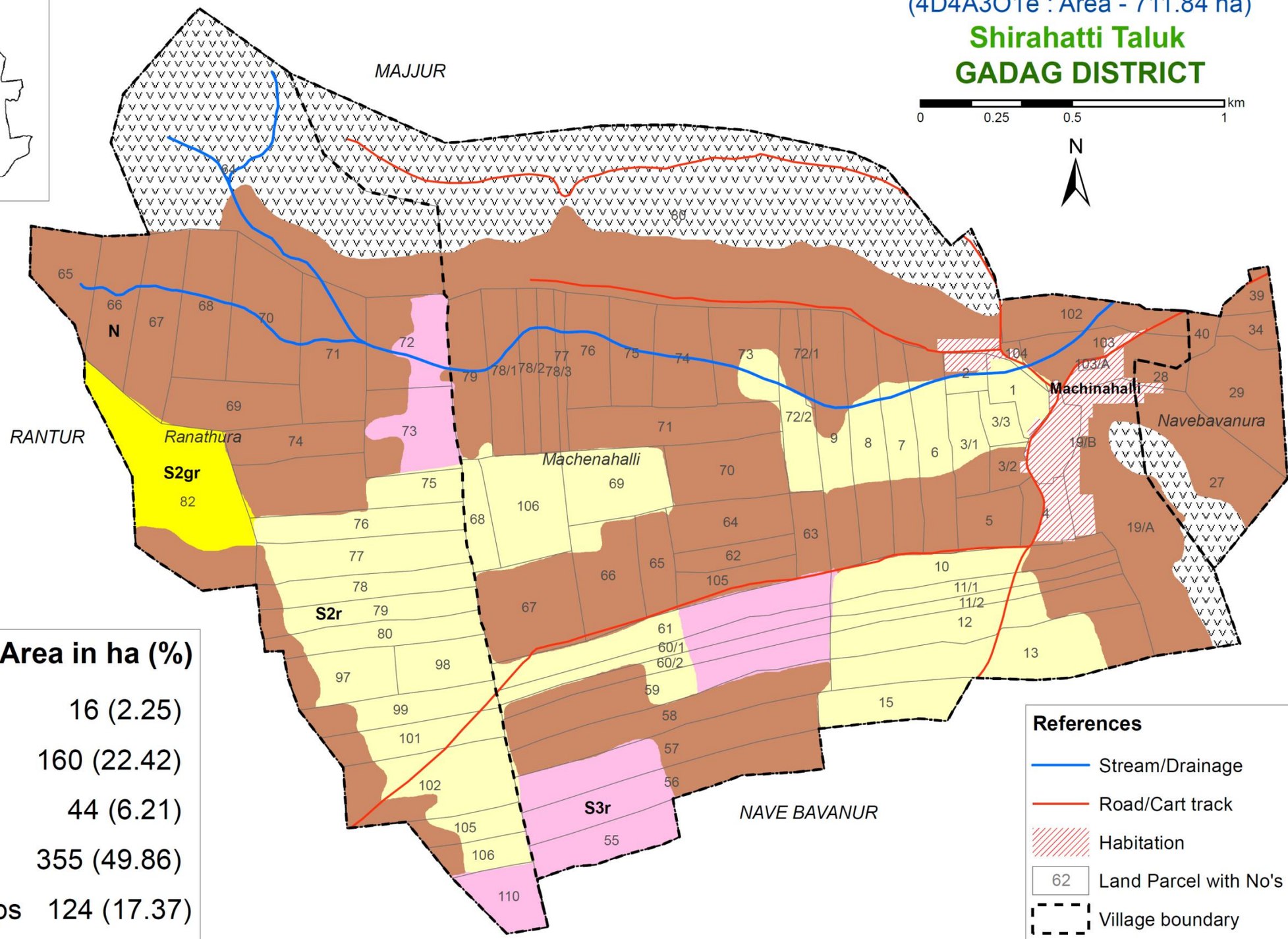
LAND SUITABILITY FOR MUSAMBI

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



Key
S2-Moderately Suitable
S3-Marginally Suitable
N-Not Suitable

Limitations
g- gravelliness
r- rooting condition

Suitability	Area in ha (%)
S2gr	16 (2.25)
S2r	160 (22.42)
S3r	44 (6.21)
N	355 (49.86)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

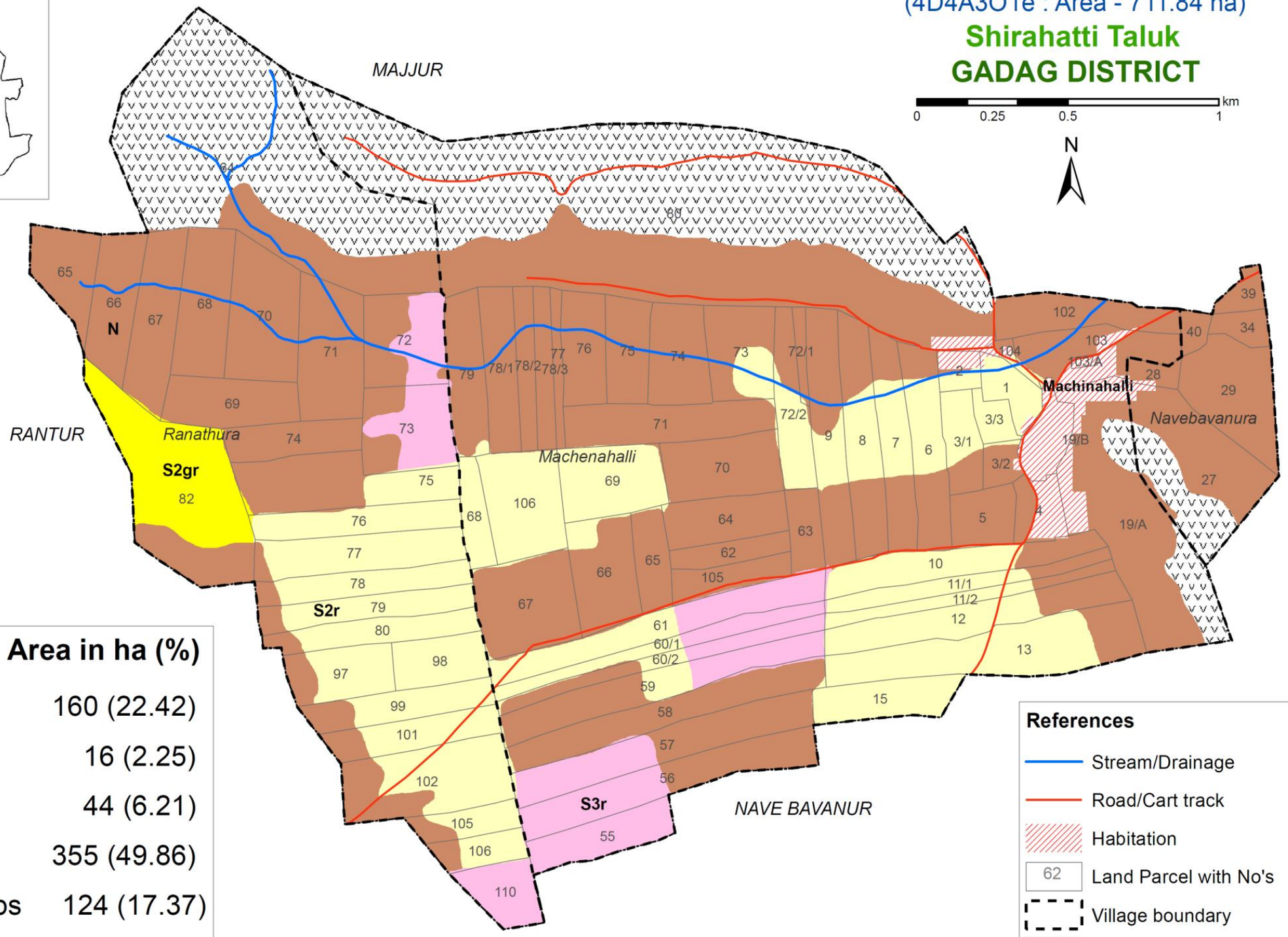
LAND SUITABILITY FOR LIME

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



Key
S2-Moderately Suitable
S3-Marginally Suitable
N- Not Suitable

Limitations
g- gravelliness
r- rooting condition

Suitability	Area in ha (%)
S2r	160 (22.42)
S2gr	16 (2.25)
S3r	44 (6.21)
N	355 (49.86)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

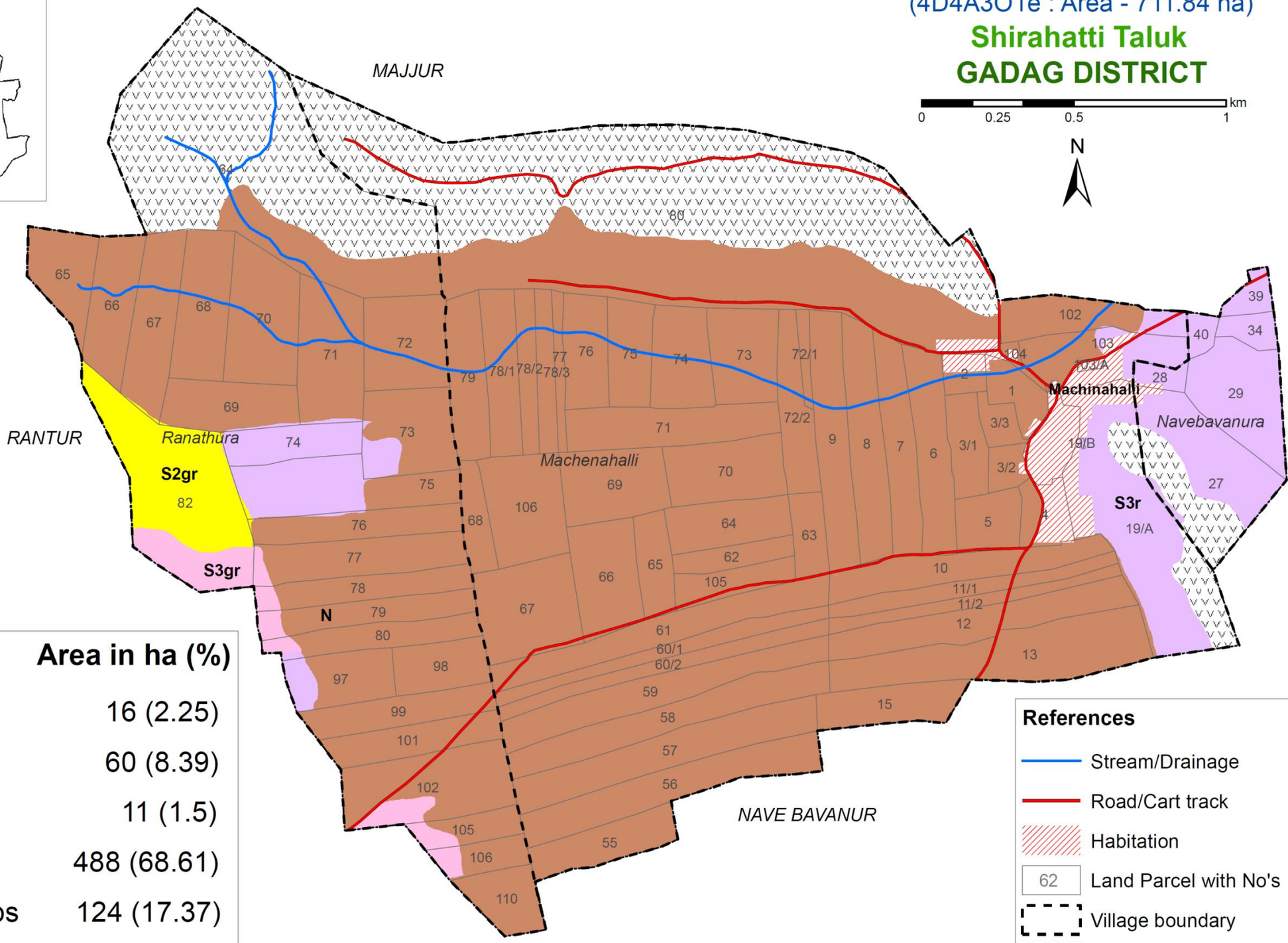
LAND SUITABILITY FOR CASHEW

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



Key
S2-Moderately Suitable
S3-Marginally Suitable
N- Not Suitable

Limitations
g- gravelliness
r- rooting condition

Suitability	Area in ha (%)
S2gr	16 (2.25)
S3r	60 (8.39)
S3gr	11 (1.5)
N	488 (68.61)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

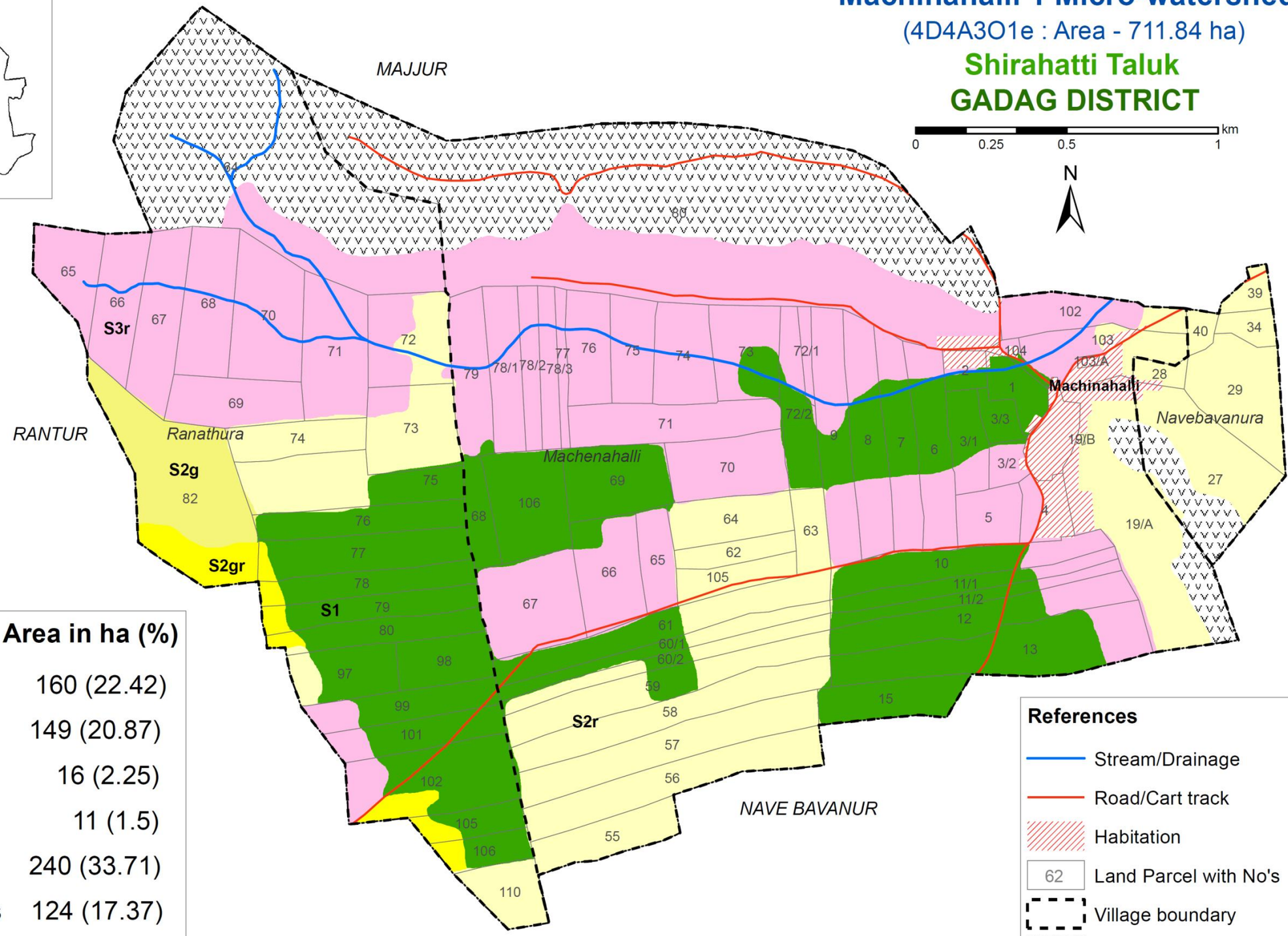
LAND SUITABILITY FOR CUSTARD APPLE

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



Key
S1-Highly Suitable
S2-Moderately Suitable
S3-Marginally Suitable

Limitations
g- gravelliness
r- rooting condition

Suitability	Area in ha (%)
S1	160 (22.42)
S2r	149 (20.87)
S2g	16 (2.25)
S2gr	11 (1.5)
S3r	240 (33.71)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

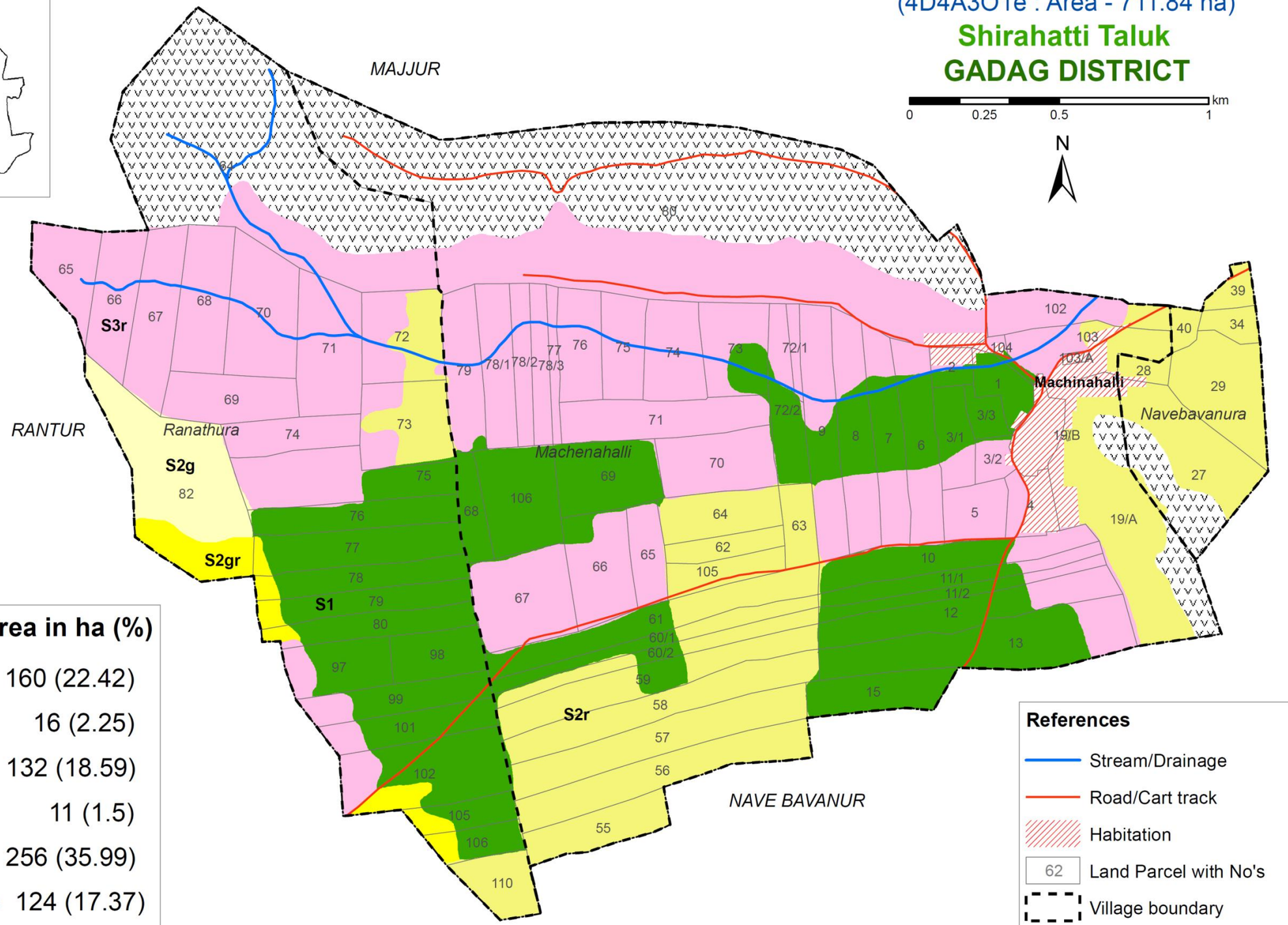
LAND SUITABILITY FOR AMLA

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



Key
S1-Highly Suitable
S2-Moderately Suitable
S3-Marginally Suitable
N- Not Suitable

Limitations
g- gravelliness
r- rooting condition

Suitability	Area in ha (%)
S1	160 (22.42)
S2g	16 (2.25)
S2r	132 (18.59)
S2gr	11 (1.5)
S3r	256 (35.99)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

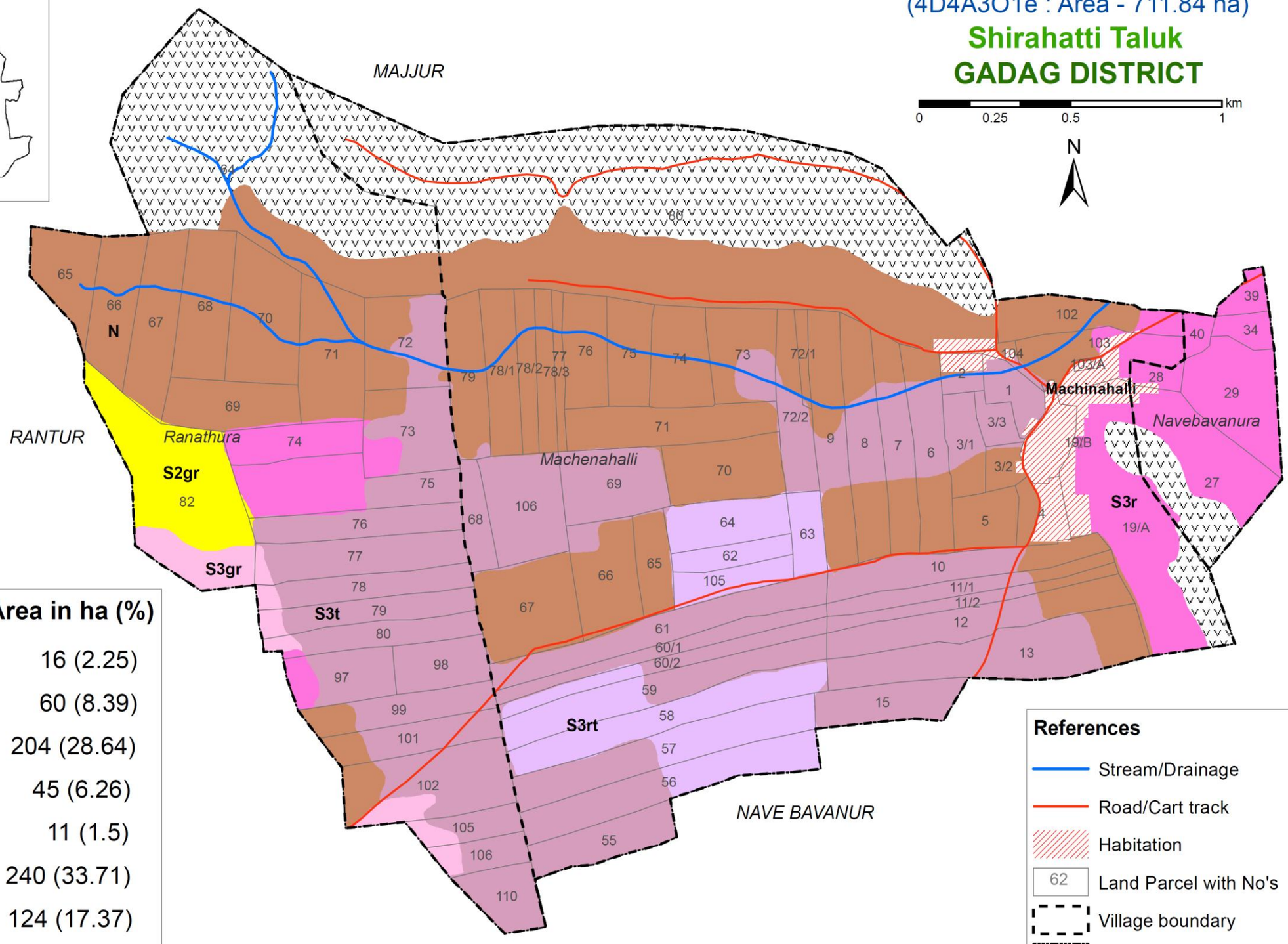
LAND SUITABILITY FOR TAMARIND

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT



Key
S2-Moderately Suitable
S3-Marginally Suitable
N-Not Suitable

Limitations
g- gravelliness
r- rooting condition
t- texture

Suitability	Area in ha (%)
S2gr	16 (2.25)
S3r	60 (8.39)
S3t	204 (28.64)
S3rt	45 (6.26)
S3gr	11 (1.5)
N	240 (33.71)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

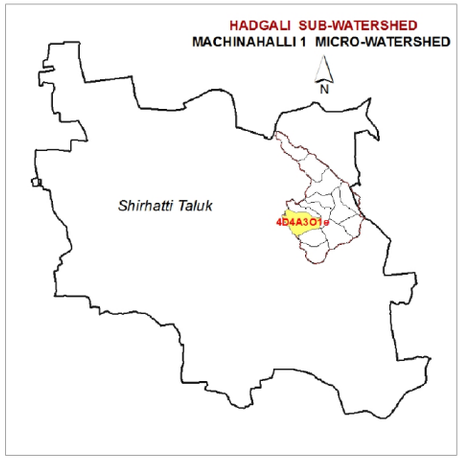
LAND SUITABILITY FOR MARIGOLD

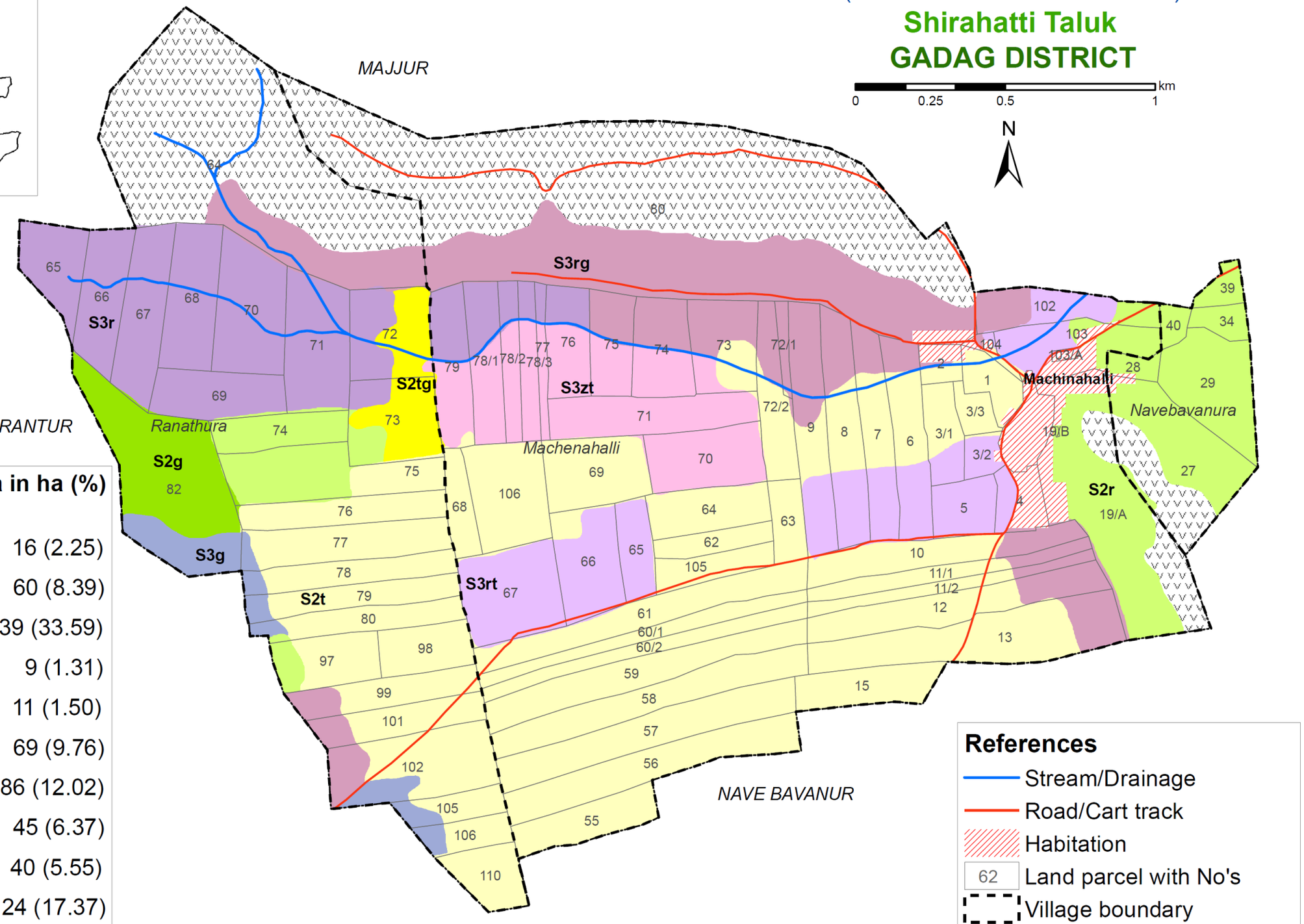
Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT





Key
S2-Moderately Suitable
S3-Marginally Suitable

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

Suitability subclass	Area in ha (%)
S2g	16 (2.25)
S2r	60 (8.39)
S2t	239 (33.59)
S2tg	9 (1.31)
S3g	11 (1.50)
S3r	69 (9.76)
S3rg	86 (12.02)
S3rt	45 (6.37)
S3zt	40 (5.55)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

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

Source: ICAR-NBSS&LUP, Bengaluru

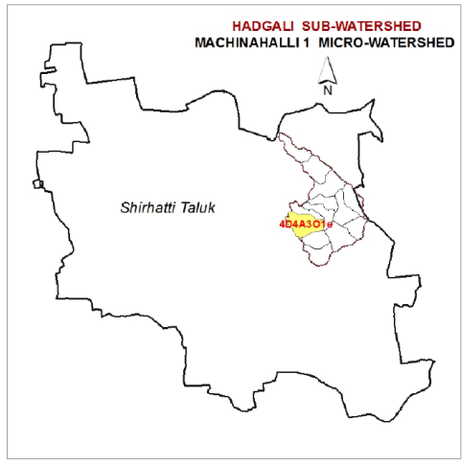
LAND SUITABILITY FOR CHRYSANTHEMUM

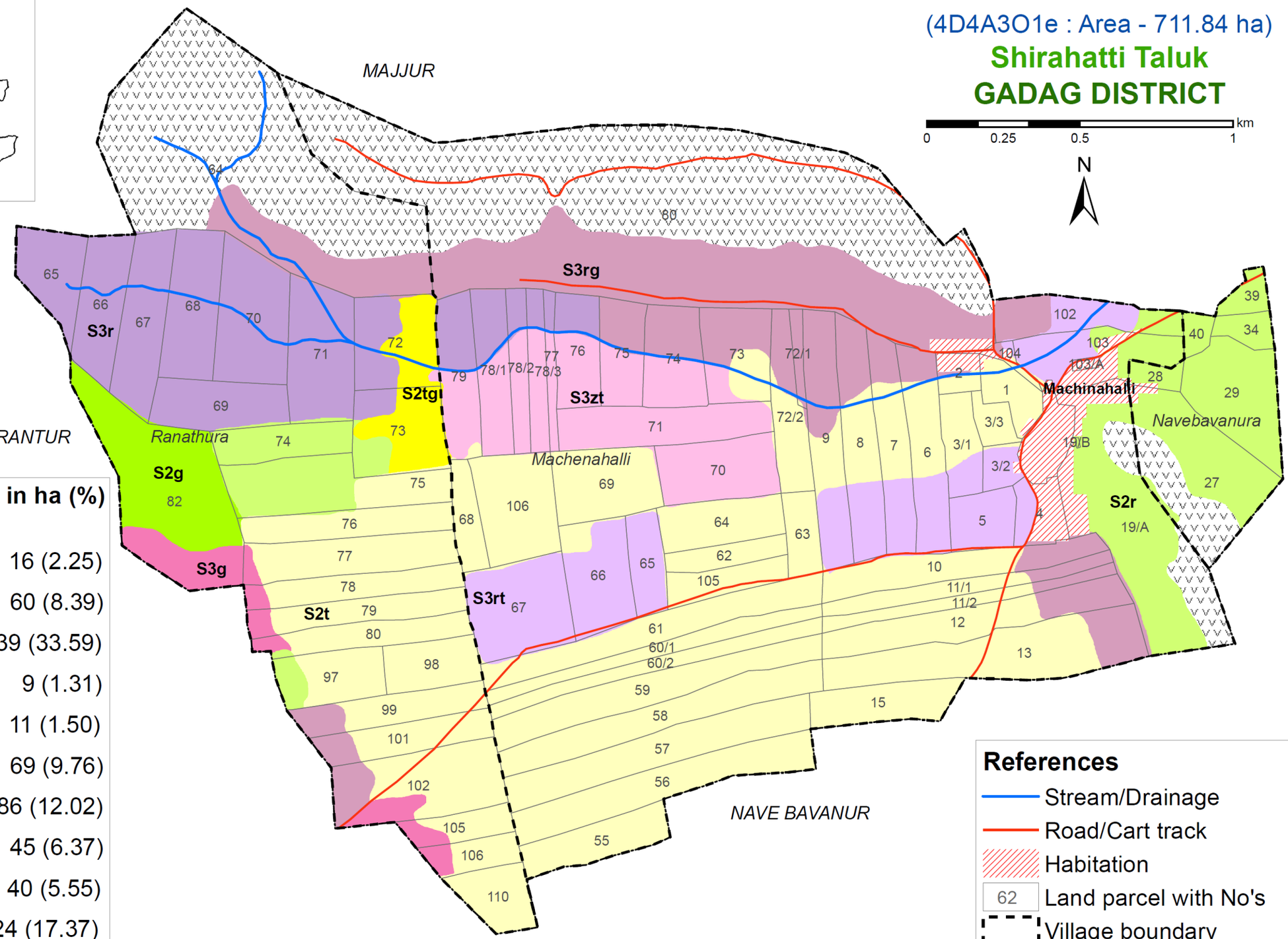
Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT





Key
S2-Moderately Suitable
S3-Marginally Suitable

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

Suitability subclass	Area in ha (%)
S2g	16 (2.25)
S2r	60 (8.39)
S2t	239 (33.59)
S2tg	9 (1.31)
S3g	11 (1.50)
S3r	69 (9.76)
S3rg	86 (12.02)
S3rt	45 (6.37)
S3zt	40 (5.55)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

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

Source: ICAR-NBSS&LUP, Bengaluru

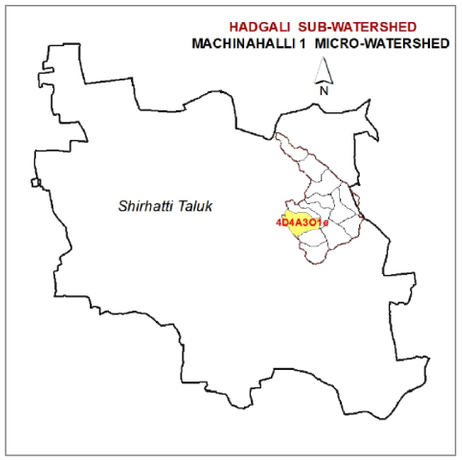
LAND MANAGEMENT UNITS

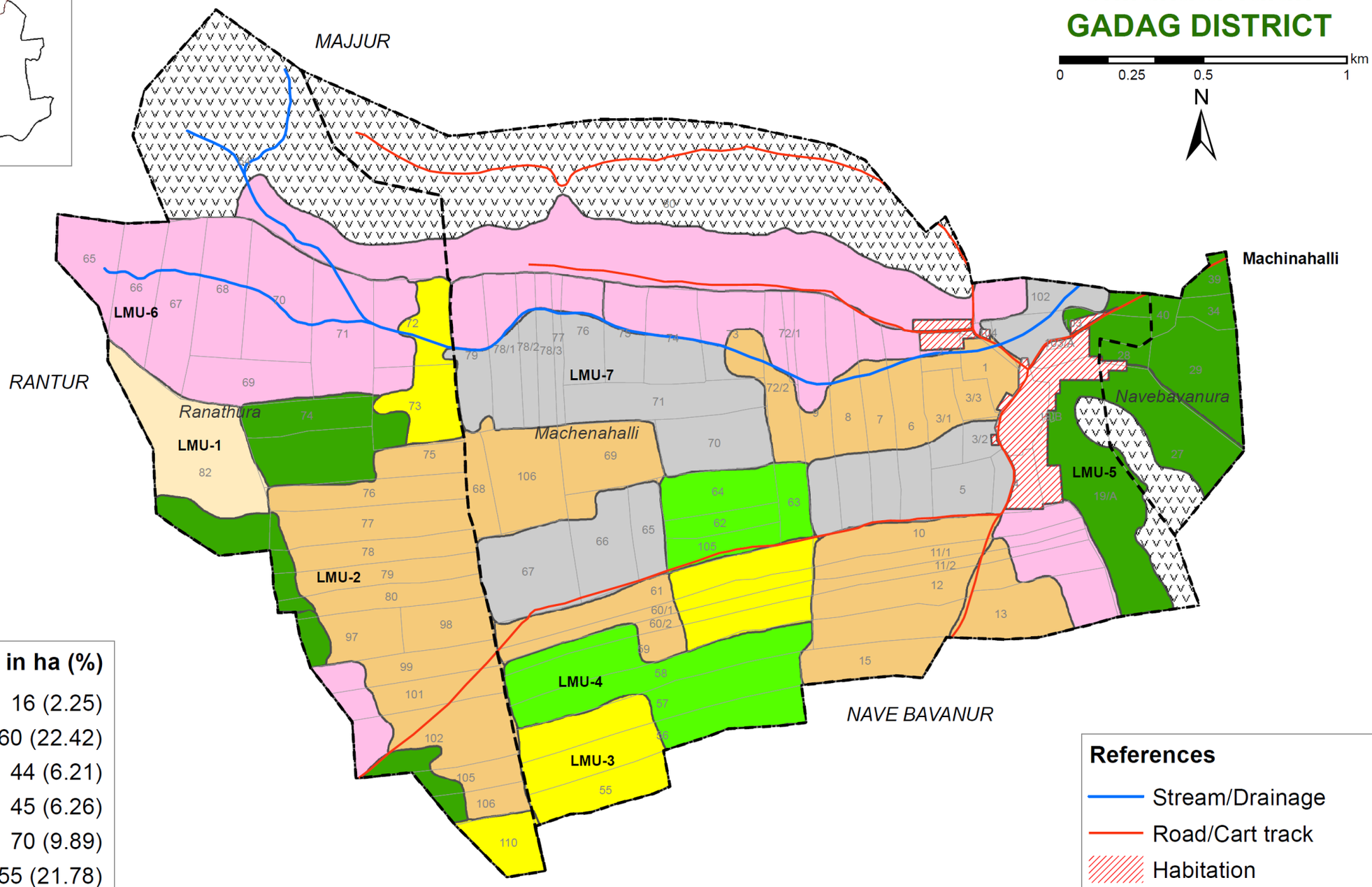
Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT





Legend	Area in ha (%)
LMU-1	16 (2.25)
LMU-2	160 (22.42)
LMU-3	44 (6.21)
LMU-4	45 (6.26)
LMU-5	70 (9.89)
LMU-6	155 (21.78)
LMU-7	85 (11.92)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

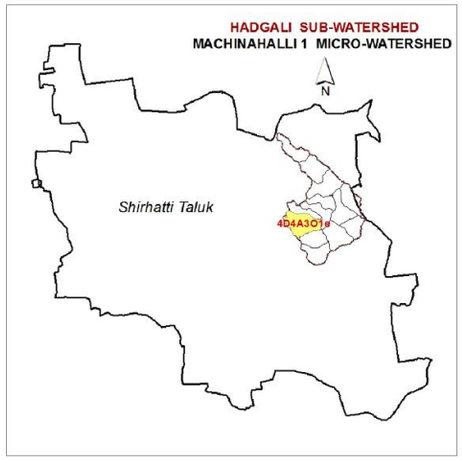
NOTE: *Proposed Crop Plan for LMU's are given in Table.*

Table. Proposed Crop Plan for Machinahalli-1 Micro-watershed, Hadgali Sub-watershed Shirahatti Taluk, Gadag District based on soil-site–crop suitability Assessment

LMU No.	Mapping Units	Survey Number	Field Crops/Forestry	Suitable Horticulture Crops under Irrigation	Horticulture Crops with suitable Interventions	Suitable Interventions
LMU 1	3 (100-150 cm)	Ranathura: 82	Ragi, Maize, Groundnut, Sorghum, Sunflower, Bajra, Sesamum, Castor	**Perennial Component:** Mango, Tamarind, Aonla, Pomelo **Intercrops:**Groundnut, Hebbal Avare, Clusterbean, Coriander **Vegetables:** Tomato, Green Chillies, French Bean, Bhendi, Vegetable Cowpea, Cucurbits **Flower Crops:** Marigold, Gaillardia	Mango, Sapota, Guava, Lime, Banana, Papaya, Jamun **Mixed Orcharding:** Mango+Guava+Drumsticks+ Curry leaf Sapota+Guava+Drumsticks+ Curryleaf **Vegetables**: Tomoto, Capsicum, Green Chillies, French Bean, Bhendi, Crucifers, Cucurbits **Flower Crops:** Tuberose, Aster, Chrysanthemum, Rose, Jasmine, Spider Lilly	-do-
LMU 2	18, 19, 20 (100-150 cm)	Machenahalli: 1,2,3/1,3/3,6,7, 8,10,11/1,11/2, 12,13,15,60/1, 61,68,69,72/2, 104,106 Ranathura: 76,77,78,79,80, 97,98,99,101, 102,105,106	Sorghum, Redgram, Cotton, Sunflower, Safflower, Linseed, Coriander, Bajra, Bengal gram **Multiple Crop rotation:** Redgram+Fodder jowar Pulses+Sorghum	**Vegetables:** Chillies, Tomato, Bhendi, Onion, Cabbage, Drumstick **Perenial Components:** Tamarind, Custard Apple, Amla, Lime, Moosambi, Pomegranate	**Flower Crops:** Marigold, Gaillardia, Tuberose, Chrysanthemum **Perenial components:** Tamarind, Custard Apple, Amla, Lime, Moosambi, Pomegranate **Vegetables:** Chillies, Bhendi, Crucifers	Drip irrigation, Mulching, other suitable conservation practises

To be continued….

LMU No.	Mapping Units	Survey Number	Field Crops/Forestry	Suitable Horticulture Crops under Irrigation	Horticulture Crops with suitable Interventions	Suitable Interventions
LMU 3	4, 5, 6, 7 (75-100 cm)	Machenahalli: 55,60/2 Ranathura: 73,110	Sorghum, Bajra, Sunflower, Cotton, Safflower **Multiple/Crop rotation:** Redgram+Maize, Redgram+Fodder jowar, Pulses+Sorghum	**Vegetables:** Chillies, Tomato, Bhendi, Onion, Cabbage, Drumstick **Perenial Components:** Tamarind, Custard Apple, Amla, Lime, Moosambi, Pomegranate	**Flower Crops:** Marigold, Gaillardia, Tuberose, Chrysanthemum **Perenial Components:** Tamarind, Custard Apple, Amla, Lime, Moosambi, Pomegranate **Vegetables:** Chillies, Bhendi, Crucifers	Drip irrigation, Mulching, other suitable conservation practices
LMU 4	1, 2 (50-75 cm)	Machenahalli: 56,57,58,59, 62,63,64,105	Sorghum, Cotton, Bajra, Bengal gram, Safflower, Redgram	**Vegetables:** Chillies, Tomato, Bhendi, Cabbage, Drumstick, Onion, Ridge Gouard, Ashguard	Bear, Fig, Aonla, Pomelo	-do-
LMU 5	14, 15, 16, 17, 22 (50-75 cm)	Machenahalli: 19/A,19/B Navebavanura: 27,28,29,34,39,40 Ranathura: 74,75	Ragi, Bajra, Horsegram, Groundnut	Bear, Custurd Apple **Vegetables:** Cluster Bean, Ridge Gouard, Ash Gouard	Fig, Aonla, Pomelo	Drip irrigation, Mulching, other suitable conservation practices
LMU 6	8, 9, 10, 11, 12, 13 (25-50 cm)	Machenahalli: 9,72/1,73 Ranathura: 65,66,67,68,69,70,71,72	Groundnut,Horsegram, Greengram **Silviculture:**Simaruba, Acacia auriculiformis,Glyricidia, Subabul, Agave, Cassiasp.	**Vegetables:** Chillies, Tomato	-	-do-
LMU 7	21, 23, 24 (25-50 cm)	Machenahalli: 3/2,5,65,66,67, 70,71,74,75,76,77,78/1,78/2,78/3,79,102,103	Bengalgram, Cowpea, Greengram	-	-	-do-



SOIL & WATER CONSERVATION PLAN

Machinahalli 1 Micro-watershed

(4D4A3O1e : Area - 711.84 ha)

Shirahatti Taluk

GADAG DISTRICT

0 0.25 0.5 1 km

N

MAJJUR

RANTUR

NAVE BAVANUR

Ranathura

Machenahalli

Machinahalli

Navebavanura

Legend	Area in ha (%)
Graded Bunding	160 (22.42)
TCB	415 (58.32)
Rock outcrops	124 (17.37)
Others*	13 (1.89)

* - Habitation

References

- Stream/Drainage
- Road/Cart track
- Habitation
- 62 Land Parcel with No's
- Village boundary
- Micro-watershed boundary

Source: ICAR-NBSS&LUP, Bengaluru

PART - B

Hydrological Inventory of Hadgali Sub-watershed, Shirahatti Taluk, Gadag 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 Hadgali Sub-watershed, Shirahatti Taluk, Gadag District, Karnataka for Watershed Planning and Development

Prepared by
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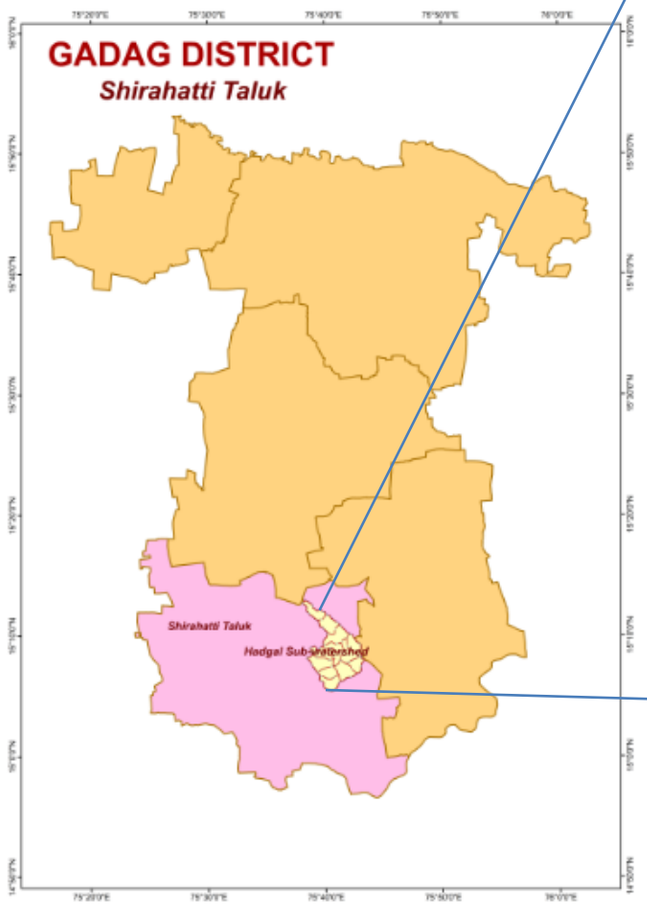
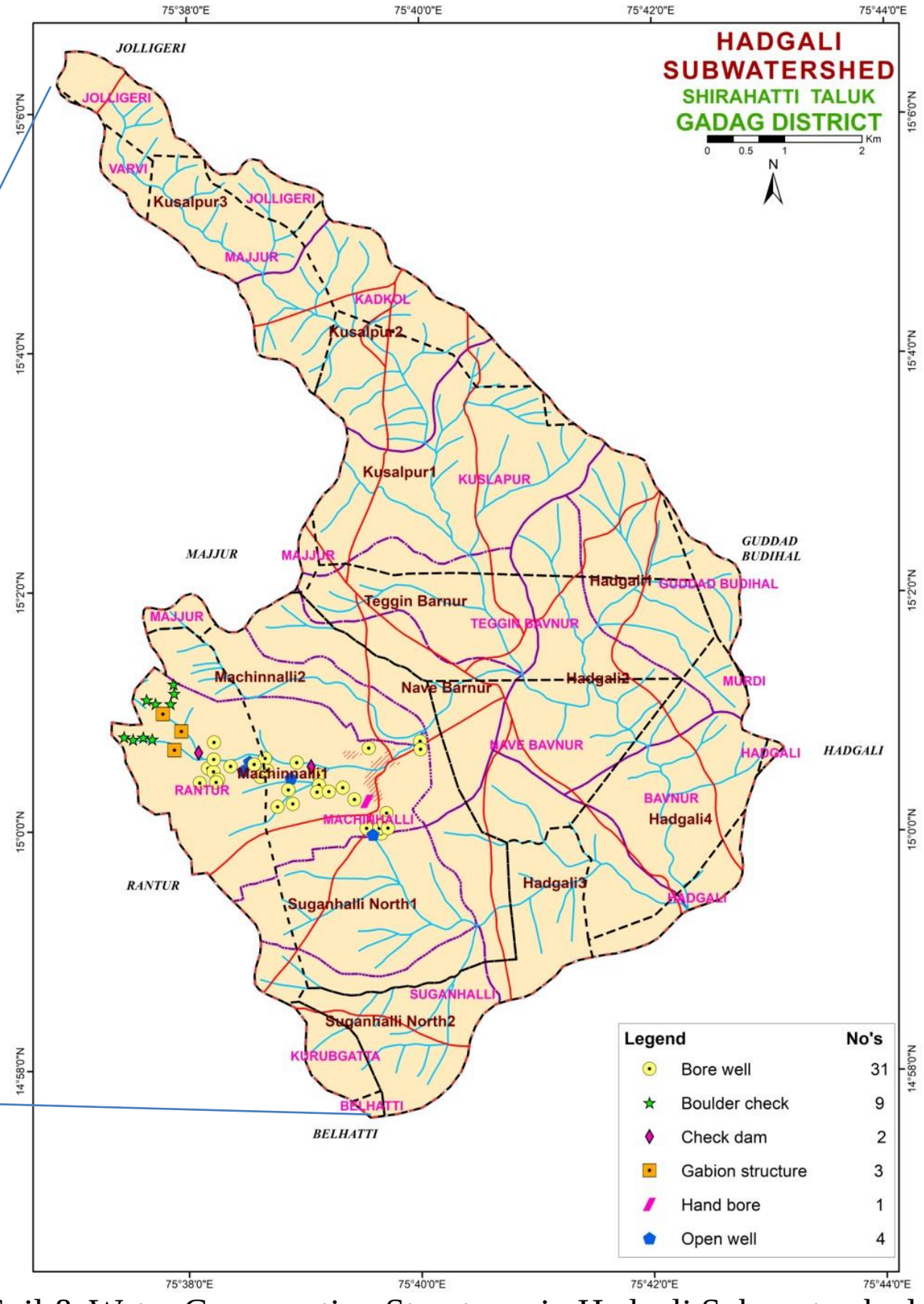
INTRODUCTION

- The inventory and documentation of spatial and temporal changes in hydrological components of Hadgali sub-watershed (4D4A3O) in Shirahatti taluk, Gadag district, has been undertaken for integrated planning, development and management at the level of soil mapping units.
- Hadgali sub-watershed (Shirahatti taluk, Gadag district) is located between $15^0$8'59''–$15^0$6'34'' North latitudes and $75^0$40'56''–$75^0$38'10'' East longitudes, covering an area of about 5896 ha.
- This sub-watershed encompasses of 13 MWs namely, Hadgali-1 (4D4A3O2a), Hadgali-2 (4D4A3O2b), Hadgali-3 (4D4A3O2f), Hadgali-4 (4D4A3O2c), Kusalpur-1 (4D4A3O1c), Kusalpur-2 (4D4A3O1b), Kusalpur-3 (4D4A3O1a), Machinnalli-1 (4D4A3O1e), Machinnalli-2 (4D4A3O1f), Nave Barnur (4D4A3O1g), Suganhalli North-1 (4D4A3O2d), Suganhalli North-2 (4D4A3O2e) and Teggin Barnur (4D4A3O1d) micro watersheds. Land Resource Inventory (LRI) was generated for one among the thirteen micro-watersheds.
- Average annual rainfall (1960-2014) of the Hobli (Block) pertaining to the sub-watershed is 685 mm.
- In this sub-watershed major *kharif* crops grown are Maize, Cotton, Sunflower, Groundnut, Onion, Sugarcane and major *rabi* crops are Sorghum, Bengal gram and Safflower.
- Hydrological components namely rainfall (annual, *kharif*, *rabi* and summer), PET, AET, runoff, surface soil moisture, ground water status and water balance are presented.

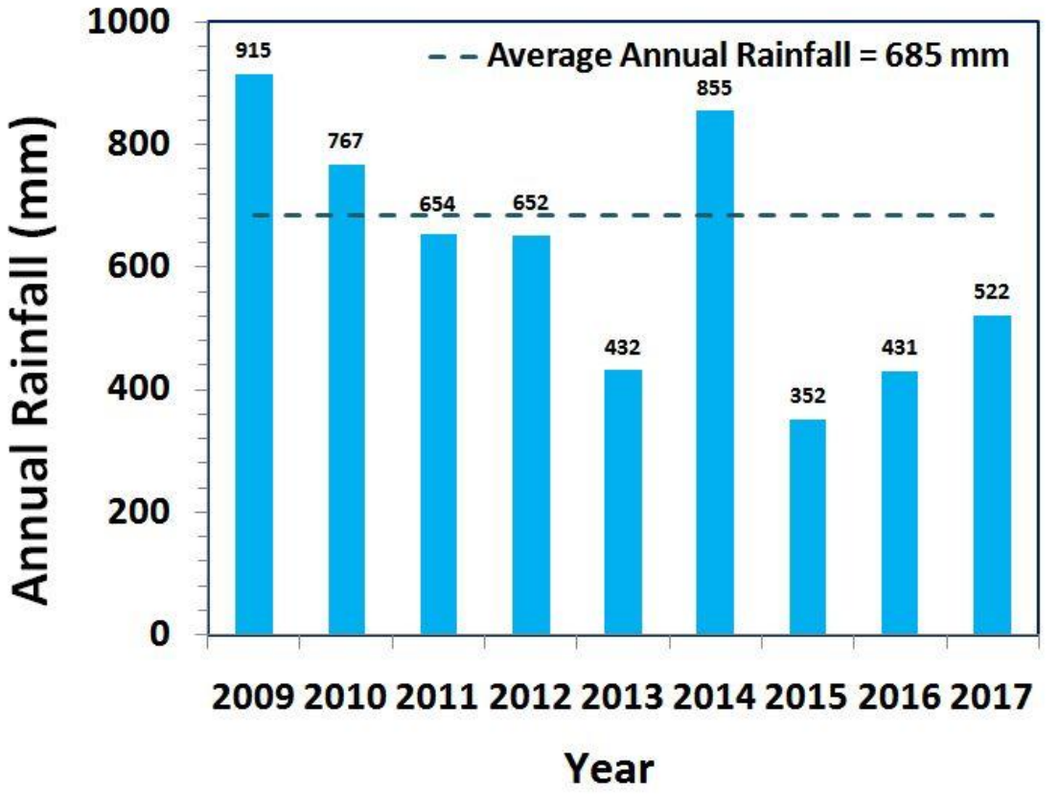
LOCATION MAP OF HADGALI SUB-WATERSHED





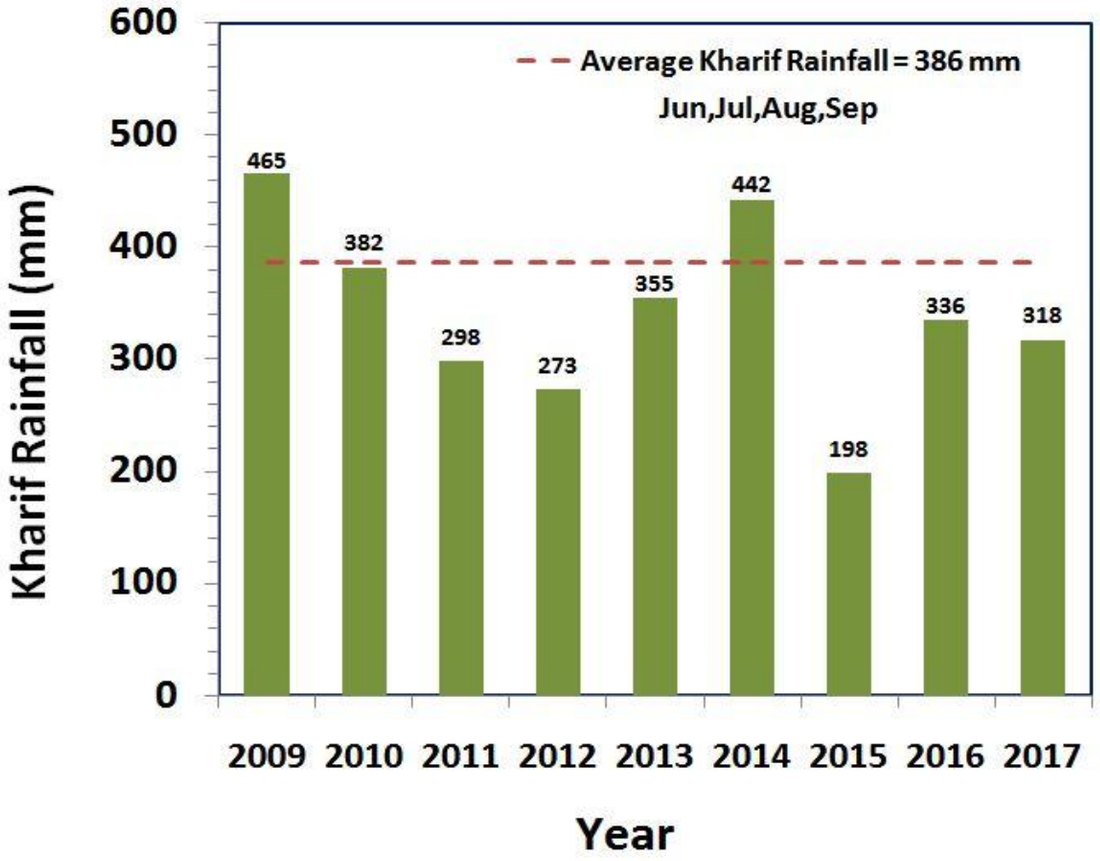
Soil & Water Conservation Structures in Hadgali Sub-watershed, Shirahatti taluk, Gadag district

RAINFALL INDEX

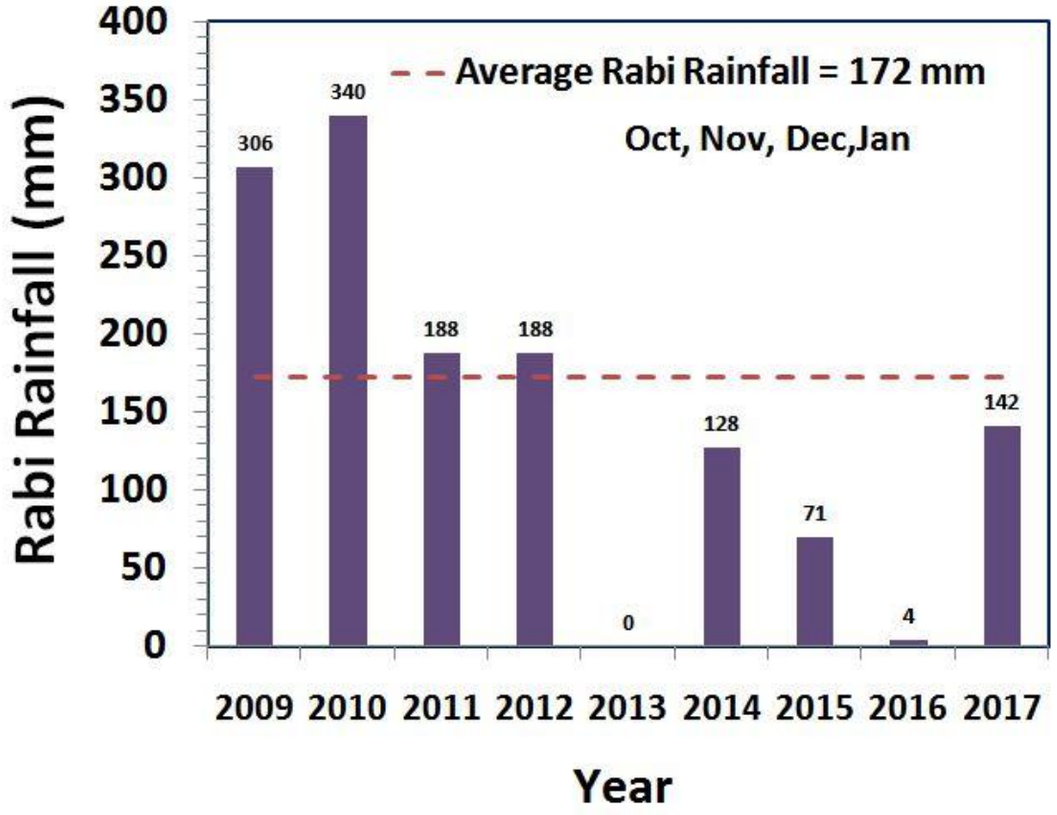


The average annual rainfall (1960-2014) recorded at the Shirahatti station in Shirahatti taluk of Gadag district is 685 mm. The annual rainfall at Shirahatti station (Hobli H.Q.) is presented. During the years 2011, 2012, 2013, 2015, 2016 and 2017 the annual rainfall was deficient by 5%, 5%, 37%, 49%, 37% and 24% respectively.

The *kharif* rainfall (Jun–Sep) is an average about 57% of the annual rainfall and it typically follows the annual rainfall patterns. During the years 2011, 2012, 2013, 2015, 2016 and 2017 the *kharif* rainfall was deficient by 23%, 29%, 8%, 49%, 13% and 18% respectively.

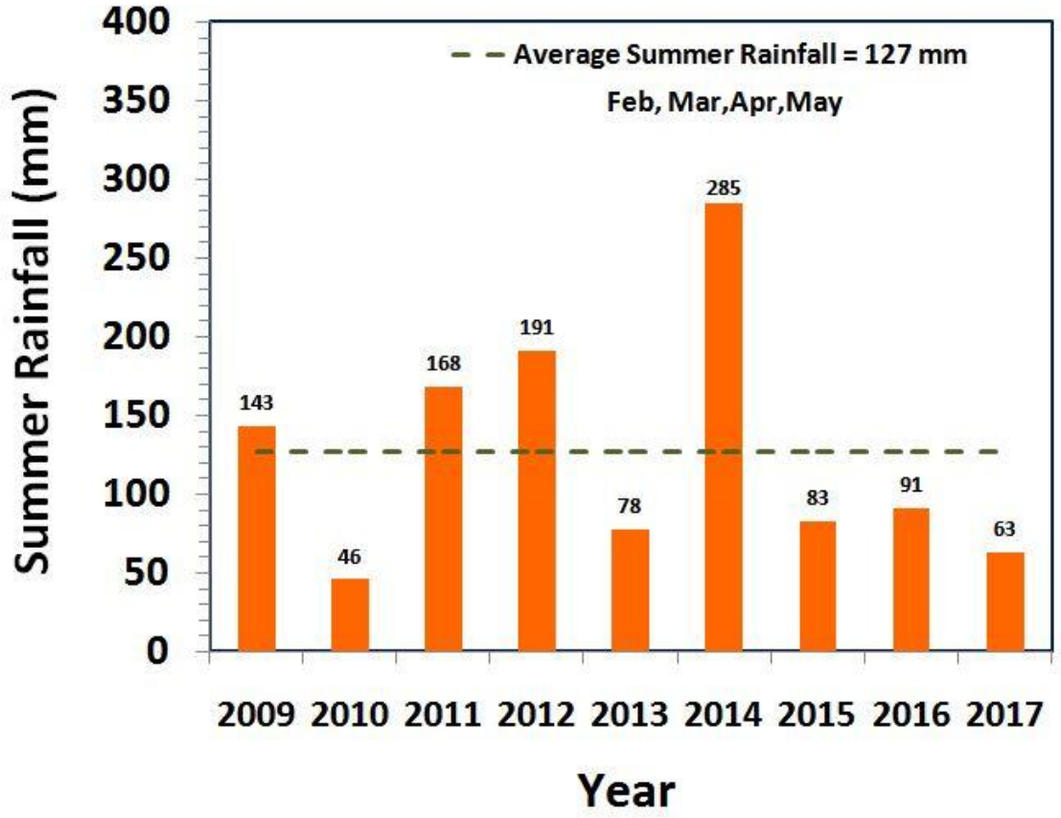


RAINFALL INDEX

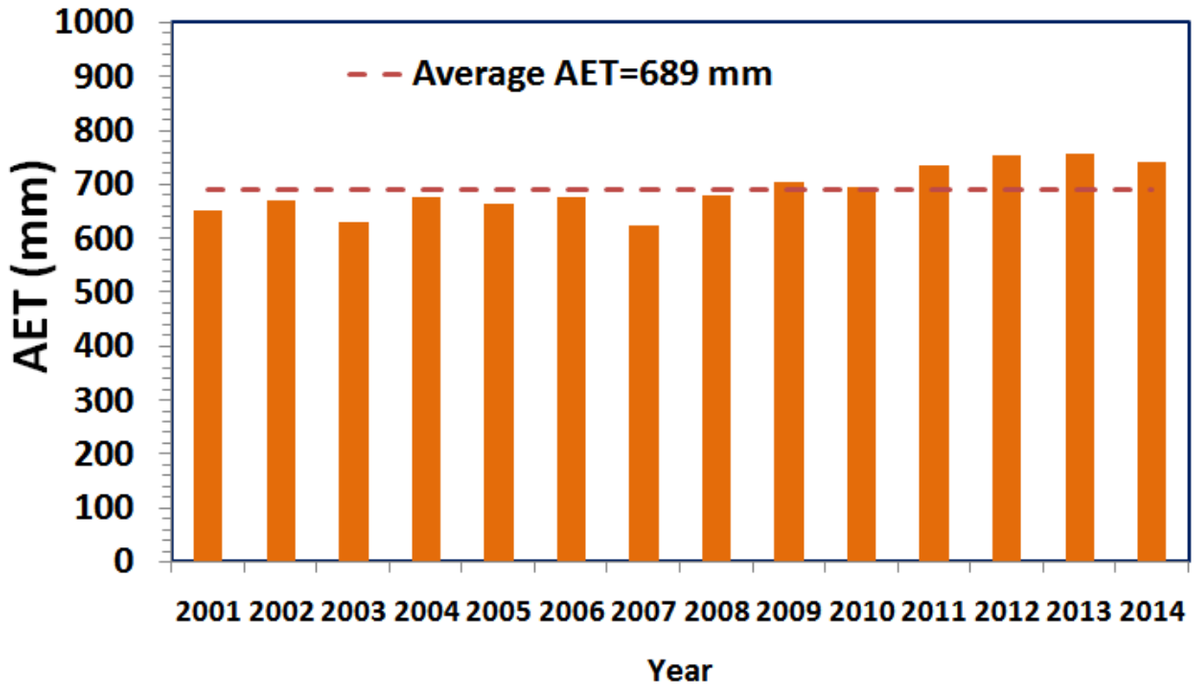


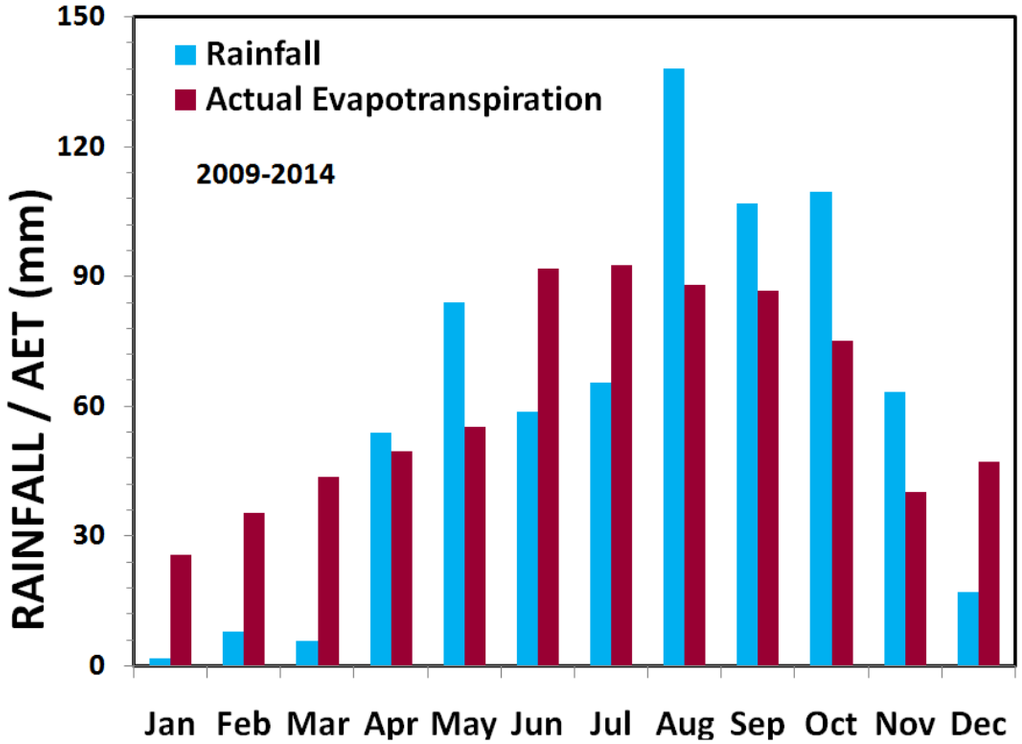
The average *rabi* rainfall (Oct-Jan) is about 22% of the average annual rainfall. During the years 2013, 2014, 2015, 2016 and 2017 the *rabi* rainfall was deficient by 100%, 26%, 59%, 98% and 17% respectively.

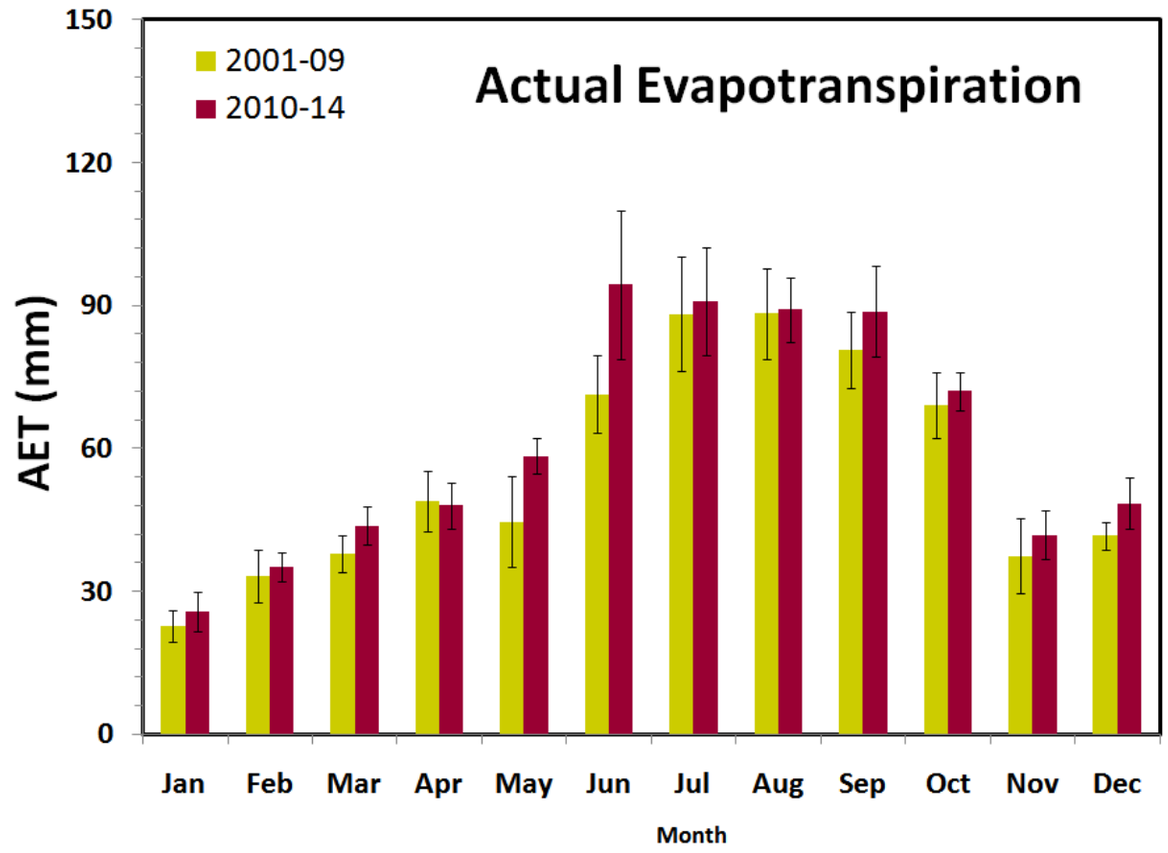
The average summer rainfall (Feb-May) is about 21% of the average annual rainfall.



EVAPOTRANSPIRATION

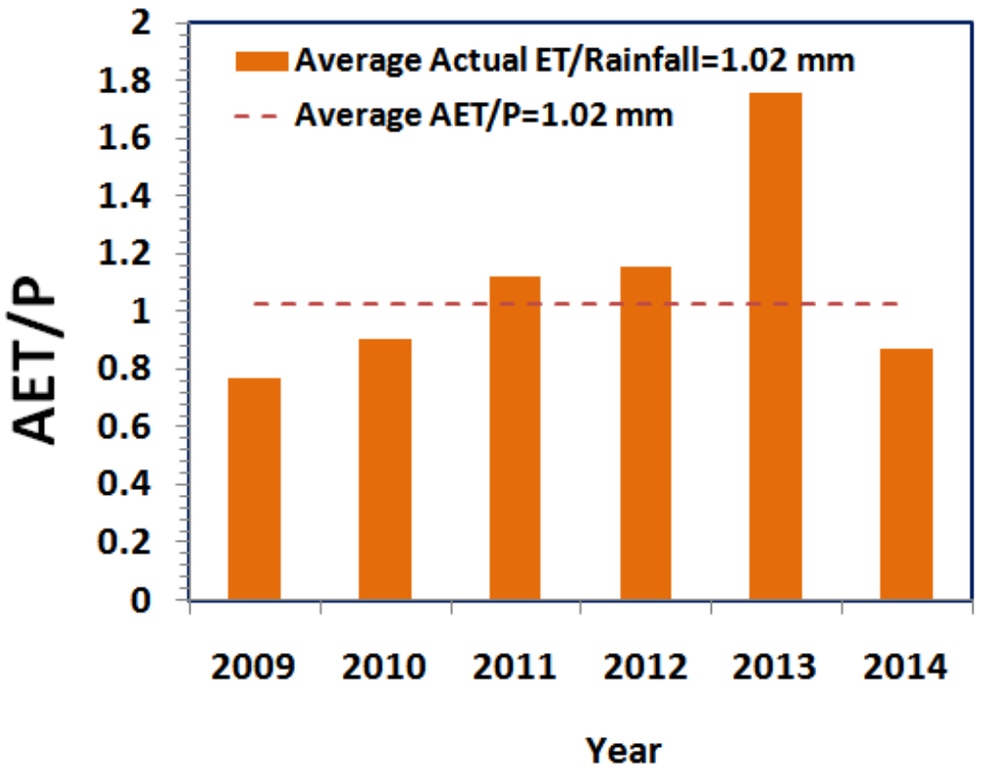




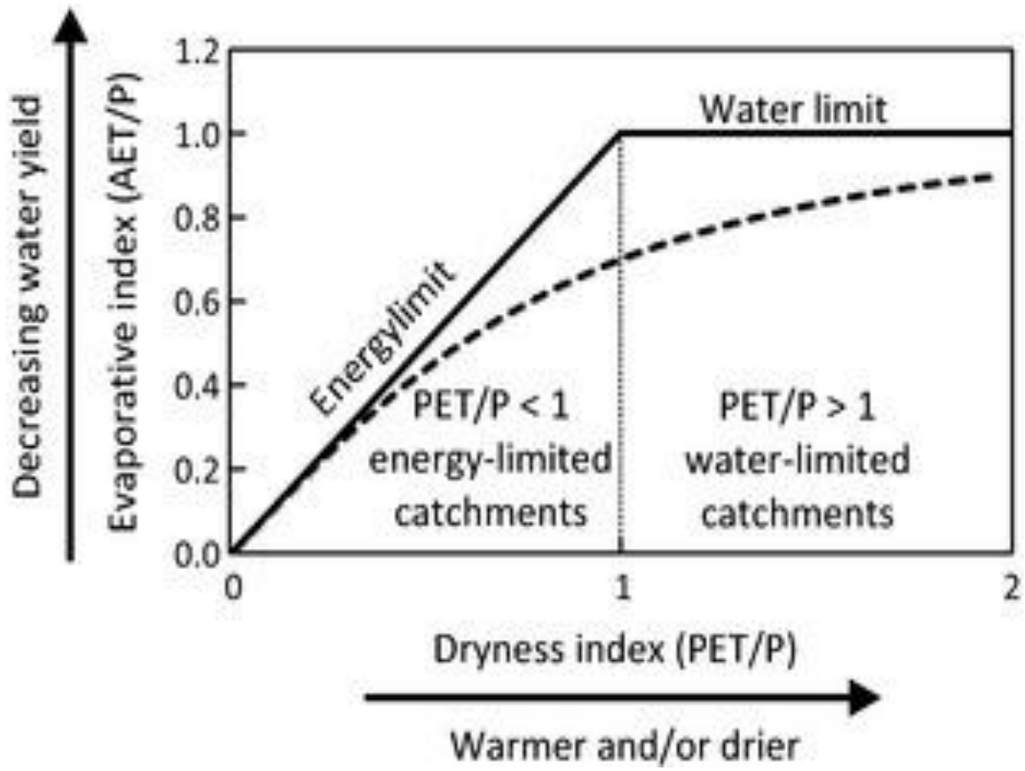


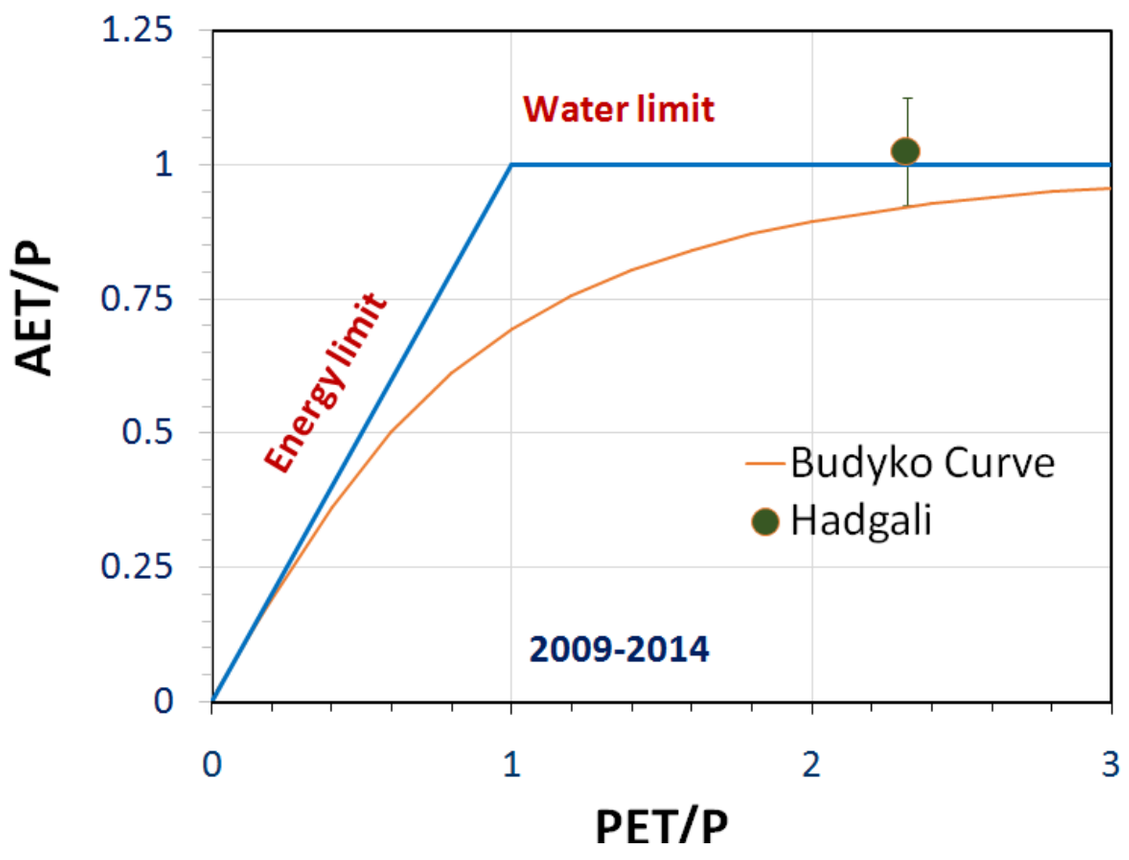
The average annual actual ET and the average rainfall found almost same. During *kharif*, average rainfall and ET was found to be 341 mm and 359 mm respectively, whereas in *rabi* it was about 152 mm and 188 mm. In comparison to the 2001-2009, the annual ET increased by 10% during 2010-2014.

EVAPOTRANSPIRATION INDEX

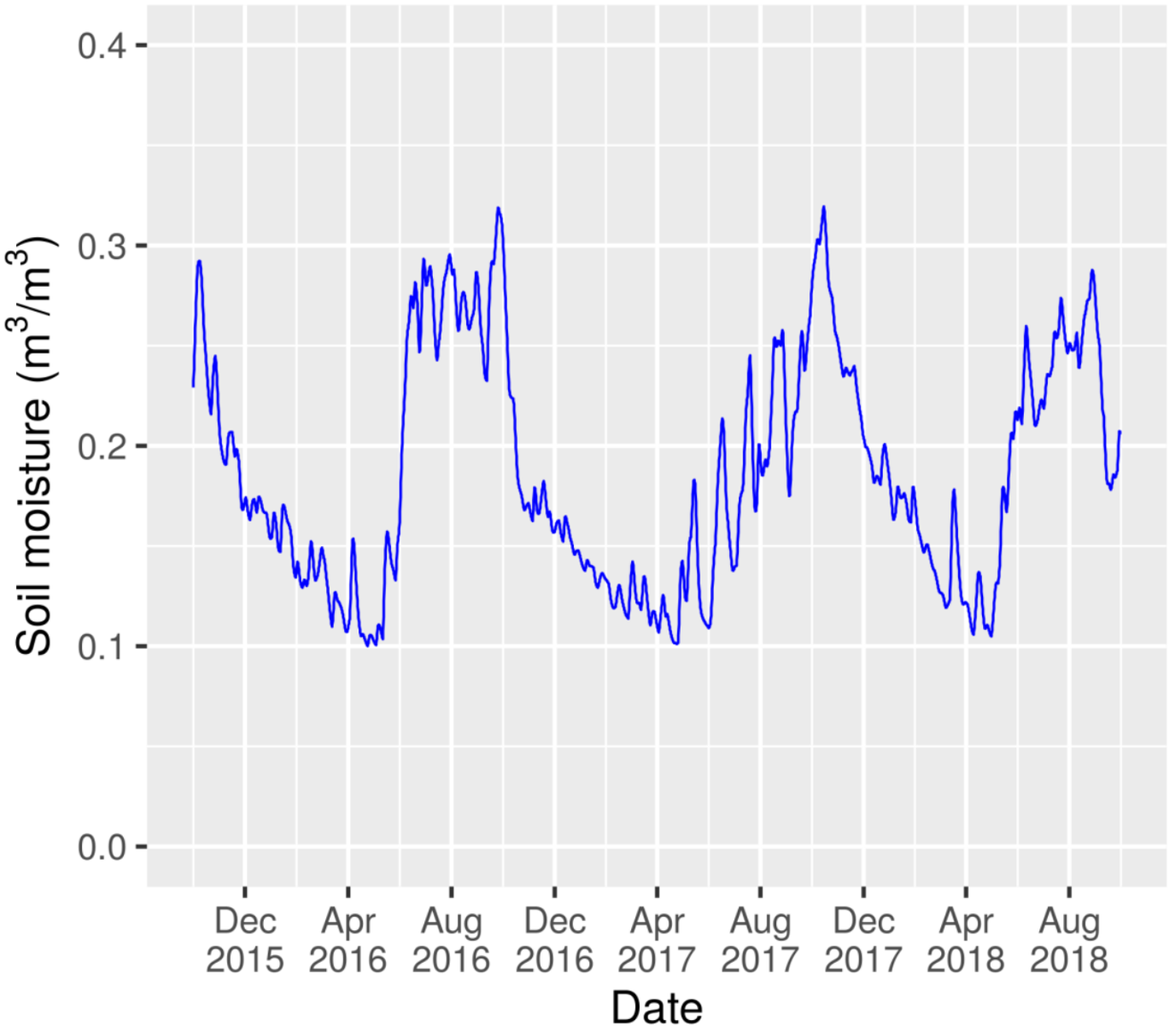


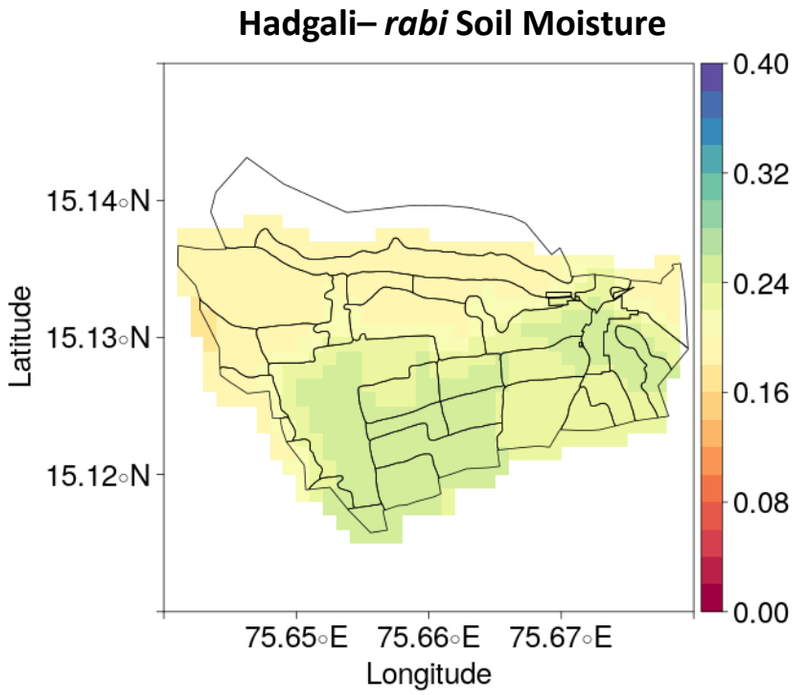
The average AET/P ratio was about 102%, which is higher than the sustainable limit of about 80%. Even during extremely lower rainfall year of 2013, AET was 690 mm. This suggests the presence of water storage and utilization from other sources such as groundwater, which buffered the lower rainfall.

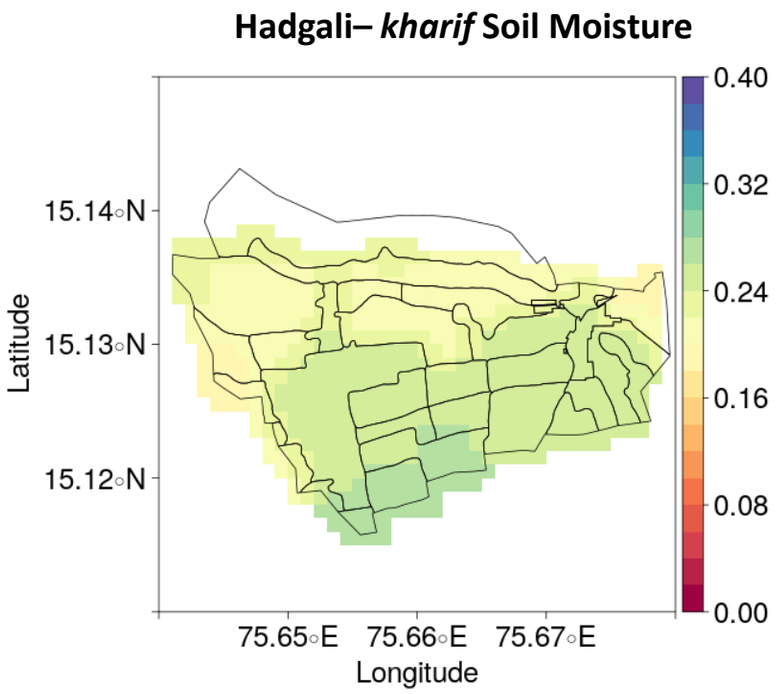




SATELLITE RETRIEVED SOIL MOISTURE





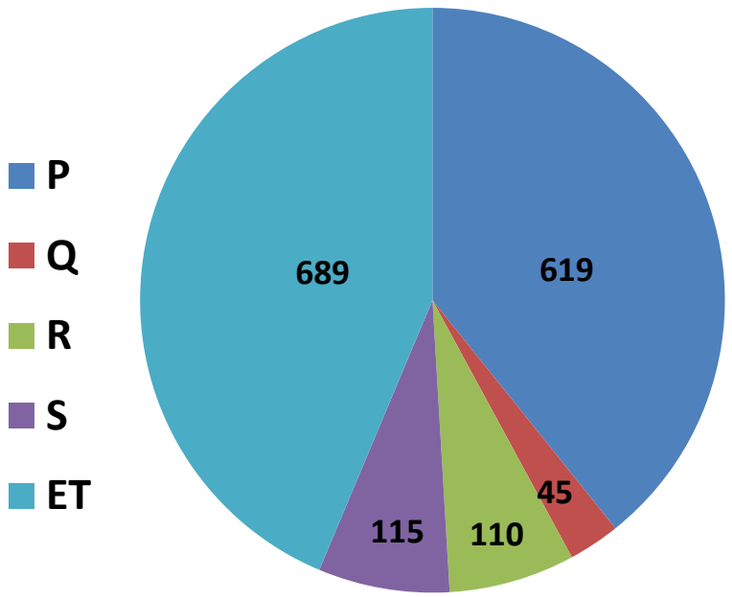


The method developed for retrieving soil moisture from multi-satellite observations allowed to map surface soil moisture behavior in the micro-watershed. The available surface moisture was varied in the range of 29-20% in *kharif* and 15-31% in *rabi* seasons of 2016 and 17-11% in *kharif* and 18-30% 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

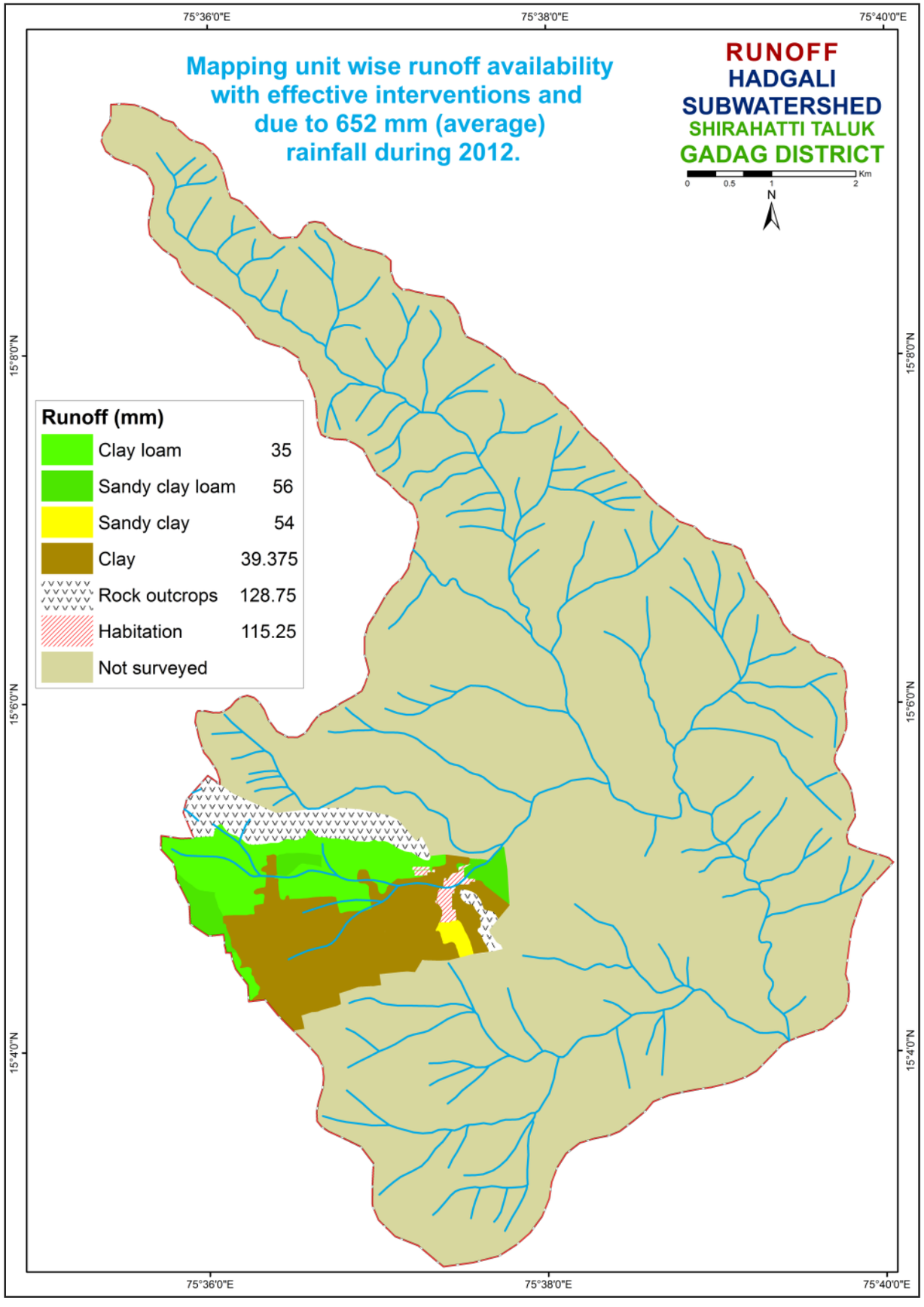


During August-October months, Precipitation is higher than Evapotranspiration, hence Runoff can occur in the watershed.

P = 619 mm (average of 2009-2017) ET = 689 mm R = 110 mm S = 115 mm Q = 45 mm

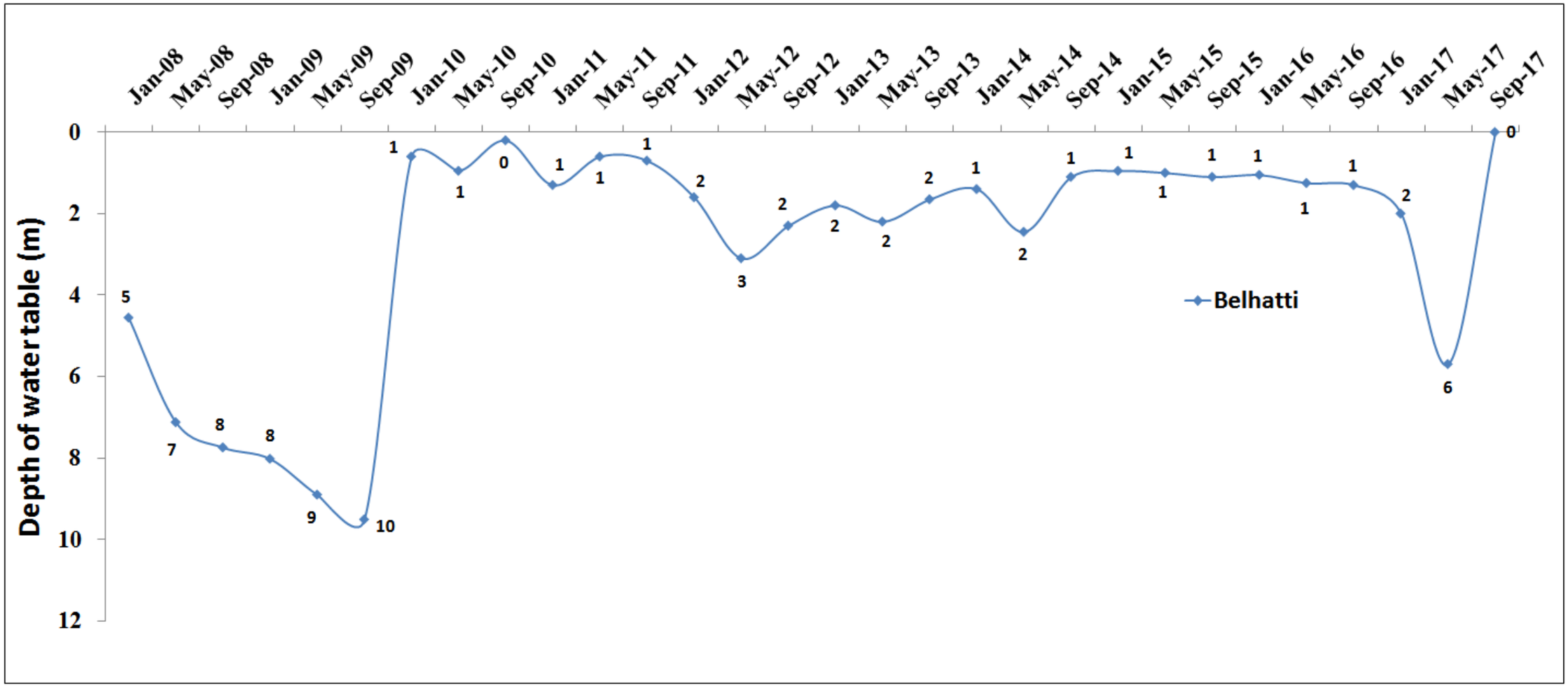
Sl. No.	Parameters	Average_ 2012 (mm)
1.	Rainfall	652
2.	Runoff availability with existing conditions	99
3.	Runoff availability with effective interventions	56
4.	Runoff allowed as environmental flow at the outlet	11
5.	Runoff excess for harvesting by construction of structures	45

RUNOFF


75°36'0"E
75°38'0"E
75°40'0"E
15°8'0"N
15°6'0"N
15°4'0"N
Mapping unit wise runoff availability with effective interventions and due to 652 mm (average) rainfall during 2012.
RUNOFF
HADGALI
SUBWATERSHED
SHIRAHATTI TALUK
GADAG DISTRICT
0 0.5 1 2 Km
N
Runoff (mm)
Clay loam 35
Sandy clay loam 56
Sandy clay 54
Clay 39.375
Rock outcrops 128.75
Habitation 115.25
Not surveyed

GROUND WATER STATUS

BELHATTI STATION



The total number of wells present in Hadgali Sub-watershed as per LRI data is 62 (44-Borewells and 18-Open wells). The groundwater level was found from the data obtained from KSNDMC for the nearest station Belhatti. The above graph depicts the groundwater levels during the years 2008-2009 were slightly declining. Whereas groundwater levels during the years 2010-2017 was slightly varying except sep 2017 year. Deepest levels were found in 2009.

X

SUMMARY

- The average annual rainfall of 685 mm in the Hadgali sub-watershed as recorded from the Shirahatti station data by KSNDMC.

- 57%, 22% and 20% 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 45 mm for an average annual rainfall of 619 mm (2009-2017). The utilizable groundwater is 77 mm (70% of 110 mm recharge estimated). This means the total available water resource combining the soil moisture store for kharif & rabi (115 mm) and utilizable runoff plus recharge is 237 (=115+77+45)

- The average actual evapotranspiration estimated in the watershed based on the current land use and irrigation practices for the kharif and rabi seasons is 547 mm. Hence the amount of water use for kharif and rabi seasons may be estimated as 684 mm (i.e 125% of AET). This demand for the two seasons is higher by 447 mm, i.e. (684-237). The AET in June-Sept months is 97% of rainfall. Hence, there is a less opportunity to harvest the excess water through watershed management practices for utilizing during rabi season.

- The total number of wells present in Hadgali Sub-watershed as per LRI data is 62 (44-Borewells and 18-Open wells). The groundwater level was found from the data obtained from KSNDMC for the nearest station Belhatti. Deepest levels were found in 2009.