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Land resource inventory of kalmali north-1 micro watershed to derive land capability and land suitability for field crops

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Abstract

A detailed study was conducted to assess the land capability and land suitability of Kalmali North-1 micro watershed. The micro watershed is located in Lingasugur taluk, Raichur district, Karnataka, India. Initially, a detailed land resource survey was carried out at 1:8000 scale to derive soil phase units based on land surface and profile characters. Six soil series were identified and further mapped into seven soil phase units. The soil phase unit "FTPmB2" covered maximum area of 143 ha (56.97%) with gently sloping (1-3%) and moderate erosion in Kalmali North-1 micro watershed. Land capability classes in the study area were I_{es}, III_{es} and IV_{es} with limitations of soil erosion, texture, soil drainage, soil fertility and topography. Suitability for agricultural crops showed that an area of 172 ha (68.78%) was highly suitable (S1) for growing Paddy, Cotton, Sorghum and Green gram and about 71 ha (21.81%) was moderately suitable (S2) for Sorghum and Green gram with limitation to topography and texture. Soil phase unit wise crop plan with suitable interventions for field crops, horticultural crops, vegetables, millets and pulses were developed, which by implementing increases productivity and farm income.

Keywords: micro watershed, land resource inventory, land capability classification, land suitability

Introduction

North-Eastern dry zone part of Karnataka is having very hot and semi-arid climate. The rainfall region is very erratic and prone to drought and most of the region is covered with black cotton soil with Pigeon pea, Paddy and Cotton as major crops. Soil which is a natural resource has variability inherent to how the soil formation factors interact within the landscape. However, variability can occur also as a result of cultivation, land use and erosion. Salviano (1996) [9] reported spatial variability in soil attributes as a result of land degradation due to erosion. The land resources inventory in the micro watershed for various crops is necessary to choose the right crop and suitable variety for the area. In order to assess, a detailed land resource inventory and its evaluation were undertaken using geospatial technology. The geospatial techniques are essential for the investigation of spatial variations of soil and crop parameters across agricultural fields, which can lead to the efficient implementation of site-specific management systems (Najafian *et al.* 2012) [1].

Therefore, the study was undertaken to assess land capability and crop suitability in relation to land resource characteristics of Kalmali North-1 micro watershed of North Eastern Dry Zone of Karnataka.

Materials and Methods

Kalmali North-1 micro watershed is located (Fig.1) in Raichur taluk of Raichur district, Karnataka state, which lies between lat-long of 77° 13' 3.543"E - 16° 15' 24.888"N (top right) and 77° 14' 13.352"E - 16° 14' 23, 78"N (bottom left) and having total area of 250.47 hectares. The Kalamali north-1 is surrounded by Venkatapur marched, Kalmali and Gonpad villages. The average rainfall of this region is 560 mm. geologically the study area is characterized by granite and gneiss.

The detailed land resource survey (at 1:8000 scale) of the entire micro-watershed was carried out in the year 2016. Rapid traversing was carried out with the help of cadastral map overlaid on Cartosat-1 merged with IRS LISS-IV imagery having 2.5 m spatial resolution, to record

soils at varying physiographic position. Based on geology, drainage pattern, surface features, slope characteristics and land use, landforms and soil profile were identified (Soil Survey Staff 1999) [11]. Six soil series were identified and further mapped into seven soil phases units and their area distribution and description were mapped in Fig.3 and tabulated in Table1. Soil morphological characteristics of different soil are shown in table 2. These data have been used to evaluate the land capability and land suitability (Sehgal 1996) [10]. For various field and horticultural crops crop plan were developed based on the soil limitations, climatic regimes and land characteristics with the suitable interventions.

Results and Discussion

Land capability classification: Land capability classification (LCC) is an interpretive grouping of soils mainly based on the inherent soil characteristics, external land features and environmental factors that limits the use of the land. Soil morphological characteristics with their limitations with respect to slope, erosion, fertility and drainage were assessed to derive LCC (Sehgal 1996) [10].

Based on soil properties, the soils of Kalmali North-1 micro watershed of Raichur taluk have been classified into three land capability classes viz., I_{es}, III_{es} and IV_{es} (Fig 4). The Gonal series was grouped under IV_{es} class which is fairly good land for cultivation. Raichur and Venkatapur series were grouped under land capability class III_{es}. These soils were marginally cultivable lands due to severe limitations of erosion, slope, texture, soil depth limitations. Whereas, Fatepur, Merchad and Kalmali series were classified into I_{es}, which are moderately cultivable lands with limitations of depth, erosion, slope and texture limitations. The area under I_{es}, III_{es}, and IV_{es} was 200, 30 and 13 ha, respectively. Major proportion of the area belongs to class I_{es} and least portion of the area belongs to class IV_{es}, indicating that the maximum area is suitable for growing agriculture and horticulture crops with little interventions for fertility management. Similar findings were also reported by (Leelavathi *et al.*, 2004).

Land suitability for field crops: The optimum requirements of a crop are always region specific. Climate and soil-site characteristics play significant role to maximize the crop yields. The soil morphological characteristics from the study area (Table 2) and climatic regimes were matched with land suitability criteria for different crops. The land suitability assessment for field crops in Kalamali north-1 MWS showed that an area of 172 ha (68.78%) was highly suitable (S1) for growing Cotton, Greengram, Paddy and Sorghum (Fig. 6, 8, 10 and 12 respectively). About 71 ha (21.81%) was moderately suitable (S2) for Sorghum and Green gram with limitation to topography and texture. In case of Cotton and Paddy cultivation, 55 ha (24%) of total land area was found to be marginally suitable (S3rt) with limitations of rooting depth and topography (Fig. 6 and 10). Land suitability to Bajra, Groundnut, Ragi and Maize in Kalamali north-1 micro-watershed showed that the majority of the area of about 247 ha (96.87%) was found to be marginally suitable (S3) with limitation of rooting depth and topography (Fig, 5, 7, 9 and 13). Similar findings were also reported by (Rajesh N.L. *et al.* 2018).

Proposed crop plan

Crop plan for field crops and horticulture crops for GNLmC3 soil phase unit with suitable interventions such as, deep and

wider size pit for fruit crops, drip irrigation with suitable soil and water conservation measures are necessary for improved productivity and farm income. Cultivation on raised bunds with mulches along with drip irrigation for vegetables and field crops. Whereas, FTPmB2, FTPmC2, MERmB2 and VKPmC3 soil phase units has interventions like drip irrigation with suitable soil and water conservation measures across the shallow, wide furrows cultivation and live bund. KLMmB2 and RCHmC2 soil phase unit has drip irrigation with suitable soil and water conservation measures cultivation on raised bunds with mulches and drip, soil manage needs as interventions (Table. 3).

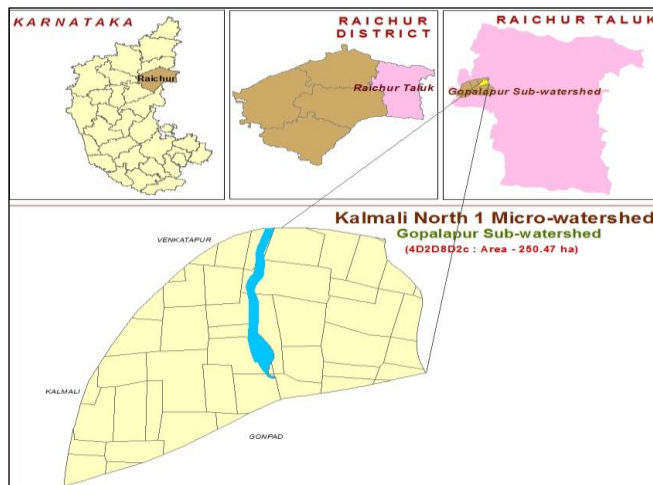


Fig 1: Location map of Kalmali North-1 micro watershed

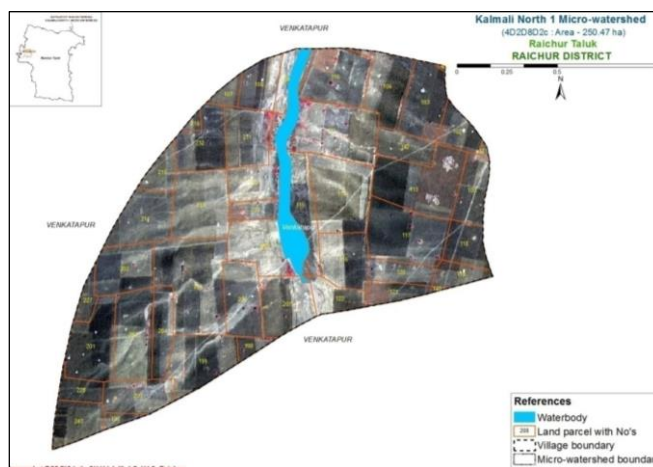


Fig 2: Cadastral map overlaid on Cartosat-I merged with LISS IV covering Kalmali North-1 micro watershed

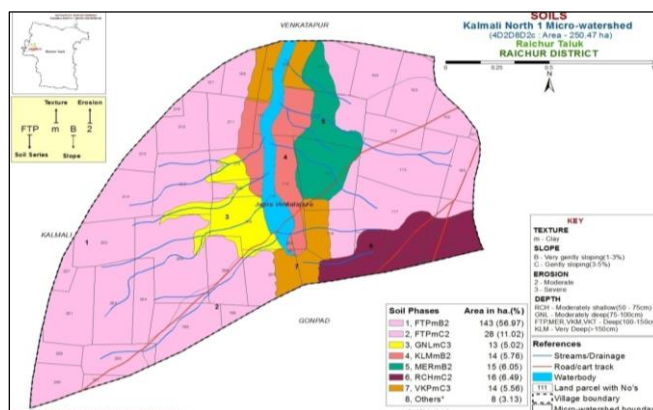


Fig 3: Area distribution of soil phase units of Kalmali North-1 micro watershed

Table 1: Area distribution and description of soil phase units of Kalmali North-1 micro watershed

S. No.	Soil phase unit	Description	Area (ha)
1.	FTPmB2	Fatepur, Clay, Very gently sloping (1-3%), Moderate erosion.	143 (56.97)
2.	FTPmC2	Fatepur, Clay, Gently sloping (3-5%), Moderate erosion.	28 (11.02)
3.	GNLmC3	Gonal, Clay, Gently sloping (3-5%), Severe erosion.	13 (5.02)
4.	KLMmB2	Kalmala, Clay, Very gently sloping (1-3%), Moderate erosion.	14 (5.76)
5.	MERmB2	Merchad, Clay, Very gently sloping (1-3%), Moderate erosion.	15 (6.05)
6.	RCHmC2	Raichur, Clay, Gently sloping (3-5%), Moderate erosion.	16 (6.49)
7.	VKPMc3	Venkatapur, Clay, Gently sloping (3-5%), Severe erosion.	8 (3.2)
8.	Others*	Habitation & Waterbody	8 (3.13)
Total			250.47 (100)

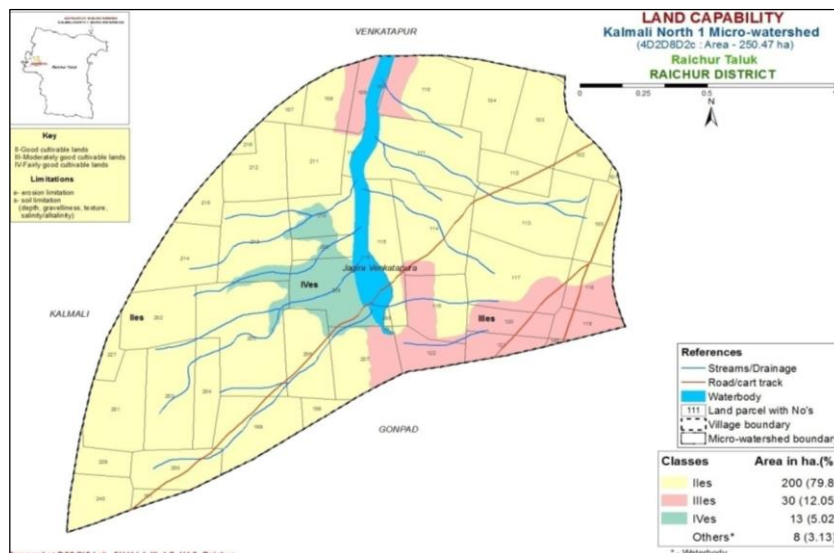


Fig 4: Land capability classification map of Kalmali North-1 micro watershed

Table 2: Soil Morphological characteristics of Kalmali North-1 MWS

Name of Soil series	Mapping unit	Geology	Colour		Soil depth (cm)		Slope (%)	Physiography	Texture	
			Surface	Subsurface	Surface	Sub surface			Surface	Sub surface
Fatepur	FTPmB2	Granite	10YR 3/4 (D) & 3/3 (M)	10YR 4/4(D) & 3/6(M)	0-16	100-120	1-3	Upland	Clay	Clay
	FTPmC2	Granite	10YR 3/4 (D) & 3/3 (M)	10YR 4/4(D) & 3/6(M)	0-16	100-120	3-5	Upland	Clay	Clay
Gonala	GNLmC3	Granite	10YR 3/4 (D) & 3/3 (M)	10YR 4/4(D) & 3/6(M)	0-15	62-90	3-5	Upland	Clay	Clay
Kalmala	KLMmB2	Granite	10YR 3/4 (D) & 3/3 (M)	10YR 4/4(D) & 3/6(M)	0-15	41-55	1-3	Upland	Clay	Clay
Merchad	MERmB2	Granite	10YR 3/4 (D) & 3/3 (M)	10YR 4/4(D) & 3/6(M)	0-16	130-148	1-3	Upland	Clay	Clay
Raichur	RCHmC2	Granite	10YR 3/4 (D) & 3/3 (M)	10YR 4/4(D) & 3/6(M)	0-16	62-90	3-5	Upland	Clay	Clay
Venkatapur	VKPMc3	Granite	10YR 3/4 (D) & 3/3 (M)	10YR 4/4(D) & 3/6(M)	0-11	35-55	3-5	Upland	Clay	Clay

Cont...

Name of Soil series	Mapping units	Structure		Consistency		effervescence	Gravelliness		Erosion	Rooting size		Stoniness	Drainage
		Surface	Sub surface	Surface	Sub surface		Surface	Sub surface		Surface	Sub-surface		
Fatepur	FTPmB2	1 msbk	2 mabk	sh, fr, ss, sp	h, fi, vs, vp	Slight	Nil	Nil	Moderate	fc	fc	Nil	Moderately well
	FTPmC2	1 msbk	1 msbk	sh, fr, ss, sp	h, fr, ss, sp	Nil	Nil	Nil	Moderate	fc	fc	Nil	Moderately well
Gonala	GNLmC3	1 msbk	2 msbk	sh, fr, ss, sp	sh, fr, ss, sp	Nil	Nil	Nil	Severe	fc	fc	Nil	Moderately well
Kalmala	KLMmB2	1 msbk	2 msbk	sh, fr, ss, sp	sh, fr, ss, sp	Nil	Nil	Nil	Moderate	fc	fc	Nil	Moderately well
Merchad	MERmB2	1 msbk	1 msbk	sh, fr, ss, sp	sh, fr, ss, sp	Nil	Slight	Nil	Moderate	fc	fc	Nil	Moderately well
Raichur	RCHmC2	1 msbk	2 msbk	sh, fr, ss, sp	sh, fr, ss, sp	Nil	Nil	Nil	Moderate	fc	fc	Nil	Moderately well
Venkatapur	VKPMc3	1 msbk	2 msbk	sh, fr, ss, sp	sh, fr, ss, sp	Nil	Nil	Nil	Severe	fc	fc	Nil	Moderately well

Note: sh - slightly hard, fr - friable, ss - slightly sticky, sp - slightly plastic, fi - firm, vs - very sticky, v p - very plastic, h - hard, m - medium, sbk - subangular blocky, abk-angular bloky, gr-granular, c - coarse, fc - few common roots, f-fine root

Table 3: Proposed Crop Plan for Kalamali north-1 Micro watershed

Land Management Unit	Soil Map Units	Survey Number	Field Crops	Horticulture Crops	Suitable Interventions
1	GNLMc3 unmanaged	J-Venkatapura, 208, 209, 210.	Sole crop; Sorghum, Bajra, Navne Red gram, Green gram, Cotton, Maize, Sun flower,	Fruit crops: Custard apple, Guava, Tamarind, Ber, Amla, Vegetables: Clusterbean, Bhendi, Brinjal, Onion, Chilli, Green leaf, Curry leaf Flowers: Gaillardia, Spider lilly, Mari gold	Deep and wider size pit, Drip irrigation, with suitable soil and water conservation measures Cultivation on raised bunds with mulches and drip.
2	FTPmB2, FTPmC2, MERmB2, VKPmC3 unmanaged	J-Venkatapura. 107, 108, 110, 111, 114, 116, 122, 191, 198, 199, 200, 202, 203, 204, 205, 206, 207, 211, 212, 213, 214, 215, 216, 227, 228, 240.	Sole crop; Redgram, Soyabean, Sunflower, Sorghum. Red gram, Green gram, Black gram, Sesame, Cotton,	Fruit crops: Custard apple, Guava, Tamarind, Ber, Amla, Vegetables: Cluster bean, Bhendi, Phundi, Brinjal, Onion, Chilli, Green leaf, Cury leaf Flowers: Gaillardia, Spider lilly, Mari gold	Drip or any suitable irrigation with suitable soil and water conservation measures. Cultivation across the slope, wide furrows cultivation and live bund.
3	KLMmB2, RCHmC2, Unmanaged	J-Venkatapure. 111, 115, 117, 118, 119, 120, 121, 122, 140, 210, 211	Sole crop; Sorghum, Bajra, Navni, Red gram, Green gram, Cotton, Maize, Sun flower	Fruit crops: Custard apple, Guava, Tamarind, Ber, Amla, Vegetables: Clusterbean, Bhendi, Phundi, Brinjal, Onion, Chilli, Green leaf, Cury leaf Flowers: Gaillardia, Spider Lilly, Mari gold	Drip irrigation with suitable soil and water conservation measures Cultivation on raised bunds with mulches and drip.

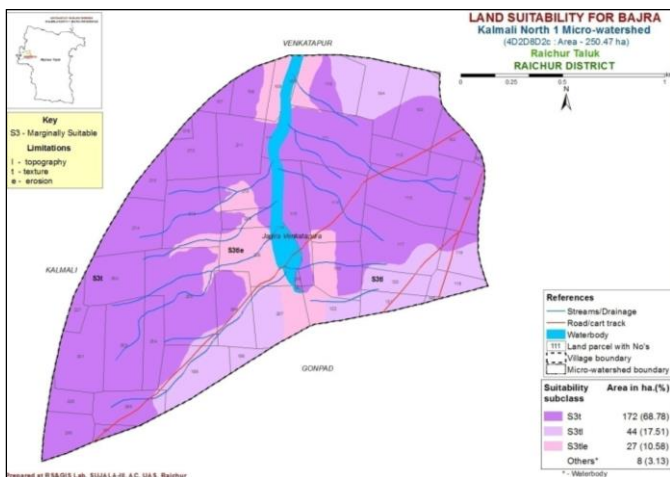


Fig 5: Land suitability map for Bajra in Kalamali North-1 MWS

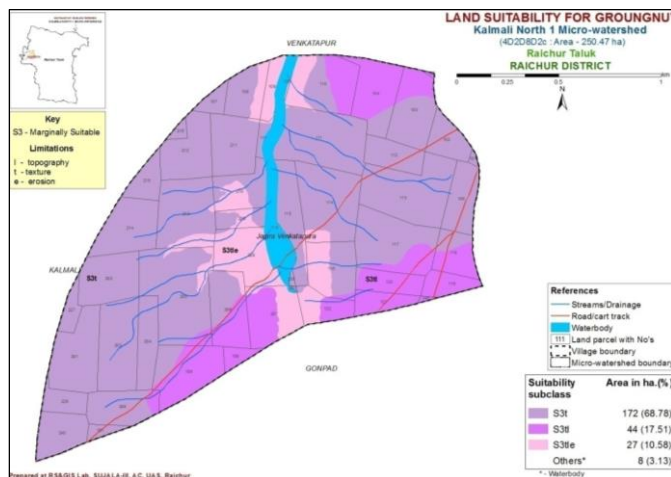


Fig 7: Land suitability map for groundnut in Kalamali North-1 MWS

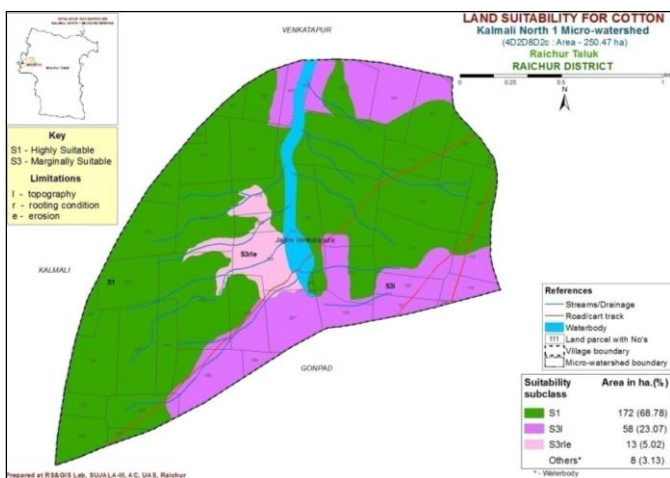


Fig 6: Land suitability map for Cotton in Kalamali North-1 MWS

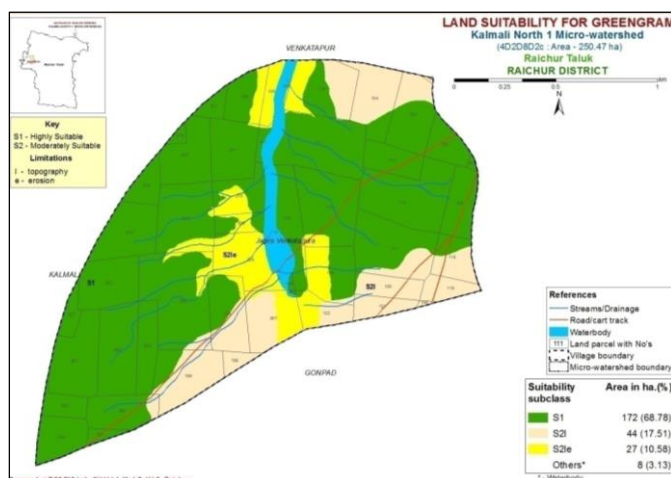


Fig 8: Land suitability map for greengram in Kalamali North-1 MWS

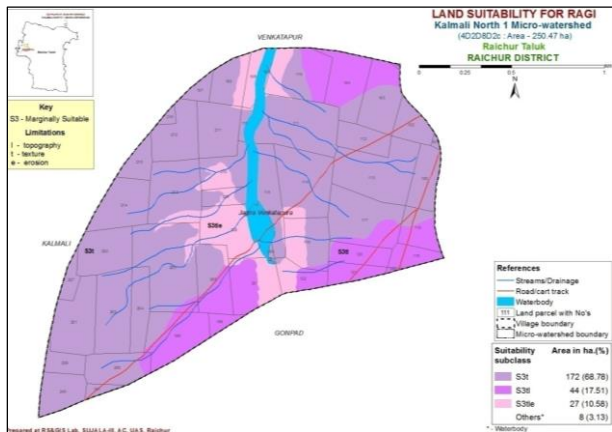


Fig 9: Land suitability map for ragi in kalamali north-1 MWS

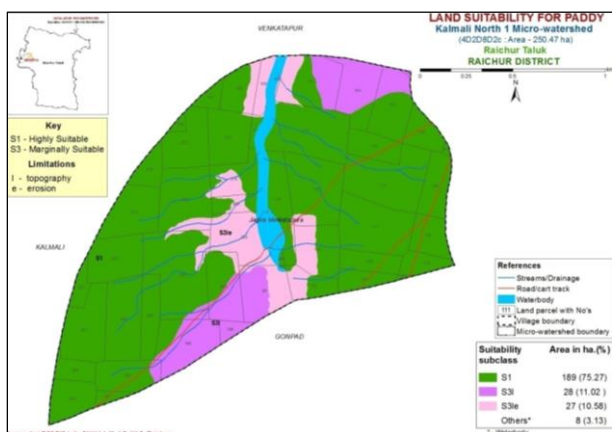


Fig 10: Land suitability map for paddy in kalamali north-1 MWS

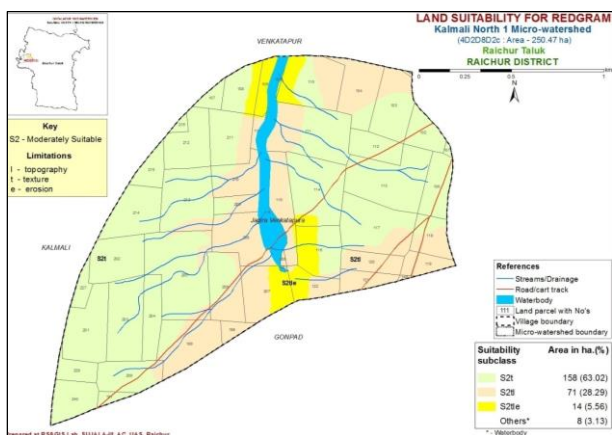


Fig 11: Land suitability map for redgram in kalamali north-1 MWS

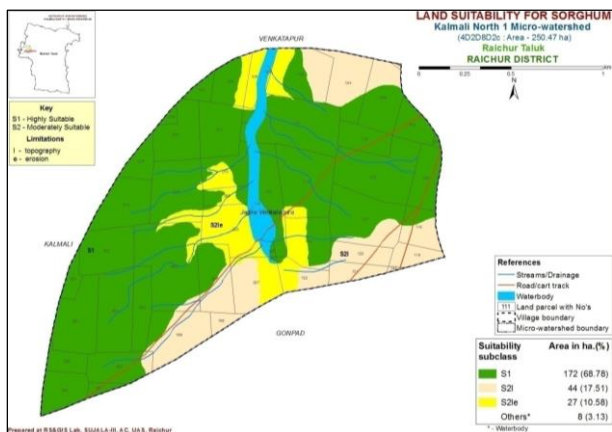


Fig 12: Land suitability map for sorghum in kalamali north-1 MWS

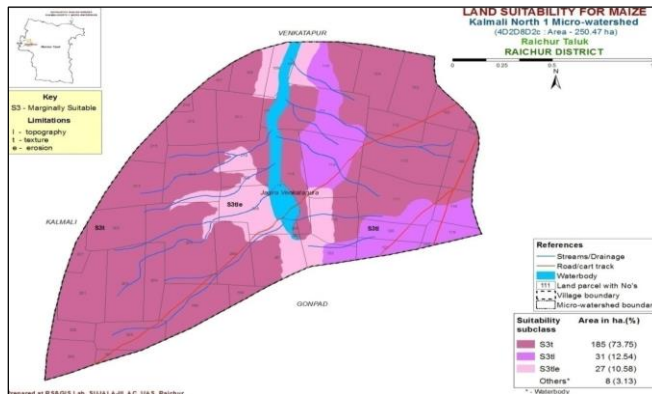


Fig 13: Land suitability map for maize in kalamali north-1 MWS

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