

# LAND EVALUATION OF VELLAMADAI VILLAGE IN COIMBATORE DISTRICT FOR SUSTAINABLE LAND USE PLANNING

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**Abstract:** A study was undertaken to evaluate four soil series belonging to Vellamadai village of Coimbatore district, Tamil Nadu for sustainable land use planning. Four soil series were tentatively identified and mapped into seven mapping units using GIS technique. These mapping units were grouped in to land capability class III and IV with limitations of soil texture and cation exchange capacity. Soil-site suitability evaluation for sorghum, cotton, sugarcane, maize and pearl millet showed that clay soils were highly suitable (S1) for Sugarcane, moderately suitable (S2) for cotton, sorghum, sugarcane and pearl millet, marginally suitable (S3) for sorghum and maize. The loamy sand soils were moderately suitable (S2) for pearl millet, marginally suitable (S3) for sorghum and not suitable for cotton, sugarcane and maize.

**Keywords:** land evaluation, GIS, soil suitability

## INTRODUCTION

Precise scientific information on soil characteristics, potentials, limitations and management needs of different soils is indispensable for planned development of land resource to maintain the soil productivity and to meet the demands of the future. Soil resource inventory provides an insight into the potentialities and limitations of soils for its optimum utilization. It also provides adequate information interms of landform, terrain, vegetation as well as characteristics of soils which can be utilized for land resources management and development (Manchanda et al., 2002). Rational utilization of land resources can be achieved by optimizing its use, ensuring its sustainable use. Therefore, increased emphasis is being laid on characterization of soils, their evaluation and precise mapping using remote sensing and GIS.

Satellite remote sensing has emerged as a powerful and efficient technology for mapping and monitoring of natural resources. The synoptic coverage, multispectral and multi-temporal sensing capabilities offered by space borne sensors are well suited to inventorying natural resources. Several workers have utilized this technique for soil mapping on different conditions at different scales (Srivastava and Saxena, 2004; Velmurugan and Carlos, 2009). In the present study, an attempt has been made to characterize and evaluate the land resources of vellamadai village of Coimbatore district, Tamil Nadu using remote sensing and GIS.

## MATERIAL AND METHOD

The study area Vellamadai village (1765 hectares) lies between 11° 08' 35" to 11° 11' 27" N latitude and 76° 58' 37" and 77° 01' 37" E longitude. It forms part of Coimbatore North Taluk of Coimbatore

district, Tamil Nadu state. The soils are derived from granite-gneiss. The climate is subtropical with mean annual rainfall of 612mm. The maximum and minimum temperature are 32°C and 21.5 °C, respectively. The major crops cultivated include sorghum, maize and pulses in the rainfed conditions and onion, turmeric, banana, coconut and sugarcane under irrigated conditions. The soil temperature and moisture regimes are isohyperthermic and Udic, respectively.

The detailed soil survey was carried out using IRS 1C PAN merged LISS III data. The pedons were exposed and studied for their morphological properties following the procedure outlined (Soil Survey Staff, 2006). The physico-chemical properties (horizon-wise) were estimated following standard procedures. Four soil series were tentatively identified in the study area and mapped into seven mapping units as phases of soil series (Fig.1; Table 1). Weighted mean of each property was calculated and soil-site characteristics of different soil units were obtained as shown in Table 2. These weighted averaged data have been used to evaluate the land capability classification and soil –site suitability. Land capability maps were prepared using ARC GIS 9.3 GIS software.

## RESULT AND DISCUSSION

### Soils and Soil characteristics

Physiographically, the area has been characterized into pediment, pediplain shallow weathered and pediplain moderately weathered which were subdivided based on erosion and slope categories. Four soil series were tentatively identified in the study area and mapped into seven mapping units as phases of soil series. The soils on the gently sloping pediment were moderately shallow when compared to pediplain shallow weathered. Soils of pediment

possessed loamy sand texture and that of pediplain shallow weathered and pediplain moderately weathered ranged from sandy clay loam to clay. The soils are slightly acidic (pH 6.5) to saline (pH 8.0). The free calcium carbonate varied from 0.50 to 7.43 per cent. The free calcium carbonate in the pediplain shallow weathered and pediplain moderately weathered were in the form of concretions and nodules. The organic carbon content was low in all the mapping units. Based on morphological, physical and chemical characteristics, the soils were grouped under three orders of USDA system of classification *viz.*, Entisols, Inceptisols and Vertisols.

#### Land capability classification

Land capability classification is an interpretative grouping of soils mainly based on the inherent soil characteristics, external land features and environmental factors that limit the use of the land. Soil site characteristics of soil units (Table 2) are matched with the criteria for land capability classification. The land capability classification of mapping units and their extent in the study area is presented in Table 3. Pyk-C-d5/Ae2, Pyk-C-d5/Ae1, Apm-C-d5/Ae1, Vld-C-d4/Ae2 and Vld-scl-d4/Ae2 mapping units are classified under class III of capability classification because of higher coarser fragments and texture limitation. Due to severe limitations of coarse fragments and texture in Kpm-ls-d4/Be2, Kpm-ls-d3/Ce2. These units are grouped under non-arable class VI. The area under IIIfs, IIIs, VIs were 822.34, 500.28 and 437.63, respectively. There was no class II and class I land in the study area. Major proportion of the area belongs to class IIIfs followed by IIIs and VIs.

#### Soil-site suitability evaluation for crops:

The optimum requirements of a crop are always region specific. Climate and soil-site parameters play a significant role in maximizing the crop yields. The kind and degree of limitations were evaluated and soil properties from the study area (Table 4) were matched with soil site suitability criteria (Sehgal, 1966).

Significant influence of rainfall, soil depth and CaCO<sub>3</sub> have been reported on the yield of cotton. A

soil depth of 100 to 200 cm, 10 to 15 per cent CaCO<sub>3</sub>, moisture storage capacity of 220 mm and base saturation of more than 80 per cent are optimum for cotton in red and black soils (Sehgal, 1991). The mapping unit Apm-C-d5/Ae1, Kpm-ls-d4/Be2 and Kpm-ls-d3/Ce2 are not suitable for the crop (N) because of very severe limitations of CaCO<sub>3</sub>, texture and cation exchange capacity. Severe limitations of CaCO<sub>3</sub> restrict other soil units Pyk-C-d5/Ae2, Pyk-C-d5/Ae1, Vld-C-d4/Ae2 and Vld-scl-d4/Ae2 for marginally suitable for the crop.

Maize requires an annual rainfall of 900 mm, soil depth of 100 cm with sandy clay loam to clay texture, free of salinity and alkalinity and good drainage. The mapping unit Vld-scl-d4/Ae2 is highly suitable for maize. The mapping unit Pyk-C-d5/Ae2, Pyk-C-d5/Ae1, Apm-C-d5/Ae1 and Vld-C-d4/Ae2 had severe limitations of texture. These map units were marginally suitable for maize. The remaining area is not suitable due to limitations of texture and low organic carbon content.

The factors that influence sorghum yield are rainfall, temperature, slope, base saturation, CaCO<sub>3</sub>, cation exchange capacity and texture (Sehgal, 1996). Due to slope and erosion limitations, large area was marginally suitable for sorghum. The map unit Pyk-C-d5/Ae1 and Apm-C-d5/Ae1 have been found moderately suitable for sorghum.

The influence of rainfall, depth, texture and free CaCO<sub>3</sub> have been reported on yield of pearl millet in Vertisols. The soil depth of <75 cm, 10 % CaCO<sub>3</sub> and clay texture were found to be favourable (Van Wambeke and Rossiter, 1987). The mapping unit Vld-scl-d4/Ae2 is highly suitable for pearl millet. All the soil units were moderately suitable for pearl millet due to texture and CaCO<sub>3</sub> limitations.

The mapping unit Apm-C-d5/Ae1, Vld-C-d4/Ae2 and Vld-C-d4/Ae2 are highly suitable for sugarcane. Due to texture and drainage limitations, the map unit Pyk-C-d5/Ae2 and Pyk-C-d5/Ae1 was moderately suitable and map unit Kpm-ls-d4/Be2 and Kpm-ls-d3/Ce2 were not suitable for sugarcane due to limitations of texture. The suitability of different soil map units for various crops is presented in Table 5.

**Table 1.** Soil Series, mapping units and area covered in Vellamadai village

Soil Series	Mapping Unit	Area covered (ha)
Periyanaickenpalayam – Fine, Montmorillonitic, isohyperthermic, Typic Haplusterts	Pyk-C-d5/Ae2	240.57
	Pyk-C-d5/Ae1	259.77
Attipalayam- Fine, Mixed, isohyperthermic, Vertic Haplustepts	Apm-C-d5/Ae1	36.12

Vellamadai- Fine loamy, Mixed, isohyperthermic, Typic Haplustepts	Vld-C-d4/Ae2	201.40
	Vld-scl-d4/Ae2	584.82
Kalipalayam-Loamy skeletal, Mixed, isohyperthermic, Typic Ustorthents	Kpm-ls-d4/Be2	321.82
	Kpm-ls-d3/Ce2	115.81
	Others	4.68
<b>Total area</b>		<b>1765.00</b>

**Table 2.** Soil- Site characteristics of mapping units of Vellamadai village

Mapping unit	Climate (c)				Land form characteristics (l)			Physico-chemical characteristics (s)				Soil fertility (f)	
	Rainfall (mm)	Max. temp. (°C)	Min.t temp. (°C)	RH (%)	Slope (%)	Erosion	Drainage	Depth (cm)	Texture	pH	Free CaCO <sub>3</sub> (%)	OC (%)	CEC (cmol(p <sup>+</sup> )/kg)
Pyk-C-d5/Ae2	612	32	21.5	98	Gently sloping	Moderate	Moderately well drained	Deep (105)	C	8.00	7.43	0.63	50.43
Pyk-C-d5/Ae2	612	32	21.5	98	Gently sloping	Slight	Moderately well drained	Deep (90)	C	8.00	7.43	0.63	50.43
Apm-C-d5/Ae1	612	32	21.5	98	Gently sloping	Slight	Moderately well drained	Medium (80)	C	7.87	14.46	0.52	44.50
Vld-C-d4/Ae2	612	32	21.5		Gently sloping	Moderate	well drained	Medium (70)	C	7.60	2.63	0.33	32.13
Vld-scl-d4/Ae2	612	32	21.5		Gently sloping	Moderate	well drained	Medium (70)	Scl	7.60	2.63	0.33	32.13
Kpm-ls-d4/Be2	612	32	21.5		Gently sloping	Moderate	well drained	Medium (70)	ls	6.55	0.50	0.21	14.62
Kpm-ls-d3/Ce2	612	32	21.5		Very Gently sloping	Severe erosion	well drained	Shallow (50)	ls	6.55	0.50	0.21	14.62

**Table 3.** Land capability classification of Vellamadai village

Mapping unit	Land capability sub-class	Area (ha)	Description
Pyk-C-d5/Ae2	III <sub>s</sub>	240.57	Moderately good cultivable land on almost level land with moderate slope (0-1%). These have limitations of drainage, texture and fertility.
Pyk-C-d5/Ae1	III <sub>s</sub>	259.71	Moderately good cultivable land on almost level land with moderate slope (0-1%). They have a vertic characteristics and drainage problem.

Apm-C-d5/Ae1	IIIifs	36.12	Moderately good cultivable land on almost level land with moderate slope (0-1%). These have limitations of drainage, texture and fertility.
Vld-C-d4/Ae2	IIIifs	201.40	Moderately good cultivable land on almost level land with moderate slope (0-1%). They have a vertic characteristics and drainage problem.
Vld-scl-d4/Ae2	IIIifs	584.82	Fairly good land suitable for limited cultivation. The soil depth and texture are the constraints and higher coarser fragments
Kpm-ls-d4/Be2	VIifs	381.82	These units are suitable for grazing and have limitations for the use of implements due to stony or rock surface texture, coarse fragments and depth are other limitations.
Kpm-ls-d3/Ce2	VIifs	115.81	These units are suitable for grazing and have limitations for the use of implements due to stony or rock surface texture, coarse fragments and depth are other limitations.

**Table 4.** Suitability of different soil series of Vellamadai village for various crops

Mapping unit	Suitability class			
	Highly suitable	Moderately suitable	Marginally suitable	Not suitable
Pyk-C-d5/Ae2		Cotton, Pearlmillet	Sorghum, Cotton, Maize	-
Pyk-C-d5/Ae1		Sorghum, Sugarcane, Pearl millet	Cotton, Maize	-
Apm-C-d5/Ae1	Sugarcane	Pearl millet, Sorghum	Maize	Cotton
Vld-C-d4/Ae2	Sugarcane	Pearl millet	Sorghum, Cotton, Maize,	
Vld-scl-d4/Ae2	Sugarcane, Maize, Pearl millet		Sorghum, Cotton	
Kpm-ls-d4/Be2		Pearl millet	Sorghum	Cotton, Sugarcane, Maize
Kpm-ls-d3/Ce2		Pearl millet	Sorghum	Cotton, Sugarcane, Maize

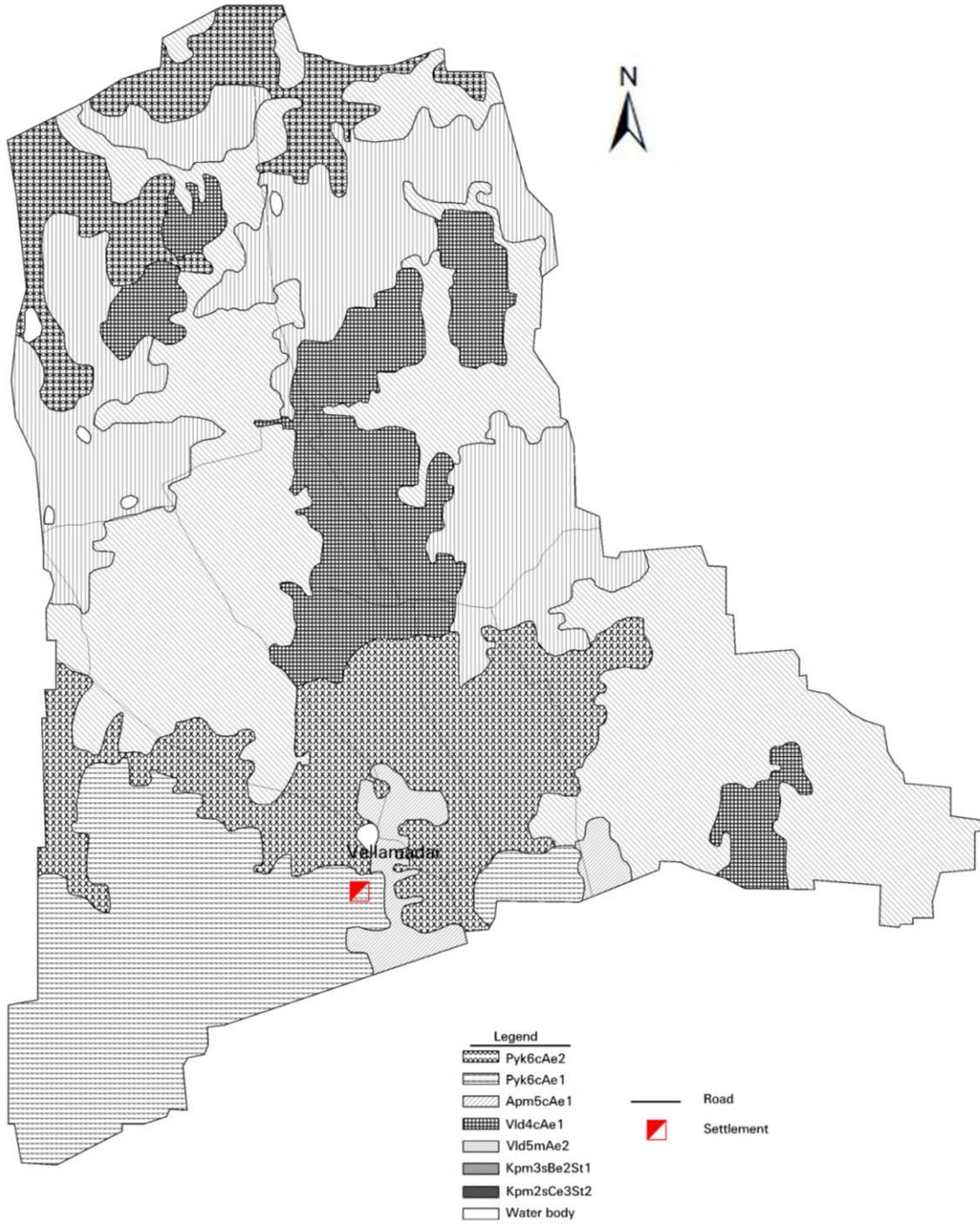
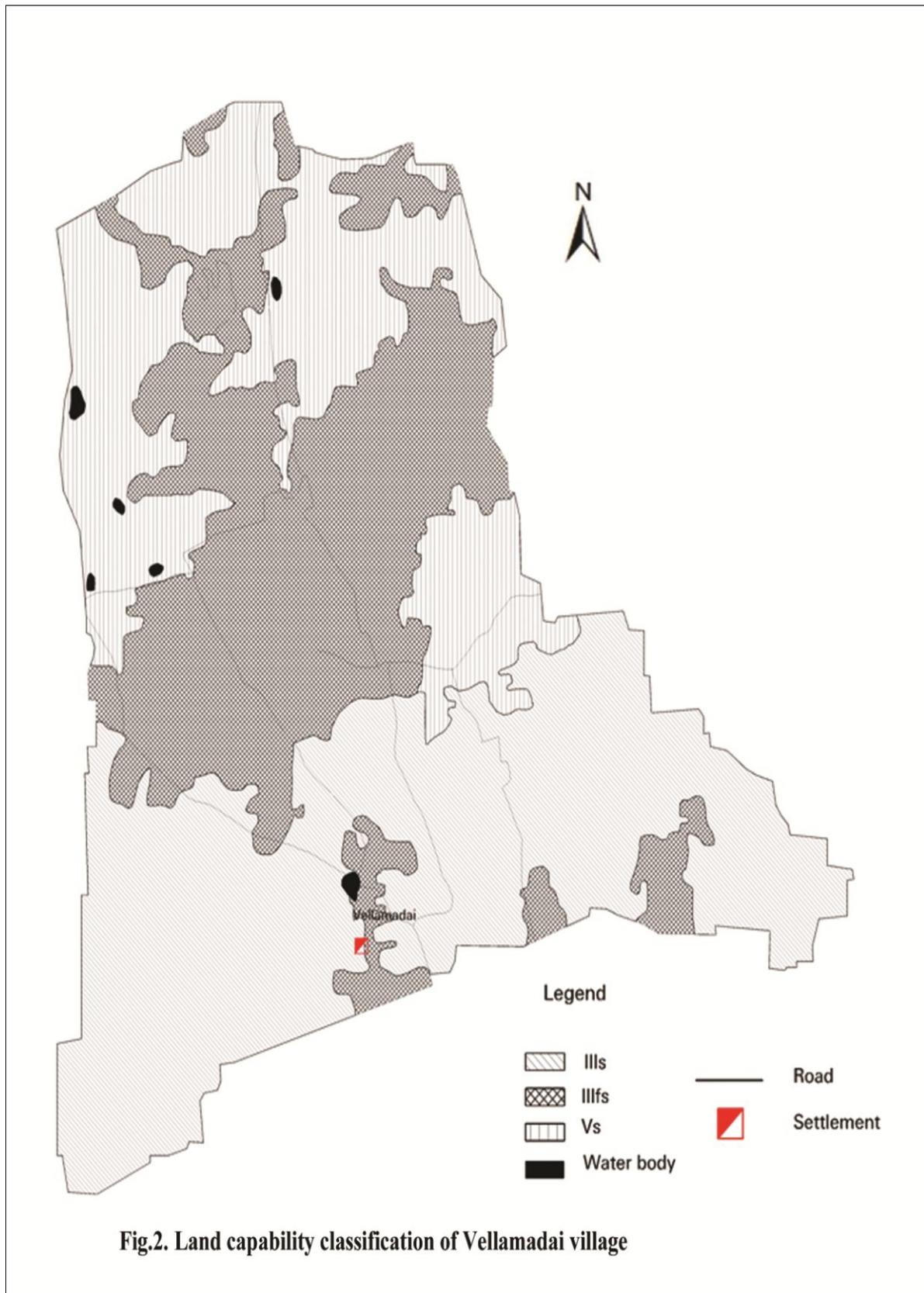
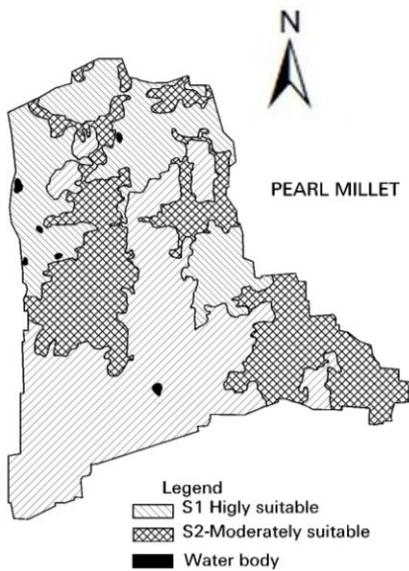
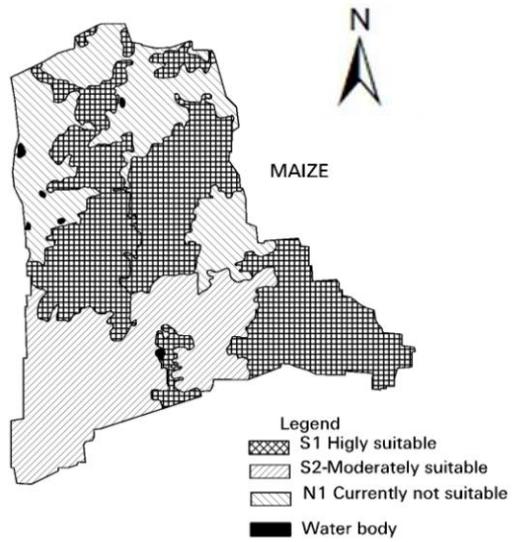
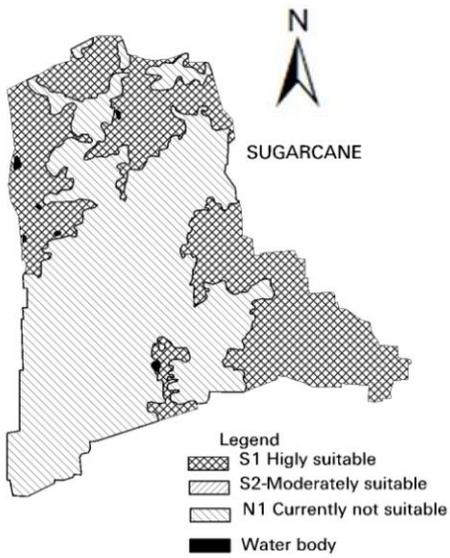
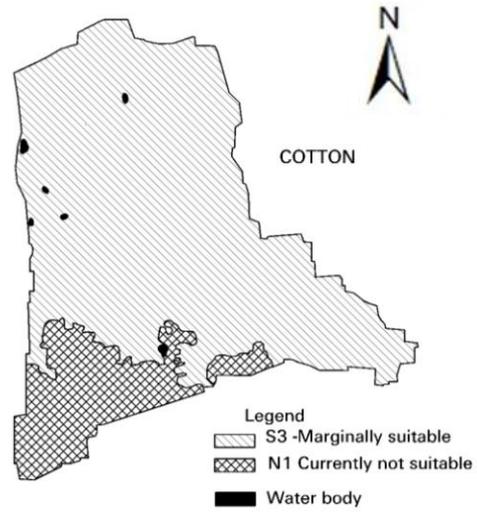
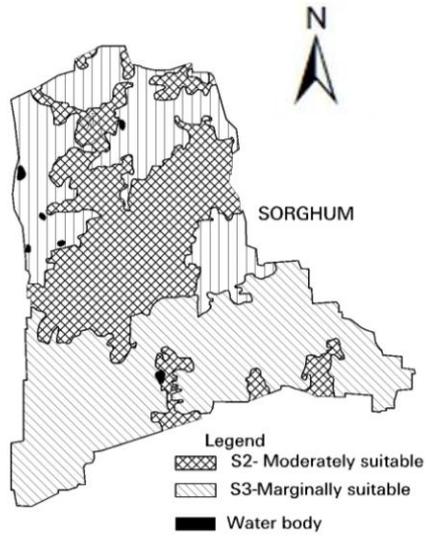


Fig. 1. Soil Map of Vellamadai Village





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