

Land suitability evaluation for rubber in tropical humid region of Kerala, India

Abstract

Land suitability assessment is a specific type of land evaluation method to assess the resources of an area for specific crop rather than for a general use. Using the soil site suitability criteria, land resources of the Elamdesam block, Idukki district, Kerala was assessed for their suitability for the rubber. Results revealed that, rubber is moderately suitable in the area constituted 23.4 per cent of total with limitation of root restriction, soil fertility, topography and soil texture. Marginally suitable in 20.75 per cent of total geographical area with limitation of topography, root restriction and soil fertility and 20.23 per cent of total area is unsuitable with limitation of depth to water table and root restriction in the Elamdesam block.

Key words: Land suitability, evaluation, rubber, tropical humid region, Kerala

Introduction

Soil survey data and the soil maps have been widely used for interpretative purposes by defining relative suitability or limitations of various soil types for different land use. Land suitability evaluation is the process of determining the potential of the land for alternative uses and forms a pre-requisite for land use planning (Sehgal 1995). It integrates soil characteristics with climate and land use. Optimal requirement of a crop is always region specific, and soil site characteristics determine the degree of suitability for land use and help in planning expansion of area under a particular crop (Shashi Yadav *et al.*, 2005). Efforts have earlier been made to evaluate soil-site criteria for rubber in the traditional tracts in India (Vilas Chandran *et al.* 1992; Kharche *et al.* 1995). Delineation of suitable areas and identification of soil and climatic constraints for better management (Naidu *et al.*, 2009) were

27 attempted through the present study so that the information can serve as a base material for
28 implementing the developmental programmes.

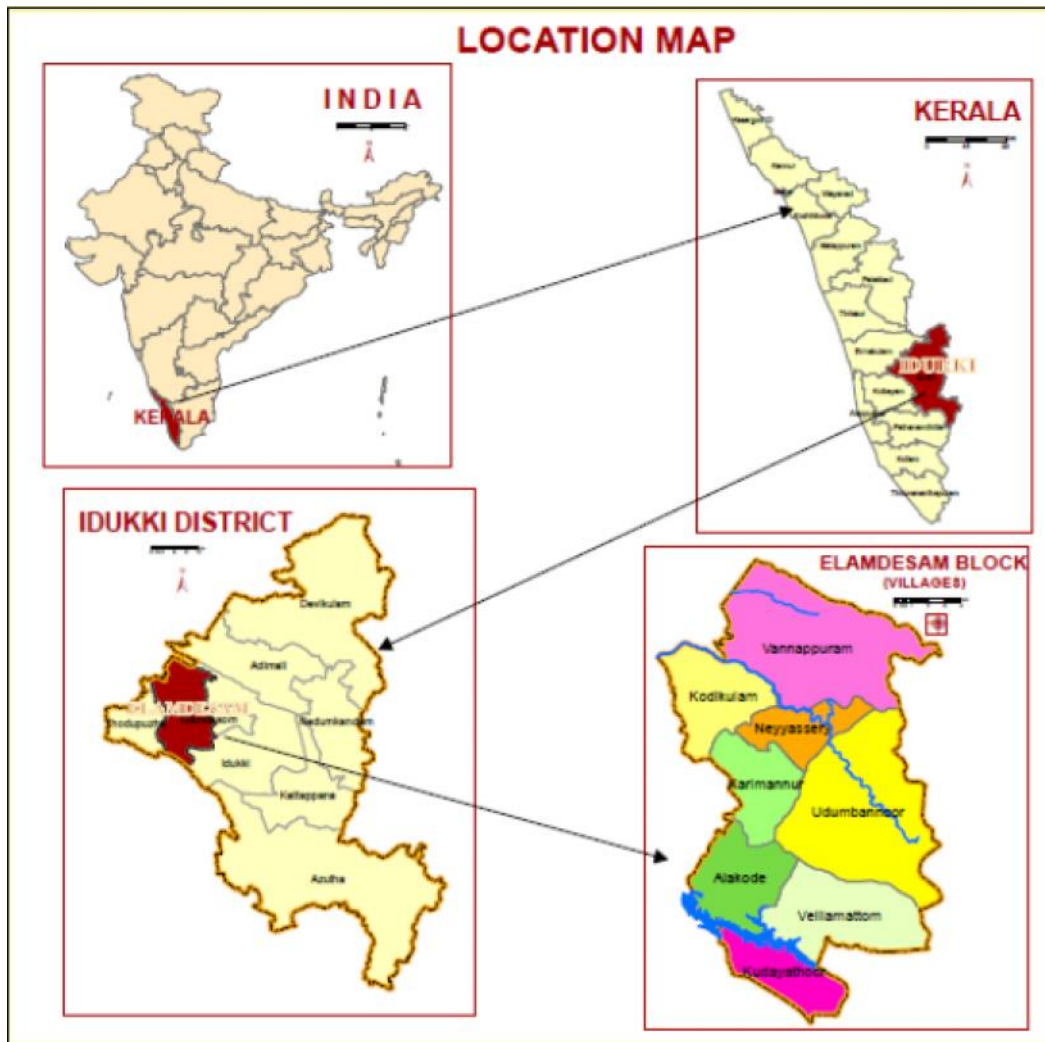
29 **Materials and methods**

30 **Details of the study area:** Elamdesam block falls under the agro-ecological zone foot hills
31 and high hills, the agro ecological units 12 and 14 i.e. southern and central foot hills and
32 southern high hills, respectively. These units are subdivided in to forests, denudational hills,
33 lateritic terrain and lateritic valley lying between north latitudes $9^{\circ} 46' 38.2''$ and $10^{\circ} 2'$
34 $18.14''$ and east longitudes $76^{\circ} 42' 59.49''$ and $76^{\circ} 53' 46.99''$. There are seven panchayats
35 namely Vannapuram, Kodikulam, Karimannor, Udumbannoor, Alakode, Velliyamattom and
36 Kudayathoor in the Elamdesam block and eight villages covering a total geographical area of
37 40,307 ha. Villages are further divided in to number of wards for the purpose of
38 administration. Geology of the area is charnockite and granite gneiss of the Archaen age.
39 elevation ranges from 30 m in low land to 850 m in high hills. Climate is tropical humid
40 monsoon type. Rainfall ranges from 3462 mm to 3602 mm and mean annual temperature
41 varies between 22°C to 27°C . Length of dry period is two to two and a half months. High
42 hills are covered by mixed forest whereas foot hills and midlands have plantation of rubber,
43 coconut, pepper, banana, pineapple, arecanut, cocoa, nutmeg, cashew. Low land is occupied
44 by paddy and tapioca, banana, coconut arecanut and rubber were also cultivating in raised
45 beds. Laterites and Ultisols are the major soil type which, are well drained, shallow to very
46 deep, strongly acidic in nature. Location map given in the Figure 1. In Elamdesam block
47 agriculture is the fundamental livelihood activity among the people. Major land uses are
48 rubber plantations, mixed forest plantations and paddy cultivation.

49 **Soil suitability Evaluation:** Soil suitability of rubber in Elamdesam block has been worked
50 out in two steps. In the first step suitability criteria for rubber crop (Table 1) have been
51 evolved with the help of existing literature with special reference to tropical humid region of
52 India. Emphasis was placed on land characteristics or land qualities (Sys, 1985 and Naidu *et*
53 *al.*, 2006) which determine the limitations. Together, these diagnostic features (limitations)
54 determine soil suitability when matched with crop or ecological requirements. In the second
55 step, the defined suitabilities are shown on soil maps according to the map legend (soil
56 composition) to prepare a relative suitability map for rubber in Elamdesam block (Naidu *et*
57 *al.*, 2006).

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61 Fig. 1: Location map of the study area (Elamdesam block)

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63 Table 1. Soil-site suitability criteria for rubber

Soil site characteristics			Rating			
		Unit	Highly suitable S1	Moderately suitable S2	Marginally suitable S3	Not suitable N
Climatic regime	Mean temperature in growing season	°C	25-30	24-20 31-32	20-18 33-34	<18 >34
	Mean max. temperature in growing season	°C	29-34	28-24 35-36	23-22 37-38	<22 >38
	Mean min. temperature in growing season	°C	>18	18-16	15-10	<10
	Total rainfall	mm	1750	1750-1500	1500-1250	<1250 >6000

	Dry months (Months with less than 50 mm rainfall)	Months	<3	3-5	5-7	>7
	Months with more than 500 mm rainfall)	Months	<3	3-4	4-5	>5
Land quality	Land characteristics					
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained, some what excessively drained	Imperfectly drained	Poorly drained, excessively drained
	Depth of water table	m	>3	2-3	1-2	<1
Nutrient availability	Texture	Class	scl, l	siel, sil (non-swelling)	c (swelling), sc	s
	pH	1:2.5	4.5-5.5	5.6-6.5 3.5-4.4	6.6-7.3 <3.5	>7.3
	CEC	cmol (p ⁺) kg ⁻¹	>4	2-4	<2	
	BS	%	<30	35-50	50-80	>80
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Presence of gravel in sub soil (loamy soils)	%	<35	35-60	>60	
	Presence of gravel in sub soil (clayey soils)	%	<60	60-80	>80	
Erosion hazard	Slope	%	10-15	15-30, <10	30-50,	>50

64

65 **Result and discussion**

66 In Kerala rubber is grown in about 4.78 lakh hectares, and production is 6.55 lakh
67 tons with an average productivity of 1369 kg per ha. It is the most important commercial
68 perennial plantation cum latex yielding crop of the state. Areas receiving good rains
69 throughout the year (1750-2000 mm) and high relative humidity (>80 %) and preferably with
70 a dry period of less than 3 months and temperature ranges from 25 to 30 °C are favourable,
71 preferably with warm and sunny days (>6 hrs sunshine per day). An annual rainfall of 2000
72 mm has been observed to be lower limit of rainfall for the optimum growth of rubber
73 (Sanjeeva Rao and Vijayakumar I 992). However, rubber can grow without limitation up to
74 4500 mm of rainfall. Soil moisture stress influences the yield components viz. initial flow
75 rate, plugging index and the dry rubber content besides the direct effect on turgor pressure
76 and water deficit triggering a series of biochemical changes in latex. Rubber gets affected by

77 extreme temperatures. The soil depth determines both the available space for root growth and
78 proliferation, and the amount of soil moisture storage (Krishnakumar and Potty 1992). It has
79 been observed that for different plantation crops, including rubber, the growth is seriously
80 affected due to shallow depth.

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82 Rubber is grown at elevations of less than 600 m and ideally below 200 m on 10-15
83 per cent slopes on a wide variety of soil types, ranging from heavy clay to sandy soils,
84 however deep to very deep, well drained and medium textured soils are most suitable. The
85 valley lands, however, are unsuitable for rubber due to water stagnation. Steep slopes with
86 slope per cent greater than 30-50 act as a severe limitation for rubber without conservation
87 measures. Soil pH from 4.5 to 5.5 is ideal and it thrives well under acid environment in the
88 soil. The optimum pH for rubber is reported to be in the range of 4 to 6.5 and it can tolerate
89 up to the pH of 3.8 at the low (Krishna Kumar and Potty 1989) and 7.0 at the higher side
90 (Krishna Kumar and Potty 1992). Rubber is grown in soils with a wide range of CEC. While
91 CEC of 2 to 16 $\text{cmol}(+) \text{kg}^{-1}$ is reported in Malaysia, it ranges from 3.5 to 18 $\text{cmol}(+)\text{kg}^{-1}$ in
92 soils under rubber in India (Krishna Kumar and Potty. 1992). In Tripura, the rubber growing
93 soils have a CEC range of 3-13 $\text{cmol}(+)\text{kg}^{-1}$ (Bhattacharyya et al. 1998). The crop is sensitive
94 to poor drainage and water logging, presence of free iron and aluminium, low pH in the
95 subsoil, extreme gravelly and stony soils, sodicity and salinity.

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97 Soil suitability for rubber in Elamdesam block is given in table 2 and map 1.
98 Moderately suitable area constituted 23.4 per cent of total area with limitation of root
99 restriction, soil fertility, topography and soil texture. Marginally suitable area is present in
100 20.75 per cent of total geographical area with limitation of topography, root restriction and
101 soil fertility and 20.23 per cent of total area is unsuitable with limitation of depth to water
102 table and root restriction. Most of the areas which are moderately suitable for rubber fall in
103 the undulating plains and uplands without forests. The area of moderately suitable (S2) lands
104 for rubber is 91,000 ha which forms about 8.3 per cent of the total geographical area of the
105 Tripura state. It may be mentioned that most of the horticultural crops have soil-site
106 requirements similar to rubber and these crops, therefore, may compete for the expansion of
107 the rubber growing areas (Bhattacharyya *et al.* 1996).

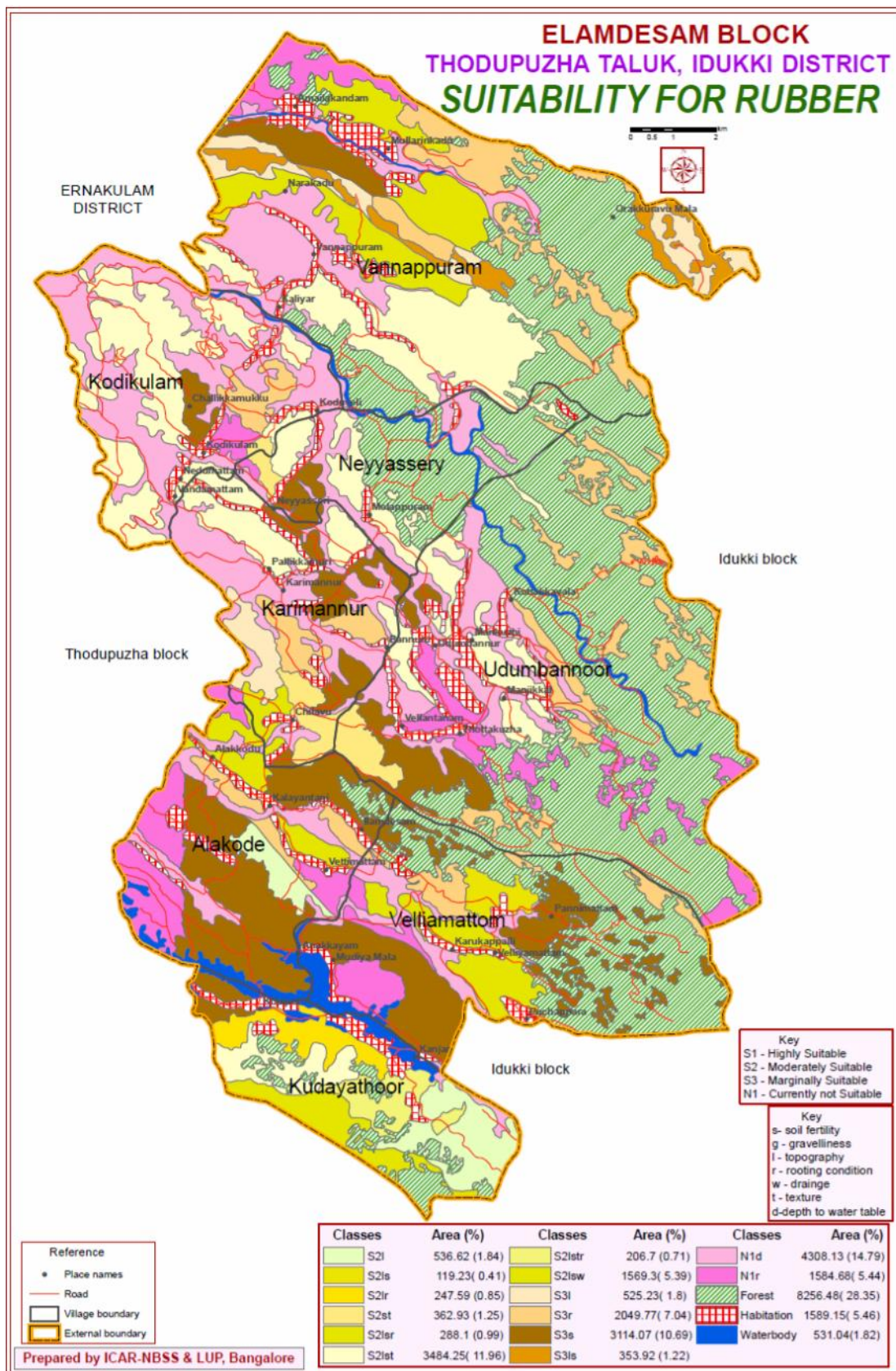
108 Table 2: Soil suitability for rubber in Elamdesam block

Mapping unit no.	Suitability classes	Description	Area ha	Area %
1	S2l	Moderately suitable land with slight limitation of topography	536.62	1.84
2	S2ls	Moderately suitable land with slight limitation of topography and soil fertility	119.23	0.41
3	S2lr	Moderately suitable land with slight limitation of topography and root restriction	247.59	0.85
4	S2st	Moderately suitable land with slight limitation of soil fertility and soil texture	362.93	1.25
5	S2lsr	Moderately suitable land with slight limitation of topography, soil fertility and root restriction	288.1	0.99
6	S2lst	Moderately suitable land with slight limitation of topography, soil fertility and soil texture	3484.25	11.96
7	S2lstr	Moderately suitable land with slight limitation of topography, soil fertility, soil texture and root restriction	206.7	0.71
8	S2lsw	Moderately suitable land with slight limitation of topography, soil fertility and drainage	1569.3	5.39
9	S3l	Marginally suitable land with slight limitation of topography	525.23	1.80
10	S3r	Marginally suitable land with slight limitation of root restriction	2049.77	7.04
11	S3s	Marginally suitable land with slight limitation of soil fertility	3114.07	10.69
12	S3ls	Marginally suitable land with slight limitation of topography and soil fertility	353.92	1.22
13	N1d	Currently not suitable land with limitation of depth to water table	4308.13	14.79
14	N1r	Currently not suitable land with limitation of root restriction	1584.68	5.44
15	Forest		8256.48	28.35
16	Habitation		1589.15	5.46
17	Waterbody		531.04	1.82
Total			29127.16	100.00

109

110 **Conclusion**

111 It may be concluded that, more than 60 per cent of the total geographical area is under
112 rubber cultivation in Elamdesam block, Idukki district, Kerala apart from soils are having
113 limitation of root restriction, soil fertility, topography, depth to water table and soil texture.



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115 Map 1: Soil suitability for rubber in tropical humid region

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