RUBBER SOIL INFORMATION SYSTEM (RubSIS): A DECISION MAKING TOOL FOR SKIPPING FERTILIZER APPLICATION IN RUBBER PLANTATIONS

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A study was carried out to estimate the extent of rubber area with high status of soil organic carbon (SOC) and soil depth greater than one meter to calculate the net savings by skipping chemical fertilizers in such holdings in the traditional rubber growing regions of Kerala and Kanyakumari district of Tamil Nadu using geo-spatial approach. Satellite-derived rubber plantation maps, SOC and soil depth maps were used for the present analysis. Thematic layers of SOC and soil depth were taken from the data base of Rubber Soil Information System (RubSIS) developed recently by Rubber Research Institute of India. The extent of rubber area with high soil OC status having a depth of more than one meter were delineated using spatial overlay analysis. Regions qualifying for this dual criteria were considered to estimate the net savings, including fertilizer cost and labour charges. Results indicated that in 1,61,911 ha of mature rubber area in Kerala and Kanyakumari district of Tamil Nadu, fertilizer application can be skipped for short periods which accounted for a net annual saving of Rs. 87 crores per year. District-wise interpretation revealed that net annual savings was the highest in Kottayam district (Rs. 27.4 crore per year) and in all other districts net annual savings would be below Rs.10 crores per year. Geo-spatial analysis was helpful in identifying mature rubber area where fertililizers can be skipped for short periods which could reduce the cultivation cost and avoid unnecessary pollution.

Key words: Chemical fertilizer, Overlay analysis, Rubber plantation, RubSIS, Soil depth, Soil organic carbon

Traditionally natural rubber (*Hevea brasiliensis*) is being cultivated across the foot hills of Western Ghats in Kerala and Kanyakumari district of Tamil Nadu which produces about 90 per cent of total latex production in India. Total rubber area (>3 years of age) in Kerala and Kanyakumari district of Tamil Nadu recorded 5,58,600 ha (RRII and ATMA, 2013). This perennial tree crop has a productive life cycle of 25 to 30 years and its continuous cultivation in Kerala and Kanyakumari district has turned third cycle and proper agro-management practices need to be followed to sustain soil health and productivity of rubber plantations in these regions.

Rubber Board had conducted an extensive soil sampling in rubber growing regions of South India and found that about 75 per cent of total rubber growing regions were having high soil organic carbon status (Rubber Board, 2017). Reduction of soil carbon content is not observed in mature rubber plantations since carbon input from leaf litter of rubber spread homogeneously all over the plantation (Guillaume *et al*.,

Table 1. **District-wise net annual savings by skipping chemical fertilizers in rubber plantations of Kerala & Kanyakumari district of Tamil Nadu**

Districts		Rrubber area in each district (Ha)	Mature NR area qualifying for skipping fertilizers (Ha)	% of mature NR area qualifying for skipping fertilizers	Net annual savings due to fertilizer skipping (in crore)
1	Kottayam	110724	50765	45.8	27.4
2	Pathanamthitta	55845	17623	31.5	9.5
3	Kannur	54292	16410	30.2	8.8
4	Ernakulam	66155	15121	22.8	8.1
5	Malappuram	38835	14172	36.4	7.6
6	Kasaragod	25424	12232	48.1	6.6
7	Idukki	37348	12107	32.4	6.5
8	Palakkad	32119	5880	18.3	3.1
9	Kollam	38998	4516	11.5	2.4
10	Kozhikode	20895	2845	13.6	1.5
11	Trivandrum	27657	1149	4.1	0.6
12	Alapuzha	4421	1099	24.8	0.6
13	Trissur	15734	760	4.8	0.4
14	Kanyakumari (TN)	21948	7234	32.9	3.9
	Total area (Ha)	550395	161911	29.4	87

2016). George and Joseph (2011) reported that growth and yield of mature rubber plantations were not adversely affected where chemical fertilizers were withdrawn for a period of seven years. Leaf litter fall and decomposition help plants to transfer nutrients to soil which further regulate nutrient cycling and mainatanence of soil fertility (Aerts and Caluwe, 1997; Prescott *et al*., 2004). Total soil carbon content increased by 14 to 62 per cent with increasing age of rubber plantations (Mandal and Islam, 2010). Amount of soil moisture, pore space and root growth of plantation crops including rubber is influenced by soil depth (Krishnakumar and Potty, 1992; Bhattacharyya *et al*., 1998). Mostly terrain properties, soil fertility, climate *etc.* would influence the yield of rubber plantations. Under the changing climate and the present low price scenario of rubber it is essential to adopt proper measures to reduce rubber cultivation cost without compromising yield and growth. Rubber Board recommended skipping of fertilizers (ad hoc basis) in deep soils with high organic carbon status, considering soil organic carbon as a general indicator of soil health by taking account the results of fertilizer response studies, nutrient dynamics in rubber plantations and adaptive strategies of rubber trees to acquire nutrients.

Geo-spatial information would be highly useful in identifying rubber plantations with specified criteria where fertilizer application can be skipped. This study was undertaken in rubber growing regions of Kerala and Kanyakumari district of Tamil Nadu to find out total spatial extent of mature rubber area qualifying for skipping chemical fertilizers (based on SOC and soil depth) and to estimate the net savings by fertilizer skipping.

Study area location chosen for the analysis is rubber growing regions in Kerala (excluding Wayand district) and Kanyakumari district of Tamil Nadu. Rubber distribution map, SOC and soil depth of the study area was used for the analysis. Spatial distribution map of rubber plantations in the study area which was delineated in 2012-2013 by RRII and ATMA (2014) was utilized in the study. Soil organic carbon content and soil depth distribution of the study area was taken from the online platform of Rubber Soil information System (RubSIS). Extent of rubber area where high SOC(>45,000 kg ha^{-1}) and soil depth with more than one meter was estimated using geo-spatial overlay technique and these regions were classified for skipping chemical fertilizers. District-wise net savings due to fertilizer skipping (fertilizer dose as N, P, K @ 30:30:30 kg ha^{-1} as urea, rock phosphate and muriate of potash) was calculated using cost for chemical fertilizers and labour charge (Rs. 5400 ha^{-1} $year^{-1}$).

Results showed that out of 5,50,395 ha of mature rubber area, about 1,61,911 ha in Kerala and Tamil Nadu were having high SOC status and more than one meter soil depth, where fertilizer application can be skipped for short periods. Skipping of fertilizer application in this area would result annual net savings of Rs. 87 crores (Table 1). Highest saving calculated was from Kottayam district (Rs. 27.4 crore) and in all other districts a net saving of below 10 crores was recorded. District-wise interpretation indicated that highest share of areas for skipping chemical fertilizers estimated at Kottayam district (50765 ha), followed by Pathanamthitta (17623 ha), Kannur (16410 ha), Ernakulam (15121 ha), Malappuram (14172 ha), Kasaragod (12232 ha) and Idukki (12107 ha) districts. Alapuzha (1099 ha) and Trissur (760 ha) districts showed the least extent of such areas. Spatial distribution of mature rubber area with high SOC status (>45,000 kg ha^{-1}) and soil depth (>1m) are given in Figure 1. From the map it is evident that central region of Kerala (Kottayam, Pathanamthitta and Ernakulam districts) and northern region (Malappuram, Kannur and Kasaragod districts) and Kanyakumari district of Tamil Nadu showed large extent of such rubber growing regions. Field experiment conducted in a 10 year old mature rubber plantation showed that the growth and yield of rubber plants were not significantly influenced by skipping the fertilizer application for a period of seven years. The study also reported that mature rubber plantation could be considered as a partially self-sustaining ecosystem with a regular cycle of uptake and return of nutrients to the soil and it is possible to skip fertilizers in well-maintained rubber plantations with suitable terrain conditions *etc.* (George and Joseph, 2011). In mature rubber plantation annual leaf litter fall ranges from 6.8 to 7.8 tonnes ha^{-1} and contributes nutrients to the soil (Varghese *et al*., 2001). Rubber growing regions in the study area under high SOC content and soil depth >1m may sustain proper soil health and yield even if chemical fertilizers is skipped for a period of three years. After three years of skipping, the soil fertility status may be assessed. The study helps the rubber farmers to minimise the application of chemical fertilizers in mature rubber plantations which is economically and environmentally beneficial.

The study showed the usefulness of RubSIS platform to identify rubber area with high organic carbon status and soil depth more than one meter where chemical fertilizer application could be skipped for short periods. Mature rubber growing regions under high status of soil OC and soil

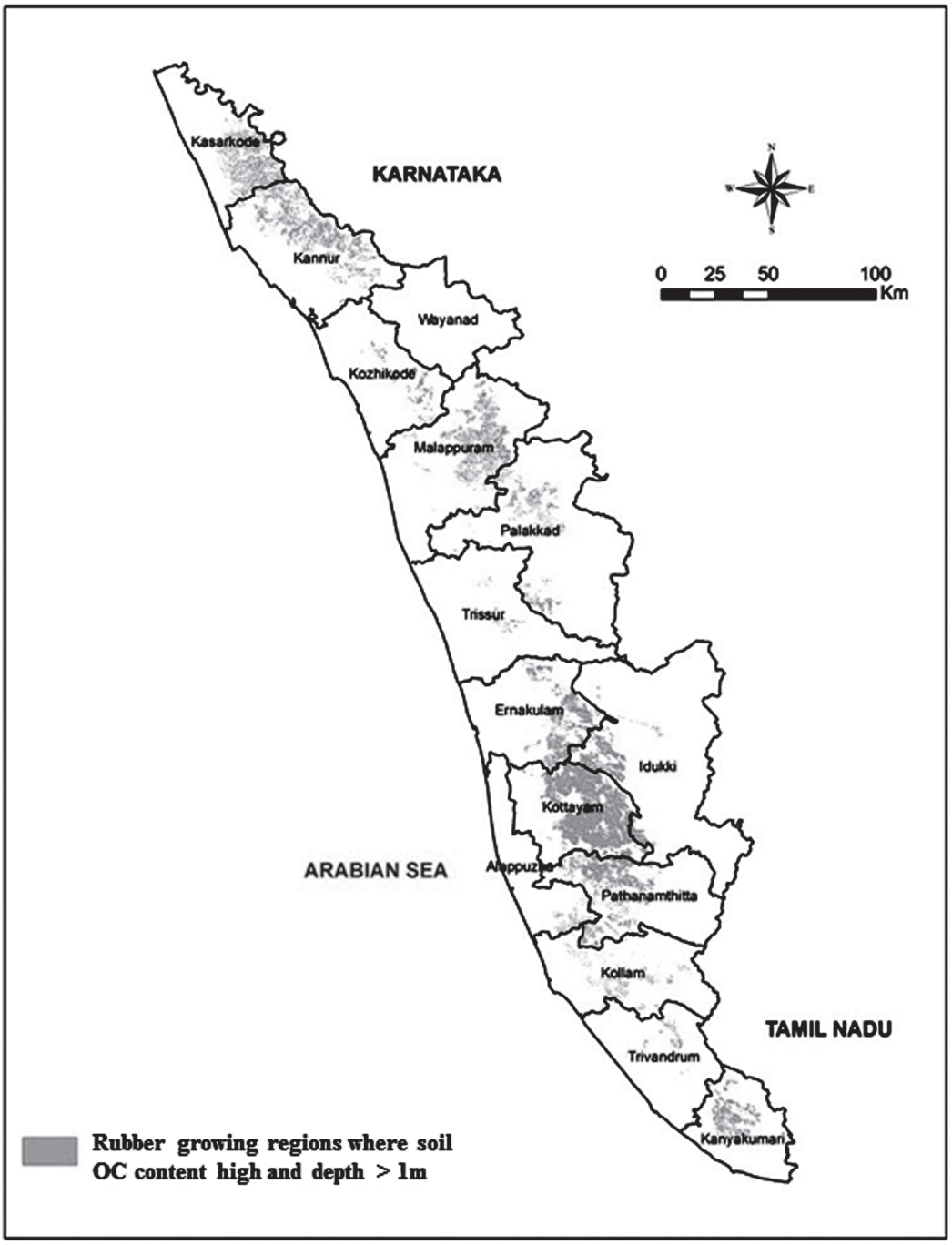

Fig. 1. Distribution of rubber area qualifying for skipping chemical fertilizers in Kerala and Kanyakumari district of Tamil Nadu as of 2012-2013

depth one meter and above in Kerala and Kanyakumari district of Tamil Nadu were estimated to be 1,61,911 ha. A net annual saving of about Rs. 87 crores was estimated from these regions if fertilizer application is skipped.

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