DOI: http://doi.org/10.4038/jrrisl.v97i0.1877

Journal of the Rubber Research Institute of Sri Lanka (2017) **97**, 1-11

Ground level impediments for proper adoption of rubber cultivation in Northern Province of Sri Lanka

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Abstract

The Government of Sri Lanka has taken a decision to expand the rubber cultivation to non-traditional areas with drier climates in the country. With the success of rubber cultivation in the Uva and Eastern Provinces, the Northern Province has been the next focus in the expansion process. Despite the evidence of having reasonable growth and acceptable climatic conditions in this region, rubber cultivation has only been successful in Vavuniya district. Therefore, the present study was conducted in Vavuniya, Mullaithivu and Kilinochchi districts in the Northern Province of Sri Lanka to identify possible socio economic, cultural and agronomic limitations affecting the adoption of rubber cultivation. Further, it was expected to identify farmer perceptions on the promotion of expansion process. All farmers with successful rubber cultivation in each district were selected along with similar numbers of unsuccessful farmers and farmers who are willing to cultivate rubber. Factors affecting the success of the rubber cultivation were determined using logistic regression method. Proficiency in Sinhala language, usage of mulch at early stage of rubber plants, affiliation to social organizations and availability of water source were identified as factors significantly contributed to the success of rubber cultivation. The study concludes that success of rubber cultivation in Northern Province of Sri Lanka depends mainly on communication efficiency between Sinhalese officers and Tamil farmers and usage of moisture conservation practices at the early stage of growth of rubber plants. Although many farmers failed in rubber cultivation, their perception on cultivating rubber is one of optimism, demanding organizational support for initial establishment. Involvement of government and non-government organizations and social interactions among farmer communities are required in such attempt.

Key words: adoption, agronomic, farmer perception, rubber, socioeconomic

Introduction

Rubber has become an essential commodity in day to day life with the increase in living standards of human. Having specific features, natural rubber (*Hevea brasiliensis* Muell Arg.) has been secured vital position in rubber industry providing renewable raw material for wide range of industries (Anon, 2016). Nevertheless, production of natural

rubber has to be increased in order to cater the growing demand. Originally, cultivation of rubber was confined to wet tropics based on the specific agro-climatic requirements for optimum growth performance (Rao and Vijayakumar, 1992). However, many rubber growing countries have examined the posibility of expanding rubber cultivation to marginally dry non-traditional areas. Of them, some countires such as China, India, Vietnam, Thailand, Laos and Brazil have been able to establish rubber successfully under sub optimal climatic conditions (Chandrashekar *et al*., 1998; Fox and Castella, 2013; Priyadarshan *et al*., 2005).

The potential for expanding rubber cultivation to non-traditional drier areas has also been emphasized in Sri Lankan context too (Iqbal *et al*., 2010; Rodrigo *et al*., 2011a; 2012). First, rubber was introduced to the Intermediate zone of the country; *i.e.* Eastern Province and proven with satisfactory growth and yields (Rodrigo and Iqbal, 2009; Rodrigo *et al.,* 2014). Considering this success, Government of Sri Lanka (GoSL) has decided to extend the rubber cultivation to the drier climates in Northern Province. Rubber was established in Vavuniya, Kilinochchi and Mullaitivu districts of Northern Province, where similar agro climatic conditions are available. In this process, Rubber Research Institute of Sri Lanka (RRISL) and Rubber Development Department (RDD) were instrumental in providing technology required and subsidy payments (Rodrigo *et al.,* 2011b). Despite the evidence of having reasonable growth and acceptable climatic conditions in this region, rubber cultivation has only been successful in Vavuniya district (Iqbal *et al.,* 2016), raising doubts of any socio-economic and cultural impediments for the adoption of rubber cultivation in this region. With such background, the present study was aimed to identify any socio-economic, cultural and agronomic limitations associated with poor adoption of rubber cultivations in Northern Province of Sri Lanka.

Methodology

The study was conducted in Vavuniya, Kilinochchi and Mullaithivu districts where rubber cultivation has been initially targeted in the Northern Province of Sri Lanka. Farmers having successfully established rubber fields were the focal group for the study. Total number of farmers enabling to maintain successful rubber fields had been limited to 14; hence, the same was taken for information collection. For the comparison purpose, 20 farmers who failed in rubber cultivation were selected randomly from the same area. Further, similar number of farmers which have shown an interest on rubber cultivation were chosen randomly to identify their perceptions on new cultivation programme. A semi-structured questionnaire was used as the data collection tool. Information on socioeconomic, cultural and agronomic factors related to rubber cultivation were gathered. Socio-economic variables comprised demographic information of

farmer and farm family, properties of the farm family, provision of technical and advisory services, issues related to land tenure, involvement in social organizations and financial situations such as income, expenditure and saving patterns. Under the cultural factors, farmer ethnicity and proficiency in languages were considered. Soil properties, water availability and experience on farming practices were considered under agronomic variables. Logistic Regression Method (LRM) and descriptive analytical methods were used to analyze quantitative and qualitative variables, respectively. Also non-programmed mathematical method was used to identify and rank farmer perceptions on rubber cultivation. In that, responses of rubber farmers were put into a Likert scale and then converted to numerical values. Data analyses were conducted using SAS statistical software.

Results

Contribution of socioeconomic, cultural and agronomic parameters to the success of rubber cultivation

Socio-economic and cultural parameters

Socio-economic variables showed no any significant difference between farmers having successful and unsuccessful rubber fields. Farmers were in the age range of 32 to 74 years with the average of 50 years. Most families were male headed (85%) and consisted with average of four members. Majority of them (70%) were educated only up to secondary level or remained below. On average, a family owned *ca.* 4.8 and 1.5 hectares upland and lowland extents, respectively. The greater number of farmers (70%) have not attended any other occupation than farming. They had farming experience of *ca.* 25 years, however none of their offspring engaged in farming activities. On average, farmers have been used to hire three labourers to assist farming activities of a hectare of land throughout at a cost of LKR 1,200 per labourer per day (Table 1).

Being newly introduced crop to the area, rubber farmers were mainly supported by RRISL and RDD in commencement of rubber cultivation. Almost all the farmers (97%) have accessibility for agricultural credit facilities, therefore many of them were able to carry out their farming activities without much suffering from financial difficulties. Irrespective to the outcome in rubber cultivation, 70% of farmers were willing to plant rubber again.

Total monthly income of a farmer household varied between LKR 15,000 to LKR 617,000 with the average value of LKR 175,000. Income received from the sales of farm products had been the main income contributor (65%) to this amount. On average, expenditure of a farmer household was LKR 135,000 per month; however, 60% of that was for the expenses of farming activities whilst the rest for household expenses. Therefore, farmers were able to save LKR 1,800 to LKR 120,000 per month (Table 1).

Table 1. *Socioeconomic background of farmers*

	Successful farmers		Unsuccessful farmers	
	Mean	**Range**	**Mean**	**Range**
Age of farmer (years)	49.7	36 - 68	51.7	32-74
Family size	4.6	3 - 8	3.7	1- 6
Farming experience (years)	26.4	7 - 45	23.8	10-40
Farm lands-upland (ha)	4.8	0.4 - 29	4.8	0.2-20.8
Farm lands-lowland (ha)	0.4	0 -1.45	2.5	0 to 21
Family labour	1.0	0 to 2	1.0	0 to 2
Hired labour per hectare per day	3.14	0 to 10	3.00	0 to 10
Monthly total income (LKR)	193,214	40,000-617,000	149,839	15,000-600,000
Monthly income from farming (LKR)	103,785	20,000-480,000	120,938	15,000-600,000
Monthly total expenditure (LKR)	151,321	38,000-603,500	115,060	13,200-505,000
Monthly expenditure for farming (LKR)	58,678	8,500-290,000	84,960	1,200-480,000
Monthly expenditure for household (LKR)	29,357	15,000-65,000	24,950	12,000-48,000
Monthly Savings (LKR)	41,892	2,000-120,000	34,779	1,800-110,000

Majority of farmers (74%) considered for the study have been confined to Vavuniya district whilst others represented Kilinochchi and Mullaitivu Districts. Of the total, 65% was Sinhalese and the rest were Tamils with no fluency in Sinhala language. Being in the Sinhalese ethnic group and fluency in Sinhala language were identified as factors that have significantly contributed to the successful establishment of rubber in this area. Further, formation of social organizations was observed as a common practice among Sinhalese farmers and it has significantly contributed for the success in rubber cultivation (Table 2). However, no traditional criticisms or believes on rubber cultivation were prevailed among both ethnic groups.

Table 2. *Summary of statistical (logistic regression) analysis for cultural parameters significantly contributed to the success of rubber cultivation in Northern Province of Sri Lanka*

Cultural parameters	Number of farmers (%)	Pr > ChiSq
Language skills (proficiency in Sinhala)		
Yes	22 (65)	0.0145*
No	12 (35)	
Ethnicity		
Sinhala	22 (65)	0.0145*
Tamil	12 (35)	
Membership of social organization		
Yes	23 (68)	0.0011*
No	11 (32)	

* at 5% significance level

Agronomic parameters

Farmers had shown more interest towards cultivating seasonal crops in Maha (major) season whist maintaining perennials in Yala (minor) season. They have used both own and hired farm implements for field activities. Agro-wells were the major water source (71%) for irrigating farm lands and access to an agro-well has significantly contributed to the success of rubber cultivation (Table 3). Common water canals have been used as an alternative approach where agro-wells were lacking. Only 68% of farmers were able to afford for water pumps to support in irrigating activities whilst the rest have used to divert canal water by making leader drains towards the farm lands. The surface irrigation method was the most popular irrigation method (91%) practiced by farmers; however, few used high tech irrigation such as sprinkler and drip systems. As a moisture conservation practice 56% of farmers had used mulch application around young rubber plants which significantly contributed to the success of rubber cultivation in this area (Table 3).

Table 3. *Summary of statistical (logistic regression) analysis for agronomic parameters significantly contributed to the success of rubber cultivation in Northern Province of Sri Lanka*

Agronomic parameters	Number of farmers (%)	Pr > ChiSq
Water source		
Agro well	24 (71)	0.0366*
Irrigation cannel	10 (29)	
Mulch usage for rubber plants		
Yes	19 (56)	0.0029*
No	15 (44)	

* at 5% significance level

Quantification of the contribution of key factors on the success of rubber cultivation

As per the linear regression analyses, success of the rubber cultivation has been mainly governed by two factors, *i.e*. proficiency in Sinhala language of the farmer and usage of mulch as a moisture conservation method at early stage of growth (Model 1). Other factors which were individually became significant at non-parametric logistic regression, were not strong enough to contribute the regression a model. Accordingly, proficiency in Sinhala language affect the success of rubber by 1.3 times whist usage of mulch as a moisture conservation method at early stage of growth by 1.7 times. (If the estimate is positive (above zero), then farmers are likely to be successful in rubber cultivation.

Success of rubber cultivation = -1.5552 + 1.3188 (proficiency in Sinhala language) + 1.6585 (Mulch usage at early stage of growth)

Model 1. Linear regression model fitted to quantify the effect of key factors affecting the success of rubber cultivation. Farmers proficient in Sinhala language and those who used mulch at early stage of growth were coded as '1' whilst those not as '0'

Farmer perception on rubber cultivation

Farmers in all categories have highly been concerned on continuous and effective extension service, uninterrupted water supply, improved transportation system and introduction of suitable agronomic practices to enhance soil properties and moisture conservation. Farmers having successful rubber fields were expecting to have more lands to expand their cultivation whilst unsuccessful farmers were demanding quality planting materials, guidance from experienced rubber farmers and high tech irrigation systems to avoid any failures in subsequent attempts. Farmers who had no experience on rubber, have shown the interest to cultivate rubber in following seasons should subsidies and credit facilities be provided in addition to demands of rubber farmers mentioned above (Table 4).

Irrespective of the outcome of rubber cultivation, farmers in the area have been demanding institutional support from RDD and RRISL for the establishment of rubber in top priority (Table 5).

Table 4. *Farmer perception on agronomic and socio economic factors for rubber cultivation. (Ranks were given according to Likert Scale with the highest influenced factor shown by '1' and the lowest by '15')*

	Ranks		
	Successful farmers	**Unsuccessful farmers**	**Newly interested farmers**
Availability of extension services	1	4	2
Strength of farmer organization	10	9	10
Access of credit facilities	6	11	4
Access to advance technology	13	7	9
Availability of subsidies	14	13	11
Availability of skilled labors	8	10	12
Improved transportation facility	4	1	3
Availability of planting material	9	3	5
Availability of fertilizer	12	15	14
Uninterrupted water supply	2	2	1
Availability of farm land	7	8	13
Protection from wild animals	11	12	8
Awareness of diseases	15	14	15
Suitability of climate	5	6	6
Suitability of the soil condition	3	5	7

Table 5. *Farmer perception on institutional support given for rubber cultivation. (Ranks were given according to Likert Scale with the highest perceived support shown by '1' and the lowest by '6')*

	Ranks		
	Successful farmers	**Unsuccessful farmers**	**Newly interested farmers**
Neighboring farmers	5	4	5
Social groups	4	3	4
RRISL	2	1	2
RDD	1	2	1
Agriculture Department	3	5	3
Non-governmental organizations	6	6	6

Discussion

Despite the profitability and any other perceived benefits, introducing a crop to a new region is a challenge as it should fit not only with agro-climatic conditions but also with socio-cultural matrix of the local community. Moreover, farmers must be confident else are to be convinced on the compatibility of the particular crop with their desires. Initially, only risk seeking farmers adopt the technology and the rest would follow them after seeing the benefits. Rubber cultivation is considered to be profitable

and proven to provide stable income to the peasant community (Rodrigo *et al.*, 2000). Nevertheless, introduction process of this crop to the Eastern Province of Sri Lanka took over 7 years to be buoyant in the farming community. In particular, attraction of farmers to this crop took place after seeing the latex tapping and financial benefits.

In Northern Province, rubber was introduced recently and farmers have never experienced its benefits as rubber trees are yet to be harvested. Therefore, it is acceptable to have low level of adoption in this region. Only risk seeking farmers would go for rubber at this stage and in order to accept any risk, farmers are to be economically sound. The present study has shown that income level of farmers in the Northern Province is reasonably high strengthening them to accept the risk. Some level of their risk seeking quality is further confirmed by their willingness to cultivate rubber. Even the farmers who failed in rubber cultivation in early attempts, have shown an interest to cultivate rubber again. Nevertheless, in accepting the risk, farmers expect additional outside support for cushioning any potential losses. Further, with the intervention of GoSL for establishing rubber through the government institutions, farmers would have realized the nature of supply driven approach. Hence their risk seeking approach is rather conditional and farmers expect all necessary supports to cultivate rubber. Moreover, lengthy payback period of rubber (Herath and Takeya, 2003) compared to the quicker returns from traditional short term crops, it is not surprising to observe such expectations of farmers in this region.

Obviously, water is a limiting factor for plant growth in dry regions. Being a crop originated from Amazon wet forests, water is more critical for rubber cultivation when grown in the Dry Zone. Therefore, water sources such as agro-wells and soil moisture conservation measures such as mulching have been the significant agronomic factors for successful rubber cultivation. Rubber is grown initially with traditional short-term crops as an intercropping system which water is irrigated to. Irrigation is not problematic at the beginning of dry season; however water availability for irrigation becomes limited towards end of the dry period. Therefore, soil moisture conservation measures is important for plant survival at this stage. This could be the reason for high level of significance in mulching for the success of rubber cultivation. This effect has been more prominent in model fitting in the quantification approach. Being not practiced, other soil moisture conservation methods such as silt/moisture pits and rain water harvesting ponds, have not been considered in this study. However, with the present evidence, introduction of such measures undoubtedly will play a positive role in successful cultivation of rubber in this region of the country.

In introduction process, technology transfer is the most essential element for the success. The technology is to be provided to make farmers knowledgeable and more convinced. Clarity of technology, attractiveness in

expressions, friendliness and continuity in associations are essential to drive the farmers for the new crop. In such attempt, fluency in communication is a crucial factor. Officers of RRISL and RDD are mostly Sinhalese and not able to speak in Tamil. Communication barrier existed in establishing rubber with Tamil farmers as they could not speak and understand Sinhalese. Failures in rubber cultivation has mostly taken place among the farmers in the Tamil community reasoning out the significance in language and ethnicity factors in statistical analyses of this study. In particular, the proficiency in Sinhalese is one of the two determining factors of the model developed to assess the success of rubber cultivation.

It has been evident that social organizations play a positive role in introducing new technologies to stakeholders (Bebbington *et al*., 1994). Even in the present study, social organizations have been an important factor for rubber cultivation. These social organizations comprised farmers organizations, welfare societies, self-employers societies and were operative in Sinhalese dominated areas where rubber cultivation was successful. Such organizations encouraged farmers to be interactive hence facilitated to get sufficient knowledge and to be self-supportive for successful rubber cultivation.

In the model developed to quantify the effect of key parameters on the success of rubber cultivation, the proficiency in Sinhalese and mulching were the key driving factors. Positive output values show the potential for success with that farmers proficient in Sinhalese and apply mulch have the highest potential for successful rubber cultivation. Mulching has been more critical than the other due to the highly valued co-efficient. Even without being proficient in Sinhalese, a positive value is derived by the model if mulching is done. Though the potential level of success is low here with decimal product value, it indicates the level of importance in mulching in terms of conserving soil moisture.

The study guides the decision makers in the expansion process of rubber cultivation in the Northern region of Sri Lanka to identify the key governing factors, so that, future failures could be minimized. In agronomic activities, measures on soil moisture conservation should be in priority. Although proficiency in Sinhalese is important, it is rather difficult to educate the Tamil community in Sinhalese. Instead, Tamil speaking officers are to be employed to educate Tamil farmers in technology transfer process. Further, technology transfer should also be done through local affiliations (social organizations) to which farmers are attached.

Conclusion

Success of the rubber cultivation in Northern Province of Sri Lanka mainly depends on Sinhala language proficiency of farmers and usage of mulch as a moisture conservation practice at the establishment and early stage of growth of rubber plants. Further being a Sinhalese, a member of a social group and accession to a water source play

significant role in successful establishment of rubber cultivation in the area. Although many farmers failed in rubber cultivation, their perceptions on cultivating rubber are still optimistic demanding organizational support at top priority.

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