DOI: https://doi.org/10.4038/jrrisl.v103i1.1918

Journal of the Rubber Research Institute of Sri Lanka (2023) 103, 54-64

Present status of rubber farming based inter-cropping systems in Moneragala District

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Abstract

This study has assessed the present status of rubber farming based inter-cropping systems in Moneragala District. Eighty-eight percent of rubber smallholdings had been inter-cropped during their immature period. Banana (Musa acuminate), maize (Zea mays), cowpea (Vigna unguiculata), passion fruit (Passiflora edulis) , groundnut (Arachis hypogaea) and vegetables were prominent among the cultivated inter-crops in rubber smallholdings. The majority of rubber smallholders used family members for up keeping of inter-crops. The major reasons for not adopting to inter-cropping were difficulty in protecting the crop from wild animals, lack of interest, distance from the residence to the rubber land and non-suitability of the land. The education level of rubber smallholders and their spouses, the experience in rubber farming, membership of the Thurusaviya rubber society, number of family members, total extent of rubber farming were positively related to the adoption on rubber farming based inter-cropping, while the age of smallholder and the spouse have negatively affected. The most of rubber smallholders highlighted that low net-return, lack of subsidy facilities to buy inputs of inter-cropping, lack of knowledge on inter-cropping systems by inter-crops as the major constraints faced by them. The rubber smallholders should be motivated and encouraged further on inter-cropping and mix cropping to increase the land productivity while improving economic stability in Moneragala.

Key words *:* Adoption, Advisory, Rubber smallholders, Rubber farming based inter-cropping

Introduction

Although Rubber Farming (RF) originated as a mono-culture system, it has now been grown with different short-term and long-term crops creating an agroforestry system. It is quite advantageous in terms of crop diversity providing both financial and environmental benefits especially during the prolonged immature period which causes significant problems in terms of income generation mainly for Rubber Smallholders (RSs) who have a limited extent of land. One means of addressing

the gap income during the immature phase of rubber plants is to grow short- and long-term crops in the spaces between the rubber rows, generally referred to as "inter-cropping". RSs in different rubber growing countries practise different inter-cropping and animal production systems with RF (Romyen *et al*., 2018). For example, shifting cultivation of upland rice with wild rubber (Van *et al*., 2012), jungle rubber gardens with multipurpose tree species (Penot *et al*., 2002) and cultivation of short-period crops. Growing inter-crops with rubber brings about an additional income to the RSs, during the immature phase of rubber. Hence, certain crops are recommended by the Rubber Research Institute of Sri Lanka (RRISL) as a mean of improving land productivity (Rodrigo *et al*., 2004). It was found that inter-cropping has no injurious effect on growth performance of rubber, irrespective of climatic conditions.

During the immature stage (6-7 years) expenditure is incurred on planting and maintenance of the rubber tree but there is no yield, except the returns from inter-crops if inter cropping is practised to provide an essential way of increasing land-use efficiency during the unproductive immature stage of rubber cultivation (Rodrigo *et al*., 2001a). The most common inter-crops are maize, watermelon, banana, tea, cocoa, pineapple, vegetables and medicinal plants (Thennakoon, 1998; Thennakoon, 2002). Inter-cropping of rubber with short-term crops provides a win-win situation via providing early returns from inter-crops during the immature period of rubber (Rodrigo *et al*., 2004a; Rodrigo *et al*., 2004b). Inter-cropping of rubber lands has been successful to increase the overall productivity of the land. Also, recent research studies have proved that inter-cropping has ameliorates the micro climatic conditions of the farm area and provides a better environment for the growth of rubber (Rodrigo *et al*., 2001; Rodrigo *et al*., 2004a, Rodrigo *et al*., 2014).

This study was carried out to explore the present status of Rubber Farming based Inter-cropping systems (RFIS) in immature rubber smallholdings in Moneragala District (Moneragala). Studying the existing condition of RFIS is a basic necessity to identify areas, which need to be strengthened to increase rubber land productivity in immature stage of RF by appropriate planning of extension and advisory service.

Materials and Methods

The study was conducted in Moneragala during 2020. The smallholder survey was conducted with 129 Rubber Smallholders (RSs) who had rubber smallholdings (immature stage) in eight rubber growing DS divisions. The stratified sampling technique was applied according to distribution of RSs in each division. Pre-tested questionnaire and field observations were used to collect data from the respondents. The questionnaire consists of questions from the three main domains and key general

information of RSs, smallholdings, perceived constraints of RFIS and suggestions to solve the identified constraints. The perceived constraints of RFIS in Moneragala were evaluated at the ground level. There were 4 constraints identified by the focus group discussion with 28 RSs, who were selected from eight rubber growing DS divisions based on stratified sampling technique, prior to the questionnaire survey and the list was then administrated to RSs for response. Identified constraints of RFIS were listed on the questionnaire. The respondents were asked to assign a rank for all constraints and the outcomes of such ranking have been converted into a score with the help of the following Eq. 1;

$$\text{Percent Position of Each Rank} = 100\ (R_{ij} - 0.5) / N_j \ldots\ldots \text{Eq. 1}$$

Where;

R_{ij} = Rank given for the i^{th} variable by j^{th} respondents

N_j = Number of variables ranked by j^{th} respondents

Based on the results of the calculation of ranks using the formula mentioned above, Garrett values were determined using Garrett Ranking Conversion table. The Garrett values were then multiplied by the frequencies of the constraints in every rank. The mean score was used as the basis of the final ranking of the constraints. Suggestions were obtained from the rubber development officers, officials of *Thurusaviya* Rubber Societies (TRSs) and RSs through questionnaire survey in order to remove and find solutions for the constraints. Descriptive analysis and Spearman's correlations were used to analyze the data by using STATA version14 software.

Results and Discussion

Profile of study sample

Male RSs has dominated (91%). The age of RSs varied from 20 to 79 years. The majority (62%) of RSs belonged to the age category of 36-40 years. Nearly 10% of the respondents was above 60 years, while only 35% was found below 35 years. However, the young age (<35 years) category was not prominent in this study area, and it differs from a previous study carried out in Moneragala by Wijesuriya *et al*., 2008. The age of spouse of the RSs varied from 21 to 70 years. Also, 45% of the spouses of RSs were less than 40 years of age, while only 20% were more than 60 years of age.

None of the RSs has obtained higher education (diploma and degree level), and 1% of RSs had not attended to a school. Further, only 6 % of RSs had attended to tertiary education level (GCE A/L). According to the education level of the spouses of smallholders, nobody was found in the categories of no schooling and higher education qualified in both smallholder categories. The most

prominent educational level was up to Ordinary Level of the spouses of RSs (50%).

The most of RSs utilized land for cultivation of rubber (31%) and their land for chena cultivation (27%). Average extent of land of RSs was 6.4 ac. RSs have not utilized land for animal husbandry comparative to the extent of commercial scale farming. These findings are confirmed with the findings of the research undertaken on rural livelihood strategies by Thennakoon (2002 and 2017).

Experience of smallholders in agricultural activities was measured in years of experience in farm related activities. The range of the farming experience was from 5 to 55 years where experience in RF was low since the most of smallholders were new to RF, and it was varied from 8 to 14 years (Mean = 10 years). Mean farming experience of RSs was 37 years.

TRSs are the smallholder rubber societies known to be operated under the control of *Thurusaviya* fund of Ministry of Plantation Industries and that is the body responsible to provide RSS manufacturing facilities, enhance sales and rubber marketing of RSs (Dissanayake and Wijesuriya, 2012). Around 78% of RSs are members of TRSs in the study area. TRSs have been formulated in a view to enhance the agricultural extension activities and it was reported as a way of increasing awareness and which in turn increases the adoption rate of RF and RFIC.

Adoption of rubber farming based inter-cropping systems

Eighty-eight percent of rubber smallholdings had been inter-cropped during their immature period. Adoption rate for RFIS in Moneragala was found to be higher than that of traditional rubber growing areas (Wijesuriya *et al.*, 2011). There was diversity among inter-crops which can be seen in immature rubber smallholdings in Moneragala, unlike in traditional rubber growing areas (Wijesuriya *et al.*, 2011). The major reasons for not adopting to inter-cropping were difficulty in protecting the crop from wild animals (78%), lack of interest (12%), distance from the residence to the rubber land (9%) and non-suitability of the land (1%).

Figure 1 shows the inter-cropping with rubber in the study area. Around half of the RSs (51%) had cultivated banana (*Musa acuminate)* as the inter-crop in the immature rubber smallholdings, while 19% of RSs had cultivated maize *(Zea mays)* as the inter-crop. Other inter-crops (Figure: 1) include cowpea (*Vigna unguiculata)* (8%), passion fruit (*Passiflora edulis*) (1%), groundnut (*Arachis hypogaea)* (12%) and vegetables (9%) which contribute towards food self-sufficiency, by providing food products while increasing the ability to obtain more income during the time period, when the rubber trees are still unproductive. The most of RSs (96%) practiced RFIS as single inter-crop.

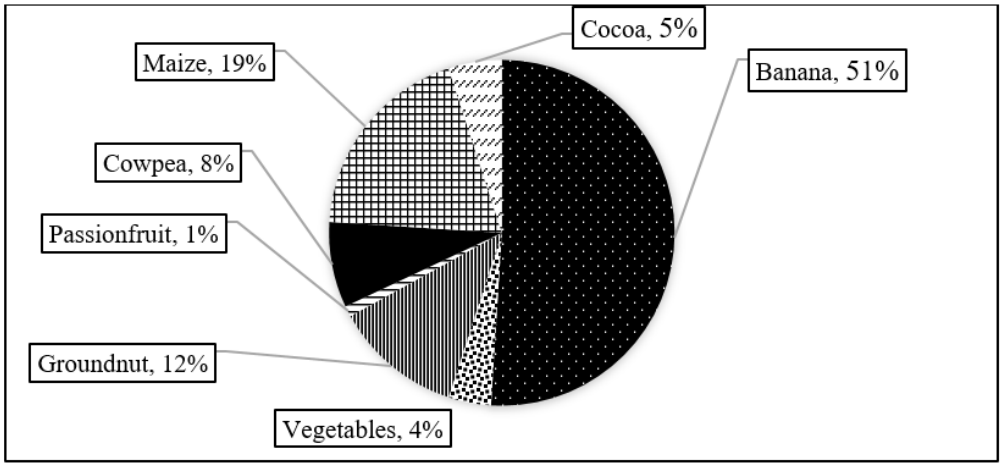

Fig. 1. Inter-cropping with rubber farming in the study area

RRISL also has introduced several mix cropping systems with mature RF as a mean to improve land productivity (Rodrigo *et al.*, 2004). However, the most of RSs (98%) have not adopted to mix cropping systems, merely because they were not interested in mix cropping systems. There are only two percent of RSs who have grown cocoa as mix cropping with rubber smallholdings in Moneragala.

Land area distribution among the different types of RFIS has shown in Table 1. Banana was inter-cropped with rubber in all land categories. The most of RSs (68%) were having rubber smallholdings falling into 1.1 to 2 acre category and they cultivated Cowpea, Maize and Banana. Cocoa (*Theobroma cacao)* was cultivated above three acres. The reason of cultivated Cocoa in large land categories was reasonable profit can't be achieved by cultivating small land categories. Literature revealed that smaller farms appear to have lower efficiencies than larger farms due to the more efficient use of inputs (Manjunatha *et al*, 2012). The smallest land category (<1 acre) of RSs had cultivated different types of Vegetables, Passion fruits, Maize and Banana. The most of RSs of this category highlighted that cultivated vegetables used for home consumption and surplus were marketed.

Table 1. *Cultivated land area and type of inter-crops*

Size of the holding (acres.)	% (N=129)	Type of intercrops
<1	6	Vegetables, Passion fruits, Maize, Banana
1.1-2	68	Cowpea, Maize, Banana
2.1-3	21	Groundnut, Maize, Banana
3.1-4	5	Cocoa, Banana

Condition of the inter-crops and rubber smallholdings

The condition of the inter-crops was measured with scales namely, good, moderate and weak. The most of inter-crops (65%) and 47 % of rubber cultivation were in good condition recommended by the RRISL. The 38% of both of rubber and inter-crops were in good condition and it was not satisfactory level. This certainly has serious implications on the sustainability of RF. The clone RRIC 121 occupies 82% of the smallholdings selected for the study. The average number of rubber trees was reported as 416 per hectare (Range 312 – 471). Delaying tapping opening and poor girthing were the adverse repercussions of the above issue. Therefore, extension services should be focused to improve the condition of both rubber plants and inter-crops. At the beginning of the planting, RSs should be aware the importance of the up-keeping of RFIS.

Labour usage for up keeping practices of inter-cropping

Figure 2 indicates the labour usage up keeping practices of RFIS. Three types of labour were used for RFIS as family, share basis and hired for planting, weeding, disease controlling and manuring of RFIS. The majority (86%) of RSs used family members for up keeping of RFIS. Planting done by share basis was prominent in share basis category

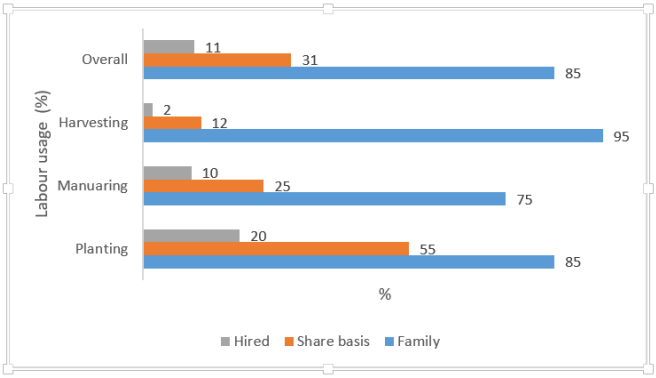

Fig. 2. Labour requirement for up keeping practices of rubber farming based inter-cropping

Distribution of rubber smallholdings

Figure 3 indicates the distance to the rubber smallholding from the residence. The average distance from rubber smallholding to residing house was 4 km and it ranged from 0 to 9.5 km. Nearly 41% of the RSs live in their rubber smallholding and altogether 12% live in the vicinity of 1 km (Figure 4). Accessibility by vehicles is possible in about 75% of the rubber smallholdings. RFIS in homesteads shows 70% of good condition of RFIS. It assures better care on up keeping of rubber smallholdings with inter-crops.

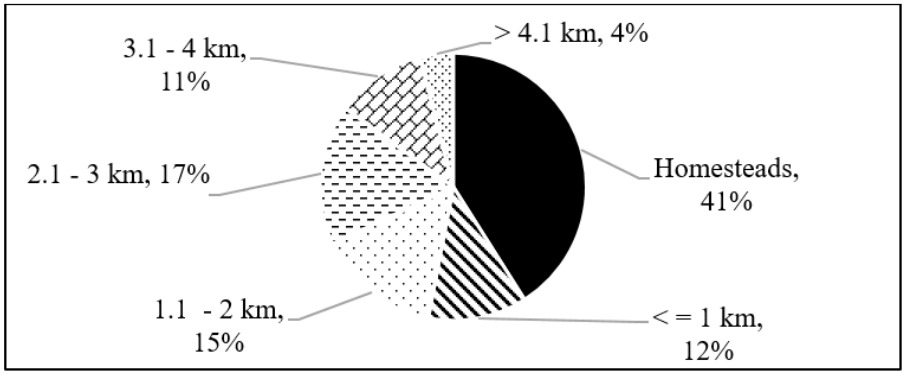

Fig. 3. Distance to the rubber smallholding from the residence

Constraints

Table 2 reveals that the constraints for RFIS faced by RSs. The most of RSs highlighted that low net-return by RFIS. This return was calculated based on the general cost of production without considering family labour into the calculation. Mean net return was estimated around LKR 90,000/acre/year in with family labour situation during first two years except Cocoa. Lack of subsidy facilities to buy inputs was also highlighted by RSs. At present subsidy for RFIS was delayed or not provided. Lack of knowledge on inter-cropping systems was third prominent constraint of RFIS. RSs (78%) practiced 12' X 18' spacing for rubber planting and planted inter-crops with this spacing. Lack of knowledge of recommended spacing RFIS was major issue for plant growth. While many (73%) of the RSs applied manure for rubber plants only and 20 % applied both rubber and inter-crops. Only few (5%) RSs highlighted deficiencies of rubber plants. Pest attack and disease for inter-crops were common issues in RFIS and pesticides and fungicides were applied for these attacks.

Table 2. *Constraints faced by rubber smallholders for rubber farming based inter-cropping*

Constraints	Garret mean score	Rank
Low net return	73.56	1
Lack of subsidy facilities to buy inputs	70.01	2
Lack of knowledge on inter-cropping systems	65.53	3
Nutrient deficiencies of rubber plants	63.22	4
Pest and disease attack for inter-crops	51.44	5

Factors affecting the adoption of rubber farming based inter-cropping systems by rubber smallholders in Moneragala District

Age of the RSs and their spouses was negatively and significantly (r= - 0.3430, p=0.0000) related to the adoption on RFIS which indicated that, the most of younger generation has been adopted on RFIS. This is aligned with the study of Simtowe *et al.*, 2016, as the age of household head was the major determinant factor of adoption on livelihood agricultural strategies at household level. Generally, younger generations are early adopters on diffusion of technology transferring process (Rogers, 2003). As a result of that younger smallholders show adoption on RFIS than that of older.

Education level of RSs and their spouses was positively related to the adoption on RFIS (r=0.8730, p=0.0000). Education level is an important variable to be considered when studying the adoption on agricultural farming systems (Rogers, 2003). The education level of the household head and their spouses has immense influence on decision making ability in adoption on livelihood agricultural strategies at household level. And in the area of modern agriculture education level of the household heads has significant role than in traditional agriculture, especially where selection and allocation of inputs is crucial in modernizing agriculture. Studies of Perz, 2002; Magaña-lemus *et al*., 2016 also have confirmed this circumstances.

Thus, experience in RF was positively related to the adoption on RFIS (r=0.7430, p=0.0000). Hossain and Crouch, (1992) have explained that the experienced farmers could have the ability to analyse the pros and cons of farming systems and adoption on new farming practices of a given farming system. The most of smallholders in Moneragala engage on traditional farming systems which they have been practising since long time. As a result of that smallholders have experience to compare pros and cons of RF and RFIC and traditional farming systems to decide on adoption on RFIS as an agricultural livelihood strategy at the household level.

Social participation of smallholders positively influences the level of adoption on farming practices (Amarasinghe, 1993; Hyland, *et al*., 2018). Membership of the TRSs was positively related to the adoption on RFIS (r=0.6435, p=0.0000). Social

participation of RSs is important on various fronts in RF such as knowledge sharing on farming practices, establishment of volunteer groups in basic infrastructure development and formulation of a micro-credit scheme, etc. RSs who have participated in the discussion group show higher adoption on technology and are more focused on farm profit improvement. Designing and delivering agricultural extension programmes can be easily implemented through TRSs. However, promotional campaigns on RFIS have to be arranged through TRSs for further improvement of the membership of TRSs.

Adoption on RFIS was correlated (r=0.6435, p=0.0000) with number of household members of RSs in Moneragala, which does support with the findings of Meijer *et al*., 2015. Daily workforce is necessary for the tasks of weeding, manuring and other cultural practices of RFIS. Therefore, high work force is required in RFIS, when compared to other farming systems. As a result of that, number of household members is important for adoption in RFIS.

One of the major factors that determine the quantity of crop production at household level is total cultivable land extent. When smallholders adopt on RF as an agricultural livelihood strategy, extent of land is considered as an important factor. As rubber is a perennial crop, at least one acre is needed for cultivation of rubber plants in order to get marginal benefits. It was supported by this study the fact that the total extent of cultivated of RF was significantly and positively related to the adoption on RFIS (r=0.7812, p=0.0000).

Herath (2003), highlighted that smallholders' awareness and attitudes towards RFIS, land extent, extension contacts, education level, and experience with farming other crops are positively associated with the probability of adoption of RFIS. While higher levels of off-farm income, farmers who are sole owners of the land, engaged in part-time RF, social participation, family size, experience with RF were not significantly influence on adoption of RFIS. Therefore, the RSs should be motivated and encouraged further on inter-cropping and mix cropping to increase the land productivity while improving economic stability in Moneragala.

Conclusion

1. Rubber smallholders should be motivated and encouraged further on intercropping and mix cropping to increase the land productivity in Moneragala.
2. The recommended immature up keeping practices of rubber based intercropping systems should be promoted among the rubber smallholders to maximize land productivity.
3. The policy changes regarding rubber based intercropping should be organized in more efficient manner to be appropriate for Moneragala.
4. Animal husbandry based farming systems also should be promoted.

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