FACTORS INFLUENCING CONVERSION OF RUBBER LANDS TO ALTERNATIVE CROPS IN SRI LANKA: A CASE STUDY IN PALINDANUWARA IN KALUTARA DISTRICT

Sri Lanka Journal of
Economic Research
Volume 4 (2) June 2017
SLJER.04.02.02: pp. 25-43
Sri Lanka Forum of
University Economists

Shanika Madushani Jayasuriya

Nandasiri Keembiyahetti

Abstract

Using binary logistic model with primary data collected from a sample of 300 former and present rubber smallholders in Palindanuwara DS division in Kalutara district, this study attempts to answer the question of why rubber smallholders convert to alternative crops despite increasing rubber prices. Our findings concludes that the individual decision to transit from rubber to alternative crops is positively influenced by expected net income and expected leisure time after conversion. Relative profit margin of the old crop (rubber) compared to the new crops is found to negatively influence the decision to convert. However, conversion at national level is mostly due to money illusion where smallholders misinterpret an increase in relative income as an increase in relative profit. Smallholders' gender, age and education were proven irrelevant to the decision of convert.

Key Words: Rubber, Binary Logistic, Pobit Model, Sri Lanka

Shanika Madushani Jayasuriya

Graduate Research Student of University of Ruhuna, Sri Lanka

Telephone: +94 717 22 68 44, Email: go2shanijayasuriya@gmail.com

Nandasiri Keembiyahetti

Senior Lecturer in Economics, Department of Economics, University of Ruhuna,
Sri Lanka

Telephone: +94 715 35 93 88, Email: nandasiri2007@gmail.com

INTRODUCTION

During the British Colonial era, that is in 1876, Henry Wickham, an Englishman introduced rubber to Sri Lanka by planting the first rubber plant at the Henarathgoda Botanical Gardens, Gampaha. A tree which previously grew in the wild, Rubber has become a major domestic cash crop in about 50 years. In 1895, Henry Ridley from the Singapore Botanical Garden was able to convince two coffee growers to test the feasibility of rubber by planting it in two acres of their land. The trees grew well and rubber plantations were successfully begun. With the invention of the automobile in the late 19th century, the rubber boom began. By 1905 more than 300,000 hectares of rubber were growing in Ceylon and Malaysia (History of Rubber-Horana Plantation PLC).

By the end of the colonial era, Sri Lanka's economy was highly specialized, with three tropical export crops, namely tea, rubber and coconut, which accounted for 80 percent of total export earnings and 45 percent of GDP. Owing to the Korean War boom, rubber prices increased substantially in the world market during 1950-51, and this helped Sri Lanka to accumulate a great deal of foreign exchange reserves (De Silva, 1988). According to the latest statistics, however, the extent of land under rubber cultivation dropped from 202,000 ha in the late 1970s to 133,000 ha in 2013 (Ministry of Plantation Industries, 2014). This remarkable decline was largely due to diversification of rubber lands for other alternative uses, mainly driven by unattractive rubber prices during 1998 to 2002, coupled with the rise in cost of production and the scarcity of labour. Fluctuation of rubber prices is a major concern among rubber growers and is a major factor for transition into other crops (Marambe, 2001; Wijesuriya *et al.*, 2004). Sluggish prices in the world market seem to have severely affected the rubber cultivation in Sri Lanka. Replanting schemes in the estate sector were also not implemented properly during this period and some smallholders abandoned cultivation.

Recovery from this unfortunate situation for rubber began in the latter part of 2002. Prices improved as a result of increased demand from China. The Memorandum of Understanding (MoU) signed by the three major producers of natural rubber, *viz.* Thailand, Malaysia and Indonesia, to curtail rubber output by 4 percent and the rapid increase in crude oil prices in world market also contributed to this recovery. This situation reversed the declining trend in rubber land extent from year 2004 onwards (Kulasekera, *et al.*, 2010).

There are 14 rubber growing districts in Sri Lanka, of which Kalutara, Ratnapura, and Kegalle are leading districts located in the wet zone (See Figures 1 and 2). Rain interference to rubber tapping is very frequent and high in this zone, and land availability and trained labour shortage act as major obstacles to the expansion of cultivations. To avoid this problem, the government has at present taken up initiatives to

expand rubber cultivation in Monaragala district in Uva Province and in the suburbs of the Eastern Province. Research into soil quality conducted by the Rubber Research Institute (RRI) has been successful in these areas (Bulletin of the RRI, 2005).

During the 1982-2010 period, the land extent under rubber cultivation significantly dropped in all three leading districts with Kalutara district reporting the biggest drop of 45 percent (See Table 1).

Figure 1: Rubber-growing Districts in Sri Lanka

Figure 2: Total Land Extent under Rubber by Districts, 1982-2010

District	1982	2002	2010
Kegalle	45,919	34,753	37,178
Kalutara	47,632	29,922	29,299
Rathnapura	29,329	21,669	24,800
Colombo	10,317	7,064	7,702
Galle	14,637	6,518	6,160
Moneragala	2,192	1,831	4,764
Gampaha	3,364	3,055	3,826
Matara	6,637	3,614	3,779
Kurunegala	3,290	2,753	3,018
Kandy	2,127	1,166	1,821
Badulla	969	412	1,633
Matale	4,422	1,861	1,311
Puttlam			193
Hambantota	67	41	155
Nuwara Eliya	224	22	6

Source: Rubber Development Department & IRSG Statistic Bulletin 2010.

Table 1: The Rubber Land Extent in the Major Rubber Growing Districts of Sri Lanka, 1982-2010

Year	Kegalle (ha)	Kalutara (ha)	Rathnapura (ha)
1982	45,919	47,632	29,329
2002	34,753	29,922	21,669
2010	37,178	29,299	24,800

Source: Department of Census and Statistics (2010).

The transition from rubber, which began during the 1970-1975 period, grew more rapid after 1985. The transition from rubber to tea was at its highest during the decade from 1986 to 1995, which accounted 67 percent of all transition from Rubber to alternative crops, (Kulasekera *et al.*, 2010).

Research Problem

According to the Department of Census and Statistics (DCS), rubber prices continued to increase during the past decade or so. In 2000, the average rubber price (for RSS1) was reported as Rs. 54.91 per kg and in 2011 it increased to Rs 513.05 per kg. It is more meaningful to consider this increasing trend in terms of relative price: as depicted in Figure 3, the relative price of rubber as against that of tea has been increasing. Meanwhile, on contrary, the land extent under rubber cultivation has declined from 157,000 ha in 2000 to 128,120 ha in 2011 while the smallholder sector usage dropped from 64 percent of total land extent to 62 percent.

This controversy gives birth to our central research question as to why the rubber smallholders of Sri Lanka shift to alternative crops, irrespective of rising rubber prices.

Objectives

The objective of this study is to examine economic and noneconomic factors causing the transition of rubber smallholders to alternative cash crops.

Economic factors include the ratio of expected income before and after conversion, relative profit of rubber vs. other crops, labour shortage, leisure time and subsidies, whereas noneconomic factors include number of rainy days, nature of landownership, growers' gender and age *et cetera*.

The rest of the paper is organized as follows. Section two is devoted to a brief literature review about previous studies. In section three, we develop the methodology which will be followed by the empirical data analysis and discussion in section four. In section

five, we conclude findings and finally elaborate the limitations of the study in section six.

Figure 3: Relative Price of Tea and Rubber, 2000-2012

Source: Central Bank of Sri Lanka, Annual Reports-various years.

LITERATURE REVIEW

Studies on transition from rubber to other crops are limited in number and seem incomplete from a statistical point of view. Now we summarise a few such studies done in major rubber growing areas in Sri Lanka.

Jayasuriya and Carrad (1975) conducted a survey in the Colombo, Kalutara and Ratnapura districts using a sample of 165 smallholdings with the objective of ascertaining how smallholders arrive at the decision to replant rubber. The responses showed a wide range of influences at work: the main incentives for farmers to replant were the promise of a steady flow of output and a reasonable income, low risk and the lack of viable alternative crops. Disincentives ranged from fear to lose current income (albeit very low) by removing old rubber trees, insufficiency of the replanting subsidies and the greater profitability of the other perennial crops. This study has given greater emphasis to the replanting of rubber than to the transition from rubber to alternative crops.

Wijesuriya *et al.* (2004), examining the reasons for abandoning rubber cultivation in Pohorabava village in the Ratnapura district, disclosed that there was a 20 percent risk of abandoning rubber cultivation as a combined effect of interactions between the

environment, society and technology in the rubber smallholder sector. Using Participatory Rural Appraisal (PRA) techniques, the said study discovered that the factors directly influencing the decision of abandoning rubber are reduced income caused by lower rubber prices, shortage of labour, inefficiency of advisory services, insufficient subsidies and long immature period. Further it revealed that the shortage of labour was due to the prevalence of opportunities in other occupations which were superior to tapping while the reduced income was due to low rubber prices and heavy rainfall. As remedial measures they recommended a reduction in the degree of price fluctuation through government intervention, increasing subsidies, awareness building, and finally changing the attitudes of people on rubber tapping as a livelihood.

Kulasekara (2007) in a case study done in Baduraliya under the theme of 'economics of transition from rubber to other alternatives' emphasised that about 28 percent of the total rubber plantation area has already been converted to other alternatives. The majority consisting of 94 percent of the total transition was for tea cultivation, with a margin of 3 percent for coconut and cinnamon. This study identified the reduction of rubber prices as the major reason for the transition. In presence of a higher IRR and relatively a shorter payback period for tea cultivation compared to rubber this study concluded that tea is economically more viable than rubber for the Baduraliya division of Kalutara district. However, it appears that national level data do not support the low price argument. As shown in Figure 3, the relative price of Rubber has continued to increase during the 2000-2006 period.

Kulasekara *et al.* (2010) carried out a study in Baduraliya in the Kalutara district using a sample of 104 farmers including 29 rubber growers who transferred to other crops. A structured questionnaire and participatory tools were employed in the study. The transition from rubber to tea and other crops was 94% and 28% respectively. Fluctuating rubber prices, shortage of latex harvesters, disease outbreaks and rain interference were identified being the major factors behind transition. Those who transferred to tea cultivation had claimed that the involvement in tea did not permit them to engage in another occupation as it reduced leisure time. The cash flow analysis confirmed that the Net Present Value (NPV) and Internal Rates of Return (IRR) were high for tea although Benefit Cost (BC) ratio was slightly high for rubber. However, they concluded tea has better prospects in this area since the payback period was three years for tea and 10 for rubber.

Mudalige *et al.* (2015) examined various reasons for the reluctance to engage in rubber cultivation and other socio economic factors to see whether there is an association for the decision to transit from rubber to other crops in a study carried out in Seethawaka DS division in Colombo district. The sample consists of 120 smallholders who are still engaged and shifted from rubber cultivation. Data collection was done through a

structured questionnaires and descriptive analysis was done using nonparametric tests such as Chi-squared test and factor analysis. As revealed from the sample tested, 18 percent have totally dropped rubber cultivation and 14 percent are partially planning to go to other cultivations. The most critical problems revealed in the study seem compatible with findings in previous studies such as fluctuating product prices, rain interferences, lack of skilled tappers, diseases in rubber and low yield per acre. Furthermore, they found an association between the decision to drop rubber cultivation and age, level of education, number of family members, experience, level of total income, level of income from rubber, land extent, harvest per acre, stage of cultivation, land ownership. It was also found that most of the farmers preferred to grow tea or coconut instead of rubber.

Our study attempts to eliminate at least two weaknesses detected in previous studies. First, in terms of methodology, majority of such studies seem subject to omitted variable bias as done without controlling the influences emerging from social and demographic factors. Second, most of the findings seem to have been concluded based on what respondents revealed as per their perspectives but not as the results of a proper analysis of such responses. For example, heavy rainfall has been identified as one common reason to give up rubber cultivation in almost all studies discussed. Nevertheless, those studies disregard the fact that there is a vast majority who continue with rubber and even replant rubber despite of heavy rainfall in the same geographical vicinity. We argue that selecting a sample consisting only of those who have transited from rubber to alternatives is itself biased.

METHODOLOGY

As our major concern is to identify the factors motivating the smallholders to convert rubber lands into alternatives, we employ the binary logistic regression model considering the binary nature of the dependent variable (converted/not converted) in this study.

We assume the decision of an individual to changeover to alternative or not to depends on an *unobservable utility index* I_i^* , which in turn depends on a set of explanatory variables (X) such as relative price of rubber, shortage of skilled harvesters, income variation, bad weather conditions, availability of subsidies, supplementary employment of smallholders, age structure, gender and education level of smallholders. This can be indexed as:

$$I_i^* = BX + u_i \quad (1)$$

where X is set of explanatory variables, $i = i^{\text{th}}$ individual and u = error term. In the unobservable index related to the actual decision of transition or nontransition to alternatives is reasonable to assume that:

$$\begin{aligned} Y_i &= 1(\text{transition to alternative crops}) & \text{if } (I - I_i^*) \geq 0 \\ Y_i &= 0(\text{nontransition to alternative crops}) & \text{if } (I - I_i^*) < 0 \end{aligned}$$

That is, if a person's utility index I exceeds the threshold level I^* , he or she will transit to alternative crops but if is less than I^* , that individual will not transit to alternative crops.

The probability of transition to alternative crops is:

$$\begin{aligned} P(Y_i = 1) &= P(I^* \geq 0) \\ &= P(BX + u_i) \geq 0 \\ &= P[u_i \geq -(BX)] \end{aligned} \quad (2)$$

This probability depends on the (probability) distribution of Y_i , which in turn depends on the probability distribution of the error term, u_i . If this probability distribution is symmetric around its (zero) mean value, then equation (2) can be written as:

$$P(u_i \geq -BX) = P(u_i \leq BX) \quad (3)$$

Therefore,

$$P_i = P(Y_i = 1) = P(u_i \leq BX) \quad (4)$$

Obviously P_i depends on the particular probability distribution of u_i . The probability that a random variable takes a value less than some specified value is given by the **cumulative distribution function** (CDF) of that variable. The logit model assumes that the probability distribution of u_i follows the **logistic probability distribution**, which can be written as:

$$P_i = \frac{1}{1+e^{-Z_i}} \quad (5)$$

where P_i = probability of transition $Y_i = 1$ and

$$Z_i = BX + u_i \quad (6)$$

Then the probability of nontransition $Y_i = 0$, is given by

$$1 - P_i = \frac{1}{1+e^{Z_i}} \quad (7)$$

It can be easily verified that as Z_i range from $-\infty$ to $+\infty$, P_i ranges between 0 and 1 and that P_i is nonlinearly related to Z_i (i.e. X_i), thus satisfying the requirements discussed

earlier. The model given by equation (5) is nonlinear not only in X but also in the parameters. A simple transformation will help to make the model linear in X_s and coefficients. Taking the ratio of equations (5) and (7), that is the ratio of the probability of transition to the probability of nontransition, we obtain:

$$\frac{P_i}{1-P_i} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} = e^{Z_i} \quad (8)$$

Now $P_i / (1-P_i)$ is simply the **odds ratio** favouring transition into alternative crops, which is the ratio of the probability of transition to the probability of non-transition towards alternative crops.

Taking the (natural) log of equation (8) now we can obtain very interesting equations that form the logit model:

$$L_i = \ln\left(\frac{P_i}{1-P_i}\right) = Z_i = BX_i + u_i \quad (9)$$

In equation (9) the log of the odds ratio is a linear function of the B_s as well as the X_s . In this transformation, L_i is known as the **logit** (log of the odds ratio) and hence the model is known as the **logit model**. Usually in linear probability models (LPM) P_i is assumed linearly related to X_i , where in the logit model the log of the odds ratio is assumed linearly related to X_i . The interpretation of the logit model in equation (9) is as follows: each slope coefficient shows how the **log of the odds** changes as the value of the X variable changes by one unit.

Equation (9) can be converted to an empirically testable equation by introducing the explanatory variables relevant to this study.

$$L_i = \ln\left(\frac{P_i}{1-P_i}\right) = Z_i = \beta_0 + \beta_1 EXIN_i + \beta_2 RPROFIT_i + \beta_3 LAB_i + \beta_4 FREE_i + \beta_5 RDAYSi + \beta_6 OWN_i + \beta_7 EDU_i + \beta_8 GEN_i + \beta_9 AGE_i + \beta_{10} SUBT_i + u_i \quad (10)$$

where Z = Dummy dependent variable $\begin{cases} 1 & \text{if transited} \\ 0 & \text{otherwise} \end{cases}$

$EXIN$ = Ratio of expected income from new cultivation to the previous cultivation at the time of conversion. Since the expected income is unobservable, it was assumed to be equal to realised income

$RPROFIT$ = Ratio of profit margins after conversion to before conversion

LAB = labour shortage as a percent of total labour requirement in rubber at the time of conversion

FREE	= Number of free days per week when the owner is not involved in cultivation after conversion
RDAY	= Number of untapped (lost harvest) days during the year before conversion
OWN	= Categorical variable showing ownership whether own, government or combined
EDU	= level of education measured by year of schooling of the smallholder
GEN	= Dummy variable $\begin{cases} 1 & \text{if male} \\ 0 & \text{otherwise} \end{cases}$
AGE	= Age of smallholder at the time of Conversion, current age for others
SUBT	= Dummy variable $\begin{cases} 1 & \text{if new crop received subsidies} \\ 0 & \text{otherwise} \end{cases}$
u_i	= error term

Hypothesis

$\beta_1 > 0$ = Higher the expected income from new cultivation, higher the odds of tendency to transit to alternative crops because rational people always prefer high income to low income

$\beta_2 < 0$ = Higher the rubber profit compared to that of alternatives, lower the odds of tendency to transit to alternative crops

$\beta_3 > 0$ = Higher the skilled labour shortage, higher the odds of tendency to transit to alternative crops

$\beta_4 > 0$ = Greater the free time available after conversion, higher the tendency to transit to alternative crops

$\beta_5 > 0$ = Higher the rain interference, higher the odds of tendency to transit to alternative crops because rain interference causes loss of harvest

$\beta_6 < 0$ = The more ownership rights are vested with an outside party, lower the tendency to transit to alternative crops

$\beta_7 > 0$ = Higher the level of education, higher the tendency to transit to alternative crops because educated smallholders are more likely to find alternative jobs

$\beta_8 > 0$ = When the smallholder is male, higher the tendency to transit to alternative crops because of male dominance in Sri Lankan culture

$\beta_9 > 0$ = Older the smallholder, higher the odds of transit to alternative crops

$\beta_{10} > 0$ = The more subsidies are available for tea, higher the tendency to transit because subsidies keep people motivated

Sample and Data

Kalutara district comprising an extent of 29,299 ha land cultivated with rubber is ranked the second largest rubber growing district in Sri Lanka. It belongs to the agro ecological zone, where 3,200 mm of annual rainfall can be expected with 75 percent probability (Kulasekera *et al.*, 2010). The terrain in this area is categorised as rolling, undulating and hilly, and land use in this area comprises tea, rubber, paddy, cinnamon and mixed-cropped home gardens. The study used stratified random sampling techniques where the study population was divided into subgroups called strata. In the first step, five Grama Niladari (GN) divisions were selected considering two factors namely;

- (1) Density of rubber cultivation and
- (2) Adequacy of reported transition cases from rubber to alternatives crops

Accordingly Baduraliya, Lathpandura, Hedigalla, Morapitiya, and Pelenda GN divisions in Palindanuwara divisional were selected. Then, a sample of 300 respondents was selected randomly using a computer generated random number list. A single smallholder who has transformed a part of the rubber cultivation while keeping the remainder unchanged was considered as two individual smallholders for analytical convenience. Questionnaire survey and PRA techniques were employed to collect primary data. The relevant secondary data were collected from the Central Bank Annual Reports; bulletins published by Rubber Development Authority and previously collected data available in the Rubber Research Institute in Agalawatta.

RESULTS AND DISCUSSION

The binary logit model developed in section three was estimated by Maximum Likelihood (ML) method with the help of E-views-7 statistical software. The dummy variable SUBT was dropped as it was found highly correlated with other explanatory variables and did not improve **likelihood ratio (LR) statistic** either. Accordingly, the estimated equation is given by:

$$\hat{Z}_i = 61.939 + 4.183EXIN_i - 52.776RPROFIT_i - 14.43LAB_i + 0.489FREE_i - 0.0239RDAYS_i - 0.899OWN_i - 0.053EDU_i - 0.757GEN_i - 0.105AGE_i \quad (11)$$

In the *logit model* the slope coefficient of a variable gives the change in the log of the odds associated with a unit change in that variable, all else being equal. But as previously emphasised, for the logit model the rate of change in the probability of an

event occurring is given by $\beta_j P_i(1 - P_i)$, where β_j is the (partial regression) coefficient of the j^{th} regressor. But in evaluating P_i , all the variables included in the regression are involved (Gujarati, 2003). Therefore, this study primarily concerns the expected sign of the coefficients and their significance. Since the estimation technique used here is maximum likelihood, which is generally a large sample method, the estimated standard errors are *asymptotic*. As a result, instead of using the t statistic to evaluate the statistical significance of a coefficient, the (standard normal) Z statistic can be used. Therefore, inferences are based on the normal Z table. It is theoretically accepted that, if the sample size is reasonably large, the t distribution converges to a normal distribution. Each slope coefficient in equation 4.1 is a *partial slope* coefficient and measures the change in the estimated logit for a unit change in the value of the given regressor, holding other regressors constant.

Estimated coefficients in the Binary Logit Model together with z -statistics and probability values are reported in Table 2.

The hypothesis test revealed that the null hypotheses $\beta_5 = 0$, $\beta_6 = 0$, $\beta_7 = 0$, $\beta_8 = 0$, $\beta_9 = 0$ cannot be rejected at any conventional significance level. Thus, it can be concluded that the number of rainy days (RDAYS), nature of land ownership (OWN), smallholder's education level (EDU), land owners' gender (GEN) and smallholder's age (AGE), do not influence the decision to convert rubber cultivations to other crops. Even though one might assume rain interference must necessarily affect the decision of conversion, it is not statistically significant in our study. This is because despite the fact of whether or not they transitioned to other crops, all respondents have experienced the same amount of rainfall as they share the same geographical neighborhood.

H_0 ; $\beta_1 = 0$ is rejected at 1% significance level, correct in sign, favoring the alternative hypothesis H_1 ; $\beta_1 > 0$ that the higher the expected income from new cultivation, the higher the odds of tendency to convert. In terms of income variation, rubber is subjected to very high income variation not only because of price fluctuations but also due to nonharvesting seasons and tapping failures due to bad weather. On the contrary, tea has a constant flow of income. A day's delay in harvesting tea can be recovered the next day, but in rubber the failure to tap on a given day is irrecoverable. This finding tallies with previous studies and is plausible in the real world.

Table 2: Estimated Coefficients of Binary Logistic Model

Dependent Variable: Y

Method: ML - Binary Logit (Quadratic hill climbing)

Sample: 1 300

Included observations: 300

Variable	Coefficient	z-Statistic	Prob.
C	61.93914	2.000344	0.0455
EXIN	4.183419***	2.966547	0.0030
RPROFIT	-52.77699**	-1.778849	0.0753
LAB	-14.43008***	-2.336991	0.0194
FREE	0.489577**	1.775608	0.0758
RDAYS	-0.023920	-0.868976	0.3849
OWN	-0.899383	-1.080947	0.2797
EDU	-0.053076	-0.326661	0.7439
GEN	-0.757366	-0.538199	0.5904
AGE	-0.105147	-1.085399	0.2777
McFadden R-squared	0.777450		
LR statistic	83.85212		
Prob(LR statistic)	0.000000		
Obs with Dep =0	69	Total obs	300
Obs with Dep =1	231		

*** Significant at 1%, ** Significant at 10%.

By comparing the income per hectare from rubber and tea, (see Figure 4), it can be seen that tea has been earning higher income per hectare than rubber at national level except in 2011 where rubber prices hit its peak. Therefore, conversion from rubber to tea can be justified in terms of relative income at national level. However, increasing income from tea does not mean increasing profit from tea cultivation.

Similarly, $H_0; \beta_2 = 0$ is rejected at 7% significance level, correct in sign, favoring the alternative hypothesis $H_1; \beta_4 < 0$ suggesting that higher the relative profit margin of rubber, lower the tendency to convert from rubber to alternatives.

Figure 4: Income from Rubber and Tea per hectare (Rs.), 1999-2013

Source: Central Bank of Sri Lanka, Annual Reports-various years.

We can now compare the profit per one hectare of rubber versus tea at national level. Figure 5 depicts the relative profitability of rubber versus tea, based on the data from Central Bank Annual Reports.

According to Figure 5, it is evident that profit earned from one hectare of rubber, on average, has always been much higher than that of tea since 2003. Therefore, the finding in previous studies that the drop in profitability of rubber was the fundamental reason for conversion is rejected by secondary data at national level. Therefore, it can be concluded that the profit motive behind the conversion of most rubber growers is merely a money illusion: that is, the fact of tea cultivators collecting more income per hectare has been misunderstood as earning higher profits than rubber cultivators from a land of similar extent. This money illusion might be the primary reason for conversion.

In contrast to previous studies, the present study rejects $H_0; \beta_2 = 0$ at one percent significance level favouring the alternative hypothesis $H_1; \beta_{12} < 0$ which is not in accordance with previous studies. This suggests that the higher the skilled labour shortage, the lower the tendency to transit to alternatives. This could happen in a situation where labour shortage is a problem common to tea cultivation as well, and needs further research.

Figure 5: Net Profit from Rubber and Tea per hectare (Rs.), 1999-2013

Source: Central Bank of Sri Lanka, Annual reports-various years.

$H_0; \beta_3 = 0$ is rejected at seven percent significance level, correct in sign, favoring the alternative hypothesis $H_1; \beta_3 > 0$ suggesting that the greater the free time available after transition, higher the tendency to transit from rubber to alternatives. This is a plausible finding because rubber cultivation needs daily attendance for harvesting whereas it is enough to attend to tea once a week for harvesting and maintenance. Therefore, leisure time has been a decisive factor in transition to other crops.

A more meaningful interpretation in terms of odds can be obtained by taking the antilog of the slope coefficients. Thus, the antilog of the EXIN coefficient of 4.183 is approximately 65.59 ($=\text{Exp } 4.183$). This suggests that those who expect a one time higher income than now are 65 times more likely to transit from rubber to alternative crops than those who believe there would be no change in income after transition, all else remaining the same. In terms of leisure time, the antilog of the FREE coefficient of 0.49 is approximately 1.63 ($=\text{Exp } 0.49$). This suggests that those who believe that they would enjoy one additional free day after transition are 1.6 times more likely to transit from rubber to alternative crops than those who expect no change in leisure time after transition, all else being equal.

The probability of a respondent converting rubber to other crops, though not directly given by logit model, can be computed using equation 5 accordingly, we computed the probability values for all 300 respondents but do not present them here for brevity. When considered probability over 0.5 as converter and probability below 0.5 as non-converter, it is interesting to note that the estimated model predicts 288 out of 300

observations correctly. This helps in computing R^2 for the model as the typical Conversional R^2 is not valid in the logit model. The ratio of correctly predicted number of observations to the total number of observations is called count R^2 . The count R^2 calculated as $288/300 = 0.96$ suggests that 96 percent of the variation of the dependent variable can be explained by the explanatory variables in this model. Alternatively, the McFadden R^2 value standing at 0.78 suggests that 78 percent of the variation in odd ratio can be explained by the repressors.

To test the null hypothesis that all the slope coefficients are simultaneously equal to zero, which is equivalent to the F test in the linear regression models, the logit model uses the **likelihood ratio (LR) statistic**. Given the null hypothesis, the LR statistic follows the χ^2 distribution with d.f. equal to the number of explanatory variables, (Gujarati, 2003) that is nine in the present model. (*Note*: Exclude the intercept term in computing the d.f.). In the estimated model LR statistic is 83.85 with probability 0.0000. Accordingly, the null hypothesis that all the slope coefficients are simultaneously equal to zero is strongly rejected at any conversional level of significance.

CONCLUSIONS

Using the binary logistic model with primary data collected from a sample of 300 rubber smallholders in Palindanuwara DS division in Kalutara district, this study examined the question of why rubber smallholders transit to alternative crops despite increasing rubber prices. Our findings concluded that the individual decision to transit from rubber to alternative crops is positively influenced by expected net income and expected leisure time after conversion. The relative profit margin of the old crop (rubber) compared to new crops was found to negatively influence the decision to convert. These findings are tallying with the previous studies quoted in this paper. Nevertheless, the secondary data at national level revealed that conversion from rubber to tea has been continuing while relative income of tea is increasing but relative profit of tea is decreasing. This means that the rubber to tea conversion has been led for the most part by a “money illusion” rather than real returns, as a result of the misinterpretation of increasing income as increasing profit by smallholders.

Smallholder's gender, age and education level were proven irrelevant to the decision to convert or not. Heavy rain interference, though many researchers claimed it to be a decisive factor for abandoning rubber cultivations, was proven to be insignificant in this study. This is against the findings of Mudalige *et al.* (2015) and Kulasekara *et al.* (2010). That is because the smallholders' concern is not bad weather itself but the low income or uncertainty in income variation caused by bad weather, which is highly significant in our study.

LIMITATIONS AND SCOPE FOR FURTHER RESEARCH

In this study the division of the sample into two categories was based on whether or not the smallholder transitioned from rubber to other crops. Nevertheless, not all transition has taken place in the same point in time. Some conversion dates are from as early as 10 years ago while some others are not earlier than two or three years ago. Despite this time difference in the event of transition the whole sample was pooled. Necessary treatments were done to rectify any influence coming from price changes over time. For example profit ratios and relative income ratios were used instead of level data though it brought extra burden in interpreting the results. In some instances, where the conversion took place several years ago, the information available with the respondent was limited and sometimes erroneous. Discontinuation of land ownership at the time of conversion was another problem in analysing data. For example, it was the case that the father removed old rubber and subsequently his son cultivated tea in that bare land. In such cases we realised that the reasons for conversion could not be logically explained and hence were omitted from the sample.

In computing the cost of tea and rubber production, the researcher had to use shadow prices and estimate implicit cost when mostly family labour had been used in production. Such estimates, though done as accurately as possible, may be subjective to a certain extent.

This study examined the factors influencing smallholders to convert their rubber lands into tea or alternative crops. Nevertheless, by no means does this research recommend that such conversions be prevented or discouraged. It is beyond the scope of this study. This study only concerned the influencing factors but not the implications of such conversions on national economy. Therefore, the platform is open for potential future researchers to investigate what types of economic, climatic and geological and environmental implications would result from such conversions and how such conversions affect the national economy.

REFERENCES

- Bulletin of the Rubber Research Institute of Sri Lanka, (2005) Special Issue on Rubber Cultivation in Monaragala, Vol.46, pp __
- Central Bank of Sri Lanka (2002, 2006, 2010, 2013) Annual report, Colombo, Sri Lanka.
- De Silva, K.M. (1988) *J.R. Jayewardene of Sri Lanka. A political biography 1906-1956*, Vol. 1: University of Hawaii Press. Chp. 50 pp. 208.

Department of Census and Statistics (2012) *Annual Performance Report*, Colombo, Sri Lanka.

Gujarati, D. (2003) Basic Econometrics. 4th ed., United States Military Academy, West Point. pp. 622-640.

Gujarati, D. (2011) Econometrics by Example. 1st ed., Palgrave Macmillan. pp. 142-155.

_____. History of Rubber-Horana Plantation PLC, available at;
www.horanaplantations.com/History-of-Rubber.html, (accessed 2016.08.14)

Jayasuriya, S.K.W. & Carrad, B, (1975) *Decision Making in Smallholding Rubber: Attitudes to Replanting in Sri Lanka*, Research bulletin, Rubber Research Institute in Sri Lanka, Vol. 54, pp. 381-397.

Kulasekara, K.P. (2007) *Economics of Transition Rubber to Other Alternatives*, unpublished thesis, Department of Agriculture Economics & Extension, Faculty of Agriculture, University of Ruhuna.

Kulasekera, K.P.; Wijesuriya, Wasana; Dissanayake, D.M.A.P.; Abeywickrama, L.M., (2010), *Transition from Rubber to Tea in Baduraliya Area in the Kalutara District*, Research Bulletin. Rubber Research Institute Sri Lanka. Vol. 51 pp. 6-14.

Marambe, B. (2001) *A Brief Overview of the Tree Crop Sector in Sri Lanka during 1995-1999*. Economic Review, April/June 2001, People's Bank Colombo, pp. 6-9.

Ministry of Plantation Industries (2008) Statistical Pocket Book. Ministry of Plantation Industries. Colombo.

Ministry of Plantation Industries (2011) Statistical Pocket Book. Ministry of Plantation Industries. Colombo. pp. 13-110.

Ministry of Plantation Industries, (2014) Statistical Pocket Book. Ministry of Plantation Industries. Colombo.

Mudalige, H.M.D.E.H., P. Sivashankar, I.C. Hettiarachchi, R.P. Mahaliyanaarachchi, and B.E.S. Bandara (2015) *Factors Affecting the Diminution of Smallholders Participation in Rubber Cultivation*, in Proceedings of the Peradeniya University International Research Sessions, Sri Lanka, Vol.19, November 2015.

Wijesuriya, W., Disanayake, D.M.P.A., Wijeratne, M., Herath, K., and Edirisinghe, J.C., (2004) *Reasons for Abandoning Rubber Cultivation: A Case Study using Bayesian Network (BN) Approach*. Bulletin of Rubber Research Institute of Sri Lanka, Vo.45, pp. 32-38.