Economic Factors behind the Conversion of Rubber Cultivations into Alternative Cash Crops with Special Reference to Kalutara District

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INTRODUCTİON AND RESEARCH PROBLEM

This study focuses on economic and non-economic factors causing conversion of rubber cultivations into alternative crops. The main objective of this study is to identify the reasons and their relative importance for conversion of Rubber lands into alternative crops.

Rubber and tea both have been economically important crops for Sri Lanka for years. The observed recent trend is that rubber cultivation gradually being uprooted by the rapid expansion of tea and other alternative crops. Hence, this study attempts to answer the question, what factors cause transition of rubber cultivations into alternative crops?

Kulasekara (2007), in a case study on Baduraliya under the theme of 'Economics of Transition from Rubber to Other Alternatives' emphasized that about 28 per cent of the total area under rubber cultivation has already undergone conversion. The majority

consisting of 94 per cent of the total transition was for tea cultivation while a margin of 3 per cent for coconut and cinnamon. This study identified the reduction of rubber prices as the major reason for transition. In the presence of a higher Internal Rate of Return (IRR) and a relatively low payback period for tea cultivation compared to Rubber this study concluded that Tea is more economically viable than rubber for the Baduraliya Division in the Kalutara District.

Wijesuriya et al. (2004),examining the reasons for abandoning rubber cultivation in Pohorabava village in the Rathnapura District, disclosed that there was a 20 per cent risk of abandoning rubber cultivation as a combined effect of interactions between the environment, society and technology in the smallholder rubber sector. Using Participatory Rural Appraisal (PRA) techniques the said study discovered that factors directly influencing the decision of abandoning rubber are reduced income, shortage of labor, inefficiency of advisory services, insufficient subsidies, and long immature period. Further it revealed that the shortage of labor was due to other occupations which were indifference to tapping while the reduced income was due to low rubber prices and heavy rainfall. As remedial measures they recommended reducing the degree of price fluctuations through government policy marking, increasing subsidies, awareness building, and finally changing attitudes of people on rubber tapping as a livelihood.

Jayasuriya, and Carrad (1975) using a sample of 165 smallholdings conducted a survey in the Colombo, Kalutara and Rathanapura Districts with the objective of ascertaining how smallholders made their decision to replant rubber. The responses showed a wide range of influences at work: the main factors encouraging farmers to replant were the promise of a steady flow of output and a reasonable income, low risk, and a lack of viable alternative crops. Negative influences for replanting ranged from inability 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.

METHODOLOGY

This study assumes the decision of an individual to changeover to alternatives depends on a set of explanatory variables such as income of rubber relative to other crops, shortage of skilled harvesters, expected leisure time, bad weather conditions, availability of subsidies, age structure, gender and the education level of smallholders. We estimated following binary logistic model to identify the influencing factors in terms of odd ratios:

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

Where,

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

EXIN = Ratio of expected income from new cultivation to the previous cultivation at the time of convention. Since expected income is unobservable, it was assumed equal to realized income

LAB = labor shortage as a percent of total labor requirement in rubber at the time of convention

FREE = Number of free days where owner not involved in cultivation per week after convention

RPROFIT = Ratio of profit margins after convention to before convention

RDAYS = Number of untapped (lost harvest) days during the year before convention

OWN = Categorical variable showing ownership whether own, government, or combined

EDU = level of education measured by year of schooling of the smallholder

SEX = Dummy variable $\begin{Bmatrix} 1 & if\ male \\ 0 & otherwise \end{Bmatrix}$

AGE = Age of smallholder at the time of convention, current age for others

SUBT = Dummy variable
$\begin{Bmatrix} 1 & if\ new\ crop\ received\ subsidies \\ 0 & otherwise \end{Bmatrix}$

u_i = error term

Hypotheses

$\beta_1 > 0$ = Higher the expected income from new cultivation is, higher the odds of tendency to transit to alternative crops

$\beta_2 > 0$ = Higher the skilled labor shortage is, higher the odds of tendency to transit to alternative crops

$\beta_3 > 0$ = The more free time available after conversion is, higher the odds of tendency to transit to alternative crops

$\beta_4 < 0$ = Higher the rubber profit compared to that of alternatives is, lower the odds of tendency to transit to alternative crops

$\beta_5 > 0$ = Higher the rain interference is, higher the odds of tendency to transit to alternative crops

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

$\beta_7 > 0$ = Higher the level of education is, higher the odds of tendency to transit to alternative crops

$\beta_8 > 0$ = When the small holder is male, higher the odds of tendency to transit to alternative crops

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

$\beta_{10} > 0$ = The more subsidies are available for tea, higher the odds of tendency to c transit

Sample and Data

Kalutara District has an extent of 29,299 ha of rubber and is ranked 2nd among rubber producing districts (Department of Census and Statistics, 2012). It belongs to the agro ecological zone, where 3,200 mm of annual rainfall can be expected with 75% probability (Wijesuriya et al., 2004). The study uses primary data collected from stratified random sampling techniques where the study population was divided into subgroups called strata., In the first step 5 GN divisions were selected considering two factors, namely:

(1) Density of rubber cultivation and
(2) Adequacy of conventional cases from rubber to alternatives crops.

Accordingly Baduraliya, Lathpandura, Hedigalla, Morapitiya, and Pelenda Grama Niladari (GN) Divisions in Palindanuwara Divisional

Secretariat Division were selected. Then, a sample of 100 respondents was selected randomly using a computer generated random number list and data were collected through a questionnaire survey. Total sample size was restricted to 100 considering limitations on expenses and time. A single smallholder who has converted a part of the Rubber cultivation while keeping the remaining part unchanged was considered as two individual smallholders for analytical convenience.

RESULTS AND DISCUSSION

The binary logit model was estimated in Maximum Likelihood (ML) method with the help of E-views-5. The variable SUBT was dropped as it was found highly correlated with other explanatory variables. Accordingly, the estimated equation is given by:

$$\hat{Z}_i = 61.939 + 4.183EXIN_i - 14.43LAB_i + 0.489FREE_i - 52.776RPROFIT_i - 0.0239RDAYS_i - 0.899OWN_i - 0.053EDU_i - 0.757SEX_i - 0.105AGE_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Estimated coefficients in the Binary Logit Model together with z-statistics and probability values are reported in Table 1 below.

Table 1: Estimated Coefficients of Binary Logistic Model

Dependent Variable: Y
Method: ML - Binary Logit (Quadratic hill climbing)
Sample: 1 100
Included observations: 100

Variable	Coefficient		z-Statistic	Prob.
C	61.93914		2.000344	0.0455
EXIN	4.183419	***	2.966547	0.0030
LAB	-14.43008	***	-2.336991	0.0194

FREE	0.489577	**	1.775608	0.0758
RPROFIT	-52.77699	**	-1.778849	0.0753
RDAYS	-0.023920		-0.868976	0.3849
OWN	-0.899383		-1.080947	0.2797
EDU	-0.053076		-0.326661	0.7439
SEX	-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	:	23	Total obs	:	100
Obs with Dep = 1	:	77			

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

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, again holding all other variables constant. For the logit model the rate of change in the probability of an event happening is given by $\beta j\ Pi\ (1 - Pi)$, where βj is the (partial regression) coefficient of the jth repressor. But in evaluating Pi, all the variables included in the analysis are involved. (Gujarati, 2003) Therefore, this study initially concerns the expected sign of the coefficients and their significance. Since estimation method 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. So inferences are based on the normal table. It is theoretically accepted that, if the sample size is reasonably large, the t distribution converges to the normal distribution.

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

number of rainy days (RDAYS), nature of land ownership (OWN), smallholder's education level (EDU), land owners' sex (SEX), and smallholder's age do not influence the decision of rubber cultivations being converted to other crops. The test results are reasonable because the preliminary data analysis also does not find any noteworthy difference in nature of land ownership, smallholder's education level, land owners' sex and age among those who converted or who continued to cultivate rubber. Even though one might reasonably assume rain interference must necessarily affect the decision of convention, it was not statistically significant in this study. This is because irrespective of whether converted or not-converted, all respondents experienced the same amount of rainfall as being living in the same geographical area.

$Ho;\ \beta_1 = 0$ is rejected at 1% significance level, correct in sign, favoring the alternative hypothesis $H1;\ \beta_1 > 0$ that higher the expected income from new cultivation, higher the odds of tendency to convert. Similarly, $Ho;\ \beta_2 = 0$ is rejected at 1% significant level favoring the alternative hypothesis $H1;\ \beta_{12} < 0$ which is against the expected sign. Thus findings suggest that higher the skilled labour shortage, lower the odds of tendency to convert. This could happen if similar labour shortage problem is experienced in tea cultivation as well. This needs further studies.

$Ho;\ \beta_3 = 0$ is rejected at 7% significance level, correct in sign, favouring the alternative hypothesis $H1;\ \beta_3 > 0$ suggesting that the more free time available after convention, higher the odds of tendency to convert from rubber to alternatives. This is plausible finding because rubber cultivation needs daily attendance whereas it is enough attend one or two days per week for tea for harvesting and maintenance. Therefore, leisure time has been a decisive factor in convention.

Finally, $Ho;\ \beta_4 = 0$ is rejected at 7% significance level, correct in sign, favouring the alternative hypothesis $H1;\ \beta_4 < 0$ suggesting that

higher the relative profit margin of Rubber, lower the odds of tendency to convert from rubber to alternatives.

A more meaningful interpretation in terms of odds can be obtained by taking the antilog of the various slope coefficients. Thus, the antilog of the EXIN coefficient of 4.183 is approximately 65.59 (=Exp 4.183). This suggests that those who expect more income than currently received from rubber are more than 65 times more likely to convert from Rubber to alternative crops than those who believe no change in income will result after conversion, other things remaining the same.

In terms of leisure time, the antilog of the FREE coefficient of 0.49 is approximately 1.63 (=Exp 0.49). This suggests that those who expect they will enjoy one more day free after convention, more than 1.6 times likely to convert from Rubber to alternative crops than those who expect no change in leisure time after convention, all else being equal.

The probability of somebody converting rubber to other crops is not directly given by logit model. Nevertheless, such probability values can be computed given values for other variables for any individual using the equation given below.

$$P_i = \frac{1}{1 + e^{-z_i}}$$

When probability over 0.5 is considered as converter and probability below 0.5 as non-converter, it is interesting to note that the estimated model predicts 98 out of 100 observations correctly.

Usual R^2 is not applicable in logit model. Alternatively the McFadden R^2value standing at 0.78 suggest that 78% of the variation in odd ratio can be explained by the repressors. Moreover, using actual, predicted and residual values for the sample the count R^2 value was calculated as 96/100= 0.96 suggesting that 96% of the

variation can be explained by the explanatory variables used in this model.

To test the null hypothesis that all the slope coefficients are simultaneously equal to zero, the equivalent of the *F* test in the linear regression model is the likelihood ratio (LR) statistic. Given the null hypothesis, the LR statistic follows the $\chi 2$ distribution with df equal to the number of explanatory variables, (Gujarati, 2003) nine in the present model. (*Note:* Exclude the intercept term in computing the df). In the estimated model long-run statistic is 83.85 with probability 0.0000 which means the null hypothesis that all the slope coefficients are simultaneously equal to zero is rejected at any conventional level of significance.

In summary, above findings denote that convention from rubber to alternative crops is mostly governed by economic factors, rather than demographic factors or natural factors.

CONCLUSIONS

This study examined the question of why Rubber smallholders' transit to alternative crops. The logistic regression analysis concluded that the individual decision regarding conversion from rubber to alternative crops is positively influenced by expected net income and expected leisure time resulting from convention. Relative profit margin of the old crop (rubber) compared to the new crops and the shortage of skilled labour was found as factors negatively influencing the decision to convert. Smallholder's sex, age or education level was found irrelevant to the decision to convert or not to. Rain interference, though many respondent claimed as a severe disturbance to rubber tapping, was proved to be insignificant in econometrics model. This is because those who have not given up their rubber cultivation had also been subjected to the same rain interference and hence data does not reject the null hypothesis that

number of annual rainy days does not affect the decision to convert. Even though this study examined the factors influencing smallholders to convert their rubber lands into tea or alternative crops, by no means this research recommends such conventions must 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 conventions on national economy. Therefore, the platform is open for a potential future researcher to investigate what types of economic, climatic and geological and environmental implications would be resulted by such conventions and whether or not such conventions are favourable for national economy. It must be a combined study not only by economists but also by geologists, meteorologists and geographers and environmentalists.

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