NEXUS BETWEEN AWARENESS OF RECOMMENDATIONS AND INCOME FROM RUBBER CULTIVATION: A STRUCTURAL EQUATION MODEL

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Abstract

Rubber cultivation provides an important source of income for many small farmers in rural areas. In addition, it is a vital source of foreign exchange earnings to the country. However, in the present day rubber is less profitable due to a slump in prices. Cyclical fluctuation in rubber prices is a stylized fact. Therefore, one strategy to keep small farmers in rubber cultivation is to enhance productivity and thereby their income. It is hypothesized that productivity increases can be brought about by improved extension, which creates awareness of recommended technologies and practices in rubber cultivation. With this background, this research studied whether 'Awareness' has an impact on productivity and through that on farm income. For this data were collected from a sample of 206 smallholder rubber farmers from Kegalle District, which is one of the major rubber growing districts in Sri Lanka. The Structural Equation Model constructed show that there is a considerable impact by awareness on relevant technologies in improving farmer productivity. But the indirect effect of awareness on farm income through productivity is weak in the sample of data analyzed. Thus, policies geared towards increases in productivity should be coupled with policies related to the marketing of rubber for the small farmers to truly benefit and survive the price shock.

Keywords: Awareness, productivity, rubber cultivation.

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INTRODUCTION

Rubber is one of the most important industrial crops cultivated in Sri Lanka contributing to national income as well as improving livelihoods in rural areas. Recently, the rubber sector has been declining in its performance mainly due to declining prices in the world market, which trickle down to local conditions. However, rubber prices are cyclical in nature and it is usual for it to reduce and increase over the years. Hence, it is important that the sector survives the price shock to reap benefits when prices turn around.

For this reason, it is important to keep the rubber extents intact without letting it diversify too much into other profitable alternatives. Because of the long term nature of the crop, it takes time to obtain benefits by replanting if uprooted. Keeping rubber extents is no easy task because the majority of the extents are held by the smallholder sector who is poor on average and therefore, highly price sensitive. Smallholders will retain in rubber cultivation only if they obtain adequate income out of it. Income directly depends on the prices they receive, which is not under their control. The only controllable factor is the output, which critically depends on farm practices.

These practices [technologies] are recommended by the Rubber Research Institute of Sri Lanka [RRISL] and they are injected into the smallholder sector through the existing extension services in the country. Currently, the Advisory Services Department of the RRISL and the Rubber Development Department [RDD] are both involved in extension related to rubber cultivation through their field officers.

Extension service is a public good provided by the government in most cases. An effective agricultural extension can mediate between experimental findings and changes in individual farmer's fields. By accelerating the diffusion process of improved technology, the extension is expected to bring about a faster growth of yields and rural incomes. Governments thus invested extraordinary sums of money in developing extension all over the world. While worldwide investment in agricultural extension is quite substantial, there is a relatively small body of economic research addressing the issue of extension impact on farm productivity (Birkhaeuser et. al., 1991). According to Dinar et al. (2007), the literature dealing with the impact of extension on the performance of farms has followed two different directions. The first strand of literature has been based on the estimation of a production function in which extension is considered as a separate input. Examples of these studies include, but not limited to Huffman, (1978); Moock, (1981); Owens et al. (2003); Patrick and Kehrberg, (1973) and Pudasaini, (1983). On the other hand, the analysis of agricultural extension took a different path towards frontier models.

However, in their early review of studies concerning the extensions' impact on farm productivity, Birkhaeuser et al. (1991) note that "the extension measure is typically some form of contact by the farmer with an extension agent or program. It should be noted that if these contacts have been initiated by the extension agents, then the problem of self-

selection bias may not be serious, yet, one should be careful to establish whether extension agents' initiative is random or systematically related to unobserved farmer-characteristics". This problem prevails to date where most studies do not consider the self-selection bias. In this study, we circumvent this issue by not having a direct variable related to extension, but we treat the outcome of extension (awareness) as an exogenous variable in our model.

METHODS

Conceptual Framework

The rubber sector boasts of a very large number of recommended technologies and all are said to be important in generating an optimum level of output and hence farmer income. This research hypothesized that awareness of recommendations would lead to higher income from rubber cultivation. Farmer awareness about new technology usually occurs through the extension service. The review of studies by Swanson et al. (1998) reports strong evidence that extension does create awareness and knowledge and that T&V management makes the extension more effective in doing so. They further describe agriculture extension efforts as following an Awareness-Knowledge-Adoption-Productivity (AKAP) sequence. But Lionberger (1968) contended that the adoption process consisted of five distinct stages: awareness, interest, evaluation, trial, and adoption. However, they are not distinct and some of the stages may become condensed within the individual cognitive processes, thereby making them unrecognizable as behaviour which can be measured. Thus, in our conceptual framework, we propose that awareness encompasses knowledge about a technology which will lead to adoption and finally to improved productivity. Improved productivity is hypothesized to increase farm incomes in turn. It is assumed that the latent construct 'Awareness' to be influencing productivity and productivity to increase income in turn.

Figure 1: Conceptual framework of the study

Hence, the impact of ‘Awareness’ on income is assumed to be indirect. Awareness of three strands of recommendations is critical for rubber cultivation. They are recommendations related to soil management, tapping and processing. We assume that a farmer’s awareness encompasses awareness of all three (Figure 1).

In line with the above, we develop three hypotheses to be tested in this study.

Hypothesis 1: Awareness of recommendations can be well represented by the awareness of technologies related to soil management, tapping and processing.

Hypothesis 2: Productivity will moderate the relationship between awareness and income

Hypothesis 3: Awareness will positively predict productivity

Operationalizing Variables

Awareness of technologies is difficult to measure. It is a construct that is latent (unobserved) in nature. Therefore, we assumed that these latent constructs could be measured using a set of statements about the awareness of recommendations. The responses to statements relevant to various recommended technologies were obtained in a binary scale where a ‘yes’ response is relevant to a person who is aware of the recommendation and a ‘no’ response for a person who is not. The relevant statements regarding each broad category of recommendations are given in Table 1.

The productivity, is an observed variable measured in terms of Kg/ha and income is measured in an ordered categorical variable.

Sample and Data

For collecting data for the model, Kegalle district was chosen because it reports the highest acreage under rubber and number of smallholder rubber growers in Sri Lanka. A randomly selected smallholder from a list of smallholder farmers from the RDD was used for the analysis. The sample consisted of 206 smallholders who cultivate less than 4.5ha of land. Apart from the awareness of recommended practices, socioeconomic information about the farmers was also obtained.

Data Analysis

Data analysis proceeded with a Structural Equation Model (SEM) which can encompass a broad array of models from linear regression to confirmatory factor analysis (CFA) (StataCorp, 2017). The modelling included following: a CFA step to developing latent constructs of the three broad categories of recommendations (i.e. soil management

practices, tapping and processing). The three latent constructs are used to construct the overall ‘Awareness’ variable, which in turn is latent in nature. These latent variables thus developed are simultaneously related to income from rubber cultivation (rubber_income) though productivity, (both of them are observed, continuous variables) using a SEM.

Table 1: The List of Recommendations

Category	Code	Recommended Practice
Soil Management	Soil_1	◦ Mulching should be practiced for soil and moisture conservation
	Soil_2	◦ Establishment of cover crop has been recommended for soil and moisture conservation
	Soil_3	◦ Main drains and lateral drains should be established when it is needed
	Soil_4	◦ Stone terraces should be built up in sloppy lands
	fertilizer	◦ Recommended dosage of fertilizer should be applied for mature and immature clearings with recommended dosage
Tapping	weeding	◦ Weed management practices should be adopted in mature and immature clearings
	tapping1	◦ Recommended tapping system should be used for tapping and daily tapping should be avoided
	tapping2	◦ Tapping panel should be marked using a stencil
	tapping3	◦ Use of rain guards is recommended by the RRISL to overcome the rain interference
	tapping4	◦ New tapping knife recommended by the RRISL should be used for tapping
Processing	processing1	◦ Straining of latex should be done before processing
	processing2	◦ Acid solution preparation should be done mixing with water 1:84 ratio
	processing3	◦ 250ml from prepared solution should be added to a sheet
	processing4	◦ Mixing and removing of froth should be done
	processing5	◦ Milling two times is necessary
	processing6	◦ Milling of coagulum 2-3 times is necessary
	processing7	◦ Milling using diamond roller should be done
	processing8	◦ Washing of sheets should be done
	processing9	◦ Sun drying should be done before drying in smoke house

Figure 2: The schematic diagram of the estimated SEM

The constructed SEM model relevant to the conceptual framework developed in Figure 1 is represented in Figure 2. Here, latent variables are indicated with an oval shape while observed variables are indicated with a rectangle. As seen from Figure 1, six variables create the latent variable soil_mgt., which captures the ‘awareness’ of best practices related to managing soils in plantations. Similarly, four variables are related to ‘tapping’ and nine variables are related to ‘processing’ awareness. When the model is estimated, latent error variables are also created which are defined as ϵ_i . The model is estimated by the ‘maximum likelihood’ method in STATA version 15 software (StataCorp, 2017).

RESULTS AND DISCUSSION

The description of responses for each recommendation is given in Figure 3. It is clear that farmers are aware of most of the recommendations tested. However, there seems to be a disparity in awareness where for some recommendations, the awareness is high while for some others it is low.

Figure 3: Awareness of the recommendations

Results of the SEM estimation are reported in Table 2. Since the coefficients are in standardized form, they represent correlation coefficients in the measurement model. First, three items in the measurement model represent the relationship between the latent constructs, ‘processing’, soil management’ and ‘tapping’ and the overall construct ‘Awareness’. It is clear that these are highly correlated with ‘Awareness’. Similarly, all nine indicators used to construct the latent, ‘Processing’, six indicators used to construct the latent, ‘Soil Mgt.’ and the four indicators used to construct the latent, ‘Tapping’ are highly significant. Thus, the latent or unobserved ‘Awareness’ is fairly well represented.

In the structural model, two hypotheses are made. One is that awareness of recommendations would lead to the practice of such recommendations and hence, the farmers’ productivity would increase. Further, the education level of farmers also plays a ‘conditioning’ role in productivity. Thus, it was hypothesized that increased ‘Awareness’ would lead to higher levels of productivity conditioned on the education of farmers. Secondly, farmer income would increase with increasing productivity. In other words, ‘Awareness’ of recommendations would increase farm income through its effect on productivity.

Results prove that these hypothesizes are correct. There is a positive and significant impact of ‘Awareness’ on productivity. Nevertheless, awareness’ effect on productivity show mixed results in the literature. Dadi et al (2004) failed to find a relationship between awareness and technology adoption which of course leads to productivity.

Table 2: Results of the Structural Equation Model

	Coef.	Std. Err	z	P>z	R ²
Structural Model					
Productivity → Rubber Income	0.057	0.014	4.160	0.000	0.003
Education → Productivity	0.147	0.022	6.640	0.000	0.461
Awareness → Productivity	0.663	0.022	30.030	0.000	
Measurement Model					
Processing ← Awareness	0.944	0.010	98.480	0.000	0.892
Soil Mgt. ← Awareness	0.998	0.005	221.410	0.000	0.995
Tapping ← Awareness	0.981	0.006	169.250	0.000	0.962
processing1 ← Processing	0.925	0.008	114.960	0.000	0.856
processing2 ← Processing	0.818	0.008	96.740	0.000	0.669
processing3 ← Processing	0.736	0.010	75.920	0.000	0.542
processing4 ← Processing	0.936	0.007	141.730	0.000	0.875
processing5 ← Processing	0.994	0.003	352.700	0.000	0.988
processing6 ← Processing	0.995	0.002	594.400	0.000	0.990
processing7 ← Processing	0.982	0.005	202.490	0.000	0.965
processing8 ← Processing	0.930	0.007	128.250	0.000	0.865
processing9 ← Processing	0.935	0.005	179.380	0.000	0.873
soil_1 ← Soil Mgt.	0.901	0.011	82.510	0.000	0.918
soil_2 ← Soil Mgt.	0.958	0.004	251.050	0.000	0.915
soil_3 ← Soil Mgt.	0.957	0.005	174.010	0.000	0.873
soil_4 ← Soil Mgt.	0.934	0.009	108.440	0.000	0.812
fertilizer ← Soil Mgt.	0.932	0.007	139.040	0.000	0.868
weeding ← Soil Mgt.	0.964	0.006	174.220	0.000	0.929
tapping1 ← Tapping	0.956	0.008	118.960	0.000	0.913
tapping2 ← Tapping	0.936	0.010	89.420	0.000	0.876
tapping3 ← Tapping	0.846	0.010	88.730	0.000	0.715
tapping4 ← Tapping	0.827	0.012	67.390	0.000	0.684

Note: Standardized coefficients are reported

However, Yirga et al. (1996) find that extension (awareness) play a crucial role in adoption in new wheat technologies in Ethiopia. Thangata and Alavalapati (2003) found that awareness is higher in non-adopters than adopters in agroforestry technology in Malawi. They argue that this may be due to the fact that “agroforestry is not a new technology in the studies area and the question asked to elicit awareness was not specific to the mixed intercropping of Gliricidia and maize”. Yet, they observed the expected positive sign between adoption and awareness. In the present research, the questions

asked were specific to the context and therefore provides a significant and positive result. In line with the present result, Bargali et al. (2007) found that higher adoption of the technology components by farmers reflected their awareness of technology benefits.

Although many researchers have attempted to develop the link between awareness of technology and adoption, few have gone further to evaluate the impact on farm income. The present research finds that there is a link between awareness, productivity, and farmer income. Even though there is a strong influence of awareness on productivity, productivity's effect on income is weak (with a very low R^2). This means that there are other things at play than higher productivity in generating income. High productivity may be related to technical efficiency of farmers but they may be low in allocative efficiency resulting in low farm incomes.

CONCLUSION

This research was conducted to study the effect of awareness on recommendations on productivity and finally on income. The researchers hypothesized that awareness is a latent construct and therefore, was measured through a series of questions related to three important technologies in rubber cultivation: soil management, tapping and processing. In addition, the awareness' impact on income was hypothesized to be indirect, through its impact on productivity. The results reveal that the indicators used to develop latent awareness are adequate. There is a considerable impact by awareness on relevant technologies in improving farmer productivity. But the indirect effect of awareness on farm income through productivity is weak, at least in the present data set. This implies that farm productivity can be improved by extension efforts which creates awareness on recommended technologies. However, improved productivity does not necessarily mean that farmers will be better off. For that, other aspects such as marketing may have to be improved upon.

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