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Rubber Plantation Smallholders' Management Model in Traditional Farming Practices in North Sumatera, Indonesia

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ABSTRACT

The study is aimed at determining the role of various social-economic variables on the income of rubber plantation smallholders and help develop the plantations in North Sumatra, Indonesia. It uses descriptive methods to assess such variables. The results show the number of dependents, education, land status, seed sources, seed quality, planters, fertilization, farmer age, land area, and the age of rubber plants to determine their income by 45.2%. Also, the land status, area, and fertilization become the primary determinants of revenue in the smallholder's rubber plantation business, though their business is still managed traditionally. Traditional cultivation patterns prove that farmers try to improve land in order to boost revenues. High education does not support the increase of income when the approach to cultivation remains traditional. Efforts to encourage productivity can be made by optimizing the inputs to the land.

Keywords: Management model, traditional farming, smallholders, rubber plantation

INTRODUCTION

In Indonesia, based on rubber statistics in 2013, rubber plantation owned by smallholders cover 85 percent of the total rubber ones. However, the production per hectare under a ton per year is lower, compared to other large plantations, due to various management problems. Generally, production from smallholders' rubber plantation is not efficient because their management is traditional with poor input, marketing inefficiencies, and inappropriate use of seeds[1]. This leads to low productivity and affects the sustainability of their rubber plantation in the long term. Although, actually, smallholders have already tried to improve the plantations and encourage sustainability over the long term.

According to Strange et al.,[2], there is a need to apply various approaches in cultivation management to achieve their objectives profitably. The plantation serves as a significant source of income, especially in fulfilling household needs. However, it is difficult to depend on it when traditional farming methods are used. Therefore, it is essential to identify various social-economic variables which are critical in the management of the smallholders' rubber plantation to increase the income.

Sustainability cannot be separated from the environment and human beings. In traditional farming systems, the ties between land and smallholders are very strong. It takes various approaches to advance the smallholders' methods of managing plantations. According to Jules[3], participatory methods are crucial to encourage sustainability.

The purpose of this study is to analyze various social-economic variables affecting smallholders' income although they have been struggling to make improvements. Income is the most critical variable in case of development or maintenance of

plantations. Therefore, long-term goal of building the smallholders' rubber plantations tries to understand their difficulties in managing rubber farms.

MATERIALS AND METHOD

The research aims to understand various social-economic variables affecting the income of smallholder's rubber farmers. It is crucial to develop plantations sustainably in the long term. Income generation is affected by social-economic variables such as total liabilities, education, land status, source of seed and its quality, planters, fertilization, farmer's age, land area, and the age of rubber plants.

The research was in general conducted in North Sumatera province, in Indonesia and the locations were chosen purposively based on the distribution of smallholders' rubber plantations. Specifically, four regencies, such as, Mandailing Natal, South and Central Tapanuli, and Langkat were chosen. The farmers as the respondents were taken purposively. The study was conducted from April 2019 to October 2019. The primary data was obtained directly from the respondents to determine the management profile on the farm and included all inputs made, such as production facilities, labor and activities management of gardens, as well as other social-economic variables.

The methods and instruments for data collection include 1) observations, which were conducted before the collection of data from the field, and respondents, 2) questionnaires made to obtain data, 3) interviews conducted to deepen answers on research questionnaires, and 4) document study to complement primary data.

The economic analysis involved the activities on the rubber plantations including revenues and their relationships with the variables in the management. The SPSS 23 software version was used for data analysis. To determine the income relationship with the different determinants, the regression analysis between dependent (revenue) and independent variables such as X_1 (total liabilities), X_2 (education), X_3 (land status), X_4 (source seeds), X_5 (seed quality), and X_6 (planting), X_7 (fertilization) and X_8 (farmer Age), X_9 (land area) and X_{10} (plants age) was carried out. Two tests of R^2 test (the magnitude of the influence of variables independent of the dependent variables) and T-test (test influence variables independent of the dependent variable partially) was also carried out.

RESULTS AND DISCUSSION

Research results

The results of the study show that the number of dependents, education, land status, seed source, seed quality, planters, fertilization, farmers' age, land area, and the age of rubber crops have a significant effect on the income of rubber farmers. The overall influence of the variable is free of the dependent variable (farmer's income) by 45.2 percent (Table 1)

Table 1. Coefficient of double determination (R^2) variable social-economic to income

Model Summary				
Model	***R***	***R* Square**	**Adjusted *R* Square**	**Std. The error of the Estimate**
1	0.727[a]	0.529	0.452	0.878
a. Predictors: (Constant), Plant Age (Binned), Fertilizer, Education, Farmers Age (Binned), Plant Source, Total Liabilities, Land Area (Binned), Land Status, Seed Quality, Planting				

From the Table 1, the adjusted value of R^2 was 0452 (45.2%). This means independent variables including total liabilities, education, land status, seed source, seed quality, growers, fertilization, farmer age, land area, and age of the rubber plant jointly affect the dependent variable of farmer's income. The effect of independent variables on dependent variables was 45.2%, and the rest, 54.8%, is influenced by other variables not included in this study. The F test is performed to determine the simultaneous influence of independent variables against dependent variables, or often called the Celtic test of a regression equation. The F test can be seen in Anova (Table 2) below.

Table 2. The test result of Anova on various variables independent of income

ANOVA						
Model		**Sum of Squares**	***df***	**Mean Square**	***F***	**Sig.**
1	Regression	52.769	10	5.277	6.847	0.000[b]
	Residual	47.009	61	0.771		
	Total	99.778	71			
a. Dependent Variable: Farming Income (Binned); b. Predictors: (Constant), Plant Age (Binned), Fertilizer, Education, Age (Binned), Plant Source, Total Liabilities, Land Area (Binned), Land Status, Seed Quality, Planting						

Table 2 shows the F count value is 6.847, and the F table value at α: 5% with df (10.61) is 1.99. The F count value is greater than the f table value, and therefore H_0 is rejected. In case of a significance value of was $0.000 < \alpha = 0.05$, the H_0 was rejected (H_1 accepted). These results indicate that the simultaneous variables, including the number of dependents, education, land status, seed source and quality, planters, fertilization, farmer age, land area, and the age of rubber plants, had a significant relationship with income. This means independent variables might refer to the magnitude of dependence on income. The different characteristics of independent variables are shown in Table 3.

Table 3. Characteristics of various independent variables (social economics)

Total liabilities	0-1	2-3	4-5	6-7	8-9	
Percent	9.8	55.6	26.4	7.0	1.4	
Education	None	SD	SMP	SMA	D3	S1
Percent	1.4	36.1	20.8	36.1	1.4	4.2
Farmer age (Year)	<= 30	31- 40	41- 50	51- 60	61+	
Percent	5.6	31.9	37.5	22.2	2.8	
Land status	Self-owned	rent	Communal			
Percent	75.0	16.7	8.3			
Land area (m^2)	<= 5000	5001 - 10000	10001- 15000	15001- 20000	20001- 25000	25001+
Percent	9.7	58.3	20.8	5.6	1.4	4.2
Seed source	Self-seedling	buy	unknown			
Percent	13.9	80.6	5.6			
Seed quality	good	bad	unknown			
Percent	70.8	9.7	19.4			
Planting	Self-planting	parents	unknown			
Percent	73.6	9.7	16.7			
Plant age	<= 5	6 - 15	16- 25	26- 35	36 - 45	46+
Percent	1.4	36.1	52.8	6.9	1.4	1.4
Fertilization	yes	no				
Percent	77.8	22.2				
Income (million)	<= 3	3- 13	13 - 23	23- 33	33 - 43	43+
Percent	1.4	20.8	34.7	25.0	11.1	6.9

Total liabilities, education, and age of farmers

The total liabilities show one farmer's household involves an average family of 2-5 members; this indicates that the family burden is quite high. Therefore, with substantial dependents, a farmer needs to allocate most of the income for household use. Rural communities have low life standards caused by low-income levels that are used to meet the needs of families.

The calculation of descriptive analysis shows that the rubber farmers in average are graduated from elementary to high schools. This suggests that the majority of the public obtained formal education at the primary and intermediate levels; nevertheless, some farmers have higher education. It is vital to encourage more innovative efforts in the management of rubber plantations smallholders. Of the total samples, around 90% of farmers' average ages are between 31-60 years, while 25% of them above 50 years. This indicates that, although their old age in average, they are still productive.

Land status and land area

From a descriptive analysis shows the status of land with their ownership was 75 percent of the whole rubber plantation. This indicates that its ownership encourages better management of rubber plantation

compared to rental systems and co-ownership. But the average ownership of the land mainly ranges between 0.5 – 1.5 Ha, and self-mastery is within a limited garden. It discourages farmers from improving the management of the rubber plantation by optimizing various technological inputs. The narrow area of land tenure limits farmers ' efforts to increase the productivity of the plantation.

Source of seed, seed quality, and planting

The seeds generally purchased amounted to more than 80 percent. This shows the efforts of the smallholder's rubber farmers to obtain quality seed. They also try to gain appropriate rubber seedlings, which was at least 70 percent. Therefore, farmers' level of understanding of the good seed helps to produce more appropriate rubber, and they try to grow their own purchased seeds. The percentage of farmers planting on their rubber plantation area was 73 percent more.

Rubber plant age, fertilization, and farmer income

The average age of rubber plants in the field is 6-25 years old, which is a productive age, and farmers do not replant. In general, the fertilization rate was more than 77 percent, an approach that farmers believe can help increase productivity. The T-test was conducted to determine whether individually variables affect the dependent variables significantly. The results were shown in Table 4.

Table 4. *T*-test output results role of various socio-economic variables on income

Coefficients[a]						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	***t***	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	2.982	0.985		3.026	0.004
	Total Liabilities	0.008	0.071	0.011	0.110	0.913
	Education	-0.057	0.114	-0.053	-0.498	0.620
	Land Status	-0.544	0.246	-0.288	-2.207	0.031
	Plant Source	-0.039	0.281	-0.015	-0.141	0.889
	Seed Quality	-0.387	0.210	-0.263	-1.842	0.070
	Planting	0.503	0.268	0.325	1.878	0.065
	Fertilizer	-0.875	0.373	-0.309	-2.345	0.022
	Famers Age (Binned)	0.127	0.122	0.100	1.046	0.300
	Land Area (Binned)	0.471	0.115	0.426	4.105	0.000
	Plant Age (Binned)	0.282	0.154	0.186	1.832	0.072
a. Dependent Variable: Farming Income (Binned)						

The T-test results on the significance of income to other variables (see Table 4), including the number of liabilities, education, land status, seed sources, seed quality, investors, fertilization, age of farmers, land area, and age of the rubber plant, indicates that the land status refers to Sig = 0,031 < 5%, fertilization Sig = 0,022 < 5% and land area Sig = 0.00 < 5%. Therefore, land status, fertilization, and land area have a significant influence on the rubber farmers' income. Variables such as the age of the respondents, number of dependents, education, age of rubber, source of seed, quality of seedlings, and investors have no significant effect.

The T-test sig value was 0.031 < 5% with coefficient value -0.554. This means that the land status variable has a significant effect on the farmer's income. But the negative value of the coefficient illustrates that the direction of the change of rent and shared land is precisely lower revenue. Hence, the status of the land itself encourages a positive increase in smallholders' income in North Sumatra.

While the value of land area sig was 0,000 < 5%, with a coefficient value 0.471, this indicates that a large variety of land has a significant effect on the farmer's income. The increase of 1-unit area positively increased the farmer's income by 0.471 million. However, the deviation in value indicates that the average land area is still not optimal. In fertilizing variables, the Sig value was 0.022 < 5%, with a coefficient-8.875, indicating that fertilizer affects farmers' income. The direction of the

negative coefficient indicates the income generation occurs when farmers do not use fertilizers.

DISCUSSION

At least 79% of rubber plantation smallholders had income ranging from 3 million to 33 million, though most of them get in average 13 to 23 million annually. With an average land area of 1.11 ha means farmers' income per hectare per year is about 21.3 million or around 1.8 million per month. With the average number of dependents of more than three people in one household, the net income of farmers depending on rubber land is very low. According to Siregar et al.,[1], the low income is attributed to the old aged rubber, poor source and quality of seedlings, and low input of production facilities.

There is a need to emphasize on various social-economic variables to encourage and improve agriculture[4],[2]. The improvement of these social-economic variables plays an important role in adopting sustainable agriculture[6]. The existence of the rubber plantation smallholders in North Sumatra is suitable for the community environment and improves the social-economic conditions of the community[4],[7],[8]. Agricultural practices in the rubber plantations indicated low inputs to the land and showed a lack of clear institutional support, including policies in the transfer of agricultural technology due to less incentive given[9],[10],[11],[12].

Status of land-owned shows the farmers freely carry out management, leading to a better revenue compared to rental or shared land. According to Fort[13], land certification strengthens individual rights, including inputs to land. This increases the investment in the land that previously had weak mastery security. The land of the rubber plantation smallholders does not necessarily have the legality of ownership, but farmers with self-mastery have various rights in full. Although the farmers' management can fully control land tenure status, it is limited by the area of land owned. The average land area managed by a farmer is small and indicates inefficient management. This means the increase in the land area might still increase the yield of rubber crops per hectare.

Fertilizer significantly affects the farmers' income though their plantation is more organic. This indicates that the farmers' cultivation practices are not optimal. The fertilization treatment is a strategy for households to overcome the obstacles in their efforts to improve productivity. According to Kuivanen et al.[14], it is vital to follow the target in cultivation and earn income that meets the needs of households. However, fertilization with low input to the land makes it more environmentally friendly[15]. According to Bopp et al.[16], fertilization with organic materials such as compost manure helps to adopt sustainable agriculture.

CONCLUSION

Various social-economic variables simultaneously affect farmers' income by 45.2%, but partially, only the land status variable, fertilization, and land area have significant influences on income. This shows that the land management of the rubber plantation is still traditional, where farmers are dependent on the results of their carcass. The plantations have not been optimally cultivated with low per hectare income, specifically 1.8 million per hectare per month. For the development of rubber plantation, there is a need for better input to land. To support the traditional smallholder's rubber plantation practice towards sustainable agriculture, it is essential to consider various social-economic variables. The efforts should be focused on increasing revenues by improving the agility of inputs as a form of intensifying traditional farming practices.

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