

# Factors Influencing the Conversion of Cocoa Lands into Oil Palm in Asahan District of North Sumatra

Tavi Supriana<sup>1</sup>, Siti Khadijah Hidayati Nasution<sup>1</sup>, Tasya Chairuna Pane<sup>1</sup> and Siti Syarifah Hanum<sup>2</sup>

<sup>1</sup>Faculty of Agriculture, Universitas Sumatera Utara, Medan, Sumatera Utara, Indonesia

<sup>2</sup>Department of Agribusiness, Institut Pertanian Bogor, Bogor, Jawa Barat, Indonesia

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**Abstract:** The cocoa area in Indonesia has declined in recent years due to land conversion. The conversion of cocoa lands into oil palm is one of the causes of this happening. This study aimed to analyze the factors influencing the conversion of cocoa lands into oil palm in Asahan District of North Sumatra. The factors influencing the conversion of cocoa lands into oil palm were analyzed by binary logistic regression. The results showed the variables that have the positive and significant influence were the land size, the cocoa pests and diseases attack, and the farm income, and the variable that has the negative and significant influence was the cocoa farming experience.

## 1 INTRODUCTION

Cocoa is one of the leading plantation commodities in Indonesia. Cocoa plays an essential role in Indonesian economy as a source of income and foreign exchange by contributing third largest total export after oil palm and rubber for plantation subsector. Cocoa also plays a role in agroindustry and regional development. Cocoa plantations provide jobs and absorb labor because most of them are smallholder's plantations.

The cocoa area in Indonesia has declined in recent years due to land conversion that often occurs on agricultural lands. Land conversion occurs due to population growth that encourages the development of various infrastructures as well as the lack of incentives in the agricultural sector (Mustopa and Santosa, 2011). Increase in public income will increase the need for land for non-agricultural activities such as houses, offices, and other infrastructures and need for such lands tends to be converted from agricultural lands (Lagarene, Kapantow, Kumaat, and Lorraine, 2015).

Land conversion is done by replacing commodities planted with other commodities that are considered more prospects. Smallholder's plantations that have been planted with cocoa are not only used for infrastructures development but also replaced with other agricultural commodities. One of

the agricultural commodities that farmers are interested as a substitute for cocoa is oil palm commodity. Oil palm is chosen as a substitute for cocoa because, in addition to more demand, this commodity also has convenient and economically viable market access (Guampe, 2014).

The government has issued various policies to ensure availability of cocoa beans in the domestic market as raw material for cocoa processing industries which is expected to develop the downstream of domestic processed cocoa products. The conversion of cocoa lands into oil palm will cause a decrease in domestic dry cocoa beans production. If the decline in area and production continues, the government will fail to take advantage of prevailing policies to provide opportunities for development of the domestic cocoa downstream industries. Besides, this strategic commodity may lose its place as one of the leading plantation commodities in Indonesian. Study on cacao land conversion needs to be undertaken to understand the decline phenomenon of cocoa cultivation area further.

North Sumatra Province is the region that occupies the 8th position of cocoa producers in Indonesia. The cocoa plantation area in North Sumatra Province in 2012-2016 fluctuated and tended to decrease, while oil palm plantation area continued to increase (Badan Pusat Statistik, 2016). Asahan regency is plantation center in North

Sumatera with the largest cocoa area and also experienced the most significant decrease of land area in North Sumatra in 2012-2016 (Badan Pusat Statistik, 2017). The conversion of cocoa lands into oil palm is one of the causes of this happening.

Several factors are influencing the conversion of cocoa lands into oil palm. It is necessary to study factors that may affect the conversion of cocoa lands into oil palm. The government can develop policies in the management of plantation land to ensure availability of cocoa beans in the domestic market as raw material for domestic processing industries. This study aims to analyze the factors influencing the conversion of cocoa lands into oil palm in Asahan District of North Sumatra.

## 2 METHODS

Study location was determined purposively with a consideration that Asahan District is District with largest cocoa plantation area in North Sumatra which experienced the most significant decline during 2012-2016. Data were collected in five subdistricts in Asahan District, which are Sei Dadap, Air Batu, Tinggi Raja, Silo Laut, and Air Joman Subdistrict because these subdistricts previously had cocoa auction place, and also have many cocoa farmers and oil palm farmers. Data retrieval was conducted from February to April 2018.

First, the study performed by looking at the characteristics of cocoa farmers and oil palm farmers who had converted land of cocoa. Then, performed the analysis of the factors influencing the conversion of cocoa lands into oil palm. Factors tested were the land size, the cocoa pests and diseases attack, the farm distance from farmer's residence, the farmer's age, the cocoa farming experience, the percentage of price increase of oil palm fresh fruit bunches, and the farm income. Respondents of this study are cocoa farmers and farmers who have converted cocoa lands into oil palm.

The factors influencing the conversion of cocoa lands into oil palm were analyzed by binary logistic regression to determine which independent variables significantly influence farmer's tendency to convert their cocoa lands into oil palm and the influence of each variable on the tendency of land conversion. Logistic regression is a regression model used to analyze relationship patterns between a set of independent variables of categorical or qualitative dependent variable (Rosadi, 2012). Primary data collected was processed using SPSS version 24. The logistic regression model was chosen because the

dependent variable in this study is divided into 2 categories, by the following equation:

$$Z_i = \ln \frac{P(X_i)}{1-P(X_i)} = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 \quad (1)$$

Description:

- $P(X_i)$  = The farmer's odds to convert cocoa land (1 = land converted to oil palm, 0 = land not converted to oil palm)
- $X_1$  = The land size for farming cocoa/oil palm (hectare)
- $X_2$  = The cocoa pests and diseases attack (1 = high; 0 = low)
- $X_3$  = The farm distance from farmer's residence (kilometer)
- $X_4$  = The farmer's age (year)
- $X_5$  = The cocoa farming experience (year)
- $X_6$  = The percentage of price increase of oil palm fresh fruit bunches (percent)
- $X_7$  = The farm income (million Rupiah/hectare)

## 3 RESULTS AND DISCUSSION

Result of the model fit test with the Omnibus Test showed the Chi-square value of 21.482 with the significance of 0.000 (< 0.05), which means there is a significant difference (improvement) in -2 Log likelihood and coefficient of each addition of independent variables into the model, so the model can be said to be fit already. The Nagelkerke's R square value of 0.684 means that 68.4 percent of dependent variable function has been able to be explained by the variation of the seven independent variables, while other factors outside the model influence the remaining 31.6 percent. Result of the model goodness test with the Hosmer and Lemeshow Test showed the Chi-square value of 7.937 with the significance of 0.440 (> 0.05), which means there is no significant difference between the empirical data with the model prediction result, so the model can be said good and able to be used to predict based on the empirical data. The overall percentage value of 90.7 percent means the model prediction accuracy is 90.7 percent, so the model is acceptable.

Table 1: Results of the analysis of the factors influencing the conversion of cocoa land into oil palm.

Variable	Coefficient	Sig	Exp(B)
Constant	-0.965	0.747	0.381
The land size for farming	<b>1.972</b>	<b>0.060</b>	<b>7.186</b>

cocoa/oil palm (ha)			
The cocoa pests and diseases attack (dummy)	<b>3.074</b>	<b>0.038</b>	<b>21.618</b>
The farm distance from farmer's residence (km)	-0.223	0.400	0.800
The farmer's age (year)	-0.032	0.534	0.969
The cocoa farming experience (year)	<b>-0.206</b>	<b>0.013</b>	<b>0.814</b>
The percentage of price increase of oil palm fresh fruit bunches (percent)	0.009	0.513	1.009
The farm income (million Rp/ha)	<b>0.176</b>	<b>0.022</b>	<b>1.192</b>
Description: The <b>bold</b> text is the significant variable			

The analysis result shows the following logistic regression model:

$$\ln \frac{P}{1-P} = -0.965 + 1.972X_1 + 3.074X_2 - 0.223X_3 - 0.032X_4 - 0.206X_5 + 0.009X_6 + 0.176X_7 \quad (2)$$

$$\frac{P}{1-P} = e^{-0.965} \times e^{1.972 \times X_1} \times e^{3.074 \times X_2} \times e^{-0.223 \times X_3} \times e^{-0.032 \times X_4} \times e^{-0.206 \times X_5} \times e^{0.009 \times X_6} \times e^{0.176 \times X_7} \quad (3)$$

$$\frac{P}{1-P} = 0.381 \times 7.186^{X_1} \times 21.618^{X_2} \times 0.800^{X_3} \times 0.969^{X_4} \times 0.814^{X_5} \times 1.009^{X_6} \times 1.192^{X_7} \quad (4)$$

### 3.1 The Land Size

The land size has the significant influence on the farmer's decision to convert their cocoa lands into oil palm at the level of error tolerance of ten percent with the significance of 0.060 (< 0.10), where the cocoa farmer tendency to convert their cocoa lands into oil palm will increase by a factor of 7.186 ( $e^{1.972}$ ) for every increase of the land size of one hectare.

Based on the respondent farmers, the average land size of farmers who convert their cocoa lands into oil palm is 1.736 hectares, higher than the average land size of farmers who keep planting cocoa of 0.941 hectares. It is due to inefficient oil palm farming when cultivated on small land. Production cost is high enough for cocoa farming in a large land so that farmers with larger lands tend to convert their cocoa lands into oil palm, while land conversion to oil palm for a small land will harm farmers (Nurmedika, Basir-cyio, and Damayanti, 2015).

Cocoa is a plant that requires more intensive care than oil palm. Maintenance activities such as pruning, and pests and diseases control should be done regularly to keep cocoa plants well maintained. Cocoa farmers tend to use family labor for farming cocoa so that if cultivated in a large area will be difficult to maintain, especially if labor in the farmer's family is limited. In smaller lands, in addition to more well-maintained cacao plants, more frequent harvest frequencies may also be done by farmers.

In contrast to cocoa, oil palm farmers use more labor outside their family in cultivation. Harvesting of oil palm is generally done by harvest workers paid per kilogram according to number oil palm fresh fruit bunches harvested. Harvesting of oil palm on small farms is generally not willing to be done by harvest workers, so it becomes a consideration for farmers with small lands if they want to convert their cocoa lands into oil palm. Since most farming activities do not depend on family labor, oil palm farmers have the freedom to farming on larger lands. Therefore, the land size is one of the factors influencing the farmer's decision to convert their cocoa lands into oil palm.

### 3.2 The Cocoa Pests and Diseases Attack

The cocoa pests and diseases attack has the significant influence on the farmer's decision to convert their cocoa lands into oil palm at the level of error tolerance of five percent with the significance of 0.038 (< 0.05), where if the pests and diseases of the cocoa plants are high then the tendency of cocoa farmers to convert their cocoa lands into oil palm will be higher by a factor of 21.618 ( $e^{3.074}$ ) than the farmers who are low on pests and diseases.

In general, main types of pests and diseases of cocoa plants are more than those of oil palm or other plantation crops. There are as many as 15 stems and branches borer, eleven leaf borer, eight leaf-sucking

pests, and one fruit pest, as well as six types of diseases that can attack cocoa plants in Indonesia. While in oil palm, there are only about eleven types of pests and nine types of diseases that generally attack the plants (Direktorat Jendral Perkebunan, 2015). Besides, with certified seed types, oil palm plants can be more resistant to pests and diseases. While the cocoa seeds which generally obtained by cocoa farmers 26 years ago is still not a superior clone so pests and diseases can be more easily attack it.

Most of the cocoa farmers who convert their lands into oil palm suffer from high pests and diseases in their cocoa plants resulting in decreased production and quality of cocoa fruits. In addition to pests and diseases that attack cocoa plants quite a lot, proper handling of pests and diseases of cocoa plants are also generally not been mastered by farmers. Cocoa plants require more intensive care than oil palms, especially those that are attacked by pests and diseases. Pruning, pesticides spraying, and maintenance of affected plants are required. Farmers who do less maintenance on affected plants will exacerbate the plant's condition so that its production will decrease than expected. A reduction in production and a state of serious pests and diseases attack will encourage farmers to finally give up and decide to convert their lands into oil palm plantations.

### 3.3 The Farm Distance from Farmer's Residence

The farm distance from farmer's residence has no significant influence on the farmer's decision to convert their cocoa lands into oil palm at the level of error tolerance of five percent with the significance of 0.400 ( $> 0.05$ ), where the cocoa farmer tendency to convert their cocoa lands into oil palm will decrease by a factor of 0.800 ( $e^{-0.223}$ ) for every increase of the farm distance from farmer's residence of one kilometer.

The average distance of farm to the residential area of oil palm farmers is higher than the average distance of farm to the residential area of cocoa farmers, which is 1.147 km for cocoa and as far as 1.203 km for oil palm. However, the difference is not significant, and farmers tend to keep converting their lands without seeing the distance of farm from home.

### 3.4 The Farmer's Age

The farmer's age has no significant influence on the farmer's decision to convert their cocoa lands into oil palm at the level of error tolerance of five percent with the significance of 0.534 ( $> 0.05$ ), where the cocoa farmer tendency to convert their cocoa lands into oil palm will decrease by a factor of 0.969 ( $e^{-0.032}$ ) for every increase of the farmer's age of one year.

The farmer's age who keeps planting cocoa has an average of 59.391 years while the farmer's age who convert their cocoa lands into oil palm has an average of 55.850 years. The average age of cocoa farmers is higher than oil palm farmers, but generally, the age characteristics of farmers are not significantly different since there are 69.5 percent of cocoa farmers and 65 percent of oil palm farmers aged over 50. It indicates that the farmer's age of both commodities is not significantly different and not one of the factors influencing the farmer's decision to convert their cocoa lands into oil palm.

### 3.5 The Cocoa Farming Experience

The cocoa farming experience has the significant influence on the farmer's decision to convert their cocoa lands into oil palm at the level of error tolerance of five percent with the significance of 0.013 ( $< 0.05$ ), where the cocoa farmer tendency to convert their cocoa lands into oil palm will decrease by a factor of 0.814 ( $e^{-0.206}$ ) for every increase of the cocoa farming experience of one year.

Along with the length of experience, the farmer's knowledge about the ins and outs of the plants increased, ranging from cultivation techniques to pests and diseases management. Farmers who remained to grow cocoa generally have experience of cocoa farming for 26 years, while farmers who have converted their lands into oil palm have an average of as much as 17 years of experience. It suggests that the farming experience is one of the factors that significantly influence the farmer's decision to convert their lands into the oil palm plantations.

### 3.6 The Percentage of Price Increase of Oil Palm Fresh Fruit Bunches

The percentage of price increase of oil palm fresh fruit bunches has no significant influence on the farmer's decision to convert their cocoa lands into oil palm at the level of error tolerance of five percent with the significance of 0.513 ( $> 0.05$ ), where the

cocoa farmer tendency convert their cocoa lands into oil palm will increase by a factor of 1.009 ( $e^{-0.009}$ ) for every increase of the percentage of price increase of oil palm fresh fruit bunches of one percent.

Farmers who convert their cocoa lands into oil palm are less influenced by the percentage of price increase of oil palm fresh fruit bunches when they convert their cocoa lands into oil palm. It is evidenced by the persistence of farmers who convert their cocoa lands into oil palm in the year prices of oil palm fresh fruit bunches decrease.

Agricultural products prices fluctuate continuously throughout the year. Supply-demand conditions influence agricultural products prices, and farmers tend to act as price takers on the prices. Farmers also cannot predict the increase or decrease that will occur in the prices of agricultural products. It makes the farmers less affected by the increase or decrease in the price of oil palm in converting their cocoa lands into oil palm. Besides, the price is one of the farm income variable components. Farm income variable that has the significant influence indicate that farmers are more influenced by farm income than the fluctuating prices in deciding to convert their cocoa lands into oil palm or not.

### 3.7 The Farm Income

The farm income has the significant influence on the farmer's decision to convert their cocoa lands into oil palm at the level of error tolerance of five percent with the significance of 0.022 ( $< 0.05$ ), where the cocoa farmer tendency convert their cocoa lands into oil palm will increase by a factor of 1.192 ( $e^{0.022}$ ) for every increase of the farm income of one million Rupiah/hectare.

The decision to convert their cocoa lands into oil palm is one of the revolutionary decisions to be taken by farmers. The decision means farmers have to cut down the whole of their cocoa crops and plant the new oil palm crops on their land. The process also requires many labors both from inside and outside their family. The land conversion, of course, requires a cost that is not cheap, coupled with the time of the oil palm young plant that can reach 2 to 3 years old so that farmers do not receive any income. Farmers should consider this matter before converting their cocoa lands into oil palm. Land conversion requires much capital, therefore, the higher the farm income, the more likely the farmers to convert their cocoa lands into oil palm.

High income of oil palm and cocoa farming will increase the tendency of farmers to convert their cocoa lands into oil palm. Results of the farm income calculation showed that the average oil palm

farm income is higher than cocoa. The average oil palm farm income was Rp 22,141,642.846 per year for 25 years, while the average cocoa farm income was only Rp 14,267,322.804 per year. A massive increase in income levels makes both oil palm, and cocoa farmers who experienced an increase in revenue will continue to convert their cocoa lands into oil palm as they gain more capital to convert their lands.

## 4 CONCLUSIONS

The variables that have the positive and significant influence on the conversion of cocoa lands into oil palm in Asahan District of North Sumatra are the land size, the cocoa pests and diseases attack, and the farm income. It means that the higher the land size, the cocoa pests and diseases attack, and the farm income, then the higher the farmers tendency to convert their cocoa lands into oil palm. The variable that has the negative and significant influence is the cocoa farming experience, which means that inexperience cocoa farmers tend to convert their cocoa lands into oil palm. Several factors that lead to low incomes of cocoa farmers are the low productivity of cocoa due to pests and diseases attack, the lack of fertilizers applied, and the age of the plants that are old. Therefore, it is necessary to apply superior cultivation technology concerning seeds, fertilizers, and pests and diseases control to maximize productivity.

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farming experience (year)		
The oil palm farming experience (year)	-	9.300
The farm income (million Rp/ha)	14,267,322.804	22,141,642.846

## APPENDIX

Table 2: The characteristics of the sample farmers.

Characteristics	Average for cocoa farmers	Average for oil palm farmers
The farmer's age (year)	59.391	55.850
The land size for farming cocoa/oil palm (ha)	0.941	1.736
The farm distance from farmer's residence (km)	1.147	1.203
The cocoa	26.000	17.100