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OPTIMIZATION AND BUSINESS RISK ANALYSIS ON INDEPENDENT OIL PALM FARMING IN MUARA TEMBESI DISTRICT, BATANGHARI REGENCY

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ABSTRACT

This study aims to analyze the optimal use of production factors and business risks in independent palm oil farming. This research was conducted in Jebak, Ampelu, and Ampetu Mudo, Muara Tembesi District villages. The analytical method used is descriptive and quantitative analysis. Descriptive method to see the description of farming. A quantitative method to analyze input usage by using the cobb-Douglas function. The sample villages were determined purposively based on the consideration that the three villages had the largest area of productive plantations (TM). Determination of the number of samples used the census method with a total of 116 respondents. The results showed that (1) palm oil production produced from oil palm farming activities in the study area averaged 15,025.18 kg/ha/year with an average selling price of Rp. 2.208/kg. Farmers operate oil palm farming with a land area of 2.55 ha/farmer, plant age of 10.87 years, fertilizer 243.92 kg/ha/year, herbicides 2.29 liters/ha/year, and labor 88.60 HOK /ha/year. (2). Partially, the variables of land area, plant age, and use of fertilizers have a positive and significant effect on independent oil palm production in Muara Tembesi District, Batanghari Regency, while the variables use of herbicides and use of labor do not have a significant effect on oil palm production. The optimal use of production factors for a land area of 3.82 ha and fertilizer use is 1,053.55 kg/ha/year. (3). Independent oil palm farming is consistently profitable, with a CV value <0.5, the L value > 0, and the R/C value obtained is R/C = 4.45 per farmer and R/C = 4.48 per hectare.

INTRODUCTION

Compared to other agricultural commodities, oil palm offers advantages. In other words, it uses land efficiently and produces the best outcomes. Despite taking up 6% of the planet's land, oil palm can yield seven to ten times as much as other crops. Compared to other crops like soybeans, which only yield 0.39 tons per hectare, oil palm may yield 4.17 tons per hectare (Asianagri, 2020).

The advantages of palm oil compared to other vegetable oils include: (1) the efficiency level of palm oil is high, making it the cheapest source of vegetable oil, (2) the productivity of palm oil is high compared to other oils, namely 3.2 tons/ha (3) around 80% of the world's population, especially developing countries, still have the opportunity to increase per capita consumption of oils and fats, especially low-priced oil, (4) in several developed countries, there has been a shift in the industry using petroleum raw materials to more friendly materials with the environment, namely Leokimia which is made from CPO (Fauzi et al., 2005). In addition, several research results show that consuming palm oil can affect heart health (Rahayu, 2022).

The various advantages of palm oil have caused the demand to continue to increase. Expanding the plantation area is an effort made to meet the increasing demand for palm oil, so palm oil has developed quite rapidly from year to year in terms of area and production. Jambi Province is no exception (Rambe & Kusnadi, 2018). In 2010 the area of oil palm plantations was 646,984 ha, and in 2018 it increased to 1,032.145 ha, or an increase of 59.5%. Likewise, in terms of production, it experienced an increase in the same period of 51.80%, where production in 2010 was 1,773,148 tons, and in 2018 it increased to 2,691,270 tons (DGT, 2012 and 2019). According to Wahyudi (2022), there is enough land accessible since the agricultural land in Jambi Province is suited for plantation crops, particularly oil palm. Jambi Province is one of the centers for the production of palm oil.

Of the eleven districts/cities in Jambi Province, Batanghari District has the potential to develop oil palm plantations. According to data from the Directorate General of Plantations for 2019, Batanghari Regency has 118,081 hectares of total oil palm plantations (area of TBM, TM, and TTM). This means Batanghari Regency contributes an area of 53.18%, likewise with production. Palm oil production in Batanghari Regency was 140,905 tons. In comparison, the total production of palm oil in Jambi Province was 1,142,078 tons, meaning that from a production standpoint, Batanghari Regency contributed 12.34%, with a productivity level of 3.38 tons/hectare (of the total area of plantations producing an area of 41,722 hectares).

In Batanghari Regency, oil palm plantations are one of the primary commodities of the plantation sub-sector for farming communities. This can be seen from the data.

Jambi Province Plantation Service (2019), where the spread of oil palm plantations is evenly distributed in every sub-district in Batanghari Regency. Muara Tembesi District is one of the sub-districts in Batanghari Regency, which has the lowest productivity among other sub-districts, only 3.06 tons/hectare/year. The low production produced will impact the profits obtained by farmers. It is suspected that oil palm farmers have yet to use production inputs optimally. According to Goenadi in Sufriadi (2015), optimal use of all resources (high-yielding seeds, recommended inputs, etc.) palm oil production can reach 6-7 tons/hectare/year.

Based on data from the Plantation and Livestock Service Office of Batanghari Regency (2019), smallholder oil palm plantations in Muara Tembesi District are divided into 3 (three) patterns, namely smallholder partnerships or plasma-PIR covering an area of 1,391 hectares, assisted self-help covering an area of 395 hectares, and pure self-help covering an area of 1,127 hectares. These figures help to explain why the pure self-help pattern is so prevalent in Muara Tembesi District, accounting for 38.69% of the district's total oil palm plantation area. Contracts and joint ventures are not an option for independent smallholders who oversee oil palm crops. Pure independent smallholders in Muara Tembesi District have existed since 2005, with mature plants aged 7-15 years. According to Pahan (2011), the age of the plant is 3-4 years. Oil palm begins to produce and increases drastically at the age of the plant at seven years until it reaches its peak at the age of 15 years (adolescent plant period). Referring to the opinion of Pahan (2011), it can be said that the pure self-help pattern of oil palm plantations in Muara Tembesi District is still at a productive age. The resulting production should be optimal if the production factors are also used optimally.

RESEARCH METHODS

Place and time

This research was carried out in 3 purposively selected villages: Jebak Village, Ampelu Village, and Ampelu Mudo Village. This village was selected based on the consideration that these three villages have high production and harvested area in Muara Tembesi District, Batanghari Regency. This research was carried out from May to October 2021.

Recruitment of Respondents

The taking of respondents uses a census technique, where all population members are sampled (Ayer et al., 2016). The number of members of the independent oil palm smallholder population in Jebak Village, Amplelu Village, and Amplelu Mudo Village is 116 farmers. Based on the technique of taking respondents using census techniques, all population members are used as research respondents.

Data collection

The data types collected in this study include primary and secondary data. Primary data was obtained directly from independent oil palm smallholders using a questionnaire through interviews. At the same time, secondary data is obtained indirectly through research reports, reading materials, and reports from relevant agencies that have something to do with research.

Data Analysis

The data that has been collected is tabulated for analysis. The Cobb-Douglas production function is used as a tool to analyze the use of production factors in independent oil palm farming, the formulation of which is;

Y = a X1b1
Y = a X1b1 X2 b2 X3b3 X4b4 X5b5u

Transformed into multiple linear equations to facilitate predictive analysis:

Ln Y = Ln a + b1 LnX1 + b2 LnX2 + b3 LnX3 + b4 LnX4 + b5 LnX5

With :

Y	= Palm oil production (kg/year)
a	= Constant
X1	= Land area (ha)
X2	= Plant age (years)
X3	= Fertilizer Use (kg/year)
X4	= Herbicides Use (Liters/year)
X5	= Labor Utilization (HOK/year)
b1-b5	= Estimating Parameters for Variable X1...X5
u	= Error
e	= 2,718 (Logarithm natural)

Test the hypothesis using the value (p-value),

- If p.value > α (0,05), > α (0,01) then Ho is accepted
- If p. value < α (0,05), < α (0,01) then Ho is rejected

The coefficient of variation (CV) and the lower limit of income (L) are used to calculate the amount of business risk on income received by farmers. (Hernanto, 1993) The CV formula is CV = V/E, where V = standard deviation and E = income earned. The bigger the CV, the greater the risk farmers have to bear compared to their income.

The lower income limit by farmers (L) shows the lowest nominal value of income that may be received. The formula for this lower income is L = E -2 V. From this formula, and a relationship can be obtained between the value of the lower bound of income and the value of the coefficient of variation. If CV > 0.5, then the value of L < 0; similarly, if CV < 0.5, then the value of L > 0. This shows that if CV < 0.5, the farmer is always profitable or breaks even; otherwise, if CV > 0.5, the farmer may suffer a loss.

RESULTS AND DISCUSSION

Description of Oil Palm Farming in the Study Area

Muara Tembesi District, one of the Batanghari Regency's Districts, people are engaged in oil palm farming. An overview of independent oil palm farming in the study area can be seen in Table 1.

Table 1. Description of Oil Palm Farming in the Study Area.

No.	Detailed	Average/farmer	Average/hectare
1.	Acreage (ha)	2,55	1
2.	Plants age (year)	10,87	-
3.	Fertilizer (kg/year)	622,00	243,92
4.	Herbicide (litre/year)	5,84	2,29
5.	Labor (HOK/year)	225,94	88,60
6.	Production (kg/year)	38.314,20	15.025,18

One element that may have an impact on productivity is the land. Production is positively impacted by land area. The yield increases with land width. Conversely, less is produced with a smaller area of land used for farming (Nambela & Sinaga, 2019). Table 1 indicates that the average land area owned by the participants is 2.55 hectares..

One of the elements that may have an impact on the quantity and caliber of the final product is the age of the oil palm plant (Ismiasih & Afroda, 2023). Plants can be categorized into young plants (3–8 years), juveniles (9–13 years), adults (14–20 years), and old plants (> 20 years) based on their age. At 25, oil palm will reach its commercial maturity. The average age of farmer-owned oil palm farms in the research region is 10.87 years.

The use of fertilizers is done to add nutrients that are not found in the soil. The purpose of this fertilizer is to maximize production and promote growth. Good fertilization can increase production until it reaches standard productivity according to its land suitability class (Mini et al., 2023). In the research area, the average fertilizer use is 243.92 kg/ha/year.

Oil palm plants must be guarded against weeds that grow around oil palm plants because they can affect the ups and downs of production and can facilitate the process of harvesting oil palm. Herbicides are sprayed to prevent weeds from growing around the oil palm plants. The use of herbicides in the study area was 2.29 liters/ha/year.

Labor is one crucial factor in the success of farming. The use of labor serves as a driving force for other factors to produce farm production (Moonik et al., 2020). The outpouring of labor in independent oil palm farming in Batanghari Regency, especially Muara Tembesi District, is 88.60 HOK/ha/year.

In the study area, on average, per hectare per year, farmers produced 15,025.18 kg or the equivalent of 3,981.67 kg of CPO/ha/year or 3.98 tonnes/ha/year. Meanwhile, Goenadi in Sufriadi (2015) explains the optimal use of all resources (high-yielding seeds, use of recommended inputs, etc.) Palm oil production can reach 6-7 tons/hectare/year.

Analysis of Factors Affecting Independent Smallholder Oil Palm Production

Based on the data processing results using SPSS, the results obtained for calculating the oil palm production function equation can be seen in Table 1 below:

Table 2. Regression Analysis Results

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	8.141	.429		18.991	.000		
	Ln_X1	.691	.061	.745	11.427	.000	.617	1.620
	Ln_X2	.274	.079	.180	3.479	.001	.978	1.022
	Ln_X3	.134	.063	.113	2.132	.035	.938	1.066
	Ln_X4	-.065	.058	-.058	-1.121	.265	.981	1.019
	Ln_X5	.075	.056	.086	1.334	.185	.634	1.577

a. Dependent Variable: Ln_Y

Based on the calculation results in Table 2, the data processing results obtained a logarithmic equation model for oil palm farming in the study area, as follows:

LnY = 8,141 + 0,691 Ln + 0,274 Ln + 0,134 Ln - 0.065Ln + 0,075 Ln

Then the Cobb-Douglas production function is obtained as follows:

Y = 3.429,4525 X1 0.691 X20.274 X30.134 X4-0,065 X5 0.075

Dimana :

Y = Oil Palm Production (Kg/year)
X1 = Land Area (Ha)
X2 = Plants Age (Year)
X3 = Fertilizer Use (Kg/Year)
X4 = Herbicides Use (Litre/Year)
X5 = Labor Utilization (HOK)

Then testing was also carried out to calculate the model feasibility test (significance) on the factors that influence independent palm oil production in Muara Tembesi District, Batanghari Regency, namely statistical testing of the coefficient of determination test, simultaneous hypothesis test (F test) and partial test (t-test).

The coefficient of determination (R^2)

Based on the data analysis, the coefficient of determination ( ) is obtained as follows:

Table 3. Determination Test Results (R2)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.853[a]	.727	.714	.24528	1.649

a. Predictors: (Constant), Ln_X5, Ln_X4, Ln_X2, Ln_X3, Ln_X1

b. Dependent Variable: Ln_Y

The statistical analysis results show that the regression equation's coefficient of determination is 0.727. To find out how much the independent variable may explain the dependent variable, utilize the coefficient of determination. The coefficient of determination of 0.727 means that the independent variables, namely land area, plant age, use of fertilizers, use of herbicides, and use of labor, can explain the dependent variable, namely palm oil production of 72.7%, and the remaining 27.8% is explained by other variables that are not included in this research model.

Simultaneous Test (F-Test)

An F-test was performed to determine the significance of the regression coefficients above. The results of the analysis can be seen in Table 3 below:

Table 4. Simultaneous Test Results (F-Test)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16.701	5	3.340	55.520	.000[b]
	Residual	6.257	104	.060		
	Total	22.958	109			

a. Dependent Variable: Ln_Y

b. Predictors: (Constant), Ln_X5, Ln_X4, Ln_X2, Ln_X3, Ln_X1

The results of the simultaneous significance test (sometimes called the F-test) show whether or not each independent variable in the model effects the dependent variable at the same time. The significance level in this investigation was set at 5%. According to Table 4's test results, the probability value is less than $\alpha = 0.05$ or 5%, indicating that the production of palm oil is the dependent variable, while the independent variables land area, plant age, fertilizer use, herbicide use, and labor utilization all significantly affect it.

Test of Significance of Each Independent Variable (t-test)

Furthermore, to determine which production factors affect the level of oil palm production of independent smallholders in Muara Tembesi District, Batanghari Regency, a t-test is carried out. The results of the analysis can be seen in Table 2.

Based on Table 2, a partial test or t-test is carried out to see the factors that affect palm oil production partially or individually. To demonstrate the extent to which the influence of a single independent variable alone explains the dependent variable, partial statistical testing (t-test) was used. The significance value is examined in order to perform the t-test. The independent factors independently affect the dependent variable if the difference is less than the significance level (Sig <0.05). Based on Table 2, obtained:

Land Area (X1)

In Table 2, the β value (regression coefficient) is 0.691, and the Sig value is 0.000 <0.05. This means that land area positively and significantly influences oil palm production. The regression coefficient value of 0.691 means that for every 1% increase in land area, palm oil production will increase by 0.691%. This implies that farmers will produce more when they cultivate a larger area. These investigations' findings are consistent with Panjaitan E's research (2020), Siswanto et al. (2020), and Hastuti et al. (2018) stated that land area affects oil palm production.

Plants Age (X2)

Based on Table 2, the β value (regression coefficient) is 0.274, and the Sig value is 0.001 <0.05. This means that the age of the plant has a positive and significant effect on palm oil production. The regression coefficient value of 0.274 means that every 1% increase in plant age will increase palm oil production by 0.274%. This means that the increasing the oil palm plant age, the higher the production level. From the research results, the average age of the respondents' oil palm plants is still the productive age, namely 12 years. According to Pahan, oil palm begins to produce at the age of the plant 3-4 years and continues to increase at the age of the plant at seven years until it reaches a peak at the age of 15 years (adolescent plant period) (Pahan, 2011). Because of this circumstance, the amount of palm oil produced at the research site will rise as the oil palm plants get older. The findings of this investigation are consistent with those of Alfayanti and Efendi's (2013) study, Yudistina et al. (2017), and Heriyanto et al. (2018), who stated that plant age affects oil palm production.

Fertilizer Use (X3)

Table 2, the β value (regression coefficient) for fertilizer use is 0.134, and the Sig value is 0.035 <0.05. This means that fertilizer use positively and significantly affects oil palm production. The regression coefficient value of 0.134 means that every 1% additional fertilizer use will increase palm oil production by 0.134%. Fertilizers are nutrients contained in every material, which is usually a complement to nutrients in the soil. Fertilization is carried out to increase the availability of nutrients in minimal soil so plants can absorb them according to the needs of oil palm development. According to Hakim (2007), plants can grow well and have optimal potential with fertilization. Implementing fertilization must undoubtedly pay attention to rainfall to avoid losing fertilizer nutrients. This study's results align with Pranata & Afrianti's research (2020); Khairai (2020) states that fertilizer has a positive and significant effect.

Herbicide Use (X4)

Based on Table 2, the β value (regression coefficient) for herbicide use is -0.065, and a Sig value of 0.265 > 0.05, this means that herbicide use has a negative and insignificant effect on palm oil production. The results of this study are in line with Hikmahwan's research I (2021); Ningsih et al. (2021); Gunawan & Juliani (2012), which stated that herbicides had a negative and insignificant effect.

Labor Utilization (X5)

Table 2 displays a Labor Utilization β value (regression coefficient) of 0.075 and a Sig value of 0.185 > 0.05. This indicates that the production of palm oil is positively but marginally impacted by labor utilization. The findings of this investigation are consistent with the studies conducted by Arsyad and Maryam (2017) and Panjaitan, E (2020).

Business Scale

To determine the scale of business carried out by independent oil palm smallholders, it is necessary to calculate the elasticity of production by adding the regression coefficient. According to Gaspersz (2001), production elasticity is obtained from the sum of the regression coefficient values for the Cobb-Douglas production function. If the number of regression coefficients (production elasticity) is > 1, it means that the production system is in a condition of increasing output scale (increasing returns to scale), if the total regression coefficient (production elasticity) = 1, it means that the production system is in a constant state of output scale (constant returns to scale), and if the total) < 1, means that the production system is in a state of decreasing returns to scale.

Based on the analysis results in Table 4, the production elasticity value can be calculated, namely:

$$
\begin{aligned}
Ep &= \beta 1 + \beta 2 + \beta 3 + \beta 4 + \beta 5 \\
&= 0{,}691 + 0{,}274 + 0{,}134 - 0.065 + 0{,}075 \\
&= 1{,}109
\end{aligned}
$$

This figure indicates that the production elasticity value is 1.109, which is greater than 1 (Ep > 1), which means an increase in production based on the input of land area, plant age, fertilizer use, the use of herbicides, and the use of labor is in the stage of increasing returns to scale (there is an increase in production) due to the addition of inputs.

Optimization Analysis of Independent Oil Palm Farming

Farmers must use production factors optimally to achieve maximum profit in oil palm farming. The following is the optimal use of production factors.

Table 5. Use of Optimal Production Factors in Independent Oil Palm Farming in Research Areas, 2021.

Production Factors	**Price (Rp) (Hx_1)**	**$b_i * H_Y * Y_i$**	**Optimum Production Factors (X_i)**
Acreage (ha)	6.000.000,00	22.924.337,80	3,82
Fertilizer (kg)	4.219,57	4.445.530,06	1.053,55

Table 5 illustrates that, whereas independent oil palm smallholders in Muara Tembesi District, Batanghari Regency, cultivate an average of 2.55 ha, the ideal land usage for oil palm cultivation is an area of 3.82 ha. This indicates that there is still a deficiency in the research area's economic utilization of oil palm producing land. The land area must be increased by another 1.27 ha to achieve optimum production.

Based on the calculation results, the optimal fertilizer use is 1,053.55 kg/ha/year. This is in line with the opinion of Susanti,Ari et all (2021), the number of oil palm trees per hectare ranges from 139 – 238 stems. Fertilizer use 4-5 kg/stem/year for plants over three years old. So the optimal fertilizer use ranges from 625.5 – 1,071 kg/ha/year. Meanwhile, the use of fertilizers in the study area was only 243.92 kg/ha/year. This indicates that there is still a lack of independent oil palm smallholders in the study area using fertilizers. Farmers must increase fertilizer use by 809.63 kg/ha/year for optimal production.

Risk Analysis of Independent Oil Palm Farming

The expected income (E) is the average income respondent farmers earn from their production activities. While the value of standard deviation (V) is the magnitude of fluctuations in income that may be obtained, or in other words, it is the amount of business risk that farmers will bear. The value of the coefficient of variation (CV) and the lower income limit (L) indirectly indicate whether the invested capital is safe from possible losses. The value of CV ≤ 0.5 or L ≥ 0 states that farmers will always avoid losses, and preferably if the CV value is 0.5 or L 0, it means that there is a chance of losses that will be suffered by farmers (Hernanto, 1993). The average income of the respondent farmers, the standard deviation, the coefficient of variation, and the lower limit of income can be seen in Table 6 below.

Table 6. Average Income, Standard Deviation, Coefficient of Variation, and Lower Limit of Independent Coconut Farming Income in the Study Area, 2021.

Details	**Per Farmer**	**Per Hectare**
Average Revenue (E) (Rp)	64.914.398,60	25.456.626,90
Income Deviation Standard (V) (Rp)	29.451.662,60	11.506.395,40
Coefficient Variation (CV)	0,45	0,45
Lower Limit (L) (Rp)	6.011.073,40	2.443.836,10
R/C	4,45	4,48

Table 6 explains that the respondent farmers will get an average income from oil palm farming of Rp. 64,914,398.60/year or Rp. 25,456,626.90/ha/year with income fluctuations/variations ranging from Rp. 29,451,662.60 per farmer or Rp. 11,506,395.40 per hectare. This income variation (risk) is worth 0.45 of the average income value. The lower income limit is IDR 6,011,073.40 per farmer or IDR 2,443,836.10 per hectare. Thus, independent smallholders in cultivating oil palm based on this production period (at the time of the study) received a profit of IDR 6,011,073.40 per farmer or IDR 2,443,836.10 per hectare.

Based on the calculation results in Table 6, the Coefficient of Variation (CV) is obtained at 0.45. This number is less than 0.5. This means that oil palm farming is always profitable. Where is the R/C value obtained, namely R/C = 4.45 per farmer and R/C = 4.48 per hectare? According to Hernanto (1993), if the CV value is <0.5, the L value is > 0. This shows that farmers are always profitable or break even in running their farming business.

CONCLUSIONS AND RECOMMENDATIONS

Conclutions

Based on the results of the research that has been done and the discussion that has been previously described, the following conclusions can be drawn:

1. The average production of palm oil from oil palm farming activities in the study area is 15,025.18 kg/ha/year with an average selling price of Rp. 2.208/kg. Farmers manage oil palm farming with a land area of 2.55 ha/farmer, the age of the plant 10.87 years, fertilizer 243.92 kg/ha/year, herbicide 2.29 liters/ha/year, and labor 88.60 HOK/ha/year.
2. Simultaneously or together, the variables of land area, plant age, use of fertilizers, use of herbicides, and use of labor have a significant influence on independent oil palm production partially using the t-test, variable land area, plant age, and use of fertilizers has a positive and significant effect on independent palm oil production in Muara Tembesi District, Batanghari Regency while the use of herbicides and the use of labor do not have a significant effect on palm oil production. The optimal use of production factors for a land area of 3.82 ha and fertilizer use is 1,053.55 kg/ha/year.
3. Independent oil palm farming is consistently profitable, with a CV value <0.5, the L value > 0, and the R/C value obtained, namely R/C = 4.45 for each farmer and R/C = 4, 48 per hectare.

Recommendations

Based on the results of the research that has been done and the discussion that has been described previously, it is recommended:

1. It is hoped that the local government will increase guidance and counseling to farmers, especially independent oil palm farmers so that farmers can use better production facilities, especially fertilizers.
2. Future studies must examine additional variables influencing the production of palm oil in Batanghari Regency's Muara Tembesi District..

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