Research Paper

Is the Oil Palm Land Efficient in Indonesia?

Wenny Restikasari[1], Ruth Eviana Hutabarat[1]*, Dyah Wulan Sari[2], Hendy Cahyono[1]

[1]Department of Economics Faculty of Economics and Business, Universitas Negeri Surabaya
[2]Department of Economics, Faculty of Economics and Business, Airlangga University

ORCID
Ruth Eviana Hutabarat: https://orcid.org/0000-0002-0039-9360

Abstract.
The plantation's sub-contribution sector to the country's gross domestic product reflects the role oil palm plantations have played in boosting the economy. The goal of this study is to examine land efficiency and the variables that affect its value in Indonesian national superior plantations, by the application of the Stochastic Frontier Analysis (SFA) method. Age, education, financial situation, and geographic location of the farmer all affect their engagement in agriculture, particularly when it comes to spreading new techniques. Therefore, policies that are based on input variables that demonstrate substantial outcomes in boosting the output of rubber plantations in Indonesia must be implemented by the government through certain institutions.

Keywords: palm oil, efficiency, Stochastic Frontier Analysis (SFA)

Corresponding Author: Ruth Eviana Hutabarat; email: ruthhutabarat@unesa.ac.id

Published 24 January 2024

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the 4th INCLAR Conference Committee.

1. Introduction

The palm oil industry plays a crucial position in Indonesia's macroeconomic economy as the country's top foreign exchange earner, a source of employment, the engine of the national economy, the engine of the people's economic sector, and a source of energy sovereignty. The oil palm plantation revolution is seen in Indonesia's rapidly expanding oil palm estates. Kalimantan and Sumatra are the two main islands in Indonesia where oil palm plantations are concentrated. Each island is home to around 90% of Indonesia's oil palm farms, which together produce 95% of the country's palm oil (CPO) output.

Due to the diversification of energy supply, palm oil has been used as a raw material for biofuel in many countries in recent years. This has increased the global demand for palm oil. In Indonesia, palm oil products make a significant contribution to national development. The value of palm oil exports reached 23 billion (Reily and Ekarina, 2018; PASPI Research Team, 2018). 17% of palm oil contributed to agricultural gross domestic products in 2014 (Ministry of Agriculture, 2015a, b). Based on the 2013 agricultural census, two million smallholders cultivate oil palm (Badan Pusat Statistik, 2013). GAPKI

How to cite this article: Wenny Restikasari, Ruth Eviana Hutabarat*, Dyah Wulan Sari, Hendy Cahyono, (2024), "Is the Oil Palm Land Efficient in Indonesia?" in *The 6th International Research Conference on Economics and Business*, KnE Social Sciences, pages 496–509. DOI 10.18502/kss.v9i4.15097

(Indonesian Palm Oil Entrepreneurs Association) has employed 7.8 million workers in all oil palm plantations (PASPI Research Team, 2018).

Economic development is characterized by the availability of infrastructure, the development of enterprises, the increasing level of education, technology and job opportunities so that incomes increase and the community prospers. Economic growth will determine the economic development of a country. According to (Jhingan, 2010), economic development can be measured over the long term by increasing national income (gross domestic product), rising per capita income, and creating economic prosperity.

The Gross Domestic Product of Indonesia calculating using several approaches. One is the income approach, calculated using the value added of different economic sectors. The agricultural sector, as one of the economy's business sectors, has the potential to contribute significantly to the growth and development of the national economy (BPS). Three major businesses dominated the structure of the Indonesian economy by business sector in 2014. The first is the manufacturing industry with 21.02%, the second is the agriculture, forestry and fisheries industry with 13.38%, and the third is the large retail industry. Auto motorcycle repair accounts for 13.38% and is also the largest labour force in the agricultural sector. According to (Suryamin, 2014) noted that in August 2014, the agricultural industry absorbed 34 per cent of the total labour force. The agricultural sector also provides raw materials for the industry and a source of foreign exchange income from exports. According to the Ministry of Agriculture's Director General of Processing and Marketing of Products (PHP), agricultural exports were 2.54 million tons, or US$2.31 billion, in January 2014. This demonstrates that Indonesia's economic foundation is the country's agricultural industry.

The food crops subsector, the plantation subsector, the horticulture subsector, the fisheries subsector, the livestock subsector, and the forestry subsector are all part of Indonesia's agricultural sector. The Indonesian government expanded its oil palm plantations to support Indonesia's economic growth above 5% in 2017-2018. Even the Indonesian government set a target for palm oil productivity and production of 40 million tons in 2020.

The table above shows that the plantation subsector in Indonesia dominating by palm oil commodities, whose land area is 6,088.70 and production is 2892 tons. The palm oil commodity is a leading plantation subsector that has an important role in economic development, presenting in the value of GRDP. Plantation development is one of the supports for economic growth and increased productivity which an increase can follow in the income of workers in the plantation sector. It can expand people's purchasing power and employment opportunities.

Table 1: Indonesia's Crop Area and Plantation Production, 2021.

No.	Commodity	Acreage (ha)	Production (tons)
1.	Rubber	3.421,90	324
2.	Coconut	3.343,60	-
3.	Palm Oil	**6.088,70**	**2892**
4.	Coffee	1.235,50	92
5.	Cocoa	1.465,90	62
6.	The	51,10	98
7.	Cashew	476,60	-
8.	Shovel	254,20	-
9.	Lada	181,40	-
10.	Clove	566,60	-
11.	Cane Sugar	251,10	86
12.	Tobacco	200,00	3
13.	Patchouli	17,40	-

Source: Central Bureau of Statistics, 2022.

Therefore, this study aims to support the role of palm oil in improving the national economy. It can be seen from the product performance when it reaches optimal conditions. The indicator to measure performance is the technical efficiency of the output produced with the inputs used. Efficiency in oil palm plantations can be seen from the maximum output with inputs and the maximum profit obtained by producers. In addition, it provides options for decision-makers and policymakers for the future of the palm oil industry in Indonesia. The remainder of the essay is structured as follows: Section 2 of the palm oil literature review examines its potential effectiveness. Data and technique estimation are presented in Section 3. Empiric outcomes are the main topic of Section 4. Section 5 concludes with some concluding observations.

2. Literature Review

A lot of research has been done on the contribution of palm oil. Some use value chain analysis and system dynamics modelling. (Herry Purnomo et al., 2020). According to this study, there is a trade-off between environmental protection and economic growth. According to Jon Horas V. Purba (2017), the palm oil business supports sustainable development financially by fostering regional growth, earning foreign exchange, and elevating farmers to middle-class status. The growth of the palm oil sector is inclusive and encourages the growth of other industries. Additionally, the oil sector helps with rural development, income inequality reduction, growth, and equitable economic development.

Research by Rany Utami et al. (2017) stated that the expansion of oil palm plantations in Penyabungan Village resulted in farmers converting part or all of their rubber plantations into oil palm plantations. This conversion changed the revenue structure from rubber to palm oil. This increased the income of farmers. The overall change in farmers' income was 33.42%. Meanwhile, Pitriani's research (2019) stated that the contribution of oil palm plantations to the GRDP of Bungo Regency tends to increase from year to year, and the factor of land area production is not a real influence on the contribution of oil palm plantations in Kabupaten Bungo.

According to the Coordinating Ministry for Economic Affairs of the Republic of Indonesia (2021), palm oil is one of the products produced on plantations that plays a crucial strategic role in the country's economic growth. The palm oil business has directly or indirectly supported 16 million employment as the largest producer of palm oil in the world. Production of palm oil and palm kernels was 48.68 million tons in 2018, with 40.57 million tones of crude palm oil (CPO) and 8.11 million tons of palm kernel oil produced (PKO). Smallholder Plantations, which produced 16.8 million tons (35%) of the total, State Large Plantations, which produced 2.49 million tons (5%), and Large Private Plantations, which produced 29.39 million tons (60%) of the total. The primary source of the nation's income and foreign money is from exports of plantation goods, which totaled 28.1 billion dollars in 2018 or 393.4 trillion rupiahs. To support the growth of plantations, the plantation subsector's contribution to the national economy is anticipated to rise. The effectiveness of engineering is determined by various aspects. The education and age of the farmers were two of the elements that Varina et al. looked at as they examined the impact of several variables on the technical efficiency of oil palm plantations. The findings indicated that technical efficiency was influenced by age and education. Research on the technological efficiency of oil palm in the Central African Republic has an impact on smallholders' productivity. Age and education play a big role in how technically proficient farmers in Nahon, Thailand are.

Age has a significant impact on smallholders' technical efficiency in West Kalimantan, Indonesia (Ariyanto, et al). In Nigerian oil palm plantations, smallholder farmers' technical efficiency is positively impacted by their age (Bankole et al.). Age and education have a favorable impact on how well palm oil is produced (Varina, et al). While the technical efficiency of Indonesia's Jambi Province's oil palm farmers, who have an average efficiency score of 66%, is influenced by the source of the seed. This demonstrates the ongoing need to improve productivity. The effectiveness of Ghanaian farmers is likewise impacted by age. The technological effectiveness in East Java and Ethiopia is also impacted by the age of the farmers in Thailand's palm oil fields. Education has an impact on technical efficiency.

The findings of the technical efficiency analysis, according to Rivanda et al. (2015), revealed that the factors of land area, fertilizer, labor, and pesticides each had a favorable effect on output, whereas the factor of seed quantity had a negative impact. Ningsih, et al. (2015) found that labor had a negative impact while land area and seeds had a favorable impact on the technical efficiency determinants of soybean cultivation. In their study on the effectiveness of applying production variables in People's Palm Oil Farming (Elaeis Guineensis Jacq), Aprilyani, et al. (2022) concluded that seeds have no appreciable impact on the volume of production. The amount of production in oil palm farming is significantly influenced by the fertilizer variable, but the labor variable has a less impact. Syuhada et al (2022) in the research on oil palm farming, technical efficiency analysis: stochastic frontier analysis, fertilizer, pesticide and labor variables have a significant effect.

The data obtained from a survey of agriculture cultivation households conducted by the Indonesia Central Board of Statistics (BPS) covering a selected period in 2014. The data are designed to survey crude palm oil plantations. The data used in this study includes 13,390 observation, which consist of one output (y) and multiple input such as mature plants $(myp)(myp)$, fertilizer ($fr\ fr$), pesticides ($ps\ ps$), labor ($l\ l$), land area ($land\ land$). The input and output will be represented by a geometric natural logarithm. Nevertheless, the explanatory variables which denoted as Z in the equation (1a) contains age ($age\ age$), sex ($sex\ sex$), completing elementary school (ess), completing junior high school (jhs), senior high school ($shs),shs),$ collage (cs), seed quality ($seed\ seed$), financing source ($finance\ finance$), climate *(climate)* business assistance ($assistance\ assistance$), and plant pest organisms ($opt\ opt$). Table 2 provides a data description of all agriculture cultivation used.

Furthermore, an estimate is needed to answer technical efficiency in palm oil. Stochastic frontier analysis (SFA) is used to measure firm technical efficiency. A function that illustrates the highest output possible given a given set of inputs is known as a production frontier. According to the traditional production function, businesses create their output at maximum efficiency using a specific number of inputs. Contrarily, the stochastic production function makes the assumption that a firm is inefficient if its output falls below a certain level. Since the two components of mistakes are divided, the stochastic production function's goal is to estimate both inefficiency and the parameters of the production function.

TABLE 2: Variables Description.

Variable	Description
y (output)	Total number of harvest plant plus by-products, production reduction, and bonded which calculated based on the value of several thousand rupiahs
p(mature plants)	Total number of mature plants
ll(land area)	The area per hectare of featured plantation
pp (fertilizer)	Total amount of fertilizers, such as urea, TSP/SP36, ZA, KCL, NPK, organic fertilizer (manure/compost), etc.
ps (pesticides)	Total amount of solid and fluid pesticides
l (labor)	Total number of worker
sex (sex)	Dummy, 1= the household farmer are men
age (age)	Number of years of the household farmer
ess (elementary school)	Dummy, 1= the household farmer completing elementary school
jhs (junior high school)	Dummy, 1= the household farmer completing junior high school
shs (senior high school)	Dummy, 1= the household farmer completing senior high school
cs (college)	Dummy, 1= the household farmer completing college or more
seed (seed quality)	Dummy, 1= the household farmer used certified seed to their farm
climate (effect climate)	Dummy, 1= the household farmer disturb by climate
finance (financing source)	Dummy, 1= the household farmer is self-financing their farm
assistance (business assistance)	Dummy, 1= the household farmer has received assistance in a form of a grant, free or subsidies in agricultural input

Additionally, the panel data stochastic production function for the inefficiency effect, u_{it} u_{it}, is specified in a common form as follows:

$$Y_{it} = f(X_{it}; \alpha, \beta).\exp(v_{it} - u_{it}) Y_{it} = f(X_{it}; \alpha, \beta).\exp(v_{it} - u_{it}) \quad (1a)$$

$$u_{it} = Z_{it}\delta + \omega_{it} u_{it} = Z_{it}\delta + \omega_{it} \quad (1b)$$

Equation 1 -- Stochastic Production Function

where Y Y shows output, X X represents inputs input that used in the production process, α α and β β are parameters to be estimated. Subscript i i and t t stand for firm i i and year t t. v v is the stochastic error term and u u is the technical inefficiency. Z Z denotes exogenous variables which influence technical inefficiency. δ δ denotes parameters of the inefficiency effect and to be estimated. ω ω is an error term of inefficiency function. The translog production function will be used as a baseline model and contrasted with other production functions, including Cobb-Douglas and production functions with no inefficiency effect. When the input coefficients are equal to zero, the Cobb-Douglass production function appears. $(\beta_{xx} - \beta_{kl} - \beta_{t} - \beta_{ll} - 0)(\beta_{xx} - \beta_{kl} - \beta_{t} - \beta_{ll} - 0)$. Furthermore, no inefficiency effect function takes place when the coefficients of inefficiency functions equal to zero ($\gamma - \delta_0 - \delta_m - 0 \gamma - \delta_0 - \delta_m - 0$), where $\gamma \gamma$ is variance of inefficiency function. If $\gamma = 0 \gamma = 0$, then a conventional production function with the exogenous variables directly included into the model will be executed.

Additionally, the following equation can be used to get the generalized likelihood ratio statistic that will be used to choose the best production function:

$$\lambda - -2[l(H_0) - l(H_1)] \lambda - -2[l(H_0) - l(H_1)] \quad (2)$$

Equation 2 -- Generalized Likelihood Ratio Statistic

where $l(H_0) \, l(H_0)$ stands for the log-likelihood statistic of the sub-various production functions, while $l(H_1) \, l(H_1)$ represents the log-likelihood statistic of a translog production function. When, the value of statistic is around a $\chi^2 \chi^2$ distribution with degrees of freedom equal to the amount of coefficients restricted in the sub-various production functions, then the null hypothesis ($H_0 H_0$) is not rejected. However, the statistic test for no inefficiency effect production function is using a mixed $\chi^2 \chi^2$ distribution. Table 2 presents the statistical summary of all variables discussed above.

3. Results and Discussion

Once the correct stochastic production function is adopted, the estimation coefficients efficiency will be accurate (Sari, 2019). The results of the production function sub-variable models were compared to the translog model have shown in Table 3. The data cannot be well represented by the sub-variable model of the production function, according to the generalized likelihood test. As a result, the results of Model 1's estimation of a translog stochastic production function will be utilized to interpret the amount of technical inefficiency.

Table 5 reveals that the translog stochastic model's estimated coefficients in Model 1 have no economic importance (Sari, 2019). Hence, this study deduces the output elasticity of each input, such as mature plants, land area, fertilizers, pesticides, and labor. Model 1's first-order partial derivative is used to calculate the output elasticity. They will be assessed based on specific values of the variables, which will be derived using the sample's average.

The coefficient of gender ($gender \, gender$) in Model 1 (Table 4) is no different with zero, indicating that the genders of household heads, both female and male, may have no impact on efficient. The coefficient of age ($age \, age$) in the inefficiency function is statistically significant. The age of the household represents the smallholder's experience. The findings indicate that the age of the household has a 1 percent negative impact

DOI 10.18502/kss.v9i4.15097

Table 3: Descriptive Statistic.

Variables	Unit	Obs	Mean	SD	Min	Max
Production Variables						
y (output)	ln (thousand rupiah)	13390	-0.451	1.164	6.070	12.368
p(mature plants)	ln (thousand rupiah)	13390	0.838	0.845	6.030	8.962
ll(land area)	ln (hectare)	13390	0.191	0.877	4.330	13.775
pp (fertilizer)	ln (thousand rupiah)	13390	-0.861	1.245	5.130	10.426
ps (pesticides)	ln (thousand rupiah)	13390	-0.446	1.022	5.030	9.696
l (labor)	ln (worker)	13390	0.054	0.577	0.940	4.248
Inefficiency Variables						
sex (sex)	binary dummy	13390	0.924	0.264	0.000	1.000
age (age)	number of years	13390	47.013	11.420	17.000	99.000
ess (elementary school)	binary dummy	13390	0.402	0.490	0.000	1.000
jhs (junior high school)	binary dummy	13390	0.202	0.401	0.000	1.000
shs (senior high school)	binary dummy	13390	0.188	0.391	0.000	1.000
cs (college)	binary dummy	13390	0.041	0.199	0.000	1.000
seed (seed quality)	binary dummy	13390	0.489	0.499	0.000	1.000
climate (effect climate)	binary dummy	13390	0.282	0.450	0.000	1.000
finance (financing source)	binary dummy	13390	0.264	0.440	0.000	1.000
assistance (business assistance)	binary dummy	13390	0.326	0.468	0.000	1.000
opt (plant pest organisms)	binary dummy	13390	0.092	0.290	0.000	1.000

Note**:** Mean = arithmetical average; SD = standard deviation; Min = minimum; Max = maximum; the estimates production variables are the natural logarithm.

Table 4: Rontier Models of Stochastic Production Function Hypothesis Testing.

Model	[illegible]	χ^2	Conclusions
Cobb-Douglas	11895.52	30.578	Ho Rejected
No inefficiency	15240.615	24.049	Ho Rejected

Note*:* Calculation of λ from the generalized likelihood ratio statistic. Using critical values of Mix χ^2 χ^2 at α = 1 percent. (This critical value is taken from Table 1 of Kodde and Palm (1986))

on inefficiency. This demonstrates that older farmers outperform younger farmers in terms of efficiency. Furthermore, increased agricultural experience aids in assessing the importance and complicacies of good agricultural decision-making, including the effective use of inputs (Dessale, 2019).

Table 5: Stochastic Production Frontier Maximum-Likelihood Estimation.

Variables	Parameters	Model 1		Model 2	
Production Function					
constant	β_0	0.799	*	0.873	*
		(0.253)		(0.015)	
p	β_p	0.671	*	0.881	*
		(0.051)		(0.014)	
ll	β_{ll}	-0.311	*	-0.151	*
		(0.383)		(0.013)	
pp	β_{pp}	0.204	*	0.243	*
		(0.072)		(0.007)	
ps	β_{ps}	0.112	**	-0.024	*
		(0.042)		(0.008)	
tk	β_{tk}	0.195	*	0.097	*
		(0.032)		(0.012)	
p^2	β_{p^2}	0.154			
		(0.379)			
ll^2	β_{ll^2}	0.014			
		(0.118)			
pp^2	β_{pp^2}	-0.036			
		(0.018)			
ps^2	β_{ps^2}	0.068	*		
		(0.013)			
tk^2	β_{tk^2}	0.114			
		(0.121)			
pll	β_{pll}	-0.056			
		(0.231)			
ppp	β_{ppp}	0.028			
		(0.090)			
pps	β_{pps}	-0.116	*		
		(0.044)			
ptk	β_{ptk}	-0.025			
		(0.332)			
llpp	β_{llpp}	-0.010			
		(0.086)			
llps	β_{llps}	0.062	***		
		(0.033)			
lltk	β_{lltk}	-0.061			
		(0.254)			
ppps	β_{ppps}	0.006			
		(0.008)			

Table 5: Continued.

Variables	Parameters	Model 1		Model 2	
		Production Function			
pptk	β_{pptk}	0.080			
		(0.066)			
pstk	β_{pstk}	-0.005			
		(0.044)			
Ineficiency Function					
constant	d_0	-0.121	**	-0.106	**
		(0.051)		(0.027)	
sex		0.000		0.000	
		(1.000)		(1.000)	
age	d_{age}	-0.067	*	-0.031	*
		(0.005)		(0.024)	
ess	d_{ess}	-0.004	*	-0.003	*
		(0.001)		(0.000)	
jhs	d_{jhs}	-0.031	*	-0.017	*
		(0.006)		(0.003)	
shs	d_{shs}	-0.077	*	-0.055	*
		(0.014)		(0.002)	
cs	d_{cs}	-0.034	***	-0.015	*
		(0.017)		(0.001)	
seed	d_{seed}	0.062		0.035	
		(0.146)		(0.030)	
finance	$d_{finance}$	-0.025	**	-0.021	*
		(0.012)		(0.004)	
climate	$d_{climate}$	-0.025	*	-0.019	*
		(0.004)		(0.002)	
assistance	$d_{assistance}$	0.015		0.029	
		(0.013)		(0.033)	
opt		0.100	***	0.120	*
		(0.052)		(0.015)	
Sigma-squared	σ^2	0.550	*	0.528	*
		(0.007)		(0.008)	
Gamma	γ	0.121	*	0.000	*
		(0.025)		(0.000)	
Log likelihood function			-14637.561		-14722.464
LR test of the one-sided error			97.501		147.012

Note: Model 1 is a translog production function, and Model 2 represent Cobb Douglas production function. Standard errors are in parentheses and presented significances until α= 10 percent.
*Significance 1 percent; **Significance at 5 percent, *** Significance at 10 percent

On the other side, education promotes farmers' access to and utilization of improved technical information. Comparing four coefficients of completing elementary school *(ess),* junior high school *(jhs),* senior high school *(shs),* and collage *(sc)* have significant negative sign significant on technical inefficiency. In general, well-educated farmers can notice, comprehend, and respond to new information more quickly than their colleagues, and they can embrace enhanced technology like fertilizers, pesticides, and planting materials at a faster rate (Dessale, 2019; Tothmihaly et al., 2019).

The coefficient of seed quality (seed) dummy is not significant, this indicates that farmer who use improved or certified seed not impact on inefficiency. This study incompatible the study berfore, The seed is applied properly, it will get a higher yield of cocoa yield per hectare (Ali et al., 2019). The negative sign of finance *(finance)* dummy in this study is estimated to be significant, the indicates that farmer who have access to financial institute are less inefficient than farmer who do not have accessed.

The coefficient of climatic conditions *(Climate)* is negative and significant. This result indicated that unstable climate will increase the inefficiency. The coefficient business assistance ($Assistance$) is estimated to be significantly negative. The negative sign in this study suggesting that household farmers who get grant, subsidies, and free assistance of palm oil seed, fertilizer, pesticides, and machine are technically more efficient rather than farmers who are not getting those access. The remaining regressor, the coefficient of plant pest organisms (OPT) is estimated to be significantly positive. The positive sign in this study suggesting that farmers with healthy cocoa crop without any pest, disease, or weed such as pod borer, black pod, or VSD, and so om are technically efficient despite farmers with attacked pest crops.

TABLE 6: Output Elasticity in Relation to Each Input.

Commodity	Variables	Elasticity
Crude Palm Oil	Mature Plants Elasticity (ε_{p})	0.189
	Land Area Elasticity (ε_{ll})	0.014
	Fertilizer Elasticity (ε_{pp})	0.609
	Pesticides Elasticity (ε_{ps})	0.081
	Labor Elasticity (ε_{tk})	0.081
	Total Elasticity (ε)	0.974

Note: Total elasticity is $\varepsilon = \varepsilon_{p} + \varepsilon_{ll} + \varepsilon_{pp} + \varepsilon_{ps} + \varepsilon_{tk}$

As shown in Table 6, the results of output elasticity estimations for each input are presented. These output elasticity show how much the output change percentage grows as the input change percentage grows. In terms fertilizer, the average output elasticity us highest in all commodity. Meanwhile, the output elasticity with respect to land area is the lowest in all commodities. This suggests that smallholder farmers frequently use fertilizers rather than pesticides to bring nitrogen to trees, particularly old trees that were losing foliage, and to help fight diseases like black pod (Ruf & Bini, 2011).

This study also generates estimates of output efficiency Palm oil plantation in Indonesia, as shown in Table 7. The average efficiency is in the value range 0.004 and 0.891 and the mean efficiency is at 0.621. As a result, by implementing good agricultural practices, it is possible to increase crude palm oil farming productivity in the short term.

Table 7: Efficiency Estimation Palm Oil Plantation.

Commodity	Efficiency	Total Area	Range of technical efficiency					
			Up to 60	61–70	71–80	81–90	>90	1
Crude Palm Oil	0.621	63541258.05	9193	6080	8484	2981	22	0

Note: Efficiency: the average value of efficiency in each commodities; total area: the total area in each commodities analyzed by hectare (ha); range of technical efficiency: the value level achieved by each smallholder characterized on the basis of the score acquisition

Oil palm can occasionally be harmful to locals' ability to support their families (L.Potter, unpublished manuscript). Orth (2007) demonstrates the detrimental effects oil palm expansion has had in Central Kalimantan. Additionally, oil palm has a detrimental societal impact on indigenous peoples and rural communities (Telapak 2000, Marti 2008, Sirait 2009, FoE 2010). Oil palm can enhance incomes, but it also impacts rural land ownership and social relationships, which improves the welfare of the poor (McCarthy, 2010). Marti (2008) cited instances of plantation firms violating human rights, particularly during the construction and acquisition of new plantations. Another study discovered that environmental neglect and agreement violations were the main causes of disputes between communities and plantation developers (Casson 2002, Colchester et al. 2006, Sawit Watch 2006, cited in Down to earth 2007, L.Potter, manuscript not published). In an effort to reduce poverty in rural regions, Syahza (2011) contends that oil palm plantation development operations have accelerated community economic development. According to additional research, the economic impact of oil palm expansion can expand the range of investment choices and produce steady revenue (Unjan et al. 2013).

4. Conclusion

This empirical study finds that extension service to farms significantly potential in farm level efficiency of national featured plantation. The characteristics of farmer such as age, education, finance, and climat are also playing a role in farm participation, particularly in the dissemination of new practices. Results also indicate that gender, seed, business assistance, and pets organisms less inefficient than farms with pawning or free land used status.

The elasticity output to input show that, increasing land area will give small impact to output. The average technical efficiency is appraised to 0.621, connoting that actual output might be raised by around 38 percent without requiring extra resources. According to the findings, encouraging featured plantation farmer groups to interact and commutation ideas among old and young farmers, as well as adept and inexperience farmer, can assist increase featured plantation farm productivity by eliminating technical inefficiency. More agents for extension trips should be hired to strengthen advisory service work. To attract new recruits, such as women and young people, increased understanding of the benefits of featured plantation growing is essential.

References

[1] Dyah Wulan Sari AI, Tri H, Thinzar W. Analysis of factors affecting the technical inefficiency on Indonesia palm oil plantation. Sci Rep. 2022.

[2] Aprilyani K, Nasution MP. Efficiency of using production factors in people's palm oil farming (Elaeis Guineensis Jacq) (Case Study: Tanjung Medan Village, Kec. Kampung Rakyat, South Labuhanbatu Regency). Jurnal Agriuma. 2022. ISSN 2657-1749.

[3] Casson A. The political economy of Indonesia's oil palm sub-sector. In: Colfer CJ, Resosudarmo IA, editors. Which way forward? People, forests and policy making in Indonesia. Washington, D.C., USA: Resources for the Future; 2002. pp. 221–245.

[4] Colchester M, Jiwan N, Sirait AM, Firdaus AY, Surambo A, Pane H. Promised land: palm oil and land acquisition in Indonesia: Implications for local communities and indigenous peoples. Forest Peoples Programme and Perkumpulan Sawit Watch, Moreton-inMarsh, UK and Bogor, Indonesia. 2006. [online] URL: http://www.forestpeoples.org/sites/fpp/files/publication/2010/08/promisedlandeng.pdf

[5] Colchester M. Land acquisition, human rights violations, and indigenous peoples on the palm oil frontier. UK: Forest Peoples Programme, Moreton-in-Marsh; 2010.

[6] Dessale M. Analysis of technical efficiency of small holder wheat-growing farmers of Jamma district, Ethiopia. Agric Food Secur. 2019;8(1):1–8.

[7] Down To Earth. New investment law is not pro-poor. Down to Earth, No. 73 May. 2007. [online] URL: http://dte.gn.apc.org/73.pdf

[8] Friends of the Earth Europe (FoE). Too green to be true: IOI Corporation in Ketapang District, West Kalimantan. Milieudefensie and Friends of the Earth Europe, Brussels, Belgium. 2010. [online] URL: http://www.foeeurope.org/publications/2010/Too_Green_to_be_True0310.pdf

[9] Marti S. Losing ground: The human rights impacts of oil palm plantation expansion in Indonesia. Friends of the Earth, Life Mosaic and Sawit Watch, London, UK. 2008.

[10] McCarthy JF. Processes of inclusion and adverse incorporation: Oil palm and agrarian change in Sumatra, Indonesia. Journal of Peasant Studies. 2010;37(4):821-850. http://d x.doi.org/10.1080/03066150.2010.512460

[11] Rivanda DR, Wini Nahraeni, Arti Yusdiarti. Technical efficiency analysis of paddy field rice farming (stochastic frontier approach) a case study with SL-PTT Farmers in Telagasari District Karawang Regency West Java Province. Jurnal AgribiSains. 2015 April;1(1). ISSN 2442-5982.

[12] Sari DW, Khalifah NA, Suyanto S. The spillover effects of foreign direct investment on the firms' productivity performances. J Prod Anal. 2016;46(2-3):199–233.

[13] Sirait M. Indigenous peoples and oil palm plantation expansion in West Kalimantan, Indonesia. The Hague, the Netherlands: Universiteit van Amsterdam; 2009.

[14] Telapak. Planting disaster: Biodiversity, social economy, and human rights issues in large-scale oil palm plantation in Indonesia. Telapak Indonesia, Bogor, Indonesia; 2000.

[15] Tothmihaly A, Ingram V, von Cramon-Taubadel S. How can the environmental efficiency of Indonesian cocoa farms be increased? Ecological Economics. 2019;158(July 2018):134–145. https://doi.org/10.1016/j.ecolecon.2019.01.004

[16] Unjan R, Nissapa A, Phitthayaphinant P. An identification of impacts of area expansion policy of oil palm in Southern Thailand: A case study in Phatthalung and Nakhon Si Thammarat Provinces. Social and Behavioral Sciences. 2013;91:489496. http://doi.org/b9xt https://doi.org/10.1016/j.sbspro.2013.08.446