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Identification of Agricultural Socioeconomic Factor and its Relationship with Exports of Palm and Palm Kernel Oils in Indonesia

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ABSTRACT

The research aim was to study the influence of area size consisting of Government Estate (Government Estate), Private Estate (PBS), Smallholder (PR), price and exchange rate on production, and the influence of production, price and Exchange rate on palm oil exports which consists of Crude Palm Oil (CPO) and Palm Kernel Oil (PKO) using panel data for 2000-2022. Whether viewed from CPO or PKO, the results of the analysis show that the Government State has a real negative influence on production where the elasticity of the Government Estate for CPO towards production is lower than for PKO. The increase in production was significantly caused by the increase in PR for both CPO and PKO, where the elasticity of the increase in PR for CPO was higher than the increase in PKO. PBS provides a positive influence on production which is significant for PKO but not significant for CPO, while prices and exchange rates do not have an influence on CPO production, nor on PKO production. CPO and PKO exports are significantly influenced by prices, where CPO's price elasticity is higher than that of PKO. Furthermore, production and exchange rates have no influence on exports of either CPO or PKO, while the increase in CPO exports is determined significantly by PR, where the elasticity of CPO is higher than PKO.

Keywords: Government Estate, Private Estate, Smallholder Production, Price, Exchange Rate and Export

JEL Classification: Q12, Q13, Q17.

1. Introduction

International trade is an important factor in the globalization process because trade with various countries in the world will be able to provide benefits to exporters and importers thereby having an impact on domestic economic growth, both directly in the form of influences on resource allocation and efficiency, and indirectly. in the form of an increase in the level of investment which brings a country to achieve prosperity. International trade is an important sector for state income where there are export and import activities which provide benefits for the community, province and country (Dewi & Nawawi, 2022). International trade creates profits for countries that want to sell their production or raw materials abroad. Thus creating a challenge for poor countries and developing countries to maintain and develop the economy and participate in global competition from a country, then developed countries hit by an economic crisis provide challenges for developing countries to export their commodities for direct consumption and raw materials for industry (Maming, at al., 2022).

International trade has the main objective, namely to increase Gross Domestic Product or GDP, meaning that international trade aims to increase the total value of the production of goods and services sold by one country to other countries during one year. Fulfilling needs in other countries and gaining internal and external benefits. It is clear that the benefits of international trade include: obtaining goods that cannot be produced by the country itself, benefits from specialization, expanding markets and increasing profits, transfer of modern technology, improving friendly relations between countries, expanding employment opportunities and encouraging maximum production of goods (Gramedia blog, 2022)

As an agricultural country, Indonesia has the opportunity to become a market leader in various agricultural commodities. The opportunities and prospects for the agro-industrial market are quite wide open, especially since the government has provided incentives for its development (Arifin, 2016). It is understood that the development of palm oil agribusiness is an industry that is believed to be able to help the government to eradicate poverty in Indonesia. Palm oil is a plantation commodity that has a strategic role in Indonesia's economic development. As the largest palm oil producer in the world, the palm oil industry has provided employment for 16 million workers, both directly and indirectly (Ministry of Coordination Economic Sector, 2021).

Goods included in global trade come from various sectors or industries which are expected to gain added value and foreign exchange. One sector that can be relied on is the agricultural sector which has quite an important role in economic activities in Indonesia, this can be seen from its contribution to Gross Domestic Product (GDP), which is quite large, namely around 12.40 percent in 2022 or is the third place after the Processing Industry sector at 18.34 percent and the Wholesale and Retail Trade sector; Car and Motorbike Repair by 12.85 percent. One subsector that has quite large potential is the plantation subsector. The contribution of the plantation subsector in 2022 is 3.76 percent of total GDP and 30.32 percent of the Agriculture, Forestry and Fisheries sectors or is the first in this sector. The Indonesian agricultural commodity that is the mainstay of the economy is palm oil, making it a leading commodity for improving the economy in Indonesia (Papilo, P. et al.,2020).

Indonesia and Malaysia are the world's largest producers of CPO and its derivatives and since 2016 Indonesia has outperformed Malaysia where in that year Indonesia's share reached 53.4% of total CPO while Malaysia only had a share of 32% (BPS, 2023). Furthermore, in 2023 Indonesia will produce 50.07 million tons of crude palm oil (CPO) and 4.77 million tons of PKO palm oil, which is an increase of 5.66% from the previous year. Furthermore, this production was followed by domestic consumption which also increased from 23.13 million tons in 2023 with the implementation of biodiesel (B35) being the main driver, where biodiesel consumption increased significantly and also consumption for domestic food needs (Faisal Basri, at al., 2023).

The Indonesian government remains committed to rejuvenating or replanting 180 thousand hectares of oil palm plantations owned by smallholders in 2021. This is aimed at increasing the productivity of oil palm plantations, especially at the smallholder plantation level. Cooperation and collaboration in sustainable palm oil development between all areas of the palm oil industry, from plantations to the use of palm oil products and their derivatives in various industrial sectors, is a necessity. Support from all stakeholders is needed, including stakeholders who took part in the webinar on this occasion. Hopefully plantations in Indonesia will be more sustainable (Minitry of Economic Coordinator Sektors, 2023).

Palm oil is one of the plantation commodities which has quite an important role in economic activities in Indonesia because of its ability to produce vegetable oil which is much needed by the industrial sector1. Crude Palm Oil (CPO) is one of the non-oil exports that has the largest contribution to the total main

exports of non-oil and gas commodities in Indonesia (Hati, A. at al., 2021). Furthermore (Achmad Alfian, et al., 2016) stated that the main results that can be obtained from palm oil production are crude palm oil or CPO (Crude Palm Oil), palm kernel oil or PKO (Palm Kernel Oil), fiber, shells and empty palm oil. Then, its properties that are resistant to oxidation under high pressure and its ability to dissolve chemicals that are insoluble in other solvents, as well as its high coating capacity, mean that palm oil can be used for various purposes, including cooking oil, industrial oil, and fuel (biodiesel).)2. As the largest palm oil producing country in the world3, Indonesia has great potential to market palm oil and palm kernel both at home and abroad. Potential markets that will absorb the marketing of palm oil (CPO) and palm kernel oil (PKO) are the fractionation/refining industry (especially the cooking oil industry), special fats (cocoa butter substitute), margarine/shortening, oleo chemicals and bath soap. In order to support increased development of the palm oil industry in Indonesia (Central Statistics Agency Publishes, 2022).

There are three types of palm oil plantations in Indonesia, namely PBN, PBS and PR. It is known that oil palm plantations do not support the environment, so problems arise, in adding areas that can bring disaster to the population through environmental problems, as research (Utami R., at al. 2017) states that the public's perception of the environmental impact due to the expansion of oil palm plantations is in the form of reduced quantity of ground water, water pollution, and reduced animal populations and deforestation. Furthermore, it is said that the expansion of oil palm plantations will open up opportunities for the development of the crude palm oil (CPO) processing industry where these industrial activities cause externalities for communities in industrial areas. However, the land used for oil palm generally comes from Satellite imagery (Gunarso, at al., 2012) reveals that the origin of land for Indonesian oil palm plantations mostly comes from abandoned land (degraded land), conversion of agricultural land, and only 3 .4% converted from primary forest. Thus, oil palm development is still necessary to protect the environment.

The area of oil palm plantations in Indonesia continues to grow rapidly, as does the production and export of palm oil. The area of oil palm plantations increased from 290 thousand hectares in 1980 to 5.9 million hectares in 2006 or a 20-fold increase. However, at the end of this year the increase was not significant, in 2020, Indonesia's oil palm plantation area in 2020 reached 16.38 million hectares, including 55.76 percent of large private plantations (PBS), 40.41 percent of which were community plantations (PR). and the remaining 3.83 percent is Government Estate and in 2022, 8.58 million hectares or 56% will be controlled by the private sector, following PR 6.21 million or 40.51% and the remaining 0.55 million ha will be controlled by Government Estate (BPS; Indonesia Palm Oil Statistics, 2022). So the area actually decreased by 6.78%. However, there was also an increase, namely private plantations which rose 0.24% and PR 0.10%. In the same period, production, in the form of CPO (crude palm oil) and CPKO (crude palm kernel oil), increased 17-fold from 0.85 million tons to 14.4 million tons. Indonesia is currently the first largest producer of palm oil (CPO) in 2023, number one in the world, surpassing Malaysia since 2007. This is a very sharp development, so that in 2022 the area of oil palm will reach 15,338,556 consisting of 548,311 ha of land. Large state plantations (Government Estate), 8,576,838 ha of large private plantations (PBS) and 6,213,407 ha of community plantations (PR) (BPS, 2022). Detailed development of the areas of the three types of oil palm plantations can be seen in Figure 1.1

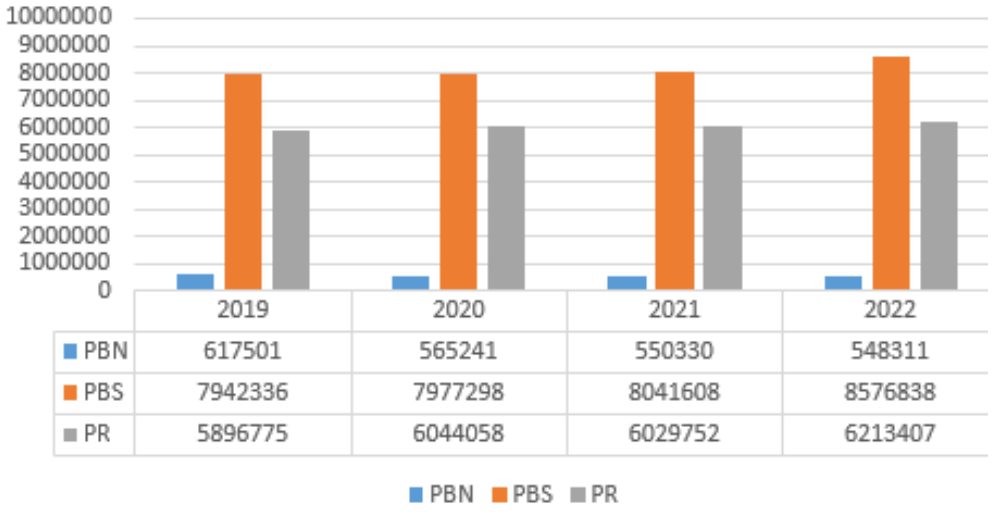


Figure 1.1. Development of Oil Palm Area
Source: Processed from Palm Oil data, 2024.

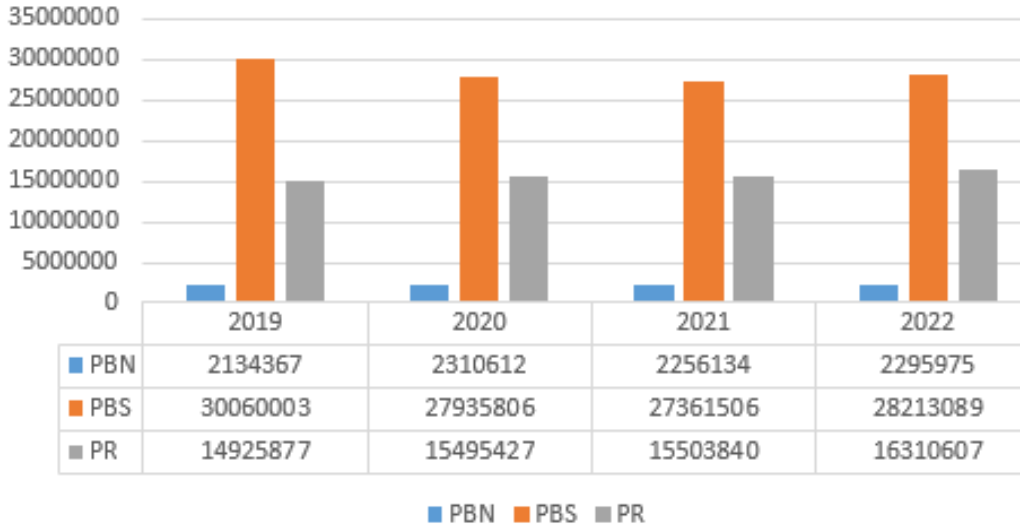


Figure 1.2. Development of Palm Oil Production
Source: Processed from Palm Oil data, 2024.

Indonesia's production of crude palm oil (CPO) and PKO palm oil in 2023 will reach 50.07 million tons and 4.77 million tons respectively, an increase of 7.15% and 5.66% from the previous year. This increase in production was influenced by several factors such as high prices which encouraged production development, improving gardens and expanding crop areas. However, due to price fluctuations, demand also fluctuates. So Indonesian palm oil exports are estimated to be affected by a decrease in the quantity of both CPO and PKO (GAPKI, 2024**).** Furthermore, detailed development of production from the three plantations can be seen in Figure 1.2. This production development can encourage export growth for both CPO and PKO.

Export is an economic activity that provides very valuable benefits to a country's economy because this activity is one of the country's main sources of foreign exchange. Exports provide foreign exchange income for the country concerned which will later be used to finance import needs in particular and country

development in general. Judging from palm oil exports, this commodity decreased by 2.38% to 32.21 million tons. However, this decline in exports can be a challenge for the government and exporters in responding to future conditions. It is known that even if demand for an item decreases, it cannot be a reason to reduce production because the market in the world is very wide, especially for palm oil or CPO.

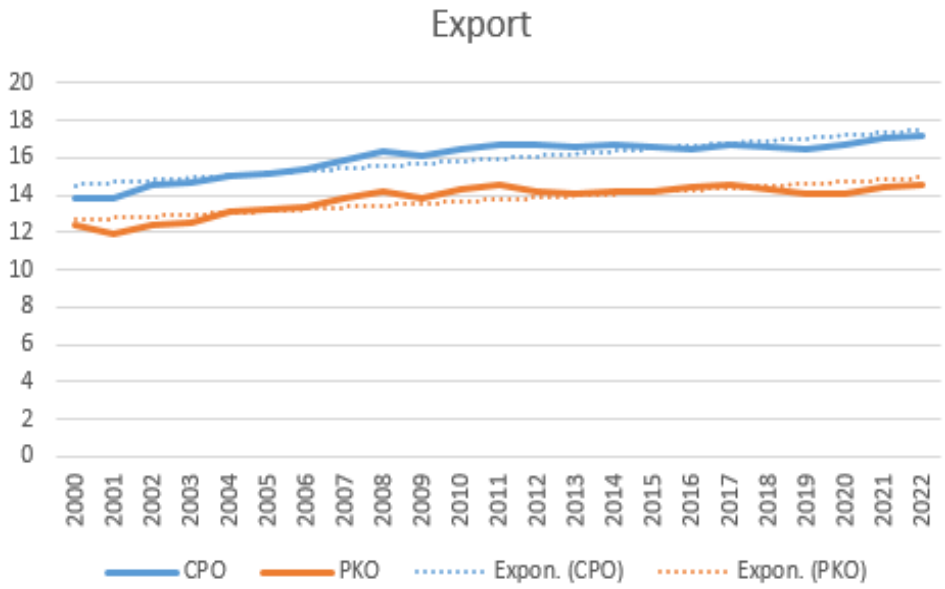


Figure 1.3. Development of Indonesian CPO and PKO Exports
Note: Figures are in natural logarithms in tons
Source: BPS, Indonesia Oil Palm Statistics, 2022.

Figure 1.3 shows that Indonesia's CPO exports experience fluctuations from year to year, namely from 200 to 2022, however, they have a positive trend. Likewise, PKO also experiences fluctuations and continues to show a positive direction. Using an exponential trend shows that palm oil exports in the future will remain active with results always increasing. So that production can be increased which can result in exports also increasing by always trying to look for export opportunities or potential destination countries. Throughout 2023, Indonesia's palm oil export volume will increase by 4.84% (year-on-year) to around 27.5 million tons. This figure is the highest since the 2020 pandemic. However, the export value in 2023 will reach US$23.97 billion, a decline of 19.08% and the lowest in the last three years.

Furthermore, for 2024, precisely in March, Indonesia's total exports of palm oil products in March rose by 18.21 percent from 2,166 thousand tons in February to 2,560 thousand tons in March. The largest increase of exports in March was seen in CPO at 114.73 percent from 152 thousand tons in February to 327 thousand tons in March (GAPKI, 2024). It was followed by the increase of oleo chemical exports at 17.91 percent from 364 thousand tons in February to 429 thousand tons in March, and processed CPO at 12.20 percent from 1,495 thousand tons in February to 1,677 thousand tons. In the same period, Palm PKO Oil (PKO) exports experienced a significant decline, reaching 0.19 thousand tons from 15 thousand tones or a decline of 98.73%. Judging from the value of CPO exports, there was a significant increase from US$2,082 million in February to US$2,178 million in March, namely an increase of 4.47%. It was further said that the result of this increase in value was an increase in the price of CPO itself (GAPKI, 2024).

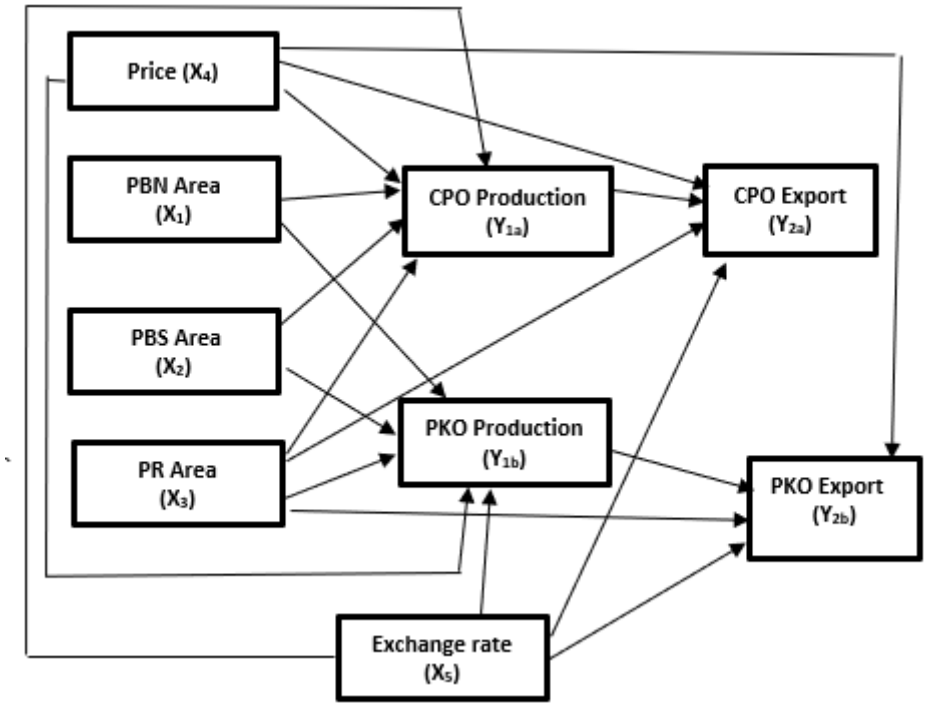


Figure 1.4. Framework

PBN = Government estate
PBS = Private Estate
PR = Stallholder

The relationship between the variables in this study can be seen in Figure 1.4, where the plant area variable can influence or determine the amount of production for both CPO and PKO. Furthermore, this production together with prices and exchange rates can determine the development of exports for the two types of commodities from oil palm plants.

Based on the relationship between these variables, this research aims to analyze and examine the relationship between industrial sector growth and environmental quality in two regions through socio-economic factors in the form of:

1. Assess the effect of area size on CPO and PKO production
2. Examining production, prices and foreign exchange for exports of palm oil (CPO) and PKO
3. Compare the elasticity of production, price and foreign exchange towards exports between CPO and PKO exports

2. Literature Review

2.1. Production

Production is an activity carried out to convert input into output or can be understood as an activity to add value to a good or service by involving production factors as input. This activity is a link in the chain of economic activities so it is very important for the survival of society and should continue to be carried out well by the private sector and the government. The relationship between the amount of input and output within a certain period of time is called the production factor. In this theory there is an explanation of producer behavior or producer behavior that maximizes profits from production but by using a combination of production factors and production functions that are as effective as possible. In a

production process, input is needed in the form of production factors, namely tools or facilities so that activities run smoothly. So, if there are no production factors, the production process will not take place. Production factors include capital, labor, skill or expertise or ability, and land. The capital that often comes to mind is usually in the form of money. However, capital can also take the form of production function tools, which is a technical relationship that connects production factors or inputs with production results or output. The relationship between input and output in the production process can be written as a functional relationship: $Q = f(X1, X2, X3, \dots, Xn)$. In this equation, Q represents the output or amount of production in a certain period, and X represents the production factors or inputs in the production process. One function that is often used in the production process is the Cobb-Douglas function. expressed in the general form:

$$Q = AK^{\alpha}L^{\beta}, \quad \alpha + \beta = 1 \ldots\ldots..(**)$$

Where:
Q = amount of production/output
L = number of workers
K = amount of capital.
This form can be developed according to analysis needs so that (**) can be writte

$$Q = A\prod_{i=1}^{n} X_i^{\alpha_i}, \quad i = 1, 2, 3.....n$$

Where:
Q = amount of production/output
Xi = input factor
K = amount of capital.
A = Technology or efficiency.
The values α and β in the Cobb Douglas equation respectively indicate the elasticity of the input factors of L and K. In the Cobb Douglas equation the sum of the elasticity of the input factors can indicate the additional level of results with the following conditions:
a. If α + β = 1 there is a constant additional return to scale of production, (Constant return to scale)
b. If α + β > 1 there is additional increasing return to scale of production, (Increasing return to scale).
c. If α + β <1 there are additional decreasing returns to scale of production, (Decreasing return to scale).
The production scale can be described (Figure 1)

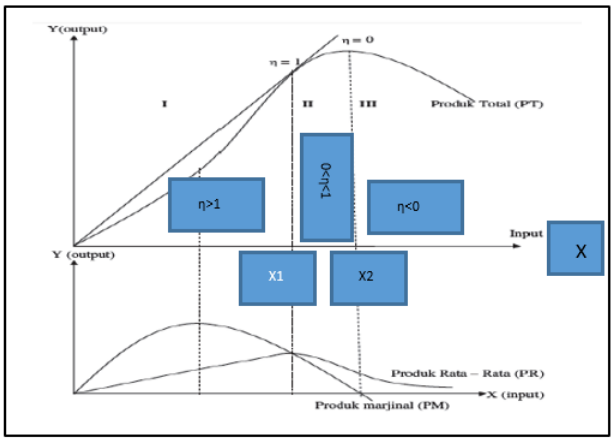


Figure 2.1. Production Function and Three Production Areas
Source: Yasin, 2016.

It can be seen in Figure 2.1 that the area with elasticity η is greater than 1, where production area I (irrational 1) is an area with an increasing return to scale production stage located between the origin and X2. In this area, marginal production (PM) reaches a maximum point with elasticity, meaning that the addition of input is smaller than the addition of output. Production region II is an area with (constant return to scale) is an area located between X1 and This shows that the use of production factors in region II is a rational region. Region III (irrational PKO Export) is an area with elasticity smaller than zero. In this area, total production decreases, if input is added, which is indicated by negative marginal production, so that area III is called an irrational region. One of the advantages of the Cobb-Douglas function is that the power is elastic as Elasticity as

$Q = AK^{\alpha}L^{\beta}$

$\frac{\partial Q}{\partial K} = A\alpha K^{\alpha-1}L^{\beta}$, $\frac{\partial Q}{\partial K} = A\alpha\frac{K^{\alpha}}{K}L^{\beta}$ or $\frac{\partial Q}{\partial K} = \alpha\frac{Q}{K}$, so $\alpha = \frac{\partial Q}{\partial K}\frac{Q}{K}$. The same process can be done for input L

2.2. Export

International trade is something that is absolutely carried out by every country, it is a relationship of economic activities from one country to another, which is carried out through a voluntary and mutually beneficial process of exchanging services or goods (Adolf, H. 2004). Currently, there is not a single country that is in autarky or an isolated country without any economic relations with other countries. This is because no country can meet its needs independently. To meet the domestic needs of a country, it can not only be done by producing or producing its own goods/services within its country but can also be done by purchasing goods/services produced by other countries. The existence of an open economic system can encourage a country to carry out international trade cooperation to meet the consumption needs of the population in that country. Both in selling or buying goods/services. International trade allows countries to expand their markets and access goods and services that otherwise may not have been available domestically (Heakal, 2024). These international trade activities are exports and imports.

In general, international trade theory can basically be divided into three main groups, namely the Classical Theory from Adam Smith which is also called the Absolute Advantage Theory, the Comparative Advantage Theory, and the Heckscher-Ohlin (H-O) Theory. The Absolute Advantage theory is based more on real quantities/variables, not monetary, so it is often known as the pure theory of international trade. Purely in the sense that this theory focuses its attention on real variables, for example the value of an item is measured by the amount of labor used to produce the item. The more labor used, the higher the value of the goods (Labor Theory of value).

Comparative Advantage JS Mill states that a country will produce and then export goods that have the greatest comparative advantage and import goods that have a comparative disadvantage (goods that can be produced more cheaply and import goods that would cost a lot of money to produce themselves). So this theory states that the value of an item is determined by the amount of labor devoted to producing the item. Comparative Cost from David Ricardo (labor efficiency), menyatakan bahwa a country will gain benefits from international trade if it specializes in production and exports goods where the country can produce relatively more efficiently and imports goods where the country produces relatively less/inefficiently.

Modern H-O Theory Heckscher-Ohlin (H-O) theory explains several trade patterns well, countries tend to export goods that use relatively abundant production factors intensively. According to Heckscher-Ohlin,

a country will trade with other countries because that country has a comparative advantage, namely superiority in technology and superiority in production factors. The basis of comparative advantage is: 1) Endowment factors, namely ownership of production factors in a country. 2) Intensity factor, namely the technology used in the production process, whether labor intensity or capital intensity. Based on the theory above, it can be concluded that international trade exists because of the limited resources owned by each country. Thus, one of the international trade activities is exports and imports to meet the needs of the people in each country and seek profits in increasing the economic growth of each country. This theory can be expanded to include the service sector which produces non-traded domestic services in the fields of transportation, warehousing, wholesale and retail which are needed to market goods to final buyers (Lutz, M., 2011)

2.3. Palm oil

Oil palm is a plant that provides many benefits to humans for their welfare. This plant is very often found in tropical areas, especially in Indonesia and Malaysia. Oil palm is much more efficient and productive compared to other vegetable oil producing crops, where one hectare of land can produce 4.17 metric tons of palm oil per year, compared to 0.56 tons of sunflower oil, 0.39 tons of soybean oil and 0.39 tons of soybean oil. 16 tons of peanut oil. Another fact is that in 2016 palm oil only used 7% of the world's total agricultural land producing vegetable oil with production reaching 32 percent. The economic value of palm oil is so high that the palm oil industry has helped lift millions of people out of poverty in Indonesia and Malaysia, which accounts for around 85 percent of global production. Palm oil plantations have created millions of well-paying jobs, and enabled tens of thousands of small farmers to own their own land. Products from palm oil are very versatile and useful, and have lifted millions of people out of poverty and with good management can bring benefits to the environment (Asian Agree, 2024).

The oil palm tree (Elaeis guineensis and Elaeis oleifera) is a tropical plant that bears fruit, originating from West Africa and Central and South America. Oil palm fruit consists of the *exocarp*, which is the reddish and smooth part of the skin of the fruit, the *mesocarp* which is the fruit fiber and the endocarp which is the protective shell of the core (kernel). Mesoscarp which is the fruit fiber and Endocarp which is the protective shell of the kernel (Paspi, 2024). The three components produce CPO oil and kernel oil. So one palm fruit consists of palm fruit husks (fiber), palm fruit flesh (palm fruit), palm shell (kernel shell), and palm fruit core (kernel). For details on the structure of oil palm fruit, see Figure 2.2.

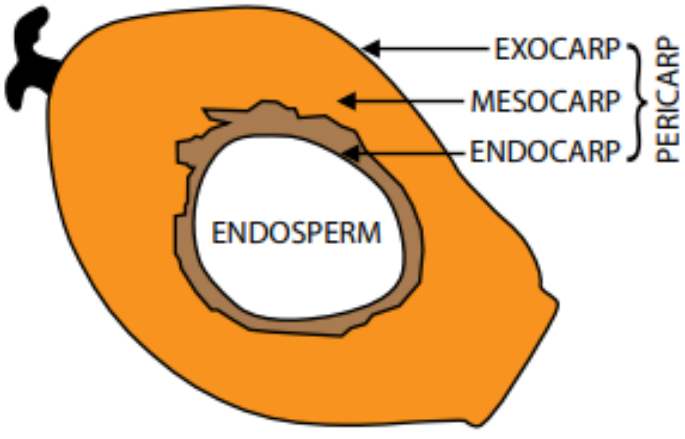


Figure 2.2. Palm Oil Fruit Structure (Sheil, D. at al., 2009)

3. The Method

3.1. The Type of Reteach and Sources of Data

This type of research is quantitative, taking the type of study of comparative causality that processes numerical data that can be calculated using statistical formulas. The data analysis technique used in this study is path analysis which estimates the direct and indirect influence of exogenous variables on endogenous variables although in this study we only look at and discuss the direct effect, both effects are available in the statistical program used for estimation in this study.

This study uses secondary data, namely data that is already available and collected by other parties and it was panel data. The data was taken from the Indonesia Central Statistics Agency (BPS) and the Ministry of Environment and Forestry (MEF) which covers 34 provinces in Indonesia, where since the end of 2022 there have been 38 provinces, but the necessary data is not yet available. The data export used which is divided into two groups, CPO Export and PKO Export. The statistical analysis technique used is path analysis using the Amos 18 statistical application program.

3.2. Model Specification

Based on the conceptual relationship in the framework of thinking, mathematically functional relationships can be written as

$Y_1 = f(X_1, X_2, X_3, X_4, X_5, D1, D1X_1, D1X_2, D1X_3, D1X_4, D1X_5)$ …..(1)

$Y_2 = f(X_3, X_4, X_5, Y_1, Y_2, D2, D2X_3, D2X_4, D2X_5, D2Y_1, D2Y_2)$ …..(2)

Whereas:

D1= Type of production, D1= 0, production of CPO and D1=1, Production of PKO

D2= Type of Export, D2= 0, export of CPO and D2=1, export of PKO

X1 = government estate (area of Government Estates, Ha)

X2 = private estate (area of Private Estates, Ha)

X3 = smallholder (smallholder area, Ha)

X4 = price (crude palm oil price, United States dollars)

X5 = exchange rate (dollar exchange rate against the rupiah)

Y1 = production (amount of production from plantation area, tons)

Y2 = export (amount of exports, tons)

Algebraically, equation (1) can be written as

$$\ln Y_1 = \ln \alpha_0 + \alpha_1 \ln X_1 + \alpha_2 \ln X_2 + \alpha_3 \ln X_3 + \alpha_4 \ln X_4 + \alpha_5 \ln X_5 + \alpha_6 D_1$$
$$\alpha_7 D_1 \ln X_1 + \alpha_8 D_1 \ln X_2 + \alpha_9 D_1 \ln X_3 + \alpha_{10} D_1 \ln X_4 + \alpha_{11} D_1 \ln X_5 + \mu_1 \ldots (3)$$

Based on equation (3), 2 new regression equations can be created

Regression Equation for CPO production, D1 = 0,

$$\ln Y_{1a} = \ln \alpha_0 + \alpha_1 \ln X_1 + \alpha_2 \ln X_2 + \alpha_3 \ln X_3 + \alpha_4 \ln X_4 + \alpha_5 \ln X_5 + \mu_1 \ldots (4)$$

or

$$Y_{1a} = \alpha_0 X_1^{\alpha 1} X_2^{\alpha 2} X_3^{\alpha 3} X_4^{\alpha 4} X_5^{\alpha 5} e^{\mu 1}$$

Regression Equation for PKO production, D1=1,

$$\ln Y_{1b} = (\ln \alpha_0 + \alpha_6) + (\alpha_1 + \alpha_7) \ln X_1 + (\alpha_2 + \alpha_8) \ln X_2 + (\alpha_3 + \alpha_9) \ln X_3 +$$
$$(\alpha_4 + \alpha_{10}) \ln X_4 + (\alpha_5 + \alpha_{11}) \ln X_5 + \mu_1 \ldots (5)$$

$$Y_{1b} = \phi_0 X_1^{\phi 1} X_2^{\phi 2} X_3^{\phi 3} X_4^{\phi 4} X_5^{\phi 5} e^{\mu 1}$$

where as

$\ln \alpha_0 + \alpha_6 = \phi_0;\ (\alpha_1 + \alpha_7) = \phi_1;\ (\alpha_2 + \alpha_8) = \phi_2;\ (\alpha_3 + \alpha_9) = \phi_3$

$(\alpha_4 + \alpha_{10}) = \phi_4;\ (\alpha_5 + \alpha_{11}) = \phi_5$

Next, continue with the Y2 equation which states exports

$\ln Y_2 = \ln \beta_0 + \beta_1 \ln X_3 + \beta_2 \ln X_4 + \beta_3 \ln X_5 + \beta_4 \ln Y_1 + \beta_5 D_2 + \beta_6 D_2 \ln X_3 +$

$\beta_7 D_2 \ln X_4 + \beta_8 D_2 \ln X_5 + \beta_9 D_2 \ln Y_1 + \mu_2$ .....(6)

Substituting the value of dummy variable, D2=0 in the equation (6), new equation is obtained as Regression Equation for CPO Exports, D2= 0,

$\ln Y_{2a} = \beta_0 + \beta_1 \ln X_3 + \beta_2 \ln X_4 + \beta_3 \ln X_5 + \beta_4 \ln Y_1 + \mu_2$ ……..(3.6)

Or in nonlinear form

$Y_{2a} = \beta_0 X_3^{\beta 1} X_4^{\beta 2} X_5^{\beta 3} Y_1^{\beta 4} e^{\mu 2}$

then substituting the value **,** D=1 in the equation (4), new equation as Regression Equation for PKO Exports, D1= 1,

$\ln Y_{2b} = (\ln \beta_0 + \beta_5) + (\beta_1 + \beta_6) \ln X_3 + (\beta_2 + \beta_7) \ln X_4 + (\beta_3 + \beta_8) \ln X_5 +$

$(\beta_3 + \beta_8) \ln X_5 + (\beta_4 + \beta_9) \ln Y_1 + \mu_2$ ...(3.7)

$Y_{2b} = \varphi_0 X_3^{\varphi 1} X_4^{\varphi 2} X_5^{\varphi 3} Y_1^{\varphi 4} e^{\mu 2}$

where as:

$\ln \beta_0 + \beta_5 = \varphi_0;\ (\beta_1 + \beta_6) = \varphi_1;\ (\beta_2 + \beta_7) = \varphi_2;\ (\beta_3 + \beta_8) = \varphi_3$

$(\beta_4 + \beta_9) = \varphi_4$

4. Result and Discussions

4.1. Model fit test

Chi-square statistic, as stated earlier, is the most fundamental test to measure overall fit, it is very sensitive to the size of the sample used and the relation of exogenous variables, almost the same as the model Regresi Linear Berganda. The model is considered good if the Chi-square value is small. The smaller the value, the more feasible the research, meaning that the more it describes the match between the variance of the sample taken and the research population. The results of data processing that have been carried out using the AMOS 18 program are as shown in Table 1.

Tabel 1. Goodness of Fit Index

No.	Goodness of fit Measure	Cut-off Criteria	Estimation (cut off Value)	Fit Situation
1	Chi-Square (χ^2) Significance Probability (p)	smaller the better $\geq$ 0.05	6.627 0.760	Fit

2	RMSEA (the Root Mean Square Error of Approximation)	≤ 0.05	0.000	Fit
3	NFI (Normed of Fit Index)	≥ 0.95	0.988	Fit
4	IFI (Incremental Fit Indices)	≥ 0.95	1.006	Fit
`5	CMIN/DF (the minimum Sample Discrepancy Function)	≤ 2	0.663	Fit
6	TLI (Tuckler Lewis Index)	≥ 0,95	1.027	Fit
7	CFI (Comparative Fit Index)	≥ 0,95	1.000	Fit
8	Hoelter's Index	≥ 200	123	Non-Fit

Sumber: Malkanthie, 2015; Wan, 2022 and Research Finding

4.2. Research findings

As is known, this research divides export in 2 commodities type, so the estimation results consist of two components. The estimation results for CPO export, D2=0, can be seen in Figure 4.1.

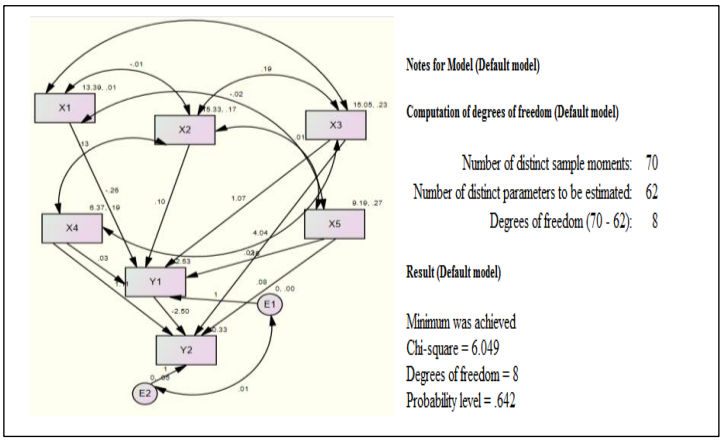
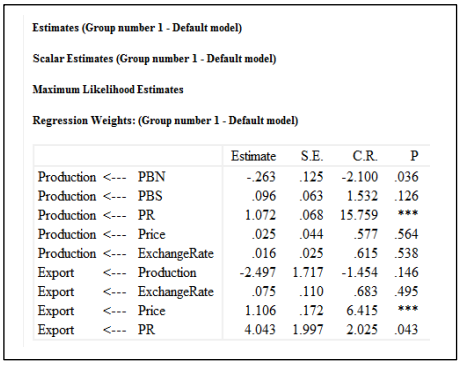


Figure 4.1. Variable Coefficients for CPO Export and Result of Default Model

Recourse: Amos 18 data processing results.

As can be seen in Figure 4.1, where there is no level of confidence or probability for each coefficient or path, the estimation results are also displayed as a scalar estimate for CPO Export (Group 1), which describes the level of significance of each path, Figure 4.2.



Estimates (Group number 1 - Default model)

Scalar Estimates (Group number 1 - Default model)

Maximum Likelihood Estimates

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P
Production	<---	PBN	-.263	.125	-2.100	.036
Production	<---	PBS	.096	.063	1.532	.126
Production	<---	PR	1.072	.068	15.759	***
Production	<---	Price	.025	.044	.577	.564
Production	<---	ExchangeRate	.016	.025	.615	.538
Export	<---	Production	-2.497	1.717	-1.454	.146
Export	<---	ExchangeRate	.075	.110	.683	.495
Export	<---	Price	1.106	.172	6.415	***
Export	<---	PR	4.043	1.997	2.025	.043

Figure 4.2. Scalar Estimates CPO

Resource: Amos 18 data processing results.

Further illustrating the estimation results for PKO Export, D_2=1 or PKO Export, as carried out in CPO Export, can be seen in Figure 4.3.

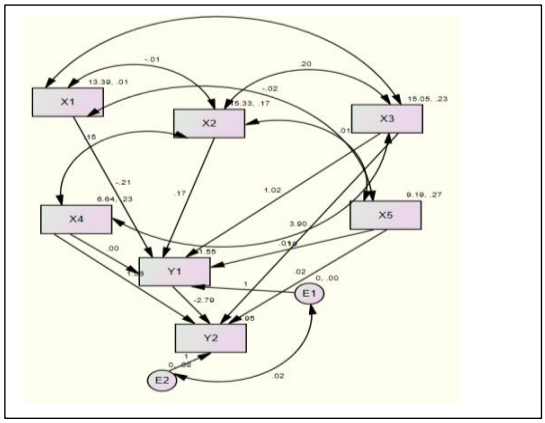


Figure 4.3. Variabel Coefficients in PKO Export
Resource: Amos 18 data processing results

Next, in PKO Export, the estimation results are presented, variable coefficients with confidence level or probability (P), Regression Weights for PKO Export, can be seen in Figure 4.4.

Estimates (Group number 2 - Default model)

Scalar Estimates (Group number 2 - Default model)

Maximum Likelihood Estimates

Regression Weights: (Group number 2 - Default model)

			Estimate	S.E.	C.R.	P
Production	<---	PBN	-.210	.102	-2.054	.040
Production	<---	PBS	.172	.085	2.026	.043
Production	<---	PR	1.025	.088	11.696	***
Production	<---	Price	.004	.043	.093	.926
Production	<---	ExchangeRate	.013	.025	.512	.609
Export	<---	Production	-2.793	2.077	-1.345	.179
Export	<---	ExchangeRate	.023	.136	.173	.863
Export	<---	Price	1.059	.215	4.930	***
Export	<---	PR	3.905	2.470	1.581	.114

Figure 4.4. Scalar Estimates PKO Export
Resource: Amos 18 data processing results

The results of the analysis show the influence of one variable on another variable according to the research objectives so based on Figure 3 and Figure 4, a summary of the influence of independent variables on dependent variables can be represented in Table 2. The table also shows that CPO Export and PKO Export each have a coefficient and probability according to the relationship between variables. The estimation results show the coefficient of the independent variable on the dependent variable which is clearly visible in Table 2.

Table 2. Coefficient/Elasticity of the variables of Production and Export

No	The Relation of the variables		CPO		PKO	
	Dependent variables	Independent variables	Coefficient	Probability	Coefficient	Probability.
1	Production	1.Government Estate	**-0.263**	**0.036**	**-0.210**	**0.040**

		2.PBS	**0.096**	**0.126**	**0.172**	**0.043**
		3.PR	**1.072**	**0.000**	**1.025**	**0.000**
		4.Price	**0.025**	**0.564**	**0.004**	**0.926**
		5.Exchange Rate	**0.016**	**0.538**	**0.013**	**0.609**
2	Export	1. Production	**-2.497**	**0.146**	**-2.793**	**0.179**
		2.Exchange Rate	**0.075**	**0.495**	**0.023**	**0.863**
		3.Price	**1.106**	**0.000**	**1.059**	**0.000**
		4.PR	**4.043**	**0.043**	**3.905**	**0.114**

Source: Research Finding, 2024

Based on Table 1, it is known that increasing CPO and PKO production causes a decrease in production. If the Government Estate area increases by 1%, CPO production will decrease by 0.26% and PKO will decrease by 0.21%. It is known that the condition of the Government Estate oil palm plantation has experienced a decline in production due to old plants that need rejuvenation, but this has not been done because the government has instructed the development of other types of plantations, namely PBS and PR (IOPS, 2022). Thus, it is clear that there has been a decline in production from the Government Estate while much land has not yet been converted into use, especially from the Government Estate area to the Private Estate and smallholder areas.

Furthermore, in the same table it is also known that the PBS area has a positive influence on production due to government policies encouraging the development of private oil palm plantations and smallholder oil palm plantations. In this case, the influence of PBS area on CPO production is not significant, but PKO has a significant positive influence on production. The coefficient of 0.096 shows that if the PBS area increases by one percent it will cause an increase in production as wet as 0.10% of CPO production and 0.04% of PKO production.

The PR area shows a positive influence on production for both CPO and PKO. This fact shows that increasing the PR area will cause an increase in CPO and PKO production, although not proportionally. It can be seen in the same table that the PR area coefficient is 1.10 for CPO and 1.03 for PKO, respectively. This fact shows that an increase in PR area of 1% will cause an increase in CPO production of 1.10% and PKO of 1.03 percent. From this fact it can also be seen that the elasticity of the PR area on CPO production is higher than the elasticity of the PKO proxy, however, both have elastic properties, the percentage change in area is smaller than the percentage change in CPO production and also PKO production.

Production and exchange rates do not have any influence on CPO production or PKO production. This is because price changes are not uniform and can increase production, but it takes some time, as it is known that the fastest production for palm oil is four to six years and can only be harvested or ripe after 7 to 10 years. Palm oil with good quality will continue to produce until it is 25 years old (Sawit Kita , 2022). Furthermore, in 11 to 20 years, production will experience a decline. Furthermore, it is said that currently plantations are faced with the problem of the Ganoderma fungus which causes oil palms to die. As with prices, the exchange rate does not have an influence on production because it is generally known that the value of the rupiah against the United States dollar is very volatile, although it tends to increase, while recent palm oil production tends to decrease (BPS, 2022). However, the results of this research contradict research conducted by Purba and Magdalena (2017) which states that the exchange rate has a positive influence on palm oil exports.

The research results show that production and exchange rates have no influence on exports. This is because, as is known, palm oil exports have decreased due to decreased demand from partner countries, China, Europe and India. CPO exports experienced a decline in 2024 with a volume of 1.24 tons and in the previous year 2023, namely in February, it reached 2.10 tons (BPS, 2024). Thus almost half of the export volume is reduced in the same month, different years. The research results conflict with research conducted by Khofifah Sari Hasibuan, et al, 2023 which stated that production had an influence on CPO exports, which used the time period 2000-2020.

Prices have a significant positive influence on exports. This is in accordance with the theory that if demand increases it will cause prices to increase in the economy. Many studies explain the influence of prices on exports, including: research (Santosa, R. et al, 2021; Advent, R. et al, 2021; R Rosita, 2014;). In general, an increase in demand is followed by an increase in supply because the reaction of supply is that this causes the price to also increase because there is an adjustment towards a new balance. The price elasticity for CPO exports is 1.11 while for PKO it is 1.06. This means that if prices increase by one percent, CPO exports will increase by 1.11% while PKO exports will increase by 1.06%. This shows that the price elasticity of both exports is elastic, but CPO exports are more elastic than PKO exports. So CPO exports are more responsive to price changes than PKO. Furthermore, in the same period in terms of price, the opposite happened, where in 2023 the price was 767.51 US dollars per ton, while in January 2024 the price reached 835.43 tons or an increase of 8.84%. It was further said that export performance was influenced by world trade policy, namely the opening of new trade routes through the Black Sea Grain Initiatives signed by Russia. Furthermore, the decline in Indonesian palm oil exports was also influenced by CPO stocks in China and India, which still have high CPO stocks (BPS, 2022).

The PR area has a positive influence on CPO exports significantly at the confidence level of α=0.05 with a regression or elasticity coefficient of 4.04, which means that if the growth of the PR plantation area increases by 1% it will cause an increase in CPL exports of 4.04% which means elastic. Meanwhile, this variable also has an influence on PKO exports but is not significant at level confidence α=0.05. The elasticity of PR area on production is 3.91 with Prob. 0.114 so the effect is acceptable if α=0.15. It has been explained that production has no influence on CPO and PKO at level confidence α=0.05. The absence of this influence is closely related to the ever-increasing need for domestic palm oil consumption. Apart from that, it is known that Indonesia is experiencing CPO export problems because the European Union Parliament has issued a policy to stop the use of Crude Palm Oil (CPO) in 2021 (Sidik, R.M., 2018). So it is natural that in 2021 and the results of this research production will show a negative influence on CPO and PKO in Indonesia.

5. Conclusion

Based on the analysis and the results of the previous discussion, the following conclusions are drawn:

1. Whether viewed from CPO or PKO, the results of the analysis show that the Government estate has a real negative effect on production where the elasticity of CPO towards production is lower than PKO.
2. The increase in production is caused significantly by the increased PR area, as well as the tendency for the increase in PR production in CPO to be higher than the increase in PKO, where the influence of PR is elastic.
3. PBS has a positive influence on production which is significant for PKO but not significant for CPO, both types of production are inelastic.
4. Prices and exchange rates have no influence on CPO production or PKO production.

5. The price elasticity of exports of both types of goods is elastic, but CPO exports are more elastic than PKO exports. So CPO exports are more responsive to price changes than PKO. Furthermore, production and exchange rates have no influence on exports of either CPO or PKO
6. The increase in CPO exports is determined significantly by the high PR, but the PKO is not significant
7. Comparing the elasticity of the two types of palm oil exports, it is known that CPO is more elastic than PKO towards prices and also towards smallholders.

6. Recommendation

The suggestions to be put forward based on the discussion and conclusions that have been stated, among others:

1. The government should continue to develop PBS and PR because production is elastic by providing assistance facilities such as seeding and fertilization and training for smallholder oil palm farmers. On the other hand, the Government should be careful in developing the Government Estate area because it will no longer provide positive results from increasing the plantation area
2. The government and private sector should work together to overcome foreign demand for palm oil which tends to decrease in quantity, even though its value tends to increase and prioritize meeting domestic demand and always looking for and expanding export opportunities to countries on various continents, apart from countries in Europe.
3. Palm oil production, especially PKO, should pay attention to quantity and quality, especially transportation because the elasticity of PKO is lower than CPO.
4. In connection with palm oil production which tends to decline and limits exports, the government should develop the palm oil industry, such as piloting the establishment of derivative industrial factories.

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