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Analysis of the Effect of Palm Oil Productivity on Indonesian Palm Oil (CPO) Supply Chain Management 2015-2021 Through Government Policy as a Mediation Variable

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Abstract. Supply chain management is important for palm oil companies so it is necessary to analyze the capacity and quality of trading actors, analysis related to control and distribution. So that production output supply chain mapping can be carried out to ensure production, distribution and marketing systems are effective and efficient. This research aims to determine the influence of palm oil productivity measurement variables on palm oil supply chain management through government policy as an intervening variable. This research is exploratory in nature using inferential analysis techniques. Information used in the time setting framework for the 2015-2021 period. This research uses simple linear regression statistical data analysis with the Structural Equation Model (SEM) with the alternative Partial Least Square (PLS) method. The research results show that the influence of palm oil productivity is significantly positive on government policy (0.000) < (0.05) with an estimated magnitude of 0.552. And the influence of government policy is significantly positive on supply chain management (0.000) < (0.005) with an estimated magnitude of 0.834. In this case, there is a positive and significant influence of palm oil productivity on supply chain management through government policy.

Keywords: oil palm, smallholder, supply chain management

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1. Introduction

Currently, supply chain management has become important for palm oil companies, in line with increasing business competition and the parallel position of suppliers and palm oil mills as partners [1]. It is imperative to carry out supply chain investigation within the preparing of FFB into CPO and kernel kernels so that you simply can analyze the capacity and quality of trade performing artists, analyze related controls and dispersion, so it can map the CPO supply chain and kernel core as production output. Apart from that, it can ensure that the production, distribution and marketing systems can run effectively and efficiently [2]. Research conducted by

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Nashr et al. [3] shows that there is a problem of unsustainability in the supply chain sector and the public sector.

A decrease in worldwide palm oil costs, for illustration, will disturb the soundness of the supply chain, since palm oil ranchers tend to be hesitant to offer new palm natural product bunches and hence disturb the fulfillment of palm oil generation targets. In expansion, social dangers such as non-tariff obstructions to palm oil squander contamination are also risks that will disturb the solidness of the whole supply chain [4].

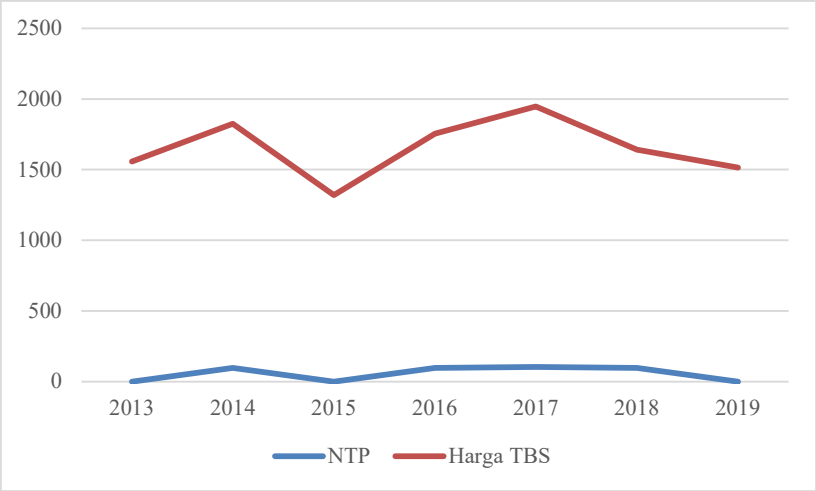


Figure 1. Comparison of NTP for Smallholders and TBS Prices in Riau Province
(Source: madaniberkeringan.id)

The allocation of government funds is also related to the palm oil supply chain management system in Indonesia. From the picture above, it is clear that from 2013-2015 the NTP and TBS values were before the existence of palm oil funds, which since 2015 have not had a significant impact on farmers' welfare. Meanwhile, from 2016 to 2019, these are the NTP and TBS values after the palm oil funds. BPDPKS funds are expected to direct palm oil funds towards farmer welfare. From Figure 1 above, it can be seen that even though the government provided palm oil funds, it has not provided significant benefits to NTP.

The efficiency of smallholder oil palm is decided by the quality of generation inputs utilized in overseeing smallholder oil palm ranches beginning from selecting prevalent seeds, support, fertilization, arrive reasonableness, normal variables, workforce capacity as directors to gather administration. This will be an pointer of farmers' victory in overseeing oil palm manors [5]. According to Pranata and Afrianti [6] that workers are inhabitants who have or are right now working, who are trying to find work and carrying out other exercises such as going to school and taking care of the family. The labor production factor determines the level of success of the plantation if the amount of labor used is in accordance with needs.

The supply chain for palm oil is influenced by various interacting or related factors, such as the area of palm oil land, availability of palm oil land, weather and climate, demand and supply prices, oil taxes and world crude oil prices. Rising global demand for food, energy and other industrial processes is also increasing demand for palm oil. Then the palm oil market was also affected by the economic crisis where supply disruption occurred [7].

To extend the level of efficiency of farmers' arrive and crops, it is trusted that the government can act more effectively, particularly with respect to diminishing farmers' generation costs, particularly the arrangement of supporting generation calculate endowments (fertilizers, pesticides, rural apparatus and equipment, basic plantation foundation) [8]. The complex reflects how distinctive organization designs and courses of action, connected to obligatory state directions and deliberate private measures, work in conjunction to direct, give motivation and progress the financial performance of the palm oil segment, whereas tending to the most social and natural impacts and trade-offs rising from their fast advancement, which influence its in general execution [9].

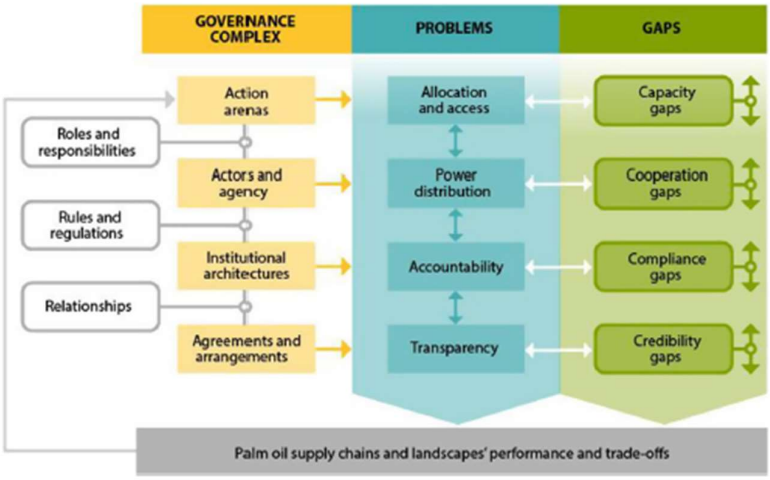


Figure 2. A System to Assess the Performance of the Palm Oil Administration Complex [10]

Supply chain management (SCM), in this case, supply chain management for palm oil commodities, is a complex system that is very interesting to study. Palm oil supply chain management has not received much attention from Lema and Choy [23] stated that improving the welfare of farmers involved in the palm oil value chain; increased stability and certainty of government policies will support and incentivize investment to increase smallholder production and continue to incorporate them into global supply chains. From the cultivation aspect, ongoing efforts are made to increase productivity [4].

The palm oil factory is one of the production supply chains in the palm oil industry which functions to process palm fresh fruit bunches (FFB) into CPO. The smallholder has contributed to deliver Unrefined Palm Oil (CPO) approximately more than 40 percent within the supply chain.

The number of agriculturists who don't have and those who have problems with their land and how to distinguish between them within the supply chain are obscure. The same is genuine for huge companies. Aside from companies that have gotten maintainability certification, there's no component to guarantee that all palm oil items created and circulated in Indonesia have clear generation legitimateness [11]. Agro-industrial supply chain management places the harvest-transport management system as a key factor. Crude palm oil agro-industry supply chain management needs to consider costs and quality as one unit in the decision-making process. Supply chain performance is determined by decisions related to inventory, production, and transportation [12].

The implications of the research results by Heryani et al. [13] can be seen in cultivating the utilize of innovation in realizing straightforwardness, particularly with respect to the cost, quality, and traceability of new natural product bunches, the realization of a observing framework for policymakers and capital help for free oil palm smallholders. Based on the presentation of the literature above, the hypothesis in this research is there is an influence of palm oil productivity on palm oil (CPO) supply chain management through government policy as a mediating variable.

2. Materials and Methods, or Methods

2.1. Data Types and Sources

Secondary data is supporting data that provides the information needed in this study. This study also used secondary data.

Table 1. Research Indicators

Year	PRO1	PRO2	PRO3	KP1	KP2	MRP1	MRP2	MRP3	MRP4	MRP5
2015	11260277	31070015	1790342	26467564	0.53	4500	7958	7725	623	1600
2016	11201465	31730961	1560394	22761814	10.92	1000	10218	7433	700	1592
2017	14048722	37965224	1646201	27353714	10.87	1070	11056	8877	751	1695
2018	14326350	42883631	1774427	27898875	6.24	3261	13491	6941	599	2052
2019	14456611	47120247	1881129	28279350	5.49	4597	16730	6501	601	2056
2020	14658300	45741845	1757004	25935257	30.75	4867	17349	6501	752	2335
2021	15081021	46854457	1822587	25624258	30.75	3570	18422	11079	1094	2892

Data source: Area Size (Superior Statistics – BPS); Palm Oil Production (Unggulan Statistics – BPS), Wages/Salaries (Indonesian Statistics), CPO Export Volume (Unggulan Statistics – BPS), BPDP-KS Budget Funds (BPDP); Stock (BPDP-KS, GAPKI, Money.kompas), Consumption (GAPKI), Global and Domestic CPO Prices (Ditjenbun), Number of Factories (Leading Statistics – BPS).

where: PRO1= area (Ha); PRO2 = palm oil production (tons); PRO3 = wages/salary (million Rupiah); KP1 = CPO export volume (tons); KP2 = budget funds (trillions); MRP1 = stock (thousand tons); MRP2 = consumption (thousand tons); MRP3 = global CPO price (Rp/kg); MRP4 = global cpo price (US Dollar/metric ton); MRP5 = number of factories (CPO).

In this research, the definition of each build variable of oil palm efficiency, supply chain management, and government policy are outlined as follows:

a. PRO1 is the area of land used to cultivate oil palm trees with the aim of producing palm oil.
b. PRO2 implies comes about collected from manor businesses without going through assist preparing.
c. PRO3 is the compensation within the frame of cash or merchandise given straightforwardly to laborers for work/services that have been performed, and typically a ostensible wage. The least wage is anticipated to move forward the welfare of low-wage specialists.
d. KP1 is CPO processing results exported by Indonesia to foreign countries.
e. KP2 is budget reserves, in this case, come from BPDP-KS. The Palm Oil Manor Support Administration Office (BPDPKS) may be a manor finance administration body that was set up as an appearance of the command of Government Control Number 24 of 2015 concerning the Collection of Oil Palm Ranch Reserves, which is entrusted with collecting reserves to empower the improvement of oil palm manors. One utilize of the reserves collected is inquire about and improvement of oil palm ranches. The dissemination of stores is of course a matter for farmers in palm oil revival, so there ought to be comprehensive direction and help for oil palm agriculturists. MRP1 is the amount of palm oil inventory.
f. MRP2 is the amount of palm oil used to meet product processing needs.
g. MRP3/ MRP4 means CPO selling prices are influenced by world economic conditions. Global CPO prices fall, so CPO export tax rates will also fall and be cheaper. On the other hand, if the global CPO price rises, the CPO export tax levy rate will also rise and be considered expensive.
h. MRP5 is the place for processing palm oil fresh fruit bunches (FFB) into crude palm oil (CPO), palm kernel, fiber and palm shell.

2.2. Data Analysis Technique

Structural equation modeling (SEM) based on variance or component based SEM, which is famously called Partial Least Square (PLS), could be a effective examination strategy, since it does not accept information must be on a certain scale of estimation, little test measure, and can also be used to affirm hypothesis. SEM may be a multivariate investigation strategy that can be utilized to at the same time depict straight connections between watched factors (markers) and factors that cannot be measured straightforwardly (inactive factors). Inactive factors are imperceptibly factors or cannot be measured specifically, but must be measured through a few pointers. There are two sorts of inactive factors in SEM, to be specific endogenous (η) and exogenous (ξ) [14].

This research is non-parametric statistics. Non-parametric statistics is usually used to carry out analysis on nominal or ordinal data. In common, PLS-SEM incorporates a level of factual control and appears higher joining compared to CB-SEM (Covariance-based SEM). The least test

estimate for PLS-SEM must be rise to to or more noteworthy than: a. Ten (10) times the biggest number of developmental markers utilized to degree a build; b. Ten (10) times the biggest number of internal model paths are straightforwardly associated to certain builds within the internal demonstrate. The examination stages in PLS-SEM are not much diverse from CB-SEM. The contrast as it were lies within the parameter estimation strategy and the nonattendance of goodness of fit (GOF) testing in PLS-SEM. The PLS-SEM investigation stages in this inquire about comprise of show detail, demonstrate parameter estimation, basic demonstrate testing and estimation demonstrate testing [15]. The stages in PLS-SEM investigation proposed by Sinaga et al. [16] incorporate: testing the estimation demonstrate (external demonstrate) and auxiliary testing (internal demonstrate).

In this research, PLS has points of interest since of its capacity to handle non-normal information. In terms of the capacity to control information, PLS-SEM is moderately strong when managing with skewed information compared to CB-SEM. The issue in social science investigate is that information ordinariness is nearly outlandish [17].

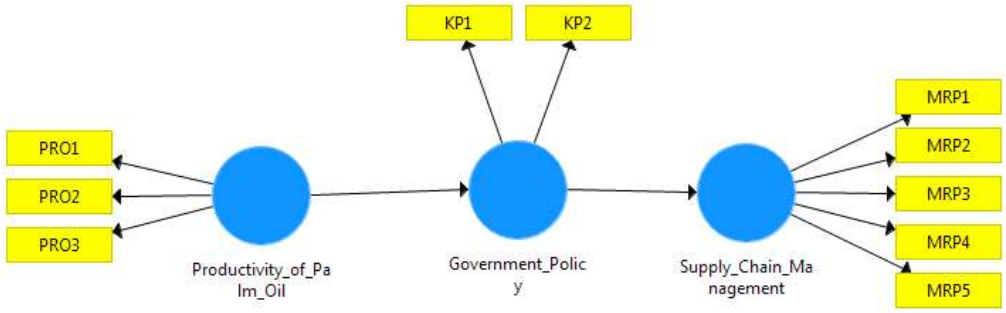


Figure 3. Research Framework

3. Results and Discussion

3.1. Assessing the Outer Model or Measurement Model

There are three criteria in the use of data analysis techniques with SmartPLS to assess the outer model, namely convergent validity, discriminant validity and composite reliability.

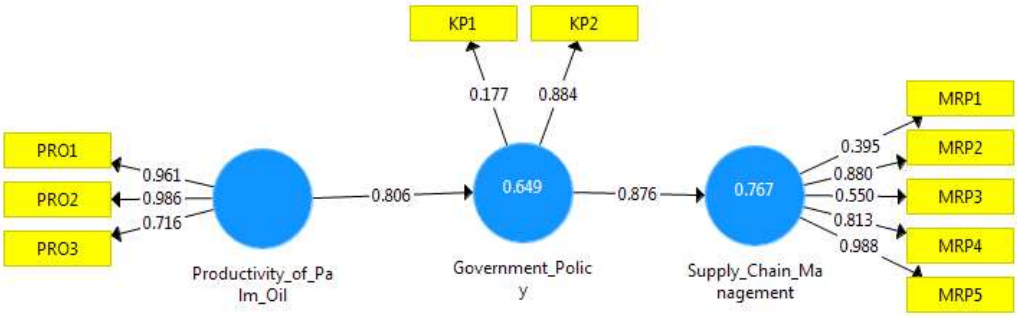


Figure 4. Initial Path Analysis Model Results with SEM-PLS

The outer model value or correlation between the construct and the variables initially (Figure 4) did not meet convergent validity because there was still one indicator that had a loading factor value. The modified model as in Figure 5 shows that all loading factors so that no constructs for all variables have been eliminated from the model.

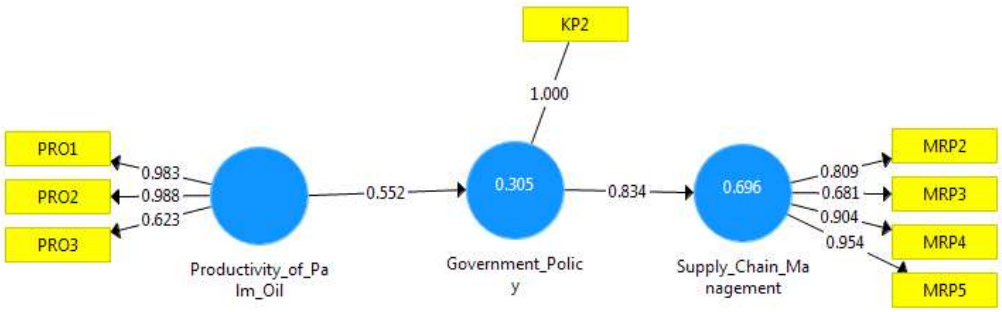


Figure 5. Results of Path Analysis Modification Model with SEM-PLS

Discriminant validity is carried out to guarantee that each concept of each idle variable is distinctive from other factors. The demonstrate has great discriminant legitimacy in the event that each stacking esteem of each pointer of an inactive variable has the biggest stacking esteem with other stacking values for other idle factors.

Table 2. Discriminant Validity Value (Fornell-Larcker Criteria)

No	Information	KP	MRP	PRO
1	KP	**1.000**		
2	MRP	0.834	**0.843**	
3	PRO	0.552	0.708	**0.881**

Source: Research results, 2023 (processed data)

Table 3. Discriminant Validity Value (Cross Loading)

No	Information	KP	MRP	PRO
1	KP	1.000	0.834	0.552
2	MRP2	0.721	0.909	0.902
3	MRP3	0.415	0.681	0.135
4	MRP4	0.793	0.904	0.373
5	MRP5	0.794	0.954	0.808
6	PRO1	0.561	0.700	0.983
7	PRO2	0.553	0.701	0.988
8	PRO3	0.048	0.374	0.623

Source: Research results, 2023 (processed data)

Based on Table 4, all the roots of the AVE (Fornell-Larcker Criterion) for each construct are greater than their correlation with other variables. Based on Table 4 it can be concluded that all constructs meet the criteria of being reliable. This is indicated by the composite reliability value above 0.70 and AVE above 0.50 as the recommended criteria.

Table 4. Composite Reliability and Average Variance Extracted

No	Information	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
1	KP	1.000	1.000	1.000	1.000
2	MRP	0.861	0.903	0.907	0.711
3	PRO	0.878	1.014	0.910	0.777

Source: Research Results, 2023 (Processed Data)

3.2. Assessing the Inner Model or Structural Model

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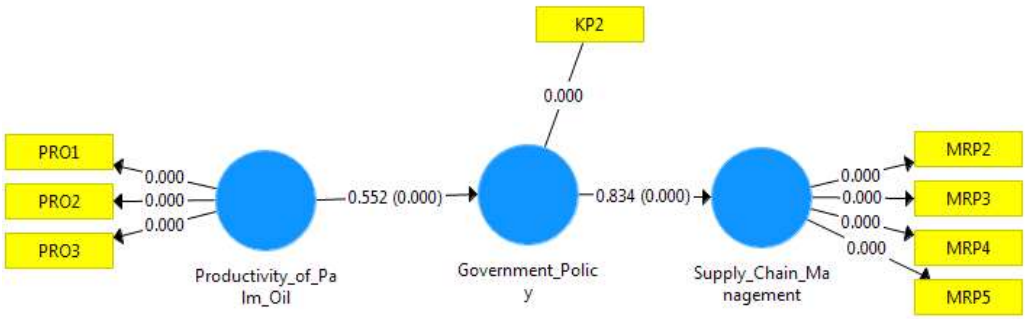


Figure 6. Inner path analysis model results with SEM-PLS

From Figure 6 above, it shows that the influence of the construct variables on each latent variable is with a significance value of 0.000< from the alpha level of 5%. This is supported by research where the influence of all construct variables on the latent variables is 0.000 [14], [18].

In assessing the model with PLS begins by looking at the R-square for each dependent latent variable. Table 5 is the result of R-square estimation using SmartPLS.

Table 5. R Square

	R Square	R Square Adjusted
Government Policy	0.305	0.166
Supply Chain Management	0.696	0.635

Source: Research results, 2023 (processed data)

Table 5 shows the R-square value for government policy is 0.305 while the Adjusted R-square value is 0.166. These results show that 30.5% of government policy variables are explained by palm oil productivity variables, the remaining 69.5% are explained by other variables not examined in this research. Likewise, the supply chain management variable is explained by

government policy, amounting to 69.6%, the remaining 30.4% is explained by other variables not examined in this research.

Table 6. Result for Inner Weight (Path Coefficients**)**

	Original Sample (O)	**P Values**
Productivity of Palm Oil >> Government Policy	0.552	0.000
Government Policy >> Supply Chain Management	0.834	0.000

Source: Research results, 2023 (processed data)

The results of hypothesis testing are that there is a significant positive influence of palm oil productivity on government policy (0.000) < (0.05) with an estimated size of 0.552, and the influence of government policy is significantly positive on supply chain management (0.000) < (0.05) with an estimated size of 0.834. This means that Hypothesis 1 is accepted, where there is a positive and significant influence of palm oil productivity on supply chain management through government policy.

3.3. Factors Affecting Palm Oil Productivity

Based on the results of data processing, the measuring variables for palm oil productivity are area, production and wages for workers in the plantation sub-sector. From the results of the outer model test, it was found that the exogenous latent variable met the criteria without making modifications to the model. This is in accordance with research by Permatasari and Suryani [7] that the productivity of oil palm land is influenced by various factors. The production and productivity of oil palm are influenced by the area of the oil palm plantation, the higher the demand, the higher the price because much more production is needed. The amount of FFB supply is most determined by farmer production and productivity. The greater the oil palm production, the greater the added value obtained by farmers in the FFB value system [1].

In research, Adwiyah et al. [19] stated that the implications of increasing palm oil productivity support the palm oil supply chain system because it is related to the quality of the palm oil obtained. High palm oil production can meet the need for palm oil and its distribution to the downstream level, supported by a good supply chain system. This provides significant benefits for companies, such as increased profitability, better company reputation in the eyes of customers, and increased customer satisfaction.

3.4. Factors Influencing Government Policy

Based on the results of data processing, the measuring variables of government policy are the distribution of BPDP-KS budget funds and the volume of palm oil exports. From the results of the outer model test, it was found that the exogenous latent variable had met the criteria by making modifications to the model.

As the complexity of esteem chains increments, the controls and activities administering palm oil gotten to be more complex, coming about in complex transnational administrations that combine state directions and private guidelines, such as certification, codes of conduct, and self-regulatory activities. The three primary objectives to progress the viability and authenticity of the transnational palm oil administration complex are: (i) to fortify responsibility and straightforwardness within the esteem chain and political frameworks; (ii) increment smallholder strengthening, and generation and natural execution; and (iii) introduce unused motivating forces to extend the take-up of maintainability hones, in ways that level the playing field for free smallholders. These three objectives ought to be sought after at the same time [9].

According to research by Salim et al. [20], increasing productivity and efficiency in the entire supply chain is expected to provide competitive support to be able to compete in the global market. Evaluation of government intervention in supply chain management requires a priority scale in the implementation of supply chain management policies. Policy intervention priorities need to be formulated clearly by considering the interests of stakeholders in supply chain management so that there is no confusion at the implementation stage.

3.5. Factors Influencing Government Policy

Based on the results of data processing, the measuring variables of supply chain management are stock, consumption, domestic and global CPO prices, and number of factories. From the results of the outer model test, it was found that the exogenous latent variable had met the criteria by making modifications to the model. The implication is that companies can increase their integration with business partners up to the global level in the supply chain and realize good cooperation between departments or divisions as well as cooperation with company partners. Supply Chain Management can be defined as various activities that are collected to be involved in various processes of previous changes to new changes in the distribution of goods from raw materials to finished products that are ready for use by consumers. In short, SCM is a process from upstream to downstream (start to end). The Supply chain Management system in the palm oil industry is: 1). How large is the palm oil land, what is the position or location of the palm oil location, and how many tons of palm oil harvest each year are the functions and responsibilities of the Supplier; 2). After the palm oil is taken from the supplier, the palm oil is processed into crude oil by the producer; 3). Then the crude oil is sent to domestic consumers who use crude oil as raw material to produce the products they want, such as making cooking oil products and margarine. Meanwhile, palm oil is exported abroad, namely to China, Malaysia, Singapura and the Netherlands [21].

Indonesia is the largest player in palm oil. Extraordinary stock can influence international price trends. So how much is Indonesia's stock, what is the volume of exports, and how much is domestic consumption greatly influencing the dynamics of world CPO. The country of Indonesia

has a dilemma because the abundance of palm oil stocks in Indonesia, if it is exported to the world market, will cause prices to plummet, but if palm oil remains held domestically, this cannot accommodate current CPO production which causes prices among farmers to continue to decline [21].

According to research by Salim et al. [20] that the supply chain is a coordination system between human resources, activities, information, organizational resources and other resources involved in the activity of moving products from consumers to producers. The crude palm oil supply chain model is built on four main functions. These functions are: 1) Harvest. The harvest function is part of the management system for harvesting fresh fruit bunches in oil palm plantations. The main decision that is the focus is the forecast of the number of fresh fruit bunches harvested per division, even down to the block level; 2) Production. The production function is planning the use of all required resources so that crude oil can be produced in accordance with demand forecasts; 3) Stock up. The inventory function is a company policy as an effort to anticipate demand fluctuations and maintain service levels to consumers; 4) Distribution. The distribution function is an important part of marketing activities because it is related to the delivery of products to all consumers according to the time and hours that have been determined [22].

The palm oil supply chain is a system with complex problems involving various components, elements and components within which are integrated with each other. One example of the weakness of the palm oil supply chain is farmer welfare, where the supply chain is long, causing palm oil prices to drop drastically among small farmers. This system is influenced by various factors, both internal factors such as various things related to the production and productivity of palm oil as well as external factors such as climate change. This study presents an analysis in a model that has some useful information regarding the factors that influence the quality of the palm oil supply chain [7].

4. Conclusion and Recommendation

The implications of the research results show that increasing palm oil productivity has a direct impact on government policy. This means that high productivity encourages the government to create policies that support the palm oil industry, such as subsidies, incentives or special regulations that support efficient supply chains.

Furthermore, government policies formed in response to high palm oil productivity have a significant positive impact on palm oil supply chain management. With the right policies in place, supply chain management in the palm oil sector will become more effective and efficient, for example through improving infrastructure, facilitating logistics, or setting quality standards. Thus, palm oil productivity, government policy, and supply chain management interact synergistically,

where productivity drives supportive policies, and these policies, in turn, improve supply chain efficiency.

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