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Analysis of Production and Consumption of Palm-Oil Based Biofuel using System Dynamics Model : Case of Indonesia

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ABSTRACT

Indonesia biodiesel blending mandate emerged in 2006 driven by strengthening energy security while in parallel reducing and toning down the need for fossil fuels, strengthen the country's balance of payments and increasing environmental demand to reduce CO_2 emission while leveraging the abundance of Crude Palm Oil as raw material. The purposes of this study were to analyze production and consumption of palm Oil-based biofuel. System dynamics model was developed based on 4 stages, Palm Oil Plantation, CPO Production, Palm Oil-based biofuel production and consumption and the validation of the model through Mean Absolute Percentage Error (MAPE) test confirms the correspondence between structures and phenomena. Baseline simulation analysis shows that there is no single strategy capable of improving the production and consumption of palm-based Palm Oil-based biofuel. We suggest that combined strategies such as government support hand in hand with industrial conversion efficiency, increase in palm oil on-farm productivity, 5% reduction in CPO export, Increase biodiesel production capacity and generally biodiesel utilization target cannot be achieved without the support from the government in form of subsidy which require additional IDR 409 a 15% increase in subsidy.

Keywords : Crude Palm Oil, Biodiesel, Mandatory Policy, System Dynamics

I. INTRODUCTION

The energy sector plays a fundamental role and it's a strategic sector in the achievement of social, economic and environmental goals for a sustainable development. Indonesia's energy consumption increased by 5.9% in 2016, having doubled over the last 20 years and energy intensity rose by 0.8% in 2016 while remain at 2.90 intensity for final energy consumption per capita in comparison with an average annual decline of 2.6%. Such relationships can be defined that changes in the growth of energy consumption because of changes in economic activities and rapid population growth. Indonesia, petroleum fuels reserves continue to decline 10% per year (Bambang,. 2006).If there is no oil field discovery and exploration of new oil reserves estimated to be only sufficient to meet consumption needs until the year 2053 (Kuncahyo *et al*, 2013). In 2013 the rate of reserve discovery compared to production or Reserve to Replacement Ratio (RRR) of about 55%. This RRR is relatively low compared to the ideal RRR target of 100. In the year 2003 Indonesia begun importing oil and changed its status from oil exporter into oil importer. The import of petroleum in 2013 amounted to 118 million barrels with dependency ratio of fossil fuel imports is above the average of 37% (DEN 2014).The U.S. Energy Information Administration's (EIA) short-term outlook (2015) shows a broadening gap for petroleum and other liquid supplies versus consumption in Indonesia, after more than a decade of being a net oil importer (Figure 1). An energy shortage is forecasted by 2022, as Indonesia's crude production continues to fall as its domestic demand is climbing.

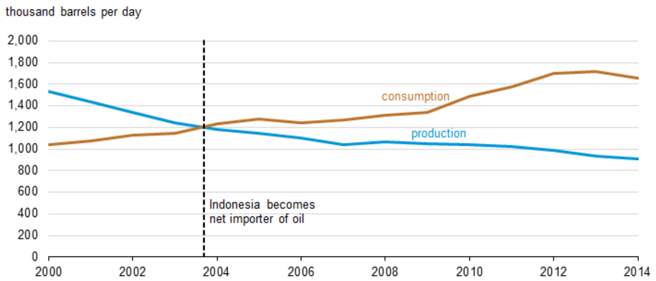


Figure 1 : Petroleum and other liquids supply and consumption in Indonesia

Increasing trend of imported fuel from overseas encourages various parties to explore renewable energy sources. The exploration of renewable energy sources aims to reduce the proportion of fuel oil, increase fuel supply by relying on locally renewable resources. It is strongly believed that the biofuels are favorable substitutes for fossil fuel (Wang *et al.,* 2011) and that the production and consumption have potential to provide a simultaneous pathway to rural development, employment opportunities, reduced emissions and less dependency on fossil fuels (Nasution *et al*., 2006, Wang *et al.,* 2011).Therefore, the need for diversification of energy in addition to fossil-based energy in the national energy supply to palm-based energy as opportunity to reduce petroleum import by utilize biofuel was initiated by regulation 1/2006, which enforced its distribution and implementation. The first biodiesel mandate was established through MEMR Regulation No 32/2008. The regulation is revised several times and the latest MEMR Regulation No 12/ 2015 enforces blending diesel with biodiesel by 20% (B20) in 2016 and 30% (B30) B30 mandate will be started in 2020. Based on predictions made, the biodiesel production target is the amount of biodiesel needed to meet the mandatory biodiesel target far higher than Indonesia's level of biodiesel production, in 2018 reached 3.9 million kl or only reached 46% of the target. The need for biodiesel in the country will increase in the future this is caused by the encouragement of government policies that require the use of biodiesel for both economic and environmental reasons.

There are several studies that were conducted specifically on, Factor Influencing Crude Palm Oil (CPO) Biodiesel Supply using Error Correction Model (Larasati S.2015). However there is insufficient information available on forecasting production and consumption of palm based biofuel in Indonesia are eventually confirming the main logical reasoning for further research. This research was conducted to forecast the production and consumption of palm-based biofuel and design palm Oil-based biofuel alternative policy recommendation.

II. LITERATURE REVIEWS

2.1 Palm oil-based biodiesel

Liquid biofuels (biodiesel, bioethanol) are generally classified as conventional or first-generation biofuels if derived from food crops such as rapeseed, soybean, sugarcane or oil palm. Advanced or second-generation biofuels can be produced from a variety of biomass sources such as wood, residues and waste, using more sophisticated technologies (Mukherjee *et al.,* 2014). There are also biofuels derived from algae, so-called third generation biofuels. The second and third-generation biofuels have the advantage of not directly competing with food crops (Lee et al., 2013).

Biodiesel is produced from oilseed crops including palm fruits, soybeans and rapeseeds. Oil yields per cultivated area are larger for oil palm than other oil sources (Balat, 2011). Nevertheless, although palm oil was the most produced vegetable oil in 2013, soybean oil was the most used for biodiesel production in the world (31%). Rapeseed oil was used for 24% of the biodiesel production, and palm oil for only 18% of the biodiesel production (Souza *et al.,* 2017). The European Union accounts for more than half of the global biodiesel production in the world, which is based on rapeseed oil. Soybeans are mostly used in the United States and Brazil. In Indonesia, 100% feedstock for biodiesel comes from palm oil (Lee *et al.,* 2013). International prices of the CPO have generally been lower compared to other feedstocks for biodiesel (e.g. rapeseed oil, soybean oil), but this does not seem to be enough to achieve a competitive palm-oil-based biodiesel production.

Biodiesel has several other advantages including low carbon dioxide is emitted (Rakopoulos, 2008) and a high cetane number (Crookers, 2006). Cetane number indicates the size of the delay time of combustion of fuel (fuel ignition), where the figure higher cetane number indicates a shorter time between the entry of fuel and combustion.

Biodiesel produces less carbon monoxide at 100% combustion and emissions of sulfur dioxide and hydrocarbons burn completely so as biodiesel capable of reducing air pollution (Gandhi *et al* 2013). For pure biodiesel (B100) its CO_2 emissions could be reduced by up to 73%, the methane emissions reduced by 51%, unburned hydrocarbons reduced by 67%, emissions of carbon monoxide down 48% and sulfur oxides can be reduced up to 100% and the reduction of waste and potential pollution other environments. Various study has estimated using 1 Kg of Biodiesel Reduce amount of 3KG of CO_2. Hence the use of biodiesel result into significant CO_2 emission reduction (65%-90% less than conversional diesel)

Biodiesel Quality Standards, The use of biodiesel as a commercially diesel fuel engine requires an analysis and evaluation to meet international biodiesel fuel quality standards (Sarin 2012). Biodiesel quality evaluation was conducted to measure the chemical composition and physical characteristics of biodiesel. Currently, biodiesel testing standards in some countries are generally based on European EN 14214 and American Society for Testing and Materials (ASTM) D-6751 (Sarin 2012). The standard of biodiesel quality in Indonesia is stipulated by National Standardization Agency (BSN) through SNI 04-7182-2006. The standard of biodiesel quality testing in Indonesia is conducted on the basis of ASTM and AOCS standards (National Standardization Body 2006).

III. METHODS AND MATERIAL

3.1 Types and Data Sources

This study uses secondary data in the form of time series data in the period 2006-2018. The data was obtained from the Ministry of Agriculture, the Ministry of Energy and Mineral Resources, the Central office of Statistics and data from other sources that support this research.

3.2 Research Approach

System dynamics model of Production and consumption of palm-based biofuel in Indonesia is carried out according to the stages in the dynamics model approach. The issue of production and consumption to meet domestic mandatory requirement is a fairly complex problem, many variables are related in it. Setting objectives and limiting relevant problems are needed in building models to clarify the scope of the problem. In addition, a needs analysis was carried out to determine the needs of the system actors. The needs of each system actor are different but interact with each other and influence the entire system (Purnomo 2012).

After the objectives, problem boundaries and needs analysis are established, the related variables are identified, analyzed and formed models in the form of causal loop diagrams. After a model is formed, the design and development of an arrow box diagram is done using Vensim PLE software. Formulations are made according to historical data and information / past so that it describes the problems in the model. Verification is done by checking the model on the mathematical equations that have been made with running simulations, it can be seen that the programs and models conceptualized in the flow diagram have been going well.

Simulation was done according to the specified time horizon, namely at the start time is 2018 and the stop time is 2028. To see the behavior of the model, several scenarios are tested in model simulations. Several scenarios were able to demonstrate the ability to meet domestic production target. Model validation is done by comparing model behavior to real systems by testing the Mean Absolute Percentage Error (MAPE) calculated by the formula (Makridakis et al. 1995): This test can be used to determine the suitability of the simulation data with the actual data. The criteria for the accuracy of the model with the MAPE test (Lomauro and Bakshi 1985 in Somantri *et al.* 2005) are MAPE <5%: very precise 5% <MAPE <10%: Acurate MAPE> 10%: incorrect.

3.3 System Description

Based on literature studies, some system actors who play a role in palm-based biofuel production and consumption can be identified. Table 1, Presents the needs of each system actor. The actors of the system and their needs have been adjusted to the limits of the study. The input output diagram of this system can be seen in table 1.

Table 1. Identified system actors and their needs

No	System Actors	Need
1	Government	Palm-based biofuel meet the mandatory target by 2025 Providing policy incentives and disincentives
2	Biodiesel Producers	The amount of palm-based biofuel production continues to increase
3	CPO and palm oil industry	The amount of CPO allocated for palm-based biofuel production continue to increase (feedstock supplier)
4	Diesel and biodiesel mixing industry	Manufacturer of diesel and biodiesel mixed fuels
5	Industrial users	Domestic users using mixed fuels

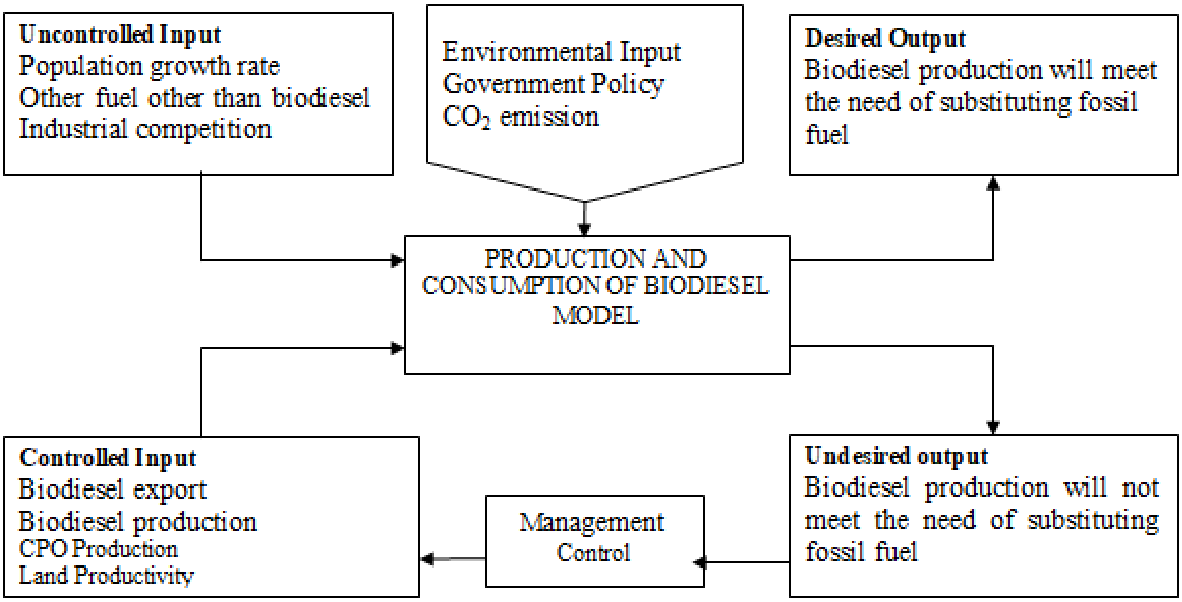


Figure 2. Input- output diagrams of system dynamics of palm Oil-based biofuel Production and consumption.

3.4 System Conceptualization

The problem of the production and consumption of palm based biofuel to meet biodiesel mandate target of Indonesia is a complex system problems involving various components of variables that interact and integrated. The production and consumption of palm-based biofuel is viewed as a system dynamics problem that changes over time and is influenced by factors that are also dynamic.

Causal Loops are used to indicate the dynamic processes present within a system. Causal loops show the chain effects of variables that are related through various links. The causal effect of a variable can thus be traced through an entire causal loop to investigate the adverse effects and eventual influences of all the variables that are linked together to form a causal loop. There are two types of causal loops; Balancing (Negative) and Reinforcing (Positive) (Maani, K. & Cavana, R. Y. 2007).

Palm-based biofuel production is influenced by CPO production; CPO production is affected by land productivity. If CPO production are higher, biodiesel production will increase. Palm Oil-based biofuel will take place with higher production capacity and feedstock availability, Feedstock availability for biodiesel production is influenced by CPO production, CPO export quantity and CPO allocated for food and domestic use. Higher CPO production results in higher availability of CPO for energy,export and food. Availability of biodiesel feedstock will get lower if the export level of CPO increases. On the other hand, the greater the amount of biodesel exports will decrease the supply of biodiesel domestically. Biodiesel consumption is influenced by biodiesel price and domestic mandatoy policy. Biodiesel consumption is also influenced by the population and decrease in fossil fuel import. If the population increases then the demand for biodiesel will increase so that biodiesel consumption will increase as well.

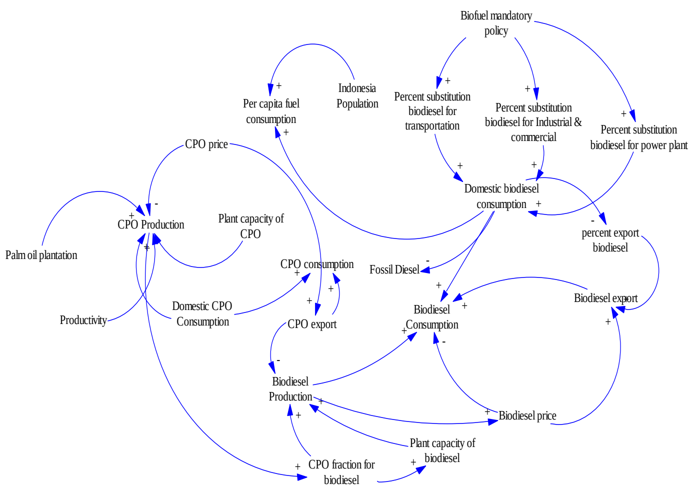


Figure 3. Causal loop for biodiesel production and consumption

The dynamically developed system model is limited to matters related to the production (supply) of biodiesel and the consumption (demand) of biodiesel for mandatory target.

Indonesian biodiesel production and consumption model

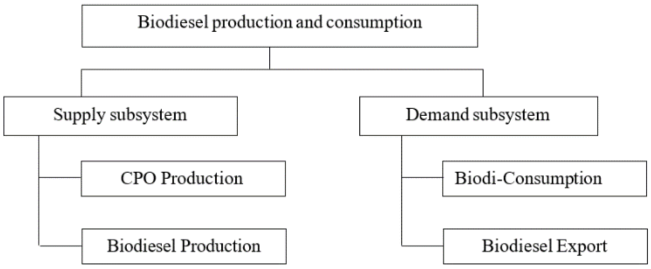


Figure 4. Hierarchy of Indonesian palm Oil-based biofuel production and consumption model

Model Formulation

The basic equation of a dynamic system is

$$\frac{df}{dt} = f(x, y, \alpha)$$

Where: $x, y,$ is the stock vector, α is the parameter, and f is the non-linear vector function.

CPO Production Sub-Model

The CPO Production in Indonesia is produced from several types of oil palm plantations including the People's Plantation (PR), the State Large Plantation (PBN) and the Large Private Plantation (PBS). Each type of plantation has a different land area, productivity and land growth rate. Imports of CPO which also affect the availability of CPO do not enter into modeling because the import value is relatively small.

The growth rate of PR land, PBN land and PBS land are 5.32% respectively; 0.69% and 5.89% per year. PR, PBN and PBS productivity were 4.1 tons / ha respectively; 3.6 tons / ha and 3.5 tons / ha (BPS 2017). Value 4,756,272; 752,585 and 6,798,820 are the initial land area of 2018 for each plantation in units of hectares (ha).

$$CPO\ Production = Total\ smallholder\ farmer\ production + total\ government\ production + total\ private\ production$$

$$Total\ smallholder\ Production = Total\ smallholder\ area\ X\ Productivity$$

$$Total\ government\ \ Production = Total\ government\ area\ X\ Productivity$$

$$Total\ Private\ Production = Total\ Private\ area\ X\ Productivity$$

$$Smallholder\ area = 4{,}756{,}272 + (smallholder\ area\ \ growth)X\ dt$$

$$Government\ area = 752{,}585 + (Government\ area\ \ growth)X\ dt$$

$$Priavte\ area = 6{,}798{,}820 + (Private\ area\ growth)X\ dt$$

$$IF(CPO\ Production < CPO\ production\ capacity)THEN\ (CPO\ production)ELSE($$

$$CPO\ Production\ capacity = CPO\ \ production\ capacity\ \ (t - dt) + (CPO\ production\ capacity\ growth)x\ dt$$

Biodiesel Production Sub-Mode

The biodiesel production sub-model is prepared to produce potential biodiesel which can be used as a diesel mixture. Input of the biodiesel production sub-model is the amount of CPO Produced from Palm oil plantation. The CPO material that can be used to produce biodiesel is obtained through equations

$$Biodiesel = (CPO\ for\ Biodiesel\ X\ Biodiesel\ Conversion)$$

Where: Biodiesel is the amount of biodiesel production based CPO allocated for biodiesel (ton); biodiesel conversion is the conversion of biodiesel from tons to KL. The yield of biodiesel from CPO.

biodiesel production is calculated by equation

$$Biodiesel\ production = CPO\ for\ Biodiesel\ X\ Biodiesel\ conversion$$

$$IF(bio - Production < biod - capacity) THEN\ (biodiesel\ production)$$

$$ELSE(biodiesel\ capacity)$$

$$Biodiesel\ Production\ capacity = Biodiesel\ production\ capacity\ (t - dt) + (biodiesel\ capacity\ growth) x\ dt$$

Biodiesel consumption sub-model

Indonesia biodiesel consumption is driven by the biodiesel mandatory program according to Ministry of Energy and Mineral Resources regulatory No. 12 of 2015. Biodisel consumption is a total palm Oil-based biofuel that has been utilized by various sectors, both in the industrial and commercial, power plant and transportation. Biodiesel consumption is affected by biodiesel price. The consumption of biodiesel per capita is influenced by the population. Indonesia's population continues to increase following its growth rate. Indonesia's growth rate per year in 1990-2000 and 2000-2010 was 1.49% (BPS, 2012). So it is assumed that in the future Indonesia's growth rate is the same, namely 1.49%. Value 252 124 458 is the number of population in early 2018 which was obtained from the population projection data from BPS (2012) with units of people / people (ppl).

Mathematical Equation for biodiesel consumption

$$Biodiesel\ consumption = (Transport + Powe\ plant + commercial\ )$$

$$Transport\ consumption = Transport\ consumption\ (t - dt) + (Transport\ growth) X\ dt$$

$$Power\ plant\ consumption = Electricity\ consumption\ (t - dt) + (Power\ plant\ growth) Xdt$$

$$Industrial\ and\ commercial\ cons = Industrial\ consumption\ (t - dt) + (Industrial\ growth) X\ dt$$

$$Population = Round\ (Indonesia\ population)$$

$$Total\ Indonesia\ Population = Total\ Indonesia\ population\ (t - dt) + (population\ growth) X\ dt$$

Biodiesel Export Sub-Model

Most of Indonesia's biodiesel production is used as an export commodity without a further downstream process. The amount of biodiesel exports is influenced by the growth rate of -22% per year with the initial value in 2018 being 1,000,000 KL. The biodiesel export subsystem is formulated with the following mathematical equations

$$Biodiesel\ export = biodiesel\ export\ (t - dt) + (export\ growth) X\ dt$$

Subsidy sub-model

Subsidies for biodiesel have been provided since the programme was launched, initially in the form of a fixed subsidy until 2015, and later in the form of variable subsidy, to compete with fossil diesel price. The latter scheme channels the export tax on Crude Palm Oil (CPO) products to finance the price discrepancy between biodiesel and diesel for Indonesian consumers. Energy support policy in PP No. 79 of 2014 article 26 stipulates that energy prices include biofuels. determined based on fair economic value in accordance with the mandate of Law No. 30

of 2007 concerning energy. Based on the Presidential Regulation (Perpres) No. 45 of 2009, Minister of Energy and Mineral Resources Decree No. 6034 K / 12 / MEM / 2016 concerning the Price of the Biofuel Market Index Mixed in Oil Fuel and the Minister of ESDM Decree No 350 K / 12 / DJE / 2018 concerning the Price of Biodiesel Type Market for Vegetable Fuels Mixed into Oil Fuels. Therefore, the Selling Price formula of regulated by the GOI will used for analyzing the subsidy as a support from the government. The current GOI biodiesel subsidy from government budget is limited to RP 2000/L and CPO supporting Fund as Incentive RP 568.19/L

$$\begin{aligned} Pricing\ Policy: HIP &= Average\ CPO\ reference\ Price \\ &+ 100 USD/100)\ X\ 870\ kg/M3 \\ &+ delivery\ cost \end{aligned}$$

Subsidy =HIP – MOPS

HIP= Biodiesel Market Price Index

MOPS= Price of MOPS (Gasoline)

IV. RESULTS AND DISCUSSION

System dynamics model was performed to compare the amount of palm Oil-based biofuel production and consumption. Comparison of the alternatives was done with and without changing the existing conditions.

1. Baseline Scenario

This case references are the programs when there is no change in government policy concerning the development of biodiesel. It will mainly based on the ministry of Energy and Mineral Resources regulation MEMR Regulation no. 12/2015.The growth rate of CPO for biodiesel is 12.7%, biodiesel consumption growth rate is 29.7% per year and different CPO to biodiesel conversion was used (1.176 according to SNI 7182: 2012 – Biodiesel), 1.123 according to (SBRC, 2009), 1.042 according to (Papong S, Chom-In T, Noksa-nga S, *et al* 2010, Queiroz AG *et al* 2012)

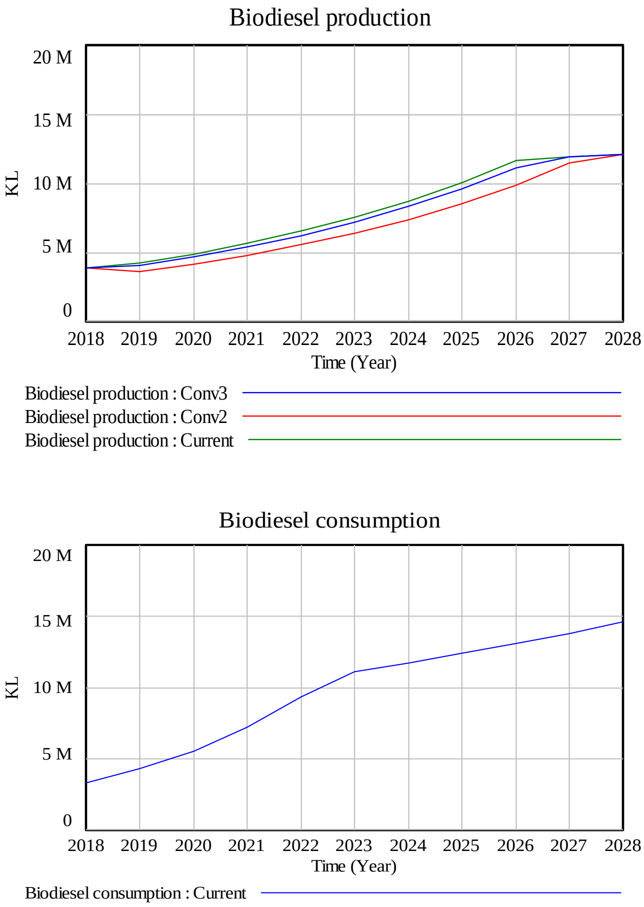


Figure 5. Production and consumption of biodiesel baseline scenario

The simulation result of the baseline conditions showed biodiesel Production is below biodiesel production target until the end of the analysis period, namely in 2028 this because availability of biodiesel feedstock is limited. The predicted biodiesel production capacity will increase and will be higher than biodiesel production until 2026. Then, between 2027 and 2028 they will be equal. Therefore, production capacity will limit biodiesel production.With this level of biodiesel production will lead to an unsatisfied demand of biodiesel in Indonesia. The increase in the availability of biodiesel raw materials in this study will be achieved through increase onfarm productivity and an increase in biodiesel plant capacity in such a rate that the potential availability of biodiesel feedstock could be processed. Its also shown that the increase in industrial conversion efficiency means that less palm oil is required to produce the same quantity of biodiesel.

1. **First scenario : The increase land productivity and biodiesel production capacity**

The baseline scenario in fugure 5. considers the present average yield of 3.7 tonne/ha, implying no improvements.This is in line with past trends (2006–2018). The second case Figure 5. implies medium improvements or better yields (that is, from 3.7-4.5 tonne/ha) by 2025.The last case implies reaching high yields up to 6.0 tonne/ha in 2025, in line with government support through palm oil financing scheme the most well-known are the establishment of the CPO fund and KUR-loans for replanting and the potential yield indicated in various studies (Corley RHV and Tinker PB 2016, Afriyanti *et al* 2016) also Increase in biodiesel plant capacity in such a rate that the potential availability of biodiesel feedstock from 2019 to 2028 could be processed.

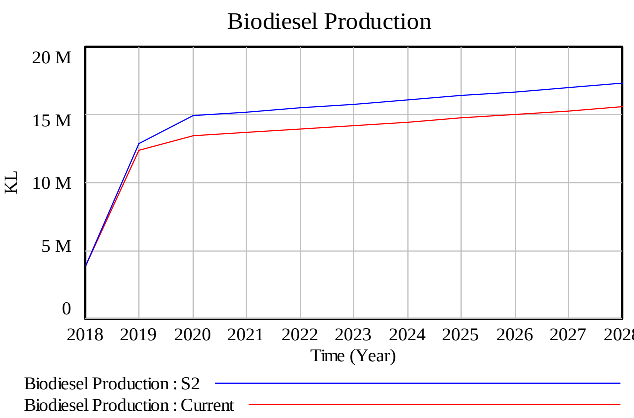


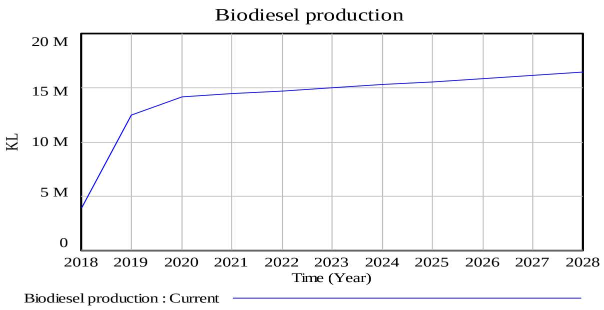
Figure 6. Simulation results of biodiesel production with productivity increase

The simulation results show If yields remain at 3.7tonne per ha, a total of 17 .1Mha will be needed by 2025. This implies 4.8 Mha in addition to the 12.3 Mha occupied by palm oil plantations by 2018. Achieving medium yield improvements (3.7 to 4.5 tonne per ha) will reduce land needs to 14.6 Mha. However, if the potential yield of 6 tonne per ha is achieved, only 10.5 Mha will be required until 2025. To achieve biodiesel production target using medium improvement CPO export has to be reduced by 5% and with no room for biodiesel export. Increasing onfarm productivity levels can support the government's policy to increase oil palm production and will have no problem realizing palm oil based biofuel production targets without opening new land for oil palm plantations.

2. **Scenario of achievement of production and consumption of palm Oil-based biofuel with Subsidies**

Subsidy levels play important roles in encouraging the adoption of biodiesel as a replacement for fossil diesel, especially as biodiesel is less attractive economically when compared to fossil diesel. Subsidy is given in accordance with Minister of Energy and Mineral Resources Regulation No. 26 of 2015, the biodiesel business entity has the right obtain biodiesel financing from CPO supporting Fund (CSF). The fund is export tax on Crude Palm Oil (CPO) products in accordance with Presidential Regulation No. 61 of 2015, Minister of Energy and Mineral Resources Decree No. 6034 K / 12 / MEM / 2016 concerning the Price of the Biofuel Market Index Mixed in Oil Fuel and the Minister of ESDM Decree No 350 K / 12 / DJE / 2018 concerning the Price of Biodiesel. In this scenario the assumptions used are built-in stock and flow models, namely the amount of Indonesia's biodiesel production is the same as the number of requests based on mandatory utilization requirement because Pertamina is a single consumer.

With this scenario, the simulation results of palm-based biodiesel Production and consumption can be seen in Figure 7. The simulation results show that from 2019 to 2028, the palm-based biodiesel production and consumption has always increased. Based on the analysis conducted, with the subsidies given by the government, it causes prices biodiesel to lower and domestic consumers are in this case only Pertamina is more interested in buying it. A lower price will make Pertamina's demand increasing and the use of biodiesel as a mixture of diesel fuel will also increase. Thus, this subsidy is expected able to improve both production and consumption biodiesel considering that the increase in the biodiesel-diesel blend ratio was predicted to be 20% in 2016-2020 and 30% in 2025. Biodiesel production with a subsidy policy has increased from current limited subsidy of RP 2568 to RP 2977. The average amount of biodiesel subsidies per year Rp. 409/ liter 15% increase in subsidy.



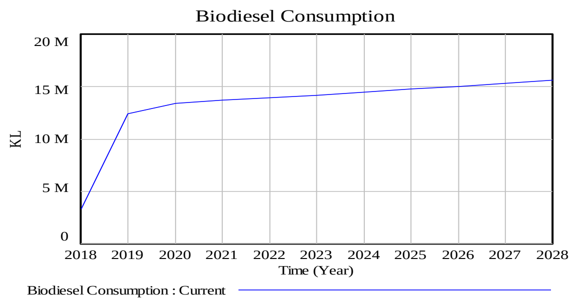


Figure 7. Production and consumption on third scenario

MAPE Validation

Validation conducted on system dynamics model consisted of structure and behavior validity tests of the model to the real system (quantitative behavior pattern comparison).MAPE value CPO for biodiesel production obtained from model simulation results, which was compared with actual data of CPO for biodiesel production in 2016-2018 was at 3.9%. MAPE value of biodiesel consumption obtained from model simulation results, which was compared with the actual data in 2016-2018, was 4.6 %. Based on MAPE values of two key variables, it could be concluded that the constructed dynamic model had high accuracy.

Table 2. Validation for biodiesel consumption

Year	Biodiesel consumption (KL)		Error
	Simulation data	Actual data	
2016	3 160 280	3 008 000	5.1%
2017	3 239 290	2 900 000	8%
2018	3 342 270	3 300 000	0.6%
MAPE			4.6%

Table 3 Validation of CPO for biodiesel production

Year	CPO for Biodiesel (tons)		Error
	Simulation data	Actual data	
2016	3 463 890	3 363 000	3%
2017	3 567 810	3 243 000	1%
2018	3 674 840	3 588 000	2.4%
MAPE			3.9%

V. CONCLUSION

The system dynamics model of palm-based biofuel production and consumption has been developed in this study and been able to describe the condition of the production and consumption of palm Oil-based biofuel in Indonesia. Simulation result of the existing conditions showed that biodiesel production was below its mandatory requirement with greater failure difference over the period of time hence cannot fulfill the biodiesel production target of 14.76 million kiloliter by 2025. Thus various efforts need to be carried out by the Indonesian government in order to meet domestic palm-based biodiesel production and consumption which is the mandatory target. In terms of production, efforts need to be made to increase CPO supply for biodiesel. Efforts to increase investment in the biodiesel sector are urgently needed, especially in terms of production, processing and distribution of palm Oil-based biofuel. Efforts to reduce Import of fossil diesel need to be done to increase domestic biodiesel production and consumption.In terms of demand, the need for palm-based biofuel has always increased marked by an increase in palm oil-based biofuel consumption each year. Therefore, efforts need to be made to improve the efficiency of biodiesel use, limiting the use of fossil diesel and additional subsidy of IDR 409 to palm Oil-based biofuel producers. which empirically applied in several other countries including Malaysia, Brazil, European Union, the United States, Malaysia and The Philippines. In line with the increasing commitment of the government to encourage Utilization of palm Oil-based biofuels is one alternative that can be done in anticipation of the decreasing availability of fossil fuel as an alternative energy source.

VI. ACKNOWLEDGMENT

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