Palm oil-based biofuels and sustainability In Indonesia: assess social, environmental and economic aspects

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Abstract. Palm oil as an agricultural commodity plays an important role in the development of the Indonesian economy, considering it in producing vegetable oil. Policies for developing new and renewable energy in Indonesia aims to encourage the optimization of the use of biofuels from oil palm. This policy still raises pros and cons, so that analysis needs to be carried out through an environmental science perspective. This study aims to assess the sustainability of palm oil (CPO) as a basic material for making biodiesel from environmental, social, and economic aspects, as well as to provide recommendations on a sustainable palm oil biodiesel policy strategy. The method used is a qualitative analysis. Descriptive analysis of supporting literature is used to assess environmental, social, and economic aspects of palm oil-based biodiesel sustainability in Indonesia. The use of biodiesel in the country is expected to be sustainable in line with the stipulation of the mandatory biodiesel of 30 percent (B30) in 2019 by the Government as a substitute for fuel mixture. It was found that there are advantages to using palm oil-based biodiesel compared to other vegetable oils. Palm oil-based biodiesel can be produced in a sustainable manner.

1. Introduction

The human need for energy will continue to increase with the increasing world population. The world's most frequently used fuel energy comes from fossil fuels. Global conditions indicate a tendency for world oil consumption to continue to increase by around 70% in 2030 [15][22][34]. Unfortunately, the existence of an energy that comes from fossil-based fuels continues to run low. One of the solutions that have emerged to overcome the deficit problem of petroleum fuels is the use of renewable alternative energy sources that are sourced from vegetable oil or biofuels (BBN) [13]. The development of renewable alternative energy is a strategic step in realizing the Government of Indonesia's plan to transition energy sources, from fossil energy, which tends to be not environmentally friendly to the energy that is more environmentally friendly and sustainable. In addition, biofuel has the potential to become a solution to fulfill commitments to reduce global emissions amid the threat of climate change.

Policy development for the use of Biofuels (BBN) in Indonesia began in 2006 [6][7]. This was motivated by soaring oil prices due to the depletion of world oil supplies. On the other hand, Indonesia has abundant reserves of palm oil, which is the raw material for biofuel for biodiesel. The development of the palm oil industry is currently proving to have a positive impact. In addition to being a foundation or a mix for new fuel sources, the palm oil industry can also generate foreign exchange through exports and create new jobs [13][18][28]. But on the other hand, the oil palm plantation industry has many problems from upstream to downstream, especially in environmental and social aspects. The massive
growth of oil palm plantations and not accompanied by good planning has become a threat to the sustainability of natural forest ecosystems in Indonesia, as is the case deforestation, degradation, drainage of peatlands, burning of forests and land that causes haze, increased emissions of greenhouse gases, removal of biodiversity, and threatens areas of conservation areas that should be protected [2][11][12][16][23][31]. Based on data from The National Human Right Commission, social problems that usually occur due to the existence of oil palm are human rights violations in the form of land conflicts between customary law communities and plantations [29].

Sustainable development requires a balance between three basic aspects, namely social, economic, and environmental. The rotation of the economic wheel must be based on social welfare so as to improve community welfare (poverty alleviation). At the same time, it must also pay attention to the carrying capacity and carrying capacity of the environment so that it can meet the needs of present and future generations (inter and intragenerational equity). The purpose of this paper is to assess the sustainability of palm oil (CPO) as a basic material for making biodiesel from environmental, social, and economic aspects, as well as to provide recommendations on a sustainable palm oil biodiesel policy strategy.

2. Method
This article focuses on the sustainability of palm oil as a feedstock for biodiesel in Indonesia. To better understand the environmental elements that have an impact on the sustainability of palm oil. This article uses a descriptive study method and emphasizes a qualitative analysis approach as a research methodology through reference to relevant theories and information-based policies regarding palm oil and biodiesel. The data was collected by using the literature study with triangulation technique. Secondary data used were obtained or collected from scientific literature, mass media, government agencies, statistical agencies and other related documents on sustainable palm-based biodiesel. Data collection was carried out by snowball sampling by taking a number of cases through the relationship between one case and another which gave rise to an important theoretical picture of sustainable palm-based biodiesel, until the data obtained was biased and could be the basis for drawing conclusions. After that, related documents (journals, articles, reports, and reviews) are identified, reviewed, analyzed, and synthesized with data triangulation techniques as a basis for providing research recommendations, in addition to the problems or constraints faced.

3. Results and discussion
3.1. The concept of palm oil biodiesel
Bioenergy in the form of biofuels (BBN) is a form of green energy consisting of biodiesel, bioethanol, and bio-oil (pure plant oil / PPO) [4]. Biodiesel is an ester form of vegetable oil that is mixed with diesel oil in a certain ratio (after going through the transesterification process by adding methanol), such as B30 which is a mixture of 30 percent biodiesel with 70 percent commercial diesel oil. The advantages of biodiesel compared to diesel is that it is an environmentally friendly fuel because it produces much better emissions (free sulfur, lower smoke) according to global issues, higher cetane (> 57) so that combustion efficiency is better than diesel oil. It has lubricating properties for engine pistons, is biodegradable, is a renewable energy because it is made from renewable natural materials, and increases the independence of fuel supply because it can be produced locally.

As the largest palm oil-producing country in the world, accounting for half of global production [10], So in addition to food needs, the potential for palm oil as the main raw material source for Indonesia biodiesel is also very large [5][32]. Apart from palm oil's raw material, Indonesian biodiesel is also sourced from jatropha and coconut plants. However, biodiesel made from crude palm oil (CPO) is currently considered more competitive than other sources and also has a large supply of raw materials. In addition, when compared to oil derived from other crops, the biodiesel that can be produced through palm oil will be much more efficient in its production, and regional economic activities in palm oil-producing areas will be better off.
3.2. Palm oil biodiesel regulation in Indonesia

The development of biodiesel from palm oil in the article is analyzed through the development of regulations that support biodiesel in Indonesia. The Indonesian government established a national energy management blueprint for 2005-2025, which states that alternative energy is included in one of the main programs to develop alternative energy and intensify the search for renewable energy sources. Policy developments in support of bioenergy, including palm oil-based biodiesel (biofuel) in Indonesia can be seen in Table 1.

Table 1. Development of regulations supporting biodiesel in Indonesia, 2006-2019.

| Year   | Regulations                              | Discussion of regulations                                                                 |
|--------|------------------------------------------|------------------------------------------------------------------------------------------|
| 2006   | Presidential Decree No. 5/2006           | Biodiesel program initiation                                                             |
|        | Presidential Instruction No. 1/2006       | Division of main tasks and government functions of the biodiesel program                 |
|        | Presidential Decree No. 10/2006          | Formation of a team to accelerate the application of biodiesel for poverty alleviation   |
|        | MEMR No. 51/2006                        | Biofuel Business Material Licensing                                                     |
| 2008   | MEMR No. 32/2008                        | Setting the target for the transportation sector mix:                                   |
|        |                                          | • 1% in 2008                                                                            |
|        |                                          | • 2.5% in 2010                                                                          |
|        |                                          | • 5% in 2015                                                                            |
|        |                                          | • 20% by 2020                                                                           |
|        |                                          | • 30% by 2025                                                                           |
| 2009   | Presidential Regulation No. 45 of 2009   | The use of APBN for biodiesel subsidies                                                 |
| 2013   | MEMR No. 25 of 2013                      | Changes in the target transportation sector mix:                                        |
|        |                                          | • 10% in 2013                                                                           |
|        |                                          | • 20% in 2016                                                                           |
|        |                                          | • 25% by 2025                                                                           |
| 2014   | MEMR No. 20/2014                        | Changes in the target transportation sector mix:                                        |
|        |                                          | • 10% in 2014                                                                           |
|        |                                          | • 20% in 2016                                                                           |
|        |                                          | • 30% by 2020                                                                           |
| 2015   | MEMR No. 12 of 2015                      | Changes in the target transportation sector mix:                                        |
|        |                                          | • 15% in 2015                                                                           |
|        |                                          | • 20% in 2016                                                                           |
|        |                                          | • 30% by 2020                                                                           |
|        | Government Regulation No. 24/2015 and    | Establishment of BPDPKS (Palm Oil Fund Management Agency)                                |
|        | Presidential Regulation No. 16/2015      |                                                                                         |
| 2018   | EU RED II                               | Re-evaluation of biofuel as renewable energy                                            |
|        | Presidential Regulation No. 66/2018      | Expanding incentives to the non-PSO (Public Service Obligation) sector                  |
|        | Presidential Instruction No. 8/2018      | A moratorium on oil palm land and increasing oil palm productivity in Indonesia           |
|        | MEMR Regulation No. 45/2018              | Provision and utilization of biodiesel biofuels within the framework of the BPDPKS       |
| 2019   | MEMR Decree No. 227/2019                 | The trial implementation of mixing 30% biodiesel (B30) biofuel into diesel oil for the    |
|        |                                          | period 2019                                                                             |

The energy diversification (mix) policy including the development of new and renewable energy (EBT) in Indonesia has generally been initiated since the 1980s. Efforts to develop the energy mix as a form of
government concern for the importance of energy began with the issuance of Presidential Decree (Keppres) No. 46 of 1980 concerning the National Energy Coordination Agency (BAKOREN). The Presidential Decree still focuses on saving fuel oil (BBM) and replacing it with coal. The government's attention regarding EBT continues to grow with the issuance of Presidential Regulation (Perpres) No. 5/2006 on the National Energy Policy (KEN). Based on the importance of establishing an energy management agency, including for its diversity and availability, the Presidential Regulation (Perpres) No. 26 of 2008 concerning the Establishment of the National Energy Council (DEN), which is a national, independent and permanent institution that is responsible for national energy policies. In 2014, a clearer policy regarding the development of a new and renewable energy mix with the existence of Government Regulation (PP) No. 79 of 2014 concerning National Energy Policy and Regulation of the Minister of Energy and Mineral Resources.

Attention to bioenergy development continues with the existence of bioenergy development policies in Indonesia, which are generally contained in the Minister of Energy and Mineral Resources Regulation No. 12 of 2015 and Government Regulation No. 24/2015 and Presidential Regulation No. 16/2015. This regulation is used in determining the national energy general plan (RUEN) policy and the regional energy general plan (RUED). In 2018, the European Union's Renewable Energy Directive II (EU RED II) conducted a re-evaluation of biofuel as renewable energy. EU RED II as a CPO supplier as a basic material for making biodiesel does not meet EU market requirements due to Indirect Land Use Change (ILUC) and deforestation. To answer this, the Indonesian president issued presidential instruction No. 8 of 2018 regarding a review of oil palm plantation permits and increasing land productivity as an effort to moratorium on oil palm land. In addition, limiting export production to the European Union has made the Indonesian government take the initiative to take advantage of its palm oil production in the domestic market by developing B30 by the end of 2019, in general set out in the Minister of Energy and Mineral Resources Decree No. 227/2019 concerning the trial of mixing 30% biodiesel (B30) biofuel into diesel fuel for the 2019 period.

3.3. Problem analysis

Renewable energy has many advantages in terms of environmentally, socially, and economically sustainable development. Biodiesel has become the prima donna of bioenergy in Indonesia in recent years. The main raw material source for biodiesel used today is palm oil, which reaches 90 percent [8]. This is because palm oil-based biodiesel has a large supply of raw materials and is also considered more competitive and efficient for commercial-scale than other sources. Initially, the use of palm oil as the main raw material for biodiesel was based on the drastic drop in CPO prices. According to research by Nuva et al. (2019), low CPO prices ranged from ± IDR 1,000 / kg in independent plantations and ± IDR 1,400 / kg in plasma to ± IDR 300 / kg and IDR 600 / kg at the end of 2008 as well as an increase in world crude oil prices which are reached $ 100 per barrel [21]. However, various obstacles also accompany the development of palm oil-based biodiesel in Indonesia and in various other biofuel producing countries such as Thailand, the Philippines, and Malaysia. The issue raised in biofuel development is inseparable from the potential trade-offs, where on the one hand biodiesel as bioenergy is an opportunity for the government and the Indonesian people to reduce dependence on imported fossil fuels, as well as stimulate economic growth through new jobs opportunities, increase home income, and has positive implications for regional development. However, on the other hand, the production of biomass for bioenergy, such as biofuel (biodiesel) is also considered a threat to social justice and environmental sustainability where oil palm plantations as the main raw material for biodiesel are considered to have the potential to damage the ecology if not managed properly. Another problem faced in the development of palm oil-based biodiesel at this time is the gap between the target and the actual use of biodiesel, even though the government has mandated the use of B30 in 2025. The main cause is market uncertainty, both national and global. Since 2015, biodiesel exports to European and American countries have decreased significantly due to various environmental and dumping issues, while the domestic market is still limited to PERTAMINA for the transportation sector PSO (Public Service Obligation) and has not been fully absorbed by the industrial sector, and power generation [26].
3.4. The challenge of palm oil biodiesel in Indonesia

The challenges of biodiesel development in Indonesia in this article divided into three aspects, including environmental aspects, social aspects and economic aspects.

3.4.1 Environmental aspects. The use of biodiesel is often associated as an effort to conserve the quality of the environment through reducing emissions and using renewable resources, however, facts such as the use of methanol as an alcohol component make biodiesel not 100% "bio". In addition, several other environmental impacts need to be considered, such as the use of fertilizers and energy during the agricultural stage and the use of chemicals and emissions during the biodiesel production process. Therefore, it is necessary to compare the magnitude of the total environmental impact resulting from biodiesel and diesel manufacturing from fossil fuels. One of the comparative methods that can be used is the Life Cycle Assessment. Research related to LCA biodiesel itself has been done a lot both from oil palm and jatropha plants, but this LCA still needs to be compared with diesel LCA derived from fossil fuels in order to know how “environmentally friendly” the use of biodiesel is. In general, the biodiesel life cycle consists of three stages, namely agriculture, milling, and the transesterification process [33]. The system limitations in biodiesel production can be seen in Figure 1.

![Figure 1. Boundaries of the biodiesel production system.](image)

The results of research by Yee et al., showed that the amount of CO₂ absorbed by oil palm cultivation is more than the CO₂ released in the biodiesel production life cycle (Table 2).

| Parameter                              | CO₂ (kg CO₂/ton biodiesel) |
|----------------------------------------|-----------------------------|
| Plantation                             | 5.462.257,45                |
| Gross assimilation                     |                             |
| Total respiration                      | 3.273.961,76                |
| Peatland                               | 211.996,97                  |
| NPK Fertilizers                        | 11.630,88                   |
| Traction (diesel)                      | 5.872,81                    |
| Palm oil mill                          |                             |
| CPO Production Biomass incineration    | 117.234,33                  |
| Diesel for boiler start up             | 702,65                      |
| Diesel for vehicles                    | 358,16                      |
| Transesterfication                     |                             |
Biodiesel production CPO | 39,392,72
Methanol | 232,95
Sodium hydroxide | 5,63
Electricity | 2,087,26
Boiler | 199,01
Biodiesel combustion | 1,614,00
Total | 5,462,257.45

The life cycle process of diesel production starts from the exploitation of crude oil, which will then be transported to the refinery for fractional distillation into diesel. Diesel is then channelled to the gas station and then burned in the vehicle. Nanaki & Koroneos conducted research related to diesel LCA with the limitations of product production and transportation [20]. The results obtained are to produce 1000 liters of diesel; it will emit 120 kg of $\text{CO}_2$; 0.023 kg of CO; 0.57 kg of NOx; 0.25 kg of SO2, and 2.26 kg of Volatile Organic Compound (VOC).

Research results from Nanaki & Koroneos, shows that to produce 1000 liters of diesel it will emit 120 kg of $\text{CO}_2$ [20]. If a diesel density value of 0.875 kg/liter is taken, then for every production of 1 ton of diesel, $\text{CO}_2$ emission of 144.23 kg is taken. As for biodiesel production, from the life cycle, it can be seen that oil palm cultivation will absorb 5,462,257.45 kg of $\text{CO}_2$ and will emit 3,665,289.12 kg of $\text{CO}_2$ so that in total for every 1 ton of biodiesel it will absorb 1,796,968.33 kg of $\text{CO}_2$ [33]. When viewed in terms of $\text{CO}_2$ emissions, the use of biodiesel is more environmentally friendly. This is similar to the LCA biofuel research results in Thailand, where palm oil-based biodiesel has a lower environmental impact than fossil fuels [17]. Biodiesel is indeed superior when compared to greenhouse gas parameters, use of fossil fuels, acidification, eutrophication, and carcinogenic effects, but if viewed from the Eco toxicity parameters it will be inferior to ordinary diesel [12].

3.4.2 Social aspects. The development of the biodiesel industry from palm oil affects environmental and economic aspects and the socio-cultural aspects of the community. The development of biodiesel from palm oil is often associated as an effort to reduce poverty in oil palm plantation areas [25]. In addition, there are social aspects related to the existence of biodiesel from palm oil, including human rights, working conditions, cultural heritage, socio-economic impacts, and governance. One method of studying the social implications of palm oil biodiesel is through study cases using the Social Life Cycle Assessment (SLCA) framework. Existing SLCA research on palm oil biodiesel in Indonesia illustrates the palm oil biodiesel supply chain's impact upstream, which is a highly significant process in the entire palm oil biodiesel supply chain. Based on research Falcone & Imbert, the impact categories used consisted of 5 categories, including human rights, working conditions, cultural heritage, socio-economic impacts, and governance [9].

![Figure 2. Stakeholder perspective in a radar graph [9].](image)

Results from the survey stakeholder research perspective Falcone & Imbert shown in the radar graph showing the average gap for each impact category (Figure 2). It is clear that the two impact categories (working conditions and cultural heritage) have a much wider gap than others. The categories of human
rights impacts do not have gaps, while the socio-economic and governance impact categories show relatively narrow gaps. It does not fully meet stakeholder expectations, the gap in socio-economic impacts is relatively small. This reflects that the community agrees that the palm oil industry has brought positive socio-economic impacts to the community, such as its contribution to local employment and economic development. Suppose palm oil biodiesel is to be produced sustainably. In that case, social impacts such as working conditions must be enhanced by strengthening regulations on casual daily labor, such as increased wages and benefits [18], health and safety standards, and the right to collective bargaining.

3.4.3 Economic aspects. The dominance of palm oil in the world vegetable oil trade is an advantage for Indonesia as the world's largest palm oil producer. The global vegetable oil trade is generally dominated by palm oil (50%), rapeseed oil, sunflower oil and soybean oil [10]. In 2018, Indonesian palm oil exports in the sequence were Other Palm Oil (HS 15119000) amounting to 71.93% of total exports, Crude Palm Oil (HS 15111000) by 22.09%, Other Palm Oil Kernel (HS 15132900) of 4.73%, and Crude Oil of Palm Kernel (HS 15132110) by 1.24% [3]. In general, during the last 4 years palm oil exports have increased, namely since 2014 the total export volume has reached 24.37 million tons with a total value of US $ 19.01 billion, increasing to 29.67 million tons in 2018 with a total value of US $ 19.01 billion (Figure 3). US $ 18.23 billion, the largest importing countries for palm oil during 2018 were India, the Netherlands, Malaysia, Singapore and Italy [3][30]. During the 2008-20015 period there was an increase in palm oil area by 5.67% and palm oil production by 6.17%, while exports increased by 8.35% [24].

The increase in palm oil exports as a base for making biodiesel is in line with the projection that in the 2008-2018 period, Indonesia's biodiesel exports will grow by 1.62% per year. Production and export of Indonesian biodiesel increased at a rate of 16.46% and 13.26% so that the availability of biodiesel increased by 20.65% [24]. Biodiesel is the choice of a renewable energy source that comes from vegetable oil and is low in emissions. A number of factors determine Indonesia's palm oil exports, namely the export price, palm oil production, export tax, the Rupiah exchange rate against the US dollar, the non-cash dummy, and year t-1 palm oil exports. Exports of palm oil and its downstream products (cooking oil, biodiesel and other industrial products) were recorded as the largest contributor to Indonesia's foreign exchange, reaching IDR 239 trillion in 2017 [3]. The export price of palm oil has a positive and responsive effect in the short term on the area to produce palm oil with an elasticity of 4.64%, which means that a 1% increase in domestic palm oil prices will be responded to by an increase in the area to produce palm oil by 4.64% [24].

![Figure 3. Development of Palm Oil Export Volume and Value 2014-2018](image-url)
increases [24]. This condition can be used as an advantage for Indonesia to develop biodiesel. Consumption of biodiesel in Indonesia refers to the mix program, which is an obligation and is supported by a levy of funds from exports. Consumption of biodiesel in Indonesia is used in the road transportation sector. The Public Service Obligation (PSO) sector accounts for 90% of biodiesel consumption in Indonesia [30]. Meanwhile, the non-PSO transportation sector has not applied the B20 mixture. In accordance with the Minister of Energy and Mineral Resources Regulation number 25/2013, there is an obligation to mix 10% of palm oil biodiesel (B10) in January 2014, then B15 in 2015, B20 in 2016 and B30 in 2020, which are currently focused on Public transportation. Service Obligation (PSO).

3.5 Pros and cons of palm oil biodiesel
The development of the use of CPO from an economic perspective can have positive and negative impacts. One of the resulting negative impacts is an increase in CPO prices between 4.82% - 12.76% so that there will be an increase in cooking oil prices of 3.86% - 10.21% [28]. The research results also support this statement that the increase in CPO prices will reduce the demand for CPO for the cooking oil industry by 0.147% so that there will be an increase in the price of cooking oil by 0.012%. The positive impact of using biodiesel is to reduce carbon emissions, increase employment opportunities, reduce imports of fossil fuels [19]. By increasing the number of workers, it can reduce poverty around palm oil processing factories. The use of CPO as biodiesel can positively impact reducing the number of poor people by 21,000 to 55,000 (0.005% - 0.15%) [27].

The impact of the expansion of the emergence of oil palm plantations is the transformation of the livelihoods of field farmers, rubber planters and fishermen to become oil palm plantation farmers, causing the domination of the income percentage from oil palm farming [1]. The average growth of palm oil is 4.62% per year while soybean oil grows 1.55% once year [14]. This potential productivity can be advantageous for palm oil in producing biodiesel for domestic and export consumption. The growth in palm oil productivity is also supported by the expansion of the increasing area of oil palm plantations. It was noted that there was an increase in the area of oil palm plantations from 2014 amounting to 10.75 million hectares to 12.76 million hectares in 2018, this is in line with CPO production in 2014 which was 29.28 million tons to 36.59 million tons [3]. The increase in the amount of land area can trigger social, economic and environmental impacts. If management is not carried out wisely, the impact that will often arise is conflict. There were at least 663 ongoing conflicts between oil palm companies and local communities in 201 in Indonesia, with Sumatra and Kalimantan's most locations. The causes of conflicts that occur in oil palm plantations include lack of consultation, displacement of local communities, restrictions on access and disruption of livelihood sources.

4. Conclusion
The development of the biodiesel industry from palm oil has implications for society's environmental, economic, and social aspects in Indonesia. The development of biodiesel from palm oil must be able to adopt an overall energy system approach in providing sustainable energy benefits for all. Energy transition from systems based on fossil fuels (carbon-intensive) to systems based on low carbon (renewable energy) is an interrelated policy challenge. The development of biodiesel from palm oil in Indonesia could to provide opportunities for policy managers to non-PSOs or the public with provisions that provide incentives for efficiency and to reduce poverty and unemployment; to reduce carbon emissions by reducing consumption of carbon-intensive or fossil fuels; and encouraging economic activities in the procurement of biofuels (the trade balance). Attention to the development of bioenergy in Indonesia continues to increase, the Government of Indonesia is targeting the percentage of renewable energy to be 17 percent by 2025. One of the implications of this policy is the development of palm oil-based biodiesel in Indonesia. Regardless of the pros and cons, the sustainability of palm oil-based biodiesel in Indonesia needs to be the concern of all parties.

The issue of palm oil-based biodiesel in Indonesia is also inseparable from the issues and problems that continue to develop related to the main raw material source, namely palm oil, which is considered one of the causes of deforestation Indonesia. The sustainability of palm oil-based biodiesel will be
difficult to succeed without the right, strong, and coherence policy direction, both for the domestic market to support the government's energy mix target and for the export market. In order to ensure the sustainability of palm oil-based biodiesel in Indonesia, including the continuity of overseas markets, it is necessary to involve the management of three-core energy trilemma, including Energy Security, Energy Equity, and Environmental Sustainability of the Energy System during the transition process. In addition, the commitment of all parties is to ensure the management and practice of the sustainable palm oil-based biodiesel industry from upstream to downstream.

In order to continue to access international markets, diplomacy, and the strength of Indonesia's foreign policy are needed to ensure that Indonesian palm oil-based biodiesel is sustainable and there is no dumping issue. The strategy for the sustainability of CPO as a basic material for biodiesel can be done by balancing three basic aspects: social, economic, and environmental. If palm oil biodiesel is to be produced sustainably, what needs to be done is that the economic cycle must be based on social welfare so that it can improve people's welfare (poverty alleviation). At the same time, it must also pay attention to the carrying capacity of the environment so that it can meet the needs of present and future generations. In order to support it, of course, the government, palm oil entrepreneurs, and smallholders need to be serious in ensuring that Indonesian palm oil production does not contain problems, both from economic, social, and environmental aspects.

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