

Development prospects of Indonesia's biodiesel industry: A study of raw material, market, and policy aspects

Mirawati Yanita^{1,2*}, Zulkifli Alamsyah^{1,2}, Gina Fauzia^{1,3}, Ernawati Hamid³, and Dompok Napitupulu³

¹Universitas Jambi, CSSPO, Jambi, Indonesia

²Universitas Jambi, PUI BLasTs, Jambi, Indonesia

³Universitas Jambi, Agribusiness Department, Faculty of Agricultural, Jambi, Indonesia

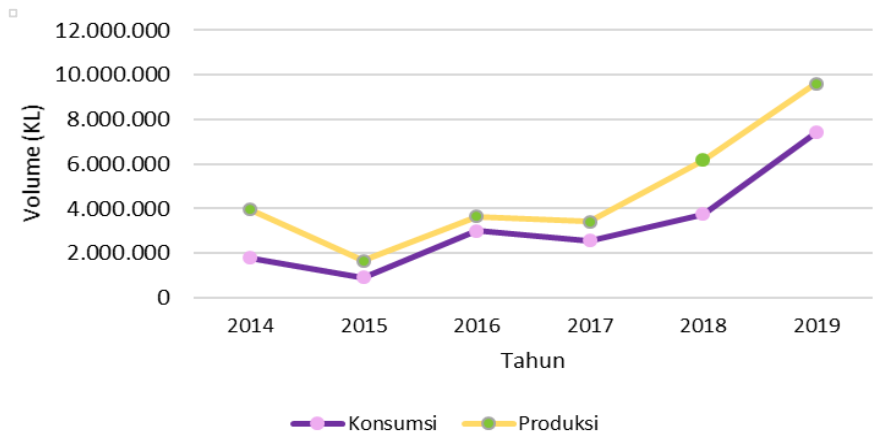
Abstract. Biodiesel is a fuel substitute for diesel which is considered more environmentally friendly because the raw materials used come from a mixture of palm vegetable oil, increasing production. The emergence of black palm oil campaigns in several importing countries has encouraged the urgency of biodiesel development in Indonesia. This study aims to; photograph the development of the Indonesian biodiesel industry and describe the development prospects of the Indonesian biodiesel industry in terms of raw materials, markets and policies. This research method uses descriptive analysis to examine the chances of developing the Indonesian biodiesel industry regarding raw materials, markets, and policies. The results showed that; the development of the Indonesian biodiesel industry continues to increase when viewed from the aspects of increasingly large raw materials, promising markets, and policies. It will continue to be studied and updated by the Indonesian government, so it is hoped that this biodiesel can significantly replace imported diesel and absorb Indonesian palm oil. The biodiesel industry in Indonesia has an extensive prospect to continue after implementing the B-30, which was first implemented in 2020. It can be achieved by paying attention to the available raw materials used in the biodiesel industry.

1 Introduction

The EU Parliament issued a resolution on palm oil and rainforest deforestation in which the ultimate goal is to ban the import of palm oil that is incompatible with sustainable development and its derivative products into the territory of the European Union. It is indicated by the issue of linking palm oil to environmental health [1]. The resolution states that palm oil carbon emissions are more abundant than other oils, such as sunflower seed oil, soybean oil, sesame oil, and olive oil, which are considered to worsen the greenhouse effect currently occurring in the world. These issues then lead to

* Corresponding author: mirawatiyanita@unja.ac.id

deforestation of forests, loss of biodiversity of animals and fauna, and forest fires [2]. Therefore, to overcome the accumulation of palm oil that can occur in the future, the Indonesian government issued a policy to use palm oil as an environmentally friendly fuel in the form of biodiesel.



Source: *Ministry of Energy and Mineral Resources* [3].

Fig. 1. Consumption and production of biodiesel Indonesia 2014 - 2019.

Figure 1 shows that Indonesia's biodiesel production and consumption every year continues to increase even though, in 2017, it experienced a decrease in volume. Previous research shows that Indonesia's policy of supporting the use of renewable energy through the mandatory use of biodiesel as a mixture for diesel fuel has a significant impact on increasing the use of biodiesel, even though this target has not yet reached 100 percent [4]. In addition, Purwanto et al. [5] shows that developing sustainable biodiesel raw materials is the first key to sustainable biodiesel in Indonesia, where the criteria for environmentally friendly raw materials are socially acceptable and economically viable. Therefore, the government should secure the supply of CPO as feedstock for biodiesel by providing sustainable oil palm plantations exclusive to biodiesel.

Moreover, Murtiningrum and Firdaus [6] researched the Development of Biodiesel in Indonesia Review of Current Conditions, Production Technology & Prospective Analysis. The Indonesian government wants to meet the biodiesel supply from the national industry by implementing the mandatory use of biodiesel. The results of the forthcoming study found that the direction of biodiesel development must start from biodiesel production technology to achieve an increase in production yields at a low cost. Next, Devita [7] also researched Biodiesel as An Alternative And Prospective Bioenergy. Whether non-toxic or renewable, biodiesel is essential for plant and animal origin. The primary raw materials of biodiesel are vegetable oils, animal fats, and recycled fats. The supporting raw material is alcohol, in addition to vegetable oil and alcohol, as well as the necessary catalysts.

Then, Mekhilef et al. [8] researched the demand of increasing price in fossil fuel has prompted the global oil industry to look at the alternative sources of fuel from renewable energy source which is biodiesel. Palm oil is the main raw stock for biodiesel production

in Malaysia as the country is one of the leading palm oil producers in the world. Moreover, Koçar and Civaş [9] aims to present a comprehensive review on the production of biofuels from lignocellulosic agricultural products and promising energy crops. In addition, it is intended to highlight the energy crops used as staples by discussing them in detail for biofuel production. Furthermore, the energy crops used as raw materials for bioenergy today and their potential are compared both worldwide and in Turkey.

2 Research methods

This study uses secondary data with descriptive analysis methods obtained from government agencies, regular research reports, related agencies, scientific magazines, journals, and literature studies related to this research. The scope and limitations in this study are only carried out on the development and prospects of the Indonesian biodiesel industry in terms of the availability of raw materials, policies issued, and the automotive industry as a biodiesel market. The biodiesel demand forecasting analysis uses *time series* data from January 2019 to May 2020 for 17 months. Time Series data is a series of data sets that are ordered by time order. The analysis method used is a descriptive quantitative analysis method to photograph the development of the biodiesel industry in Indonesia, as well as describe the development prospects of the Indonesian biodiesel industry in terms of the availability of raw materials, policies issued, the automotive industry as a biodiesel market.

3 Results and discussion

3.1 Biodiesel Industry in Indonesia

Ministry of Energy and Mineral Resources [10] stated that the birth of the biodiesel industry is in line with the development of biodiesel research which continues at the stage of application and commercialization. BPPT (Agency for the Assessment and Application of Technology, Lemigas), ITB (Bandung Institute of Technology), PPKS (Palm Oil Research Center), and similar research institutions have a hand in pioneering biodiesel plants in various parts of Indonesia. Developing New and Renewable Energy (EBT) and energy conservation efforts have become the government's priority in meeting national energy needs. Policies, steps, and strategies are formulated to achieve the target of 23 percent of the share of NRE in the national energy mix by 2025. Through the Directorate General of EBTKE (Directorate General of New Renewable Energy and Energy Conservation) and ESDM (Ministry of Energy and Mineral Resources), these steps and strategies are realized to realize equitable energy.

The year 2015 was a transition period from state budget subsidies (APBN) to intensive from the Palm Oil Plantation Management Agency (BPDPKS), where in 2016, the mandatory B-20 mix for the PSO (Public Service Obligation) sector through BPDPKS incentives was carried out, while the non-PSO sector was implemented without intensive implementation. This development went well in line with the expansion of biodiesel incentives to non-PSOs in September 2018, with the performance of the Indonesian Railways rail test and the preparation of the B-100 spec for B-30 testing. This

development was also continued in 2019, when the 30 percent biodiesel road test was carried out for 2020, along with testing of trains, heavy equipment, and the leading equipment of the weapon system , and the issuance of the Indonesian National Standard for SNI biodiesel in 2015.

Furthermore, on January 1, 2016, an increase in biodiesel content was carried out by up to 20 percent (B-20) through the mandatory B-20 program. It was running well with providing incentives from BPDPKS for the PSO sector. While on September 1, 2018, the stimulus was again expanded to the non-PSO sector. The mandatory blend of palm biodiesel was again increased to 30 percent in 2020 and is planned to be 50 percent by 2021. The required policy issued by the government is expected to reduce dependence on petroleum even more [11].

Currently, four major industries produce biodiesel for 620,000 per day. These industries include; PT. Eterindo Wahanatama, Wilmar Bioenergy, PT. Sumi Asih and PT. Mas Season [2]. The government also continues to encourage the development of biodiesel to reach B-100; even with the implementation of the B-30 program in 2020, it is expected to save foreign exchange of 13 billion US dollars or around IDR 63.39 trillion per year by increasing the use of biodiesel for domestic needs by 9.59 million kiloliters [3].

Table 1. A balance sheet of Indonesia's palm biodiesel industry in 2014-2019.

Year	Production (KL)	Domestic Consumption (KL)	Export (KL)	Stock (KL)
2014	3.961.081	1.844.663	1.629.262	487.156
2015	1.652.801	915.460	328.573	408.767
2016	3.656.359	3.008.474	476.937	170.948
2017	3.416.417	2.571.569	187.349	657.499
2018	6.167.837	3.750.066	1.802.926	614.845
2019	9.623.455	7.424.719	1.319.428	879.308

Source: Directorate General of EBTKE, Ministry of Energy and Mineral Resources, 2021.

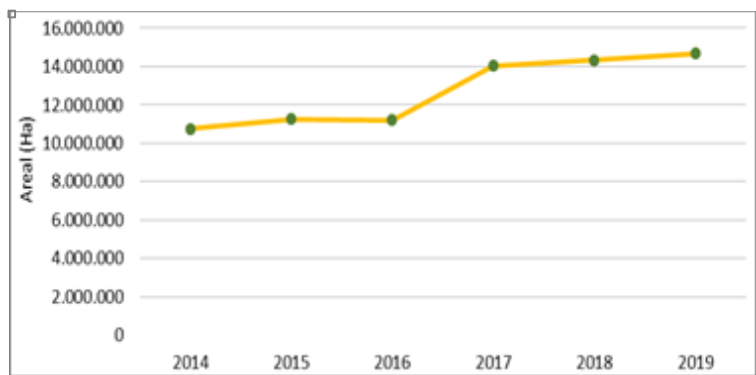
In 2014 when the B-10 began to be run, Indonesia produced 3,961,081 KL of biodiesel with a domestic consumption level of 1,778,684 KL, while the rest was used for export sales and stocks in the country. Most of Indonesia's biodiesel production is oriented toward the domestic market. Table 1 shows that the development of household consumption is much greater than its export consumption. Its growth continues to be carried out so that Indonesia can reduce diesel consumption significantly while continuing to focus on the domestic palm oil market in the future.

3.2 Development prospects of Indonesia's biodiesel industry

The development prospects of the Indonesian Biodiesel Industry can run smoothly if the process is supported by three essential aspects, namely the aspect of raw materials for production, the market for selling biodiesel products, and policies for the development of the biodiesel industry in Indonesia.

3.2.1 Availability of palm oil raw materials

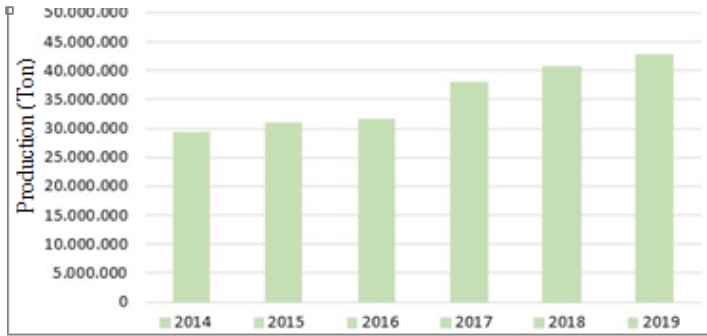
Indonesia is one of the largest producers and exporters of crude palm oil (CPO) in the world; where there are only a few industries in Indonesia that have shown as fast development as the palm oil industry over the past 20 years. The growth of this industry can be seen in the amount of production and the area of oil palm plantations that continue to increase. In addition, it is supported by Oil World (2017), which states that Indonesia controls a 62 percent market share of palm oil production, which covers the Asian region to expand to the Middle East, Africa, and the European Union.



Source: Directorate General of Plantations [12].

Fig. 2. The area of Indonesian oil palm plantations in January 2014 - November 2019.

Palm oil is the most productive raw material in the biodiesel industry compared to other crops like Canola. It can produce 3.5 tons of vegetable oil, while Canola can make 0.8 tons. The area of Indonesian palm oil shown in Figure 2 continues to increase yearly. In 2015 Indonesia had an area of oil palm plantations of 11,260,277 Ha, while in 2019, it grew to 14,677,560 Ha. From this data, it can be concluded that there is an increase in acreage by 30 percent in Indonesian oil palm plantations.



Source: Directorate General of Plantations [12].

Fig. 3. Indonesian palm oil production January 2014 - November 2019.

Indonesia's palm oil production, shown in Figure 3, has increased from 29,278,189 tons in 2014 to 42,869,429 tons in 2019. Meanwhile, the domestic needs for Indonesian palm oil in 2019 amounted to 12,750,000 tons. There is a potential of around 30 million tons of palm oil that can be processed and developed into palm oil derivative products. The absence of a special division of oil palm plantations used as food raw materials – with oil palm plantations for raw materials for the biodiesel industry, it is feared that it will cause a surge in biodiesel prices in the future.

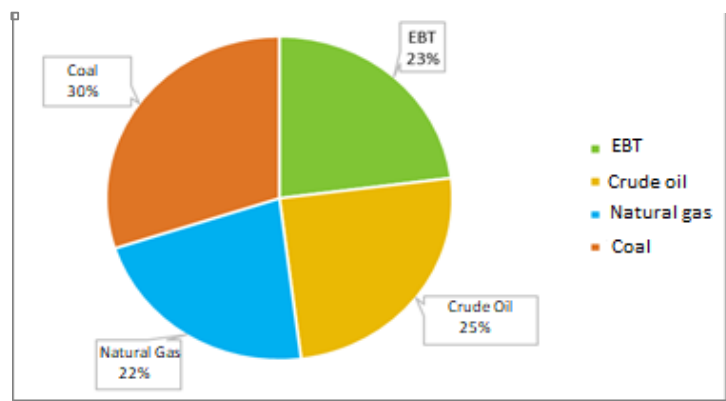
3.2.2 Biodiesel market

In the final energy needs of 2011, the share of energy needs in the transportation sector was 27 percent, which is expected to increase to 33 percent by 2030. One of the alternative fuels for the transportation sector that has begun to be implemented is biodiesel as a substitute for diesel oil. In supporting the development of biodiesel as a BBN to replace diesel in the transportation sector, road tests for vehicles with a capacity of fewer than 3.5 tons and more than 3.5 tons were carried out from May to November 2019 involving the Ministry of Energy and Mineral Resources, BPDPKS, BPPT, PT. Pertamina (Persero), APROBI, GAIKINDO, and IKABI—on November 28, 2019, stated that the results of the B-30 road test showed effects that its use increased engine power, reduced emissions, and did not harm the engine. GAIKINDO, in this case, wants biodiesel fuel as a fuel used in motor vehicles in Indonesia to meet the standards of the *World Wide Fuels Charter* (WWFC) so as not to interfere with the performance of motor vehicle engines. The improvement of vehicle manufacturers as a biodiesel industry market can absorb domestic biodiesel consumption. While an increase in the production and sales of vehicles in demand can indirectly support oil palm plantations [13].

3.2.3 Policies related to biodiesel development

Presidential Instruction No.1 of 2006 concerning the provision and utilization of BBN as another fuel was issued to accelerate the development of Biofuels (BBN), which was then followed up with the formation of a national team for BBN development in the Acceleration of Poverty and Unemployment Reduction through Presidential Decree No. 10 of 2006. This national team is obliged to compile a *Blue Print* and *Road Map for BBN*

Development. Furthermore, the government, through Presidential Regulation No.79 of 2014, also issued a national energy policy which is a revision of Presidential Regulation No.5 of 2006, which aims to realize the security of the domestic energy supply.



Source: Directorate General of New and Renewable Energy, 2020.

Fig. 4. Energy mix achievement target.

In addition (see figure 4), there is also a policy regarding the price of the biodiesel market index through the issuance of a ministerial decree on February 27, 2015, regarding the determination of the BBN benchmark price calculation formula, which refers to the price of raw materials. The price formula has been effective since March 1, 2015, through the Decree of the Menteri ESDM Number 0726 K/12/ME/2015, and replaces the previous price formula, which refers to fuel prices in the means of plants of Singapore. The regulation governing the mandatory phasing is the Regulation of the Minister of Energy and Mineral Resources No. 12 of 2015 concerning the Third Amendment to the Regulation of the Minister of Energy and Mineral Resources No. 32 of 2008 concerning the Provision, Utilization, and Commercial Administration of Biofuels (Biofuels) as Other Fuels. This regulation targets phasing biodiesel blending for all relevant sectors [13].

Table 2. Implementation of minimum obligation stages for biodiesel utilization.

Type/Sector	April 2015	January 2016	January 2020	January 2025
Household	-	-	-	-
Micro enterprises, Fisheries Businesses, Businesses Agricultural Transport and Public service (PSO)Public service (PSO)	15 %	20 %	30 %	30 %
Non PSO Transportation	15 %	20 %	30 %	30 %
Industrial and Commercial	15 %	20 %	30 %	30 %
Power Plant	25 %	30 %	30 %	30 %

Source: Ministry of National Development Planning of the Republic of Indonesia, 2015.

In this implementation, the Government has expanded the incentives for biodiesel financing funds to all industries, including Non-PSO, so that the realization of biodiesel utilization increases. Furthermore, the government emphasized the development of the biodiesel industry in Indonesia, where he mentioned that in 2019 Indonesia had succeeded in producing and using B-20 well so that in 2020 the B-30 mixture began to be carried out so that Indonesia could reduce the value of oil imports even more [10]. The potency of the biodiesel industry in Indonesia is supported by the increasing palm oil production and the government's funding policy. So that the prospects of the Indonesian palm biodiesel industry in the future can be considered positive, Indonesia can further increase the shortcomings that still exist in the industry to be much more optimal (see Table 2).

The three aspects are closely related to the future biodiesel industry's development. The previous research, Silalahi et al. [4] shows that Indonesia's policy of supporting the use of renewable energy through the mandatory use of biodiesel as a mixture for diesel fuel has a significant impact on increasing the use of biodiesel, even though this target has not reached 100 percent. The study found that the policy of providing mandatory use of biodiesel as a mixture of diesel fuels impacted the economy, society, and environment. This policy also has a positive impact on the industry because although the price of biodiesel has so far proven to be unable to compete with diesel fuel derived from fossils, the government still provides economic incentives to offset producers for these price differences. In addition, Khatiwada et al. research [14] shows that Indonesia's palm oil industry can develop nationally and internationally without expanding oil palm plantations since Indonesia can meet its domestic demand for CPO by 2025 by using about 63 percent of the area planted with oil palm in 2014. While research [5] shows that the development of sustainable biodiesel feedstock is the first key to sustainable biodiesel development in Indonesia.

4 Conclusion

Most of Indonesia's biodiesel production is oriented toward the domestic market, and the enactment of mandatory B-20 biodiesel indirectly causes domestic biodiesel production and consumption to increase. Furthermore, the mandatory acceleration of the B-30 in 2020 made Indonesia the first country to implement biodiesel by 30 percent worldwide. Meanwhile, aspects of raw materials, markets, and policies issued by the government in supporting the development of Indonesia's biodiesel industry continue to increase so that all three of them are considered significant enough to replace imported diesel and absorb Indonesian palm oil.

References

1. European Parliament, European Parliament Resolution of 4 April 2017 on Palm Oil and Deforestation of Rainforests (European Parliament, 2017)
2. GAPKI, Resolusi Minyak Sawit Eropa dan Isu Deforestasi (GAPKI, 2018)

3. Kementerian Energi dan Sumberdaya Mineral, Produksi dan Konsumsi Biodiesel Indonesia (Kementerian Energi dan Sumberdaya Mineral, Jakarta, 2019)
4. F.T.R. Silalahi, T.M. Simatupang, M.P. Siallagan, *AIMS Energy* **8**(1), 81–101 (2020)
5. B.A. Purwanto, E. Hambali, Y. Arkeman, H. Wijaya, J. *Sustain. Dev.* **9**(4), 124 (2016)
6. M. Murtiningrum, A. Firdaus, J. *PASTI* **9**(1), 35–45 (2015)
7. L. Devita, *Agrica Ekstensia* **9**(2), 23–26 (2015)
8. S. Mekhilef, S. Siga, R. Saidur, *Renew. Sustain. Energy Rev.* **15**(4), 1937–1949 (2011)
9. G. Koçar, N. Civaş, *Renew. Sustain. Energy Rev.* **28**, 900–916 (2013)
10. Kementerian Energi dan Sumberdaya Mineral, Biodiesel, Jejak Panjang Sebuah Perjuangan (Kementerian Energi dan Sumberdaya Mineral, Jakarta, 2021)
11. Dirjen EBTKE, FAQ : Program Mandatori Biodiesel 30% (B30) (Dirjen EBTKE, 2019)
12. Direktorat Jendral Perkebunan, Statistik perkebunan Indonesia 2017-2019: Kelapa Sawit (Direktorat Jendral Perkebunan, Jakarta, 2019)
13. Kementerian Perencanaan Pembangunan Nasional, Kajian Pengembangan Bahan Bakar Nabati (BNN) (Kementerian Perencanaan Pembangunan Nasional, Jakarta, 2015)
14. D. Khatiwada, C. Palmén, S. Silveira, *Biofuels* **12**(2), 135–147 (2021)