

OIL PALM AND BIODIESEL: TRENDS, DEFORESTATION, AND EFFORTS TO PROTECT NATURAL FORESTS

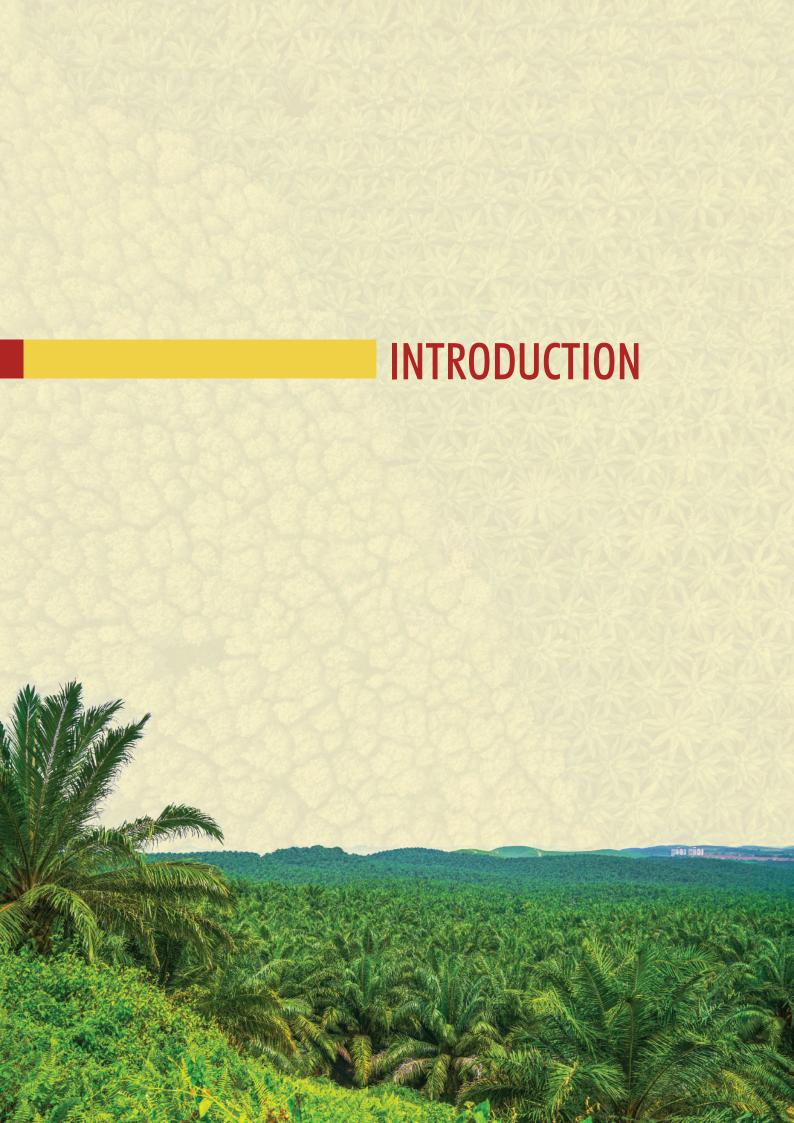
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Palm oil is a strategic national commodity for food, energy, and international trade. As the Indonesian government continues to raise the biodiesel blend target, even faster than planned (see Figure 1), it will increase the demand for national palm oil in the coming years. Moreover, Indonesian palm oil is also widely exported to meet the needs of other countries. The increasing trend in global vegetable oil demand (see Figure 2) is also driving demand for national palm oil.

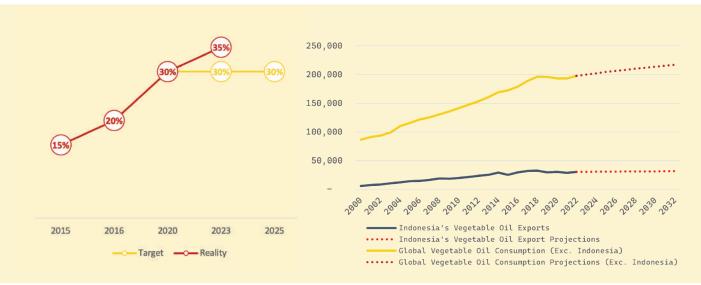


Figure 1. Target Vs Reality of Biodiesel Blends Source: Minister of Energy and Mineral Resources Regulation No. 12/2015; Directorate General of EBTKE, Ministry of Energy and Mineral Resources, 2023.

Figure 2. Trends in Indonesian Palm Oil Exports and Global Vegetable Oil Consumption (in thousand metric tons) Source: oecd/fao (2023).

The Indonesian government began adopting biofuel policies in 2006, marked by the issuance of Presidential Instruction No. 1/2006 on the Provision and Utilization of Biofuels as Other Fuels and Presidential Regulation No. 5/2006 on the National Energy Policy. For the first time, biofuels were included in the 2025 primary energy mix target. About six months later, Presidential Decree No. 10/2006 on the National Team for the Development of Biofuels to Accelerate Poverty Reduction and Unemployment was issued. The policy of using New & Renewable Energy (EBT), especially biofuels, was further strengthened with the issuance of Law Number 30 of 2007 concerning Energy. Biodiesel began to be used after the issuance of Regulation of the Minister of Energy and Mineral Resources Number 32 of 2008 on September 26, 2008 concerning the Provision, Utilization and Administration of Biofuels as Other Fuels.

Furthermore, from year to year, several policies were developed to accelerate biofuel utilization obligations in the energy mix with certain concentrations. B2.5-B7.5 was implemented during 2008-2010, B10-B15 was implemented during 2014-2015, and B20 was implemented during 2016-2019.1 Finally, through the Decree of the Minister of Energy and Mineral Resources

¹ Directorate General of New Renewable Energy and Energy Conservation, Ministry of Energy and Mineral Resources. (2019). FAQ: Program Mandatori Biodiesel 30% (B30). Accessed on September 10, 2023, from https://ebtke.esdm. go.id/post/2019/12/19/2434/faq.program.mandatori.biodiesel.30.b30#:~:text=Program%20B30%20adalah%20program%20pemerintah,bahan%20bakar%20minyak%20jenis%20Solar.

Number 205.K/EK.05/DJE/2022 dated December 15, 2022 concerning the Determination of Fuel Oil Business Entities and Biodiesel Type Biofuel Business Entities and the Allocation for Blending of Diesel Fuel Oil Types for the Period January - December 2023, as well as the Decree of the Director General of EBTKE concerning Implementation Guidelines for Blending Biodiesel Type Biofuel into Diesel Fuel Oil by 35%, the government established the B35 program as of January 1, 2023.2 And as of May 2023, trials have been conducted for the B40 program.

The B40 program means mixing 40% biodiesel with 60% diesel fuel oil. The escalation of the biodiesel mix program is implemented with the aim of reducing greenhouse gas (GHG) emissions by 29% from BAU by 2030, increasing energy security and independence, stabilizing palm oil prices, increasing added value through downstreaming the palm oil industry, meeting the target of 23% contribution of renewable energy in the total energy mix by 2025, reducing fuel import consumption, reducing GHG emissions and improving the trade balance deficit.3 Through Permen ESDM No. 24 of 2021 concerning the Provision and Utilization of Biodiesel Type Biofuels in the Framework of Financing by the Palm Oil Plantation Fund Management Agency (BPDPKS), business entities that carry out oil and gas processing and trading business activities are required to mix biodiesel type Biofuels with diesel type fuel oil according to the specified percentage. Failure to mix biodiesel and diesel fuel in accordance with the percentage will be subject to an administrative fine, by calculating each liter of biodiesel volume that must be mixed with diesel fuel per month of distribution.4 The current biodiesel policy has been more ambitious than originally designed. Moreover, in the Draft Law on New and Renewable Energy (RUU EBT) biomass is made one of the renewable energy sources promoted and given many facilities in the future energy transition process.

The main raw material for biodiesel production is palm oil, whose use for domestic food and industrial needs is also increasing. In addition, the export of palm oil and its derivative products is one of the national strategic export commodities. However, since 2015, exports of palm oil and its derivative products have been subject to levies. Most of the export levy revenue collected and managed by the Palm Oil Plantation Fund Management Agency (BPDPKS) is used to promote domestic biodiesel production and markets through subsidies.5 From 2015 to 2022, the amount of levy funds that have been used for biodiesel has reached IDR144.7 trillion.6

² Directorate General of New Renewable Energy and Energy Conservation, Ministry of Energy and Mineral Resources. (2023). Program Bahan Bakar Nabati B35 Siap Implementasi Mulai 1 Februari 2023. Accessed on 6 October 2023, from https://ebtke.esdm.go.id/post/2023/01/09/3395/program.bahan.bakar.nabati.b35.siap.implementasi.mulai.1.februari.2023

³ Directorate General of New Renewable Energy and Energy Conservation, Ministry of Energy and Mineral Resources, loc. cit., 2019.

⁴ Article 33 Permen of ESDM 24/2021

⁵ Article 9 paragraph (2) of PP 24/2015 states that the collection of funds for sustainable plantation development is carried out for the purpose of fulfilling plantation products for food needs, biofuels and downstream plantation industry. Previously, in the provisions of Law No. 39/2014 on Plantations, the allocation of BPDPKS funds was limited to human resource development, research and development, plantation promotion and plantation rejuvenation, as well as plantation facilities and infrastructure.

⁶ BPDPKS Annual Report 2015-2022. Accessed on October 30, 2023, from https://www.bpdp.or.id/category/laporan-keuangan

The government's conventional strategy to meet the growing demand for palm oil has been to expand oil palm plantations. Since 2006, Indonesia has been the world's largest palm oil producer, the result of decades of government support to expand oil palm plantations.7 Only in recent years, the government began to implement a policy of intensifying oil palm plantations through replanting.8 By 2022, the national oil palm plantation area has reached 17.77 million hectares, an increase of 145% or 2.45 times compared to only 7.25 million hectares in 2001.9 Meanwhile, oil palm productivity increased by 30% or 1.3 times.

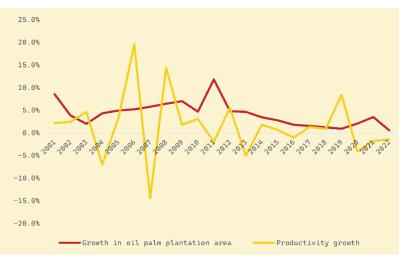


Figure 3. Growth of Oil Palm Plantation Area and Palm Oil Productivity Source: mapbiomas project - collection 2.0; Directorate general of plantation, ministry of agriculture.

The area of oil palm plantations has grown at an average rate of 4.2% per year since 2001. By 2021, oil palm plantations will occupy about 84.34% of Indonesia's plantation land.10 Meanwhile, forest area has shrunk by an average of 0.3% per year since 2001.11 The expansion of oil palm plantations in Indonesia has been widely criticized by national and international environmentalists, as it has been identified as the main cause of deforestation in Indonesia, fires, and loss of biodiversity.12,13,14,15 Interpretation of satellite imagery by the TreeMap

⁷ Dilip Khatiwada, Carl Palmén & Semida Silveira. (2021). Evaluating the palm oil demand in Indonesia: production trends, yields, and emerging issues, Biofuels, 12:2, 135-147, DOI: 10.1080/17597269.2018.1461520

⁸ Regulation of the Minister of Finance Number 84/PMK.05/2017 Year 2017 on the Use of Palm Oil Plantation Replanting Funds of the Public Service Agency of the Palm Oil Plantation Fund Management Agency

⁹ MapBiomas Project - Collection 2.0. Annual Map of Indonesia Land Use and Cover, accessed on November 17, 2023 through the link: https://platform.indonesia.mapbiomas.org/.

¹⁰ Indonesia Central Bureau of Statistics. (2020). Recapitulation of Forest and Non-Forest Land Cover Area by Province 2014-2021 (Thousand Ha). Accessed on December 18, 2023, from https://www.bps.go.id/id/statistics-table/1/MjEx-MCMx/rekapitulasi-luas-penutupan-lahan-hutan-dan-non-hutan-menurut-provinsi-tahun-2014-2021--ribu-ha-. html.

¹¹ MapBiomas Project - Collection 2.0. loc. cit.

¹² Koalisi Indonesia Memantau. (2021). Menatap ke Timur: Deforestasi dan Pelepasan Kawasan Hutan di Tanah Papua. February, 2021. Jakarta, Indonesia.

¹³ Greenpeace. (2013). Izin Memusnahkan. Jakarta, Indonesia.

¹⁴ Vijay V, Pimm SL, Jenkins CN, Smith SJ. (2016). The Impacts of Oil Palm on Recent Deforestation and Biodiversity Loss. PLoS ONE 11(7): e0159668. https://doi.org/10.1371/journal.pone.0159668

¹⁵ Cattau, M. E., Harrison, M. E., Shinyo, I., Tungau, S., Uriarte, M., & DeFries, R. (2016). Sources of anthropogenic fire ignitions on the peat-swamp landscape in Kalimantan, Indonesia. Global Environmental Change, 39, 205-219. https://doi.org/10.1016/j.gloenvcha.2016.05.005

in Nusantara Atlas platform shows an increase in the area of oil palm plantations over the period 2001-2022 of 8.84 million hectares. ¹⁶ The average growth of oil palm cover is 401,792 hectares per year. If we combine the trend of deforestation and the growth of oil palm cover, it can be seen visually in Figure 4.

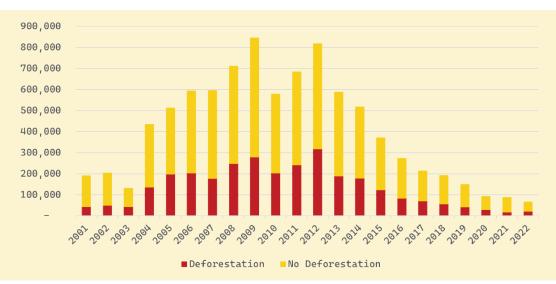


Figure 4. New Oil Palm Plantation Development 2001-2022 (in hectares) Source: the treemap, (2023).

The conversion of natural forests is one of the largest contributors to emissions in Indonesia. The amount of deforested carbon stock during the period 2006 to 2020 reached 342.5 million tCO2e per year. Biodiesel is one of the government's strategies to reduce emissions, especially from the energy sector. The ambition to continuously increase the biodiesel blend target could threaten this government goal if the increased domestic demand for biodiesel leads to further deforestation and conversion of natural forests. Thus, increasing emissions in the forestry and land use sectors.

Many studies have been conducted to assess the potential impacts of biodiesel policies on land use and deforestation.^{20,21,22} However, the scale of domestic and international demand

¹⁶ The TreeMap. (2023). Annual expansion of oil palm and pulpwood plantations, and associated forest conversion. Accessed November 11, 2023, from https://map.nusantara-atlas.org/.

¹⁷ Siswadi, A. (2021). Peneliti: Indonesia Sumbang Emisi, Terbesar dari Deforestasi dan Kebakaran Hutan. Tempo. https://tekno.tempo.co/read/1523136/peneliti-indonesia-sumbang-emisi-terbesar-dari-deforestasi-dan-kebakaran-hutan

¹⁸ Republic of Indonesia. (2022). National Forest Reference Level for Deforestation, Forest Degradation and Enhancement of Forest Carbon Stock.

¹⁹ Republic of Indonesia. (2022). Enhanced Nationally Determined Contribution. Accessed September 10, 2023, from https://unfccc.int/sites/default/files/NDC/2022-09/ENDC%20Indonesia.pdf.

²⁰ Chris Malins. (2018). Driving deforestation: The impact of expanding palm oil demand through biofuel policy. Cerulogy and Rainforest Foundation Norway.

²¹ LPEM FEB UI. (2020). Risiko Kebijakan Biodiesel dari Sudut Pandang Indikator Makroekonomi dan Lingkungan. Jakarta: Indonesia.

²² Ramadhan, R., Mori, A., Abdoellah, O.S. (2023). Biofuels Development and Indirect Deforestation. In: Triyanti, A., Indrawan, M., Nurhidayah, L., Marfai, M.A. (eds) Environmental Governance in Indonesia. Environment & Policy, vol 61. Springer, Cham. https://doi.org/10.1007/978-3-031-15904-6_10

for palm oil, the amount of land needed to meet that demand, the natural forests at risk of deforestation, the companies at risk of deforestation, and the Indonesian government's efforts to protect natural forests have not been specifically addressed in previous studies. These matters hold significance due to the necessity of land for palm oil production to fulfill biodiesel targets, domestic food demand, domestic oleochemical demand, and exports. Detecting companies with exposure to deforestation in their supply chains can serve as a foundation for reducing deforestation risks by enhancing transparency and supply chain management. Assessing the government's stance on preserving natural forests is imperative to gauge the policy's efficacy.

DATA & METHODS



Projected Palm Oil Demand, Land Requirements, and Potential Deforestation

The palm oil demand projection analysis was conducted for the period 2023 to 2042 under three different biodiesel blend rate scenarios (see Table 1). The first is business as usual (BAU), which assumes a constant biodiesel blend rate of 35% from 2023 to 2042. The second scenario is ambitious with a biodiesel blend rate of 35% in 2023 and 40% in 2024 through 2042. The third scenario is aggressive with biodiesel blend rates of 35% in 2023, 40% in 2024, and 50% in 2025 through 2042.

 Scenario
 Mixed Target

 BAU
 B35 implemented in 2023 - 2042

 Ambitious
 B35 in 2023 and B40 in 2024 - 2042

 Aggressive
 B35 in 2023, B40 in 2024, and B50 in 2025 - 2042

Table 1. Biodiesel Policy Scenarios

The three scenarios were generated from observations of current policies. The BAU scenario is the scenario with the current policy, where the biodiesel blend target has reached 35%. In the ambitious scenario, the blend target is assumed to increase to 40% by 2024. This is based on the implementation target by the Ministry of Energy and Mineral Resources. Meanwhile, the aggressive scenario with an increase in the blend target to 50% by 2025 is based on the statement of the Palm Oil Research Center (PPKS) in the media. The BAU scenario is the BAU scenario with a scenario with an increase in the blend target to 50% by 2025 is based on the statement of the Palm Oil Research Center (PPKS) in the media.

This study linearly extrapolates palm oil demand projections to meet biodiesel blending targets, food production, other industrial needs, and exports. This approach assumes that there will be no significant changes until 2042 in the development of palm oil demand. Potential interactions with other vegetable oil-producing substitute crops and possible price conflicts, weather, and natural disasters in palm oil production are not included in the scope of this study.

The projected demand for palm oil for biodiesel production was obtained through projected biodiesel distribution, biodiesel distribution realisation, unit conversion factor, and palm oil biodiesel conversion factor. The base for biodiesel distribution utilizes data from the Ministry of Energy and Mineral Resources (ESDM) regarding biodiesel distribution in 2022

²³ Setiawan, V. N. (2023). Sempat tertunda, B35 berlaku penuh 1 Agustus. CNBC Indonesia. Accessed November 29, 2023, from https://www.cnbcindonesia.com/news/20230712162342-4-453706/sempat-tertunda-b35-berlaku-penuh-1-agustus.

²⁴ Zahira, N. (2023). Penerapan B40 di 2024 Berpotensi Kurangi Emisi hingga 40%. Katadata. Accessed November 29, 2023, from https://katadata.co.id/lonaolavia/berita/64f5dabebde0e/penerapan-b40-di-2024-berpotensi-kurangi-emisi-hingga-40.

²⁵ Editorial Team. (2019). PPKS Uji Jalan Kendaraan B50, Tempuh Jarak 5.000 km. Sawit Indonesia Magazine Online. Accessed November 29, 2023, from https://sawitindonesia.com/ppks-uji-jalan-kendaraan-b50-tempuh-jarak-5-000-km/.

and 2023, with an anticipated annual growth of 3% in subsequent years. Meanwhile, the actual biodiesel distribution is assumed to be equal to the ratio of biodiesel distribution to biodiesel allocation in 2022. The unit weight conversion factor is assumed to be 0.87 mt/m3. While the conversion factor of palm oil-based biodiesel is assumed to be 95.87%. Note that biodiesel production in this study is dedicated to meeting the biodiesel blending target, and there is no room for biodiesel exports.

Projections of palm oil demand for other domestic consumption, namely food and oleochemical production, were obtained from projections of population and palm oil consumption for food and oleochemicals per capita. Population projection uses data from the Central Bureau of Statistics (BPS).²⁶ Palm oil consumption for food and oleochemicals in 2022 uses data from the Indonesian Palm Oil Association (GAPKI). While the projection of palm oil consumption for food and oleochemicals per capita is assumed to remain the same as 2022.

The projection of palm oil demand for exports uses the OECD-FAO projection figure until 2032, which is the vegetable oil export figure assumed to be the export of palm oil and its derivative products. This figure is then assumed to increase by 0.43% per year.²⁷

Total palm oil demand is generated from the sum of all usage components (biodiesel, food, oleochemicals, and exports). The total palm oil demand is then adjusted with the assumption that 10% will be met from palm kernel oil. Assuming that the productivity level of palm oil per hectare remains at 3.693 mt,²⁸ we can obtain the number of producing crops each year. The number of producing crops is then summed up with the assumption that there are damaged plants of 3.9%²⁹ and immature plants of 21.6% of the producing crop area.³⁰ Thus, the area of oil palm plantations needed to meet the demand for palm oil is the sum of the area of producing crops, the area of damaged crops, and the area of immature crops.

The expansion of oil palm plantations is calculated from the difference between the required area of oil palm plantations to meet the demand for palm oil and the area of oil palm plantations in 2022, which is 17,767,966 hectares. The expansion is assumed to take place three years before the need for expansion arises. Potential deforestation is calculated by assuming 28% (average deforestation in new oil palm plantation establishment during the period 2001-2022) of the oil palm plantation expansion area.

In addition, in order to see the framework of biodiesel development and the regulatory

²⁶ Central Bureau of Statistics. (2023). Indonesia population projection 2020-2050: 2020 population census results. Central Bureau of Statistics. ISBN: 978-602-438-521-7.

²⁷ Lease square growth from OECD-FAO 2023-2032 projections for vegetable oil exports from Indonesia. OECD/FAO. (2023). OECD-FAO Agricultural Outlook 2023-2032, OECD Publishing, Paris, https://doi.org/10.1787/08801ab7-en.

²⁸ Palm oil productivity rate per hectare in 2022. Directorate General of Plantation, Ministry of Agriculture. (2022). National leading plantation statistics 2021-2023.

²⁹ Average area of damaged crops to the area of producing crops in 2014-2023. Collection of Statistical Reports of the Directorate General of Plantation of the Ministry of Agriculture from 2014 to 2022.

³⁰ Average area of immature crops to the area of producing crops in 2014-2023. Collection of Statistical Reports of the Directorate General of Plantation of the Ministry of Agriculture from 2014 to 2022.

direction in protecting deforestation, normative juridical research is applied using a statute approach and a conceptual approach. The statutory approach is carried out by examining all laws and regulations related to the development of biodiesel and the regulatory direction of Indonesia's deforestation protection. Meanwhile, the conceptual approach is carried out by analyzing and criticizing formal legal systems, theories, as well as norms and views in legal science, to produce relevant concepts and overcome the problems at hand.

Mapping Biodiesel Supply Chains, Remaining Natural Forests, and Deforestation History

The biodiesel supply chain mapping in this study only includes biodiesel business entities (BU BBN) that belong to five major corporate groups in Indonesia, namely Wilmar, Royal Golden Eagle, Musim Mas, Permata Hijau, and Sinar Mas. The mapping process involved pinpointing the biodiesel companies that supplied biodiesel to the fuel oil companies (BU BBM) in 2022, in line with the most recent regulation on B30 allocation for 2022, as outlined in the Decree of the Minister of Energy and Mineral Resources No. 160.K/EK.05/DJE/2022.

Once the biodiesel and fuel companies have been identified, the subsequent action involves charting the palm oil mills that provide palm oil to these biodiesel firms. This mapping is based on each biodiesel company's traceability reports, which are then cross-referenced with the mill's name, corporate affiliation, and location, aligning with the characteristics of Indonesian palm oil mills data.³¹

In mapping oil palm plantations that have the potential to supply fresh fruit bunches (FFB) to mills, this study uses a 30 km radius approach from the mill point. The supply chain mapping analysis at the concession level was carried out by selecting and intersecting the concession map taken from the Nusantara Atlas platform with a buffer radius of 30 km from the mill point (see the buffer example in Figure 5).

To determine the extent of remaining natural forest still within the concession area, this research utilized the 2022 land cover map made available by the Ministry of Environment and Forestry (MoEF) on the website geoportal.menlhk.go.id. The natural forest class used in this study does not include industrial plantation forests. The 2022 land cover map was then intersected with a map of oil palm plantation concessions within a 30 km radius of the mill.

³¹ POM data was verified through palm oil mill data published by Benedict, J. J., Carlson, K. M., Febrian, R., & Heilmayr, R. (2023). Characteristics of Indonesian palm oil mills (Version V2) [Dataset]. Harvard Dataverse. https://doi.org/10.7910/DVN/SMPITC.

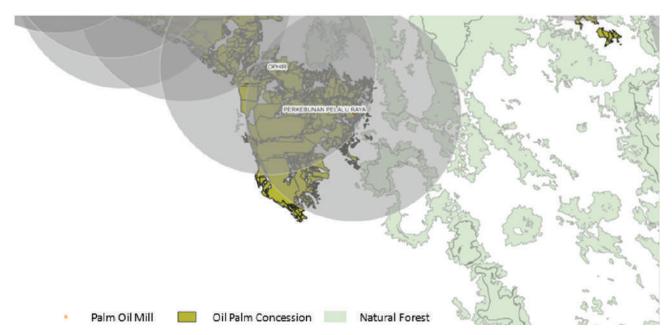


Figure 5. Example of 30 km Buffer and Intersect of PTPN VI Ophir and PT Perkebunan Pelalu Raya POM in West Sumatra

The deforestation history in this study is defined as deforestation that has been carried out by oil palm plantation companies within a 30 km radius of the location of the palm oil mill supplying the biodiesel companies between 2001-2022. Data on historical deforestation from oil palm plantation development from Greenpeace publications.

The estimated 2022 biodiesel realization of the biodiesel companies is based on a biodiesel "realization factor" calculated based on the 2022 biodiesel realization volume and the biodiesel allocation amount using the equation FR = VR/AB, where FR is the realization factor, VR is the realization volume, and AB is the biodiesel allocation.

This factor then allows us to estimate the level of realization of BU BBN's based on the volume of each BU BBN's allocation to the BU BBM with the equation $JR_{BU BBN} = FR \times JA_{BU BBN}$, where JR is the amount of realization, FR is the pre-calculated realization factor, and JA is the amount of BU BBN allocation.

Estimates of palm oil mill CPO production for biodiesel are based on "production factors" calculated based on the amount of realization of $JR_{BU\ BBN}$, biodiesel unit factor from mt to m³, palm oil to biodiesel conversion factor, total palm oil mill capacity, palm oil yield, and mill operating time for one year using the equation $CPO_{eq} = JR_{BU\ BBN} \times FKS^{32} / FK^{33}$, where CPO_{eq} is the amount of palm oil equivalent biodiesel, FKS is the unit weight conversion factor from tons to m³, and FK is the palm oil to biodiesel conversion factor.

^{32 0.87} mt/m3, referring to the Decree of the Minister of Energy and Mineral Resources No. 146.K/HK.02/DJE/2021 on the Market Index Price of Biodiesel Fuel Mixed into Fuel Oil as amended by the Decree of the Minister of Energy and Mineral Resources No. 21.K/HK.02/DJE/2023.

³³ The average biodiesel yield of the five studies was 95.87%. Saputra et al. (2022); Saetiao et al. (2023); Nurhayati et al. (2020); Paminto et al. (2022); and Alkabbash et al. (2009).

CPO Production Capacity_{POM BU BBN} = Total CPO Capacity_{BU BBN} x Palm Oil Yield 34 x Annual Operating Time 35

Production Factor_{CPO Biodiesel} = CPO eq / CPO Production Capacity_{POM BU BBN}

This factor then allows us to estimate the amount of palm oil production from biodiesel at the palm oil mill (POM) level that is specific to the BU BBN based on the PKS capacity of each supplier of the BU BBN with the equation:

CPO Production Allocation_{BU BBN} = Production Factor_{CPO Biodiesel} x Mill Capacity³⁶ x Palm Oil Yield x Annual Operating Time³⁷

³⁴ The average palm oil yield of the 6 groups, namely Teladan Prima Agro, ANJ, DSN, Musim Mas, Sinarmas, and Wilmar in 2022 was 21.36%.

³⁵ Factory operating time is assumed to be 20 hours a day for 285 days a year or 5700 hours following research by Nuryadi et al. (2019).

^{36 34} out of 809 mills or 4% supplying to BU BBN in 2022 were not found to have capacity data from either Benedict et al or the internet. The 34 mills are assumed to have a capacity of 45 mt FFB/hour.

³⁷ Nuryadi et al. (2019), loc. cit.

RESULTS & DISCUSSION



Domestic and International Palm Oil Demand to 2042

By 2042, biosolar deliveries will reach 65.8 million kl (see Figure 6). If the Indonesian government does not increase the biodiesel blend target (BAU scenario), the biodiesel allocation to meet this biodiesel demand will reach 23 million kl, while if the biodiesel target is increased to 40% by 2024 and remains fixed until 2042 (ambitious scenario), this demand increases to 26.3 million kl, and becomes even greater if the biodiesel blend target is increased to 50% by 2025 and remains fixed until 2042 (aggressive scenario), at 32.9 million kl. The amount of palm oil required reaches 19.9 million mt in the BAU scenario, 22.75 million mt in the ambitious scenario, and 28.4 million mt in the aggressive scenario.

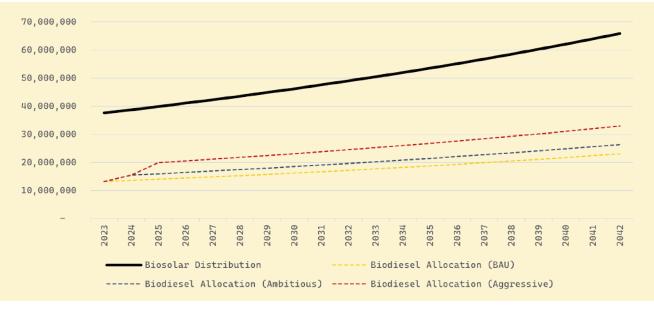


Figure 6. Projected Demand for Biosolar and Biodiesel (in kilolitres)
Source: ministry of energy and mineral resources and author's projection with an increase of 3% per year.

According to statistics compiled by GAPKI, domestic consumption can be divided into three main groups: biodiesel, food, and oleochemicals. In 2022, domestic palm oil consumption has reached 20.97 million mt with 8.84 million mt for biodiesel, 9.94 million mt for food, and 2.18 million mt for oleochemicals.³⁸ The domestic palm oil consumption rose 36% from 13.5 million mt in 2018. The majority of this increase came from biodiesel consumption, which rose by 5 million mt or 67% of the increase.

In the next two decades, most of the increase in palm oil demand for domestic consumption will come from the need to produce biodiesel. Because other domestic consumption needs, namely food and oleochemicals in 2042, will only account for 41%-58% and 9%-13% of palm oil demand for domestic biodiesel production in 2042, respectively. While food demand was initially 4% greater than biodiesel in 2022, its share will continue to decline as palm oil demand for biodiesel production increases (see Figure 7).

³⁸ GAPKI. (2023). Indonesia Palm Oil Industry Statistics 2020-2022.

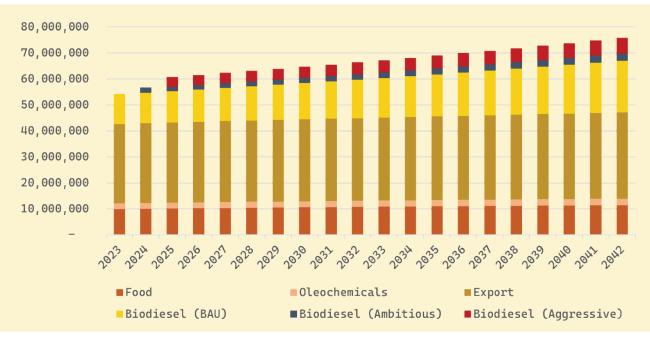


Figure 7. Projected Domestic and International Palm Oil Demand (in metric tons)

Palm oil demand for food production will reach 11.54 million mt by 2042. Meanwhile, the demand for palm oil to produce oleochemicals will reach 2.54 million mt.

To become a major global supplier of vegetable oil, Indonesia will need to produce more palm oil than just to meet domestic demand. OECD-FAO projections for 2023-2032 result in an average increase in vegetable oil exports from Indonesia of 0.43% per year. Assuming this growth is constant until 2042, Indonesia will export 33.1 million tons of crude palm oil and its derivative products (see export trends in Figure 7).

		2023	2028	2033	2038	2042
	CP0	48,683,303	51,568,210	54,447,743	57,637,254	60,386,664
BAU	СРКО	5,409,256	5,729,801	6,049,749	6,404,139	6,709,629
	Total Demand	54,092,558	57,298,011	60,497,492	64,041,393	67,096,293
	CP0	48,683,303	53,261,472	56,410,203	59,911,711	62,946,070
Ambitious	СРКО	5,409,256	5,917,941	6,267,800	6,656,857	6,994,008
	Total Demand	54,092,558	59,179,413	62,678,003	66,568,568	69,940,078
	CP0	48,683,303	56,647,995	60,335,123	64,460,625	68,064,882
Aggressive	СРКО	5,409,256	6,294,222	6,703,903	7,162,292	7,562,765
	Total Demand	54,092,558	62,942,216	67,039,026	71,622,917	75,627,647

Table 2. Demand For Palm Oil (in metric tons)

If the Indonesian government does not increase its biodiesel blend target until 2042, the amount of palm oil needed to meet domestic and international demand in 2042 will be 67.1 million mt (see Table 2). Exports and biodiesel production account for 49% and 30% of the total demand, respectively. If the biodiesel blend target is increased to 40% by 2024, then by 2042, total palm oil demand will rise to 69.94 million mt. The share of exports drops to 47%, and the share for biodiesel production rises to 33%. If the Indonesian government increases the biodiesel blend target to 50% in 2025, the total demand for palm oil in 2042 will reach 75.63 million mt, with exports falling to 44% and biodiesel production rising to 38%.

Land Requirements and the Possibility of Deforestation

Although palm oil demand is seen to grow rapidly until 2042, the average annual increase in palm oil demand is only 1.3% in the BAU scenario, 1.5% in the ambitious scenario, and 1.9% in the aggressive scenario. This is not even half of what we saw from 2003 to 2022, when it grew by 7.2% per year. The only significant increases occur in the first year of the BAU scenario, the first two years of the ambitious scenario, and the first three years of the aggressive scenario. From 3.8% (2023), to 7.1% (2025). Differing between scenarios, the blending rate becomes constant in 2024 in the BAU scenario, 2025 in the ambitious scenario, and 2026 in the aggressive scenario. The additional increase in biodiesel demand comes from the increase in biodiesel demand rather than the biodiesel blend target.

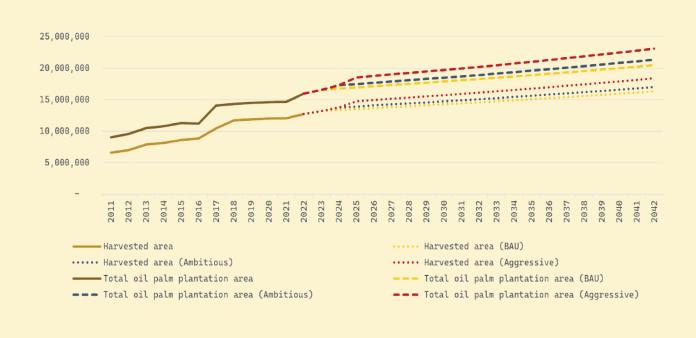


Figure 8. Projected Requirements or Producing Crops and Plantation Size of Oil Palm Plantations (in hectares)

According to data compiled by the Directorate General of Plantation of the Ministry of Agriculture, the existing oil palm plantation area in Indonesia consists of harvested area, damaged crops, and immature crops. If only calculating the area of harvested area to meet domestic and international demand in 2042, then the area needed is 16.35 million hectares in the BAU scenario, 17 million hectares in the ambitious scenario, and 18.4 million hectares in the aggressive scenario. This is a significant increase of 29%, 34%, and 45% respectively compared to 12.69 million hectares in 2022. Assuming that damaged crops and immature crops remain at 3.9% and 21.6% respectively, the required oil palm plantation area becomes even higher. In the BAU scenario, the required area of oil palm plantations is 20.52 million hectares, 21.39 million hectares in the ambitious scenario, and higher in the aggressive scenario, at 23.13 million hectares (see the trend of area development in Figure 8).

Official data on the size of oil palm plantations in Indonesia varies, but tends to be

underestimated by both BPS statistics and statistics from the Directorate General of Plantation of the Ministry of Agriculture. Compared to the Ministry of Agriculture's published oil palm cover of 16.38 million hectares in 2019, the Directorate General of Plantation only recorded 14.45 million hectares in its statistical report. More recently, it has been adopted by the Directorate General of Plantation in the Statistical of National Leading Estate Crops Commodity 2021-2023 report. The oil palm plantation area is set at 16.83 million hectares in 2021, with a confirmed area of 14.6 million hectares in 2021 and continues to increase with an estimate that in 2023 the area remains at 16.83 million hectares and the confirmed area rises to 15.3 million hectares.

The estimation results for 2022 and 2023 directly deny the development of oil palm plantation area in 2022 and 2023. Therefore, in this study, the area of oil palm cover resulting from the interpretation of satellite imagery in the MapBiomas Project - Collection 2.0 is used as the basis for the area of oil palm plantations in 2022, which amounted to 17.77 million hectares. We realize that this figure may be an overestimate, due to potential misinterpretation. But at least this figure is higher than the oil palm plantation area that has been adopted by the Directorate General of Plantation of the Ministry of Agriculture for 2021.

On the basis of this oil palm plantation area and a fixed productivity level of 3.693 mt of CPO/hectare and expansion carried out three years before the need arises. Under the BAU scenario, an expansion of 140.5 thousand hectares would have to be done by 2027. This year is the maximum time for expansion. Because by 2030, Indonesia needs at least 17.9 million hectares of oil palm plantations to meet domestic and international demand.

As the biodiesel target continues to rise, the need to expand oil palm plantations becomes more urgent. If the government sets a biodiesel target of 40% by 2024 (an ambitious scenario), the need for expansion reaches 138 thousand hectares by that year. If the blended target is increased to 50% in 2025, the need for expansion becomes higher and faster, amounting to 746.4 thousand hectares in 2022, unless the area of damaged or immature crops reduces this figure.

To meet palm oil demand until 2042, the need for oil palm plantation expansion in the BAU scenario reaches 2.75 million hectares, while in the ambitious scenario it reaches 3.62 million hectares. The aggressive scenario even requires an expansion of 5.36 million hectares.

Table 3. Accumulated Need for New Oil Palm Plantation Expansion and Potential Deforestation (in hectares)

		2023	2028	2033	2038	2039
BAU	Expansion Requirements	-	335,934	1,375,103	2,513,550	2,753,362
BAU	Deforestation Potential	-	94,061	385,029	703,794	770,941
A control of the control	Expansion Requirements		964,621	2,103,740	3,358,028	3,623,131
Ambitious	Deforestation Potential		270,094	589,047	940,248	1,014,477
Aggressive	Expansion Requirements	1,003,510	2,221,995	3,561,014	5,046,984	5,362,667
	Deforestation Potential	280,983	622,159	997,084	1,413,155	1,501,547

The average deforestation rate in the development of new oil palm plantations during the period 2001-2022 was about 28% per year. With this assumption, under the BAU scenario, potential deforestation in 2027 is estimated at 39.3 thousand hectares. To fulfill palm oil

demand until 2042, the deforestation potential reaches 771 thousand hectares. In the ambitious scenario, potential deforestation is projected at 38.66 thousand hectares by 2024, with a total potential deforestation of 1 million hectares. Meanwhile, the aggressive scenario shows a larger deforestation potential, reaching 208.98 thousand hectares in 2022, and the total deforestation potential in this scenario reaches 1.5 million hectares (see Table 3).

Supply Chain of the Five Largest Corporate Groups of Biodiesel Suppliers

The total allocation of biodiesel in 2022 has reached 11.02 million kl or 30% of the total projected demand for diesel fuel of 36.47 million kl in 2022 (commonly referred to as B30). The five corporate groups that received the largest allocations include Wilmar at 28%, followed by Royal Golden Eagle at 17%, Musim Mas 12%, Permata Hijau 9%, and Sinar Mas 8%. The biodiesel allocation given to these five groups amounts to 74% of the overall allocation for 2022.

WILMAR	ROYAL GOLDEN EAGLE	MUSIM MAS	PERMATA HIJAU	SINAR MAS	
				PT Pertamina Pa Niaga 48%	itra
PT Pertamina Patra Niaga 87%	PT Pertamina Patra Niaga 88%	PT Pertamina Patra Niaga 93%	PT Pertamina Patra Niaga 92%	PT Exxon mobil e Corporin do 17%	PT En er g
PT PT P P	PT AKR PT	111050 75%	PI PI	can PT	P P

Figure 9. Biodiesel Allocation From Five Corporate Groups To Pt Pertamina Patra Niaga Source: minister of energy and mineral resources decree no. 205.K/ek/05/dje/2022

In terms of fuel oil companies, PT Pertamina Patra Niaga is the company that receives the most biodiesel allocation, 79% of the total allocation in 2022. This subsidiary of state-owned PT Pertamina (Persero) was appointed by the government to be the main company that absorbs biodiesel. When broken down by the five largest biodiesel supplier corporations mentioned earlier, PT Pertamina Patra Niaga is the main recipient of each group's biodiesel allocation (see Figure 9).

Within the domestic biodiesel supply chain, the Indonesian government does not impose specific criteria on biodiesel producers, which includes companies that produce fuel oil. This could explain the lack of transparency in the supply chains of some biodiesel producers, as a significant portion of their products are marketed and consumed within the domestic market.

The companies receiving biodiesel allocations from the five largest corporate groups almost all have information on their palm oil suppliers. Of the 14 companies spread across the five

corporate groups, only two companies do not have information on their palm oil suppliers, namely PT Wilmar Bioenergi Indonesia from the Wilmar group and PT Sinarmas Bio Energy from the Sinar Mas group. Both companies did not have any information on their palm oil suppliers, either for 2022 or for previous years.

Based on the traceability reports of each biodiesel producer company in 2022, we were able to map the supply chain of biodiesel producers down to the mill level with the results shown in Figure 10 and Figure 11. There are 685 FFB processors with 792 palm oil mills reported to have supplied palm oil to the five corporate groups.

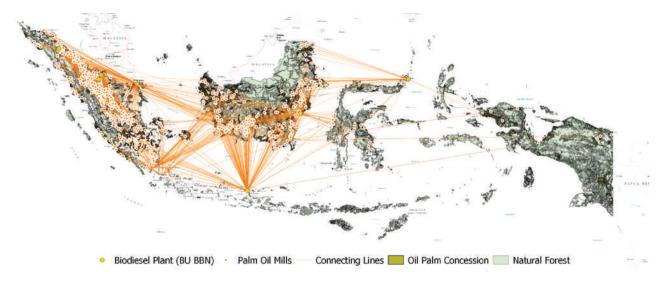
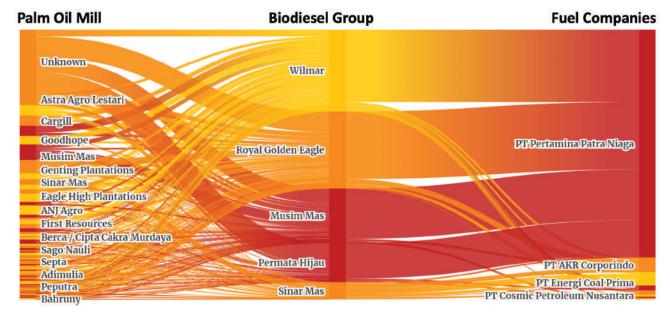


Figure 10. Supply Chain Map of Biodiesel Company To Palm Oil Mill

It can be seen from Figure 10 that the suppliers of the biodiesel are spread out. And almost all islands have palm oil mills that supply palm oil to the refineries of the five largest biodiesel producer groups. However, most of them come from Sumatra. In terms of the groups supplying palm oil, they are relatively spread out. This means that palm oil suppliers are not concentrated in any particular group. The percentage of palm oil supply from each FFB processing group ranges from 0.01% to 4.4%. Palm oil mills from the Astra Agro Lestari group (see Figure 11) became the largest supplier of these companies with an estimated amount of palm oil of 256 thousand mt, followed by PTPN III with 222 thousand tons, followed by Cargill 219 thousand mt, Dharma Satya Nusantara 211 thousand mt, and Goodhope 180 thousand mt.



Description: Unknown is a company that has not been identified as a corporate group or does not belong to a particular corporate group.

Figure 11. Flow of Palm Oil From Palm Oil Mill To Fuel Companies

The absence of efforts to achieve traceable, transparent, and deforestation-free biodiesel supply chains can create alternative markets for palm oil feedstock that may have been exposed to deforestation and other practices that have been blocked from international trade. Using a buffer approach at 30 km from the mill point, we identified concessions that could potentially supply the mill. From the identification results, there are around 1,740 palm oil plantation businesses within 30 km of the mills supplying the 2022 biodiesel companies.

The analysis shows that the palm oil concessions that are indicated to supply the five largest biodiesel producer corporate groups have a significant history of deforestation in the 2001-2022 period (see Table 4). Royal Golden Eagle has the highest exposure to deforestation, with 1.26 million hectares of deforestation during the 2001-2022 period. Similarly, palm oil plantation businesses that are indicated to be suppliers to the Wilmar group also have a significant deforestation history in the same period, with 1.24 million hectares. The other three groups are also exposed to these deforestation actors, but not as much as the previous two groups, including Musim Mas at 957 thousand hectares, Sinar Mas 567 thousand hectares, and Permata Hijau at 311 thousand hectares.

The oil palm concession owner with the largest deforestation history in each biodiesel producer group is PT Perkebunan Nusantara XIII, amounting to 23 thousand hectares. PT Perkebunan Nusantara XIII's concession locations fall within a 30km radius of the palm oil mills reported as supplying palm oil by the five-biodiesel producer corporate groups. The concession owner with the second-largest deforestation history is PT Ruta Jona Lestari, at 19,000 hectares, which supplies four biodiesel producer groups except Permata Hijau. More details about each of the top five deforestation-history palm oil companies can be seen in Figure 12.

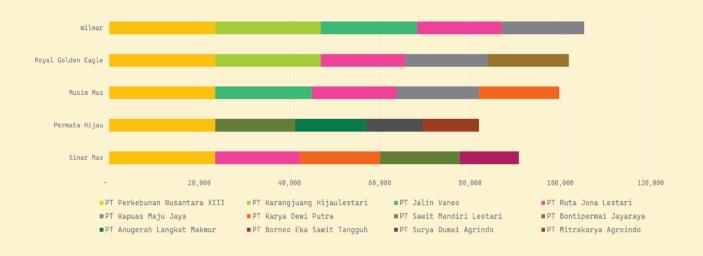


Figure 12. Five Palm Oil Companies With The Largest Deforestation History By Five Biodiesel Producer Groups (in hectares)

In the coming years, the need to expand oil palm plantations will become more urgent. This need will mostly be driven by the increasing demand for palm oil to produce biodiesel. This situation can be seen in the previous analysis (Table 3), where the need to expand oil palm plantations will accelerate as the biodiesel blend rate continues to rise.

This pressure poses a threat to our natural forests. A look at the history of new oil palm plantation development from 2001-2022 (see Figure 4) shows that deforestation has not been absent. The average deforestation in the development of new oil palm plantations reached 28%. This condition is further supported by the vast natural forests that exist within the current oil palm plantation concessions. This includes the concessions that are indicated to be the suppliers of the biodiesel company.

Based on the analysis of remaining natural forest within concessions, there are concessions of biodiesel producer corporate groups that still have large areas of natural forest (see Table 4). In the supply chains of each corporate group, Royal Golden Eagle and Wilmar, there is 226 thousand hectares of remaining natural forest within concessions, or almost four times the size of DKI Jakarta Province. In the supply chains of the other three groups, Sinar Mas covers 183,000 hectares, Musim Mas 85,000 hectares, and Permata Hijau 19,000 hectares.

Table 4. Ownership, capacity, remaining forest area, and deforestation history in the supply chains of the five largest biodiesel supplying corporate groups

	wilmar	8		permata	Sinarmas
Fuel Oil Company	7	4	8	3	7
Biodiesel Allocation (kL)	3,080,532	1,908,018	1,350,469	967,989	854,891
Biodiesel Company	4	3	3	2	2
Capasitas (kL)	4,898,276	2,246,695	2,201,120	1,216,065	1,498,170
Palm Oil Mill Company	190	314	242	197	75
Capacity (CPO eq./year)	13,148,381	21,711,081	16,510,647	11,190,915	5,264,952
Oil Palm Plantation Company in 30 km	938	1,322	975	654	519
Concession Area in 30 km (ha)	9,868,692	12,628,901	8,679,421	5,011,834	5,485,060
Area of Remaining Forest in Concession (ha)	226,084	226,281	85,109	19,427	183,170
Concession Owner Deforestation in 2001-2022 (ha)	1,237,234	1,263,704	957,417	310,791	566,852

In the Musim Mas group's supply chain, for example, there is PT Andalan Sentosa Abadi which still has natural forest within its concession of 16,000 hectares, then there is PT Graha Indosawit Andal Tunggal covering 8,000 hectares, PT Jarak Pagar Katingan Perdana covering 5,000 hectares, and many more. Meanwhile, in the supply chain of the Royal Golden Eagle group, there is PT Anugerah Lahan Kaltim, which has 17,000 hectares of natural forest in its concession, then there is also PT Andalan Sentosa Abadi as in the supply chain of the Musim Mas group, PT Cipta Hijau Bumi Etam covering 11,000 hectares, and others. More details on the top five concessions with the largest remaining natural forest in the biodiesel supply chain can be seen in Figure 13.

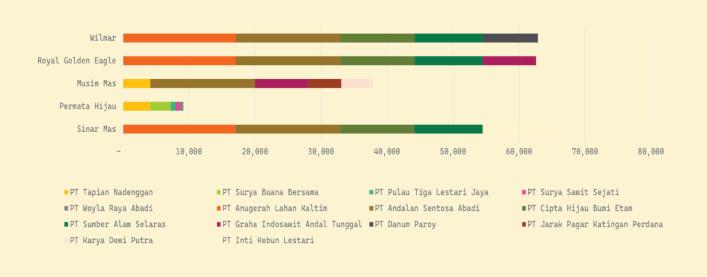


Figure 13. Five Oil Palm Concessions With The Largest Natural Forest By Five Biodiesel Producer Groups (in hectares)

With the ambition to continuously increase the biodiesel blend target and the increasing demand for palm oil in general, the remaining natural forests are in danger of being cleared to meet the increasing demand for palm oil. This is both an opportunity and a challenge that should be seized by the government and fuel oil businesses, especially PT Pertamina (Persero), to realize a better biodiesel supply chain. The fact that 79% of the biodiesel allocation is absorbed by PT Pertamina Patra Niaga shows that sustainability commitments realized at the fuel company or biosolar producer level have the potential to have a large impact by influencing the behavior of midstream and upstream suppliers, both at the biodiesel, palm oil, and FFB producer levels.

The results of Nusantara Atlas identification during the period 2001-2022, an area of 2.95 million hectares of natural forest has been converted into oil palm plantations.³⁹ This forest conversion is mostly driven by the development of new oil palm plantations by companies (see Figure 14). This pattern of establishing new oil palm plantations by clearing natural forests is mostly carried out by companies rather than independent oil palm farmers. About 80% of deforestation from new oil palm plantation development during the period.

³⁹ The TreeMap. (2023), loc. cit.

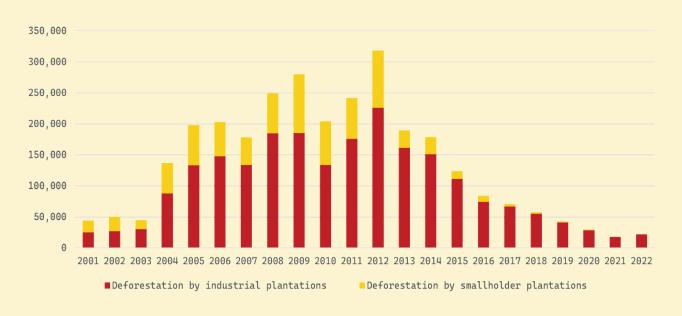


Figure 14. Patterns of Deforestation Due To New Oil Palm Plantation Development By Type Of Business Actor (in hectares)

Based on this pattern (Figure 14), PT Pertamina Patra Niaga, as well as other fuel oil companies, can minimize the risk of dirty palm oil entering their supply chains by prioritizing palm oil from smallholder farms. In addition to minimizing risk, according to a study by Traction Energy Asia,⁴⁰ incorporating independent smallholders into the biodiesel supply chain, with an emphasis on enhancing and increasing the land management capabilities of these smallholders, can elevate the well-being of farmers and contribute to the reduction of greenhouse gas emissions.

Efforts to Protect Natural Forests and the Environment

Positive policies towards the economic allocation and the acceleration of the program to increase the use of biodiesel have the potential to generate high demand for biodiesel, which is currently still dependent on palm oil. This dependence could potentially lead to new land clearing to meet the biodiesel mix requirements. In fact, land clearing produces 20 times more biodiesel emissions. 41

The lack of clear environmental safeguards to avoid massive deforestation to meet the demand for biodiesel supply makes it necessary to look at whether Indonesia's regulatory and policy framework supports deforestation for the benefit of national plantations.

In terms of international commitments, through Law 16/2016, Indonesia has ratified the Paris Agreement and in the 2021 National Determined Contribution (NDC) and has

⁴⁰ Radhianshah, T. (2021). Working Paper: Analisis Biaya-Manfaat Penempatan Pekebun Mandiri dalam Tata Niaga Biodiesel Nasional. Traction Energy Asia.

⁴¹ Yurika. (2021). Keberlanjutan pengembangan biofuel perlu pertimbangkan diversifikasi bahan baku. Dunia Energi. https://www.dunia-energi.com/keberlanjutan-pengembangan-biofuel-perlu-pertimbangkan-diversifikasi-bahan-baku.



stated a commitment to reduce deforestation from 0.820 million hectares to 0.450 million hectares. Furthermore, at the declaration of world leaders in Glasgow on forest and land use through the COP-26 Climate Summit on November 2, 2021, Indonesia committed to stop deforestation and restore forest functions by 2030 (FoLU Net Sink 2030). Indonesia commits to better conserve forests, accelerate restoration, promote sustainable practices that do not encourage land degradation, and empower indigenous and local communities to improve finance for sustainable agriculture and forest management.

The commitment was also followed up by the signing of the commitment of the country with the largest forest in the world (Brazil, Indonesia, Democratic Republic of Congo) to protect their forests. In addition, through Law No. 5 of 1994 on the ratification of the United Nations Convention on Biological Diversity, Indonesia has also stated its commitment to protect biodiversity and develop national strategies, plans, or programs for the conservation and sustainable use of biodiversity into interrelated sectoral or cross-sectoral plans, programs, and policies. It can be concluded that Indonesia's international commitments are oriented towards significantly reducing deforestation and forest preservation commitments.

However, as of this writing, there is no regulation in Indonesia that explicitly prohibits deforestation. This is in line with Minister of Environment and Forestry Siti Nurbaya's statement that achieving FOLU Netsink cannot be equated with zero deforestation.42 The instrument used to suppress deforestation is then based on implementing restrictions on the issuance of new licenses. More details are provided on Indonesia's regulatory direction in protecting deforestation.

Table 5. Indonesia's Regulatory Direction In Protecting Forests And The Environment

Regulation/Policy	Environmental Protection Efforts
Law 41/1999 on Forestry, last amended by Law 19/2004	Prohibition of forest burning and unauthorized tree cutting.
	Prohibition of burning for land clearing.
Law 32/2009 on Environmental Protection and Management	EIA obligations for landform and landscape change.
Trottotton and Management	There is an exception for land burning for local wisdom of a maximum of 2 ha per household.
Law 18/2013 on Prevention and	Prohibition of tree felling in forest areas if without and not in accordance with a forest utilization permit.
Eradication of Forest Damage	Prohibition of tree cutting with a certain radius from the edge of the reservoir/river/beach/lake/swamp. Exceptions to strategic activities after obtaining permission from the Minister.
Law 39/2014 on Plantations	Prohibition of land clearing and cultivation by burning.
PP 71/2014 on Peat Ecosystem	Prohibition of burning peatland.
Protection and Management	Prohibition of land clearing in peat ecosystems with protection functions.

⁴² Riana, F. (2021). Menteri LHK Tegaskan Inisiasi FoLU Net Sink Beda dengan Zero Deforestration. Tempo. Accessed September 10, 2023, from https://nasional.tempo.co/read/1524634/menteri-lhk-tegaskan-inisiasi-folu-net-sink-beda-dengan-zero-deforestration.

Regulation/Policy	Environmental Protection Efforts
	Allowing changes in forest area designation and changes in forest area functions to follow the dynamics of national development and community aspirations.
	Forest area swaps are conducted in permanent production forests, and/or limited production forests.
Government Regulation No. 104/2015 on Procedures for	Forest area swaps are carried out under the following conditions: a) the forest area is guaranteed to remain at least 30% of the area of the watershed, island, and/or province with a proportional distribution; b) maintaining the carrying capacity of the forest area remains feasible.
Changing the Use and Function of Forest Areas	Production forest areas that can be released are unproductive convertible production forest areas, except in provinces where unproductive convertible production forest areas are no longer available.
	Convertible production forest areas cannot be released in provinces with forest areas equal to or less than 30%.
	For matters that have an important impact, broad scope and strategic value, changes in the designation of forest areas must be approved by the DPR.
PP 46/2016 on Strategic Environmental Assessment (KLHS)	Requires SEA to be applied to policies, plans, and/or programs that have the potential to cause LH impacts and/or risks, one of which is related to an increase in the conversion of forest and/or land areas and an increase in the intensity and scope of forest and land fires.
	The establishment of a peat ecosystem function map is mandated.
	It is possible to shift the function of peat ecosystem from cultivation to protection and vice versa.
PP 57/2016 on the Amendment to PP 71/2014 on the Protection and Management of Peat Ecosystems	The obligation to establish a peat ecosystem protection function of at least 30% of the entire Peat Hydrological Unit.
Management of Feat Leosystems	Regulates several technical ways to prevent damage to peat ecosystems and requires the restoration of damage to peat ecosystems.
	Prohibition of new land clearing until the establishment of zoning for protection and cultivation functions in peat ecosystem areas for certain crops.
PermenLHK 30/2016 concerning Performance Assessment of Sustainable Production Forest Management and Timber Legality Verification of License Holders, Management Rights, or Forest Rights.	Encouraging the implementation of sustainable management practices in production forests. With this policy, many forest concessions have improved their management practices. It is targeted that by 2050 all forest concession companies have implemented sustainable harvesting practices (LTS LCCR).
	Halt the granting of new licenses for primary natural forests and peatlands located in conservation forests, protected forests, production forests including limited production forests, regular or permanent production forests, and convertible production forests, and other use areas.
Presidential Instruction 5/2019 on Halting the Granting of New Licenses and Improving the Governance of Primary Natural Forests and Peatlands	Exceptions for the implementation of national development, namely geothermal, oil and gas, electricity, land for national food sovereignty programs including rice, sugarcane, corn, sago, soybeans, and cassava, as well as infrastructure that is a national strategic project stipulated by Presidential Regulation and improvement of existing infrastructure.
	Stop the issuance of new agricultural licenses and plantation business licenses in forest areas, peatlands, and other use areas based on the Indicative Map for the Termination of New Licenses.

Regulasi/Kebijakan	Upaya Perlindungan Lingkungan Hidup
Perpres 18/2020 on the National Medium-Term Development Plan 2020-2024	Forest areas that need to be protected based on the value of forest ecosystem services were expanded from 51.8 million ha to 65.3 million ha located inside and outside forests.
PP 23/2021 on Forest Management and PP 24/2021	Tightening the administration of changes in forest area designation, forest area use, and forest utilization to be released and revoked.
Presidential Regulation 44/2020 on Indonesia's Sustainable Palm	Restriction of forest conversion in natural forests and peatlands through operational maps of plantation areas, natural forest maps and indicative maps of new license delays.
Oil Plantation Certification System	Mapping and protection of high conservation value areas.
Permentan 38/2020 on the Implementation of Sustainable	Using the ISPO certification mechanism for plantation companies and smallholders, to implement good plantation practices, as well as environmental, natural resource and biodiversity management (including fire control, fire prevention and suppression, and biodiversity conservation).
Palm Oil Plantation Certification	Prohibit new plantation development from clearing natural forests and peatlands, in accordance with applicable laws and regulations.

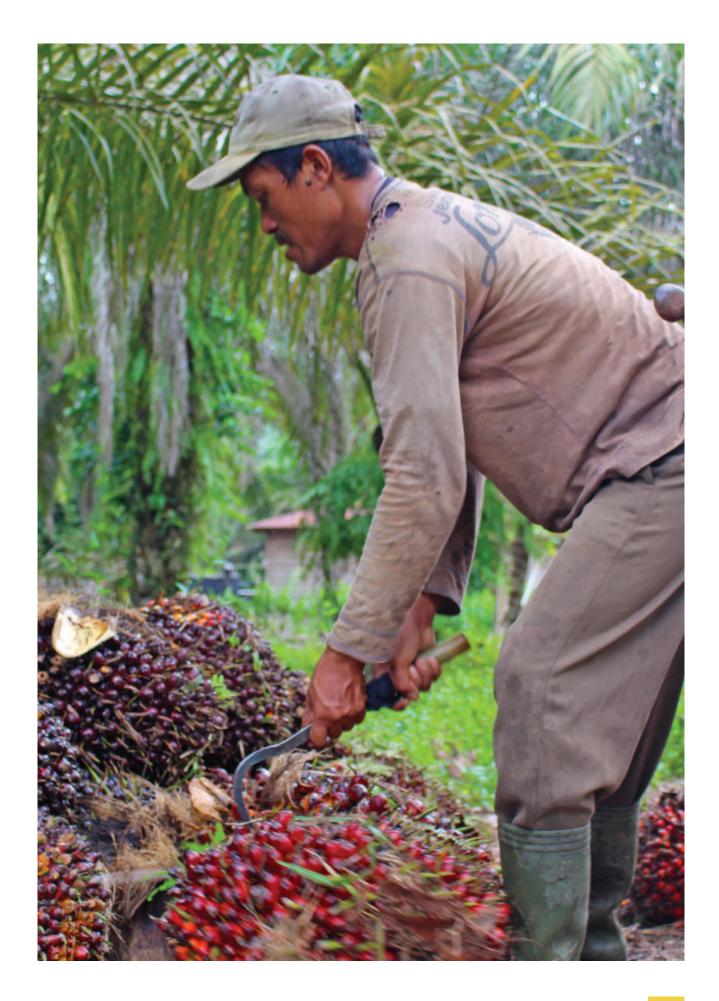
Based on Table 5, it can be concluded that in principle, Indonesia's policy and regulatory direction regarding deforestation is not oriented towards achieving zero deforestation, but on reducing deforestation through restrictions on licensing or approval/certification systems to avoid more massive damage to the environment, as well as administrative tightening of protection and restoration of forest areas. In the context of land conversion, if it is carried out through and with adequate environmental instruments in accordance with the provisions (EIA or KLHS), it can be carried out.

Unfortunately, looking at the direction of recent policy developments, a few strategic policies such as the moratorium on new permits and the obligation of SEA may be excluded for projects categorized as national strategic projects (the introduction of the Rapid SEA method/strategic feasibility study/strategic assessment which in principle weakens the environmental preconditions in project implementation). Given the current direction of biodiesel development, it should be anticipated that in the future biodiesel projects could be projected as national strategic projects in Indonesia.

Details regarding facilities in national strategic projects in the Job Creation Law are as follows:

Table 6. Ease Of National Strategic Projects (Psn) Under The Job Creation Law

Pasal	Ketentuan dalam UU CK	Catatan
Article 17 number 18	If there is a change in national policy of a strategic nature as referred to in Article 20 paragraph (5) letter d, Article 23 paragraph (5) letter d, and Article 26 paragraph (6) letter d that has not been included in the Spatial Plan and/or zoning plan, Space Utilisation can still be implemented.	National strategic policies can still be implemented even if they are not included in the spatial plan and/or zoning plan.
Article 29 umber 21	Article 67 and Article 109 of Law 39/2014 deleted	Article 67 and Article 109 of Law 39/2014 on the obligation to preserve the environment (making an AMDAL analysis or environmental management and monitoring efforts, as well as making a statement of ability to provide adequate facilities, infrastructure, and emergency response systems to cope with the occurrence of fires as a basis for business license approval) were abolished.



Pasal	Ketentuan dalam UU CK	Catatan
Article 31 number 1	In the case of public interest and/or national strategic projects, Agricultural cultivation land as referred to in paragraph (1) may be converted and implemented in accordance with the provisions of laws and regulations.	In the case of public interest and/or national strategic projects, agricultural cultivation land may be converted.
Article 36 umber 2	 The Central Government determines and maintains the adequacy of Forest Area size and Forest cover for each river basin and/or island in order to optimize environmental benefits, social benefits, and economic benefits for local communities. The Central Government regulates the area that must be maintained in accordance with the physical and geographical conditions of the watershed and/or island. 	The provision of a minimum forest area of at least 30% of the watershed area (Article 18 of the Forestry Law) was abolished and changed to the central government's discretion in regulating the area that must be maintained according to the physical and geographical conditions of the watershed, especially for national strategic projects.
Article 124 number 1	 Land that has been designated as Sustainable Food Agriculture Land is protected and prohibited from conversion. In the case of public interest and/or National Strategic Projects, the Sustainable Food Agricultural Land as referred to in paragraph (1) may be converted and implemented in accordance with the provisions of laws and regulations. 	In the case of public interest and/or National Strategic Projects, sustainable food agricultural land may be converted.
and regulations. The Central Government or Regional Governments in accordance with their authority based on norms, standards, procedures, and criteria established by the Central Government are responsible for providing land and Business Licenses for national strategic projects from the Central Government, Regional Governments, state-owned enterprises, or regionally-owned enterprises.		The central or local government is responsible for providing land and business licenses for national strategic projects.

If the biodiesel fulfillment project is categorized as a national strategic project, it is likely that many environmental provisions will be overridden and the prerequisites for land clearing will be relaxed. Moreover, through the LTS-LCCR document, Indonesia is stated to still have a deforestation quota of approximately 6.8 million hectares for the period 2020 - 2050. Furthermore, although Indonesia's regulatory framework has explicitly stated that fires are not allowed in any form and for any reason, with the elimination of the provisions of Articles 67 and 109 of Law 39/2014, the potential for fires in the process of land management and utilization is strong due to the absence of adequate safeguards to prevent forest fires, in addition to the provision of facilities and infrastructure that are often ignored by business actors. In other words, the expansion of the use of biofuels and biodiesel is carried out on a large scale with environmental protection safeguards that can be said to be weakened. This, of course, has the potential to cause damage to the environment, including deforestation and forest fires, because environmental safeguard commitments are no longer required as a condition for issuing business licenses.

Furthermore, Permentan 38/2020 has prohibited the clearing of natural forests and peatlands in the development of new plantations in accordance with the provisions of laws and regulations. The reference to natural forests and peatlands is based on the Indicative Map for Postponing the Granting of New Licenses (PIPPIB) which is revised every 6 (six) months. In other words, although it has been explicitly stated in the laws and regulations that clearing

of natural forests and peatlands is prohibited, if at the last revision of the PIPPIB there is a change in the function of the area that was originally natural forest or peatland to not, then clearing can still be carried out in that area. This legal uncertainty then has the potential for continued land clearing in natural forests and peatlands. This condition contradicts the original idea of biofuels as an effort to reduce emissions. Because in the end the Indonesian government is unable to guarantee the release of emissions that occur due to forest clearing for oil palm plantations.

Specifically, regarding environmental protection commitments in the biodiesel development program, the Minister of Energy and Mineral Resources Regulation No. 24 of 2021,43 has mandated the provision and utilization of biodiesel fuel in a sustainable manner to consider environmental, economic, and social aspects. However, until now there has been no specific regulation outlining the application of biodiesel in a sustainable manner. In the General Guidelines for Handling and Storage of Biodiesel and B30, environmental safeguards are only reflected in spill containment measures.44 The Minister of Energy and Mineral Resources, Arifin Tasrif, later expressed his commitment in efforts to develop environmental and social indicators, which will avoid large-scale land clearing that has the potential to cause environmental damage and instead increase the carrying capacity of the environment.45

The presence of the Indonesian Bioenergy Sustainability Indicator (IBSI) is a hope to ensure that environmental, economic, and social aspects are applied in bioenergy development. On environmental criteria, a full life cycle analysis from raw materials to waste management must be practiced, in addition to economic aspects that emphasize increasing productivity, distribution infrastructure, energy diversification, and clean energy balance and social aspects to increase farmers' income, create jobs and expand energy access. Unfortunately, until now IBSI has not been implemented despite the increasing percentage of biodiesel use. It is also unclear about the draft status of IBSI when it will be implemented.

⁴³ Regulation of the Minister of Energy and Mineral Resources No. 24 of 2021 on the Provision and Utilization of Biodiesel Type Biofuels in the Framework of Financing by the Palm Oil Plantation Fund Management Agency

⁴⁴ See Directorate General of New Renewable Energy and Energy Conservation, "Guidelines for Handling and Storage of Biodiesel and Biodiesel Blends (B30)", Ministry of Energy and Mineral Resources 2020.

⁴⁵ Arifin Tasrif in 3rd Palm Biodiesel Conference on March 24, 2022. See Directorate General of New Renewable Energy and Energy Conservation, "Biodiesel Development in Indonesia Gives Real Benefits", accessed on September 14, 2023.



Total palm oil demand will increase significantly until 2042 due to increased domestic demand for food, oleochemicals, biodiesel, as well as increased global vegetable oil demand. The share of palm oil for food and oleochemicals will range from 50% to 71% of the demand to produce biodiesel in 2042. Palm oil demand for biodiesel production will be a major factor in the increase in domestic palm oil demand in the coming years.

The increase in demand will force the development of new plantations, whether the biodiesel blend target scenario remains at 35% or increases to 50% by 2025. What makes the difference is how quickly or slowly the need for expansion arises. Given the history of large deforestation in the oil palm plantation preparation process and weak efforts to protect natural forests, both in terms of the biodiesel supply chain and government regulations in general. Therefore, the determination of biodiesel blending targets must consider other factors such as the availability of oil palm plantation land and production levels, the demand for palm oil for other purposes such as food and oleochemicals, and global vegetable oil demand to maintain Indonesia's position in international trade.

For this reason, the Indonesian government must improve the governance of palm oil and biodiesel as well as make a clear plan that takes into account the factors mentioned above. Some steps that can be taken are:

- 1. Limit the biodiesel blend target to 35% or less by a certain year to minimize a significant increase in demand for palm oil that would force the development of new plantations.
- 2. Set a limit on the size of oil palm plantations until a certain year by stopping the issuance of new licenses and evaluating the licenses that have been issued. This is done so that the control of oil palm plantation expansion is no longer with the license holder, but with the government. Evaluation of the need for new oil palm plantation expansion can be carried out every 5 or 10 years by considering productivity improvements or the development of new raw materials as a substitute for increased demand for palm oil and the location of the planned expansion.
- 3. Use the time until the evaluation deadline for biodiesel blend rate and plantation area targets to improve data governance of plantations and the palm oil industry; develop a traceable, transparent, and deforestation-free biodiesel supply chain scheme that prioritizes independent smallholders; develop new feedstocks as substitutes for palm oil for biodiesel; and adopt stronger and more comprehensive natural forest protection policies.

REFERENCES

Alkabbash, A. N., Alam, M. Z., Mirghani, M. E. S., & Al-Fusaiel, A. M. A. (2009). Biodiesel Production from Crude Palm Oil by Transesterification Process. Journal of Applied Sciences, 9(17), 3166-3170. https://doi.org/10.3923/jas.2009.3166.3170

ANJ. (2023). Investor Newsletter.

BPS – Badan Pusat Statistik (Indonesia Central Bureau of Statistics). (2020). Rekapitulasi Luas Penutupan Lahan Hutan dan Non Hutan Menurut Provinsi Tahun 2014-2021 (Ribu Ha) (Recapitulation of Forest and Non-Forest Land Cover Area by Province 2014-2021 (Thousand Ha)). Accessed on December 18, 2023, from https://www.bps.go.id/id/statistics-table/1/MjExMCMx/rekapitulasi-luas-penutupan-lahan-hutan-dan-non-hutan-menurut-provinsitahun-2014-2021--ribu-ha-.html.

BPS – Badan Pusat Statistik (Indonesia Central Bureau of Statistics). (2023). Proyeksi penduduk Indonesia 2020-2050: hasil sensus penduduk 2020 (Indonesia population projection 2020-2050: 2020 population census results). Indonesia Central Bureau of Statistics. ISBN: 978-602-438-521-7.

Benedict, J. J., Carlson, K. M., Febrian, R., & Heilmayr, R. (2023). Characteristics of Indonesian palm oil mills (Version V2) [Dataset]. Harvard Dataverse. https://doi.org/10.7910/DVN/SMPITC.

BPDPKS – Badan Pengelola Dana Perkebunan Kelapa Sawit (Palm Oil Plantation Fund Management Agency). (2016). BPDPKS Annual Report 2015. Accessed on October 30, 2023, from https://www.bpdp.or.id/category/laporan-keuangan.

BPDPKS – Badan Pengelola Dana Perkebunan Kelapa Sawit (Palm Oil Plantation Fund Management Agency). (2017). BPDPKS Annual Report 2016. Accessed on October 30, 2023, from https://www.bpdp.or.id/category/laporan-keuangan.

BPDPKS – Badan Pengelola Dana Perkebunan Kelapa Sawit (Palm Oil Plantation Fund Management Agency). (2018). BPDPKS Annual Report 2017. Accessed on October 30, 2023, from https://www.bpdp.or.id/category/laporan-keuangan.

BPDPKS – Badan Pengelola Dana Perkebunan Kelapa Sawit (Palm Oil Plantation Fund Management Agency). (2019). BPDPKS Annual Report 2018. Accessed on October 30, 2023, from https://www.bpdp.or.id/category/laporan-keuangan.

BPDPKS – Badan Pengelola Dana Perkebunan Kelapa Sawit (Palm Oil Plantation Fund Management Agency). (2020). BPDPKS Annual Report 2019. Accessed on October 30, 2023, from https://www.bpdp.or.id/category/laporan-keuangan.

BPDPKS – Badan Pengelola Dana Perkebunan Kelapa Sawit (Palm Oil Plantation Fund Management Agency). (2021). BPDPKS Annual Report 2020. Accessed on October 30, 2023, from https://www.bpdp.or.id/category/laporan-keuangan.

BPDPKS – Badan Pengelola Dana Perkebunan Kelapa Sawit (Palm Oil Plantation Fund Management Agency). (2022). BPDPKS Annual Report 2021. Accessed on October 30, 2023, from https://www.bpdp.or.id/category/laporan-keuangan.

BPDPKS – Badan Pengelola Dana Perkebunan Kelapa Sawit (Palm Oil Plantation Fund Management Agency). (2023). BPDPKS Annual Report 2022. Accessed on October 30, 2023, from https://www.bpdp.or.id/category/laporan-keuangan.

Cattau, M. E., Harrison, M. E., Shinyo, I., Tungau, S., Uriarte, M., & DeFries, R. (2016). Sources of anthropogenic fire ignitions on the peat-swamp landscape in Kalimantan, Indonesia. Global Environmental Change, 39, 205-219. https://doi.org/10.1016/j.gloenvcha.2016.05.005

Chris Malins. (2018). Driving deforestation: The impact of expanding palm oil demand through biofuel policy. Cerulogy and Rainforest Foundation Norway.

Dilip Khatiwada, Carl Palmén & Semida Silveira. (2021). Evaluating the palm oil demand in Indonesia: production trends, yields, and emerging issues, Biofuels, 12:2, 135-147, DOI: 10.1080/17597269.2018.1461520

Ditjen EBTKE – Direktorat Jenderal Energi Baru, Terbarukan, dan Konservasi Energi Kementerian ESDM (Directorate General of New Renewable Energy and Energy Conservation Ministry of Energy and Mineral Resources). (2023). Program Bahan Bakar Nabati B35 Siap Implementasi Mulai 1 Februari 2023 (B35 Biofuel Programme Ready for Implementation Starting 1 February 2023). Accessed on 6 October, 2023, from https://ebtke.esdm.go.id/post/2023/01/09/3395/program.bahan.bakar.nabati.b35.siap.implementasi.mulai.1.februari.2023

Ditjen EBTKE – Direktorat Jenderal Energi Baru, Terbarukan, dan Konservasi Energi Kementerian ESDM (Directorate General of New Renewable Energy and Energy Conservation Ministry of Energy and Mineral Resources). (2022). Pengembangan Biodiesel di Indonesia Beri Manfaat Nyata (Biodiesel Development in Indonesia Gives Real Benefits). Accessed on September 14, 2023, from https://ebtke.esdm.go.id/post/2022/03/24/3127/pengembangan.biodiesel. di.indonesia.beri.manfaat.nyata.

DitjenEBTKE-DirektoratJenderalEnergiBaru,Terbarukan,danKonservasiEnergiKementerian ESDM (Directorate General of New Renewable Energy and Energy Conservation Ministry of Energy and Mineral Resources). (2019). FAQ: Mandatory Biodiesel 30% (B30) Program. Accessed on September 10, 2023, from https://ebtke.esdm.go.id/post/2019/12/19/2434/faq.program.mandatori.biodiesel.30.b30#:~:text=Program%20B30%20is%20a%20 government%20program,%20fuel%20oil%20of%20solar%20type.

Ditjenbun Kementan – Direktorat Jenderal Perkebunan Kementerian Pertanian (Directorate General of Plantation, Ministry of Agriculture). (2015). Statistik Perkebunan Indonesia: Kelapa Sawit 2014-2016 (Indonesian Plantation Statistics: Palm Oil 2014-2016). Ditjenbun Kementan.

Ditjenbun Kementan – Direktorat Jenderal Perkebunan Kementerian Pertanian (Directorate General of Plantation, Ministry of Agriculture). (2016). Statistik Perkebunan Indonesia: Kelapa Sawit 2015-2017 (Indonesian Plantation Statistics: Palm Oil 2015-2017). Ditjenbun Kementan.

Ditjenbun Kementan – Direktorat Jenderal Perkebunan Kementerian Pertanian (Directorate

General of Plantation, Ministry of Agriculture). (2017). Statistik Perkebunan Indonesia: Kelapa Sawit 2016-2018 (Indonesian Plantation Statistics: Palm Oil 2016-2018). Ditjenbun Kementan.

Ditjenbun Kementan – Direktorat Jenderal Perkebunan Kementerian Pertanian (Directorate General of Plantation, Ministry of Agriculture). (2018). Statistik Perkebunan Indonesia: Kelapa Sawit 2017-2019 (Indonesian Plantation Statistics: Palm Oil 2017-2019). Ditjenbun Kementan.

Ditjenbun Kementan – Direktorat Jenderal Perkebunan Kementerian Pertanian (Directorate General of Plantation, Ministry of Agriculture). (2019). Statistik Perkebunan Indonesia: Kelapa Sawit 2018-2020 (Indonesian Plantation Statistics: Palm Oil 2018-2020). Ditjenbun Kementan.

Ditjenbun Kementan – Direktorat Jenderal Perkebunan Kementerian Pertanian (Directorate General of Plantation, Ministry of Agriculture). (2020). Statistik Perkebunan Unggulan Nasional: Kelapa Sawit 2019-2021 (Statistical of National Leading Estate Crops Commodity: 2019-2021). Directorate General of Plantation, Ministry of Agriculture.

Ditjenbun Kementan – Direktorat Jenderal Perkebunan Kementerian Pertanian (Directorate General of Plantation, Ministry of Agriculture). (2021). Statistik Perkebunan Unggulan Nasional: 2020-2022 (Statistical of National Leading Estate Crops Commodity: 2020-2022). Ditjenbun Kementan.

Ditjenbun Kementan – Direktorat Jenderal Perkebunan Kementerian Pertanian (Directorate General of Plantation, Ministry of Agriculture). (2022). Statistik Perkebunan Unggulan Nasional: 2021-2023 (Statistical of National Leading Estate Crops Commodity: 2021-2023). Ditjenbun Kementan.

Eddy Abuddarchman. Special dialogue Menggapai Sawit Tetap jadi Andalan Indonesia saat Dunia Penuh Ketidakpastian (Special dialogue Achieving Palm Oil Remains Indonesia's Mainstay in a World of Uncertainty). June 26 (2023). Accessed on September 10, 2023, from https://www.cnbcindonesia.com/news/20230626095441-8-449177/dunia-penuh-ketidakpastian-sawit-tetap-jadi-andalan-ri..

GAPKI. (2023). Statistik Industri Kelapa Sawit Indonesia 2020-2022 (Indonesia Palm Oil Industry Statistics 2020-2022).

Greenpeace. (2013). Izin Memusnahkan (Permit to Destroy). Jakarta, Indonesia.

Decree of the Director General of Oil and Gas No. 13483 K/24/DJM/2006 concerning Standards and Quality (Specifications) of Biodiesel Type Biofuel as Other Fuel Marketed Domestically

Decree of the Minister of Energy and Mineral Resources No. 91 K/12/DJE/2019 on the Amendment to Decree of the Minister of Energy and Mineral Resources No. 350 K/12/Dje/2018 on the Market Index Price of Biodiesel Fuel Mixed into Fuel Oil.

MOEF. (2023). Land Cover 2022. Accessed on November 10, 2023, from https://geoportal.menlhk.go.id/server/rest/services/SIGAP_Interaktif/Penutupan_Lahan_2022/MapServer.

Koalisi Indonesia Memantau. (2021). Planned Deforestation: Forest Policy in Papua. February, 2021. Jakarta, Indonesia.

LPEM FEB UI. (2020). Biodiesel Policy Risks from the Viewpoint of Macroeconomic and Environmental Indicators. Jakarta: Indonesia.

Musim Mas Holdings Pte Ltd. (2023). Sustainability Report 2022: Sustainability Performance Data.

Nurhayati, N., Amri, T. A., Annisa, N. F., & Syafitri, F. (2020). The Synthesis of Biodiesel from Crude Palm Oil (CPO) using CaO Heterogeneous Catalyst Impregnated with H2SO4, Variation of Stirring Speed and Mole Ratio of Oil to Methanol. Journal of Physics, 1655(1), 012106. https://doi.org/10.1088/1742-6596/1655/1/012106

Nuryadi, A. P., Pratomo, T. B., & Raksodewanto, A. A. 2019. Analysis of the feasibility of small-biomass power generation from the palm oil mill - study case: palm oil mill in Riau-Indonesia. IOP Conference Series, 336(1), 012018. https://doi.org/10.1088/1755-1315/336/1/012018

OECD/FAO. (2023). OECD-FAO Agricultural Outlook 2023-2032, OECD Publishing, Paris, https://doi.org/10.1787/08801ab7-en.

Paminto, A. K., Karuniasa, M., & Frimawaty, E. (2022). Potential Environmental Impact of Biodiesel Production from Palm Oil using LCA (Life Cycle Assessment) in Indonesia. Journal of Natural Resources and Environmental Management, 12(1), 64-71. https://doi.org/10.29244/jpsl.12.1.64-71

Minister of Energy and Mineral Resources Regulation No. 24 of 2021 Concerning the Provision and Utilization of Biodiesel Type Biofuels in the Framework of Financing by the Palm Oil Plantation Fund Management Agency. Promulgated on August 6, 2021, BN 2021, No.909.

Regulation of the Minister of Energy and Mineral Resources No. 26 of 2016 on the Provision and Utilization of Biodiesel Fuel in the Framework of Financing by the Palm Oil Plantation Fund Management Agency. Promulgated on October 12, 2016. BN 2016, No. 1508.

Regulation of the Minister of Energy and Mineral Resources No. 29 of 2015 on the Provision and Utilization of Biofuel of Biodiesel type in the Financing Framework by the Palm Oil Estate Fund Management Agency. Promulgated on September 11, 2015. BN 2015, No. 1367.

Minister of Energy and Mineral Resources Regulation No. 41 of 2018 on the Provision and Utilization of Biodiesel Type Biofuels in the Framework of Financing by the Palm Oil Plantation Fund Management Agency. Promulgated on August 24, 2018. BN 2018, No. 1137.

Presidential Regulation No. 61 of 2015 on the Collection and Use of Palm Oil Plantation Funds. Promulgated on May 25, 2015. LN 2015, No. 105.

MapBiomas Project - Collection 2.0. Annual Map of Indonesia Land Use and Cover, accessed on November 17, 2023 through the link: https://platform.indonesia.mapbiomas.org/.

PT Dharma Satya Nusantara Tbk (2023). PT Dharma Satya Nusantara Tbk (DSNG:IJ).

Accessed on September 5, 2023, from https://dsn.co.id/press-release/in-2022-dsngs-cpo-production-increased-by-17/

Radhianshah, T. (2021). Working Paper: Cost-Benefit Analysis of Independent Smallholder Placement in the National Biodiesel Trade. Traction Energy Asia.

Ramadhan, R., Mori, A., Abdoellah, O.S. (2023). Biofuels Development and Indirect Deforestation. In: Triyanti, A., Indrawan, M., Nurhidayah, L., Marfai, M.A. (eds) Environmental Governance in Indonesia. Environment & Policy, vol 61. Springer, Cham. https://doi.org/10.1007/978-3-031-15904-6_10

Editorial Team. (2019). PPKS Road Tests B50 Vehicle, Covering 5,000 km Distance. Sawit Indonesia Magazine Online. Accessed November 29, 2023, from https://sawitindonesia.com/ppks-uji-jalan-kendaraan-b50-tempuh-jarak-5-000-km/.

Republic of Indonesia. (2022). Enhanced Nationally Determined Contribution. Accessed September 10, 2023, from https://unfccc.int/sites/default/files/NDC/2022-09/ENDC%20 Indonesia.pdf.

Republic of Indonesia. (2022). National Forest Reference Level for Deforestation, Forest Degradation and Enhancement of Forest Carbon Stock.

Riana, F. (2021). Menteri LHK Tegaskan Inisiasi FoLU Net Sink Beda dengan Zero Deforestration (Minister of Environment and Forestry Affirms FoLU Net Sink Initiative is Different from Zero Deforestration). Tempo. Accessed September 10, 2023, from https://nasional.tempo.co/read/1524634/menteri-lhk-tegaskan-inisiasi-folu-net-sink-beda-dengan-zero-deforestration.

Royal Academy of Engineering. (2017). Sustainability of Liquid Biofuels, Royal Academy of Engineering. July 2017.

Saetiao, P., Kongrit, N., Cheng, C. K., Jitjamnong, J., Direksilp, C., & Khantikulanon, N. (2023). Catalytic conversion of palm oil into sustainable biodiesel using rice straw ash supported-calcium oxide as a heterogeneous catalyst: Process simulation and techno-economic analysis. Case Studies in Chemical and Environmental Engineering, 8, 100432. https://doi.org/10.1016/j.cscee.2023.100432

Saputra, W., Sulistyanto, S., & Isnaini, K. N. (2022). Analisis Kerentanan Korupsi dalam Kebijakan Subsidi Biodiesel di Indonesia (Analysis of Corruption Vulnerability in Biodiesel Subsidy Policy in Indonesia). Integritas, 7(2), 279-290. https://doi.org/10.32697/integritas. v7i2.815

Setiawan, V. N. (2023). Sempat tertunda, B35 berlaku penuh 1 Agustus. CNBC Indonesia (Delayed, B35 takes full effect August 1). CNBC Indonesia. Accessed November 29, 2023, from https://www.cnbcindonesia.com/news/20230712162342-4-453706/sempat-tertunda-b35-berlaku-penuh-1-agustus.

Siswadi, A. (2021). Peneliti: Indonesia Sumbang Emisi, Terbesar dari Deforestasi dan Kebakaran Hutan (Researcher: Indonesia Contributes the Most Emissions from Deforestation and Forest Fires). Tempo. https://tekno.tempo.co/read/1523136/peneliti-indonesia-sumbang-emisi-terbesar-dari-deforestasi-dan-kebakaran-hutan

SMART. (2022). Smartnews - June 2022.

Stallard, E., & Song, W. (2021). Biodiesel Indonesia: Harapan untuk mengurangi gas emisi yang justru mendorong deforestasi (Indonesian biodiesel: A hope to reduce emissions that drives deforestation. BBC News Indonesia). Accessed on September 14, 2023, from https://www.bbc.com/indonesia/indonesia-59574175Esme Stallard and Wanyuan Song. Biodiesel Indonesia: Hope to reduce emissions that drive deforestation. BBC News Indonesia December 8, 2021 edition. Accessed on September 14, 2023.

Teladan Prima Agro. (2023). Investor Newsletter FY-2022.

The TreeMap. (2023). Annual expansion of oil palm and pulpwood plantations, and associated forest conversion. Accessed November 11, 2023, from https://map.nusantara-atlas.org/.

Law No. 39 of 2014 on Plantations. Promulgated on October 17, 2014. LN 2014, No. 308, TLN No. 5613.

Law Number 6 of 2023 on Stipulating Government Regulation in Lieu of Law Number 2 of 2022 on Job Creation into Law. Promulgated on March 31, 2023. LN 2023, No. 41, TLN No. 6856.

Vijay V, Pimm SL, Jenkins CN, Smith SJ. (2016). The Impacts of Oil Palm on Recent Deforestation and Biodiversity Loss. PLoS ONE 11(7): e0159668. https://doi.org/10.1371/journal.pone.0159668

Wahyuni, H., & Suranto, S. (2021). Dampak Deforestasi Hutan Skala Besar terhadap Pemanasan Global di Indonesia (The Impact of Large-Scale Deforestation on Global Warming in Indonesia). JIIP: Scientific Journal of Government Science, 6(1), 148-162. https://doi.org/10.14710/jiip.v6i1.10083

Wilmar International Limited. (2023). Sustainability Report 2022: Base Data Tables.

Yurika. (2021). Keberlanjutan pengembangan biofuel perlu pertimbangkan diversifikasi bahan baku. Dunia Energi (Sustainability of biofuel development needs to consider feedstock diversification. Energy World). https://www.dunia-energi.com/keberlanjutan-pengembangan-biofuel-perlu-pertimbangkan-diversifikasi-bahan-baku

Zahira, N. (2023). Penerapan B40 di 2024 Berpotensi Kurangi Emisi hingga 40% (B40 Implementation in 2024 Potentially Reduces Emissions by 40%). Katadata. Accessed November 29, 2023, from https://katadata.co.id/lonaolavia/berita/64f5dabebde0e/penerapan-b40-di-2024-berpotensi-kurangi-emisi-hingga-40.Peraturan Legislation





