UNIVERSITAS GADJAH MADA
FAKULTAS KEHUTANAN

SUPPORTING INDONESIA'S BIODIESEL POLICY:

DO WE NEED TO EXPAND THE OIL PALM PLANTATION?

NOVEMBER 2023


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THIS POLICY PAPER AIMS TO PROVIDE RECOMMENDATIONS TO THE INDONESIAN GOVERNMENT IN ITS EFFORTS TO MEET FUTURE PALM OIL NEEDS TO MEET BIODIESEL DEVELOPMENT TARGETS WITHOUT PUTTING MORE SIGNIFICANT PRESSURE ON THE FOREST COVER THAT STILL EXISTS IN INDONESIA.

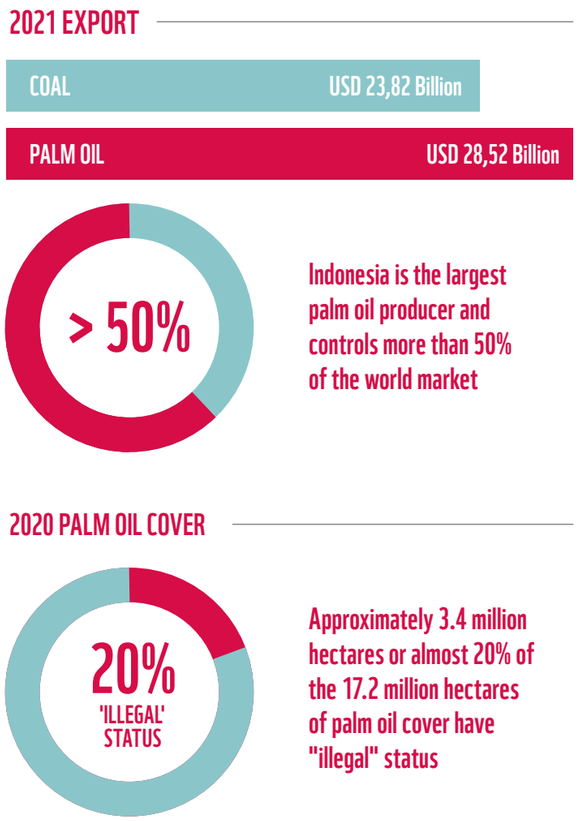
PART 1

PROLOG

Palm oil undoubtedly serves as a crucial commodity for the national economy. Over the past decade, it has emerged as Indonesia's most favored export product and has become a staple commodity, surpassing the value of once-dominant exports like wood and petroleum, and even coal exports.

According to BPS, in 2021, palm oil exports recorded a value of USD 28.52 billion, exceeding that of coal exports, which achieved USD 23.82 billion. The significant rise in export value in 2021 is closely tied to the surge in global CPO prices, with Indonesia as the leading producer controlling over 50% of the market. The expansion of the palm oil industry is thriving due to the proliferation of derivative products, which results in a remarkable increase of palm oil plantation area throughout Indonesia.

Official data from the Ministry of Agriculture (2019)[1] indicates that Indonesia had 16.4 million hectares of palm oil cover. Latest figures provided by WWF Indonesia in 2020 show an increase of around 0.9 million hectares of national palm oil cover to 17.2 million hectares as of now. Of this area, approximately 3.4 million hectares have "illegal" status because it is in forest areas (Bakhtiar et al., 2019)[2]. The controversy surrounding palm oil emerged when it was blamed for causing widespread deforestation, leading to its boycott across the globe and affecting Indonesia's economy.



One method employed by the Indonesian government to decrease deforestation induced by the growth of oil palm plantations involves implementing a moratorium policy on new permits. This action is stipulated in Presidential Instruction Number 8/2018. This regulation is also reinforced by Presidential Instruction No. 5/2019, which terminates the issuance of new permits, and enhances the governance of primary natural forests and peatlands. Additionally, Permentan No. 38/2020 mandates the implementation of ISPO for all oil palm plantation business actors. Various other regulations also uphold this principle[3]. The policy of imposing a moratorium on the permanent utilisation of primary natural forests and peatlands, and enacting a moratorium policy on permits for palm oil plantations, between 2018 and 2021 has shown to be highly effective in mitigating deforestation in Indonesia. Indonesia displayed the lowest deforestation rate in the past thirty years during the year 2019-2020, registering only 115.46 thousand hectares/year (KLHK, 2021)[4]. The moratorium policy has a duration of three years and will cease in September 2021, with no further extended.

The conclusion of the palm oil moratorium policy presents a notable hurdle to forest and land governance in Indonesia. The amplified domestic demand for palm oil, based on the policy of using 30% biodiesel (B30) for all sectors by 2025, pursuant to Minister of Energy and Mineral Resources (ESDM) Regulation Number 12 of 2015, is driving up the risk of expansion of oil palm plantations. Moreover, there are discussions about advancing the B100[5] policy. According to the LPEM FEB-UI study (2020)[6], fulfilling the demand for biodiesel conversion (B30-B50) necessitates the incorporation of 5-9 million hectares of new oil palm plantation land. In addition to catering to the domestic palm oil requirements, which are expected to escalate in tandem with the biodiesel strategy, the worldwide demand for Indonesian palm oil goods is anticipated to persistently grow at around 1.8%[7]. The rising demand for palm oil both locally and internationally raises concerns about the surge in deforestation rates in Indonesia. Despite successfully reducing the rates in 2020, it is predicted that the rates will escalate once again, leading to detrimental effects on the environment and biodiversity.

This policy paper aims to provide recommendations to the Indonesian Government in its efforts to meet future palm oil needs to meet biodiesel development targets without putting more significant pressure on the forest cover that still exists in Indonesia.

1,8%
Global demand for palm oil is predicted to continue to rise

5-9 Million Hectares
Palm oil plantations are predicted to continue to expand

The rising demand for palm oil raises concerns about the surge in deforestation rates and leading to detrimental effects on the environment and biodiversity

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5. https://www.bpdp.or.id/kementan-berhasil-kembangkan-b100
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PART 2

UNDERSTANDING INDONESIA'S BIODIESEL POLICY

A. HISTORY & DEVELOPMENT OF BIODIESEL REGULATIONS IN INDONESIA

Thoughts of developing biodiesel emerged in the 1970s in response to the world oil crisis[8]. Only in the 1990s did diverse research endeavors in Indonesia start to explore biodiesel's potential as an environment-friendly substitute fuel. At that time, the Oil and Gas Technology Research and Development Center (LEMIGAS), the Agency for the Assessment and Application of Technology (BPPT), the Palm Oil Research Center (PPKS), the Indonesian Plantation Research Institute (LRPI), and the Bandung Institute of Technology (ITB) initiated preliminary research and studies on biodiesel production from different raw sources[9]. Although biodiesel research has been conducted in Indonesia since the 1990s, the pivotal moment for the research was in 2005 when Indonesia was confronted with a dilemma due to the surge in the price of fuel oil. The price rose over 100%, from US$ 60 per barrel to US$ 148, resulting in a severe blow to the national finances. The ongoing fossil energy crisis prompted the Indonesian government to seek a solution, which involved reducing fuel consumption and exploring alternative energy sources like biodiesel.

The Indonesian biodiesel policy originated in 2006 via Presidential Instruction Number 1 of 2006, which addressed the Provision and Utilization of Vegetable Fuels as Other Fuels (Inpres 1/2006). The goal of the policy was to encourage the use of biofuels as a sustainable and eco-friendly option while also reducing reliance on fossil fuels. In the period between 2004 and 2007, global oil prices underwent a considerable hike leading the government to release the Minister of Energy and Mineral Resources Regulation Number 32 of 2008. This regulation involves the utilization, provision, and trading procedures of Vegetable Fuels as Other Fuels (ESDM Ministerial Regulation 32/2008). It was enacted as a follow-up action from Presidential Instruction 1/2006 and aimed to counteract the oil crisis that arose during that time[10]. During the initial period of this policy, specifically from 2008 to 2009, a requirement was established for the addition of 1% biodiesel (B1) to diesel fuel. Additionally, ESDM Ministerial Decree 32/2008 outlined a plan for biodiesel development, valid from 2008 to 2025, for the first time.

After five years, the Minister of Energy and Mineral Resources amended Regulation 32/2008 through Regulation Number 25 of 2013 (Permen ESDM 25/2013) to support macroeconomic policies, reduce fuel oil imports, and accelerate the expansion of biofuel use. The Government incentivized biodiesel producers to encourage swift execution of the Biodiesel Policy. Apart from that, the government has implemented a policy to raise the biodiesel blend to 10% (B10)[11]. In 2014, the Minister of Energy and Mineral Resources Regulation Number 20 of 2014 (Permen ESDM 20/2014) amended the Minister of Energy and Mineral Resources Regulation 32/2008 for the second time.

In 2015, the ESDM Ministerial Regulation 32/2008 underwent a third amendment to rationalize the biodiesel policy. This amendment resulted in the Minister of Energy and Mineral Resources Regulation Number 12 of 2015 (ESDM Ministerial Regulation 12/2015), which modified the percentage of biodiesel utilization implemented in the previous policy. This amendment resulted in the Minister of Energy and Mineral Resources Regulation Number 12 of 2015 (ESDM Ministerial Regulation 12/2015), which modified the percentage of biodiesel utilization implemented in the previous policy. The Palm Oil Plantation Fund Management Agency (BPDPKS) was created with the issuance of Minister of Energy and Mineral Resources Regulation Number 29 of 2015. This regulation concerns the financing framework for the provision and utilization of biofuels of the Biodiesel Type within the Palm Oil Plantation Fund Management Agency. The creation of BPDPKS is expected to stimulate the advancement of biodiesel policy in Indonesia by providing incentives and sufficient funds. Two revisions to ESDM Ministerial Decree 12/2015 were made in 2016 and 2018, specifically ESDM Ministerial Decree 26/2016 and ESDM Ministerial Decree 41/2018, to enhance the allocation and utilization of funds for biodiesel-type biofuel production. With the aforementioned policy package, the biodiesel industry in Indonesia is beginning to exhibit notable growth and improvement. Based on BPDPKS data from 2018 [12], the budget for biodiesel financing in 2018 was set at IDR 9.8 trillion with a target volume of 3.20 million kiloliters of biodiesel to be paid. As per this budget, the actual biodiesel incentive payments realized between 2018 and April 2018 amounted to IDR 3.24 trillion with a volume of 0.97 million kiloliters (30.31%).

In 2021, the Indonesian government sought to enhance the biodiesel policy in Indonesia by implementing the updated policy, Regulation of the Minister of Energy and Mineral Resources Number 24 of 2021, which pertains to the provision and utilization of biodiesel type vegetable fuel within the framework of financing by the Palm Oil Plantation Fund Manager. This policy supersedes the previous ESDM Ministerial Regulation 41/2018, which has been rescinded. The biofuel policy outlined in Regulation 24/2021 from the Minister of Energy and Mineral Resources enforces compliance among business entities that refuse to follow the government's biodiesel percentage regulations. According to Article 3, paragraph (1), BBM Business Entities are obligated to mix Biodiesel BBN with Diesel Oil BBM in accordance with the Minister's designated percentage. Furthermore, according to Article 33, paragraph (1), BBM Business Entities that violate the provisions outlined in Article 3, paragraphs (1) and (2) may be subject to administrative sanctions, including payment of fines. In addition to the requirement to mix biodiesel, biodiesel companies are obligated to distribute Biodiesel Type BBN to fuel businesses, as stated in paragraphs (4) and (5) of Article 11 of Minister of Energy and Mineral Resources Regulation 41/2021. BBN Business Entities that have been designated as such in paragraph (4) must distribute Biodiesel Type BBN to BBM Business Entities. Additionally, Article 33, paragraph (2) stipulates that BBN Business Entities that contravene the intended provisions in Article 11, paragraph (5) will be subjected to administrative penalties in the form of fines.

The history of Indonesian biodiesel policies is summarized in the Figure 1 below.

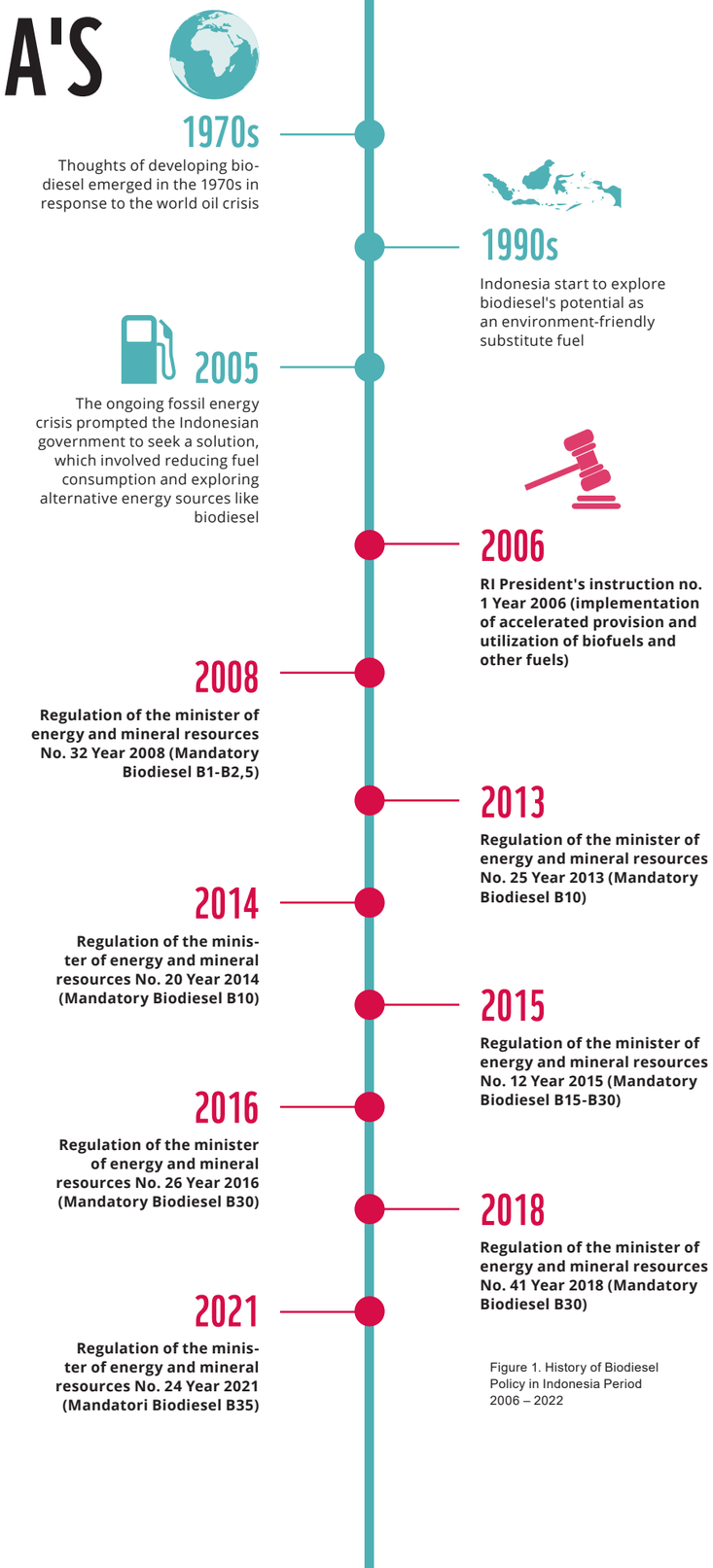

Figure 1. History of Biodiesel Policy in Indonesia Period 2006 – 2022

8. Jatmiko, A. 2023. KataData. Dapat diakses pada: https://katadata.co.id/agungjatmiko/ekonopedia/63db755ee5769/menilik-sejarah-panjang-pengembangan-biodiesel-indonesia
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12 BPDPKS. 2018. Mengembangkan Infrastruktur BPDPKS, Mengembangkan Sawit Indonesia yang Berkelanjutan. Laporan Tahunan. Jakarta: BPDPKS.

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B. DEVELOPMENT OF THE VOLUME OF BIODIESEL NEEDS BASED ON POLICY

Since the publication of the biodiesel policy in 2006, the percentage of biodiesel blending has consistently increased to meet the rising biodiesel volume demand. Figure 2 illustrates how the national biodiesel volume determination changed during the 2015-2023 period according to the Minister of Energy and Mineral Resources Decree.

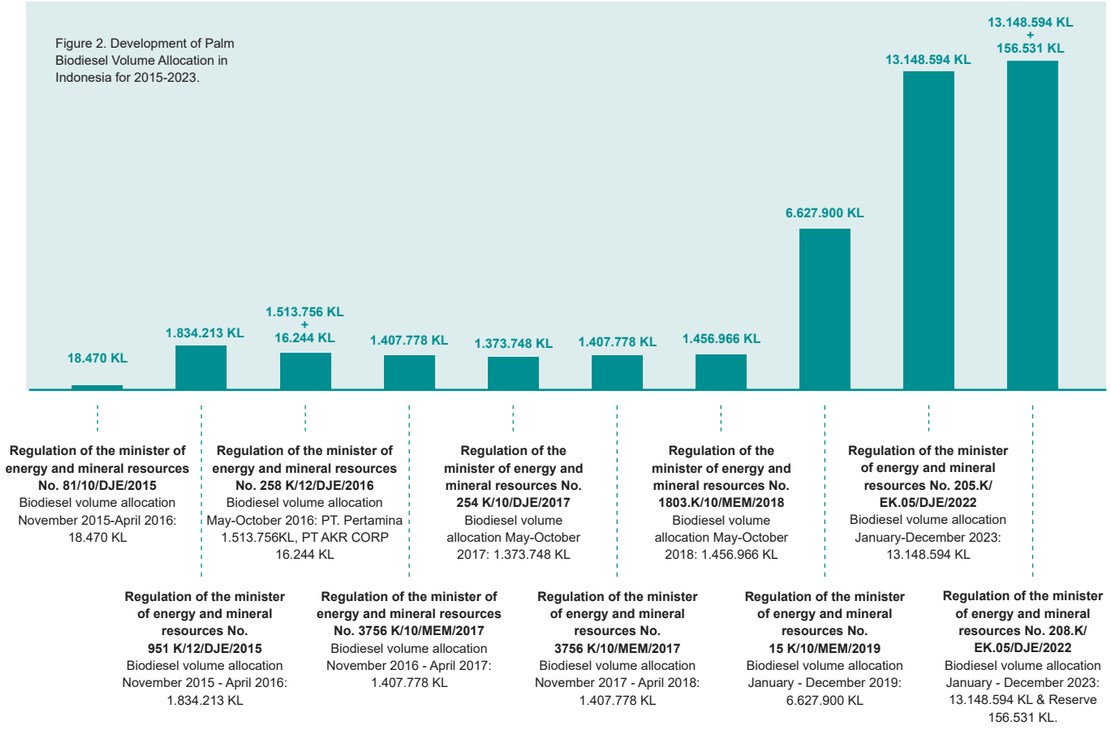
Based on Figure 2, it is known that the determined biodiesel volume continues to increase, especially in the period 2019 - 2023. In 2023, the determined biodiesel volume will reach 13,148,594 kiloliters with biodiesel reserves of 156,351 kiloliters.

C. BIODIESEL POLICY CHALLENGES IN INDONESIA

Energy and development are interconnected aspects in a region because alternative raw materials for energy sources are linked to a potential trade-off between the economy and ecology[13]. In Indonesia, efforts towards energy independence through the development of biodiesel can lead to ecological problems due to the increasing demand for the primary raw material, CPO.

One of the challenges of the proposed biodiesel policy is the potential expansion of palm oil plantations as a logical consequence of the high demand for CPO as a raw material for biodiesel production. It is crucial to consider the environmental impacts of such expansion and to explore alternative sources of raw materials for biofuel production. Objective evaluation and logical structuring of the relevant information are essential to address this challenge. Based on the projections derived from the study conducted by LPEM University of Indonesia[14], the implementation of the B50 policy would result in a substantial demand for CPO. This demand would potentially lead to the expansion of new oil palm land, ultimately covering an area of 9.29 million hectares until 2025. The projected need for 9.29 million hectares is concerning, as it could lead to the expansion of oil palm plantations into forest areas. Currently, there are already 3.4 million hectares of illegal oil palm plantations in forest areas, and this new expansion could potentially encroach upon areas with high conservation value or on peatland.

Figure 2. Development of Palm Biodiesel Volume Allocation in Indonesia for 2015-2023.



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PART 3

GAP ANALYSIS OF CPO DEMAND AND SUPPLY IN SUPPORT OF BIODIESEL POLICY

A. DECREASING TREND IN NATIONAL CPO SUPPLY

Over the past 20 years, from 2000 to 2020, CPO production has increased significantly, particularly in Southeast Asia (including Indonesia) and South America. In sub-Saharan Africa, CPO production has not really increased, but has tended to stagnate. The main driver of the increase in CPO production from 2000 to 2020 is the increase in oil palm area, which has increased significantly, particularly in Southeast Asia and South America. The increase in CPO production in Southeast Asia, including Indonesia, is not due to an increase in CPO productivity per hectare of oil palm area, as the data shows that CPO productivity tends to stagnate (see Figure 3).

Based on current trends in CPO production, it is expected that Indonesia's annual palm oil production will level off since 2021 and may even experience a decline. This development can be attributed to the prolonged increase in oil palm cultivation due to various barriers to expanding the cultivation areas. Based on the aggregated data from the Indonesian Ministry of Plantations, the Indonesian Palm Oil Entrepreneurs Association (GAPKI), and the Central Statistics Agency (BPS), Indonesia's production of Crude Palm Oil (CPO) witnessed an upward trend solely from 2017 to 2019. Later, there was a descending trend observed between 2019 and 2021. The decrease in production since 2019 is attributed to a lack of expansion in oil palm cultivation areas, caused by three main factors: 1) The implementation of RED II and the Delegated Act in the European Union since 2018, which classifies oil palm plantations as causing Indirect Land Use Change (ILUC), is at high risk. 2) A moratorium on permits for clearing forests and peat for plantations and the timber industry (Inpres 5/2019) is in effect and 3) a moratorium on permits for opening new oil palm plantations (Inpres 8/2018) is also in place.

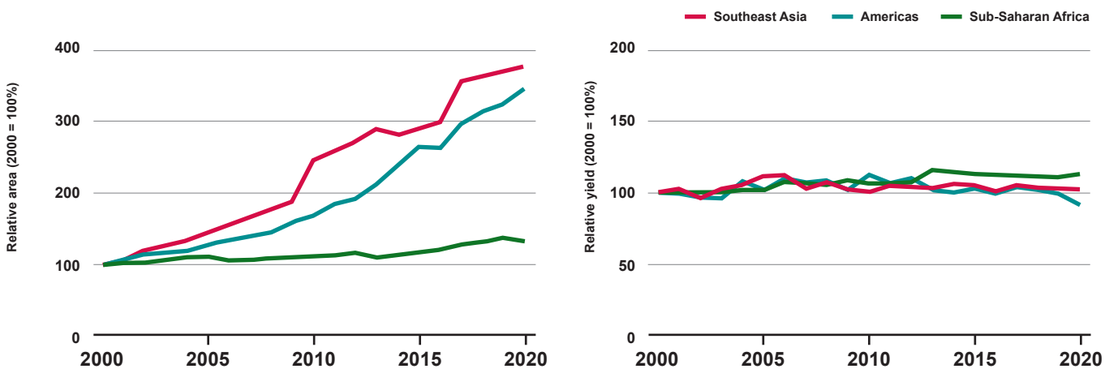

Figure 3. Trends in changes in oil palm plantation area (left) and productivity in Southeast Asia, America and Sub-Saharan Africa during the 2000-2020[15]

15. Sumber: FAO. 2021. Agricultural Production Statistics 2000-2020. Dapat diakses pada: https://www.fao.org/3/cb9180en/cb9180en.pdf

B. TREND OF DECLINING NATIONAL PALM OIL SUPPLY

According to data from BPDPKS (2021), national productivity of CPO has not increased over the past 20 years. In fact, since 2014, there has been a downward trend in the average CPO productivity of national oil palm plantations (see Figure 4).

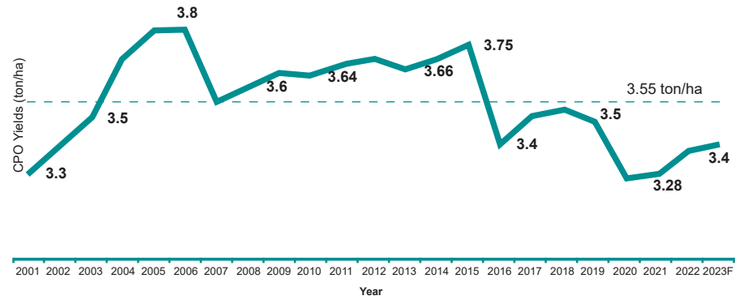

Figure 4. National CPO Productivity Trends 2001-2022[16]

Based on management, oil palm plantations can be divided into three broad groups: large state plantations (PBN), large private plantations (PBS), and community plantations (PR) (Figure 5). According to the cultivation area, PBN manages 0.80 million hectares (5% area), PBS manages 8.64 million hectares (53% area), and PR manages 6.94 million hectares (42% area). Technical term abbreviations are explained when first used. Passive tone and impersonal construction are used, and first-person perspectives are avoided. The productivity of crude palm oil (CPO) in oil palm plantations managed by PBN, PBS, and PR exhibit significant variations. Specifically, the oil palm plantations managed by PBN exhibit the highest CPO productivity at a rate of 4.70 tons of CPO/ha/year, compared to 4.2 tons of CPO/ha/year and 3.43 tons of CPO/ha/year, respectively, for PBS and PR. The oil palm plantations managed by PBS exhibit the second-highest CPO productivity, whereas PR-managed plantations exhibit the lowest CPO productivity. However, the achieved CPO productivity in national oil palm plantations managed by PBN, PBS, and PR falls significantly short of the commodity's genetic potential of 7-8 tons of CPO/ha/year. Large plantations, including both PBN and PBS, maintain a yield gap of 38%, while PR-managed plantations experience a yield gap of 47%.

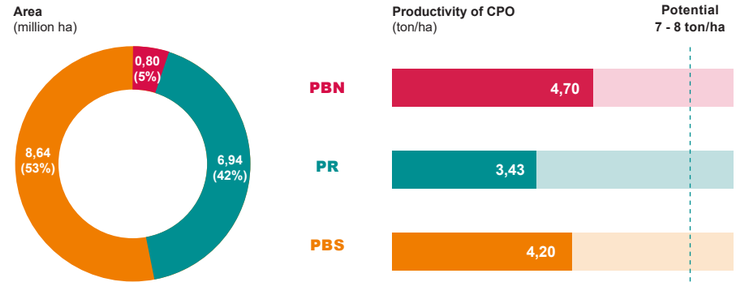

Figure 5. Differences in plantation area (Ha) and CPO productivity (tons/Ha) between state plantations, private plantations and smallholder plantations.

The extensive yield gap is attributed to several factors, including the slow pace of the replanting program, limited labor due to the slow regeneration of farmers and farm laborers which results in crop yield loss as FFB is not harvested, inadequate nutritional management, suboptimal soil health management, negligent use of planting material in the form of a high proportion of dura stands, substandard weed control, and decreased yield due to pest and disease attacks. Subject-specific vocabulary is employed where appropriate to accurately convey meaning.

Apart from that, the high yield gap in smallholder plantation is due to the low proportion of mature plants (TM) compared to immature plants (TBM) and non-mature plants (TTM). The area of smallholder plantations that are TBM (immature) is 1.64 million hectares, while 3.94 million hectares are mature, with 1.36 million hectares being over 25 years old. Proportionally, 24% of smallholder plantations are TBM, 57% are TM, and 20% are over 25 years old (Figure 6). Based on the data, it can be concluded that in smallholder plantation, the proportion of unproductive land is significant, reaching 20%, due to the condition of old

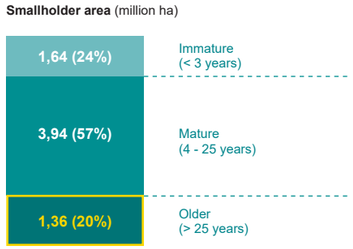

Figure 6. Proportion of Older Oil Palm Plantations in Smallholder Plantations

16 Direktorat Jenderal Perkebunan Kementrian Pertanian RI. 2021. Statistik Perkebunan Unggulan Nasional 2020- 2022. Dapat diakses pada: https://ditjenbun.pertanian.go.id/template/uploads/2022/08/STATISTIK- UNGGULAN-2020-2022.pdf

plants. The slow replanting program is the primary cause of the high proportion of older gardens in smallholder plantation land.

C. TREND OF INCREASING NATIONAL CPO CONSUMPTION

Based on the combined data from the Indonesian Ministry of Plantations, the Indonesian Palm Oil Entrepreneurs Association (GAPKI), and the Central Statistics Agency (BPS), the demand for national CPO can be categorized to meet domestic consumption and export requirements. Table 1 shows the CPO production and demand for domestic consumption and export in 2017-2021. The data indicates a continuous increase in the demand for CPO exports from 2017 to 2019. Subsequently, a decline in demand occurred from 2020 to 2021 due to a decrease in production. Notably, the most significant increase in palm oil exports took place in 2019 with an export volume of 28,279 thousand tons of CPO, representing a 3.38% increase from 2017.

Indonesia exports palm oil to five continents: Asia, Africa, Australia, North America, and Europe. Based on 2021 BPS data, the five major importing countries for Indonesian Crude Palm Oil (CPO) are India, Kenya, Italy, the Netherlands, and Spain. These five countries account for 92.75% of Indonesia's total CPO exports. The main destination for Indonesian CPO exports is India, accounting for 1.92 million tons or 75.65% of total export volume and valued at 2.08 billion USD.

Domestic consumption of CPO is primarily used for food, biodiesel energy, and oleochemical purposes. According to Figure 7, the volume of domestic CPO consumption between 2018 and 2022 is displayed. The data indicates that domestic palm oil consumption will reach 20.9 million tons by the end of 2022. This is a 13% increase from the previous year and the highest record since 2018. Biodiesel experienced the most significant consumption growth. The trend of rising domestic consumption of CPO is also present in the oleochemical sector, but only to a minor extent (9.23% of the total domestic CPO consumption). In contrast to the biodiesel and oleochemical sectors, where the trend is continuously increasing, CPO consumption in the food industry tends to fluctuate.

YEAR	CPO PRODUCTION* (thousand tons)	DOMESTIC CPO CONSUMPTION*** (thousand tons)	EXPORT** (thousand tons)	TOTAL DEMAND (thousand tons)
2017	37.965	11.056	27.353	38.409
2018	42.884	13.491	27.899	41.390
2019	47.120	16.727	28.279	45.026
2020	45.742	17.349	25.935	43.284
2021	45.121	18.422	25.624	44.046

*Data Source: *Direktorat Jenderal Perkebunan, **BPS, ***GAPKI*

Table 1. Demand and Supply of CPO for Domestic and Overseas

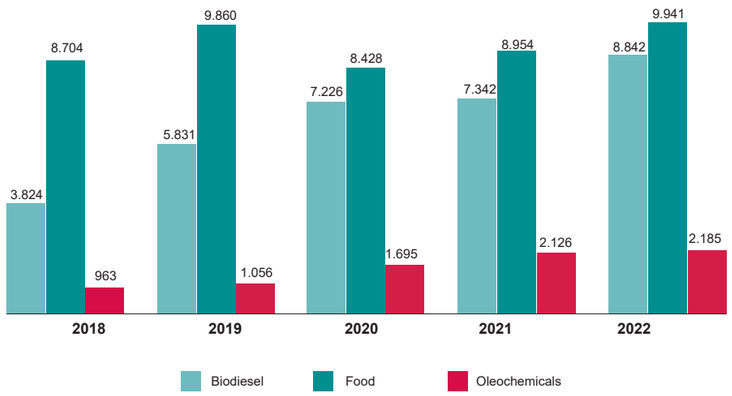

Figure 7. Domestic CPO Consumption Volume in 2018 – 2022 (Source: Indonesian Palm Oil Entrepreneurs Association(GAPKI), 2022)[17]

D. GAP ANALYSIS OF NATIONAL CPO SUPPLY AND DEMAND

According to the given description, there are divergent trends in national CPO production levels and consumption. As for production trends, data indicates that annual national CPO production has been stagnant in recent years. Conversely, there is a notable increase in the trend of national CPO consumption mainly triggered by the government's mandate under the biodiesel program. Based on Presidential Decree No. 22/2017 concerning the General National Energy Plan, under a moderate scenario, the demand for CPO (crude palm oil) to meet national diesel consumption needs is projected to reach 5 million kiloliters from 2022 to 2030. The moderate scenario mandates a CPO blending percentage of 29.7% in 2022, 36.1% in 2027, and 41.6% in 2030, equating to approximately 15 million kiloliters of CPO for B41 blending in 2030.

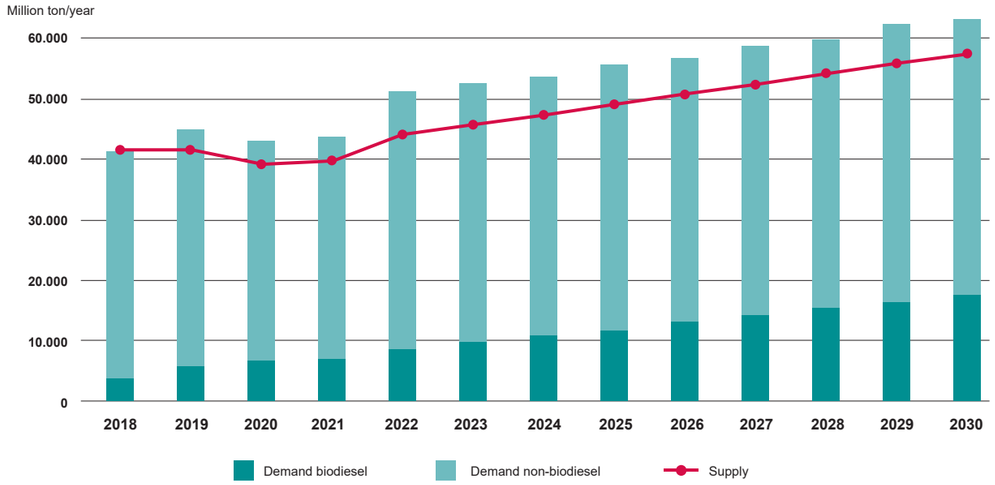

Figure 8. National CPO supply-demand projections are based on analysis of national CPO consumption trends and national CPO production trends

Assuming that the total demand for CPO both domestically and internationally will follow a linear trend, and that CPO supply will follow production trends from the past 20 years according to BPDPKS data (2021), an imbalance between national CPO supply and demand is expected (refer to Figure 8). The figure illustrates the continual increase of the national CPO supply-demand gap; projecting a deficit of up to 5,000 million tons by 2030. If an effective national governance plan for palm oil plantations is not developed, there may be a deficit in national crude palm oil production. This shortfall could have a negative impact on the government's ability to meet its targets for national energy policy.

17 Sumber: GAPKI. 2022. Kinerja Industri Minyak Sawit 2022. Dapat diakses pada: https://gapki.id/news/2023/01/25/kinerja-industri-minyak-sawit-2022/


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PART 4

STRATEGY TO INCREASE PALM OIL PRODUCTION TO MEET CPO DEMAND TARGETS

In the previous discussion, it was noted that the increase in national CPO production has been solely reliant on the expansion of oil palm plantations, despite stagnant productivity. There is a growing demand for CPOs in both domestic and export markets.

Efforts to boost crude palm oil (CPO) production through plantation expansion face numerous barriers, mainly due to international regulations (European Union), which identify palm oil as the main cause of indirect land use change, and the moratorium declared by the government through Presidential Instructions 8/2018 and 5/2019. Therefore, it is imperative to augment domestic CPO production through the following three main strategies.

A. EFFORTS TO INCREASE NATIONAL CPO PRODUCTION WITH A PRODUCTIVITY INCREASE SCENARIO

There are three types of productivity in oil palm plantations: 1) potential productivity, 2) operational productivity, and 3) realized productivity of existing plantations. Achieving 100% potential productivity is impossible due to the varying limiting factors at the operational level in different plantation conditions. The potential productivity is a number provided by breeders, which can only be achieved under ideal conditions at the research level. It requires high-quality planting materials, optimal temperature conditions, carbon dioxide levels, adequate water supply, suitable soil types, and appropriate plant ages. However, at the plantation operational level, it is nearly impossible to fulfill all these ideal conditions perfectly. Hence, the most reasonable expectation is to achieve productivity on an operational scale. This means that 70% of the potential productivity can be attained. Meanwhile, the existing plantations' productivity reflects the average productivity capable of being achieved currently.

The actual CPO productivity of national oil palm plantations is still far below the operational productivity that should be achieved, which is 70% of the potential productivity. This difference between actual productivity and the operational potential is known as the yield gap. By implementing an intensification approach in plantation management, it is possible to achieve the productivity value defined by this yield gap. Yield gaps are prevalent in national oil palm plantations due to nutritional deficiencies, inadequate management of pests and diseases, poor weed management, yield losses due to improper harvesting practices and careless planting material.

Evaluation of the achievable operational productivity levels in the seven oil palm producing provinces, namely Riau, Jambi, North Sumatra, West Kalimantan, Central Kalimantan, East Kalimantan, and North Kalimantan. The expected production is 33.40 tons of fresh fruit bunches (FFB) per hectare per year. Based on data regarding the average FFB productivity in seven central oil palm-producing provinces, it was found that for large plantations, PBS and PBN, the average productivity was 20.71 tons of FFB per hectare per year. Conversely, for smallholder plantations, the average productivity realization was 17.70 tons of FFB per hectare per year. Combining this data revealed that the average productivity achievement for PBN and PBS was 62%, while PR was 53%. In the seven central provinces that produce palm oil nationally for PBN and PBS, the yield gap is still at 38%, while in PR, it reaches 47%. Capitalizing on this existing yield gap through a yield gap minimization program with an intensification scenario presents a substantial opportunity to enhance national CPO production.

As an intensification effort to minimize the yield gap, three main stages are proposed as follows:

Phase 1. Grouping oil palm plantations based on land suitability class characteristics

Oil palm plantations in Indonesia are generally categorized into several land classes, including S1, S2, and S3. The optimal productivity level for oil palm plantations is achievable on S1-class land. Limiting factors are not an obstacle for oil palm plantations on S1-class land, regardless of their existence. Even if the barriers are of minimal size, they do not naturally affect productivity. Oil palm plantations in the S2 land class typically face minor hurdles that can impede productivity if not addressed. To overcome these limitations, additional resources must be allocated to the affected areas. Fortunately, the necessary input is minimal, allowing growers to independently surmount the constraints.

Oil palm plantations are often found in S3 land areas, which are known to present significant challenges. If these challenges are not managed, oil palm plantations in S3 land class are routinely faced with severe limiting factors that can significantly reduce productivity. Planters must invest in large quantities of production inputs, requiring significant capital. In some cases, government assistance may be necessary to overcome certain limiting factors. To overcome the severe limiting factors in S3-class oil palm land, state intervention is necessary.

Figure 9 illustrates the productivity level attained in each land suitability category of various provinces, including North Sumatra, Riau, Jambi, Bengkulu, and Lampung. The North Sumatra, Riau, and Jambi provinces are categorized as the S1 land class zone for oil palm cultivation due to their high and evenly distributed rainfall throughout the year without any distinct dry months. Bengkulu Province falls under the S2 land class with comparable high rainfall, but with two consecutive dry months. In contrast, Lampung Province is considered as the S3 land class due to high but uneven rainfall throughout the year, caused by more than two consecutive dry months. According to Figure 8, land with suitability class S1 has an average operational productivity of 33.40 tons of FFB/ha/year, while S2 and S3 land have productivity levels of 31.40 and 28.64 tons of FFB/ha/year, respectively. The average productivity on S2 and S3 land is 94% and 86% of that on S1 land. Assuming a CPO oil yield of 20% from FFB, the average operational productivity in land classes S1, S2, and S3 can respectively yield 6.68 tons of CPO per hectare per year, 6.28 tons of CPO per hectare per year, and 5.73 tons of CPO per hectare per year.

National palm oil plantations are predominantly located on land in Sumatra and Kalimantan islands, which receive high annual rainfall throughout the year with no dry months. The intense rainfall, humidity, and air

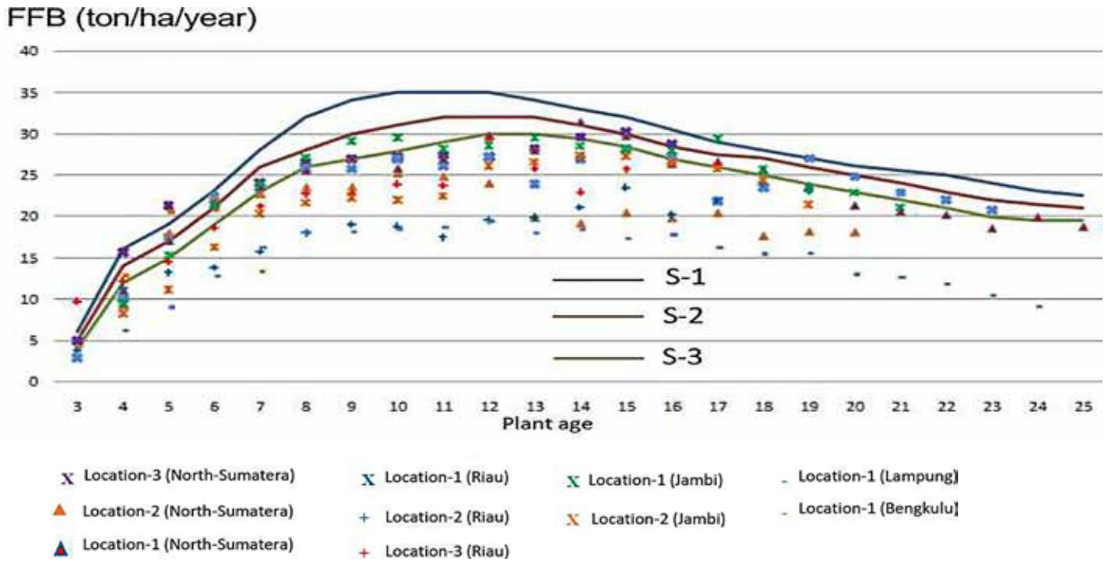


Figure 9. FFB productivity levels in each land suitability class in the provinces of North Sumatra, Riau, Jambi, Bengkulu and Lampung.

temperature accelerate the weathering of soil parent rocks and biomass on these islands. This weather phenomenon leads to the complete decomposition of the parent rocks that constitute the soil, resulting in the depletion of their mineral reserves and causing a lack of nutrients. The soil on both islands is dominated by red-yellow podzolic mineral soil and peat. These two types of land suitable for plant cultivation largely belong to the S3 land suitability classification, which can affect the potential productivity that can be achieved.

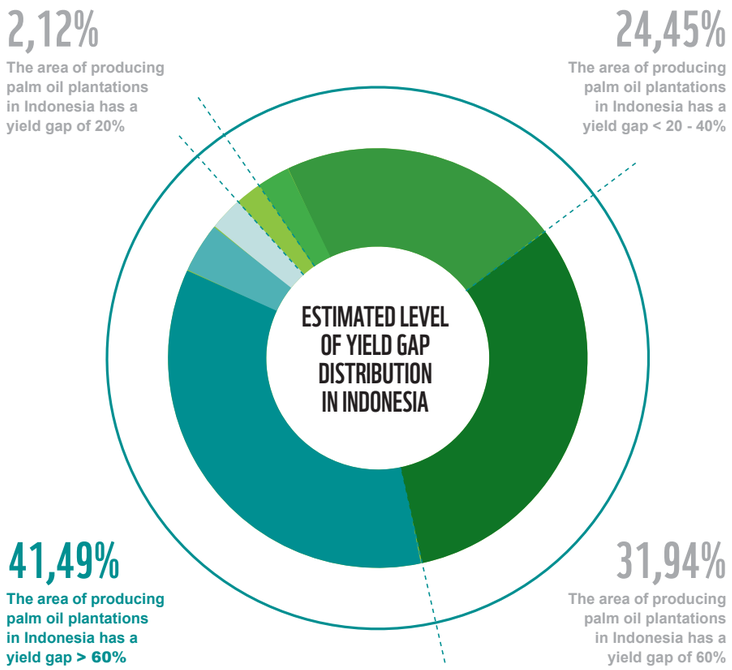
Phase 2. Characterization and Clarification of Yield gaps for Oil Palm Plantations

The productivity shortfall in the national average is significant, given that the actual national CPO productivity only reaches 42% of its expected productivity. Opportunities to enhance national CPO production through intensification programs on existing oil palm lands remain substantial.

An intensification program is necessary to close the yield gap of existing oil palm plantations to the maximum extent possible. National oil palm plantations experience yield gaps that can be classified into three categories. Specific scenarios can be developed for each of these categories to address and close the gaps accordingly. The three categories of yield gap classifications are:

1. The yield gap is 20%
2. The yield gap is 40%
3. The yield gap is 60%

A yield gap of 20% can be caused by several factors, namely the use of random planting material, soil type, climate and planting density. The primary causal factor of the 40% yield gap is the combination of the 20% yield gap with nutritional status and fertilizer recommendations. Meanwhile, the yield gap stands at 60%, with the factors responsible for its occurrence accounting for 40% of the gap. These factors include fertilizer application, legume cover crop, canopy management, pest and disease attacks, harvest management, water management, and general aspect management. Additionally, strategies for addressing the yield gap vary across different groups.



YIELD GAP	CAUSAL FACTORS
The yield gap is 20%	the use of random planting material, soil type, climate and planting density
The yield gap is 40%	+ nutritional status and fertilizer recommendations
The yield gap is 60%	+ fertilizer application, legume cover crop, canopy management, pest and disease attacks, harvest management, water management, and general aspect management

Oil palm plantations in Indonesia typically present low CPO productivity. Based on a spatial analysis that accounts for land suitability conditions and productivity distribution maps based on data from the Directorate General of Plantation (2021), it is known that the estimated level of yield gap distribution in Indonesia is: 1) 2.62% of producing oil palm plantations in Indonesia have a yield gap > 80%, 2) 4.07% of mature oil palm plantations in Indonesia have a yield gap > 70% - < 80%, 3) 34.80% of mature palm oil plantations in Indonesia have a yield gap > 60% - < 70%, 4) 31.94% producing palm oil plantations in Indonesia have a yield gap of > 50% - < 60%, 5) 22.01% of producing palm oil plantations in Indonesia have a yield gap of > 30% - < 40%, 6) 2.44% of producing palm oil plantations in Indonesia it has a yield gap of > 20% - < 30% and 7) 2.12% of producing oil palm plantations in Indonesia have a yield gap of > 10% - < 20%. This data indicates that most oil palm plantations in Indonesia still have a relatively large productivity yield gap, with as much as 41.49% of the area of producing oil palm plantations in Indonesia having a yield gap of >60%. For complete yield gap distribution data for each province, please refer to Appendix 1.

YIELD GAP	AREA OF PRODUCING PALM OIL PLANTATIONS
> 10 - 20%	2,12%
> 20 - 30%	2,44%
> 30 - 40%	22,01%
> 50 - 60%	31,94%
> 60 - 70%	34,80%
> 70 - 80%	4,07%
> 80%	2,62%

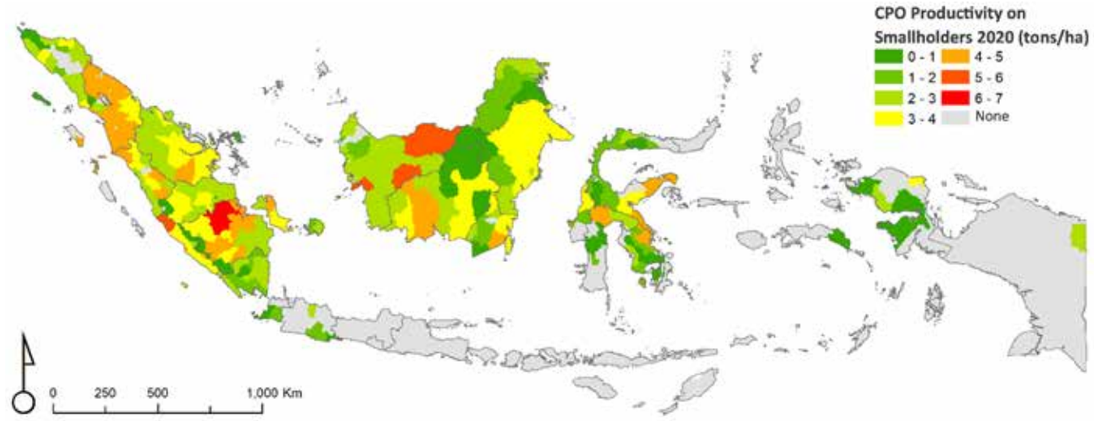


Figure 10. Map of distribution of CPO productivity in smallholder oil palm plantations in 2020 (Source: BPS data analysis).

Provinces in Indonesia with high yield gap oil palm plantation areas are Aceh, Jambi, Lampung, Riau, West Kalimantan, South Kalimantan, East Kalimantan, North Kalimantan, Papua, West Papua and Southwest Papua. However, the productivity of crude palm oil (CPO) in these areas is relatively low, not following its production potential. Meanwhile, the provinces with a lower yield gap in plantation productivity, or in other words, relatively higher CPO productivity, include Bengkulu, West Sumatra, North Sumatra, South Sumatra, and Central Kalimantan. Based on the available data, the strategy to increase CPO productivity and bridge the yield gap should prioritize plantations located in Aceh, Jambi, Lampung, Riau, West Kalimantan, South Kalimantan, East Kalimantan, North Kalimantan, Papua, West Papua, and West Papua Power provinces. Figure 10 illustrates a map of the CPO productivity distribution across every FFB-producing district in Indonesia, providing an overview of the potential regional yield gap that can be closed.

Phase 3. Productivity Improvement Scenarios in Three Yield Gap Classes

The scenarios needed to overcome the factors causing the yield gap in gardens with a yield gap of 20% are to improve the quality of planting material, improve soil characteristics, improve climatic conditions and optimize plant density. However, improving the quality of planting materials in established oil palm plantations is a challenging task as the necessary replanting schedule is often delayed. Therefore, maximizing the production capacity of existing stands is the most viable option before the replanting schedule arrives, despite their genetic potential being less than ideal.

Improving climate conditions through micro weather modification efforts is not an easy task. Our agricultural concept currently relies on given conditions with minimal modification effort. Improving the inherent properties of soil that are not ideal, especially those related to soil physics, is also difficult. Achieving ideal soil properties for oil palm productivity requires long-term and high-cost improvement efforts. The optimization of stand density poses similar difficulties. This task can only be undertaken during the replanting period.

Under these conditions, even though oil palm plantations have a yield gap of only 20% with few limiting factors, the remaining ones are difficult to overcome. Currently, our reliance on natural resources surpasses our efforts

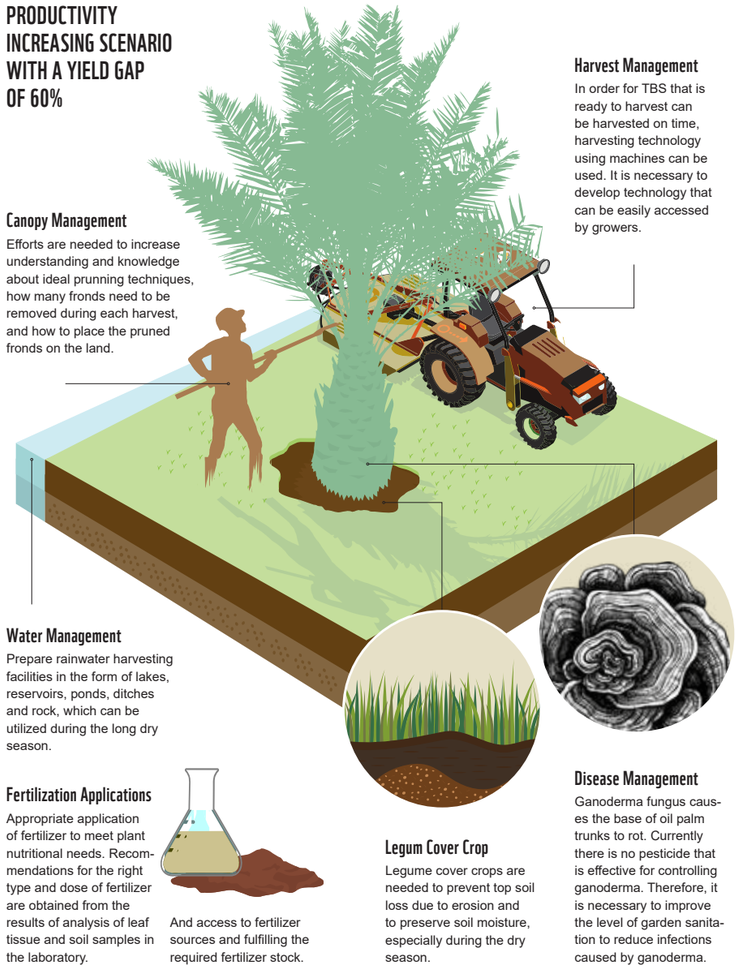
to manipulate them. This results in oil palm plantations with a yield gap of 20% being increasingly difficult to optimize. Therefore, it is crucial to address these challenges to close the yield gap and achieve optimal conditions.

In oil palm plantations with a yield gap of 40%, nutrient status is another factor causing the yield gap, so fertilizer recommendations can be made as long as they have access to soil fertility assessment technology and fertilizer stocks. To determine fertilization recommendations, soil fertility evaluations are regularly conducted every semester. This activity is carried out to make appropriate fertilization suggestions each semester. Fertilization recommendations are established through analysis of soil sampling units and leaf sampling data, ensuring the precise fulfillment of plant nutritional requirements and the absence of any nutritional deficiencies. Growers must have access to laboratory services capable of analyzing both leaf tissue and soil samples to overcome this issue.

After getting accurate fertilizer recommendations, it is necessary to procure fertilizer of the recommended type and dose. Every oil palm planter has to be able to access the necessary fertilizer sources in order to get fertilizer. Accessing services from institutions that offer precise fertilizer recommendations and ensuring fertilizer stocks from institutions that supply fertilizer is the main scenario for overcoming some of the factors that cause yield gaps in plantations where the yield gap is 40%.

Oil palm plantations have yield gaps of 60%; other factors contributing to the yield gap include fertilizer application, legume cover crops, canopy management, pest management, harvest management, water management and general management. Incorrect fertilizer application techniques have the potential to cause nutrient deficiencies. Despite precise fertilizer recommendations and accessible fertilizer, oil palm plants can still experience nutrient deficiencies if the fertilizer is not properly applied. To avoid this problem, it is important to closely supervise the fertilization process on the land. Legume cover crops are necessary on oil palm land to prevent topsoil loss from erosion and maintain soil moisture, particularly during the dry season. Canopy management involves trimming palm fronds by workers during harvest, and the pruning program in oil palm plantations does not require additional labor as it is integrated with harvesting activities. However, there is a considerable need to improve the understanding and knowledge of the harvesters regarding the ideal pruning techniques, how many fronds need to be removed at each harvest and how to place the pruned fronds on the land surface. This comprehensive knowledge of pruning can improve the condition of the oil palm canopy, which is ideal for production.

Pest and disease challenges in oil palm plantations are less severe than in other commodities. The most hazardous factor among them is the Ganoderma fungus, which causes oil palm stem rot.



EXISTING PRODUCTIVITY CLASS (Ton CPO/Ha/Year)	EXISTING PRODUCTION OIL PALM LAND AREA (Ha)	EXISTING PRODUCTION (Tons of CPO/Year) - YIELD GAP OCCURS	FUTURE PRODUCTION (Tons of CPO/Year) - YIELD GAP RESOLVED WITH SEVERAL SCENARIOS
0,0 – 1,0	97.820	48.910	547.795
1,1 – 2,0	95.347	143.021	533.943
2,1 – 3,0	475.330	1.188.325	2.661.847
3,1 – 4,0	10.475.025	36.662.587	58.660.139
4,1 – 5,0	3.638.193	16.371.867	20.373.878
5,1 – 6,0	178.285	980.569	998.398
Amount	14.960.000	55.395.278	83.776.000

Table 2. Existing plantation productivity class, plantation area per class, existing CPO production per plantation class and future CPO production if the yield gap scenario is success

Unfortunately, there is no effective pesticide to control it. Hence, the most feasible management action is to improve the level of garden sanitation to reduce infections caused by Ganoderma.

One of the factors contributing to the yield gap is yield loss due to mismanagement of the harvest. In oil palm plantations, a substantial amount of fruit bunches are left unharvested due to the limited number of workers. These plantations are mainly located in Sumatra and Kalimantan islands, where the population is relatively small, complicating the search for plantation workers. In order to harvest FFB (fresh fruit bunches) on time amidst limited human resources, corrective action must be taken. This can be achieved through the implementation of harvesting technology using machines. The development of mechanization technology that is easily accessible to planters is therefore essential to address the yield gap and ensure efficient palm oil plantation management.

Climate change is the primary factor that can lead to the yield gap. The primary climate variable influencing the occurrence of the yield gap is prolonged drought, where the dry spell lasts for more than two consecutive months. FFB productivity will significantly decrease during extended dry periods. These periods are marked by high spear leaf emergence per stand, a large number of broken fronds, faster leaf death, abortion of female flower clusters, fruit malformation, and fertile and non-viable pollen. Additionally, a low sex ratio is dominated by the number of female flowers. In contrast, the number of female flower clusters is minimal or nonexistent. To mitigate potential water scarcity, it is advisable to construct rainwater harvesting infrastructure, such as lakes, reservoirs, ponds, ditches, and rock formations.

Various efforts have been made to surpass the yield gap, resulting in an operational productivity of 5.6 tons of CPO per hectare annually. This productivity figure is 70% of the potential productivity achieved by several superior oil palm progenies, currently available, with a potential value of 8 tons of CPO per hectare annually. Assuming all conditions are met, the annual CPO production can potentially reach 83.78 million tons if the entire yield gap is bridged, resulting in a 151.23% increase from the current production (refer to Table 2). This figure greatly exceeds the 10% gap in the projected CPO deficit in 2030 shown in Figure 8. A surplus in the national production of CPO can be attained without the consequent expansion of the area under oil palm or the opening of new oil palm plantations, which can lead to deforestation problems.

B. EFFORTS TO INCREASE NATIONAL CPO PRODUCTION WITH AN ACCELERATED REPLANTING PROGRAM SCENARIO

The second strategy is to accelerate the replanting program. This approach was formulated after our analysis revealed that one of the leading factors affecting the low realization of existing CPO productivity was the high proportion of old plantations that are more than 25 years old. This situation mainly occurs in oil palm plantations managed by smallholders.

Regarding the distribution of the general classes of smallholder oil palm plantations, the data shows that the distribution of smallholder oil palm plantation area is TBM (immature) 1.64 million hectares (24%), mature (mature) 3.94 million hectares (57%) and old (more than 25 years) covering an area of 1.36 million hectares (20%). It is suggested that old plantations over 25 years old and covering 20% should be replanted through a replanting program. Oil palm plantations in these conditions should not be maintained due to their low productivity. Furthermore, old oil palm plantations are gen-

erally filled with stands of oil palm with high trunks, which affects the performance of harvesters as the harvesting process becomes more complicated.

The continued prevalence of old plantations in Indonesian oil palm plantations, particularly smallholder plantations, is mainly due to the slow implementation of the replanting program. This sluggishness has emerged as a primary factor contributing to the significant yield gap. Based on data from BPDPKS (2021), the government aimed to replant 3.28 million hectares of land over five years, equivalent to 0.656 million hectares annually. However, only 0.878 million hectares were actually replanted over the five-year period, equivalent to only 0.177 million hectares per year, or 27% of the target area. This accomplishment is, of course, meager and affects the continued annual increase in the area of old gardens. Therefore, to boost national CPO production, the main objective is to accelerate the implementation of replanting programs in smallholder oil palm plantations.

Three main factors cause the low realization of the implementation of the replanting program, namely 1) the limited level of availability of quality planting materials (seeds), 2) the limited support of financial funds, especially from banks, and 3) the fear of smallholder plantation actors regarding the gap insufficient income for a long period during the TBM period, namely for at least four years. Regarding the limited availability of quality seeds, innovation is needed in the seed supply chain where smallholder plantations do not have access to quality planting materials that favor large plantations. Banks' insufficient financing, especially for oil palm plantations run by smallholders, needs to be solved through a low-interest loan scheme. Additionally, a monthly income allowance program can be established and saved through farmer groups/cooperatives to fund the replanting program once the plantation reaches 25 years old. To address concerns over the loss of income during the replanting period, the TBM oil palm plantation areas could introduce the innovative Double Cropping System (SPG). SPG can be implemented by incorporating short rotation crop groups, such as annual crops, between the rows of TBM oil palm stands. This ensures that farmers receive income from the plantations they manage during the TBM period from the same short rotation plant types, which are planted between the rows of oil palms. If the replanting program functions effectively, national CPO production can be increased by utilizing existing oil palm land without a program to increase the size of new plantations areas.

C. INCREASED CPO PRODUCTION FROM SOCIAL FORESTRY FOREST FARMER GROUP PLANTATIONS

It is undeniable that the expansion of oil palm plantations in forest regions is presently stalled. According to Kehati Foundation's (2019)[18] data, approximately 3.4 million hectares of the national palm oil coverage, out of the total of about 16.5 million hectares, are located in forest areas and hence lack legal status, rendering them ineligible for the supply chain. In 2021, the Ministry of Environment and Forestry (KLHK) issued a Social Forestry policy as delineated in the Minister of Environment and Forestry Regulation Number 9 of 2021 regarding Social Forestry Management (PermenLHK 9/2021). This policy allows oil palm to remain managed in forest areas for 25 years in production forest areas and 15 years in protected and conservation forest areas. An obligatory "Jangka Benah" will be implemented to enhance the structure and function of the ecosystem.

With this policy, oil palm plantation farmers who are in forest areas have the opportunity to continue to benefit from their plantation products on condition that they carry out the obligation to plant other commodities (productive forest plants) through a "Jangka Benah" scheme. Under these circumstances, the production of CPO from plantations in forest areas can be viewed as a contribution to increasing national palm oil production to fill the target gap deficit due to the need for biodiesel.

However, while a legal regime in the form of a Social Forestry Agreement with "Jangka Benah" commitments for community oil palm plantations in forest areas is possible, there are still policy barriers that prevent FFB products from PS farmers in forest areas from entering the supply chain. This situation pertains to the agricultural/plantation sector's policies regarding farmer registration via the STDB program and ISPO/RSPO sustainability certification. However, the STDB/ISPO/RSPO application requirements do not currently acknowledge Social Forestry approval as one of the recognized legalities. Therefore, a policy breakthrough is necessary to ensure "land legality" by incorporating social forestry as a legal document for accessing and managing state-owned land, with the requirement of "Jangka Benah".

BPHP X Palangkaraya is a Technical Service Unit (UPT) of MoEF in Central Kalimantan, one of whose functions is to facilitate social forestry groups. There are interesting facts from the management of HKm and HTR in the BPHP X Palangkaraya area where some HTR and HKm holders also manage oil palm plantations in the Social Forestry approval area. Referring to Appendix II of the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number: P.64/Menlhk/Setjen/Kum.1/12/2017, oil palm fruit bunches originating from state forests include fruits/tubers that are subject to Forest Resources Provision (PSDH). Based on the above provisions, BPHP Palangkaraya has applied PSDH to the management of oil palm plantations in HKm/HTR areas. Based on the records of the Jangka Benah Team - Faculty of Forestry UGM, the PSDH obtained by BPHP Palangkaraya from oil palm plantations in social forestry areas reached Rp.1.3 billion for the period January - July 2022. These findings show that there is a potential contribution of the presence of oil palm in state forests through social forestry schemes, so that it can be part of the national CPO supplier.

D. EFFORTS FOR INCREASING NATIONAL CPO PRODUCTION WITH AN EXTENSIFICATION SCENARIO

The extensification option will be implemented if the efforts proposed in points A, B and C above are still insufficient to meet market needs. Extensification can occur through two schemes: 1) expanding oil palm cultivation in existing concession areas that have not yet been utilized, and 2) expanding oil palm cultivation in new concession areas. As of 2020, GAPKI data indicates that approximately 14.63% of oil palm concession land remains unplanted. This is equivalent to an area of 2.4 million acres, primarily distributed across East Kalimantan, North Kalimantan, Central Kalimantan, and West Kalimantan. This indicates that there is still a significant amount of undeveloped concession land for oil palm plantations, providing ample opportunity for increasing national CPO production through the extensification program. The program would aim to optimize these undeveloped areas.

Based on a study conducted by the Palm Oil Research Center in 2022, there is still potential land available in Indonesia for the development of new oil palm plantations for long-term future interests. This potential land can be sorted into three clusters based on its land suitability class, namely land classes S1, S2, and S3. The land suitable for oil palm development, classified in detail as S1, is distributed over Kalimantan Island (covering 1.67 million hectares), Sulawesi Island (covering 0.5 million hectares), Maluku Island (covering 0.06 million hectares), and Papua Island (covering 0.76 million hectares). S2 covers 0.36 million hectares on Kalimantan Island, 0.29 million hectares on Sulawesi Island, 0.04 million hectares on Maluku Island, and 1.08 million hectares on Papua Island. In contrast, the areas covered by the S2 and S3 classes vary across Indonesian islands. Meanwhile, S3 covers 0.27 million hectares on Kalimantan Island, 0.53 million hectares on Sulawesi Island, 0.07 million hectares on Maluku Island, and 0.39 million hectares on Papua Island. These data show that the total area of potential new land for oil palm development with S1 class land in Indonesia reaches 2.99 million hectares, S2 class land is 1.77 million hectares and S3 class land is 1.26 million hectares. The combined potential new land area for oil palm development in Indonesia is 6.02 million hectares, distributed across Kalimantan Island (2.30 million hectares), Sulawesi (1.32 million hectares), Maluku (0.17 million hectares), and Papua (2.23 million hectares).

However, it must be understood that the scenario of adding new planting locations (extensification) for oil palm plantations cannot be carried out by clearing forests and is carried out in peat areas that function as protection. For this reason, from the potential planting locations in the unplanted concession area of 2.4 million hectares and the potential new concession candidate area of 6.02 million hectares, it is still necessary to select land that can be developed as an expansion area for new plantations does not add to environmental problems.

18 Bakhtiar, I., Diah, S., Hery, S., & Wiko, S. 2019. Hutan Kita Bersawit - Gagasan Penyelesaian Untuk Perkebunan Kelapa Sawit dalam Kawasan Hutan. Jakarta. KEHATI.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PART 5

EPILOG

From the various descriptions discussed previously, it can be seen that the existing conditions of national oil palm plantation management are still not optimal, which has an impact on stagnating productivity, which tends to be low. Increasing CPO production has depended on expanding the oil palm plantations, which has directly and indirectly contributed to the high rate of land conversion, including deforestation.

With the biodiesel program policy, there is a projected rapid increase in national demand for CPO, which necessitates an increase in national CPO supply. To prevent inadvertent negative impacts on forest areas as a result of increased CPO production demands to support biodiesel policies, the government must prepare policy tools to address these challenges. At a minimum, the policy formulation process can consider the following three policy aspects:

1. POLICY TO INCREASE THE PRODUCTIVITY OF OIL PALM PLANTATIONS

After the period of Presidential Instruction Number 8 of 2018 regarding Postponement and Evaluation of Licenses for Palm Oil Plantations and Increased Productivity, there are no longer policies that address the enhancement of productivity in palm oil plantations, particularly those owned by smallholders. Government Regulation Number 26 of 2021, which addresses the implementation of the agricultural sector (PP 26/2021), currently lacks guidelines regarding technical strategies aimed at boosting agricultural/plantation productivity, particularly in oil palm plantations. Due to the identified policy gap, although the potential for increasing national CPO production via intensification is substantial (as elaborated in section 3), it is imperative to establish various supportive policies that regulate strategies for enhancing the productivity of oil palm plantations through the four strategies proposed in the policy report.

2. A COMPREHENSIVE POLICY IS NECESSARY TO ENFORCE REPLANTING STANDARDS FOR SMALLHOLDERS

Currently, the regulations pertaining to the replanting of smallholder oil palm plantations are explicitly stipulated in Minister of Agriculture Regulation Number 3 of 2022, which focuses on human resource development, research, restoration, and facilities and infrastructure for palm oil plantations (Permentan 3/2022). The later amended by the Minister of Agriculture Regulation Number 19 of 2023 (Permentan 19/2023), which focuses on human resource development, research, restoration, facilities and infrastructure for palm oil plantations. While the regulation has established procedures for proposing and funding oil palm rejuvenation programs, it does not currently enforce quality standards for planting materials, such as seeds, used in these programs. Section 3 emphasizes the significance of regulating seed quality, as careless usage can drastically reduce the productivity of oil palm plants during replanting efforts. Furthermore, this regulation fails to address the smallholder plantation farmers' concerns about the relatively long income gap during the TBM period, i.e. at least four years. In light of the significance of the replanting program's successful completion in the effort to increase national CPO production, it is necessary to increase the financial resources that have been used to date by the BPDPKS. By strengthening the policy of the Minister of Agriculture's Regulation 3/2022 in conjunction with the Minister of Agriculture's Regulation 19/2023 by incorporating the above elements and with adequate financial support from the BPDPKS, the gap in CPO production to support the biodiesel program can be closed without expanding new plantation areas.

3. POLICY FOR SUSTAINABLE EXPANSION OF OIL PALM PLANTATIONS.

This proposal aims to address the issue of insufficient national CPO supply despite the implementation of policies to boost productivity in palm oil plantations. To expand plantation areas, the Government should adopt a strategy to optimize unused concession land. This can be achieved by first enforcing the control of abandoned land as mandated by Government Regulation Number 20 of 2021 regarding Controlling Abandoned Land (PP 20/2021). Referring to Article 7 of PP 20/2021, land can be deemed abandoned if intentionally uncultivated, unused, and unexploited for two years from the issuance of the right. This regulation presents an opportunity to optimize land availability for oil palm plantation development. However, it should be emphasized that the expansion of oil palm plantations does not involve the clearing of forests and peat areas that serve as protective zones.

In addition to the pursuing of the three policies mentioned above, there is an important aspect related to the low role of smallholder farmers in fulfilling the biodiesel policy. Biodiesel policy in Indonesia has undergone multiple revisions, yet participation of smallholder farmers in the Indonesia biodiesel program remained unregulated until the recent change brought about by the Minister of Energy and Mineral Resources Regulation 24/2021. The participation of smallholder farmers in supporting crude palm oil (CPO) production is vital to meet the growing demand for biodiesel, considering that smallholder palm oil plantations represent almost 50% of the total national palm oil plantations. Thus, their involvement is crucial. Therefore, the Minister of Energy and Mineral Resources Regulation 24/2021 needs to be revised. This should include new clauses such as the inclusion of oil palm farmers as an essential part of supporting the Biodiesel policy. Norms regarding the mechanism for involving oil palm farmers as providers of raw materials for making biodiesel and minimum quality standards for smallholder palm oil should also be regulated. Institutionalization of smallholder oil palm farmers and norms requiring biodiesel business entities to collaborate with palm oil farmer cooperatives in providing raw materials for making biodiesel should also be included.

Appendix 1. Area of oil palm producing land for each productivity cluster in each province

PROVINCE	LAND AREA OF PRODUCING CROPS PER PRODUCTIVITY CLUSTER (HA)							AMOUNT (HA)
	PRODUCTIVITY CLUSTER (TONS OF CPO/HA/YEAR)							
	1 (YG 87,5%)	2 (YG 75%)	3 (YG 62,5%)	4 (YG 50%)	5 (YG 37,5%)	6 (YG 25%)	7 (YG 12,5%)	
Aceh	2.742	29.217	458.549	197.994	-	-	-	688.501
	0,0040	0,0424	0,6660	0,2876	-	-	-	
Bengkulu	413	-	64	389.839	-	191.040	-	581.356
	0,0007	-	0,0001	0,6706	-	0,3286	-	
Jambi	572	-	646.318	317.967	-	-	-	964.857
	0,0006	-	0,6699	0,3295	-	-	-	
Lampung	46.569	131.801	198.262	-	-	-	-	376.631
	0,1236	0,3499	0,5264	-	-	-	-	
Riau	-	-	1.476.456	1.563.910	358.776	-	-	3.399.142
	-	-	0,4344	0,4601	0,1055	-	-	
West Sumatera	760	-	225.697	61.226	307.228	-	-	594.910
	0,0013	-	0,3794	0,1029	0,5164	-	-	
South Sumatera	21.656	-	208.302	236.590	373.053	-	355.289	1.194.890
	0,0181	-	0,1743	0,1980	0,3122	-	0,2973	
North Sumatera	1.704	-	1.154	695.006	1.559.294	-	-	2.257.158
	0,0008	-	0,0005	0,3079	0,6908	-	-	
West Kalimantan	-	217.401	1.751.393	-	-	217.118	-	2.185.912
	-	0,0995	0,8012	-	-	0,0993	-	
South Kalimantan	82.729	89.531	37.205	234.434	127.558	-	-	571.457
	0,1448	0,1567	0,0651	0,4102	0,2232	-	-	
Central Kalimantan	125.245	-	367.629	560.510	955.929	-	-	2.009.312
	0,0623	-	0,1830	0,2790	0,4757	-	-	
East Kalimantan	21.716	175.380	251.040	1.065.019	-	-	-	1.513.154
	0,0144	0,1159	0,1659	0,7038	-	-	-	
North Kalimantan	89.367	37.850	167.656	-	-	-	-	294.873
	0,3031	0,1284	0,5686	-	-	-	-	
Papua	-	-	25.630	-	-	-	-	25.630
	-	-	1,0000	-	-	-	-	
West Papua	26.896	-	-	21.040	-	-	-	47.936
	0,5611	-	-	0,4389	-	-	-	
Southwest Papua	17.838	-	6.011	-	-	-	-	23.850
	0,7480	-	0,2520	-	-	-	-	
Indonesia	438.206	681.179	5.821.366	5.343.535	3.681.836	408.159	355.289	16.729.570
	0,0262	0,0407	0,3480	0,3194	0,2201	0,0244	0,0212	

*YG = Yield Gap

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