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WORKING PAPER

COST-BENEFIT ANALYSIS OF INCLUDING INDEPENDENT PALM OIL SMALLHOLDERS IN INDONESIA'S NATIONAL BIODIESEL TRADING SYSTEM

2021

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Preface

According to the *Statistik Perkebunan Indonesia* (Indonesian Plantation Statistics) 2018–2020 study by the Directorate General of Plantations (2020), independent palm oil smallholders produced 30% of Indonesia's crude palm oil (CPO), showing that they could play a significant role in improving the sustainability of CPO, one of the nation's main foreign currency-generating commodities. Unfortunately, the sizeable contribution that Indonesia's independent palm oil smallholders make to national CPO production does not necessarily improve their welfare, considering the lower purchase price of Fresh Fruit Bunches (FFB) from smallholder farmers compared to those purchased from plasma farmers[1], or procured from state and private plantations. The large number of FFB suppliers competing to sell their product to a small number of buyers (oligopsony), and a long supply chain with many intermediaries, has led to independent farmers receiving very low prices for the FFB that they produce.

Meanwhile, from the perspective of the buyers, the palm oil mills (POM), FFBs from smallholder farmers do not meet the industry standards. Therefore, the objective of this cost-benefit analysis study is to provide policy options that can be implemented to improve the welfare of smallholder farmers by restructuring the national biodiesel trading system to incorporate them as a formal part of the system. This study focuses on independent smallholders, defined as farmers who own or claim land of less than five hectares, procure seed and fertilizer on their own, and cultivate their own land without the support of a plantation company (Sudaryadi, 2020).

This study is designed to serve as a reference for policymakers to consider the feasibility of placing independent smallholder farmers in the biodiesel trading system, and in general, to provide new insights. In addition, this study is expected to be able to trigger further research that could provide the best policy recommendation to improve the welfare of independent smallholders' and mutual benefit for all parties involved in the biodiesel trading system.

[1] Plasma farmers are small farmers who lease their land to local palm oil companies, who provide, employment, and technical support, in return for produce at a price set by the government. See https://www.asianagri.com/en/media-en/articles/indonesia-s-plasma-farmer-scheme-explained, accessed 02/09/2021

Executive Summary

Key Findings:

1. The sizeable contribution that independent smallholders make to national CPO production has not improved their welfare.

2. Including independent smallholders in the biodiesel trading system, and providing them with support to increase their capacity to improve their crop yields and land management, can increase their welfare, as well as contributing to the reduction of greenhouse gas emissions.

3. The cost-benefit ratio is 2.13 (> 1), meaning that each unit of cost spent on program implementation will generate 2.13 units of benefit. Therefore, implementing the policy of including independent smallholders in the biodiesel trading system is feasible.

4. The sensitivity analysis shows that implementing this program is still feasible when the aggregate cost component increases by 80%, or when the aggregate benefit component decreases by 40%, all other things being equal.

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List of Abbreviations

BPDPKS	: Palm Oil Plantation Fund Management Agency
BPNT	: *Bantuan Pangan Non-Tunai* (Non-Cash Food Assistance)
BPS	: Statistics Indonesia
BU BBN	: Biofuel Business Entity
CPO	: Crude Palm Oil
FAME	: Fatty Acid Methyl Ester
GAPKI	: Indonesian Palm Oil Association
GRK	: Greenhouse Gas (GHG)
ISPO	: Indonesia Sustainable Palm Oil
JKN	: *Jaminan Kesehatan Nasional* (National Health Insurance)
KPM	: Benefit Recipient Family
MOP	: Murriate of Potash
NDPE	: No deforestation, no peat, no exploitation principles - sustainable production commitments made by companies that produce palm oil.
OPD	: Regional Apparatus Organization
PBI	: *Penerima Bantuan Iuran* (Non-Contributory Health Insurance)
Permentan	: Minister of Agriculture Regulation
Perpres	: Presidential Regulation
PIP	: *Program Indonesia Pintar* (Smart Indonesia Program)
PKS	: Palm Oil Mill (POM)
PKH	: *Program Keluarga Harapan* (The Family Hope Program) - a program providing conditional social assistance to families in need
PKO	: Palm Kernel Oil
PTPN	: PT Perkebunan Nusantara (State Plantation Company)
RAN-GRK	: National Action Plan for Greenhouse Gas Emission Reduction
RPJMD	: Regional Mid-Term Development Plan
RSPO	: Roundtable on Sustainable Palm Oil
TBS	: Fresh Fruit Bunches (FFB)
TSP	: Triple Superphosphate
VGF	: Viability Gap Fund

CHAPTER 1. INTRODUCTION

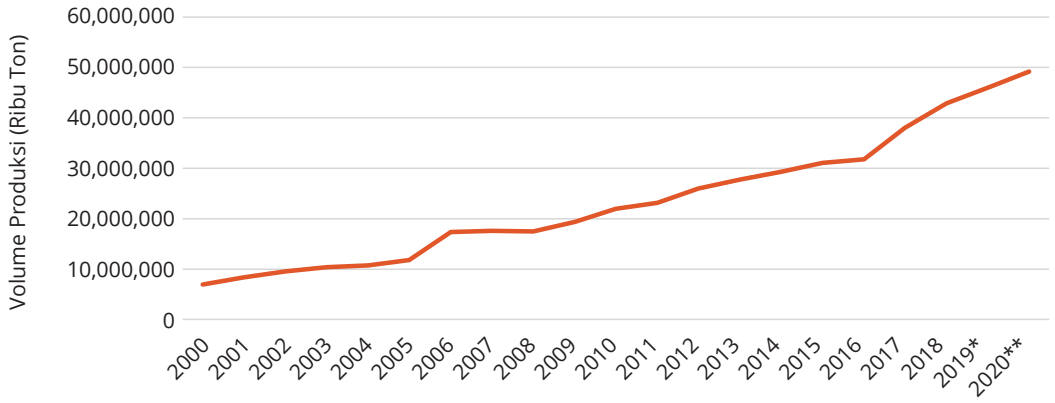
1.1 Introduction

Palm oil is one of the mainstay products of Indonesia's plantation sector. As a plantation commodity, palm oil can be processed as feedstock for vegetable oil, industrial oil, and biodiesel. The palm oil industry in Indonesia is distributed across 22 provinces, with 95% of national Crude Palm Oil (CPO) production based on the islands of Kalimantan and Sumatra (Purba & Sipayung, 2017).

Radar DePlantation Volume 1 Number 1 Year 2020 describes the five main strategic roles that palm oil plays in Indonesia's national economy: (1) Palm oil as a labor-intensive industry. In 2018, the palm oil industry employed 16.2 million workers, both directly and indirectly; (2) CPO as the largest foreign exchange contributor. The foreign exchange value from CPO export in 2018 was Rp289 trillion (US$20.54 billion) according to GAPKI in katadata.co.id, 2019); (3) Palm oil as the main food commodity for the cooking oil industry. In 2019, 9.86 million tons of palm oil was processed into cooking oil; (4) Palm oil plantations as centers of local and regional economic growth; and (5) The CPO-based mandatory biodiesel policy implemented in 2016 reduced oil imports by 12.61 million kiloliters.

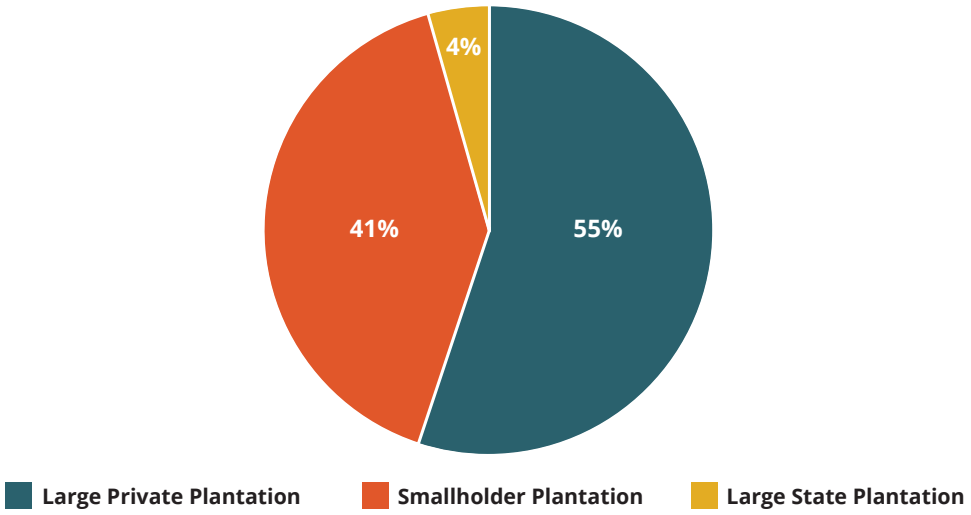
The business actors in the palm oil plantation sector are private plantations, smallholder plantations, and state plantations managed by PT Perkebunan Negara (PTPN). The main products of palm oil fresh fruit bunches are CPO and palm kernel oil (PKO). Figure 1.1 shows an increase in CPO production for the period of 2000–2020. In 2018, CPO production reached 42,883,631 tons, a 13% increase from the previous year's production of 37,965,224 tons. The increased CPO production is also driven by the increasing demand for palm oil products, as well as the biodiesel policy that mandates the use of palm oil as biodiesel blending component. The current blending proportion is 30% or B30 (2021).

Figure 1.1 CPO Production (2000–2020)



Source: Indonesian Plantation Statistics for Palm Oil 2018–2020

Figure 1.2 Palm Oil Plantation Ownership



Source: Indonesian Plantation Statistics for Palm Oil 2018–2020

Note: 1) PBS: *Perkebunan Besar Swasta* (Large Private Plantation);
2) PBN: *Perkebunan Besar Negara* (Large State Plantation); 3) PR: *Perkebunan Rakyat* (Smallholder Plantation)

In Figure 1.2, we can see that in 2018, out of the total of 14,326,350 hectares of palm oil plantations, 55% (7,892,706 hectares) are large private plantations, 41% (5,818,888 hectares) are smallholder plantations, and the remaining 4% are large state plantations, with smallholders contributing 38.26% of national palm oil production. This illustrates the important role that independent smallholders play in the national palm oil supply chain.

From the above description, we can conclude that palm oil smallholders are one of the supporting pillars of national palm oil production. Unfortunately, although they hold a strategic role, smallholders are the only upstream actors that are still struggling with their welfare. Their role as palm oil producers does not improve their welfare, as shown by their low socio-economic indicators in a study conducted by Sudaryadi (2020) in two distaricts with large concentrations of palm oil plantations: Siak in Riau Province, and Sanggau in West Kalimantan Province. **First**, the majority of smallholders live in debt. **Second**, the majority of smallholders have to take side jobs to meet their daily needs. **Third,** the majority of smallholders have low educational backgrounds (primary and junior high school level).

The same study concluded that the low welfare of independent smallholders - defined as farmers who own or claim land of less than five hectares, procure seed and fertilizer on their own, and cultivate their own land without the support of a plantation company (Sudaryadi, 2020), is mainly caused by the low return (income) due to the long FFB marketing chain.

Figure 1.3 Palm Oil Supply Chain of Independent Smallholders

Source: Adopted from Sudaryadi, 2020.

The CPO trading system in Indonesia consists of upstream and downstream activities. Downstream business actors are palm oil mills (POM) as CPO manufacturers, whereas upstream business actors are palm oil farmers that produce the FFB raw material for CPO, including state plantation companies, private plantation companies, plasma farmers, and independent farmers. As seen in Figure 1.3, from the four business actors, independent farmers are the only sector facing structural challenges as they are unable to sell their FFB directly to palm oil mills, resulting in lower FFB selling prices compared to other business actors.

This "discriminative" treatment indicates that independent farmers have yet to become a formal part of the CPO trading system supply chain. The majority of independent farmers have to sell their FFB to middlemen - usually their only choice of buyer. Middlemen will then sell the FFB to the FFB collection and trading depot as the owner of delivery order, which will in turn sell the FFB on to palm oil mills.

The reluctance of the CPO industry to include independent farmers as suppliers is based on their inability to supply FFB at the required standards, posing a risk to their supply obligations. Nevertheless, if we consider other factors - **first**, CPO's oligopsony market structure (a few large buyers, many small suppliers); **second,** FFB from independent farmers are also processed into CPO; and **third,** if all palm oil mills in Indonesia were run at full capacity, there would be a deficit of raw material supply in the CPO industry, including independent farmers in the CPO supply chain for the biodiesel trading system is a rational step and supports the mandatory use of CPO as a biodiesel feedstock.

Based on the above argument, we can conclude that the essence of including independent farmers as actors in the CPO supply chain for the biodiesel trading system lies on the change in characteristics and improvement of business performance of independent farmers to meet industrial standards. Therefore, a cost-benefit analysis is required to support the feasibility level argument of this policy strategy and to maintain its objectivity.

From the technocratic perspective, aspects that need intervention to improve the performance and productivity of independent farmers to be able to meet industrial standards, include strengthening of business legality, encouraging productivity, and encouraging the application of a good and sustainable plantation business pattern in accordance with the principles and criteria for sustainable palm oil, such as Indonesia Sustainable Palm Oil (ISPO) and Roundtable on Sustainable Palm Oil (RSPO), as well as good agricultural practices. Surely, the government plays a key role in the implementation of these intervention programs.

This study analyzes the "profit-loss" of the policy strategy of placing independent farmers as an actor in the CPO supply chain of biodiesel trading system by using the cost-benefit analysis tool. Cost-benefit analysis is used to compare the benefit received

from the implementation of a project and the cost required to implement the project. In this context, the project is the feasibility of placing independent farmers in the CPO supply chain by comparing the benefit of the placement and the cost it requires. If the benefit is larger than the cost (> 1), this indicates that implementation of the policy is feasible.

1.2 Problem Statement

1. What are the cost components of including independent farmers as an actor in the CPO supply chain of biodiesel trading system?

2. What are the benefit components that will be gained from including independent farmers as an actor in the CPO supply chain of biodiesel trading system?

3. What is the feasibility level of placing independent farmers as an actor in the CPO supply chain of biodiesel trading system?

1.3 Purpose and Objectives of the Study

The purpose of this study is to provide a cost-benefit analysis to assess the feasibility of Placing Independent Farmers as Actors in CPO Supply Chain of Biodiesel Trading System Policy. The objectives of this study are:

1. To analyze and determine the cost components of formalizing independent farmers' placement as actors in the CPO supply chain of biodiesel trading system.

2. To analyze and determine the benefit components of formalizing the inclusion of independent farmers' as actors in the CPO supply chain of biodiesel trading system.

3. To analyze the feasibility of including independent farmers as actors in CPO supply chain of biodiesel trading system policy implementation.

1.4 Benefits of the Study

The cost-benefit analysis of placing independent farmers as actors in the CPO supply chain of biodiesel trading system will be beneficial to the following parties:

1. Stakeholders
   This study can be a conceptual and technical reference for considering the feasibility of placing independent farmers in biodiesel trading system because the goal of this policy is to increase the competitiveness of independent farmers' CPO production as well as the welfare of independent farmers.

2. Academics
   This study is expected to be a reference in related research and provide more insights especially into the CPO supply chain scheme of the biodiesel trading system and the problems within, so that future research can develop the insights to produce new and improved solutions.

3. General public
   This study provides an insight into the CPO supply chain phenomenon in the biodiesel trading system and the conditions of the elevant parties, especially the position of independent farmers in the CPO supply chain.

CHAPTER 2. LITERATURE REVIEW

2.1 Sustainable Palm Oil in Indonesia

Sustainable palm oil production has to meet several criteria, including the legal aspect, economic value, and good environmental and social management (RSPO, 2013). The reference for management of sustainable palm oil plantations in Indonesia is Presidential Regulation No. 44 of 2020 on the certification system of sustainable palm oil plantations. ISPO places legal requirement as the key principle, especially regarding land status, environment, and human rights. The purpose of ISPO certification is to increase the acceptability of Indonesian palm oil products in the national and international markets, as well as to accelerate the reduction of greenhouse gas emissions.

Presidential Regulation No. 44 of 2020 emphasizes the seven principles of ISPO, namely: 1) compliance with laws and regulations; 2) implementation of good agricultural practices; 3) management of environment, natural resources, and biodiversity; 4) employment responsibility; 5) social responsibility and community economic empowerment; 6) transparency; and 7) continuous business improvement.

Good agricultural practices is still one of the most challenging aspects for independent farmers in meeting the industrial standards in order to have their FFB accepted by palm oil mills. Good agricultural practices include the traceability of all raw materials in palm oil and CPO-based biodiesel production processes. ISPO certification can only be issued for palm oil plantations that have met the legal requirements. Palm oil plantations without land legality are considered non-sustainable. Presidential Regulation No. 44 of 2020 emphasizes that currently, all palm oil plantation business actors must obtain ISPO certification, including plantation companies that produce renewable energy as well as farmers (previously, ISPO certification for the latter two was voluntary).

With regard to ISPO certification, the Indonesian Palm Oil Farmers Association (*Asosiasi Petani Kelapa Sawit Indonesia*/Apkasindo) claimed that independent palm oil farmers are facing difficulties in obtaining ISPO certification due to three main factors. First, land ownership. According to Apkasindo's survey in Riau Province, 64% independent farmers are still operating in Limited Production Forest (*Hutan Produksi Terbatas*/HPT) areas. This finding is in line with another study (Jelsma & Schoneveld, 2016), which concluded that the majority of independent farmers have not obtained land legality, which makes it difficult for them to obtain ISPO certification. Second, the cost of obtaining land legality is usually quite high, and unaffordable for independent farmers. Third, the majority of independent farmers do not have any membership in cooperatives or farmers associations as required by ISPO.

In order to maske their palm oil plantations more sustainable, independent farmers also face other issues, such as lack of access, not only to distribute their yields, but also to intellectual or guidance resources that could help increase their productivity and obtain ISPO or RSPO certification. Low plantation productivity is usually resolved by expanding the plantation area (extensification). In addition, the scattered nature of smallholder plantations has hindered FFB distribution, considering the maximum quality of FFB can only be retained for 12 hours (Jelsma & Schoneveld, 2016).

Independent farmers need capacity building to change their mindset from land expansion to intensification. According to the 2nd

Biennial Update Report In the document of NDC Indonesia, it is stated that as of January 2016, 43.59% of Indonesia's 1,457 $GtCo_2$ total greenhouse gas emissions were caused by land conversion activities, particularly peatland fire.

The National Movement for Natural Resource Rescue (*Koalisi Gerakan Nasional Penyelamatan Sumber Daya Alam*/GN PSDA) of Kalimantan (2018) have also raised concerns about smallholder plantations. Independent farmers have no management and guidance, and face legal consequences from uncertain land status as they usually farm hereditary land without any documentation, as well as using uncertified seeds. Independent farmers also have no access to facilities, capital, and guidance from the government, and therefore, their yields are often rejected by palm oil mills as they do not meet the industry standard.

2.2 Raw Material Supply Chain Policy in Palm Oil Processing Industry

Government policy on the raw material supply chain for the palm oil processing industry is stipulated in Minister of Agriculture Regulation No. 98 of 2013 on the Guidelines for Plantation Business Licensing. The policy emphasizes vertical integration between the processing industry and plantations. The purpose of this vertical integration is to maintain the sustainability of the processing industry by ensuring its raw material supply. In general, raw the material supply chain for the processing industry can be categorized into two patterns: supply from plantations that are integrated with the processing industry, and supply from independent smallholder plantations to the processing industry.

In the first pattern, the supply chain in the FFB trading system is very simple. FFB is delivered from plantations to palm oil mills without any middlemen. In the second pattern, the raw material supply in the trading system must follow the market mechanism. All middlemen (small and large traders, collection and trading depots, etc.) have their own mechanism and transaction variables, and together, they build a trading system. The supply chain policy is an effort by the government to ensure the availability of raw material supply for the continuity of the palm oil processing industry. The government does not regulate or determine the FFB trading system. The FFB trading system, as a bridge that connects raw material with the processing industry, must follow the market mechanism. Relevant actors, transaction mechanism, price determination at the farmer or plantation level, and other matters follow normal market mechanisms. Nevertheless, the provincial government is still involved in the determination of the FFB purchase price from independent farmers by palm oil mills.

FFB trading system of independent farmers involves several levels of middlemen, resulting in FFB price distortion at the farmers' level. The price distortion iss caused by the trading system supply chain, delayed information about the price of FFB, and farmers' reliance on palm oil mills.

2.3 The Current Position of Independent Farmers in the Upstream Supply Chain of the Palm Oil Industry

The study conducted by Sudaryadi (2020) on independent palm oil farmers supply chain in Riau Province found that there are two types of marketing pattern for FFB produced by independent farmers. Figure 2.1 is the most common marketing pattern: the non-association marketing pattern. In this pattern, independent farmers - with all their limitations, particularly in distribution - must sell their FFB to middlemen, who seek larger margins, resulting in price distortion for independent farmers. The long market chain also further distorts the FFB price for independent farmers.

On the other hand, plasma farmers - farmers who work on lands belonging to palm oil mills or farmers who directly cooperate with palm oil mills - have more certainty about the price, which is directly determined by the palm oil mills, whereas independent farmers must rely on FFB prices set by middlemen, collection and trading depots, or company bosses (*tauke)*.

There are many factors that are not beneficial to independent farmers, including the long palm oil supply chain. This has made it difficult for independent farmers to obtain better return for their yields. According to Sudaryadi (2020), the problems faced by independent farmers are:

1. Technical competency and understanding of sustainable plantation principles
   Most independent farmers have a low educational background, inadequate technical competency, and low understanding of sustainable agricultural principles, and therefore unable to apply good agricultural practices. In fact, technical competency is important in improving their productivity. In addition, an understanding of sustainable agricultural principles is also required to change their current mindset that land productivity can only be improved by land expansion instead of intensification.

2. Business Capital
   Limited business capital has hindered independent farmers from replanting their plantation, which is required to increase their productivity. The study even found a plantation with plants more than 25 years old (Sudaryadi, 2020).

3. Access to seeds and fertilizers
   In addition to the capital limitation, the majority of independent farmers are unable to utilize certified or high quality seeds and fertilizers as they lack access to those products. Independent farmers are unable to find local agents or distributors that are willing to sell seeds or fertilizers in smaller quantities.

4. Trading system unsuitable for the business characteristics of independent farmers
   The end point of FFB marketing activities in Indonesia are palm oil mills. However, there are relatively few palm oil mills compared to the large number of independent farmers. This market structure, where there are more sellers than buyers, is called oligopsony, and this has reduced the bargaining power of independent farmers with palm oil mills.

5. Distribution infrastructure
   Independent farmers need roads to connect their palm oil plantations with inter-district highways to directly distribute their produce to the mills. Inadequate infrastructure means higher logistic costs and this has forced independent farmers to sell their produce

to middlemen *(tengkulak)*, instead of selling directly to the mills as it will cost them more to get their produce to market.

Based on the literature study, it can be concluded that there are several problems faced by independent farmers in the national biodiesel trading system:

1. Market imperfection (oligopsony) has weakened the bargaining power of independent farmers, particularly in the determination of FFB price at the initial stage of FFB distribution.

2. Lack of technical competency in good and sustainable agricultural practices resulting in their inability to meet the industrial standards.

3. No access to capital and fertilizers, resulting in low productivity, which subsequently increases the probability of land extensification.

4. Independent farmers have not implemented good agricultural practices and have not obtained land legality, resulting in their inability to get ISPO certification as a requirement for collaboration with palm oil mills.

5. Independent farmers do not have adequate guidance in the implementation of good and sustainable plantation management.

Independent farmers play an important role in the national CPO supply chain. CPO is currently being mandated as the feedstock for biodiesel by virtue of Minister of Energy and Mineral Resources Regulation No. 12 of 2015. The independent farmers' 38% contribution shows their significant role in the national biodiesel trading system. Therefore, it is appropriate that independent farmers should receive better revenue for better welfare. This can be achieved by formally including independent farmers in the national biodiesel trading system. This study will compare the benefit and cost of implementing the program that will formally include independent farmers in the biodiesel trading system. Hopefully, the result of this study will become a reference for policymakers in considering the policies that will improve the welfare of independent farmers as well as improve the quality and increase the quantity of CPO production.

CHAPTER 3. RESEARCH METHODOLOGY

This study uses qualitative and quantitative approaches in building a synthesis and analyzing data to answer the questions posed in the research. The analysis method used is a cost-benefit analysis that will calculate and measure the feasibility of the policy that includes independent palm oil farmers in the CPO supply chain of biodiesel trading system. The majority of this analysis is based on a literature study of various reports and past research results from many sources.

3.1 Cost-Benefit Analysis Method

Cost-benefit analysis method is a technique that compares the investment value of implementing a project and the benefit received from the project (Shively & Galopin, 2014). Technically, the cost-benefit analysis calculates all identified benefits and compares them with total cost spent on the project. From the calculation, we will derive a benefit-cost ratio (BCR) value that could be interpreted as follows:

a) BCR > 1 indicates that implementation of the planned project or policy is feasible.
b) BCR < 1 indicates that implementation of the project or policy is not feasible.

In this study, the cost-benefit analysis is used to measure the feasibility of including independent farmers in the CPO supply chain of biodiesel trade system. Sudaryadi (2020) defines independent smallholders as farmers who own or claim land of less than five hectares, procure seed and fertilizer on their own, and cultivate their own land without the support of a plantation company.

Before conducting a cost-benefit analysis, it is necessary to formulate the indicators for both benefit and cost variables. It is also necessary to conduct a sensitivity test to determine the magnitude of change in BCR when there is a change in one of the components in the cost-benefit analysis, in order to measure the reliability of this analysis.

Changes in components can be caused by a change in price or production volume. In this study, the sensitivity analysis was conducted by comparing benefit reduction to a fixed cost or fixed benefit to an increased cost.

3.1.1 Assumptions Used in the Cost-Benefit Analysis

1. The program to increase the work performance of independent farmers, including business legality, productivity improvement, and application of good and sustainable agricultural practices, is initiated by the government.

2. The cost-benefit analysis simulation was conducted on the objects of analysis, namely the 5,000 independent farmers in Riau Province and 5,000 independent farmers in West Kalimantan Province.

3. The objects of analysis are independent farmers with a plantation area of two hectares.

4. The objects of analysis are independent farmers with plant ages of between 6–20 years.

5. The objects of analysis are independent farmers with four household members (father, mother, and two children in primary school or junior high school).

Pekebun mandiri yang menjadi objek analisis adalah pekebun mandiri kelapa sawit dengan jumlah anggota rumah tangga sebanyak empat orang yang terdiri satu orang bapak, satu orang ibu, dan dua orang anak pada jenjang pendidikan SD dan SMP.

3.2 Data Sources

Data used in this study are primary and secondary data. The primary data is directly obtained from in-depth interviews with experts in the study sessions conducted in Riau Province (2–6 December 2019) and West Kalimantan Province (26–29 November 2019). The experts are those with knowledge and direct involvement in palm oil plantation business management, as seen in Table 3.1.

The secondary data in this study is used to sharpen the assumption on the cost and benefit components. This data is used to make assumption on the benefit received from the greenhouse gas emission reduction budget saving and training on sustainable palm oil plantation technique. The secondary data sources are as follows:

1. Strategic Plan of Riau Province Plantation Office Year 2018–2023.
2. Strategic Plan of West Kalimantan Province Plantation Office Year 2020.

Tabel 3.1 List of Experts

No	Institution	Element	Data
1	Forum Petani Kelapa Sawit Berkelanjutan (Fortasbi) Indonesia	Palm Oil Group/Association	Cost of obtaining ISPO certification
2	Serikat Petani Kelapa Sawit (SPKS)	Palm Oil Group/Association	Price of palm oil fertilizer and other fertilization needs
3	Perkumpulan ELANG	Companion Mass Organization	Cost of obtaining land legality for independent farmers

3.3. Research Framework for the Cost-Benefit Analysis

Apart from the BCR result from the cost-benefit analysis, the critical point of this method is the relationship of the cost component spent and benefit component received. The purpose of the cost-benefit analysis is to measure the feasibility of formally including independent farmers in the palm oil production chain with government intervention. This intervention is expected to encourage independent farmers to meet the industrial standards of palm oil production, such as guaranteed supply of FFB, as well as reliable supply time and volume, in line with the industry requirement. To achieve this, the initial step to be taken is to meet ISPO certification requirements that are directly related to the obligation of palm oil mills to collaborate with ISPO holders.

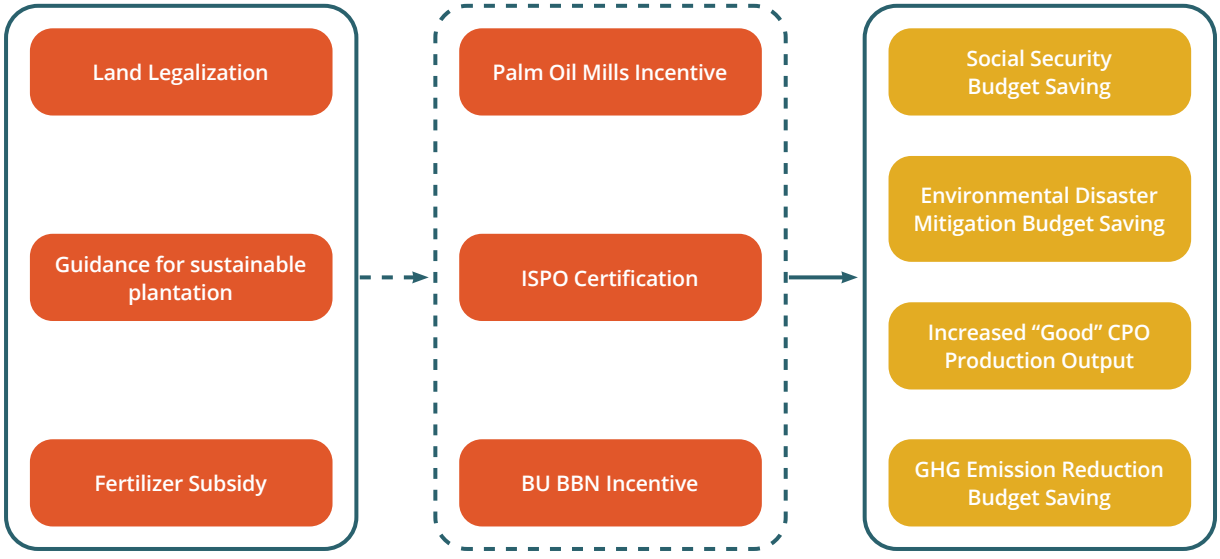
ISPO encourages sustainable agricultural practices. Therefore, providing independent

farmers with support to obtain documentation of land ownership and to increase their productivity through land intensification are crucial for avoiding land expansion to grow more palm oil, which is prone to causing environmental disasters, such as forest and land fires. The subsequent step is the mediating factor, which is also important in achieving the final objective, namely farmers' competencies in meeting the industrial standards. The main mediating factor is obtaining ISPO certification to ensure that palm oil mills will acceptFFB from independent farmers. The government's intervention in palm oil mills with the Viability Gap Fund scheme is necessary to increase the selling price of FFB from independent farmers to be at least equal to the FFB selling price of middlemen.

At the final stage, policy intervention is required to increase the biodiesel quota for Biofuel Business Entities (*Badan Usaha Bahan Bakar Nabati*/BU BBN) that purchase their CPO from palm oil mills that collaborate with independent farmers. This scheme will be of mutual benefit to both parties. The independent farmers will obtain ISPO certification, and the palm oil mills will receive incentives while at the same time procuring viable FFB. BU BBN in partnership with palm oil mills that collaborate with independent farmers will have more quota to produce biodiesel. Regarding the social aspect, the income of independent farmers will increase along with the increase in land productivity and the FFB purchase price. The resulting increase in independent farmer welfare would mean that their families should no longer need to be included in the Benefit Recipient Family (*Keluarga Penerima Manfaat*/KPM) program, which in turn will reduce the budget for social welfare security.

Guidancefor the implementation of sustainable agricultural practices is not the only way to obtain ISPO certification for independent farmers. With land intensification, independent farmers will no longer increase their productivity by land expansion, which should result in increased prevention of environmental disasters, such as forest and land fires. This is in line with the mandate in Law No. 16 of 2016 on Indonesia's commitment to reduce greenhouse gas emissions. If we are able to prevent environmental disasters and deforestation caused by land conversion, the budget for environmental disaster mitigation efforts and greenhouse gas emission reduction can also be minimized. The complete mechanism can be seen in Figure 3.2.

Figure 3.1 Thinking Framework for the Cost-Benefit Analysis



3.3.1. Cost Component in Detail

1. **Cost of legalizing 20,000 hectares of independent farmers' land.**
   To obtain ISPO certification, independent farmers must fulfill ISPO requirements. One of the problems faced by the majority of independent farmers is land legality, where they require assistance to obtain land legality for their plantation.

2. **Cost of fertilizer subsidy program for 20,000 hectares of land.**
   Fertilizer subsidy is required to help independent farmers purchase fertilizer to increase their land productivity. The high cost of fertilizer and the challenges faced by independent farmers in selling their FFB directly to palm oil mills have also reduced their income. Therefore, a special budget is required to support independent farmers by providing a fertilizer subsidy.

3. **Cost of providing guidance on good and sustainable agricultural practices for 10,000 independent farmers.**
   Presidential Regulation No. 44 of 2020 emphasizes good agricultural practices. However, field data shows that independent farmers still lack the knowledge and capacity to implement good and sustainable agricultural practices. Therefore, special training on good and sustainable agricultural practices is required to support the productivity of independent farmers as well as to fulfill the requirements for ISPO certification.

4. **Cost of obtaining ISPO certification for 10,000 independent farmers.**
   The cost of ISPO certification is the cost required to assist independent farmers to obtain the required certification.

5. **Cost of providing incentives for palm oil mills that collaborate with independent palm oil farmers.**
   Currently, the incentive distributed by Palm Oil Plantation Fund Management Agency (*Badan Pengelola Dana Perkebunan Kelapa Sawit*/BPDPKS) of the BU BBN is oriented to the viability gap fund (VGF). or to close the gap between the selling price to the general public and the biodiesel purchase price from BU BBN. Using a similar concept to VGF and BPDPKS fund availability, the fund can be used to provide incentives for palm oil mills that purchase FFB from independent farmers.

6. **Cost of providing incentives for BU BBN that purchase their CPO from the palm oil mill partners of independent pal oil farmers.**
   This incentive for BU BBN is a policy to increase the quota for fatty acid methyl ester (FAME/B100) production. This policy will require further scientific study; therefore the cost of the scientific study is included in this cost component.

3.3.2. Benefit Component in Detail

1. **Budget saving for the social security program of independent palm oil farmers.**
   During the study in Siak, Riau Province, we found that a large number of independent farmers family are categorized as Benefit Recipient Family (KPM). This shows that independent farmers have low welfare. Including independent farmers in the biodiesel trading system, along with land intensification, will increase the welfare of independent farmers by increasing their land productivity and FFB purchasing price by selling them directly to palm oil mills. Their increased income should remove them from the KPM list.

   In this study, the author identified several assistance programs for KPM, such as:

a. *Program Keluarga Harapan* (PKH);
b. *Bantuan Pangan Non-Tunai* (BPNT);
c. *Program Indonesia Pintar* (PIP);
d. *Jaminan Kesehatan Nasional Penerima Bantuan Iuran* (JKN PBI).

To calculate the fund received by each family of independent farmers, the author has made an assumption that one independent farmer has 4 family members, including one child each in primary school and junior high school.

2. **Budget saving for environmental disaster mitigation effort in palm oil plantation centers.**
Improvement in the technical competency of independent farmers and implementation of good plantation management practices will encourage farmers to carry out land intensification to increase their productivity. This kind of mindset change in plantation management should prevent land clearing or land conversion, which poses high risk for forest and land fires. Land intensification and technical competency improvement will reduce the budget for the environmental disaster mitigation effort of the national and provincial Disaster Recovery National Agency *(Badan Nasional Penanggulangan Bencana/*BNPB).

3. **Increased "good" CPO production output.**
The implementation of land intensification will automatically encourage land productivity. From the in-depth interviews, we found that comprehensive implementation of good agricultural management practices will increase land productivity by 70%. In this cost-benefit analysis, possible interventions include a fertilizer subsidy and technical assistance without a seed subsidy, with the assumption that productivity can increase by 25%.

4. **Budget saving for program to reduce Greenhouse Gas (GHG) emissions**
Indonesia's Nationally Determined Contribution (NDC) document (January 2016) states that 47.8% of the nation's total greenhouse gas emissions of 1,453 GtCo2e comes from land conversion, particularly peatland fire. In response to this phenomenon, the National Action Plan for Greenhouse Gas Emission Reduction *(Rencana Aksi Nasional Penurunan Emisi Gas Rumah Kaca/*RAN-GRK) 2010–2020 allocated a special budget for controlling greenhouse gas emissions. Reducing the possibility of independent farmers clearing land to grow more palm oil will save the budget required to prevent the expansion of peatland, which is prone to fire and will increase greenhouse gas emissions.

3.3.3. Sensitivity Analysis

The sensitivity analysis is useful to understand the reliability of cost-benefit analysis result when there is a change in one or more components in the cost-benefit analysis, which will also impact the benefit-cost ratio. The change in cost-benefit analysis components can be caused by several factors, as follows:

1. **Price**
The cost component, such as fertilizer and seed subsidies, may change according to market price dynamics. The FFB production component may also change due to FFB price dynamics.

2. **Production volume**
Increase in production volume is a benefit component with a significant effect compared to other components. Beyond numbers, this component is also directly related to the welfare of the farmers, particularly the purchase of FFB. Sensitivity analysis must be performed if there is a decrease in production absorption, which could be due to a variety of factors. The sensitivity analysis will be conducted by comparing the reduction in benefit to a fixed cost or fixed benefit to an increased cost.

CHAPTER 4. RESULT AND DISCUSSION

This chapter will explain the result of cost-benefit analysis of including independent farmers in the biodiesel trading system. The cost-benefit analysis is described in three aspects:

i. identification of the benefit and cost components of the program,
ii. calculation of each benefit and cost components, and
iii. sensitivity analysis of the cost-benefit analysis result.

4.1 Cost and Benefit Calculation

4.1.1 Cost Calculation

1. **Cost of legalizing 20,000 hectares of land owned by 10,000 independent farmers.**
   Assuming that the cost of land legalization is Rp4,000,000/hectare, the cost required is
   a. Rp4,000,000 x 2 x 10,000 = **Rp8,000,000,000**

2. **Cost of fertilizer subsidy.**
   For a two-hectare plot, 38 bags of fertilizer are required, consisting of urea, muriate off potash (MOP), triple superphosphate (TSP), and kieserite. Assuming that the government allocates Rp50,000/bag of fertilizer, the required cost is
   a. Rp50,000 x 38 x 10,000 = **Rp19,000,000,000**

3. **Cost of providing technical guidance on sustainable agricultural practices.**
   The strategic plan of the Plantation Office of the two target provinces (Riau and West Kalimantan) has allocated a special budget of **Rp2,904,974,300** for technical guidance on sustainable agricultural practices. The following is the budget scheme for the two provinces:
   a. Strategic Plan of Riau Province Plantation Office (2018–2023)
      The budget for providing technical guidance that is oriented to the implementation of good and sustainable agricultural practices in Riau Province is **Rp1,293,768,000,** broken down as follows:

Tabel 4.1 Components of Plantation Technique Guidance Program in Riau Province

Program	Anggaran
Partnering access of palm oil farmers improvement program	Rp87,466,000,00
Plantation intensification program	Rp623,700,000,00
Plantation pest control program	Rp100,000,000,00
Produce quality improvement program	Rp283,386,000,00
Guidance and procurement of post-harvest equipment and management of produce	Rp199,216,000,00
Total	**Rp1,293,768,000,00**

Source: Strategic Plan of Riau Province Plantation Office (2018–2023)

b. The budget for providing technical guidance that is oriented to the implementation of good and sustainable agricultural practices in West Kalimantan Province is **Rp1,611,206,300,** broken down as follows:

Tabel 4.2 Components of Plantation Technique Guidance Program in West Kalimantan Province

Program	Anggaran
Development of smallholder palm oil plantations	Rp906,794,000,00
Training in plantation pest control in smallholder plantations	Rp70,000,000,00
Facilitating replacement of fake palm oil seeds	Rp187,500,000,00
Monitoring the distribution, procurement, and utilization of pesticides	Rp72,058,000,00
Initiation and development of farmers institution and business partnership	Rp72,549,000,00
Palm oil yield test	Rp302,305,300,00
Total	**Rp1,611,206,300,00**

Source: Work Plan of West Kalimantan Province Plantation Office (2020)

4. **Incentive for palm oil mills that purchase FFB directly from independent farmers.**
   The incentive provided is Rp300/kg for one ton of FFB purchased by palm oil mills from independent farmers. One ton is 20% of the five tons of FFB produced by independent farmers. APROBI data shows that, on average, palm oil mills can absorb 20% of the total FFB produced by independent farmers. Therefore, the total incentive for palm oil mills is **Rp36,000,000,000.**

5. **Cost of ISPO certification.**
   Assuming the cost of ISPO certification is Rp3,000,000 for each independent farmer, the government has to provide a fund of **Rp30,000,000,000** for 10,000 independent farmers.

6. **Incentive for BU BBN that collaborate with palm oil mill partners of independent farmers**
   The form of incentive that can be given to BU BBN that purchases their FFB from palm oil mills in partnership with independent farmers is a quota for FAME/B100. A decision from policymakers is required to encourage collaboration between BU BBN and palm oil mills that purchase their FFB from independent farmers. In addition, scientific research is required to ensure that the policy will be more accurate. Therefore, the cost to issue a policy that encourages collaboration between BU BBN and palm oil mills that purchase their FFB from independent farmers is equal to the cost of the scientific research, estimated at **Rp500,000,000.**

4.1.2 Benefit Calculation

1. **Reduced cost allocation for social security program of independent palm oil farmers.**
   The productivity of independent farmers' plantations that have undergone a series of palm oil land intensification efforts, such as the utilization of certified high-

quality seed and implementation of good agricultural practices, will improve at least by 25%, or one ton per hectare. Furthermore, by assuming the increased productivity of independent palm oil farmers is 1.25 ton per hectare, each independent farmer can harvest five tons of FFB per month, based on two harvests per month. Including independent farmers in the CPO production supply chain will shorten the production chain and therefore enable farmers to sell their FFB at Rp300 higher compared to the previous FFB selling price of Rp900.

The increased land productivity and FFB selling price will increase the income of the farmers. The increase of income can be calculated as follows:

a. FFB harvest at five tons per month
b. FFB price is Rp1,200/kg. Therefore, the income of an independent farmer is Rp1,200 x 5,000 kg = Rp6,000,000

With an income of Rp6,000,000 per month, independent farmers will no longer be categorized as Benefit Recipient Family. This calculation assumes that each independent farmer has four family members, including one child each in primary school and junior high school. The following is the detailed calculation for the saving in social security budget:

a. Budget for Program Keluarga Harapan = Rp1,600,000/family/year
b. Budget for BPNT = Rp1,320,000/ family/year
c. Budget for Program Indonesia Pintar = Rp1,200,000/ family/year
d. Budget for JKN PBI = Rp2,016,000/ family/year

Total budget saving is Rp6,136,000/family/year. Total benefit from social security budget saving is **Rp61,360,000,000** for 10,000 independent farmers.

2. **Reduced cost allocation for disaster mitigation efforts in palm oil plantation centers.**
   The implementation of performance improvement programs for independent farmers and their inclusion in the supply chain will encourage palm oil plantation intensification and, in theory, decrease land clearing activities that could trigger forest and land fires. The Strategic Plan of Disaster Recovery National Agency (*Rencana Strategis Badan Nasional Penanggulangan Bencana*/ Renstra BNPB) 2015–2019 allocated Rp2,348,634,814,554.3 (Rp2.3 trillion) for disaster recovery efforts in 2019, of which Rp468,660,000,000 was spent on recovery efforts for 90,550 hectares of forest and land fires, equal to Rp5,175,704 per hectare. From this data we can calculate that the implementation of good and sustainable agricultural practices for 10,000 independent farmers will reduce the budget for forest and land fires mitigation by Rp103,514,080,000 for 20,000 hectares of land in Riau and West Kalimantan Provinces.

   At the regional level, the budget allocated for disaster mitigation efforts in Riau and West Kalimantan Provinces reaches **Rp7,048,100,000**. Therefore, the benefit gained by formally including independent farmers in the CPO supply chain of biodiesel trading system is the reduction of fire mitigation budget by **Rp110,562,180,000**..

3. **Reduced budget allocation for emissions reduction.**
   The RAN-GRK 2010 - 2020 planned for an encroachment of 20,000 hectares peatland in Riau and Kalimantan, with a budget allocation of **Rp60,000,000,000** in four areas (Riau, Jambi, South Sumatra, and Central Kalimantan) and emission reduction performance indicator of 734,000 tons CO_2e, as well as a plan for the

fire control activities in 20,000 hectares of forest, with a budget allocation of **Rp44,000,000,000** in the same four areas, and emission reduction performance indicator of 367,000 tons CO_2e.

Including independent farmers in the biodiesel supply chain will improve the quality of palm oil plantation management, resulting in better quality and sustainable palm oil in adherence to the principles of no-deforestation, no-peat, and no-exploitation (NDPE). Finally, the policy makers will be able to reduce the budget allocation for greenhouse gas emission reduction. The Regional Mid-Term Development Plan (*Rencana Pembangunan Jangka Menengah Daerah*/RPJMD) of Riau Province for the period of 2019–2024 has allocated a budget of Rp4,466,770,000 for greenhouse gas emission reduction activities, therefore, the total budget reduction will be **Rp30,466,770,000.**

4. **Increased "good" CPO production.**
   Currently, the productivity of independent farmers prior to the land intensification program is one ton per hectare of palm oil plantation. The implementation of various land intensification policies in palm oil plantations will increase the productivity by at least 25%, so that independent farmers will able to produce 1.25 ton of FFB per hectare, multiplied by the assumed 2 hectare land holding, and a total of five tons for two harvests per month. ISPO certification and sustainable agricultural training will result in high-quality FFB and "good" CPO. Plantation intensification activities will produce an additional 120,000,000 kg of FFB per year or 26,400 tons of CPO per year (assuming 22% yield).
   a. FFB production improvement = 1 ton x 10,000 x 12 = 120,000 tons of CPO/year
   b. CPO production improvement = 22% x 120,000 tons = 26,400 tons of CPO/year
   c. Increased annual income
      - FFB = 120,000,000 kg x Rp1,200/kg = Rp144,000,000,000

   Land intensification and collaboration between palm oil mills and independent farmers could generate **Rp144,000,000,000** more income from the sales of FFB to palm oil mills.

4.1.3 Cost-Benefit Analysis

From the calculation of each cost and benefit component, the author conducted a cost-benefit analysis of including independent farmers in the CPO trading system. The cost-benefit analysis was conducted by *first* calculating the total cost components and total benefit components, then *second* calculating the benefit cost ratio. The result is shown in Table 4.3.

Tabel 4.3 Cost-Benefit Analysis

Cost		Component	Total
Independent farmers land legalization			Rp80,000,000,000.00
Fertilizer subsidy			Rp19,000,000,000.00
Guidance on sustainable plantation technique			Rp2,904,974,300.00
ISPO certification			Rp30,000,000,000.00
Incentive for palm oil mills in partnership with independent farmers			Rp30,000,000,000.00
Incentive for BU BBN that purchases CPO from palm oil mills in partnership with independent farmers			Rp500,000,000.00
Total			**Rp162,404,974,300.00**
Benefit			
Budget saving from social security programs			
1	Keluarga Harapan program	Rp16,000,000,000.00	
2	Indonesia Pintar program	Rp12,000,000,000.00	
3	Bantuan Pangan Non-Tunai program	Rp13,200,000,000.00	
4	Penerima Bantuan Iuran program	Rp20,160,000,000.00	
			Rp61,360,000,000.00
Budget saving from environmental disaster mitigation efforts			Rp110,562,180,000.00
Budget saving from greenhouse gas emission reduction efforts			Rp30,466,770,000.00
Increased income from "good" CPO			Rp144,000,000,000.00
Total			**Rp346,388,950,000.00**
Benefit Cost Ratio			**2,13**

Source: Analysis result, author's calculation (2021)

It can be seen from Table 4.3 that the total benefit of Rp346,388,950,000 is larger than total cost of Rp162,404,974,300, resulting in benefit cost ratio of 2.13. In other words, each one unit of cost spent on the program will give 2.13 unit of benefit. Therefore, it can be concluded that the placement of independent farmers in the biodiesel trading system where the palm oil mills can purchase FFB directly from independent farmers is beneficial from an investment point of view. From the income distribution and community economic development point of view, this policy will encourage community economic independency as independent farmers will benefit from a more efficient market mechanism. From the profit-loss point of view, there is no loss on the government side by implementing this policy. In addition, the cost-benefit analysis shows other economic benefits which will be gained - but not yet calculated - such as the foreign exchange increase due to the reduction of fossil diesel imports, and an increase in exports of biodiesel.

4.2 Sensitivity Analysis

Sensitivity analysis was conducted by comparing the reduction in benefit to a fixed cost or a fixed benefit to an increase in cost.

Tabel 4.4 Sensitivity Analysis

	Increase in Cost (000)				Reduction in Benefit (000)			
	10%	20%	80%	150%	10%	20%	40%	60%
Benefit	394,388,950	394,388,950	394,388,950	394,388,950	311,750,055	277,111,160	207,833,370	138,555,580
Cost	178,645,472	194,885,969	292,328,954	406,012,436	162,397,994	162,397,994	162,397,994	162,397,994
Ratio	2.21	2.02	1.35	0.97	1.92	1.71	1.28	0.85

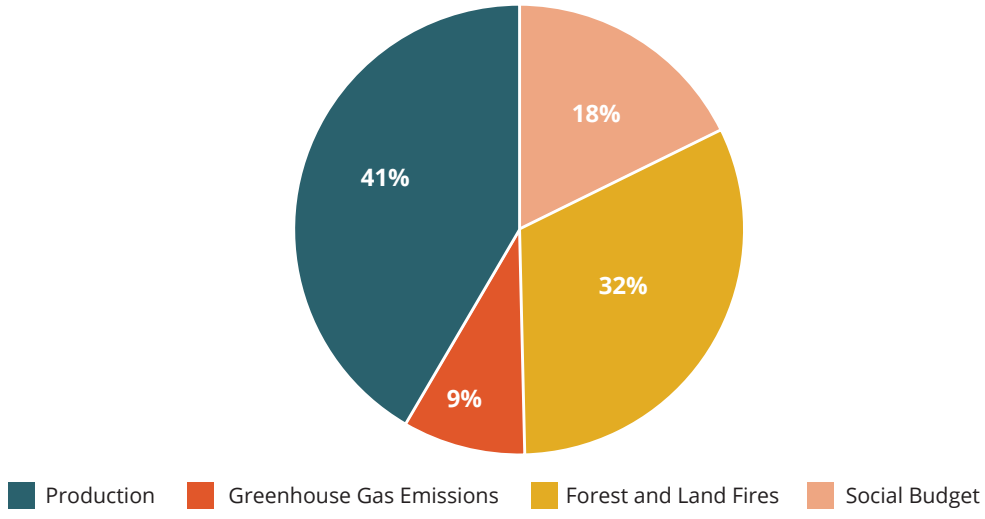
Source: Analysis result, author's calculation (2021)

From the sensitivity calculation in Table 4.4, it can be seen that 150% increase in cost will decrease the benefit-cost ratio to less than 1 (0.97). Meanwhile, 60% reduction in benefit will also decrease the benefit-cost ratio to less than 1 (0.85). To maintain the feasibility of the program, the increase in cost should not exceed 80% with a ratio of 1.35 and the reduction in benefit should not exceed 40% with a ratio of 1.28.

4.2.1 Proportionate Comparison between Cost and Benefit Components

Each cost and benefit component has its own weight toward the total cost and resulting benefit. We have to understand the portion of each component to measure the resulting impact if one of the components changes. Furthermore, this analysis will complement the sensitivity analysis as it will predict which components have a higher probability to change compared to other components.

Figure 4.1 Benefit Components Percentage

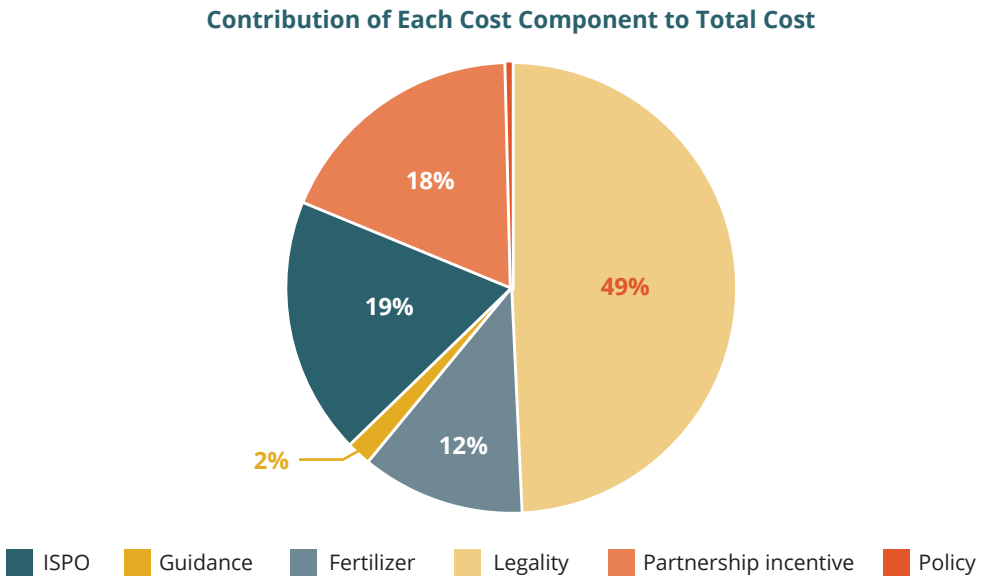


Source: Analysis result, author's calculation (2021)

Figure 4.1 shows that the production increase is the highest contributor to benefit compared to the other three components. The basis for the production calculation is the increase in the FFB purchase price and production of independent farmers. If the production benefit is decreased due to the reduction in FFB purchase price from independent farmers or production volume (to 90%), the benefit cost ratio will stay at 1.03, assuming that other benefit components remain the same. This means that this program is still feasible under market price volatility conditions, although the probability of market price volatility or a reduction in production volume to 90% is almost zero. Although the saving in forest and land fires mitigation efforts will not be possible when there are incidents of fire, however, the benefit cost ratio during forest and land fires is still more than 1 (1.10).

Figure 4.2 describes the cost components in the cost-benefit analysis. Seed, fertilizer, and partnership incentives are the components with a higher probability of change compared to other components. As seed is only for one-time use, we should consider the cost increase of other components, namely the fertilizer subsidy and partnership incentive cost. With an increase in fertilizer subsidy by 100%, with the assumption that other benefit and cost components stay the same, the benefit-cost ratio will decrease from 2.13 to 1.91. With an increase in partnership incentive by 100% (Rp600/kg), with the assumption that other benefit and cost components stay the same, the benefit-cost ratio will decrease from 2.13 to 1.80.

Figure 4.2 Cost Component Percentage



Source: Analysis result, author's calculation (2021)

CHAPTER 5. CONCLUSION

At the completion of this paper, there are at least 2,740,000 households with independent palm oil farmers. Independent farmers are defined as palm oil farmers with plantation areas of five hectares or less. This figure takes into consideration that the majority of small farmers and their families can only practically manage to farm an area of 5 hectares. In practice, independent farmers can contribute 30% of the total FFB production. However, this significant contribution is not reflected in their welfare. The main reason is the oligopsony market structure, as well as supply chain with a large number of middlemen and lack of understanding on FFB price determination. Therefore, independent farmers must sell their FFB yields to middlemen (*tengkulak*) at low prices.

On the other hand, the inability of independent farmers to meet industrial requirements has made palm oil mills reluctant to be in permanent partnership for FFB supply. The low FFB purchase price from independent farmers and the absence of partnership with palm oil mills have both affected the palm oil business continuity of independent farmers. The only way to improve the performance and business scale of independent farmers is by formally including them in the supply chain of the biodiesel trading system, enabling them to enjoy the added economic value from CPO trading.

The government intervention required for this policy is to mandate productivity improvement by way of land intensification, land legality, and partnership program from the upstream (independent farmers) to downstream (BU BBN). With this intervention, independent farmers will become permanent partners of palm oil mills and BU BBN can collaborate with palm oil mill partners of independent farmers. The next step is to formally include independent farmers in the national biodiesel supply chain through a well-reviewed regulation. The cost-benefit analysis is used in this study to consider the above policy, with the following result:

1. Formal inclusion of independent farmers in the biodiesel supply chain will result in a higher benefit compared to the cost spent, with a ratio of 2.13.

2. Total cost required for this program is Rp162,404,974,300, or Rp16,240,497 for each independent farmer in the 10,000 sample, whereas the total benefit gained is Rp346,388,950,000, or Rp34,638,895 for each independent farmer in the 10,000 sample.

3. Sensitivity analysis shows that this program is still feasible to implement even if the total cost component increases by 80%, all things being equal, or if the total benefit component decreases by 40%, all things being equal.

4. If there is a decrease in production benefit due to the decrease of FFB purchase price from independent farmers and/or FFB production volume reduced to 90%, benefit-cost ratio will still be 1.03, with the assumption that other benefit components remain the same.

5. If there is an increase of 100% in the fertilizer subsidy, with the assumption that other benefit and cost components stay the same, the benefit-cost ratio will decrease from 2.13 to 1.91. From the partnership incentive point of view, if there is an increase of 100% (Rp600,00/kg), while other cost benefit components stay the same, the benefit-cost ratio will decrease from 2.13 to 1.80.

In the end, this program will be mutually beneficial for all parties. First, independent farmers will be able to improve their welfare. Second, palm oil mills will be able to collaborate with independent farmers with

no loss, and BU BBN will be able to enjoy the additional quota for biodiesel production. Lastly, the government will have played an active role in improving both the welfare of independent farmers', and the imperfection in the market structure.

5.1 Recommendations

Implementation of formally including independent farmers in the national biodiesel trading system policy will increase the welfare of independent farmers' families. In addition, this policy will directly contribute to greenhouse gas emission reduction by preventing land extensification, or indirectly, by preventing carbon emissions resulting from forest and land fires. In reconstructing the role of independent farmers in the biodiesel trading system, policymakers can increase the role of various programs related to land intensification and aspects that support the partnership between independent farmers and palm oil mills. Further study is required to analyze other factors that hinder the partnership between independent farmers and palm oil mills as well as the impact of the partnership on the macroeconomy.

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TRACTION
ENERGY ASIA