

FAIR PRICING FORMULATION FOR PALM OIL FRESH FRUIT BUNCH PRODUCED BY SMALLHOLDER FARMERS: A DEVELOPMENT METHOD TO FORM A MORE EFFECTIVE FORMULA FOR PALM OIL FRESH FRUIT BUNCH PRICING TO ACHIEVE A FAIR PRICE FOR SMALLHOLDER FARMERS

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ABSTRACT

Objectives: The study aims to address the disparity in pricing received by smallholder farmers for their palm oil fresh fruit bunches (FFBs). It seeks to establish a fair pricing formula that balances the interests of smallholder farmers and crude palm oil (CPO) mills, ensuring the sustainability of smallholder farming practices and supporting the achievement of Sustainable Development Goals (SDGs).

Methods: The research models the cost structures of palm oil smallholder farmers and CPO mills over a 30-year investment horizon. Using profitability analyses and the constraint that the Internal Rate of Return (IRR) for smallholder farmers is greater than or equal to the IRR of CPO mills, the study derives a pricing formula. The proposed formula calculates the price of FFBs (PFFB) as a function of the price of CPO (PCPO) and oil extraction yield (OER), supported by statistical simulations.

Results: The study presents a pricing equation, $PFFB = -2438.7971 + 0.1784 PCPO + 10219.2072 OER$, which is transparent and based on significant parameters. The formula provides a practical approach to determining a fair price for FFBs, ensuring equitable profit distribution between smallholder farmers and CPO mills. This eliminates the need for prolonged negotiations while fostering sustainability and financial stability for smallholder farmers.

Conclusion: The proposed pricing formula offers a straightforward and equitable method for determining FFB prices, aligning the profitability of smallholder farmers and CPO mills. This approach supports the palm oil industry's sustainability objectives and contributes to achieving the SDGs by empowering smallholder farmers and promoting fair trade practices.

Keywords: disparity in pricing, smallholder farmers, palm oil, Sustainable Development Goals (SDG).

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1 THE IMPORTANCE ROLE OF PALM OIL SMALLHOLDER FARMERS IN INDONESIA

Palm oil contributes significantly to local and national economic development (Ashton-Butt *et al.*, 2019; Purnomo *et al.*, 2018). Smallholder farmers play a crucial role in the palm oil sector in Indonesia (Raharja *et al.*, 2020). There are palm oil smallholder areas of about 4.6 million ha and produce 15.5 million tons of CPO accounting for around 34% of the country's palm oil production. Their contributions are essential to meeting global demand for this commodity (BPS Statistic Indonesia, 2023). Smallholder farmers are present in Indonesia's palm oil growing provinces, with all significant areas in at least 18 provinces (Glenday & Paoli, 2015). Smallholder farmers provide a significant source of income for rural communities and help to reduce poverty levels (Astuti *et al.*, 2020). They also promote sustainable land use practices and help to conserve biodiversity by maintaining forested areas on their land (Ngan *et al.*, 2022). Additionally, smallholder farmers contribute to the country's economy by providing jobs and generating income by selling their products. Smallholder farmers also provide employment opportunities and contribute to the economic development of rural areas (Abazue, Er, Ferdous Alam, & Begum, 2015; Chrisendo, Siregar, & Qaim, 2022). However, they face challenges such as limited access to finance, land tenure insecurity, market vulnerability, and low crop yield or low productivity (Alwarritzi, Nanseki, & Chomei, 2015; Sukiyono *et al.*, 2017; Wissler, 2015). The government and private sector have been implementing programs to address these challenges and improve the livelihoods of smallholder farmers in the palm oil sector (Barlow, Zen, & Gondowarsito, 2003; Wissler, 2015).

2 THE IMPORTANCE OF SMALLHOLDERS TO RECEIVE FAIR PRICES FOR THEIR PALM OIL FRESH FRUIT BUNCH

Smallholders are farmers who own or manage small plots of land, typically less than 25 hectares (according to Ministry of Agriculture criterion), 10 hectares (Jelsma, Woittiez, Ollivier, & Dharmawan, 2019), or using another author 5 hectares or less. In 2021 there are at least 2.74 millions household

smallholder farmers with areas less than 5 hectares (Radhianshah, 2021). Palm oil is an important cash crop for smallholders in Indonesia and smallholder can be portrayed as the Achilles heel for the oil palm sector's sustainability (Jelsma *et al.*, 2019). Independent smallholders tend to receive lower and inadequate prices (Nesti, Tan, Ridwan, & Ampuh Hadiguna, 2018) than large-scale farmers or those smallholders associated with company-managed plantations (Voora, Bermúdez, Farrell, Larrea, & Luna, 2023). Crude palm oil mills should consider smallholder palm oil fresh fruit bunches more as partners than as vendors. This requires truly transparent pricing, reciprocal, and participatory processes to ensure fair dealing between both parties (Jezeer, Singerland, Laan, & Pasiecznik, 2020; Rijali, 2017).

A fair price for palm oil fresh fruit bunch is crucial for smallholder farmers' economic, social, and environmental sustainability (Ngan *et al.*, 2022). There are some reasons why it is important for smallholders to receive a fair price for their palm oil fresh fruit bunch in terms of poverty alleviation, sustainability including certification and traceability (Falgenti & Hambali, 2022; Ruml *et al.*, 2022).

Smallholders are often poor and vulnerable to price fluctuations in the market (Afrianto, Hutabarat, & Asminar, 2020; Arifin, Emalisa, & Salmiah, 2013). A fair price for their palm oil fresh fruit bunch can help them earn a decent income and improve their standard of living (Ahmad, Osman, Omar, Rahman, & Ishak, 2020; Ayompe, Nkongho, Masso, & Egoh, 2021).

Smallholders who receive a fair price for their palm oil fresh fruit bunch are more likely to invest in sustainable practices, such as replanting and soil conservation, which can improve the long-term productivity of their land (Ogahara, Jespersen, Theilade, & Nielsen, 2022). Smallholders who receive a fair price for their palm oil fresh fruit bunch are more likely to be able to afford certification schemes, such as the Roundtable on Sustainable Palm Oil (RSPO), which can help them access premium markets and improve their environmental and social performance (Gallemore, Jespersen, & Olmsted, 2022). Smallholders who receive a fair price for their palm oil fresh fruit bunches are more likely to participate in traceability systems, which can help ensure their palm oil is

produced sustainably and ethically (Witjaksono *et al.*, 2023). Fair prices can help smallholders afford certification schemes and encourage smallholders to participate in traceability systems, such as the Roundtable on Sustainable Palm Oil (RSPO), which can help them access premium markets and improve their environmental and social performance because their palm oil fresh fruit bunches are produced sustainably and ethically (Hutabarat, Slingerland, Rietberg, & Dries, 2018).

3 BARGAINING POSITION OF SMALLHOLDER FARMERS

Smallholder farmers often have weaker bargaining positions than CPO mills/processors when negotiating prices for their palm oil fresh fruit bunches. This is due to several factors, such as the fragmented nature of smallholder farming, limited access to market information, and low quality of fresh fruit bunches production (Herdiansyah, Negoro, Rusdayanti, & Shara, 2020). They are often seen as a weak point in the development of oil palm plantation production (Februningsih, 2019; Mulyasari, Djarot, Sasongko, & Putra, 2023). However, there are initiatives aimed at improving the bargaining position of smallholder farmers, such as the development of farmer groups and cooperatives, which can help to increase their collective bargaining power. Policies that promote fair trade and sustainable palm oil production can also help improve the bargaining position of smallholder farmers through institutional strengthening activities (Armin, 2023; Erdi, 2017; Raharja *et al.*, 2020).

For several reasons, palm oil fresh fruit bunch smallholder farmers may have a weaker bargaining position against crude palm oil mills, and they do not hold any power to determine the price, particularly when the price slumps due to market shocks (Jelsma, Giller, & Fairhurst, 2009; Novira, 2023). One reason could be that the processors have greater market power and can set the price of crude palm oil, which affects the price offered to farmers. Additionally, smallholders' location is remote, and they may not have access to information on market prices or be unable to negotiate prices effectively. They may also lack the resources or economies of scale to compete with larger producers,

which can limit their bargaining power (Wissler, 2015; Yee Chuok, 2021). Because of low production volume, they tend to sell fresh fruit bunches to intermediaries, creating a longer supply chain and causing a high risk of oil palm fruit and increasing free fatty acid levels, eventually decreasing the quality (Falgenti & Hambali, 2022; Mawardati, 2018; Sarkum, Mustamu, & Yanris, 2020). Smallholder farmers also tend to sell to intermediaries because of their shark loan agreement (Jelliani, Maifianti, & Kriswanto, 2020).

4 EXISTING PRICING PRACTICE FOR FRESH FRUIT BUNCH PRODUCED BY SMALLHOLDER FARMERS

In Indonesia, the price setting for palm oil fresh fruit bunches produced by smallholder farmers is typically based on a combination of factors. One common practice is using reference prices, which regional (provincial) government agency determines based on the Ministry of Agriculture regulation (Ministry of Agriculture, 2018). These reference prices are a benchmark for procuring fresh fruit bunches from smallholder farmers by CPO mills. The regulation only provides guidance for the purchase price of FFB and the establishment of a Pricing Team in the region, but in real market situation, the determination of the actual selling price remains under the dominance of CPO mills because there is no other place to sell, hence it is not transparent because the calculation of CPO mills largely determines it. There is no protection for smallholders to receive better prices (Bachtiar, Dasrol, & Fitriani, 2020). The price set by the government at the provincial level may not be effectively implemented to the lower level (district or sub-district levels where the real transaction happened) (Sitorus, Napitupulu, & Elwamendri, 2017). In addition, actual prices may vary depending on marketing channels or role of intermediaries, and other factors. In fact, smallholders are often selling their fresh fruit bunches at poor prices to local mills (Barlow *et al.*, 2003; Sarkum *et al.*, 2020). The worst case is when the price of palm oil fresh fruit bunches is determined unilaterally by the CPO mill (Lukman, Ismail, -, & Budi, 2019; Nesti, Tan, Ridwan, & Ampuh Hadiguna, 2018; Rahamawati, 2023). Prices set by CPO mills are often unfair. Smallholders have no protection against such poor prices

because of market competition and the diverse sources of fresh fruit bunches from farmers or collectors (Bachtiar *et al.*, 2020; Rahamawati, 2023).

The existing formula for fresh fruit bunches price contains a constant 'K' which is considered very questionable because it acts as a pressure factor to lower the price of palm oil fresh fruit bunch. The decision to apply K as a specified number is not transparent because it incorporates various components not readily known by farmers such as processing costs, marketing costs, depreciation costs, indirect operational costs, and overhead costs (Maryadi, Yusuf, & Mulyana, 2004; Rahman, Malik, & Sinta, 2018). It is clear that inefficiencies in CPO mills can be passed unfairly to the smallholders by lowering the index K. Therefore, a new price formula must be developed with transparent and easy-to-understand variables to avoid confusion and abusive practices.

It's worth noting that there are ongoing efforts to improve price transparency and fairness in the palm oil sector. Initiatives such as the Indonesian Sustainable Palm Oil (ISPO) certification and the Roundtable on Sustainable Palm Oil (RSPO) aim to promote sustainable practices and ensure fair prices for smallholder farmers (de Vos, Suwarno, Slingerland, van der Meer, & Lucey, 2023). These initiatives encourage greater transparency and accountability in price negotiations, benefiting smallholder farmers in the long run (Jezeer *et al.*, 2020). There is also a proposal to use the fuzzy logic method to determine palm oil fresh fruit bunches price (Amriana, Kasim, & Maghfirat, 2020) or another proposal to use Analytical Hierarchical Process (Prayudy & Shilul Imaroh, 2019) or to use the Backpropagation Artificial Neural Network method (Ismanto, Effendi, & Cynthia, 2018), but in our opinion, they are very complex and very complicated to comprehend for smallholders, and we expect to develop a simpler but more effective price formula.

5 THE IMPORTANCE OF FAIR PRICING FOR PALM OIL FRESH FRUIT BUNCH

Receiving a better price for their palm oil fresh fruit bunches is important for Indonesia's smallholder farmers to achieve several Sustainable Development Goals (SDGs) (Chiriaco, Bellotta, Jusić, & Perugini, 2022; Purnomo *et al.*, 2018).

Firstly, a fair price can help to improve the economic well-being of smallholder farmers and their families, which is essential for achieving SDG 1 (No Poverty). Fair prices can create economic development in local communities by giving smallholders a decent income. Fair prices can help smallholders reduce poverty and improve their living standards, which can positively impact the local economy. This can lead to increased access to education, healthcare, and other basic needs, contributing to SDG 3 (Good Health and Well-being) and SDG 4 (Quality Education) (Situmorang, 2016; Elisa Wildayana, Zahri, Mulyana, & Husin, 2011).

Secondly, a fair price can also help to promote sustainable practices in the palm oil sector, contributing to SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action). Farmers in Indonesia suffer from incentive-incompatible pricing practices limiting the extent to which farmers increase productivity and reduce environmental effects (Degli Innocenti & Oosterveer, 2020). By receiving a fair price, smallholder farmers are incentivized to adopt sustainable practices such as reducing waste, using less harmful pesticides, and protecting biodiversity through certification (Eggen *et al.*, 2024; Fadilah, Dewi, & Hutabarat, 2018; Chye Ing Lim & Biswas, 2019).

Finally, a fair price can help to promote partnerships between smallholder farmers and CPO processors, contributing to SDG 17 (Partnerships for the Goals) (Napitupulu, Ernawati, Elwamendri, Yanita, & Fauzia, 2019b). This can lead to greater partnership, collaboration, and knowledge-sharing, ultimately strengthening transactional and organizational models, benefiting both parties and contributing to the long-term sustainability of the palm oil sector (Ekine & Onu, 2009; Glenday & Paoli, 2015). Partnership model between smallholders and oil palm companies that focus on improving sustainable palm oil governance should be strengthened (Ichsan, Saputra, & Permatasari, 2021). The palm oil industry can create employment opportunities for local people, which can help stimulate the local economy. Fair prices can help maintain local stability and social sustainability by reducing the risk of social unrest and conflict caused by poverty and inequality (Amriana *et al.*, 2020; Dahniar & Difa, 2021; Ngan *et al.*, 2022).

6 INCREASING BARGAINING POSITION OF PALM OIL FRESH FRUIT BUNCH SMALLHOLDERS

Increasing the bargaining position of palm oil smallholders to receive higher prices for their fresh fruit bunches can be challenging. There are some strategies that can help, for instance, using collective action, direct sales, certification, government support, market transparency, and the use of technology, particularly to meet and comply with sustainability standards and access the market (Candra, Hadi, Dewi, & Anggraini, 2021; Dar, Sarkum, Nasution, & Mustamu, 2018).

Smallholders can form cooperatives or associations to increase their bargaining power and negotiate better prices with intermediaries (Afrino, Syahza, Suwondo, & Heriyanto, 2024; Sarkum *et al.*, 2020). Smallholders can sell their fresh fruit bunches directly to mills or processors, bypassing or shortening intermediaries and potentially receiving higher prices or margins (Hutajulu, Chalil, & Sembiring, 2019).

There are opportunities for sustainable palm oil practices by smallholder farmers (Manurung *et al.*, 2021). Smallholders can obtain certification, such as the Roundtable on Sustainable Palm Oil (RSPO), which can help them access premium markets and receive higher prices for their fresh fruit bunches.

Governments can provide support to smallholders, such as access to credit, technical assistance, and infrastructure, which can help increase their bargaining power and improve their livelihoods, produce better fresh fruit bunches, and negotiate better prices with intermediaries so that they can meet and comply with the sustainability standards (Abideen, Sundram, & Sorooshian, 2023; Candra *et al.*, 2021). The use of technology, such as mobile phones and online platforms, can help smallholders access market information (for instance, daily FFB price for reference) and connect with buyers, which can help increase their bargaining power because of a more transparent FFB marketing system (Nordin, Chandramohan, Basiron, & Venugopal, 2001).

This study focuses on formulating a simple and more transparent price formula for pricing palm oil fresh fruit bunches of smallholder farmers as an integral part of improving their bargaining position toward CPO mills.

7 FACTORS THAT DETERMINE THE PRICE OF PALM OIL FRESH FRUIT BUNCHES

Several factors determine the price of palm oil, including the quality of the fresh fruit bunches, the price of CPO in the market, and the role of intermediaries (Bankole, Ojo, Olutumise, Garba, & Abdulqadir, 2018; Lifianthi, Rosana, & Thirtawati, 2022; Sarkum *et al.*, 2020). The most profitable for the smallholder farmers is when they deal with the shortest marketing channel (Hutajulu *et al.*, 2019). The price of CPO in the market reflects the demand for palm oil in the global market, which eventually can affect the price of palm oil fresh fruit bunches. Intermediaries, such as FFB traders, can affect the price of palm oil by setting the price they are willing to pay smallholders (Sarkum *et al.*, 2020). In this study, it is assumed that smallholder farmers can sell their fresh fruit bunches directly to CPO mills without any intermediaries so that they receive the price of fresh fruit bunches as formulated here. They can receive the price about 43.7% higher than selling through intermediaries (Moneka, Alamsyah, & Saputra, 2021).

The quality of the FFBs, including their ripeness, size, and oil content, can affect the price of palm oil. Smallholders can improve the quality of their FFBs by using good agricultural practices, such as proper use of sufficient and balanced nutrient inputs such as fertilizers, integrated pest management, and soil conservation, harvesting, and handling techniques, which can help them receive higher prices from crude palm oil processors (Ya Li Lim *et al.*, 2023; Marimin *et al.*, 2020; Sugianto *et al.*, 2023). In this study, the quality of fresh fruit bunches is represented by the oil extraction rate (OER) which determines the quantity of CPO produced by CPO mills.

8 FORMULATING A FAIR PRICE FOR PALM OIL FRESH FRUIT BUNCHES

While oil palm plantation seems to be very profitable, but selling price of fresh fruit bunches is very sensitive to yield than other investment cost and recurrent costs (Svatoňová, Herák, & Kabutey, 2015). Formulating a fair price for palm oil fresh fruit bunches (FFBs) produced by smallholders can be complex. Many factors can affect the price of FFBs, including the cost of

production, market demand, and global prices. Some companies that have partnerships with farmers have taken steps to support independent smallholders by purchasing FFBs above the market rate. This can help alleviate declining prices' impact on smallholder livelihoods (Hasan, Fadhil, Fahmid, & Ahmad, 2022).

In addition to market factors, there are also initiatives aimed at improving the sustainability of palm oil production by smallholders. For example, the Roundtable on Sustainable Palm Oil (RSPO) has a program to certify FFB production by independent smallholders. Certified FFBs can command a higher price in the market, which can help to improve smallholder incomes (Candra *et al.*, 2021).

Ultimately, a fair price for FFBs produced by smallholders would need to take into account the quality of production and market demand. In fact, its implementation may also be influenced by government policies and initiatives aimed at supporting smallholder livelihoods by determining fair prices for smallholder fresh fruit bunches (Purba, Nasution, Amalia, & Wahyono, 2015) because of the role of risk and uncertainty involved in the process (Papenfus, 2005).

It is important for the government and all stakeholders in the palm oil industry to work together to ensure that smallholders receive a fair price for their produce if sustainability initiatives and objectives are expected to be implemented by smallholder farmers (Nesti, Tan, Ridwan, & Hadiguna, 2018; E. Wildayana, 2016).

9 INCOME ANALYSIS USING COST STRUCTURE OF PALM OIL FRESH FRUIT BUNCH PRODUCTION

The cost structure for producing palm oil fresh fruit bunches can vary depending on several factors, such as the size of the plantation, location, direct labor costs, and direct material/input costs and overhead costs. The typical costs involved in producing palm oil fresh fruit bunches, namely, land preparation and planting, fertilizers and pesticides application, labor costs, transportation, maintenance/upkeep, harvesting and overhead costs. Land

preparation and planting include clearing land, preparing soil, and planting seedlings. Fertilizers and pesticides are used to maintain palm oil plant health and productivity. Labor costs include hiring workers for harvesting, pruning, and other tasks (Sembiring, Sarma Sinaga, Wahyuni, Budiman, & Rumenda, 2017). Transportation costs include transporting fresh fruit bunches from the plantation to the processing mill (Suswatiningsih, Yulistiana, Ayiek, & Sayekti, 2021). Maintenance and upkeep include the cost of maintaining equipment and repairing any damage caused by pests or weather conditions. Overhead costs include administrative costs such as permits and taxes (Ismail, Arif, Noor, & Bidin, 2003; Masyarah, 2022). This study classified them as total variable costs (TVC) and total fixed costs (TFC).

If the plantation is managed in accordance with the rule and requirements, it will significantly improve the productivity and quality of oil palm fruit fresh bunches (Salmiyati, Heryansyah, Idayu, & Supriyanto, 2014). Smallholder farmers may face additional challenges, such as limited access to financing and higher input costs due to smaller economies of scale to fulfill necessary requirements (Wissler, 2015).

The income analysis using the above-mentioned cost structure in general for smallholder farmers is written as follows (Khoirunnisa, Riswani, & Lifianthi, 2023; Napitupulu, Ernawati, Elwamendri, Yanita, & Fauzia, 2019a):

$$\Pi_f = TR_f - TC_f \quad (1)$$

where:

$$TR_f = P_{FFB} \times Q_{FFB}$$

$$TC_f = TVC_f + TFC_f$$

Π_f : income of smallholder farmers (Rp)

TR_f : total revenue of smallholder farmers (Rp)

TC_f : total costs of smallholder farmers (Rp)

P_{FFB} : price of fresh fruit bunch (Rp)

Q_{FFB} : quantity of fresh fruit bunch (ton/year)

TVC_f : total variable costs of smallholder farmers (Rp)

TFC_f : total fixed costs of smallholder farmers (Rp)

10 INCOME ANALYSIS USING COST STRUCTURE OF PALM OIL PROCESSING

Palm oil processing is not only a profitable enterprise, it also possesses great potentials for poverty alleviation and rural transformation in the surrounding area (Iwala OS, 2009; Nze, Nzeakor, & Egbosionu, 2017).

Costs for processing palm oil from palm oil fresh fruit bunches can also vary depending on several factors, such as the size of the processing mill, location, labor costs, and input costs, and rely on oil extraction yield (Biodiin, Akinlabi, Okokpuije, & Fayomi, 2021; Rijali, 2017). There are some of the typical costs involved in processing palm oil, namely labor costs, energy costs, chemicals, packaging and transportation, and overhead costs. Labor costs include hiring workers for operating machinery, maintenance, laboratory analyst and other tasks. Production cost for CPO can be grouped according to mill operating cost, overhead cost, depreciation and other cost (Dahniar & Difa, 2021; Man & Baharum, 2011). In this study, they are then classified as total variable costs (TVC) and total fixed costs (TFC).

The income analysis using above mentioned cost structure in general is written as follows (Ernawati *et al.*, 2021; Napitupulu *et al.*, 2019a):

$$\Pi_p = TR_p - TC_p \quad (2)$$

where:

$$R_p = P_{CPO} \times Q_{CPO}$$

$$TC_p = TVC_p + TFC_p$$

Π_p : income of CPO mill (Rp)

TR_p : total revenue of CPO mill (Rp)

TC_p : total costs of CPO mill (Rp)

P_{CPO} : price of CPO produced (Rp/kg)

Q_{CPO} : quantity of CPO produced (kg/year)

TVC_p : total variable costs of CPO mill (Rp)

TFC_p : total fixed costs of CPO mill (Rp)

Energy costs include the cost of electricity, fuel, and other energy sources used in the processing mill. Chemicals are used in the refining process

to remove impurities and improve the quality of the final product. Packaging and transportation include the cost of packaging the final product and transporting it to customers. Overhead costs include administrative costs such as taxes, permits, and insurance.

It's worth noting that the cost structure can vary significantly depending on the sustainability level of processing involved and the quality of input in terms of oil extraction ratio (OER). OER affects the production cost of CPO where OER is directly proportionate to production capacity and inversely proportionate to CPO production cost (Dahniar & Difa, 2021; Man & Baharum, 2011). Mills that apply sustainable practices and certifications, such as RSPO may have higher costs due to additional compliance requirements.

11 SIMULATION PROCESS

This study models the cost structure of palm oil farmers and the cost structure of CPO mills to generate a simple pricing formula in the form of $P_{FFB} = B_0 + B_1 P_{CPO} + B_2 OER$ (the price of palm oil fresh fruit bunches (P_{FFB}) as a function of CPO price (P_{CPO}) and the palm oil fresh fruit bunches oil extraction yield (OER)), where P_{FFB} is the price of palm oil fresh fruit bunches; B_0, B_1, B_2 are constants, P_{CPO} is the price of Crude Palm Oil (CPO); and OER is the oil extraction rate of fresh fruit bunch.

In order to generate the price equation, it is developed the method using basic steps as follows:

1. To perform income analysis of farmers using hypothetical standard costs representing the most efficient practice of good agricultural practices, and then to perform profitability analysis using a 30-year investment horizon to generate IRR of farmers (IRR_F) based on their level of productivity;
2. To perform income analysis of CPO mills using hypothetical standard costs representing the most efficient of good manufacturing practices, and then to perform profitability analysis using a 30-year investment horizon to generate IRR of CPO mills based on the input level of CPO price (P_{CPO}) and oil extraction rate (OER);

3. To find out at what level of CPO price and OER, when the condition IRR_F and IRR_P will be equal based on comparison on the table generated from the step 1 and 2. Whenever necessary it is applied intrapolation as the exact number may not appear on the referred table;
4. To compile the data collected from the step 3 and to perform curve fitting using regression analysis to generate the price equation formula ($P_{FFB} = B_0 + B_1 P_{CPO} + B_2 OER$).

Assumptions applicable in this study:

- a. Palm Kernel Oil as output process from palm oil fresh fruit bunch for the sake of simplicity is not incorporated in this early stage of development;
- b. Investment horizon both for palm oil plantations and CPO mills is set at the same period of 30 years;
- c. Income analysis for both palm oil plantation and CPO mills are using a hypothetical standard cost representing the most efficient costs applicable;
- d. The most efficient hypothetical standard costs is applicable to encourage efficient practices both for farming and CPO manufacturing so that there is no inefficiencies burden remaining in the pricing formula.

12 RESULTS

The result of step 1 is shown on the Table 1 below.

Table 1

$IRR_F(\%)$ on Various Levels of P_{FFB} (Rp/kg) and Productivity (FFB ton/ha)

Daftar IRR, Analisa Kelayakan Kebun dalam Constrain Yield dan Harga TBS

Pffb (Rp/kg)	ffb Yield (t/ha)										
	12	14	16	18	20	22	24	26	28	30	32
800	-	-	-	-	-	-	-	(11.6%)	(6.7%)	(3.6%)	(1.2%)
1,000	-	-	-	(8.6%)	(3.6%)	(0.1%)	2.5%	4.8%	6.7%	8.5%	10.1%
1,200	-	(6.7%)	(1.2%)	2.5%	5.4%	7.9%	10.1%	12.0%	13.9%	15.6%	17.2%
1,400	(3.6%)	1.7%	5.4%	8.5%	11.1%	13.4%	15.6%	17.6%	19.5%	21.2%	22.9%
1,600	2.5%	6.7%	10.1%	13.0%	15.6%	18.0%	20.2%	22.3%	24.2%	26.1%	27.9%
1,800	6.7%	10.6%	13.9%	16.8%	19.5%	21.9%	24.2%	26.4%	28.4%	30.4%	32.3%
2,000	10.1%	13.9%	17.2%	20.2%	22.9%	25.5%	27.9%	30.1%	32.3%	34.4%	36.3%
2,200	13.0%	16.8%	20.2%	23.2%	26.1%	28.7%	31.2%	33.6%	35.8%	38.0%	40.0%
2,400	15.6%	19.5%	22.9%	26.1%	29.0%	31.8%	34.4%	36.8%	39.1%	41.4%	43.5%

Source: Prepared by Authors

The example result of step 2 is shown on the Table 2 as represented on the condition that P_{FFB} is Rp2,400/kg.

Table 2

IRR_P(%) on Various Levels of P_{CPO} (Rp/kg) and OER (%) given that P_{FFB} is Rp2,400/kg

Pffb	2,400							
Pcpo (Rp/kg)	OER (%)							
	14	16	18	20	22	24	26	28
8,000	-	-	-	-	-	-	-	-
9,000	-	-	-	-	-	-	-	(16.3%)
10,000	-	-	-	-	-	-	(8.1%)	2.6%
11,000	-	-	-	-	-	(5.0%)	5.3%	12.8%
12,000	-	-	-	-	(4.6%)	6.3%	14.2%	20.9%
13,000	-	-	-	(6.9%)	5.8%	14.4%	21.6%	27.9%
14,000	-	-	(12.7%)	3.5%	13.4%	21.2%	28.1%	34.3%
15,000	-	-	(0.6%)	10.9%	19.8%	27.3%	34.0%	40.2%
16,000	-	(8.7%)	7.1%	17.1%	25.5%	32.8%	39.5%	45.8%
17,000	-	0.7%	13.2%	22.5%	30.7%	38.0%	44.8%	51.1%

Source: Prepared by Authors

The example result of step 3 is shown on the Table 3 as represented on some conditions of P_{FFB} (Rp/kg), P_{CPO} (Rp/kg), and OER (%) that meet criteria $IRR_P(\%) = IRR_F(\%)$.

Table 3

Examples of Various Condition of P_{FFB} (Rp/kg), P_{CPO} (Rp/kg), and OER (%) when $IRR_P(\%) = IRR_F(\%)$

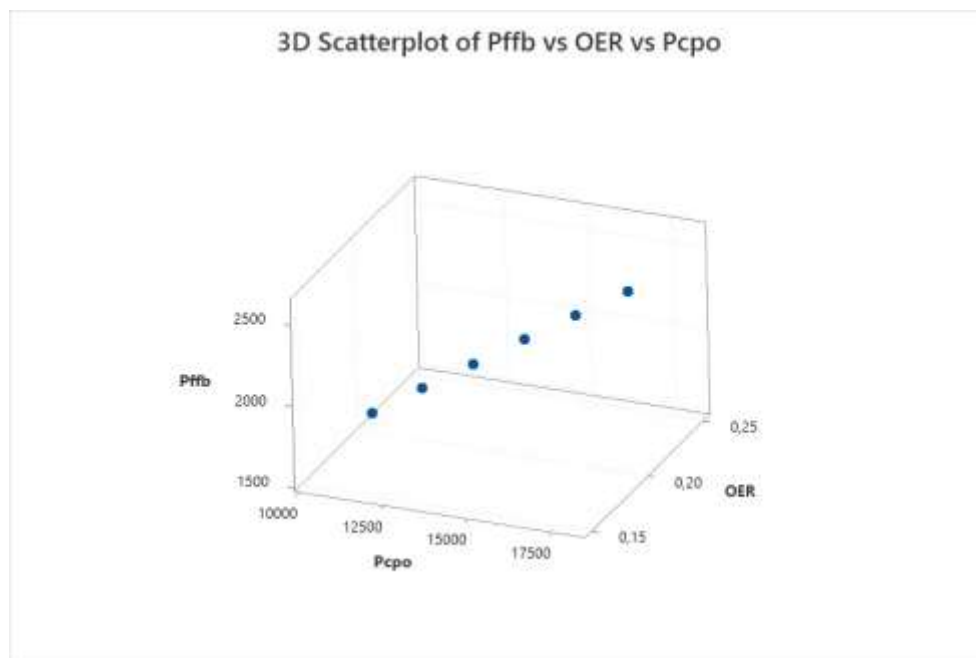
IRR	Pffb	Pcpo	OER
13.0%	1,600	10,316	20.0%
16.8%	1,800	11,832	20.0%
20.2%	2,000	13,360	20.0%
23.2%	2,200	14,900	20.0%
26.1%	2,400	16,451	20.0%
28.7%	2,600	18,011	20.0%

Source: Prepared by Authors

After compiling the conditions of P_{FFB} , P_{CPO} , and OER that meet the criteria $IRR_F = IRR_P$ from the previous step (it is graphically represented as the Figure 1), it is performed curve-fitting using regression analysis.

Figure 1

Graphical Representation of Combination of P_{FFB} , P_{CPO} , and OER that Meet the Criteria $IRR_F = IRR_P$



Source: Prepared by Authors

In this study, it is found that the regression equation is:

$$P_{FFB} = -2438.7971 + 0.1784 P_{CPO} + 10219.2072 OER \quad (3)$$

Regression analysis result is shown in Table 3. In this regards, it is satisfying because it shows significant goodness of fit as shown by their significant levels of the parameters tested.

Table 3

Summary Output of Regression Analysis

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.9965
R Square	0.9931
Adjusted R Squ	0.9929
Standard Error	45.1018
Observations	111

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	2	31415309	15707654.69	7721.8897	0.000000
Residual	108	219691	2034.1724		
Total	110	31635000			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	-2438.79711	62.2605	-39.1709	0.000000
Pcpo	0.17835	0.0014	124.2730	0.000000
OER	10219.20721	274.7437	37.1954	0.000000

Source: Prepared by Authors

13 CONCLUSION

The role of smallholder farmers is very important in palm oil industry, particularly to ensure that sustainability initiatives and objectives, including Sustainable Development Goals can be implemented and achieved. The fact that smallholder farmers often receive lower selling prices for their palm oil fresh fruit bunches must be addressed. Besides the problem of intermediaries, it is argued that the price for palm oil fresh fruit bunches must be formulated fairly to balance the interests of smallholder farmers and CPO mills to help and support palm oil smallholder farmers. This study models the cost structure of palm oil farmers and the cost structure of CPO mills, then uses a 30-year investment horizon to analyze the profitability of both palm oil farmers and CPO mills, applying necessary assumptions to make it workable. By maximizing profit for both smallholder farmers and CPO mills with the constraints that IRR of smallholder farmers is greater than or equal to IRR of CPO mills, it is expected that this study would generate the formula for the price of palm oil

fresh fruit bunches (P_{FFB}) as a function of CPO price (P_{CPO}) and the palm oil fresh fruit bunches oil extraction yield ratio (OER). Using $P_{FFB} = \beta_0 + \beta_1 P_{CPO} + \beta_2 OER$ as the model, after curve fitting using regression, the price of palm oil fresh fruit bunches becomes $P_{FFB} = -2438.7971 + 0.1784 P_{CPO} + 10219.2072 OER$. As all parameters are found significantly, this simple equation, as a result, can help determine fairly the price of palm oil fresh fruit bunches transparently without any difficulty in developing lengthy and difficult negotiation processes between smallholder farmers and CPO mills.

There are several subsequent research for consideration. Firstly, it will be performed using actual data based on the best actual standard cost approach both for farmers and CPO mills to keep efficiency standard on the pricing. Secondly, it will be conducted to test against the actual price of palm oil fresh fruit bunches in various locations to identify whether the model is realistic enough and whether the actual price is underpriced, fair enough, or even overpriced compared to the price as suggested by applying this fair price model. Thirdly, it will be refined by relaxing some assumptions, for instance, by incorporating the price of palm kernel oil (PKO) as part of the equation so that there will be four independent variables to determine the price of palm oil fresh fruit bunches namely, the price of CPO (P_{CPO}), the crude palm oil extraction rate (OER_{CPO}), the price of PKO (P_{PKO}), and the palm kernel oil extraction rate (OER_{PKO}). Fourthly, the simulation process can be improved by developing and re-arranging the components of the equation so that all calculations can be conducted in the worksheet without additional manual work outside the worksheet.

REFERENCES

- Abazue, C. M., Er, A. C., Ferdous Alam, A. S. A., & Begum, Halima. (2015). Oil Palm Smallholders and Its Sustainability Practices in Malaysia. *Mediterranean Journal of Social Sciences*. <https://doi.org/10.5901/mjss.2015.v6n6s4p482>
- Abideen, Ahmed Zainul, Sundram, Veera Pandiyan Kaliani, & Sorooshian, Shahryar. (2023, March 1). Scope for Sustainable Development of Small Holder Farmers in the Palm Oil Supply Chain—A Systematic Literature Review and Thematic Scientific Mapping. *Logistics*, Vol. 7. <https://doi.org/10.3390/logistics7010006>
- Afrianto, E., Hutabarat, S., & Asminar. (2020). Fluktuasi Harga TBS Petani Plasma dan Swadaya (Studi Kasus Koperasi Unit Desa Sinar Kerakap Dusun Pulau Kerakap Kecamatan Bathin II Pelayang Kabupaten Bungo). *Jurnal Agri Sains*, 4(1), 31-36.
- Afrino, Rino, Syahza, Almasdi, Suwondo, Suwondo, & Heriyanto, Meyzi. (2024). Model of partnership in sustainable palm oil: efforts to increase partnerships in the palm oil business in Indonesia. *Journal of Science and Technology Policy Management*. <https://doi.org/10.1108/JSTPM-09-2023-0154>
- Ahmad, Azhar, Osman, Hakim, Omar, Ahmad Rafli Che, Rahman, Mara Ridhuan, & Ishak, Suraiya. (2020). Contributions and Challenges of Palm Oil to Smallholders in Malaysia. *International Journal of Scientific and Technology Research*, 9(6), 270-273. Retrieved from www.ijstr.org
- Alwarritzi, Widya, Nanseki, Teruaki, & Chomei, Yosuke. (2015). Analysis of the Factors Influencing the Technical Efficiency among Oil Palm Smallholder Farmers in Indonesia. *Procedia Environmental Sciences*, 28, 630-638. <https://doi.org/10.1016/j.proenv.2015.07.074>
- Amriana, Amriana, Kasim, Anita Ahmad, & Maghfirat, Maghfirat. (2020). Penentuan Harga Tandan Buah Segar (TBS) Kelapa Sawit Menggunakan Metode Fuzzy Logic. *ILKOM Jurnal Ilmiah*, 12(3), 236-244. <https://doi.org/10.33096/ilkom.v12i3.619.236-244>
- Arifin, Muhamad Zainul, Emalisa, & Salmiah. (2013). Analisis Harga Pokok Tandan Buah Segar (TBS), CPO dan Inti Sawit di Kebun Gunung Bayu PT Perkebunan Nusantara IV Kabupaten Simalungun. *Journal of Agriculture and Agribusiness Socioeconomics*, 2(11).
- Armin, Armin. (2023). Analysis of Palm Oil Income and Production for Farmers Joined in Cooperatives in Pakawa Village, Pasangkayu District. *ProBisnis: Jurnal Manajemen*, 14(2), 369-376. <https://doi.org/10.62398/probid.v14i2.170>
- Ashton-Butt, Adham, Willcock, Simon, Purnomo, Dedi, Suhardi, Aryawan, Anak A. K., Wahyuningsih, Resti, Naim, Mohammad, Poppy, Guy M., Caliman,

- Jean Pierre, Peh, Kelvin S. H., & Snaddon, Jake L. (2019). Replanting of first-cycle oil palm results in a second wave of biodiversity loss. *Ecology and Evolution*, 9(11). <https://doi.org/10.1002/ece3.5218>
- Astuti, Niluh Sari, Makmur, Karim, Ikawati, Nurlaela, Abdullah, Muhammad Arafat, & Dahniar. (2020). Contribution of oil palm (*Elaeis guineensis* J.) plantations to farmers' income in West Sulawesi. *Anjoro: International Journal of Agriculture and Business*, 1(2), 45-51. <https://doi.org/10.31605/anjoro.v1i2.892>
- Ayompe, Lacour M., Nkongho, Raymond N., Masso, Cargele, & Egoh, Benis N. (2021). Does investment in palm oil trade alleviate smallholders from poverty in Africa? Investigating profitability from a biodiversity hotspot, Cameroon. *PLoS ONE*, 16(9 September). <https://doi.org/10.1371/journal.pone.0256498>
- Bachtiar, Maryati, Dasrol, Dasrol, & Fitriani, Riska. (2020). *Legal Protection of Independent Plantation Farmers in Determining the Price of Selling FFB*. Retrieved from <http://pekanbaru.tribunnews.com/2018/11/20/bikin-tercengang-ini-luas->
- Bankole, A., Ojo, S., Olutumise, A., Garba, I., & Abdulqadir, M. (2018). Efficiency Evaluation of Small Holders Palm Oil Production in Edo State, Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology*, 24(4), 1-9. <https://doi.org/10.9734/AJAEES/2018/40850>
- Barlow, Colin, Zen, Zahari, & Gondowarsito, Ria. (2003). The Indonesia Palm Oil Industry. *Oil Palm Industry Economic Journal*, 3(1), 8-15. Retrieved from <https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=cc4dc d27dda5411a887e6600ae54f1f1b1c43b02>
- Biodiin, M. B., Akinlabi, E. T., Okokpujie, I. P., & Fayomi, O. S. I. (2021). An Overview of Palm Oil Production Processing in Nigeria: A Case Study of Ilashe, Nigeria. *IOP Conference Series: Materials Science and Engineering*, 1107(1), 012134. <https://doi.org/10.1088/1757-899x/1107/1/012134>
- BPS Statistic Indonesia. (2023). Indonesian Palm Oil Statistics. *BPS*, 16, 152.
- Candra, Erwin, Hadi, Syaiful, Dewi, Novia, & Anggraini, Rizqi Sari. (2021). Independent Oil Palm Smallholder Farmers; Household Income, Consumption, and Sustainability Challenges. *Jurnal Agribisnis*, 23(1).
- Chiriaco, Maria Vincenza, Bellotta, Matteo, Jusić, Jasmina, & Perugini, Lucia. (2022, June 1). Palm oil's contribution to the United Nations sustainable development goals: Outcomes of a review of socio-economic aspects. *Environmental Research Letters*, Vol. 17. <https://doi.org/10.1088/1748-9326/ac6e77>
- Chrisendo, Daniel, Siregar, Hermanto, & Qaim, Martin. (2022). Oil palm cultivation improves living standards and human capital formation in smallholder farm households. *World Development*, 159, 106034.

<https://doi.org/10.1016/j.worlddev.2022.106034>

- Dahniar, & Difa, S. I. A. (2021). The price analysis of palm oil commodity in Banjarmasin South Kalimantan. *IOP Conference Series: Earth and Environmental Science*, 758(1). <https://doi.org/10.1088/1755-1315/758/1/012005>
- Dar, Muhammad Halmi, Sarkum, Sumitro, Nasution, Ade Parlaungan, & Mustamu, Novilda Elizabeth. (2018). Strategies to Overcome the Selling Price Fluctuations of Palm Oil Fresh Fruit Bunches (FFB): The Farmers Efforts in Welcoming Industry 4.0. *IIC 2018 Proceeding*, (November). Retrieved from <https://ssrn.com/abstract=3416080>
- de Vos, Rosanne E., Suwarno, Aritta, Slingerland, Maja, van der Meer, Peter J., & Lucey, Jennifer M. (2023). Pre-certification conditions of independent oil palm smallholders in Indonesia. Assessing prospects for RSPO certification. *Land Use Policy*, 130, 106660. <https://doi.org/10.1016/j.landusepol.2023.106660>
- Degli Innocenti, Elena, & Oosterveer, Peter. (2020). Opportunities and bottlenecks for upstream learning within RSPO certified palm oil value chains: A comparative analysis between Indonesia and Thailand. *Journal of Rural Studies*, 78. <https://doi.org/10.1016/j.jrurstud.2020.07.004>
- Eggen, Michael, Heilmayr, Robert, Anderson, Patrick, Armson, Rebecca, Austin, Kemen, Azmi, Reza, Bayliss, Peter, Burns, David, Erbaugh, J. T., Ekaputri, Andini Desita, Gaveau, David L. A., Grabs, Janina, Greenbury, Aida, Gulagnar, Ibrahim, Hanu, Mansuetus Alsy, Hill, Tony, Leegwater, Marieke, Limberg, Godwin, Opal, Charlotte, Putri, Violace, Rodrigues, Judy, Rosoman, Grant, Satar, Musnanda, Sheun, Su Sin, Rafik, Rukaiyah, Walen, Sarah, & Carlson, Kimberly M. (2024). Smallholder participation in zero-deforestation supply chain initiatives in the Indonesian palm oil sector: Challenges, opportunities, and limitations. *Elem Sci Anth*, 12(1). <https://doi.org/10.1525/elementa.2023.00099>
- Ekine, DI, & Onu, ME. (2009). Economics Of Small-Scale Palm Oil Processing In Ikwerre And Etche Local Government Areas Of Rivers State, Nigeria. *Journal of Agriculture and Social Research (JASR)*, 8(2). <https://doi.org/10.4314/jasr.v8i2.43342>
- Erdi. (2017, February 27). Sengkarut Pembelian TBS PTPN XIII. *Harian Suara Pemred Pontianak*, p. 10.
- Ernawati, H. D., Saputra, A., Alamsyah, Z., Napitupulu, D. M. T., Yanita, M., & Fauzia, G. (2021). Analysis of independent oil palm farming income after replanting in Muaro Jambi District. *IOP Conference Series: Earth and Environmental Science*, 782(3). <https://doi.org/10.1088/1755-1315/782/3/032055>
- Fadilah, F., Dewi, Novia, & Hutabarat, Sakti. (2018). ANALISIS PEMASARAN TBS (TANDAN BUAH SEGAR) KELAPA SAWIT PEKEBUN SWADAYA DI KOPERASI

SAWIT JAYA KAMPUNG BENTENG HULU KECAMATAN MEMPURA KABUPATEN
SIAK. *Indonesian Journal of Agricultural Economics (IJAE)*, 9(2), 1-9.

- Falgenti, K., & Hambali, E. (2022). The analysis and design of independent smallholders FFB palm oil supply system to support traceability of CPO product derivatives. *IOP Conference Series: Earth and Environmental Science*, 1063(1). <https://doi.org/10.1088/1755-1315/1063/1/012035>
- Februningsih, Asih. (2019). *Bargaining Position Analysis of Farmers in Palm Oil Pricing TBS (FFB) in Nagari Sungai Kunyit South Solok Regency*. Universitas Andalas.
- Gallemore, Caleb, Jespersen, Kristjan, & Olmsted, Paige. (2022). Harnessing relational values for global value chain sustainability: Reframing the roundtable on sustainable palm oil's offset mechanism to support smallholders. *Ecological Economics*, 193, 107303. <https://doi.org/10.1016/j.ecolecon.2021.107303>
- Glenday, S., & Paoli, G. (2015). Overview of Indonesian Palm Oil Smallholder Farmers: A Typology of Organizational Models, Needs, and Investment Opportunities. *Deemeter Consulting Monograph*, 5(1). Retrieved from <https://daemeter.org/en/home>
- Hasan, Mohamad Fadhil, Fadhil, Ilma, Fahmid, Mirah Midadan, & Ahmad, Tauhiduddin. (2022). Impact of the European Union Regulations on Indonesian Oil Palm Smallholder Farmers. *International Journal of Oil Palm*, 5(1), 1-15. Retrieved from <https://api.semanticscholar.org/CorpusID:249633060>
- Herdiansyah, Herdis, Negoro, Habibullah Adi, Rusdayanti, Nurul, & Shara, Siti. (2020). Palm oil plantation and cultivation: Prosperity and productivity of smallholders. *Open Agriculture*, 5(1), 617-630. <https://doi.org/10.1515/opag-2020-0063>
- Hutabarat, Sakti, Slingerland, Maja, Rietberg, Petra, & Dries, Liesbeth. (2018). Costs and benefits of certification of independent oil palm smallholders in Indonesia. *International Food and Agribusiness Management Review*, 21(6), 681-700. <https://doi.org/10.22434/IFAMR2016.0162>
- Hutajulu, Petrus Oktavianus, Chalil, Diana, & Sembiring, Surya Abadi. (2019). Efficiency and Marketing Margins Estimation of Oil Palm's Fresh Fruit Bunches (FFB) in Labuhanbatu Utara and Asahan Regency. *Indonesian Journal of Agricultural Research*, 2(2), 8-17. <https://doi.org/10.32734/injar.v2i2.1209>
- Ichsan, Muhammad, Saputra, Wiko, & Permatasari, Anita. (2021). Oil Palm Smallholders on the Edge: Why Business Partnerships Need to be Redefined. *SPOS Information Brief*, (July). Retrieved from <https://sposindonesia.org/wp-content/uploads/2021/07/Oil-palm-smallholders-on-the-edge-Why-business-partnerships.pdf>

- Ismail, Azman, Arif, Mohd Simeh, Noor, Mohd, & Bidin, Izuddin Zanal. (2003). The Production Cost of Oil Palm Fresh Fruit Bunches: the Case of Independent Smallholders in Johor. *Oil Palm Industry Economic Journal*, 3(1), 1-7. Retrieved from <https://www.researchgate.net/publication/242681084>
- Ismanto, Edi, Effendi, Noverta, & Cynthia, Eka Pandu. (2018). Implementation of Backpropagation Artificial Neural Networks to Predict Palm Oil Price Fresh Fruit Bunches. *IJISTECH (International Journal Of Information System & Technology)*, 2(1), 26. <https://doi.org/10.30645/ijistech.v2i1.17>
- Iwala OS. (2009). Economic Analysis of Small Scale Palm Oil Processing and Its Potentials for Poverty Alleviation and Rural Transformation in Ondo State Nigeria. *Nigerian Journal of Rural Sociology*, 9(1). Retrieved from <https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=18a364baf2647ec66155064d1f4ad22c1c472168>
- Jelliani, Maifianti, Khori Suci, & Kriswanto. (2020). Analisis Perilaku Pasar Tandan Buah Segar (TBS) Kelapa Sawit Perkebunan Rakyat di Kecamatan Darul Makmur Kabupaten Nagan Raya. *Jurnal Bisnis Tani Universitas Teuku Umar*, 6(2), 83-97.
- Jelsma, Idsert, Giller, Ken, & Fairhurst, Thomas. (2009). *Smallholder Oil Palm Production Systems in Indonesia: Lessons Learned from the NESP Ophir Project*. Retrieved from <https://edepot.wur.nl/148600>
- Jelsma, Idsert, Woittiez, Lotte S., Ollivier, Jean, & Dharmawan, Arya Hadi. (2019). Do wealthy farmers implement better agricultural practices? An assessment of implementation of Good Agricultural Practices among different types of independent oil palm smallholders in Riau, Indonesia. *Agricultural Systems*, 170, 63-76. <https://doi.org/10.1016/j.agsy.2018.11.004>
- Jezeer, R., Singerland, M., Laan, C. van der, & Pasiecznik, N. (2020). Improving smallholders inclusiveness in palm oil production - a global view. *Wageningen University ETFRN News*, 59, vi-xxi.
- Khoirunnisa, Khosy, Riswani, Riswani, & Lifianthi, Lifianthi. (2023). Expenditure on lil Palm Farmers' Households in Bayung Lencir SubDistrict Musi Banyuasin Regency. *BIOVALENTIA: Biological Research Journal*, 9(1), 41-47. <https://doi.org/10.24233/biov.9.1.2023.379>
- Lifianthi, Lifianthi, Rosana, Elly, & Thirtawati, Thirtawati. (2022). Marketing Functions and Farmers' Share of Oil Palm Fresh Fruit Bunch of Self-Support Farmers in Banyuasin Regency South Sumatra. *Jurnal AGRISEP: Kajian Masalah Sosial Ekonomi Pertanian Dan Agribisnis*, 21(2), 255-270. <https://doi.org/10.31186/jagrisep.21.2.255-270>
- Lim, Chye Ing, & Biswas, Wahidul. (2019). Sustainability assessment for crude palm oil production in Malaysia using the palm oil sustainability assessment framework. *Sustainable Development*, 27(3), 253-269.

<https://doi.org/10.1002/sd.1872>

- Lim, Ya Li, Tenorio, Fatima A., Monzon, Juan P., Sugianto, Hendra, Donough, Christopher R., Rahutomo, Suroso, Agus, Fahmuddin, Slingerland, Maja A., Darlan, Nuzul H., Dwiyaeheni, Asri A., Farrasati, Rana, Mahmudah, Nurul, Muhamad, Tohirin, Nurdwiansyah, Denni, Palupi, Sandri, Pradiko, Iput, Saleh, Shofia, Syarovy, Muhdan, Wiratmoko, Dhimas, & Grassini, Patricio. (2023). Too little, too imbalanced: Nutrient supply in smallholder oil palm fields in Indonesia. *Agricultural Systems*, 210, 103729. <https://doi.org/10.1016/j.agsy.2023.103729>
- Lukman, Indra Agus, Ismail, Munawar, -, Sasongko, & Budi, Dwi. (2019). Analysis of Inti-Plasma Palm Oil Plantation Partnership's Performance in Kuantan Singingi Region. *The International Journal of Accounting and Business Society*, 27(2), 92-114. <https://doi.org/10.21776/ub.ijabs.2019.27.2.5>
- Man, Elaine Lau Ying, & Baharum, Adam. (2011). A qualitative approach of identifying major cost influencing factors in palm oil mills and the relations towards production cost of Crude Palm Oil. *American Journal of Applied Sciences*, 8(5), 441-446. <https://doi.org/10.3844/ajassp.2011.441.446>
- Manurung, Gulat Medali Emas, Siregar, Yusni Ikhwan, Syahza, Almasdi, Suwondo, Suwondo, Medali Emas Manurung, Gulat, Ikhwan Siregar, Yusni, & Syahza, Almasdi. Opportunity for Sustainable Palm Oil Practices by Smallholder Farmers in Riau. , 48 *Journal of Hunan University (Natural Sciences)* 5 (2021).
- Marimin, Djatna, T., MacHfud, Asrol, M., Papilo, P., Taufik, B., & Darmawan, M. A. (2020). Supply chain performance measurement and improvement of palm oil agroindustry: A case study at Riau and Jambi Province. *IOP Conference Series: Earth and Environmental Science*, 443(1). <https://doi.org/10.1088/1755-1315/443/1/012056>
- Maryadi, Yusuf, Abdul Karim, & Mulyana, Andy. (2004). *Pricing of Palm Oil Fresh Fruit Bunches for Smallholders in South Sumatra*. Palembang.
- Masyarah, Renny. (2022). Effectiveness Methods in Determining The Cost of FFB Production in Palm Oil Plantations. *Jurnal Mantik*, 6(3), 3400-3405. <https://doi.org/https://doi.org/10.35335/mantik.v6i3.3201>
- Mawardati. (2018). Selection of Fresh Fruit Bunch Marketing Channel in Smallholder Oil Palm Plantation in Aceh Province. 246 *JOURNAL OF APPLIED MANAGEMENT*, 16(2). <https://doi.org/10.21776/ub.jam.2018>
- MinistryofAgriculture. (2018). *Peraturan Menteri Pertanian Republik Indonesia Nomor:01/Permentan/KB.120/1/2018 tentang Pedoman Penetapan Harga Pembelian Tandan Buah Segar Kelapa Sawit Produksi Pekebun*.
- Moneka, Mota Eja, Alamsyah, Zulkifli, & Saputra, Ardhiyan. (2021). *Analisis Faktor-faktor yang Mempengaruhi Harga TBS Petani Kelapa Sawit Swadaya di Kabupaten Tebo*. Retrieved from <https://repository.unja.ac.id/11133/>

- Mulyasari, Gita, Djarot, Ira Nurhayati, Sasongko, Nugroho Adi, & Putra, Agusta Samodra. (2023). Social-life cycle assessment of oil palm plantation smallholders in Bengkulu province, Indonesia. *Heliyon*, 9(8), e19123. <https://doi.org/10.1016/j.heliyon.2023.e19123>
- Napitupulu, Dompok, Ernawati, H. D., Elwamendri, E., Yanita, Mirawati, & Fauzia, Gina. (2019a). Comparative analysis between smallholder and partnership oil palm farming system in Jambi Province. *IOP Conference Series: Earth and Environmental Science*, 336(1). <https://doi.org/10.1088/1755-1315/336/1/012015>
- Napitupulu, Dompok, Ernawati, HD, Elwamendri, Yanita, Mirawati, & Fauzia, Gina. (2019b). Comparative analysis between smallholder and partnership oil palm farming system in Jambi Province. *IOP Conference Series: Earth and Environmental Science*, 336(1), 012015. <https://doi.org/10.1088/1755-1315/336/1/012015>
- Nesti, Lisa, Tan, Firwan, Ridwan, Endrizal, & Ampuh Hadiguna, Rika. (2018). Vertical Integration Market Analysis of Palm Oil Fresh Fruit Bunches in West Sumatera, Indonesia. *International Journal of Engineering & Technology*, 7(4.9). <https://doi.org/10.14419/ijet.v7i4.9.21090>
- Nesti, Lisa, Tan, Firwan, Ridwan, Endrizal, & Hadiguna, Rika Ampuh. (2018). Government Policy Analysis of Sales Realization at the Independent Farmer Price of FFB in West Sumatera Province. *Jurnal Teknologi Industri Pertanian*, 28(3), 354-362. <https://doi.org/10.24961/j.tek.ind.pert.2018.28.3.342>
- Ngan, Sue Lin, Er, Ah Choy, Yatim, Puan, How, Bing Shen, Lim, Chun Hsion, Ng, Wendy Pei Qin, Chan, Yi Herng, & Lam, Hon Loong. (2022). Social Sustainability of Palm Oil Industry: A Review. *Frontiers in Sustainability*, Vol. 3. <https://doi.org/10.3389/frsus.2022.855551>
- Nordin, Jamil, Chandramohan, D., Basiron, Yusof, & Venugopal, R. (2001). MPOB Daily FFB Reference Price: Towards a More Transparent Market. *Oil Palm Industry Economic Journal*, 1, 17-20.
- Novira, Nina. (2023). The Vulnerability of Indonesian Smallholder Oil Palm Farmers in the Times of Global Crisis. *IOP Conference Series: Earth and Environmental Science*, 1190(1), 012044. <https://doi.org/10.1088/1755-1315/1190/1/012044>
- Nze, E. O., Nzeakor, F. C., & Egbosionu, C. (2017). A Comparative Analysis of Palm Fruit Processing and Palm Oil Marketing in Anambra State Nigeria. *FUNAI Journal of Accounting, Business and Finance*, 1(1), 13-19. Retrieved from <https://www.fujabf.org/wp-content/uploads/2018/01/A-Comparative-Analysis-of-Palm-Fruit-Processing-and-Palm-Oil-Marketing-in-Anambra-State-Nigeria.pdf>
- Ogahara, Zoë, Jespersen, Kristjan, Theilade, Ida, & Nielsen, Martin Reinhard. (2022). Review of smallholder palm oil sustainability reveals limited

- positive impacts and identifies key implementation and knowledge gaps. *Land Use Policy*, 120, 106258. <https://doi.org/10.1016/j.landusepol.2022.106258>
- Papenfus, Michael M. (2005). Investing in Oil Palm :An Analysis of Independent Smallholder Oil Palm Adoption in Sumatra, Indonesia. *Southeast Asia Policy Research Working Paper*, No. 15, (15). Retrieved from <https://apps.worldagroforestry.org/downloads/Publications/PDFS/RP00133.pdf>
- Prayudy, Herdy, & Shilul Imaroh, Tukhas. (2019). Application of Analytical Hierarchy Process Method on the Selection Process of Fresh Fruit Bunch Palm Oil Supplier (Case Study PT Sahabat Mewah and Makmur). *International Journal of Innovative Science and Research Technology*, 4(8). Retrieved from www.ijisrt.com600
- Purba, Abdul Razak, Nasution, Zulfi Prima Sani, Amalia, Rizki, & Wahyono, T. (2015). Profile of Sumatera Oil Palm Smallholders. *Environmental Science & Ecotechnology*, 4(1), 253-261. Retrieved from <https://www.researchgate.net/publication/365184455>
- Purnomo, Herry, Okarda, Beni, Dewayani, Ade Ayu, Ali, Made, Achdiawan, Ramadhani, Kartodihardjo, Hariadi, Pacheco, Pablo, & Juniwati, Kartika S. (2018). Reducing forest and land fires through good palm oil value chain governance. *Forest Policy and Economics*, 91, 94-106. <https://doi.org/10.1016/j.forpol.2017.12.014>
- Radhianshah, T. (2021). Cost-Benefit Analysis of Including Independent Palm Oil Smallholders in Indonesia's National Biodiesel Trading System. *Traction Energy Asia Working Paper*.
- Rahamawati, Sofia. (2023). Penerapan Asas Kepastian Hukum dalam Peraturan Menteri Pertanian Nomor 01/PERMENTAN/KB/120/1/2018 Tentang Pedoman Penetapan Harga Pembelian Tandan Buah Segar Kelapa Sawit Produksi Pekebun. *AGRIFITIA : Journal of Agribusiness Plantation*, 2(2), 123-132. <https://doi.org/10.55180/aft.v2i2.310>
- Raharja, Sapta, Marimin, Machfud, Papilo, Petir, Safriyana, Massijaya, M. Yusram, Asrol, Muhammad, & Darmawan, M. Arif. (2020). Institutional strengthening model of oil palm independent smallholder in Riau and Jambi Provinces, Indonesia. *Heliyon*, 6(5). <https://doi.org/10.1016/j.heliyon.2020.e03875>
- Rahman, A., Malik, Adlaida, & Sinta, Ratnawati. (2018). Identifikasi Faktor Penentu Besaran Indeks “K” dan Kebijakan Penetapan Harga TBS Kelapa Sawit Pola Kemitraan di Kabupaten Muaro Jambi. *JALOW | Journal of Agribusiness and Local Wisdom*, 1(1), 87-99. <https://doi.org/10.22437/jalow.v1i1.5450>
- Rijali, Ahmad. (2017). *The Influence of Price Determination of Fresh Fruit Bunch (FFB) on Company Profitability: Case Study in PT AMP Plantation*.

Universitas Andalas.

- Ruml, Anette, Chrisendo, Daniel, Iddrisu, Abdul Malik, Karakara, Alhassan A., Nuryartono, Nunung, Osabuohien, Evans, & Lay, Jann. (2022). Smallholders in agro-industrial production: Lessons for rural development from a comparative analysis of Ghana's and Indonesia's oil palm sectors. *Land Use Policy*, 119, 106196. <https://doi.org/10.1016/j.landusepol.2022.106196>
- Salmiyati, Heryansyah, Arien, Idayu, Ida, & Supriyanto, Eko. (2014). Oil Palm Plantations Management Effects on Productivity Fresh Fruit Bunch (FFB). *APCBEE Procedia*, 8, 282-286. <https://doi.org/10.1016/j.apcbee.2014.03.041>
- Sarkum, Sumitro, Mustamu, Novilda Elizabeth, & Yanris, Gomal Juni. (2020). The marketing channels for fresh fruit bunches at farmers palm oil plantation. *Innovative Marketing*, 16(4), 139-144. [https://doi.org/10.21511/im.16\(4\).2020.12](https://doi.org/10.21511/im.16(4).2020.12)
- Sembiring, Meilita Tryana, Sarma Sinaga, Tuti, Wahyuni, Dini, Budiman, Irwan, & Rumenda, Rori. (2017). Penentuan Harga Pokok Produksi Tandan Buah Segar dengan Pertimbangan Nilai Tambah. *Proceeding Seminar Nasional Institut Supply Chain Dan Logistik Indonesia (ISLI) 2017*. Retrieved from <https://www.researchgate.net/publication/324246573>
- Sitorus, Richi Rivay, Napitupulu, Dompok, & Elwamendri. (2017). Analisis Integrasi Harga TBS Dinas Perkebunan dan Harga Pembelian TBS Petani Kelapa Sawit di Kecamatan Sungai Bahar Kabupaten Muaro Jambi. *Jurnal Ilmiah Sosio Ekonomika Bisnis*, 20(1).
- Situmorang, Jefferson. (2016). Analisis Kebijakan Harga TBS Kelapa Sawit pada PIR Perkebunan Sei Besitang Sumatera Utara. *Forum Penelitian Agro Ekonomi*, 6(2), 61-70. Retrieved from <https://epublikasi.pertanian.go.id/berkala/fae/article/view/1216>
- Sugianto, Hendra, Monzon, Juan P., Pradiko, Iput, Tenorio, Fatima A., Lim, Ya Li, Donough, Christopher R., Sunawan, Rahutomo, Suroso, Agus, Fahmuddin, Cock, James, Amsar, Joni, Farrasati, Rana, Iskandar, Ridho, Rattalino Edreira, Juan I., Saleh, Shofia, Santoso, Heri, Tito, Antonius P., Ulfaria, Nadib, Slingerland, Maja A., & Grassini, Patricio. (2023). First things first: Widespread nutrient deficiencies limit yields in smallholder oil palm fields. *Agricultural Systems*, 210, 103709. <https://doi.org/10.1016/j.agsy.2023.103709>
- Sukiyono, Ketut, Cahyadinata, Indra, Purwoko, Agus, Widiono, Septri, Sumartono, Eko, Asriani, Nyayu Neti, & Mulyasari, Gita. (2017). Assessing smallholder household vulnerability to price volatility of palm fresh fruit Bunch in Bengkulu Province. *International Journal of Applied Business and Economic Research*, 15(3), 1-15. Retrieved from https://www.researchgate.net/profile/Ketut-Sukiyono/publication/315898174_Assessing_smallholder_household_vulnerability_to_price_volatility_of_palm_fresh_fruit_Bunch_in_Bengkulu_Provin

ce/links/5907434ea6fdccd580d63385/Assessing-smallholder-household-vulne

- Suswatiningsih, Tri Endar, Yulistiana, Eka, Ayiek, Agatha, & Sayekti, Sih. (2021). Struktur Biaya dan Penentuan Harga Angkut Tandan Buah Segar Kelapa Sawit oleh Kontraktor. *AGRITECH, XXIII*(1), 84-90.
- Svatoňová, Tereza, Herák, David, & Kabutey, Abraham. (2015). Financial Profitability and Sensitivity Analysis of Palm Oil Plantation in Indonesia. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 63(4), 1365-1373. <https://doi.org/10.11118/actaun201563041365>
- Voora, Vivek, Bermúdez, Steffany, Farrell, Johanna Joy, Larrea, Cristina, & Luna, Erika. (2023). Palm Oil Prices and Sustainability. *IISD Sustainable Commodities Marketplace Series*.
- Wildayana, E. (2016). Control Approach of Fresh Fruit Bunches Price Fluctuations on Income of Farmers. *Jurnal Habitat*, 27(3), 103-108. <https://doi.org/10.21776/ub.habitat.2016.027.3.12>
- Wildayana, Elisa, Zahri, Imron, Mulyana, Andy, & Husin, Laila. (2011). Partisipasi Petani Plasma Pola Kemitraan PIR-Trans Kelapa Sawit di Sumatera Selatan. *Prosiding Seminar Nasional Perhepi Kemitraan Dalam Pengembangan Agribisnis Berbasis Sumberdaya Lokal*, (978-979-8420-13-9).
- Wissler, Laurie. (2015). Smallholder challenges in the growing palm oil industry. *Boston University Issues in Brief*, 30(May), 1-8. Retrieved from <https://open.bu.edu/handle/2144/22738>
- Witjaksono, Julian, Yaumidin, Umi Karomah, Djaenudin, Deden, Astana, Satria, Harianja, Alfonsus H., Fery, Samuel, Hasibuan, Abdul Muis, Khotimah, Husnul, Hidayatina, Achsanah, Rusdin, Bungati, Imran, Rusdi, & Purba, Resmayati. (2023). The assessment of fresh fruit bunches supply chain of palm oil independent smallholder farmers in southeast Sulawesi. *Uncertain Supply Chain Management*, 11(3), 941-950. <https://doi.org/10.5267/j.uscm.2023.5.004>
- Yee Chuok, Gan. (2021). *Improving Competitiveness of Palm Oil Fruit Dealer to Increase the Fresh Fruit Bunches (FFB) Trading*. Universiti Teknologi Malaysia.