



Fostering Economic Resilience in Berau through Smallholder Crop Diversification

Report
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INITIATIVE

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ABOUT CPI

CPI is an analysis and advisory organization with deep expertise in finance and policy. Our mission is to help governments, businesses, and financial institutions drive economic growth while addressing climate change. CPI has six offices around the world in Brazil, India, Indonesia, Kenya, the United Kingdom, and the United States.

ABOUT LEOPALD

This paper is the second in a series of studies to be conducted by CPI in Berau, East Kalimantan, as part of Project LEOPALD (Low Emissions Palm Oil Development). As part of the International Climate Initiative (IKI), this project is led by The Nature Conservancy and implemented jointly with GIZ and CPI. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) supports this initiative based on a decision adopted by the German Bundestag. Project LEOPALD aims to support East Kalimantan to achieve its Green Growth Compact through more sustainable palm oil practices. CPI focuses on the climate financing aspects of this goal.



SECTOR

Land use

REGION

Indonesia

KEYWORDS

Land use, palm oil, smallholder finance

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EXECUTIVE SUMMARY

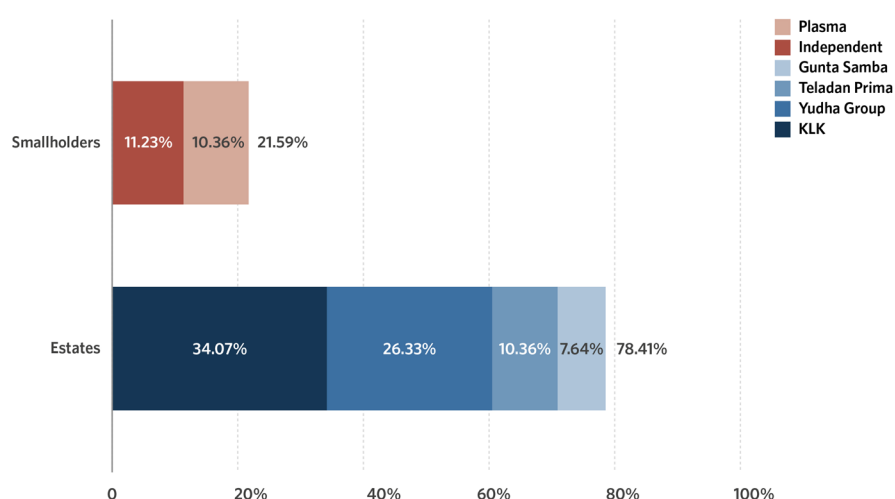
The expansion of the palm oil industry over the last decades has resulted in deforestation and other land use shifts across Indonesia (K.G. Austin et al., 2017). At the same time, palm oil is touted as a major economic driver and a source of welfare for smallholders. An estimated 40% of Indonesia's total plantation area is managed by smallholder farmers involved in palm oil production, and this continues to grow as international demand rises.¹

The Berau regency in Eastern Kalimantan is a good example to understand this trend at the community level. A recent study from CPI (Mafira et al, 2019) shows that Berau's economy is undergoing a shift from extractive industries, particularly coal mining, to agricultural production, with a particular focus on palm oil.

However, this upward trend in palm oil increases the dependence on one main commodity, putting Berau's economy at risk, as was previously the case with coal (Mafira et al, 2019; Mafira, et al. 2018). It also poses as a conflict to Indonesia's national and community goals with palm oil plantations potentially increasing deforestation, and consequently causing other harmful environmental impacts.

This trend is particularly striking for independent smallholders in Berau. Data shows that 21.23% of total palm oil land in Berau² is owned by independent smallholder farmers. And young palm oil trees cover 47% of smallholders' land while private companies plant only 2% of their land³. This contributes to the lack of economic diversification with palm oil edging out other estate crops, leaving Berau exposed to price and demand risks.

Figure ES 1. Independent palm oil smallholders in Berau



In Berau, dependency on single estate crops like palm oil decimate food crops, affect livelihood, and increase food security risks. Moreover, we find that smallholders' income from palm oil is not as significant as it may seem. Policy change is, therefore, required to improve

¹ Jong, H (2020). "Indonesia aims for sustainability certification for oil palm smallholders." Mongabay. <https://news.mongabay.com/2020/04/indonesia-aims-for-sustainability-certification-for-oil-palm-smallholders/>

² Survey data from Menapak (2017)

³ [Tree Crop Estate Statistics of Indonesia 2017- 2019 Palm Oil made by Indonesia Plantation Agency \(DJP\)](#)

the wellbeing of smallholders, in harmony with increasing the region's economic resiliency and environmental protection goals.

This CPI study, produced as part of Project LEOPALD or Low Emissions Oil Palm Development, explores crop diversification opportunities to support independent smallholders in Berau for better long-term outcomes,⁴ outlining options to push Berau towards economic resilience and achieve its sustainability goals. It is thus replicable across regencies in Indonesia, especially those with similar attributes as Berau.

The key findings are as follows:

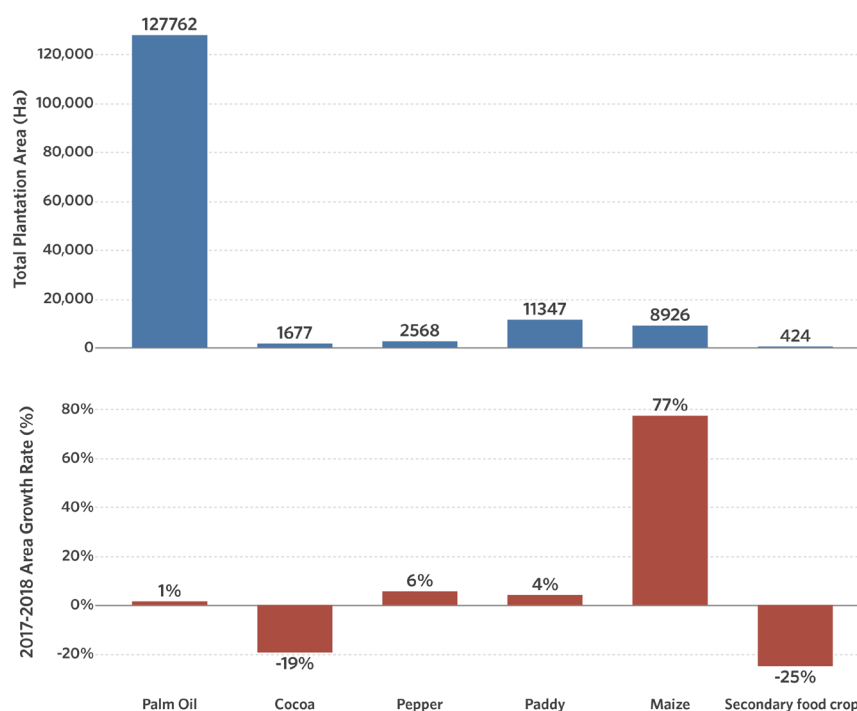
1. Palm oil has been a popular livelihood option among independent smallholders in Berau, but is insufficient to cover minimum living costs and creates risks

Berau's central statistics show that estate crops, including palm oil, coconut, cocoa, pepper, rubber, and coffee, contributes to a major portion of Berau's economy, and amounts to 84.7% of Berau's total GDP. Palm oil has become an increasingly popular choice in Berau because it provides a recurring income and has relatively low labor needs. Berau's central statistics also show that FFB (Fresh Fruit Bunches) production increased by 84% in 2018 YoY, alongside the increase in palm oil plantation area (BPS, 2019)⁵.

Palm oil is edging out food crops and other state crops such as cocoa and pepper (Mafira et al, 2019). This raises a red flag as Berau, a food secure region with enough staple food such as rice to self-subsist, is transitioning into a region that is increasingly reliant on imports of food crops from other regions for food security (ibid). The following figure illustrates the stark dominance of palm oil plantation area by comparing it with other commodities and food crops in Berau. Certain food crops, especially maize, have significantly increased plantation area and production in 2018, though the scale is much smaller when compared to palm oil.

⁴ The study focuses on independent smallholders who typically own and manage 2-5 Ha plots of plantation land with no buyer contract. They rely on middlemen, have low productivity, and limited access to finance. This study also employs a financial modelling approach with a focus on modelling a smallholders' 2 Ha plot.

⁵ BPS. 2019. "Statistik Daerah Kabupaten Berau." Badan Pusat Statistik.

Figure ES 2. Berau Regency Crops Statistics

Notes: Palm oil dominates plantation area of estate crops with the highest production, it implies that palm oil gains its popularity amongs other option of state crops in Berau. Certain other food crops, especially maize, have increased plantation area and production in 2018, though the scale is much smaller when compared to palm oil.

Source: Berau Regency Plantation Office, 2019

Nevertheless, palm oil alone is not enough to generate sufficient income growth in Berau. Through survey data and the Monte Carlo approach, we developed a financial model to assess the return on investment from an independent smallholder's business model. The results indicate that palm oil smallholders in Berau can only generate a return on investment at a level that is far below the region's minimum wage. On average, the net return on a two hectare palm oil plot generates 439% lower returns than minimum wage and regency GDP per capita across a span of 25 years.

In addition, palm oil smallholders face several risks that could impact their earning potential. These risks include the selling price volatility on their commodities, and low land productivity due to a range of reasons such as climate risks and a lack of access to capital.














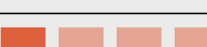










2. Compared to palm oil monocrops, crop diversification can yield up to 800% more revenue for smallholders

Our research on the Berau regency indicates that maize is the most recommended crop to diversify palm oil plantations due to its high-income potential, infrastructure preparedness, and lower knowledge gap. Cocoa is the second most preferred as maize has a higher revenue potential. Diversifying palm oil with maize will generate an income potential of up to 825% more, while cocoa can generate an income potential of up to 495% more than monocropping.

Maize and cocoa can increase smallholders' income while diversifying the region's plantation portfolio, which is currently dominated by palm oil.

Berau is designated by the central government of Indonesia as the center for cocoa production, and our model resonates with the government program. To date, there are existing national and subnational policy frameworks supporting Berau's diversification priorities. These include village priority economic activity programs (Program Unggulan Kawasan Pedesaan - "PRUKADES") and farmers' corporation plantation zones (Pengembangan Kawasan Pertanian-Perkebunan Berbasis Korporasi Petani).

Table ES1. Potential investment return from diversification

Alternative commodity	Existing palm oil plantation composition*	Baseline scenario**	Diversification scenario	Potential investment return from diversification as compared to baseline scenario***
Maize				+166.3%
Maize (1/4) Cocoa (1/4)				+165.6%
Cocoa				+29.7%
Maize				+496.1%
Maize (2/3) Cocoa (1/3)				+495.5%
Maize (1/3) Cocoa (2/3)				+195.9%
Cocoa				+60%
Maize				+825.9%

Notes:

*) Average age of palm oil trees in the existing land is 10 years. Vacant land is allocated for future plantation, no deforestation for additional plantation activities

**) Baseline scenario is smallholders fill the non-productive vacant land with palm oil within 22 years ahead

***) Potential = maximum return. Period of calculation of Return of Investment is 25 years

This study also explores the range of public financial instruments available to smallholders, such as interest subsidy (Kredit Usaha Rakyat/ KUR), credit guarantee scheme, insurance, and concessional sharia loan. These instruments can be accessed by smallholders looking to diversify their crops.

3. Diversification of crops can potentially absorb the business risks faced by palm oil smallholders, while remaining in line with Berau's sustainability agenda

Certain policy options have the potential to grow and safeguard smallholders' incomes, such as expansion, intensification via replanting, and diversification. The expansion option should not be endorsed as it promotes deforestation.

Meanwhile, intensification through replanting requires a high amount of capital and technical knowledge, both of which are currently lacking among independent smallholders. Diversification, which includes planting additional crops that can coexist with palm oil, is therefore the most efficient option, as it does not incur a large amount of capital but promises high returns, and does not require intensive capacity building.

Promoting more diversified plantations can help Berau achieve sustainability while improving economic resiliency. This increases land use effectiveness and reduces smallholders' sensitivity towards market price volatility, all while providing revenue during the beginning and the end of the palm oil life cycle, or the zero and declining productivity period.

4. For smallholders who own vacant lands specifically allocated for planting, it is less financially risky to start crop diversification when the existing palm oil plantation is at peak productivity (approximately year 10) than to begin during unproductive years

To ensure positive cashflows, diversification is best started during the period where smallholders are generating high cash revenues from their existing palm oil plots, as this is the most bankable period for smallholders to access finance.

Palm oil plantations are known for being challenging to intercrop with other commodities⁶. Intercropping is usually done during the first three to five years before the palm oil trees become productive and the canopy becomes tall and dense, leaving insufficient light for other crops to grow. This study does not discuss intercropping in between palm oil trees in the first years, but does recommend that part of the land is reserved for other crops.

While maintaining positive cashflow is important, this must be done by considering the context of smallholder's existing lands. Those smallholders that have completely planted their lands with palm oil must wait until their trees are no longer productive, and then diversify by replacing them with alternative crops.

On the other hand, smallholders who have allocated vacant land for plantations should immediately start utilizing these for alternate crops, rather than continue planting oil palms.

We provide specific simulations of optimal proportions of land and alternative crop types in this study, all of which recommend beginning alternative plant cropping after the existing palm oil trees mature.

Even so, challenges remain for smallholders who do not have proper licenses and supporting documentation such as STDB (Surat Tanda Daftar Budidaya), as they will find it difficult to obtain financing no matter how good their cash flow is.

⁶ Slingerland et. al. 2019, Improving Smallholder Inclusivity through Integration of Oil Palm with Crops.

KEY RECOMMENDATIONS

This study formulates key recommendations for Berau's government. These recommendations have the potential to be replicated across other regencies in Indonesia that have similar attributes, to encourage crop diversification and use finance as a lever to drive crop diversification by palm oil smallholders.

We recommend the following steps:

1. Strengthen the ongoing support for crop diversification through village priority economic activity programs (Program Unggulan Kawasan Pedesaan – “PRUKADES”). This can be accomplished by educating stakeholders about optimal crop mixes, ensuring smallholder ownership of plantation permits such as STDB, and facilitating access to financiers and off-takers.
2. Strengthen development plans for farmers' corporation plantation zones (Pengembangan Kawasan Pertanian-Perkebunan Berbasis Korporasi Petani), by building-in components regarding innovative financing schemes to support farmer crop diversification. It is also necessary to explore opportunities to cooperate with financial institutions, particularly to bring (Kredit Usaha Rakyat/KUR) and agricultural credit guarantee schemes to rural areas, design regency-financed maize insurance subsidies, and enable sharia concessional schemes for diversification financing.
3. At the national level, the government can support Berau's government through national agricultural commodity programs to continue diverse crop prioritization based on geographical or regency-based potential. It is also necessary to engage with financial institutions to bring more agricultural smallholder financing into their portfolios, and enable capacity building on financial instruments and products for cooperative and Micro, Small, and Medium Enterprises (MSMEs) and smallholder actors.

Though in this study we recommend moving away from monocropping, further research is required to investigate the environmental impacts of different types of crops in various geographical conditions. While maize and cocoa provide high economic return compared to palm oil, research shows that these commodities may pose negative environmental impacts (Ntiamoah and Afrane, 2008; Chew et al., 2013; Konstantas et al., 2018). Hence, concrete steps towards crop diversification would also entail Government of Berau outlining sound environmental safeguards for these commodities.

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1. INTRODUCTION

1.1 EXPLORING POLICY OPTIONS TO IMPROVE THE INCOME OF PALM OIL SMALLHOLDERS IN BERAU, WHILE SERVING INDONESIA'S SUSTAINABILITY AGENDA

For the last five years, Berau's economy has been primarily dependent on a single commodity – coal – with fluctuating prices and a downward trend. Meanwhile, the plantation business, particularly palm oil, continues to grow.

Compared with other commodities such as coffee, rubber, coconut, rice, pepper, and corn, palm oil dominated 29% of the plantation portfolio in 2014 (Mafira, et al. 2019). As in the case of coal, palm oil's upward trend and dominance exposes Berau's economy to the risks associated with depending on one main commodity and leads to an unsustainable economy.

If Berau continues to depend on a single commodity, palm oil smallholders will become vulnerable as the selling price of palm oil Fresh Fruit Bunch (FFB) impacts their incomes. Under such conditions, the government of Berau is faced with the challenge of balancing economic growth, economic resiliency, and environmental protection.

Maize and cocoa, however, may pose negative environmental impacts that needs to be taken into account while diversifying. Research shows that maize production has a potential to cause soil erosion, water depletion, or chemical contamination (Chew et al., 2013). Meanwhile, cocoa production in some countries has found to contribute to global warming because of change in land use (Konstantas et al., 2018).

Hence, concrete steps towards crop diversification would also entail Government of Berau outlining sound environmental safeguards for these commodities.

Therefore, the prescribed solution to this problem must consider the wellbeing of smallholders, without necessarily expanding their current palm oil plantations.

We established and compared three policy options to increase the income of smallholders. These options are expansion, intensification, and diversification.

Table 1. Policy options

Expansion	Intensification	Diversification
<ul style="list-style-type: none"> ● Not preferred because it promotes deforestation, which is against Berau's sustainability agenda 	<ul style="list-style-type: none"> ● Prevent deforestation because the focus is on increasing yields (WRI, 2018) of fresh fruit bunch from the existing palm oil plantation ● Intensification can be done through replanting. Palm oil replanting can potentially improve smallholder cashflow by 42-52% 	<ul style="list-style-type: none"> ● Decrease GHG reduction/unit product (Khasanah et al. 2020) ● Preferred by smallholders because it provides food and revenues while waiting for the palm oil to come into production (Nchanji et al. 2016) ● Easier to implement especially by smallholder farmers with preexisting knowledge on the selected alternative livelihood

Source: CPI analysis

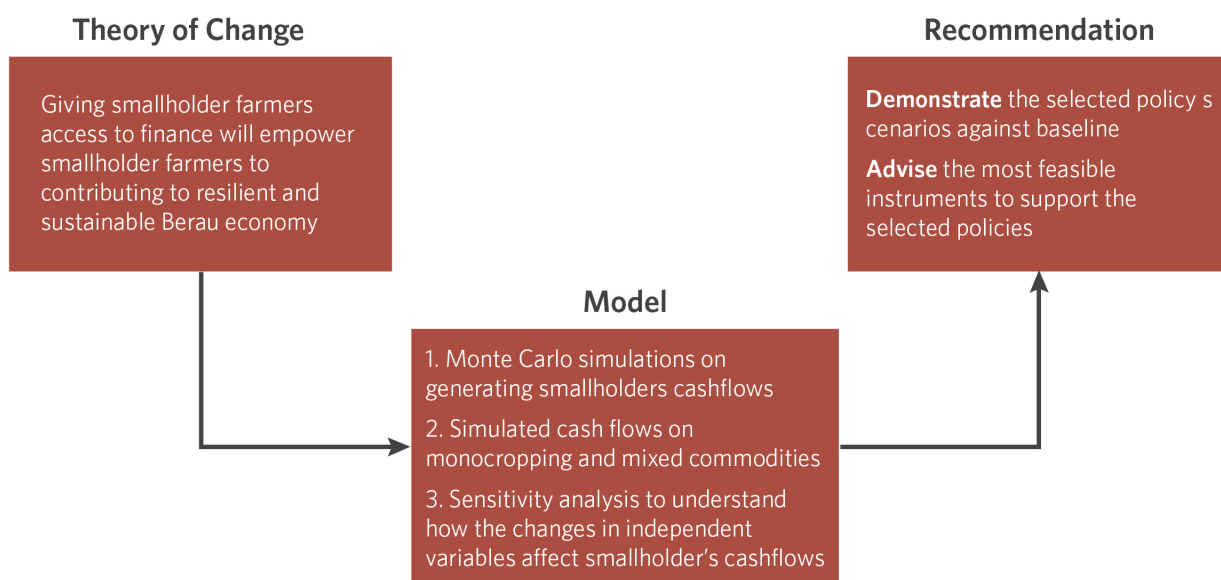
The study identifies diversification as a policy recommendation because it is preferred by smallholders, can safeguard their income, and is easier to implement due to their familiarity with it.

The study also examines whether diversification can be implemented in tandem with promoting Berau's sustainability goals, and without increasing deforestation risks by answering the following questions:

1. What are the characteristics of palm oil smallholders in Berau?
2. What are the potential interventions available?
3. What are the barriers, and what instruments are available to address them?

1.2 RESEARCH METHODS

This study provides an overview of palm oil smallholders' finance in Berau. It is based on a theory of change that puts forth an increasingly resilient and sustainable economy in Berau, but is premised on the smallholder's access to finance.



This theory uses the Monte Carlo simulation⁷ to generate smallholder cashflows. The cashflows further estimate the optimal mix of alternative livelihoods on a two hectare plot of land.

We develop the model and use ex-ante financial analysis to quantify the potential economic value of smallholder palm oil diversification, comparing it to continued cultivation of the crop under a ceteris paribus assumption. We identify opportunities to optimize the crop combinations of diversification scenarios and perform sensitivity analyses to understand the key variables that affect smallholder cashflows.

With the assessment of selected policy scenarios, i.e. diversification against the baseline, we formulate key recommendations on the most feasible smallholder financing instruments to support the selected policy. This is in line with the broader goal to move towards a more sustainable economy in Berau.

1.3 REPORT STRUCTURE

This report provides a qualitative and quantitative analysis of the selected policy option and its scenario against the baseline. It also recommends the use of certain financial instruments to make more informed decisions regarding the potential for increased investment returns.

Section 2 looks at the characteristics of palm oil smallholders in Berau, highlighting the focus of this study on independent smallholder farmers.

Section 3 outlines diversification as a policy recommendation for alternative livelihoods.

Section 4 provides an overview of the role of finance in smallholder diversification. It also offers key recommendations for the Berau government to use finance as a lever to drive palm oil diversification, and encourage sustainable economic growth in the regency.

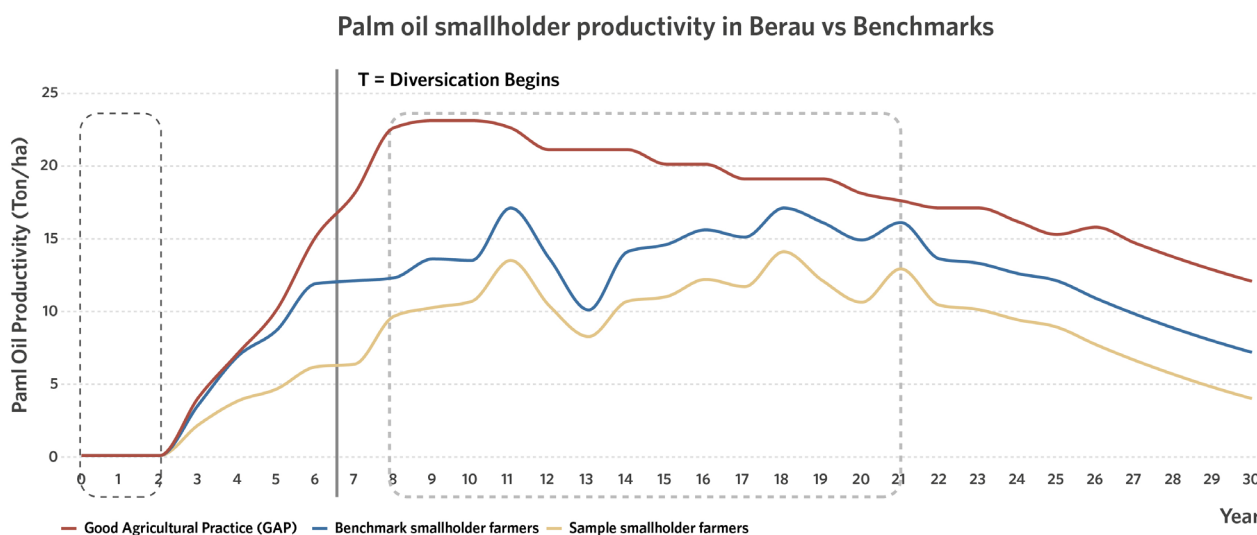
⁷ A technique used to understand the impact of risk and uncertainty in financial, project management, cost, and other forecasting models. A Monte Carlo simulator helps one visualize most or all of the potential outcomes to have a better idea regarding the risk of a decision. (Joseph, 2018).

2. UNDERSTANDING PALM OIL SMALLHOLDERS IN BERAU

This study identifies different smallholder business models. It focuses on the independent smallholder model, with the characteristics of: (i) ownership and management of two to five hectares of land, (ii) no buyers' contract, (iii) reliance on middlemen, (iv) low productivity, and (v) limited access to finance. In the financial model, this study focuses on modelling smallholders with two hectare-sized plots as this is the most common model in the villages studied in Berau Regency.

2.1 PALM OIL PROMISES RECURRING INCOME, BUT CANNOT COVER THE SMALLHOLDER'S MINIMUM COST OF LIVING

Figure 1. Smallholder farmers' productivity vs. benchmarks



Source: IFC Case Study Report (2015) and CPI analysis

Smallholder plantations contribute to 21.23% of palm oil plots in Berau. The palm oil plantation business has a long life-cycle of approximately 30 years. Fresh fruit bunches (FFB) are harvested every two weeks, making it suitable to smallholders who seek recurring income, despite its high upfront investment requirement.

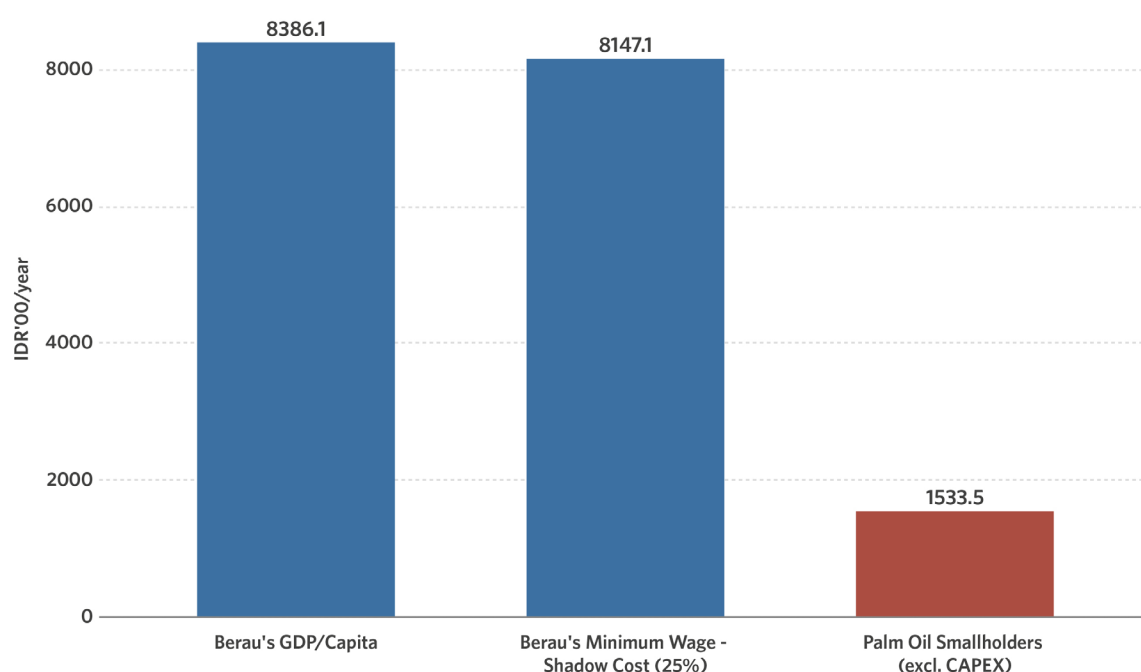
Access to capital in the early stages is critical to ensure productive and efficient use of land. However, due to lack of funding, many smallholders often neglect the importance of good agricultural practice (GAP) at this stage and experience low productivity in the long run. On average, independent smallholders in Berau have 29.5% lower productivity than the average

national productivity and 48.5% lower productivity than the average GAP productivity. Low productivity has implications on the revenue generation of smallholders throughout the planting period.

The study models Berau's smallholders using a sample of 400 independent palm oil smallholders, to understand the efficacy of the palm oil smallholding business to fulfil basic needs in the region. Then we undertake a Net Present Value (NPV) analysis to compare revenue generation from FFB sales with regency GDP per capita and the regency's minimum wage (Upah Minimum Regional—UMR) subtracted by the shadow cost. The results of the analysis show that smallholders can only generate a return on investment at a level far below the region's minimum wage.

On average, the net return on a two-hectare palm oil plot generates 439% lower returns than the minimum wage and regency GDP or capita across a span of 25 years. The revenue from FFB sales do not generate sufficient income to cover Berau's basic living costs, even when assuming that the average FFB price is 25% higher than IDR 1,467/kilogram (2017 price).

Figure 2. NPV analysis of smallholders' income from FFB sales vs. regency's GDP/capita vs. minimum wage for period of 25 years



- Berau's Minimum Wage (2018): IDR 2.889 million
- Shadow cost = 25%*
- Berau's GDP/capita= IDR 26,764 mi/year
- Annual growth: 5%
- Weighted average cost of capital (WACC): 17%
- Palm oil FFB price: IDR 1,467/kg
- CAPEX is excluded assuming the cost was incurred in the past and this calculation is onwards
- Land size: 2 ha
- Investment period: 25 years

Government Regulation 78/2015 Article 41 PP on Salary, Minimum Wage can exclude bonus and benefits.

Minimum Wage (UMR/P) = base salary + benefit; while base salary is at least 75% of minimum wage.

Source: CPI calculation

2.2 DIVERSIFICATION IS KEY TO ENSURE BETTER EARNINGS AND FUTURE ECONOMIC RESILIENCY

Most palm oil tree samples collected from independent smallholders are relatively young (~78% of the trees are aged 11 years or younger). Meanwhile, our benchmark data shows that oil palm trees are at their peak productivity at ages 8 to 13 years, indicating that the palm oil productivity in Berau is currently at its peak and is gradually decreasing.

Policy makers are faced with the following choices to safeguard the income of smallholders in the future:

1. Clearing new lands for more palm oil (expansion). This option must be avoided, as it promotes deforestation but without intervention, this may be the easiest option for smallholders who face the possibility of decreased earnings.
2. Replanting (intensification) by optimizing the productivity of the current monocrop palm oil plantation.
3. Diversifying their plantation with alternative commodities (diversification). They can align with the existing policy framework regarding Berau's diversification priorities, such as Program Unggulan Kawasan Pedesaan (PRUKADES) and Pengembangan Kawasan Pertanian-Perkebunan Berbasis Korporasi Petani (Farmers cooperation zones). The prioritized commodities range from cash crops such as cocoa and pepper, agricultural produce such as paddy and maize, horticultural products such as garlic and onion, and livestock farming such as cows and poultry.

Diversification is the most viable intervention if the Berau government aims to increase smallholder income, align with the sustainability agenda, and ensure future economic resilience.

This option is preferable to smallholders because it provides food and revenue while waiting for the palm oil to reach the production stage (Nchanji et al. 2016). In addition, it is easier to implement, especially for smallholder farmers who have preexisting knowledge regarding an alternative livelihood.

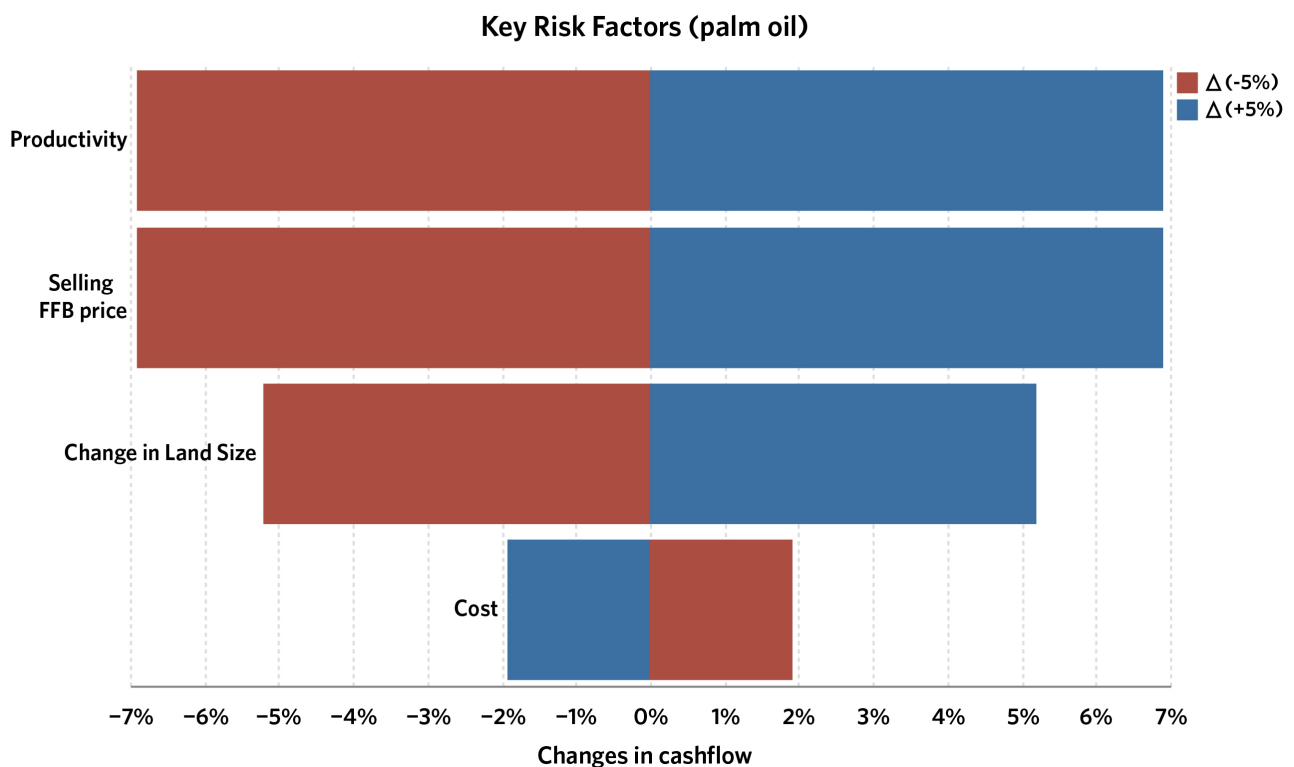
2.3 PRICE VOLATILITY IS A KEY RISK FOR PALM OIL SMALLHOLDERS, BUT DIVERSIFICATION MAY ABSORB THIS RISK

We performed a sensitivity analysis to understand the key risks faced by smallholder-managed palm oil plantations. Price volatility is deemed the riskiest factor. A decline of 1% in the FFB price is equivalent to 1.36% decline in annual cashflows for smallholders.

Productivity loss is the second highest risk. When the FFB price is largely driven by external factors, it is necessary to diversify investments to mitigate the risk of future price drops in the FFB price.

The income of independent palm oil smallholders in Berau depends upon the stability of the selling price of fresh fruit bunches, making it vulnerable when prices fall. Diversification can help improve the economic resilience of smallholders, but this needs to be done without exacerbating deforestation.

Figure 3. Sensitivity analysis of palm oil key risk factors



Source: CPI analysis

3. THE PATH TO DIVERSIFICATION

Palm oil-planted areas in Kalimantan have increased rapidly, and it is now the dominating crop across the region, including Berau. Livelihood diversification amongst independent palm oil smallholders can potentially improve their livelihood and provide better insurance against the uncertainty of commodity market prices. For example, in the case of falling FFB prices, alternative livelihoods offer a better certainty to the income of smallholders.

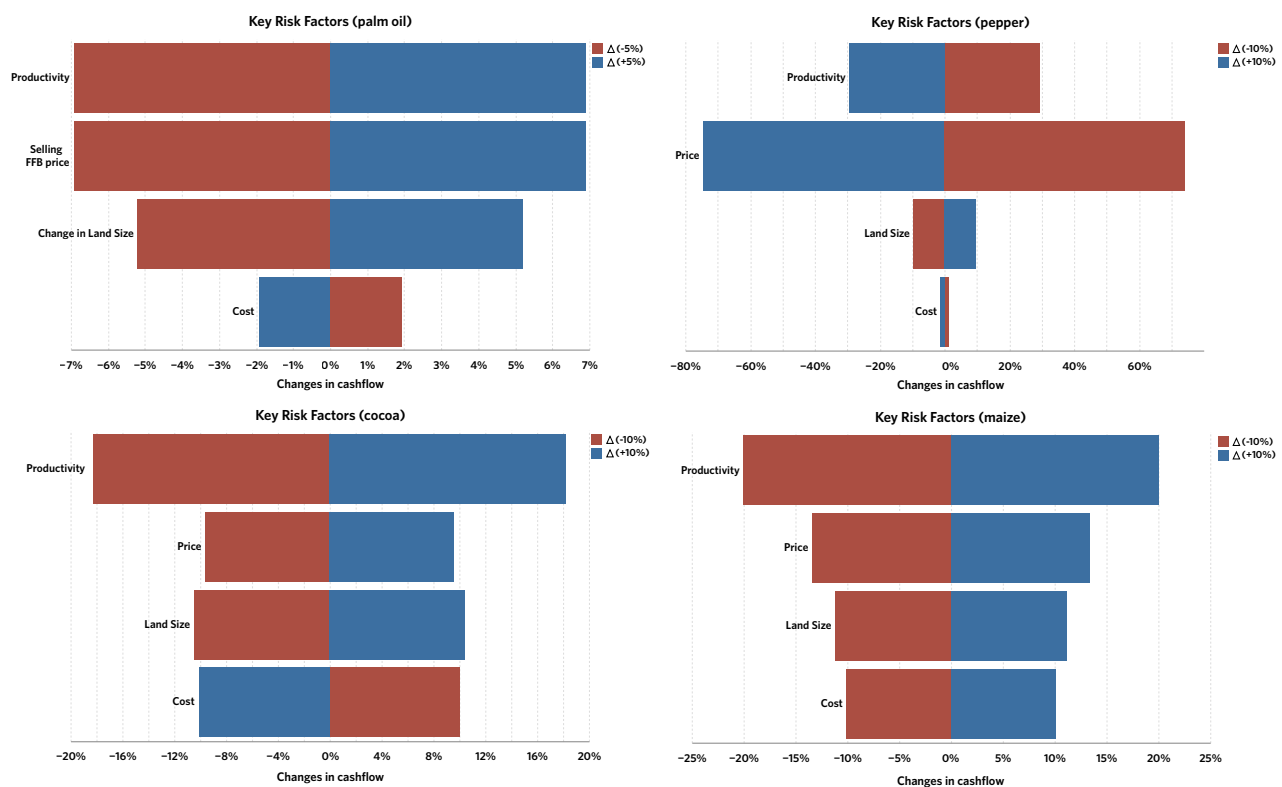
3.1 MAIZE, COCOA, AND PEPPER ARE PREFERRED FOR BERAU PALM OIL DIVERSIFICATION, BUT PEPPER IS THE LEAST ATTRACTIVE DUE TO ITS PRICE VOLATILITY

A diversified plantation can help Berau achieve sustainability while improving economic resiliency because it increases land use effectiveness, reduces smallholders' sensitivity towards market price volatility and declining productivity of palm oil. If independent smallholders have allocated vacant land for plantations in the future, the most economical way forward is to diversify. If all the lands are already planted with palm oil, our model shows that it is more economically sound for smallholders to wait until their palm oil trees are no longer productive, and only then to replace them with alternative crops.

Diversification is only focused on smallholders who have existing lands that are already allocated for plantation. It must not expand into forest land. Smallholders who have already planted their lands completely with oil palms, should not cut their existing and productive palm oil trees, as they generate the most revenue during their productivity period. Diversification can start when palm oil productivity declines.

Maize, cocoa, and pepper are the most preferred crops to diversify palm oil plantations due to their high-income potential, infrastructure preparedness, and lower knowledge gap. Cocoa is the second most preferred as it has lower income generation potential when compared to maize. However, of all these alternative commodities, pepper is the least preferred because of its price has been falling over the years, according to our sensitivity analysis result.

A 10% price drop can result in 74% loss in cashflow for pepper. This is much higher when compared to palm oil's 13% loss in cashflow. This indicates that price volatility affects pepper and palm oil more significantly than cocoa and maize. Historical selling price data shows that pepper has experienced significant plummeting prices, at almost a third of its current value per year. Meanwhile, the selling price of cocoa and maize on average are more stable than pepper, compared to palm oil. Therefore, maize and cocoa are considered more attractive crop options for diversification purposes on palm oil plantations compared to pepper.

Figure 4. Sensitivity analysis comparison of palm oil, maize, cocoa, and pepper against key risk factors.

Source: CPI analysis

3.2 DIVERSIFYING WITH MAIZE AND COCOA CAN YIELD HIGHER FINANCIAL RETURNS THAN CONTINUING WITH PALM OIL MONOCROPPING














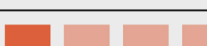
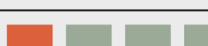









We modelled four cases of diversification with the percentage of alternative commodities ranging from 0% (baseline) to 25%, 50%, and 75%, with a total land size of two hectares and an investment period of 25 years.

This model offers a comparison analysis to identify which diversification scenarios are better than the baseline. Our financial analysis illustrates several land use scenarios for diversification that are more profitable than land use for palm oil.

The model shows that diversification using maize and/or cocoa has the potential to provide higher rates of return. Further, Berau is designated by the central government of Indonesia as the center of cocoa production⁸. Therefore, our model and analysis support this government initiative, where cocoa is the crop preferred after maize.

⁸ Based on Regulation of the Ministry of Agriculture No. 472 year 2018 on Masterplan Kawasan Perkebunan Berbasis Korporasi Petani, PRUKADES

Table 2. Potential investment return from diversification

Alternative commodity	Existing palm oil plantation composition*	Baseline scenario**	Diversification scenario	Potential investment return from diversification as compared to baseline scenario***
Maize				+166.3%
Maize (1/4) Cocoa (1/4)				+165.6%
Cocoa				+29.7%
Maize				+496.1%
Maize (2/3) Cocoa (1/3)				+495.5%
Maize (1/3) Cocoa (2/3)				+195.9%
Cocoa				+60%
Maize				+825.9%

Notes:

*) Average age of palm oil trees in the existing land is 10 years. Vacant land is allocated for future plantation, no deforestation for additional plantation activities

**) Baseline scenario is smallholders fill the non-productive vacant land with palm oil within 22 years ahead

***) Potential = maximum return. Period of calculation of Return of Investment is 25 years

Diversifying palm oil using cocoa and maize mixes has been proven to yield higher financial returns than the baseline, based on the following planting scenarios:

- Multicropping A (palm oil: maize = 25%: 75%) can potentially yield up to 825% higher return than monocropping.
- Multicropping B (palm oil: maize = 50%: 50%) can potentially yield up to 496% higher returns than monocropping.
- Multicropping C (palm oil: cocoa: maize = 25%: 25%: 50%) can potentially yield up to 495% higher returns than monocropping. In this scenario, besides maize, cocoa is also a potential alternative commodity. This resonates with the central government of Indonesia's program to designate Berau as the center of cocoa production.

Palm oil diversification by maize and/or cocoa can potentially provide higher rates of return. As Berau is designated to be Indonesia's center of cocoa production, the findings from our model support this government initiative, where cocoa is the second crop preferred after maize.

3.2.1 OPPORTUNITY FOR MAIZE FARMING

Between cocoa and maize, maize has several advantages towards providing an alternative livelihood in Berau. First, maize has a quicker cashflow generating capacity than cocoa. Maize is a seasonal crop that requires one season before its first harvest, while cocoa needs three to four years.

In 2017, maize plantations in Berau accounted for 5,032 hectares or 45.2% of all maize planted area East Kalimantan. Berau contributes towards 62.7% of maize production in East Kalimantan. In addition, the selling price of maize in Berau is stable with an average of IDR 3500-4200 per kg. Secondly, it has established several key players in the maize supply chain to ensure income stream stability.

Thirdly, maize plays a crucial role in ensuring food security. It finds use as both staple food and raw material for industrial food processing, and cattle food mixture. Maize farming is also more appealing as it is prioritized in the government agricultural portfolio and many programs are in place to stabilize the price of maize. For instance, during the harvest period, The Indonesian Bureau of Logistics (Badan Urusan Logistik—BULOG) will absorb the purchase and distribution of local corn from the farmers using commercial schemes.

On the other hand, unlike palm oil, which is a perennial crop, maize is a seasonal crop which means that maize has a different productivity cycle and additional labor requirements. Therefore, the opportunity for maize farming (explained with financial modelling here) is contingent on the willingness of smallholder farmers to adapt a new habit following maize's seasonal requirements.

3.2.2 BERAU'S COCOA AS A NATIONAL PRIORITIZATION PROGRAM

In Berau, cocoa is also a preferred alternative commodity. Cocoa development also supports the national program on cocoa prioritization in Berau, under the Ministry of Village Development (PRUKADES).

In terms of its impact on the smallholder's income streams, cocoa's price volatility can be mitigated by government intervention to protect the government's priority commodity.

Berau's cocoa may be priced at premium rates based on the following influencing factors:

INFLUENCING FACTORS	DESCRIPTION
Geographical characteristics and market presence	<p>Based on geographical indicators, East Kalimantan's original cocoa will receive certifications for its name and protection labels. The labels will be available in the form of trade patents and will be registered in the Geographical Indication Book, so that its products can be recognized at the national and international levels.</p> <p>In addition:</p> <ul style="list-style-type: none"> ▪ Berau's cocoa is already spread out across sub-regencies with a total area of 7,298 hectares. Dry beans produced amount to 2,393 tons/year particularly from Kelay, Gunung Tabur, Segah, Sambaliung, Teluk Bayur and Tabalar sub-regencies. ▪ Berau's dry cocoa bean products already have a market share in several countries, courtesy of the 'Berau Cocoa' of PT. Berau Coal. ▪ Cocoa farmers have a strong institutional presence through the Berau Cocoa Farmers Association, Gapoktan, Cocoa Farmers Group, and Berau's Cocoa Geographical Protection Society (Masyarakat Perlindungan Indikasi Geografis—MPIG).

End-product processing	Most of Berau's cocoa is raw. PT Berau Coal can support cocoa fermentation and smallholder training, and add value to cocoa production and the supply chain. Generally, fermented and dry cocoa beans are worth more than wet cocoa beans.
Securing cocoa selling price	Cocoa's price is highly dependent on domestic international market prices shaped by supply and demand. If "Indikasi Geografis" is implemented, this can be factored into the price of cocoa. This means that Berau's cocoa can become a prioritized commodity and obtain patents through geographical indicators so that its cocoa has added value and can be exported directly to different countries.
Increasing supplies for cocoa industries	Supply must be ramped up to fulfil the cocoa demand for industry, and more cacao processing industries are required to fulfil domestic demand. In 2018, the demand for cocoa beans for the industry was 800,000 tons. While the domestic cocoa bean production was only 210,887 tons, the additional 239,377 tons of cocoa beans came from imports. In total, the cocoa beans used in the industry amounted to 450,000 tons, thus the utilization of the cocoa processing industry only reached 57%.
Government priority	Based on the Agriculture Ministry Regulation 472 Year 2018 on the Farmers Cooperation Masterplan on Plantation, Berau is designated to become the production center for palm oil, cocoa, and coconut in East Kalimantan. East Kalimantan's cocoa productivity shows a decreasing trend from 710 kg/ha in 2011 to 567kg/ha in 2019. To align cocoa production with government priorities, Berau needs to focus on end-product processing and marketing Berau's cocoa.

3.3 CROP DIVERSIFICATION THAT STARTS WHEN EXISTING PALM OIL IS AT PEAK PRODUCTIVITY (APPROXIMATELY YEAR 10), IS LESS FINANCIALLY RISKY THAN STARTING IT FROM UNPRODUCTIVE YEARS

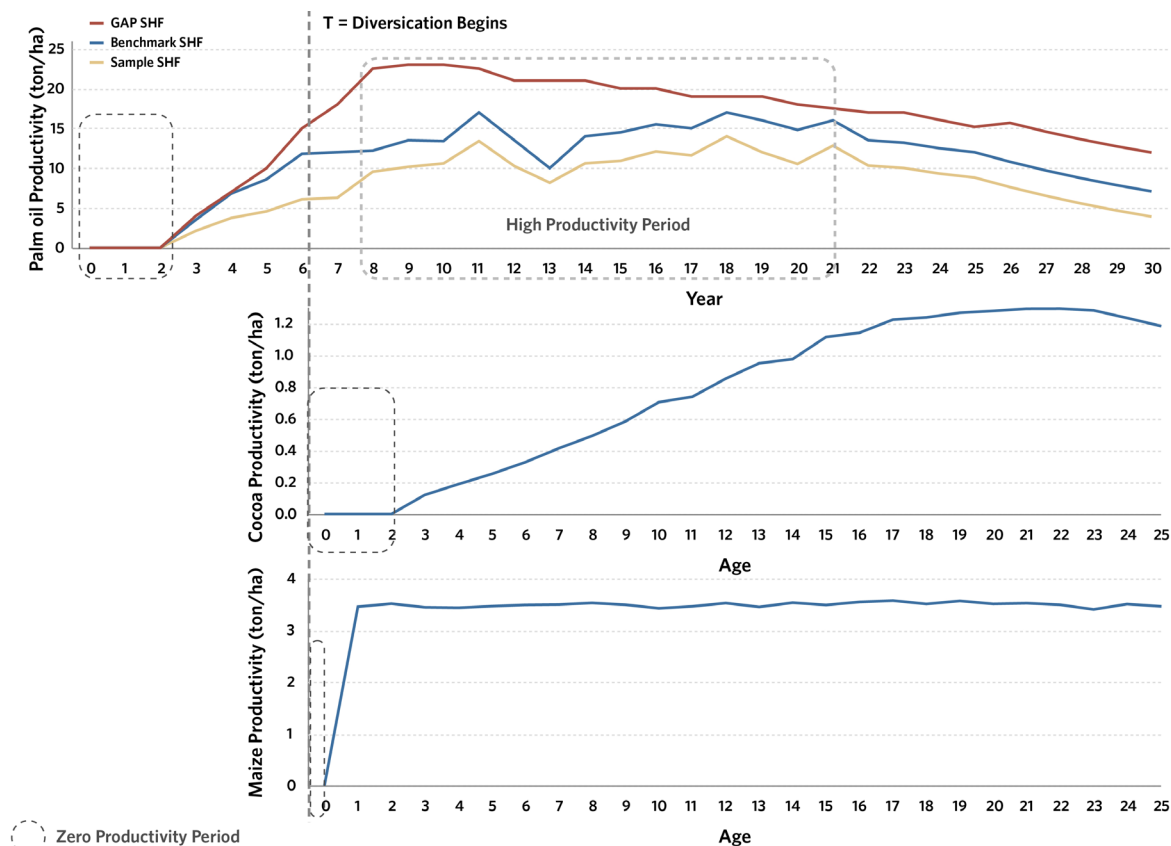
Unlike maize that only requires a season before its first harvest, cocoa requires three to four years. During this period, smallholders cannot generate revenue from the alternative commodities. Diversification should start at a time when smallholders are still generating high revenues from palm oil. This will ensure positive cashflows throughout the zero and declining productivity period of alternative livelihoods, as it determines their credit worthiness to repay their loans.

We modeled two different starting times ($t=0$ and $t=10$) where smallholders diversify their palm oil plantation with cocoa and maize.

We modeled two different starting times ($t=0$ and $t=10$) where smallholders diversify their palm oil plantation with cocoa and maize. With the debt/equity ratio at 20:80 and diversification investment cost at IDR ~27 million, smallholders will be proven to be more

credit worthy⁹ if they start diversifying during the peak productivity of palm oil trees than at any other time.

Figure 5. Productive period of palm oil, maize, and cocoa



Source: CPI analysis

We modeled two different starting times ($t=0$ and $t=10$) where smallholders diversify their palm oil plantation with cocoa and maize. With the debt/equity ratio at 20:80 and diversification investment cost at IDR ~27 million, smallholders will be proven to be more credit worthy¹⁰ if they start diversifying during the peak productivity of palm oil trees than at any other time.

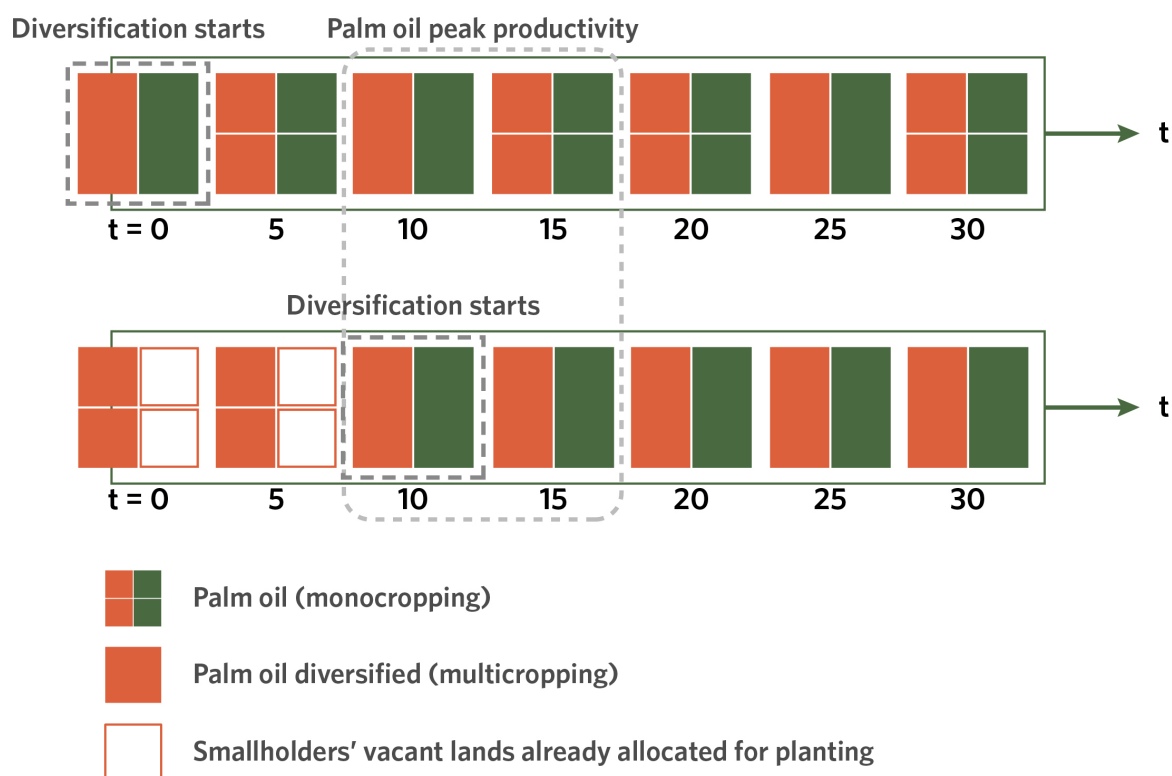
Smallholders most likely require additional investment or working capital to help them diversify. Although our model shows that smallholders have the capacity to apply for loans during palm oil peak productivity, changes in FFB prices will impact their bankability, impacting cash flows.

In a diversified plantation, however, the price of alternative commodities can be factored into cashflow generation. Our analysis shows that a 25% price decrease on a diversified plantation can result in a lower drop in average cashflows compared to a monocropping plantation. Therefore, it is more price-resilient despite fluctuating commodity prices.

⁹ We simulate the values of Debt Service Coverage Ratio (DSCR) from 1,000 smallholders. DSCR indicates the debtor's ability to cover debt payments. Results show that diversification at year $t=10$ results in 96.5% of smallholders with $DSCR > 1.25$, while diversification at year $t=0$ results with only 18.5% with $DSCR > 1.25$. Typically, most commercial banks require a ratio of DSCR at 1.15–1.35 to ensure that cash flows sufficient to cover loan payments are available on an ongoing basis.

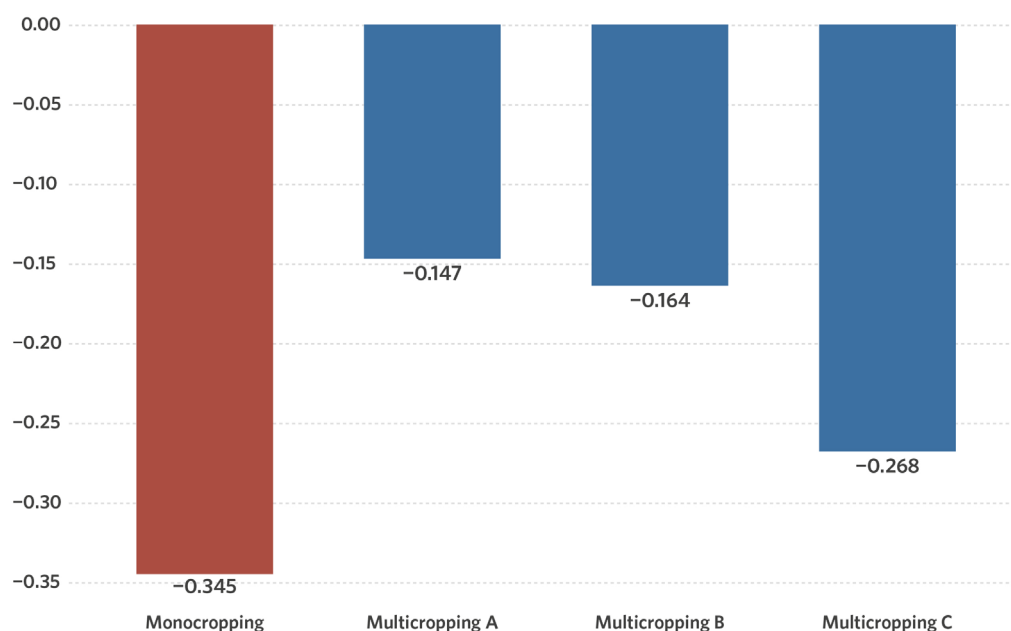
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Figure 6. Comparison of two diversification starting periods



Source: CPI analysis

Figure 7. Analysis on -25% price drop in commodity prices



Source: CPI analysis

Diversification should start at the time when smallholders are still generating high revenues from palm oil, to ensure positive cashflows before the alternative commodities start to harvest, which determines their credit-worthiness to repay their loans.

4. THE ROLE OF FINANCE: A KEY LEVER FOR THE BERAU GOVERNMENT TO SUPPORT THE SMALLHOLDER DIVERSIFICATION AGENDA

While alternative livelihoods other than palm oil offer additional sources of income for smallholders, incentives on finance and technical aspects are both necessary to encourage independent smallholders to diversify their plantations.

The barriers to diversification include price risk, market access, loss of revenue, production cyclicity, and access to finance. These barriers can impact the income potential of smallholders, and without proper solutions, diversification would not prove attractive to smallholders. We identified potential financial instruments to address financing barriers faced by smallholders, including interest rate subsidy, credit guarantee scheme, insurance, and concessional loan agreement.

4.1 INTEREST RATE SUBSIDY: KREDIT USAHA RAKYAT (KUR) PROGRAM

The average commercial banks' interest rate is perceived as too high by small businesses. This is because most small businesses do not have the collateral as a prerequisite to obtain a commercial loan.

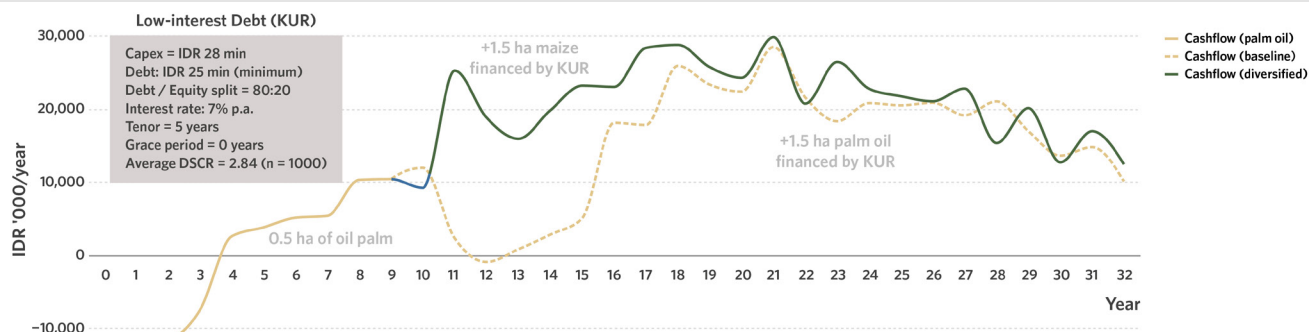
The People Business Credit (KUR) is a government credit program for MSMEs and Cooperatives who have been unable to access credit or financing from banks (Bank Indonesia, 2017). KUR is issued by the government by subsidizing the loan interest provided by banks and non-bank institutions.

It is one of the most popular financing instruments for Micro, Small, and Medium Enterprises (MSME) in Indonesia as it offers the applicant a lower annual interest rate (7% p.a.) than commercial banks (13-18.5% p.a.). As of date, the government has allocated IDR 140 trillion KUR in 2020, a 13% increase from 2019.

Some banks offer KUR Khusus, a sub-type of the KUR program, which is specific for plantations, farming, and fishery businesses, and this should help finance the capital needs for diversification.

Case study: The use of KUR for palm oil diversification in Berau in our developed scenario multicropping A

We further develop our model to incorporate scenario monocropping A if the planter uses KUR for palm oil diversification. The result showed that diversified livelihood generates higher cashflows compared to the baseline.



If individual smallholder farmers has an ID card (Kartu Tanda Penduduk—KTP), business permit (Izin Usaha), and are in the age range of 21 to 65 at the end of the credit term, they will be eligible for KUR. Documents proving business profitability and land legal status are not strict requirements for KUR, but having these would increase the probability for smallholders to access credit. In this case, the KUR loan amount available for continuing with palm oil is IDR 48 million. The amount for diversification is IDR 25 million.

If a smallholder farmer in Berau has 0.5 hectares of palm oil, with an average tree age of 10 years, and wants to utilize 1.5 hectares of unproductive land for maize through intercropping, they can apply for the minimum KUR loan at IDR 25 million. If they choose to diversify, they will receive a higher return of 364.69% than if they continue with 1.5 hectares of palm oil.

Why documents proving the business profitability and land legal status may be important?

Farming identification such as Surat Tanda Daftar Budidaya (STDB) serve as proof of legal administration. It outlines several key characteristics of plantations, such as land or plantation permit, sketch of the plantations, and seed certificates. For policy makers, STDB is pivotal to maintain a database and synchronize plantations with the government's land use masterplan. STDB is useful to independent smallholders who own less than 25 hectares when applying for bank credit.

Why is STDB important?

STDB is a complementary of a business permit, but having one is important because it may:

- **Improve financial and market access:** STDB may streamline the requirements for financial access and supply chain. This is because independent smallholders with STDB may sell its yields to companies that adhere to Indonesia Sustainable Palm Oil certificates
- **Prevent deforestation:** Encouraging independent smallholders to register for STDB may reduce expansion and invasion of the State's Forest Zone (*Kawasan Hutan Negara*), thereby preventing illegal land tenancy.

STDB Requirements

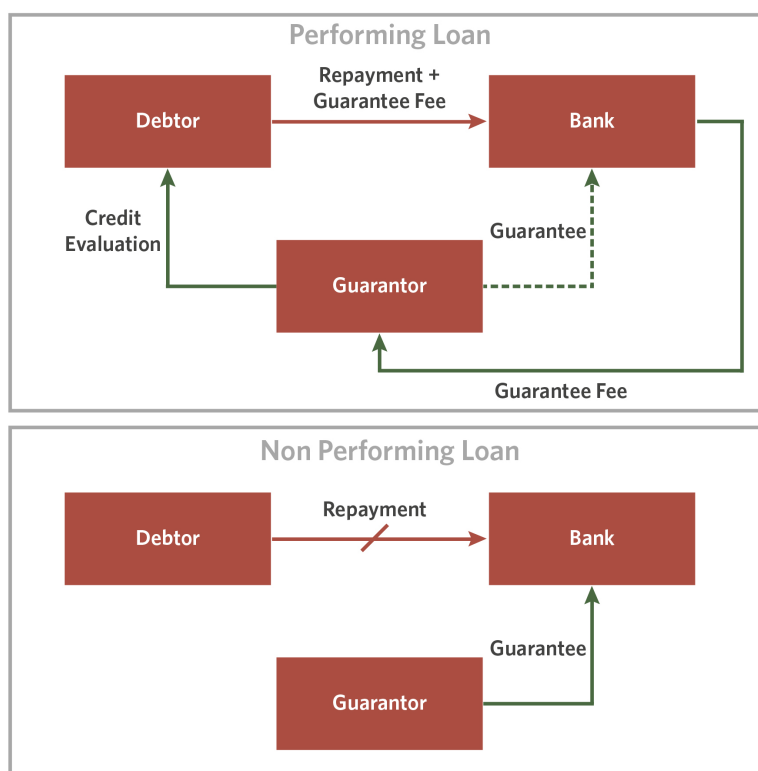
1. Original request form
2. Copy of ID Card/Letter of Residence
3. Original village-issued plantation rights certificates
4. Copy of land-ownership certificate
5. Seeds certificate
6. Original seeds handover certificate
7. Sketch of the plantation plot
8. Original letter of ownership on the plot of plantation
9. All documents above made in 2 copies

4.2 AGRICULTURE CREDIT GUARANTEE SCHEME (CGS)

The agricultural credit guarantee scheme (CGS) is an instrument that reduces credit risk by reducing the loss from non-performing loans (NPL). A guarantee instrument is a crucial instrument that helps reduce the risk perceived by financial institutions (FIs) because it encourages them to provide credit to those who are unable to access loans under normal conditions.

CGS was designed to support cooperatives and MSMEs who are unable to get financial assistance from financial institutions. Guarantors will cover the loan repayment (partially or fully) for FIs if debtors are unable to repay their loan, at an annual fee of 0.5-3% of the total credit amount.

Figure 8. Credit Guarantee Scheme



Source: Wardhono, A., et. al, 2019

For smallholders, CGS can only be granted if they satisfy the criteria for an MSME. Individual smallholders, however, can be categorized as microbusinesses if they own a business permit (Izin Usaha).

In general, there are certain requirements for a smallholder's loan to be guaranteed. The smallholder must fulfil the Financial Service Authority (OJK)'s definition of an MSME¹¹, have a business permit, and have a clear business site (a site visit for appraisal by the guarantor for appraisal may be required). They must also have a minimum experience of two years in the business and should be able to prove that the business is profitable, and is not under an NPL,

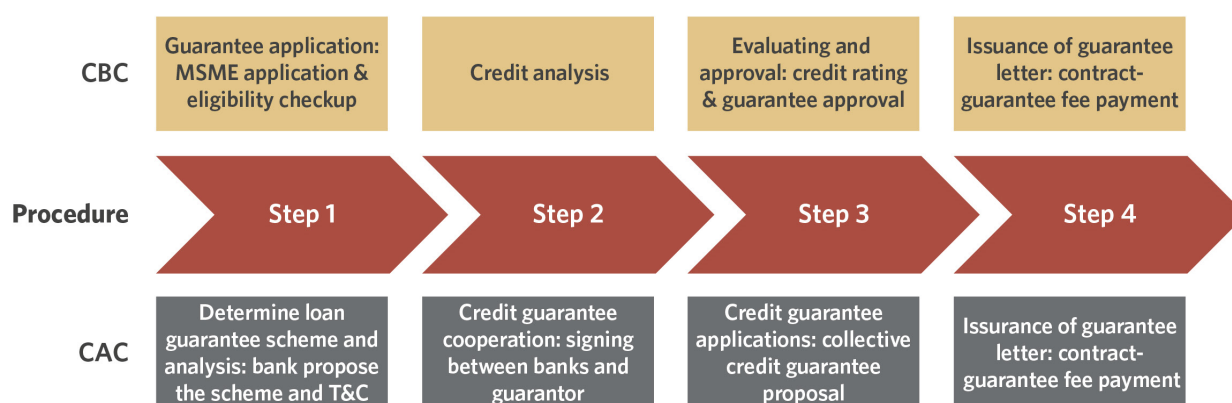
¹¹ Criteria of MSME is based on Law No. 20/2008 Chapter IV Article 6 MSMEs

claim process, or bankruptcy. They must have the supporting documents that prove that they meet these requirements.

There are two main types of CGS for MSMEs. These are conditional automatic cover (CAC) guarantee and case by case (CBC) guarantee. Most of the guaranteed MSMEs, particularly MSMEs in the agricultural sector, are under the CAC scheme.

Therefore, smallholders may undergo the guarantee process through the CAC procedure. As of date, we identified four credit guarantee providers in Indonesia. The CBC is typically applicable to specific borrowers, products, or terms.

Figure 9. Credit guarantee scheme and its providers in Indonesia



Four Credit Guarantee Providers in Indonesia

PROVIDER	MAJOR SHAREHOLDERS	GUARANTEE COVERAGE	GUARANTEE FEE P.A.	MAX LEVERAGE RATIO
PT. Penjamin Kredit Pengusaha Indonesia (PKPI)	Private	75% of loan amount	1.5%	
PT. Asuransi Kredit Indonesia (ASKRINDO)	55% BI, 45% MoF	70-80% of loan amount	1.2-1.5%	10x net worth
Jamkrindo	Government affiliated company	70-80% of loan amount	2.28%	10x net worth
Perum Sarana	100% Government owned	Max 75% of loan amount	0.5-1.5% (risk based)	

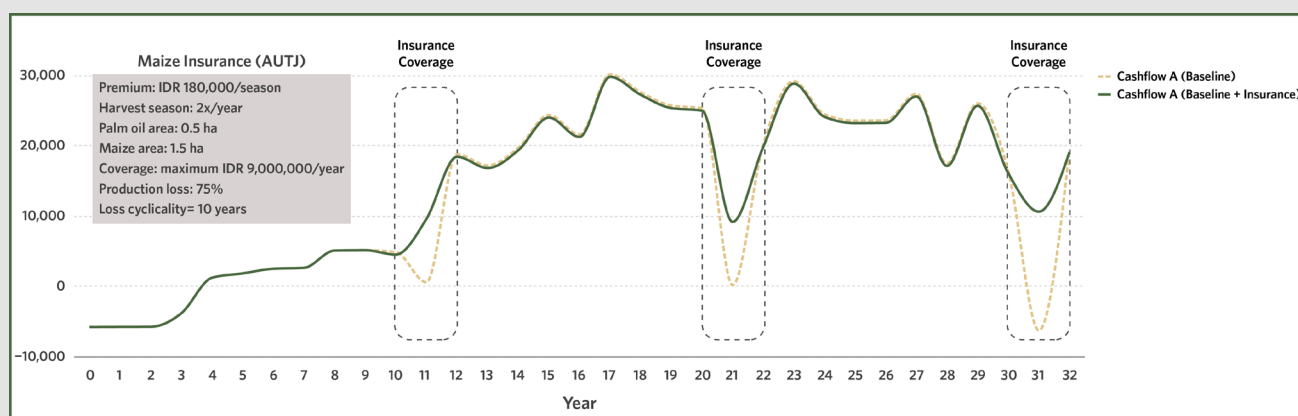
Source: Wardhono, A., et. al, 2019 PT.

4.3 INSURANCE: MAIZE INSURANCE (ASURANSI USAHA TANI JAGUNG—AUTJ)

PT. Jasindo Agri (next to be referred as Jasindo) is a government-appointed company that specializes in agriculture and farming insurance, particularly for smallholder farmers. At present, the government-supported operational insurance products available are applicable to paddy and cow farming.

Maize insurance or Asuransi Usaha Tani Jagung (AUTJ) is currently not considered to be a government-backed agri-insurance product from Jasindo. AUTJ covers productivity loss due to natural reasons and will be supported by the government later. AUTJ is not yet operational and is expected to be operational in 2021. Under this scheme, the claim amount is proportionate with the production cost, while the monthly premium would be 2% of that production cost per hectare of land.

Case study: Maize insurance under 10-year cyclical productivity loss for scenario multicropping A



Source: CPI calculation

In this scenario, when the total area of the maize plantation is 1.5 hectares, the annual premium is IDR 360,000 per year for maize planters who are insured. Under this scheme, any natural cause that results in 75% loss of productivity will be insured for up to IDR 9,000,000 per year. Assuming a lifespan of 22 years for a maize plantation, and 75% productivity loss once in 10 years, maize farmers who are insured will receive 7% greater returns compared to those without insurance. The return will be higher if such losses occur more often, i.e., if it occurs once in seven years, insured maize farmers will receive 9% more than uninsured farmers, and 11% for a 5 year cycle. Therefore, insurance is a key tool for smallholder farmers to secure their income in the face of climate risks.

Table 3. A comparison of paddy and maize insurance

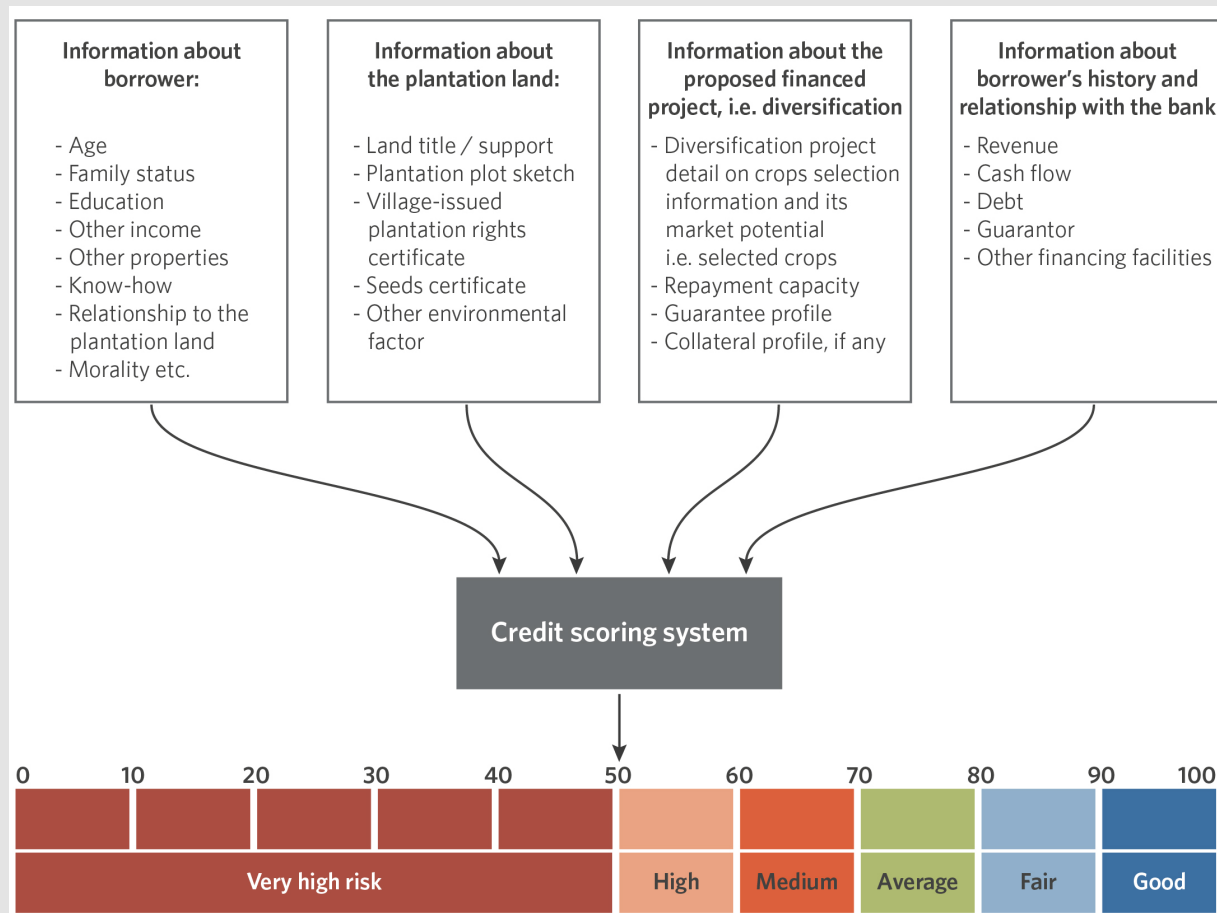
	Paddy Insurance	Maize Insurance*
Premium per season	IDR 180,000/ ha, but the government subsidizes 80%. Total premium IDR 36,000 /ha	2% of average production cost /ha, or IDR 100,000 - 120,000 /ha. No government subsidy
Maximum Coverage (IDR '000/ha)	IDR 6,000,000 /ha	IDR 5,000,000- IDR 6,000,000/ha
Eligibility	Maximum land size of 2 ha and has access to irrigation	N/A
Coverage	For loss \geq 75%	N/A

*)to be operational in 2021

Source: Ministry of Agriculture, Insyafiah & Wardhani, 2014

Case study: Credit scoring model – the level of risk of credit applicants

Commercial banks use credit scoring to assess an applicant's profile as part of the know your customer (KYC) process. Credit scores have six categories of profiles, i.e., very high risk, high risk, medium, average, fair and good. The score is used to predict the ability of the customer to repay based on their character and history with the bank, as well as other information, including business profiles and proposed financed plantation projects.



Source: Ramirez & Hernandez, 2016. Adaptation from FAO, 2016 (<http://www.fao.org/3/a-i6166e.pdf>)

In Indonesia, the average value of the guarantee that is covered by the guarantor is 75%, while the remaining 25% is borne by the bank in the case of non-performing loans. Based on the credit scoring model, a guarantee can improve a smallholder's credit score and bankability to access finance, while providing risk coverage for banks.

4.4 CONCESSIONAL LOAN AGREEMENT

Concessionality is achieved either through longer maturities, longer grace period, lower interest rate, lower collateral requirement, sub-debt or quasi-equity finance, grants and technical assistance. It covers the KUR and guarantee, but these instruments can be combined, as it emphasizes flexibility in a cooperation arrangement.

The general practice of concessionality allows banks to allocate concessional deposits. Commercial banks will lend a fixed quota of their total lending amount to the agricultural sector through two methods, i.e., direct and indirect deposit.

Table 4. Concessional loan schemes in Indonesia

DIRECT DEPOSIT	INDIRECT DEPOSIT
<p>Banks allocate a fixed share¹² of their loan portfolio directly towards MSMEs in the agricultural sector.</p> <p>This is done through their microfinance vehicles- BTPN, BRI, and certain banks.</p>	<p>Banks allocate their compulsory proportion of MSME loan financing through specialized banks.</p> <p>Real case: Bank BRI is assigned to the Agricultural Bank of Indonesia to lend these compulsory funds to the final borrower. The source of concessional financing comes from bond proceeding. For example, banks will buy BRI's bonds at low fixed interest rates - BRI sustainability bonds, with a 3.95% coupon rate, and a 5-year tenor.</p>

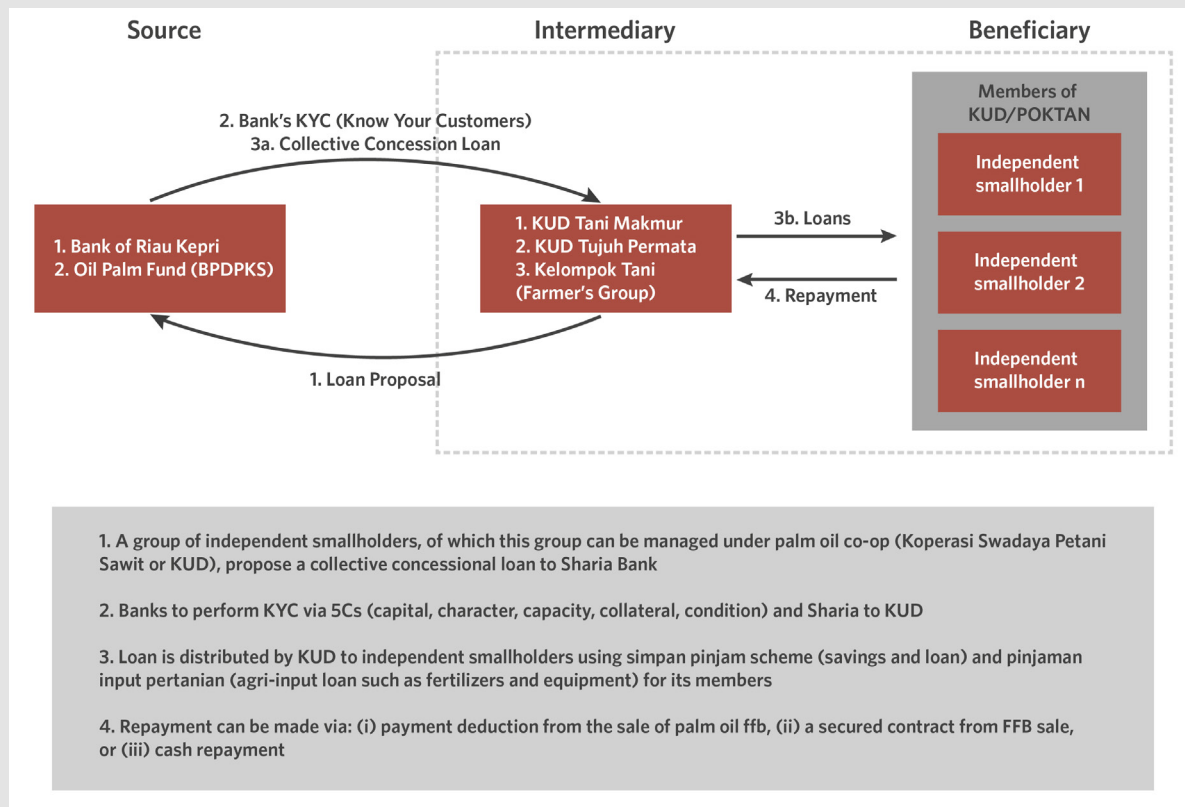
Concession sharia arrangement (Islamic banks) is a significant portion of the MSMEs' investment and working capital financing in Indonesia. This is higher than that of conventional banks in 2016 (Wardhono, A., et. al, 2019). This scheme can act as leverage for Berau to promote smallholder diversification, as it addresses the two financing barriers of access to finance and markets. Arrangements can be explored to supply famers with inputs, and secure purchase orders for crops produced. The smallholder may repay the loan using secured contracts.

A range of smallholder financing instruments is generally applicable to all commodities, except insurance which is only specific to maize. It is also important to note that each instrument has unique characteristics and should be deployed in specific situations.

Further, all financial instruments have the potential to address all smallholder financing barriers except for market access. This is because market access is contingent upon the terms and conditions that smallholders have with buyers. These can be addressed with specific concession terms

¹² Following PBI No 14/ 22 /PBI/2012, public banks are obliged to finance MSMEs with a minimum of 20% of the total portfolio.

Case study on sharia concession: sharia loan to palm oil independent smallholders – indirect deposit via village cooperation (example from Riau)

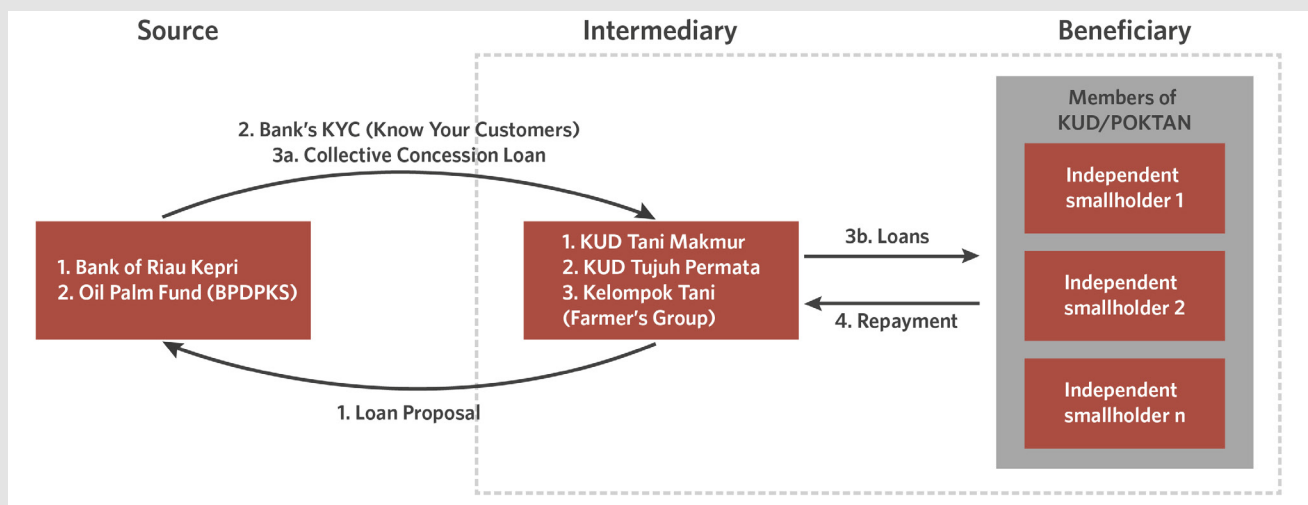


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Case study on sharia concession: Sharia loans for cocoa smallholder financing in Sulawesi Tenggara

The scheme is similar to Riau's palm oil concession loan via Village Cooperative Units (Koperasi Unit Desa—KUD). In this case, Sharia financial institutions provide the sharia loan to independent smallholders, indirectly via LEMS (Lembaga Ekonomi Masyarakat Sejahtera) as the intermediary.



Reference: <https://www.bi.go.id/id/umkm/kelayakan/pola-pembiayaan/perkebunan/Pages/Pola-Pembiayaan-Usaha-Kecil-Menengah-Syariah---Budidaya-Kakao.aspx>

Table 5. Potential instruments to apply to each commodity

Instrument	Palm oil	Pepper	Cocoa	Maize
Interest rate subsidy	✓	✓	✓	✓
Insurance				✓
Credit guarantee	✓	✓	✓	✓
Concessional loan	✓	✓	✓	✓

Table 6. Smallholder financing barriers and the efficacy of instruments to address the financing barriers

Barriers to diversification		The efficacy of instruments to address the financing barriers			
Risk Category	Description	Interest rate subsidy	Credit guarantee	Insurance	Concessional Loan
Price risk	Palm oil is one of the most traded commodities globally, and prices are determined by market forces beyond the control of smallholders. The price of FFB that smallholders sell is directly correlated with the crude palm oil (CPO) market price. Similarly, cocoa may also face a fluctuation in selling prices.		✓		
Market access	As more and more CPO buyers around the world put sustainability standards on the CPO that they purchase, producers may face difficulties finding buyers, which will also directly impact the ability of smallholder's to sell FFB. A growing awareness of sustainable cocoa sourcing and agricultural products, including maize, is another factor.				✓
Loss of revenue	FFBs need to be processed within 48 hours of harvest. The failure of smallholders to process and sell FFB within this timeframe may result in loss of revenue. Mills often apply a levy when purchasing FFB sourced from smallholders because low quality FFB leads to low CPO yields. This levy is often passed down to smallholders in the value chain.	✓	✓	✓	

Production cyclicalit	There are certain periods within a year where palm oil, cocoa, or maize production drop below average productivity. This includes the period where production jumps above average. In a 'low season', smallholders will yield lower product volume and receive lower revenues. On the other hand, during peak seasons, smallholders yield a high volume of products, but it is more difficult to sell them as there are often very long queues at the mill (or mills are unable to process the sudden increase in product intake).		✓	✓	
Access to finance	Smallholders tend to have limited access to finance and often have to forego quality due to this constraint. Application of low-quality seeds or seedlings result in low productivity over a long period of time.	✓	✓	✓	✓
<div> <div></div> Available <div></div> Not readily available </div>					

A range of smallholder financing instruments is generally applicable for all commodities, except insurance, which is only specific to maize. It is also important to note that each instrument has unique characteristics and should be deployed in specific situations.

NEXT STEPS: KEY RECOMMENDATIONS

Based on this analysis, there are several key recommendations that Berau's government may consider to use finance as a lever to drive palm oil diversification by Berau's smallholders.

First, strengthen crop diversification through village priority economic activity programs (Program Unggulan Kawasan Pedesaan – “PRUKADES”) by educating farmers on optimal crop mixes, ensuring smallholder ownership of plantation permits (Surat Tanda Daftar Budidaya – STDB), and facilitating access to financiers and off-takers.

Second, strengthen development plans for farmers' corporation plantation zones (Pengembangan Kawasan Pertanian-Perkebunan Berbasis Korporasi Petani), by building in components of innovative financing schemes to support farmer crop diversification. They can also explore opportunities to cooperate with financial institutions. This is particularly with regard to bringing KUR and agricultural credit guarantee schemes to rural edges, designing regency-financed maize insurance subsidies, and enabling sharia concessional schemes for diversification financing.

Our recommendation can be potentially replicated in other regencies or districts in Indonesia besides Berau that have similar attributes.

Further, at the national level, the government can support Berau's government through national agricultural commodity programs to continue diverse crop prioritization based on geographical or regency potential. They can also support engagements with financial institutions to access more agricultural smallholder financing into their portfolio, and enable capacity building for accessing financial instruments or products for MSME actors, particularly smallholders.

5. CONCLUSION

- In general, a cooperative model tends to have a higher level of productivity than an independent smallholder model. However, smallholder business models in Berau vary. This study particularly focuses on the independent smallholder model, which accounts for 11.23% of Berau's palm oil estates.
- Palm oil has become an increasingly popular choice because it provides recurring income with low labor needs. However, the low productivity of smallholders means that they are unable to generate sufficient revenue to cover minimum living costs.
- Smallholders face various risks that can impact their earning potential, with price volatility and low productivity being the most significant factors. Although typical policy intervention tends to favor intensification, a diversification of palm oil plantations can potentially absorb some of the existing risks faced by smallholders, and stay in line with Berau's sustainability agenda at the same time.
- A diversified plantation can help Berau achieve sustainability while improving the region's economic resiliency. This is because it increases land use effectiveness, reduces smallholder sensitivity towards market price volatility, and protects them from the zero and declining productivity period of palm oil. In cases where independent smallholders have vacant land allocated for plantations in the future, diversification is the most economical way forward.
- If all the lands are fully planted with palm oil, our study recommends that smallholders wait until their palm oil trees are no longer productive, and replace them with alternative crops after that.
- Maize, pepper and cocoa are most preferred to diversify palm oil plantations due to their high-income potential, infrastructure preparedness and low knowledge gap. However, of all these alternative commodities, pepper is the least preferred because of its plummeting price over the years.
- Cocoa is the second most preferred while maize has the highest income generation potential. In addition, Berau is designated by the central government of Indonesia as the center of cocoa production. Our model aligns with this, as cocoa is the second most preferred crop after maize.

This study highlights the following factors:

- As smallholders are vulnerable to various risks that may impact their revenue stream, diversification is best started during the period where they are generating high revenues from palm oil. This period is also the most bankable period for smallholders to access loans. But this advice only applies for smallholders who own vacant lands for planting. For those who do not, it is better switch to alternative commodities after their palm oil trees are no longer productive.
- The barriers to diversification include price risk, market access, loss of revenue,

production cyclicalities and access to finance. These barriers can severely impact the income potential of smallholders, and without addressing these barriers, diversification will not be attractive from their perspective.

- Finance is one of the key levers that can help the Berau government to promote a diversification agenda. Finance acts as an economic instrument to incentivize smallholders and compensate them for unmitigated losses from diversification activities.
 - There are four potential instruments to address smallholders' barriers to diversification. These are interest rate subsidy, credit guarantee, insurance, and concessional loans.
 - All financial instruments have the potential to address the financing barriers that smallholders face except market access. This is because market access is contingent on the smallholder's terms and conditions with buyers and these can be addressed with specific concession terms.
 - While the proposed financial instruments are accessible to smallholders, the possession of business permits and basic financial knowledge can improve their accessibility to these instruments, especially guarantees.
 - This study identifies key recommendations for the Berau government to optimize finance as a lever to drive palm oil diversification.
1. First, continue support for crop diversification program by educating smallholders about optimal crop mixes, ensuring smallholder ownership of plantation permits (STDB), and facilitating access to financiers and off-takers.
 2. Second, strengthen development plans for farmers' corporation plantation zones by building in components of innovative financing schemes to support farmer crop diversification. They can also explore opportunities to cooperate with financial institutions. This is particularly with regard to bringing KUR and agricultural credit guarantee schemes to rural edges, designing regency-financed maize insurance subsidies, and enabling sharia concessional schemes for diversification financing.
 3. Finally, at the national level, the government can support Berau's government through national agricultural commodity programs to continue diverse crop prioritization based on geographical or regency potential. They can also engage with financial institutions to receive more agricultural smallholder financing into their portfolio and enable capacity building on financial instruments and products for MSME actors.
- Based on our findings, we recommend that the Berau government in its role as the policy maker, may pursue the option of smallholder crop diversification because their palm oil productivity per land capita is expected to decrease by 2025.
 - Diversification has the potential to improve the income of smallholders although additional investment and working capital is required. Addressing financing barriers may help promote this policy option and ease policy implementation. Enabling smallholders to access financing options may contribute towards a more resilient and sustainable economy in Berau.
 - Further research is required to investigate the environmental impacts of different types of crops in various geographical conditions. Maize and cocoa provide high economic return, but may pose negative environmental impacts. Hence, concrete steps towards

crop diversification would also entail Government of Berau outlining sound environmental safeguards for these commodities.

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7. APPENDIX

FREQUENTLY ASKED QUESTIONS (FAQS)

I. GENERAL QUESTIONS

- **What is the Monte Carlo Simulation and how is it used in this study?**

The Monte Carlo Simulation is a technique used to understand the impact of risk and uncertainty in financial, project management, cost and other forecasting models. A Monte Carlo simulator helps one visualize most or all of the potential outcomes to have a better idea regarding the risk of a decision (Joseph, 2018). For this study, the Monte Carlo simulation was used to generate cashflow prediction and estimate the optimal mix of alternative livelihoods on a two hectare plot of land.
- **What is the definition of an ‘independent smallholder’ in this study?**

This study focuses on independent smallholders who own between two to five hectare-sized plots of land. They have no buyer contract, rely on middlemen, experience low productivity, and have limited access to finance. In the financial model, this study focuses on modelling smallholders with a two-hectare plot.
- **How does the economic return of palm oil smallholder compare with Berau’s minimum needs?**

Our model indicates that smallholders in Berau can only generate a return on investment at a level that is far below the region’s minimum wage. On average, the net return on a two-hectare palm oil plot is 439% lower return than the minimum wage and regency GDP or capita over a span of 25 years.
- **At what ratios of crop mixes should smallholders diversify their palm oil plantation?**

Financial modeling shows that there are three land-use mixes from which smallholders can generate the highest revenue instead of continuing with planting oil palms. We found that a combination of land use in which palm oil: maize = 1:3 or 1:1, and palm oil: cocoa: maize = 1:1:2, promise the highest return compared with expanding palm oil tree planting.
- **When should smallholders diversify, especially when they need loans to do so?**

Smallholders should diversify during the peak of palm oil productivity without cutting down their productive palm oil trees. This is the time at which plantations generate the highest revenue. During this period, smallholders are more likely to repay their loans if they need to do so in order to finance the diversification efforts.
- **Does this study advise smallholders to cut down their existing palm oil trees?**

This study does not advise smallholders to cut down their existing palm oil trees, unless they are no longer productive. This is because cutting down trees during this period is more likely to incur a higher opportunity cost. The study identifies the optimal mix of palm oil and alternative crop combinations based on financial modelling.

- **What is the context of ‘smallholders’ diversification to alternative commodities’ in this study?**

This study suggests that if independent smallholders have vacant land already allocated for plantations in the future, the most economical way is to diversify. If all the lands are already planted with palm oil, this study suggests that smallholders wait until their palm oil trees are no longer productive, and replace them with alternative crops only after that.

- **Does diversification in this study suggest that smallholders expand into forest land and promote deforestation?**

This study does not recommend that smallholders expand their already planted two-hectare plots into forested areas and cause deforestation. We recommend the use of business permits (including plantation ID or STDB) to prevent expansion and invasion of the State’s Forest Estate, and prevent illegal land tenancy.

- **What should farmers do to diversify if their plantation is already at full capacity and they have no extra lands allocated for plantation? Should they expand?**

No. This study strongly discourages any means of deforestation. It would be more economically beneficial for smallholders to wait until their existing palm oil trees become unproductive before replacing them with alternative livelihood plantations.

- **Berau is designated to be the center for cocoa production. How does it resonate with this study?**

After maize, cocoa is still a preferred alternative commodity in Berau (slide 36). Case 4 on this study shows that a planting ratio of palm oil: cocoa: maize = 25:25:50, can potentially yield up to 435% higher returns than monocropping. Besides maize, cocoa is also a potential alternative commodity.

- **How does an annual crop like palm oil compare with seasonal crops like maize?**

Unlike palm oil, which is a perennial crop, maize is a seasonal crop. Therefore, maize has a different productivity cycle and additional labor requirements. Therefore, the opportunity for maize farming explained with financial modelling here is contingent upon the willingness of smallholder farmers to adapt a new habit, including putting in more time and labor, following the seasonal requirements for maize.

II. QUESTIONS ON SCENARIOS

- **Scenario 1:** Smallholder A has already completely planted his four hectares of land with palm oil and the trees are still productive. Should they cut down his trees to plant alternative crops?
 - Smallholder A should not cut down the existing productive palm oil trees, as the peak productivity period generates the most revenue. As A has already filled their lands with palm oil, it is best to keep them growing until the productivity declines, i.e., replanting age. Diversification can start after productivity declines.
- **Scenario 2:** Smallholder B has four hectares of land allocated for agricultural plantation. One hectare of this is already planted with palm oil. Should Smallholder B plant alternative crops on the remaining lands?
 - As Smallholder B has three hectares allocated for planting, they should opt to plant

alternative crops to increase income. The most economical scenarios would be to plant the remaining three hectares with: (i) three hectares of maize, (ii) one hectare of palm oil + two hectares of maize, or (iii) one hectare of cocoa + two hectares of maize.

- **Scenario 3:** Smallholder C has five hectares of land. Three hectares of this is categorized as forest land. If one hectare is already planted with palm oil trees, how should Smallholder C proceed with diversification?
 - If Smallholder C wants to plant alternative crops such as maize or cocoa, they should proceed only in the non-forested lands. This means only $(5 - 3 - 1) = 1$ hectare of land can be used for alternative crop

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