



## FEASIBILITY STUDY OF A PARTNER BANK LOAN SCHEME FOR SMALLHOLDER PALM OIL REPLANTING (PSR)

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Community oil palm plantations experience a decline in productivity when the oil palms are approximately twenty years old. Therefore, the government has launched a program in the form of community-led rejuvenation to restore production and maintain the long-term sustainability of farmers' income. This study attempts to examine and analyze the costs of rejuvenating small-scale oil palm commodities, including estimating the loan repayment period, monthly installment obligations, and opportunities when production and commodity price fluctuations impact farmers' ability to make repayments. The study was conducted at the Suka Makmur Palm Oil Producers Cooperative (KPKS) in Suka Makmur Village, Sungai Lilin District, Musi Banyuasin Regency, South Sumatra Province. Respondents were 397 cooperative member households. The financial feasibility study of oil palm commodity rejuvenation investments for farmers was conducted using the Net Present Value (NPV), Internal Rate of Return (IRR), and Net Benefit-Cost Ratio (Net B/C) methods. The study results indicate that the proposed oil palm rejuvenation program implemented by KPKS Suka Makmur is financially feasible and generates positive economic returns. Farmers are projected to begin repaying the rejuvenation costs from the fifth to the 25th year. The estimated monthly installment is IDR 381,151 per hectare or approximately IDR 762,303 per plot. A sensitivity analysis indicates that financial viability is vulnerable to extreme conditions, including significant production declines, lower fresh fruit bunch prices, increased production costs, or increased loan interest rates. The study results emphasize the importance of risk management, production efficiency, and supporting policies to ensure the program's sustainability.

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## INTRODUCTION

The plantation sector plays an important role in supporting both regional and national economic development. In South Sumatra, this sector contributes significantly to economic growth and serves as a major source of foreign exchange through the export of palm oil-based products. Among various plantation commodities, oil palm has become the most dominant crop, exceeding the contribution of other commodities such as rubber and pepper. The cultivation of oil palm in South Sumatra is largely concentrated in lowland areas, where agroecological conditions are favorable for its growth and productivity (Syamsafitri et al., 2023).

The increasing interest of smallholder farmers in expanding oil palm cultivation has made South Sumatra one of the major contributors to Indonesia's palm oil production. The plantation sector is a crucial sector in the national economy. In addition to supporting income, this sector also provides opportunities for job creation. Palm oil plantations contribute raw materials to various downstream industries at the local level. The development of palm oil plantations can create value, strengthen regional competitiveness, and encourage more sustainable natural resource management (Zahoor et al., 2022).

Palm oil contributes significantly to national economic development. In recent times, oil palm cultivation has become the primary source of livelihood for many smallholder farmers across the country. This expansion of planted area is largely related to strong market demand and favorable economic prospects. This presents significant opportunities to increase farmers' incomes and overall well-being (Purnomo et al., 2020).

Palm oil stands out as a key plantation commodity due to its significant economic potential. In 2020, the province recorded an oil palm production volume of 3,826,784 tons, cultivated across 1,190,766 hectares, demonstrating a highly favorable level of productivity. This production is distributed across 17 districts and municipalities, illustrating the extensive development of oil palm cultivation throughout the region (Naylor et al., 2019; Syahza et al., 2018).

Suka Makmur Village, Sungai Lilin District, is one of the centers of oil palm plants that have high productivity in Musi Banyuasin Regency. However, oil palm productivity in Sungai Lilin District tends to decrease from year to year. This is because most oil palm plants that exceed the age of 25 years have not been rejuvenated due to farmers' financial limitations. The amount of funds needed for replanting is often an obstacle for farmers. Zhao et al, (2023) in their research stated that oil palm commodities after reaching the age of around 20 years. Palm oil will soon be replanted to maintain production.

Replanting is one of the efforts to increase the productivity of oil palm plants. In general, oil palm plants have a productive and economical age between 4-25 years. After oil palm plants exceed this age, usually the productivity of oil palm plants tends to decrease and it is necessary to rejuvenate the oil palm plant. During rejuvenation, oil palm farmers' income tends to decrease due to immature plantations. The impact of replanting will affect the livelihoods of farmers. It means farmer will not be able to

harvest oil palm land even to meet its needs, and Farmers must be smart in finding alternative jobs (Kushairi et al., 2019).

Some considerations in replanting oil palm, namely, first is the age of plants that are more than the economic age or around 25 years and above, old plants with low productivity or below 12 tons of FFB / Ha / Year so that it is less profitable for farmers. The second consideration is the difficulty of harvesting, related to the height of plants that have exceeded 12 meters so that farmers find it difficult to harvest fresh fruit bunches. The third consideration is plant density, where areas with low density are also not economical to manage so it is necessary to replant oil palm, while in general the plant density is <80 trees / Ha and there are also companies that use half the number of the initial density as a population that needs immediate replanting.

According to the informants, in order to cope with the replanting period, palm oil farmers prepare in advance by having other oil palm plantations of varying ages. This way, when one plantation is being replanted, the farmers still have a source of income from the plantations that are not undergoing replanting. Oil palm replanting is something that must be done and cannot be ignored. Rejuvenation is an effort to replace old plants with new plants and is an annual crop management practice to maximize and stabilize income. However, farmers generally do not do it in a timely manner. The delay in oil palm replanting is thought to be due to lack of funds for replanting. Various financing schemes are offered by formal financial institutions, such as banks, governments, cooperatives, palm oil companies, and microfinance institutions. Various loan schemes are offered by these banks, among others, KUR (People's Business Credit), KMK (Working Capital Credit), and KI (Investment Credit).

Oil palm smallholders frequently encounter financial constraints, particularly when evaluating the long-term economic viability of sustainable cultivation. Fundamental concerns include the profitability of oil palm production over the plantation's lifecycle, the total investment required for replanting, and the expected repayment schedule when such investments are financed through credit institutions. Equally important is understanding the extent to which smallholders can meet their debt obligations under changing economic conditions, including shifts in yields and market prices.

This study examines the financial feasibility of oil palm replanting programs supported by bank financing in Sungai Lilin District, Musi Banyuasin Regency. The analysis focuses on estimating the loan repayment period as well as the monthly installment obligations that farmers need to fulfill when participating in replanting credit schemes. In addition, the study evaluates how sensitive the project is to potential changes in production levels and palm oil prices, which may affect farmers' ability to repay loans and influence the long-term sustainability of replanting activities.

The results of this study are expected to offer useful insights for smallholder farmers and cooperatives in planning effective replanting strategies for aging or less productive oil palm plantations. The findings may also support financial institutions in assessing the feasibility and potential risks associated with replanting investments. Furthermore, the study provides relevant information for regional and national policymakers in designing appropriate financial support mechanisms to promote sustainable oil palm replanting programs in the future.

## RESEARCH METHOD

Another important consideration is how farmers are able to meet their debt obligations during economic turmoil, based on crop yields and market prices. This study was conducted to examine the effectiveness of the oil palm replanting program, which is based on loans provided by banking institutions in Sungai Lili sub-district, Musi Banyuasin Regency. The analysis was conducted by estimating the loan repayment period for farmers under the credit scheme.

Furthermore, this study aimed to evaluate the program's sensitivity to potential changes in palm oil production levels and prices, which could impact farmers' ability to repay loans and affect their long-term sustainability. The results of this study are expected to benefit smallholder farmers and large-scale cooperatives in planning effective replanting of oil palm plantations that are already in the unproductive age category. The results are also expected to support financial institutions in assessing the feasibility and potential risks associated with replanting investments in oil palm.

Furthermore, the results of this study are relevant for regional and national policymakers in developing appropriate financing strategies for introducing sustainable oil palm replanting programs. In addition, the analysis assumes relatively stable fresh fruit bunch (FFB) prices based on prevailing market conditions. These parameters provide the basis for assessing the financial feasibility and long-term sustainability of the oil palm replanting program.

The third objective to determine the sensitivity of the feasibility of oil palm replanting in the event of a decrease in production and prices will use data from KPKS Suka Makmur, about price fluctuations and production during the current year. To determine the sensitivity of the feasibility of oil palm replanting in the event of a decrease in production and prices using sensitivity analysis. Sensitivity analysis is an analysis used to calculate how sensitive oil palm is if it experiences a decline and increase in costs (Safitri et al., 2025). To calculate NPV, IRR, and Net B/C ratio, the following formula is used:

$$NPV = \sum_{t=1}^{t-n} \frac{Bt - Ct}{(1+i)^t}$$

$$IRR = i_1 \frac{NPV_1}{(NPV_1 - NPV_2)} (i_2 - i_1)$$

$$NetB/C = \sum_{t=1}^n \frac{Bt - Ct}{(1+i)^t}$$

## RESULT AND DISCUSSION

### Feasibility Analysis of Smallholder Palm Oil Plantations

The first and second objectives of this study are to assess the financial feasibility of oil palm replanting activities financed through bank credit in Sungai Lilin District, Musi Banyuasin Regency, using cost and revenue data from smallholders affiliated with KPKS Suka Makmur. The estimation of the repayment

period and the corresponding installment amounts was conducted using several investment appraisal indicators, namely Net Present Value (NPV), Internal Rate of Return (IRR), Net Benefit–Cost Ratio (Net B/C), Payback Period, Capital Recovery Factor (CRF), and the Present Worth of Annuity Factor (PWAF).

The primary data source was generated through a survey method conducted with respondents, while to support the primary data, secondary data was also used from financial records and supporting financing documents available at the Suka Makmur KPKS. The research results provide information that currently there are 397 farmer households managing oil palm plantations that have been rejuvenated with an area of approximately 794 hectares. The total investment required to implement the community oil palm commodity rejuvenation program is estimated to exceed IDR 9.9 billion for the entire plantation area. This amount is equivalent to an average investment cost of approximately IDR 12,520,455 per hectare. A more detailed description of the investment components is presented in Table 1.

Table 1. The Amount of Investment Costs Required for the Replanting of Smallholder Oil Palm Plantations

| No. | Description       | Per 794 ha (IDR) | Per ha (IDR) |
|-----|-------------------|------------------|--------------|
| 1   | Tumble Chipping   | 5,065,335.700    | 6,379.516    |
| 2   | Palm Seeds        | 3,150,000.000    | 3,967.254    |
| 3   | Plant Stake       | 135,735.252      | 170.951      |
| 4   | Planting Oil Palm | 1,090,170.492    | 1,373.011    |
| 5   | Office            | 300,000.000      | 377.834      |
| 6   | Warehouse         | 200,000.000      | 251.889      |
|     | SUM               | 9,941,241.444    | 12,520.455   |

The rejuvenation process for smallholder oil palm plantations requires significant operational costs, starting from land clearing until newly planted oil palm trees begin producing fresh fruit bunches ready for harvest, which typically takes four years. During this period, farmers often experience a decline in income due to decreased production because the oil palms have not yet reached their productive age. Kurniati, (2024) suggests a strategy for optimizing existing oil palm plantations as a primary source of income for farmers. This study attempts to maintain their livelihoods during the rejuvenation period by planting oil palms elsewhere by expanding their agricultural land, Mousavijad et al, (2022) emphasize that rejuvenation activities require careful planning and preparation to ensure efficient operation without significant disruption to farmers' economic activities.

This research also indicates that farmers often prepare for replanting by securing other agricultural land or plantations to compensate for the temporary loss of production from the replanted land. In addition, Muryunika, (2015) showed that the adoption of intercropping techniques among smallholders remains much lower than conventional methods such as felling and total clearing, largely due to the higher maintenance costs associated with mixed-age stands. Details of operational expenses and projected income over the economic life of the plantation are presented in the following table.

Table 2. Operational Costs of Smallholder Oil Palm Plantations Covering an Area of 794 Ha in Years 1 – 8 in Suka Damai Baru Village, Year 2021

| No | Description              | Year 1 (IDR)  | Year 2 (IDR)  | Year 3 (IDR)  | Years 4-8 (IDR) |
|----|--------------------------|---------------|---------------|---------------|-----------------|
| 1  | Harvesting               | -             | -             | -             | 3,603,097.500   |
| 2  | Disc Care                | 534,886.040   | 693,260.456   | 2,336,554.616 | 509,335.000     |
| 3  | Wicket Care              | 803,575.436   | 815,419.040   | 371,342.436   | 396,570.000     |
| 4  | Road Control Maintenance | -             | -             | -             | 359,175.000     |
| 5  | Road Improvement         | -             | -             | 399,732.000   | -               |
| 6  | Fertilization            | 874,814.016   | 3,698,902.992 | 1,871,078.652 | 7,650,622.500   |
| 7  | OPT Control              | 68,366.000    | 284,934.776   | 86,987.940    | 44,767.500      |
| 8  | Consolidation            | 385,187.208   | 39,593.604    | 31,714.776    | -               |
| 9  | Castration               | -             | 261,308.560   | 263,828.660   | -               |
| 10 | KUD Operations           | 105,000.000   | 105,000.000   | 120,000.000   | 182,000,000     |
|    | Total operating costs    | 2,771,828.700 | 5,898,419.428 | 5,481,239.080 | 12,745,567.500  |

Table 3. Operational Costs of Smallholder Oil Palm Plantations Covering an Area of 794 Ha in 9 – 25 in Suka Damai Baru Village, Year 2021

| No | Description              | Year 9 – 15 (IDR) | Year 16 – 20 (IDR) | Year 21 – 25 (IDR) |
|----|--------------------------|-------------------|--------------------|--------------------|
| 1  | Harvesting               | 4,731,422.647     | 4,880,966.569      | 2,219,100.000      |
| 2  | Disc Care                | 534,864.088       | 554,627.682        | 247,170.000        |
| 3  | Wicket Care              | 434,386.265       | 459,609.776        | 220,590.000        |
| 4  | Road Control Maintenance | 382,697.412       | 398,259.812        | 230,760.000        |
| 5  | Road Improvement         | -                 | -                  | -                  |
| 6  | Fertilization            | 8,977,401.868     | 7,716,115.353      | 7,747,221.471      |
| 7  | OPT Control              | 45,409.794        | 45,753.082         | 46,145.412         |
| 8  | Consolidation            | -                 | -                  | -                  |
| 9  | Castration               | -                 | -                  | -                  |
| 10 | KUD Operations           | 197,000.000       | 234,500.000        | 234,500.000        |
|    | Total operating costs    | 15,303,182.074    | 14,289,832.275     | 10,945,486.882     |

Table 4. Estimated Production, and Receipt of Oil Palm Plantations Covering an Area of 794 Ha in the 4th to 25th Year

| Year | Total Production (kg) | FFB Price (IDR/Kg) | Reception (IDR)   |
|------|-----------------------|--------------------|-------------------|
| 4    | 3,970.000             | 2,600              | 103,22.000.000    |
| 5    | 11,116.000            | 2,600              | 28,901.600.000    |
| 6    | 13,498.000            | 2,600              | 35,094.800.000    |
| 7    | 16,674.000            | 2,600              | 43,352.400.000    |
| 8    | 20,644.000            | 2,600              | 53,674.400.000    |
| 9    | 22,232.000            | 2,600              | 57,803.200.000    |
| 10   | 23,820.000            | 2,600              | 61,932.000.000    |
| 11   | 24,614.000            | 2,600              | 63,996.400.000    |
| 12   | 25,408.000            | 2,600              | 66,060.800.000    |
| 13   | 25,408.000            | 2,600              | 66,060.800.000    |
| 14   | 25,408.000            | 2,600              | 66,060.800.000    |
| 15   | 24,614.000            | 2,600              | 63,996.400.000    |
| 16   | 23,820.000            | 2,600              | 61,932.000.000    |
| 17   | 22,629.000            | 2,600              | 58,835.400.000    |
| 18   | 21,835.000            | 2,600              | 56,771.000.000    |
| 19   | 21,438.000            | 2,600              | 55,738.800.000    |
| 20   | 20,644.000            | 2,600              | 53,674.400.000    |
| 21   | 19,850.000            | 2,600              | 51,610.000.000    |
| 22   | 19,056.000            | 2,600              | 49,545.600.000    |
| 23   | 18,262.000            | 2,600              | 47,481.200.000    |
| 24   | 17,468.000            | 2,600              | 45,416.800.000    |
| 25   | 17,071.000            | 2,600              | 44,384.600.000    |
|      | 439,479.000           |                    | 1,142,645.400.000 |

Table 4 above shows the production pattern of small-scale oil palm plantations after the replanting process. Generally, oil palms begin to produce fresh fruit bunches (FFB) in the fourth year after planting, also known as "sand fruit." During this phase, productivity is relatively low, as the oil palm is still in its vegetative growth phase. Production during this period is estimated at around 417 kg per hectare per month, or around 5 tons per hectare per year. Yields increase gradually starting in the fifth year and typically peak between the twelfth and fourteenth years. During this peak period, yields can reach around 2.7 tons per hectare per month. After that, productivity begins to decline gradually as the trees age, dropping to around 1.7 tons per hectare per month in the twenty-fifth year.

Previous studies have shown that mature oil palm plantations produce an average of around 27,364 kilograms of fresh fruit bunches (FFB) per hectare per year. With an average market price of IDR 1,396 per kilogram, this production level generates an estimated annual income of around IDR 38,624,178 per hectare (Hakim, 2018). (Hakim, 2018). Ikhsan & Hajad, (2025) note that when smallholders undertake replanting, they face a temporary loss of their primary income source until the newly planted palms resume production. In Koto Besar District, Dharmasraya Regency, farmers reportedly experience a significant reduction in household income during this period, as oil palm serves as their main livelihood. Consequently, many farmers must seek alternative employment or diversify their income sources to compensate for the loss incurred during the replanting phase (Yusdar & Hamzah, 2025).

Based on data obtained during 2022 until November, the average price of oil palm Fresh Fruit Bunches (FFB) averages around IDR 2,600/kg, with the lowest price range of IDR 1,591/kg and the highest of IDR 3,390/kg. The price obtained by KPKS Suka Makmur is the best price received because of the intense and careful negotiation system carried out with FFB buyers. The estimated revenue of KPKS from FFB sales per year from all managed land covering an area of 794 ha, in detail can be seen in Table 4 above.

From the calculation results, the average gross revenue received by farmers per month per hectare in year 4 was IDR 1,083.333, increased in year 5 to IDR 3,033,333 and peaked in year 12 at IDR6,933.333 and decreased at the end of economic life of IDR 4,658.333/ha/month. At the productive stage, oil palm provides relatively stable income for smallholder farmers (Paul Jr et al., 2023). The income from oil palm cultivation can reach ten times greater compared to the yield from rice cultivation. However, on the other hand, the replanting process can impose a significant financial burden on small farmers. The cost for replanting is estimated to range from 3,200 to 3,800 per hectare (Chrisendo et al., 2022).

From the analysis of the data above, the Discount Factor = 6% obtained NPV of IDR 343,4 billion per area of 794 hectares or IDR 432,537.503 per hectare at a discount factor of 6% and with an IRR of 46%, and a Net B/C ratio of 15.45. These results show that replanting oil palm plantations is very feasible. Even when looking the implementation of the people's palm oil rejuvenation policy (PSR) still has limitations in the availability of certified seedlings, so some residents who already have land ready for rejuvenation must wait for the availability of certified seedlings to participate in this PSR program.

Table 5. Calculation of the Feasibility Analysis of Smallholder Oil Palm Replanting Business in Suka Damai Baru Village, Sungai Lilin District, Year 2021

| Yrs | Total Cost of Investment | Total Operating Costs | Total Cost     | Total Acceptance | Benefits        | Discount Factor | NPV Business PSR |
|-----|--------------------------|-----------------------|----------------|------------------|-----------------|-----------------|------------------|
| 1   | 9,941,241,444            | 2,771,828.700         | 12,713,070.144 | 0                | -12,713,070.144 | 0.943396        | -11,993,462.400  |
| 2   |                          | 5,898,419.428         | 5,898,419.428  | 0                | -5,898,419.428  | 0.889996        | -5,249,572.293   |
| 3   |                          | 5,481,239.080         | 5,481,239.080  | 0                | -5,481,239.080  | 0.839619        | -4,602,154.026   |
| 4   |                          | 12,745,567.500        | 12,745,567.500 | 10,322,000.000   | -2,423,567.500  | 0.792094        | -1,919,692.459   |
| 5   |                          | 12,745,567.500        | 12,745,567.500 | 28,901,600.000   | 16,156,032.500  | 0.747258        | 12,072,727.327   |
| 6   |                          | 12,745,567.500        | 12,745,567.500 | 35,094,800.000   | 22,349,232.500  | 0.704961        | 15,755,327.022   |
| 7   |                          | 12,745,567.500        | 12,745,567.500 | 43,352,400.000   | 30,606,832.500  | 0.665057        | 20,355,291.680   |
| 8   |                          | 12,745,567.500        | 12,745,567.500 | 53,674,400.000   | 40,928,832.500  | 0.627412        | 25,679,255.855   |
| 9   |                          | 15,303,182.074        | 15,303,182.074 | 57,803,200.000   | 42,500,017.926  | 0.591898        | 25,155,695.311   |
| 10  |                          | 15,303,182.074        | 15,303,182.074 | 61,932,000.000   | 46,628,817.926  | 0.558395        | 26,037,288.384   |
| 11  |                          | 15,303,182.074        | 15,303,182.074 | 63,996,400.000   | 48,693,217.926  | 0.526788        | 25,650,979.775   |
| 12  |                          | 15,303,182.074        | 15,303,182.074 | 66,060,800.000   | 50,757,617.926  | 0.496969        | 25,224,981.078   |
| 13  |                          | 15,303,182.074        | 15,303,182.074 | 66,060,800.000   | 50,757,617.926  | 0.468839        | 23,797,15.960    |
| 14  |                          | 15,303,182.074        | 15,303,182.074 | 66,060,800.000   | 50,757,617.926  | 0.442301        | 22,450,143.358   |
| 15  |                          | 15,303,182.074        | 15,303,182.074 | 63,996,400.000   | 48,693,217.926  | 0.417265        | 20,317,978.535   |
| 16  |                          | 14,289,832.275        | 14,289,832.275 | 61,932,000.000   | 47,642,167.725  | 0.393646        | 18,754,162.273   |
| 17  |                          | 14,289,832.275        | 14,289,832.275 | 58,835,400.000   | 44,545,567.725  | 0.371364        | 16,542,638.859   |
| 18  |                          | 14,289,832.275        | 14,289,832.275 | 56,771,000.000   | 42,481,167.725  | 0.350344        | 14,883,013.353   |
| 19  |                          | 14,289,832.275        | 14,289,832.275 | 55,738,800.000   | 41,448,967.725  | 0.330513        | 13,699,423.105   |
| 20  |                          | 14,289,832.275        | 14,289,832.275 | 53,674,400.000   | 39,384,567.725  | 0.311805        | 12,280,294.383   |
| 21  |                          | 10,945,486.882        | 10,945,486.882 | 51,610,000.000   | 40,664,513.118  | 0.294155        | 11,961,686.233   |
| 22  |                          | 10,945,486.882        | 10,945,486.882 | 49,545,600.000   | 38,600,113.118  | 0.277505        | 10,711,728.131   |
| 23  |                          | 10,945,486.882        | 10,945,486.882 | 47,481,200.000   | 36,535,713.118  | 0.261797        | 9,564,949.631    |
| 24  |                          | 10,945,486.882        | 10,945,486.882 | 45,416,800.000   | 34,471,313.118  | 0.246979        | 8,513,674.873    |
| 25  |                          | 10,945,486.882        | 10,945,486.882 | 44,384,600.000   | 33,439,113.118  | 0.232999        | 7,791,267.562    |
|     | 9,941,241,444            | 311,178,195.00        | 321,119,436.45 | 1,142,645,400.00 | 821,525,963.54  |                 | 343,434,777.50   |

Different with the research of Siahaan et al, (2020) which shows that the rejuvenation cost efficiency ratio is 82.93%, it can be concluded that the rejuvenation cost efficiency is in the less efficient category. Another study shows that the rejuvenation of oil palm plantations using the undeIDRlanting model yields an NPV of IDR 83,750,145, a Net B/C of 65.12, and an IRR of 23.15%, indicating that this rejuvenation program is financially profitable. Resurreccion & Chavez, (2019) shows that the results indicate an NPV value greater than zero (NPV>0), suggesting that rejuvenation with this total replanting model is profitable and feasible to implement.

### Analysis of Smallholder Oil Palm Replanting With Bank Loan Installments

The investment analysis indicates that the total cost required for smallholder oil palm replanting in the first year exceeds IDR 9,941,000,000 for the 794 hectares managed by KPKS Suka Makmur, equivalent to approximately IDR 12,520,455 per hectare. Findings from Meliala et al, (2025) show that the overall replanting expenditure borne by farmers can reach IDR 52,045,898 per hectare. The highest proportion of costs is concentrated in the initial planting phase (P0), accounting for 46.64 percent of total expenses, while maintenance costs during the first to third years range from 15.92 to 19.29 percent. A detailed breakdown of operational expenditures from the first through the fourth year up to the point when the newly replanted palms begin producing fruit can be found in Table 6.

From table 6, it can be seen that the amount of funds needed by KPKS Suka Makmur for the replanting of 794 hectares of smallholder oil palm is IDR 36,838,000,000 or IDR 46,395.839. The funds needed will be collaborated with financial institutions that can distribute People's Business Credit funds with an interest rate of no more than 6% per year.

Table 6. Investment and operational costs needed by farmers until the fourth year

| Years | Description        | Funds for      |              | Discount Rate | NPV for        |              |
|-------|--------------------|----------------|--------------|---------------|----------------|--------------|
|       |                    | 794 ha (IDR)   | Per Ha (IDR) |               | 794 ha (IDR)   | Per Ha (IDR) |
| 1     | Cost of Investment | 9,941,241.444  | 12,520.455   | 1,060.000     | 10,537,715.931 | 13,271.683   |
| 1     | Operational Year 1 | 2,771,828.700  | 3,490.968    | 1,060.000     | 2,938,138.422  | 3,700.426    |
| 2     | Operational Year 2 | 5,898,419.428  | 7,428.740    | 1,123.600     | 6,627,464.069  | 8,346.932    |
| 3     | Operational Year 3 | 5,481,239.080  | 6,903.324    | 1,191.016     | 6,528,243.444  | 8,221.969    |
| 4     | Operational Year 4 | 12,745,567.500 | 16,052.352   | 1,262.477     | 16,090,985.311 | 20,265.725   |
|       | Total              | 36,838,296.152 | 46,395.839   |               | 42,722,547.177 | 53,806.734   |

Farmers participating in oil palm replanting are given a grace period of 4 years and only start paying in installments in the fifth year. The amount of loan funds will be capitalized for 4 years with an interest rate of 6% per year, then after the fourth year the loan value will be IDR 42,722 billion or IDR 53,806,734 per hectare. If you look at the results of research conducted by Kurniasih et al, (2021) that the Product indicator with a percentage of achievement reached 48.97%. This means in terms of product of the implementation of the People's Palm Oil Rejuvenation program in Nibung H Angus District, Batubara Regency, North Sumatra, is said to be ineffective.

Assuming that production and prices run normally as they should, by the fifth year the farmers will have a surplus from the oil palm crops that can be used to start paying off their debts. If the installment payment period is assumed to last for the economic lifespan of the oil palm plants until the 25th year, then the installment payment period is 21 years, from the 5th year to the 25th year. Pramudya et al., (2025) research shows that the use of certified seeds increases production by 66.34%, with NPV, IRR, and ROI rising by 79.45%, 31.84%, and 55.19%, respectively. Farmers also recoup their capital faster compared to those using uncertified seeds.

The amount of installments of participating farmers per year can be calculated using the capital recovery equation  $\{i(1+i)^n\} / \{(1+i)^n - 1\}$ . From the calculation results, the number of installments paid by KPKS is IDR 3,631 billion per year or IDR 302,634,230 per month. If calculated per farmer, the amount of installment per hectare is IDR 383,151 per month. Farmers generally have 1 plot covering an area of 2 hectares, so the installments that must be paid by farmers participating in oil palm replanting at KPKS Suka Makmur are IDR 762,303 per month. The amount of revenue from oil palm farmers participating in the PSR (People's Palm Oil Rejuvenation) in detail can be seen in table 7.

From the table 7, it can be seen that enough farmers participating in the PSR are capable of repaying their oil palm replanting loans from year 5 to year 25. This can be seen from the remaining net income per month per plot after deducting installments is around IDR 2,628,972 in year 5, until the peak in years 12 - 14 of IDR 9,892,109 and decreases to year 25 of IDR 6,256,822.

The average income obtained by farming households from rubber plantations in Balian Makmur Village is IDR 6,289,398 Lg/3 Months. Looking at the article written by Pramudya et al, (2022) that the average total cost of PSR/ha is IDR. 33,490,088/ha. The cost of replanting from government assistance amounts to IDR 30,000,000/ha. If we look at the comparison of farmer household income from rubber plantations before and during the increase in income, this is influenced by the price and also the enthusiasm of farmer households to get additional income during the oil palm replanting period.

Table 7. Estimated net income of PSR participating farmers after installment obligations

| Year | Revenue    |           |            | EMI<br>kav/month | Net income<br>kav/month |
|------|------------|-----------|------------|------------------|-------------------------|
|      | ha/year    | ha/month  | kav/month  |                  |                         |
| 1    | -          | -         | -          | -                | -                       |
| 2    | -          | -         | -          | -                | -                       |
| 3    | -          | -         | -          | -                | -                       |
| 4    | -          | -         | -          | -                | -                       |
| 5    | 20,347.648 | 1,695.637 | 3,391,275  | 762.303          | 2,628,972               |
| 6    | 28,147.648 | 2,345.637 | 4,691,275  | 762.303          | 3,928,972               |
| 7    | 38,547.648 | 3,212.304 | 6,424,608  | 762.303          | 5,662,305               |
| 8    | 51,547.648 | 4,295.637 | 8,591.275  | 762.303          | 7,828.972               |
| 9    | 53,526.471 | 4,460.539 | 8,921.078  | 762.303          | 8,158.776               |
| 10   | 58,726.471 | 4,893.873 | 9,787.745  | 762.303          | 9,025.442               |
| 11   | 61,326.471 | 5,110.539 | 10,221.078 | 762.303          | 9,458.776               |
| 12   | 63,926.471 | 5,327.206 | 10,654.412 | 762.303          | 9,892.109               |
| 13   | 63,926.471 | 5,327.206 | 10,654.412 | 762.303          | 9,892.109               |
| 14   | 63,926.471 | 5,327.206 | 10,654.412 | 762.303          | 9,892.109               |
| 15   | 61,326.471 | 5,110.539 | 10,221.078 | 762.303          | 9,458.776               |
| 16   | 60,002.730 | 5,000.228 | 10,000.455 | 762.303          | 9,238.152               |
| 17   | 56,102.730 | 4,675.228 | 9,350.455  | 762.303          | 8,588.152               |
| 18   | 53,502.730 | 4,458.561 | 8,917.122  | 762.303          | 8,154.819               |
| 19   | 52,202.730 | 4,350.228 | 8,700.455  | 762.303          | 7,938.152               |
| 20   | 49,602.730 | 4,133.561 | 8,267.122  | 762.303          | 7,504.819               |
| 21   | 51,214.752 | 4,267.896 | 8,535.792  | 762.303          | 7,773.489               |
| 22   | 48,614.752 | 4,051.229 | 8,102.459  | 762.303          | 7,340.156               |
| 23   | 46,014.752 | 3,834.563 | 7,669.125  | 762.303          | 6,906.822               |
| 24   | 43,414.752 | 3,617.896 | 7,235.792  | 762.303          | 6,473.489               |
| 25   | 42,114.752 | 3,509.563 | 7,019.125  | 762.303          | 6,256.822               |

Institutionally, KPKS likes to prosper and all its members, numbering around 394 households, are very feasible for the next palm oil replanting with a pattern of financial institution loans that distribute people's business loans with a low interest rate of only 6% per year.

Sensitivity analysis of the feasibility of smallholder palm oil rejuvenation businesses is useful for seeing how viable this business is able to withstand changes in variables that can change flexibly at any time and can occur at any time. In this study, the factors considered to be most sensitive to declines in production and prices. Other factors that are also sensitive are rising costs and rising interest rates.

### The Sensitivity Analysis

What is analyzed in this study is the partial change. The sensitivity analysis calculation was conducted by performing a simulation using Excel. Due to the decrease in production, the community's palm oil replanting business will no longer be profitable if production drops by 69%. In this decline, it can be seen that the NPV is already negative and the IRR is 4.91%, which is below the OCC of 6%, and the Net B/C ratio of 0.87 is already less than 1. The analysis results by Naylor (2019) indicate that the sensitivity analysis conducted shows changes in NPV, IRR, Net B/C, and Payback Period if there are changes in variable cost increases and TBS price decreases.

Simulation results using data tables in Microsoft Excel show a price reduction of up to IDR 826. The smallholder palm oil rejuvenation business is no longer profitable where the NPV is negative, the IRR is already smaller than the OCC 6%, and the Net B/C ratio is already equal to 1. Simulation calculations show that with an increase in investment and operational costs of 315%, the people's palm oil rejuvenation business will no longer be profitable. Where the NPV is already negative, the IRR of 5.95 is already lower than the OCC and the Net B/C ratio of 0.99 is already smaller than 1.

Other simulation calculations show that an increase in interest rates of 46% makes palm oil rejuvenation efforts impossible. worth it again. The results of the sensitivity on research by Marlina (2020) analysis to a 15% increase in production factor prices while keeping the selling price of FFB constant, and a 15% decrease in the selling price of FFB while keeping production factor prices constant, both types of oil palm replanting remain feasible to implement.

From the results of this sensitivity analysis simulation calculation, it shows that smallholder oil palm plantation businesses are very strong against the changes that occur. A decline in production of up to 69% is something that has never happened in all the farming carried out by farmers. A decrease in the price of FFB to IDR 826 per kilogram is also rare, with the large role of palm oil plantations in various derivative products, which can even be converted into high quality premium fuel, the tendency for future increases in palm oil prices is very wide open. Currently the final price for FFB in November 2022 is IDR 2,450 per kilogram.

A cost increase of 315% is a very large range and is very unlikely to occur if the economy and inflation are stable. Likewise, an increase in interest rates to 46% is also something that has never happened in our economy in almost the last 3 decades. The sensitivity analysis to the increase in production factor prices is estimated from the trend of price changes in production means and the increase in the production factors used.

## CONCLUSION

This study, conducted as a case study at KPKS Suka Makmur, shows that the smallholder oil palm replanting business is highly feasible and profitable under the specific local conditions examined. Using a 6% discount rate, the program yielded a Net Present Value (NPV) of IDR 432,537,503.16 per hectare, an Internal Rate of Return (IRR) of 46%, and a Net Benefit-Cost Ratio of 15.45. These results indicate that oil palm replanting financed by bank loans is financially viable. Farmers are projected to easily repay their loans over 21 years, starting from the fifth year after replanting, with monthly installments of approximately IDR 381,151 per hectare or IDR 762,303 per plot. These installments remain affordable considering the relatively standard expected income. The program also demonstrates strong resilience to risk, remaining profitable even if production declines by 69%, prices fall to IDR 826 per kg, costs rise by 315%, or interest rates rise by up to 46%. These results demonstrate that the replanting program is financially robust across challenging scenarios. While the results of this study are based on a specific location and therefore cannot be generalized to all smallholder oil palm plantation contexts, it is hoped that this research will provide valuable insights for similar initiatives. These findings can serve as a reference for farmers, cooperatives, financial institutions, and

policymakers in planning and supporting sustainable replanting programs in comparable environments.

### **AUTHOR CONTRIBUTION STATEMENT**

[Author 1]: conceptualization, study designed, analytical framework, data analysis, and writing original draft; [Author 2]: data collection, data analysis, writing manuscript; [Author 3]: literature review, data collection, revised the manuscript.

### **DECLARATION OF COMPETING INTEREST**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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### **ETHIC STATEMENT**

Ethical review and approval were waived for this study as it involved non-invasive survey methods and posed minimal risk to participants. Nevertheless, informed consent was obtained from all respondents prior to their participation. All data were collected voluntarily, anonymized, and treated with strict confidentiality in accordance with ethical research standards.

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