Vol.23 No.2 September 2026: 188-206

SEPA
Jurnal Sosial Ekonomi Pertanian dan Agribisnis
Program Studi Agribisnis Fakultas Pertanian
Universitas Sebelas Maret Surakarta
ISSN : 1829-9946 (Cetak) ISSN : 2654-6817 (Online)
Website: https://jurnal.uns.ac.id/sepa/

FINANCIAL FEASIBILITY ANALYSIS AND PRODUCTIVITY ENHANCEMENT STRATEGIES FOR SMALLHOLDER OIL PALM PLANTATION IN MUARO JAMBI REGENCY TO SUPPORT SUSTAINABLE AGRIBUSINESS

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Abstract. This study analyzes the financial feasibility of post-replanting smallholder oil palm farming and formulates priority strategies to enhance productivity in support of sustainable agribusiness development in Muaro Jambi Regency. Primary data were collected through structured interviews with 30 smallholder farmers in Sungai Bahar District who had participated in the Oil Palm Replanting (PSR) program. Financial feasibility was evaluated using Net Present Value (NPV), Internal Rate of Return (IRR) and Payback Period (PP), while strategic priorities were determined using a SWOT–QSPM approach. The results show that post-replanting oil palm farming is financially feasible, with an NPV of IDR 28,450,000 per hectare, an IRR of 18.2%. The payback period is estimated at 4.4 years, indicating a relatively fast return on investment under existing conditions. The average farmer income reaches IDR 68,326,560 per year. However, income constraints remain significant during the immature crop phase (TBM), which limits short-term cash flow. The QSPM analysis identifies institutional strengthening, intercropping-based diversification, and optimization of PSR support as priority strategies to enhance productivity and ensure long-term sustainability. These findings provide empirical evidence that integrating financial feasibility with strategic planning is essential for improving the resilience of smallholder oil palm agribusiness.

Keywords: Financial sustainability, Smallholder palm oil, Productivity, Improvement strategies, Agribusiness sustainability

Citation: Rahmah, K., Siadari, U., Lestari, S. U., Rahayu, V. I., Arianti, D. (2026): financial feasibility analysis and productivity enhancement strategies for smallholder oil palm plantation in muaro jambi regency to support sustainable agribusiness. SEPA (Jurnal Sosial Ekonomi Pertanian dan Agribisnis), 23 (2), 188-206. https://dx.doi.org/10.20961/sepa.v23i1.111943

INTRODUCTION

Oil palm plantations play a strategic role in Indonesia's agribusiness-based economic development, contributing significantly to national foreign exchange and serving as a primary livelihood source for millions of smallholders (Eliyanti et al., 2025). In Jambi Province, particularly in Muaro Jambi Regency, smallholder oil palm farming dominates the agricultural landscape and is a critical pillar of rural household income. However, many plantations have surpassed their optimal productive age, leading to a substantial decline in yield and, consequently farmer income (Li, 2024). To address this productivity crisis, the government launched the smallholder Oil Palm Replanting

Program (PSR), designed to rejuvenate aging plantations and enhance long-term economic sustainability (Hendrawan, 2024).

Despite its potential benefits, replanting imposes significant financial challenges for smallholders. During the immature period, known as Tanaman Belum Menghasilkan (TBM), farmers experience zero revenue while continuing to bear maintenance and input costs. As a result, many are forced to seek alternative income sources, often outside agriculture, which may not provide financial stability (Lestari, 2025). This condition underlines the urgent need for a comprehensive financial feasibility assessment of smallholder oil palm farming after replanting, especially to determine whether the investment and financial commitments are viable under current socio-economic constraints.

The present study was conducted in Sungai Bahar District, one of the earliest PSR-implementing regions (2018–2019), where farmers have adopted both conventional replanting and underplanting methods. While both approaches have been proven agronomically beneficial, their economic implications have not been sufficiently evaluated, particularly in the context of independent smallholders who operate outside formal plasma schemes (Fayza et al., 2024). Understanding the post-replanting financial performance is therefore essential for guiding future investment, institutional strengthening, and sustainable agribusiness planning at the grassroots level.

To achieve these objectives, this research applies a quantitative descriptive approach combining financial feasibility indicators Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PP) with SWOT and QSPM (Quantitative Strategic Planning Matrix) analyses to formulate prioritized strategies for enhancing productivity. This integrated method not only quantifies financial returns but also aligns them with institutional and environmental factors influencing smallholder sustainability (Hoo, 2024). Therefore, a more integrated analytical approach is required to explicitly connect financial feasibility outcomes with strategic decision-making in smallholder agribusiness systems. The specific objectives of this study are (1)To analyze the financial feasibility of smallholder oil palm farming after replanting in Muaro Jambi Regency and (2)To formulate strategic priorities for improving smallholder productivity and sustainability within the local agribusiness framework.

Operationally, financial feasibility in this study refers to the ability of replanting investment to generate a positive NPV and IRR exceeding the prevailing bank interest rate, with a reasonable payback period under typical cost and revenue structures. Meanwhile, productivity enhancement strategies are defined as adaptive measures economic, institutional, and technical that smallholders can apply to improve efficiency and ensure long-term viability. This integrated analysis is expected to produce actionable insights for policymakers, development institutions, and farmer organizations to strengthen the resilience and competitiveness of Indonesia's smallholder palm oil sector.

Although numerous studies have examined the financial feasibility of oil palm replanting using standard investment indicators such as NPV, IRR, and Payback Period, most of them focus primarily on economic evaluation without integrating strategic decision-making frameworks. In addition, previous research often relies on secondary data or broader regional estimates, with limited emphasis on empirical evidence derived from independent smallholders at the farm level.

This study addresses these gaps by combining financial feasibility analysis with a SWOT–QSPM approach to generate prioritized, actionable strategies based on field-level data collected through structured interviews with independent smallholders in Muaro Jambi Regency. This integrated approach provides a more comprehensive perspective by linking investment feasibility with strategic agribusiness development. Therefore, this study contributes to agribusiness science by offering an integrated analytical framework that links financial feasibility with strategic prioritization, based on original field data from independent smallholders. Based on these gaps, this study is structured to systematically link empirical financial evidence with strategic prioritization, ensuring coherence between analytical stages.

METHOD

This methodological structure ensures that each analytical stage directly corresponds to the research objectives, thereby maintaining logical consistency between problem formulation, analysis, and expected outcomes. This research employed a descriptive–quantitative design to analyze the financial feasibility of smallholder oil palm farming after replanting and to formulate applicable productivity enhancement strategies tailored to local smallholder conditions. The study was conducted from May 2025 to November 2026, encompassing preparation, data collection, data processing, analysis, interpretation, and dissemination stages.

The research was located in Marga Mulya Village, Sungai Bahar District, Muaro Jambi Regency, Jambi Province, which was purposively selected as it represents one of the most active areas implementing the smallholder Oil Palm Replanting Program (PSR) between 2018 and 2019. The study population consisted of independent smallholder oil palm farmers who had completed replanting activities at least five years earlier. Using purposive sampling, 30 respondents were selected, ensuring representation of various land sizes and management practices.

Primary data were obtained through structured questionnaires and in-depth interviews. The questionnaires captured data on costs, yield, and income. Interviews with key informants explored institutional and technical factors affecting productivity. Secondary data were derived from the District Plantation Office, BPS, Agricultural Extension Centers, and relevant academic literature (Nurlaili & Pradana, 2024; Sari & Hidayat, 2023).

The financial analysis assumes an economic lifespan of 25 years, reflecting the typical productive cycle of oil palm plantations. A discount rate of 10% is applied based on prevailing commercial interest rates, and the analysis is conducted using constant prices without inflation adjustment. The cash flow structure includes initial investment costs during the replanting phase, annual operating costs, and revenues generated from Fresh Fruit Bunch (FFB) production during the productive phase. Investment costs consist of land preparation, seedlings, and planting, while operating costs include fertilizers, labor, and maintenance. Revenue is calculated based on annual production and prevailing prices.

Financial Feasibility Analysis

The financial feasibility of smallholder oil palm farming was assessed using three standard investment indicators: Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PP). Together, these indicators capture long-term profitability, capital efficiency, and investment recovery. NPV was used to determine whether the discounted value of net benefits exceeds total costs over the project's economic lifetime, while IRR was applied to identify the discount rate at which the project breaks even, thus capturing the rate of return relative to prevailing market interest conditions. Complementing these measures, the PP indicator illustrates the speed at which initial investment can be recovered, an aspect particularly relevant for smallholders who typically face liquidity constraints. The use of these three indicators is consistent with methodological standards in agribusiness financial analysis, as applied in recent studies on smallholder oil palm replanting and agricultural investment evaluation (Iskandar & Yusuf, 2023; Nasution et al., 2024; Widodo & Fitrani, 2025).

1. Net Present Value (NPV) measures the difference between the present value of net benefits (Bt) and costs (Ct) discounted at the interest rate (i) over a time period (t) is formulated in equation (1).

$$NPV = \sum_{t=0}^{n} \frac{B_t - C_t}{(1+i)^t} \qquad (1)$$

where: NPV = Net Present Value (Rp); Bt = Benefit or income in year *t;* Ct = Cost in year *t;* i= Discount rate (interest rate); t = Year

A project is considered financially feasible if NPV > 0, indicating that the discounted benefits exceed the total investment cost (Iskandar & Yusuf, 2023).

2. Internal Rate of Return (IRR) determines the discount rate that equates NPV to zero. The IRR formula is expressed in equation 2:

$$IRR = i_1 + \frac{NPV_1}{NPV_1 - NPV_2} x (i_1 - i_2) \qquad (2)$$

where: IRR = Internal Rate of Return; i_1 = Lower discount rate giving positive NPV; i_2 = Higher discount rate giving negative NPV; NPV_1 = Positive NPV; NPV_2 = Negative NPV

An investment is feasible if IRR > DR (Discount Rate), implying that its return surpasses the prevailing market interest rate (Nasution et al., 2024).

3. Payback Period (PP) identifies the time required to recover the total investment cost from annual net cash inflows. The formula in equation 3:

$$Payback\ Period = \frac{I}{Ab} x\ 1\ tahun \qquad (3)$$

where: PP = Payback Period (years); I = Total investment (Rp); Ab = Average annual net cash inflow

A shorter PP indicates a quicker recovery and lower financial risk, which is preferred for smallholder investments (Widodo & Fitrani, 2025).

This stage provided a quantitative evaluation of profitability, capital efficiency, and investment recovery time, forming the foundation for the sustainability assessment of replanting-based smallholder farming systems. Financial feasibility results are used to identify key constraints and opportunities, which are then translated into strategic priorities using the SWOT–QSPM framework. These financial indicators serve as the primary basis for identifying internal strengths and weaknesses, which are further examined in the subsequent strategic analysis.

Strategic Analysis (SWOT–QSPM)

Following the completion of the financial analysis, the study proceeded with a strategic assessment using the SWOT–QSPM framework to systematically identify and rank the most critical actions required to enhance productivity and strengthen agribusiness sustainability among smallholder oil palm farmers. The SWOT component served as a diagnostic tool for capturing the complex interplay between internal capabilities and external forces shaping farmer decision-making. The analysis identified key internal factors, including farmer knowledge, institutional support, access to inputs, financial capacity, and production practices, as strengths and weaknesses. At the same time, broader contextual dynamics, including price fluctuations, climate variability, policy programs, and opportunities for partnership with mills or diversification initiatives, were categorized as opportunities and threats. By integrating qualitative insights with structured assessment criteria, the SWOT analysis ensured that each factor reflected the realities faced by farmers while recognizing its influence on long-term competitiveness(Ayompe et al., 2025).

To translate these SWOT findings into strategic priorities, each factor was subsequently assigned a weight and rating to measure its relative significance and the farmers' response capacity, resulting in the development of the IFAS (Internal Factor Analysis Summary) and EFAS (External Factor Analysis Summary) matrices. This quantitative step, as emphasized by Rachmawati and Sunaryo (2023), is

essential for producing an objective representation of strategic conditions and avoiding subjective bias in decision-making (Rajakal et al., 2023). The weighted scores allowed the study to identify which internal strengths should be leveraged, which weaknesses require urgent attention, and which opportunities or threats carry the greatest strategic implications. These structured matrices then served as the foundation for the QSPM (Quantitative Strategic Planning Matrix), enabling the calculation of Total Attractiveness Scores (TAS) that ranked alternative strategic interventions based on their feasibility and expected impact. Together, the SWOT–QSPM sequence provided a rigorous, evidence-based approach for developing targeted strategies that align financial viability with agronomic, institutional, and environmental sustainability objectives (Wong Chee et al., 2024).

The rating values for IFAS and EFAS were assigned on a scale of 1 to 4, where 1 indicates a major weakness/threat and 4 indicates a major strength/opportunity. The weighted score for each factor was calculated by multiplying the assigned weight by its rating. This procedure ensures objectivity and allows replication of the analysis. QSPM) was used to prioritize alternative strategies derived from the SWOT analysis. The Attractiveness Score (AS) was assigned to each strategy based on its relative importance in addressing the identified factors, using a scale from 1 (not attractive) to 4 (highly attractive). The AS values were determined through respondent evaluation, and the Total Attractiveness Score (TAS) was calculated by multiplying the factor weight by the AS. Strategies with higher TAS values were considered more preferable. TAS for each strategy was calculated using the following formula (4):

$$TAS=\sum(ASi\times Wi) \qquad (4)$$

where: TAS= Total Attractiveness Score; AS_i = Attractiveness Score of strategy *I*; W_i = Weight of internal or external factor

The strategy with the highest TAS value was subsequently prioritized as the most feasible and impactful option for improving smallholder oil palm productivity and strengthening the broader agribusiness system(Abubakar et al., 2023). This ranking reflects not only the numerical superiority of the TAS score but also the degree to which each strategic alternative addresses the core constraints identified in the SWOT analysis. Strategies with higher TAS values indicate a stronger alignment between internal capacities such as institutional readiness, farmer skills, and resource availability and external conditions, including market opportunities, partnership prospects, and policy support. In this way, the QSPM does more than simply quantify preferences; it provides a structured justification for selecting strategies that promise the greatest contributions to economic performance, risk reduction, and long-term resilience. Such an approach is particularly important in smallholder contexts where resources are limited, and decision-making must be both targeted and efficient to ensure meaningful outcomes (Singh et al., 2016).

This quantitative decision-making framework ultimately provided an objective and transparent way to harmonize financial feasibility with broader institutional and environmental sustainability goals. By combining the methodological rigor of weighted factor analysis with strategic prioritization, the QSPM ensured that selected interventions were not only profitable but also institutionally relevant and ecologically responsible. (Handoko et al., 2024) highlight that the integration of SWOT–QSPM in agribusiness planning allows stakeholders to avoid subjective judgments and instead rely on evidence-based assessments that reflect real-world complexities. Similarly, earlier research underscores the value of QSPM in aligning economic objectives with long-term sustainability considerations, particularly in plantation-based and smallholder agricultural systems where decision-making must account for fluctuating markets, climatic uncertainties, and institutional constraints (Hoo, 2024; Rachmawati & Sunaryo, 2023). Through this integrated approach, the study provides a robust analytical foundation for

selecting strategies that enhance competitiveness while safeguarding the long-term viability of smallholder oil palm agribusiness.

After the feasibility analysis is carried out, a SWOT analysis will be prepared to identify the strengths, weaknesses, opportunities, and threats faced by farmers. The results of this SWOT are then developed using the QSPM (*Quantitative Strategic Planning Matrix*) Matrix to determine the priority strategy for increasing productivity based on the relative attractiveness score.

QSPM provides a quantitative assessment of SWOT strategies by:

1. Giving weight to SWOT factors,
2. Provide an alternative attractiveness score strategy,
3. Generate *a Total Attractiveness Score* (TAS) to choose the best strategy.

Table 1. SWOT Analysis Matrix

	Strenghts	**Weakness**
Threats	ST Harnessing the potential to confront threats	WT Minimizing Weaknesses to Deal with Threats
Opportunities	SO Harnessing the potential to seize opportunities	WO Overcoming weaknesses to seize opportunities

Source: Data Processed, 2025

The SWOT matrix presented in Table 1 provides a structured framework for analyzing how internal strengths and weaknesses interact with external opportunities and threats within smallholder oil palm farming systems. The SO quadrant illustrates how farmers can leverage institutional support, improved agronomic capacity, and access to superior planting materials to capitalize on emerging opportunities such as government PSR programs and partnership schemes with processing mills. The WO quadrant reflects strategies aimed at reducing financial limitations and low diversification so that farmers are better positioned to exploit intercropping opportunities and value-chain linkages. Meanwhile, the ST quadrant emphasizes the role of strong farmer institutions and enhanced technical knowledge in mitigating threats such as price volatility and climate risks. Conversely, the WT quadrant highlights critical structural vulnerabilities limited capital, dependence on a single commodity, and rising input prices that require targeted interventions to prevent further exposure to external shocks. Such an integrative interpretation aligns with previous findings asserting that the SWOT framework is essential for translating complex agribusiness challenges into actionable strategies (Benzaghta et al., 2021; Puyt et al., 2020; Sarsby, 2016). Building on this analytical foundation, the identified SWOT factors serve as key inputs for the QSPM analysis, enabling a quantitative prioritization of strategic alternatives as summarized in Table 2.

Table 2. Matrix QSPM

Key Factors	Rating	Alternative Strategies					
		Strategy 1		Strategy 2		Strategy 3	
		AS	TAS	AS	TAS	AS	TAS
Opportunities							
–							
-							
Threat							
-							
-							
Strength							
-							
-							
Weakness							
-							
-							
Total							

Source: Puyt, 2020

Table 2 presents the Quantitative Strategic Planning Matrix (QSPM), which systematically evaluates the relative attractiveness of each strategic alternative by assigning weights and attractiveness scores (AS) to key internal and external factors identified in the SWOT analysis. Through this matrix, opportunities, threats, strengths, and weaknesses are quantified based on their strategic importance, and each strategy is assessed using Total Attractiveness Scores (TAS) to determine its overall priority. The QSPM approach ensures that decision-making is objective and data-driven, allowing researchers and policymakers to compare strategies based on measurable criteria rather than subjective judgment (Herdiansyah & Majesty, 2024; Putra & Rizal, 2019). The final TAS values provide the basis for selecting the most feasible and impactful strategy, which is further elaborated in the subsequent section. The entire methodology ensured that the research outcomes were empirically grounded, analytically robust, and practically oriented to support sustainable agribusiness development among smallholder oil palm farmers in Jambi Province.

RESULT AND DISCUSSION

This structure ensures that the empirical findings are interpreted in direct alignment with the analytical framework established in the methodology. The analysis begins by presenting the core empirical evidence generated from field surveys and financial assessments conducted among independent smallholder oil palm farmers who participated in the replanting program. These findings establish a quantitative basis for understanding the economic viability of post-replanting farming systems and how productivity trajectories shift once farmers adopt improved planting materials and management practices. By examining the structure of production costs, the patterns of annual revenues, and the resulting net income profiles, the study demonstrates the degree to which replanting initiatives have enhanced farmers' productive capacity and financial resilience. Similar studies emphasize that rejuvenated plantations often produce higher yields and more stable income streams due to improved agronomic performance (Witjaksono, 2024), reinforcing the importance of evaluating financial indicators in a post-replanting context.

Beyond the strictly financial dimension, the results also illuminate institutional and technical factors that shape farmer behavior, decision-making, and long-term sustainability. Institutional support such as farmer groups, extension services, and partnerships with local estates—plays a crucial role in influencing farmers' access to inputs, information, and market channels, while technical aspects related

to fertilizer management, pest control, and harvesting practices determine the effectiveness of replanting interventions. Socio-economic variables, including labor availability, household income diversification, and risk perceptions, further contribute to variations in performance among smallholders. These multi-layered findings are consistent with evidence from other regions showing that institutional strength and technological adoption significantly affect smallholder productivity and competitiveness in oil palm systems (Pradipta, 2024).

To integrate these diverse dimensions into a coherent strategic interpretation, the study employs a combination of SWOT and QSPM analyses, enabling a structured linkage between observed financial outcomes and broader agribusiness considerations. This integrated method ensures that the discussion not only examines economic feasibility but also identifies structural bottlenecks and potential leverage points for policy and institutional intervention. By weighting internal and external factors, and ranking strategic alternatives based on their Total Attractiveness Score (TAS), the analysis reveals the most effective strategies for strengthening resilience and enhancing long-term sustainability among smallholder farmers. As noted by (Handoko et al., 2024; Hoo, 2024), such analytical approaches provide a robust framework for translating empirical findings into actionable strategies, particularly in plantation-based agribusiness systems where financial viability must be aligned with institutional capacity and environmental challenges.

Characteristics of Post-Replanting Smallholder Farms

Field data were collected from 30 independent smallholders who completed replanting activities between 2018 and 2019, providing a representative overview of post-replanting performance in one of the earliest PSR implementation zones in Muaro Jambi. These farmers operated under diverse household conditions, yet shared similar agronomic trajectories shaped by replanting obligations, the adoption of improved seed materials, and exposure to extension guidance. Replanting has been widely documented as a transformative phase that alters production structure, labor allocation, and cost composition for smallholder oil palm farmers, particularly during the transition from immature to productive stages (Hidayat, 2024). The data gathered in this study thus serve as a critical foundation for evaluating how these changes translate into financial outcomes and overall farm resilience.

Most respondents relied primarily on family labor for routine maintenance activities, including weed control, harvesting, and fertilizer application. This reliance on household labor is typical within independent smallholder systems in Indonesia, where family-based labor allocation helps minimize operational costs while maintaining flexibility in managing seasonal tasks. During peak activities such as pruning or heavier fertilization, farmers commonly hired additional laborers to manage workload surges. This blended labor strategy aligns with findings from similar smallholder contexts, where efficient labor use often combining family and hired labor contributes significantly to cost efficiency and sustained productivity (Hidayati, 2025; Jelsma, 2024). The prominence of family labor also reflects socio-economic characteristics of rural farming households, where labor decisions are shaped by household size, income diversification, and risk preferences.

Agronomically, most farmers had adopted certified high-yielding planting materials recommended under the PSR program, a shift that is strongly associated with higher future yields, improved tree uniformity, and reduced vulnerability to pests and diseases. The use of certified seeds has been identified as one of the strongest drivers of yield improvement in smallholder oil palm systems, especially when combined with appropriate fertilization and field management practices (Halimatussadiah, 2025; Mayarni, 2025). This widespread adoption among respondents indicates strong compliance with PSR technical standards and raises expectations for enhanced productivity during the mature phase. To provide a detailed overview of the economic implications of these management conditions, the average financial performance of smallholder oil palm farming after replanting is

presented in Table 3, summarizing key indicators such as land area, total costs, revenues, and net income.

Table 3. Average Financial Performance of Smallholder Oil Palm Farming After Replanting (n = 30)

Component	Unit	Average Value
Cultivated land size	ha	2.06
Total annual cost	IDR	24,804,416
Total annual revenue	IDR	93,130,976
Annual net income	IDR	68,326,560
Monthly net income	IDR	5,693,880

Source: Data Processed, 2025

The financial performance displayed in Table 3 provides a comprehensive snapshot of how smallholder oil palm farmers in Muaro Jambi have benefited economically following replanting activities conducted between 2018 and 2019. The average cultivated land size of 2.06 hectares indicates that farmers in the study area operate within the typical scale of independent smallholders in Indonesia, where landholdings commonly range between 2–3 hectares. This farm size is often considered optimal for balancing labor availability, family-based management capacity, and resource allocation efficiency. Several studies emphasize that smallholder units around this size tend to achieve relatively stable productivity while maintaining manageable operational costs (Febian, 2024; Firdaus, 2025). Thus, the reported land size aligns with national patterns and supports the representativeness of the sample.

The annual cost structure, averaging IDR 24.80 million per year, reflects expenditures for fertilizer, routine maintenance, pest and disease management, and periodic hired labor. Fertilizer typically represents the largest portion of smallholder expenditure, particularly during the early productive years when nutrient demand is relatively high. These costs are consistent with findings from similar post-replanting studies, which show that operational input expenses increase significantly during the transition from immature to mature phases due to intensified agronomic activities (Chen, 2024). Despite these costs, smallholders benefit from greater control over expenditures by using family labor where possible, reducing cash outflows and maintaining cost efficiency. This pattern of blended labor and input optimization is a key characteristic of financially resilient smallholder systems.

The total annual revenue of IDR 93.13 million demonstrates the revitalized earning potential of replanting efforts, driven primarily by increased Fresh Fruit Bunch (FFB) yields from certified high-yielding planting materials. Comparable research reports similar revenue gains where smallholders adopt certified seeds and improved management practices, resulting in substantial increases in FFB output per hectare (Braga, 2024; Chalil, 2025). This income performance indicates that replanting not only renews the economic potential of smallholder plantations but also enhances farm competitiveness in the long term.

The resulting annual net income of IDR 68.33 million highlights the strong profitability of post-replanting smallholder farming. This level of profitability is particularly significant when compared with pre-replanting conditions, where aging palms typically suffer from declining yields and rising maintenance costs. Research across Indonesia shows that the shift from old, unproductive palms to rejuvenated, high-yielding plantations can increase farmer income by up to 40–60% depending on management quality and local price conditions (Anas, 2025). The substantial profit margin observed in this study demonstrates that farmers in Muaro Jambi have successfully transitioned into a more productive and financially stable phase of plantation management.

Lastly, the monthly net income of IDR 5.69 million underscores the importance of oil palm farming as a primary livelihood source for rural households. This income level is notably higher than

the Jambi Provincial Minimum Wage (UMP), indicating that post-replanting oil palm farming contributes meaningfully to household welfare and economic security. Similar studies consistently report that oil palm remains one of the most profitable smallholder commodities in Indonesia when supported by adequate institutional assistance, access to certified planting materials, and adherence to good agricultural practices (Amalia, 2024). Therefore, the financial indicators summarized in Table 3 not only confirm the feasibility of replanting investments but also highlight their broader socio-economic impacts on rural livelihoods.

Financial Feasibility Analysis

Financial feasibility was evaluated using three standard investment indicators Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PP) which together provide a robust assessment of the long-term profitability and economic soundness of post-replanting smallholder oil palm farming. The analysis applied a discount rate of 10%, consistent with prevailing interest rate conditions and commonly used benchmarks in agricultural investment studies in Indonesia. NPV was used to determine whether the present value of future net benefits exceeded the initial and operational costs, providing a clear measure of whether the replanting investment generated positive economic returns over the plantation cycle. Meanwhile, IRR identified the rate at which the investment breaks even, offering insight into capital productivity and the attractiveness of replanting relative to alternative uses of capital. These methodological choices reflect best practices in agribusiness financial analysis, aligning with prior empirical assessments of smallholder plantation investments (Adisetya, 2024).

In addition to profitability indicators, Payback Period (PP) was calculated to estimate the length of time required for farmers to recover their initial replanting costs, an important metric given the liquidity constraints commonly faced by smallholders. The PP measure is particularly relevant in contexts where farmers must withstand several years of non-productive immature palm growth (TBM phase) before harvesting resumes. Studies on smallholder financial behavior emphasize that shorter payback periods enhance resilience by reducing financial vulnerability during early phases of replanting (Hendrawan, 2024). By integrating NPV, IRR, and PP into a single financial evaluation, this analysis provides a comprehensive understanding of the economic feasibility of replanting, demonstrating not only the profitability of the investment but also its practical implications for cash flow management and long-term livelihood stability. The findings show:

NPV 28,450,000, indicating that the project is financially profitable over its economic lifespan.

IRR = 18.2%, exceeding the benchmark discount rate (10%), meaning that the return on investment is favorable relative to bank interest rates.

Payback Period = 4.4 years, demonstrating rapid capital recovery.

These quantitative results provide strong empirical evidence that the proposed farming system is financially feasible and reinforce the robustness of the study beyond qualitative claims. The financial feasibility assessment shows a positive NPV, indicating that the discounted value of future net benefits exceeds the total investment cost over the economic lifespan of the project. The financial feasibility analysis shows that the oil palm replanting and intercropping system is economically viable, as reflected by the NPV of IDR 28,450,000 per hectare at a discount rate of 10%. The IRR is estimated at 18.2%, which exceeds the prevailing interest rate, indicating strong investment attractiveness. The Payback Period is approximately 4.4 years, suggesting a relatively moderate investment recovery time.

A positive NPV is a central indicator of financial viability, demonstrating that the replanting investment provides returns significantly above the minimum acceptable threshold. In smallholder plantation systems, a positive NPV is often associated with improvements in yield, reductions in maintenance inefficiencies, and the adoption of certified planting materials, all of which enhance long-term profitability (Iskandar & Yusuf, 2023; Fayza et al., 2024). The presence of a strong and positive

NPV in this study therefore confirms that replanting under the PSR scheme is a financially sound decision that generates sustained economic benefits for smallholders.

The IRR further strengthens this conclusion, with an estimated value of 18.2%, clearly surpassing the benchmark discount rate of 10% used in the analysis. An IRR that exceeds the market interest rate signifies that the investment yields a rate of return higher than what farmers could obtain through alternative financial instruments such as commercial savings or agricultural credit schemes. Empirical studies consistently show that IRR values above prevailing interest rates are strong predictors of long-term investment attractiveness in plantation agribusiness, particularly for smallholders operating under liquidity constraints (Abas, 2025). Thus, the IRR value derived in this research emphasizes that the replanting investment not only restores production potential but also delivers returns well above opportunity costs.

The PP, estimated at 4.4 years, reflects a relatively rapid recoupment of capital outlay, which is particularly significant for smallholders who often face financial pressures during the non-productive immature crop phase (TBM). The payback period is considered realistic within oil palm replanting systems, particularly when supported by intercropping, which provides additional income during the immature phase and accelerates capital recovery. Shorter payback periods reduce vulnerability to income shocks and enable farmers to stabilize household finances sooner, thereby improving resilience during the transition to mature production stages. Literature on smallholder replanting programs highlights that PP values below five years are generally considered favorable, especially when supported by high-yielding varieties and adequate agronomic management (Rachmawati & Sunaryo, 2023). The PP outcome in this study therefore signals strong capital efficiency and reduced investment risk for participating farmers.

Taken together, the positive NPV, high IRR, and short payback period collectively affirm that smallholder oil palm replanting in Muaro Jambi is financially feasible, commercially attractive, and economically competitive. The positive financial indicators indicate feasibility, while income gaps during the TBM phase justify the need for diversification strategies. These indicators not only demonstrate strong profitability but also align with broader research showing that PSR-based rejuvenation programs enhance farmer welfare, strengthen agribusiness sustainability, and contribute to regional economic development. Overall, the financial metrics provide robust evidence that the replanting intervention delivers tangible economic benefits while supporting long-term productivity and livelihood security for rural smallholder households. These findings not only confirm economic feasibility but also provide a logical foundation for identifying strategic interventions required to address remaining structural constraints.

SWOT Analysis of Smallholder Oil Palm Farming After Replanting

Building on the financial feasibility results, the analysis is extended to examine strategic conditions through a SWOT framework. A SWOT analysis was conducted to comprehensively assess the internal and external environment influencing the performance of smallholder oil palm farming after replanting, capturing a holistic understanding of the strengths, weaknesses, opportunities, and threats that shape farmers' production capacity and long-term sustainability. This analytical approach enables the identification of key internal attributes such as institutional support, adoption of certified planting materials, labor availability, and financial limitations while simultaneously examining external factors including market fluctuations, climate risks, government replanting programs, and potential partnership opportunities with processing mills. By systematically mapping these multidimensional factors, the SWOT framework provides a structured foundation for strategic decision-making and helps clarify which aspects should be strengthened, which challenges require intervention, and which opportunities offer the greatest potential leverage for improving smallholder competitiveness. The synthesized results of this assessment are presented in Table 4, offering a concise representation of the critical factors that

influence the development trajectory of smallholder oil palm farming systems in the post-replanting period.

Table 4. SWOT Analysis Matrix for Post-Replanting Smallholder Oil Palm Farming

Strengths (S)	Weaknesses (W)
S1. Strong support from local institutions (farmer groups, extension officers).	W1. Limited capital for routine maintenance and inputs.
S2. Improved agronomic knowledge after PSR training.	W2. Low diversification of income sources.
S3. Adoption of certified high-yielding planting materials.	W3. Dependence on a single commodity (oil palm).
Opportunities (O)	**Threats (T)**
O1. Continued government support through PSR programs.	T1. Volatility in FFB prices.
O2. Partnership opportunities with CPO mills.	T2. Climate-related risks affecting productivity.
O3. Potential for intercropping with corn or taro.	T3. Rising input prices and limited access to finance.

Source: Data Processed, 2025

The SWOT analysis presented in Table 4 highlights a number of internal strengths that position post-replanting smallholder oil palm farmers for improved productivity and financial performance. Strong institutional support from farmer groups and extension officers remains one of the most critical strengths, as collective action and advisory services play a central role in disseminating good agricultural practices, managing input distribution, and improving bargaining power within the value chain. Studies in various smallholder palm oil regions show that institutional support significantly enhances farmers' decision-making capacity and accelerates the adoption of modern agronomic technologies (Li, 2024). The adoption of certified high-yielding planting materials, as reflected in the PSR program, further strengthens farmers' productive potential by increasing yield uniformity and reducing susceptibility to pests and diseases. Together, these strengths contribute to a more stable and efficient post-replanting production system. These factors are not interpreted as isolated findings but as reinforcing elements of the financial performance previously identified, thereby avoiding conceptual duplication.

However, several internal weaknesses continue to constrain the long-term sustainability of smallholder farming. The most prominent issue is limited capital availability for routine maintenance, fertilizer application, and the purchase of quality inputs. Smallholders typically rely on household savings or informal credit, making it difficult to maintain optimal crop management during periods of income fluctuation. This weakness is compounded by the low diversification of income sources, which increases vulnerability to financial shocks, particularly during the immature crop phase when oil palm generates no revenue. Dependence on a single commodity also exposes farmers to price volatility, a challenge frequently reported in empirical studies on smallholder livelihoods across Indonesia (Lestari, 2025; Li, 2024). These structural limitations highlight the need for improved financial access, diversification programs, and risk management strategies tailored to smallholder realities.

Externally, a number of opportunities offer promising pathways for strengthening smallholder competitiveness and resilience. Continued government support through the PSR program particularly in the form of replanting subsidies, technical assistance, and institutional strengthening serves as a key enabler for sustained productivity improvement. Opportunities for establishing partnerships with crude palm oil (CPO) mills can further improve market access, reduce transaction costs, and provide more

stable pricing mechanisms. Previous research has shown that intercropping interventions can significantly enhance smallholder cash flow while simultaneously improving soil health and input efficiency (Hoo, 2024). These opportunities collectively represent strategic entry points for enhancing both economic and environmental sustainability.

Despite these opportunities, smallholders also face several external threats that could undermine their long-term performance. The volatility of Fresh Fruit Bunch (FFB) prices remains a persistent challenge, as global price fluctuations directly influence farm income and investment decisions. Climate-related risks, including irregular rainfall patterns and prolonged droughts, pose additional threats to productivity and crop health, particularly for smallholders with limited access to climate-resilient technologies or irrigation infrastructure. Rising input prices and restricted access to formal financing further exacerbate these challenges, increasing production costs and reducing profitability margins. Contemporary studies on Indonesian oil palm systems emphasize that without systematic interventions such as improved credit mechanisms, climate adaptation programs, and price stabilization initiatives smallholder farmers remain highly vulnerable to external shocks (Braga, 2024). Recognizing these threats is essential for designing policies and strategies that safeguard farmer livelihoods and promote agribusiness sustainability.

Overall, the SWOT analysis provides a clear and structured understanding of the internal and external dynamics shaping post-replanting smallholder oil palm farming systems in Muaro Jambi. The combination of strong institutional support, improved agronomic practices, and access to certified planting materials offers a solid foundation for enhancing productivity. However, persistent financial constraints, limited diversification, and exposure to commodity price and climate risks underscore the need for adaptive strategies that address both structural and contextual challenges. By recognizing how these strengths, weaknesses, opportunities, and threats interact within the smallholder environment, this analysis lays the groundwork for developing targeted interventions that are not only financially viable but also institutionally and environmentally sustainable. The insights gained from the SWOT assessment thus serve as a critical input for the subsequent QSPM analysis, enabling the formulation of strategic priorities that align with farmers' capacities while responding to the broader agribusiness landscape. To improve methodological transparency and ensure reproducibility, the internal and external factors identified in Table 4 were further quantified using IFAS and EFAS matrices. Each factor was assigned a weight (0.0–1.0) based on its relative importance and a rating (1–4) reflecting its condition. The resulting weighted scores provide a measurable basis for subsequent QSPM analysis in Table 5.

Table 5. Internal Factor Analysis Summary (IFAS)

Internal Factors	Weight	Rating	Weighted Score
Strengths			
S1. Strong institutional support	0.15	4	0.60
S2. Improved agronomic knowledge	0.13	3	0.39
S3. Certified high-yielding seeds	0.17	4	0.68
Weaknesses			
W1. Limited capital	0.18	2	0.36
W2. Low income diversification	0.17	2	0.34
W3. Dependence on single commodity	0.20	2	0.40
Total	1.00		2.77

Source: Data Processed, 2025

Table 6. External Factor Analysis Summary (EFAS)

External Factors	Weight	Rating	Weighted Score
Opportunities			
O1. Government PSR support	0.20	4	0.80
O2. Partnership with mills	0.17	3	0.51
O3. Intercropping potential	0.18	3	0.54
Threats			
T1. Price volatility	0.15	2	0.30
T2. Climate risk	0.15	2	0.30
T3. Rising input prices	0.15	2	0.30
Total	1.00		2.75

Source: Data Processed, 2025

Table 6 shown the IFAS score of 2.77 indicates that internal conditions are moderately strong, with strengths slightly outweighing weaknesses. Meanwhile, the EFAS score of 2.75 reflects a balanced external environment, where opportunities are present but accompanied by significant threats, justifying the need for strategic prioritization through QSPM. The weights derived from the IFAS and EFAS matrices were subsequently used in the QSPM analysis to calculate the Total Attractiveness Score (TAS) for each strategic alternative.

QSPM Analysis and Strategy Prioritization

To ensure logical continuity, the SWOT findings are quantitatively translated into strategic priorities using the QSPM approach. To quantitatively evaluate strategy options, the SWOT factors were ranked using the Quantitative Strategic Planning Matrix (QSPM). The Total Attractiveness Score (TAS) was calculated to determine the most strategic interventions.

Table 7. QSPM Matrix for Priority Strategy Formulation

Strategy Alternatives	TAS
S1–O1: Strengthening farmer economic institutions through farmer group–based cooperatives	6.42
W2–O3: Diversification through intercropping systems (corn/taro) during early crop stages	5.77
S2–O1/T1: Optimizing PSR implementation with intensive technical & financial assistance	5.21

Source: Data Processed, 2025

Note: TAS values represent weighted attractiveness scores based on internal and external factors.

Discussion of Strategy Priorities

1. Strengthening Farmer Economic Institutions (Highest TAS = 6.42)

   The strategy with the highest Total Attractiveness Score emphasizes the importance of strengthening farmer economic institutions through cooperatives or farmer-group–based organizations. Strong institutional structures play a pivotal role in enhancing collective bargaining power, reducing transaction costs, and improving farmers' access to credit, quality inputs, and stable market channels. Institutional strengthening also facilitates the dissemination of agronomic innovations and financial literacy, enabling farmers to adopt better management practices and negotiate more effectively with traders or mills. Evidence from recent studies suggests that farmer organizations significantly contribute to efficiency gains, transparency in marketing systems, and

long-term resilience in smallholder agribusiness sectors (Rachmawati & Sunaryo, 2023). Therefore, prioritizing institutional development not only supports economic empowerment but also creates an enabling environment for the sustained success of replanting initiatives.

2. Diversification Through Intercropping (TAS = 5.77)
   The second-highest strategic priority focuses on diversification through intercropping systems, particularly the integration of short-cycle crops such as corn or taro during the immature crop (TBM) stage. Intercropping provides an essential supplementary income source for farmers who typically face several years without revenue after replanting, thereby reducing financial stress and mitigating dependency on a single commodity. Beyond income generation, diversified planting systems can enhance soil fertility, improve nutrient cycling, and optimize land use efficiency. Studies have shown that well-managed intercropping systems can increase overall farm productivity while reducing risk exposure to market and climate uncertainties (Hoo, 2024). As a result, this strategy directly addresses the weaknesses identified in the SWOT analysis limited income diversification and financial vulnerability making it a practical and impactful intervention for smallholders.
3. Optimizing PSR Support Programs (TAS = 5.21)
   The final strategic priority emphasizes the need to optimize the implementation of the People's Oil Palm Replanting Program (PSR) through enhanced technical and financial assistance. Although PSR has successfully supported the transition to high-yielding planting materials, many farmers still require ongoing guidance on best agronomic practices, fertilizer management, record-keeping, and cost-efficient farm operations. Strengthening extension services, increasing the frequency of field monitoring, and expanding access to financial mentoring can significantly improve farmers' capacity to manage their plantations effectively throughout the production cycle. Previous research highlights that continuous technical assistance is essential for maintaining high productivity levels and ensuring that replanting outcomes meet expected yield trajectories (Li, 2024). By optimizing PSR support systems, this strategy helps bridge the gap between policy design and field-level implementation, ensuring that the replanting program generates sustained agronomic and financial benefits for smallholder farmers..

Synthesis and Implications

Integrating the financial and strategic analyses, this section synthesizes how empirical findings translate into practical agribusiness implications. Overall, the findings clearly demonstrate that post-replanting smallholder oil palm farming in Muaro Jambi is financially viable and capable of delivering substantial economic returns to rural households. The strong net income figures, complemented by favorable NPV, IRR, and payback period indicators, underscore the effectiveness of the replanting program in revitalizing aging plantations and restoring their productive capacity. These outcomes also affirm the broader economic significance of oil palm as a primary livelihood source, particularly when supported by certified planting materials, improved agronomic practices, and institutional guidance. The financial performance observed in this study aligns with evidence from other regions showing that replanting interventions foster higher yields, improved farm profitability, and enhanced household welfare when implemented effectively.

However, ensuring long-term sustainability requires careful attention to several persistent structural constraints that continue to shape smallholder realities. Vulnerability during the plants that have not yet produced (TBM) period remains a critical challenge, as farmers experience years without direct revenue while still incurring maintenance costs. Low diversification of household income further compounds this vulnerability, exposing farmers to financial stress when commodity markets fluctuate or when unexpected shocks occur. Dependence on a single commodity—oil palm—also limits resilience, particularly in the face of price volatility and global market uncertainty. Additionally,

exposure to climate-related risks, including unpredictable rainfall patterns and extreme weather events, threatens both productivity and farmer stability. If left unaddressed, these structural constraints can undermine the financial gains achieved through replanting (Abubakar et al., 2023).

The strategic priorities generated through the QSPM analysis provide an integrated and actionable roadmap for overcoming these challenges. Strengthening farmer institutions—such as cooperatives and farmer groups can enhance bargaining power, improve access to inputs and credit, and support collective marketing initiatives. Promoting diversification, especially through intercropping during the TBM phase, offers farmers alternative income streams and reduces reliance on oil palm as the sole economic engine. Enhancing the implementation of PSR programs through continuous technical assistance, financial mentoring, and field monitoring helps ensure that productivity gains are sustained across the plantation cycle. Together, these strategies not only bolster economic performance but also contribute to building a more resilient and competitive smallholder agribusiness ecosystem (Chalil, 2025).

In summary, the synthesis of financial, institutional, and strategic analyses highlights the need for a balanced approach that simultaneously strengthens economic viability, mitigates risks, and supports long-term sustainability. Policymakers, extension agencies, and farmer organizations can use these insights to design targeted interventions that align with smallholder realities and regional agribusiness priorities. By integrating financial feasibility with strategic development pathways, this study provides a comprehensive foundation for future planning and reinforces the importance of replanting programs as a cornerstone of sustainable smallholder palm oil development in Indonesia.

The findings of this study provide important implications for agricultural investment decision-making, particularly for smallholders considering participation in replanting programs. The positive NPV and high IRR indicate that replanting is not only economically viable but also competitive compared to alternative investment options. Meanwhile, the relatively short payback period reduces financial risk. This study is subject to several limitations, particularly related to the relatively small sample size (n = 30). A limited number of respondents may reduce the statistical representativeness and increase the risk of sampling bias, as the selected farmers may not fully capture the heterogeneity of all smallholders participating in the PSR program. In addition, the use of purposive sampling potentially introduces subjectivity in respondent selection, which may affect the generalizability of the findings. Therefore, the results of this study should be interpreted with caution, especially when extrapolating to broader populations. Future research is recommended to involve a larger and more diverse sample size, as well as probabilistic sampling techniques, to improve robustness and external validity.

CONCLUSION

The study concludes that smallholder oil palm farming after replanting in Muaro Jambi Regency is financially feasible, as reflected in the positive Net Present Value (NPV), an Internal Rate of Return (IRR) of 18.2% that surpasses the prevailing commercial interest rate of 10%, and a relatively short Payback Period of 4.4 years. These financial indicators, reinforced by the average annual net income of IDR 68,326,560 and monthly earnings of IDR 5,693,880, demonstrate that the replanting program effectively restores economic productivity and strengthens household financial security. The integration of SWOT–QSPM analysis further reveals that sustainability can be enhanced through strategic interventions, particularly the strengthening of farmer-based economic institutions, diversification efforts such as intercropping, and improved technical and financial assistance within the PSR framework. Overall, this research contributes scientifically by combining financial feasibility assessment with strategic planning tools, offering a comprehensive analytical foundation for developing more resilient, competitive, and sustainable smallholder oil palm agribusiness systems in Indonesia.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to the Research and Community Service Institute of Universitas Jambi (Lembaga Penelitian dan Pengabdian kepada Masyarakat Universitas Jambi) for providing essential support, guidance, and facilitation throughout the implementation of this research. Appreciation is also extended to the funding sponsors and all stakeholders who contributed to the successful completion of the study, including the farmers, local institutions, and extension officers in Sungai Bahar District whose cooperation and valuable insights greatly enriched the research outcomes.

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