Journal of Smart Agriculture and Environmental Technology
e-ISSN:3021-8802
Vol. 3, No. 2, August 2025
https://josaet.com | https://doi.org/10.60105/josaet.2025.3.2.72-79

Research Paper

Optimizing Replanting Strategies for Oil Palm Plasma: Financial Patterns and Farmer Concerns in South Sumatra, Indonesia

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Article History: Received: January 21, 2025, Accepted: March 7, 2025

Abstract
This study examines the financial feasibility of different replanting patterns for oil palm plasma and assesses farmers' concerns regarding replanting decisions. The research was conducted in three districts of South Sumatra (OKI, Muara Enim, and Musi Banyuasin) with plasma farmers as respondents. Three financing patterns were analyzed: self-financing through savings, insurance-based financing, and bank loans. The research used a survey method and sampling was determined with a balanced random sampling technique with 90 respondents. The research concluded that the financing pattern of oil palm replanting can be done through savings, insurance, and bank loans. The best financing pattern for replanting is conducted by using their savings because it can produce the highest net B/C value; NPV; and the shortest payback period. Sensitivity analysis showed that Fresh Fruit Bunch (FFB) price reduction is the most sensitive for the financing patterns of their savings and bank loans, however for the financing patterns of insurance, the decrease in FFB production is mentioned as the most sensitive. The government has to maintain stable FFB pricing, and it is advised that they use their funds, which are arranged by KUD, to support the oil palm replanting. Five factors -complexity, compatibility, relative profitability, trialability, and observability - will be used to gauge farmers' concerns about oil palm replanting.

Keywords
Financing patterns; oil palm replanting; plasma farmers; concern of farmers

1. INTRODUCTION

In South Sumatra, Indonesia, almost 35% of the plasma of oil palm farms is already old (more than 20 years) and has low production (Armanto, 2019a). Until the next five years at least the oil palm replanting owned by smallholders (plasma) is about 75 thousand ha at a cost of more than Rp 200 billion (Wildayana and Armanto, 2018a,b). Revitalization of the oil palm plasma aimed to produce Fresh Fruit Bunches (FFB), improve the income of rural households, and increase the CPO (Crude Palm Oil) production of South Sumatra, which is currently about 3 million tons per year and production costs are not comparable with the FFB harvest (Wildayana and Armanto, 2018d).

Due to a lack of production resources, including seeds, fertilizer, and insecticides, farmers have had difficulty raising FFB productivity (Armanto et al., 2022). Second, farmers' FFB prices are less than the going rate. Thirdly, there is no support for replanting and little expertise of oil palm replanting (Syakina et al., 2024a,b). Fourth, they lack the funds necessary for replanting. They also face difficulties in accessing financing in banks, namely complicated administrative processes, collateral matters, and a considerable distance to banks (Byg et al., 2023). They hope banks provide the following loan facilities: low-interest loans, unsecured loans, low installment loans, easy loan terms, and easy payment methods (Wildayana, 2017). The replanting process needs a considerable amount of funds, and farmers do not have adequate funds to finance the whole replanting process (Armanto et al., 2024; Kaban et al., 2024).

The oil palm replanting is different from the Nucleus Estate System (NES or PIR, Plasma), which was initiated by the government in the 1980s (Armanto et al., 2022, 2023). In the NES, the whole source of funding was entirely taken over by the central government, while the bank functions as a dealer only (Lázaro-Lobo et al., 2023; Zuhdi et al., 2019). Thus, farmers have no difficulty in obtaining loans (Guth et al., 2022). In the current condition, the government did indeed intend to develop oil palm plantations for rural households in the villages (Wildayana and Armanto, 2017, 2019).

Now, the government has no longer a strong budget to finance oil palm plantations for rural households in the form of NES (plasma). To solve this financing problem, the banks need to be positioned as a source of funding

for farmers. Meanwhile, the government's role is limited to subsidizing loan interest. The banks propose some requirements according to their regulations, thus making the proposed loan more bankable.

As of now, stakeholders have not established a clear financing pattern for oil palm plasma replanting. The biggest constraint to oil palm replanting is land issues and sources of financing. Implementation of new replanting will be effective if it is done on a land with a minimum area of around 500 ha and if it is less than this, then the cost of replanting will be too expensive. It means that too small is inefficient and ineffective for bringing heavy equipment into the fields and so on (Armanto et al., 2025b,a).

According to the governmental regulation, the minimum area, that can receive governmental assistance, is farmers with a maximum land area of 4 ha and will at least involve around 100 farmers (Petri et al., 2024). Therefore, it is not easy to design a business with hundreds of farmers at once, especially when discussing the issue of oil palm replanting (Armanto, 2019b).

Factors influencing farmers' concerns regarding replanting can be categorized into internal and external factors. Internal factors include personal characteristics such as age, land ownership, household size, and income levels. External factors, on the other hand, include government policies and market conditions (Wildayana and Armanto, 2019, 2021). Farmers still struggle to access government programs designed to facilitate financing, which further complicates their ability to replant (Siregar et al., 2024).

Given these challenges, this study aims to address the following key research questions:

1) What are the current financing patterns available for oil palm replanting, and how do they impact farmers' ability to fund the process?
2) To what extent can smallholder farmers afford replanting under existing financing patterns?
3) How sensitive is the replanting process to fluctuations in FFB prices, production levels, and input costs?

To answer these questions, this study seeks to examine the financing patterns available for smallholder oil palm replanting; analyze the accessibility of bank financing for farmers, and evaluate farmers' concerns and constraints in undertaking replanting initiatives.

The findings of this research will serve as a valuable reference for policymakers in designing financing schemes for smallholder replanting initiatives. Furthermore, the study provides insights for stakeholders aiming to enhance the welfare of oil palm farmers through improved financing mechanisms (Armanto and Wildayana, 2022a,b).

2. RESEARCH METHOD

This research was conducted in oil palm plasma plantations in three districts, namely Ogan Komering Ilir (OKI), Muara Enim, and Musi Banyuasin. This study used a survey method. This method was used to search data in the field with a large number of population categories, samples taken from one population with interview by using open questionnaires as a tool to collect data. Plasma farmers were ready to do replanting with a financing pattern based on their funds, their funds, and Idapertabun loans as well as bank loans. The population of plasma farmers was determined using a proportionate stratified random sampling technique. Around 30 samples per KUD, Village, and District were surveyed. Total number of samples was 90 samples.

In order to produce comprehensive and detailed results, the field data was first categorized according to replanting patterns. After that, it was tabulated and subjected to descriptive analysis, which entails presenting the findings in a methodical manner. Quantitative analysis was a form of methodical, planned, and structured study from the outset to the creation of the research design in population and sampling, whereas the qualitative approach to data analysis described a real situation that existed in the field.

Both qualitative and quantitative methodologies were used to analyze the primary data. The feasibility of a project was assessed using the investment criterion analysis approach, which determined which funding options were practical and which were not, as well as the farmers' capacity to supply funds for replanting. A qualitative statistical analysis was performed to examine farmers' concerns over replanting. Financial metrics (net B/C, IRR, NPV, payback period, and sensitivity analysis) were used to support the quantitative technique for feasibility analysis. It was carried out to ascertain the occurrence effects of shifting conditions, specifically declining price, declining FFB production, and raising production input. SPSS version 21 was used to process the data analyses.

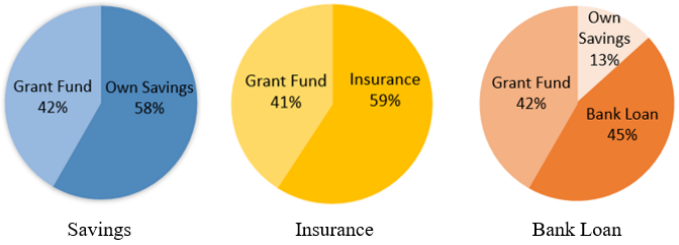
3. RESULTS AND DISCUSSION

This study analyzed financing patterns, financial feasibility, and sensitivity of oil palm replanting, along with farmers' concerns regarding to replanting.

3.1 Financing Pattern of Replanting on Oil Palm Plasma (NES)

While government assistance for farmers is just Rp 25 million per hectare from the Fund Board of Palm Oil Plantations (BPDP KS), which is collected from CPO export levies, financial support for oil palm replanting often amounts to Rp 52 million per hectare. Through the bank, financial assistance will be given. Farmers must self-fund the remaining Rp 27 million per hectare, which they may do by using bank loans or their own resources. In the event that a land certificate serves as security, the banks are willing to grant loan credit for replanting.

Until now the banks are still rigid in the process of disbursement of funds, especially for farmers. New loans will be given to farmers who have collaterals, while most lands



Source: Analyses results of primary data (2024).

Figure 1. Provision of funds for oil palm replanting per ha

owned by self-employed farmers do not have certificates of property rights that can be used as collateral. Thus, farmers want to conduct a gradual replanting pattern or under planting, but the banks in their direction tend towards total replanting. When the total replanting is conducted, then they will automatically lose income from oil palm plasma. Therefore, total replanting requirements have to be guaranteed by the government, which has to provide the income of households for five years, such as giving food crops or livestock until oil palm can be harvested. These problems and approaches were in line with other work (Petri et al., 2024) which stated that banks have difficulty in providing loans to farmers because of the dominant internal and external factors that hinder lending to farmers for replanting.

Replanting oil palm only happens once throughout the investment term, which lasts four years, and requires an investment cost of about Rp 52 million per hectare. Their money, insurance (Idapertabun), and bank loans provide the pattern for oil palm replanting. The government assists farmers by providing grant funding of Rp 25 million per hectare, and bank loan repayments would be spread out over ten years at a discount rate of 9.95%. When the reforestation project is underway, this grant will be secured. Figure 1 summarizes three types of allowing for plasma plantation replanting per hectare.

Figure 1 shows that the farmers having their savings have sufficient capital capacity to conduct replanting as much as Rp 35 million (58%) plus a grant fund of Rp 25 million or 42% (to be 100%) and they do the replanting with their capital. Farmers who do not have enough funds do the replanting with Rp 24.50 million (41%) plus a grant fund of Rp 35.50 million (59%) of the insurance, while those who do not have their savings, each farmer requires to have their savings as much as Rp 8.00 million (13%) plus the grant fund (Rp 25 million or 42%) and Rp 27 million or 45% from the Bank loan, so the total fund for replanting amounted to 100%. The composition of the provision of funds for oil palm replanting per ha was in line and comparable as also described by Ishak et al. (2020).

3.2 Financial Feasibility of Replanting on Oil Palm Plasma

Calculation of financial feasibility analysis of oil palm replanting is completely shown by parameters, namely net B/C; NPV; IRR, and payback period. The conclusion of the calculation based on three types of financing is presented in Table 1.

Table 1. Financial feasibility analysis of oil palm replanting

Financial parameters	Their Savings	Insurance Fund	Bank Loan
Net B/C	4.15	3.76	3.16
NPV (Rp Million)	113.57	105.70	72.73
IRR (%)	28.79	28.61	25.05
PP (Payback period)	6 years; 9 months	7 years; 6 months	9 years; 9 months

(Source: Analyses results of primary data (2024).

Their Savings

Financing oil palm replanting with the capital of farmers is conducted based on 100% of their savings from the sale of FFB. Income is obtained from the revenue minus the total cost. The amount of FFB production will affect the income received by farmers. Farmers' sales results for 25 years fluctuated based on the production cycle. The highest benefit was received by farmers when the 11-year-old plant is Rp 49 million per hectare and the FFB production peaks from 9-12 years. This condition shows that sales value is strongly influenced by FFB production and price. In general, revenues continue to increase as plants begin to produce up to 17-year-old plants. Furthermore, revenues continue to decline with declining FFB production until the end of the economic life of the plant (25 years).

The calculation result with their savings shows a Net B/C value of 4.15, meaning that any investment value invested by one rupiah will generate profits of Rp 4.15. The financing pattern of replanting is mentioned in very good condition because the Net B/C value indicator is greater than one. The NPV value with their capital is Rp 113.57 million with an interest rate of 9.95%. It means that future revenues if they are received now and minus investments, amount to Rp 113.57 million with an interest rate of 9.95%. The IRR value with their capital is 28.79%. It indicates that the pattern of financing with loan capital is above the interest rate of 9.95%, which means it is feasible to be executed. It will take six years and nine months to reach the repayment period or break even (return completely). This indicates that the investment in replanting oil palm will

pay for itself in 6 years and 9 months. Nearti et al. (2021) came to a nearly same conclusion, which is that the payback period will be over in 6 years and 8 months.

Insurance Fund

Financial feasibility analysis of oil palm replanting with insurance is used to determine whether it is economically feasible or not. The total cost for oil palm replanting consists of investment (Rp 38 million per hectare, 0-4 years) and operational costs. The operational costs are incurred after the plasma plantation is handed over by the nucleus company (5-25 years). Funding in this pattern using the monthly installments was the 16-year package with an overall total of Rp 28.61 million per hectare charged to farmers. The first-year installment was around Rp 360,000 per year and the longer premium payment will increase, only in the 19th year it will decrease by Rp 1.80 million per year due to the time of replanting.

The highest revenue is calculated in the 12^{th} year of Rp 52.32 million per hectare. Revenue increases and decreases with the increasing age of the plant due to lower production and lower prices will be lower, so the revenue will decrease. The profit of oil palm replanting with insurance for 25 years amounted to Rp 537,064,444 per hectare. The highest profit in the 11^{th} year is Rp 38.24 million per hectare.

Net B/C was obtained of 3.76, which means that each investment value invested by Rp 1.00, - will generate profits of Rp 3.76, - NPV calculation results in the financing pattern is Rp 105.70 million with an interest rate of 9.95%, which was categorized that it feasible to run because this project has an NPV value greater than zero or positive value of Rp 105.70 million. The IRR value amounted to 28.61% indicating that the financing pattern of replanting is much higher than the interest rate (9.95%). The payback period is 7 years and 6 months (or 90 months). The project will return the loan capital after 90 months, so it can be concluded that the project is feasible to be implemented.

Bank Loan

The highest profit was received by farmers when the 17-year-old plant amounted to Rp 34.87 million per hectare then farmers also experienced an increase in the production of FFB reached 31 tons per hectare. Revenue was obtained after the 5-year-old plant and profits increased as production in the 17^{th} year also increased. The highest revenue was received after plants were 17 years old (amounted to around Rp 45.76 million per hectare).

The replanting fund is already empty, then farmers through the KUD borrow from Bank Negara Indonesia (BNI) with the withholding of the loan taken from 30% of the gross income or salary for 10 years with a discount rate of 9.95%. This deduction is taken from 30% of FFB sales proceeds to repay the replanting credit so that the profit earned by farmers will be low. Generally, the refund of palm oil plasma credits can be repaid by the plasma farmers through the production of FFB until the palm oil plant is 14 years old or when the palm oil plant has 10 years to produce. The increase in new profits enjoyed by smallholders after their 15-year-old oil palm plantations.

Net B/C value of 3.16 meaning that each Rp 1.00, - investment will produce a profit of Rp 3.16. The replanting pattern of financing with a Bank loan is in good condition because the Net B/C value indicator is greater than one, so the project is feasible to run. The NPV value is calculated using the interest rate of 9.95% and the NPV calculation yields a value of Rp 72.73 million, which can be categorized as a financially feasible investment. The IRR value of 25.05% indicates it is higher than the bank interest rate (9.95%). This means this financing with a Bank loan is feasible to cultivate. The payback period is 9 years and 9 months (equivalent to 117 months) which means that investment will come back after the project runs for 117 months, so it can be concluded that the project is feasible to work on. In line with this research, a replanting project for oil palm was very feasible to do because, after about 115 months, the investment will return.

3.3 Sensitivity Analysis of Financing of Oil Palm Plantation Replanting

Sensitivity analysis is conducted to determine the changing dynamics of factors affecting NPV, IRR, and Net B/C to anticipate the risk of changes. Sensitivity analysis is conducted on three possible risks, namely falling FFB price, decreasing FFB product, and rising input price (Table 2).

Sensitivity Analysis for their Savings

The degree of risk changes brought on by declining FFB prices, declining FFB products, and growing input costs that are impacted by purchases of fertilizer, labors, and oil palm seedlings can be utilized to gauge the sensitivity analysis. Compared to other scenarios (decreasing FFB products and rising input prices), the declining FFB prices are more sensitive. Given an FFB price decrease of 37%, NPV of Rp 45.87 million, Net B/C of 2.32, and IRR of 19.01%, it was expected that the project would still be viable to execute. Local government regulations can limit FFB price decreases, and private enterprises use these regulations to determine FFB pricing.

Sensitivity Analysis for Insurance

Sensitivity analysis is done by lowering FFB prices, decreasing FFB, and increasing input prices that are influenced by seed purchases, labor usage, and fertilizer purchases. Replanting sensitivity analysis with an assumed FFB price reduction of 37%, FFB decline is assumed to be 25% and the input price increase is assumed 55%, it is still feasible to cultivate. The sensitivity analysis of replanting with insurance showed that the more sensitive is a 25% FFB decrease. If it is assumed that FFB decreases by 25%, it will result in a decrease with net B/C of 1.76 and IRR of 14.31%.

Table 2. Sensitivity analysis of financing pattern of oil palm replanting

Financial parameters	Falling FFB Price	Decreasing FFB Product	Rising Input Price
		Their Savings	
NPV (Rp million)	45.87	53.77	143.23
Net B/C	2.32	2.81	3.87
IRR (%)	19.01	21.85	27.56
		Insurance Fund	
NPV (Rp million)	36.45	24.85	60.46
Net B/C	2.25	1.76	2.23
IRR (%)	16.99	14.31	18.99
		Bank Loan	
NPV (Rp million)	5.98	16.85	28.10
Net B/C	1.11	1.65	1.94
IRR (%)	11.51	14.62	14.41

(Source: Analyses results of primary data (2024).

The decline of FFB is due to the plant being old, so it needs to be replanted so that production will increase.

Sensitivity Analysis for Bank Loan

Sensitivity analysis is strongly influenced by the falling FFB price assumed by 37%, declining FFB product is assumed to be 25% and the increasing input prices are assumed to be 55%, which is strongly influenced by seed purchases, labor use, and fertilizer purchases. Sensitivity analysis with Bank loan shows that the risk factors that significantly affect the financing pattern of oil palm replanting with the Bank loan are the factor of FFB price decrease causing the decrease of NPV to Rp 5.98 million, Net B/C of 1.11 and the lowest IRR (11.51%). To maintain sustainability in the financing pattern with a Bank loan, it is necessary to anticipate the decrease in FFB price. The sensitivity analysis of bank loans for oil palm replanting per ha was in line and comparable as also described by Ishak et al. (2020).

3.4 Concern of Farmers for Replanting Patterns of Oil Palm Plasma

Most farmers were already motivated to do oil palm replanting because they realized the importance of replanting in order not to lose their livelihood. This motivation is improved by existing grant funds from the government and the government has given demonstration plots (demplots) for farmers. The demplots can be directly observed in the process of replanting by farmers and they will participate in replanting, although they have done with a different technique than the government demonstrated. The concerns of farmers are how to avoid the possibility of losing their livelihoods, besides that farmers are still hoping for the government to find alternative jobs during the oil palm replanting period.

Therefore, five factors - complexity, compatibility, relative profitability, trialability, and observability - will be used to evaluate farmers' concerns over oil palm replanting.

Complexity is defined as the level of difficulty or ease of a replanting innovation to be applied by farmers. Most farmers (71.22%) have argued that conventional replanting systems was difficult to implement because they are considered inconvenient and costly, even though they recognized that the replanting system is easy to understand and apply. The government has to seek solutions to this problem more simply and followed by a simple financing system.

Compatibility is the extent to which an innovation is perceived to be compatible with farmer-adopted systems in their daily lives, including the value, experience, and needs of farmers. They tend to adopt replanting s if replanting innovations are more compatible with the values and needs of existing farmers, and they do not need to make too many changes in their lives. If compatibility is low, this means then the level of high uncertainty and the gap will arise due to the innovation becoming larger. The compatibility is positively associated with the acceptance of farmers to the replanting. More than half of the total respondents (51.92%) stated that it was not fully compatible with their lives. This means that the proposed replanting system by the Government is inadequate to the current condition of farmers. The main problem is that they do not have their savings and other livelihoods to sustain their daily life. If they consider that replanting is needed and by the conditions it faces,

it will be easier for a replanting system to be adopted by farmers.

The relative profitability is the extent to which replanting is considered better than not replanting. The relative profitability will strongly influence them in adopting the replanting system. In general, relative profitability can be measured from economic benefits, social status, comfort, and low cost. Replanting offers higher profits, which are believed to provide greater revenue and higher development. Positively relative profitability is related to acceptance, and one of the most effective factors for predicting revenue. Most farmers (71.03%) stated that relative profitability such as the superiority of replanting compared with the conventional intercropping system suggested by the government is viewed in terms of economic, social, comfort and satisfaction in both good and excellent categories. At this time farmers choose to use the intercropping system, i.e. oil palm replanting by not cutting old plants, but planting young plants in inserting to old plants, so that old plants can still be harvested. Using the intercropping system, most farmers still get income even if it does not have a good impact on the growth of oil palms newly inserted or planted.

Trialability is defined as a level where replanting can be tried on a small scale and can be tested easily. Most farmers (74.12%) argued that government-proposed replanting cannot be piloted on a small scale, although they are easy to implement. It is not effective to be developed if the area of less than 2 ha. A small percentage of farmers (3.76%) stated that replanting could be tested and the majority of farmers who have less than 2 ha will be also involved in replanting. Farmers will adopt replanting if replanting has been tried by others and succeeded because farmers are rational. Farmers will not adopt replanting if they still have to bear the risk of failure or uncertainty.

Observability is a condition that replanting can be observed (calculated) or the measure of the extent to which something can be observed (both in the form of results and processes). Less than half of farmers (43.99%) can directly see the government's recommended replanting process starting from harvesting and maintenance to the present phase of harvesting. Farmers obtain information from other farmers who implement demonstration plots in the form of fertilizer doses or various attacks of pests and diseases. The easier one observes or sees, the more success of replanting likely the person is to adopt replanting.

The adoption process of replanting has to go through the stages of awareness, interest, judgment, trial and error, and applying replanting that may not be sustainable (discontinue). This means that the adoption process requires a long phase so that the implementation of replanting is continuous. If the assessment is completed, the need for replanting transfer is easily to be conducted. Wildayana and Armanto (2018c) explained that the concerns of farmers were necessary and would determine whether the replanting of oil palm could be understood and done by farmers. Another researcher (Zhao et al., 2023) stated that based on the appearance of GIS data, it turned out that palm oil replanting was closely related to the concerns of farmers in the field.

CONCLUSIONS

Several significant inferences can be drawn from the analysis findings, including the following:

1) The financing pattern of oil palm replanting can be done through savings, insurance, and bank loans.
2) The best financing pattern for replanting is conducted by using savings because it can produce the highest net B/C value; NPV; and the shortest payback period.
3) The sensitivity analysis showed that FFB price reduction is the most sensitive for the financing patterns of their savings and bank loans; however, for the financing patterns of insurance, the decrease in FFB production is mentioned as the most sensitive.
4) It is recommended to finance the oil palm replanting with their savings coordinated by KUD and the government has to control stable FFB prices.
5) The concern of farmers on oil palm replanting was assessed from five variables, namely the level of complexity; compatibility; relative profitability, trialability, and observability.
6) The research weakness was that the collected data were taken only from three districts as the center of oil palm production, while the research discussion was regionally for the entire Province of South Sumatra. In addition, this research needed to comprehensively examine whether each farmer has a land certificate that can be used as bank collateral.

ACKNOWLEDGEMENT

The author expresses gratitude to the Sriwijaya University staff and postgraduate students who have contributed to the completion of this paper, as well as to the local field and laboratory residents who have been willing to work with the authors to complete field and laboratory work.

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