ASA: Journal ofAgribusiness and Sustainable Agriculture *Original Paper*
Vol 2 No 2, Juli 2026; Halaman 85-99

Financial and Economic Feasibility of Smallholder Oil Palm Plantations: Investment Implications in Rokan Hilir Regency

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ABSTRACT

This paper analyzes the financial and economic feasibility of a smallholder oil palm plantation producing fresh fruit bunches (FFB) in Bagan Timur Village, Bangko District, Rokan Hilir Regency. Oil palm plays a crucial role in rural income generation and regional economic development, yet feasibility assessments at the farm level are still largely limited to financial indicators, overlooking broader economic and environmental dimensions. The core problem addressed is the lack of integrated feasibility studies that incorporate both private profitability and economic externalities; the research asks whether smallholder oil palm farming remains viable once these factors are considered. The novelty of this study lies in integrating financial and economic feasibility analysis by applying shadow prices, including carbon sequestration valuation, to a smallholder FFB-based oil palm system. A case study approach was employed using primary data collected in August–September 2025 through interviews, observations, and farm records. Standard investment criteria (NPV, Net B/C, Gross B/C, IRR, and Payback Period) were applied under financial and economic frameworks. The results show that the plantation is financially and economically feasible, with positive NPVs, B/C ratios above one, IRRs exceeding discount rates, and acceptable payback periods. The findings confirm that smallholder oil palm farming remains viable even after accounting for economic and environmental costs, underscoring the importance of comprehensive feasibility analysis for sustainable investment decisions.

ARTICLE INFO

Keywords:
Carbon valuation, economic feasibility, financial feasibility, oil palm, shadow pricing

1. INTRODUCTION

Oil palm (*Elaeis guineensis*) is a strategic plantation crop that plays a pivotal role in Indonesia's plantation subsector. The development of oil palm cultivation contributes significantly to improving farmers' incomes and rural livelihoods. In addition, oil palm production serves as a primary raw material for downstream agro-processing industries, generating substantial domestic value added and contributing to export earnings and foreign exchange revenues (Fadillah *et al.,* 2022).

Riau Province is endowed with abundant natural resources that can be optimally utilized, particularly in the agricultural and plantation sectors. Among plantation commodities, oil palm is the most extensively cultivated crop by local communities. This condition positions Riau as one of Indonesia's leading provinces in terms of both plantation area and oil palm production. The dominance of oil palm cultivation reflects its comparative economic advantage and adaptability to local agroecological conditions.

Rokan Hilir Regency represents one of the regions with highly fertile soils suitable for oil palm cultivation, resulting in a large proportion of the population relying on oil palm farming as their primary livelihood (Refli, 2020). The regency encompasses approximately 193,285 hectares of oil palm plantations, with total production reaching 515,287.12 tons and an average productivity level of 2.66 percent. Rokan Hilir is recognized as a major oil palm production center in Riau Province, characterized by diverse ownership structures, including smallholder, state-owned, and private plantations. These characteristics reinforce the perception among local communities that oil palm cultivation offers favorable economic prospects, supported by relatively stable commodity prices, suitable climatic conditions, and optimal soil characteristics. Consequently, the development of oil palm farming in Rokan Hilir Regency remains crucial for enhancing production performance and improving community welfare.

Bangko District is one of the subdistricts with a considerable oil palm plantation area, covering approximately 12,526 hectares. However, its production level, amounting to 15,578.74 tons, remains lower than that of other districts, such as Kubu Babussalam, which, despite having a smaller plantation area of 8,089 hectares, achieves a significantly higher production level of 20,115.22 tons. This disparity indicates the presence of productivity gaps that warrant further economic and technical assessment.

The development of oil palm plantations contributes not only to economic growth but also to social, environmental, and legal dimensions of rural development. Oil palm cultivation exerts a substantial influence on local economic dynamics, particularly through income generation, employment creation, and regional economic expansion (Mustofa & Bakce, 2023). The success of smallholder oil palm enterprises is closely linked to farmers' socio-economic characteristics. Social factors are commonly reflected in landholding size and educational attainment. Land expansion is undertaken with dual objectives: increasing production through extensification and improving land productivity to enhance competitiveness, efficiency, and environmental sustainability. At the

national level, the oil palm industry has demonstrated a significant positive impact on Indonesia's economic and social development, positioning oil palm as the country's second most successful agricultural commodity after rice (Syafri Alfizar, 2018).

The distribution of oil palm products from production centers to final consumers involves multiple marketing institutions, each seeking to maximize profit. The magnitude of profits captured by these institutions directly influences marketing margins. Business performance, therefore, can be evaluated through cost-based indicators derived from feasibility analysis. Financial feasibility assessment examines business viability through financial performance indicators, including sources of capital, investment requirements, revenue projections, operating costs over the business lifecycle, cash flow projections, profit and loss statements, and investment appraisal criteria (Kasmir, 2003). The structure of investment financing is particularly critical, as borrowed capital entails repayment obligations and interest expenses that directly affect cash outflows. Large-scale investments with long time horizons also influence the economic lifespan of the enterprise. By estimating revenues over the projected business period, the overall feasibility of the farming operation can be systematically evaluated (Artana *et al.,* 2022).

Beyond financial considerations, feasibility analysis must also incorporate non-financial aspects, including market conditions, technical feasibility, managerial capacity, legal compliance, socio-economic impacts, and environmental sustainability. Moreover, potential future changes must be anticipated to mitigate financial risks associated with oil palm cultivation, such as fluctuations in productivity, output prices, and production costs (Demiyati & Priatna, 2013).

Building on this context, the objectives of this study are articulated as follows. First, the study aims to identify and systematically evaluate the cost and benefit components associated with the oil palm plantation project in Bagan Timur Village, Bangko District, Rokan Hilir Regency, encompassing both investment and operational dimensions over the project lifecycle. Second, the study seeks to assess the overall feasibility of the oil palm plantation project in the study area through a comprehensive financial and economic evaluation, thereby providing empirical evidence to support farm-level investment decisions and the sustainable development of smallholder oil palm farming in Rokan Hilir Regency.

1. LITERATURE REVIEW

According to Soekartawi (1995), farm management is a scientific discipline that examines how available resources can be organized and utilized effectively and efficiently in order to achieve maximum economic returns within a given time horizon. Effectiveness is attained when farmers or producers are able to allocate their resources optimally, whereas efficiency is achieved when the use of these resources generates a higher level of output relative to the inputs employed. In the Indonesian context, farm enterprises are commonly characterized by small landholdings, limited capital availability, low levels of farmer knowledge, and

weak managerial dynamism, conditions that collectively contribute to persistently low farm incomes (Soekartawi et al., 1986; Rahim & Hastuti, 2008).

The determinants of farm costs and income are inherently complex and multidimensional. Suratiyah (2009) classifies these determinants into internal factors, external factors, and managerial elements, all of which interact to shape farm performance. Internal factors include farmer age, education, knowledge, experience, skills, family labor availability, land size, and capital endowment. External factors influence farm outcomes through both input and output markets, encompassing the availability and prices of production inputs on the one hand, and market demand and output prices on the other. These interacting forces determine the cost structure and revenue-generating capacity of farm enterprises, thereby affecting overall economic viability.

Farming activities can therefore be understood as an organized production system in which farmers act as the principal decision-makers responsible for coordinating natural resources, labor, and capital within the agricultural sector. In this context, farmers function not merely as producers but as managers who oversee the allocation of inputs and outputs. Land, labor, capital, and management constitute the fundamental components of farm operations, and the farmer's managerial capacity plays a critical role in determining production efficiency and profitability. As entrepreneurial agents, farmers seek to optimize resource allocation in order to maximize production outcomes and enhance income from their farming activities (Hernanto, 1996).

Thus, the literature underscores that farm performance is shaped not only by biophysical and market conditions but also by socio-economic and managerial characteristics at the farm level. However, empirical evidence remains limited in integrating these conceptual insights into comprehensive financial and economic feasibility assessments of smallholder plantation systems, particularly in the context of oil palm farming in rural Indonesia. Accordingly, this literature review provides the theoretical foundation for identifying the research gap addressed in this study and serves as the basis for formulating the research questions and hypotheses that align with the study's objectives.

2. METHOD, DATA, AND ANALYSIS

This study adopts a case study approach focusing on a oil palm plantation project located in Bangko District, Rokan Hilir Regency, Indonesia in collaboration with the ADIDAS farmer group (*gapoktan*). The research was conducted during August–September 2025 and examines a plantation established in 2009, with production oriented toward fresh fruit bunches (FFB) supplied to local intermediaries and registered palm oil collection facilities (RAM). Primary data were obtained through field observations, structured interviews, and farm records, while secondary data were sourced from official statistics and relevant literature. Inputs were categorized into fixed and variable components to capture investment and operational costs over the project life cycle. The

analysis integrates financial feasibility assessment using standard investment appraisal indicators and economic feasibility analysis incorporating shadow pricing, particularly for carbon emissions, to internalize environmental externalities and evaluate the project's viability from both private and societal perspectives.

2.1. Net Present Value

Net Present Value (NPV) represents the difference between the total present value of benefits and the total present value of costs, or equivalently, the sum of the present values of net incremental benefits generated over the project's economic life. An investment is considered financially feasible when the total discounted benefits exceed the total discounted costs, resulting in a positive NPV (NPV > 0). Conversely, when NPV is less than zero (NPV < 0), the project is deemed financially unviable. The NPV is calculated using the following formula:

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

Descriptions:

Bt = benefits in year *t*

Ct = costs in year *t*

t = time period (years)

i = discount rate or interest rate

2.2. Gross benefit Ratio

Gross B/C *ratio* is another eligibility criterion commonly used in business analysis, both benefits and costs are gross value (*gross*). This criterion provides guidelines that the business is feasible to run if *Gross* B/C *ratio* greater than one (*Gross* B/C *ratio* > 1), while if the Gross B/C ratio is less than one (*Gross* B/C *ratio* < 1) then the effort is not worth doing. Formula of *Gross* B/C *ratio* as follows:

$$Gross\ BC = \frac{\sum_{t=0\ or\ 1}^{n} \frac{(B_t)}{(1+i)^t}}{\sum_{t=0\ or\ 1}^{n} \frac{(C_t)}{(1+i)^t}} \quad (2)$$

Description:

Bt : Benefits (*benefit*) in the year t

Ct : Cost (*cost*) in the year t

t : Year period

i : Interest rate

2.3. Net Benefit Cost

Net B/C Ratio is the ratio between positive net benefits and negative net benefits. Business activities can be said to be feasible if there is more than one Net B/C and can be said to be unfeasible if the Net B/C is smaller than one. The formula of the Net B/C ratio is as follows:

$$Net\ BC = \frac{\sum_{t=0\ or\ 1}^{n} \frac{(B_t)}{(1+i)^t} \ [B_t - C_t] > 0}{\sum_{t=0\ or\ 1}^{n} \frac{(C_t)}{(1+i)^t} \ [B_t - C_t] < 0} \quad (3)$$

Description:

Bt : Benefits (*benefit*) in the year t

Ct : Cost (*Cost*) in the year t

t : Year period

i : Interest rate

2.4 Internal Rate of Return

IRR is a *discount rate* (DR) which produces an NPV equal to zero. The amount resulting from this calculation is in percentage units (%). A farmer is

said to be viable if the IRR is greater than *opportunity cost of capital* (DR). The formula of the IRR is as follows:

$$\text{IRR} = i_1 + \left(\left(\frac{NPV_1}{NPV_1 - NPV_2} \right) \times (i_2 - i_1) \right) \quad (4)$$

Description:

i1 : Interest rates that produce positive NPV values

i2 : Interest rates that result in negative NPV values

NPV1 : NPV with positive value

NPV2 : NPV with a negative value *Payback Period* (PP)

2.5 Payback Period

Payback Period (PP) is the time when all costs are covered by unearned benefits (*break-even*). PP is known manually through *data tracing* of benefit cost analysis starting from the costs to when the benefits begin to be seen. A project is said to be feasible if all costs incurred can be returned long before the end of the project period.

3. RESULT AND DISCUSSION

3.1. Identification of the Benefits and Costs of Oil Palm Plantation Farming in East Bagan Village

3.1.1 Identification of Benefit Components

Benefits (*Benefit*) obtained from oil palm plantation farming in East Bagan Village is represented through the receipt of the sale of fresh fruit bunches (FFB). This is because the ownership of plantations is private or self-owned and managed by a combination of local farmer groups. Oil palm plantations in the area began to receive revenue in the fifth year because it takes time for oil palm seedlings to grow with an estimated four years until they are ready to bear fruit (produce FFB).

Products sold in the form of FFB are produced from the harvest period in one month twice. The FFB sold is very diverse with the lowest price at Rp800 to Rp1700 for the highest price per kilogram. In 1 *Stuttgart* The selling price of FFB can reach IDR 15,000 to IDR 32,000 per 1 FFB. Details of the value of benefits in farming can be seen in Table 1.

Table 1 Components of the benefits of oil palm plantation farming in East Bagan Village

Products	Quantity (/year)	Units	Price (Rp/unit)	Benefit (Rp/year)	Value
Fresh fruit bunches	12.211,27	kg	28.400	346.800.000	
Total Benefits				**346.800.00**	

Source : processed from primary data (2025)

Based on the results of the calculation in Table 1, the total potential benefits obtained by oil palm plantation farming businesses in East Bagan Village for one year are Rp346,800,000,- which consists of the full sale of plantation output, namely 12,211.27 kilograms of fresh fruit bunches.

3.1.2 Identification of Cost Components

Cost component (*Cost*) used in farming activities oil palm plantations in East Bagan Village are divided into three types of costs, namely investment costs, fixed costs, and variable costs. The cost component data was obtained through interviews with oil palm plantation farm owners.

A. Investment Costs

Investment costs are a cost of the same type as the whole incurred at the beginning of the project for the preparation of fixed and variable components in a project (Sari *et al.* 2018). Investment costs can be incurred during the period of the project being enforced, known as re-investment with the criterion that the cost has expired its useful life so that it must be repurchased. Generally, in the selection of investment cost components, it can be chosen with the categories of economic life and long technical life to minimize cost expenditure in the middle of the ongoing project. Details of the investment cost components can be seen in Table 2.

Table 2 Components of investment costs for oil palm plantation farming in East Bagan Village

Cost Component	Economical Lifespan (years)	Quantity (Units)	Price (Rp/unit)	Investment Cost (Rp/year)
Land	-	10 Ha	5.000.000	50.000.000
Truck	25	1	400.000.000	400.000.000
Sprayer	4	1	600.000	600.000
Palm Seeds	25	1200	15.000	18.000.000
Total investment costs				**468.000.000**

Source : processed from primary data (2025)

Based on the results of the calculation scenario in Table 2, the total investment cost incurred in the first year is IDR 468,000,000. These components consist of land, trucks, oil palm seedlings and sprayers with a technical life of 4 years so that in a period of 4 years specifically for sprayers, reinvestment will be carried out. The project period is selected through the longest life of the goods, namely the palm tree which has an economic life of 25 years.

B. Fixed Costs

Fixed costs are a component of costs that are incurred annually from the beginning of the project activities until the end of the project. In this oil palm plantation farming business in East Bagan Village, the fixed cost component includes land tax per year and warehouse rental per year to store FFB crops if the harvest exceeds the ability to transport middlemen in one day. Details of the fixed cost component can be seen in Table 3 below.

Table 3 Component of fixed costs of oil palm plantation farming business in East Bagan Village

Cost Component	Quantity (/unit)	Units	Price (Rp/unit)	Fixed Fee (Rp/year)
Land tax	10	Ha	90.000	900.000
Warehouse rental	1	Plot	5.000.000	5.000.000
Total fixed costs				5.900.000

Source : processed from primary data (2025)

Based on the results of the scenario in Table 3, it shows that the fixed cost incurred every year is IDR 5,900,000,- with details of land tax covering an area of 10 hectares and warehouse rent of 1 plot in the area.

C. Variable Costs

Variable costs are a component of costs that are influenced by the productivity of a project so that the value incurred can differ between components per time period. Details of the variable cost components can be seen in Table 4.

Table 4 Variable cost components of oil palm plantation farming in East Bagan Village

Cost Component	Quantity (/unit)	Units	Price (Rp/unit)	Variable Cost (Rp/year)
Fertilizer	30,4	kg	525.000	16.000.000
Transportation	882	liters	6.800	6.000.000
Fertilization TKLK	32,5	HOK	80.000	2.600.000
TKLK (other than fertilization)	765	HOK	80.000	61.200.000
Total variable costs				**84.500.000**

Source : processed from primary data (2025)

Based on Table 4, the variable cost consisting of NPK and dolomite fertilizers in the same package, transportation for the cost of diesel transportation from transporting FFB crops to sell to middlemen. The workforce used is male out-of-family call workers (TKLK) for two types of activities, namely fertilization of one person with a total of 32.5 working days (HOK) and 5 workers with a total of 765 HOK for activities other than fertilization such as harvesting or dodosing. The calculation of HOK wages follows the applicable standard, which is IDR 80,000 per HOK.

D. *Intangible Costs*

With the existence of oil palm plantation farming projects in East Bagan Village, it can cause natural resource and environmental problems. One of the costs *intangible* What is taken into account in this project is the declining carbon sequestration function due to oil palm land. If the actual condition of the oil palm plantation area with an area of 10 ha is a production forest, then the carbon absorption capacity is 639.14 tons/ha/year (Sultan *et al.* 2020). Furthermore, with the planting of oil palm trees, the carbon absorption capacity is only 161 tons/Ha/year (Anggraini 2021).

E. Shadow *Price*

In the oil palm plantation farming project in East Bagan Village, there are several components of the shadow price that will be taken into account, including the labor wage of 0.8 because the labor used is unskilled labor so that it can reduce the conversion rate (Lagman-Martin 2004). Furthermore, the shadow price of NPK fertilizer which is an imported commodity uses the CIF shadow price of US$ 0.605 per kg with the applicable dollar value against the rupiah being Rp16,255.10 (Maharani 2014). The existence of

tools (trucks and sprayers) has a float price calculated from the depreciation value with the formula of the actual price of foreign components/(1 + import duty) then divided by the economic life, the import duty for imports is 10 percent (Squire and Van der Talk 1975). Furthermore, the calculation of the shadow price analysis on *cashflow* economics will be explained in the next sub-chapter.

3.2. Feasibility Analysis of Oil Palm Plantation Project in East Bagan Village, Bnagko District, Rokan Hilir Regency

3.1.1 Investment Eligibility Criteria

Table 5 Value of Investment Criteria for Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency

No	Investment Criteria	Value
1	*Net Present Value* (NPV)	812.985.486,67
2	*Net Benefit Cost Ratio* (Net B/C)	2,17
3	*Gross Benefit Cost Ratio* (Gross B/C)	1,66
4	*Internal Rate of Return* (IRR)	19,745%
5	*Payback Period* (PP)	9 Years 4 Months 19 Days

Source : processed from primary data (2025)

Based on the results of the business analysis, the bank's interest rate is 10% for 25 years, obtaining an NPV value of IDR 812,985,486.67. Based on the feasibility of the NPV, it is known that the NPV > 0 is declared feasible. So, the Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency is worth pursuing.

At the level of Net B/C feasibility, it can be seen the ability to generate profit per unit of investment value. Based on the investment criteria at the Net B/C level, it shows that Net B/C > 1, then a business is feasible to run. The prevailing interest rate is 10%. The calculation result at the 10% interest rate is 2.17 which shows that every additional cost of Rp1, will get a profit of Rp2.17. So it can be seen that at the level of the Net B/C investment criteria of the Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency is feasible to be run.

The value *of the Gross Benefit-Cost Ratio* (Gross B/C) is obtained from the comparison between the amount of present *value benefit* and the amount of present *value cost*. The results of the analysis of the gross B/C investment criteria are 1.66, which means that a cost expenditure of Rp1 will generate a revenue of Rp1.66 so that there is still a profit of Rp0.66. This value shows that the Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency is feasible to run because the gross value of B/C of 1.66 is greater than 1.

Based on the results of the analysis carried out, the 25-year Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency obtained an IRR of 19.745%. Based on the eligibility criteria at the IRR level, namely if the IRR value > *discount rate*, then 19.745% > 10%. So, it can be said that the Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency is feasible to run.

Payback Period (PP) is a period of time in return on investment. Based on the results of the analysis that has been carried out on the Oil Palm Plantation Project, the results of the PP are obtained, namely 9 Years 4 Months 19 Days which means that the

investment capital will return in 9 Years 4 Months 19 Days. According to Umar (2009), if *the Payback Period* has a period of less than the *maximum payback* or the specified period of return on investment capital, then the investment is accepted. The *maximum payback* on the Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency is 25 years, so it can be said that the Oil Palm Plantation Project from the *Payback Period* investment criteria is worth pursuing.

Table 6 Total Cost Sensitivity Analysis (Operating Costs and Investment Costs) Up 10%, fixed inflow

No	Investment Criteria	Value
1	*Net Present Value* (NPV)	688.961.741,19
2	*Net Benefit Cost Ratio* (Net B/C)	1,90
3	*Gross Benefit Cost Ratio* (Gross B/C)	1,51
4	*Internal Rate of Return* (IRR)	17,853%
5	*Payback Period* (PP)	10 Years 5 Months

Source : processed from primary data (2025)

Based on the results of the sensitivity analysis on the state of Total Costs (Operational Costs and Investment Costs) Increased by 10%, *fixed inflows*, were obtained from the calculation of the five investment feasibility criteria. The results of the calculation of the five investment feasibility criteria obtained an NPV value of IDR 688,961,741.19. Based on the feasibility of the NPV, it is known that the NPV > 0 is declared feasible. Net B/C value of 1.90 which indicates that every additional cost of IDR 1, will get a profit of IDR 1.90. The result of the analysis of the gross B/C investment criteria is 1.51, which means that a cost expenditure of Rp1 will generate revenue of Rp1.51, so there is still a profit of Rp0.51. The IRR is 17.853%, then the IRR value > *discount rate* of 10%. The PP yield is 10 years and 5 months which means that the investment capital will return in 10 years and 5 months. So that it can be stated that the Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency is feasible to be pursued, even though the Total Cost (Operational Cost and Investment Cost) has increased by 10%, because it still meets the five eligibility criteria.

Table 7 Total Cost Sensitivity Analysis (Operating Costs and Investment Costs) remains the same, FFB prices decreased by 10%

No	Investment Criteria	Value
1	*Net Present Value* (NPV)	608.124.672,52
2	*Net Benefit Cost Ratio* (Net B/C)	1,87
3	*Gross Benefit Cost Ratio* (Gross B/C)	1,49
4	*Internal Rate of Return* (IRR)	17,658%
5	*Payback Period* (PP)	10 Years 6 Months

Source : processed from primary data (2025)

Based on the results of the sensitivity analysis on the state of the Total Cost (Operational Cost and Investment Cost), the price of FFB decreased by 10%, as obtained from the calculation of the five investment feasibility criteria. The results of the calculation of the five investment feasibility criteria obtained an NPV value of IDR 608,124,672.52. Based on the feasibility of the NPV, it is known that

the NPV > 0 is declared feasible. Net B/C value of 1.87 which shows that every additional cost of Rp1, will get a profit of Rp1.87. The result of the analysis of the gross B/C investment criteria is 1.49, which means that a cost expenditure of Rp1 will result in a revenue of Rp1.49, so there is still a profit of Rp0.49. The IRR is 17.658%, then the IRR value > *discount rate* of 10%. The PP yield is 10 years and 6 months which means that the investment capital will return in 10 years and 6 months. So that it can be declared that the Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency is worth pursuing, even though the price of FFB has decreased by 10% because it still meets the five eligibility criteria.

3.2.1 Economic Eligibility Criteria

Investment criteria analysis is an analysis of the feasibility of a project that is projected based on income and financial costs calculated in the form of projected *inflows* and *outflows* based on the selected technical options. Economic feasibility analysis is different from financial feasibility analysis, economic feasibility analysis takes into account the feasibility of a project based on costs and economic benefits coupled with matters related to environmental and social issues that are in line with the principles stated in the legislation (Ministry of Finance 2024). The difference in the analysis of financial and economic feasibility in the research of the Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency lies in labor wages, NPK fertilizers, depreciation of tools, taxes, interest rates, and additional *intangible* costs in the form of reduced carbon sequestration. Therefore, adjustments are needed in the calculation of business feasibility criteria through the use of *shadow prices* and social interest rates.

a) Labor Wages

The workforce employed in the Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency is assumed to be unskilled labor due to the skill factor possessed by the workforce, so this study uses the *shadow wage rate factor* (SWRF) in the agricultural sector based on a report published by the Asian Development Bank (ADB) which is 0.8 (Lagman-Martin 2004). The comparison of labor costs can be seen in the table below with a conversion of 0.8 in the shadow price of labor.

Table 8 Differences in labor costs in financial feasibility and economic feasibility analysis

Workforce	Fees on financial feasibility / year	costs on economic viability/year
Fertilization TKLK	2.600.000	2.080.000
TKLK (other than fertilization)	61.200.000	48.960.000

Source : processed from primary data (2025)

b) NPK Fertilizer Cost

The shadow price of NPK fertilizer which is an imported commodity uses the CIF shadow price of US$ 0.605 per kg with the prevailing dollar value against the rupiah being Rp16,255.10 (Maharani 2014). So that the *result of the shadow price* of NPK fertilizer was Rp9,834.3355 per kg. The annual NPK fertilizer input in the Oil Palm Plantation Project is 727.27 kg, so that the variable cost of

NPK fertilizer per year in the Oil Palm Plantation Project is Rp7,151,973.18 for 25 years.

c) Tool Depreciation Cost

The plantation equipment used in the Oil Palm Plantation Project includes trucks and sprayers. The equipment is obtained mostly through imports from other countries. Thus, the shadow price is obtained from the depreciation value of the equipment. The depreciation value is obtained from the actual price of foreign components/(1 + import duty) and then divided by the economic life. Import duty for imported goods is 10 percent. (Squire and Van der Tak, 1975).

d) Taxes

There is a tax component that must be paid by the Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency every year, namely land and building tax (PBB) of Rp900,000 which begins to be paid in the first year. In financial analysis, the tax component is included in the fixed cost component that must be incurred. However, in economic analysis, the tax component is ignored so that it is not included in the calculation of the cost component that must be incurred because the tax is a transfer.

e) Interest Rate

The interest rate used as a discount rate in the calculation of *present value* in this study uses the social *discount rate* based on a report published by the Asian Development Bank (ADB) which is 12% (Zhuang *et al*. 2007)

f) Decreased Carbon Absorption Function

The ability of forests with timber plants to absorb carbon is much higher than the ability of oil palm plants. The conversion of pine forests to oil palm plantations has led to a decrease in the amount of carbon that can be absorbed. Pine forests have an average carbon absorption capacity of 32.81 tons/Ha/year (Sultan *et all*. 2020) while oil palm plantations averaged 18.01174 tons/Ha/year (Anggraini and Arifin 2021). Based on the Indonesia *Carbon Exchange* (2023) report, the trading price of carbon units in the regular market is IDR 69,900.

Table 9 Cost of reducing carbon sequestration of the Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency

Reduced Value of Carbon Absorption	
Volume of carbon sequestration reduction (tons/ha/year)	14,80
Carbon Price (Rp/ton)	69.900
Total cost of reduced carbon sequestration function (Rp/year)	**10.343.984**

Source : processed from primary data (2025)

Table 9 shows the results of calculations related to the cost of reducing carbon sequestration of the Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency. The total cost of reducing carbon sequestration (Rp/year) was obtained at Rp10,343,984.

Table 10 Value of Economic Feasibility Criteria for Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency

Yes	Economic Eligibility Criteria	Value
1	*Net Present Value* (NPV)	677.451.543,37
2	*Net Benefit Cost Ratio* (Net B/C)	2,11
3	*Gross Benefit Cost Ratio* (Gross B/C)	1,68
4	*Internal Rate of Return* (IRR)	22,07%
5	*Payback Period* (PP)	8 Years 11 Months 21 Days

Source : processed from primary data (2024)

Based on the results of the business analysis, the bank's interest rate is 12% for 25 years, an NPV value of IDR 677,451,543.37 was obtained. Based on the feasibility of the NPV, it is known that the NPV > 0 is declared feasible. So, Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency worth working on.

At the level of Net B/C feasibility, it can be seen the ability to generate profit per unit of investment value. Based on the investment criteria at the Net B/C level, it shows that Net B/C > 1, then a business is feasible to run. The prevailing interest rate is 12%. The calculation result at the 12% interest rate is 2.11 which shows that every additional cost of Rp1, will get a profit of Rp2.11. So it can be seen that at the level of the Net B/C economic feasibility criteria of the Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency is feasible to run.

The value *of the Gross Benefit-Cost Ratio* (Gross B/C) is obtained from the comparison between the amount of present *value benefit* and the amount of present *value cost*. The result of the analysis of gross B/C investment criteria is 1.68 , which means that a cost expenditure of Rp1 will result in revenue of Rp1.68 so that there is still a profit of Rp0.68. This value shows that the Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency is economically feasible because the gross value of B/C of 1.68 is greater than 1.

Based on the results of the analysis carried out, the 25-year Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency obtained an IRR of 22.07%. Based on the eligibility criteria at the IRR level, namely if the IRR value > *discount rate*, then 22.07% > 12%. So, it can be said that the Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency is economically feasible to run. *Payback Period* (PP) is a period of time in return on investment. Based on the results of the analysis that has been carried out on the Oil Palm Plantation Project, the PP results are obtained, namely 8 Years 11 Months 21 Days which means that the investment capital will return 8 Years 11 Months 21 Days. *The maximum payback* for the Oil Palm Plantation Project in East Bagan Village, Bangko District, Rokan Hilir Regency is 25 years, so it can be said that the Oil Palm Plantation Project from the economic feasibility criteria *of the Payback Period* is worth pursuing.

4. CONCLUSION AND SUGGESTION

The private oil palm plantation business can generate a *benefit* value of IDR 346,800,000 per year. There are three components of costs incurred in

this private oil palm plantation business, namely the initial investment cost of IDR 468,600,000, labor costs of IDR 63,800,000 per year, and operational costs of IDR 85,400,000 per year. Based on the results of the investment feasibility criteria, this private oil palm plantation business is financially and economically feasible as shown by the NPV value of > 0, Gross BC > 1, Net BC > 1, IRR > interest rate, and PP < 9 years of business life.

For business managers, it is recommended to start planning the sale of products in the form of *Crude Palm Oil* (CPO) so that it can provide higher added value compared to just selling Fresh Fruit Bunches (FFB). By processing FFB into CPO, businesses can take advantage of greater increase in product value, attract higher selling prices in the market, and reach a wider market segment. In addition, this step will strengthen the company's position in the palm oil industry's supply chain and open up opportunities for product diversification, which can ultimately improve profitability and long-term business sustainability. The government is advised to provide more support to oil palm plantation businesses that have demonstrated feasibility and benefits by providing administrative incentives, technical training, technology access, low-interest financing schemes, and conducive regulatory policies to accelerate business legalization and increase product added value, so that these businesses can operate sustainably and contribute more to the national economy.

Declaration of AI and AI-assisted technologies in the writing process

During the preparation of this work, the author(s) used **Chat GPT** in order to recheck the sentences based on a suitable grammar. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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