



Research Paper

Analysis of the Prospects of Oil Palm Development in Alue Bilie Village, Darul Makmur District, Nagan Raya Regency

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Abstract

This study analyzes the prospects for oil palm development in Alue Bilie Village, Darul Makmur District, Nagan Raya Regency, Aceh, from technical and financial perspectives. The study used a survey method with a sample of 27 oil palm farmers. Primary data were collected through questionnaires and field observations, while secondary data were obtained from various sources. The financial analysis used Net Present Value (NPV), Net Benefit-Cost Ratio (Net B/C), Internal Rate of Return (IRR), and Break-Even Point (BEP) at a discount rate of 12% over a 25-year economic life. The results indicate that oil palm development in the study area is financially feasible, with an NPV of IDR 307,653,762, a Net B/C of 3.8, an IRR of 21.1%, which is higher than the discount rate, and a BEP reached after 7 years and 4 months, well before the end of the plant's economic life. Sensitivity analysis shows that the business remains feasible when operating costs increase by 10%, the price of fresh fruit bunches decreases by 20%, or benefits decrease by 10%. Technically, land and climatic conditions in the study area are suitable for oil palm cultivation. The study recommends intensifying plantation maintenance and making use of agricultural extension services to increase productivity and farmer welfare. Further research is recommended to extend the analysis to social and environmental aspects.

Keywords: Prospects, Development, Oil Palm, Technical Aspects, Financial Aspects

1. Introduction

Indonesia continues to pursue development in all sectors, and agriculture is one of the key sectors in the country's economic development, contributing significantly to both economic and social life. The performance of Indonesia's agricultural sector is particularly strong in the plantation sub-sector. Oil palm (*Elaeis guineensis* Jacq.) is one of Indonesia's leading commodities in international trade and is among the country's main export commodities because of its competitive



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advantage in the global market [1], [2]. Oil palm also plays a crucial role in providing employment, promoting regional development, and improving the welfare of communities in plantation areas [1], [3]. Among smallholders in Indonesia, the adoption of oil palm has been shown to increase household income and living standards [4], [5].

In Aceh, smallholder oil palm plantations have become an important sector in the regional economy [6] and contribute to the welfare of farm households [7]. Several sub-districts in Nagan Raya Regency continue to expand agricultural land, particularly plantations. Darul Makmur District has the largest area of oil palm plantations among the districts of Nagan Raya Regency, and oil palm farming is an important source of household income for farmers in the district [8]. Oil palm plantations in Darul Makmur were initially developed by private companies, which opened plantations and created jobs in the area. From 2014 to 2024, farmers in the district, especially in Alue Bilie Village, showed growing interest in cultivating oil palm and were even willing to convert land previously planted with other commodities, such as rubber, cocoa, patchouli, and rice, to oil palm plantations. Similar conversions from other crops to oil palm have been widely observed among smallholders in Sumatra [9], [10].

This trend raises the question of whether oil palm farming is indeed worth developing, such that farmers convert their land to it. Previous studies have assessed the feasibility of smallholder oil palm farming and replanting in other areas [11], [12], including in Nagan Raya [13], but studies that assess the technical and financial prospects of oil palm development at the village level in Darul Makmur District remain limited. This study therefore aims to analyze the prospects of oil palm development in Alue Bilie Village, Darul Makmur District, Nagan Raya Regency, from technical and financial perspectives.

2. Method

Research Site and Sampling

This study used a survey method. Alue Bilie Village was selected purposively because it is the center of oil palm development in Darul Makmur District, Nagan Raya Regency. The sample consisted of 27 oil palm farmers, representing 20% of the population of 136 farmers, who had relatively uniform land characteristics (less than 3 ha). The study was conducted in 2024–2025, with an investment projection period of 25 years, corresponding to the economic life of oil palm plants. Primary data were collected through questionnaires and field observations, while secondary data were obtained from relevant institutions and literature.

Variables and Analysis

The analysis covered two main aspects: technical and financial. The technical aspect included soil suitability, climate, rainfall, temperature, humidity, pH, altitude, and land topography. The financial aspect measured investment feasibility using Net Present Value (NPV), Net Benefit-Cost Ratio (Net B/C), Internal Rate of Return (IRR), and Break-Even Point (BEP), which in this study refers to the payback period [12], [13], [14]. The discount rate used was 12%, based on the interest rate of Bank Syariah Indonesia (BSI) at the time of the study. The operational definitions of the variables were as follows: land area (ha) is the total area planted with oil palm; production value (IDR) is the product of production volume and selling price; investment cost (IDR) is the initial cost of plantation development (seedlings, equipment, and land preparation); operating cost (IDR/year) is the annual routine cost (maintenance, fertilizer, and labor); labor is measured in man-days (HOK); and wages (IDR/HOK) are daily labor costs.

The financial criteria were calculated as follows:

$$NPV = \sum (B_t - C_t) / (1 + i)^t, \quad t = 0 \dots n$$

$$IRR = i1 + [NPV1 / (NPV1 - NPV2)] \times (i2 - i1)$$

$$\text{Net B/C} = \sum PV(NBt > 0) / |\sum PV(NBt < 0)|$$

$$BEP = Tp-1 + (\sum TCi - \sum Bicp-1) / Bp$$

where B_t is the benefit in year t (IDR), C_t is the cost in year t (IDR), n is the economic life of the crop, i is the discount rate, $i1$ and $i2$ are the discount rates that produce a positive NPV (NPV1) and a negative NPV (NPV2), $Tp-1$ is the year before the BEP occurs, TCi is the total discounted cost, $Bicp-1$ is the total discounted benefit before the BEP year, Bp is the benefit in the BEP year, and $PV(NBt)$ is the discounted net benefit $(B_t - C_t)/(1 + i)^t$. The business is considered feasible if $NPV > 0$, $\text{Net B/C} > 1$, IRR is greater than the discount rate, and the BEP is reached before the end of the project's economic life [12], [15].

A sensitivity analysis was conducted to assess the resilience of the business to changes in key variables, namely (1) a 10% increase in operating costs with production and prices held constant, (2) a 20% decrease in the price of fresh fruit bunches (FFB) with operating costs held constant, and (3) a 10% decrease in benefits (production and price). These scenarios reflect the risks of rising input costs, falling FFB prices as production expands, and delays in production [12], [16].

3. Result and Discussion

Characteristics of the Farmers

The average age of oil palm farmers in Alue Bilie Village is 47.40 years, which is within the productive working age. Their average education is 12.18 years, equivalent to completing senior high school, and their average farming experience is 11.51 years, indicating that they are sufficiently experienced in farming. The average number of family dependents is 3.26 persons, and the average area of oil palm land is 2 hectares.

Costs of Oil Palm Farming

Investment costs are incurred at the initial stage of planting, before the oil palms begin to produce. For a 2-hectare plantation, the investment costs consist of seedlings (IDR 5,400,000 for 270 seedlings), equipment (IDR 12,850,000, including a motorized cart worth IDR 6,000,000), and labor for land preparation and planting (IDR 7,600,000), giving a total investment cost of IDR 25,850,000 in the first year. In addition, the analysis includes a land cost of IDR 80,000,000. Operating costs are incurred annually and include labor for weeding, fertilizing, harvesting, and transportation (IDR 1,800,000 per year) and fertilizer (IDR 6,412,500 per year in years 1–4 and IDR 5,197,500 per year in years 5–25).

Technical Aspects

The research area meets the requirements for oil palm cultivation. Soil pH ranges from 4.02 to 6.47, air humidity from 76% to 80%, temperature from 21°C to 32°C, annual rainfall is 3,704 mm, and the altitude ranges from 0 to 600 meters above sea level. Although rainfall in the area is relatively high, the main climatic constraint on oil palm yields is water deficit rather than high rainfall [17], and the humid tropical climate of the region, like that of most of Sumatra, remains suitable for oil palm growth [18], [19]. Therefore, from a technical perspective, oil palm cultivation in Alue Bilie Village is feasible to develop.

Financial Aspects

The NPV at a 12% discount rate is IDR 307,653,762. Because the NPV is greater than zero, oil palm farming with an economic life of 25 years is feasible and is expected to generate a net benefit of IDR 307,653,762 in present value terms. The Net B/C is 3.8, meaning that every one rupiah invested generates a benefit of 3.8 rupiah; because the Net B/C is greater than 1, the business is

feasible. The IRR is 21.1%, meaning that the business can recover its invested capital up to a discount rate of 21.1%. Because the IRR is higher than the applied discount rate of 12%, the business is feasible. Finally, the BEP is reached between the 7th and 8th years, specifically after 7 years and 4 months, well before the end of the 25-year economic life, indicating a relatively short payback period.

Sensitivity Analysis

Sensitivity analysis examines how the feasibility results change if the assumptions on costs or benefits change. Such changes may arise from rising operating costs, falling FFB prices as oil palm cultivation expands and production increases, or delays in production that reduce expected benefits. Table 1 presents the results.

Table 1. Results of the sensitivity analysis

Scenario	NPV (IDR)	Net B/C	IRR (%)	BEP
Base case	307,653,762	3.80	21.10	7 years 4 months
Operating costs increase by 10%	300,529,236	3.70	21.06	7 years 5 months
FFB price decreases by 20%	214,398,194	2.90	20.20	7 years 8 months
Benefits decrease by 10%	218,968,737	3.03	20.30	7 years 8 months

Source: Primary data, 2025.

Under all three scenarios, the NPV remains positive, the Net B/C remains above 1, the IRR remains above the 12% discount rate, and the BEP is still reached in less than 8 years. Oil palm farming in Alue Bilie Village is therefore relatively resilient to changes in costs and prices, with FFB prices being the most influential variable.

Discussion

The results indicate that oil palm development in Alue Bilie Village is feasible both technically and financially. The financial indicators show that oil palm farming not only covers its investment costs but also generates substantial profits. These findings are consistent with Irawan *et al.* [13], who found that smallholder oil palm replanting in Nagan Raya is financially feasible, and with studies in Rokan Hulu [12] and Tanah Bumbu [11], which reported that smallholder oil palm farming is profitable and feasible. They also align with evidence that oil palm farming contributes to the income and welfare of farm households in Darul Makmur [8] and Aceh Utara [7], and that related businesses, such as oil palm seedling nurseries in Darul Makmur, are also profitable [14], [20].

The sensitivity analysis shows that FFB prices have the greatest influence on feasibility, which is consistent with Saprida [12], who found that oil palm farming is more sensitive to price declines than to cost increases. Because FFB prices fluctuate with crude palm oil prices and production levels [16], and because farm-level welfare is vulnerable to such price changes [7], efforts to increase productivity and strengthen farmers' bargaining position are important for maintaining the feasibility of the business. The relatively high returns of oil palm compared with other crops also help explain why farmers in Alue Bilie have converted land previously used for rubber, cocoa, patchouli, and rice, a pattern consistent with studies showing that land area, farmer characteristics, and the prices of competing commodities influence conversion decisions [9], [10].

The socioeconomic characteristics of the farmers also support the sustainability of the business. With an average age of 47 years, more than 11 years of farming experience, and an education level equivalent to senior high school, farmers have the capacity to manage their plantations and are fairly open to adopting innovations. However, their moderate level of education may limit their

understanding of managerial aspects and modern cultivation technologies, which are important for closing yield gaps in smallholder plantations [17]. Finally, social and environmental aspects were not the focus of this study. Because the oil palm boom has significant environmental and social consequences [3], [5], further studies incorporating these dimensions are needed to ensure that oil palm development is not only profitable but also environmentally sustainable and socially equitable.

4. Conclusion

Oil palm development in Alue Bilie Village, Darul Makmur District, Nagan Raya Regency, is financially feasible, as indicated by an NPV of IDR 307,653,762, a Net B/C of 3.8, an IRR of 21.1%, which is higher than the 12% discount rate, and a BEP reached after 7 years and 4 months, well before the end of the 25-year economic life. Sensitivity analysis shows that the business remains feasible when operating costs increase by 10%, FFB prices decrease by 20%, or benefits decrease by 10%. Technically, the land and climatic conditions are also suitable for oil palm cultivation.

The study recommends that farmers intensify plantation maintenance and make use of agricultural extension services to increase productivity and welfare, and that local governments support farmers in dealing with FFB price fluctuations. This study is limited to the technical and financial aspects of a single village; future research should extend the analysis to social and environmental aspects.

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Authors' contributions and responsibilities

Siti Nadilla: conceptualization, investigation, data collection, formal analysis, writing – original draft. Sri Fitri: supervision, methodology, writing – review & editing. Diah Eka Puspita: supervision, validation, writing – review & editing.

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Availability of data and materials

All data are available from the authors upon reasonable request.

Competing interests

The authors declare no competing interest.

Ethical approval

This study involved questionnaires and interviews with adult farmers on farm management and costs. All respondents participated voluntarily after being informed of the purpose of the study, and their identities are not disclosed in this article.

Additional information

No additional information from the authors.

Declaration of Generative AI and AI-Assisted Technologies

During the preparation of this manuscript, Claude (Anthropic) was used to improve the language and readability of the English text and to format the manuscript, tables, equations, and references according to the journal template. The tool was not used to generate research data, perform the analysis, or draw conclusions. The authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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