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Financial Feasibility of Rubber Plantation in Southeast Sulawesi

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***Abstract*: Indonesia is the second rubber-producing country in the world. Rubber is not a priority crop in Southeast Sulawesi, but there exist some smallholder rubber plantations in the province. This research aimed to analyze feasibility of rubber plantations in Southeast Sulawesi province. The research was conducted in Puriala Subdistrict, Konawe District, Southeast Sulawesi Province, from September 2022 to February 2023. Data analysis used Net Present Value (NPV), Internal Rate of Return (IRR), Benefit-Cost Ratio (BCR), Payback Period (PP), and Sensitivity Analysis. Data collection methods included interviews, observation, and documentation. Research results showed that the NPV was Rp96,840,424, BCR = 1.18, IRR = 24%, and PP = 9.13 years, indicating that rubber plantation is financially feasible. The results of the sensitivity analysis of a 10% decrease in sales price or a 10% increase in costs showed that the plantation is still feasible. However, the simultaneous 10% decrease in sales price and a 10% increase in production cost indicated that plantation is no longer feasible. Given that the data used are only 12 years from the potential 25 years of economic life of the plantation, rubber plantation is highly feasible in the province.**

***Keywords*: Feasibility, investment criteria, plantation, rubber, smallholder.**

1. Introduction

Rubber is a perennial crop cultivated in Indonesia since 1864 [1]. Rubber has developed well in Indonesia since then due to its better comparative and competitive advantage in the development of rubber plantation. As a result, Indonesia is now the second largest rubber producing country in the world, producing 3.05 million metric tons of natural rubber (23.8%) in 2021 [2]. Rubber plantations are divided into smallholder, private, and state-owned plantations. In 2021, the area of natural rubber plantations in Indonesia reached around 3.8 million ha, consisting of 3.433 million ha (90.9%) of smallholder plantation, 214 thousand ha (5.7%) of state owned plantation, and 129 thousand ha (3.4%) of private plantation [3]. In the last several years, there has been tendency for the areas for state-owned and private plantation to decrease, whereas smallholder plantation to increase. These plantation areas are mainly located in five provinces, namely South Sumatra 0.89 million Ha, North Sumatra 0.38 million Ha, Riau 0.34 million Ha, Jambi 0.41 million Ha, and West Kalimantan 0.42 million Ha [3].

Rubber is an export commodity that can contribute to efforts to increase Indonesia's foreign exchange. Several locations have suitable land conditions to grow rubber, most of which are located in Sumatra and Kalimantan islands [3]. Rubber plantations play an essential role in development programs, especially the development of the agricultural sector, because they can provide livelihoods to millions of smallholders, source of raw materials for industry, and source of foreign exchange.

Smith as quoted by Syarifa (2014) predicts that growth in natural rubber consumption in the future will continue to increase beyond production growth rates. It is estimated that the demand for natural rubber in 2035 will reach around 15 million tons, while production growth will be stable at around 2% per year, so world natural rubber production in 2035 will only reach around 13.6 million tons. This means there will be a need for more natural rubber supply to meet world consumption needs. Opportunities to increase production to take advantage of this global market opportunity remain open in Indonesia because of land and labor availability.

Southeast Sulawesi is a well-known producing province for some plantation crops, such as cocoa, cashew, pepper, and clove [5]–[8]. However, rubber is not a common plantation commodity in the province. In 2020, the province only had an area of 720 hectares for rubber cultivation under smallholder plantations [3]. This small area of rubber plantation shows that rubber is not a priority crop in the province. However, it suggests that rubber cultivation is also possible in the province. In this regard, there is a need to study various aspects that affect the development of rubber plantations in the area.

Along with the increasing world demand for rubber commodities in the future, efforts to increase rubber production through expanding rubber plantations are an effective measure to implement. However, to develop a rubber plantation, various factors need to be carefully considered, not only land suitability and agro-climate factors but also socio-economic factors. A financial feasibility study is one of the studies that needs to be carried out before a rubber development project is established. Financial feasibility is carried out to determine whether or not the business of developing rubber plantations in certain areas is feasible, and to provide an overview of the profit or loss levels of rubber plantation business during the plant life (25 years). A

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financial feasibility study needs to be carried out because the plantation business is a long-term type business with uncertain future factors that need to be estimated. This study aimed to analyze the feasibility of investing in rubber plantations in Southeast Sulawesi. The results of the analysis will provide an overview regarding the feasibility of investment for stakeholders planning to develop rubber plantations.

2. Materials and Methods

Rubber is not a popular tree crop in Southeast Sulawesi, and hence rubber plantation is only found in several districts, including in Konawe District. The largest plantation area in Konawe District is in Puriala subdistrict, which is concentrated mainly in Watusa village, where this study was from September 2022 to February 2023. The research location was determined purposively as it has several rubber plantations. There are eight rubber growers who have cultivated rubber for 12 years in the village. The largest plantation (135 ha) in the village was selected as the sample farming for further analysis in this study. The sample plantation was the first being established in the village, and despite its large farming area, it has been operated in a smallholder style. The data consisted of primary and secondary data. Primary data were collected through observation and direct interviews with all farmers, while secondary data were collected from previous studies and several government agencies.

To determine the feasibility of smallholder rubber plantation, we applied four financial tools, namely Net Present Value (NPV), Internal Rate of Return (IRR), Benefit-Cost Ratio (BCR), and Pay Back Period (PP) [9], [10]. Also, sensitivity analysis was undertaken to ascertain the economic viability of rubber production. The calculations were done at 15% discount interest rate.

(i) NPV refers to the difference between the present value of cash inflows and cash outflows in a certain period. If he NPV is positive, an investment is acceptable; if it is negative, an investment is not acceptable.

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

Where:

NPV = Net Present Value
Bt = Benefits in year t
Ct = Costs in year t
t = year of the cash flow
i = interest rate

(ii) BCR**:** BCR is calculated as the present value of benefits divided by the present value of costs.

$$BCR = \frac{\sum_{1}^{t} B_t (1+i)^t}{\sum_{1}^{t} C_t (1+i)^t}$$

The project yields more benefits than costs if the ratio exceeds one. Therefore, investment is acceptable if the BCR exceeds one and not if it is less than one.

(iii) IRR: IRR is a discount rate that makes the NPV of a project equal to zero.

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

Where:
IRR = internal rate or return
i_1 = discount rate 1
i_2 = discount rate 2
NPV_1 = NPV at a discount rate 1
NPV_2 = NPV at a discount rate 2

(iv) PP: PP is used to ascertain the time required to generate returns to cover spent capital and investment. If PP is less than the plantation's economic life, the plantation is feasible. The plantation is not feasible if PP exceeds the economic life of the plantation.

(v) A sensitivity analysis was carried out to determine changes in the decision criteria owing to potential changes in prices, costs, production, or revenue. Three scenarios were used as follows: (i) sales price decreasing by 10% (Scenario 1), (ii) production costs increasing by 10% (Scenario 2), and (iii) a simultaneous 10% increase in production cost and 10% decrease in output price (Scenario 3).

3. Results and Discussion

A. Investment Cost

Investment costs needed to establish smallholder rubber farming include opening and clearing land, and purchasing seed and tools (Table 1). The land with the size of 135 ha was not included in the calculation. The farmer initially planted rubber in the land of 10 ha, and gradually increased the size until reaching 135 in year 5. Tools include machetes, hoes, chainsaws, sprayers, tapping knives, rubber bowls, basins, scales, and tarpaulin. All these investment costs must be spent at the year 0 prior to launching the business. Total investment cost is Rp98,080,000. The largest proportion (51.0%) of this amount is for land opening and clearing.

Table 1
Investment costs of rubber plantation

No.	Item	Cost	
		Rp	%
1	Land opening and clearing	50,000,000	51.0
2	Seedling	15,000,000	15.3
3	Tools and equipment	33,080,000	33.7
	Total investment	**98,080,000**	**100.0**

B. Operational Cost

Table 2 shows the operational costs of a rubber plantation in 12 years. Operational costs consist of variable and fixed costs. Variable costs include expenses for fertilizer, plant vitamin, transportation, and labor. Fixed costs include labor expenditure and tax. Total operational costs for 12 years amounted to Rp1.5 billion, consisting of variable costs of Rp956 million and fixed costs of Rp549.5 million.

Table 2
Operational cost in rubber plantation

No.	Cost Components	Value (Rp)
A	Variable cost	956,000,000
1	Fertilizer, vitamin, herbicide	18,980,000
2	Transportation	1,400,000
3	Labor cost	936,000,000
B	Fixed cost	549,500,000
1	Labor cost	405,000,000
2	Tax	144,500,000
	Total	**1,505,500,000**

The fixed and variable costs varied each year, depending on the size of cultivated land, plant needs, and emerging activities. For example, fixed costs in Year 0 included labor for opening land and planting seeds. In years 1-3, the fixed cost components included labor costs for planting seeds, fertilizer application, and the use of herbicides. However, from Year 6 onwards, the fixed cost stayed mostly the same as it was derived from land tax which was constant each year.

Fluctuation in variable costs was due to the application of fertilizers and herbicides according to plant growth. Fertilizers and herbicides are applied in Years 1-4, whereas liquid fertilizer and plant vitamins are applied from Year 5 onwards. The largest component of variable cost is the labor for harvesting. Unlike labor cost in Years 1-4, labor cost for harvesting is regarded as variable cost as it is linked with the number of days workers are performing.

C. Benefits

The revenue referred to in this study is the amount of production multiplied by the latex price prevailing at the time of harvest which is expressed in Rupiah (Rp). Rubber plantation income or benefits constitute the difference between the revenue and the total costs incurred, expressed in Rupiah per year (Rp/Year). Rubber plantation income can be seen in Table 3.

Rubber can be tapped initially in year 5. This gestation period of four years is shorter than that reported in other studies [11]. This means that the first four years are the immature phase during which there are no returns for all costs spent. The income from rubber plantations in the 5th year is relatively low because the plantations are producing latex for the first time, so their productivity is still low. From year 5, rubber plantation enters the mature phase with both expenditure and revenue.

Table 3 shows that the benefits or income incrementally increases until year 11. The highest production occurs in year 12, resulting in the highest revenue. However, the income in year 12 is slightly lower than in year 11 due to additional costs in year 12. The increased trend in benefits is due to an increase in production, which may reach its peak at year 17 [12]. Rubber trees continue to produce latex until the age of 25, but the annual production of latex decreased well before this [12].

Table 3
Benefits of rubber plantation

No.	Year	Benefits (Rp)
1	0	(131,270,000)
2	1	(96,690,000)
3	2	(100,365,000)
4	3	(102,865,000)
5	4	(167,895,000)
6	5	(15,495,000)
7	6	75,525,000
8	7	122,325,000
9	8	184,775,000
10	9	309,825,000
11	10	352,975,000
12	11	676,950,000
13	12	658,920,000
Total		**1,766,715.000**

The total benefit is the multiplication of productivity and the price of natural rubber. The recent sales price of rubber at the village level is Rp14,000 per kg. As shown in Table 3, the highest income from rubber plantations is in Year 11, which is Rp676,950,000, while the lowest income for rubber plantation farming is in Year 6, which is Rp75,525,000. The total income earned during 11 years of rubber plantations is Rp1.77 billion, with an average annual income of Rp92.3 million.

D. Financial Feasibility

Feasibility analysis was carried out to find out the feasibility of rubber plantations. The investment criteria used in measuring rubber plantations include NPV, IRR, BCR, and PP. The interest rate or discount factor used is 15% taken from the interest rate for KUR (*Kredit Usaha Rakyat*) credit scheme at Bank Rakyat Indonesia (BRI). The financial feasibility of rubber plantations can be seen in Table 4.

Table 4
Indicators of financial feasibility of rubber plantation

Investment Criteria	Value	Standard	Remarks
NPV	Rp96,840,424	> 0	Feasible
IRR	24%	> 15%	Feasible
BCR	1.18	> 1	Feasible
PBP	9.13	< economical age of rubber tree	Feasible

Table 4 reveals the feasibility criteria of smallholder rubber plantation. At the discounted rate of 15% per annum, NPV is positive, IRR exceeds the prevailing interest rate, BCR is greater than 1, and PP is shorter than the economic life of rubber crops. A positive NPV means that the plantation will be profitable as it can generate earnings that exceed the anticipated costs. The IRR exceeding the interest rate of 15% indicated that the plantation is a feasible business proposition as it is higher than the minimum acceptability rate for the business to generate returns. The BCR of 1.18 means that for every rupiah invested, the project will generate returns of 1.18 rupiahs. The payback period of 9.13 years where the production only starts in the fifth year is highly encouraging as it is far less than the economic life of the rubber trees. The results of all these investment criteria thus demonstrate that rubber plantation is financially feasible.

The good financial feasibility of smallholder rubber

Table 5
Sensitivity analysis of rubber plantation

No.	Scenario	Investment criteria	Value	Standard	Remarks
1	10% decrease in output price	NPV	Rp1,282,993	> 0	Feasible
		BCR	1.00	> 1	Feasible
		IRR	15.0%	> 15%	Feasible
		PP	9.8 years	< 25 years	Feasible
2	10% increase in production cost	NPV	Rp13,328,325	> 0	Feasible
		BCR	1.03	> 1	Feasible
		IRR	16%	> 15%	Feasible
		PP	9.75 years	< 25 years	Feasible
3	10% decrease in output price, 10% increase in cost	NPV	(Rp82,229,107)	> 0	Not feasible
		BCR	0,85	> 1	Not feasible
		IRR	3%	> 15%	Not feasible
		PP	10.04 years	< 25 years	Feasible

plantations was also reported in various studies. For example, Hudaya Makmur and Mustafa [13] found that rubber plantation in Langsa of Aceh province is financially feasible. Marampa and Maskan [1] reported the financially feasible operation of rubber plantations in West Kutai of East Kalimantan province. Bardana, Ismail and Kamarubayana [14] investigated rubber plantation in Kutai Kartanegara of East Kalimantan province and concluded that rubber plantation is feasible. Similar studies in South Sumatera [4], Cambodia [15], and India and Thailand [16] also resulted in financially feasible conditions.

The result of the payback period of 9.13 years is consistent with many stu dies, which revealed that rubber plantation would generally cover their initial investment costs for around nine years or more [4], [15], [17].

E. Sensitivity Analysis

The rubber plantation business is affected by uncertainty, so a sensitivity analysis is done to review the feasibility of the plantation in the long run due to changes in conditions such as decreased rubber production, increased production costs, and decreased sales price. The sensitivity analysis results are expected to show whether or not the rubber plantation is sensitive to these changes. The results of the calculation of NPV, BCR, IRR, and Payback period with sales price decreasing by 10%, production costs increasing by 10%, and simultaneous 10 % decrease in sales prices and a 10% increase in costs can be seen in Table 5.

As shown in Table 5, when the selling price of rubber drops by 10% and costs are fixed (scenario 1), the NPV is positive, BCR > 1, and IRR > 15%. The payback period of 9.75 years is shorter than the economic life of the rubber plant. Therefore, rubber plantation is still financially feasible.

Likewise, when production costs increase by 10% and revenue is constant (scenario 2), the rubber plantation business is still feasible because the NPV obtained is positive with a value of Rp13,328,325, BCR is 1.92, and IRR is 18%. The PP is 9.75 years, which is shorter than economic life of the rubber plant.

A different result was obtained in Scenario 3. If the output sales price is decreased by 10% and at the same time costs are increased by 10%, NPV is negative, IRR is less than prevailing interest rate of 15%, and BCR is less than 1. This result indicated that, despite the payback period being less than the economic life of rubber trees, a simultaneous decrease in sales price and increased costs will lead to the plantation being no longer feasible.

Given the data coverage of only 12 years from the potential 25 years of plantation economic life, the analysis results of investment criteria proposed in this study, including that of sensitivity analysis, definitely showed that rubber plantation is highly feasible. This is because the years 13-25, not included in the calculation, are years with surplus cashflows. The question is, then, why both smallholder and private rubber plantations are hardly found in Southeast Sulawesi province. One of the possible explanations is the payback period, which might be considered too long for most smallholder farmers. It is generally accepted that the more years of the payback period, the more risky the business is. This is especially true for smallholder farmers who generally face the issue of capital insufficiency. The payback period of 9 years is much longer than that of all popular estate crops such as cocoa, pepper, clove, and patchouli, which might be the reason why they cultivate these crops rather than rubber.

One solution to deal with the long gestation and payback period of rubber farming is to cultivate rubber along with other crops. Many crops have been used as intercrops in other areas, such as banana, ginger, cassava, pineapple, mung bean, and tea [18]–[20]. The government and research institutes might need to identify which intercrops are more suitable for the local conditions.

4. Conclusion

Rubber plantation in Southeast Sulawesi is financially highly feasible. This can be seen from the NPV of Rp96,840,424; IRR of 24%; BCR of 1.18; and Payback Period of 9.13 years. Likewise, under unfavorable conditions where the price of natural rubber fell by 10%, or the production cost increased by 10% from the planned normal conditions, rubber plantation was still feasible. The feasibility is even more encouraging given the data coverage in this study which only cover the period until year 12. Given the non-popularity of rubber in Southeast Sulawesi, this study provides helpful information for the development of smallholder and private rubber plantations in the province.

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