

Feasibility Analysis of Cocoa Rejuvenation in Jambewangi Village, Sempu District, Banyuwangi Regency

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Abstract

Cocoa is one of the leading plantation commodities that plays an important role in the agricultural sector. Banyuwangi Regency is the largest cocoa-producing region in East Java Province, with the highest cocoa production concentrated in Sempu District. However, despite its high production, cocoa productivity in Sempu District remains relatively low compared to other districts within the regency. This low productivity is mainly attributed to the aging cocoa trees, which are more susceptible to pests and diseases, as well as inadequate crop management practices. One of the strategies to improve cocoa productivity is through rejuvenation. This study aimed to evaluate the financial and non-financial feasibility of cocoa rejuvenation. The research was purposively conducted in Jambewangi Village, Sempu District, Banyuwangi Regency. Both primary and secondary data were collected and analyzed using Net Present Value (NPV), Net Benefit-Cost Ratio (Net B/C), Internal Rate of Return (IRR), and Payback Period (PP) analyses. The results indicated that the replanting method generated a Net Present Value (NPV) of IDR 83,671,483, a Net B/C ratio of 2.88, an Internal Rate of Return (IRR) of 20.78%, and a Payback Period (PP) of 6.3 years at a discount rate of 6% over a 20-year production period. Meanwhile, rejuvenation through side grafting and top grafting produced an NPV of IDR 52,858,871, a Net B/C ratio of 2.43, an IRR of 34.31%, and a Payback Period of 3.2 years at the same discount rate over a 7-year production period. From a non-financial perspective, cocoa rejuvenation in Jambewangi Village was also found to be feasible, as it provides significant benefits to cocoa farmers and the surrounding community. Therefore, cocoa rejuvenation can be considered a viable strategy to improve cocoa productivity and support the long-term sustainability of cocoa farming.

Keywords

Cocoa, Feasibility, Financial Analysis, Productivity, Rejuvenation, Replanting



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INTRODUCTION

Cocoa is one of the most important plantation commodities, alongside oil palm, coffee, rubber, and sugarcane, and plays a strategic role in Indonesia's plantation subsector. The plantation sector contributes significantly to employment generation, household income, gross domestic product (GDP), export earnings, and national economic growth (Faza & Widiyanti, 2022). According to Statistics Indonesia (BPS), the plantation subsector contributed 3.94% to Indonesia's Gross Domestic Product (GDP) in 2021. Furthermore, data from the Directorate General of Estate Crops (2022) indicate that national cocoa production reached 728.50 thousand tons in 2021. Among the provinces in Java, East Java is the largest cocoa-producing province, with an average annual production of 25,157 tons. Table 1 presents cocoa production by regency/municipality in East Java Province during the 2019–2022 period.

Table 1 Cocoa Production by Regency in East Java Province, 2019-2022 (Tons)

| Regency/ Municipality | Production (ton) | | | | |
|--------------------------|------------------|---------|---------|---------|---------|
| | 2019 | 2020 | 2021 | 2022 | Average |
| Blitar | 3.216,0 | 3.290,0 | 3.290,0 | 3.178,0 | 2.444 |
| Kediri | 3.121,0 | 3.145,0 | 2.896,0 | 2.804,0 | 2.992 |
| Jember | 3.130,0 | 3.125,0 | 2.993,0 | 2.957,0 | 3.051 |
| Banyuwangi | 8.193,0 | 8.246,0 | 7.800,0 | 8.017,0 | 8.064 |
| Madiun | 2.814,0 | 2.826,0 | 1.004,0 | 2.465,0 | 2.277 |

Source : Badan Pusat Statistik, 2023

Based on Table 1, Banyuwangi Regency consistently recorded the highest cocoa production among all regencies and municipalities in East Java between 2019 and 2022. The highest production was achieved in 2020, reaching 8,246 tons, while the lowest production occurred in 2021, amounting to 7,800 tons. Compared with the previous year, cocoa production declined by 446 tons in 2021. Nevertheless, Banyuwangi Regency maintained an average annual cocoa production of 8,064 tons, which was considerably higher than that of other regencies and municipalities in East Java Province. The distribution of cocoa productivity across districts in Banyuwangi Regency from 2019 to 2022 is presented in Table 2.

Table 2 shows that Sempu District recorded the highest average cocoa production in Banyuwangi Regency, reaching 221.8 tons per year. It also had the largest cocoa cultivation area, averaging 288.8 hectares annually. Despite having the highest production and the largest cultivated area, Sempu District exhibited the lowest cocoa productivity, averaging only 0.768 tons per hectare per year. The low productivity is largely attributed to the aging cocoa trees and the deterioration of

plantations (Wijayati et al., 2022). In contrast, Glenmore District achieved the highest average cocoa productivity at 0.835 tons per hectare. According to Rosyady et al. (2022), the low productivity in Sempu District is associated with the declining priority given to cocoa cultivation, resulting in inadequate crop management and lower production efficiency.

Tabel 2 Average Cocoa Productivity by District in Banyuwangi Regency, 2019–2022

| District | Average Production (Tons) | Average Cultivated (Ha) | Average Productivity (Tons/Ha) |
|-------------|---------------------------|-------------------------|--------------------------------|
| Pesanggaran | 53,3 | 69,0 | 0,772 |
| Glenmore | 41,8 | 50,0 | 0,835 |
| Kalibaru | 35,3 | 45,0 | 0,783 |
| Sempu | 221,8 | 288,8 | 0,768 |

Source: Statistics Indonesia (BPS), 2023

One of the most effective strategies to improve cocoa productivity in Jambewangi Village is through cocoa rejuvenation. Cocoa rejuvenation can be implemented using several methods, including replanting, top grafting, and side grafting (Widiyani et al., 2022). The replanting method has an economic life of approximately 20 years because it involves establishing new cocoa trees. In contrast, top grafting and side grafting have an economic life of approximately seven years since the grafting techniques utilize existing mature rootstocks. Therefore, selecting an appropriate rejuvenation method is essential to ensure both technical effectiveness and economic viability. This study aimed to evaluate the financial and non-financial feasibility of cocoa rejuvenation using replanting, side grafting, and top grafting methods in Jambewangi Village, Sempu District, Banyuwangi Regency.

METHODE

The research site was selected using a **purposive sampling method**. The study was conducted in Jambewangi Village, Sempu District, Banyuwangi Regency, Indonesia. This location was intentionally selected because it is one of the major smallholder cocoa production centers and records the highest cocoa production among villages in Sempu District. The study was carried out over a two-month period, from December 2023 to January 2024. This study employed both quantitative and qualitative descriptive approaches. According to Sugiyono (2016), as cited in Sudaryana and Agusady (2022), a quantitative descriptive method presents research findings in the form of numerical data while describing the actual conditions of the study. This approach was used to evaluate the financial feasibility of cocoa

rejuvenation. Meanwhile, the non-financial feasibility assessment employed a qualitative descriptive approach, in which the researchers explored the social conditions of the study area through an in-depth investigation. The study utilized both primary and secondary data. Primary data were obtained directly from the respondents, whereas secondary data were collected and compiled by other institutions or researchers (Amruddin et al., 2022). Primary data were collected through field observations and structured interviews with respondents. Secondary data were obtained from relevant literature, including previous studies, scientific journals, books, publications of Statistics Indonesia (BPS), and reports issued by the Directorate General of Estate Crops.

The respondents were selected using a non-probability sampling technique, specifically purposive sampling. This technique involves selecting respondents based on predetermined criteria established by the researchers. A total of 12 respondents participated in the study, consisting of 11 cocoa farmers and one farmer group leader. The selection criteria required respondents to be smallholder cocoa farmers who had implemented cocoa rejuvenation practices on their farms. Financial feasibility was evaluated using four investment appraisal indicators, namely Net Present Value (NPV), Net Benefit-Cost Ratio (Net B/C), Internal Rate of Return (IRR), and Payback Period (PP) (Rustiadi et al., 2017).

Net Present Value (NPV)

Net Present Value (NPV) represents the difference between the present value of cash inflows and the present value of cash outflows over a specified investment period. The NPV was calculated using the following equation (Lusianti et al., 2023):

$$NPV = \sum_{t=0/1}^n \frac{Bt - Ct}{(1+i)^t}$$

Where:

(Bt) = benefit (revenue) in year t

(Ct) = cost incurred in year t

t = year of the cocoa rejuvenation project

i = discount rate (%)

The decision criteria for evaluating the financial feasibility of cocoa rejuvenation are as follows:

- a. If $NPV > 0$, the cocoa rejuvenation project is considered financially feasible, indicating that the present value of benefits exceeds the present value of costs.
- b. If $NPV = 0$, the cocoa rejuvenation project is considered financially marginal

(break-even), indicating that the present value of benefits is equal to the present value of costs.

c. If $NPV < 0$, the cocoa rejuvenation project is considered financially infeasible, indicating that the present value of benefits is lower than the present value of costs.

Net Benefit-Cost Ratio (Net B/C)

The Net Benefit-Cost Ratio (Net B/C) is the ratio of the present value of positive net benefits to the present value of negative net benefits. It is used to evaluate the economic feasibility of an investment project. The Net B/C ratio is calculated using the following equation (Kasmir & Jakfar, 2015):

$$\text{Net } \frac{B}{C} = \frac{\sum \frac{B_t - C_t}{(1+i)^t}}{\sum \frac{B_t - C_t}{(1+i)^t}} \quad \begin{matrix} (B_t - C_t) > 0 \\ (B_t - C_t) < 0 \end{matrix}$$

Where:

(Bt) = benefit (revenue) in year *t*

(Ct) = cost incurred in year *t*

i = discount rate (%)

t = year

The decision criteria for the Net Benefit-Cost Ratio (Net B/C) are as follows:

a. If $\text{Net B/C} > 1$, the cocoa rejuvenation project is considered financially feasible, indicating that the present value of positive net benefits exceeds the present value of negative net benefits.

b. If $\text{Net B/C} < 1$, the cocoa rejuvenation project is considered financially infeasible, indicating that the present value of positive net benefits is lower than the present value of negative net benefits.

c. If $\text{Net B/C} = 1$, the cocoa rejuvenation project is at the break-even point, where the present value of benefits is equal to the present value of costs.

Internal Rate of Return (IRR)

The Internal Rate of Return (IRR) is the discount rate at which the Net Present Value (NPV) of an investment equals zero. It represents the rate of return generated by an investment and is expressed as a percentage. The IRR was calculated using the following equation (Fauzan et al., 2023):

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

Where:

(i₁) = discount rate (DR) that produces a positive Net Present Value (NPV)

(i₂) = discount rate (DR) that produces a negative Net Present Value (NPV)

(NPV₁)= positive Net Present Value (NPV)

(NPV₂) = negative Net Present Value (NPV)

The decision criteria for the Internal Rate of Return (IRR) are as follows:

- a. If IRR > DR, the cocoa rejuvenation project is considered financially feasible.
- b. If IRR < DR, the cocoa rejuvenation project is considered financially infeasible.
- c. If IRR = DR, the cocoa rejuvenation project is at the break-even point.

Payback Period (PP)

The Payback Period (PP) is an investment appraisal method used to determine the length of time required to recover the initial investment through the project's net cash inflows. A shorter payback period indicates a more attractive and financially viable investment (Suliyanto, 2010). The Payback Period was calculated using the following equation:

$$\text{Payback period} = \frac{I}{Ab}$$

Where:

I = total investment cost incurred for the cocoa rejuvenation project.

Ab = average annual net benefit generated from the cocoa rejuvenation project.

The decision criteria for the Payback Period (PP) are as follows:

- a. If the Payback Period is shorter than the economic life of the cocoa plantation—20 years for the replanting method and 7 years for the side-grafting and top-grafting methods—the cocoa rejuvenation project is considered financially feasible.
- b. If the Payback Period exceeds the economic life of the cocoa plantation—20 years for the replanting method and 7 years for the side-grafting and top-grafting methods—the cocoa rejuvenation project is considered financially infeasible.
- c. If the Payback Period is equal to the economic life of the cocoa plantation, the investment is considered to be at the break-even point.

FINDINGS AND DISCUSSION

Overview of the Study Area

Jambewangi Village is located in Sempu District, Banyuwangi Regency, East Java, Indonesia. The village consists of six hamlets: Sidomulyo, Krajan, Parastembok, Sambirejo, Tlogosari, and Panjen. Jambewangi Village is recognized as one of the main cocoa-producing areas in Banyuwangi Regency and has become a focal area for cocoa plantation development. The village is situated at an altitude of approximately 270 meters above sea level (m a.s.l.), which is suitable for cocoa cultivation as it is below the recommended maximum elevation of 800 m a.s.l. The average air

temperature ranges from 28 to 30°C, while the annual rainfall reaches approximately 3,220 mm. These agroclimatic conditions provide a favorable environment for cocoa production.

Most cocoa farmers in Jambewangi Village cultivate cocoa on privately owned land, while some also utilize land managed by the State Forestry Enterprise (*Perhutani*) under land-use rights agreements. Farming activities are generally carried out using conventional agricultural tools to meet production requirements. Agricultural inputs, including fertilizers, pesticides, and other farming materials, are obtained from agricultural supply stores located near the study area. Cocoa farmers in Jambewangi Village are organized under the Manggar Kencono Farmer Group, which was established in 2019 and currently has approximately 70 active members. The farmer group plays an important role in facilitating knowledge sharing, improving farming practices, and supporting cocoa production among its members.

Financial Feasibility Analysis

Cocoa farming in Jambewangi Village requires various investment and operational expenditures throughout the production cycle. In this study, the financial cash flow was divided into cash inflows and cash outflows. Cash inflows represent revenues generated from the sale of cocoa beans, whereas cash outflows represent all expenditures incurred during cocoa farming activities. Investment costs include the purchase of farming equipment such as hoes, sickles, crowbars, sacks, tarpaulins, water tanks, shovels, knapsack sprayers, pruning shears, and cocoa seedlings. Operational costs consist primarily of expenditures on fertilizers, pesticides, and labor.

The economic life of cocoa farming differs according to the rejuvenation method employed. The replanting method has an economic life of 20 years because it involves establishing new cocoa trees. In contrast, the side-grafting and top-grafting methods have an economic life of seven years since they utilize existing mature rootstocks. The financial feasibility analysis in this study employed a 6% discount rate, corresponding to the prevailing savings interest rate of Bank Rakyat Indonesia (BRI), as the majority of respondents maintain savings accounts at the bank.

Table 3. Investment Feasibility Analysis of Cocoa Rejuvenation per Hectare under Normal Price Conditions in Jambewangi Village

| Rejuvenation Method | NPV (IDR) | Net B/C | IRR (%) | Payback Period (years) |
|---------------------|---------------|---------|---------|------------------------|
| Replanting | Rp 83.671.483 | 2,88 | 20,78% | 6,3 Tahun |

| | | | | |
|-----------------------------------|---------------|------|--------|-----------|
| Side Grafting and Top Grafting | Rp 52.858.871 | 2,43 | 34,31% | 3,2 Tahun |
|-----------------------------------|---------------|------|--------|-----------|

Source: Primary data processed by the authors (2024).

Financial Feasibility Analysis

Net Present Value (NPV)

The Net Present Value (NPV) represents the difference between the present value of benefits and the present value of costs incurred during the cocoa rejuvenation project. Benefits were derived from the sale of non-fermented dried cocoa beans, while costs consisted of expenditures for cocoa rejuvenation and plantation maintenance in Jambewangi Village. All cash flows were discounted using a 6% discount rate, which was applied throughout the study. The results indicated that the replanting method generated an NPV of IDR 83,671,483 per hectare over a 20-year production period. Meanwhile, the side-grafting and top-grafting methods produced an NPV of IDR 52,858,871 per hectare over a 7-year production period.

According to the investment decision criteria, the NPV values of all rejuvenation methods were positive ($NPV > 0$), indicating that the projects are financially feasible. The replanting method generated a net present benefit of IDR 83,671,483 per hectare, while the side-grafting and top-grafting methods generated a net present benefit of IDR 52,858,871 per hectare. These findings demonstrate that cocoa rejuvenation in Jambewangi Village is financially viable. The results are consistent with the findings of Jasmaloe (2019), who reported that cocoa rejuvenation projects with positive NPV values are financially feasible.

Net Benefit-Cost Ratio (Net B/C)

The Net Benefit-Cost Ratio (Net B/C) was calculated by comparing the present value of positive net benefits with the present value of negative net benefits generated by cocoa rejuvenation activities. This indicator measures the magnitude of benefits obtained for every unit of cost incurred. The analysis showed that the Net B/C ratio for the replanting method was 2.88 at a 6% discount rate, indicating that every IDR 1.00 of discounted cost generated IDR 2.88 of discounted net benefits. Similarly, the side-grafting and top-grafting methods produced a Net B/C ratio of 2.43, implying that every IDR 1.00 of discounted cost generated IDR 2.43 of discounted net benefits.

Since the Net B/C values for both rejuvenation methods exceeded one (2.88 and $2.43 > 1$), both investment alternatives were considered financially feasible. These findings indicate that the discounted benefits outweigh the discounted costs. This

result is consistent with Norfahmi et al. (2019), who concluded that cocoa rejuvenation is financially feasible when the Net B/C ratio exceeds one.

Internal Rate of Return (IRR)

A discount rate of 6%, based on the prevailing interest rate of Bank Rakyat Indonesia (BRI), was adopted in this study. The replanting method generated an Internal Rate of Return (IRR) of 20.78%, whereas the side-grafting and top-grafting methods yielded an IRR of 34.31%. The IRR represents the annual rate of return generated by an investment and serves as an indicator of the project's ability to recover the invested capital. The side-grafting and top-grafting methods produced a considerably higher annual return than the replanting method.

Because the IRR values of both rejuvenation methods (20.78% and 34.31%) exceeded the 6% discount rate, both investment alternatives were considered financially feasible. These findings are consistent with Tussadia et al. (2021), who reported that cocoa farming projects are financially feasible when the IRR exceeds the applicable discount rate.

Payback Period (PP)

The Payback Period (PP) was used to determine the length of time required to recover the initial investment in cocoa rejuvenation. The results showed that the investment in the replanting method could be recovered within 6.3 years per hectare, whereas the side-grafting and top-grafting methods required only 3.2 years. According to the investment decision criteria, both payback periods are shorter than the respective economic life of the plantations, namely 20 years for the replanting method and 7 years for the side-grafting and top-grafting methods. Therefore, both rejuvenation methods are considered financially feasible. These findings are consistent with Frisca et al. (2022), who concluded that cocoa farming is economically viable when the payback period is shorter than the project's economic life.

Non-Financial Feasibility Analysis

The non-financial feasibility analysis was conducted using a descriptive qualitative approach based on field observations and interview results. The assessment covered four major aspects: marketing, technical, management and legal, and socio-economic and environmental aspects.

Marketing Aspect

Market analysis is essential for identifying potential markets and evaluating product marketing opportunities. Cocoa farmers in Jambewangi Village are free to market their products to any buyer; however, most farmers sell their cocoa beans to local and regional collectors. Farmers practicing the replanting method received an

average selling price of IDR 26,800 kg⁻¹, while those adopting the side-grafting and top-grafting methods received an average price of IDR 27,286 kg⁻¹. Price differences were mainly influenced by bean quality and prevailing market supply and demand. The primary product marketed by farmers is non-fermented dried cocoa beans. Small collectors subsequently sell the beans to larger collectors, who distribute them to wholesale traders in Bali and Malang.

Technical Aspect

The technical feasibility analysis focuses on the rejuvenation process and the production technology employed, as these factors directly influence production performance. Although cocoa rejuvenation generally follows conventional cocoa cultivation practices, the main difference is that rejuvenation is carried out on existing cocoa plantations. The rejuvenation process consists of land preparation, planting, crop maintenance, harvesting, and post-harvest handling. Land preparation includes tree removal, land clearing, planting-hole preparation, and basal fertilization. Existing cocoa trees are felled using chainsaws and hand saws, after which plant residues are removed by controlled burning. Planting holes measuring approximately 40 × 40 cm are prepared only for the replanting method and are fertilized with farmyard manure before planting.

Planting practices among farmers vary because planting distances are adjusted according to field conditions. Replanting begins with complete removal of old cocoa trees before new seedlings are planted. In contrast, side grafting and top grafting retain the existing rootstock, with scions grafted onto the side or top of the remaining stem. Crop maintenance includes fertilizer application two to three times annually, pruning from approximately one year after planting, pesticide application for pest and disease control, and regular weeding to reduce competition from weeds. Harvesting generally begins when cocoa trees are two to three years old. Mature pods are identified by their yellowish color and harvested using pruning shears. Harvesting activities include pod picking and pod breaking. Post-harvest handling involves sun-drying cocoa beans for approximately five to seven days, depending on weather conditions. Farmers primarily market non-fermented dried cocoa beans because knowledge of cocoa fermentation remains limited. In addition, non-fermented beans are considered easier to market and require less labor.

Management and Legal Aspect

Cocoa farmers in Jambewangi Village are organized under the Manggar Kencono Farmer Group, established in 2019 under the leadership of Mr. Khoirudin Irsyad. The farmer group facilitates communication, knowledge sharing, and access

to agricultural information. It also enables farmers to obtain subsidized fertilizers more easily, thereby supporting the development of cocoa farming in the village. Land ownership constitutes the principal legal aspect of cocoa farming. The average cocoa farm size is approximately 0.34 ha. Farmers cultivate either privately owned land or land managed by the State Forestry Enterprise (Perhutani) under land-use rights agreements. Farmers cultivating privately owned land generally possess legally recognized land certificates, while a small number are still completing the certification process.

Socio-Economic and Environmental Aspect

Jambewangi Village has considerable potential for cocoa development because its agroecological conditions are highly suitable for cocoa cultivation. Cocoa rejuvenation has generated positive socio-economic impacts by creating additional employment opportunities for agricultural laborers and increasing farmers' incomes through higher cocoa production. From an environmental perspective, cocoa rejuvenation also provides important ecological benefits. Although the study area is prone to flooding and landslides, cocoa trees possess deep taproot systems that help stabilize sloping land and reduce the risk of soil erosion and landslides. While some farmers continue to apply inorganic fertilizers, others have begun adopting organic fertilizers. Overall, the socio-economic and environmental assessment indicates that cocoa rejuvenation in Jambewangi Village is feasible to implement because it provides substantial benefits for both farming households and the surrounding community.

CONCLUSION

The results of the investment feasibility analysis indicate that cocoa rejuvenation in Jambewangi Village is financially feasible. The replanting method generated a Net Present Value (NPV) of IDR 83,671,483, a Net Benefit-Cost Ratio (Net B/C) of 2.88, an Internal Rate of Return (IRR) of 20.78%, and a Payback Period (PP) of 6 years, 3 months, and 6 days, based on a 6% discount rate over a 20-year production period. Meanwhile, the side-grafting and top-grafting methods generated an NPV of IDR 52,858,871, a Net B/C ratio of 2.43, an IRR of 34.31%, and a Payback Period of 3 years, 2 months, and 24 days, using the same 6% discount rate over a 7-year production period. From a non-financial perspective, cocoa rejuvenation in Jambewangi Village was also found to be feasible. The project demonstrated positive outcomes in terms of marketing, technical implementation, management and legal aspects, as well as socio-economic and environmental impacts. Overall, cocoa rejuvenation provides substantial benefits for cocoa farmers while contributing

positively to the welfare of the surrounding community. These findings suggest that cocoa rejuvenation, particularly through replanting and grafting techniques, represents a sustainable investment strategy for improving cocoa productivity and enhancing farmers' income. Therefore, broader implementation of cocoa rejuvenation programs should be encouraged through technical assistance and institutional support

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