The Simulation of Investment Cost and Operational Cost to Improve the Financial Performance of Agroindustry SME Units of Cocoa in North Lombok Regency, Indonesia

Halil Halil, Tajidan Tajidan, Efendy Efendy, Edy Fernandez, Sharfina Nabilah, and Sri Mulyawati

Agribusiness Study Program, Faculty of Agriculture, University of Mataram

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ABSTRACT

Investment and operational costs are key determinants of the financial feasibility of a cocoa processing business unit; therefore, it is necessary to conduct simulations to assess the cocoa processing business's resilience to potential future cost increases. This research aims to fill the research gap by presenting a comprehensive model of investment and operational cost simulation. The simulation model is specifically designed to align with the socio-economic and operational characteristics of cocoa agro-industry SMEs in North Lombok Regency. This research is designed based on dynamic modeling, which functions as a simulation tool to estimate the behavior of cost components over time. Through analysis of financial feasibility using a dynamic model, the interaction and causal links among financial variables in the cocoa agro-industry subsystem can be considered feasible for sustainable implementation. The results of the study show that the cocoa agro-industry business is feasible to be carried out at an interest rate of 12% per year, but it is sensitive to an increase in investment costs and operational costs of 10%, so there is a risk if there is an increase in investment costs and operational costs in the future. Therefore, it is necessary to avoid unnecessary cost components while maintaining production capacity and securing efficient input prices.

Keywords: cocoa, financial, investment cost, operational cost, simulation

INTRODUCTION

Agriculture and the agro-industry sector play a crucial role in Indonesia's national economic structure, especially as labor absorbers and foreign exchange contributors (Hayana, 2026). One of the plantation commodities with high economic value in the global market and a focus of government downstreaming programs is cocoa (Yuliana et al, 2025). The cocoa agroindustry not only increases the value of raw materials by converting them into semi-finished or finished products such as chocolate powder, cocoa butter, and chocolate candy but also significantly strengthens the economic structure of rural areas (Afoakwa, 2016).

As one of the world's largest cocoa producers, Indonesia has a great opportunity to control the global cocoa supply chain. However, this opportunity is often hindered by inefficient management in the downstream industry, especially in Small and Medium Industry (SMI) units (Hadinata dan Maryanti, 2020). In addition, some large cocoa agro-industrial SMEs still operate traditionally and face limitations in business financing structures, the adoption of modern technology, and the mapping of sustainable market segments.

North Lombok Regency was identified as a potential area for cocoa cultivation on Lombok Island. Based on regional data, the largest distribution of cocoa plantations on Lombok Island is in North Lombok Regency, with significant planting areas in Gangga, Kayangan, and Tanjung Districts (Central Statistics Agency North Lombok Regency, 2024). Cocoa commodities in this region are supported by dry, fertile land and a tropical climate with a temperate microclimate suitable for plantation cultivation. However, the development of cocoa processing SMI units in North Lombok Regency faces complex structural obstacles. Most local business actors tend to sell cocoa harvests as wet or dry cocoa beans, without fermentation or further processing (Jayanti et al., 2021).

As a result, the bargaining power of farmers and local processors becomes very low in the value chain. When SMEs attempt to engage in downstreaming—such as producing chocolate bars or local cocoa powder—they face operational efficiency challenges, high production costs, high machinery costs for processed foods, and limited initial capital (Wahyudi et al., 2021).

Fundamentally, sustainability in the agroindustry is largely determined by health and financial performance. Optimal financial performance is reflected in a business unit's ability to generate profit, maintain healthy, optimized cash flow, and deliver an attractive return on investment (ROI) for investors (Brigham & Ehrhardt, 2020). At the level of the North Lombok Cocoa Agroindustry MSME, the fundamental weaknesses stem from the absence of mature, structured financial planning. Financing business is often conflated with financing house ladder owners and operational finance companies, so the real profit calculation becomes blurred (Hanafi et al, 2025). In general theory, expenditure finance in agro-industry is divided into two main components: cost of investment (capital expenditure) and operational costs (operational expenditure) (Gittinger, 2018).

Investment costs cover the procurement of assets with long-term implications, such as land, buildings, a factory, machinery (ball mill, conching machine), tools, sorting, and infrastructure supporting processing (Beckett, 2019). Errors in allocating investment at the beginning—for example, buying machine capacity that is too large, even though supply material standards are not consistent—will result in idle capacity (unemployed), which is a burden on the business's finances. Operational costs cover routine expenses, such as purchasing seed cocoa as material standard main, cost packaging, wages of labour, costs depreciation machine, up to cost utilities (electricity, water, materials, and fuel).

Price fluctuations in material standards at the local market level are often not capable anticipated by SMI actors, so that squeeze profit margins clean business (Putri, 2026). Without a precise cost-calculation structure, vulnerable Small and Medium Industry units incur financial losses or even technical bankruptcy due to bloated operational costs that exceed projections. To overcome uncertainty in economic parameters and the complexity of cost structures in Cocoa Agroindustry SMEs in North Lombok Regency, the conventional, static nature of management finance approaches is assessed as inadequate. Therefore, it is necessary to use modern predictive simulation finance analysis instruments (Law, 2015).

Simulation of investment costs and operational functioning as a dynamic mathematical model capable of projecting various future business scenarios (forecasting). Through modeling and simulation, SMI management can test various uncertainty parameters in the economy or conduct scenario what-if analyses (Sterman, 2010). For example, the model can simulate the impact on finances if the price of standard cocoa seed increases by 20%, sales volume decreases, causing a decline in Power Buy society, or investment costs improve due to modernization of the roaster machine.

The main advantage of this technique is that it provides an accurate visualization of the Break-Even Point, Net Present Value, internal rate of return, and Benefit-Cost Ratio for each scenario run (Boardman et al., 2018).

Thus, the perpetrator business and taker policy can mitigate financial risk early, before real investment capital is poured into the field. Although studies on cocoa commodities in North Lombok Regency have been conducted several times, most previous studies focused on upstream aspects, such as plant cultivation techniques, integrated pest and disease control, and the analysis of the cocoa seed marketing chain (Pebriandini et al., 2026). Specific studies that integrate downstream industry aspects with dynamic financial simulation modeling of processed Small and Medium Industry units of chocolate in this area remain very limited.

This study is aimed at filling the scientific gap (research gap) by presenting a comprehensive investment and operational cost simulation model, designed specifically in accordance with the socio-economic characteristics and operations of cocoa agro-industrial SMEs in North Lombok Regency.

This research result is expected to make a dual contribution: academically, as a scientific reference in financial management for agroindustry; and practically, as a tactical guide for SMI owners in making investment decisions, as well as for local governments in formulating coaching policies for small industries based on featured regional commodities.

METHOD

Approach Study

This study uses a quantitative descriptive exploratory approach because the analysis focuses on numerical data in a financial report that can be measured mathematically (Creswell & Creswell, 2018). For descriptive properties, an exploratory approach was used to examine in depth the characteristics of structure, cost, investment, and operations in cocoa agro-industrial SME units (Sugiyono, 2019).

Research Design

This research was developed based on dynamic modeling (dynamic modeling). Approach: This serves as a simulation tool to estimate the cost behavior of components over time (Sterman, 2000). Through a dynamic model, this interaction and relationship cause-and-effect (causal link) between financial variables in the agro-industry chocolate sector can be mapped in a structured way (Lane & Sterman, 2011).

Operation and design of dynamic simulation models. This is all based on a computer running Microsoft Excel for Windows 2010. This spreadsheet-based tool is optimized for mathematical computing. It is used for compiling financial formulas, matrix integration, cost analysis, and scenario analysis (what-if analysis) to predict the sustainability and sensitivity of cocoa SME finance to future economic fluctuations (Kibira & McLean, 2014).

Object of Study

Object of study: This is a business unit in the agro-industry that processes cocoa (chocolate) at a small- and medium-enterprise (SME) scale. The analysis was conducted using valid and relevant secondary data (Sugiyono, 2019).

The data collected are comprehensive, including scientific journal publications, national seminar papers, international papers, and various study-related reports on the cost structure of agro-industry cocoa processing (Sari & Rahma, 2023).

4. Data Collection Techniques

Secondary data collection in this study was sourced from scientific publications, electronic library (e-journal) databases, and open-access databases (Creswell & Creswell, 2018). To enrich the discussion and complete the information needed, researchers employed a documentation technique to collect archival materials and relevant financial reports (Sugiyono, 2019). Furthermore, the approach used in this study is descriptive-analytical to broaden the conceptual outlook and sharpen theoretical argumentation regarding the structure of cost object research (Suryabrata, 2003). The third integration technique confirms that the data obtained have high validity for modeling and simulation.

Data Analysis

Simulation analysis eligibility for financial in the Cocoa Agroindustry SMI integrates technique Modeling Dynamic through testing three pillars of the scenario sensitivity (Sterman, 2000):

- Scenario Optimistic: Decrease investment costs by 50% and operational costs by 10%, with production volume and selling price remaining in normal condition.
- Scenario Moderate: Normal investment and operational costs, reflecting the average operational realization moment.
- Scenario: Rising investment costs by 50% and operational costs by 10%, with production volume as well as selling price still stable in normal conditions.

Evaluation criteria for the eligibility of financial resources used include *Net Present Value* (NPV) and *Internal Rate of Return* (IRR) (Ross et al., 2019). Second instrument: They complete each other in measuring the time value of money. A project is assessed as worthy if it produces a positive NPV (NPV > 0) and an IRR value that exceeds the required discount rate (*IRR > discount interest rate*).

The mathematical formula criteria for eligibility are:

$$NPV = \sum \frac{Bt - CT}{(1+i)^t}$$

$$IRR = i_1 + [\frac{NPV^+}{(NPV^+ - NPV^-)} x (i_2 - i_1)]$$

Information:

NVP = Net Present Value

IRR = Internal Rate of Return

Bt = Benefet t-year

Ct = Cost t-year

i = interest rate

Simulation of investment costs and operational costs: theRevised IRR value is determined by opportunity cost (i) when NPV ≥ 0

RESULTS AND DISCUSSION

Investment Costs and Operational Costs

Sustainability in the agroindustry business is largely determined by strategic capital allocation through two main financing instruments. First, investment costs (*capital expenditure*) play an important role in procuring long-term assets to build production capacity and facilitate the adoption of modern technology (Beckett, 2019). Second, operational *expenditure funds* daily activities, ensures the smooth conversion of materials to standard, and maintains stable short-term cash flow (Gittinger, 2018). The precise integration of these two components becomes the foundation for optimizing profitability and mitigating the risk of bankruptcy for technical companies.

Investment Costs (Cost)

Investment costs (*capital expenditure*) are the main pillar in the establishment and development of agro-industrial SMEs allocated to cocoa procurement assets for the long term (Gittinger, 2018). In the context of chocolate processing, investment financing is allocated specifically to procure essential physical components. These components include the main machine-processing equipment, production support, office furniture, digital scales, coolers or refrigerators for temperature-controlled product storage, packaging tools (e.g., a sealing *machine),* and other technical infrastructure (Beckett, 2019).

A fundamental characteristic of investment cost is that it is not completed in a single production cycle. Return on investment capital occurs gradually in the long term through cost elimination and depreciation *expense* calculated based on the economic value of each asset (Ross et al., 2019). Therefore, investment in technology processing requires a relatively long time to reach the break-even point and recoup the initial capital invested.

Details on the estimated price and type-specific equipment requirements for optimizing cocoa or chocolate processing units are shown in Table 1.

Table 1. Investment Costs

No	Tool Name & Use	Standard Specifications	Estimated Unit Price (IDR)
1	Machine Roasted Cocoa (*Cocoa Roaster*). Roasting seed cocoa dry For gives off a distinctive aroma chocolate.	Capacity 10 kg/process, stainless steel drum, LPG gas heater.	15,000,000
2	Peeling Machine & Nibs Separator (*Winnower*). Break seed cocoa bake and separate skin Ari with meat nibs.	Capacity 10-15 kg/hour, separator blower, type *home-scale.*	6,000,000
3	Chocolate Grinding Machine (*Ball Mill / Melanger*). Grinding *nibs* into chocolate paste liquid (*liquor*) until fineness <20 microns.	capacity 2–5 kg/batch, granite stone cylinder or *stainless steel* ball.	20,000,000
4	Temperature Control Machine Chocolate (*Tempering Machine*). Maintain stability pasta temperature for best results mold chocolate shiny (*glossy*).	Capacity 10 kg, heater electricity automatic with regulator digital temperature.	7,500,000
5	Granite Separator Table Temperature. Used For technique manual *tempering* (optional / supporting) machine *tempering*).	Granite material thick pure, size 60 x 120 cm.	1,800,000
6	Precision Digital Scales. Weighing material raw materials (*nibs,* sugar, milk) and measuring heavy product before packed.	Accuracy up to 0.1 gram, max capacity 5 kg.	450,000
7	Print Chocolate Polycarbonate (*Chocolate Molds*). Mold container For form chocolate bars or praline.	Food-grade rigid polycarbonate, take it package contains 15–20 units.	1,000,000
8	Refrigerator Special / *Chiller Cooler.* Compacting chocolate after printed for easy issued from mold.	door showcase type, organizer temperature cold stable.	3,500,000
9	Packaging Sealing Tools (*Hand / Continuous Sealer*). Sealing aluminum foil packaging product chocolate to seal air.	Hand sealer type 30 cm long or mini continuous sealer.	1,200,000
10	Equipment Supporters Sanitation & Production. Thermometer infrared / skewer, silicone spatula, stainless steel basin, container storage.	Food-grade standard draft eligibility SMI hygiene.	1,500,000
	Amount		57,950,000

Source: Quoted from various secondary sources

The above investment costs do not yet include the cost of land and buildings, place activity, or business. In case this assumed entrepreneur owns that activity business processing inside buildings that have been there and become the part that is not inseparable from house or forge, the entrepreneur stays.

Operating costs

Operating Costs Variable

Operational expenses are a significant source of power consumption in daily operations and are generally consumed within a single production cycle (Gittinger, 2018). This component also includes the procurement of minor equipment damaged by age and technical depreciation not covered within one year (Ross et al., 2019).

Accurate mapping of operational costs is critical for financial stability and short-term cash flow. Detailed components and values of routine financing are presented in Table 2.

Table 2. Operational Costs Variables

No	Cost Components	Specifications & Requirements (Per month)	Operating costs (IDR/ month)
1	Fermented Dried Cocoa Beans	Main raw material (local SME quality of North Lombok) as much as 250 kg.	22,500,000
2	Granulated Sugar / Palm Sugar	Sweetener for paste mixture, needs 125 kg.	2,250,000
3	Added Cocoa Butter	To increase softness texture chocolate, it needs 25 kg.	3,750,000
4	Packaging Aluminum Foil & Labels	Primary and secondary packaging products (assuming 5,000 sticks of chocolate size 50 g), need 5,000 sets.	3,750,000
5	LPG Gas (3 Kg)	For material burn machine roasting (roaster) for ±2 hours process, need 12.5 tubes.	650,000
6	Electricity Costs (Utilities)	For operational machine breakers, mixer Melanger (running 5,8 hours and 24 days), and chiller, need ±375 kWh.	450,000
7	Clean Water & Sanitation	Cleaning tool standardized hygienic food, need ±12.50 liters.	3,125,000
Total Operating Costs Variable (IDR/ month)			35,925,000

Source: Quoted from various secondary sources

Cost per unit is calculated in proportion to the number of production days, based on assumptions from the processing standard formula for chocolate, with 50%–60% cocoa combined with added sugar and fat (Beckett, 2019). Total monthly expenses are calculated by multiplying the daily cost by 25 (Purnomo, 2014). In addition to the component cost variables, routine agro-industry expenditure is supported by fixed operational costs that are constant in nature with production volume. Details and values of the components are still provided comprehensively in Table 3.

Fixed Operating Costs

Table 3. Fixed Operating Costs

No	Cost Components	Calculation & Allocation of Expenses	Total (IDR/ month)
1	Direct Labor	1 worker for special part production (household scale).	2,259,000
2	Depreciation Machines & Tools	Total machine assets (assuming IDR 55,000,000) depreciated over 5 years without residual value (straight-line method).	91,000
3	Equipment Maintenance	Lubricant costs machine, service periodic, replacement component wear out small.	150,000
4	Marketing & Transportation Costs	Delivery of sample products, internet credit /digital marketing, gasoline logistics local.	500,000
		Amount cost still per process	3,000,000

Source: Quoted from various secondary sources

Operating costs are expenses incurred regardless of whether a production process is underway. Operational costs still include employee fixed wages, amortization (depreciation), maintenance, administrative, and other costs of a fixed and semi-fixed nature. All costs are further added up, resulting in the recapitulation of costs shown in Table 4.

Cost Recapitulation

Investment costs are separated from operational costs because they will be used in ways that are distinct in the financial eligibility analysis. Investment costs and operational fees are summarized in Table 4.

Table 4. Recapitulation of Operational Costs

No	Cost Components		Amount (IDR)
1	Initial Investment Cost		57,950,000
2	Monthly operating costs		38,925,000
2.1	Operating costs variables	IDR 35,925,000	
2.2	Operating costs still	IDR 3,000,000	

Source: Processed from the data in Tables 1, 2, and 3.

Estimated initial capital required for initiating business units processing cocoa ranges between IDR 93 million and IDR 100 million, with allocation of investment costs by 61.73% and operational costs by 38.27% (Table 4). In the manufacturing industry, operational expenditure generally dominates the financing structure (Ross et al., 2019). However, the dominance of cost investment begins. This is a characteristic common to financial operations in micro, small, and home business sectors (Sari & Rahma, 2023). This is due to the high initial capital costs for procuring core technology and processing mechanics for middle-capacity daily production, which remain limited.

Production and Production Value (Benefit)

Production (kg/ month) = 400 kg
Price (IDR/pcs) = 109,000
Production Value = IDR 43,600,000

The production volume of chocolate is estimated to reach 400 kg per month, obtained from the combined mass of standard cocoa seed, sugar, and supporting ingredients such as flavors and emulsifiers (Beckett, 2019). As mentioned, the annual output projection reached 4,800 kg. The total value of production or income, net of taxes, amounts to IDR 43,600,000 per month, calculated as the product of daily output volume and the per-unit selling price (Purnomo, 2014). Indicator mark production is integrated into the analysis of financial eligibility over a term length (Ross et al., 2019). Furthermore, the difference between accumulated mark production and total operational costs is defined as the profit margin, or profit before taxes; the details are presented in Table 5.

Profit Margin

Profit margin is often used as an indicator of performance in large and industrial companies, as well as in small and medium enterprises (SMEs). The profit margin (IDR/ month) is shown in Table 5.

Table 5. Profit Margin Per Month

No	Description	Volume (units)	Unit Price (IDR/unit)	Acceptance Value (IDR/month)
1	Production (kg/ month)	400	109,000	43,600,000
2	Operation Costs (IDR/month)			38,925,000
3	Profit Margin (IDR/month)			4,675,000

Average profit margin for business processing chocolate with material sourced from raw materials from farmer produce profit or profit dirty IDR 4,675,000 per month. Profit margin as part of added value is the difference between production revenue and operational costs (Zukiya, 2021). Investment and Operational Cost Simulation. Assumptions for analysis eligibility investment in business units processing cocoa or chocolate as follows:

a. Number of working days: 25 days per month or 300 days per year
b. Investment Opportunity Cost 1%/ month or 12% per year
c. Age: 60-month project or 5 years. Input and output prices increase according to the inflation rate.
d. Analysis done in unit years, with multiplying benefits (value production) and operational cost per month for one year. One year has 12 months.
e. Simulation of investment and operational costs is conducted at three levels: optimistic, normal, and pessimistic. Optimistic: a 10% increase in investment and operational costs relative to normal conditions. Pessimistic: a 10% decrease in investment and operational costs relative to normal conditions. The simulation results are shown in Table 6.

Table 6. Simulation investment cost and operational costs

No	Investment Eligibility Criteria	Optimistic (Up 10%)	Normal (Constant)	pessimistic (Down 10%)
1	Net Present Value (NPV) (IDR)	-29,896,151.46	144,277,944.95	318,452,041.36
2	Internal Rate Return (IRR)	Uncertain	0.9321	1.9626

In a way, quantitative, projection cumulative profit margin of processing SMEs chocolate reaching the real IDR 144 million mark in five years. However, the nominal amount does not yet reflect variables risk external outside control management (*force majeure*), such as anomaly climate, disruption social and vulnerability disaster nature. Considering that North Lombok Regency is geographical is area vulnerable earthquake earthquakes, tsunamis, and drought, risk swelling cost investment costs (capital expenditure) and operational *expenditure* becomes very high (National Agency for Disaster Management). If the escalation cost happens without being offset by an increase in production volume or an increased selling price, then business profitability will be depreciated and vulnerable trigger loss financial (Table 6).

Modeling results dynamic confirm that under normal business conditions, this own eligibility sustainable financial performance (Lane & Sterman, 2010). The value of the enterprise with increasing costs is still below the critical tolerance limit. On the other hand, if capital rates swell beyond the threshold, SMEs have the opportunity to face big liquidation business. Therefore, the implementation of strict procurement to mitigate *idle capacity* assets becomes an absolute strategy (Beckett, 2019).

Characteristics of financial agro-industry: This is classified as a very sensitive to change component expenditure. Pebriandini et al (2025) recommend that the government should strengthen Farmer Groups and Women Farmer Groups (KWT) through management training and environmentally friendly technology. At the same time, the application of modern technologies—such as superior cocoa varieties and the standardization of seed fermentation—must be accelerated in order to improve product quality and market value

Evidence of sensitivity is reflected from the results of the pessimistic simulation scenario (Table 6). Increase cost investment and operations in a way simultaneously by 10% directly degrade mark *Net Present Value* (NPV) becomes negative (NPV < 0), which indicates project No worthy executed (Ross et al., 2019).

On the other hand, if management succeed do efficiency cost in a way simultaneous of 10%, the NPV value will increase significantly to IDR 318.4 million, with a growth in *Internal Rate of Return* (IRR) of 1.96% per year. Phenomenon this prove that success and sustainability term The long-term development of chocolate SMEs in North Lombok is highly dependent on capabilities management in apply principle efficiency cost (*cost leadership* to optimize financial performance.

CONCLUSIONS AND SUGGESTIONS

Conclusions

a. An increase in investment costs and operational costs of 10% each means that household-scale cocoa processing business activities may not be feasible even if prices and production remain constant under normal conditions.
b. Pessimistic simulations show that a 10% reduction in investment and operational costs each provides the opportunity for household-scale cocoa processing business activities to be carried out sustainably if production and prices remain constant under normal conditions.
c. The household-scale chocolate agro-industry business is considered sensitive, because if there is an increase in investment costs and operational costs of 10% each, then the household-scale chocolate agro-industry business has the potential to go bankrupt.

Suggestions

a. Further simulations are needed to determine the impact of price and production shocks on the sustainability of household-scale chocolate processing businesses.
b. The chocolate processing business is feasible to develop but is very sensitive to an increase in investment costs and operational costs of 10%.
c. Non-essential investment and operational costs should be avoided, or efforts should be made to obtain lower input prices by purchasing directly from producers during the harvest season.

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