Sensitivity Analysis of Chocolate Processing Businesses Based Small and Medium-Sized Industries in Palu City, Central Sulawesi

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Abstract: Agroindustry, as a vital subsystem in agribusiness, has great potential to boost economic growth through significant market share and added value. Most of this sector is dominated by small and medium enterprises (SMEs). Business sustainability can be assessed by its response to changes, such as raw material prices and production declines due to falling demand. This study aims to evaluate business feasibility and sensitivity to changes in raw material prices and production in the chocolate industry. This quantitative descriptive study was conducted in four chocolate processing SMEs in Palu, Central Sulawesi, from September to November 2023 with respondents selected purposively, namely 4 leaders of chocolate SMEs. The analysis used included financial feasibility and sensitivity analysis. The results show that the financial feasibility of chocolate SMIs in Palu, both for secondary and tertiary products, is feasible based on the NPV, IRR, and B/C criteria, with Ema Cokelat SMI being the best. The fastest return on investment was also achieved by Ema Cokelat SMI, which was 2 years and 4 days. In the sensitivity analysis, secondary and tertiary products with an interest rate of 18% showed that the Chocolate Home Industry and Rapoviaka Simple SME were sensitive to a 30% decrease in production and an increase in raw material prices. Meanwhile, Ema Cokelat SME was not sensitive to these two changes, and Sakaya Cokelat SME was sensitive to a decrease in production but not to an increase in raw material costs.

Keywords: Business feasibility; Chocolate; Process; Sensitivity

Introduction

Cocoa (Theobroma cacao L.) is a very important commodity for the global market, as it serves as the main ingredient in the manufacture of chocolate products. The taste and aroma of cocoa cannot be replaced by other commodities (Ramlan et al., 2018). Indonesian processed cocoa products have a comparative advantage (Rahmadona et al, 2023) Export value reached USD 1.78 billion and export volume amounted to 506,926 tons in 2021 (Masitah & Hasbiadi, 2022). Currently, people around the world enjoy chocolate in various forms, with cocoa bean consumption reaching more than 3 million tons annually, according to data from the International Cocoa Organization (ICCO) (Utami & Sisfahyuni, 2013; Purba et al., 2018). Cocoa beans, rich in flavonoids, a type of antioxidant, play an important role in fighting free radicals that can support health (Nurhayati et al., 2020).

Indonesia occupies a very significant position as the third largest exporter in the world, after Ivory Coast and Ghana (Lestari dan Idris, 2019). But, cocoa production and export globally, especially to the European and American markets (Ramdhani & Dewi, 2025). However,

Indonesia's export value is greater in dried beans, so the benefits obtained by all cocoa stakeholders are not very significant (Marliyah, 2022). Despite the global economic downturn, the processed cocoa market still has great potential for growth (Aviny, 2022). cocoa also contributes to regional development and agro-industry development (Kementan, 2023; Zulfiandri & Marimin, 2012; Hasibuan et al., 2012; Maulana & Kartiasih, 2017).

Agro-industrial development is a strategic step in agricultural development (Astuti & Nofialdi, 2014; Gultom & Sulistyowati, 2018). One agro-industrial product that is now known and loved by almost all circles, and has become a favorite food, especially among children and teenagers, is processed chocolate. Over time, the demand for chocolate increased, and chocolate became famous throughout the world, including in Indonesia (Ramlah, 2016; Rawel et al., 2019). The cocoa agroindustry, in this case processed chocolate, which consists of various derivative products, both secondary and tertiary, has enormous development potential (Marliyah et al., 2020). An increase in the added value of agroindustrial products can improve comparative and competitive advantages (Marliyah, 2022).

In Indonesia, specifically in the city of Palu, Central Sulawesi, there are several industries that process chocolate, namely the Rumah Cokelat Industry, which processes cocoa beans into chocolate bars, and there are several Small and Medium Industries (SMI), including Ema Cokelat SMI, Rapoviaka Simple, and Sakaya Cokelat, which process tertiary chocolate with various types of products and their own characteristics. Like any business, for its development and sustainability, a business analysis should be conducted to evaluate the performance of the business in order to generate maximum profits (benefits) and business efficiency. Therefore, it is necessary to know how much benefit and profit is obtained, the costs incurred, the investment payback period, and how sensitive the business is to changes in raw material prices and in the event of a decline in production. This study aims to evaluate business feasibility and sensitivity to changes in raw material prices and production in the chocolate industry.

Method

Research location and time

The research location was determined purposively (purposive sampling), namely four chocolate processing industries, one industry that processes fermented cocoa beans into chocolate bars, and three small and medium industries (SMI) that process chocolate bars into tertiary chocolate products, considering that these four industries are consistent in processing and developing

Central Sulawesi chocolate products. This research was conducted from September to November 2023.

Sampling methods

The determination of samples/respondents in this study was determined purposively (purposive sampling), consisting of 1 representative from the chocolate bar processing industry (Industri Rumah Cokelat) and 3 tertiary chocolate processing SMEs in Palu City (Rapoviaka Simple SMI, Ema Cokelat SMI, and Sakaya Cokelat SMI). Each of these four industries was represented by its leader, considering that the leaders of these SMEs were deemed to have the most knowledge about their businesses, ranging from the processing of each product, the amount of costs and production, and the types of materials used for each type of product produced, so that they could provide accurate information.

Type of research and data sources

This research is a quantitative descriptive study conducted through surveys and direct interviews with each respondent. The data collected in this study consists of primary and secondary data. Primary data is information obtained directly from the respondents who are the subjects of the study, including data on fixed costs, such as equipment depreciation, employee salaries, business taxes, and others. Meanwhile, variable costs include expenses for raw materials, additional materials, packaging costs, and costs incurred in the process of processing fermented cocoa beans into chocolate bars and tertiary chocolate products produced by the three SMEs. Secondary data was obtained from various government agencies and related parties. This data includes various publications issued by the Central Statistics Agency or Regional Statistics Offices and other institutions related to this study, including literature studies such as books and journals from previous research.

Data collection techniques

Data collection techniques are a stage in obtaining the primary and secondary data required for research. Systematic data collection procedures can be carried out through various methods, such as observation, interviews using questionnaires, and documenting everything relevant to the research (Nasih, 2017).

Data analysis methods

This study applies data analysis, namely Financial Feasibility and Sensitivity Analysis with investment criteria that include: Net Present Value (NPV), Net Benefit-Cost Ratio (Net B/C), Internal Rate of Return (IRR), and Payback Period (PP). The business calculations were carried out over five (5) years, which

were analyzed using the following formula Kadariah et al. (2000):

Net Present Value (NPV)

$$NPV = \Sigma PV\ Bt - \Sigma PV\ Ct \qquad (1)$$

Note:

Bt = Revenue (benefit) in year t

Ct = Cost in year t

The assessment criteria are as follows:

NPV >0 : The chocolate agroindustry venture is feasible/profitable

NPV < 0: The chocolate agroindustry venture is not feasible/loss-making

NPV = 0: The chocolate agroindustry is at break-even point

Internal rate of return (IRR)

IRR is the interest rate that makes the NVP of the business equal to zero. Mathematically, IRR is expressed by the formula of Kadariah et al. (2000):

i_1 = Discount rate that produces a negative NPV

i_2 = Discount rate that produces a positive NPV

Net Benefit Cost Ratio (Net B/C)

Net B/C is the ratio between the total present value of positive net benefits (Bt-Ct>0) and the total present value of negative net benefits (Bt-Ct<0). Mathematically, Net B/C is formulated as expressed by Kadariah et al. (2000):

$$Net\frac{B}{C}Ratio = \frac{\Sigma PV\ net\ Bt\ Positive}{\Sigma PV\ net\ Bt\ Negetive} \qquad (2)$$

Note:

Bt = Net benefit in year t

Based on business criteria:

Net B/C>1: Business is viable

Net B/C<1: Business is not viable

Payback Period (PP)

The payback period (PP) is an evaluation method used to determine the duration (period) of return on investment for a project or business. The payback period can be expressed by the following formula:

$$PP = \frac{Investment\ amount \times 12\ months}{Net\ cash\ flow} \qquad \textbf{(3)}$$

The evaluation criteria for the payback period are as follows:

- If the *payback period* is less than the maximum time, the project proposal will be accepted.

- If the Payback Period is longer than the maximum time, the project proposal will be rejected.

Sensitivity Analysis

Sensitivity analysis is a method for assessing the impact that may arise due to changes in conditions. This method is used to calculate the sensitivity of economic analysis (NVP, IRR, Net B/C, Gross B/C, and PP) to variations that occur, such as increases in production costs, decreases in selling prices, and reductions in production volume. Sensitivity rate analysis can be formulated as follows (Kadariah et al., 2000).

$$Sensitivity\ rate = \frac{\frac{x_1 - x_0}{x_r}}{\frac{Y_1 - Y_0}{Y_r}X} \times 100\% \qquad (4)$$

Description:

X1= NVP/IRR/ Net B/C Ratio/Gross B/C Ratio after change

Xo= NPV/IRR/ Net B/C Ratio/ Gross B/C Ratio /PP/ before change.

Xr= Average change in NPV/IRR/ Net B/C Ratio/ PP/ Gross B/C Ratio

Y1= Selling price/production cost/production after change

Yo= Selling price/production cost/production before change
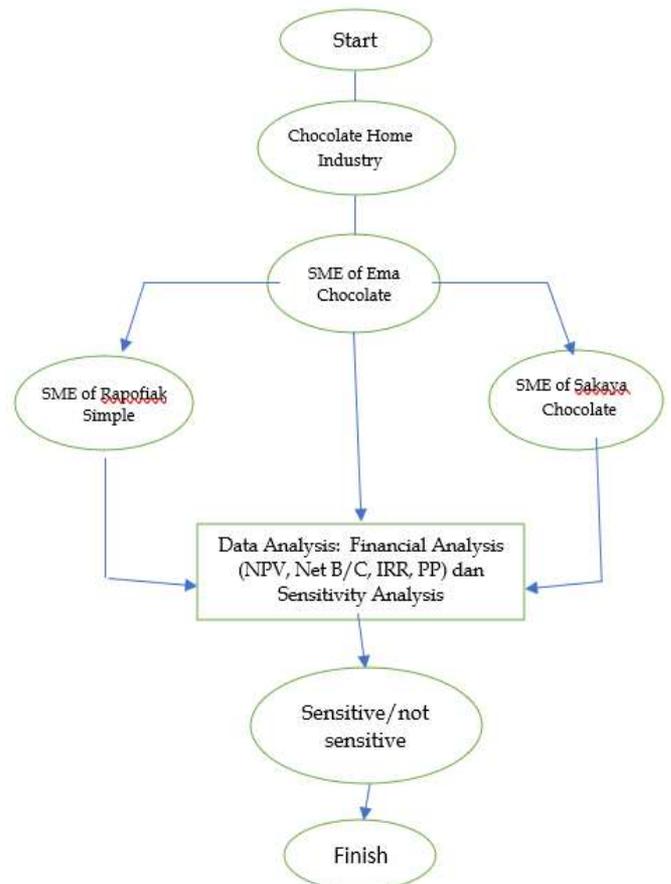
Yr= Average change in selling price/production cost

Figure 1. Research Flow Chart

Result and Discussion

The Central Sulawesi cocoa agroindustry is a processing industry that processes locally fermented cocoa beans into chocolate paste (liquor), which is then used to produce five types of chocolate products (liquor, dark 90%, dark 80%, milk 60%, and milk 56%) as semi-finished materials or finished materials in the form of chocolate bars. These are considered finished products because chocolate paste that has been added with sugar, milk, chocolate fat, lecithin, and vanilla (chocolate bars) can be consumed directly by consumers and can also be reprocessed to add flavor variants according to consumer tastes, such as coffee, peanut, chocolate coco chips, and so on, as is done by several SMEs in Palu City. The costs and revenue figures used in this study were calculated from the establishment of the business in 2019 up to 2023 (the last five years of production).

Table 1. Revenue, Investment Costs, Fixed Costs, and Variable Costs of Chocolate Processing SMEs in Palu City Over 5 Years of Production

No	Description	Chocolate Home Industry	Ema Chocolate SMI	Rapoviaka Chocolate SMI	Sakaya Chocolate SMI
	Revenue				
A	Total sales	2,266,250,000	1,642,400,000	1,297,200,000	1,196,000,000
	Avarage	453,250,000	328,480,000	259,440,000	239,200,000
B	Investment	329,101,183	356,698,060	261,690,000	179,770,714
	Fixed cost				
C	Total	356,124,250	228,580,000	171,430,000	138,638,570
	Avarage	43,584,800	45,716,000	34,286,000	27,727,714
D	Variable cost	1,371,503,690	308,904,000	198,682,500	495,420,500
	Avarage	274,300,738	61,780,800	39,736,500	99,084,100

Variable Costs

The chocolate processing industry incurs various costs, such as production costs or variable costs, which are incurred according to the type and quantity of production we aim to achieve and vary in each production process. Variable costs, often referred to as variable costs, are costs incurred by companies that vary according to the quantity of products produced. The higher the volume of products produced, the greater the costs that must be incurred for the production process. Conversely, if the volume of products produced is low, the costs incurred will also be reduced (Assauri, 2008). The variable costs referred to in this study are raw material costs, auxiliary material costs, and packaging costs. The use of variable costs is shown in Figure 2.

Figure 2. Total and Average Variable Costs of the Chocolate Processing Industry Over 5 Years

The total and average variable costs incurred by the chocolate industry over 5 years show that the Chocolate Home Industry ranks first in variable cost expenditure among the four industries studied, amounting to IDR 1,371,503,690 with an average of IDR 274,300,738 per year. The SME with the smallest variable cost expenditure is Rapoviaka Simple SME, with a total expenditure not exceeding the average expenditure of the Chocolate Home Industry, amounting to IDR 198,682,500 with an average of IDR 39,736,500. As shown in Figure 2.

Fixed Costs

Fixed costs, often referred to as fixed expenses, refer to business expenses that are not affected by fluctuations in the quantity of goods or services produced. In other words, these fixed costs will remain constant even if there are variations in the quantity of goods and services produced within certain limits. These expenses are generally related to time, such as building rent, property tax, machine depreciation costs, and insurance paid monthly or annually. These costs must still be borne or paid even if the company does not produce any goods or services at all (Assauri, 2008). In this study, the fixed costs taken into account include depreciation of machinery and equipment, labour wages, electricity costs, laboratory testing costs, and taxes.

Figure 3 shows the fixed costs incurred by four chocolate processing industries over the last five years, indicating that Rumah Cokelat has the largest fixed costs at IDR 356,124,250, followed by Ema Cokelat SMI at IDR
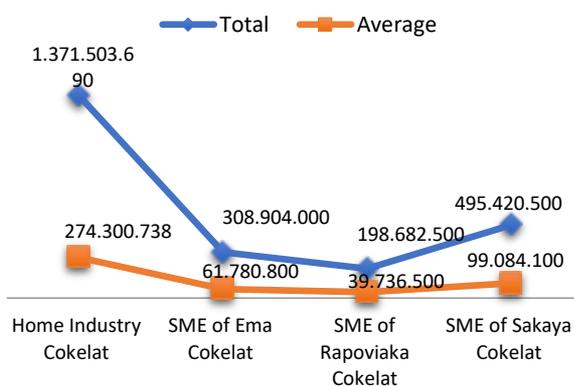
228,580,000. Then, Rapoviaka Simple SMI has fixed costs of IDR 171,430,000, and the smallest is Sakaya Cokelat SMI with a value of IDR 138,638,570. As seen in Figure 3.
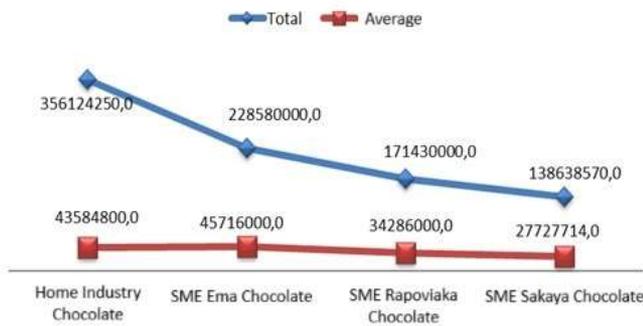

Figure 3. Total and Average Fixed Costs of the Chocolate Processing Industry Over 5 Years

Equipment Depreciation Costs

Equipment depreciation costs in the chocolate processing agroindustry, both at the secondary and tertiary product processing levels, namely in the Chocolate Factory Industry and respondent SMEs, each use different equipment and therefore have different equipment depreciation costs, as shown in Figure 3 below. Based on the calculation of equipment depreciation costs for each chocolate processing industry, the highest average annual equipment depreciation cost was for the Chocolate House Industry at IDR 29,370,050.0, followed by Ema Chocolate SMI at IDR 25,188,000.0, Rapoviaka Simple SMI at IDR 13,082,000.0, and the lowest was Sakaya Chocolate SMI at IDR 9,845,714.0. The depreciation costs of equipment from the four chocolate processing industries can be seen in Figure 4.
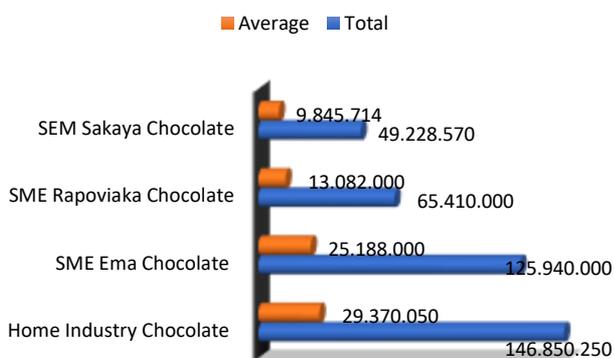

Figure 4. Total and Average Depreciation Costs for Chocolate Processing SMEs Over 5 Years

Investment Costs

Investment activities are crucial activities that require significant funds and have a long-term impact on business continuity. Therefore, systematic and rational analysis is required before implementing such activities. Investment is a process of placing capital for the long term, where it is important to realise from the outset that this investment will be accompanied by various additional expenses that need to be prepared periodically. These expenses include buildings, vehicles and office inventory. The investment costs incurred for each secondary and tertiary chocolate processing industry are as follows: The investment costs for the Rumah Cokelat industry are IDR 329,101,183, Ema Cokelat SMI are IDR 356,698,060, Rapoviaka Simple SMI are IDR 261,690,000, and Sakaya Cokelat SMI are IDR 179,770,714.

Production and Revenue

Production is an activity in which a number of goods and services known as inputs are processed into other goods and services called outputs.

Activities that take place in the production process include changes in form, location, and time, as well as the utilisation of the results of that production. The main objective of industry is to make a profit from the products produced. In industry, sufficient sales volume and market demand are absolute requirements for a business to start, run, and succeed. Sales volume determines decisions regarding production volume, the amount of capital that needs to be provided, labour requirements, and others. Revenue is the product of the amount of production and the selling price. The amount of revenue is greatly influenced by the volume of production and the price of the product. An overview of the revenue of the four chocolate processing SMEs in Palu City is shown in Figure 5.
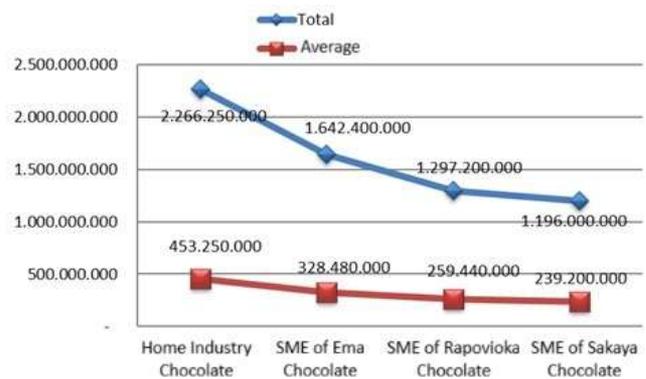

Figure 5. Total and Average Revenue of Chocolate Processing SMEs Over 5 Years

Figure 5 above shows that of the four chocolate processing industries, the one in first place is chocolate home industry with revenues reaching IDR 2,266,250,000 or average revenues of IDR 453,250,000/year. Next, the second largest revenue is Ema Chocolate SMI with IDR 1,642,400,000 or an

average revenue of IDR 328,480,000/year, followed by Rapoviaka Simple SMI, which had revenues of IDR 1,297,200,000 or an average revenue of IDR 259,440,000 per year. And the lowest revenue is Sakaya Cokelat SMI with IDR 1,196,000,000 or an average revenue of IDR 239,200,000 per year.

Financial Feasibility Analysis

An effort to achieve maximum profit is highly dependent on the amount of profit generated from the production process. Therefore, when planning a business, it is important to consider whether the business is capable of generating profits or not. In addition, it is necessary to understand how much profit can be obtained, the costs that must be incurred, the total expected profit, and the time required to return the investment. All of this is done to assess whether a business is feasible and will provide the expected benefits.

Financial analysis is a method of assessing whether an investment is feasible or not based on financial aspects. In general, there are several criteria used to determine the feasibility of a business, depending on the conditions and requirements, namely NPV (Net Present Value), Net B/C (Benefit Cost Ratio), IRR (Internal Rate of Returns), PP (Payback Period), and BEP (Break Even Point). A more detailed explanation can be seen in Table 2.

Table 2. Revenue, Investment Costs, Fixed Costs and Variable Costs of Chocolate Processing SMEs in Palu City During 5 Years of Production

No	Financial Analysis	Description				Note
		Chocolate Home Industry	Rapoviaka Chocolate SMI	Ema Chocolate SMI	Sakaya Chocolate SMI	
1	NPV	10,136,268	280,112,603	321,725,583	151,806,971	Worthy
2	Net B/C	1.03	2.07	1.91	1.84	Worthy
3	IRR (%)	18.62	48.35	48.20	43.49	Worthy
4	PP (Thn)	2.53	2.54	2.04	2.12	Worthy

Sumber: Data primer setelah diolah, 2023

Based on the financial analysis conducted on four chocolate processing industries, as shown in Table 2 above, it can be concluded that:

NPV (Net Present Value)

Net Present Value (NPV) of a project is the current value of the difference between benefits and costs at a certain discount rate. NPV shows the advantage of benefits over costs incurred. The NPV method is one way to calculate the time value of money related to an investment. Using this method, we can determine whether investments made in the past or present will provide future returns.

Based on the calculation results of an 18% discount factor, the NPV value for five years of calculation according to the present value was obtained for each industry, namely the Chocolate House Industry obtained an NPV of IDR 10,136,268; Rapoviaka Simple SMI obtained an NPV of 280,112,603; Ema Chocolate SMI generated an NPV of IDR 321,725,583, while Sakaya Chocolate SMI recorded an NPV of IDR 151,806,970. These figures show that the cash inflows from the four industries exceed the cash outflows (NPV > 0), or in other words, the NPV obtained is positive or greater than zero. This indicates that investment in the four industries is financially profitable and feasible.

Net B/C (Benefit Cost Ratio)

The Net Benefit Cost Ratio is the comparison between the total positive NPV and the total negative NPV. The Net B/C calculation method is used to provide an overview of how much benefit can be obtained compared to the costs incurred (Kadariah et al., 2000). The analysis results show that in each industry, such as the Chocolate House Industry, the B/C value obtained is 1.03. With a B/C value greater than 1, this indicates that the business is feasible to continue. A B/C value of 1.03 indicates that for every IDR 1,000 spent, a benefit of IDR 1,030 will be obtained. Furthermore, Rapoviaka Simple SME recorded a B/C value of 1.86 (B/C > 1), Ema Chocolate SMI achieved a B/C value of 1.91 (B/C > 1), and Sakaya Chocolate SMI had a B/C value of 1.84 (B/C > 1). This means that every additional cost of IDR 1,000 will generate a benefit of IDR 1,840. Of the four industries, it can be seen that the highest B/C ratio is achieved by Ema Cokelat SMI.

IRR (Internal Rate of Return) (%)

IRR is the interest rate obtained from a project in a certain period that makes the NPV value of the project zero. This analysis aims to identify the rate of return on investment generated from capital investment in related projects (Kadariah et al., 2000). Furthermore, Nuryanti et al (2023) state that Internal Rate of Return (IRR) is a business feasibility analysis that seeks the interest rate at which the present value of the investment is equal to the

present value of the revenue. A business can be considered feasible if the interest rate calculated by IRR is greater than the prevailing bank interest rate at that time. Based on the calculation results, the IRR values obtained from the four industries are as follows: the Chocolate House Industry obtained an IRR of 18.624%, Rapoviaka Simple SME obtained an IRR of 48.35%, Ema Chocolate SMI obtained an IRR of 48.20%, and Sakaya Chocolate SMI obtained an IRR of 43.49%.

This value is higher than the bank interest rate used in the calculation, which is 7.5% (the current Bank Indonesia interest rate). This shows that the rate of return on investment in establishing a cocoa agro-industry business is higher than the rate of return obtained from investing in a bank. Therefore, entrepreneurs should invest their capital in establishing a cocoa agro-industry business rather than keeping their money in a bank.

PP (Payback Period)

The payback period (PP) is the duration that indicates when the cumulative cash flow equals the total investment in present value. PP is used to assess how long it will take for an investment in the development of the chocolate processing industry to pay for itself (Kadariah et al., 2000). The payback period (PP) is the number of years required for a business to recover its initial investment costs through the accumulation of discounted net profits. The payback period is a business feasibility analysis based on the time required to recover the investment from the total revenue (calculated in present value) (Nuryanti et al., 2023). Based on the calculation results, the average PP value for the chocolate processing industry, which consists of four processing industries, is 2 years, 5 months, and 3 days for the Chocolate House Industry, 2 years, 5 months, and 4 days for the Rapoviaka Simple SMI, 2 years and 4 days for the Ema Chocolate SMI, and 2 years, 1 month, and 2

days for the Sakaya Chocolate SMI. This means that if the chocolate processing business can cover the initial investment costs before the business reaches its end, then the establishment of this business is worth implementing.

Sensitivity

According to Wicaksono (2012), the purpose of establishing a business is to obtain maximum profit and maintain business continuity, but at the same time, companies also face various risks, including receiving profits that are not as expected. The company's operational activities in generating profits are influenced by several factors, including operational costs and the prices of the products produced.

The higher the operational costs, the lower the profit received by the company. Kadariah et al (2000) state that sensitivity analysis aims to assess the extent to which a company responds to changes in factors that affect its operations in generating profits. This analysis focuses on the company's sensitivity to changes, namely: (1) an increase in raw material costs and (2) a decrease in production levels.

The current increase in raw material prices has the potential to cause a significant decline in the level of profits that can be achieved by companies. This shows that fluctuations in raw material costs have a considerable impact on a company's financial performance. To provide a clearer picture of the impact of rising raw material costs, particularly in the context of the Chocolate Processing Industry, a sensitivity analysis has been conducted, the results of which can be seen in Table 3 below. The table provides detailed information on how changes in raw material prices can affect the profitability of companies in this industry. Thus, a thorough understanding of these factors is essential for company management to take the right strategic steps in facing the challenges posed by rising raw material costs.

Table 3. Results of Sensitivity Analysis of a 30% Increase in Raw Material Costs and a 30% Decrease in Production Discount Factor 18% in the Chocolate Processing Industry in Palu City

Industry	Sensitivity	NPV (i = 18 %)	Net B/C (i = 18 %)	description
Chocolate House Industry	Normal Conditions	10,136,268	1.03	TS
	Production decreases by 30%	- 408,288,986.88	0.24	S
	Raw materials increase by 30%	-6,323,712	0.98	S
Ema Chocolate SMI	Normal Conditions	321,725,583.00	1.90	TS
	Production decreases by 30%	20,125,983.00	1.06	TS
	Raw materials increase by 30%	286,971,708.00	1.80	TS
Rapoviaka Simple SMI	Normal Conditions	280,112,602.50	2.07	TS
	Production decreases by 30%	-223,309,937.50	0.15	S
	Raw materials increase by 30%	252,912,802.50	1.97	TS
Sakaya Chocolate Industry SMI	Normal Conditions	151,806,970.41	1.84	TS
	Production decreases by 30%	61,212,229.59	0.66	S
	Raw materials increase by 30%	88,445,170.41	1.49	TS

Source: Processed primary data, 2023

Note: S (sensitive), TS (not sensitive)

In Table 3 above, there are three scenarios used to examine sensitivity analysis, namely under normal conditions, a 30% decline in production, and a 30% increase in raw material costs with a discount factor of 18% to see if there are changes in NPV and Net B/C.

The sensitivity analysis for the Chocolate Industry shows that under normal conditions with an interest rate (i = 18%), the NPV is IDR 10,136,268, with a net B/C value of 1.03, which means that this business is feasible. In Scenario 1, with a 30% decrease in production, the Chocolate Home Industry incurred a loss of IDR 408,288,986.88. In Scenario 2, when raw material costs are increased by 30%, the Chocolate House Industry still experiences a loss of IDR 6,323,712. Thus, it can be said that if there is a 30% increase in raw material costs and a 30% decrease in production, the Chocolate House Industry will experience a loss. In conclusion, the Chocolate Home Industry is sensitive to a 30% decrease in production and a 30% increase in raw material costs (i-18%). The industry has already suffered losses when raw material prices rose 30% from the normal price of IDR 48,000/kg. When measured against the current conditions, where cocoa bean prices have risen by 150% since the end of 2024, one can imagine the current state of the chocolate industry. This will certainly affect the cost of production of secondary chocolate (bars) that will be processed by tertiary chocolate processing SMEs. Once again, the performance of the chocolate industry will deteriorate further and have an impact on the economic conditions of the communities involved in it.

The results of the sensitivity analysis of Ema Cokelat SMI show that under normal conditions, the NPV value is IDR 321,725,583, where this SME is in a profitable position, with a Net B/C value of 1.90, which means that this business is feasible to run. In Scenario 1, with a 30% decrease in production, it can be seen that this SMI still makes a profit of IDR 20,125,983, and the Net B/C value is 1.06, which means that this business is feasible. In Scenario 2, where raw material costs are increased by 30%, Ema Cokelat SMI still makes a profit of IDR 286,971,708, and the Net B/C value is 1.80. Thus, in Scenarios 1 and 2, namely an increase in raw material costs and a 30% decrease in production, this business is still feasible to run. In conclusion, Ema Cokelat SMI is not sensitive to a 30% increase in raw material costs and a 30% decrease in production.

The results of the sensitivity analysis on Rapoviaka Simple SMI show that under normal conditions, the NPV value obtained is IDR 280,112,602.50, which means that SMI makes a profit with a discount factor (i = 18%) and a Net B/C value of 2.07, which means that this business is feasible. In Scenario 1, with a 30% decline in production, Rapoviaka Simple SMI incurred a loss of IDR 223,309,937.50, with a Net B/C value of 0.15, which means that it is not feasible to run. Meanwhile, in Scenario 2, when raw material costs are increased by 30%, this SMI earns a profit of IDR 252,912,802.50, with a Net B/C value of 1.97, which means that this business is feasible. In conclusion, the Rapoviaka Simple SMI is sensitive to a 30% increase in raw material costs, but not sensitive to a decrease in production.

The sensitivity analysis results for the Sakaya Cokelat SMI show that under normal conditions, the NPV is IDR 151,806,970.41, placing the industry in a profitable position with a discount factor (i = 18%) and a Net B/C value of 1.84, meaning that this business is feasible. In Scenario 1, with a 30% decrease in production, Sakaya Chocolate SMI is at a loss with a value of IDR 61,212,229.59, where the Net B/C value is 0.66, which means that this business is not feasible. Meanwhile, in Scenario 2, when raw material costs are increased by 30% with a discount factor (i=18%), SMI still makes a profit of IDR 88,445,170.41, with a Net B/C value of 1.49, which means that this business is feasible. In conclusion, Sakaya Cokelat SMI is sensitive to a 30% decrease in production but not sensitive to a 30% increase in raw material costs.

When compared to the results of research conducted by Sadimantara et al (2014) on the financial feasibility of vacuum roasting cocoa powder and cocoa butter products on a small industrial scale, where the total investment value was IDR 690,859,730 and the total production cost was IDR 476,676,567. The investment feasibility test results consist of a Net B/C value (2.05), NVP (IDR 1,418,869,949), IRR (43.1%), and a return on investment period of 2 years and 7 months. The results are not sensitive to a 10% decrease in production and increase in raw material costs, with a discount factor of 15%. In addition, the capital invested is also greater than that in this study. Therefore, the results of this study show that the investment criteria value is lower with a higher discount factor (18%). In addition, the study by Sadimantara et al (2014) also invested much higher capital, almost half of the investment value of this study, and produced different products, resulting in different operational costs.

Conclusion

Based on the results of data analysis, it can be concluded that of the four chocolate processing SMEs in Palu City, Central Sulawesi, the financial feasibility of the cocoa agroindustry, both from secondary and tertiary products of the four chocolate processing industries, can be said to be feasible with the criteria (NPV, IRR, B/C), and the highest is Ema Cokelat SME. followed by the fastest investment return period (PP) also obtained from Ema Cokelat SME, which is 2 years and 4 days. Meanwhile, the results of the sensitivity analysis of secondary and tertiary products with an

interest rate (18%) show that the Chocolate Home Industry and Rapoviaka Simple SME are sensitive to a 30% decrease in production and an increase in raw material costs. IKM Ema Cokelat is not sensitive to a 30% decrease in production and a 30% increase in raw material costs; IKM Sakaya Cokelat is sensitive to a 30% decrease in production and not sensitive to a 30% increase in raw material costs. With the 150% increase in cocoa bean raw material prices since the end of 2024, all chocolate processing industries can be said to be sensitive to increases in raw material prices and declines in production. This situation requires serious attention from the government so that SMEs that depend on the cocoa agroindustry for their livelihoods can provide quick and appropriate solutions.

Conflicts of Interest
No conflict of interest.

References

Assauri, S. (2008). *Manajemen Produksi dan Operasi* (4th ed.). Fakultas Ekonomi Universitas Indonesia.

Astuti, H., & Nofialdi. (2014). Strategi Pengembangan Agroindustri Cokelat Olahan Berbasis Kelompoktani Di Kelurahan Kapalo Koto Kota Payakumbuh Sumatera Barat Agroindustry Development of Strategy Processed Chocolate Farmer Groups in Kapalo Koto Village Payakumbuh City West Sumatera. *Jurnal Agroindustri*, *4*(1), 1–7. https://www.scribd.com/document/406971881/2757-10178-4-PB

Aviny, E. Y. (2022). Kinerja Keuangan Perusahaan Kakao Selama Pandemi Covid-19: Sebuah Pendekatan Economic Value Added (EVA). *Jurnal Agribisnis Indonesia*, *10*(1), 76–84. https://doi.org/10.29244/jai.2022.10.1.76-84

Gultom, J. Y. T., & Sulistyowati, L. (2018). Strategi Pengembangan Agroindustri Manisan Mangga (Studi Kasus Pada Umkm Satria Di Kecamatan Kedawung, Kabupaten Cirebon). *Jurnal Ilmiah Mahasiswa AGROINFO GALUH*, *5*(1), 961–972. https://doi.org/http://dx.doi.org/10.25157/jimag.v5i1.1442

Hasibuan, A. M., Nurmalina, R., & Wahyudi, A. (2012). Analisis Kebijakan Pengembangan Industri Hilir Kakao (Suatu Pendekatan Sistem Dinamis). *Informatika Pertanian*, *21*(2), 59–70. https://doi.org/10.21082/ip.v21n2.2012.p59-70

Kadariah, Karlina, L., & Gray, C. (2000). *Pengantar Evaluasi Proyek* (Revisi). Lembaga Penerbit Fakultas Ekonomi Universitas Indonesia.

Kementan. (2021). *Statistik Pertanian. 2021. Pusat Data dan Sistem Informasi Pertanian Kementerian Pertanian Republik Indonesia*. Kementerian Pertanian Republik Indonesia.

Lestari, U., & Idris, M. (2019). Peran Kelompok Tani Dalam Kegiatan Usahatani Kakao Di Desa Ketulungan Kecamatan Sukamaju Kabupaten Luwu Utara. *Jurnal Agribisnis Indonesia*, *7*(2), 92–101. https://doi.org/10.29244/jai.2019.7.2.92-101

Marliyah. (2022). *Analisis Mutu, Nilai Tambah, Kelayakan Finansial dan Pengembangan Agroindustri Kakao Di Kota Palu*. Universitas Tadulako.

Marliyah, Anshary, A., Antara, M., & Setiawan, B. (2020). Raw Materials Quality and Additional Value of Central Sulawesi Cocoa Agroindustry on Rumah Coklat Industry in Palu , Indonesia. *International Journal of Agriculture and Biological Sciences*, *3*, 26–36. https://zenodo.org/records/4625377

Masitah, & Hasbiadi. (2022). Daya Saing Komoditas Ekspor Unggulan Kakao Sulawesi Tenggara , Indonesia di Pasar Internasional (Competitiveness of Southeast Sulawesi , Indonesia's Leading Export Commodity Cocoa in the International Market) daripada dijual di pasar domestik . Hal ini. *Agro Bali : Agricultural Journal*, *5*(3), 559–567. https://doi.org/https://doi.org/10.37637/ab.v5i3.1025

Maulana, A., & Kartiasih, F. (2017). Analisis Ekspor Kakao Olahan Indonesia ke Sembilan Negara Tujuan Tahun 2000–2014. *Jurnal Ekonomi Dan Pembangunan Indonesia*, *17*(2), 103–117. https://doi.org/10.21002/jepi.v17i2.664

Nasih, M. (2017). *Metode Penelitian*. Ghalia Indonesia.

Nurhayati, R., Agustin, I., Rahayu, E., & Herawati, N. (2020). Aktivitas Antioksidan dan Total Fenol Coklat yang Diperkaya Dengan Kayu Manis (Cinnamomum verum) dan Jahe (Zingiber officinale). *Jurnal Penelitian Pascapanen Pertanian*, *17*(3), 146–153. https://doi.org/10.21082/jpasca.v17n3.2020.146-153

Nuryanti, D. M., Dewi, I. C., Akbar, A., Olii, N., Erwina, Insani, N., Jafar, I., Bachri, S., Asih, E. W., Rasyid, S.

A., Mappatoba, M., Marliyah, & Nurwati, N. (2023). *Kewirausahaan Dan Kelayakan Usaha* (Indriana (ed.); Pertama). CV. Ayrada Mandiri.

Purba, H. hardi, Maarif, M. S., Yuliasih, I., & Hermawan, A. (2018). Pengembangan Produk Makanan Cokelat Berbasis Preferensi Konsumen. *Jurnal Teknologi Industri Pertanian*, *28*(1), 40–47. https://doi.org/10.24961/j.tek.ind.pert.2018.28.1.40

Rahmadona, L., Nauly, D., & Putri, D. I. (2023). Analisis Daya Saing Kakao Olahan Indonesia di Negara Tujuan Utama Dunia. *Jurnal AGROSAINS Dan TEKNOLOGI*, *8*(1), 39. https://doi.org/10.24853/jat.8.1.39-46

Ramdhani, B. N. R., & Dewi, N. P. M. (2025). Analysis Of Factors Influencing The Volume Of Cocoa Bean Exports In Indonesia. *International Journal of Management Research and Economics*, *3*(1), 269–290. https://doi.org/10.54066/ijmre-itb.v3i1.2728

Ramlah, S. (2016). Karakteristik Mutu Dan Citarasa Cokelat Kaya Polifenol. *Jurnal Industri Hasil Perkebunan*, *11*(1), 23. https://doi.org/10.33104/jihp.v11i1.3553

Ramlan, Tamrin, & Asyik, N. (2018). Pengaruh Penambahan Nib Kakao Terhadap Karakteristik Fisik, Kimia, Organoleptik Serta Aktivitas Antioksidan Cokelat Batang. *J. Sains Dan Teknologi Pangan*, *3*(5), 1615–1628. http://dx.doi.org/10.63071/jstp.v3i5.5220

Rawel, H. M., Huschek, G., Sagu, S. T., & Homann, T. (2019). Cocoa bean proteins-Characterization, changes and modifications due to ripening and post-harvest processing. *Nutrients*, *11*(2). https://doi.org/10.3390/nu11020428

Sadimantara, M. S., Tamrin, & Asyik, N. (2014). Analisis Kelayakan Produksi Bubuk Kakao Sistem Vacuum Roasting Dan Lemak Kakao Skala Industri Kecil. *AGRIPLUS*, *24*(03), 251–257. https://garuda.kemdiktisaintek.go.id/documents/detail/333060

Utami, S. S., & Sisfahyuni, M. R. Y. (2013). Analisis Sensitivitas Pendapatan Usahatani Kakao Di Desa Buranga Kecamatan Ampibabo Kabupaten Parigi Moutong. *AGROTEKBIS : JURNAL ILMU PERTANIAN (e-Journal)*, *1*(4), 391–398. https://media.neliti.com/media/publications/247806-analisis-sensitivitas-pendapatan-usahata-570fdc9b.pdf

Wicaksono, I. B. (2012). *Analisis Usaha Dan Strategi Pengembangan Agroindustri Rumah Tangga Keripik Pisang Agung (Studi Kasus Pada Kabupaten Lumajang)*. Universitas Brawijaya.

Zulfiandri, & Marimin. (2012). Strategi Pengembangan Agroindustri Kakao Berbasis Kelompok Tani Di Propinsi Sumatera Barat. *Jurnal Inovisi™*, *8*(1), 1–13. https://ejurnal.esaunggul.ac.id/index.php/inovisi/article/view/957/885