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TECHNO-ECONOMIC ANALYSIS FOR THE PRODUCTION OF CASSAVA INTO PLASTIC BAGS WITH A COLLABORATIVE GOVERNANCE PERSPECTIVE TO SUPPORT SUSTAINABLE DEVELOPMENT GOALS (SDGS)

CECEP WAHYUDIN[1], NENG VIRLY APRILIYANI[1*], DESI HASBIYAH[1], GINUNG PRATIDINA[1], RITA RAHMAWATI[1], IRMA PURNAMASARI[1], DEDE SYAHRUDIN[1], MOHAMMAD BINTANG PAMUNCAK[2]

[1]Universitas Djuanda, Jl Tol Ciawi No. 1, Bogor Indonesia
[2]Universitas Kebangsaan Malaysia, Bangi, Selangor, Malaysia. 43600
*Corresponding Author: neng.virly@unida.ac.id

Abstract

This research aims to analyze the techno-economy of cassava into plastic bags from a collaborative governance perspective. The research method was carried out by analyzing cassava into plastic bags, which was seen from production for 20 years by carrying out analysis from various perspectives. The research results show that cassava production into biodegradable plastic bags has economic feasibility if production is carried out for 20 years. This is proven by the technical analysis of converting 1000 kg of cassava to produce 200,000 plastic bags/day with a total production cost per piece of USD 0.018 at the selling price of USD 0.02. However, when production is started, there were significant losses due to equipment and raw materials, reaching a negative value of -2000. Still, in the third year, there was a relatively stable increase until it reached an increase in cumulative net profit each year. Thus, the analytical calculations show significant profit potential with the achieved break-even point (BEP). However, fluctuating raw material prices and operational costs can affect profitability, so there is a need for collaborative governance involvement from the government sector in the policy of using environmentally friendly bags and providing assistance in financing the community as cassava-producing farmers and the private sector as production. Therefore, this research will impact the government's goal of achieving environmental beauty by creating environmentally friendly bags and creating profit opportunities for the community and entrepreneurs/private parties. This study also supports current issues in sustainable development goals (SDGs).

Keywords: Cassava, Collaborative governance, Plastic bag, Techno economy.

1. Introduction

Plastic bag pollution is the biggest and most significant environmental problem globally because plastic bags are everyone's tertiary need. Therefore, plastic bag reduction policies are implemented in various countries, especially in Indonesia, to deal with plastic waste that cannot be destroyed quickly. Much research regarding plastic has been well-developed [1-8].

There is a need to find alternatives to plastic. Many research regarding alternatives have been reported [9]. One of them is the use of cassava [10]. The production of cassava as a primary material for making plastic is a solution for making environmentally friendly bags. Thus, the production of biodegradable plastic becomes an opportunity for sustainable production.

Sustainability in producing biodegradable plastic requires support from various parties. Thus, it needs collaborative governance. Collaborative governance in managing cassava into environmentally friendly plastic bags requires government, community, and private sector/entrepreneur involvement. The government has the authority to make regulations, policies, and financing. The community is a provider of cassava raw materials that can support production. Private/entrepreneurs produce cassava in plastic bags. Thus, the general public can use it. It can encourage the reuse of biodegradable plastic through recycling to avoid the greenhouse effect.

Based on our previous study [11, 12], this research aims to analyze the techno-economics of cassava into biodegradable plastic from a collaborative governance perspective and to describe the production flow of biodegradable plastic. With techno-economic analysis, the total manufacturing costs can be determined starting from raw material costs, equipment costs, utilities, employee salaries, production costs, potential income, and profitability. Meanwhile, with collaborative governance analysis, sustainability can be identified in production, governance, and marketing. The novelty in this research can be seen from an integrative approach between environmentally friendly production technology and collaborative governance. Combining in-depth techno-economic analysis with collaborative governance can significantly contribute to providing solutions to global society to overcome environmental and economic challenges. Apart from that, this research is also expected to become a basis for developing policies to create beauty in the environment and can strengthen collaboration between various stakeholders to realize sustainable development goals and achieve SDGs in protecting land and sea ecosystems [13-23]. The novelty in this research is integrating a collaborative approach in techno-economic analysis to produce cassava-based plastic bags, creating innovative solutions that support current issues in sustainable development goals (SDGs), as reported elsewhere [24-26].

2. Methods

The method used is to analyze the needs of cassava production in plastic bags, starting with an analysis of raw material needs and equipment needs. Raw material prices and equipment prices are analyzed commercially through products available through online shopping websites at current prices. Then, all data is calculated using simple mathematical calculation techniques assisted by analysis in Excel. Next, an economic evaluation is carried out to determine the parameters used,

namely raw material calculations, equipment calculations, utility calculations, employee salary processing, production details, and Total Manufacturing Cost. Next, descriptive analysis was carried out on curves, and collaborative governance analysis was conducted to determine the feasibility and sustainability of cassava production into environmentally friendly plastic bags that the global community can consume [27-29].

This research used a literature review study (see Fig. 1) and calculation for getting a feasibility study.

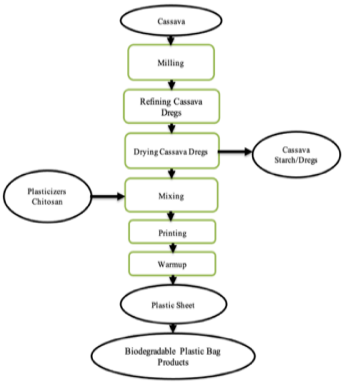

Fig. 1. Flowchart produksi plastik biodegradable.

3. Results and Discussion

The results of the calculation show the number of raw materials needed to produce biodegradable plastic bags on a scale of 1000 kg of cassava for USD 0.99 kg, so it can be seen the total cost per year is USD 690,000. Thus, cassava is the primary basic material used to make biodegradable plastic and has the most significant funding. At the same time, chitosan is needed in lower quantities but has the highest price, and plasticizers have the lowest total costs compared to other raw material needs (see Table 1).

Table 1. Calculation of raw materials.

	Raw material	Requirements per small scale production (kg/hour)	Unit	Requirements per large scale production (scale up 1000x)	Price/kg	Total
A	Cassava	1000	Kg	1	1	1,000
B	Plasticizers	100	Kg	1	4	400
C	Chitosan	10	Kg	1	90	900
			Price/day			2,300
			Price/year			690,000

Biodegradable plastic production requires equipment calculations with a total cost of USD 4.160. Based on the results of the analysis, the plastic industrial mixer

is the most expensive piece of equipment, accounting for 75% of the total equipment cost. Thus, machine quality can influence increasing production efficiency and quality of biodegradable plastic.

Biodegradable plastic production requires utility calculations. The total daily utility costs for all equipment are USD 27.8, using electrical power from various production equipment. In other words, the total annual cost is USD 6.672. This shows significant investment in all production equipment to ensure effective operations in manufacturing biodegradable plastic. Biodegradable plastic production requires employees in the manufacturing process. Hence, the number of employees required is six, with a total monthly salary of USD 1,576 or an annual salary of USD 18.909. The employees needed include a supervisor, assistant supervisor, finance, and three staff members. Thus, labor is part of operational financing. The analysis results on production details show that the production capacity for biodegradable plastic bags per day reaches 200,000 and can reach monthly production of up to 4,000,000 plastic bags assuming 20 working days and reaches production of 48,000,000 biodegradable plastic bags per year. Meanwhile, the total production cost of plastic bags is USD 0.018, with a selling price of USD 0.02, so the total annual income reaches USD 960,000. In other words, even though the production costs per plastic bag are quite high, a profit margin can still be achieved if you consider the difference between production costs and selling prices. Meanwhile, large production capacity also allows for economies of scale to optimize efficiency and profits.

The results of the Fixed cost analysis reached USD 74.952,93, which includes capital costs and depreciation. The Variable Costs reached USD 798.608, consisting of raw materials, utilities, operational labor worth, labor-related costs worth, and costs related to sales worth. With annual sales reaching USD 960,000.00, manufacturing costs worth USD 867.682,40, and investment worth USD 63.009,74, it can be said that the biodegradable plastic bag production project produces a profit of 0.10 with a profit margin. 1.47. In other words, the BEP that can be achieved in producing biodegradable plastic bags from cassava reaches 48,000,000 units, with fixed costs reaching USD 74.952,93 and variable costs reaching USD 798.608. Meanwhile, the resulting Return on Investment (ROI) is 1.57, with a payback period of around 0.60 years. Analysis of the assumptions for biodegradable plastic production from cassava raw materials shows that there is good profit potential with a fast return on investment, even though if you look at the profit margin per unit, it is relatively small.

The curve analysis results show changes in the cumulative net present value (CNPV) to total investment cost (TIC) during the 20-year production period. At the start of production, CNPV/TIC experienced a sharp decline to a negative value of around -2000, reflecting significant initial losses due to large investment costs. However, during the 3rd year of production, the curve begins to rise steadily and increases, so it can be said that biodegradable plastic production experiences an increase in cumulative net profit. Then, in the 5th year of production, the curve reaches the breakeven point and continues to rise steadily until the end of the 20th year. In other words, if we look at the 20th year, it is known that the CNPV/TIC value reached more than 10,000; this shows that the production of biodegradable plastic bags from cassava raw materials produces substantial profits in the long term. Thus, the results of this analysis indicate initial losses when the production process starts. Still, this production has the potential to provide a very positive

return on investment in the long term, accompanied by stability and increasing profits from year to year. The results of the curve analysis can be seen in Fig. 2.

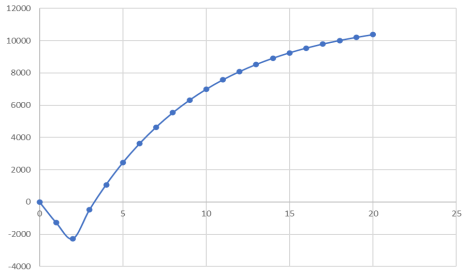

Fig. 2. Cumulative net present value (X) and investment period (Y).

The results of collaborative governance analysis to determine sustainability in the production of cassava into environmentally friendly plastic bags, especially in Indonesia, can become a strategy and support government policy in creating an environmentally friendly environment, which is in line with presidential regulation number 97 of 2017 and the Minister of Environment and Forestry regulation number P.10 /MENLHK/SETJEN/ PLB.0/4/2018. Thus, the results of the techno-economic analysis of cassava production into plastic bags have economic feasibility that can support government policies to create an environmentally friendly environment. Therefore, in realizing the sustainability of cassava production to be environmentally friendly, there needs to be collaborative support from the government, the private sector, and the community in aspects of management, production, and marketing thust it realize sustainable goals that can have a positive impact on the success of government programs to create an environmentally friendly and impactful environment. in an economy that supports increasing social welfare [30].

4. Conclusion

This research concludes that producing biodegradable plastic bags from cassava has economic feasibility if carried out for 20 years. Analysis of various cost components, including raw materials, equipment, utilities, employee salaries, and total production costs, shows that with the conversion of 1000 kg of cassava, 200,000 plastic bags can be produced per day with a production cost per bag of IDR 271.15 and a selling price of IDR 300. Capacity Annual production reaches 48,000,000 bags with an annual income of IDR 14,400,000,000. Despite initial losses due to investment in equipment and raw materials, cumulative net profit began to increase steadily in the third year. Biodegradable plastic production shows significant profit potential, with a break-even point achieved and a return on investment of 1.57 in less than one year. However, fluctuations in raw material prices and operational costs can affect profitability, so collaboration is needed between the government, society, and the private sector to support policies for using environmentally friendly bags and provide financial assistance. This research positively impacts the government's goal of a more beautiful environment and creates profit opportunities for communities and entrepreneurs. Suggestions for further research include research that discusses the sustainability analysis of the

cassava production program into environmentally friendly plastic bags and analysis of collaborative support from the government, private sector, and the community.

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