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PRODUCTION OF ORGANIC FERTILIZER FROM COOKING OIL WASTE TO SUPPORT SUSTAINABLE DEVELOPMENT GOALS (SDGS): TECHNOLOGY AND COST ANALYSIS

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Abstract

The purpose of this study is to provide an evaluation of the economic feasibility analysis of making liquid organic fertilizer from used cooking oil. The research method used is content analysis based on economic feasibility analysis in the next 20 years. The results showed that with the production of liquid organic fertilizer from used cooking oil as much as 50 litres, the total cost for purchasing raw materials was $ 13.35 and purchasing equipment was $128.57. By adding the lang factor, the total investment cost should be less than $ 10,844. This value is considered economical in reducing used cooking oil waste with a calculation of 5,000 L/year and 100,000 L/20 years the project is prospective and profitable as a business opportunity. This economic feasibility study of liquid organic fertilizer production from used cooking oil waste is an effort to support presidential regulation number 97 of 2017 concerning national policies and strategies for managing household waste and waste similar to household waste, which is a government priority program that involves community participation in household waste management which have an impact on changing people's behaviour and culture in forming a clean, healthy and good environment. This study also supports current issues in sustainable development goals (SDGs).

Keywords: Analysis, Cooking oil waste, Economy, Policy, Presidential regulation, SDGs.

1. Introduction

Cooking oil is a liquid material obtained from the distillation process of vegetable materials such as nuts, palm oil, and other materials [1-5]. Cooking oil can be easily found especially in the kitchen for cooking purposes, the results of using cooking oil with a periodic duration of use for a long time will produce used oil that is difficult to handle and can cause pollution [6-10]. Seeing this phenomenon, various innovations have emerged in efforts to utilize waste cooking oil processing, such as waste cooking oil as raw material for organic fertilizer [11-13]. Several parameters that are the focus of the economic feasibility analysis in this study are presented as a description of the business such as gross profit margin (GPM), internal rate of return (IRR), payback period (PBP), cumulative net present value (CNPV), breakeven point (BEP) are analysed to inform the potential production of valuable raw materials from used cooking oil. Then these economic parameters are tested with various economic conditions, such as purchasing raw materials, purchasing equipment, employee salaries, and utility calculations [14]. There have been many studies on techno economic analysis, which are presented in Table 1.

Table 1. Previous studies regarding techno-economic analysis.

No.	Title	Ref.
1	Techno-economic assessment of coal to SNG power plant in Kalimantan	[15]
2	Techno-economic analysis on the production of zinc sulphide nanoparticles by microwave irradiation method	[16]
3	Techno-economic evaluation of hyaluronic acid production through extraction method using yellowfin tuna eyeball	[17]
4	Computational bibliometric analysis on publication of techno-economic education	[18]
5	Techno-economic evaluation of gold nanoparticles using banana peel (m*usa paradisiaca*)	[19]

The novelty of this study presents an innovative approach through the management of household cooking oil waste which later be utilized as a business opportunity with a focus on the production of liquid organic fertilizer from cooking oil waste. The uniqueness of this study focuses on and supports the synergy of SDGs with the implementation of presidential regulation number 97 of 2017. Through technoeconomic integration analysis, this study not only examines the technical and economic feasibility of organic fertilizer production but also evaluates its contribution in supporting national waste management policies. Based on our previous research [20-27], the research aim is to provide an overview of the evaluation of the economic feasibility analysis of making liquid organic fertilizer from used cooking oil and this study provides a concrete solution in waste management and has economic value and benefits for the agricultural sector [28].

2.Literature Review

Figure 1 shows the flow of making liquid organic fertilizer from waste cooking oil which goes through at least 6 stages to produce liquid organic fertilizer that is ready to be used as a plant fertilizer, the stages start with raw materials in the form of waste cooking oil which takes approximately 21 days to make. To process used cooking oil, follow 6 steps: initial filtering to remove dirt (step 1), oil activation by mixing molasses (step 2), adding other ingredients such as EM4 solution, rice bran, and NaHCO3 (step 3), stirring until evenly mixed, fermentation for 14-21 days (step 5), and finally filtering to separate the dregs (step 6). The resulting liquid organic fertilizer can be used to fertilize plants [29].

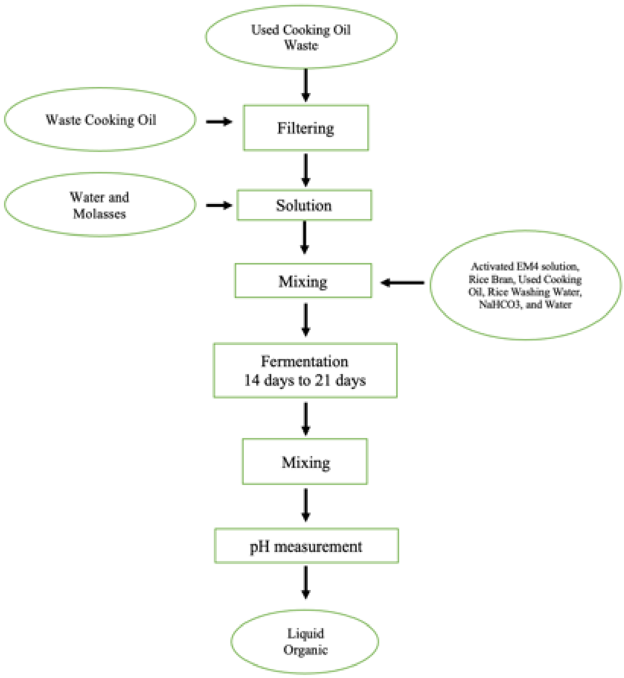

Fig. 1. Process of making liquid organic fertilizer from waste cooking oil.

3. Method

The method in the study uses content analysis based on the economic feasibility analysis of cooking oil waste with data sources based on product prices found on online websites or e-commerce that are sold commercially as a picture of current material prices. The data that has been obtained is calculated using simple mathematical analysis using Microsoft excel. To answer the description of the economic feasibility evaluation in this study, several parameter indicators are used such as CNPV, GPM, PBP, and BEP.

4. Results and Discussion

To ensure the analysis of the economic feasibility of liquid organic fertilizer production from waste cooking oil, several assumptions are used to predict several possibilities that will occur in the implementation, the assumptions are (i) the composition of production is waste cooking oil, bran, NaHCO2, decomposer, molasses, rice washing water, and EM4; (ii) All analyses use financing using $ with a value of 1 $ = Rp.16,100; (iii) Based on commercial prices sourced from the web regarding raw materials for waste cooking oil, bran, NaHCO2. Decomposer, Molasses, Rice Washing Water, and EM4 amounting to $13.35; (iv) total

Investment Cost based on Lang Factor; (v) one cycle of making liquid organic fertilizer is made with a duration of 21 days; (vi) the selling price of the product per liter is $ 2.17; (vii) the composition of the comparative material measurement size is adjusted to the amount of production; (viii) the production project of 1 duct can produce 50 litres using 5 ducts can produce as much as 250 L and in 1 month the production is 2 times with 5 large ducts that in 1 month it produces 500 L with the assumption of production for 10 months in 1 year (the remaining time is used for cleanliness management and other activities), (ix) in simplifying utilities, each utility unit is converted as a kWh Electricity unit, then converted into costs and multiplied by the Electricity cost. The utility cost assumption is $ 0.031 /kWh; (x) the employee cost assumption is $ 20,029.09; and (xi) the production project lasts for 20 years.

The raw material spreadsheet, the daily cost for large-scale production is $ 13.35, with an annual total of $ 4,006.21. The key cost items include waste cooking oil, rice bran, NaHCO2, decomposer, molasses, and EM4. Equipment acquisition in 2026 totals $ 128.57, with 20 L jerry cans being the largest expense. Investment in equipment is crucial for efficient production. Monthly employee salary expenditure is $ 242.42, with equal wages in marketing, finance, and general roles. The annual salary cost is $ 2,909.09, reflecting a simple wage structure for cost control in small to medium-sized operations. The daily cost of using a 1.2 kWh mixer for 1 hour is $ 0.39. The annual operational cost of the mixer at $ 0,32 /kWh is $ 115.49. Despite low power consumption, continuous daily use leads to high operating costs. It is crucial to calculate operating costs properly for budget planning to ensure effectiveness and sustainability. Assuming a daily production of 50 L, a total of 5,000 L/year, and a selling price of $ 2.27 /L, the annual income from selling organic liquid fertilizer made from waste cooking oil is $ 11,362.75 The economic feasibility analysis confirms long-term profitability of the product.

Figure 2 shows the CNPV and TIC analysis with various approaches. The results of the analysis show that the production of organic liquid fertilizer from waste cooking oil is prospective. The results of the economic analysis are very good and promising. This is certainly an opportunity that can be utilized, especially to support increased income and support SDGs and the policy of presidential regulation of the republic of Indonesia number 97 of 2017 concerning the national policy and strategy for household waste management and waste similar to household waste.

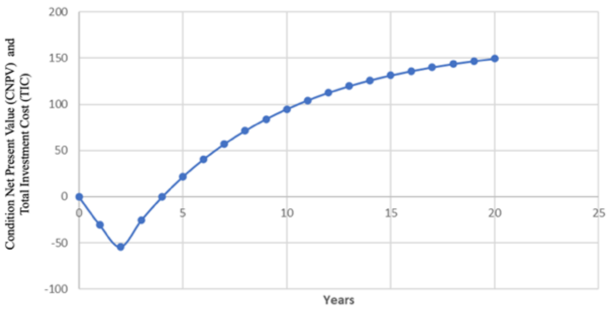

Fig. 2. CNPV/TIC with various economic evaluation parameters in the ideal condition.

The CNPV/TIC curve above shows the change in the Current Cumulative Net CNPV to TIC over 20 years. Initially, CNPV/TIC fell sharply in the second year, indicating an initial loss due to high investment costs in the form of purchasing equipment and raw materials. However, after the lowest point, the curve begins to rise steadily, indicating an increase in cumulative net profit. In the fifth year, CNPV/TIC broke out and continued its positive growth to reach more than 150 at the end of the 20 years. This shows that, despite losses in the first two years, this investment generate significant profits in the long term, reflecting the potential for good investment returns and financial stability after several years of operation. The economic feasibility study of liquid organic fertilizer production from cooking oil waste is an effort to support presidential regulation number 97 of 2017. A summary of the techno-economic analysis can be seen in Table 2.

Table 2. Summary of techno-economic analysis.

Component	Parameter	Cost (Rp/$)
Fixed cost	Loan interest	
	Capital related cost	Rp 26,737,338.60 / $ 1,715.51
	Depreciation	Rp 2,100,249.00 / $ 134,76
	Total fixed cost	Rp 28,837,587.60 / $ 1,850.27
Variable cost	Raw material	Rp 64,500,000.00 / $ 4,138.42
	Utilities	Rp 1,800,000.00 / $ 115.49
	Operating labour (OL)	Rp 36,000,000.00 / $ 2,309.82
	Labor related cost	Rp 10,800,000.00 / $ 692.95
	Sales related cost	Rp 12,250,000.00 / $ 785.98
	Total variable cost	Rp 125,350,000.00 / $ 8,042.66
% Profit estimated	Sales	Rp 175,000,000.00 / $ 11,228.28
	Manufacturing cost	Rp 152,087,338.60 / $ 9,758.17
	Investment	Rp 22,511,790.00 / $ 1,444.39
	Profit	Rp 0.13 / $ 0.0000083
	Profit to sales	Rp 1.02 / $ 0.000077
BEP	Unit	5,000
	Fixed cost	Rp 28,837,587.60 / $ 1,850.27
	Variable cost	Rp 125,350,000.00 / $ 8,042.66
	Variable cost	Rp 0.00 / $ 0.00
	Sales	Rp 175,000,000.00 / $ 11,228.28
	Sales	Rp 0,00 / $ 0,00
	BEP	$ 2,904,087372
	Percent profit on sales	$ 0,130929494
	Return on investment	$ 1,090949759
	Pay out time	$ 0,839665983

The general public is part of the largest contributor of waste, especially households that produce household waste every day, household waste that we often encounter is cooking oil because the use of cooking oil every day is often used as a raw material in processing food. Cooking oil produced from household waste is very much and have a dangerous impact if not handled properly, one of the impacts that be caused is environmental pollution. The solution that can be done is to carry out a cooking oil waste management program into a product that has economic value and benefits. Ideas and thoughts are needed in the development of cooking oil waste management, such as processing cooking oil waste into organic liquid fertilizer that it can become a product that has economic value that can be mass-produced in the industrial sector and can be an idea in business development, this cooking oil waste management program is in line with and supports the policy issued by the president through Presidential Regulation of the Republic of Indonesia Number 97 of 2017. The results of the calculation of the economic analysis of the utilization of cooking oil waste into organic liquid fertilizer are prospective and profitable. Various analyses show positive and promising things. CNPV/TIC analysis also shows a graph that tends to increase in each period, the project in an ideal time of 20 years. Economic analysis to calculate the production potential of liquid cooking oil waste raw materials, including gross profit margin, rate of return, BEP, percentage of profit to sales, and others.

5. Conclusion

The conclusion of this study explains that the production of liquid organic fertilizer from cooking oil is economically feasible. With a production capacity of 50 L/day, annual raw material costs of $ 4,187.99, and equipment costs of $134,41, the total investment cost is less than $ 10,844 which illustrates the efficiency of capital use. The estimated use of cooking oil of 5,000 L/year or 100,000 L/ 20 years and a cost of around $ 16 per ton shows that this solution is economical and has the potential to significantly reduce waste. The evaluation shows that considering factors such as labour, sales, raw materials, and estimated income, it is economically feasible to develop the project on a larger scale. With the reprocessing of cooking oil waste, which is included in household waste or waste, it is a positive form for us as a society to support the regulation of the President of the Republic of Indonesia number 97 of 2017.

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