

TECHNO-ECONOMIC ANALYSIS FOR THE PRODUCTION OF PAPER FROM WASTE PAPER FOR EDUCATION MEDIA

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Abstract

This research aims to analyze the techno-economics of the use of waste paper for becoming media for education. Economic analysis was used to calculate production potential from waste paper materials, including gross profit margin, return rate, break-even point, sales-to-profit percentage, and others. The research results showed that the production of media from waste paper is prospective. The production of material from waste paper can minimize unproductive waste and can be sustainably used to create media. The impact of this research is that paper waste produced by educational institutions can be recovered to be used as media.

Keywords: Bullying, Education, Paper, Techno-economic, Waste.

1. Introduction

Paper waste is the remainder of paper disposal or use. Waste paper recycling is the use of waste paper to make it more useful. It reduces the use of raw materials for making new paper and is friendlier and more environmentally sustainable [1, 2]. Recycling of waste paper can also be analyzed through an economic approach [3]. Paper waste is an inseparable part of the operations of institutions or office institutions. Waste results from the office administration activities of an institution. Thus, as long as the institution or institution exists, paper waste continue to be produced. Many techno-economic analyses done by researchers have been carried out (see Table 1).

Table 1. Previous studies on techno-economic analysis.

No	Title	Ref.
1	Integration of techno-economic analysis and life cycle assessment for sustainable process design–A review.	[4]
2	Techno-economic analysis and Monte Carlo simulation of green hydrogen production technology through various water electrolysis technologies	[5]
3	A Techno-economic analysis of solar hydrogen production by electrolysis in the north of Chile and the case of exportation from Atacama Desert to Japan	[6]
4	A comprehensive techno-economic analysis and multi-criteria optimization of a compressed air energy storage (CAES) hybridized with solar and desalination units	[7]
5	Techno-economic analysis for the production of LaNi ₅ particles	[8]
6	Techno-economic evaluation of biodiesel production from edible oil waste via supercritical methyl acetate transesterification	[9]
7	Techno-economic analysis on the production of zinc sulfide nanoparticles by microwave irradiation method	[10]
8	Techno-economic evaluation of hyaluronic acid production through extraction method using yellowfin tuna eyeball	[11]
9	Techno-economic evaluation of the production of resin-based brake pads using agricultural wastes: Comparison of eggshells/banana peels brake pads and commercial asbestos brake pads	[12]
10	Computational bibliometric analysis on publication of techno-economic education	[13]
11	Implementation of numeracy literacy through economics learning in elementary school	[14]

Based on our previous studies [15-18]. The aim of this research is to analyze the techno-economic analysis of making material for education from waste paper. The novelty in this research is (i) recycling paper waste on environmental preservation, (ii) the use of waste paper as a media campaign to prevent bullying in schools, and (iii) an overview of the prospects for the waste paper industry. In addition, the successful of this method should be implemented for simple actions [19-22], such as the use of waste paper for pamphlet that do not need expensive materials, such as pamphlet for informing anti-bullying campaign media in schools. This study also supports current issues in sustainable development goals (SDGs), as reported elsewhere [23-27].

2. Literature Review

The stages of paper production from waste paper are shown in Fig. 1. Paper produced from waste paper consists of eight production stages. The process of processing waste paper into new paper resulting from waste paper recycling follows the following steps: stage 1, the waste paper is crushed, stages 2 and 3 are the process of grinding the waste paper using commercial equipment and then mixing it with water and cornstarch, stage 4 is the filtering stage and then add water (stage 5) again. Thus, it can be printed (stage 6) using commercially available printing equipment, stage 7 is the drying process using a dryer, and stage 8 produces paper from recycled paper waste.

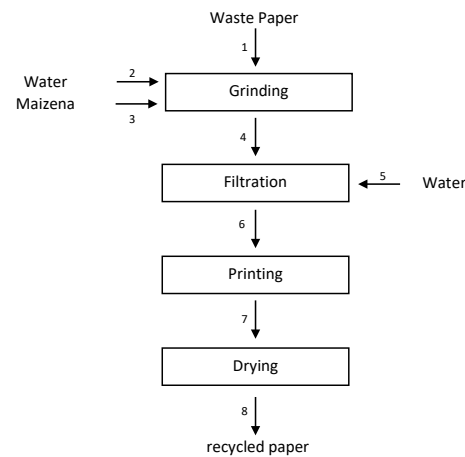


Fig. 1. Process flow diagram for the production of paper from waste paper.

3. Method

The method was a calculation of economic analysis for 20 years. Economic analysis to calculate production potential from waste paper materials, including gross profit margin, rate of return, break-even point (BEP), and others. The data used is the average price of products available online on online shopping websites. The analysis used a simple mathematical calculation to produce a projection of the business prospects, labor costs, capital for purchasing raw materials, and interest rates. Detailed information for the calculation is explained elsewhere [28, 29].

4. Results and Discussion

Economic analysis is carried out the assumptions used, such as: (i) economic analysis using a currency of 1 USD = IDR. 16,000; (ii) the price of used paper of IDR. 9,000/kg, cornstarch of IDR. 19,000/kg, and water of IDR. 3,900/L; (iii) equipment prices commercial prices in online shopping; (iv) calculation of total capital investment calculated from direct costs, indirect costs, and starting-up fees; (v) production costs projected from the start of the project; (vi) wages labor per production of IDR. 840,045,863.12; and (vii) length of operation is 20 years (see table 2).

Table 2. Price of equipment and the process condition.

No	Tool Name	Unit Price (IDR)	Qty	Total Price (IDR)	CEPCI 2016	CEPCI 2026
1	Grinding (for waste paper)	8,434,890	1	8,434,890	541.7	672,889
2	Filtration (for paper pulp)	320,000,000	1	320,000,000	541.7	672,889
3	Printing (for recycled paper)	199,789,000	1	199,789,000	541.7	672,889
4	Oven (for recycled paper)	208,000,000	1	208,000,000	541.7	672,889
5	Water system	16,000,000	1	16,000,000	541.7	672,889
Year Price 2026 (IDR)					752,223,890	

Notes: All the prices, as well as apparatus information, are adopted from currently available apparatuses in the online shopping web.

Figure 2 shows the cumulative net present value (CNPV) and total investment cost (TIC) analysis with various approaches. The analysis results show that paper production from paper waste is very prospective. The results of the economic analysis are very good and promising. This is certainly an opportunity that can be exploited, especially in the context of a campaign to prevent bullying in schools by utilizing waste paper. Apart from that, this project can minimize unproductive paper waste, to preserve the environment as well as utilize economic factors.

A techno-economic analysis of opportunities for commercialization of the use of waste paper to develop bullying-free school campaign media has been described. Apart from Fig. 2, the CNPV/TIC has been described, Table 3 is a summary of the techno-economic analysis.

Educational institutions are one of the units producing paper waste. The productivity of educational institutions in producing work waste, if not managed properly, negative impact on the school environment. Through various kinds of waste management programs, work can be made more valuable or useful. Ideas and ideas for developing the use of work waste must be present internally in educational institutions as one of the paper waste-producing units. Utilizing waste paper as a necessity for educational purposes is the best idea. Therefore, industrialization as the next stage is a breakthrough that could be widely duplicated.

The results of the economic analysis on the use of paper waste for developing bullying prevention campaign media in schools are prospective. Various analyses show positive and promising things. CNPV/TIC analysis also shows a graph that tends to increase in each period, projects within an ideal time of 20 years. Economic analysis to calculate production potential from waste paper materials, including gross profit margin, rate of return, BEP, profit-to-sales percentage, and others.

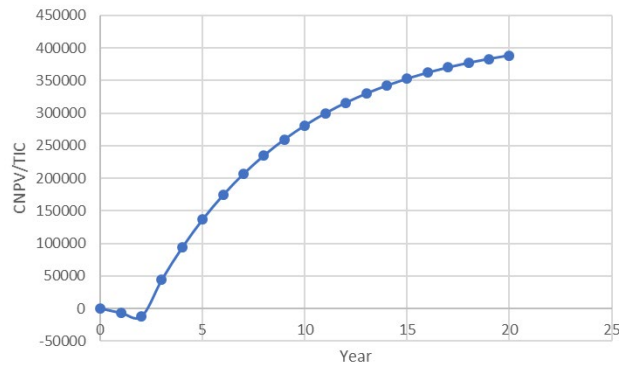


Fig. 2. CNPV/TIC with various economic evaluation parameters in the ideal condition.

Table 3. Summary of techno-economic analysis.

Component	Parameter	Price (IDR)
Fixed cost	Loan interest	-
	Capital related cost	5,674,783,659.27
	Fixed cost+Depresiasi	-
	Depreciation	476,025,989.10
	Fixed cost less depreciation	-
	Total fixed cost	6,150,809,648.38
Variable cost	Raw material	6,372,000,000.00
	Utilities	124,920,000.00
	Operating labor	1,960,200,000.00
	Labor related cost	1,313,334,000.00
	Sales related cost	4,309,200,000.00
	Total variable cost	14,079,654,000.00
% Profit estimated	Sales	61,560,000,000.00
	Manufacturing cost	19,754,437,659.27
	Investment	5,102,346,008.13
	Profit	0.68
	Profit to sales	8.19
BEP	Unit	1026000
	Fixed cost	6,150,809,648.38
	Variable cost	14,079,654,000.00
	Sales	61,560,000,000.00
	BEP	132912.4834
	Percent profit on sales	0.679102702
	Return on investment	8.782201665
Pay out time	0.112584699	

5. Conclusion

The economic analysis carried out shows that the production of anti-bullying campaign media in schools using paper waste is very prospective. Development of media campaigns to prevent bullying in schools using waste paper as raw materials using economic analysis methods on the use of waste paper as media for anti-bullying campaigns in schools for 20 years. Economic analysis to calculate production potential from waste paper materials, including gross profit margin, rate of return, BEP, percent profit on sales, and others. The results of the research show that paper production from waste paper can minimize unproductive paper waste and can be used sustainably to create media campaigns to prevent bullying in schools.

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