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The technical and financial feasibility analysis of art paper production from betel nut husk fibre and paper waste

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KEYWORDS

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Betel nut
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ABSTRACT

Art paper made of betel nut husk fibre and paper waste is one example of an innovative product. Therefore, an analysis of the technical and financial feasibility of this innovation needed to be conducted. This research aimed to determine the technical and financial feasibility of the production business of art paper from betel nut husk fibre and paper waste. The technical aspect will focus on the technology utilized, primary raw material and additional raw material, production capacity, and any workforce involved in the business. Meanwhile, the financial aspect will emphasize the calculation of the Main Production Cost (MPC), Break Even Point (BEP), Business Efficiency (R/C Ratio), Payback Period (PP), Net Present Value (NPV), and Internal Rate of Return (IRR). The calculation result of the feasibility analysis shows that Production Cost (HPP) is IDR 12,786.00, BEP_{unit} is 9,271 paper sheet, BEP (IDR) is IDR 148,326,906.00, R/C Ratio is 1.56, PP will be for 2.2 years, NPV is IDR 2,078,713,958.00, and IRR is 68.36%. Based on this result, this business on betel nut husk fibre and paper-based waste art paper is considered worth running.

Introduction

Art paper has an aesthetic visual appearance and can be used as an alternative agricultural waste since its fibre is commonly non-wood fibre and is rich in cellulose (Muraleedharan and Perumal, 2010). The use of wood as the primary raw material in the manufacture of paper can harm the environment. So that deforestation becomes more frequent year by year and causes deforested forests to expand. In addition, making paper wood raw materials also produces chemical waste because the process of making paper uses complex chemicals to degrade (Del Rio et al., 2022). These problems can be overcome by making paper with non-wood raw materials because using non-wood raw materials is more environmentally friendly. One of the materials that can be utilized as raw material is betel nut husk fibre because the dry husk fibre of betel nut has low water content, which is an ideal aspect of making art paper. Betel nut husk fibre's cellulose composition is around 70%. The areca nut is mainly used for traditional activities as a habit for generations in some areas of Indonesia. In other words, the areca nut plant only benefits from its leaves and seeds, while the areca nut fibre is often wasted with minimal utilization. Betel nut fibre (*Areca catechu L.*) is regarded as waste containing 70.2% cellulose content, 10.92% water, and 6.02% ash. Because the direct use of areca nut is unpopular, innovation is required to utilize areca nut in art paper making. Betel nut plants (*Areca catechu L.*) are included in the family Palmaceae, which spreads over any region in Indonesia. This plant can be found primarily in Jambi Province, one of the best betel nut-producing places in the world.

Meanwhile, art paper making from areca fibre requires the addition of used paper. Used paper is one of the potential sources of fibre, which can provide a source of secondary fibre in the manufacture of art paper from non-wood plant fibres. According to data from the Ministry of Environment and Forestry (KLHK), in 2019, the amount of paper waste was 9% of the total landfill, or around 5.7 million tonnes. Paper waste needs to be processed correctly to save the environment. It is necessary to consider the paper waste recycling process to convert the waste into products with high economic value. For example, paper waste can be recycled into art paper by improving the

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physical quality such as tensile strength, tear-resistance, and gramatur. According to (Apriani and Kurniasari, 2016), using secondary fibre as raw material in the paper industry may provide several advantages, such as lower prices, high dimensional stability, and better sheet formation.

The procedure of making art paper from betel husk fibre and paper waste consists of peeling the betel nut husk, drying the betel nut husk fibre, cutting betel nut husk fibre and paper waste into a smaller size, delignification, blending, mixing, and art paper moulding/pressing. The mixing process of betel nut husk fibre and paper waste is performed in the mixing tank. For this reason, the mixing tank plays an essential role in the art paper manufacturing process. The moulding/pressing process of the art paper will be performed by hand (handmade). Art paper is named after the handmade recycled product and is commonly used to create other crafts. Handmade art paper has a unique appearance and characteristics, especially its texture, design, colour, and dimension (Mandegani et al., 2016). The manufacture of art paper using raw materials for areca nut waste and used HVS with a ratio of 20:80, where 20% of areca nut waste materials and 80% of paper waste materials produce the best comparison. This result is evidenced by the results of the physical characteristics test of the art paper, namely the grammage value of 340.2 g/m2, the thickness value of 0.825 mm, the tensile resistance value of 0.552 kN/m, the brightness value of 85.7%, and the stiffness value of 66 mm (Aprilyo, 2019). Based on this composition, an analysis of the technical and financial feasibility of making art paper from waste betel nut and HVS paper still needs further investigation.

The benefit obtained from the business depends on the production cost and the amount of paper produced (Sartori et al., 2014). However, producing art paper from betel nut husk fibre and HVS paper waste is a brand innovation. Therefore, designing an art paper processing unit from waste palm fibre and paper waste is necessary. The design of the processing unit requires a business feasibility analysis to determine whether the business is worth running. The feasibility analysis carried out in this research was technical and financial. The technical feasibility analysis includes the technology, raw materials, production capacity, facility layout, and workforce. Financial feasibility analysis involves calculating the Cost of production (HPP), break-even point (BEP), business efficiency, payback period, net present value (NPV), and internal rate of return (IRR).

This research investigated the design of a small-scale art paper processing unit. No art paper industry uses areca palm fibre and paper waste as raw materials, and designing requires minimum labour. Therefore, this research aimed to analyze the technical and financial feasibility of a small-scale art paper-making industry.

Research Methods

This research was conducted in Malang, East Java, from April to November 2020. The art paper was made in the Laboratory of Agrochemical Technology, Agroindustrial Technology Study Program, Faculty of Agricultural Technology, UniversitasBrawijaya, and Entrepreneurship Laboratory of Faculty of Agricultural Technology, Universitas Brawijaya.The materials used in this research included Betara betel nut husk fibre from Jambi, scrap HVS paper, NaOH, distilled water, and water. Any tools and machines include a blender, mixing tank, reactor, stopwatch, digital scales, basin, and spatula.

This research was qualitative descriptive research. The data used to analyze technical eligibility was obtained by testing the tools and machines used for art paper making and interviewing the art paper and areca nut industries. The data becomes the basis for analyzing the technology, raw materials and additives, production capacity, and labour (Dikareva and Voytolovskiy, 2016). Meanwhile, the data used to analyze financial eligibility was obtained from the direct calculation performed during the research, along with some assumptions. Some required data include investment, fixed, and variable costs of the art paper production. The calculation of financial feasibility comprises of:

Production cost

Production cost can be determined by calculating the total production cost for a year and dividing this sum by the number of units produced for a year (Dewi and Muryati, 2017). Therefore, production cost is calculated by using Eq. 1:

$$Production\ Cost = \frac{Total\ Production}{Production\ quantity} \quad \text{..... (1)}$$

Break-even point (BEP)

BEP is a condition where the production expenses equal the revenues gained or show that a business has no profits or losses (Noviantoro et al., 2020). BEP can be calculated using Eq. 2 and 3:

$$BEPunit = \frac{fixed\ cost}{price\ variable\ cost\ per\ unit} \quad \text{..... (2)}$$

$$BEP(IDR) = \frac{fixed\ cost}{1 - \frac{price\ variable\ cost\ per\ unit}{price\ per\ unit}} \text{ ..... (3)}$$

Business efficiency (R/C Ratio)

Business efficiency is the comparison between the revenues achieved from the selling process and any cost spent from the beginning of the production process to the final product. If the R/C ratio is < 1, the business is inefficient or operating at a loss. If the R/C ratio = 1, then the business does not make any profit or loss. If the R/C ratio > 1, the business is efficient and gaining any profit (Rohaeni et al., 2021). Business efficiency can be calculated by using Eq. 4:

$$R/C = TR/TC \text{ .....(4)}$$

TR (or *Total Revenue*) is the total receipt that can be obtained by multiplying the price of the goods by the unit quantity, and TC (or *Total Cost*) is the sum of total expenses.

Payback period (PP)

The payback period (PP) refers to a period needed to recover the investment cost or, in other words, the term needed to achieve any profit to cover the investment cost spent. Shorter paybacks mean more interesting investments (Thoriq et al., 2019). A project can succeed if the PP is shorter than the projected project term. The PP can be calculated by using Eq. 5:

$$PP = \frac{initial\ investmen}{Net\ income} \text{ x 1 year .....(5)}$$

Net present value (NPV)

Net present value is the calculation performed to assess the feasibility of a project based on some investment criteria. NPV is determined by calculating the difference between the present value of an investment and the future value of the net revenue gained in the applicable interest rate. There are two criteria for NPV calculation; first, if the NPV is negative, it can be said that a business is not worth operating, while positive NPV indicates that a business is valuable. (Gumilang et al., 2016). NPV can be calculated by using Eq. 6:

$$NPV = (\sum PVin) - (\sum PVout) \text{.....(6)}$$

Internal rate of return (IRR)

According to Girdzijauskas (2019), the internal rate of return (IRR) is a method to calculate the discount rate that makes the net present value of the estimated overall cash flow equal to the present value of the expected cash outflow. There are some criteria in IRR. First, a business is worth developing if the IRR > i. Second, if the IRR = i, a business is in BEP condition. Third, if the IRR <i, a business is not worth developing. The IRR can be calculated by using Eq. 7:

$$IRR = i_2 \frac{NPV2\ x\ (i2 - i1)}{NPV1 + NPV2} \text{.....(7)}$$

i_1 refers to the first interest rate, and i_2 refers to the second interest rate. NPV1 is the *net present value* of the first interest rate, while NPV2 is the *net present value* of the second interest rate.

Results and Discussion

Production process

The production process of art paper made from betel nut husk and HVS paper waste is as follows (Figure 1):

1. Production process of betel nut husk pulp

The betel nut is peeled and separated from the seeds to obtain the areca nut. The size of the areca fibre is reduced into 2-3 cm chips and then dried in the sun for two days. Dried betel nut is weighed according to the mass of the material in the experiment. The material is delignified by cooking using 500 mL of distilled water and a solution of NaOH at a concentration of 25% for 90 minutes at a temperature of 100 C. Then, the material from the delignification process is ground using a blender for 5 minutes to smooth the fibre into a fibre slurry form (or pulp). The pulp was filtered and cleaned from any residual chemical solutions.

2. Production of paper waste pulp

The HVS paper waste was reduced in size to facilitate the following process. The HVS paper was weighed and ground using a blender for 3 minutes to form a pulp.

3. Paper Printing

Areca nut pulp and HVS paper waste pulp were then put into a blender, added 500 mL of water, and blended for 3 minutes until homogeneous. The homogeneous slurry was poured on a 70-mesh screen measuring 30 x 40 cm, given a screen and placed into a tub filled with water. Afterwards, the pulp was flattened and stirred by hand to avoid clogging. The screen was lifted slowly horizontally once the pulp had been evenly distributed to prevent uneven paper thickness. The wet printed paper was covered with a plywood plate, then manually pressed and levelled using a rack until it was flat and the water content was reduced. This step facilitated the release of printed paper. The screen and plywood

were removed to ensure the art paper sticks to the plywood, then aerated to dry. The dried paper was then removed from the plywood, and trimmed the edges using scissors. The paper was then measured for grammatur and tensile resistance.

Technical aspect

a. Product Quality

Art paper products made from areca palm fibre waste and HVS paper waste have a grey with brown strike colour with a grammage value of 257 g/m^2, tensile strength of 0.3 kN/m^2, roughness of 1692 mL/minute, stiffness of 8.5 mN.m, water absorption capacity of 297.068%, and water content of 9.03%.

b. Location

The art paper processing unit was in West Tanjung Jabung Regency, Jambi Province. This industry requires raw materials such as areca palm fibre waste of 120 kg/year and HVS paper waste of 480 kg/year. The areca fibre waste was available in the location, costing 9,955 tons/year, while the HVS paper waste was 50 A4 sheets/day or 15,000 A4 sheets/year.

c. Technology Used

Tools and machines facilitate the production process. Furthermore, tools and machines can support production and become one of the leading industrial strengths in production process continuity (Fernández-Miranda et al., 2018). Machine refers to any device that processes input into output in production (Thomas, 2012). Some machines used in art paper making from betel nut husk fibre and paper waste are mixing tanks and blenders. Both are semi-automatic machines since they operate automatically but still need assistance from the human force. A mixing tank is a machine used to mix the husk fibre pulp and HVS paper waste. This machine is operated by putting raw material into the inlet, and the mixer motor runs the mixer to homogenize all material inside the tank. The capacity of the mixing tank used is 90 L. Blender functions to make pulp from paper waste. Two blenders with 1 L of capacity were used in this research.

Tool refers to any equipment or container to support a particular work. Any tools used in the study were a digital scale, 2 L glass beaker, 500 mL measuring glass, 1.5 L plastic bottle, stove, 3-kg LPG, reactor, cooking spatula, small basin, large basin, 30x40 cm screen mesh 70, and plywood. A digital scale was used to measure the amount of NaOH. A glass beaker was used to dissolve technical NaOH with distilled water. A 500 mL measuring glass was used to measure the amount of distilled water needed to dissolve technical NaOH. A 1.5 L plastic bottle was used as a 25% NaOH solution storage container. The critical point of making a paper is the delignification process. Delignification, the process of extracting lignin from plant sources, can be done using various methods. It aims to disintegrate the lignocellulosic structure into its fibrous components (Bajpai, 2017). The reactor was utilized as a container during the delignification process.

Meanwhile, stoves and LPG were used as heat sources during the delignification process. A cooking spatula was used to stir the pulp mixture of betel nut husk fibre and HVS paper waste. Small and large basins were used to place pulp yield of betel nut husk fibre, HVS paper waste, and hold soaked HVS paper waste. A large pail is used as a water container during paper moulding. A 30x40 cm screen with 70 mesh was used to press the paper. Plywood was used to base the result of the paper. The production process flow chart can be seen in Figure 1.

d. Primary and additional raw material

The primary raw material of the art paper-making process is betel nut husk fibre and paper waste. This research used dry betel nut fibre since it has low water content and is ideal for making art paper. The cellulose composition of betel nut husk fibre is relatively high, at 70% (Sultana et al., 2020). As the critical raw material, betel nut fibre is taken directly from Kuala Tungkal, Tanjung Jabung Barat Regency, Jambi Province. The paper waste used was HVS paper 70 gsm. Paper waste is one of the fibre sources that can provide the secondary fibre from the non-wood fibre in art paper making (Fatriasari et al., 2017). Those HVS papers will be cut in the size of 2-3 cm and soaked in the water overnight. This step was done to eliminate the ink written on the paper to make the resulting paper brighter. Art paper making needs 160 g of betel nut fibre daily or 41.6 kg/year. Meanwhile, the paper waste needed for this process was 640 g daily or 166.4 kg/year.

The additional raw materials required in art paper making are technical NaOH, distilled water, and water. Technical NaOH was needed in the delignification process to remove lignin from betel nut fibre. Technical NaOH needed in the art paper making was 800 g/day or 208 kg/year. Distilled water needed to dissolve technical NaOH was around 3.2 L/day or 832 L/year. Water was needed for crushing paper waste and mixing betel nut fibre and waste pulp. The water needed was 7 L/day or 1,820 L/year.

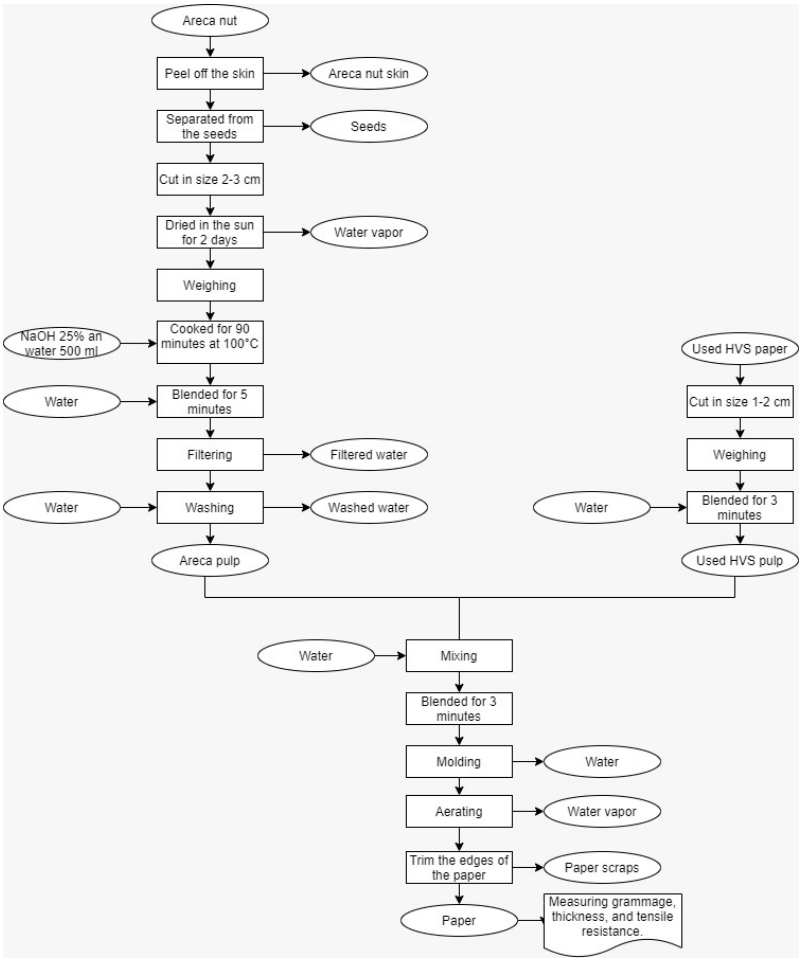

Figure 1. Flow chart of the production process

Table 1. Production capacity of art paper

No	Capacity	Betel nut fiber (g)	Amount of paper waste (g)	The yield of paper produced (Sheets)
1	Per day	160	640	20
2	Per month*	3,200	12,800	400
3	Per Year	41,600	166,400	5,200

*) it is assumed that there are 20 active working days in a month

e. Production capacity

The production capacity of art paper made from betel nut husk fibre and paper waste can be seen in Table 1. The betel nut fibre needed for one-day production activity was around 160 g. Besides, it also needed 640 g of paper waste. Those betel nut fibre and paper wastes were then processed, yielding around 20 sheets. Production capacity for one month or 20 workdays needs 3,200 g of betel nut fibre and 12,800 g of paper waste. A one-round production process will yield around 400 sheets of paper. Additionally, the production process for one year will need 41,600 g of betel nut husk fibre and 166,400 g of paper waste. This amount will yield around 5,200 sheets of paper per year.

f. Labour

Labour is any person who can perform a job that can generate output as goods or services to meet individual or community needs (Dongoran, 2016). Labour is crucial in supporting the production process's success. Art paper-making business needs a minimum of 3 labourers, comprising two direct and one indirect labour. Indirect labour is the owner of the art paper business. Meanwhile, direct labour is any employee involved directly in the production process (Syafitri & Putra, 2018). Those direct

labourers hired are local people who live around the production location and have a minimum qualification of the educational background of Junior High School or equivalent. Some activities performed in the art paper-making business do not need specific expertise and are relatively easy to do.

Financial aspect

The analysis of the financial aspect includes the calculation of Production Cost, Break Event Point (BEP), Business Efficiency (R/C Ratio), Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PP). Several types of costs used in the financial calculation of art paper making from betel nut husk fibre and paper waste include primary raw material and additional raw material, utility cost, fixed capital, and fixed and variable costs.

In this case, the Cost to purchase the primary raw material is 41.6 kg of betel nut husk fibre, IDR 840,000.00. Furthermore, the 166.4 kg/year of paper waste cost is around IDR 668,000.00. The annual Cost of additional raw material, 208 kg of technical NaOH, and 832 L of distilled water is IDR 12,480,000.00 and IDR 2,828,000.00, respectively.

Utility cost for the production process covers water, electricity, and LPG usage. Water usage needed for the washing process of betel nut husk fibre was 4 L, paper blending was 10 L, mixing the pulp of betel nut fibre and paper waste was 6 L, and paper moulding was 20 L. The total water needed for a one-time process was 40 L or 0.04 m^3 daily. Water needed for other activities was around 50 L or 0.05 m^3. Therefore, the total water needed for this art paper industry was 90 L or 0.09 m^3. In a month, the water used was around 0.18 m^3. The basic fare for the industry was 0-10 m^3 per month, around IDR 14,300.00. For one day, the water cost covered was IDR 715.00.

The electricity needed is for the use of a blender. Each blender needs 250 W per hour. The electricity needed for the process is 333.33 watts or 0.333 kW per day. The electricity used for the facilities was 0.496 kW per day. Electricity basic fare for the medium industries was around IDR 1,035.78/kWh. The daily electricity fare is IDR 510.63, and the monthly is IDR 10,212.79. A 3-kg LPG is calculated from the pulp cooking process. LPG is running out after continually being used for 4 hours. The Cost for one-time LPG refuelling is IDR 17,000.00. In a cooking time (90 minutes), the Cost is IDR 6,375.00. Furthermore, the operational Cost is shown in Table 2.

The fixed capital spent in this research includes machine and production equipment costs. The total cost spent on purchasing machinery and equipment was around IDR 34,638,000.00. Besides, the Cost spent on employee salary was IDR 1,200,000.00, where each employee receives IDR 600,000.00 of salary per month. Fixed Cost is any constant cost spent in a particular activity course (Alonso et al., 2019). Any fixed cost spent on this business is the reinvestment cost listed in Table 3, the depreciation cost in Table 4, and the maintenance cost in Table 5, for which the total Cost is IDR 9,241,340.00. Variable Cost is any cost that varies with the quantity change (Ishmael et al., 2012). The incurred variable Cost is the operational Cost, as much as IDR 33,192,964.00. Production cost refers to the total fixed Cost plus the total variable Cost. The total production cost can be seen in Table 6.

Table 2. Total operation cost within a year

Description	Total Requirement/Batch	Unit	Unit Price (IDR)	Value in 1 year (IDR)
Installation:				
Electricity				132,764
Water				185,900
Raw Material :				
Used HVS Paper	640	g		668,000
Betel Nut Husk Fiber	160	g		840,000
NaOH	800	g		12,480,000
Aquades	3,200	mL		2,828,800
Water	40,000	mL		185,900
LPG	6,375	IDR	6,375	1,657,500
Labor Wage				
Wage	2	person	600,000	14,400,000
Total				**33,192,964**

Table 3. Investment and reinvestment cost

Description	Quantity	Unit Price (IDR)	Total Price (IDR)	Economic Age (th)	Reinvestment Cost (IDR)
Building:					
Outlet	1	75,000,000	75,000,000	35	-
Machine:					
Blender	2	250,000	500,000	3	500,000
Mixing Tank	1	16,000,000	16,000,000	10	-
Tools:					
Weighing Scale	1	130,000	130,000	3	130,000
Beaker Glass	1	170,000	170,000	3	170,000
Measuring Glass	1	36,000	36,000	3	36,000
Stove	1	135,500	135,500	2	135,500
Reactor	1	17,000,000	17,000,000	10	-
Cooking Spatula	1	23,000	23,000	3	23,000
Small Bucket	3	6,600	19,800	3	19,800
Big Bucket	2	36,600	73,200	3	73,200
Big Basin	1	50,000	50,000	3	50,000
Screen	2	22,500	45,000	1	45,000
Filter Cloth	5	20,000	100,000	1	100,000
Regulator	1	80,500	80,500	3	80,500
Plywood	5	55,000	275,000	1	275,000
Installation:					
Electricity	260	511	132,764	-	-
Water	260	715	185,900	-	-
Total			**109,956,664**		**1,638,000**

Table 4. Depreciated Cost

Description	Quantity	Unit Price (IDR)	Total Price (IDR)	Economic Age (year)	Depreciation Value
Building:					
Outlet	1	75,000,000	75,000,000	35	2,142,857
Machine:					
Blender	2	250,000	500,000	3	166,667
Mixing Tank	1	16,000,000	16,000,000	10	1,600,000
Tools:					
Weighing Scale	1	130,000	130,000	3	26,000
Beaker Glass	1	170,000	170,000	3	56,667
Measuring Glass	1	36,000	36,000	3	12,000
Stove	1	135,500	135,500	2	45,167
Reactor	1	17,000,000	17,000,000	10	1,700,000
CookingSpatula	1	23,000	23,000	3	11,500
Small Bucket	3	6,600	19,800	3	9,900
Big Bucket	2	36,600	73,200	3	24,400
Big Basin	1	50,000	50,000	3	16,667
Screen	2	22,500	45,000	1	-
Filter Cloth	5	20,000	100,000	1	-
Regulator	1	80,500	80,500	3	26,883
Plywood	5	55,000	275,000	1	-
Total			**109,956,664**		**5,838,657**

Table 5. Maintenance cost

Description	Volume	Total Price (IDR)	Economic Age (year)	% Maintenance	Maintenance Cost per year
Machine:					
Blender	2	500,000	3	5%	25,000
Mixing Tank	1	16,000,000	10	5%	800,000
Tools:					
Weighing Scale	1	130,000	3	5%	6,500
Beaker Glass	1	170,000	3	5%	8,500
Measuring Glass	1	36,000	3	5%	1,800
Stove	1	135,500	3	5%	6,775
Reactor	1	17,000,000	5	5%	850,000
CookingSpatula	1	23,000	2	5%	1,150
Small Bucket	3	19,800,000	2	5%	990
Big Bucket	2	73,200,000	3	5%	3,660
Big Basin	1	50,000	3	5%	2,500
Screen	2	45,000	1	5%	2,250
Filter Cloth	5	100,000	1	5%	5,000
Regulator	1	80,500	3	5%	4,025
Plywood	5	275,000	1	5%	13,750
				Total	**1,731,900**

Table 6. Total production cost within a year

Production Cost Components	Value in a year (IDR)
Fixed Cost	
Reinvestment Cost	1,638,000
Cost of depreciation	5,871,440
Maintenance Cost	1,731,900
Total Fixed Cost	**9,241,340**
Variable Cost	
Operating Cost	33,192,964
Total Variable Cost	**33,192,964**
Total Production Cost	**42,434,304**

a. Production cost

The total production costs for one year are IDR 153,432,891.00, and the total production in one year is 15,000 sheets with IDR 15,325.00/sheet. The Cost of production is calculated by dividing the total production costs for one year by the amount of production. These calculations require a boost if non-food products at the producer level go directly to consumers at 20%. If it goes through agents to retailers, it is 40%, and retailers sell products to final consumers at 20% (Choiriyah et al., 2016).

The calculation of the production cost of this art paper research will use an elevation of 20% because the product is distributed directly from the manufacturer. Hence, the expected selling price of the art paper is IDR 16,000.00. The selling price of art paper products on the market is still much higher than the boosted price, around IDR. 11,000.00 – IDR. 18,000.00, therefore art paper product is suitable for sale.

b. Break-even point (BEP)

BEP analysis (or break-even analysis) helps company management to quickly obtain information related to the minimum sales amount and production volume required to achieve the expected profits. Break-even analysis is one of the techniques used to explain the relationship between

total costs, sales volume and expected profits (Choiriyah et al., 2016). BEP analysis can be carried out if a business has fixed costs (i.e., labour costs, depreciation costs, and office costs) and variable costs (i.e., raw materials, additional materials, and utility costs) (Prabhaswara and Savitri, 2004).

Based on the BEP(Q) calculation results, it is known that the minimum sales volume that must be achieved is 9,871 shares. The BEP calculation result is IDR 148,326,906.00. The results show that the BEP from art paper sales reached 9,871 pieces of art paper, and the costs achieved from the sales were IDR 148,326,906.00. BEP can be achieved if the production process runs 198 days, seven months, and 23 days. This calculation shows that the business unit has experienced no profits or losses if the sales figure has been reached.

c. Business efficiency (R/C Ratio)

Business efficiency or R/C ratio compares sales receipts and costs incurred during the production process to produce a product. Business efficiency is calculated by dividing total revenues in one year by total costs.

The business efficiency calculation results show that the total revenue is IDR 240,000,000.00, s obtained by multiplying the amount of production annually by the product's selling price. The expenditure costs consist of fixed costs and variable costs during the year. Annual fixed costs were IDR 130,985,451.00, and annual variable costs were IDR 22,447,440.00. The total revenue obtained was IDR 153,432,891.00. The result of the R/C ratio calculation was 1.56 (R/C ratio > 1), so producing art paper from areca palm fibre waste and using HVS paper waste is feasible.

d. Payback period (PP)

The ROI calculation results for the art paper business made from areca palm fibre waste and HVS paper waste are faster when compared to the prolonged economic life of the project. The ROI for this business is 2.2 years, while the project's economic life is five years. Based on the results of these calculations, the art paper business made from areca palm fibre waste and paper waste can be feasible. A previous study by Prasetya et al. (2014) demonstrated that the PP of the paper business made from seaweed was four years and two months, with a 10-year project period indicating that the project is feasible.

e. Net present value (NPV)

Cash flow projections for art paper production are IDR 187,534,250.00 per year. The cash flow is used as an NPV calculation with an interest rate of 10%. Based on the NPV calculation, the final value was obtained at IDR 2,078,713,958.00, showing a positive NPV result of > 0 or feasible for further operation. According to research conducted by Prasetya et al. (2014), making paper from seaweed has an NPV value of > 0 (or IDR 6,349,823,484.00). Based on the positive NPV results, the business is feasible.

f. Internal rate of return (IRR)

The IRR analysis is a method used to calculate the interest rate on an investment and equate it with the initial investment value based on future net cash calculations. This calculation uses two interest rates, namely 10% and 25%. Based on the IRR calculation, a value of 68.36% was obtained. This value shows that the IRR value was higher than the discount factor. Thus, the art paper business made from areca palm fibre waste and HVS paper waste is feasible. According to Prasetyo et al. (2019), the IRR calculation of the paper business made from seaweed was 26.048%, demonstrating that the business was feasible.

g. Evaluation

The results of the technical and financial feasibility analysis (BEP, R/C Ratio, Payback Period, NPV, and IRR) on a small-scale art paper unit design were feasible. Therefore, further studies on designing a skalling-up art paper processing unit made from areca fibre and HVS paper waste. However, this study still needed to consider a marketing strategy for the art paper products. Therefore, further study is also essential to design the processing unit from raw materials and marketing.

Conclusions

In conclusion, based on the financial calculation results of all parameters, the production cost, BEP, R/C ratio, PP and NPV confirmed that designing a small-scale art paper from areca palm fibre waste and HVS paper waste is feasible. The results show that the industry used semi-automatic machines with the facility layout of an odd-angle material flow pattern involving four labourers in production.

Declarations

Conflict of interests: The authors declare no competing interests.

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