








## Feasibility and Development Strategies for Mangrove Fruit-Based Products in Karawang, West Java

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<https://doi.org/10.18280/ijdne.190207>

### ABSTRACT

**Received:** 1 October 2023  
**Revised:** 16 February 2024  
**Accepted:** 24 February 2024  
**Available online:** 25 April 2024

#### Keywords:

*analytic hierarchy process, coastal community, feasibility, financial aspect, food products, health products, mangrove fruit, priority*

This study aims to analyze the feasibility of processing mangrove fruit into various processed products and the priority of developing mangrove fruit processing into various products. The research method uses a survey method by interviewing all members of the Joint Business Group (JBG). This research also interviewed and conducted Focused Group Discussions (FGD) with the government, universities, and social community institutions with a total of 20 people. Data analysis using revenue-cost ratio (R-C ratio) analysis, Break-Even Point analysis (BEP), and Analytic Hierarchy Process (AHP). The results showed that: (1) All processed products: dodol, syrup, jam, candy, and soap deserve to be developed with their respective revenue-cost ratio values of 1.2581, 1.4814, 1.2798, 1.8122, and 1.2142; (2) BEP revenue (Rp) for each product: dodol, syrup, jam, candy, and soap, respectively: 14,786.00; 11,131.13; 12,890.15; 6,451.28; and 16,065.51; while BEP production (units) of each dodol product, syrup, candy, jam, and soap in a row: 0.161; 0.696; 0.4297; 0.08; and 0.5354; while BEP price (Rp/unit) of dodol, syrup, candy, jam, and soap products, respectively: 91,838.51; 15,993.00; 29,998.02; 80,641.00; and 29,750.94; (3) Dodol is a product that is prioritized in its development. Dodol product development is prioritized by paying more attention to product quality. Future research will address economic viability in greater depth, market dynamics, potential risks, and scalability. Further research involves partnerships between micro, small, and medium enterprises, collaborating with food experts, health experts, and tourism experts.

## 1. INTRODUCTION

Mangrove forests are very important for the habitat of various fish and other animals, timber and non-timber forest products, and ecotourism. In addition, mangrove forests can be useful for mitigating climate change [1]. However, mangrove forests have suffered acute damage. The decline in the quantity and quality of mangrove forests is a serious threat to areas whose populations depend highly on mangrove ecosystems. The destruction of mangrove forests is caused by human activities that open pond land for cultivation purposes and is also caused by pest attacks. The main pests that attack mangrove forests are invasive species (*Derris trifoliata*) [2]. As a result, it will impact human health and damage ecosystems and resources [3]. There are ecological impacts that can be caused by the destruction of mangrove forests. These impacts are loss of biodiversity, decline in decomposing microbes, reduction of C-organic in soil, and fish spawning grounds. The further result is that there are relatively large economic losses in the form of disrupted fish growth and development, low fish production, and low income in coastal

communities [4].

Damage to mangrove forests needs to be repaired. Replanting mangrove forests can reduce environmental damage to mangrove forests themselves [3]. One way to reduce the risk of high waves is to replant mangrove forests. Mangrove forest replanting programs can engage communities through training and change how they are planted. This effort has a positive impact on the economic resilience of the community to meet their daily needs. Efforts to save mangrove forests in Karawang have been carried out by various parties, both by the district, provincial, and State governments of Indonesia and by non-governmental organizations (NGOs). Although these efforts have been made, developing the vast area of mangrove forest planting could have been faster. One of the triggers for the slow restoration of mangrove forests is the low participation of the community in planting and maintaining the mangrove forest itself. In addition, it is also caused by the lack of economic benefits from mangrove forests felt by coastal communities.

Mangrove fruit can be processed into food products or health products. People living around mangrove forests can

use mangrove fruit as a source of food and medicine [4]. In Demak, mangrove fruit is used as a raw material for making cakes with a mixture of mangrove flour and soybeans [5]. In Aceh Tamiang, it has made syrup, crackers, and drinks from mangroves [6]. Malaysia has reported research on jams and syrup [7]. On Pulau Sembilan, North Sumatra, we have researched syrup and crackers (mangrove leaves) [8]. Processing mangrove fruit into dodol, candy, and soap is another alternative to the use of mangrove fruit that has not been widely done by the community and/or researchers.

Traditionally, mangrove fruit can treat various diseases such as diarrhea, cholera, dysentery, fever, malaria, and viral infections-the benefits of mangrove forests are valuable as a food source [8]. Mangrove fruit types *S. caseolaris* and *A. corniculatum* help treat diarrhea [9]. Ten types of mangroves are useful anti-bacterial, anti-diarrheal, and cytotoxic. The ten types of mangroves are *Aegiceras corniculatum*, *Avicennia officinalis*, *Bruguiera gymnorhiza*, *Ceriops decandra*, *Heritiera fomes*, *Nypa fruticans*, *Phoenix paludosa*, *Sarcobolus globosus*, *Sonneratia caseolaris*, and *Xylocarpus mekongensis* [10].

So far, the economic benefits of mangrove forests are seen as indirect environmental benefits. Direct economic benefits are still limited to timber products from mangrove forests. The identification results in Tangkolak, Sukrit village, and Sedari Karawang village, West Java, show that the use of mangrove forests by the community is limited to the use of wood and environmental services. In contrast, the use of mangrove fruit in various food, beverage, and health products has yet to be carried out. To add economic value to mangrove forests, processing mangrove fruit into food, drink, and health products is very important.

Like pineapples, durians, bananas, and other fruits, mangrove fruits can be processed into various products. Efforts to process mangrove fruit can create jobs and overcome poverty in coastal areas. This processed product is advantageous as an alternative source of new income for coastal communities and is helpful for motivating communities to replant mangrove forests. Therefore, research has been conducted on "Feasibility and Development Strategies for Mangrove Fruit-Based Products in Karawang, West Java". This study aims to (a) analyze the feasibility of processing mangrove fruit into various processed products and (b) analyze the priority of developing mangrove fruit processing into various products.

## 2. RESEARCH METHODS

Recipes for processing mangrove fruits into various processed food products (dodol, syrup, jam, and candy) and health products (soap) were made and tested by a team of researchers and students of Kuliah Kerja Nyata. Develop recipes for each product by taking and modifying recipes from social media and coastal communities, then testing the recipes. The results of this recipe testing are what become new recipes. The criteria for selecting these products are: (a) the price and availability of mangrove fruit raw materials, and auxiliary materials; (b) output prices; (c) product benefits; (d) product quality; and (e) product packaging.

The recipe for making syrup is as follows: mangrove fruit, sugar, pandan leaves, water, and food coloring. The recipe for making dodol is as follows: mangrove fruit, sticky rice, palm sugar, sesame, sugar, and coconut milk. The recipe for making

jam is as follows: mangrove fruit, sugar, and food coloring. The recipe for making candy is as follows: mangrove fruit, sugar, gelatin swallow, gelatin plai nutrijel, vanilla, powder, food coloring, and sugar. The soap making recipe is as follows: mangrove fruit, noni fruit, fragrance, food coloring, yeast, texafon, and water.

In order to increase the production of each product by analyzing the availability of raw materials and auxiliary materials, the availability of skilled labor, market potential, especially tourist potential, and the general public. If market demand increases, the reproduction of such processed products can be increased.

Members of the Joint Business Group (JBG) previously used to process fishermen's catches in the coastal communities of Sukakarta village, especially Tangkolak Hamlet. JBG members conducted counseling on processing pibreasts into various processed products with the group method. After that, JBG members tried processing, starting from taking "pidada" (mangrove fruit), sorting, processing, packaging, expiration testing, and marketing.

Research implementation during September 2020-August 2023. The data collection method uses the census method by interviewing all JBG members based on questionnaires made previously. Meanwhile, the determination of policy-making stakeholders by "purposive sampling" totalled 20 people. They are the Forestry Service (1 person); the village (2 people, head and secretary); 2 people each for the NGO, the Industry and Trade Office, the Faculty of Agriculture-Unsika, the Fisheries Service officer in Karawang-West Java; and 3 people each for the JBG, the Fisheries Service in Cilamaya Wetan sub-district, and the Tourism Service in Karawang district. These respondents have been involved in focused group discussion (FGD) activities. This result has been done by Abdurrahman et al. [11], and a previously made questionnaire guided the interview. The questionnaire for data collection skills was conceptualized first by the research team, then a questionnaire trial was conducted for the respondents, and after that, the questionnaire was updated, and interviews were conducted with stakeholders. After data collection, a FGD was conducted to design a strategy for developing mangrove fruit processing into various processed products.

The collected data were analyzed using the revenue-cost ratio (R-C ratio) in the short term the production process. The R-C ratio is a comparison between total receipts and total costs [12]. This analysis is very useful for business actors to assess their business feasibility [13-15]. While the Break-Even Point (BEP) analysis is a break-even point, where business activities do not experience losses or do not receive profits. In other words, the total cost and total receipt are the same [15]. Furthermore, knowing the BEP of an economic activity can explain the company's financial performance.

Measuring business feasibility can be done with various criteria such as: (1) revenue/cost (R/C)>1 [16]; then (2) assessing the BEP by looking at the BEP of production, BEP of revenue, and BEP of price. The BEP formula is as follows:

$$BEP_{revenue} = \frac{FC \times S}{S - VC} \quad (1)$$

$$BEP_{production} = \frac{FC}{P - AVC} \quad (2)$$

where, FC, S, VC, P, and AVC is fixed cost, sales, variable cost, price, and average variable cost, respectively [17, 18].

The Analytic Hierarchy Process (AHP) is used to analyze information provided by stakeholders in determining decisions on the selection of processed mangrove fruit products into processed products that are prioritized for development [18, 19]. AHP uses the Likert scale for questions answered by stakeholders. AHP is a method that can be used to define developed products. There are five alternative products that will be chosen by stakeholders, namely dodol, syrup, jam, candy, and soap. There are five criteria that form the basis for product development decisions, namely: availability of mangrove fruit raw materials and auxiliary materials, packaging, product benefits, product prices, and product quality [16, 18-21]. Priority is the relative weight given by stakeholders to five criteria for product selection. Combined priorities are arranged from highest to lowest. The highest combined priority is the decision about the product to be developed.

To determine the scoring of stakeholders' views and assessments using the AHP tool. The assessments of respondents (stakeholders) are combined and averaged using a geometric mean (geometric mean). The number that appears to have a decimal value, is then multiplied by 100 to obtain a value of hundreds, so that each criterion is in the range of 100 to 900. This method is to reduce bias in rounding values. As an illustration, if the geometric mean value of 5.14 for a scale of 1 to 9 is changed to a value of 514 for a scale of 100 to 900. Assessment of each criterion using weighting through the AHP rating direct method, namely by direct assessment of each object asked in interviews with stakeholders and not comparing one object with another object because the assessment directly means not using the comparison matrix method. For weighting using this direct method, the analysis uses Cd Plus 3.0 software.

### 3. RESULT AND DISCUSSION

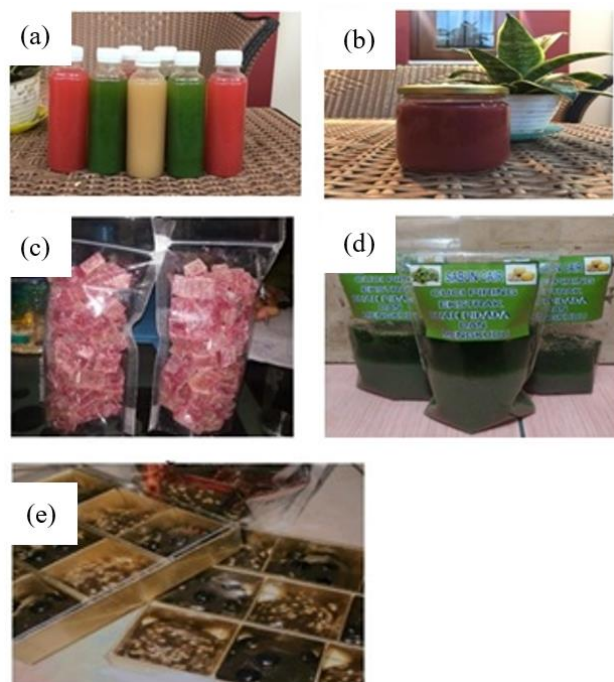
Mothers who are members of the JBG have been busy processing fish caught in the waters of the Java Sea. However, fish catches are not always available in sufficient quantities to be processed. As a result, there is free time for mothers to fill their time with other activities, such as processing mangrove fruit into various processed products such as dodol, syrup, jam, candy, and soap. The processing of mangrove fruit into various processed products was introduced by the research team and continued with Kuliah Kerja Nyata (KKN) activities for students from various study programs at Universitas Singaperbangsa Karawang (UNSIKA) for three months. This activity is a continuation of the trial activity of recipes for processing pibreasts into various processed products. This is also a new way of introducing the use of mangrove forests that are not only in the use of wood and the environment that has been done by researchers in various coastal areas in Indonesia. The processing of mangrove fruit into various food, beverage, and health products can enhance the economic value of the development of mangrove forest natural resources.

The development of mangrove fruit processing into food products has also been carried out by studies [5, 22-26]. According to Afifah et al. [5], one food source that contains high energy and carbohydrates is mangrove fruit (*Bruquiera gymnorhiza*). A mixture of mangrove fruit flour and soybeans can produce nutrient-rich pastries for toddler consumption and all age groups. According to Nawar et al. [4], in certain areas such as Lubuk-Kertang, Pulau Sembilan, Langkat and North

Sumatra with their great diversity, mangrove plants are a source of food and medicine. Lately, the number of diabetes patients has increased sharply and alarmingly. This condition sparked interest in finding alternative medicines. The source of alternative medicine is mangrove forests [27]. Even researchers [28] say that grey mangrove (*Avicennia marina* (Forssk) Vierh). The fruit is a traditional medicine and health food in various countries.

#### 3.1 The production cost of processing mangrove fruit into various processed products

In production, variable and fixed inputs can be used depending on your desired product. Various products in mangrove fruit processing have similarities and differences in using auxiliary materials and packaging. In dodol, supplementary ingredients are sticky rice, palm sugar, granulated sugar, and coconut milk. This product differs from syrups, jams, sweets, and soap manufacturing. The following are the processing results presented in Figure 1.



**Figure 1.** Mangrove fruit processing products: (a) syrup, (b) jam, (c) candy, (d) soap, and (e) dodol

**Table 1.** Total production cost for making dodol from mangrove fruit in karawang

	A	B	C	D	E (%)
Mangrove fruit, kg	10,000	1.00	10,000	14.49	
Glutinous, kg	26,000	0.25	6,500	9.42	
Palm sugar, kg	18,000	0.50	9,000	13.04	
Sesame seeds, kg	15,000	0.10	1,500	2.17	
White sugar, kg	14,000	0.25	3,500	5.07	
Coconut milk, L	40,000	0.40	16,000	23.19	
Oil paper, pack	8,000	1.00	8,000	11.59	
Worker, person	100,000	0.10	10,000	14.49	
LPG gas	25,000	0.20	5,000	7.25	
Total variable cost			69,000	94.36	
Total fixed cost (tool depreciation)			3,622.53	5.64	
Total cost			73,123.53	100.00	

(Source: primary data processed, with variable A until E is the cost component, price, volume, total cost, and percentage, respectively.)

The complete cost component for making syrup until dodol from mangrove fruit are presented in Tables 1-5. In Table 1, it can be seen that variable costs dominate fixed costs, where variable costs are 94.36%. From variable costs, some costs dominate coconut milk, followed by mangrove fruit costs and labor costs. It will likely be different if the price of mangrove fruit rises along with more groups of dodol makers from mangrove fruit.

The development of mangrove fruit processing into food, beverage, and health products can encourage the improvement of mangrove forest quality and the expansion of the mangrove forest area itself. The continued impact has resulted in job openings for the younger generation in coastal areas. The use of this labor has the opportunity to overcome covert unemployment that often occurs in coastal communities, especially in the western season. It can also reduce the poverty rate. In addition to overcoming unemployment and poverty, the development of mangrove fruit processing into various processed products can encourage increased production of auxiliary materials that are relatively cheap and easily obtained from the results of local farmers, such as sesame, coconut milk, palm sugar, sticky rice, agar-agar, and noni.

Syrup involves auxiliary ingredients such as water, food coloring, and pandan leaves. The complete cost component for making dodol from mangrove fruit can be seen in Table 2. In Table 2, it can be seen that variable costs dominate fixed costs, where variable costs are 97.21%. From variable costs, some costs dominate labor costs, followed by the cost of sugar, tissue, mangrove fruit, water, and gas fuel. The high use of labor can help the absorption of work by making syrup.

**Table 2.** Total production cost for making syrup

A	B	C	D	E (%)
Mangrove fruit, kg	10,000	0.50	5,000	10.04
Granulated sugar, kg	16,000	0.50	8,000	16.06
Water, L	5,000	1.00	5,000	10.04
Food coloring, ml	1,000	1.00	1,000	2.01
Pandan leaf, sheet	400	5.00	2,000	4.02
CMC, ml	2,000	1.00	2,000	4.02
LPG gas	25,000	0.20	5,000	10.04
Tissue, pack	6,000	1.00	6,000	12.05
Bottle packaging, pcs	1,200	4.00	4,800	9.64
Label, pcs	250	4.00	1,000	2.01
Manpower, person	100,000	0.10	10,000	20.08
Total variable cost			49,800	97.21
Total fixed cost (tool depreciation)			1,427	2.79
Total cost			51,227	100.00

**Table 3.** Total production cost for making jam

A	B	C	D	E (%)
Mangrove fruit, kg	10,000	0.50	5,000	9.06
Sugar, kg	16,000	0.50	8,000	14.49
Food coloring, ml	200	1.00	200	0.36
Water, L	5,000	1.00	5,000	90.06
Label, pcs	300	5.00	1,500	2.72
Packaging, pcs	3,500	5.00	17,500	31.70
LPG fuel, kg	20,000	0.05	1,000	1.81
Manpower, person	100,000	0.10	10,000	18.12
Total variable cost			55,200	98.88
Total fixed cost (tool depreciation)			628	1.12
Total cost			55,828	100.00

In Table 3, it can be seen that variable costs dominate fixed costs, where variable costs are 98.88%. Of the variable costs, some costs dominate are the costs for packaging, followed by

labor costs the cost of granulated sugar. The high cost of packaging because it uses packaging from thick glass.

The manufacture of sweets involves auxiliary ingredients such as plai swallow agar and plai nutrijel agar. In Table 4, variable costs dominate fixed costs, where variable costs are 99.11%. From variable costs, some costs are gelatin, followed by the cost of sugar, LPG gas, and labor.

**Table 4.** Total production cost for making candy

A	B	C	D	E (%)
Mangrove fruit, kg	10,000	0.25	2,500	6.10
Sugar, kg	12,500	0.60	7,500	18.29
Plai swallow gelatin, pcs	5,000	2.00	10,000	24.39
Puji nutrijel agar, pcs	5,000	1.00	5,000	12.20
Vanilla powder, pcs	1,000	2.00	2,000	4.88
Food coloring, ml	200	2.00	200	0.49
Refined sugar, spoon	500	1.00	500	1.22
Water, L	5,000	0.10	500	1.22
Label, pcs	450	4.00	1,800	4.39
Packaging, pcs	250	4.00	1,000	2.44
LPG fuel, kg	10,000	0.50	5,000	12.20
Manpower, person	100,000	0.05	5,000	12.20
Total variable cost			41,000	99.11
Total fixed cost (tool depreciation)			370	0.89
Total cost			41,370	100.00

In Table 5, it can be seen that variable costs are 97.92%. Of the variable costs, some dominants are the costs for texafon, followed by the cost of bottle packaging and labor costs. Making soap from mangrove fruit involves many available auxiliary materials, namely noni with a relatively cheap one.

**Table 5.** Total production cost for making soap

A	B	C	D	E (%)
Mangrove fruit, kg	10,000	0.50	5,000	8.86
Noni fruit, kg	500	0.50	250	0.44
Water, L	10,000	0.50	5,000	8.86
Food coloring, bottle	5,000	0.20	1,000	1.77
Essence, bottle	15,000	0.30	5,000	8.86
Yeast, g	5,000	0.50	2,500	4.43
Texafon, kg	22,000	0.50	11,000	19.49
LPG gas, kg	10,000	0.20	2,000	3.54
Ice and black plastic, pcs	3,500	0.50	3,500	6.20
Tissue, pack	10,000	0.10	1,000	1.77
Packaging, pcs	1,000	10.00	10,000	17.71
Label, pcs	200	1.00	200	0.35
Manpower, person	100,000	0.10	10,000	17.71
Total variable cost			56,450	97.92
Total fixed cost (tool depreciation)			1,198	2.08
Total cost			57,648	100.00

### 3.2 Revenue and profit from processing mangrove fruit into various processed products

Revenue can be obtained from selling processed mangrove fruit products to KUB/JBG in the research area, as shown in Table 6. Income is multiplied by the number of products sold and the prevailing price. At the same time, profits are obtained from the difference between receipts and the total costs incurred during production. Each of these processed products appears in different sizes. Dodol products appear in the form of long cylinders packed with oil paper in small sizes, so the weight of one kg is equivalent to 46 sticks. Syrup comes in small bottles with a volume per bottle of 100 ml. Jam is packaged in bottles with a size of 200 ml. Candy is wrapped

in small sizes and packaged, weighing 250 grams-the last is soap in bottles weighing 100 ml.

**Table 6.** Profit from processing mangrove fruit into various processed products

	F	G	H	I	J	K
Dodol, kg	46	2,000	92,000	73,123.53	18,876.47	
Syrup, L	10	8,000	80,000	51,227.00	28,773.00	
Jam, L	5	15,000	75,000	55,828.00	19,172.00	
Candy, kg	4	20,000	80,000	41,370.00	38,630.00	
Soap, L	10	7,500	75,000	57,648.00	17,352.00	

(Variables F until K are product type, total, price, revenue, cost, and profit, respectively.)

Revenue per kilogram of dodol obtained exceeds syrup, jam, sweets, and soap products (shown in Table 7). The receipt of syrup and confectionery products is the same, and the receipt of jam and soap products is the same. However, judging from the profits obtained, the earnings of candy products are higher than other products. This result happens because the cost of producing confectionery products is relatively lower. The most increased production cost is dodol because the price of auxiliary materials is rather expensive.

**Table 7.** Revenue-cost ratio and BEP analysis of various processed products

F	L	M		
		M1	M2	M3
Dodol, kg	1.2581	0.161	14,786.00	91,838.51
Syrup, L	1.4814	0.696	11,131.13	15,993.00
Jam, L	1.2798	0.430	12,890.15	29,998.02
Candy, kg	1.8122	0.080	6,451.28	80,641.00
Soap, L	1.2412	0.535	16,065.51	29,750.94

(Variables L, M, and M1 until M3 are revenue-cost ratios, BEP, BEP for product, BEP for revenue, and BEP for price, respectively.)

### 3.3 Feasibility analysis of mangrove fruit processing business into various processed products

Analyzing business feasibility, all costs incurred, such as equipment and building depreciation, should be carefully calculated-variable costs, such as raw and auxiliary materials used during production. Another tool for assessing business viability is the revenue-cost ratio. This tool can illustrate how the role of increased costs, incredibly variable costs, can affect company revenues due to changes in total production. The analysis results on the feasibility of processing mangrove fruit into various processed products can be seen in Table 7.

The ratio R/C is calculated by comparing the amount of receipts with the total costs incurred. The ratio R-C for five processed mangrove fruit products in Karawang regency is 1.2581 (dodol); 1.4814 (syrup); 1.2798 (jam); 1.8122 (candy) and 1.2412 (soap) and worthy of development. Of the three products, the highest value of the R-C ratio is obtained from processed mangrove fruit into candy, and the R-C ratio's lowest value is soap. As an illustration, if it is assumed that there is an increase in the price of mangrove fruit raw materials, auxiliary materials, and other variable inputs in making dodol due to inflation in the next year of 10 percent while the output price is fixed, then what happens to the R-C ratio of dodol products is 1.149, or down from the original R-C ratio of dodol. However, if the increase in variable input prices by 10 percent is followed by an increase in the output price of dodol by 5%, then the R-C ratio (1.2064) will decrease compared to the

existing R-C ratio and be greater than the R-C ratio with an increase in variable input prices by 10%.

The study's results also show that judging from the feasibility of using BEP criteria, revenue BEP, production BEP, and price BEP, processing mangrove fruit into various processed products is feasible. This result can be seen from the significant value of the BEP. Judging from the amount of production BEP value, the BEP value of each processed product successively from low to high is candy, dodol, jam, soap, and syrup. Judging from the amount of BEP value of receipts, the BEP value of each processed product in a row from low to high is candy, syrup, jam, dodol, and soap. Judging from the amount of BEP value of the price, the BEP value of each processed product successively from low to high is syrup, jam, soap, candy, and dodol. In order to avoid bias in the discussion about the amount of BEP value, it is better for a new entrepreneur in product development to focus on product BEP for the reason that you want to benefit by increasing the number of products produced.

Over time, it can result in price changes in both input prices and output prices as a result of changes in demand and supply. To anticipate these price changes, sensitivity analysis is needed. As an illustration, if it is assumed that there is an increase in the price of raw materials for mangrove fruit, auxiliary materials, and other variable inputs in making dodol due to inflation in the next year of 10%. While the output price is fixed, what happens is that the BEP value of both production BEP, price BEP, and sales BEP increases successively: 0.233 kg; Rp. 80,072.53/kg; Rp. 21,209.19. Conversely, if the variable input price falls, there will be a decrease in the BEP value. If the increase in variable input prices is followed by an increase in dodol prices by 5%. Production BEP (0.1798 kg) and sales BEP (Rp. 17,365.9160) are high when compared to existing BEP but lower than BEP due to an increase in variable input prices of 10%.

### 3.4 Selection of AHP model criteria and product development priorities

The research team and student's KKN tested five processed products. These products are also counseling materials for JBG members. In the early stages, JBG members made only one processed product in each group. In order to determine the priority product, an analysis is needed, namely AHP. There are five criteria that determine the most for stakeholders in making decisions on what products to develop [21]. The five criteria are product price, price and continuity of banana raw materials, product benefits and distinctiveness, product quality, and product packaging. In the AHP, Criterium Decision Plus 3.0 (Cd Plus 30) software is used. These five criteria are labeled with product price, raw material price, product distinctiveness, product quality, and product packaging. The determination of production costs and profit expectations largely comes from the selling price of various processed mangrove products from the producer's point of view. However, the price of processed mangrove products is also determined by the market in the form of the attraction between demand and supply. The law of demand states that the lower the price of a good, the more demand for that good; conversely, the higher the price of a good, the less demand for the good, provided that other factors are constant. Demand for products, including processed mangrove products, is determined by the price of processed products themselves, prices of other goods that are closely related to the product, consumer income, taste of the

community or consumers, population, and forecasts about future conditions. The price of processed mangrove products is an attraction for groups of mothers (producers) to produce. So far, producers have stated that the high selling price of mangrove-processed products, in addition to increasing producer revenue, can also increase their business motivation to continue to exist.

So far, there are no people selling mangrove fruit in the market. This happens because there are not many people who know its benefits. People know mangrove forests as a place to grow and play with marine animals and birds, as breakwaters and wood can be used as firewood, raw materials for frames, and tourist attractions in coastal areas. In Cilamaya Wetan District, there are 4.5 ha of mangrove forest that can produce mangrove fruit. If the community continues to make various preparations from mangrove fruit, the availability of raw materials must be continuous. The existence of coastal potential that has not been planted with mangroves in other

Karawang coastal areas provides opportunities for the development of mangrove fruit processing into various processed products.

Processed mangrove fruit products can be classified into three groups of benefits, namely food, beverages, and health. Dodol, jam, and sweets belong to this type of food. Syrup is classified as a type of drink, while soap is a health product for washing dishes, spoons, pans, and others. The selling value of the product is not only determined by its existence but also by its packaging. This point is presented in Figure 2. At this time, the form of product packaging is so varied and attractive. Manufacturers can choose the form of packaging according to consumer demands. Many designers who are specialized in the shape, pattern, message, and color of the packaging produce packaging designs. Product packaging can increase production costs, which in turn can affect the high total cost. Along with that, it will affect the selling price of the product.

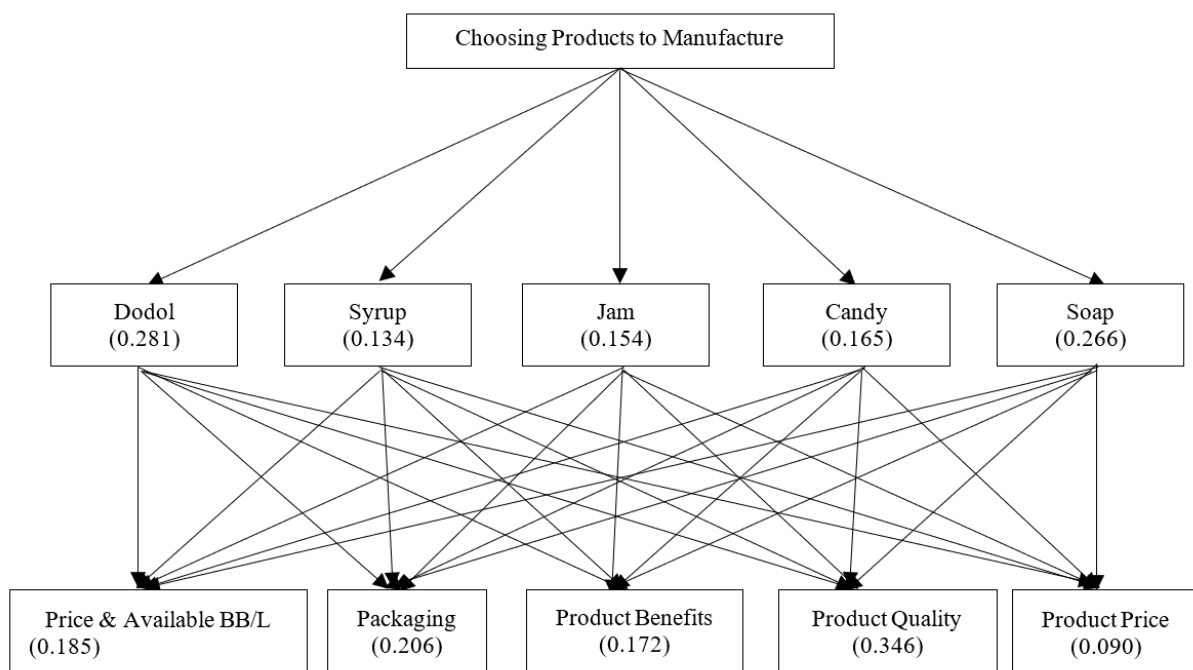


Figure 2. AHP model hierarchy for determining mangrove-processed products

This analysis involves five criteria, namely the price and availability of raw materials and auxiliary materials, the form of packaging, product benefits, product quality, and product price. After knowing the ranking, it is then determined based on whether the product can sell well in the market or not. After going through the filtering stage, there are two dominant products, namely, dodol and soap. The results of the analysis show that the most prominent criterion is product quality. On that basis, the first priority for the development of processed mangrove fruit products is dodol, although it provides low profits. Many product processing experts, such as studies [15, 29-37] argue that product quality is more important than anything else. The results of this AHP illustrate the hierarchy between goals, criteria, and alternatives. The hierarchical arrangement of the AHP model can be seen in the following Figure 3. AHP was chosen for determining the strategy for developing processed mangrove fruit products considering that in AHP there is a hierarchy to the farthest in strategic decision making, can make decisions with multi-factor

problems or complex multi-criteria into a hierarchy, has a lower consistent value compared to many other strategic decision analyses such as strengths weakness opportunities treats (SWOT) analysis [38].

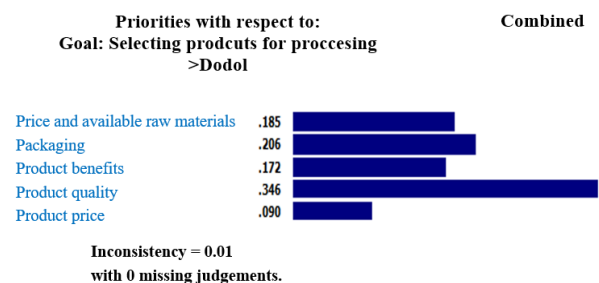


Figure 3. Contribution of criteria to the selection of processed products of mangrove fruit into various products

At the level of criteria that occupy the order of priority,

respectively, are product quality, packaging, price and availability of raw materials or auxiliary materials, product benefits, and product prices with their respective weight values: 0.346; 0.206; 0.185; 0.172; and 0.090. Based on the results of AHP priorities, product quality development goes hand in hand with product selection and continues towards product packaging. This is quite reasonable because, as a souvenir in the form of food, it depends very much on the quality of the product. For this reason, producers should be able to make preparations from mangrove fruit with good quality and good packaging as well.

Product price is the smallest reason for product selection criteria. This is in accordance with the results of interviews with policy-making stakeholders in the development of mangrove-processed fruit products. The selection of processed products that can be considered by the mothers of the coastal area of Karawang from the perspective and opinions of stakeholders and has a relatively good chance to be developed can be seen in Table 8.

**Table 8.** Profit from processing mangrove fruit into various processed products

	F	G	H	I	J	K
Dodol, kg	46	2,000	92,000	73,123.53	18,876.47	
Syrup, L	10	8,000	80,000	51,227.00	28,773.00	
Jam, L	5	15,000	75,000	55,828.00	19,172.00	
Candy, kg	4	20,000	80,000	41,370.00	38,630.00	
Soap, L	10	7,500	75,000	57,648.00	17,352.00	

(Variables N and O are weight and priority, respectively.)

Table 8 shows that the weight of dodol ranks first (0.281), then soap (0.266), then candy (0.165), jam (0.154), and finally syrup (0.134). The selection of products by stakeholders that can be suggested to JBG members is dodol because these products get a lot of attention from stakeholders in urban and rural communities. Soap is the second choice in the development of processed products from mangrove fruit. This product is classified as a health product. Every day, the household always washes the dishes after eating staple foods such as rice and others. So at the initial stage, the products of concern are dodol and soap. The next stage is that, in line with the development of tourist visits, both local, domestic (Indonesia), and foreign, it is possible to develop all types of processed breasts into various processed products.

Along with the development of mangrove fruit processing, it must be balanced with the development of mangrove planting to support the mangrove fruit processing industry. There are forces that support mangrove forest planting, such as the motivation of coastal communities to replant the potential of land that was once mangrove forest land. It's just that the weakness is the knowledge of coastal communities about the use of mangroves only in environmental services. In terms of the opportunity for mangrove forest development is very high from the government which spends a lot of budget, government support for the development of the mangrove fruit processing industry is very high, the development of coastal tourism is also high. The rapid progress of tourist areas such as Bali, Yogyakarta, Lombok Island, Toraja land, Komodo island, and other tourist areas has a broad impact on carving products, typical foods and drinks, clothing, and others. Therefore, it is very possible for the development of mangrove forest tourism areas [6, 39] along with the development of processed mangrove fruit products into various processed products as souvenirs for tourists. This product [40] is

marketed as a souvenir for tourists. Apart from the benefits of products as food, beverages, and health, these products consumers consider as souvenirs or gifts [41], these products can also be consumed as souvenirs, online memes, or videos [42]. However, the development of mangrove forests faces uncertain weather problems due to global warming. In addition, there are many other processed fruit products that can be competitors for processed mangrove fruit products.

#### 4. CONCLUSIONS

Based on the data from this study, it can be concluded that: (1) all processed products: dodol, syrup, soap, jam, and candy are eligible to be developed with revenue-cost ratio values of 1.2581, respectively; 1.4814; 1.2412; 1.2798; and 1.8122. (2) Judging from the R-C ratio, all dodol, syrup, candy, jam, and soap products are worthy of development. (3) Judging from the Break Even Point, the BEP receipt (Rp) of each dodol, syrup, candy, jam, and soap is consecutive: 14.786,00; 11.131,13; 12.890,15; 6.451,28; and 16.065,51; while BEP production (units) of dodol, syrup, candy, jam, and soap, respectively, was consecutive: 0,161; 0,696; 0,4297; 0,08 and 0,5354, while BEP prices (Rp/unit) of dodol, syrup, candy, jam, and soap, respectively, are 91,838.51; 15.993,00; 29.998,02; 80.641,00 and 29.750,94. (4) The development of processed breast products is more focused on dodol and/or soap products, with more attention to product quality and packaging. This research is still limited in terms of making new processed products, so to strengthen the contribution of research results, it is necessary to deepen the focus of R-C ratio analysis, production BEP, and AHP in depth in the hierarchy. Future research will discuss economic feasibility in more depth, market dynamics, potential risks, and scalability. In addition, further research is needed by involving partnerships from micro, small, and medium enterprises. In principle, this research is still very far from expectations. Therefore, this research must collaborate with food experts, health experts, tourism experts, and micro, small, and medium enterprises (MSME).

#### ACKNOWLEDGMENT

We would like to express our deepest gratitude to the Research and Community Service at Universitas Singaperbangsa Karawang for supporting research funding on Priority Grant scheme (No.: 1713.127/SP2H/UN64/LL/2020).

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