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Feasibility Study of Snake Fruit Chips Business as a Value-Added Transformation for Strengthening Sustainable Agroindustry

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ABSTRACT
The processing of snake fruit into value-added products such as chips represents an important agro-industrial innovation to address the challenges of oversupply and declining prices during peak harvest periods. This study contributes to analyse the business feasibility of snake fruit chips based on market, technical production, management, and financial aspects. The research employed a feasibility study approach using data collected through market surveys, production trials using vacuum frying technology, and cost analysis of operational activities. Market analysis was conducted to evaluate demand potential and marketing opportunities, while technical analysis assessed the production process and operational requirements. Management analysis examined the organisational structure and labour needs of small-scale agroindustry. Financial feasibility was evaluated using investment appraisal parameters, namely Payback Period (PP), Net Present Value (NPV), Internal Rate of Return (IRR), and Profitability Index (PI), which were calculated based on projected costs, revenues, and cash flows from the snake fruit chips production system. The results show that the snake fruit chips business is financially feasible, with a PP of 5 months, NPV of IDR 346,415,523, IRR of 240.53%, and PI of 1.29, indicating strong profitability and rapid capital recovery. These results demonstrate that the adoption of vacuum frying technology combined with effective market strategies can significantly increase the added value and shelf life of snake fruit while expanding market opportunities, including export potential. Therefore, the development of snake fruit chips agroindustry represents a viable strategy to strengthen local agro-industrial competitiveness, improve farmers' welfare, and support the achievement of Sustainable Development Goal (SDG) 12 on responsible consumption and production.

KEYWORDS
Added value; Agroindustry; Business feasibility; Snake fruit chips; Sustainable innovation

1. INTRODUCTION

Indonesia is an agrarian country with vast potential in the agricultural and plantation sectors, contributing significantly to national food security and export opportunities. One of the country's leading horticultural commodities is snake fruit (*Salacca zalacca*), which ranks fifth among the top fruit producers in Indonesia, with a production volume of 1,118,953 tons, accounting for approximately 5.65 percent of total national fruit production [1]. Beyond its economic value, snake fruit is also recognised for its nutritional content, including carbohydrates, protein, calcium, phosphorus, vitamin B, vitamin C, and dietary energy, which makes it an attractive raw material for processed food products [2].

In addition to its basic nutritional value, various studies have revealed that snake fruit contains high levels of phenolics and antioxidants, suggesting its potential as a functional food ingredient [3], [4]. Cultivation innovations such as the application of organic fertilisers and *Bacillus* bacteria have also been shown to improve the nutritional quality and antioxidant content of the fruit [4]. However, despite its high

production potential, snake fruit farmers often face challenges related to price instability and oversupply during peak harvest seasons. These conditions frequently lead to declining market prices and reduced farmer income, highlighting the importance of product diversification and agroindustrial development to increase the added value of snake fruit commodities.

Globally, the market for fruit-based snack products has experienced significant growth in recent years, driven by increasing consumer demand for healthy, natural, and convenient food products. Fruit chips have become an increasingly popular segment of the snack market due to their nutritional value, long shelf life, and convenience. Several studies indicate that the development of fruit-based snack products presents promising economic opportunities for agroindustry, particularly in countries with abundant tropical fruit resources [5], [3]. Within this context, processing snake fruit into value-added products such as chips offers a strategic opportunity to strengthen the competitiveness of local agroindustry and expand market opportunities both domestically and internationally.

One of the most promising processing technologies is vacuum frying, which has been widely applied in the production of fruit chips. This method has been shown to preserve nutritional and antioxidant content more effectively while producing a crisp texture and longer shelf life compared to conventional frying techniques [6], [3]. Studies report that vacuum frying at approximately 90 °C for 50 to 60 minutes can produce fruit chips with low moisture content and desirable sensory characteristics [7], [8]. Factors such as temperature, frying duration, and pre-processing stages also influence the final characteristics of snake fruit chips [9]. These technological developments provide opportunities for improving the commercial value of snake fruit-based products and expanding their potential in global snack markets.

Despite the growing interest in snake fruit processing technologies, previous studies have largely focused on the technological performance, nutritional characteristics, or product development aspects of snake fruit chips. Comprehensive studies that integrate technological innovation with market analysis, management considerations, and financial feasibility assessment remain limited. As a result, the economic viability and investment potential of snake fruit chips agroindustry have not been fully explored. This gap highlights the need for a more integrated feasibility analysis that evaluates the development potential of snake fruit chips production from multiple business perspectives.

Therefore, this study aims to evaluate the feasibility of developing a snake fruit chips agroindustry using an integrated analytical approach covering market potential, technical production aspects, management readiness, and financial feasibility. Specifically, this study addresses the following research objectives: (1) to analyse the market potential and competitive opportunities for snake fruit chips products; (2) to assess the technical and operational feasibility of snake fruit chips production using vacuum frying technology; (3) to evaluate management and organisational requirements for small-scale agroindustry development; and (4) to determine the financial feasibility of snake fruit chips production using investment indicators including Payback Period (PP), Net Present Value (NPV), Internal Rate of Return (IRR), and Profitability Index (PI).

The novelty of this research lies in integrating technological innovation in snake fruit chip processing with a comprehensive business feasibility assessment that simultaneously examines market, technical, management, and financial aspects. By combining production technology analysis with investment feasibility indicators, this study provides a more holistic evaluation of snake fruit chips agroindustry development. The findings are expected to provide practical insights for entrepreneurs, farmers, and policymakers in developing sustainable snake fruit-based agroindustry, increasing the economic value of local horticultural commodities, and strengthening rural economic development.

2. MATERIALS AND METHODS

2.1. Materials

The main raw material used in this research was fresh snake fruit fruit sourced from Turi District, Sleman Regency, located in the Yogyakarta Special Region, one of the most productive snake fruit fruit areas in Indonesia. Additional materials included cooking oil used as the frying medium, silica gel for moisture control during storage, and ziplock plastic bags for packaging and preservation. The equipment used in this research consisted of a vacuum fryer for processing snake fruit chips, an analytical balance for

precise weighing, a moisture analyser for determining water content, a colourimeter for assessing product colour, a texture analyser for evaluating crispiness, and a laptop for data processing and financial analysis.

The production process involved several stages including fruit sorting, peeling, slicing, vacuum frying, draining, cooling, and packaging. The frying process was conducted using vacuum frying technology at approximately 90 °C for 50–60 minutes based on procedures reported in previous studies. To improve the reliability of the results, the production trial was conducted in three replications. Product quality parameters observed included moisture content, colour characteristics, and texture (crispiness).

The feasibility of the snake fruit chips agroindustry was evaluated using financial indicators including PP, NPV, IRR, and PI. The financial analysis was based on estimated investment costs, operational costs, production capacity, and projected revenues derived from the production trial and market survey results. To assess potential financial risks, a sensitivity analysis was also conducted by examining possible changes in key variables such as production costs and selling prices. The financial projection assumes that the produced chips can be absorbed by the market based on survey results and current demand trends for fruit chip products.

2.2. Research Site and Duration

This study was conducted at the Laboratory of Agroindustrial Systems Management, Department of Biological and Veterinary Technology, Vocational School, Universitas Gadjah Mada, between July and August 2025. The laboratory environment provided full facilities and controlled conditions required for each stage of the research, including product processing, quality analysis, and feasibility assessment.

In addition to laboratory experiments, a market survey was conducted to identify consumer preferences and potential demand for snake fruit chips products. The survey involved 50 respondents selected using purposive sampling, consisting of consumers familiar with fruit-based snack products. Data was collected using a structured questionnaire that included questions regarding purchasing behaviour, preferred product attributes, and acceptable price ranges. The data collected were analysed using descriptive statistical analysis to determine market potential and consumer demand trends.

2.3. Research Procedures

The production process is summarised in the flow chart presented in Figure 1. Research began with problem identification, which included examining market demand for snake fruit chips, assessing product quality standards, and analysing the level of competition in the market. This stage was followed by a comprehensive literature review focused on snake fruit chip processing technology, product quality benchmarks, and the business feasibility of such ventures. Data collection was carried out through market surveys on consumer preferences and selling prices of snake fruit chips in the market, production trials to test processing methods, and further analysis of production costs.

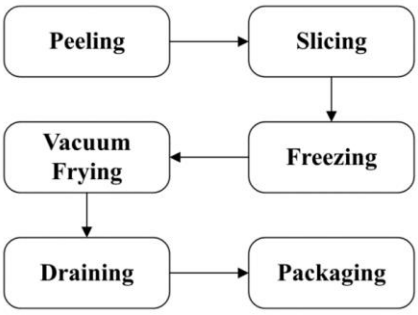

Figure 1. Flowchart of snake fruit chips processing.

The technical stages of snake fruit chip production (Figure 1) started with peeling the snake fruit fruit and separating the flesh from the seeds, then dividing the flesh into two parts. The fruit was then placed into ziplock plastic bags, with a capacity of one kilogram per bag, and stored in a freezer. Once frozen, the

snake fruit was processed using a vacuum fryer filled with cooking oil for 90 minutes at a pressure of -68 cmHg. The resulting snake fruit chips were then drained and packaged in standing pouch packaging, ready for distribution and sale.

2.4. Feasibility Analysis Framework

The business feasibility analysis in this study comprised four aspects: market and marketing, technical or operational production, management, and finance [10]. Market and marketing analysis aimed to identify the scale of potential market, estimate achievable market share, and formulate effective marketing strategies. This aspect involved the identification of market potential, competition analysis, demand projections, and the establishment of marketing strategies, in accordance with the framework proposed by [11].

The technical or operational production aspect concerned the selection of the right location and production area, scale of production, facility layout, and the application of technology and equipment. Through technical feasibility analysis, the research identified the requirements for raw materials, labour, location, layout, production scale, and all technologies and equipment to be utilised. This step was crucial to ensure the technical components of the business were implemented efficiently and met both production and market needs [12].

The management aspect addressed the readiness of human resources to operate the business and the formulation of an appropriate organisational structure. Feasibility analysis in this domain was performed by identifying the most suitable organisational model, job descriptions, key personnel, recruitment and payroll systems, workforce capacity, and employee development planning [13], [14].

This study also employed a SWOT analysis to identify internal and external factors influencing the development of the snake fruit chips business. SWOT analysis is widely used as a strategic planning tool to evaluate internal strengths and weaknesses as well as external opportunities and threats affecting organisational performance [15], [16]. In this study, the SWOT framework was used to analyse the internal capabilities of the snake fruit chips business and the external environmental conditions that influence market development. The results of the SWOT analysis were then used to formulate strategic recommendations for the development of the snake fruit chips agroindustry.

2.5. Financial Analysis

The financial aspect of the feasibility study aimed to determine the soundness of the investment plan by weighing expected benefits against costs. This assessment used four main investment appraisal methods: PP, NPV, IRR, and PI. Each method is explained as follows. PP measures how quickly the initial investment is recovered. The shorter the payback period, the more attractive the investment. A business is considered feasible if the payback period is shorter than the loan term. The formula (1) is written to calculate Payback Period [10].

$$PP = \frac{\text{Initial Investment}}{\text{Annual Net Cash Flow}} \tag{1}$$

NPV calculates the difference between the present value of the investment and the present value of all future net cash inflows. Business is feasible if NPV is greater than zero. The NPV [10] is calculated using formula (2).

$$NPV = \Sigma \frac{CF_t}{(1+r)^t} - I \tag{2}$$

where CF_t is the net cash flow at time t, r is the relevant discount rate, t is the period, and I is the initial investment.

Internal Rate of Return (IRR) is used to calculate the discount rate that equates the present value of investment with the present value of future net cash inflows. The project is considered profitable if IRR

exceeds the relevant interest rate. The IRR was calculated using formula (3) [10]. If IRR>r, the project is feasible; if IRR<r, it is not.

$$0 = \Sigma \frac{CF_t}{(1 - IRR)^t} - I \quad (3)$$

Profitability Index (PI) is used to assess investment feasibility by comparing the present value of future net cash inflows to the initial investment. The formula (4) is written for PI [10]. If PI>1, the project is profitable; if PI<1, it is not.

$$PI = \frac{\Sigma \frac{CF_t}{(1 + r)^t}}{I} \quad (4)$$

The results of these analyses were used to evaluate the feasibility of snake fruit chips production and to make recommendations for improvement as needed (Figure 2).

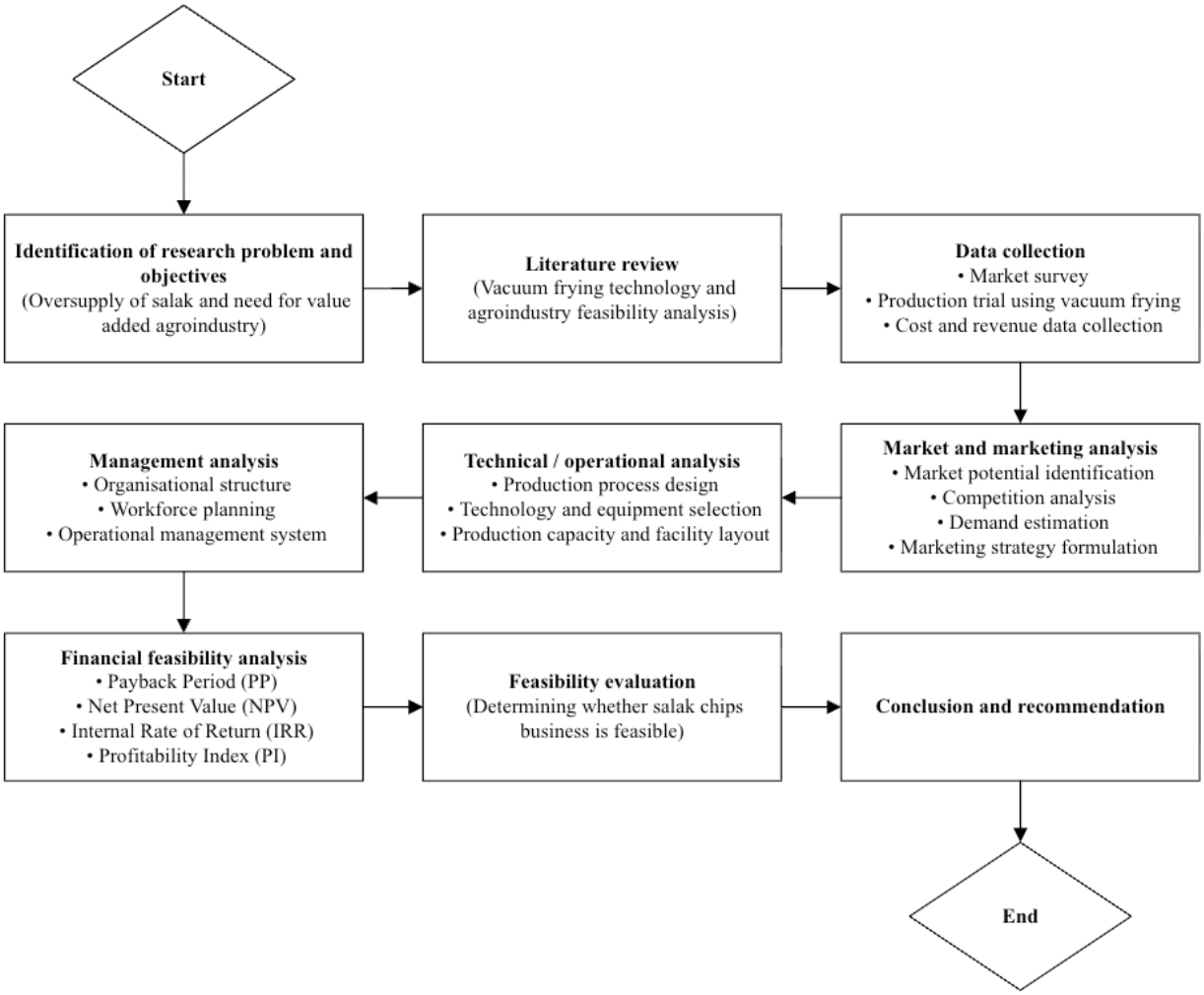

Figure 2. Research method flowchart.

3. RESULTS AND DISCUSSION

3.1. Market and Marketing Aspect

The market and marketing aspect forms the core of a feasibility study, as it aims to ensure that the product offered aligns with market demand. This aspect involves analysing the level of market demand for the proposed product, the degree of competition, the strategies used by competitors to market their products, and the identification of a favourable market position. Consequently, the product design and marketing approach should enable the business to remain competitive and capture consumer interest effectively. Market share analysis is also conducted by considering key factors such as demand trends, supply conditions, and marketing programmes [17], [18], [19]. These elements collectively provide insights into the product's potential performance in the market and guide strategic decision-making for achieving sustainable growth and competitive advantage, as elaborated in the following discussion [20], [21], [22].

3.1.1. Market Potential

Fruit chips represent one of the most effective innovations in food processing, extending the shelf life of fresh fruit while expanding product distribution to wider geographic markets. The primary advantage of snake fruit chips lies in their long shelf stability, allowing for interregional and even international distribution while simultaneously reducing financial losses caused by price fluctuations during peak harvest seasons [6]. Beyond serving as a solution to the oversupply of fresh snake fruit, the increasing trend of low-calorie and healthy snack consumption among urban communities has further driven market demand for fruit-based chips [23], [24], [25], including snake fruit chips [26], [27].

The fruit chips market, both in Indonesia and globally, has experienced steady growth supported by consumer behaviour characterised by frequent repurchases. This indicates that fruit chips have secured a broad and stable market share, no longer confined to small-scale home industries but evolving into a dynamic agroindustrial business with significant export potential [28]. Snake fruit chips, in particular, can be marketed not only in their original flavour but also in diverse variants such as sweet–spicy, balado, and cheese flavours. Such diversification meets consumer preferences for flavour variety and product innovation, aligning with global snack trends where flavour variation serves as a key factor in capturing and maintaining market interest [29], [30].

From an export perspective, snake fruit chips possess strong potential to enter international markets, including Europe, the United States, Hong Kong, South Korea, and other ASEAN countries. Indonesian fruit chip products have already penetrated markets in Germany, the United Kingdom, the Netherlands, and Belgium through modern retail channels and digital marketplaces [5], [3]. Furthermore, tropical fruit-based products such as snake fruit chips are increasingly popular among global consumers due to their perception as healthy, gluten-free snacks rich in antioxidants and dietary fibre, key selling points in the nutraceutical and functional food markets [31].

Demographically, snake fruit chips are highly inclusive and appeal to a wide range of consumer segments (from children to adults) irrespective of social class, economic background, religion, or education level. The product also targets both urban and rural populations, at national and international scales, given that its raw materials are abundant and derived from one of Indonesia's most popular fruits [29].

Technological advancements such as vacuum frying have further enhanced the competitiveness of snake fruit chips in the global market [32], [33], [34], as this method ensures superior taste [35], [36], crisp texture [37], [38], and high nutritional retention [39], [40], [41]. Therefore, snake fruit chips exemplify a promising model of tropical agroindustrial product innovation, with strong potential for both domestic and export market penetration, while contributing to the overall competitiveness of Indonesia's horticultural sector.

3.1.2. SWOT Analysis of Snake Fruit Chips Agroindustry

Snake fruit chips have several key strengths that support their competitiveness in both domestic and international markets. Indonesia's favourable agroclimatic conditions across many regions allow snake fruit to grow optimally throughout the year, ensuring a consistent supply of raw materials [1]. In addition, innovations in flavour development and processing technology, particularly the use of vacuum frying,

produce chips with authentic taste, crisp texture, and high nutritional value, which serve as major selling points [34], [35]. The relatively affordable price and attractive packaging design further increase the appeal of the product, especially among urban and modern consumers [29], [42]. However, several weaknesses must be considered. The technology for producing fruit chips is relatively easy to imitate, making the product vulnerable to replication by competitors. Furthermore, small and medium-sized enterprises often face limitations in production technology and capital, which restrict their ability to increase production capacity and improve distribution efficiency [4], [10].

In terms of opportunities, the shift in consumer lifestyles toward healthy and practical snacks has encouraged market growth for fruit chips, including snake fruit chips [3], [23], [17]. The easy availability of raw materials and relatively simple production process make business expansion feasible for entrepreneurs. Government support for agroindustry development and farmer empowerment through training, financing, and product promotion also serves as a strong catalyst for business growth [43], [17]. Positive consumer recommendations and the trend of trying new product variants further enhance the potential for market expansion (Table 1).

Table 1. SWOT analysis of snake fruit chips agroindustry.

Internal Factors	Description
Strengths	Abundant availability of snake fruit raw materials in Indonesia; favourable agroclimatic conditions enabling year-round production; use of vacuum frying technology producing crispy texture and high nutritional value; relatively affordable price; attractive packaging and flavour innovation.
Weaknesses	Production technology is relatively easy to imitate by competitors; limited production capacity among small and medium enterprises; constraints in capital and processing technology; limited distribution networks.
External Factors	**Description**
Opportunities	Increasing consumer demand for healthy and practical snack products; availability of raw materials and simple processing technology; government support for agroindustry development; potential for product diversification and export markets.
Threats	Competition from other fruit chips such as banana, cassava, and apple chips; seasonal variability of snake fruit supply affecting production costs; fluctuating consumer preferences; uncertainty in domestic and international markets.

On the other hand, snake fruit chips face several external threats (Table 1). These include intense competition from producers of banana, cassava, apple, and other tropical fruit chips that offer various flavours at competitive prices [5], [29]. The seasonal nature of snake fruit can affect raw material availability and production costs, requiring efficient stock management and supply planning strategies [44]. In addition, market uncertainty for processed snake fruit products in both domestic and international markets, along with fluctuating consumer preferences, presents challenges for long-term business sustainability [18], [19].

Therefore, the development strategy for snake fruit chips should focus on enhancing innovation, strengthening distribution networks, diversifying flavour variants, managing sustainable raw material supply, and adapting to market dynamics. These strategies will help snake fruit chip producers remain competitive and maximise the growth potential of this agroindustrial sector.

3.1.3. Marketing Strategy

An effective marketing strategy for snake fruit chips can be optimised through the implementation of the marketing mix 4P framework, which includes product, price, place, and promotion. In the product aspect, it is crucial for producers to ensure that snake fruit chips are made from high-quality raw materials such as snake fruit pondoh and meet food safety and halal standards. This includes obtaining halal

certification, using certified cooking oil, packaging, and production equipment, as well as clearly stating the expiration date, nutritional information, production code, and allergen content on the packaging. Certification from the National Agency of Drug and Food Control (BPOM) is mandatory to enable broad distribution in modern retail markets and for export purposes. Product innovation through flavour diversification, including original, sweet and spicy, balado, and cheese flavours, is highly relevant to address shifting consumer preferences and enhance competitiveness amid the growing healthy snack market [29], [30], [42].

The price strategy should take into account production costs, reasonable profit margins, and the pricing of similar competing products. A selling price of around IDR 15,000 per package is considered competitive and accessible to a wide range of consumers. Price adjustment strategies such as seasonal discounts and bundling offers can be applied to boost sales volume and strengthen customer loyalty [29]. For the place or distribution aspect, choosing the right sales channels is essential to expanding market access. Snake fruit chips can be distributed through souvenir shops, minimarkets, and modern retail stores, while also being marketed via online platforms such as Tokopedia and Shopee. In the digital era, online marketing is highly effective for expanding reach, connecting with consumers across wider regions, and providing easier access for potential international buyers [5], [18], [19].

From the promotion perspective, producers should actively utilise various communication channels, particularly social media platforms such as Instagram, Facebook, WhatsApp, and TikTok, to build brand awareness and increase consumer purchase intention. Promotional activities can be strengthened through free product samples, special discounts, participation in SME exhibitions, and collaborations with food bloggers or influencers to shape a positive perception of the product [6]. Branding plays a vital role in establishing a distinctive identity for snake fruit chips in consumers' minds. This can be achieved through attractive packaging design, highlighting unique selling points such as authentic flavour, low fat, preservative-free qualities, and consistent communication of the product's added value and uniqueness [3], [42], [18]. Positioning snake fruit chips as a healthy and innovative snack serves as a key attraction to expand their market potential both domestically and internationally.

3.2. Technical and Technological Aspects

The technical and technological aspects in the production of snake fruit chips begin with the selection of raw materials, the production process, and the equipment used. The production of snake fruit fruit chips requires sufficient capital, appropriate equipment, reliable methods, and skilled labour to ensure the success and sustainability of the product. The technical aspect, specifically the work method for making snake fruit chips, includes selecting fresh and ripe snake fruit, peeling the skin from the flesh, separating the flesh from the seeds, cutting the fruit into two parts, freezing, frying, draining, packaging, and cleaning the equipment. The technology employed for frying snake fruit chips is vacuum frying, which produces chips with a crispy texture, lower fat content, improved flavour quality, and longer shelf life.

3.2.1. Location

The physical design and adequacy of the production area are crucial for the operational efficiency, safety, and scalability of snake fruit chips processing. For a small-scale agroindustry, a minimum production space of 24 m² (for example, 6 metres in length and 4 metres in width) is considered sufficient to support the entire production workflow. This layout allows the establishment of clear functional zones, which are essential for preventing cross-contamination, streamlining the movement of raw materials and personnel, and maintaining hygiene and safety throughout the production process [29], [6].

The minimum space requirements for each production activity are summarised in Table 2. As shown, the production facility should include designated areas for raw material receiving, peeling and slicing, soaking, freezing, frying, oil draining, packaging, finished product storage, and inter-operational movement. Allocating specific space to each stage ensures a logical workflow and helps maintain compliance with national and international food safety standards, such as those set by the National Agency of Drug and Food Control (BPOM).

Table 2. Production area requirements.

Area	Size (m^2)
Raw material receiving	2
Peeling and slicing	6
Soaking	2
Freezing	2
Frying	4
Oil removal	2
Packaging	4
Finished product storage	2
Inter-operational space	2
Total	24

This allocation covers all essential work zones required for snake fruit chips production, allowing for effective workflow, compliance with food industry best practices, and the flexibility for future expansion. The selection of location should also consider proximity to snake fruit plantations, which ensures the availability of fresh raw materials and reduces transportation costs [43], [44]. Furthermore, access to skilled labour and distribution channels, as well as adherence to local zoning regulations, are critical factors for sustainable and economically viable production.

3.2.2. Production Layout

An effective production layout is essential to facilitate the smooth flow of materials, optimise the use of space, and minimise unnecessary movement and bottlenecks in the snake fruit chips production process. The arrangement should achieve the most efficient and economical combination of labour, equipment, and material movement, from raw material receiving to processing and finished product dispatch. By structuring the production area to follow the sequential flow of materials—starting from raw material storage, peeling, slicing, freezing, frying, oil removal, packaging, and finally to finished product storage—the facility can ensure maximum space utilisation and maintain process integrity. Figure 3 illustrates the recommended layout design for a snake fruit chips production facility.

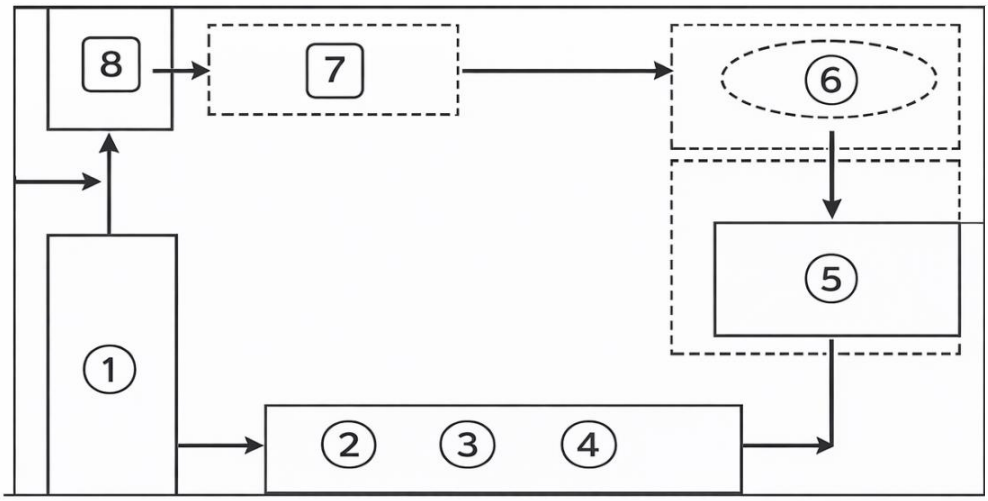

Figure 3. Recommended layout design for a snake fruit chips production facility.

The flowchart shows that each processing stage is arranged logically to prevent cross-traffic and maintain hygienic conditions. Materials move in a one-way direction, ensuring that raw materials and finished products do not intersect, which is a fundamental principle in food industry facility design [29].

This production layout not only supports operational efficiency but also helps meet food safety standards by separating processing areas and supporting streamlined workflows. Well-designed layouts are proven to reduce production time, decrease contamination risks, and improve both product quality and worker safety [6], [43].

3.2.3. Production Type

The snake fruit chips business applies to a one-line production layout, which is suitable for enterprises that manufacture a single product type using a clear and sequential series of processing steps. In this system, all production activities are organised in a linear arrangement according to the order of operations. This enables materials to move smoothly from one stage to the next without backtracking or crossing paths. The one line or product layout is highly effective for ensuring consistent product quality, optimising production efficiency, and facilitating straightforward quality control [29]. Each stage in the production process for snake fruit chips (from raw material preparation, peeling, slicing, freezing, frying, oil removal, packaging, to finished product storage) follows a standardised and consecutive workflow, as illustrated in the previous facility layout (Figure 3).

The implementation of a one-line system allows the facility to maximise space utilisation, allocate labour and machinery efficiently, and support stable production output. This type of production system is commonly used in the food industry for single product manufacturing lines. It reduces waiting times, minimises the risk of contamination, and supports compliance with food safety requirements [6]. Furthermore, it allows for easier monitoring of production flow and simplifies troubleshooting and process improvement activities.

3.3. Management Aspect

In a feasibility analysis, the management aspect highlights the importance of effective human resource management to achieve business targets and maintain product quality. The snake fruit chips business operates only when existing inventory is depleted rather than producing every day. This strategy is intended to maintain operational efficiency and ensure that every batch of snake fruit chips is always fresh and of high quality, which directly contributes to increased customer satisfaction [29].

Production can be managed with a small team, typically consisting of three people: the owner as the business manager and two production staff members. The owner is responsible for business oversight and coordination, while the production staff focus on producing snake fruit chips with consistent quality and taste. Human resource management practices in this business include initial training for new employees to ensure they possess the required skills, as well as ongoing daily evaluations to support continuous product improvement and personal development. This approach to team management is not only cost-effective but also helps foster a culture of quality and accountability [43].

Such a model of flexible production scheduling and focused human resource development aligns with best practices in small-scale agroindustry and is supported by research in the field. Effective management of human resources and production processes is proven to enhance product quality, operational efficiency, and long-term business sustainability [29], [43].

3.4. Financial Aspect

Establishing a snake fruit chips business requires a significant initial investment, with various types of costs that must be carefully considered. The financial requirements begin with fixed costs (Table 3), which include monthly expenses for production site rent, insurance, salaries for permanent employees, electricity, water, marketing, and equipment maintenance. The total monthly fixed cost is IDR 5,026,200. These are essential expenses that must be covered regardless of the scale of production to ensure operational continuity [10].

Variable costs (Table 4) are incurred based on the actual production volume. These costs include purchasing 100 kg of snake fruit, 200 litres of cooking oil, 280 standing pouch packages, 100 ziplock packages, 280 silica gel packets, daily wages for three temporary workers (20 working days), and gas for 100 hours of operation. The total variable cost per month is IDR 7,742,633.43. Both fixed and variable

costs are determined using the prevailing market prices at the time of the feasibility study, in accordance with company planning [29].

Table 3. Fixed costs for snake fruit chips production business.

Expense Type	QTY	Unit	Unit Price (IDR)	Total (IDR)
Production site rent	1	month	1,500,000	1,500,000
Insurance	1	month	150,000	150,000
Permanent employee salary	1	month	3,000,000	3,000,000
Electricity	1	month	111,200	111,200
Water	1	month	15,000	15,000
Marketing	1	month	150,000	150,000
Maintenance	1	month	100,000	100,000
Total				5,026,200

The cost of goods sold (COGS) (Table 5) is calculated by combining the variable cost, fixed cost, and depreciation, divided by a monthly production capacity of 280 units, as shown in Table 4. This data results in a COGS of IDR 46,111.76 per piece. Applying a 30 percent mark-up produces a selling price of IDR 59,945.28 per piece, rounded to IDR 60,000. This pricing strategy ensures that the business covers all costs while earning a profit of IDR 13,833.53 per piece.

The financial analysis is based on several key assumptions. At the macro level, it is assumed that Indonesia's economy will continue to recover, supporting positive growth for MSMEs and ensuring a stable environment. Specific assumptions include the use of current market prices for all costs, an investment allocation of IDR 5,026,200 for fixed costs and IDR 7,742,633.43 for variable costs, and business performance that aligns with the financial analysis projections.

General assumptions include an investment interest rate of 5.5 percent, 8 working hours per day over 20 working days per month, cleaning every six days, five production cycles per day, consumption of 20 litres of oil every two days, use of a 5.5 kg gas cylinder, average gas replacement of 5.54 times daily and 3.61 refills per month. It is also assumed that all products produced are sold within the same period, and that inventory turnover matches sales. Further details on projected capacity, financial overview, and sales forecasts are provided in the appendix.

Table 4. Variable costs for snake fruit chips production business.

Expense Type	Description	QTY	Unit	Unit Price (IDR)	Total (IDR)
Snake fruit		100	kg	5,000.00	500,000.00
Cooking oil		200	L	19,047.50	3,809,500.00
Standing pouch packaging		280	pcs	160	44,800.00
Ziplock packaging		100	pcs	166.67	16,666.67
Silica gel		280	pcs	166.67	46,666.76
Daily labour wages	20 working days	3	people	1,000,000.00	3,000,000.00
Gas		100	hours	3,250.00	325,000.00
Total					7,742,633.43

The projected profit and loss for the first year indicate that the snake fruit chips business will generate a profit after the initial grace period, with efficiency and profitability expected to increase in subsequent years. Cash flow projections show that the business can meet its short-term and long-term obligations, indicating a healthy level of liquidity. By combining detailed analysis of all cost components, realistic pricing, and clear operational assumptions, this financial overview provides a robust foundation for assessing the feasibility and sustainability of the snake fruit chips business. Such structured financial planning is crucial for minimizing risk and achieving long-term growth [10], [29].

3.5. Financial Feasibility Analysis

A business feasibility study requires a comprehensive financial assessment to evaluate investment plans by calculating the expected costs and benefits. This process involves comparing expenditures and revenues, assessing funding availability, modelling costs, determining the project's repayment capacity within a set timeframe, and evaluating whether the business can sustain ongoing development. For the snake fruit chips business, the financial analysis employs several standard investment appraisal methods: PP, NPV, IRR, and PI. The results of the feasibility analysis are summarised in Table 6.

Table 5. Cost of Goods Sold (COGS) and price determination per piece.

Component	Amount	Unit
Variable Cost	7,742,633.43	IDR
Fixed Cost	5,026,200.00	IDR
Depreciation	142,458.33	IDR
Production Capacity	280 (pcs)	pcs
COGS (per piece)	46,111.76	IDR
Mark-up	0.3	IDR
Profit (per piece)	13,833.53	IDR
Selling Price (per pc)	59,945.28	IDR
Rounded Selling Price	60,000.00	IDR

According to Table 6, the PP is 6 months, indicating that the initial investment of IDR 18,795,010 can be recovered within less than one year. This period is significantly shorter than the assumed investment lifespan of 10 years, highlighting the project's high level of financial viability. Such a rapid payback allows the business owner to repay loans well before the end of the investment period, reducing financial risk [10].

The Net Present Value (NPV) analysis, which measures the difference between the present value of cash inflows from sales and the present value of investment outflows over the project's lifetime, results in an NPV of IDR 346,415,523.97. The calculation uses a discount rate of 5.5 percent, reflecting the current benchmark interest rate set by Bank Indonesia. The analysis assumes no other expenses beyond the listed fixed and variable costs over a ten-year period, and annual sales of 3,360 units. Since the NPV is greater than zero, the project is deemed financially feasible and profitable over the ten-year evaluation period [29].

Table 6. Project feasibility analysis results.

Analysis Tool	Result	Description
Payback Period	5 months	Feasible
Net Present Value (NPV)	IDR 346,415,523.97	Feasible
Internal Rate of Return (IRR)	240.53%	Feasible
Profitability Index (PI)	1.29	Feasible

The Internal Rate of Return (IRR) for the snake fruit chips business is calculated at 240.53 percent, representing the discount rate at which the NPV of the project becomes zero. This value is substantially higher than the benchmark interest rate of 5.5 percent used in the financial analysis. The IRR is derived from the projected annual cash flows generated from product sales after deducting operational costs, based on the estimated production capacity of 280 units per month and the calculated selling price per unit. Although the resulting IRR appears relatively high, this outcome is influenced by the relatively small initial investment compared with the projected cash inflows from production activities. Therefore, the IRR value should be interpreted cautiously and alongside other financial indicators such as NPV, PP, and PI, which are commonly used to evaluate investment feasibility [10]. In addition, the sensitivity analysis presented in Section 3.6 further examines the robustness of the financial projections under potential variations in key cost and revenue parameters.

The Profitability Index (PI) for the project is 1.29, which is above the threshold value of 1, further confirming the investment's financial soundness. The PI values greater than 1 assures investors that the project will generate returns exceeding the initial capital outlay. If the PI were less than 1, the project would be considered unprofitable; however, in this case, all metrics support a positive decision to proceed.

By taking into account the results for IRR, NPV, PI, and PP, it is clear that the snake fruit chips investment plan is feasible and worth implementing. This strong financial foundation should provide confidence to both entrepreneurs and potential investors regarding the business's sustainability and profitability [10], [29].

3.6. Sensitivity Analysis and Break-Even Evaluation

Although the financial feasibility indicators show strong investment potential, additional analysis is required to evaluate the robustness of the financial projections and to reduce the risk of overestimation. Therefore, a sensitivity analysis and break-even evaluation were conducted to examine the impact of potential variations in key economic variables on the financial performance of the snake fruit chips business. Sensitivity analysis was carried out by simulating changes in several critical parameters that commonly fluctuate in agro-industrial businesses. These parameters include raw material price, cooking oil price, sales volume, and the discount rate used in financial calculations. Each variable was tested under a variation range of ±10 percent and ±20 percent to assess how sensitive the NPV and IRR are to potential market and operational changes.

The results indicate that the financial feasibility of the snake fruit chips business remains positive under moderate fluctuations. A 10 percent increase in raw material prices reduces the NPV value but does not cause it to become negative, indicating that the project remains financially viable. Similarly, a 10 percent increase in cooking oil prices slightly reduces profitability but does not significantly affect investment feasibility. However, a 20 percent decrease in sales volume has the greatest impact on financial performance, demonstrating that market absorption is the most critical factor influencing business sustainability. Even under this scenario, the investment indicators remain above the minimum feasibility threshold, although the IRR value decreases substantially.

To further strengthen the financial evaluation, a BEP analysis was conducted to determine the minimum production level required for the business to cover all operational costs. Based on the calculated cost of goods sold and selling price, the break-even point occurs at approximately 188 units of snake fruit chips per month. This means that the business must sell at least 188 units per month to reach the break-even condition, while the projected production capacity is 280 units per month. This margin indicates a relatively safe operational buffer for maintaining profitability.

Furthermore, the assumption that all products produced are sold within the same period has been clarified in the financial model. The sales projection is based on estimated market demand derived from the market survey results and current demand trends for fruit-based snack products. Nevertheless, the sensitivity analysis demonstrates that profitability may decline if market absorption decreases significantly. Therefore, continuous marketing efforts, product diversification, and market expansion strategies are necessary to maintain stable sales performance.

Overall, the addition of sensitivity analysis and break-even evaluation provides a more realistic and comprehensive assessment of the financial feasibility of the snake fruit chips agroindustry. These analyses strengthen the reliability of the financial projections and provide a more cautious interpretation of the investment attractiveness.

4. CONCLUSIONS

The results of this study indicate that the establishment of a snake fruit chips business is feasible from market, technical, management, and financial perspectives. The use of vacuum frying technology enables the production of snake fruit chips with a crispy texture, longer shelf life, and competitive product quality, while the availability of raw materials and market demand for healthy snack products supports its market potential. Financial feasibility analysis shows positive results, with a Payback Period (PP) of 5 months, NPV of IDR 346,415,523, IRR of 240.53%, and a PI of 1.29, indicating that the investment is

financially viable and profitable. Therefore, the development of snake fruit chips agroindustry can be considered a promising strategy to increase the added value of snake fruit commodities, improve farmers' income, and strengthen the competitiveness of local agroindustrial products.

AUTHOR CONTRIBUTIONS

All authors contributed significantly to the development of this paper. **Wildan Fajar Bachtiar** conceptualized the research, supervised the project, and secured funding. **Annie Mufyda Rahmatika** contributed to data analysis and manuscript drafting. **Galih Kusuma Aji** and **Sonia Dora Febri Esa** were responsible for conducting experiments and data collection. **Artisya Ramadhanti** and **Convelica Tanaya Sugwanti** performed market survey analysis and contributed to data interpretation. **Ghefira Tsaniya Raihani** assisted in data validation and manuscript editing. **Mohd Hairy Ibrahim** contributed to the methodological framework and critically reviewed the manuscript. All authors read and approved the final version of the manuscript.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

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