



## Risk Analysis of Palm Sugar Processing as a Local Leading Product in Mamuju Regency

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### ABSTRACT

*The palm sugar processing industry has significant economic potential as a leading local product; however, it faces various challenges that may hinder sustainability. This study aims to identify the risks encountered by palm sugar businesses in Mamuju Regency and to analyze their severity levels. The research focuses on uncertainties arising from internal and external factors, including raw material availability, production processes, marketing, financial access, and environmental and social aspects. This study employed a descriptive-exploratory method with a mixed-methods approach. Data were obtained through semi-structured interviews, observations, and closed-ended questionnaires involving eight purposively selected respondents. The analysis applied the Risk Matrix, with scores calculated as the product of probability and impact. Risks were then categorized into four levels: low, medium, high, and extreme. Data validity was strengthened through source triangulation and expert judgment from academics and related institutions. The findings identified 13 major risks. Extreme risks included reduced sap supply during the dry season (score 16) and declining market demand (score 20). High-level risks involved equipment damage, price fluctuations, limited access to capital, and extreme weather. Medium risks included inconsistent sap quality, adulteration of raw materials, and conflicts among tappers. Low-level risks were related to delayed payments and workplace accidents. The study concludes that external risks are more dominant than internal risks in determining business sustainability. Comprehensive mitigation strategies are therefore required, including equipment modernization, quality standardization, market diversification, process innovation, and improved access to capital, to enhance the competitiveness of palm sugar as a leading local product.*

**Keywords:** Palm Sugar, Business Risks, Risk Matrix, Business Sustainability, Local Product

### INTRODUCTION

Palm sugar is one of the leading local products that has high economic value and plays an important role in improving the welfare of rural communities. This product is not only used as a natural sweetener, but is also increasingly in demand due to the trend of healthy lifestyles that prioritize natural and environmentally friendly food ingredients. (Mahmud, Morad, and Satria 2024) In several regions, including Mamuju Regency, palm sugar has become a mainstay commodity that can drive local economic growth. However, despite its great potential, the palm sugar processing business faces various challenges and risks that can affect its sustainability.

Risks in the palm sugar business can arise in various aspects, ranging from the availability of raw materials, the production process, marketing, to environmental and social factors. For example, the supply of palm sap, which depends on the season, is one of the main risks. During the dry season, the availability of palm sap decreases dramatically, which affects production quantity. (Salam, Tantu, and Dwiparipurna 2021) Conversely, high rainfall can dilute the sap and hinder the sugar drying process, thereby reducing product quality. This condition shows that external factors such as weather have a significant impact on business continuity.

Risks also arise from the production side. Most businesses still use traditional equipment that is prone to damage and requires maintenance costs. This reduces efficiency and product quality consistency. (Hidayati and Wibowo 2023) The inconsistent quality of palm sap and the potential for mixing raw materials are also obstacles to maintaining quality. Without good processing standards, palm sugar products find it difficult to compete in modern markets that demand consistent quality and certain certifications (Hidayati and Wibowo 2023).

From a marketing perspective, the risks faced include sales price fluctuations and declining market demand. Competition with other products such as coconut sugar, cane sugar, and synthetic sweeteners further increases the challenge for palm sugar to maintain its position in the market. These conditions put pressure on business operators' profit margins. In addition, access to working capital from formal financial institutions is still limited, making it difficult for businesses to innovate and expand. (Worokinasih 2012).

Social risks also need to be considered, such as dependence on family labor, which can hamper production if a family member is sick or unable to work. Conflicts between tappers or businesses can also disrupt production and distribution. Therefore, palm sugar processing businesses require appropriate mitigation strategies to minimize the negative impact of these risks.

The results of the analysis show that risks in the palm sugar business can be categorized into internal and external risks. External risks, such as climate change and market fluctuations, tend to be more dominant and difficult for business actors to control. Meanwhile, internal risks such as the use of traditional technology, quality inconsistency, and limited capital and human resources can still be managed with good planning. Risk mapping through modern risk management approaches such as risk matrices is important so that business actors can understand the severity of risks and determine appropriate mitigation strategies.

Thus, research on the types of risks faced in the palm sugar processing business is highly relevant. The results of this study are expected to provide a comprehensive picture of the challenges faced by business actors and serve as a basis for formulating risk control strategies. These efforts are important to ensure the sustainability of the palm sugar business as a leading local product that not only has economic value but also great social and cultural potential.

## RESEARCH METHODS

This study uses an exploratory descriptive research design with a mixed methods (qualitative–quantitative) approach. The qualitative approach is used to explore in-depth information related to the perceptions, experiences, and strategies of business actors in dealing with risk through semi-structured interviews and direct observation, while the quantitative approach is used to measure the probability and impact of risk through a closed questionnaire. The research location was purposively determined in Mamuju Regency, specifically in the palm sugar processing center in Kalukku District. The research was conducted in July–August 2025 with a total of 8 respondents selected using purposive sampling techniques, consisting of farmers who tap and process palm sugar, MSME/farmer group managers, local government representatives, and supporting parties (cooperatives and academics).

The data obtained were analyzed using the Risk Matrix approach in accordance with the ISO 31000:2018 standard, with the risk score formula = probability × impact. Each risk was given a score of 1–5 and then classified into low, medium, high, and extreme categories. The results of the risk assessment were then mapped in a 5×5 matrix to determine control priorities. To strengthen the analysis results, data source triangulation was carried out by comparing the results of interviews, questionnaires, and observations, supported by expert judgment. In addition, SWOT analysis was also used optionally to provide a more comprehensive picture of the strategic position of palm sugar as a local superior product.

## RESULTS AND DISCUSSION

The results of the study show that palm sugar processing businesses in Mamuju Regency face various risks that can affect business sustainability. Based on interviews with business actors, farmers, distributors, and expert judgment from academics and relevant agencies, 13 main types of risks were identified, divided into five major categories, namely raw materials, production, marketing and pricing, finance, and the environment and society. The identification of these risks is an important step because it provides an understanding of the factors that have the potential to hinder or even harm business actors in carrying out palm sugar processing activities (Ramusu, Djaafar, and Mahmud 2023).

In the raw materials category, the main risk that arises is the highly volatile price of palm sap, which depends on the season and competition between actors. These fluctuations have implications for production cost uncertainty and profit margins. On the production side, the traditional equipment used is still very susceptible to

damage, thereby reducing production efficiency and requiring additional maintenance costs (Andini 2024). This is in line with Hasanah's (2021) research, which emphasizes that traditional technology is one of the main obstacles in palm sugar processing in Sulawesi.

In terms of marketing and pricing, significant risks were found in the increase in palm sap prices and declining market demand. These conditions have the potential to erode profit margins and make palm sugar difficult to compete with other products such as coconut sugar, cane sugar, and synthetic sweeteners. These risks highlight the importance of product diversification, digital marketing strategies, and strengthening branding so that palm sugar products can maintain their competitiveness in the market. (Nugraha 2025).

From a financial perspective, businesses face difficulties in obtaining working capital and investment capital from formal financial institutions. These capital constraints hamper business development, particularly in terms of modernizing production equipment and expanding market access. Meanwhile, in terms of the environment and society, high rainfall can dilute the sap during the tapping process and slow down the sugar drying process, which ultimately reduces the quality and quantity of production. In addition, dependence on family labor also poses a risk, because if one family member is unable to work, the production process can be disrupted or stopped.

Risk analysis was conducted using the Risk Matrix method (ISO 31000:2018; PMI, 2021), which calculates risk scores by multiplying probability and impact. This approach was chosen because it can measure risk systematically by considering two dimensions, namely the likelihood of an event occurring and the severity of the losses incurred. Each risk is scored on a scale of 1–5 for both probability and impact, then categorized into four levels: low, medium, high, and extreme (Rachmaniah et al. 2024).

The results of the analysis show that extreme risks arise from a decrease in palm sap supply during the dry season and a decline in market demand. High risks include equipment damage, price fluctuations, capital constraints, and extreme weather. Moderate risks are related to inconsistent palm sap quality, mixing of raw materials, palm sugar that is not completely dry, and conflicts between business actors (Setiawan 2012). Meanwhile, low risks include late payments from buyers and the potential for workplace accidents. These findings reinforce Rahman's (2020) opinion that external factors, particularly the availability of raw materials and market uncertainty, are the dominant challenges in the palm sugar business. Thus, this study confirms that external risk management must be a priority, in addition to internal improvements in technology, product quality, and business management.

**Table 1.** Risk Management on Palm Sugar

No	Risk Category	Risks	K (1–5)	D (1–5)	K×D	Risk Level	Control Strategy
1	Raw Materials	Decreased supply of palm sap during the dry season	4	4	16	Extreme	Stock management during the rainy season
		Inconsistent palm sap quality	3	3	9	Moderate	Sterile storage containers
		Mixing of palm sap by tappers	2	5	10	Moderate	Education and training
2	Production	Damage to processing equipment	3	4	12	High	Routine maintenance, equipment investment
		Palm sugar not completely dry	2	3	6	Moderate	Dry storage areas
		Workplace accidents	2	1	2	Low	Safety training, basic PPE
3	Marketing & Price	Fluctuating palm sugar prices	3	5	15	High	Attractive packaging, product diversification
		Products difficult to compete with other sugars	1	3	3	Low	Strategic partnerships
		Declining market demand	5	4	20	Extreme	Innovation, digital marketing
4	Finance	Difficulty obtaining business capital	5	3	15	High	Efficiency, access to loans
		Late payments	2	2	4	Low	Proactive communication
5	Social & Environment	Extreme weather affects production	3	4	12	High	Drying innovation, stock management
		Conflicts between tappers	3	2	6	Moderate	Active mediation, clear work rules

Source: Primary Data, 2025

The analysis shows that palm sugar processing businesses in Mamuju Regency face various risks of varying severity. Extreme risks were found in the decline in palm sap supply during the dry season (score of 16) and declining market demand (score of 20). These two risks are external factors that greatly affect business continuity, as they can cause a drastic decline in both production quantity and business income. These findings are in line with Rahman's (2020) research, which confirms that in the palm sugar business, uncertainty in raw material supply and market demand fluctuations are the dominant risks that must be anticipated. Similarly, Hasanah (2021) states that the palm sugar business in Sulawesi faces significant risks in terms of raw material quality and limited market access, thus requiring the implementation of modern processing standards and marketing systems. Thus, this study reinforces the evidence that external risks are more dominant in influencing the sustainability of the palm sugar business than internal risks.

The results of risk level mapping through the Risk Matrix produced a classification of risks into four categories, namely low, moderate, high, and extreme. Extreme risks are characterized by very high probability and impact, requiring immediate attention, such as a decline in nectar supply during the dry season and a decline in market demand. (Intyas, Putritamara, and Haryati 2022) High risks include damage to processing equipment, fluctuations in selling prices, and limited access to capital. These risks are urgent because they can hinder business stability if not addressed immediately. Moderate risks are found in aspects that have moderate probability or impact, such as inconsistent palm sap quality, palm sugar that is not completely dry, or conflicts between business actors. These risks require continuous monitoring and mitigation strategies. Meanwhile, low risks such as late payments or work accidents with minimal impact can be handled by implementing standard operating procedures. Visually, this risk mapping is illustrated in color categories: green (low), yellow (medium), orange (high), and red (extreme).

**Table 2** Probability

Probability ↓ / Impact →	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

Source: Primary Data, 2025

Based on the results of risk identification and score calculation using a combination of probability (likelihood) and impact (severity), it was found that the palm sugar processing business in Mamuju Regency faces risks ranging from low, moderate, high, to extreme. Extreme risks (scores of 16–25) were found in the decline in palm sap supply during the dry season (score of 16) and the decline in market demand (score of 20). These two risks indicate the dominance of external factors which, if not managed properly, can result in a drastic decline in production and sales. High risks (scores of 11–15) include damage to production equipment, fluctuations in selling prices, and limited access to business capital. These risks are both internal and external and require rapid mitigation strategies to maintain business stability. Moderate and low risks (score 2–10) are generally related to technical aspects, such as inconsistent sap quality, poor sugar storage, or workplace accidents. Although the impact is relatively smaller, these risks still need to be monitored regularly to maintain product quality and consistency.

The analysis results classify risks into two broad categories, namely external risks and internal risks. External risks are risks that are beyond the direct control of business actors. In the context of palm sugar processing in Mamuju, the most prominent external risk is extreme weather. Long dry seasons can reduce sap production because palm trees need a certain amount of moisture to produce sap optimally, while high rainfall or flooding can damage the palm tree environment and hinder the tapping process. . (Rahman et al. 2025) As a consequence, palm sugar production becomes unstable, raw material supplies decline, and sap quality deteriorates, which ultimately affects the quality and quantity of the final product. In addition, market price fluctuations and competition with substitute products (coconut sugar, cane sugar, and synthetic sweeteners) also pose a serious threat to the competitiveness of palm sugar in local and national markets.

Internal risks are more related to conditions that can still be managed directly by business actors. The two main aspects that constitute internal weaknesses are processing technology and product quality standards. Most palm sugar businesses still use traditional techniques, resulting in low production efficiency and inconsistent product quality. In addition, the absence of consistent product quality standards makes it difficult for palm sugar to penetrate modern markets that require guaranteed quality, from hygienic packaging and appropriate moisture content to halal certification and organic labeling. Capital constraints are also a serious obstacle because they hinder equipment modernization, while the lack of skilled labor slows down innovation. Therefore, internal risk control strategies need to focus on improving technology, implementing quality standards, strengthening human

resources, and expanding access to business financing.

SWOT analysis shows that the palm sugar processing business has various strengths and opportunities that can be optimized to support business sustainability. In terms of strengths, palm sugar is known as a local superior product with traditional values and a distinctive natural flavor, as well as having the potential for value-added product diversification. The trend towards healthy food consumption and government support for the development of local products also present significant opportunities. In addition, the growth of digital marketing and the export potential of palm sugar as a natural sweetener provide ample opportunity to strengthen competitiveness in both the domestic and international markets.

On the other hand, the palm sugar business also faces weaknesses and threats that need to be managed strategically. Internal weaknesses include the continued dominance of inefficient traditional equipment, inconsistent raw material quality, limited access to capital, and a shortage of skilled labor. External threats include fluctuations in the price of palm sap and palm sugar, extreme weather affecting production, competition with substitute products such as cane sugar and synthetic sweeteners, and the potential for a decline in market demand. Therefore, development strategies need to be directed at utilizing internal strengths to capture external opportunities, while minimizing internal weaknesses so that they are not exacerbated by external threats.

## CONCLUSION

This study shows that palm sugar processing businesses in Mamuju Regency face various risks that can affect their business continuity. Based on the Risk Matrix analysis (ISO 31000:2018), 13 main types of risks were identified and grouped into five categories, namely raw materials, production, marketing and pricing, finance, and environment and social. The risk mapping results reveal that there are two risks in the extreme category, namely a decline in palm sap supply during the dry season and a decline in market demand. Both are external factors that greatly affect business stability. There are high-category risks that include damage to processing equipment, selling price fluctuations, limited access to capital, and extreme weather. Medium and low category risks are generally related to technical aspects, such as inconsistent palm sap quality, conflicts between tappers, palm sugar not being completely dry, and late payments. Although the impact is relatively small, these risks still need to be managed systematically to maintain product quality. It can be concluded that external risks are more dominant than internal risks in the palm sugar business. Therefore, a comprehensive risk management strategy is needed, including raw material stock management, production equipment modernization, product innovation, market diversification, digital marketing implementation, and increased access to business capital. These mitigation efforts are crucial to ensure the sustainability of the palm sugar business as a local flagship product with high economic, social, and cultural potential.

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