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Risk mitigation strategies in Cut Chrysanthemum farming: Evidence from "Agro Pudak Lestari" Farm, Bali

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***Abstract*---**Cut chrysanthemum (Chrysanthemum) farming is a high-value horticultural agribusiness activity with significant potential to increase farmers' income and promote value-added agribusiness development (Jaskani & Khan, 2021). However, this farming activity is exposed to various production, market, financial, and environmental risks due to its dependence on living organisms as well as external factors such as climate variability and pest and disease attacks (Theuvsen, 2013). This study aims to identify and analyze risks and to formulate risk mitigation strategies in cut chrysanthemum farming at the Agro Pudak Lestari Ornamental Plant Farmers Group, Pancasari Village, Buleleng Regency. The study employs a descriptive quantitative approach using Failure Mode and Effect Analysis (FMEA) to prioritize risks based on the Risk Priority Number (RPN) and the Analytical Hierarchy Process (AHP) to determine priority risk mitigation strategies. The results indicate that production risk is the main priority, particularly risks related to pest and disease attacks and climate variability. The prioritized mitigation strategies include strengthening pest and disease control, using high-quality seedlings, improving cultivation management practices, and enhancing marketing partnerships.

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Introduction

The agricultural sector plays a strategic role in Indonesia's economy and food security, particularly in providing employment and supporting rural livelihoods (Rojun & Nadziroh, 2020). As of February 2023, agricultural employment reached 38.14 million workers, accounting for 27.52% of the total national workforce, indicating that agriculture remains a key pillar of national economic development (Hasanah et al., 2023). Within this sector, horticulture holds a vital position due to its high economic value, flexible production characteristics, and strong demand in domestic and international markets (Jaskani & Khan, 2021).

Horticultural commodities, including ornamental plants and cut flowers, contribute significantly to farmers' income and agribusiness development. Among cut flowers, chrysanthemum (Chrysanthemum) is one of the most widely cultivated and demanded commodities, owing to its color diversity, relatively long vase life, and adaptability to various climatic conditions (Pangestika et al., 2018). Chrysanthemum farming not only supports domestic markets such as floristry, ceremonial events, and agrotourism, but also has export potential to countries such as Japan, the Netherlands, and Singapore. Despite this potential, chrysanthemum farming faces substantial challenges that threaten production stability and farm profitability.

Agricultural activities are inherently risky because they depend on living organisms that are highly sensitive to external factors such as climate variability, pest and disease attacks, and environmental changes (Theuvsen, 2013). In cut chrysanthemum farming, these risks are intensified by strict quality standards imposed by the market. Production risks—particularly pest and disease infestations such as white rust, Fusarium wilt, thrips, and aphids—can significantly reduce yield and flower quality, leading to higher production costs and economic losses. In addition, farmers face market and financial risks, including price fluctuations, high input costs, and limited access to capital, which further increase business uncertainty (Joy Harwood et al., 1999).

Agro Pudak Lestari Farm, an ornamental plant farmers group located in Pancasari Village, Sukasada District, Buleleng Regency, Bali, is one of the major producers of cut chrysanthemums in the region. Although supported by favorable agroecological conditions, the farm experiences multiple risks related to production, climate change, price volatility, and the availability of quality seedlings. If not properly managed, these risks can lead to production instability and declining farmer income.

Effective risk management is therefore essential to ensure the sustainability of cut chrysanthemum farming. Risk management provides a systematic approach to identifying, evaluating, and mitigating potential threats that affect productivity and profitability. This study aims to identify and analyze the risks faced in cut chrysanthemum farming and to formulate appropriate risk mitigation strategies.

Failure Mode and Effect Analysis (FMEA) is employed to prioritize risks based on their severity, occurrence, and detectability, while the Analytical Hierarchy Process (AHP) is used to determine the most effective mitigation strategies. By integrating these methods, this study seeks to provide practical, data-driven recommendations to support sustainable agribusiness development at Agro Pudak Lestari Farm.

Methods

The research methodology was designed to address the main problem of **identifying risks in cut chrysanthemum farming and formulating appropriate mitigation strategies** at the Agro Pudak Lestari Ornamental Plant Farmers Group, Pancasari Village, Sukasada District, Buleleng Regency, Bali. The study was conducted purposively from July to November 2025 using a **mixed-methods approach** that integrates quantitative and qualitative data to capture technical, economic, and experiential dimensions of farming risks. Primary data were collected through **questionnaires, semi-structured interviews, and field observations** involving 15 active chrysanthemum farmers selected through purposive sampling, along with two horticulture experts as key informants. Secondary data were obtained from farmers group documents, Statistics Indonesia (BPS), and relevant scientific literature (Siyoto & Sodik, 2015; Sulung & Muspawi, 2024; Abdussamad, 2021).

Data analysis was carried out in two main stages. First, risks across all stages of chrysanthemum farming—from seedling to marketing—were evaluated using **Failure Mode and Effect Analysis (FMEA)** by assessing **severity, occurrence, and detection** on a scale of 1–10 to calculate the **Risk Priority Number (RPN = S × O × D),** thereby identifying the most critical risks requiring immediate attention (Hisprastin & Musfiroh, 2020; Rasyid, 2018). Second, the prioritized risks identified through FMEA were used as inputs for developing **risk mitigation strategies** using the **Analytical Hierarchy Process (AHP)**. Pairwise comparisons were conducted to assign weights to criteria and rank mitigation alternatives based on respondents' judgments, with consistency ratios (CR ≤ 0.1) applied to ensure logical and reliable decision-making outcomes (Pratiwi, 2020).

Result and Discussion

Risks in Cut Chrysanthemum Farming

In response to the first research question, the findings indicate that cut chrysanthemum farming at the Agro Pudak Lestari Ornamental Plant Farmers Group faces multiple and interrelated risks, including production, market, financial, and environmental risks. Among these, production risk emerges as the most dominant, particularly related to pest and disease attacks, seedling quality, and dependence on climatic conditions. Market risks in the form of price fluctuations, along with financial risks arising from high production costs and limited access to capital, also pose significant threats to farm sustainability. Environmental risks, especially climate variability and weather uncertainty, further exacerbate production instability and income volatility.

Risk Levels in Cut Chrysanthemum Farming
Addressing the second research question, the Failure Mode and Effect Analysis (FMEA) results reveal that not all identified risks carry the same level of urgency. Risks with the highest Risk Priority Number (RPN) are predominantly associated with production risks, particularly pest and disease infestations and climate variability, which are difficult to predict and control. These risks are classified as high-priority risks requiring immediate mitigation due to their high severity and frequency, coupled with relatively low detectability. Market and financial risks fall into the moderate-risk category; however, they remain significant as they directly affect farmers' income and business continuity. Overall, production instability is identified as the key determinant of risk severity in cut chrysanthemum farming.

Risk Mitigation Strategies in Cut Chrysanthemum Farming
In response to the third research question, the Analytical Hierarchy Process (AHP) results indicate that the most prioritized mitigation strategies are those that directly address production risks as the primary source of vulnerability. The highest-ranked strategies include strengthening pest and disease control, using high-quality seedlings, and improving cultivation management practices to enhance adaptability to climate variability. In addition, strengthening marketing partnerships and farmer institutions is identified as an important strategy to reduce market risks and improve price stability. These strategies are considered the most effective and feasible, as they align with farmers' actual conditions, available resources, and the long-term sustainability of cut chrysanthemum farming.

Conclusion

The identification of risks in cut chrysanthemum farming indicates that risks arise at all stages of farming activities, ranging from business management and planning, procurement of production inputs, cultivation processes, to product marketing. The identified risks are not only technical in nature but also encompass managerial and market-related aspects that are interrelated. Risks occurring at the input procurement and production stages exert the greatest influence on farming success, as they directly affect both the quality and quantity of harvested output. These findings suggest that risk management in cut chrysanthemum farming cannot be implemented in a partial manner, but rather requires a comprehensive and integrated approach across all stages of farming activities to ensure business sustainability.

Risk level mapping using the **Failure Mode and Effect Analysis (FMEA)** method shows that risks in cut chrysanthemum farming are distributed across three risk levels—low, medium, and high—with the majority of risks classified as low-level risks. Risks categorized within the green zone **(Broadly Acceptable/BA**) include A1, A2, A3, A4, A5, A6, A11, A12, A13, A14, A15, A16, A17, A18, A19, A20, A21, A23, A24, A25, A26, A27, and A28, reflecting risks with low severity and frequency and relatively easy controllability. Risks in the yellow zone **(As Low As Is Practicable/ALARP)** consist of A10 and A22, indicating moderate-risk levels that require control measures. Meanwhile, risks in the red zone **(Intolerable/INT),** namely A7, A8, and A9, represent critical risks with high risk levels that require immediate mitigation priority. These ALARP and INT risks are

primarily concentrated at the seed and production input procurement stage, making this stage the focus of risk management in cut chrysanthemum farming.

Risk mitigation strategies for cut chrysanthemum farming based on the **Analytical Hierarchy Process (AHP)** indicate that strategies oriented toward strengthening upstream farming activities constitute the highest priority. The strategy with the highest priority weight is the strengthening of the seed procurement system, particularly through enhanced quality control of seedlings and improved management of supplier relationships, as a response to the high level of risk at this stage. The next priority strategies include improving the implementation of integrated pest and disease management and enhancing farmers' capacity through technical training and mentoring. In addition, improvements in business management and the strengthening of marketing strategies serve as supporting measures to reduce risks related to price fluctuations and demand uncertainty. The prioritization of these mitigation strategies demonstrates that effective risk management in cut chrysanthemum farming largely depends on farmers' ability to control production and input procurement risks, while simultaneously strengthening managerial and marketing aspects.

Managerial Implication
The findings demonstrate that cut chrysanthemum farming at Agro Pudak Lestari Farm is highly vulnerable to risk, particularly in terms of production-related factors. The integration of **FMEA and AHP** provides a comprehensive and systematic framework for identifying **risk types**, assessing **risk levels**, and determining **practical and prioritized mitigation strategies**. This study underscores the importance of structured, participatory risk management approaches in improving production efficiency, reducing potential losses, and ensuring the long-term sustainability of cut chrysanthemum agribusiness in the study area.

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