# RISK MITIGATION STRATEGIES FOR THE STRAWBERRY SUPPLY CHAIN IN BANDUNG REGENCY

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**Abstract:**

**Background:** The strawberry supply chain in Bandung Regency involves multiple actors and is characterized by high perishability, short shelf life, and strong dependence on climatic conditions, which expose the supply chain to various risks that may disrupt supply continuity and product quality.
**Purpose:** This study aims to map the strawberry supply chain structure, identify and prioritize dominant supply chain risks, and formulate effective and feasible risk mitigation strategies.
**Design/methodology/approach:** This research applies an integrated House of Risk (HOR) and Analytic Hierarchy Process (AHP) approach. HOR Phase 1 is used to identify risk events and prioritize risk agents based on Aggregate Risk Potential (ARP) values, while HOR Phase 2 formulates mitigation actions using the Effectiveness to Difficulty (ETDk) criteria. AHP is employed to select the optimal mitigation strategy based on effectiveness, cost, ease of implementation, and implementation time. Primary data were collected through 2 months surveys (June - July 2025), with 21 respondents to participate in interviews, and questionnaires involving 18 actors in the strawberry supply chain located in the Pacira area of Bandung Regency and 3 experts (Farmer Champion, Government, Academic), supported by secondary data from official reports and literature.
**Findings/Result:** The results indicate that dominant risks originate from upstream actors, particularly farmers, with weather variability and cultivation practices identified as the main risk agents. Among the proposed mitigation alternatives, a collaborative Farmer Field School is ranked as the most effective and feasible strategy.
**Conclusion:** Capacity-building-based mitigation strategies are more effective in reducing supply chain risks than capital-intensive solutions and play a crucial role in strengthening supply chain resilience.
**Originality/value (State of the art):** This study contributes by integrating HOR and AHP to provide a structured and practical decision-making framework for risk mitigation in perishable horticultural supply chains, particularly strawberries.

**Keywords:** analytical hierarchy process, house of risk, risk management, risk mitigation strategy, strawberry supply chain

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## INTRODUCTION

The agricultural sector remains one of the main pillars of Indonesia's economy, contributing significantly to national gross domestic product (GDP) and employment. In 2024, the agriculture, forestry, and fisheries sector accounted for approximately 13.2% of Indonesia's GDP and absorbed a substantial proportion of the labor force, making it the third-largest contributor after manufacturing and wholesale–retail trade (BPS, 2024). This contribution demonstrates the strategic importance of agriculture not only as a driver of economic growth but also as a key source of employment, particularly in rural areas. Furthermore, the agricultural sector plays a crucial role in supporting rural livelihoods and maintaining socioeconomic stability. Within this sector, horticulture occupies an important position due to its relatively high economic value and its potential to increase farmers' income through the production of high-value commodities.

Strawberry is one of the horticultural fruit commodities that has experienced significant production growth in recent years. National data indicate that strawberry production in Indonesia increased steadily during the period 2018–2023, with West Java Province emerging as the main production center. This production trend reflects the growing importance of strawberries as a high-value horticultural commodity in the national agricultural sector. The increasing contribution of West Java to national strawberry production highlights the province's strategic role in supporting supply availability and market demand. This trend is further illustrated by the distribution of strawberry production across provinces in Indonesia, as shown in Figure 1.

In 2024, West Java recorded strawberry production of 28,089 tons, with Bandung Regency contributing the largest share of provincial output (BPS West Java, 2024). Within Bandung Regency, strawberry production is highly concentrated in the southern area comprising Rancabali, Ciwidey, and Pasirjambu, commonly referred to as the PACIRA area. This concentration is supported by favorable agroclimatic conditions and the development of strawberry-based agrotourism. Empirical data show that Rancabali alone contributed more than 94% of total strawberry production in Bandung Regency in 2024, indicating a high level of production specialization. The dominance of the PACIRA area in provincial strawberry production is illustrated by the production increment shown in Figure 2.

Despite this strong production performance, the strawberry supply chain in Bandung Regency faces increasing complexity and vulnerability. Strawberries are highly perishable commodities with a short shelf life and high sensitivity to temperature, humidity, and handling practices throughout the supply chain. These characteristics increase the likelihood of quality deterioration and post-harvest losses, particularly when handling and distribution processes are not properly managed. As a result, the strawberry supply chain is exposed to various risks, including production risks, post-harvest risks, logistical disruptions, and market-related uncertainties. This condition indicates that high production levels alone are insufficient to ensure supply chain performance without effective risk management mechanisms.

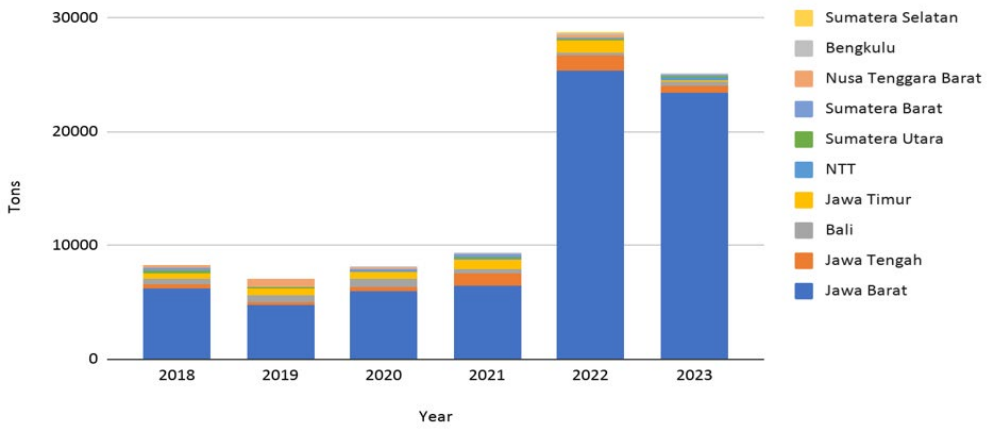



Figure 1. National strawberry production in Indonesia by Province, BPS RI 2023

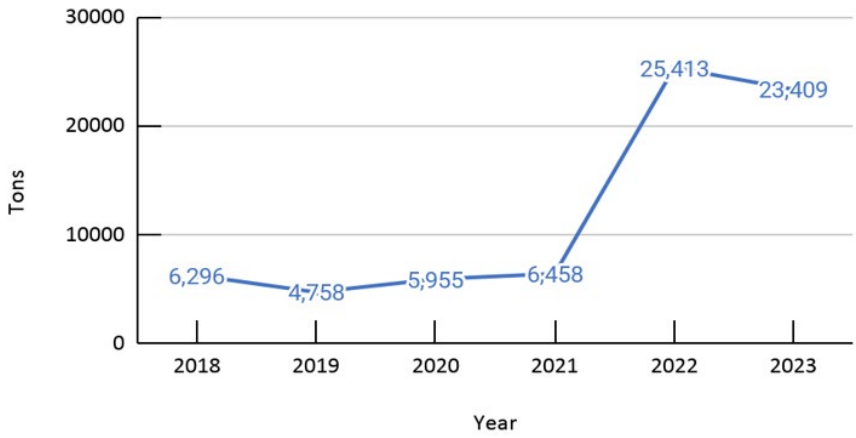



Figure 2. Strawberry production increment in West Java Province

Distribution of strawberry land area, production and productivity in Bandung Regency by District in Table 1. Several empirical studies and field reports confirm that supply chain risks have caused substantial losses for strawberry farmers and traders in Bandung Regency. Extreme weather conditions, particularly prolonged rainy seasons, have resulted in production declines of up to 40%, mainly due to increased incidence of fungal diseases and fruit spoilage. In addition to climate-related risks, price volatility and farmers' dependence on middlemen weaken their bargaining position, often leading to farm-gate prices that do not adequately cover production costs (Dewi et al., 2024). These conditions indicate that supply chain risks are not limited to production stages but also extend to market and coordination aspects. Similar findings were reported by Furqon (2014), who identified weak post-harvest handling, inefficient distribution, and unequal value distribution among supply chain actors as persistent problems in the strawberry supply chain of Rancabali.These conditions highlight the importance of understanding supply chain risks from both empirical and scientific perspectives.

From a supply chain perspective, strawberries in Bandung Regency are distributed through multiple actors, including farmers, collectors, modern trade, and traditional trade, each of whom is exposed to different types of risks. Farmers primarily face risks related to climate variability, pest and disease attacks, and fluctuating input prices, which directly affect production volume and quality (Maghfira et al., 2020). Collectors and distributors encounter risks associated with product damage during transportation, quality deterioration, and logistical inefficiencies that may lead to increased losses and higher distribution costs (Chumairo, 2018; Keswari & Rinawati, 2017). At the downstream level, retailers are exposed to risks such as declining product quality, intense price competition, and changing consumer preferences that influence market demand (Ningsih et al., 2024). These risks are interconnected across supply chain stages, indicating that effective risk management requires a comprehensive and structured approach that considers the entire supply chain rather than isolated actors.

Despite the growing body of literature on supply chain risks in agricultural and horticultural commodities, most existing studies primarily focus on risk identification and descriptive analysis at specific stages of the supply chain. Limited attention has been given to systematic risk prioritization that considers the relative importance of risk agents across different supply chain actors. Moreover, empirical studies that integrate risk prioritization with the selection of feasible mitigation strategies remain scarce, particularly at the regional level for perishable commodities such as strawberries. As a result, decision-makers often lack structured analytical tools to determine which risks should be addressed first and which mitigation actions are most effective under practical constraints. This study addresses this gap by integrating the House of Risk (HOR) method with the Analytic Hierarchy Process (AHP) to provide a structured and practical decision-making framework for prioritizing supply chain risks and selecting appropriate mitigation strategies in the strawberry supply chain of Bandung Regency.

Table 1. Distribution of strawberry land area, production and productivity in Bandung Regency by district

| District | Land Area (Ha) | Production (Ton) | Productivity (Ton/ Ha) |
|---|---|---|---|
| Pasirjambu | 43 | 471 | 10.9 |
| Ciwidey | 18 | 989 | 54.9 |
| Rancabali | 394 | 26,346 | 66.8 |
| Others | 0 | 0 | 0 |

Risk mitigation in supply chains aims to maintain distribution continuity and reduce losses caused by disruptions through systematic risk identification, impact analysis, and the implementation of appropriate mitigation strategies (Ganesh & Kalpana, 2022). In horticultural supply chains, effective risk mitigation is particularly crucial due to the perishable nature of products and their high exposure to environmental uncertainty (Djazuli et al., 2024). Disruptions occurring at any stage of the supply chain may lead to quality deterioration, increased post-harvest losses, and reduced market competitiveness. However, existing practices among strawberry supply chain actors in Bandung Regency remain largely reactive and fragmented. This condition reflects the limited adoption of structured and proactive risk management tools among supply chain actors.

Previous studies on agricultural supply chain risk management have applied various qualitative and quantitative approaches to analyze supply chain risks. However, empirical applications that integrate systematic risk prioritization with the selection of appropriate mitigation strategies remain limited, particularly for strawberry commodities at the regional level. The House of Risk (HOR) method offers a structured framework to identify and prioritize risk agents based on their aggregate risk potential, allowing decision-makers to focus on the most critical sources of risk. Meanwhile, the Analytical Hierarchy Process (AHP) enables the evaluation and selection of mitigation strategies based on multiple criteria, including effectiveness, cost, ease of implementation, and implementation time. Nevertheless, the combined application of HOR and AHP in the context of strawberry supply chains in Bandung Regency has not been sufficiently explored.

Previous studies emphasize that supply chain risk mitigation should not only focus on technical solutions but also on managerial and organizational alignment among supply chain actors. Effective coordination and shared decision-making are essential to ensure that mitigation strategies can be implemented consistently across the supply chain. Mulyati and Gelderman (2017) highlight that effective risk mitigation requires structured decision-making and coordination mechanisms to ensure that mitigation strategies are both feasible and accepted by stakeholders. In the context of strawberry supply chains dominated by smallholder farmers, such alignment is particularly important due to resource constraints and varying levels of managerial capacity. Therefore, a structured and participatory decision-making approach is required to enhance the effectiveness of supply chain risk mitigation.

Therefore, this study aims to analyze the structure of the strawberry supply chain in Bandung Regency to obtain a comprehensive understanding of the relationships and activities among supply chain actors. The study further seeks to identify and prioritize dominant supply chain risks that affect production, distribution, and market performance. To achieve these objectives, an integrated House of Risk (HOR) and Analytic Hierarchy Process (AHP) approach is applied to systematically evaluate risk sources and mitigation alternatives. The analysis focuses on formulating risk mitigation strategies that are both effective and feasible under the operational conditions of the strawberry supply chain. The findings are expected to provide practical managerial insights for supply chain actors and policymakers in strengthening the resilience and sustainability of strawberry agribusiness.

## METHODS

This study employs a descriptive-analytical approach to analyze supply chain risks and formulate mitigation strategies for the strawberry supply chain in Bandung Regency. The descriptive approach is used to map supply chain structures and identify risk sources, while the analytical approach supports the prioritization and evaluation of mitigation strategies. The research focuses on the southern part of Bandung Regency, which represents the main strawberry production area in West Java. Specifically, the study covers the PACIRA

area, comprising Pasirjambu, Ciwidey, and Rancabali sub-districts. This study area was selected due to its dominant contribution to provincial strawberry production and its strategic role in the regional supply chain.

This study uses both primary and secondary data to support the analysis of supply chain risks and mitigation strategies. Primary data were collected in June - July 2025 with the direct help from key actors involved in the strawberry supply chain, including 9 farmers, 5 collectors, and 4 traders operating in modern and 1 traditional markets. Some of them have multiple roles such as farmer and collector, collector and trader, etc which are represented by 18 unique individuals. These data were used to capture information related to risk events, risk agents, and existing mitigation practices. Secondary data were obtained from official statistical reports, previous research publications, and relevant institutional documents related to strawberry production and supply chain management in Bandung Regency. The combination of primary and secondary data enables a comprehensive understanding of both empirical conditions and supporting contextual information.

Primary data collection was conducted through field observations, semi-structured interviews, and questionnaires. Field observations were carried out to understand supply chain activities, operational flows, and handling practices at different stages of the strawberry supply chain. Semi-structured interviews were used to explore supply chain structures, coordination mechanisms, and perceived risks faced by each actor. Questionnaires were designed to assess the frequency and impact of identified risks, as well as to evaluate alternative mitigation strategies. Respondents were selected using purposive sampling, considering their direct involvement and experience in the strawberry supply chain.

Data analysis was carried out using an integrated approach combining the House of Risk (HOR) method and the Analytical Hierarchy Process (AHP). The first stage applied House of Risk Phase 1 (HOR 1) to identify Risk Events *(RE)* and Risk Agents *(RA)* across supply chain activities. Each risk event was assessed based on the severity of impact *(S)* and occurrence level *(O)* of the risk agent, and the degree of relation of *RE* and *RA (R)*, resulting in the calculation of Aggregate Risk Potential (ARP) = $\Sigma(S \times O \times R)$. Risk agents with the highest ARP values were prioritized as critical risks requiring mitigation. The second stage employed House of Risk Phase 2 (HOR 2) to design and evaluate mitigation strategies with calculation $\Sigma(ARP \times E)/D$ by assessing their Effectiveness Level *(E)* in reducing prioritized risk agents and the level of Difficulty of Implementation (D), resulting the Effectiveness to Difficulty ratio (ETD) used to rank mitigation strategies and determine priority actions. To support decision-making, the Analytical Hierarchy Process (AHP) was applied to select the most appropriate mitigation strategy based on multiple criteria, including effectiveness, cost, ease of implementation, and implementation time. Pairwise comparison matrices were constructed based on expert judgments, and consistency ratios were calculated to ensure the reliability of the assessments.

The overall research framework (Figure 3) integrates several sequential stages to analyze and mitigate risks in the strawberry supply chain of Bandung Regency. The framework begins with supply chain mapping to identify key actors and activities involved from production to distribution. This stage is followed by risk identification and risk prioritization using House of Risk Phase 1 (HOR 1) to determine dominant risk agents based on their aggregate risk potential. Subsequently, House of Risk Phase 2 (HOR 2) is applied to formulate and evaluate alternative mitigation strategies by considering their effectiveness and difficulty of implementation. Finally, the Analytical Hierarchy Process (AHP) is employed to select the most appropriate risk mitigation strategy based on multiple decision criteria. This integrated framework ensures that the selected mitigation strategies are prioritized, feasible, and applicable to the operational conditions of the strawberry supply chain.

## RESULTS

### Identification of the Strawberry Supply Chain in Bandung Regency

The supply chain includes not only the flow of physical goods but also the flow of information that serves as the basis for coordination and control among system actors (Vorst et al., 1998). Information flow plays a critical role in aligning activities, reducing uncertainty, and supporting decision-making across different stages of the supply chain. An efficient supply chain ensures that products reach consumers with acceptable quality,

competitive prices, and timely delivery. Inefficiencies in coordination or information exchange may increase costs, delays, and quality deterioration, particularly for perishable products. Therefore, successful supply chain management is heavily influenced by the ability to establish and manage appropriate relationships among all parties involved.

The strawberry supply chain in Bandung Regency involves four main actors: farmers, collectors, modern trade, and traditional trade. The upstream segment is dominated by farmers located in the PACIRA area (Pasirjambu, Ciwidey, and Rancabali), which serves as the main production center for strawberries. After harvesting, strawberries are distributed through collectors who perform basic sorting and grading activities before forwarding the products to downstream channels. These downstream channels include modern trade outlets such as supermarkets and traditional trade channels, including local markets and small retailers. The interaction and flow of activities among these actors form a relatively long distribution chain, which increases exposure to quality deterioration and coordination risks, as shown in Figure 4.

This supply chain structure reflects a relatively long distribution channel, particularly for strawberries supplied to modern trade outlets. The presence of multiple stages between farmers and end markets increases the complexity of coordination and information flow across the supply chain. Similar patterns were reported by Furqon (2014), who highlighted the dominant role of collectors in determining quality standards and price formation in the strawberry supply chain of Bandung Regency. These findings are consistent with the observations of Furqon (2014), who highlighted that supply chain structures dominated by intermediaries frequently result in disparate bargaining leverage among participants and exacerbate logistical inefficiencies throughout the distribution process. The involvement of multiple intermediaries increases the risk of quality deterioration due to repeated handling and extended distribution time, especially for highly perishable products such as strawberries. In addition, longer distribution channels may contribute to price inefficiency and unequal value distribution among supply chain actors.

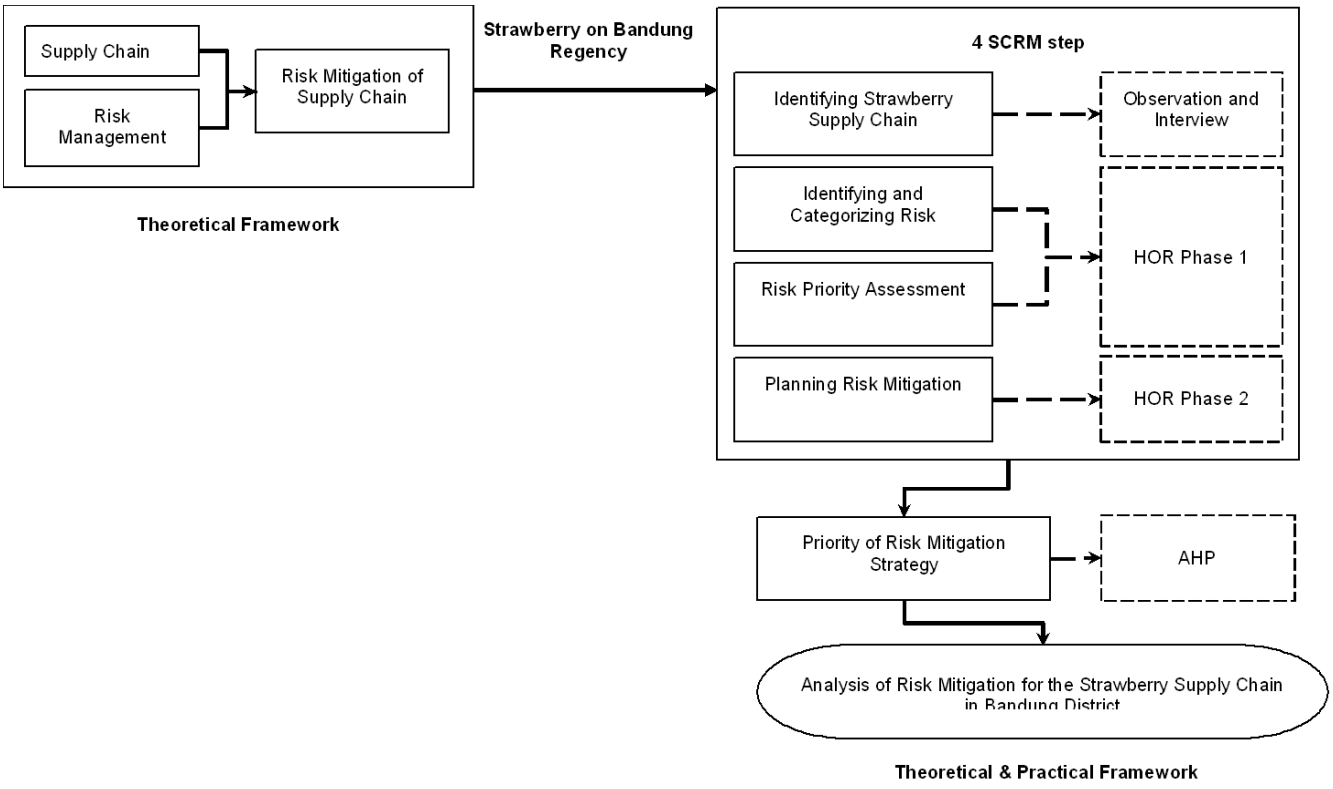



Figure 3. Research framework of strawberry supply chain risk mitigation

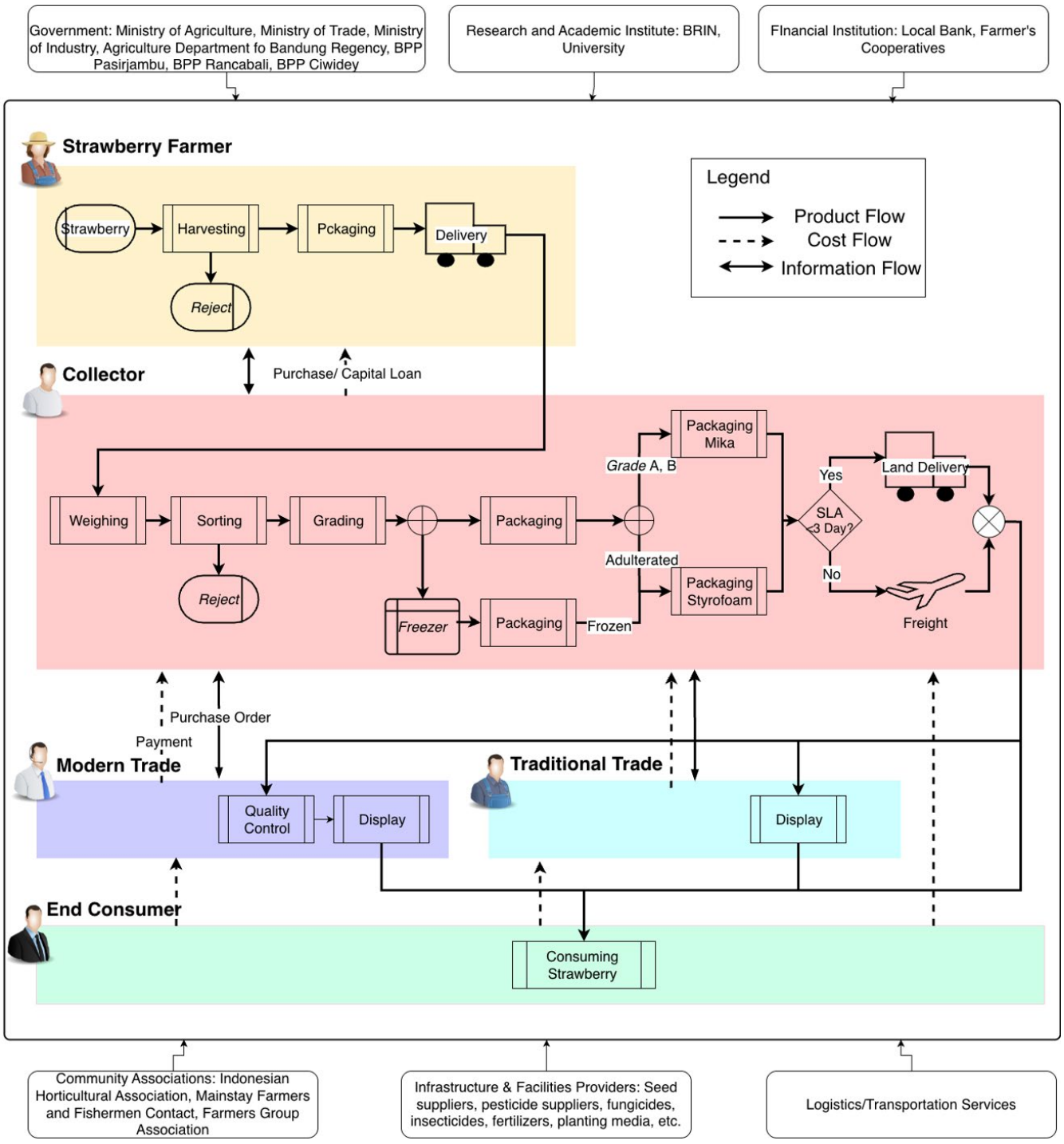



Figure 4. Activity flow of strawberry supply chain in Bandung Regency by actors

**Strawberry Supply Chain Risk Identification**

Risk identification results indicate that supply chain risks occur at all stages of the strawberry supply chain, ranging from production to distribution. Based on field observations and semi-structured interviews with supply chain actors, identified risks were classified into internal and external categories. Internal risks primarily include production failure, improper post-harvest handling, inadequate sorting and packaging practices, and logistical inefficiencies that may reduce product quality. External risks are mainly associated with climate variability, price fluctuations, and market uncertainty, which are largely beyond the direct control of supply chain actors. This classification provides a systematic overview of risk sources and highlights the diverse nature of risks affecting the strawberry supply chain, as illustrated in Figure 5.

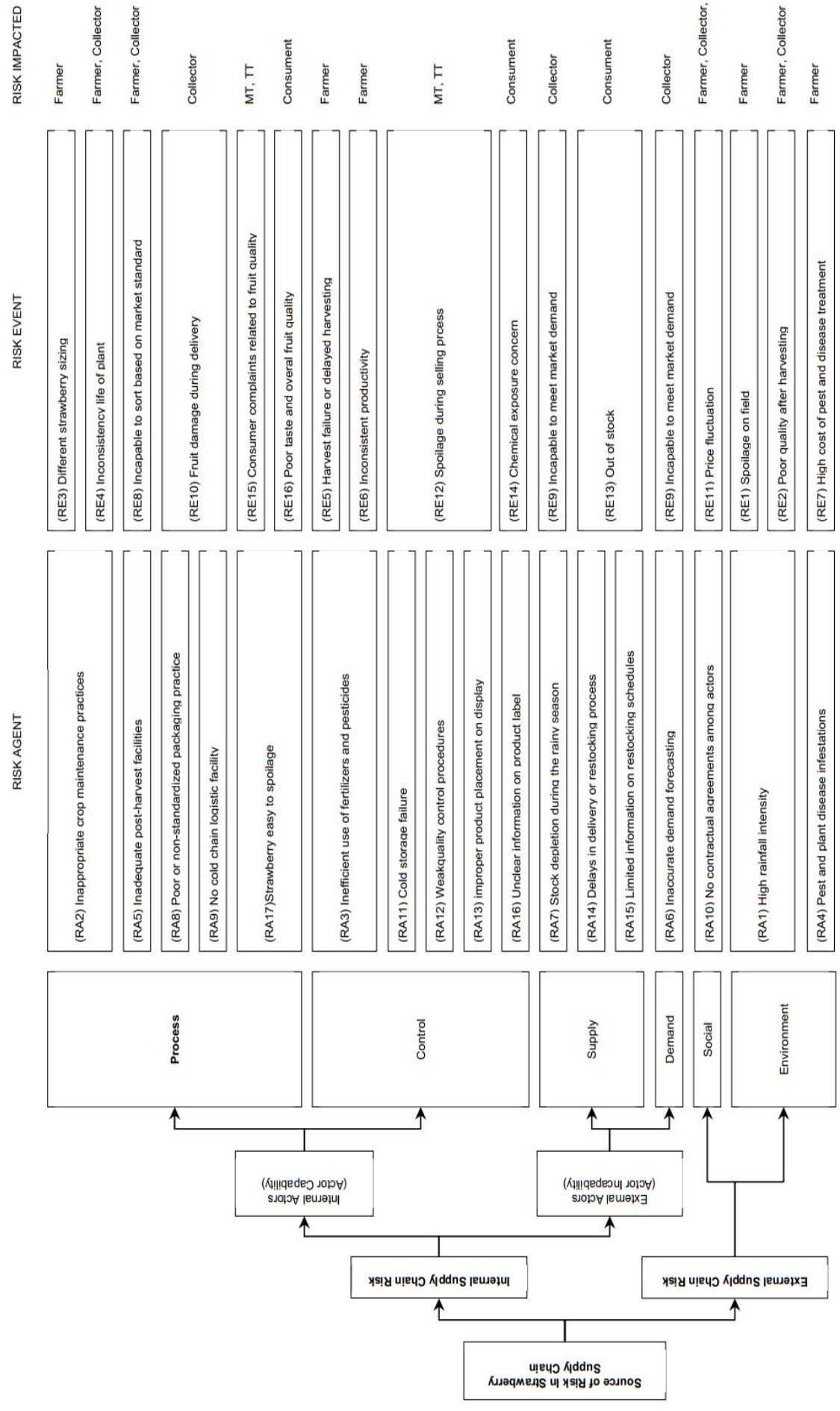



Figure 5. Identification of risk based on internal and external strawberry supply chain

Farmers face the highest exposure to climate-related risks, pests, and diseases, which directly affect production volume and product quality (Maghfira et al., 2020). At the intermediary level, collectors and traders are more exposed to risks related to transportation delays, product damage, and declining quality during storage and distribution processes (Chumairo, 2018). These risks are intensified by the perishable nature of strawberries and the relatively long distribution channels identified earlier. Differences in risk exposure among supply chain actors indicate that risk impacts are not evenly distributed across the supply chain. These findings are consistent with previous studies showing that horticultural supply chains are highly sensitive to environmental and operational disturbances (Ningsih et al., 2024). The results of this analysis are consistent with the findings of Maghfira et al. (2020), which indicate that climatic variability and biological disturbances continue to be the most dominant sources of production risk in horticultural supply chains, particularly for commodities characterized by high perishability.

**Risk Prioritization Using House of Risk Phase 1**

House of Risk Phase 1 analysis was conducted to prioritize risk agents based on their Aggregate Risk Potential (ARP) values. The ARP metric integrates the likelihood of risk occurrence and the severity of its impact, allowing a systematic comparison among identified risk agents. Through this approach, risk agents that contribute most significantly to supply chain vulnerability can be distinguished from those with relatively lower impacts. The results indicate that supply chain vulnerability is not evenly distributed across all identified risks. Instead, a limited number of risk agents account for a disproportionate share of overall risk exposure, as summarized in Table 2.

The results show that a limited number of risk agents contribute significantly to overall supply chain vulnerability. Climate uncertainty, inadequate post-harvest handling practices, and weak coordination among supply chain actors emerge as the most critical risk agents, as reflected by their high ARP values. These findings are consistent with the results of Ganesh and Kalpana (2022), who highlighted that a small proportion of high-impact risk agents frequently account for a disproportionate share of the aggregate vulnerability within a supply chain. These risk agents represent dominant sources of disruption that affect production continuity, product quality, and distribution efficiency across the strawberry supply chain. This finding confirms that effective risk mitigation should prioritize high-impact risk agents rather than attempting to address all identified risks simultaneously. Concentrating mitigation efforts on risk agents with high ARP values enables more efficient allocation of limited resources and enhances the practicality of supply chain risk management strategies. Similar prioritization approaches have been recommended in previous supply chain risk management studies, emphasizing the importance of focusing on high-impact risks to strengthen operational resilience (Ganesh & Kalpana, 2022).

**Proposed Risk Mitigation Actions**

Based on the identification and prioritization of supply chain risks, several mitigation actions were formulated to address the dominant risk agents in the strawberry supply chain of Bandung Regency. These mitigation actions are designed to be practical, context-specific, and applicable at both the farmer and supply chain actor levels. The formulation of mitigation actions considers the nature of prioritized risks as well as the operational conditions of the supply chain. Each proposed action is linked to specific risk agents identified in House of Risk Phase 1. A summary of the proposed risk mitigation actions and their corresponding risk agents is presented in Table 3.

The proposed mitigation actions target both production-related and coordination-related risks within the strawberry supply chain. For climate-related risks, the implementation of simple greenhouse or rain-protection systems is proposed to reduce crop damage during periods of excessive rainfall. Inefficient use of fertilizers and pesticides is addressed through training programs that promote the use of locally produced organic inputs, which are more affordable and environmentally friendly. Supply-related risks during the rainy season are mitigated through inter-regional sourcing strategies aimed at stabilizing market availability. In addition, cultivation risks caused by improper maintenance practices are addressed through the establishment of Farmer Field School (FFS) programs in major strawberry-producing villages.

Table 2. House of risk phase 1 results: prioritization of Risk Agents (RAs)

| Code | Description | ARP | % | %Kum | Rank |
|---|---|---|---|---|---|
| RA1 | High/Erratic Rainfall | 1170 | 24.98 | 24.98 | 1 |
| RA3 | Inefficient Fertilizer/Pesticide Use | 720 | 15.37 | 40.36 | 2 |
| RA7 | Stock depletion during the rainy season | 486 | 10.38 | 50.74 | 3 |
| RA2 | Mistakes in plant care patterns | 432 | 9.22 | 59.96 | 4 |
| RA5 | Poor Quality Post-Harvest Packaging | 378 | 8.07 | 68.03 | 5 |
| RA10 | No formal contract between the actors | 315 | 6.73 | 74.76 | 6 |
| RA4 | Pest and Disease Attacks | 288 | 6.15 | 80.91 | 7 |

Table 3. Proposed risk mitigation actions based on risk prioritization

| Code | Risk Agent | Code | Preventive Action |
|---|---|---|---|
| RA1 | High and unpredictable rainfall | PA1 | Implementation of a simple greenhouse system (paranet) to protect crops from excessive rainfall |
| RA3 | Inefficient use of fertilizers and pesticides | PA2 | Training and application of liquid organic fertilizers and environmentally friendly pesticides produced through local fermentation |
| RA7 | Stock shortages during the rainy season | PA3 | Raising the farm-gate price to attract farmers' interest |
| RA2 | Improper crop maintenance practices | PA4 | Establishment of Farmer Field Schools (FFS) in each strawberry-producing village |
| RA5 | Inadequate post-harvest facilities | PA5 | Establishment of a capital loan cooperative dedicated to financing the development of farming enterprises |
| RA10 | Absence of formal contracts among supply chain actors | PA6 | Development of simple memoranda of understanding (MoU) between farmers, collectors, and modern/traditional trade regarding volume and price agreements |

Post-harvest risks are mitigated through improved access to financing for the development of post-harvest facilities, enabling better handling and quality preservation. Coordination risks among supply chain actors are addressed through the development of simple contractual arrangements or memoranda of understanding (MoU) related to volume and price agreements. These institutional mechanisms are expected to reduce uncertainty and improve coordination among farmers, collectors, and traders. Overall, the proposed mitigation actions reflect a combination of technical, institutional, and managerial interventions. The results of this analysis supports previous studies by Mulyati and Gelderman (2017), who highlighted that successful risk mitigation within the supply chain requires the integration of technical interventions with structured coordination and managerial alignment among all relevant actors. This integrated approach ensures that risk mitigation efforts are not limited to on-farm activities but also extend to coordination and governance within the strawberry supply chain.

**Prioritization of Mitigation Actions Using House of Risk Phase 2**

After the mitigation actions were defined, House of Risk Phase 2 was applied to evaluate and prioritize these actions based on their effectiveness in reducing prioritized risk agents and the level of difficulty of implementation. This phase focuses on assessing the relationship between mitigation actions and dominant risk agents identified in House of Risk Phase 1. Each mitigation action was evaluated in terms of its potential impact on reducing risk exposure and the practical challenges associated with its implementation. The prioritization process aims to identify mitigation actions that offer the most favorable balance between effectiveness and feasibility. The results of the House of Risk Phase 2 analysis are summarized in Table 4.

The results show that mitigation actions related to capacity building, particularly the establishment of Farmer Field School (FFS) programs, achieved the

highest Effectiveness to Difficulty (ETDk) values and were ranked as the top priority. Empirical comparisons with previous research suggest that capacity-building-based mitigation strategies are frequently more effective and sustainable within smallholder-dominated agricultural supply chains, as they necessitate lower capital intensity while concurrently addressing a broad spectrum of operational risks. This finding indicates that training-based interventions provide a strong impact on risk reduction while remaining relatively feasible to implement under existing resource constraints. Compared to infrastructure-intensive or coordination-heavy strategies, capacity-building programs require lower capital investment and can be implemented more flexibly across production areas. In addition, knowledge and skill improvement through FFS programs can address multiple risk agents simultaneously, including cultivation practices and post-harvest handling. Therefore, prioritizing capacity-building-oriented mitigation actions is considered a practical and efficient approach for strengthening risk management in the strawberry supply chain.

**Selection of Mitigation Strategies Using Analytical Hierarchy Process**

To strengthen decision-making in selecting the most appropriate mitigation strategy, the Analytical Hierarchy Process (AHP) was applied as a multi-criteria decision-making tool. AHP enables the evaluation of alternative strategies by structuring complex decision problems into hierarchical levels consisting of goals, criteria, and alternatives. In this study, the evaluation criteria included effectiveness, cost, ease of implementation, and implementation time, which reflect both technical and practical considerations faced by supply chain actors. Pairwise comparisons were conducted to assess the relative importance of each criterion and alternative strategy. The hierarchical structure of the AHP model and the results of the alternative weight evaluation are presented in Figure 6 and Table 5, respectively.

Table 4. House of Risk Phase 2 Result: risk mitigation ranking

| | PA1 | PA2 | PA3 | PA4 | PA5 | PA6 | PA7 | ARP |
|---|---|---|---|---|---|---|---|---|
| RA1 | 3 | | | | | | | 1170 |
| RA3 | | 3 | | | | | | 720 |
| RA7 | | | 3 | | | | | 486 |
| RA2 | | | | 9 | | | | 432 |
| RA5 | | | | | 9 | | | 378 |
| RA10 | | | | | | 3 | | 315 |
| RA4 | | | | | | | 1 | 288 |
| TE-k | 3510 | 2160 | 1458 | 3888 | 3402 | 945 | 288 | |
| Difficult | 5 | 3 | 5 | 4 | 4 | 5 | 4 | |
| ETD | 702 | 720 | 291.6 | 1296 | 850.5 | 189 | 72 | |
| Rank | 4 | 3 | 5 | 1 | 2 | 6 | 7 | |

Table 5. AHP alternative weight evaluation for each alternative strategy

| Alternative | Eigen Vector Kriteria | | | | | | Alternative Weight Evaluation |
|---|---|---|---|---|---|---|---|
| | K1 | K2 | K3 | K4 | K5 | K6 | |
| | 0.316 | 0.080 | 0.077 | 0.087 | 0.226 | 0.192 | |
| A1 | 0.074 | 0.724 | 0.556 | 0.568 | 0.087 | 0.300 | 0.253 |
| A2 | 0.283 | 0.083 | 0.090 | 0.098 | 0.273 | 0.369 | 0.250 |
| A3 | 0.643 | 0.193 | 0.353 | 0.334 | 0.639 | 0.332 | 0.497 |

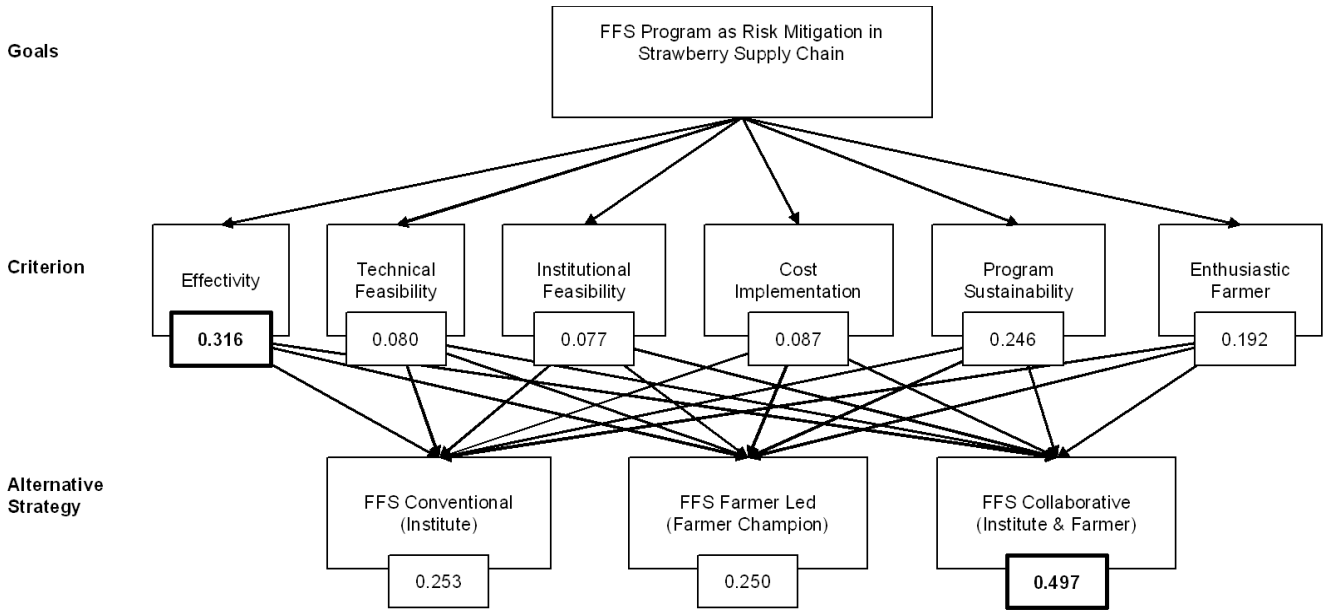



Figure 6. AHP hierarchical structure based on goals, criterion, and alternative strategy

The AHP results indicate that mitigation strategies emphasizing training and knowledge transfer through Farmer Field School (FFS) programs receive the highest priority weight among the evaluated alternatives. This outcome suggests that strategies with higher effectiveness and ease of implementation are more strongly preferred by decision-makers in the strawberry supply chain. Effectiveness and ease of implementation were identified as the most influential criteria, highlighting the importance of practical feasibility alongside potential impact. Similar findings were reported by Saaty (2008), who emphasized that decision-makers within complex systems frequently prioritize mitigation alternatives that offer the greatest practical utility while ensuring feasibility under established operational constraints. Compared to strategies requiring substantial financial investment or complex coordination, training-based interventions are perceived as more adaptable to local conditions. These findings are consistent with Saaty (2008), who emphasized the importance of consistency and multi-criteria evaluation in supporting rational decision-making for complex problems.

**Managerial Implications**

The findings of this study provide important managerial implications for strawberry supply chain actors in Bandung Regency. For farmers, structured training programs can enhance cultivation techniques, pest and disease management, and post-harvest handling practices, thereby reducing production and quality-related risks. Improved knowledge and skills enable farmers to better adapt to climate variability and operational challenges. For collectors and traders, improved coordination mechanisms and standardized sorting and packaging procedures can minimize quality degradation and logistical losses during distribution. From a policy perspective, government agencies and extension services can play a strategic role by facilitating Farmer Field School programs as a cost effective and scalable risk mitigation instrument across major strawberry producing areas.

Overall, the integration of the House of Risk and Analytical Hierarchy Process offers a practical and structured framework for supply chain risk management. This framework supports decision-makers in prioritizing risks and selecting mitigation strategies based on both impact and feasibility considerations. The approach enables more efficient allocation of limited resources while improving coordination among supply chain actors. Furthermore, the proposed framework can be adapted and applied not only to strawberry supply chains but also to other perishable horticultural commodities with similar risk characteristics. As such, the findings contribute to the development of more resilient and sustainable agri-food supply chains.

## CONCLUSIONS AND RECOMMENDATIONS

### Conclusions

This study demonstrates that the strawberry supply chain in Bandung Regency, particularly in the PACIRA area, is characterized by the involvement of multiple actors and relatively long distribution channels, which increase vulnerability to various risks. The most critical risks are associated with climate uncertainty, improper cultivation and post-harvest practices, limited supporting facilities, and weak coordination among supply chain actors. The application of the House of Risk (HOR) method successfully identifies and prioritizes key risk agents that contribute significantly to supply chain disruptions. The results confirm that risk exposure is concentrated in a limited number of high-impact risk agents rather than being evenly distributed across all identified risks. This finding emphasizes the importance of focused and structured risk mitigation efforts instead of fragmented and reactive interventions. Furthermore, the integration of House of Risk Phase 2 and the Analytical Hierarchy Process (AHP) provides a systematic and robust framework for selecting appropriate risk mitigation strategies. The results show that mitigation actions related to capacity building, particularly through the implementation of Farmer Field School (FFS) programs, emerge as the most effective and feasible strategy based on both ETDk values and multi-criteria evaluation. This indicates that knowledge transfer, skill improvement, and enhanced coordination among supply chain actors play a more critical role in reducing supply chain risks than infrastructure-intensive solutions. Overall, the study confirms that the integrated HOR–AHP approach offers practical and applicable managerial insights for managing risks in perishable horticultural supply chains. Therefore, this approach can support decision-makers in improving the resilience and sustainability of strawberry agribusiness in Bandung Regency and similar contexts.

### Recommendations

Based on the findings, several recommendations are proposed for supply chain actors, particularly farmers and collectors. The adoption of structured training programs such as Farmer Field School (FFS) should be prioritized to improve cultivation techniques, post-harvest handling practices, and risk awareness among farmers. Enhanced technical capacity is expected to reduce production losses and quality deterioration caused by improper practices. In addition, strengthening coordination through simple contractual arrangements among farmers, collectors, and traders is recommended to reduce uncertainty related to price and volume. Such arrangements can improve trust, stabilize transactions, and support more efficient supply chain operations.

For policymakers and local government agencies, stronger support for capacity-building programs is essential to enhance supply chain resilience. Facilitating institutional arrangements and collaboration among supply chain actors can help improve coordination and risk-sharing mechanisms. Investment in extension services plays a critical role in disseminating knowledge and promoting best practices across production areas. Furthermore, the development of collaborative platforms involving farmers, collectors, traders, and local authorities can improve communication and collective decision-making. These policy interventions are expected to strengthen the sustainability and competitiveness of the strawberry supply chain at the regional level.

Future research is encouraged to expand the scope of analysis by incorporating quantitative performance indicators such as efficiency, profitability, and service level. Evaluating the long-term impact of implemented mitigation strategies on supply chain performance and farmer income would provide deeper insights into their effectiveness. Longitudinal studies may also help capture dynamic changes in risk exposure and mitigation outcomes over time. In addition, applying the proposed HOR–AHP framework to other horticultural commodities can test its robustness across different contexts. Such studies would enrich the understanding of supply chain risk management in the agricultural sector and support broader policy and managerial applications.

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## REFERENCES

Badan Pusat Statistik. (2023). Produksi Tanaman Sayuran dan Buah Buahan Semusim Menurut Provinsi dan Jenis Tanaman 2023. BPS RI.

Badan Pusat Statistik. (2024). *Produk domestik bruto Indonesia menurut lapangan usaha 2024*. Badan Pusat Statistik Republik Indonesia.

Badan Pusat Statistik Provinsi Jawa Barat. (2024). *Produksi hortikultura Provinsi Jawa Barat 2024*. BPS Provinsi Jawa Barat.

Chumairoh, I. (2018). *Strategi pemasaran stroberi PT. Kusuma Satria Dinasastri Wisatajaya (Kusuma Agrowisata) Kota Batu Jawa Timur* (Skripsi Sarjana, Universitas Islam Negeri Syarif Hidayatullah Jakarta). Universitas Islam Negeri Syarif Hidayatullah Jakarta.

Dewi, N. K., Arffien, A., Nurhayana, H. F., & Saefudin, A. (2024). Strawberry distribution in Ciwidey: An analysis of value chain and price disparity. *Agrisocionomics: Jurnal Sosial Ekonomi dan Kebijakan Pertanian*, 8(3), 756–770. https://doi.org/10.14710/agrisocionomics.v8i3.2024

Djazuli, M., Rahman, A., & Putri, N. (2024). Risk mitigation strategies in horticultural supply chains. *International Journal of Agricultural Management*, 13(2), 89–101.

Furqon, C. (2014), Analisis Manajemen dan Kinerja Rantai Pasokan Agribisnis Buah Stroberi di Kabupaten Bandung, *Jurnal Riset Manajemen, 3(2),* 109-126.

Ganesh, K., & Kalpana, P. (2022). Supply chain risk mitigation strategies: A systematic review. *Journal of Supply Chain Management*, 58(4), 345–360.

Keswari, I., & Rinawati, D. I. (2017). Analisis risiko distribusi pada sistem logistik produk segar. *Jurnal Teknik Industri*, 18(1), 45–54.

Maghfira, A., Rahmi, D., & Putra, E. (2020). Risiko produksi hortikultura dan strategi mitigasinya. *Jurnal Agribisnis*, 14(3), 201–213.

Mulyati, H., & Gelderman, C. J. (2017). Supply chain risk management: A structured approach to risk mitigation decision-making. *Journal of Purchasing and Supply Management*, 23(3), 190–201. https://doi.org/10.1016/j.pursup.2017.02.003

Ningsih, S., Handayani, R., & Pratama, Y. (2024). Kinerja dan risiko rantai pasok stroberi di Jawa Barat. *Jurnal Manajemen & Agribisnis*, 21(1), 45–58.

Saaty, T. L. (2008). Decision making with the analytic hierarchy process. *International Journal of Services Sciences*, 1(1), 83–98.

Van der Vorst J. G. A. J., Beulens, A. J. M., De Wit, W., and Van Beek, P. (1998). Supply Chain Management in Food Chains: Improving Performance by Reducing Uncertainty. *International Transactions in Operational Research*, 5: 487-499.