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Supply chain and value chain analyses of West Java's Gedong mango variety for modern markets

Analisis rantai pasok dan rantai nilai varietas mangga gedong Jawa Barat untuk pasar modern

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Abstract

The main challenge in the supply and value chains of Gedong and Gedong Gincu mangoes lies in the suboptimal diversity, quantity, quality, and consistency of supply in response to market dynamics and consumer preferences, particularly for modern markets. This study aims to: (1) examine the supply chain of Gedong and Gedong Gincu mangoes; (2) analyze the value chain and marketing margins; and (3) formulate an integrated supply chain management strategy to improve access to modern markets. A case study approach was employed between November 2021 and December 2022, utilizing snowball sampling, which involved farmers, collectors, suppliers, modern retailers, and end consumers. Data analysis was carried out using quantitative methods (farm share, margins, and value added) and qualitative methods (roles, interaction patterns, and coordination among supply chain actors). The research results identified six key actors in the supply chain targeting the modern markets. Modern retailers generated the highest value added, at IDR 18,250/kg for Gedong mangoes and IDR 20,000/kg for Gedong Gincu, with the largest profit margins also captured at the retail level. These findings underscore the importance of integrated supply chain management strategies through farmer−retailer partnerships to improve efficiency, enhance value added, and increase the competitiveness of mango products. Policy implications include strengthening farmer institutions in terms of management, financing, fair contract arrangements, and member participation. The government is expected to play a facilitative and mediating role in fostering mutually beneficial and sustainable business partnerships across the supply chain actors.

Keywords: Gedong mango, marketing margin, modern market, supply chain management, value added

Abstrak

Permasalahan utama dalam rantai pasok dan rantai nilai mangga gedong dan gedong gincu terletak pada belum optimalnya keberagaman, kuantitas, kualitas, dan kesinambungan pasokan sesuai dinamika pasar dan preferensi konsumen, khususnya untuk pasar modern. Penelitian ini bertujuan untuk (1) mengkaji rantai pasok produk mangga gedong dan gedong gincu; (2) menganalisis rantai nilai dan margin tata niaga; dan (3) merumuskan strategi manajemen rantai pasok terpadu untuk meningkatkan akses ke pasar modern. Penelitian ini menggunakan pendekatan studi kasus yang dilaksanakan pada November 2021 hingga Desember 2022 dengan teknik *snowball sampling*, melibatkan petani, pedagang pengumpul, pemasok, pasar modern, dan konsumen. Analisis data dilakukan menggunakan metode kuantitatif *(farm share*, margin, dan nilai tambah) dan metode kualitatif (peran, pola interaksi, dan koordinasi antarpelaku rantai pasok). Hasil penelitian menunjukkan bahwa terdapat enam pelaku utama dalam rantai pasok produk mangga gedong dan mangga gedong gincu ke pasar modern. Pasar modern menciptakan total nilai tambah sebesar Rp18.250/kg untuk mangga gedong dan Rp20.000/kg untuk mangga gedong gincu, dengan margin keuntungan terbesar berada di tingkat retail modern. Temuan ini menegaskan bahwa strategi integrasi rantai pasok melalui kemitraan petani dan pasar modern penting untuk meningkatkan efisiensi, nilai tambah, dan daya saing produk. Implikasi kebijakan mencakup penguatan kelembagaan petani dalam manajemen, permodalan, penyusunan kontrak yang adil, dan partisipasi anggota. Pemerintah diharapkan berperan

sebagai fasilitator dan mediator dalam mendorong terjalinnya kemitraan usaha yang saling menguntungkan dan berkelanjutan antarpelaku rantai pasok.

Kata kunci: mangga gedong,manajemen rantai pasok, margin pemasaran, nilai tambah, pasar modern

1. Introduction

The strategic landscape for agricultural commodities is rapidly evolving due to factors such as trade liberalization, urbanization, market segmentation, shifting consumer preferences, and the impact of the COVID-19 pandemic. These changes necessitate greater agility and adaptability in supply chain operations, particularly in the context of highly perishable horticultural products such as mangoes. Modern supply chains are increasingly fragmented by market destinations, requiring a flexible, responsive system to meet diverse demands (Reuschl et al. 2022; Yang et al. 2024). For West Java's Gedong mangoes, understanding the supply and value chain dynamics is critical to satisfy the requirements of modern retail outlets, such as supermarkets and hypermarkets, which demand consistent product quality, quantity, and supply continuity (Saptana 2020).

Agribusiness supply chain partnerships are viewed as a promising strategy to achieve both economic growth and equitable income distribution (growth with equity) (Saptana 2020). Studies have shown that supply chain resilience (SCR) strategies enhance logistics, flexibility, agility, and collaboration, which are the key elements in adapting to market volatility (Scholten and Schilder 2015; Yang et al. 2024). Complementary initiatives, such as horticultural zones and regional fruit fly management programs, further contribute to resource optimization, value addition, and employment generation (Yingmin et al. 2017). In Indonesia, this aligns with national policies, such as the Ministry of Agriculture Regulation No. 03/2024 concerning the Development of Agricultural Zones, which promotes the development of competitive and sustainable agricultural commodities. This regulation emphasizes strengthening horticultural supply chains through innovation, partnership, and regional-based agribusiness models.

The integration of industrial activities across the agricultural sector can be conceptualized as a continuous supply chain that extends to modern market systems. For instance, Fernandez-Stark et al. (2017) introduced the global value chain (GVC) framework in their study of the mango industry in the Philippines. Their analysis illustrated direct linkages across stages, including production, cold storage and packaging, processing, distribution and marketing, and retail. These linkages were governed through buyer-driven global commodity chains, where lead firms coordinate operations without requiring direct ownership. In other words, global value chains can be constructed through partnership relationships between businesses (Saptana et al. 2018; Saptana 2020).

West Java serves as Indonesia's primary production center for Gedong mangoes, with major production areas located in Indramayu, Cirebon, Majalengka, Sumedang, and Kuningan Regencies (Suhaeni 2019). The Gedong mango variety (*Mangifera indica* L. var gedong) produces two variants: Gedong and Gedong Gincu. These are differentiated based on harvest maturity. Gedong mangoes are harvested semi-mature (less than 108 days after full bloom, DAFB), while Gedong Gincu mangoes are harvested fully mature (109−120 DAFB), resulting in more pronounced color and flavor attributes (Utami et al. 2020). Gedong Gincu mangoes are particularly valued for their round shape, small size, yellowish-red skin, and reddish hue at the base (Fahri et al. 2016). Gedong mangoes, especially their premium tree-ripened variant, Gedong Gincu, are renowned for their unique flavor, aroma, and vibrant appearance, making them highly sought after by middle-to-upper-class consumers (Ariningsih et al. 2021). Initially grown in backyard gardens, mango cultivation in West Java has expanded into larger-scale commercial production on both upland and lowland areas, with progressive farmers establishing medium-sized plantations.

Despite their favorable attributes and rising demand, the Gedong mango value chain faces significant constraints. Challenges at the farm level include small and fragmented landholdings, limited access to capital, and suboptimal production and post-harvest practices, such as premature harvesting and poor handling. These issues, compounded by weak market linkages and dependency on bulk or fixed-price contracts, result in limited access to modern markets and minimal value addition for farmers (Rasmikayati 2018; Ashari et al. 2021). Consequently, the supply chain remains fragmented and inefficient, underscoring the need for an integrated supply chain management strategy that promotes marketing efficiency, value creation, and equitable profit distribution through improved coordination among stakeholders.

Although several studies have addressed aspects of production production (Rasmikayati et al. 2018), market behavior (Andriani et al. 2019; Awaliyah and Saefudin 2020; Prabowo and Komara 2020; Ashari et al. 2021; Sumantri 2021), institutional arrangements (Sulistyowati and Natawidjaja 2016; Awaliyah 2018; Muftiadi et al. 2023), or partial value chain mapping (Suhaeni et al. 2015; Deliana et al. 2017; Pardian et al. 2024), they often focus on Gedong Gincu alone or are limited to certain localities. These studies rarely distinguish between Gedong and Gedong Gincu or address the integrated dynamics of the supply and value chains in relation to modern market access. This fragmented research approach presents a clear gap in understanding how variant differentiation affects market segmentation, coordination mechanisms, and value distribution in the context of modern retail.

This study directly addresses the identified research gap by offering a comprehensive and comparative analysis of the supply and value chains for both Gedong and Gedong Gincu mangoes in West Java's major producing regencies. Emphasizing modern market destinations, where quality and supply consistency are critical, it investigates three key questions: (1) What are the structure and characteristics of the supply chains for Gedong and Gedong Gincu mangoes in modern markets? (2) How do the value chain and marketing margin distributions function within these supply chains? (3) What supply chain management strategies are most effective in improving supply sustainability and farmers' access to modern markets?

Accordingly, this study aims to comprehensively analyze West Java's Gedong mango supply chain and value chain for modern markets, differentiated between Gedong and Gedong Gincu. Specifically, it seeks to (1) examine the structure and characteristics of the supply chain for Gedong and Gedong Gincu mangoes, (2) analyze the value chain and marketing margin distribution, and (3) formulate an integrated supply chain management strategy to enhance farmers' access to modern markets. By answering these questions, the study identifies inefficiencies, coordination gaps, and unequal value distribution that hinder competitiveness and sustainability.

The novelty of this study lies in its holistic, market-oriented approach. It explicitly differenciates between Gedong and Gedong Gincu mangoes, integrates multiple regions and actor categories, and grounds the analysis in the operational and quality requirements of modern retail systems. By combining quantitative and qualitative analysis across the full supply chain, the study offers original insights and practical policy implications for improving efficiency, competitiveness, and inclusiveness in the mango agribusiness sector.

2. Methodology

2.1. Conceptual framework

Prior research on agricultural supply chains has largely focused on horticultural commodities, examining the factors influencing the formation and performance of supply chains involving companies, organizations, and individual farmers. Emphasis has been placed on access to resources such as capital, information, and market networks (Ali and Golgeci 2019; Mishra et al. 2021; Zhao et al. 2021). This study focuses on analyzing the supply and value chains of Gedong and Gedong Gincu mangoes to improve farmers' access to modern markets (Alam 2018; Yang et al. 2024) and enhance the resilience of supply chain organizations (Reuschl et al. 2022).

According to HPSP (2011), a supply chain is a series of logistics processes and the flow of goods or services from raw material suppliers and producers to distributors and end consumers. Its main focus is to enhance the efficiency of goods and logistics distribution, both physically and informationally. The concept of Supply Chain Management (SCM) encompasses the integrated management of production, distribution, and marketing processes to ensure that consumers receive products that meet their preferences, while producers deliver the right quantity and quality at the appropriate time and location (Marimin and Maghfiroh 2013).

Kaplinsky and Morris (2001) define value chain analysis as encompassing the entire sequence of activities—from concept development and production to distribution through traders, processors, and distributors—ultimately reaching the end consumer. ACIAR (2012) adds that the value chain comprises all activities that connect producers to consumers, with each stage adding value to the final product. Meanwhile, Porter (1985) emphasizes that the value chain focuses on creating customer value and achieving competitive advantage through internal activities that enhance product value. Its primary focus is on enhancing the added value of goods or services through internal company processes.

Value addition is central to the concept of the value chain. It refers to the incremental increase in product value as it progresses through various stages of processing, packaging, branding, and delivery (Fernandez-Stark et al. 2016; Muzaki 2020). In the context of Gedong and Gedong Gincu mangoes, this includes product differentiation through quality grading, improved packaging, branding, and consistency in meeting modern market requirements.

Marketing margin, on the other hand, is the difference between the price received by producers and the price paid by consumers, adjusted for the costs incurred by intermediaries (Thakur et al. 2023). It includes compensation for services such as aggregation, transportation, processing, packaging, storage, and retailing. This margin serves as a performance indicator for marketing systems, reflecting the efficiency and equity of value distribution across the supply chain. An analysis of marketing margins enables the assessment of intermediary profitability and the distribution of value along the supply chain, highlighting inefficiencies or possible market power imbalances (Dawe and Maltsoglou 2009; Thakur et al. 2023).

The distinction between the supply chain and the value chain lies in their respective focuses. The supply chain focuses on the physical flow of goods and logistics management, spanning from upstream suppliers to downstream consumers, with the goal of achieving cost efficiency and timely delivery. In contrast, the value chain focuses on creating consumer-oriented products that justify higher market prices through added value at each stage (HPSP 2011; Muzaki 2020).

Figure 1 illustrates the conceptual framework that links supply and value chains within the SCM process, highlighting the key actors and stages, from mango farmers to modern retail markets. The supply chain encompasses a range of activities, including production, post-harvest handling, packaging, logistics, and marketing. The value chain involves stages where value is added through technological innovations, branding, packaging, and quality enhancements.

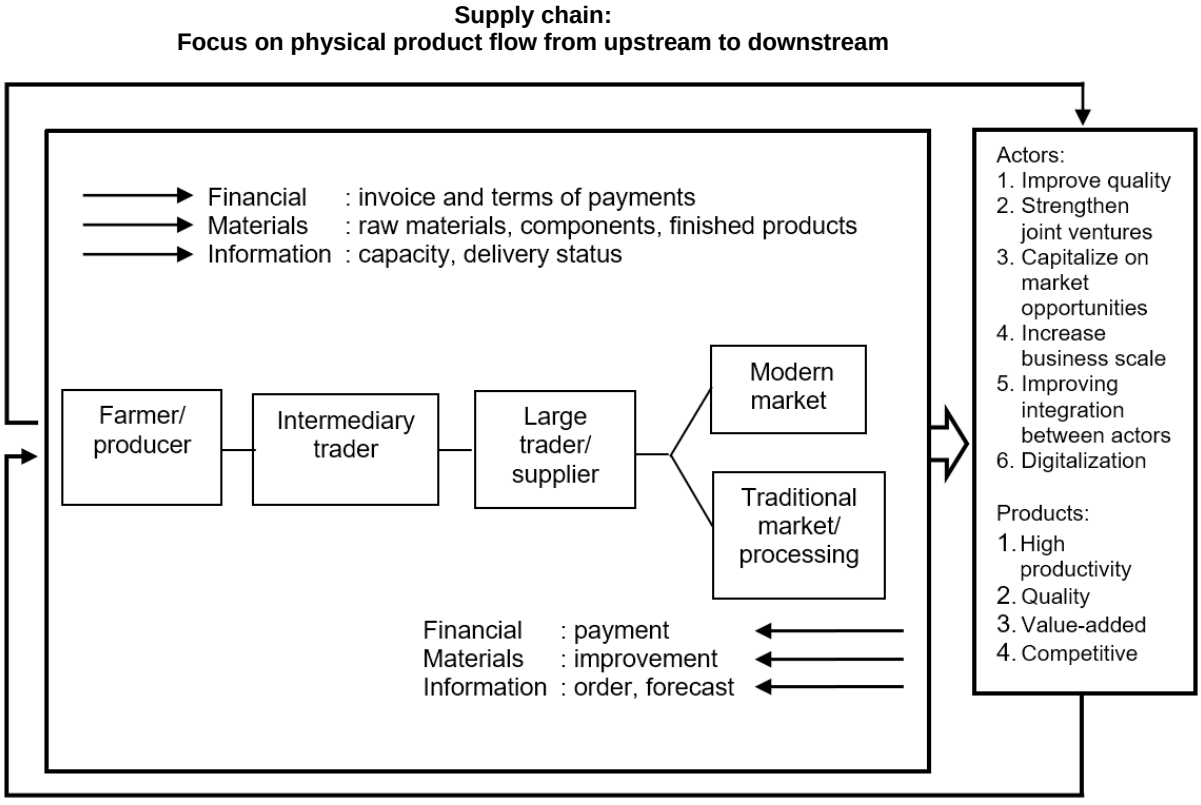

Figure 1. Supply chain and value chain linkages in the product SCM process from producer to consumer

Effective SCM integrates various dimensions, including order fulfillment, supplier selection, quality control, production planning and control, AI-enabled products, service and maintenance, transportation, warehouse management, sales processes, customer interactions (Helo and Hao 2021), inventory

management (Svoboda and Minner 2022), demand forecasting (Kantasa-ard et al. 2021), risk management (Baryannis et al. 2019; Wong et al. 2024), and organizational agility (Aliyyah et al. 2024). Thus, SCM is an approach that integrates the efficiency of suppliers, companies, distributors, and retailers to produce and deliver products in the right quantity, at the right location, and at the right time, thereby reducing distribution costs and meeting customer satisfaction. In developing countries, horticultural SCM is still evolving, with the Philippines offering examples of successful practices (Fernandez-Stark et al. 2017) and India highlighting existing bottlenecks (Rais and Sheoran 2015).

Saptana et al. (2018, 2019) outlined six principles for effective SCM: (1) customer focus, (2) quality assurance, (3) efficient logistics, (4) information sharing, (5) institutional strengthening, and (6) equitable value distribution. These principles underpin efforts to upgrade supply chain performance, reduce transaction costs, enhance product value, and facilitate sustainable technology transfer.

In summary, the conceptual framework integrates supply chain and value chain concepts to assess the marketing margin and value added in the Gedong and Gedong Gincu mango industry, aiming to support integrated supply chain strategies that improve farmer access to modern markets and enhance overall system efficiency and fairness.

2.2. Scope of the study

This study initially focused on the Indramayu and Cirebon Regencies. Subsequently, the scope was expanded to include Sumedang and Majalengka. All the regencies are the primary production centers for Gedong and Gedong Gincu mangoes in West Java. The study focuses on modern markets in Jakarta and Tangerang. The research encompasses the supply chain, value chain, marketing margins, and integrated supply chain management. The study of integrated supply chain management strategies includes understanding supply chain concepts and implementation, quality management and product standardization, product handling, transportation modes, written contracts, supply continuity, market information systems, product development and promotion, and the importance of marketing efficiency.

2.3. Study site and time

This study was conducted in Krasak and Pawidean villages (Jatibarang subdistrict, Indramayu Regency) and Sedong Lor, Putat, and Panongan villages (Sedong subdistrict, Cirebon Regency) in West Java Province. These locations were selected because they represent major production centers of Gedong and Gedong Gincu mangoes, featuring agroecosystem characteristics typical of key mango-growing areas in the region. Additionally, these sites have established marketing linkages with actors in the supply chain serving modern markets.

Exploratory research was also carried out in Kertajati subdistrict (Majalengka Regency) and Jatigede subdistrict (Sumedang Regency), which are considered emerging production zones. These areas were chosen to capture the dynamics of early-stage supply chain development and assess their potential to contribute to broader market integration.

The study focused on the supply and value chains oriented toward modern markets in Cirebon, Jakarta and Tangerang markets: key consumption centers with stringent product quality and continuity standards. To this end, interviews were conducted with several modern retailers known to source and market Gedong and Gedong Gincu mangoes within this area. Data collection was conducted from November 2021 to December 2022.

2.4. Data types and collection methods

This study employed a case study approach to examine the structure, coordination, and performance of the Gedong and Gedong Gincu mango supply chains in West Java, as well as their linkages to modern markets in the Greater Jakarta area. The case study method facilitated an in-depth exploration of contextual dynamics, actor roles, and supply chain processes across multiple locations.

Both primary and secondary data were utilized. Primary data were obtained through focus group discussions (FGDs), semi-structured interviews, and direct field observations. Respondents included a wide range of supply chain actors, such as farmers, farmer groups, village collectors, inter-regional traders, suppliers, wholesalers, retailers, modern retailers, and end consumers. Primary market destinations included Cirebon, Jakarta, and Tangerang. Secondary data were collected from published research, statistical reports, and official documents issued by relevant government agencies, including

the Agricultural Offices of Indramayu and other regencies, Statistics Indonesia (BPS), and other supporting institutions.

To identify relevant respondents across the supply chain, the study employed a snowball sampling technique, starting from key informants such as lead farmers or core traders, who then referred other actors within the supply chain. This method was effective in tracing informal and undocumented relationships. However, snowball sampling carries the risk of selection bias, as it may overrepresent well-connected individuals and underrepresent marginal or less-visible actors. To enhance coverage, purposive and stratified sampling were also applied based on actor roles.

This study relied on cross-sectional data collected during 2021–2022, which reflects a snapshot in time. Thus, findings may not fully capture seasonal or long-term variations. Future research using time-series data is recommended for dynamic analysis.

Sampling was conducted in four key production areas: Indramayu and Cirebon Regencies (major production centers) and Sumedang and Majalengka Regencies (emerging mango-producing areas), as well as in the urban markets of Jakarta and Tangerang, which represent critical downstream destinations. Stratification was based on actor roles in the Gedong and Gedong mango supply chain, which included farmer groups, village collectors, large-scale traders/inter-regional traders, suppliers, wholesalers, retailers/outlets, modern retailers, provincial/regency agricultural offices, researchers from the Indonesian Agricultural Research and Development Agency (IAARD), and representatives from the Directorate General of Horticulture, Ministry of Agriculture.

A total of 64 respondents were proportionally selected across the supply chain based on their strategic roles and locations within the Gedong mango supply chain and marketing system. In Jakarta and Tangerang, the focus was on downstream actors, including modern retailers and central government institutions, to capture insights on policies and programs. Sampling distribution is summarized in Table 1.

Table 1. Distribution and number of respondents across locations and actor categories, 2021-2022

Description	Indramayu	Cirebon	Sumedang	Majalengka	Jakarta, Tangerang	Total
1. Farmer group	4	4	2	2	-	12
2. Village collector	2	2	1	1	-	6
3. Large-scale trader/inter-regional trader	2	2	1	1	-	6
4. Supplier/distributor	2	2	1	1	-	6
5. Wholesaler	1	1	1	1	2	6
6. Retailer/outlet	2	2	1	1	4	10
7. Supermarket/hypermarket	-	1	-	-	5	6
8. Agricultural Offices at provincial/regency/subdistrict levels	2	2	1	1	-	6
9. Indonesian Agency for Agriculture Research and Development (IAARD)	-	-	-	-	3	3
10. DG of Horticulture	-	-	-	-	3	3
Total	15	16	11	11	17	64

Several focus group discussions (FGDs) were conducted to capture perceptions and experiences of supply chain actors: 10 farmers and five collectors in Krasak Village, Indramayu; 10 farmers and five traders in Pawidean Village, Indramayu; and 15 farmers and five traders in Sedong Lor Village, Cirebon. These FGDs were complemented by in-depth interviews with three inter-regional wholesalers supplying modern retail chains, and six modern retailers (three in Jakarta, one in Cirebon, and two in Tangerang).

The combination of quantitative and qualitative data collection supported a mixed-methods approach to data analysis, which included assessing farm share, marketing margins, and value added, as well as examining actor roles, interaction patterns, and supply chain coordination mechanisms.

2.5. Data analysis

This study employed both quantitative and qualitative descriptive approaches to analyze supply chain dynamics, actor specific roles, and marketing performance in the Gedong and Gedong Gincu mango chains. The analysis included mapping actor roles along the supply chain, from farmers to modern retailers, supported by spatial data and supply volume shares.

To assess marketing efficiency, the farmer's market share (farm share) was calculated by comparing the farm-gate price to the final retail price. A higher farm share indicates more efficient marketing, while a lower share suggests inefficiencies (Rosmawati 2011).

$$FS = \frac{P_f}{P_r} * \% \quad (1)$$

where *FS* represents farmers' share (%), P_f denotes the farm-gate price (IDR/kg), and P_r indicates the price at the distributor/retailer level (IDR/kg).

Marketing margin analysis was conducted to assess the difference between the retail price and the price received by producers, capturing both marketing costs and intermediary profits (Saptana and Rahman 2015; Qadri 2018). Profit margins were also evaluated as the proportion of profit earned by each actor relative to the final selling price.

$$PM = Pr - Pf \quad (2)$$

where *PM* is the marketing margin (IDR/kg).

Marketing margin encompasses all marketing costs incurred by market intermediaries and the profits they earn from the farmer to the consumer. The mathematical formula used is as follows:

$$M = \sum_{i=1}^{m} C_i + \sum_{j=1}^{m} \pi_i \quad (3)$$

where *M* is the marketing margin, C_i represents the *i*th marketing cost (*i* = 1, 2, 3, …, *m*), where m denotes the number of cost types, *j* represents the *j*th marketing actor (*j* = 1, 2, 3, …, *n*), and π_i denotes the profit earned by the marketing actor. Additionally, a profit margin analysis was conducted, expressed as a percentage by dividing the profit by the selling price, using the following formula:

$$\pi M = \frac{\pi_i}{Pr} * 100 \quad (2)$$

where πM is the profit margin (%), π_i is the profit margin of each trade actor, and Pr is the retail price.

Value that is added was analyzed using the framework proposed by Smith et al. (2022), Sahara et al. (2019), and Wallace and Randal (2021), which goes beyond traditional price-based value added. This concept captures not only the price spread between actors but also the contribution of each actor to enhancing product quality, branding, packaging, service, and sustainability, which are key aspects valued by modern market consumers. Mathematically, the *value that is added* can be expressed using the following formula (Smith et al. 2022):

$$VtA_i = P_i - P_{i-1} \quad (3)$$

where VtA_i is the *value that is added* by actor *i*, P_i is the selling price of the product by actor *i*, and P_{i-1} is the purchase price of the product by the previous actor (*i*−*1*).

This study does not adopt the Hayami (1987) approach but instead emphasizes perceived value creation at each stage of the chain as a more market-responsive measure of competitiveness and consumer appeal.

3. Results and discussion

3.1. Market prospects and challenges for Gedong and Gedong Gincu mangoes in modern markets

Indonesia's national fruit production has increased at an average annual rate of approximately 9% between 2016 and 2020, driven by population growth, rising income levels, and greater public awareness of the health benefits of consuming fruits and vegetables. In line with the global healthy living movement, a 2024 survey reported that 70% of Indonesian respondents actively seek healthier food options, citing freshness and natural ingredients as key factors in food choices (Haryono 2024). National

dietary campaigns such as "*Isi Piringku*" also advocate for a balanced diet, recommending that fruits and vegetables make up at least half of every meal, which reinforces public health messaging (Ariani et al. 2018). These trends indicate a structural shift in consumer behavior, opening policy opportunities to support fruit value chain upgrading.

Mango production was specifically targeted to reach 2.7 million tons in 2020 and is projected to grow to 3.4 million tons by 2024, reflecting an annual growth rate of 5.01% (Kementan 2020). In West Java, total mango production reached 438,295 tons in 2023 (BPS 2024), with the Gedong mango variety estimated to contribute 30–35% of this total. Despite this production growth, per capita fruit consumption in Indonesia remains below the global average. While the FAO (2021) reported a global average fruit consumption of 65.75 kg per capita annually, Indonesia's average stands at only 40 kg. This suggests substantial untapped domestic potential, particularly for premium-quality fruit. The shift in consumer preferences toward high-value, nutrient-rich commodities presents an opportunity to revitalize the tropical fruit sector, including mangoes, through the concept of the "value ladder" (Saptana et al. 2018; Saptana 2020). However, Indonesia faces structural challenges in the marketing and trade of fruits. In 2018, the country recorded a trade deficit of USD 18.6 billion, equivalent to IDR 260 trillion, including a significant fruit import bill of IDR 15 trillion (Kiloes and Puspitasari 2019). Without strengthening local production and market access, this deficit may widen due to rising fruit imports.

Gedong and Gedong Gincu mangoes are considered premium tropical fruit commodities, with increasing demand in both domestic modern retail and export markets (Andayani et al. 2016; Roni et al. 2022). However, mango exports remain unsustainable due to various risks within the supply chain (Maulida et al, 2022). Capitalizing on such opportunities remains difficult due to constraints in production consistency, quality, and supply chain infrastructure. Empirical findings indicate a lack of quality management and product standardization in the mango supply chain. Most farmers perform only basic sorting and grading, often delegated to small-scale aggregators in traditional markets. Key constraints include limited human resource capacity, weak farmer institutions, low community engagement, and minimal gender participation—factors that hinder effective and inclusive supply chain management.

Consumer preferences are central to value creation. Kiloes and Puspitasari (2019) found that freshness is the most important attribute influencing fruit purchases, followed by taste, price, color, texture, aroma, and size. Similarly, Putrinda et al. (2017) identified sweetness, orange-red skin color, soft flesh, and medium fruit size (200–300g) as preferred characteristics for Gedong Gincu mangoes. These traits closely mirror the strict standards of modern retailers.

Despite this alignment, market access remains limited. In Indramayu and Cirebon, farmer groups have remained disconnected from modern retail networks such as AEON, All Fresh, Yogya Group, and Total Buah Segar. The case of the Angling Darma Farmer Group in Indramayu highlights these limitations. Although interest was expressed by AEON to source directly from farmers, the group was difficult to meet requirements for fruit size, appearance, and consistent supply. Mangoes were expected to weigh 200–300 grams, have a uniform red blush, and minimal defects. However, 15.7% of the group's initial shipments were rejected due to anthracnose and poor skin coloration.

The financial burden of upfront costs, coupled with delayed payment terms, proved unsustainable. Groups also lacked skilled personnel to handle procurement processes and retailer engagement. Institutional weaknesses, such as informal governance structures, minimal contract negotiation experience, and centralized leadership, undermine group bargaining power. As a result, most farmers remain reliant on middlemen, losing access to higher margins and long-term retail partnerships.

In Sumedang, a trader supplied mangoes to a modern retailer (AEON), but discontinued the relationship after one shipment. Although the offered price was attractive at IDR 45,000/kg, the quality standards were stringent and difficult to meet, particularly during the off-season when Gedong Gincu mangoes were scarce. Consequently, the trader chose to supply the main wholesale market instead, which offered higher volumes and more flexible quality requirements. These case examples illustrate how quality inconsistency and operational constraints create bottlenecks in accessing modern markets.

The core issue is the inability of the supply chain to consistently deliver diverse, high-quality, and continuous volumes tailored to modern consumer preferences. Multiple studies and field-based observations confirm that supply chain fragmentation, inadequate infrastructure, and institutional weaknesses are key barriers to integration into premium markets (De Faveri et al. 2016; FAO 2021; Smith et al. 2022).

To address these challenges, policy interventions must be prioritized, including farmer capacity building, inclusive supply chain partnerships, and better access to finance and infrastructure. These directions align with the Ministry of Agriculture's policy on Agricultural Zone Development (Permentan No. 03/2024), which promotes innovation, competitiveness, and sustainable value chains. Strengthening Gedong and Gedong Gincu mango supply chains will require targeted investments in postharvest handling, certification, and institutional support. Doing so would not only increase competitiveness in modern markets but also enhance farmer welfare and rural livelihoods.

3.2. The structure and characteristics of the supply chain for Gedong and Gedong Gincu mangoes

The supply chain for Gedong and Gedong Gincu mangoes in West Java, particularly in Indramayu and Cirebon, is multitiered, involving farmers, village-level collectors, inter-regional traders, and specialized suppliers. This category of supply chain actor has been similarly identified in various international contexts, as evidenced by multiple studies (Alam 2018; Badar et al. 2019; Musyoka et al. 2020; Teyung and Luitel 2023). Farmers sell generally operate under a non-contractual, open-market system, selling to various intermediaries, who distribute the mangoes to traditional or modern markets. Field observations reveal that postharvest handling practices vary by destination: local and traditional markets apply minimal and inconsistent standard operating procedures (SOPs), while modern markets, particularly those sourcing from large-scale or progressive farmers, impose stricter handling and quality standards.

Grade A and AB Gedong Gincu mangoes, those meeting modern retail standards for size, color, and appearance, are typically sold to suppliers who serve supermarkets and hypermarkets. Mangoes that do not meet these specifications, whether due to blemishes, irregular size, or suboptimal ripeness, are diverted to traditional markets or sold through roadside vendors in urban and suburban areas. In contrast, Gedong mangoes, which are often harvested at an earlier maturity stage, are primarily sold through traditional marketing channels by collectors and wholesalers.

Specialized suppliers play a critical role in connecting farmers to modern retail outlets. In the local markets of Cirebon, Majalengka, Kuningan, and Indramayu, retailers such as Junction Fresh, Grand Yogya, Transmart, Lotte Mart, and Giant are among the regular buyers. In larger urban centers such as Jakarta, Bogor, Depok, Tangerang, Cirebon, and Bandung, certain suppliers cater to high-end markets. For example, one supplier in Cirebon reported distributing to three modern outlets in Jakarta: All Fresh (Gatot Subroto), Capital Fruits (Pejompongan), and Total Buah Segar (Warung Buncit). All the supplied mangoes are of the Gedong Gincu type and are categorized as Grade A. Each supplier has distinct sourcing patterns and distribution routes based on long-term partnerships and their ability to consistently meet volume and quality requirements.

Empirical data indicate that approximately 50% of mangoes first pass through small-scale collectors, 30% through inter-regional wholesalers, and 20% go directly to retailers or fruit vendors. Among the mangoes handled by small-scale collectors, about 40% are sold to traditional markets, another 40% are transferred to inter-regional wholesalers, and the remaining 20% are supplied to modern market-focused suppliers. These suppliers often supplement their procurement by sourcing from wholesalers to ensure sufficient volume for their retail clients.

Product specifications for Gedong Gincu mangoes destined for modern markets vary slightly by retailer. Mid-tier supermarkets typically accept fruit weighing between 180–250 grams, while premium outlets prefer sizes in the 250–350 gram range. Common quality requirements include a predominantly green skin with a reddish blush at the base (indicating at least 85% ripeness), no defects or signs of rot, uniform shape, and a clean surface free of sap stains or soil. The fruit should also exhibit firmness and freshness to meet shelf-life and handling standards.

Although modern retail channels offer higher returns, many farmers face persistent barriers to entry, such as difficulty meeting quality standards, inconsistent production volumes, and limited access to postharvest handling facilities. As a result, most producers continue to rely on traditional intermediaries who offer easier transactions, immediate payments, and more flexible grading. While the structural pathway to modern market integration exists, it remains underutilized by the majority of Gedong and Gedong Gincu mango farmers. As illustrated in Figure 2, this section has outlined the structure and actor relationships of the Gedong and Gedong Gincu mango supply chains, highlighting their segmentation, flow patterns, and quality-driven differentiation, which are essential to understanding how these systems function in both traditional and modern market contexts.

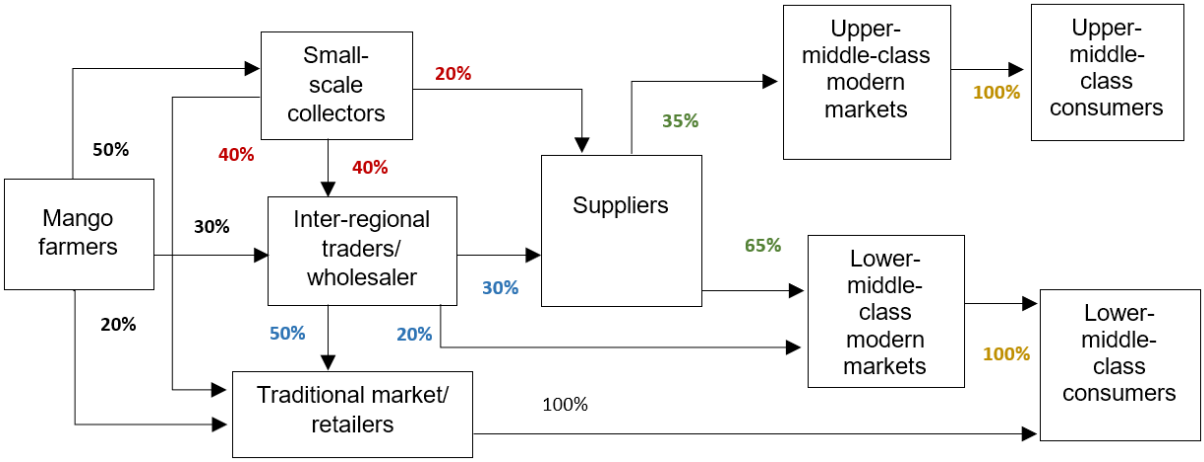

Figure 2. Supply chain of Gedong and Gedong Gincu mangoes for modern markets (supermarkets/hypermarkets)

3.3. Value chain and value that is added of Gedong and Gedong Gincu mangoes

Figures 3 and 4 depict the value chain structures for Gedong and Gedong Gincu mangoes in key producing regencies in West Java: Indramayu, Cirebon, Majalengka, and Sumedang. For Gedong mangoes, modern retailers capture the highest value that is added, amounting to IDR 6,000 per kilogram. This is followed by suppliers and farmer groups or collectors, who contribute IDR 4,250 per kilogram, and then by wholesalers/inter-regional traders at IDR 3,750 per kilogram. In the case of Gedong Gincu mangoes, supermarkets and hypermarkets retain the largest share of value that is added, at IDR 6,500 per kilogram. Large-scale collectors and inter-regional wholesalers each contribute IDR 5,000 per kilogram, while village-level collectors account for IDR 4,500 per kilogram. This aligns with Alam's (2018) study in Bangladesh, which found that retailers captured the largest share of value added. In contrast, Chay et al. (2019) in Ethiopia reported that farmers received the highest portion of value added, accounting for 64%. While the per-unit value created by downstream actors is higher, wholesalers and traders earn substantial overall profits due to the high volume of trading they manage.

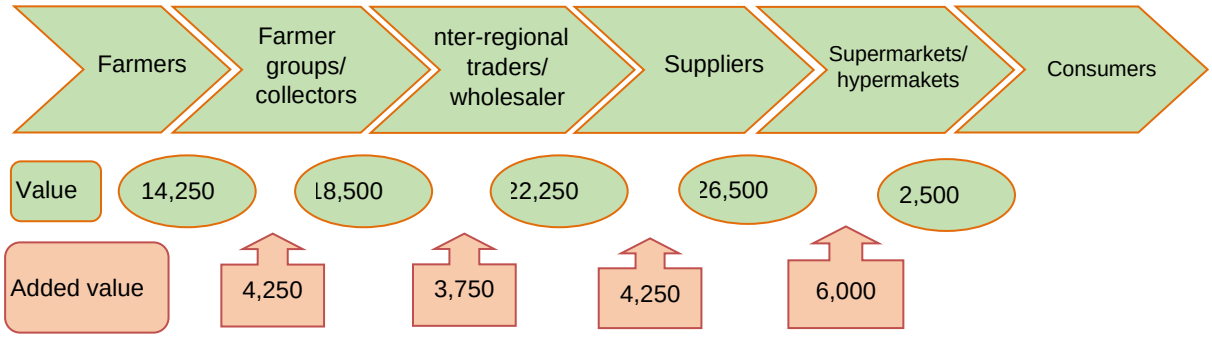

Figure 3. Gedong mango value chain in upper-middle-class retail

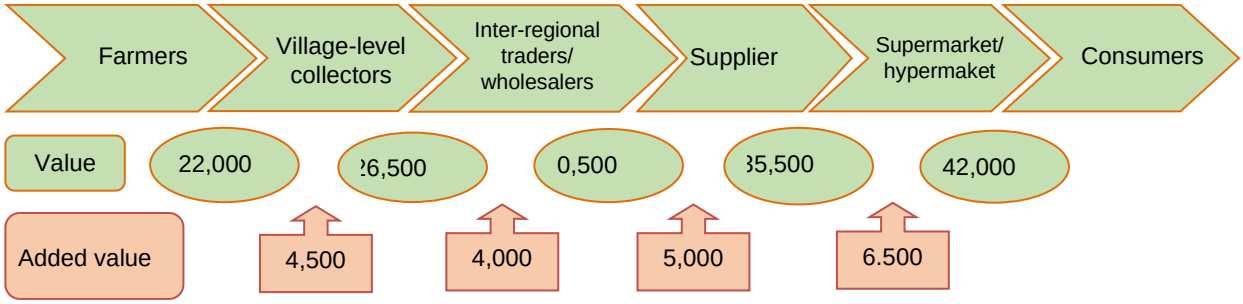

Figure 4. Gedong Gincu mango value chain in upper-middle-class retail

These findings highlight the downstream concentration of value creation in the mango supply chain. Modern retailers dominate value addition due to their control over product presentation, including grading, labeling, attractive packaging, branding, and customer service, all of which appeal to middle- and upper-income consumers. Upstream actors, particularly smallholder farmers and village-level collectors, capture a relatively smaller portion of total value added, despite being central to the production process. The study by Musyoka et al (2020) in Kenya indicated that only 33.52% of farmers added value to their mangos. Field evidence confirms that these upstream actors often lack the capacity to meet modern retail specifications, including consistent supply, minimum quality standards, and advanced postharvest handling.

The implications of this value distribution are critical. Smallholders' limited ability to capture higher value reduces their incentives and capacity to improve quality, adopt postharvest innovations, or participate in formal supply contracts. Instead, they remain dependent on traditional marketing channels, which offer lower and more volatile returns. The relatively low share of value added received by farmers and village collectors indicates structural inefficiencies in the chain that constrain inclusive growth and long-term competitiveness. For example, although Gedong Gincu mangoes demonstrate a higher farmer share (52.38%) than Gedong mangoes (43.85%), both figures remain lower than the 65.22% reported by Suhaeni et al. (2015) in traditional markets, underscoring the challenges of equitably integrating smallholders into modern supply chains.

These findings are consistent with previous studies. Smith et al. (2012) and Wallace and Randall (2021) emphasize that value chains often disadvantage upstream actors unless mechanisms are in place to support inclusive upgrading. Fernandez-Stark et al. (2017) found that supermarkets and exporters in the Philippine mango sector captured the majority of value through product standardization, branding, and quality control, a trend similar to that observed in West Java. Meanwhile, Ningsih et al. (2024) note that digital marketing can increase farmer access to high-value markets, but adoption remains limited due to weak institutional capacity, infrastructure gaps, and market readiness. This underscores the importance of strengthening farmer organizations and investing in postharvest systems, digital tools, and inclusive supply chain governance.

The results of this value chain analysis reveal a clear asymmetry in value distribution, with downstream actors benefiting most. This condition is in accordance with a study by Muftiadi et al. (2023) in the Sumedang Regency, showing that there is an imbalance in the distribution of the value chain in the Gedong Gincu mango supply chain. Addressing this imbalance requires targeted interventions to enable smallholder participation in value creation through better access to infrastructure, market information, certification, and buyer partnerships. Without such efforts, the integration of Gedong and Gedong Gincu mangoes into high-value markets will remain fragmented, limiting both farmer income and the broader potential of Indonesia’s mango sector.

3.4. Marketing margins of Gedong and Gedong Gincu mangoes

The analysis of marketing margins provides critical insights into the distribution of costs and profits among supply chain actors from the point of production to the final consumer. Based on data collected from the field and presented in Table 2, the marketing chains for both Gedong and Gedong Gincu mangoes involve multiple intermediaries, including farmers, village collectors, inter-regional wholesalers, major suppliers, and modern retailers. Each actor adds a certain cost and derives a margin that collectively shapes the final retail price.

For Gedong mangoes, the total marketing margin—from the farm gate to the supermarket shelf—amounts to IDR 18,250 per kilogram. Modern retailers capture the largest share of profit, reaching IDR 4,800 per kilogram or 14.77% of the retail price. This is followed by suppliers at IDR 3,125/kg (9.62%), village collectors at IDR 3,075/kg (9.46%), and inter-regional wholesalers at IDR 2,425/kg (7.46%). Retailers located farther from production areas tend to have higher marketing margins. This pattern aligns with findings by Shrestha et al. (2020), who reported that distant markets in Nepal had significantly larger margins (NPR 55.18) compared to nearby ones (NPR 30.18). Marketing costs are relatively consistent across actors, with village collectors incurring 3.62% and inter-regional wholesalers 4.08% of the retail price. The farmer’s share stands at 43.85%, which is below the efficiency threshold typically cited in the literature.

Table 2. Marketing margins of Gedong and Gedong Gincu mangoes from West Java for modern markets, 2021

Actor	Components of cost and price	Gedong mango		Gedong Gincu mango	
		(IDR/kg)	(%)	(IDR/kg)	(%)
1. Farmers	- Selling price	14,250	43.85	22,000	52.38
2. Village collectors	- Buying price	14,250	43.85	22,000	52.38
	- Transportation	650	2.00	800	1.90
	- Loading and unloading	225	0.69	250	0.60
	- Handling and packaging	100	0.31	100	0.24
	- Storage	100	0.31	100	0.24
	- Parking & retribution	50	0.15	50	0.12
	- Rental space	50	0.15	50	0.12
	- Others (shrinkage, damaged)	50	0.15	60	0.14
	- Marketing cost	1,225	3.62	1,390	3.33
	- Profit margin	3,025	9.46	3,100	7.05
	- Selling price	18,500	56.92	26,500	63.10
3. Inter-regional traders/ wholesaler	- Buying price	18,500	56.92	26,500	63.10
	- Transportation	850	2.62	1,000	2.38
	- Loading and unloading	150	0.46	150	0.36
	- Handling and packaging	100	0.31	100	0.24
	- Storage	100	0.31	100	0.24
	- Parking & retribution	50	0.15	50	0.12
	- Rental space	25	0.08	25	0.06
	- Others (shrinkage, damaged)	50	0.15	50	0.12
	- Marketing cost	1,325	4.08	1,475	3.51
	- Profit margin	2,425	7.46	2,525	6.01
	- Selling price	22,250	68.46	30,500	72.62
4. Supplier	- Buying price	22,250	68.46	30,500	72.62
	- Transportation	650	2.00	800	1.90
	- Loading and unloading	150	0.46	150	0.36
	- Handling and packaging	125	0.38	125	0.30
	- Storage	100	0.31	100	0.24
	- Parking & retribution	25	0.08	25	0.06
	- Rental space	25	0.08	25	0.06
	- Others (shrinkage, damaged)	50	0.15	50	0.12
	- Marketing cost	1,125	3.46	1,275	3,04
	- Profit margin	3,125	9.62	3,725	8.87
	- Selling price	26,500	81.54	35,500	84.52
5. Modern retailers (supermarket/ hypermarket)	- Buying price	26,500	81.54	35,500	84.52
	- Loading and unloading	150	0.46	200	0.48
	- Porter	800	2.46	1,000	2.38
	- Handling and packaging	100	0.31	125	0.30
	- Storage	50	0.15	50	0.12
	- Retribution	25	0.08	25	0.06
	- Rental space	25	0.08	25	0.06
	- Others (shrinkage, damaged)	50	0.15	50	0.12
	- Marketing cost	1,200	3.69	1,475	3.51
	- Profit margin	4,800	14.77	5,025	11.96
	- Selling price	32,500	100.00	42,000	100.00

In the case of Gedong Gincu mangoes, the total marketing margin is higher, at IDR 20,000 per kilogram. Profit margins follow a similar pattern: modern retailers earn IDR 5,025/kg (11.96%), wholesalers IDR 3,725/kg (8.87%), village collectors IDR 3,150/kg (7.05%), and inter-regional wholesalers IDR 2,525/kg (6.01%). The marketing cost shares range between 3.33% and 3.51%. Farmers receive 52.38% of the final retail price, which is significantly higher than that for Gedong mangoes.

These findings suggest that Gedong Gincu mangoes are marketed more efficiently than Gedong mangoes, at least in terms of the farmer's share. This interpretation is supported by Rosmawati (2011), who states that a higher farmer share indicates greater efficiency and more equitable distribution of value. Similarly, Suhaeni et al. (2015) reported that farmers' shares above 60% are associated with simplified chains and fewer intermediaries. Roni et al. (2022) also indicate that the marketing of Gedong Gincu mangoes is considered efficient, with an efficiency value of less than 1. Although the current figures fall short of that benchmark, the relative difference between the two mango types is notable and reflects stronger market alignment and price realization for Gedong Gincu.

Empirical evidence from the case of Angling Darma Farmer Group in Indramayu Regency supports this interpretation. It documents that suppliers to modern retailers are often required to provide mangoes daily while receiving payments only after 15 to 30 days, creating significant working capital pressure. To manage this, some suppliers form financing partnerships with external investors through profit-sharing schemes. Moreover, suppliers bear substantial quality risk. These quality-related losses reduce profitability and underscore the need for improved coordination and technical capacity across the chain.

Improving marketing efficiency in the Gedong and Gedong Gincu supply chains requires strengthened vertical linkages and better information sharing among supply chain actors. Retailers and suppliers should routinely communicate changing market preferences and quality standards to producers, allowing upstream actors to adjust their practices and meet expectations. At the same time, farmers need support in adopting improved harvesting, postharvest handling, and packaging techniques to reduce rejection rates and enhance value capture.

The role of modern retailers as dominant value holders aligns with previous findings by Wallace and Randall (2021) and Smith et al. (2022), who emphasize that actors with access to consumers and control over branding and presentation tend to retain the highest margins. In this context, strategies that increase upstream participation in value-adding activities, such as collective marketing, branding, and digital promotion, are essential for more equitable and sustainable supply chains. However, as noted by Ningsih et al. (2024), the adoption of digital marketing tools among mango farmers remains limited and uneven, often hindered by infrastructure gaps and capacity constraints.

Overall, while Gedong Gincu mangoes offer a relatively more efficient marketing pathway than Gedong mangoes, both supply chains exhibit structural inefficiencies that constrain farmer income and limit broader sectoral competitiveness. A more balanced distribution of value and risk, facilitated by inclusive partnerships, improved infrastructure, and institutional support, is essential to enhance the performance and fairness of mango marketing systems in West Java.

3.5. Integrated supply chain management strategy

The Gedong and Gedong Gincu mango supply chain in West Java faces systemic constraints that hinder its competitiveness in modern markets. These include weak institutional coordination, poor postharvest practices, inconsistent supply, limited infrastructure, low digital engagement, and minimal value addition. Based on empirical findings, this section outlines seven integrated strategies to enhance the performance, sustainability, and inclusivity of the supply chain. These strategies are developed to reflect real conditions in the field and propose practical, scalable solutions.

3.5.1. Strengthening farmer group institutions for collective action

Farmer groups play a crucial role in aggregating production, negotiating with buyers, and ensuring the coordination of the supply chain. However, in many production centers, these groups remain informal, poorly organized, and lack the capacity to engage in commercial partnerships. Strengthening the institutional structure of farmer groups, by formalizing their legal status, improving internal governance, and enhancing leadership capacity, is essential for enabling collective marketing and building trust with buyers. Training in basic management, finance, and contract negotiation will enable groups to operate more professionally and enhance their role in supply chain decision-making. Special efforts are needed

to foster the active participation of women and youth in leadership roles, thereby contributing to innovation, equity, and long-term resilience.

3.5.2. Improving product quality standardization and postharvest handling

Meeting the quality expectations of modern retailers remains a challenge for many smallholder mango producers. Empirical evidence from the field shows that product rejection rates are high, often due to inadequate to meet a prerequisite for market acceptance. However, farmers need support to implement these standards effectively. This includes practical training on harvesting at the right maturity, postharvest handling techniques, and the use of simple tools and facilities such as crates, shade covers, and ripening racks. Improving postharvest practices at the group level will reduce losses, increase compliance with buyer specifications, and enhance overall value capture in the supply chain.

3.5.3. Ensuring continuity of supply through coordinated production and contract farming

The seasonal and fragmented nature of mango production makes it challenging for farmer groups to consistently supply modern markets. Buyers, however, expect reliability in volume and delivery schedules. To address this gap, farmer groups need to coordinate production planning across members. This includes synchronizing planting and harvesting schedules, as well as selecting suitable varieties for staggered harvests. Contract farming can play a pivotal role in aligning production with market needs by establishing clear expectations between producers and buyers regarding volume, quality, and timing. When backed by technical support and mutual commitment, such contracts can reduce market uncertainty and improve farmer access to stable, higher-value sales channels.

3.5.4. Expanding cold chain and transport infrastructure

One of the main causes of postharvest losses and quality degradation is the absence of reliable cold storage and transportation systems. Most smallholder farmers lack access to cooling facilities or appropriate vehicles for transporting fruit over longer distances. To overcome this barrier, investment is needed in village-level or cooperative-based cold storage, grading stations, and packing houses. Shared-use facilities managed by farmer groups or local enterprises can offer economies of scale and improve supply chain efficiency. Partnerships with logistics providers and retailers can also help address infrastructure gaps. Facilitating access to affordable credit or equipment rental schemes will enable farmer groups to make incremental improvements that preserve product quality and reduce waste.

3.5.5. Promoting written contracts to improve market coordination

In the current supply chain, transactions are dominated by verbal agreements that often lack clarity and enforcement mechanisms. This creates risks for both producers and buyers, particularly in cases of price fluctuation, delivery delays, or quality disputes. Encouraging the use of written contracts can help formalize relationships, define roles and responsibilities, and improve transparency. A good contract should include provisions on product specifications, pricing, payment terms, delivery schedules, and penalties for non-compliance. Farmer groups may need assistance in understanding contract terms, drafting agreements, and resolving disputes. Providing access to contract literacy training and legal advisory services can facilitate the adoption of fair and balanced agreements.

3.5.6. Enhancing access to market information and digital technologies

A persistent constraint in the Gedong mango supply chain is the limited access of farmers to timely and accurate market information. Many rely on middlemen for price updates and lack direct links to buyers. Introducing low-cost information systems, such as mobile applications, SMS-based price alerts, or WhatsApp groups, can bridge this gap. These platforms can provide real-time data on prices, demand trends, quality standards, and contact information for buyers. Additionally, digital literacy programs targeting young farmers and group administrators can help accelerate the adoption of e-commerce tools and online marketing channels. Improved access to information not only strengthens negotiation capacity but also allows farmers to respond more effectively to dynamic consumer preferences.

3.5.7. Encouraging value addition and product innovation

Gedong and Gedong Gincu mangoes are mostly sold fresh, with limited processing into value-added products. During peak harvests, oversupply leads to price drops and unsold fruit. Small-scale processing, such as juice, dried mango, mango cake (*dodol*) or pickles, can absorb surplus, create

added value, raise farmer income, and expand market reach. In some areas, women and young farmers have started home-based processing, which should be supported through training, equipment access, and simplified certification.

These seven strategies form a practical framework to strengthen the mango value chain in West Java by addressing key constraints. While adaptable to local contexts, their collective impact will be greater with coordinated implementation and stakeholder collaboration.

4. Conclusions and policy implications

4.1. Conclusions

This study highlights that the supply and value chains for Gedong and Gedong Gincu mangoes from West Java to modern markets have significant potential but face various challenges, particularly in terms of technical, socio-economic, institutional, and policy-related factors. Key issues include low quality standards, limited access to modern markets for farmers, inefficient distribution and marketing systems, and unfair profit distribution.

The supply chain for Gedong and Gedong Gincu mangoes involves multiple stakeholders and diverse marketing channels. Strengthening the institutional capacities of farmer groups, enhancing efficient distribution systems, and integrating modern market access are essential for improving the overall performance of the supply chain. By consolidating and formalizing partnerships, farmers can reduce inefficiencies and increase their competitiveness in modern markets.

The value chain analysis reveals that Gedong and Gedong Gincu mangoes generate added value through marketing, services, and profits at various stages. Supermarkets and hypermarkets capture the highest marketing margins, highlighting the need for farmers to focus on producing high-quality mangoes to meet modern market standards. Furthermore, Gedong Gincu mangoes provide a higher farmer's share compared to Gedong mangoes, indicating greater potential for value creation at the farm level.

Modern markets offer significant opportunities for farmers by providing better pricing and increased payment certainty, especially through contractual agreements. Direct marketing from farmer groups to modern markets helps eliminate unnecessary intermediaries, improving efficiency. Strengthening partnerships between farmer groups and modern markets is essential for enhancing value addition and ensuring a fairer distribution of marketing margins, ultimately supporting sustainable and competitive growth for Gedong and Gedong Gincu mangoes in the modern market space.

The most effective strategy to improve the sustainability of supply and farmers' access to modern markets is to build direct partnerships between farmers and modern retailers through cooperatives or farmer groups. Integrated supply chain approaches such as contract farming, the application of ICT for market information, and traceability systems have also been proven to strengthen the position of farmers and maintain continuity of supply according to modern market standards.

4.2. Policy implications

This study identifies key policy directions to strengthen the supply and value chains of Gedong and Gedong Gincu mangoes. The proposed strategies include enhancing the institutional capacity of farmer groups, improving postharvest handling and packaging, ensuring consistent product quality, and facilitating greater access to modern markets. Integrating supply chain and value chain concepts through inclusive business partnerships is essential. Strengthening collaboration between farmer groups and modern retailers will help improve efficiency, sustainability, and farmer welfare while enhancing the competitiveness of Gedong and Gedong Gincu mangoes.

In the short term (within the next 1–2 years), several priority programs can be implemented. These include capacity building and training for farmer groups, extension workers, and facilitators on integrated supply chain approaches; support for basic postharvest infrastructure; facilitation of market linkages; and institutional strengthening through initial grants or revolving funds to support farmer group operations. Additionally, simple grading standards should be developed, and local branding and labelling initiatives for Gedong and Gedong Gincu mangoes should be introduced to enhance product identity and marketability.

In the longer term (over the next 3–10 years), investment in integrated value chain infrastructure, such as cold storage facilities, logistics systems, and refrigerated transportation, is necessary.

Sustainable business models should be promoted by supporting long-term contractual agreements between farmer groups and buyers and encouraging cooperative or farmer-owned agribusiness enterprises. At the regulatory level, policies should provide incentives for contract farming, farmer–market partnerships, and fair trade practices, while also ensuring compliance with national and international food safety and traceability standards. Furthermore, research and innovation should be supported, particularly on consumer preferences, export potential, and the digitalization of supply chain functions. Digital platforms can increase transparency, improve traceability, and facilitate better access to market information and pricing.

Operationally, formal written contracts between farmer groups and modern markets are critical. These agreements should specify the quantity, quality, and delivery schedule of mangoes, along with payment systems and dispute resolution mechanisms. Farmers must guarantee supply continuity and product quality, while modern retailers must commit to timely payments and transparent procurement practices. Establishing such contracts can foster mutually beneficial partnerships and reduce transaction uncertainty.

Further support should include public and private investments in cold chain infrastructure and transportation systems to minimize postharvest losses and maintain fruit quality. The development of digital platforms or mobile applications that connect producers with modern markets and provide real-time price and demand information is also essential. Farmer training programs focused on Good Agricultural Practices (GAP), pest and disease management (particularly fruit fly control), and quality assurance are needed to align production with modern retail standards and enhance competitiveness.

The government can incentivize supply chain actors, including farmers, traders, suppliers, and retailers, to engage in upstream–downstream coordination through targeted fiscal measures and access to financing instruments such as the People's Business Credit (KUR). These efforts will encourage investment in essential supply chain functions such as sorting, grading, and packaging. Finally, establishing traceability and certification systems for Gedong and Gedong Gincu mangoes will improve transparency, build consumer trust, and support branding efforts. Regular monitoring and evaluation of supply chain performance and sustainability will be essential to ensure long-term market integration and value capture for smallholder farmers.

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