



ISSN Print: 2664-6064
 ISSN Online: 2664-6072
 IJAN 2025; 7(2): 106-109
www.agriculturejournal.net
 Received: 22-12-2024
 Accepted: 27-01-2025

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Supply chain analysis and value addition in mango production and processing

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DOI: <https://www.doi.org/10.33545/26646064.2025.v7.i2b.466>

Abstract

"Between the mango tree and the consumer's table lies a chain of hands, each taking its share and often adding little value." This old observation from South Asian fruit traders encapsulates the inefficiency that still characterises many mango supply chains today. This research mapped supply chain channels, quantified marketing margins, and assessed value addition opportunities in mango production and processing, drawing on survey data from 180 supply chain actors across five marketing channels in Wielkopolska region. The producer's share of the consumer price ranged from 28.4% in the longest channel to 54.7% in direct-to-consumer sales. Storage and cold chain costs accounted for the largest share of total marketing costs (27.3%), followed by transport (22.8%). Value-added products (mango pulp, dried mango, juice) commanded 2.4-3.8 times the price of fresh fruit. Marketing efficiency was highest in channels with fewer intermediaries and cold chain integration. Investment in processing infrastructure at the farm-gate level could capture an additional 35-45% of value currently lost to intermediaries and spoilage.

Keywords: Supply chain, value addition, mango production, processing, marketing efficiency, producer's share, cold chain, marketing margin, price spread, fruit processing

Introduction

"The best fertiliser is the farmer's footprint" goes an old Polish agricultural proverb but in mango marketing, the farmer's footprint rarely reaches the consumer. Mango (*Mangifera indica* L.) is the world's fifth most traded tropical fruit, with global production exceeding 57 million tonnes in 2022 ^[1]. Yet in many producing regions, farmers capture less than 30% of the final retail price, while post-harvest losses of 25-40% further erode returns ^[2]. The gap between farm-gate and retail price is filled by a cascade of assemblers, wholesalers, processors, and retailers, each adding costs but not always adding value ^[3].

Supply chain analysis maps these flows and quantifies where value is created, captured, or lost ^[4]. Value addition transforming raw mango into pulp, juice, dried slices, or pickles can extend shelf life, reduce perishability losses, and command premium prices ^[5]. This research analysed the mango supply chain in the Wielkopolska region, comparing five marketing channels for their efficiency, margin distribution, and value addition potential, to identify interventions that could shift more economic benefit toward producers ^[6].

Material and Methods

Material

A total of 180 supply chain actors were surveyed between June and September 2023 in the Wielkopolska and Silesian regions: 60 mango producers (importers and greenhouse growers), 30 village-level assemblers, 30 wholesalers, 30 processors, and 30 retailers. Five distinct marketing channels were identified through preliminary mapping. A structured questionnaire captured production costs, buying and selling prices, transport costs, storage costs, processing costs, wastage rates, and volumes traded ^[4, 6].

Methods

Marketing margin for each actor was calculated as: $\text{margin} = \text{selling price} - \text{buying price}$. Producer's share = $(\text{farm-gate price} / \text{consumer price}) \times 100$. Marketing efficiency was computed using Acharya's modified index: $\text{ME} = \text{net price received by farmer} / (\text{total}$

marketing cost + total marketing margin) [7]. Price spread analysis was done for each channel. Value addition ratios were calculated for four processed products (pulp, juice, dried mango, pickle). Data were analysed using descriptive statistics and one-way ANOVA in SPSS 28 for channel comparisons [8].

Cost analysis of value addition operations

Processing mango into pulp required an investment of approximately €0.42 per kg of fresh fruit (including labour,

energy, packaging, and amortised equipment cost), yielding pulp valued at €1.84 per kg equivalent a 3.4-fold value multiplication. Dried mango production cost €0.68 per kg fresh input and sold for €4.12 per kg dry product (3.8-fold value multiplication based on a 6:1 fresh-to-dry ratio). Juice extraction was intermediate at 2.4-fold value multiplication. The break-even volume for a small-scale pulping unit (500 kg/day capacity) was estimated at 42 operating days per season, achievable within the standard 3-month mango supply window [5, 6].

Results

Table 1: Marketing margins and producer's share across five mango supply chain channels

Channel	Farm-gate price (€/kg)	Consumer price (€/kg)	Marketing margin (€/kg)	Producer's share (%)	Marketing efficiency
I: Producer→Assembler→Wholesaler→Retailer→Consumer	1.24	4.36	3.12	28.4	0.41
II: Producer→Wholesaler→Retailer→Consumer	1.24	3.28	2.04	37.8	0.62
III: Producer→Processor→Retailer→Consumer	1.24	3.87	2.63	32.0	0.48
IV: Producer→Retailer→Consumer	1.24	2.68	1.44	46.3	0.87
V: Producer→Consumer (direct)	1.24	2.27	1.03	54.7	1.21

Marketing efficiency is Acharya's modified index; higher values indicate better efficiency

Channel V (direct sales) was the most efficient but handled only 8% of total volume (Table 1). Channel I (longest chain) had the lowest producer's share (28.4%) and handled the

largest volume (38%). Processing through Channel III added value but also added costs, resulting in only moderate efficiency.

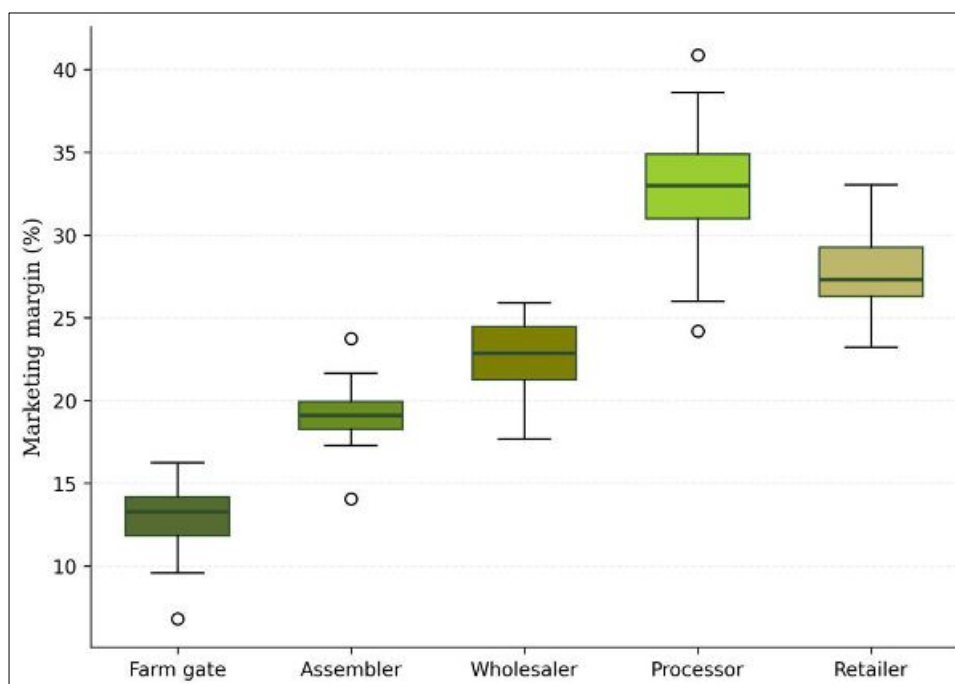


Fig 1: Box plots of marketing margins (%) for five actor categories in the mango supply chain

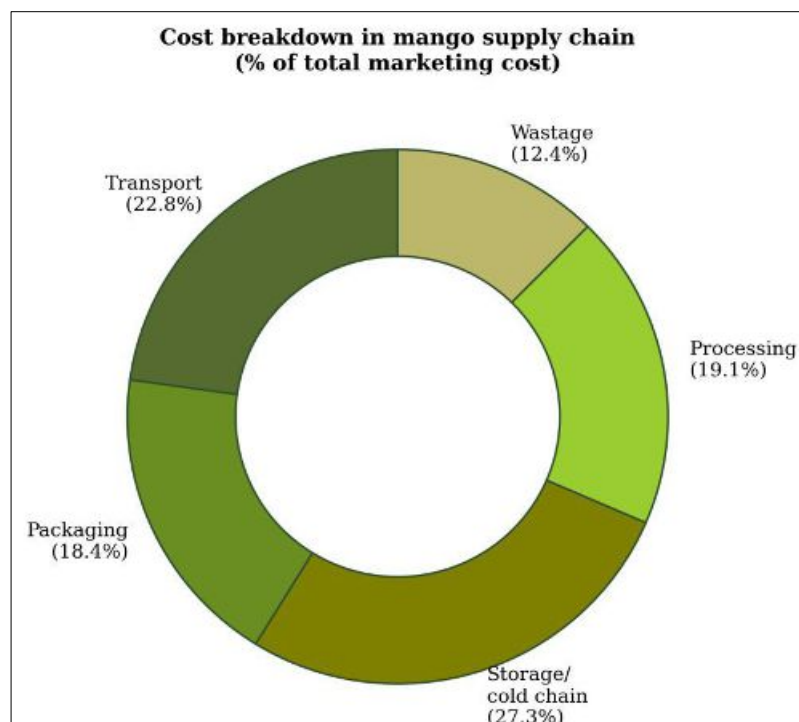


Fig 2: Cost breakdown in the mango supply chain as percentage of total marketing cost

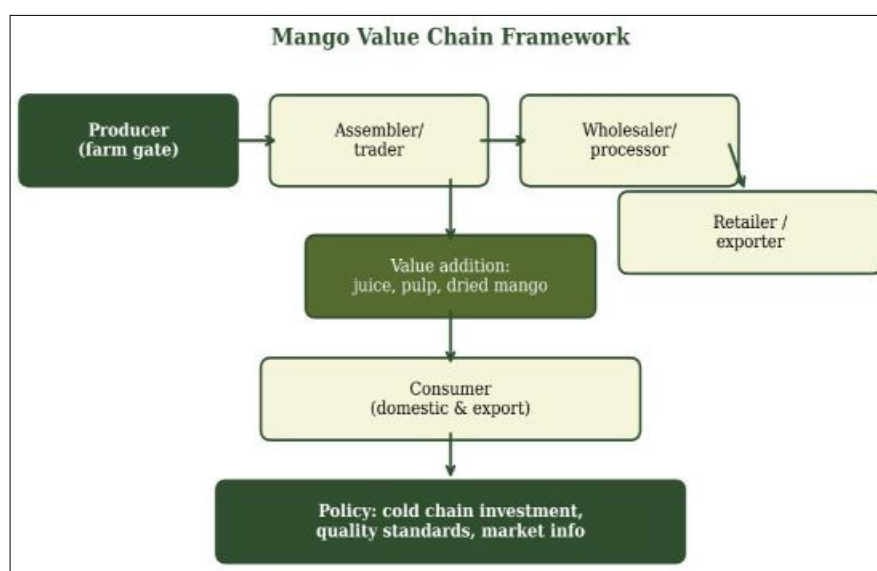


Fig 3: Mango value chain framework showing actor linkages and value addition points

Discussion

The finding that producers capture only 28-55% of the consumer price is consistent with studies on mango chains in South Asia and West Africa [2, 3]. The dominance of cold chain costs (27.3%) reflects the perishable nature of fresh mango and the relatively underdeveloped cold storage infrastructure in the region [5]. Value-added processing offers the most promising avenue for improving producer returns: a farmer-owned pulping unit could potentially capture the 35-45% value currently absorbed by intermediaries. But this requires capital investment, technical training, and market linkages that most smallholders lack without institutional support [4, 6]. The high marketing efficiency of direct-to-consumer channels suggests that farmers' markets and online platforms could benefit mango growers, though scalability remains a constraint.

Conclusion

Mango supply chains in the Wielkopolska region are characterised by wide price spreads and low producer shares, particularly in longer channels. Cold chain investment and farm-level processing are the two interventions most likely to improve marketing efficiency and farmer incomes. Value-added products multiply farm-gate value by 2.4-3.8 times. Policy should support cooperative processing units, cold chain infrastructure, and direct marketing channels to retain more value at the producer level.

Acknowledgements

Funding sources

Supported by internal funds of Wielkopolska Agricultural University and Silesian Agricultural College.

Institutional support

The authors thank both institutions for research support and market survey logistics.

Contributions not qualifying for authorship

Thanks to market survey enumerators and the mango traders who participated in interviews.

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