Market Linkages and Pricing Dynamics for Leafy Vegetables: Farmer Experiences and Retailer Requirements in Western India

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Abstract— *Leafy vegetables such as coriander, spinach, and mint play a vital role in nutrition and farmers' livelihoods in India. Farmers face challenges including unstable prices, dependence on intermediaries, and post-harvest losses, while retailers require consistent quality, volume, and traceability. This study explores sources of procurement, post-harvest handling practices, and constraints faced by farmers in Nenpur (Kheda) and Padra (Vadodara), Gujarat, alongside retailer perspectives from organized and unorganized markets.*

Data were collected from 60 farmers using semi-structured interviews and analyzed using the Problem Perceived Index (PPI) and Garrett's Ranking Technique. Results show that most farmers are smallholders with less than one acre under leafy vegetables and moderate annual incomes (Rs. 2–3 lakh). Mint is cultivated year-round, while spinach and coriander are seasonal. Although 78% of farmers are aware of grading and sorting, packaging mainly involves gunny bags, contributing to post-harvest losses. Primary constraints include pests, natural calamities, distant markets, and high transportation costs.

The study suggests that direct procurement through collection centers, training in post-harvest handling, and investment in cold-chain infrastructure can improve farmer incomes and meet retailer requirements.

Keywords— Leafy vegetables, Market linkages, Post-harvest handling, Farmer experiences, Retailer requirements, Gujarat.

I. INTRODUCTION

India's agricultural landscape is increasingly horticultural, with vegetables playing a pivotal role in ensuring food and nutritional diversity. Among these, leafy vegetables are particularly vital due to their short cropping cycle, high nutritional density, and potential for generating continuous income for small and marginal farmers. In the state of Gujarat, the cultivation of greens like coriander, spinach, and mint is widespread, catering to both local and urban markets.

Despite their importance, the supply chains for leafy vegetables are notoriously fragmented and inefficient. These commodities are highly perishable, with a shelf life often limited to a few days under ambient conditions, making them susceptible to significant post-harvest losses estimated between 8-25% nationally. Farmers, often operating on small landholdings, remain at the mercy of traditional *mandi* systems characterized by asymmetrical information, price volatility, and a high dependency on intermediaries who capture a substantial share of the consumer rupee. Conversely, the retail sector, encompassing both unorganized vendors and organized players (e.g., supermarkets, online platforms), is evolving towards a demand for standardized quality, assured supply, and food safety—requirements that traditional chains struggle to fulfill.

Previous research highlights this disconnect. Studies by Mangala & Chengappa (2008) and Singh & Singla (2011) underscore the potential of direct farmer-retailer linkages in improving farmgate prices. However, gaps persist in understanding the on-ground constraints from the farmer's perspective, particularly concerning specific post-harvest practices for leafy greens, and their alignment with retailer procurement models. This study aims to bridge this gap by addressing the following objectives:

1. To profile the socio-economic characteristics and cropping patterns of leafy vegetable farmers in selected districts of Gujarat.
2. To assess the awareness and adoption levels of post-harvest handling practices among these farmers.
3. To identify and rank the major production, marketing, and post-harvest constraints faced by them.
4. To analyze farmer awareness and willingness to participate in modern, direct procurement systems.
5. To provide policy and intervention recommendations for strengthening market linkages.

II. MATERIALS AND METHODS

2.1 Study Area and Sampling:

The research was conducted in two major leafy vegetable-producing clusters of Central Gujarat: Nenpur in Kheda district and Padra in Vadodara district. These locations were purposively selected due to their known commercial cultivation of coriander, spinach, and mint. A sample of 60 farmers (30 from each district) cultivating at least one of the target crops was selected for primary data collection. Given the lack of a definitive sampling frame, a non-probability **snowball sampling** technique was employed, where initial contact farmers helped identify other cultivators in the vicinity, ensuring access to the relevant population.

2.2 Data Collection:

Primary data were gathered through **pre-tested, semi-structured interviews** conducted in the local language between [Insert Data Collection Period, e.g., January-March 2023]. The schedule covered modules on socio-economic profile, cropping patterns, cost of cultivation, marketing channels, post-harvest practices, and perceived constraints. **Field observations** supplemented self-reported data, particularly for post-harvest handling. Secondary data were collated from district agricultural offices, published literature, and government reports to contextualize the findings.

2.3 Analytical Framework:

Data were analyzed using descriptive statistics and specialized ranking techniques:

- **Descriptive Statistics:** For presenting socio-economic profiles, awareness levels, and cropping patterns in frequency and percentage terms.
- **Problem Perceived Index (PPI):** Used to quantify the severity of various constraints. Farmers rated each problem on a Likert-type scale (e.g., 1=Not Severe to 5=Extremely Severe). PPI was calculated as: PPI = (Sum of individual scores for a problem / Maximum possible score) * 100.
- **Garrett's Ranking Technique:** Employed to convert qualitative rank orders (assigned by farmers to listed constraints) into quantitative scores. The per cent position of each rank was converted into a Garrett's table score, and the mean score for each constraint was calculated. The constraint with the highest mean score was assigned the first rank.

III. RESULTS AND DISCUSSION

3.1 Socio-Economic Profile of Sample Farmers:

As presented in Table 1, the farming community surveyed is predominantly middle-aged (68% above 40 years) with moderate levels of formal education (50% with secondary schooling). A critical finding is the prevalence of **smallholder farming**, with 75% of respondents operating on less than one hectare of land dedicated to leafy vegetables. This aligns with the national pattern of fragmented holdings in horticulture. The average annual income from leafy vegetables fell in the range of Rs. 2–3 lakh, indicating a moderate but vulnerable economic dependence on these crops.

TABLE 1
SOCIO-ECONOMIC CHARACTERISTICS OF SAMPLE FARMERS (N=60)

Parameter	Category	Frequency	Percentage (%)
Age	20–30	6	10
	30–40	13	22
	40–50	20	33
	50–60	21	35
Education	Primary	10	16.7
	Secondary	30	50
	Higher Secondary	20	33.3
Landholding (ha)	<1	45	75
	1–2	15	25

3.2 Cropping Patterns and Seasonal Availability:

Mint emerged as a **year-round crop** in both locations due to its hardy nature and continuous demand, primarily for chutney and culinary uses. Spinach cultivation was concentrated in the Rabi (winter) and Summer seasons, avoiding the heavy rains of Kharif. Coriander, more sensitive to climatic conditions, was predominantly a Rabi-season crop in Nenpur, while in Padra, some farmers extended its cultivation into summer under managed irrigation (Table 2). This seasonality creates supply fluctuations that challenge consistent retail procurement.

TABLE 2
SEASONAL AVAILABILITY OF LEAFY VEGETABLES IN STUDY AREAS

Vegetable	Nenpur (Kheda)	Padra (Vadodara)
Mint	Year-round	Year-round
Spinach	Rabi, Summer	Rabi, Summer
Coriander	Rabi	Rabi, Summer

3.3 Post-Harvest Handling Practices: The Awareness-Adoption Paradox:

A significant insight from the study is the gap between awareness and adoption of post-harvest practices. As shown in Table 3, while 78% of farmers were aware of concepts like grading, sorting, and packaging, the adoption rates were lower (65-75%). More critically, the **technology and materials used were rudimentary**. Grading and sorting were done manually by hand, a time-consuming process prone to inconsistency. Packaging was almost exclusively done in **gunny bags (jute sacks)**, which offer no protection against mechanical damage, moisture loss, or wilting, directly contributing to significant post-harvest losses during transportation. This practice persists despite known advancements in breathable plastic crates and modified atmosphere packaging for greens (Ali et al., 2022).

TABLE 3
AWARENESS AND ADOPTION OF POST-HARVEST PRACTICES

Practice	Awareness (%)	Adoption (%)	Material Used
Grading	78	75	Hand sorting
Sorting	78	70	Manual sorting
Packaging	78	65	Gunny bags

3.4 Ranking of Major Constraints:

The application of Garrett's Ranking Technique revealed the hierarchy of challenges (Table 4). **High transportation cost** emerged as the foremost constraint, a direct consequence of small, dispersed marketable surpluses making dedicated transport economically unviable. This was closely followed by **pest and disease attacks**, which affect yield and quality. **Distance to the primary wholesale market** ranked third, exacerbating transportation costs and time to market, thereby increasing perishability. The **lack of accessible cold storage** infrastructure ranked fourth, highlighting a critical bottleneck in the supply chain for preserving quality. **Price volatility**, often cited in literature, was acknowledged but ranked fifth, suggesting that immediate logistical and production challenges are more acutely perceived.

TABLE 4
RANKING OF MAJOR CONSTRAINTS FACED BY FARMERS (GARRETT'S RANKING)

Constraint	Mean Score	Rank
Transportation cost	82	1
Pest/disease attack	76	2
Market distance	70	3
Lack of cold storage	65	4
Price volatility	60	5

3.5 Market Linkages and Willingness for Change:

A promising finding was the high level of **awareness (78%)** among farmers about modern retail platforms like Bigbasket. Furthermore, **75% expressed willingness to supply directly** to such entities or through organized collection centers, provided assured prices and transparent weighing/payment systems were in place. This indicates a readiness to transition away from traditional channels if viable alternatives are presented.

IV. CONCLUSION AND RECOMMENDATIONS

This study confirms that the supply chain for leafy vegetables in Gujarat remains fraught with challenges that disadvantage smallholder farmers and fail to meet the quality consistency demands of a modernizing retail sector. The core issues are logistical (transport, distance), infrastructural (cold storage deficit), and practice-based (rudimentary post-harvest handling).

To bridge this gap, the following interventions are recommended:

1. **Promotion of Farmer Collectives and Collection Centers:** Facilitate the formation of Farmer Producer Organizations (FPOs) or strengthen existing ones. Establishing localized **primary collection and aggregation centers** at the village/cluster level can reduce transportation costs per unit, enable bulk marketing, and provide a direct interface for retailers.
2. **Targeted Capacity Building:** Extension programs must move beyond awareness to **skill development**. Hands-on training in proper harvesting at the right stage, pre-cooling techniques, and the use of low-cost improved packaging (e.g., perforated polyethylene bags, reusable plastic crates) is essential.
3. **Investment in Cool-Chain Infrastructure:** Public-private partnerships should be encouraged to establish **networked cool-chain facilities** (pack-houses with pre-cooling units, refrigerated vans) at strategic hubs. This can drastically reduce post-harvest losses and extend shelf-life.
4. **Facilitation of Direct Market Linkages:** State agricultural departments and FPO promoters should act as facilitators to create **structured tie-ups** between farmer groups and organized retailers/processors, ensuring fair pricing and contractual agreements.

Future research could focus on the economics of adopting improved post-harvest technologies and longitudinal studies on the impact of direct linkage models on farmer income resilience.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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