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Assessing Marketing Constraints of Kinnow Farmers in Punjab: A Factor Analysis Approach

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Abstract

Kinnow, a commercially important citrus fruit in Punjab, significantly contributes to rural income and agricultural revenue. However, farmers face various marketing constraints that reduce profitability and disrupt value chain efficiency. This study provides in-depth analysis of the marketing challenges faced by kinnow farmers using primary data. To collect primary data, a multistage sampling technique was employed, using non- disguised structured questionnaire in major kinnow producing districts of Punjab - Fazilka, Muktsar Sahib, and Hoshiarpur. The final data set comprises responses from 180 kinnow farmers. The analysis revealed issues including inadequate storage facilities, poor marketing infrastructure, high transportation costs and improper packaging materials. These constraints contribute to post-harvest losses, restricted market access, and low farm returns. Addressing these challenges is crucial for enhancing marketing efficiency and ensuring the sustainability of kinnow farming. The study emphasizes the need for targeted policy support through investment in rural infrastructure, cost-effective logistics, better packaging solutions, and strengthened market linkages to improve farmer income and reduce losses.

Keywords: Marketing constraints, Value chain, Citrus marketing, Market inefficiency

JEL Classification: Q12, Q13, Q18

Introduction

Over time, Punjab's horticultural industry has become diversified and has placed an increasing focus on high-value fruit crops. Due to its high yield potential, improved shelf life, and market demand, Kinnow a hybrid citrus fruit created by crossing 'King' and 'Willow Leaf' mandarins, has become one of the most popular commercial fruit crops (Chadha, 2010). More than 40 percent of India's Kinnow output comes from the state, with districts like Fazilka, Hoshiarpur, and Muktsar Sahib producing the majority of it (National Horticulture Board, 2022).

Despite being one of India's most economically significant citrus fruits, farmers' profits from Kinnow are restricted by ineffective marketing strategies, particularly in Punjab, the state that produces the bulk of the fruit. Inadequate infrastructure for storage, transportation, and grading, reliance on pre-harvest contractors, low negotiating power, substantial post-harvest losses, and lack of direct market access are some of the obstacles that farmers frequently encounter. These problems discourage long-term investment in Kinnow agriculture since a smaller portion of the consumer rupee reaches the producer (Kumar et al., 2014; Singh and Sharma, 2019). These restrictions lead to large post-harvest losses, and a limited market reach, particularly in high-value export markets.

Marketing restrictions in horticulture products, especially citrus fruits like kinnow, have garnered a lot of attention because of their effects on supply chain effectiveness and farmer profitability. Some of the previous studies (Iftikhar, 2009; Kaur and Singla, 2016) pointed to structural flaws in fruit marketing that lower producer profits and cause losses after harvest. These problems restrict market access in addition to lowering output quality. In addition, Punjab's poor cold chain infrastructure and the perishable nature of kinnow is seen as major marketing barriers. They noted that farmers' net returns are greatly lowered by high handling and transportation expenses.

The Kinnow value chain's main bottleneck is the lack of adequate post-harvest facilities, such as cold storage and pre-cooling units. Fruits lose shelf life and market value due to rapid deterioration in the absence of these (Kherwa, 2019). Ineffective market infrastructure, lack of timely market information, and the exploitative role of middlemen are major obstacles in the Kinnow marketing system, as highlighted in

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a Punjab-specific study (Gill and Kaur, 2019).

Despite several studies on Kinnow marketing and post-harvest losses in Punjab by Sharma and Ghuman, 2006; Gangwar et al., 2005; Singh and Sharma, 2019; Mavi et al., 2012, there remains a lack of comprehensive research combining both the farmers' perspectives and quantitative assessment of marketing inefficiencies in the value chain. Further, in-depth studies are needed.

This study draws on primary data collected from Kinnow farmers to identify the marketing constraints of Kinnow in Punjab. By identifying and analysing these constraints, the research aims to provide evidence-based insights that can inform targeted policy and institutional reforms. The ultimate goal is to enhance the overall efficiency of the Kinnow marketing system and to promote greater inclusion of farmers within the value chain, thereby improving their income and market access. Policy and institutional changes that can improve marketing effectiveness and increase farmer involvement in the value chain are intended to be informed by the findings.

Data Sources and Methodology

The present study was undertaken to identify the marketing constraints faced by farmers in the Kinnow value chain using primary data. To achieve the objective of study data were collected from farmers through a non-disguised structured questionnaire during the year 2023–24. For this study, a Kinnow farmer was defined as an individual growing Kinnow crop for at least 15 years at the time of data collection. This criterion was used to ensure that famers included in study are those farmers who had sufficient experience about cultivation, marketing strategies and the value chain of kinnow (Table 1).

Table 1: Sample size description

Districts	No. of blocks	No. of villages	No. of farmers	Total sample from each district
Fazilka	2	3	10	(2 x 3 x 10) = 60
Muktsar Sahib	2	3	10	(2 x 3 x 10) = 60
Hoshiarpur	2	3	10	(2 x 3 x 10) = 60
Total sample size				180

A multi stage sampling technique was used to collect data from 180 kinnow farmers in Punjab as given in Table 2.

Table 2: Multi-stage sampling design for selection of Kinnow farmers in Punjab

Stage	Criteria	Selected units
Stage I	Selection of Districts (based on their highest production of Kinnow) (Anonymous 2021).	**Fazilka, Muktsar Sahib, Hoshiarpur**
Stage II	Selection of blocks (Random)	Fazilka: Abohar, Khuian Sarwar Muktsar Sahib: Lambi, Gidderbaha **Hoshiarpur**: Hoshiarpur-I, Tanda
Stage III	Selection of villages (Random)	**Abohar:** Kala Tiba, Khubban, Sito Gunno **Khuian Sarwar:** Maujgarh, Khuyan Sarwar, Chuhri Wala Dhana **Lambi:** Badal, Abul Khurana, Gaggar **Gidderbaha:** Kaouni, Dhulkot, Kot Bhai **Hoshiarpur-I:** Bullowal, Dhut Khurd, Bahadarpur **Tanda:** Chohan, Balla, Chattowal
Stage IV (final stage)	Selection of farmers (Random)	10 kinnow farmers from each selected village

Prior to the main survey, a pilot study involving 20 farmers was carried out to pre-test the questionnaire.

The statements related to marketing constraints were formulated through an extensive review of relevant literature (Mather, 2005; Sharma and Ghuman, 2006; Louw et al., 2007; Dhatt and Mahajan, 2007) and through expert consultations, field interactions with farmers. Farmers were surveyed for these agreement against the set of statements to study the perception of their marketing problems in the value chain of kinnow in Punjab using a 5-point Likert scale, where 1 represents "strongly disagree", 2 represents "disagree", 3 represents "neutral", 4 represents "agree" and 5 represents "strongly agree". To analyse the data, the statements were tested by applying one-sample t-test with a null hypothesis mean (μ) set at 3 i.e. H_0=3. In a one-sample t-test, there are two types of hypotheses: the null hypothesis and the alternative hypothesis. The null hypothesis indicates that there is no difference between the actual mean (μ) and the given value (m_0). The alternative hypothesis suggests that

there is a difference between the two. In other words, the test checks whether the average of your sample is different from a specific known value. The aim of the single-sample t-test is to determine whether to accept or reject the null hypothesis given sampling data. Depending on the question, there are three possible forms for the alternative hypothesis. A two-tailed hypothesis is employed if the objective is to quantify the difference regardless of direction. The highest (upper-tailed) or lowest (lower-tailed) hypothesis is applied if there is a relationship between the relative value and the direction of the test agent's difference. For every kind of sample t-test, the null hypothesis is the same.

The mathematical expressions of the null and alternative hypothesis are mentioned below:

H_0: $\mu = \Delta$

H_1: $\mu \neq \Delta$ (two-tailed)

$$t = \frac{\bar{x} - \Delta}{\frac{s}{\sqrt{n}}}$$

Where $\bar{x}$ is the sample mean, Δ is a specified value to be tested, s is the standard deviation of the sample and *n* is the sample size.

The reliability of the scale can be checked by the commonly utilized indicator of internal consistency known as Cronbach's Alpha. This metric reflects the average of all possible split-half reliability coefficients, calculated by dividing the scale items into various combinations. Cronbach's Alpha ranges from 0 to 1, with values above 0.6 generally considered acceptable for demonstrating adequate reliability. In the current study, Cronbach's Alpha was computed to determine the internal reliability of the scale.

$$\alpha = \frac{N\bar{c}}{\bar{v} + (N-1)\bar{c}}$$

Where, *N* is equal to the number of items, $\bar{c}$ is the average inter-item covariance among the items and $\bar{v}$ equals the average variance.

Factor analysis was used to simplify a set of data for two reasons: (1) to determine the underlying structure of the data, where a large number of variables may actually be measuring a small number of fundamental characteristics (constructs) of the sample, or (2) to reduce a large number of measures (some of which may be interrelated, causing multicollinearity for a set of respondents) to a smaller manageable number of factors that are not interrelated.

The following criteria were used to assess the acceptability of the factor analysis data:

1. To determine if the correlation matrix shows adequate correlations, it was generated and evaluated.
2. The partial correlations between variables with negative values are displayed in the anti-image correlation matrix. If there are few partial correlations between the variables, there are true factors.
3. The index known as the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (MSA) is used to compare the partial correlation coefficients' magnitudes. The index is between 0 and 1. KMO needs to be high enough for both the total MSA and the individual factors.
4. The number of statistically significant correlations between the variables is indicated by the Bartlett's test of sphericity.

Results and Discussion

Marketing problems faced by kinnow farmers in Punjab

Marketing problems for farmers are defined as the challenges and difficulties encountered at various stages of the marketing process from the farm gate to the end consumer that hinder efficient sale, pricing, and movement of Kinnow produce. Farmers were surveyed for these agreement against the set of 15 statements to study the perception of their marketing problems in the value chain of kinnow in Punjab using a 5-point Likert scale, where 1 represents "strongly disagree" and 5 represents "strongly agree". To analyse the data, the statements were tested by applying one-sample t-test with a null hypothesis mean (μ) set at 3 i.e. H_0=3 (Table 3).

Factor Analysis: Constructs for marketing problems of farmers in the value chain of kinnow in Punjab

Total 15 different statements regarding marketing problems of farmers in the value chain of kinnow in Punjab were formed. It was found that there were total 4 factors which explain the majority of the variance in the study, as initially 15 variables were taken into consideration and these variables were clubbed into only 4 factors as shown in Table 4.

Finally, it was found that the variables X2, X3,X5, X7,X9,X11 were loaded on factor 1, the variables X1,X4, X6 were loaded on factor 2, the variables X8, X10, X12, X13 were loaded on factor 3, the variables X14, X15, were loaded on factor 4.

The derived factors represent the marketing problems of farmers in the value chain of kinnow referring to Table 3, the first factor represents the processing, and Storage and finance related problems. Second factor represents Marketing problems, third factor represents Distribution and post-harvest handling, and fourth factor represents Supply issues.

Processing, storage and finance

Table 3 analysis shows that Factor 1 is the most significant, explaining 19.45 percent of total variance, with six variables loading on it. This factor highlights the

Table 3: Perception of marketing problems faced by farmers in value chain of kinnow in Punjab

S. No.	Statements	Mean	S.D.	t-value	p-value
1	Inadequate market intelligence	4.47	0.56	35.16	0.001*
2	Insufficient Post-harvest infrastructure	4.42	0.55	34.14	0.001*
3	Inadequate value addition	4.40	0.61	30.73	0.001*
4	Poor marketing infrastructure	4.56	0.56	37.33	0.001*
5	Price fluctuations	4.60	0.61	35.21	0.001*
6	Malpractices	4.51	0.56	35.93	0.001*
7	Erratic flow of produce in market chain	4.43	0.61	31.24	0.001*
8	Exploitation by middle man	4.59	0.55	38.45	0.001*
9	Inadequate Storage facilities	4.61	0.55	39.07	0.001*
10	High transportation charges	4.66	0.59	37.39	0.001*
11	Delayed payments by the procurement agencies	4.47	0.56	35.16	0.001*
12	Distant markets	4.42	0.55	34.14	0.001*
13	Perishability/ prone to post harvest losses	4.21	0.48	33.48	0.001*
14	Grading issue	4.31	0.53	33.09	0.001*
15	Improper packaging material	4.37	0.54	33.50	0.001*

*Note: *indicates Significance at a 5 % level of significance (p< 0.05)*
Source: Primary Data

importance of processing, storage, and finance in the Kinnow value chain. Value addition through processing enhances export potential, while proper storage (e.g., pre-cooling, cold storage) preserves quality and shelf life. Financial support, such as credit and investment in infrastructure, underpins the entire supply chain. Consistent with study the findings stress that inadequate post-harvest and storage infrastructure are key challenges needing urgent attention (Kherwa, 2019).

Marketing problem

Table 3 analysis identifies Factor 2 as the second most significant, explaining 17.03 percent of variance, with three key variables. It reflects issues like poor processing/storage infrastructure, lack of market intelligence, and excessive intermediaries, leading to post-harvest losses and reduced Kinnow value. Promoting direct marketing can boost farmer profits by limiting middlemen and reducing malpractices. The findings of this study align with existing literature, highlighting critical challenges in the Kinnow value chain (Gangwar et al., 2005) reported significant post-harvest losses in Kinnow due to inadequate infrastructure. Similarly (Singh and Sharma, 2019) emphasized the lack of precooling and cold storage facilities as major hurdles leading to wastage exceeding 25% of national production.

Distribution and post-harvest handling

The third factor, explaining 15 percent of variance, includes four variables related to Kinnow's perishability. Its short shelf life and high transport and handling costs lead to post-harvest losses, lower farmer profits, and limited consumer access. These costs threaten the sustainability and profitability of Kinnow farming. The dominance of intermediaries in the marketing process has been identified as a factor reducing farmers' share of the consumer price. Studies by (Mavi et al., 2012; Bannor and Oppong-Kyeremeh, 2019) suggest that strengthening direct marketing channels and farmer producer organizations can enhance profitability by minimizing middlemen and associated malpractices (Table 4).

Supply issue

The fourth factor (12.77 percent variance) highlights issues with grading and packaging. Poor grading limits market access and prices, while inadequate packaging increases damage and spoilage, leading to post-harvest losses and reduced fruit value. Similarly previous study by Baswal (2019) emphasizes the role of post-harvest treatments and packaging in enhancing the storage life and quality of Kinnow fruit, highlighting the significance of these factors in reducing losses and improving marketability (Table 5).

Factors related to marketing problems of farmers in the value chain of kinnow

Respondents were asked statements which were developed through a combination of an extensive literature review and field-based insights related to the Marketing problems to farmers in the value chain of kinnow. In total 15 statements were asked on five-point agreement scale ranging from strongly disagree to strongly agree. The statements in the questionnaire were developed based on previously

Table 4: Varimax rotated factor loading matrix

Variables	1	2	3	4	Communality
Inadequate market intelligence (X1)		0.708			0.582
Insufficient Post-harvest infrastructure (X2)	0.548				0.411
Inadequate processing facilities (X3)	0.434				0.481
Poor marketing infrastructure (X4)		0.656			0.522
Price fluctuations (X5)	0.573				0.601
Malpractices (X6)		0.762			0.675
Erratic flow of produce in market chain (X7)	0.607				0.610
Exploitation by middle man (X8)			0.821		0.786
Inadequate storage facilities (X9)	0.830				0.753
High transportation charges (X10)			0.611		0.687
Delayed payments by the procurement agencies (X11)	0.753				0.667
Distant markets (X12)			0.551		0.557
Perishability/ prone to post harvest losses (X13)			0.668		0.631
Grading issue (X14)				0.889	0.859
Improper packaging material (X15)				0.875	0.817
Eigen values	38.559	10.304	8.534	6.852	
Percent of variation	19.458	17.035	14.981	12.775	
Cumulative variation	19.458	36.493	51.474	64.249	

Table 5: Factor labels

Factor	Loadings	Statements included in the factor
Processing, storage and finance	0.830	Inadequate storage facilities
	0.753	Delayed payments by the procurement agencies
	0.607	Erratic flow of produce in market chain
	0.573	Price fluctuations
	0.548	Insufficient Post-harvest infrastructure
	0.434	Inadequate processing facilities
Marketing problem	0.762	Malpractices
	0.708	Inadequate market intelligence
	0.656	Poor marketing infrastructure
Distribution and post-harvest handling	0.821	Exploitation by middle man
	0.668	Perishability/ prone to post harvest losses
	0.611	High transportation charges
	0.551	Distant markets
Supply issue	0.889	Grading issue
	0.875	Improper packaging material

identified problems and our own understanding of marketing problems for the farmers. The statements were tested against null hypothesis of neutral perception (H_0=3) regarding role of farmers in the value chain of kinnow. All results are reported in Table 6.

According to the findings of the study, shows that a majority of respondents strongly agreed that lack of proper storage is a major constraint (Mean = 4.61, SD = 0.55, t = 39.07, $p < 0.05$). Poor storage conditions lead to post-harvest losses and reduced shelf life, Farmers reported that

Table 6: Factors related to marketing problems of farmers in the value chain of kinnow

S. No.	Statements	Mean	S.D.	t-value	p-value
Processing, storage and finance					
1	Inadequate storage facilities	4.61	0.55	39.07	0.001*
2	Delayed payments by the procurement agencies	4.47	0.56	35.16	0.001*
3	Erratic flow of produce in market chain	4.43	0.61	31.24	0.001*
4	Price fluctuations	4.60	0.61	35.21	0.001*
5	Insufficient post-harvest infrastructure	4.42	0.55	34.14	0.001*
6	Inadequate processing facilities	4.40	0.61	30.73	0.001*
	Overall	**4.48**	**0.58**	**34.25**	**0.001***
Marketing Problem					
7	Malpractices	4.51	0.56	35.93	0.001*
8	Inadequate market intelligence	4.47	0.56	35.16	0.001*
9	Poor marketing infrastructure	4.56	0.56	37.33	0.001*
	Overall	**4.51**	**0.56**	**36.14**	**0.001***
Distribution & Post Harvest handling					
10	Exploitation by middle man	4.59	0.55	38.45	0.001*
11	Perishability/ prone to post harvest losses	4.21	0.48	33.48	0.001*
12	High transportation charges	4.66	0.59	37.39	0.001*
13	Distant markets	4.42	0.55	34.14	0.001*
	Overall	**4.47**	**0.54**	**35.86**	**0.001***
Supply Issue					
14	Grading issues	4.31	0.53	33.09	0.001*
15	Improper packaging material	4.37	0.54	33.50	0.001*
	Overall	**4.34**	**0.53**	**33.29**	**0.001***

*Note: *indicates Significance at a 5 % level of significance (p< 0.05)*
Source: Primary data

insufficient market infrastructure such as lack of cold chains, grading/sorting units, and organized markets negatively affects market access and efficiency (Mean = 4.56, SD = 0.56, t = 37.33, p < 0.05). High transport costs were a widespread concern, particularly for farmers located far from major mandis or cold storage units (Mean = 4.66, SD = 0.59, t = 37.39, p < 0.05). These charges significantly reduce farmers' net margins. The use of low-quality or unsuitable packaging materials contributes to fruit damage and spoilage during transit, resulting in financial losses (Mean = 4.37, SD = 0.54, t = 33.50, p < 0.05). These findings suggest the urgent need for investment in post-harvest infrastructure, affordable transportation options, and improved packaging solutions to enhance marketing efficiency and reduce losses in the kinnow value chain. The results of the present study are in line with earlier findings, corroborating the observations of (Sharma and Ghuman, 2006; Dhatt and Mahajan, 2007 and Louw et al., 2007) regarding the key marketing challenges in the citrus value chain.

Conclusions and Policy Implications

The findings of the study indicate that kinnow farmers in the selected districts of Punjab encounter multiple challenges that affect both their profitability and market participation. Among the identified challenges, the absence of proper storage and weak marketing infrastructure have the most direct and far-reaching impact, leading to quality deterioration and reduced price realization. High transportation costs further limit competitiveness, particularly for farmers in these districts. Packaging-related issues, though relatively easier to resolve, continue to affect the kinnow appearance and acceptance in premium markets. The study primarily focus to improve post-harvest management followed by the development of reliable transport and market linkages. Affordable innovations in packaging can serve as quick and practical improvements. Encouraging collective marketing and farmer producer organizations (FPO's) can also enhance bargaining strength and market reach. A phased and well-prioritized approach in these districts can strengthen the

overall value chain and ensure more stable and rewarding market opportunities for kinnow growers in Punjab.

The study highlights the urgent need for innovation and digitization in the Kinnow value chain to improve traceability, grading, and real-time price access for farmers in the selected districts. It recommends launching a dedicated "Kinnow Mission" under horticulture development schemes to strengthen infrastructure, research, and market linkages. Subsidizing cold chain development, pack houses, which can significantly reduce post-harvest losses and enhance fruit quality. Introducing a Minimum Support Price (MSP) or Price Stabilization Fund during glut periods that would help stabilize farmer incomes. Expanding digital market integration through platforms such as e-NAM and promoting block chain or QR-based traceability systems can make the Kinnow sector more transparent and export-ready. The study also emphasizes on skill development and extension services, including value-chain-focused training for farmers and promoting entrepreneurship in packaging, cold storage, and processing. Furthermore, to boost exports, study suggests supporting GI tagging of Punjab Kinnow and investing in quality certification laboratories and export facilitation centre's to enhance brand identity, ensure compliance with international standards, and expand market opportunities.

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