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Protected Vegetable Cultivation in Haryana: An Analysis of Marketing Efficiency and Major Constraints

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HIGHLIGHTS

- Direct-to-consumer channels recorded the highest marketing efficiency across cucumber, tomato, and capsicum.
- Commission agent routes yielded the lowest efficiency and the widest price spread in protected vegetable cultivation.
- High price fluctuation and absence of MSP emerged as the most critical marketing constraints, followed by infrastructural and institutional gaps.
- Marketing efficiency and farmer profitability are jointly influenced by both marketing and production constraints under protected cultivation.

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ABSTRACT

The study presents channel-wise marketing efficiency, the major marketing and production constraints faced by protected vegetable cultivators in Haryana. Using the Yamane sampling formula, a sample of 300 farmers cultivating cucumber, tomato, and capsicum was selected and primary data was collected through a pre-tested interview schedule during 2024. Marketing efficiency across major marketing channels was estimated using Acharya Modified Method, while Garrett Ranking technique was employed to prioritise key marketing and production constraints. The results revealed that direct to consumer marketing channels consistently recorded the highest marketing efficiency and farmer's share, whereas channels involving commission agents were the least efficient due to higher marketing costs and intermediary margins. The Garrett Ranking analysis indicated that absence of minimum support price (MSP), high price fluctuations and lack of organised markets were the most severe marketing constraints. On the production side, labour shortages, high input costs, limited lifespan of polyethylene sheet and environmental pressures significantly affected profitability. The paper highlights that the issues of marketing and production are interlinked and jointly influences income stability and decision-making of protected vegetable cultivators. Strengthening market linkages, infrastructure and technical support is therefore is essential to enhance the economic viability of protected vegetable cultivation in Haryana.

INTRODUCTION

Vegetable cultivation is one of the fastest-growing components of Indian agriculture, contributing significantly to food and nutritional security, farm diversification, and rural livelihoods. India is the world's second-largest producer of vegetables (FAO, 2023), and the area under vegetable crops has increased steadily over the past two decades owing to rising consumer demand, urbanisation,

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and improvements in supply chains (Kumar et al., 2019). The perishable nature of vegetables required timely harvesting, and the need for rapid market disposal expose farmers to substantial production risks, price volatility, and post-harvest losses that often exceed 15.00-25.00 per cent under open-field conditions (Chand et al., 2020).

Protected cultivation has emerged as an important technological alternative to mitigate these risks. Structures such as polyhouses and net houses create controlled environments that reduce climatic uncertainties and enable off-season production of high-value crops including cucumber, capsicum, and tomato. Evidence shows that protected cultivation enhances yield, improves quality, increases resource-use efficiency, and raises profitability compared to open-field farming (Nimbrayan et al., 2021; Anamika et al., 2023). Chiphang et al. (2021) reports higher market responsiveness and resource-use efficiency in regulated horticultural environments, highlighting the potential of protected structures for smallholder.

Haryana has emerged as a leading state in adopting protected cultivation due to favourable agro-climatic conditions and its proximity to the National Capital Region (NCR), which provides assured market access (State Horticulture Department, 2024). Vegetable marketing differs significantly from the marketing of conventional crops. High perishability, frequent harvesting, and rapid deterioration require immediate and efficient market disposal. Intermediary-dominated channels often widen the price spread and reduce farmers' share in the consumer's rupee (Chand et al., 2020; Thakur et al., 2023). Vegetable markets are also characterised by price fluctuations, weak regulation, and asymmetric market information (Pareek et al., 2024; Birthal et al., 2021). Earlier studies confirm that shorter and organised channels improve price realisation and reduce transaction losses (Chand et al., 2020; Ogutu et al., 2020; Nuthalapati et al., 2024).

In addition to marketing challenges, protected cultivation is constrained by several production-related issues. High initial investment, scarcity of skilled labour, high seed and fertiliser costs, limited technical knowledge significantly affect productivity and profitability (Kumar et al., 2019; Ansari, 2020; Singh et al., 2022). Lack of MSP, inadequate cold storage and high transportation further restrict economic viability (Pareek et al., 2024; Birthal et al., 2021). Integrated assessment of production and marketing constraints provides a more comprehensive understanding of farmer profitability (Kumari et al., 2023; Verma, 2025).

Although protected cultivation is expanding rapidly in Haryana, limited studies have examined marketing efficiency together with production and marketing constraints. Much of the existing literature focuses on cost-benefit aspects and open-field vegetable marketing, leaving a critical gap. Against this background, the present study analyses the marketing efficiency of major marketing channels and identifies key production and marketing constraints faced by protected vegetable growers in Haryana. The findings help stakeholders strengthen market access and improve the viability of protected cultivation in the state.

METHODOLOGY

The study was conducted in Haryana in the year 2024 and in the regions where protected vegetable cultivation has grown tremendously over the last few years. Eight districts of the state - Karnal, Kaithal, Kurukshetra, Ambala, Bhiwani, Hisar, Jind, and Mahendragarh, were chosen purposely on the basis of predominance of the vegetable cultivation. These districts cover 73.46 per cent total area (1358 ha) in protected vegetable production (Department of Horticulture, Haryana, 2024). Three crops that were more adopted and had more economic value i.e. cucumber, capsicum, and tomato were selected due to their market demand and profitability in the protected environment. The District Horticulture Offices provided the list of the protected vegetable growers, which was used as the sampling frame. A sample of 300 farmers representing the selected districts and crops was determined using the Yamane (1967) formula with a precision level of 5.00 per cent. The primary data gathered by use of a pre-tested interview schedule, which contained information about the production practices, marketing channels, marketing costs, price realization, and significant constraints. The study area was studied through field investigations where three overpowering marketing channels were found. These channels were commission agents, supermarket and direct selling to the customers. The benefits of these channels were analysed crop-wise to ascertain which channel had the best benefit to the producers. The efficiency of marketing was determined using the (Acharya & Agarwal, 2019) modified method which express the net price received by the farmer to the price spread of consumer and producer price reflecting combined influence of marketing cost and margin on producer share. Study also focused on key marketing and production constraints experienced by the protected vegetable growers. Ten primary marketing constraints were defined, based on literature and field consultations (Kumar et al., 2019; Pareek et al., 2024). On the same note, ten production constraints were discovered through farmer contacts and existing literature (Kumar et al., 2019; Singh et al., 2022). In order to put constraints into perspective Garrett ranking technique was used where individual farmer rankings were converted into Garrett scores using the percent position and mean scores were used to rank the constraints (Garrett & Woodworth, 1969). This gave a clear picture of the relative significance of the various constraints to the profitability of the farmers and their marketing efficiency.

RESULTS

Channel-wise marketing share

The analysis is based on primary data collected from 300 farmers, comprising150cucumber growers, 90 tomato growers and 60 capsicum growers who sold their produce through three major marketing channels. The channel distribution of farmers showed significant differences between crops (Table 1). Commission Agent-Wholesaler-Retailer-Consumer (Channel I) appeared to be the best channel by all vegetable growers and especially in the case of capsicum, two-thirds of the growers (66.67%) used this middleman-managed channel. This over-dependence implies that the high-value and low-volume crop growers will tend to use existing mandi networks to ensure their sales are guaranteed. The participation pattern in cucumber and tomato was more distributed in channels. Commission agents received about 40.00 per cent of the growers in each crop, and the corresponding number of growers sold to the

Table 1. Distribution of farmers by marketing channel across crops under protected cultivation

Crop	Channel I (F–CA–W/R–C)	Channel II (F–SM–C)	Channel III (F–C)	Total
Cucumber	64 (42.67%)	62 (41.33%)	24 (16.00%)	150
Tomato	37 (41.11%)	20 (22.22%)	33 (36.67%)	90
Capsicum	40 (66.67%)	15 (25.00%)	5 (8.33%)	60
Total	141 (47.00%)	97 (32.33%)	62 (20.67%)	300

Source: Author's calculation: F= Farmer, CA= Commission agent, W/R= Wholesale/retail, SM= Supermarket, C= Consumer

supermarkets or under contractual agreements, as a measure of their increasing involvement with organised purchasers. Cucumber was the dominant in case of supermarket channels as 40.00 per cent sold their produce through this channel whereas tomato and capsicum were more than 20.00 per cent in this channel. Direct-to-consumer sales (Channel III) were only used by 20.70 per cent of the total farmers, so it was the least used in general. The tomato growers were however a relatively higher inclination towards direct marketing (36.70%), probably because of high frequency of harvests, stable demand and appropriateness to local retail markets. On the contrary, 16.00 per cent of cucumber growers and 8.30 per cent of capsicum growers embraced this channel.

Although traditional mandi-based or commission-agent based channels continue to prevail in protected vegetable marketing, the emerging participation in contract- linked and direct sales channels indicates a gradual diversification of marketing practices across certain crops and areas.

Channel wise marketing efficiency

The differences in performance of the major marketing channels between cucumber, tomato and capsicum are depicted in Table 2 through the comparative level of marketing efficiency. Direct-to-consumer sales (Channel III) had always the highest in producer share in consumer price, which was about 80.00 per cent for all three crops, and the highest values of marketing efficiency, which varied between 3.53 in capsicum, 3.80 in cucumber and 3.93 in tomato. These high values in channel were the results of the low marketing costs and the fact that there were no intermediary margins, thus farmers were left with higher portions of the end consumer price. This channel, especially to tomato growers, was the most benefiting of all, due to high frequency of harvesting and local demand which favours direct marketing. Supermarkets or contract-based sales (Channel II) occupied an intermediate position with farmers received about 70.00 per cent of the consumer price and recorded moderate marketing efficiency across crops, such as 2.31 for cucumber, 2.08 for tomato and 2.16 for capsicum. This proposes that organised buyers provide a comparatively better price consistency and decrease transaction expenses compared with conventional markets in spite of the fact that the implication of procurement procedures and quality assessment still creates moderate expenses.

Commission agent channel (Channel I) was the least effective in all crops. The share of Farmer was down to 54.60 per cent in tomato and the efficiency index was 1.13 indicating high commission fee, loading/unloading expenses, and numerous intermediaries. In case of capsicum and cucumber marketing efficiency were higher but not as much the other channels. So shorter channel is more beneficial in selling of vegetable crops in case of protected field. Altogether, the efficiency pattern is one of the strongest arguments in favour of shorter marketing chains, which proves that direct and organised marketing channels have a significant positive impact on income results of the protected vegetable growers.

Marketing constraints

In addition to changes in the efficiency of marketing, the outcomes show that a variety of structural and institutional constraints significantly limit the capacity of farmers to get into more lucrative avenues. In the ranking analysis, (Table 3) it was found that Minimum Support Price (MSP) was the major marketing constraint, indicated that farmers were not sure of their income and were vulnerable to the market-based price drops. Right behind this was the high price fluctuation which puts protected vegetable cultivators who already have high production costs at risk to large amounts of funds. Constraints of moderate severity included the absence of organised markets, high transportation and commission fee, and poor market information and information that affects the

Table 2. Producer's share in consumer price and marketing efficiency across crops and channels

Crop	Channel	NFp (Rs./q)	Cp (Rs./q)	Fs (%)	ME
Cucumber	Channel I	1296.88	2171.88	59.71	1.41
	Channel II	1560.48	2198.39	70.98	2.31
	Channel III	1752.08	2187.50	80.19	3.80
Tomato	Channel I	795.95	1462.16	54.56	1.13
	Channel II	1000.00	1445.00	69.29	2.08
	Channel III	1201.52	1487.88	80.80	3.93
Capsicum	Channel I	1892.50	2852.50	66.37	1.85
	Channel II	2120.00	3040.00	69.76	2.16
	Channel III	2450.00	3080.00	79.56	3.53

Source: Author's calculation; NF_p= Net Price received to farmer, C_p= Consumer price, F_s= Farmer Share, ME= marketing efficiency

Table 3. Marketing constraints faced by Protected Vegetable farmer

Constraints	Mean Garrett Score	Rank
Absence of MSP	82	1
High Price Fluctuation	70	2
Lack of Organized Market	63	3
High Marketing Costs (Transport & Comm.)	57	4
Lack of Market Information	52	5
Long Chain of Intermediaries	47	6
Inadequate Cold Storage & Transport	41	7
Limited Selling Options	35	8
Heavy Market Losses	29	9
Malpractices in Weighing & Grading	23	10

capacity of farmers to attain good prices. Lack of organised marketing platforms compel most growers to use traditional mandis where the intermediaries are dominant. Farmers also complained that the infrastructure related constraints especially the unavailability of cold storage and the inaccessibility of refrigerated transport directly led to the decline in quality and increase of post-harvest losses hence lower net returns. Despite the relatively low ranking, issues like malpractices in weighing, low selling alternatives and chain of intermediaries still undermine the bargaining power of farmers. These limitations proved that marketing environment of the vegetable industry in protection is characterized by complex problems of price volatility, inadequate infrastructure, and institutional deficiency.

In general, the evidence showed that the marketing limitations are based on an inter-dependent group of risks like prices, infrastructural, and institutional constraints that all are contributing factors to the ambiguity and complexity of selling perishable produce under protected agriculture. These similar problems inform the marketing choices of farmers and eventually determine the profitability and sustainability of protected vegetable farming in Haryana.

Production constraints

It was found that the biggest constraints to production faced by the growers of protected vegetables were the lack of skilled labour and labour shortage, because the process of protected cultivation is time-sensitive, to ensure that the activities conducted are accurate (i.e. irrigation, pruning, fertigation, pest control, etc.),

Table 4. Production constraints faced by Protected vegetable farmers

Constraint	Mean Garrett Score	Rank
Lack of skilled labour	77.76	1
Scarcity of labour	75.89	2
High cost of seed	68.74	3
High cost of fertilizer	63.70	4
High cost of labour	59.36	5
Weed infestation	55.76	6
Short life of polythene sheet	52.06	7
High weather fluctuation	48.58	8
Insect and nematode infestation	45.64	9
Lack of technical knowledge	42.23	10

the absence of trained workers directly impacts the productivity and may even result in the loss of crops. Growers complained about high cost of seed, fertilisers and labour, which came after labour related problems. Such issues associated with inputs greatly increase the production cost, especially on crops such as cucumber and capsicum where hybrid seeds with good hybrids and special nutrient solutions are required. Moreover, there was weed infestation, low life of polythene sheets, and frequent changes in the weather among the farmers that made the operations a challenge and augmented the risks involved in production. Polythene sheets used to make parts of the polyhouses are not as durable as they should be, and thus they decay easily, contributing to the cost of maintaining them. The weather inconsistency, e.g., abrupt temperature increase or hailstorms, also compromised the stability which protecting structures are expected to offer. Crops were still impacted by lower-ranked constraints (e.g., insect and nematode infestation and a deficiency of technical knowledge) that were not considered the worst ones but had still an influence on the adoption of the best management practices. Combined, these limitations underscore the complexity of the issues that covered vegetable growers encounter to continue with an effective and profitable production.

In general, the issues of production recorded by farmers are a complex of labour shortage, high costs of inputs, and technical and environmental constraints, which affect the sustainability and effectiveness of the protected cultivation. All these constraints impact on crop management, continuity in operations, and stability of yield. The findings underscore the fact that to enhance the performance of production systems in the protected vegetable systems the resource availability and technical capacity of the farm level should be addressed.

Overall, the combined analysis of marketing efficiency and the major constraints indicated that profitability in protected vegetable cultivation is shaped by multiple interlinked factors. Farmers' ability to realise better prices depends not only on channel performance but also on the severity of production and institutional challenges they face. This is particularly relevant for Haryana, where diversification is increasingly necessary and farm profits are constrained by issues such as rising input costs, declining groundwater, and higher production risks. The results underscore that improving profitability and sustaining adoption of protected cultivation requires addressing market inefficiencies and production-level bottlenecks together.

DISCUSSION

The findings of the present study are consistent with existing literature which highlights that that the marketing efficiency of perishable crops is largely determined by the choice of marketing channels and the extent of intermediary involvement. Previous studies by Nain et al. (2019); Kumar et al. (2020) & Villacis et al. (2024), demonstrated that shorter marketing chains allow farmers to keep a larger part of the rupee of the consumer. Similar patterns were observed in the present study, where growers are better off when the channels are direct selling or organised procurement systems than the conventional mandi networks. Chand et al. (2020) also reported that marketing efficiency changes negatively with an increase in the number of handlers, commissions, and transportation

stages. Crop-wise variations in channel preference further align with earlier research. For tomato cultivation, Thakur et al. (2023) noted that frequent harvesting, high perishability, and high rate of local consumption make the short chains favourable supported the presented findings. In the case of cucumber, moderate efficiency in organised retail is similar to the outcomes of Ogutu et al. (2020) and Kundu et al., (2019), who found out that the contact and supermarket associations ensure stabilisation of the prices of crops with homogenous grading and stable demand. The continued reliance of capsicum growers on the intermediaries-based channels mirrors the findings of Pareek et al. (2024), who reported that high-value crops with small distribution in the local retail markets often marketed through wholesale mandis.

The pattern of marketing constraints identified in the study is also consistent with the persisting issues documented in the Indian vegetable marketing research. Price related constraints, particularly price volatility and the absence of minimum support price (MSP), corroborate the findings of Kumar et al. (2019) & Chand et al. (2020), who highlighted the greater income vulnerability of horticultural farmers compared to cereal producers in terms of daily fluctuation of prices and seasonal harvests. The present results further authenticate that in protected cultivation where the production costs and market sensitivity based on quality and quality make the supplement of the storage and transportation facilities more important. Studies by Singh et al. (2022) & Birthal et al. (2021) similarly reported institutional constraints like absence of organised markets, lack of selling options and malpractices in weighing and grading, which have been cited to be the primary drivers behind farmers being dependent on intermediaries. These findings are reflected in the present study, where the vegetable growers are under protection and there are alternative avenues of marketing, the growers still use commission agents mainly due to the lack of accessibility or underdeveloped nature of organised structures.

Production-related constraints observed in the study further demonstrate the close interlinkage between production conditions and marketing performance. Labour scarcity and the lack of skilled labour identified as major constraints, have also been emphasised by Kumar et al. (2019) & Ansari (2020), who noted that protected cultivation presupposes specific knowledge and time and requires suitable interventions, and such measures cannot be made without skilled labour. High price of seed and fertiliser, which was also discussed in previous research, has been brought up of as one of the key hindrances to vegetable production maintenance. The limited lifespan of polythene sheets and stress due to weather conditions support the report of other studies on the protected cultivation in other regions where structural erosion and climate conditions decrease the stability of operation. Earlier studies have also reported technical and environmental limitations like pest and nematode infestation, weed pressure and insufficient technical knowledge. Effectiveness of protected cultivation is firmly conditioned by the ability of farmers to control microclimatic conditions, soil health, and pests is also the cause of technical shortcomings in the present study.

Overall, the results underscore that marketing performance cannot be assessed independently of production related constraints. The interdependence aligns with the observations of Birthal et al. (2021) & Chand et al. (2021), who emphasised the need to jointly consider production and market dynamics when evaluating horticultural profitability. The present study contributes to the literature by demonstrating how the interaction between production and marketing constraints shapes the profitability of protected vegetable cultivation in Haryana.

CONCLUSION

This study examined the efficiency of major marketing channels and the key marketing and production constraints faced by protected vegetable growers in Haryana. The findings revealed that direct-to-consumer channels were the most efficient, providing higher farmer share, whereas commission-agent channels were the least efficient as they involved multiple intermediaries and higher transaction costs. Lack of MSP, excessive variability in price, lack of market information and poor market infrastructure were some of the major marketing constraints. On the production side, lack of skilled labour, expensive inputs and environmental tensions were the significant factors that constrained profitability. The outcome of the research indicates the interdependence of production and marketing issues, which together influences the income and decision-making of farmers. The enhancement of market connections, better storage and transport facilities and better technical support can help in improving the feasibility and viability of the protected vegetable cultivation and sustainability in Haryana.

DECLARATIONS

Ethics approval and informed consent: Informed consent was sought from the respondents for the study.

Competing Interest: The authors have no competing interests.

Conflict of interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The authors declare that during the preparation of this work, they thoroughly reviewed, revised, and edited the content as needed. The authors take full responsibility for the final content of this publication.

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