DOI : 10.5958/0974-0112.2016.00024.4

Indian J. Hort. 73(1), March 2016: 87-93

Comparative analysis of vegetable production, value-addition and marketing in National Capital Region

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ABSTRACT

Agriculture, especially vegetable sector needs streamlined supply chain in the form of well functioning marketing infrastructure to make 'farm' to 'fork' model as reality. In the present study, field survey was carried out to identify different existing marketing channels among vegetable producers and processors. Marketing efficiency and price spread of the identified marketing channels were analysed. Producer's share in consumer's price significantly differed among vegetable processors (61%) and producers (30%). Acharya's marketing efficiency analysis method showed that Channel I (Processor/ producer-Consumer) was most efficient marketing channel with maximum profit to both processors and producers. Most important motivating factor identified among processor to go for value addition of vegetable produce was price of value added products (Mean ranks of Friedman's test is 12.15). Financial constraint (mean rank of Kruskal-Wallis's test 33.35) to start and run a processing unit was the major constraint faced by the vegetable processors. Under that lack of price policy (mean ranks of Friedman's test is 7.65) was identified as the major constraint in the study area. Marketing related factor was (mean rank of Kruskal-Wallis's test 45.50) identified as major inhibitor among growers to undertake processing of vegetable by their own.

Key words: Economic analysis, motivators, constraints, vegetable production, value-addition.

INTRODUCTION

Indian agriculture and nation nutritional security has a strong linkage with vegetables, due to their progrssive yield, economic viability, nutitional prosperity and ability to generate on farm and off farm employment opportunities through production and value addition of produces. India ranked second in production of fruits and vegetables all over the world. Total area under horticultural crops is 24.19 million ha and production is 280.48 million tonnes (NHB, 6). Fruits and vegetables together contribute about 92% of the total horticultural production in the country. Presently, vegetable occupies 9.39 million hectares area with the annual production of 162.89 million tonnes (NHB, 6). Even if production and productivity of vegetables in India is in a remarkable position among other countries, post production scenario in India is not up to the mark. According to Sinha (7) losses after harvest due to poor infrastructure and unorganized retail lead India to experience some of the highest food losses in the world. Lack of cold storage and harvest spoilage causes over 35 to 40% loss in farmers' produce especially the perishable commodities like fruits and vegetables. A national level post-harvest losses study conducted by Nanda *et al*. (5) covered eight vegetables, *viz*., cabbage, cauliflower, green pea, mushroom, onion, potato, tapioca and tomato also revealed the same result. The overall total losses were observed to be 6.9% in cauliflower to 13% in tomato. Producer's share in consumer price is as low as 10 to 23% (Anon, 1) in India as against 60 to 81% in developed countries. This huge difference mainly occurs due to distress sale resulting from the lack of post-harvest managerial ability by farmers along with inefficiencies and interventions of middle men traders. Kader and Rolle (3) stated the 95% of the total research investment directed for enhancing the productivity and only 5% investment involved in postharvest loss reduction of the fruits and vegetables. Similar results were found by Kitinoja *et al.* (4). India has made desired strides on production front but appallingly wanting in the field of agricultural marketing, post-harvest management and value addition of agricultural commodities. In this context, present study was undertaken in peri-urban areas of National Capital Region (NCR) to identify different marketing channel existing among vegetable processors and vegetable growers and examine its efficiency. An attempt has also been made to identify motivating factors for taking post-harvest decision, the constraints faced by processors and the inhibiting factors among the vegetable farmers to undertake value-addition and post-harvest operations.

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MATERIALS AND METHODS

The present study was purposively conducted in Hapur and Sonipat districts, which are known as vegetable hubs of Uttar Pradesh and Haryana, respectively along with Delhi to study the difference in post-harvest management behaviour of processors and producers in peri-urban areas. To study the determinants and generalize the findings among vegetable processors and vegetable producers, five different vegetables (tomato, potato, green chilli, cauliflower and radish) and main processed products from these vegetables (pickle, chips, puree and sauce) were selected purposively. A random sample of 20 respondents comprising of 10 processors and 10 producers were selected. Data collected were analysed with the help of SPSS 20.0 software to draw valid conclusion. In order to find out the producers share in consumer price, farm gate price and consumer price were collected and analysed. For analysing the marketing efficiency of different channels identified in the study area, Shepherd's and Acharya's formulae for marketing efficiency index were used. For the identification of factors, which help to take post-harvest decision by the vegetable processors, constraints faced by them and factors inhibiting the vegetable growers from undertaking processing activities, validity and reliability tested Likert like rating scale was adopted. Data collected under these variables were analysed and interpreted on the basis of nonparametric tests, *viz.*, Kruskal-Walli's one-way ANOVA and Friedman's two-way ANOVA.

RESULTS AND DISCUSSION

Huge fluctuation in vegetable price was observed at different point of time in one season, *viz*., tomato 4-9 Rs./kg, potato 2-8 Rs./kg, green chilli 10-30 Rs./kg, cauliflower 2-9 Rs./kg and radish 2-14 Rs./kg. Productivity of selected vegetables in the study area is as follows; tomato 62.5-65 t/ha, potato 50-60 t/ha, green chilli 20-22 t/ha, cauliflower 60-65 t/ha and radish 62.5-65 t/ha. On an average six rupee per kilogram was calculated as farm gate price for tomato, potato, radish and cauliflower. For chilli the average farm gate price is Rs. 20, which is almost three times the average market price of other vegetables selected for the study. However, the average productivity of chilli is one third of the average productivity of other selected vegetables. Hence, on an average the farm gate price of all the vegetables were considered as Rs. 6/ kg.

Price for the value added products from these vegetables also showed variations (50-55 Rs./kg as farm gate price and 150-200 Rs./kg as consumer price). For making one kilogram of value added products nearly 2-2.5 kilogram of raw vegetable is needed. All these parameters were considered while calculating cost and benefit of the processed vegetables and raw vegetables. Since the clients for farmer in Channel II and III in case of raw vegetables were, either wholesaler or retailer, and farmers were selling their produce to them in *Mandi* in same price, an average of five rupee per kilogram has been taken in to consideration, while calculating the gross returns to farmers in these channels.

Total cost of production of value-added products of vegetables from one hectare of land (Rs. 10,51,048.70 ± 22,508.00) was high ($t = 34.187$, $p \leq 0.05$) as compared to the total cost of production of vegetables in one hectare land (Rs. 2,62,400.90 ± 5,053.48) (from Table 1). At the same time the return side for the value added products (Rs. 6,02,551.30 ± 41,897.14) was also found significantly higher ($t = 11.770$, $p < 0.05$)as compared with vegetable cultivation (Rs. 1,05,999.10 ± 4,935.09) (from Table 1).

Study results showed that total of six (three in each group) different type of marketing channels were present in the study area in marketing of value-added vegetables and raw vegetables. But there was a remarkable difference in the marketing efficiency of the existing marketing channels due to the existance of different players, variations in marketing costs and marketing margins.

Table 1. Average production cost and average net income of vegetable processors and vegetable producers.

Cost/ Return (Rs./ha)	Vegetable	Mean	Std. Error	Levene's test for equality of variances	t-test for equality of means (equal variances)	t-test for equality of means (unequal variances)
				F (Prob. F)	t, DF (Prob. t)	t, DF (Prob. t)
Total cost	Processors	1051048.70	22508.00	9.249	34.19, 18	34.19, 9.91
	Producers	262400.90	5053.48	(p = 0.007)	(p < 0.001)	(p < 0.001)
Net returns	Processors	602551.30	41897.14	20.365	11.77, 18	11.77, 9.25
	Vegetable producers	105999.10	4935.09	(p < 0.001)	(p < 0.001)	(p < 0.001)

*DF = Degrees of freedom; F = Value of the F-statistic; t = Value of the t statistic

Identified channels among vegetable processors and vegetable growers were with almost same type of players. Channel I was with only two players, *i.e.* producer/ processor and consumer. Channel II includes market players, *viz.*, Producer/processor-wholesaler/ retailer-consumer. Whereas, channel III, the longest channel was with four different players or four different transfer of ownership of goods as producer/processor-wholesaler-retailer-consumer.

In value-added vegetable marketing and raw vegetable marketing, Channel I was efficient than Channel II and III with 100% of share in producers price by consumer. In the case of processed vegetables rate of change (decrease) of producers share in consumer's price has been found less as compared with the raw vegetables. In Channel II of value added vegetable nearly 28% of consumers price was taken up by the middle-men and not reaching to the farmers. Whereas, in Channel III, about 56% of consumers price was went to the intermediary people. In the case of raw vegetable, increase in number of middle-men in each channel resulted in more share of consumers' price to middle men. In Channel II producers share in consumers' price was about 33.33%, whereas in Channel III it was about 16.66%. From Table 2 it is clear that maximum profit/ margin was taken by retailers in all marketing channels. Acharya's marketing efficiency index also indicated that more efficient marketing channel was direct selling channel (Channel I) in both group (processor 2.74 and producer 3.47). Shepherd's marketing efficiency index indicated that when channel length increases, the margin taken up by the intermediaries will also increase.

Respondents were asked to mark their preference in a 3 point continuum with respect to the importance of selected 13 motivating factors in making post harvest decisions among them. These factors were compared using Friedman's two-way ANOVA. As the computed p-value ($p < 0.05$) is less than the significant level with test statistics $\chi^2 = 69.950$ with df = 12, it can be inferred that the level of influence of different factors to the post-harvest decision making among vegetable processors is different according to processor's perception.

The mean rank corresponding to 'price of value-added food' (11.80) has been greater than all other factors (Table 3). Processors were getting premium price and profit for the value-added products and this attracted them to take the post-harvest decisions. Since, majority of the respondents (vegetable processors) were selling their products in their own brand name through their own outlet or some specific sponsored outlets like Indian Agricultural Research Institute Farmer's Mall, they were getting more market margin. Because of these reasons, processors were

Table 2. Average price spread (Rs./ ha) in different marketing channel with respect to value-added vegetables and raw vegetables.

Particulars	Vegetable producer			Vegetable processor		
	Channel I	Channel II	Channel III	Channel I	Channel II	Channel III
1. Cost of production	2,62,400.9	2,62,400.9	2,62,400.9	10,51,048.7	10,51,048.7	10,51,048.7
2. Marketing cost of producer/ processor	13,433	13,433	13,433	16,533	16,533.0	16,533
3. Gross returns to producer/ processor	3,68,400	3,07,000	3,07,000	16,53,600	15,90,000	15,26,400
4. Net returns of producer/ processor (MM) (3-(1+2))	92,566.1	31,166.1	31,166.1	5,86,018.3	5,22,418.3	4,58,818.3
5. MC of wholesaler		15,783	15,783		18,133	1,813.30
6. MM of wholesaler (7-3+5)		5,98,217	3,06,567		6,17,867	45,467.0
7. Gross price to wholesaler		9,21,000	6,14,000		22,26,000	15,90,000
8. MC of retailer			4,559			13,026.5
9. MM of retailer (10-7+8)			9,16,441			18,94,973.5
10. Consumer price	3,68,400	9,21,000	18,42,000	16,53,600	22,26,000	34,98,000
11. Producers share in consumers price (3/10)*100	100%	33.33%	16.66%	100%	71.14%	43.63%
12. Marketing efficiency (Shepherd) [(V/TMC)-1]	26.4	30.52	53.53	99.08	63.21	72.34
13. Marketing efficiency (Acharya) [Gross return of producer/ (TMC + TMM)]	3.47	0.46	0.23	2.74	1.35	0.62

Table 3. Factors influencing post-harvest decision making among vegetable processors based on mean ranks of Friedman's test.

Factors for post-harvest decision making	Mean rank
Price of value-added food	11.80
High market margin obtained	10.50
Branding and new look of products	9.05
Increasing food demand in urban areas	8.40
Consumer satisfaction and loyalty	7.55
Labour availability	7.05
Rising disposable income in hand	6.65
Transportation facilities to market	6.10
Changing consumer needs and choice	6.05
To minimize wastage	5.70
Marketed and marketable surplus availability	4.20
Competition from the market	4.20
To avoid distress sale	3.75

ranked market margin obtained due to elimination of middle man (10.50) and branding and new look of products (9.05) as two important factors, which were motivating them to take postharvest decisions. Majority of the respondents were with small and marginal land holding. Even some of the respondents were not having farm land and they were purchasing the inputs from local market and making value-added products, like pickles, jam, jelly etc. Processors reopens were also evident to this because the factors like to minimize wastage (Mean rank 5.70) and marketed and marketable surplus availability (Mean rank 4.20) were identified as less important elements in post-harvest decision making.

Generalized category of four different constraints (technical and capacity building related, infrastructure related, financial and market related) were compared using Kruskal-Wallis's one-way ANOVA. The test ($\chi^2 = 17.283$, df = 3, $p < 0.05$) revealed a significant difference among the level of influence of different constraints.

The mean rank corresponding to 'financial constraints' (33.35) is more, hence it was the major constraint to existing post harvest management mechanism in vegetables. Least affecting constraint was market related constraints with mean rank 14.15 (Table 4). Further analysis of the each category of the constraints was conducted using the Friedman's test.

Friedman's test statistic for technical and capacity building constraint is $\chi^2 = 59.075$, df = 8, $p \leq 0.05$. The major constraint identified among the technical and capacity building constraint was 'high cost

Table 4. Major dimensions of constraints among vegetable Processors based on Kruskal-Wallis's one-way ANOVA.

Constraint	Mean rank
Technical and capacity building related	15.40
Infrastructure related	19.10
Financial	33.35
Market related	14.15

involved in purchase of suitable machineries' for the post harvest management or value addition of the vegetable with mean rank 8.45 (Table 5). This was followed by 'low cohesion in groups' (Mean rank 7.60); 'non availability of improved machineries for processing' (Mean rank 6.35). Even if many of the respondents for this study were women and they were also members in one or another groups like SHGs, they perceived that it has been very difficult to maintain the cohesion among members. Sometimes they needed to devote more time to resolve the problems in group and among the group members. It was found that this 'conflict in group' and 'time wastage to solve the problems' has been identified as a factor to reduce the profit which actually they could get. Least severe constraints identified under this category were lack of motivation (Mean rank 2.70) and inadequate technical capacity (Mean rank 2.70). Based on Friedman's test statistic for infrastructure related constraints ($\chi^2 = 41.691$, df = 8, $p < 0.05$) and the results presented in Table 5, 'non-availability of machineries in local places' (Mean rank 8.70) was the major infrastructure related constraints among the vegetable processors. Poor infrastructure for storage and lack of marketing yards/ places (Mean ranks 6.45 and 6.05, respectively) were identified as prominent constraints among them. Since the study area is in peri-urban areas and near to national capital, 'lack of proper roads and transportation' (Mean rank 2.85) was less affecting the processors in post-harvest management practices. Study results and analysis showed that financial constraints among vegetable processors also differed significantly (Friedman's test statistic is $\chi^2 = 55.207$, df = 8, $p < 0.05$). 'Lack of price policy by the government' with Mean rank 7.65 and high cost of skilled labour (Mean rank 7.40) were the two most severe financial constraints. High rate of interest for credits and lack of finance (Mean rank, 7.20 and 5.60, respectively) were also identified as prominent financial constraints. As per the Friedman's test statistic ($\chi^2 = 60.450$, df = 8, $p < 0.05$) market related constraints among the vegetable processors varied significantly. Among the listed nine marketing constraints 'lack of appropriate marketing

Table 5. Severity analysis of different constraints based on mean ranks of Friedman's test.

	Particulars	Mean rank
Technical and capacity building related	High cost involved in purchase of suitable machineries	8.45
	Low cohesion in groups	7.60
	Non availability of improved machineries for processing	6.35
	Lack of knowledge about trading options (future and forward)	6.35
	Lack of training programmes	4.05
	Lack of proper knowledge about harvesting time	3.55
	Lack of feedback/ success stories in media	3.00
	Inadequate technical capacity	2.95
	Lack of motivation	2.70
Infrastructure related	Non availability of machineries in local places	8.70
	Poor infrastructure for storage	6.45
	Lack of marketing yard/ place	6.05
	Lack of cold chain management	5.15
	Lack of proper packaging facilities	4.50
	Lack of proper grading facilities	4.15
	Lack of power and electricity	4.10
	Non availability of labour	3.05
	Lack of proper roads and transportation	2.85
Financial	Lack of price policy by the government	7.65
	High cost of skilled labour	7.40
	High rate of interest for credits	7.20
	Lack of finance	5.60
	High payback period in investment	5.55
	Lack of awareness about government support policies	3.40
	Distress sale of produce due to need of immediate liquid cash	3.30
	Lack of awareness about credit availability	2.75
	Lack of banking facilities near by	2.15
Market Related	Lack of appropriate marketing channel	8.85
	Large numbers of middlemen	6.95
	Lack of market intelligent and market facility	6.35
	Less knowledge about marketing strategies	6.25
	Inability to meet standards as prescribed	4.90
	Inability to find market for value added produce	3.30
	Difficulties of contract enforcement with wholesale processors	3.20
	Produce has low market value due to poor appearance	2.60
	Price risk and uncertainty (market value vary widely between the time of harvest and the time of local shortage)	2.60

channel' with mean rank 8.85 was identified as the most severe one. Large numbers of middlemen (Mean rank 6.95) and lack of market intelligent and market facility (Mean rank 6.35) were identified as moderately severe market related constraints among the vegetable processors.

Five different dimensions of major inhibiting factors (socio-psychological, technical, financial, marketing related and infrastructure related) were identified. Kruskal-Walli's one-way ANOVA test (χ^2 = 40.850, df = 4, $p < 0.05$) revealed that the level of influence of different inhibitors differed significantly.

The mean rank corresponding to marketing related factors (45.50) is more; therefore it was the most important inhibiting factor among the vegetable farmers. It was followed by technical factors with mean rank of 32.60. Least inhibiting factors for vegetable processing among farmers were socio-psychological factors (Mean rank 8.45). Further examination of the each group of the inhibitors was done using the Friedman's test.

Friedman's test statistic for socio-psychological inhibitors is χ^2 = 30.987, df = 6, $p < 0.05$. This indicates significantly different level of influence of different components under socio-psychological inhibitors among the vegetable growers. Lack of tolerance for ambiguity was identified as most severe inhibitor among the vegetable growers to undertake post-harvest management and value addition of vegetable (Table 7). Whereas, lack of urge for social status and lack of education (Mean ranks 2.05 and 3.20, respectively) were the two least severe inhibitors. Friedman's ANOVA statistic (χ^2 = 32.724, df = 6, $p < 0.05$) for technical inhibitors showed that there is a significant difference in influence of various components. Major identified inhibiting technical factor to undertake vegetable processing was high cost of processing activities and unavailability of processing machineries in the study area with mean rank 5.75 and 4.85, respectively. Least severe inhibiting factor was unavailability of raw materials year round (Mean rank 1.20). Lack of knowledge about processing standards, lack of knowledge about processing activities and unavailability of processing technologies were identified as moderately severe inhibiting factors. It is evident from Friedman's test statistic for financial inhibitors (χ^2 = 33.849, df = 6, $p < 0.05$) that significant difference was found among financial inhibitors. Lack of price policy by the government was perceived as most important inhibitors among financial factors with mean rank 6.30 (Table 7). It was followed by lack of awareness about government support policies and high initial investment to start value addition and processing of vegetables. Friedman's test statistics revealed a significant difference of influence of market related inhibitors among vegetable growers (χ^2 = 46.535, df = 6, $p < 0.05$). They identified lack of appropriate marketing channel (Mean rank 5.70) as the major market related inhibitor among them. This was followed by large number of middle man in marketing and distress sale of produce due to need of immediate liquid cash (Mean rank 5.40 and 5.35, respectively). Since, inability to find market for value added produce was identified as least severe inhibitor among the growers it was well evident that value-added products have a well recognized place in the competing market. It is well evident that (Table 5, Friedman's ANOVA statistic, χ^2 = 38.732, df = 6, $p < 0.05$) lack of storage facilities by own / in locality (Mean rank 6.45) and lack of cold storage for keeping the raw products (Mean rank 5.95) were bearing highest mean rank and hence those were the major infrastructure related inhibitors.

Farmers have the right to get more shares in consumer's rupee, but in India it is nearly about 16- 33% (Table 2). In order to increase this share (43 -71%, Table 2) and reducing the post harvest wastage, value addition is a valid option. Vegetable growers' main reason of inhibition to undertake post harvest management has been identified as their apprehension about the marketing of products, mainly because of the astringent incident they got from current vegetable marketing scenario (Tables 6 & 7). But the actual practicers identified market related constraints as less severe in post harvest management of vegetables (Table 4). Apprehension of grower is not an actual constraint in value addition of vegetables, especially in peri-urban areas because of its proximity to inputs, nearness to consumers and ever increasing demand of products.

ACKNOWLEDGEMENT

First author is thankful to Department of Science and Technology, Government of India for providing the financial assistance in the form of Inspire Fellowship.

Table 6. Identification of major dimensions of inhibitors among vegetable producer based on Kruskal-Walli's one-way ANOVA.

Inhibitor	Mean rank
Socio-psychological	8.45
Technical	32.60
Financial	14.50
Marketing related	45.50
Infrastructure related	26.45

Table 7. Severity analysis of different components of inhibiting factors based on mean ranks of Friedman's test.

	Particulars	Mean rank
Socio-psychological	Lack of tolerance for ambiguity	6.45
	Lack of independence in decision making	5.00
	Lack of proper direction in the needed way	4.15
	Lack of locus of control	3.80
	Negative attitude of the society	3.35
	Lack of education	3.20
	Lack of urge for social status	2.05
Technical	High cost of processing activities	5.75
	Unavailability of machineries in this place	4.85
	Lack of labour	4.65
	Lack of knowledge about processing standards	4.45
	Unavailability of processing technologies	4.35
	Lack of knowledge about processing activities	2.75
Financial	Unavailability of raw materials year round	1.20
	Lack of price policy by the government	6.30
	Lack of awareness about government support policies	4.85
	High initial investment	4.65
	High cost of raw materials	4.15
	High payback period in investment	3.65
	Lack of awareness about credit availability	2.20
	Unavailability of credits	2.20
Marketing related	Lack of appropriate marketing channel	5.70
	Large number of middle man in marketing of value added products	5.40
	Distress sale of produce due to need of immediate liquid cash	5.35
	Price risk and uncertainty	5.25
	Lack of market intelligent	2.85
	Lack of market facilities in this place	1.95
	Inability to find market for value added produce(lack of demand)	1.50
Infrastructure related	Lack of storage facilities by own/in locality	6.45
	Lack of cold storage for keeping the raw products	5.95
	Lack of space and building for processing	4.20
	High cost involved as *Mandi* charges	3.55
	Lack of electricity	3.15
	Lack of proper waste utilization / recycling facility	2.45
	Lack of good transportation facility	2.25

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Received : October, 2015; Revised : February, 2016; Accepted : February, 2016