Adoption Behaviour of Vegetable Growers Towards Post Harvest Management Practices in Punjab

Jashleen Kaur Sidhu and Lopamudra Mohapatra

Department of Extension Education, Punjab Agricultural University, Ludhiana-141 004, India
E-mail: jashleen-ee@pau.edu

Abstract: This study investigates the adoption behavior of vegetable growers towards post-harvest management practices in Nakodar, Malerkotla, and Baba Bakala Sahib, Punjab, India, using a survey of 240 growers. The 59.17% of farmers have a favorable attitude towards post-harvest practices, recognizing their role in reducing spoilage and enhancing market value. The application of the Theory of Diffusion of Innovation (DOI) demonstrated medium knowledge levels among potato (56.9%) growers, and lower levels for tomato (49.2%), cauliflower (37.5%), okra (41.5%), and pea (50.2%) growers. Only 58.62% adopted recommended harvesting methods for potatoes, while none followed proper tomato harvesting techniques, resulting in post-harvest losses. The 94.32% of cauliflower growers and 80.90% of okra growers practiced grading. Stepwise regression analysis indicated that 27% of the variation in knowledge was influenced by social participation, age, extension activities, and economic orientation. The study emphasizes the need for targeted extension programs to enhance farmers' knowledge of storage and transportation practices, alongside promoting low-cost storage technologies and skill training in post-harvest management to minimize losses and improve profitability.

Keywords: Post-harvest losses, Knowledge, Adoption, Vegetable growers

The United Nations' 2015 Sustainable Development Goals (SDGs) emphasize sustainable consumption and production patterns, focusing on more efficient production and supply chains. Annually, about one-third of the world's food production is lost or wasted. The Food and Agriculture Organization (FAO) aims to reduce food loss and waste along supply chains, including post-harvest stages (FAO 2022). Vegetables, being highly perishable, experience significant losses due to suboptimal post-harvest practices, such as harvesting, sorting, packaging, storage, and transportation (Viswanadham 2007).

India has seen remarkable growth in horticulture, with the area under cultivation increasing by 2.6% and production by 4.8% annually over the past two decades. Between 1991-92 and 2020-21, vegetable production rose from 58.5 million tonnes to 199.88 million tonnes, positioning India as the second-largest vegetable producer after China. Punjab, a leading state in horticulture, with 3.06 lakh hectares under vegetable cultivation and contributes significantly to national food security and exports (Thind and Mahal 2021). The world's population is expected to reach 10.5 billion by 2050, increasing food demand by 60% (Alexandratos and Bruinsma 2012). To meet this demand, reducing post-harvest losses is essential. In India, post-harvest losses of vegetables are estimated at 30-40%, costing approximately Rs. 2 lakh crore annually (Negi and Anand 2016). Losses in tomatoes, beans, and eggplants are particularly high, with rates exceeding 10% at the producer level (Sharma and Singh 2011).

Post-harvest losses occur due to various factors, including poor infrastructure, lack of storage facilities, and insufficient farmer knowledge of proper handling techniques (Kumar et al 2004). While some farmers regularly adopt practices like sorting, grading, and safe transportation, others lack awareness of more advanced post-harvest methods, such as cooling and modern packaging. In a study conducted by Sidhu et al (2024), the maximum losses were observed in tomato crop at farm level (17.71%) and retailer level (30.10%) whereas at wholesaler level maximum losses were recorded in pea (8.19%). Maximum losses were observed in tomato crop (17.71%) followed by cauliflower (6.79%), okra (5.57%), pea (5.2%) and potato (4.44%). The extent of losses at farm level has been higher as compared to wholesaler level and the highest at the retailer level. Studies indicate that 56% of farmers have a medium level of knowledge about post-harvest practices, but significant gaps remain in the adoption of optimal methods (Azad et al 2014, Ghanghas et al 2017). Addressing these gaps requires improving infrastructure and farmer education on post-harvest management. The present study was conducted in Punjab, India with objective to appraise stages undergone in the adoption of post-harvest management practices of among the vegetable growers.

MATERIAL AND METHODS

Study area: The study was conducted in Nakodar (Jalandhar), Baba Bakala Sahib (Amritsar) and Malerkotla

(Sangrur) of Punjab during the year 2020. Vegetables selected for the study were potato, pea, cauliflower, tomato and okra. In Amritsar district, the Baba Bakala Sahib cluster is known for cultivating potatoes. In Jalandhar district, the Nakodar cluster specializes in growing peas, tomatoes, and okra. Meanwhile, in Sangrur district, the Malerkotla cluster is focused on cultivating cauliflower and okra.

Selection of sample: Snowball sampling technique was employed for selection of respondents from every cluster to get respondents for all selected vegetables. Eighty farmers from each cluster were selected (240 farmers). Roger's innovation decision model was used to appraise stages undergone in the adoption of post-harvest management practices of among the vegetable growers. The information was collected on socioeconomic profile of the farmer (Table 1). The knowledge test for each selected crop was prepared regarding post-harvest management practices such as harvesting and collection, cleaning, grading and packaging.

Items with difficulty index between 0.25 to 0.75 and discrimination index (Di) above 0.20 were selected for knowledge test (Thorndike and Thorndike-Christ 2010). Cronbach alfa reliability of the test calculated was 0.925 which was significant at 1 % level of probability. Item analysis was done to select the items for final attitude scale. Scores for all attitude items were calculated for each farmer and arranged from highest to lowest. The upper and lower level groups were defined as the top five and bottom five farmers, respectively, representing 50 percent of the total. The mean scores for each item were computed for both groups. Items exhibiting the largest discrepancies between the means of the two groups were selected for the final scale. Specifically, items with a discrepancy value of 0.8 or greater were retained, while those below this threshold were excluded. This selection process utilized Murphy and Likert's methodology (Edward 1969), focusing on the magnitude of the difference between the means of high and low groups for each statement. Additionally, the 't-value' for each statement was calculated using Edward's formula. The items analysis was done in order to select the statements for final version of the scale with value of t equals to:

$$t = \frac{\overline{X_H} - \overline{X_L}}{\left[\dfrac{\Sigma (x_H - \overline{x}_H)^2 + \Sigma (x_L - \overline{x}_L)^2}{n(n-1)}\right]^{1/2}}$$

Where,

t = A measure of the extent to which a given statement differentiates between the high and low group

X_H = Score of given statement of individual for higher group

$\overline{X}_H$ = Mean score on a given statement for higher group

X_L = Score on same statement of individual for lower group

$\overline{X}_L$ = Mean score on a given statement for lower group

n = The number of subjects in high group = The no. of subject in low group
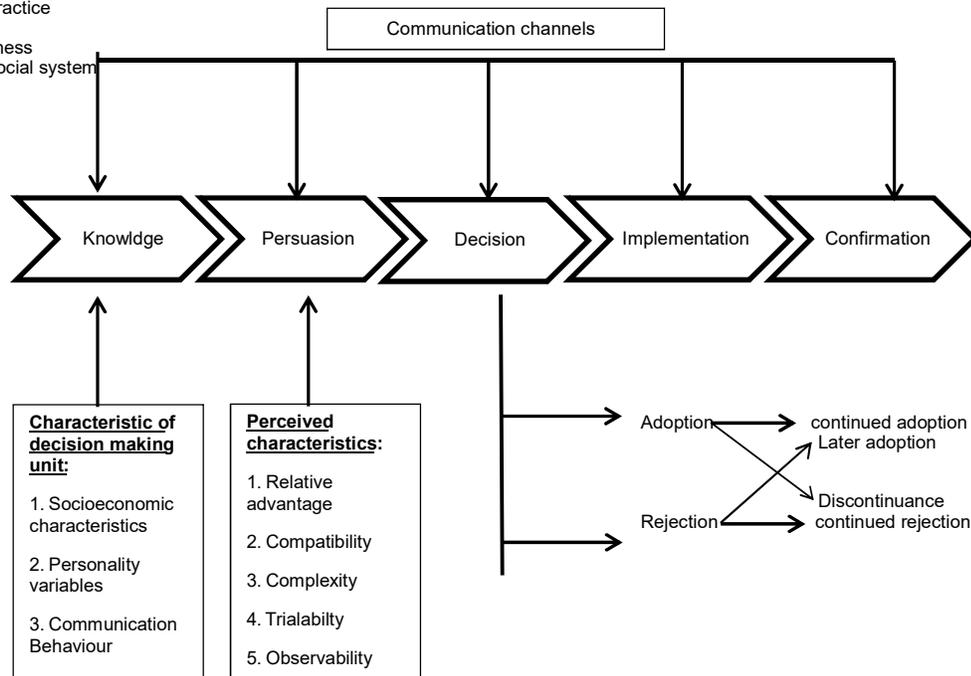

Fig. 1. Roger's innovation decision model (Rogers 1983)

The final selection of the items was done on the basis of the magnitude of difference between mean of higher group and mean of lower group for individual item and 't' value of that item. The items yielding t-value less than 1.75 were not included in the final scale. From original scale consisting of 35 items, only 10 items were retained in the final scale.

Statistical analysis: Data were analysed using Statistical Package for the Social Sciences (SPSS) software, version 23.0.

RESULTS AND DISCUSSIONS

Socio economic characteristics of vegetable growers: The socio economic characteristics of vegetable growers are given in Table 1.

Knowledge level of vegetable growers regarding post-harvest management practices: The farmers growing potatoes, tomatoes, cauliflower, okra, and peas have varying levels of knowledge about post-harvest management practices, with many lacking crucial information. In the case of potato farmers, 56.9, 38.7 and 4.3% had a medium low high level of knowledge. Although most farmers were familiar with the recommended techniques for harvesting and grading, but lacked awareness of the proper storage conditions and the optimal time period for storing potatoes under controlled environments.

Tomato: Among tomato farmers, 49.2, 37.3 and 13.4 % possessed low, medium knowledge, and high level of knowledge. Framers were aware of the harvesting time but did not understand the best method for determining fruit maturity, relying on size and color rather than cutting the fruit crosswise and were also unfamiliar with proper temperature regulation for washing and drying, and although they knew about waxing, they did not understand its purpose or technique. None of the farmers knew the storage requirements for tomatoes.

Cauliflower: For cauliflower farmers, 37.5, 30.6 and 7.9%

had low , medium and high knowledge. They were aware of cutting tools but lacked the proper technique for cutting. Though familiar with grading, the harvesting index, and packaging, most cauliflower farmers lacked knowledge of proper storage and transportation practices.

Okra: Among okra farmers, 41.5, 34.8 and 23.6% had low, medium and high knowledge. Farmers knew the harvesting index, the number of pickings, and recommended packaging materials, but lacked understanding of suitable containers for collection, leading to bruising and blackening. Moreover, they lacked knowledge of temperature regulation and humidity requirements for storing okra.

Pea: The pea farmers showed a similar pattern, with 50.2% having low knowledge, 40.4% having medium knowledge, and only 9.2% having high knowledge of post-harvest practices. They were familiar with the harvesting index, pickings for different maturity varieties, and packaging materials, but most did not know about tools like the tendrometer for checking maturity and were unaware of proper storage requirements for peas.

Farmer's knowledge of ideal time of harvesting the vegetables scored first rank with mean score of 3.10. Knowledge about different techniques of harvesting with mean score of 1.87 and harvesting stage of vegetables with

Table 1. Distribution of the vegetable growers according to their socio-personal characteristic

Socio-personal characteristics	Mean ± Standard deviation
Age	44±11
Education	3.43±1.17
Occupation followed	1±0
Operational land holding (Acres)	27.94±18.20
Farming experience (Years)	22.90±11.21
Participation level in extension activities	5.91±4.50
Level of Social participation	2.60±1.95
Level of extension contacts	12.48±7.32

n=240

Table 2. Distribution of farmers based on their knowledge of post-harvest management practices

Category	Range	Frequency (f)*	Percentage (%)
Potato (n=116)			
Low	2-5	45	38.7
Medium	5-8	66	56.9
High	8-11	3	4.3
Tomato (n=67)			
Low	5-8	33	49.2
Medium	8-11	25	37.3
High	11-13	9	13.4
Cauliflower (n=88)			
Low	3-5	33	37.5
Medium	5-7	27	30.6
High	7-9	7	7.9
Okra (n=89)			
Low	11-13	37	41.5
Medium	13-15	21	23.6
High	15-17	31	34.8
Pea (n=173)			
Low	3-5	87	50.2
Medium	5-7	70	40.4
High	7-9	16	9.2

mean score of 1.54 scored second and third rank respectively. Knowledge of farmers about temperature regulation for storage of vegetables scored last rank with mean score of 1.09.About 54.6 % of the farmers possessed low level of knowledge. About 39.6 and 5.83 % of the farmers fall in medium and high category of knowledge respectively. Farmers possessed high level of knowledge regarding time of harvesting of vegetables while they lacked knowledge about temperature regulation required for storage of vegetable crops.

Factors affecting vegetables knowledge regarding post-harvest management practices in vegetables: Stepwise regression analysis indicated that 27% of variation in knowledge of vegetable growers was determined by level of social participation (X1), age (X2), participation level in extension activities (X3) and level of economic orientation (X4). This relationship is described in the following formula: Y= -0.363X1+ -0.266X2+ 0.248X3+ 0.164X4. Participation level in extension activities and level of economic orientation have positive and significant effect on knowledge of vegetable growers regarding post-harvest management practices since through extension activities.

Adoption of recommended post-harvest practices: There were significant variations in the adoption of recommended post-harvest practices among farmers growing potatoes, tomatoes, cauliflower, okra, and peas. Potato farmers showed a mixed approach, with 58.62% using the recommended potato digger for harvesting, while others used spades, leading to the harvest of immature green potatoes. Farmers in Malerkotla and Nakodar adopted the recommended harvesting methods, whereas those in Baba Bakala Sahib used spades. None of the farmers followed cleaning practices, as middlemen collected the produce directly from the farms. For tomato harvesting, none of the farmers followed the recommended technique of lifting, twisting, and pulling the fruit. Instead, they directly pulled the tomatoes, leading to post-harvest losses. Cleaning practices with chlorinated water or dry cloth were not followed, as farmers washed the fruits with normal water after packing them in plastic crates. Sorting and grading were performed by 89.55% of farmers, while the rest packed all fruits, including damaged ones, without proper sorting. Despite using recommended plastic crates, no cushioning of fruits during transportation was done due to a lack of awareness. In cauliflower farming, all farmers followed the recommended harvesting method using a sickle and trimmed extra leaves for cleaning. Grading was done by 94.32% of farmers, and all packed the cauliflower tightly in recommended polythene bags for marketing. Among okra growers, none followed the recommended practice of harvesting with a clean knife; instead, they pulled the okra by hand. Grading was followed by 80.90% of farmers, and 89.89% used recommended polythene packaging, while others opted for gunny bags due to availability. Among, pea farmers, the recommended harvesting method was followed by all, but only 8.67% of farmers practiced grading due to the extra labor required. All farmers used the recommended red mesh bags for packaging, but none stored peas as they were unaware of the storage requirements and available technologies for proper storage.

Attitude of farmers towards post-harvest practices: The 59.17% of farmers have a favorable attitude towards post-harvest practices of vegetables, recognizing that these practices can reduce spoilage and increase the market value of their produce. Some farmers also expressed a positive attitude towards the need for training in post-harvest

Table 3. Distribution of the farmers according to their knowledge regarding various aspects of post-harvest management practices (n=240)

Knowledge statements	Response mean	Standard deviation
Knowledge about harvesting stage of vegetables grown by you	1.54	0.64
Knowledge about different techniques of harvesting vegetables	1.87	0.69
Ideal time of harvesting vegetables	3.10	0.95
Knowledge about temperature regulation for storage of vegetable crops	1.09	0.30

Table 4. Regression analysis of factors affecting vegetables knowledge regarding post-harvest management practices in vegetables

Independent variables	Dependent variables	Standard error	Coefficients	'p' value
Level of social participation (X1)	Knowledge regarding post-harvest management practices	.044	-0.363	.000
Age (X2)		.008	-0.266	.000
Participation level in extension activities (X3)		.012	0.248	.000
Level of economic orientation (X4)		.033	0.164	.005

R2 = 0.272
*significant at the 0.05 level,**significant at the 0.01 level

Table 5. Distribution of farmers on the basis of adoption of recommended post-harvest practices (n=240)

Practice	Frequency (f)*	Percentage (%)
Potato (n=116)		
Harvesting	68	58.62
Cleaning	0	0
Grading	14	12.06
Packaging	116	100
Tomato (n=67)		
Harvesting Method	0	0
Cleaning	0	0
Sorting /grading	60	89.55
Packaging	67	100
Cauliflower (n=88)		
Harvesting method	88	100
Cleaning	88	100
Grading	83	94.32
Packaging	88	100
Okra (n=89)		
Harvesting method	0	0
Grading	72	80.90
Packaging	80	89.89
Pea (n=173)		
Harvesting method	173	100
Grading	15	8.67
Packaging	173	100

*Multiple response

techniques and establishing freezing facilities for vegetables. However, many farmers showed an unfavorable attitude towards setting up rural industries for processing and storage to prevent distress sales. Additionally, there was limited positive attitude towards proper handling of vegetables at the farm level to reduce spoilage. Out of 240 farmers, 59.17% had favorable attitudes, Similar. positive attitude of farmers towards various aspects of post- harvest technologies was reported by Barua et al (2017).

CONCLUSION

The study concludes that vegetable growers have significant knowledge gaps in post-harvest practices, despite recognizing their importance in reducing spoilage and increasing market value. Only 59.17% of farmers had favorable attitudes towards post-harvest management and the need for training, many lacked knowledge on storage and transportation precautions. Adoption of recommended practices varied by crop, with medium knowledge among potato growers but lower levels for other crops. Factors such as participation in extension activities and economic orientation positively influenced farmers' knowledge.

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