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ECONOMIC ANALYSIS OF POST-HARVEST LOSSES OF VEGETABLES: A STUDY IN BOGURA DISTRICT OF BANGLADESH

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ABSTRACT

Mamun MA, Ahmad M, Sultana R (2018) Economic analysis of post-harvest losses of vegetables: a study in Bogura district of Bangladesh. *Int. J. Expt. Agric.* 8(1), 19-25.

The study has examined the nature and extent of post-harvest losses of vegetable at different stages in the Bogura. Multistage cluster sampling has been used for selection of 120 vegetable growers from six villages of three upazilla *viz*. Bogura sadar, Shibjonj and Shajahanpur. The sample has also included 25 market functionaries. Twelve major vegetables have been selected for the study. The maximum aggregate post-harvest losses were found in tomato, followed by potato, onion, okra, brinjal, chilli, country bean, cauliflower and cabbage. The results of the study indicated that post-harvest losses is the sum quantity of outputs lost in a series of operations undergone to all agricultural commodities including threshing, transportation, processing, storage and exchange before consumption. Severe losses were occurred due to poor facilities, lack of know-how, poor management and improper market facilities or careless handling of the producers, market intermediaries and consumers. Functional analysis was carried out to examine the factors affecting post-harvest losses at farm level in vegetables. Post-harvest losses at farm level were a function of several socio-economic factors like age of the farmer, education, type of family, and total production of selected vegetable crops among others. The functional analysis revealed that inadequate storage and inadequate transportation activities coupled with bad weather conditions significantly influenced the post-harvest losses at the farm level. The study suggested that establishment of producer co-operatives to handle various activities relating to production and marketing of vegetables and establishment of small sized cold storage units in the production canters would help to reduce the post-harvest losses.

Key words: *post-harvest losses, vegetables, farm level, market functionaries*

INTRODUCTION

Vegetables sub-sector plays an important role for development of Bangladesh. Nearly more than hundred types of vegetables comprising both of local and foreign origins are grown in Bangladesh. Vegetables are important for nutrition, economy and food security. Vegetables are identified as a significant one for this economy for its noteworthy contribution in raising the foreign exchange earnings and occupies an important position among the items exported from Bangladesh. Vegetables contribute 3.2% of the agricultural Gross Domestic Product (BBS 2009). Bangladesh earned US $ 41.11 million from export of agricultural products in 003-2004, which contributed 0.54% to total export earnings (BER 2008).

Bangladesh is suffering from the problems of poverty, unemployment and malnutrition. Vegetable sub-sectors can play important role to solve these problems within the shortest possible time. The importance of vegetable can be realized from two stand points such as, economic point of view and nutritional point of view. There are a large number of vegetables having different varieties, which can be grown throughout the year, due to climate and soil of Bangladesh is very much suitable for growing vegetables round the year. Based on the growing season, vegetables are categorized as summer/rainy season vegetables, winter season vegetables, and all-season vegetables. Among the summer vegetables, various cucurbits, cowpea, country bean, stem amaranth, several aroids and Indian spinach are predominant.

Winter vegetables include tomato, cabbage, Chinese cabbage, cauliflower, eggplant, carrot, spinach, bottle gourd, bush bean and radish. Crops like okra, heat-tolerant tomato, eggplant, carrot, spinach, many leafy vegetables and small onion are grown all year round. However, the largest numbers of vegetables are grown in the winter season. Vegetables are generally labour intensive crops and thus offer a considerable promise for generating increased rural employment opportunities. Outputs of all agricultural commodities produced in the field have to undergo a series of operations such as threshing, transportation, processing, and storage and exchange before they reach the consumer, and there are appreciable losses of outputs during these stages of their handling. The sum quantity of outputs lost in these operations at all of these stages is referred to as "post harvest losses". The seriousness of the problem of post-harvest losses has been discussed at several meetings, conferences, symposia, etc., at national and international levels. Many studies have been conducted for estimating the post-harvest losses particularly in the developed countries. A good number of studies (Ahmed 2001; Akhter 2006; Chowdhury 1996; Hossain 1997; Islam 2000; Mowla 1998; Naher 1998) were also being conducted which are related to costs and returns of different vegetables including tomato, cauliflower and cabbage in Bangladesh. However, the importance of post-harvest losses in agricultural commodities is not fully recognized in developing countries where agricultural production is not fully linked with marketing. The number of scientists involved in production research in these countries is significantly higher than those concerned with post-harvest losses in agricultural commodities. It is distressing to note that so much time is being devoted to the culture of the plant, so much money is spent on irrigation, fertilizers and crop protection

measures, but little attention is paid and resources devoted to the issues related with post-harvest losses resulting in failure to meet food requirement of the hungry millions. The wastage of agricultural commodities would mean not only monetary loss but also destabilization of the economy and a decline in the nutritional standards that is already low in developing countries (FAO 1980).

In perishable crops like fruits and vegetables, proper and scientific storage, packaging, transport and handling technologies are not adequate and hence, considerable amount of produce is wasted. The vegetable crops because of their moisture content are inherently more liable for deterioration in quality and quantity especially under tropical conditions. Moreover, they are biologically active and carry out transpiration, respiration, ripening and other biochemical activities, which contribute for deterioration in quality of the produce. Post-harvest losses in vegetables during post-harvest operations due to improper handling and storage are enormous. Gauraha (1997) reported that the post-harvest loss in vegetables ranges from 5.42 per cent in the case of bottle gourd to 32.64 per cent in the case of tomato. Post-harvest losses can occur in the field, in packing areas, in storage, during transportation and in the wholesale and retail markets. Severe losses occur because of poor facilities, lack of know-how, poor management and improper market facilities or due to careless handling of the produce by farmers, market intermediaries and consumers. It is, therefore, important that the post-harvest practices be given as much attention as production practices.

The study on post-harvest losses in vegetables at various stages of handling would help in assessing the extent and magnitude of losses and in identifying the factors responsible for such losses. This in turn would help in developing proper measures to reduce post-harvest losses at different stages from production point to consumption point. Under the circumstances, the reduction in post-harvest losses can help in increasing the availability of vegetables to a great extent without increasing the production. In the absence of reliable and objective estimates of post-harvest losses at different stages, the ways to evolve correct policies for minimizing such losses is more difficult. Very few studies have attempted to assess the extent of post-harvest losses in horticultural crops.

The present study attempts to estimate the post-harvest losses of major vegetable crops in Bogura. The information on the extent of losses at various stages is important not only for scientists and technologists but it would also be useful to policy makers, administrators and industrialists. The scientists and technologists would be guided by the findings of such studies in carrying out improvements in the crop production and post-harvest technologies aimed at minimizing these losses. The planners and the policy makers would be guided by the findings of such studies in formulating suitable policies that will help in reducing the post-harvest losses. Therefore, the present study was undertaken with a view to measure the extent of post-harvest losses in the selected vegetables at different stages and to study the factors affecting post-harvest losses at the farm level.

METHODOLOGY

Location of the study

The present study was conducted at three upazillas in the Bogura district under Rajshahi division. Since the region has vast potential for production, marketing and export of vegetables, it was purposively selected for the present study. For selection of vegetable growers and market functionaries multistage cluster sampling was used. At the first stage, one principal vegetable market, namely Mohasthangar (Shibgonj) market based on maximum annual arrival of vegetables was selected. At the second stage, two primary markets out of eight were selected for the present study. These were: Noynail (Shajahanpur) market and Pollimangal (Bogura Sadar) market.

The two primary markets were selected purposively in consultation with officials of department agricultural extension. At the third stage, two unions predominantly vegetables growing were chosen from each of the selected upazilla and a total six union was selected for the study. At the fourth stage, one villages from (near the road and at least 2-3 km away from the road) feeding the primary or secondary market were selected purposively considering the status of vegetable production. A total six villages were selected for the study. Finally, 20 farmers per village were selected randomly. Thus, the sample size was consisted of 120 vegetable growers.

The sample also included market functionaries of each category, *viz.* commission agents, wholesaler-cum commission agents and retailers. Five wholesale-cum commission agents were included in the sample. Ten retailers each from secondary as well the two selected primary markets were taken for the study. As such total numbers of retailers selected were 25. Several vegetable crops are cultivated in the Bogura district in different seasons. For the present study, only major vegetables grown in the study area were considered.

The selection of major vegetables was done on the basis of total annual production of different vegetables in the Bogura district. Thus, bitter gourd, tomato, potato, country bean, cauliflower, cabbage, onion, chilli, radish, yard long bean, okra and brinjal were selected for the study. The study was based on the primary data collected from

the selected farmers, wholesalers and retailers involved in the marketing using a pre-structured schedule by personal interview method. Data were collected during November 2017 to December 2017.

Table 1. Distribution of the population and sample

Upazilla	Union	Village	No of respondent	Vegetable market
Bogura Sadar	Lahiripara	Mudhumajhira	20	Pollimangal
	Shekherkola	Norual	20	
Shibgonj	Raynagar	raynagor	20	Mohasthangarh
	Mukamtala	Mukamtala	20	
Shajahanpur	Aria	Bamuniya	20	Noymail
	Khottapara	Durilia	20	
Total: Three	Total: 06	Total: 06	Total :120	Total: 03

Analytical techniques

In the study post-harvest losses in vegetables have been estimated at different stages. The losses were estimated to find out which vegetable incurred the maximum loss, as well as at which stage. In most of the cases, tabular presentation was used to present the data. Averages and percentages were used to estimate post-harvest losses. Functional analysis was carried out to examine the factors affecting post-harvest losses at farm level in vegetables. Post-harvest losses at farm level were defined as a function of several socio-economic factors like age of the farmer, his education, type of family, total production of selected vegetable crops etc. Nag *et al.* (2000) used a similar type of functional analysis to assess the influence of socio-economic factors on post-harvest losses in chickpea. The following multiple linear regression function was specified in the present study.

$Y = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + \ldots\ldots\ldots + a_9X_9 + e$

Where,

Y : Post-harvest loss at farm level in quintals per hectare,
X1: Age of the respondents in years,
X2: Education of the respondents in years,
X3: Production of onion/potato in quintals per ha,
X4: Type of family dummy [value ‘0’ for joint family and ‘1’ for nuclear family],
X5: Weather condition dummy [value ‘1’ for adverse and ‘0’ otherwise],
X6: Labour availability dummy [value ‘1’ for inadequate and ‘0’ otherwise],
X7: Storage availability dummy [value ‘1’ for inadequate and ‘0’ otherwise],
X8: Transportation availability dummy [value ‘1’ for inadequate and ‘0’ otherwise],
X9: Farmers knowledge on post harvest handling [value ‘1’ for inadequate and ‘0’ otherwise],
e : Random error.

The interest in the functional analysis was to see the influence of various socio-economic features of the farmers on post-harvest losses at farm level. The post-harvest losses [dependent variable] at the farm level were measured in terms of quintals of output lost per hectare. Age of the farmers was considered as one of the independent variables influencing the post-harvest losses at the farm level. It is assumed that as the age of the farmer increases his experience in post-harvest handling also increases and in turn helps to reduce post-harvest losses. There, it is hypothesized that age has a negative effect on post-harvest losses.

Age of the farmer is measured in terms of the number of years. The level of education is another variable that can exert influence on post-harvest losses. The educated farmers would be in a better position to have access to the knowledge of post-harvest operations. Therefore a negative association between this variable and the dependent variable was hypothesized in the study. The number of years of formal education of the farmer was included as a variable in the model. The quantity of output produced per hectare is likely to exert a positive influence on post-harvest losses. It is hypothesized that a farmer is not likely to pay full attention for post-harvest operations when large quantity of output is produced. In such cases his managerial skills might become a limiting factor and lead to higher post-harvest losses.

The production is measured in terms of quantity of output produced per ha. The type of family is another variable likely to influence post harvest loss at farm level. Higher the involvement of family members in farm operations, lower would be the post-harvest loss. However, the information on the actual number of family members involved in the farm operations was not collected. Therefore, it is thought of studying the influence of this variable on dependent variable by including this as a dummy variable. The information on type of family, namely, nuclear family or joint family was used. Value ‘0’ was assigned to joint family and value ‘1’ for nuclear family.

The type of family dummy was hypothesized to have negative association with post-harvest loss. It is assumed that the involvement of family members in post-harvest operations is more in joint families. The weather conditions prevailing at the time of post-harvest operations is another variable likely to influence post-harvest

losses and thus was included in the model. In view of the lack of exact weather data, it was decided to include this variable as dummy variable to capture the farmers' perception regarding weather conditions at the time of harvest. The dummy variable was assigned the value '1' if the farmer felt that the weather conditions at the time of harvesting were adverse [not favourable]. This variable is expected to have positive coefficient implying lower level of post-harvest losses during favourable weather conditions. Availability of labour at the time of harvesting is one of the variables, which is likely to influence the extent of post-harvest losses.

The labour availability was considered to be adequate if the farmer felt that he could avail of the required number of man-hours at the required time to carry out harvesting operations. The adequacy of labour availability was measured in terms of dummy variable, which took the value '1' if the farmer felt that labour availability for harvesting was inadequate. Therefore, this variable is expected to have a positive association with post-harvesting losses. The storage facility available at the farm level is expected to influence the post-harvest losses at the farm level. The storage availability was assumed to be adequate if the farmer has no problem in storing his farm produce.

The adequacy of storage was represented by a dummy variable. Value '1' was assigned to the dummy variable if the farmer had inadequate storage facility. Therefore, this variable is hypothesized to have a positive association with post-harvest losses. Often, it is reported that faulty methods of transporting farm produce lead to higher post-harvest losses. To examine the influence of transportation facility on post-harvest losses, a dummy variable was included among explanatory variables, which took the value '1' if the farmer had inadequate transportation facilities. The transportation was considered to be adequate if the farmer had no problem with respect to roads or the means of transportation. This variable is expected to have a positive association with post-harvest losses. To isolate the most important socio-economic factors conditioning the post-harvest losses, step-wise regression was carried out. This facilitated to retain only those factors, which significantly influenced the post-harvest losses in the regression model. The results of the study are presented and discussed in the following sections.

RESULTS AND DISCUSSION

Post-harvest losses in vegetables at farm level

The post-harvest losses were estimated first at producer level, and then at trader level. The losses at producer level have been estimated at different stages, *viz*. harvesting, grading & packing, handling & transportation and marketing; whereas the losses at trader level have been estimated at loading-unloading, transportation, grading and selling stages. The results of the analysis have been presented in Table 2.

Table 2. Post-harvest losses in vegetables at farm level in Bogura

Vegetables	Total production of selected farmer (in quintals)	Post harvest losses in stages at farm level (%)				Total losses
		Harvesting	Grading & packing	Handling & transportation	Marketing	
Tomato	53.24	8.12	3.51	2.42	0.18	14.23
Potato	526.29	4.28	1.83	-	2.23	8.34
Onion	53.35	3.25	1.51	-	1.38	6.14
Country bean	21.25	2.86	1.89	3.89	0.58	9.22
Cauliflower	27.18	1.29	3.12	2.46	1.52	8.39
Cabbage	31.62	1.68	2.64	0.98	1.13	6.43
Bitter gourd	18.57	3.13	2.05	3.07	0.46	8.71
Chilli	6.69	3.29	2.36	3.56	0.57	9.78
Radish	38.50	2.12	1.30	-	0.49	3.91
Yard long bean	5.28	2.51	1.89	1.78	1.36	7.54
Brinjal	35.36	4.03	2.76	0.94	0.59	8.32
Okra	12.51	4.35	5.12	0.50	0.53	10.5
Pointed Gourd	5.24	2.31	1.25	0.89	1.2	9.69

Table 2 presents the overall scenario of postharvest losses at different stages on sample farms. The maximum post-harvest loss of 14.23 per cent was found in tomato, okra (10.05%), chilli (9.78%), pointed gourd (9.69%), Country bean (9.22%), Bitter gourd (8.54%), brinjal (8.32%), cauliflower (8.39%), potato (8.34%), onion (6.14%), cabbage (6.43%), yard long bean (7.54%) and radish (3.91%). Amongst different stages, tomato, okra, chilli, onion, potato, brinjal, okra and Bitter gourd recorded maximum losses at the harvesting stage. However, Sharma *et al*. (1995) had reported maximum postharvest losses at grading & packing stage. The Tomato, Okra and cauliflower registered maximum losses at the grading & packaging stage, while Bitter gourd, Country bean and chilli had maximum losses during the handling & transportation stage.

Post-harvest losses in vegetables at trader level

In this section the post-harvest losses at the wholesale and retail levels have been discussed. The wholesale transactions in vegetables were being performed from early morning till around 11 am every day. The wholesaler-cum-commission agents were found not taking title in the case of green vegetables in the study area, except in potato and onion. The functionaries informed that they lost up to 13 per cent in potato and 11 per cent in onion during storage and about half of the quantity was sold without storing for a long period. Therefore, the half of these losses, *viz*. 7.5 per cent and 6.5 per cent were considered the losses at wholesale level for potato and onion, respectively. The losses at retail level were also worked out and have been presented in Table 3.

Table 3. Post-harvest losses in vegetables at retail level

Vegetables	Average quantity purchased (in quintals)	Post-harvest losses in vegetables in different Stages at retail level (%)				Total loss
		Loading unloading	Transportation	Grading	Selling	
Tomato	8.52	2.79	0.86	1.13	3.92	8.70
Potato	58.76	-	1.53	2.40	0.98	4.91
Onion	22.39	-	1.40	1.82	1.31	4.53
Country bean	3.13	0.67	0.73	1.28	3.75	6.43
Cauliflower	7.67	0.70	1.13	1.87	1.58	5.28
Cabbage	8.30	0.63	0.96	0.76	1.15	3.5
Bitter gourd	3.75	0.52	0.69	1.18	2.51	4.9
Chilli	2.89	0.7	0.88	1.23	3.53	6.34
Radish	3.33	1.13	0.57	0.49	0.57	2.76
Yard long bean	2.05	0.35	0.48	1.36	3.53	5.72
Okra	5.32	0.71	0.89	1.27	5.39	8.26
Brinjal	8.23	0.87	0.91	0.69	3.42	5.89

It was found that loss was registered maximum by tomato (8.70%), followed by okra (8.26%), Country bean (6.43%), chilli (6.34%), brinjal (5.89%), yard long bean (5.72%), cauliflower (5.28%), potato (4.91%), bitter gourd (4.90%), onion (4.53%), cabbage (3.50%) and radish (2.67%). As far as losses at different stages were concerned, the maximum losses were estimated during the selling stage in most of crops, except potato, onion, cauliflower, cabbage and radish. The maximum loss during selling stage was registered in tomato.

Total post-harvest losses in vegetables at different level

The aggregate post-harvest losses in sample vegetables were calculated by taking together the losses at producer level, wholesale level and retail level.

Table 4. Post-harvest losses in vegetables at different levels

Vegetables	Post harvest Losses at different levels (%)			Total
	Producers	Wholesaler	Retail	
Tomato	14.23	0	8.70	22.93
Potato	8.34	7.5	4.91	20.75
Onion	6.14	6.5	4.53	17.17
Country bean	9.22	0	6.43	15.65
Cauliflower	8.39	0	5.28	13.67
Cabbage	6.43	0	3.5	9.93
Bitter gourd	8.71	0	4.9	13.61
Chilli	9.78	0	6.34	16.12
Radish	3.91	0	2.76	6.67
Yard long bean	7.54	0	5.72	13.26
Okra	8.32	0	8.26	16.58
Brinjal	10.5	0	5.89	16.39

Table 4 reveals that post-harvest losses were maximum in Tomato (22.93%) and minimum in radish (6.66%). Hazarika (2006) has also observed maximum postharvest losses in tomato. The potato ranked second in the list registering 20.75 per cent loss, followed by onion (17.17%), okra (16.58%), brinjal (16.39%), chilli (16.12%), country bean (15.65%), cauliflower (13.67%), bitter gourd (13.61%), cabbage (9.93%), and raddish (6.67%). Across different levels, it was found that the losses were maximum at the grower level in all the vegetables, except radish. Similar results were obtained by Gajanana *et al.* (2006) and Kumar *et al*. (2006).

Factors affecting post-harvest losses at farm level

In order to study the influence of different socio-economic features of the farmers on total post-harvest losses at the farm level, a multiple linear regression analysis was carried out. It was hypothesized that the factors like age, education and family type have negative effect on post-harvest losses while factors like adverse weather, inadequate labour, inadequate storage and inadequate transportation have positive effect on post-harvest losses. The estimated regression coefficients are presented in Table 5. The variation in the eight independent variables included in the regression model explained nearly 68 per cent variation in the total post-harvest losses in onion and 81 per cent in the case of potato. The F-ratio was significant in both the crops thereby indicating the good fit of the regression models. The regression coefficients of all the variables except the age were positive in the regression function for onion. Thus the coefficients for six out of nine variables included in the model were in conformity with the postulated hypotheses.

The post-harvest losses were positively and significantly conditioned by onion output per hectare, adverse weather, inadequate storage and inadequate transportation as revealed by the step down regression analysis. The post-harvest losses in onion increased with an increase in onion output per hectare. Factors such as favourable weather conditions, adequate storage facilities and adequate transportation facilities would thus help in minimizing the onion post-harvest losses. The study by Nag *et al.* (2000) reported that an improvement in storage would decrease the post-harvest losses in chickpea.

Table 5. Regression estimates of factors affecting post-harvest losses at farm level

No.	Variables	All	Step down
1.	Intercept	0.0428 (0.553)	0.1870 (0.297)
2.	Age of the respondents (X1)	-0.0013 (0.009)	0.0077
3.	Education of the respondents (X2)	0.0158 (0.021)	
4.	Production of output per hectare (X3)	0.0233* (0.004)	0.0243* (0.004)
5.	Type of family dummy (X4)	-0.3270 (0.231)	
6.	Weather dummy (X5)	0.6980* (0.191)	0.5040* (0.189)
7.	Labour dummy (X6)	-0.2270 (0.257)	
8.	Storage dummy (X7)	0.4523** (0.196)	0.8230* (0.185)
9.	Transportation dummy (X8)	0.5320* (0.187)	0.6050* (0.184)
10.	Knowledge on PHH (X9)	0.8720* (0.330)	0.7670* (0.289)
11.	R^2	0.68	
12.	F-value	12. 85*	
13.	R^{-2}	0.65	

Note: Figures in parentheses indicate standard errors of coefficients. ** at 1% and * 5% level Significant

In the case of post harvest losses of vegetable contrary to the hypotheses, the coefficients of age, types of family and labour dummies were negative and the coefficients of transportation, storage, weather and knowledge of the respondents were positive. Thus in six out of nine variables the estimated regression coefficients did not support the hypothesized relationship between the dependent variable and the independent variables. However, in none of these six contradicting cases, the regression coefficients were significant.

The step down regression analysis showed that the post-harvest losses in vegetable were significantly and positively associated with production per hectare. The post-harvest losses in vegetable were positively and significantly conditioned by adverse weather, transportation, knowledge, education and inadequate storage. Thus, favourable weather conditions, training on post-harvest handling and adequate storage facilities would help minimizing the post-harvest losses of vegetable.

The post-harvest losses in vegetables were found to increase with an increase in output per hectare. This might be due to the fact that the farmers might not be in a position to give full attention and care for post-harvest operations when a large quantity of output was produced. Owing to the tender texture and high moisture content, fresh vegetable are susceptible to fungal infection, rottenness and spoilage during transportation and marketing.

CONCLUSION

The study has estimated post-harvest losses in major vegetables grown in Bogura. The post-harvest losses occur due to faulty methods of harvesting, threshing, cleaning, drying, storage, transportation, processing, packaging and distribution of agricultural commodities. At producer level, the post-harvest losses have been found maximum in tomato (14.23%) followed by brinjal (10.05%), chilli (9.78%), country bean (9.22%), and minimum in radish (3.91%). At the retail level also, tomato has registered maximum loss, followed by okra, country bean and chilli. The maximum aggregate post-harvest losses have been found in tomato, followed by potato, onion, okra, brinjal and minimum in radish. Across different stages, the losses have been found maximum at the grower level in all the vegetables, except Radish. The functional analysis revealed that inadequate storage and inadequate transportation activities coupled with bad weather conditions and knowledge

on post-harvest handling of vegetable positively and significantly influenced the post-harvest losses at the farm level. Beside these the spoilage/loss of vegetables at the grower level results from lack of his knowledge about proper post-harvest management. Improper grading, packing, lack of storage and inadequate transportation facilities contribute more to the problem. One of the most important causes of postharvest losses is harvest at inappropriate maturity, resulting in erratic ripening and poor quality.

RECOMMENDATIONS

Therefore, there is an urgent need of training the vegetable growers on scientific post-harvest techniques, if the vegetable production is to be sustained on a profitable basis in the region. The study has suggested that one possible solution to tackle these problems could be the establishment of producer co-operatives to handle various activities relating to production and marketing of vegetables. This will not only help reduce the post-harvest losses but will also increase the bargaining power of growers in marketing. It will help them in adopting consumer-oriented approach to vegetable marketing. The establishment of small sized cold storage units in the production canters would help in reducing the storage losses in vegetables.

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