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PACKAGING DECISIONS IN HORTICULTURE SECTOR OF KHYBER PAKHTUNKHWA: A Province of Pakistan

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Abstract

Packaging technology play an important role in marketing horticultural produce. In Pakistan, wooden and cardboard boxes are mostly used as packing material. This study has been undertaken to carry out the benefit cost ratio to determine factors affecting adoption of cardboard cartons for which a sample of 122 respondents was selected through proportionate random sampling. Benefit Cost Ratio of the two packaging technologies was compared through paired t-test while probit estimates were carried-out for adoption of cardboard cartons. Adopters of cardboard cartons received the price premium of 45 per cent and BCR of 4.56 as compared to 3.49 received by wooden-box users. Probit estimates with marginal effects revealed that orchard size, destination of market distance and availability of boxes in different sizes would increase the probability of adoption. Experience and cost were considered significant factors for non-adoption of cardboard packaging. In order to increase adoption of cardboard packaging; mechanical strength and storage environment/ facilities of boxes should be modified.

Key Words: Packaging Technology, Adoption, Price Premium, Cardboard Box, Benefit Cost Ratio.
JEL Classification: D41, M11, O31, Q55.

I. Introduction

The land of Pakistan has rich topographic, climatic endowments, and variations in soil where large range of horticultural crops, such as fruits, vegetables, roots and tuber-crops, ornamental, medicinal and aromatic plants, spices, etc., are grown. The important fruits produced in Pakistan are citrus, mango, dates, guava, banana, peach, plum, pear, apple, apricot, grapes, persimmon, etc. Citrus leads other fruits in term of production and is followed by mango, dates and guava. Total horticultural production (fruit and vegetables) is about 12 million tons on annual basis wherein fruit production is about 5.71 million tons, in Pakistan [GOP (2008)].

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During the recent years, significant increase has been observed in export earnings of the horticultural crops. This sector can enlarge opportunities for increasing income, curving down hunger poverty and socio-economic problems of people in the region [Alam and Mujtaba (2002)]. The issue of post-harvest losses is a great obstruction in way of realizing the aforementioned objectives. The available literature presents a figure of about 35 per cent post-harvest losses in fresh produce. In case of plum, the post-harvest losses were about 21.51 per cent [Shahzad, et al. (2013)]. Reasons for post-harvest losses are biological, microbiological, chemicals, bio-chemicals, mechanical, physical, physiological and psychological factors. The secondary factors which encourage these primary factors are inadequate harvesting methods, packaging, transportation, storage and some environmental factors, like temperature, humidity and solar radiation [Shah and Farooq (2006), Gangwar, et al. (2007), Rehman, et al. (2007), Khan, et al. (2008), Adeoye, et al. (2009), and Buyukbay, et al. (2011)]. Reduction of post-harvest losses can increase food availability, decrease the needed area for its production and, conserve natural and financial resources by adopting better management practices. The literature reveals that use of inappropriate packaging containers increase post-harvest losses by 14 to 30 per cents of perishable commodities, during shipment [Saeed, et al. (2010)]. On evaluating the cardboard and wooden packaging materials it was found that post-harvest losses of plum were 10.49 and 14.24 per cents, respectively [Shahzad (2013)]. Hence, the use of appropriate packaging material would greatly help to reduce losses by protecting the produce from mechanical injury and contamination, during the marketing process [Marsh (2001), Kader and Rolle (2004)].

Different packaging material, such as wooden and plastic crates, cardboard cartons, plastic bags, jute bags and baskets is being used for fruits and vegetables [Marsh (2001), Sharif (2011)]. However, it is pertinent to mention that prevalent packaging material have certain advantage over others. Wooden crates are being used for a wide range of fruits and vegetables because of its good mechanical protection, stacking characteristics and high weight to strength ratio, whereas, its rough surface makes the fruit susceptible to injuries, little resistance against fungus, hygroscopic and shabby look [Gajjar (2012)]. On the other hand cardboard box provides protection against injuries, due to vibration during transport but offer little moisture resistance, high tear ability and fungus susceptibility.

In Pakistan, fruits and vegetables are packed in wooden crates in a traditional way and transported to distant markets. Rough surface of these boxes cause mechanical injuries. Poor road conditions and lack of specialized vehicles for transport of horticultural produce enhances injuries due to vibration in the process of marketing. To avoid injuries and time taken for transportation to the main markets, unripe fruit is plucked and chemical is used for ripening. The literature reveals that chemical ripening is hazardous for health [Dhembare (2013)]. To reduce mechanical injuries and provide suitable cushioning to the produce, cardboard cartons have been introduced. The present study is conducted with an objective to carry out the cost benefit analysis of different packaging materials and determine factors affecting adoption of the cost effective packaging material.

II. Material and Methods

This study is based on primary data collected through a structured questionnaire in Swat district; leading to terms of production of plum in Khyber Pakhtunkhwa province, Pakistan. As decisions about packaging material are mostly taken at farm level, the data was collected from growers and contractors. Proportionate random sampling techniques were used for collection of information from different tehsils of the province. For analysis purpose, the data of 122 respondents was collected and entered in the Excel sheet and STATA 12.

1. Comparison of benefit Cost Ratios of Cardboard Carton and Wooden Crates

Cost benefit analysis was carried out by comparing the price received by farm-level respondents and the total packaging cost. Comparison of *BCRs* was carried out by paired t-test. The formula for the cost benefit ratio is:

$$BCR \quad \frac{B}{C}$$

where, *BCR* is the benefit cost ratio of packaging material, *B* is benefit in the form of average price per kg of plum accrued to respondents, and *C* is the cost of packaging material per kg of plum.

2. Price Premium

To determine the advantage of cardboard carton, the price premium analysis was carried out. Formula for the price premium is as under,

$$P_{prem} = \frac{P_t - P_r}{P_r}$$

where, P_{perm} is the premium price of target group (cardboard cartons) packaging material, P_t is the average price of plum packed in target group (cardboard cartons) packaging material, and P_r is an average price of plum packed in reference group (wooden crates) packaging material.

3. Adoption Decision

There are various factors on which decision regarding packaging technology is made. To find these factors Probit Model was employed on the basis of normality of the data [Salasaya, et al. (2007)]; which was checked through *S*. Wilk test. The model is given as below;

$$Y_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots\ldots\ldots + \beta_k X_{ki} + \epsilon_1 \qquad \epsilon_i \sim N(0,1)$$

i refers to respondent, and *X's* are explanatory variables

where

Y_i = Packaging material used: 1 for cardboard carton; 0 for otherwise,
X_{1i} = Education of growers/contractors (years),
X_{2i} = Experience of growers/contractors (years),
X_{3i} = Size of the orchard (acres),
X_{4i} = Destined market distance (kms),
X_{5i} = Total cost per pack in rupees,
X_{6i} = Maturity in percentage,
X_{7i} = Availability of different packaging sizes (Nos),
X_{8i} = Dummy storage: 1 if yes, 0 otherwise,
X_{9i} = Ownership nature; 1 if contractor, 0 otherwise,
X_{10i} = Contract stage; 1 if contracted before fruit formation, 0 otherwise.

Post-estimation test was carried out for model specification and parameters interaction. Model specification was checked through linktest, whereas; interaction between the parameters was examined by employing testparm, in Stata.

III. Results and Discussion

1. Characteristics of Growers and Contractors

The data which had different characteristics was collected from two types of respondents: the growers and the pre-harvest contractors. Pre-harvest contractors had relatively higher age and experience, as compared to growers. On an average, pre-harvest contractors cultivated orchards on an area of 5.55 acres; whereas, growers cultivated orchard on 2.57 acres. Reason for this difference is that many orchards are hired on contract by the contractors; whereas; growers harvest their own orchards. There is a highly significant difference of 23,494 kgs in the net packed plum. Contractors use more carbide which is not good for human health and hence must be prohibited; whereas, growers face relatively high cost of packaging boxes but the differences is insignificant. Details of the characteristics of growers and contractors are presented in Table 1.

2. Packaging wise Respondents' Characteristics

Two types of packaging material (cardboard cartons and wooden crates) are used for packing of plum. On the basis of packaging material, respondents were divided into two groups. There was an insignificant difference in age, education, experience, net

TABLE 1

Respondents' Characteristics

Characteristics	Growers Mean	Contractors Mean	Difference b/w Mean	t-values
Age (years)	38.21	41.04	-2.83	-1.52
Education (years)	9.57	8.61	0.96	1.29
Experience (years)	12.85	16.78	-3.93**	-2.38
Area (acres)	2.57	5.55	-2.98***	-3.12
Skilled labor used (%age)	0.870	0.866	0.004	0.11
Net quantity (kg)	24755	48249	-23494***	-3.51
Carbide quantity (grms/box)	23.16	26.95	-3.79	-1.15
Cost of packaging (Rs./box)	73.45	71.54	1.91	1.08

*** significant at 1 per cent, ** significant at 5 per cent.
Source: Field Survey.

quantity packed and quantity of carbide used per box. Cardboard carton adopters received significantly higher price (Rs.18/kg) for their plum. They also faced significantly lower packaging cost due to availability of different size of boxes, as compared to the wooden box; normally available in single size. Findings of the study reveals that cardboard carton adopters had to travel significantly less distance as volume of folded boxes is smaller and can be stored easily in small stores. Being voluminous, wooden crates are not available easily at all places as they need more space/big stores to be stocked; therefore, their users may have to travel far to procure them. Details of the characteristics of respondents (both groups) are presented in the Table 2.

TABLE 2

Packaging-wise Respondents' Characteristics

Characteristics	Mean Cardboard Cartons	Mean Wooden Crates	Difference	t-values
Age (years).	41	39	2	0.82
Education (years).	8.5	8.6	-0.1	0.106
Experience (years).	15	15.83	-0.83	0.46
Net Quantity (kg).	52940	37786	15154	0.87
Average price (Rs).	58	40	18***	12.6
Carbide quantity (grams).	25.36	25.98	-0.62	0.21
Cost of packaging (Rs).	64	81	-17***	29.50
Input market distance (km).	1.9	3.4	-1.5***	7.06

*** significant at 1 per cent, ** significant at 5 per cent.
Source: Field Survey.

3. Comparative Analysis of benefit Cost Ratios of different Packaging Materials

There are different preferences of consumers for various types of packaging material; their preference is revealed through the price they pay for fruit packed in different packaging material. The difference in price is an indicator for adoption of packaging material. Findings of the study shows that an average packaging cost of plum was Rs.12.74/kg in case of using cardboard cartons; whereas, it was Rs.11.52 for wooden crates. Though the smaller size of cardboard cartons may look expensive but good quality of plum packed in small size boxes was sold at premium price. People may prefer to give good quality of fruit packed in small boxes in the form of gift. Growers and contractors using cardboard cartons received price of Rs.58/kg of the fruit against Rs.40/kg of the wooden crate users. Respondents adopting small gift packs were able to sell at premium price. Cost benefit ratio was calculated for comparative analysis of both types of packaging material through paired t-test. Results of the model shows that mean value of Benefit Cost Ratio (BCR) was 4.56 for cardboard carton users and 3.49 for wooden crate users. High value of t-statistic showed a significant difference of 1.07 in the benefit cost ratio of cardboard cartons and the wooden crates. Details of benefit cost ratios are presented in Table 3.

4. Price Premium in case of Cardboard Carton

Difference in preference of consumers' result in price variation of fruit packed in different packaging material. Being available in four different sizes cardboard cartons could cater for need of the diversified consumers. Best quality of plum packed in small boxes (gift packs) is sold at Rs.110/kg; whereas, cardboard carton adopters receive a price of Rs.58/kg against Rs.40/kg packed in wooden crate. Price premium of about 45 per cent is accrued to the adopters of cardboard carton.

TABLE 3

Comparative Analysis of Benefit Cost Ratios of Packaging Materials

Packaging	Observations	Mean (BCR)	Std. Error
Cardboard carton	61	4.56	0.079
Wooden crates	61	3.49	0.096
Difference	61	1.07	0.13
df = 60			
t = 7.80			
critical t value = 1.65			

Source: Field Survey.

5. Determinants of Cardboard Carton Adoption (Probit Estimates and Marginal Effects)

Probit estimates were carried out to determine factors affecting adoption of cardboard cartons. After the estimation of probit model its specification was checked through linktest command in Stata. Z-value of the parameter was highly significant showing that the model was free from mis-specification problem. Interaction between variables of the model was tested by test-parm command and results of testparm revealed the rejection of no interaction hypothesis among packaging and the right hand side variables. The highly significant value of post estimation parameter test, i.e., chi^2 (10) equaled to 52.48, indicated the presence of heteroscedasticity problem in the model. In order to avoid misleading interpretation of coefficients the marginal effects were applied. Marginal effects explain that farm size, market distance and the availability of box in multiple sizez has significant positive effect on adoption of cardboard cartons' packaging technology. It is found that increase of one unit in the farm-size would increase the probability of adoption for cardboard carton by 0.063 at 1 per cent level of significance. Similarly, increasing the number of sizes from an average number of 2.09 to 3.09 may increase the adoption probability by 0.82; whereas, infinitesimal increase in distance of market (mandi) will increase adoption of the cardboard box by 0.005 at 5 per cent level of significance. Due to its smooth surface and soft cushioning cardboard carton shows greater reliability for far-off markets. Availability of different size of boxes enhances adoption because it can cater the need of diversified consumers. The respondents reported that premium quality is packed in small boxes and sent to far off markets to fetch premium prices. Education level, contract stage (dummy) also reveals positive relation but it is insignificant. Experience of respondents and cost were found to decrease significantly, the adoption probability of cardboard carton by 0.023 and 0.043 at 1 per cent level. Being a new intervention, aged and experienced respondents were found reluctant to use cardboard cartons. The tendency to adopt new technology declines with an increase in age [Sunding and Zilberman, (2001)]. Another reason for this reluctance attitude is the apparent high cost of cardboard packaging box as transportation cost of large size wooden boxes may look cheaper. Similarly, ownership (dummy), maturity level (ripeness) and storage (dummy) were also among the non-adoption factors but were insignificant. Details of the probit estimates, linktest, testpram and marginal effects are presented in Tables 4, 5, 6 and 7, respectively.

TABLE 4

Determinants of Cardboard Carton Adoption (Probit Estimates)

Packaging	Coef.	Robust Std. Err.	Z	P>z	[95% Conf.	Interval]
Education	0.0677621	0.0440933	1.54	0.124	-0.0186592	0.154183
Experience	-0.0581814	0.0209443	-2.78	0.005	-0.0992316	-0.01713
Area (acres)	0.1595655	0.0486109	3.28	0.001	0.0642899	0.254841
Ownership	-0.7015018	0.4316729	-1.63	0.104	-1.547565	0.144562
Contract Stage	0.4418485	0.4634455	0.95	0.340	-0.4664881	1.350185
Maturity	-1.723387	1.179471	-1.46	0.144	-4.035107	0.588333
Storage	-0.899836	0.7822418	-1.15	0.250	-2.433002	0.63333
Destination	0.0012397	0.0005225	2.37	0.018	0.0002156	0.002264
Cost	-0.1108327	0.0264592	-4.19	0.000	-0.1626917	-0.05897
No. of sizes	2.088752	0.3116943	6.70	0.000	1.477842	2.699662
Cons	3.849573	1.856344	2.07	0.038	0.2112065	7.48794
Number of obs. = 122						
Wald chi2 (10) = 52.48						
Prob. > chi2 = 0.000						
Pseudo R2 = 0.622						

Source: Field Survey.

TABLE 5

Post-Estimation Model Specification Test (linktest)

Packaging	Coef.	Robust Std. Err.	Z	P>z	[95% Conf.	Interval]
Hat	1.001189	0.179025	5.59	0.000	0.6503072	1.35207
Hatsq	-0.04097	0.129482	-0.32	0.752	-0.2947511	0.212809
Cons	0.040807	0.220873	0.18	0.853	-0.3920969	0.473711
Number of obs. = 122						
LR chi2(2) = 105.28						
Prob. > chi2 = 0.0000						
Pseudo R2 = 0.6225						

Source: Field Survey.

TABLE 6

Post-estimation Interaction Test (testparm)

1. [packaging] edu = 0	2. [packaging] experience = 0
3. [packaging] area = 0	4. [packaging] ownership = 0
5. [packaging] contractstage = 0	6. [packaging] maturity = 0
7. [packaging] storage = 0	8. [packaging] destination = 0
9. [packaging] cost = 0	10. [packaging] noofsizes = 0
chi2(10) = 52.48	Prob. > chi2 = 0.0000

Source: Field Survey.

TABLE 7

Determinants of Cardboard Carton Adoption (Marginal Effects)

Variable	dy/dx	Std. Err.	Z	P > z	[95%	C.I.]	X
Education	0.026803	0.01749	1.53	0.125	-0.00748	0.061086	8.53279
Experience	-0.02301	0.00838	-2.75	0.006	-0.03944	-0.00659	15.4344
Area (acres)	0.063115	0.01895	3.33	0.001	0.025973	0.100257	4.62077
Ownership	-0.26674	0.15303	-1.74	0.081	-0.56668	0.0332	0.655738
Contract Stage	0.174774	0.18096	0.97	0.334	-0.17989	0.529442	0.729508
Maturity	-0.68167	0.46746	-1.46	0.145	-1.59788	0.234543	0.666148
Storage	-0.33643	0.24604	-1.37	0.172	-0.81867	0.145806	0.065574
Destination	0.00049	0.00021	2.34	0.019	0.00008	0.000901	672.459
Cost	-0.04384	0.01059	-4.14	0.000	-0.0646	-0.02308	72.2541
No. of sizes	0.826185	0.12069	6.85	0.0	0.589637	1.06273	2.09836

Source: Field Survey.

IV. Conclusion and Recommendations

Packaging plays an important role in marketing of horticultural produces. Mostly, two types of packaging materials (cardboard cartons and wooden crates) are used for confinement of fruit during shipment. This study reveals that cardboard packaging may enables the adopters to earn 45 per cent premium price for their fruit. The benefit cost ratio of a cardboard carton is 4.56 as compared to 3.49 of wooden box. Orchard size, destination market distance and availability of different size of the boxes increase the probability of adoption. This study reveals that expe-

rienced respondents are reluctant to adopt cardboard cartons, due to the cost factors and other economic considerations.

Measures must be taken for proper ripening of fruit by determining maturity index and the associated shelf-life. They should be made cost effective and be modified with plastic coating to withstand storage atmosphere. Cardboard box should be strengthened for stacking by using good quality paper. To cater for the needs of diversified consumers, availability of cardboard cartons should be in different sizes.

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