Research Article

Household's Perception and their Willingness to Pay for Pesticides-Free Fruits in Khyber Pakhtunkhwa (Kp) Province of Pakistan: A Double-Bounded Dichotomous Choice Contingent Valuation Study

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Abstract | This study investigated household's willingness to pay (WTP) for pesticide-free locally produced fresh fruits in Khyber Pakhtunkhwa, Pakistan. A Contingent Valuation Survey Method (CVM), constructed with a double-bounded WTP elicitation format, was used to interview a randomly selected sample of 600 households. Survey data revealed that households were willing to pay on average rupees 26 more per kilogram of pesticides free fruits. Results from regression analysis showed that age of the household head and his awareness of pesticides use over fruits, household size and their total monthly income were significant determinants of their WTP. In addition, health concern and environment concern of pesticides use also influence the WTP. Findings from this study help in assessing the market potential for pesticides-free fruits in Pakistan.

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Introduction

Pesticides are agrochemical formulated to cope with the severe problems/ diseases caused by insects, fungi, virus and self-grown weeds. In modern agriculture arena, pesticides are intensively used on crops before and after harvest. The application of pesticides surged with passage of time due to an increase in the demand of agricultural commodities by the burgeoning population of the world. The overall pesticide's consumption across the globe is observed as about 2 million tons per year. While this massive pesticides utilization demonstrates that about 69 percent is used by European countries and remaining 31 percent is utilized by rest of the world as mentioned by Abhilash and Singh (2009). More alarming situation is that the aforementioned magnitude of pesticides consumption is increasing with the every passing year as reported by FAO (2002).

Despite the substantial contribution of pesticides in increasing agricultural production and control food insecurity, societies around the world are aware and concerned about the food sanitation, safety and environmental externalities owing to irrational use of pesticides and other crop's input (Wilson, 2000). Still, most of the developing countries, including Pakistan, have adopted obsolete strategies for pest control, and their farmers are out of race for agriculture export. In Pakistan, massive increase in the pesticide's use has leaded to two major harms to Pakistan's economy.

Firstly, Pakistan imports a large quantity of pesticides incurring billions of costs on it and second, overuse of pesticides on agricultural commodities has created many health and environmental hazards.

Fertile agricultural land and plenty of fresh water provides advantage to Pakistani farmers to produce best quality fruits and vegetables. Sadly, majority of the farmers are intensively using fertilizers and pesticides to get maximum production of fruits and vegetables. Some studies have reported the existence of pesticides residues for apple, peach and mango fruits above the WHO standards. The consumption of these fruits is harmful for human health. This is a serious problem for our producers and for the exporting agencies of the country. We need to aware our farmers that their production practices are not only damaging our ecosystem but also reducing their returns in the long run. They have the ability to produce them without using the pesticides, and we need to assure them that in this way they can create market for their products and can get reasonable price premium from local and foreign consumers.

The main objective of the study is to investigate local consumers' WTP for pesticides free fruits in Pakistan and identify its determinants. Results from this study helps to assure farmers and agricultural policy makers that local consumers are willing to pay price premium for pesticides free fruits. They can further utilize these results for analyzing farmers cost and benefit from pesticides free fruits production in the country.

Materials and Methods

Study area and sampling

This study was conducted in Khyber Pakhtunkhwa province of Pakistan. Khyber Pakhtunkhwa (KP) is famous for production of delicious fruit, such as peach, apple, oranges, etc. Given that the region is one of the important fruit growing regions with relatively readily available agricultural labor, growers has the potential to produce pesticides free fruit. In this direction, more research work is required to estimate a price premium households' willing to pay for fruit free of chemicals and pesticides.

A three stage stratified sampling technique was used for the collection of data from study area. In the first stage, as KP is comprised of 26 districts, Peshawar and Mardan was purposively selected. The purpose behind this selection was huge population in these two districts. In the second stage, from each selected district one urban and one rural union council were randomly selected. Thus a total of 4 union councils were taken as a sample location from both districts. In the third and final stage, a list of households was obtained from local union council's health department (BHU) and a sample of 600 households was selected randomly from those UCs using Yamane's (1967) formula. Proportional allocation sampling technique was used to decide households from each UC.

Willingness to pay elicitation

This research study employed Contingent Valuation Method (CVM) to elicit households' preferences and willingness to pay for pesticides free fruits in the study area. CVM is a stated preference approach which elicits a respondent's WTP based on a hypothetical market scenario for valuation the food product under investigation. However, the stated WTP in this approach is more sensitive to valuation question format. The widely used formats are open-ended, payment card and dichotomous choice questions. Hanemann et al. (1991) recommended the double-bounded dichotomous choice format for eliciting households' WTP. That's, based on their recommendation; we used a double-bounded format for construction of contingent valuation question for pesticides free fruits.

The wordings of the question were:
Q1. Suppose your favorite fruit, such as apple, mango and peach, regularly cost on average Rs. 100/ kg. Assuming no difference in taste and nutritional content, would you pay *Rs. B* more to consume pesticide free version of the same fruit?
Yes No
Q2. Would you be willing to pay *Rs*? B^u *(or* B^d*)* for the same fruit?
(Note: ask for B^u if the respondent reply in yes to the first bid, otherwise B^d)
Yes No

Econometric model for willingness to pay estimation
The double-bounded method confronts each respondent with two dichotomous choice WTP questions (bids). The 2nd bid value is contingent on the respondent's reply to 1st bid. If the respondent responds in "yes" to the first bid (B), then the second bid (B^u) is some amount higher than the first bid (B^u > B). If the respondent says "no" to the first bid, the

second bid (B^d) is then some lower amount ($B^d < B$). Thus there are the following four possible outcomes for the double-bounded WTP question: "yes-yes"; "yes-no"; "no-yes"; and "no-no".

According to Hanemann et al. (1991), the probability of answering "yes-yes" (Pr_{yy}) is:

$$Pr_{yy}(B, B^u) = Pr[B \leq WTP, B^u \leq WTP] = 1 - F(B^u; \theta)$$
$$= Pr[B \leq WTP \backslash B^u \leq WTP]\, Pr[B^u \leq WTP]$$
$$= Pr[B^u \leq WTP] = 1 - F(B^u; \theta)$$

Where;
Pr_{yy} is the probability of answering "yes-yes"; WTP is the respondent's willingness to pay for the product; and F is the cumulative distribution function with parameter vector θ. Similarly, the probability for each of the other three outcome responses is;

$$Pr_{yn}(B, B^u) = Pr[B \leq WTP < B^u] = F(B^u; \theta) - F(B; \theta)$$
$$Pr_{ny}(B, B^a) = Pr[B^a \leq WTP < B] = F(B; \theta) - F(B^a; \theta)$$
$$Pr_{nn}(B, B^d) = Pr[B > WTP, B^d > WTP] = F(B^d; \theta)$$

Where;
Pr_{yn}, Pr_{ym} and Prn_n are the probabilities for saying "yes-no", "no-yes" and "no-no" to the double-bounded question, respectively. Thus the log-likelihood function for the i^{th} respondent can be written as;

$$lnL(\theta) = \sum_{i=1}^{N} \{d_i^{yy} lnPr_{yy}(B_i, B_i^u) + d_i^{yn} lnPr_{yn}(B_i, B_i^u) + d_i^{ny} lnPr_{ny}(B_i, B_i^d) + d_i^{nn} lnPr_{nn}(B_i, B_i^d)\}$$

Where;
d_i^{yy}, d_i^{yy}, d_i^{yy} and d_i^{yy} are binary valued (0 or 1) indicators and the formulas for the corresponding response probabilities are given above. The model was estimated through maximum likelihood estimation method and the results were used to find out the mean and individual WTP (s) for pesticides free fruits.

Results and Discussion

Socio-economic characteristics of the household

Table 1 presents a list of socio-economic characteristics of the selected households. Around 98 percent of the household heads were male, which is consistent with our expectation because male individuals are the primary decision makers in Pakistani society. Their mean age was around 42 years and education level was on average 8.19. The average household size was around 7 members which is slightly below the national average of 8 members per household. The monthly income per household was on average Rs.53465, and daily per capita income was Rs.249, which is above the poverty line of Rs.200.

Table 1: *Summary statistics for the interviewed households.*

Variables	Description	Mean/ Percent	Std. Dev.
Gender	Gender status of the respondents	975 %	-
Head's Age	Age of respondents (years)	42.01	11.501
Head's Education	Respondents education (years)	8.19	6.655
Household's size	Number of individual in a family (one house)	7.15	2.810
Total Income	Monthly income in Pakistani rupees (1 US dollar = 105 PKR)	53,465	34314.08

Household's awareness of pesticides use

Before asking the sampled households for their WTP for pesticides free fruits, the researcher asked different questions on their awareness of pesticides use on locally produced fruits and its impact on human health and natural environment. The descriptive results for their responses to those questions are given in Table 2. Around 85.0 percent of the respondents perceived the negative effects of pesticides on human health and natural environment. Similarly, 86.0 percent of the households believed that farmer should engage in environmental friendly agricultural production practices which have a minimum adverse impact on health and the environment. The table shows that 61 percent of the households were aware that local farmers use intensive pesticides on apple, peach and mango fruits.

Table 2: *Households' perceptions of pesticides use.*

Questions	Agreed	Disagreed
I feel the use of pesticides in agriculture has negative effect on human health and natural environment.	85.1 %	14.9%
I believe farmer should engage in environmental friendly agricultural production practices with minimum impact on human health.	86.0%	14.0 %
Local farmers are intensively using pesticides on apple, peach and mango.	61%	39%

The overall results indicate that sampled households were not fully aware of the intensive pesticides use on local fruits; however, they were correctly perceived over the impacts of pesticides on human health and environment.

Estimated WTP model

Table 3 reports estimated results for double-bounded WTP model. The LR test, with a Chi^2 value of is 258.55 and p-value of < 0.001 confirms that the model with all the explanatory variables has good prediction power of household's choice and WTP for pesticides free fruits.

Table 3: *Estimated double-bounded dichotomous choice model for household's WTP.*

Variables	Coefficient	Std. Error	z-statistic	P>|z|
Constant	-67.4504	17.4824	-3.86	0.000
Age	0.1303**	0.0596	2.19	0.029
Education	0.5409**	0.1554	3.48	0.001
Log Income	7.3271**	1.8587	3.94	0.000
Household's Size	-0. 8941**	0.2491	-3.59	0.000
Health concern	4.0912**	1.9534	2.09	0.036
Environment concern	6.0685**	2.0922	2.90	0.004
Awareness	2.3474*	1.2619	1.86	0.063

*Log likelihood: -622.169; Number of observation: 600; Wald chi2 (7): 258.55; Probability> chi2: 0.000; Note: *; ** indicate statistical significance at 10% and 5% respectively.*

The estimated coefficients for most of the variables are statistically significant and have signs consistent with prior expectations. Heads' characteristics, such as age, education level and awareness of pesticides use on fruits, perception of health and environmental concerns of pesticides, are the most import determinants of the household's WTP for pesticides free fruits. Household's income and number of individuals have significant effect on their price premium for organic fruits.

Age: The coefficient for Age is positive and its value is 0.130, which reveals that a one year increase in head's age would increase household's willingness to pay a price premium of 0.130 rupees for pesticides free fruits, at constant level of other variables. This generally implies that household headed by an old individual has strong preferences and high WTP for pesticides free fruits as compared to others. This positive correlation of consumers' age and Willingness to pay a high price premium for pesticides free/organic food is in agreement with findings of (Haghiri et al., 2009; Misra et al., 1991). However, these findings are in contrast with (Govindasamy and Italia, 1999). They found that younger people like to pay a high price premium because of different study area.

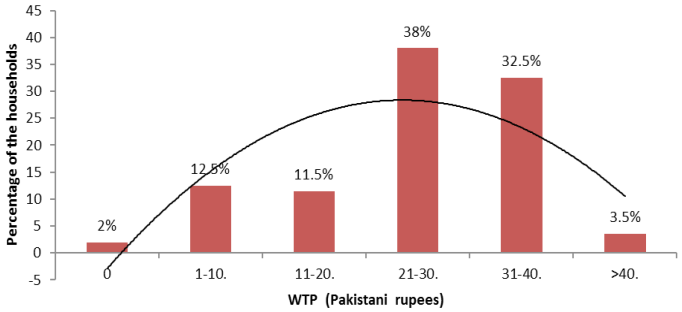

Figure 1: *Distribution of WTP response.*

Education: Head's education level has a positive significant association with household's willingness to pay a price premium for pesticides free fruits. A likely explanation is that education increases consumers' awareness regarding the adverse effect of pesticides on human health and natural environment. Consumers' with a high level of education can better understand the benefits attached to the consumption of food produced without the use of pesticides. Darby et al. (2008), Liu et al. (2009) and Misra et al. (1991) also confirmed positive association of consumer's education and willingness to pay price premium for pesticides free/ organic fruits.

Income: Household's demand for best quality fruits is expected to rise with increase in their income level. The estimated coefficient for household's income is positive which implies direct association with their price premium for pesticides free fruits and is consistent with general theory and our prior expectations. The results suggest a one percent increases in income increase the WTP of the respondents by 7.3 rupees. In future, with economic growth, increased in per capita income is expected and this increase in per-capita income will increase the demand for pesticides free fruits.

Household's size: We found a negative significant effect of the household's size on WTP for pesticides-free fruits. As the number of members increases, household become less likely to pay a price premium for pesticides free fruits. More mouths to feed reduces budget for best quality fruits, as noted previously by (Oyawole et al., 2016; Ghorbani and Harnraz, 2009). In another study, Govindasamy et al. (2001) findings

suggests that each member in a lager household has less income to spend compared to a smaller household.

Awareness and perception: Head's awareness of pesticides use on local fruits production and their health and environmental concerns over pesticides use are also the most important determinants of household's willingness to pay for pesticides free fruits. As discussed in the previous section, household's awareness and perception of pesticides use on fruits and their education level are connected and have significant influence for creating market for pesticides free/ organic fruits. In a related publication, Khan et al., 2018 examined Pakistani willingness to purchase in the similar context. They found that environmental concern and personal health concern motivates the willingness to purchase, however the previous study does not provide estimates of willingness to pay, which this study do.

Estimated mean WTP of the households

The estimated model was used to derive each household's willingness to pay price premium for pesticides free fruits. Table 4 presents the summary statistics for the estimated price premium. The Table shows that household's estimated mean willingness to pay price premium was around 26 rupees with a standard deviation of 10.6; and the estimated minimum and maximum price premium were 0 and 44.5 rupees, respectively. These statistics reveals that households on average were willing to pay 26 percent more price premium for pesticide-free fruits than the existed market price for conventional fruits in the study area, and that farmers may earn more profit by producing pesticide-free fruits.

Table 4: *Respondents estimated mean WTP.*

	Mean	Std. Dev	Min	Max
WTP	25.798	10.601	0	44.511

Conclusions and Recommendations

Findings of this survey reveal that pesticide-free fruits are highly valued in Pakistan. Households were willing to pay a price premium and certain socio-demographic characteristics do impact on consumers' WTP for pesticide-free fruits.

A plausible rationale for higher WTP from significant portion of the households is their awareness of pesticides use on fruits and their perception of pesticides negative impacts on human health and natural environment.

Research findings also reveal that socio-demographic and economic characteristics of the households, such as their size, income, head's age and education level are the important factors in determining consumers' WTP for pesticides-free fruits.

The production of pesticide-free fruits could enhance producer's profit by earning net margins. Like other technologies, pesticide-free production needs government assistance to encourage farmers.

Novelty Statement

This study will helped to the farmers in assessing the market potential for pesticides-free fruits in Pakistan.

Author's Contributions

Jahangir Khan conducted this study, collected the data, searched for literature review and wrote first draft of the manuscript. Abbas Ullah Jan supervised the research paper and checked for grammatical errors. Kar Ho Lim helped in technical writing and helped in paper setting. Syed shah helped in model specification and statistical analysis of the data. Aditya R Khanal helped in data entry and analysis in Stata software and Ghaffar Ali reviewed literature and corrected references.

References

Abhilash, P.C. and S. Nadita. 2009. Pesticide use and application: An Indian scenario. J. Hazard. Mater. 165(1): 1–12. https://doi.org/10.1016/j.jhazmat.2008.10.061

Darby, K., M.T. Batte, S. Ernest and B. Roe. 2008. Decomposing local: A conjoint analysis of locally produced foods. Am. J. Agric. Econ. 90(2): 476-486. https://doi.org/10.1111/j.1467-8276.2007.01111.x

FAO. 2002. Submission and evaluation of pesticide residues data for the estimation of maximum residue levels in food and feed. FAO, Rome: 1–279.

Govindasamy, R. and J. Italia. 1999. Predicting Willingness to pay a premium for organically grown fresh produce. J. Food Distrib. Res. 30 (2): 0044.

Ghorbani, M. and S. Hamraz. 2009. A survey

on consumer's potential willingness to pay for organic products in Iran. Trends Agric. Econ. 2(1): 10-16. https://doi.org/10.3923/tae.2009.10.16

Govindasamy, R. and J. Italia. 2001. Predicting willingness to pay a premium for organically grown fresh produce. J. Food Distrib. Res. 30(2): 44–53. https://doi.org/10.1017/S106828050000109X

Hanemann, M., J. Loomis and B. Kanninen. 1991. Statistical efficiency of double-bounded dichotomous choice contingent valuation. Am. Agric. Econ. 73(4): 1255-1263. https://doi.org/10.2307/1242453

Haghiri, M., J.E. Hobbs and M.L. Mcnamara. 2009. Assessing consumer preferences for organically grown fresh fruits and vegetables in eastern New Brunswick. Int. Food Agribus. Manage. Rev. 12(4): 81.

Khan, J., A.R. Khanal, K. Lim, A. Jan and S. Shah. 2018. Willingness to pay for pesticide free fruits: Evidence from Pakistan. J. Int. Food Agribus. Mark. 30: 392-408. https://doi.org/10.1080/08974438.2018.1449697

Liu, Y., Y. Zeng and X. Yu. 2009. Consumer willingness to pay for food safety in Beijing: A case study of food additives. Contrib. Pap. Prepared Present. Int. Assoc. Agric. Econ. Conf. Beijing, China. pp. 16-22.

Misra, S.K., C.L. Huang and S.L. Ott. 1991. Consumer willingness to pay for pesticide-free fresh produce. West J. Agric. Econ. 16(2): 218–227.

Oyawole, F.P., D. Akerele and A.O. Dipeolu. 2016. Factors influencing willingness to pay for organic vegetables among civil servants in a developing country. Int. J. Vegetable Sci. 22(2): 121-128. https://doi.org/10.1080/19315260.2014.942763

Wilson, C. 2000. Environmental and human costs of commercial agricultural production in south Asia. Int. J. Soc. Econ. 27(7/8/9/10): 816-846. https://doi.org/10.1108/03068290010335244

Yamane, T. 1973. Statistics: An introductory analysis. New York: Harper and Row.