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Investigating the Effect of Contingent Valuation Question Formats on Households' Willingness to Pay for Pesticides Free Fruits in Khyber Pakhtunkhwa

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ABSTRACT

The purpose of this study is to examine the effect of contingent valuation questions format on households' preferences revelation and willingness to pay (WTP) for chemicals free fruits in Khyber Pakhtunkhwa (KP) province of Pakistan. A sample of 1000 randomly selected households, from rural and urban areas of the KP province, were confronted with three different WTP questions for chemicals free fruits-double bounded dichotomous choice question, open-ended question and payment card question. Results show that households' willingness to pay price premium for chemicals free fruits were 14 percent from open-ended question, 16 percent from payment card format and 25 percent from double bounded question. Regression analyses identified head's age, education, monthly income, awareness regarding use of pesticides in fruit production and their impact on human health and natural environment as important determinants of households' stated WTP for chemicals free fruits. The study concludes that households are willing to pay substantial price premium for chemicals free fruits and recommends growers to start their production on commercial scale. Findings of this split-sample study reveals that results of contingent valuation method are sensitive to WTP question format and recommends that proper guidelines must be followed in order to get accurate and reliable results.

Keywords

Contingent Valuation Method, WTP question formats, Pesticides-free fruits, Split sample study, Pakistan

JEL Classification

Q13, D12

1. Introduction

Contingent valuation method (CVM) is a survey-based technique used for eliciting consumers' perceived values on goods, services and amenities. CVM has mainly been used in develop countries to determine economic values for environmental quality improvements, and which are not possible to measure through other methods such as the Revealed Preference Method (Carson et al., 2005). Its wide applications have got the interest of researchers in developing countries. Beside these advantages, CVM are more sensitive to the WTP question formats and payment mechanism (Carson et al., 2005). In this direction, to provide best guidelines for the application of CVM in developing countries, the research work of Dale Whittington (2002) has played a significant role. He found that the primary causes for the failure of most CVM research in developing nations are poor survey administration, lack of best survey design and lack of research on the robustness of the results against variations in designing research and methods adopted for survey. He suggested using split-sample experiments to test the robustness of the results against differences in CVM designs.

One issue that researchers continuously reported is the selection and choice of suitable WTP question formats. The question formats mostly used by researchers in CVM studies are open ended, single dichotomous choice, payment card and double bounded dichotomous choice questions. Research studies showed that information regarding households' willingness to pay obtained through single bounded dichotomous choice WTP question is limited and also result higher estimated WTP (Zhongmin et al., 2006). The single dichotomous choice WTP question also needs huge sample size (Carson and Hanemann, 2005). The use of an open-ended question format may give high zero WTP responses, and payment card method suffers from initial values selection bias. This study is designed to analyze the performance of different WTP question formats using a split sample case study of households' WTP for organic/ pesticides free fruits in Khyber Pakhtunkhwa, Pakistan.

Organic/Pesticides free products are fresh or processed food item produced without application/use of pesticides and chemicals (Khan and Jan, 2018). In this modern age, food consumers are extremely conscious about their health safety and best practices for environment, so they prefer to buy and consume more healthy food such as organic products (Denver & Christensen, 2015). Consumers are more aware of the fact that irrational use of pesticides on fruits and vegetables causes harmful effects on their health; they prefer to buy and use organic products. Many studies have shown that fresh fruits

and vegetables have health advantages and can help protect from diseases including diabetes, stroke, and cancer. (Stan et al., 2008). According to Slavin and Lloyd (2012), fruits and vegetables are universally recognized as healthy and beneficial.

2. Materials and Methods

2.1 Study Area

Pakistan is endowed with plenty of fresh water and fertile land. It has comparative advantage in rice and cotton production and its fruits and vegetables are famous for taste and freshness. However, the use of pesticides and chemicals on fruit and vegetable is common which is dangerous for health as well as wildlife animals and ecosystem. Farmers in Pakistan have the potential to produce fruits and vegetables organically but facing some hurdles. Firstly, the possible reduction in pesticides free fruits production and secondly, the uncertainty about local consumers' willingness to pay high prices for such produce. That's, why, this study used the case of pesticides free fruits in Khyber Pakhtunkhwa province of Pakistan and investigated consumers' WTP for pesticides free version, using three different CV question formats.

The delicious fruits such as citrus, dates, apricot, apple, peaches, mango and pesticides free dry fruits of Northern areas of Khyber Pakhtunkhwa province of Pakistan is producing. KP is also fortunate to have fertile terrain and ample water resources for agriculture. A total of 1,000 interviewees were selected at random for this research study. For sample selection, two districts namely Peshawar and Mardan were purposively selected because of having high population and huge demand for fruits. Each district was divided into Urban and Rural Union councils (UC) and then two from each stratum were selected randomly. Thus in total 4 Urban and 4 Rural UC's were selected. From each UC a sample of 125 households were randomly selected. Thus in total 1000 households were selected from both districts.

2.2 Contingent Valuation Survey Designing

Three different CV surveys were designed. They were parallel and same in all questions except in the WTP questions. Open-ended (OE), dichotomous choice' (DC), and payment card (PC), are the three primary question formats. The open ended elicitation design collect information regarding household's WTP for pesticides free fruit such as apple, peach and mango by simply asking how much he or she would be willing to pay for pesticides free version of them if available in local market.

The double bounded dichotomous choice format presents a dollar amount (\$A) to the respondents and asked for their willing to pay the presented amount for improved version. The second question is asked depending upon the response to the first question. In the second question, a higher amount is offered to the respondent if his/ her reply is in yes to the first question, or vice versa.

Payment card (PC) elicitation format is to some extent is a hybrid of the open ended and dichotomous choice formats. In PC format, ranges of willingness to pay values are presented to the respondents and are asked to select or encircle the value which indicates their stated WTP for the improved quality version. The values on payment card are based on open ended responses from a piolet survey or findings from past studies.

2.3 Empirical models for Data Analysis

2.3.1 For Open Ended CVM

For open-ended nature data, to estimate WTP and identify its determinants, a linear regression model was used. The mathematical form of open ended model is given below

$$WTP_j = \beta_0 + \sum_{i=1}^n (\beta_i X_{ij} + \varepsilon_j)$$

Where,

WTP_j , represent the j th households WTP for fruits free from pesticide use in Pakistani rupees. X_j , is the set of socio-economic characteristics of the j th household. β 's are the coefficients and ε is the error term.

2.3.2 Payment card CVM

To analyze data collected on payment card format, an ordered logit technique was used. A respondent select a value from the given set of values provided on the card. This selected value and next higher value to it are considered as lower and upper bounds, respectively and this represents true WTP (Y^*). For such set up, under latent variable framework, the WTP model can be employ as follows

$$Y_i^* = x_i' \beta + \varepsilon_i$$

Where Y_i^* shows an unobserved latent variable or true WTP for household i ; β is a vector of coefficients; x_i' explain socio-economic and demographic variables of the respondent that affect WTP; and ε_i is the error term.

Based on the assumption about the distribution of the true willingness to pay in the selected interval, different models are used to estimate the parameters of the model. This study used maximum likelihood method to estimate in order logit form (see Cameron and Huppert, 1989 for more detail).

2.3.3 Double Bounded dichotomous choice CVM

In this method, two bids are given to the respondent, where the second bid is contingent on the first bid's response. If the response of the consumer for the first bid is yes, then the second bid B^u which is a higher amount than the first bid is asked ($B^u > B$), and if the respondent is not agree with the first offered bid, then a slightly lesser amount than the first offered Bid ($B^d < B$) is presented. As a result, there are four alternative outcomes: a yes to the first bid then a yes to the second bid, the probability is shown by (yy); a yes and then a no, indicated by (yn); a no then a yes indicated by (ny) and a no followed by a no indicated by (nn).

According to Hanemann et al. (1991), the possibility that a respondent give a yes response to both the questions asked is

$$\begin{aligned} Pr_{yy}(B, B^u) &= Pr[B \leq WTP, B^u \leq WTP] = 1 - F(B^u) \\ &= Pr[B \leq WTP \setminus B^u \leq WTP] Pr [B^u \leq WTP] \\ &= Pr [B^u \leq WTP] = 1 - F(B^u) \end{aligned}$$

The probability that respondent gives a yes response to the first question asked and regret the second question is:

$$Pr_{yn}(B, B^u) = Pr [B \leq WTP < B^u] = F(B^u) - F(B)$$

The chance that respondent reject the first bid and accept the second bid with yes

$$Pr_{ny}(B, B^d) = Pr [B^d \leq WTP < B] = F(B) - F(B^d)$$

The possibility that the respondent answers in no for both questions is

$$Pr_{nn}(B, B^d) = Pr [B > WTP, B^d > WTP] = F(B^d)$$

Where,

WTP: Willingness to Pay; Pr_{yy} : the possibility of answering both bids with yes; Pr_{yn} : the possibility of answering yes to first bid and no to second bid; Pr_{ny} : the possibility of answering a no to the first question and a yes to the second; Pr_{nn} : the possibility of a no response to both the bids asked; B : shows the price in the first question; B^u : the

higher price of the second question; B^d : shows the lower price of the second question and F: the Cumulative Distribution function (CDF).

To estimate the likelihood of household responses, the maximum likelihood estimate was used. For the N sample respondents, the bids are B_i , B_i^u and B_i^d that are used for the i th respondent, the probability function is:

$$\ln L = \sum_{i=1}^N \{ yy_i \ln Pr_{yy} (B_i, B_i^u) + yn_i \ln Pr_{yn} (B_i, B_i^u) + ny_i \ln Pr_{ny} (B_i, B_i^d) + nn_i \ln Pr_{nn} (B_i, B_i^d) \}$$

Where, dummy variables are ‘yy’, ‘yn’, ‘ny’ and ‘nn’. If a respondent answers yes to both questions with a yes-yes (yy), then $yy = 1$ and the other is zero.

2.4 Willingness to pay comparison from CV question format

To compare the households’ estimated WTP for pesticides free fruits from different willingness to pay elicitation format an independent sample T-test was used. It is a parametric test used to determine whether the mean values obtained are significantly different from each other.

3. Results and Discussion

3.1 Socio-Economic characteristics of the respondents

Summary statistics for the socioeconomic characteristics of the selected households are given in Table 1. These information’s are collected from their heads. The table shows that majority of the households were headed by male and this is a prominent feature of Pakistani society. The average age of the household’s head was around 41.2 years, and his education level was on average 9.2 years of schooling. Household size was around 7 members and their average monthly income was Rs.52935.

Results related to households’ response to questions on pesticides use on fruits and their negative impacts on human health and environment are also given in Table 1. Results of the research study highlighted more than half (60 %) of the respondents were aware of the fact that farmers are using excess pesticides spray during on fruit production. Furthermore, 80 percent of the respondents perceived pesticides application on fruits and vegetables production is unsafe for human health and natural environment. These numbers indicate that respondents in the study area had not much information regarding the serious application of pesticides on fruits; however, regarding the effects of pesticides on human health and the environment, they have been correctly assessed.

Table 1: Household’s Socio-economic Characteristics and Awareness for Pesticides Use

Variables	Sample-1* (600 households)	Sample-2** (200 households)	Sample-3*** (200 households)	All (1000)
Head’s Age (years)	42.0	40.2	40.0	41.2
Head’s Gender (%)	90	90	90	90
Household size (No.)	7.2	8.3	6.2	7.2
Head’s Education (years)	8.2	10.2	11.4	9.2
Households monthly Income (PKR****)	53465.0	48750.0	55530.0	52935.0
Heads aware of pesticides used on fruits (%)	60	70	60	60
Heads concerned for pesticides effect on human health (%)	90	80	70	80
Heads concerned for pesticides effect on environment (%)	80	80	80	80

* sample-1 of 600 households was used for DC, CV survey

** sample-2 of 200 households was used for PC, CV survey

*** sample-3 of 200 households was used for OE, CV survey

****Pakistani Rupees(1PKR=0.0063 US dollars)

3.2 Estimated WTP Models

The estimated results of Willingness of households to pay for pesticide-free fruit based on different contingent valuation survey models are given in table 2. The table shows that the estimated coefficients for the age of the respondents, level of education, and awareness regarding use of pesticides on fruits and their effects on the health of human being and also the natural environment are consistently positive and statistically significant for all three models, suggesting that they are directly related to the willingness of households to pay for fruits free from pesticide used. Household monthly income is another factor having positive and statistically significant coefficient means that households’ with more disposable income gives more importance to fruit free of pesticides and like to pay more price premium compared to those having lower income. An increase in income raises purchasing power of consumers that divert their purchasing

behavior. Household's size is the single factor having an inverse relationship with WTP for pesticides free fruits pay and according to our prior expectation. A household with more people does not pay attention to high quality food because it is difficult to feed more mouths. These findings are consistent with (Haghjou et al., 2013) conducted a research study on factors influencing consumer willingness to pay for organic food in Tabriz Iran. By adopting ordered logistic regression model, results of the study showed that factors such as respondent's income, family dimension; in addition to consumer awareness, environmental and health concerns were important determinants of WTP for organic foods. In another research study on consumer perception regarding organic food in Bangkok, Roitner-Schobesberger et al., (2008) found that more than 1/3 of respondents bought organic fruit or vegetables because consumer expected that food produced organically would be good both for human health and natural environment. Based on their research findings, respondents of older age, higher income and higher education was the main purchaser.

In addition, according to the findings of our study respondents with a positive attitude toward environmental change were willing to pay a greater price for better quality fruits. Consumers who care more about their health are more willing to pay a premium price for pesticide-free fruits, according to the findings. These results are in line with Khan et al (2018).

Table 2: Determinants Effecting Respondents Willingness to Pay for Pesticide-free Fruit

Variables	Open ended model		Payment card model		Double bounded model	
	Coefficients	T-Values	Coefficients	T-Values	Coefficients	T-Values
Constant	-6.174109	1.42	-	-	-8.614601	-2.37
Age	0.2348861	5.02	0.0698807	4.74	0.294755	4.62
Gender	-2.828394	-0.91	-0.2469171	-0.29	-0.133885	0.03
Education	0.243413	3.15	0.0821316	3.68	0.4521878	2.87
Households size	-0.3936806	-2.24	-0.0975395	-1.94	-0.6690743	-2.68
Urban/rural	0.587075	0.56	0.2783974	0.94	0.2295739	0.17
Income	0.0001237	7.90	0.0000277	5.51	0.0001208	4.26
Health Concern	5.567941	3.80	2.600153	4.86	6.165207	3.28
Environment Concern	0.2999708	0.15	0.3993532	0.69	6.739389	3.28
Awareness	3.567843	3.56	0.9595126	3.38	8.194937	4.84
	No of Observation = 200 F (9) = 28.59 P- Value=0.000		No of Observation = 200 Wald chi2 (9) =158.49 Probability >chi2=0.000		No of Respondents = 600 Wald chi2 (9) =272.30 Probability >chi2=0.000	

Source: Survey Data calculation, 2016-17

3.3 Comparison of elicitation questions formats

Table 3 illustrates the estimated mean WTP for the double dichotomous, the payment card, and the open survey formats. Household willingness to pay is estimated using averages for the independent variables. Result of the predictable models confirms mean values of Pakistani rupees 25.76, 16.32 and 14.37 for the double-dichotomous, payment cards and linear regression models respectively, for pesticide-free fruit in the study area. These results are in accord with other research studies such as Ngo et al., 2013 and Rodriguez et al., 2008. The independent sample t-test results for comparison of estimated WTP for pesticides free fruit for different CVM formats are also given in

the same table 3. They are found statistically different from each other and it proves that a WTP question format has a significant effect on estimated WTP.

Table 3: Average willingness to pay based on the survey format of the CV questions

CV questions format	Mean WTP Open ended (14.37)	Mean WTP Payment card (16.32)
Mean WTP Payment card (16.32)	M.D (1.94) t-value (2.50) P-value (0.006)	—
Mean WTP Double bounded (25.76)	M.D (11.43) t-value (14.83) P-value (0.000)	M.D (9.49) t-value (12.22) P-value (0.000)

Source: Survey data calculation, 2016-17, M.D= Mean difference: 1US\$=105 PKR in 2017

3.4 Respondents' Response for zero WTP

Table 4 shows zero response rates to the three utilized WTP elicitation formats. The zero response rates to payment card format found minimum (13%) as compared to double bounded (30%) and open ended (40%) formats. From these results, it is suggested that the payment card format is valid, easy and contributes in an efficient in data collection.

Table 4: Zero WTP Responses by CV Question Format

Response to WTP question	Double bounded	Payment card	Open ended
No-No or Zero WTP responses	30%	13%	40%

Source: Survey Data Calculation, 2016-17

4. Conclusion and Recommendations

Regarding the case study of pesticides use on local fruits produce, finding of the study reveals that around two third of the households were aware of pesticides uses on local fruits and more than three fourth of the households were worried about the negative effects of pesticide residues on human health and the natural ecosystem. Consumers' were willing to pay on average 18 % higher premium for fruits produced without the use of pesticides. Based on the estimated WTP, the study recommends fruit growers

produce pesticide-free products as households in the local market are willing to pay a substantial amount for the pesticide-free version of fruit.

On technical side, the estimated mean WTP for the three elicitation formats such as open ended, payment card and double bounded were 14.37, 16.32 and 25.76 percent, respectively. One survey format is not clearly better than the other when it comes to priorities. Which elicitation format to use depends upon the circumstances of the study. For instance, if the survey has a small sample size, then payment card elicitation format best suits. However, with large sample size, it is preferred to adopt double bounded elicitation format. Findings of this split samples study recommends that results of contingent valuation method are sensitive to WTP question format and the adoption of suitable WTP question's format depends on the sample size of the respondents and their awareness for such studies.

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