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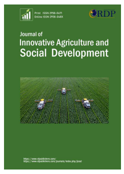

Article

Consumers Willing to Pay for Freshwater-Grown Vegetables in District Faisalabad, Pakistan

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ABSTRACT

Due to the scarcity of freshwater supplies, farmers have increasingly turned to wastewater for irrigation to grow crops. However, this practice poses risks as vegetables grown with wastewater may contain toxins and heavy metals that are harmful to human health, soil quality, and groundwater resources. Consequently, these vegetables can cause diseases, while freshwater-grown vegetables are more expensive due to the scarcity of water. This paper focuses on exploring consumers' willingness to pay for vegetables grown in freshwater and investigates factors such as age, income, education, bid price, risk perception, and health risk perception that influence their willingness to pay a premium price for these vegetables. The study was conducted in Faisalabad city, where 130 vegetable consumers were interviewed using a semi-structured questionnaire. The findings indicate that consumers highly value their health and are willing to pay a premium price for safe and healthy vegetables. This highlights the need for businesses and policymakers to meet the demand for safe vegetables by providing a consistent and reliable supply of treated water to farmers and educating them on the proper use of agrochemicals to mitigate health risks. Policymakers and other stakeholders can play a role in supporting vegetable farmers with these resources. This creates an opportunity for investors to establish businesses that meet the demand for safe and healthy vegetables in Faisalabad.

Keywords: wastewater irrigation; freshwater-grown vegetables; bid price; risk perception; health risk perception; premium price

1. Introduction

Water is a crucial element in supporting life and has multiple applications, such as drinking, domestic usage, irrigation, and industrial procedures, such as manufacturing, power generation, and mining. Unfortunately, the amount of water available has decreased in recent years due to several factors, including climate change, population growth, urbanization, and deforestation (Birol et al., 2006). This decline in water availability has resulted in the utilization of low-quality water, such as sewage or industrial wastewater, for irrigation purposes. The use of wastewater for irrigation has become more prevalent in various parts of the world, particularly in Asia, Africa, and Latin America, where freshwater scarcity is a significant problem (Qadir et al 2007; Zhang & Sn, 2019). Vegetable cultivation on more than 20 million hectares of land is irrigated with wastewater in countries like North and South Africa, South and Southwest Asia, Southern Europe, Mexico, and Central and East Asia (Thebo et al., 2017).

For instance, Pakistan uses wastewater to irrigate about 26% of its vegetable production (Ensink et al.,2004; Murtaza & Zia,2012). After analyzing the quality of municipal wastewater used for vegetable production in Faisalabad, it was discovered that several substances exceeded the permissible limits under the National Environmental Quality Standards (NEQS) for Pakistani municipal wastewater These substances included sulphate, chloride, fluoride, ammonia, cadmium, chromium, lead, mercury, nickel, zinc, barium, iron, manganese, chlorine, calcium,

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sodium, and copper. Exposure to these contaminants can have severe and permanent health effects, particularly when consumed in food (Hameed et al., 2021; Abedullah et al., 2012; Ahmad et al., 2015).

The toxic and contaminated metals can harm various organs and systems in the body, including the lungs, kidneys, joints, cardiovascular and reproductive systems, and the central and peripheral nervous systems. Zinc accumulation can also lead to impaired growth and reproduction. Consistent consumption of contaminated food can result in acute effects on human organs (Singh et al., 2010; Ogwuegbu & Muhanga 2005). As a result, the extensive use of wastewater for irrigation purposes can lead to the accumulation of contaminants, especially heavy metals, which can seriously harm both soil and plants. High levels of heavy metals such as lead, cadmium, and mercury can cause serious health problems in humans (Bigdeli & Seilsepour, 2008). Severe health impacts of anything naturally lead people to demand and desire its improvement, which in turn motivates researchers to investigate and assess the need for enhancements. To determine such demands, many researchers have examined consumers' willingness to pay (WTP) for various goods (Owusu & Owusu, 2013; Anjum et al., 2021; Ngoc et al., 2015).

In the case of Faisalabad, where many vegetables are irrigated with wastewater, there is a growing demand for fresh water-grown vegetables (FWGV) among consumers. To determine the extent of this demand, the present study aims to test consumers' willingness to pay (WTP) for FWGV using the contingent valuation method (CVM) and logit regression models. The study was conducted through a survey in various locations within Faisalabad. Faisalabad has become a focal point for research due to several primary reasons. One such reason is the city's history of being the location for numerous surveys aimed at ascertaining consumer willingness to pay for improvements in water quality and waste management (Nisa & Yaseen 2020; Zahra et al., 2012).

The main objective of this study is to analyze consumer willingness to pay for freshwater vegetables. To achieve this, the study focuses on three primary goals: (a) examining the socioeconomic characteristics of respondents, (b) identifying the factors that influence their willingness to pay a premium price for freshwater-grown vegetables, and (c) suggesting relevant policies. By providing empirical evidence on this topic, this study contributes to the research field.

The research is divided into four distinct sections. The first section presents the introduction and objectives of the study. The second section outlines the research methodology employed in this study. The third section focuses on the presentation of the results obtained from the study. The final section comprises a discussion and conclusion section

2. Methodology

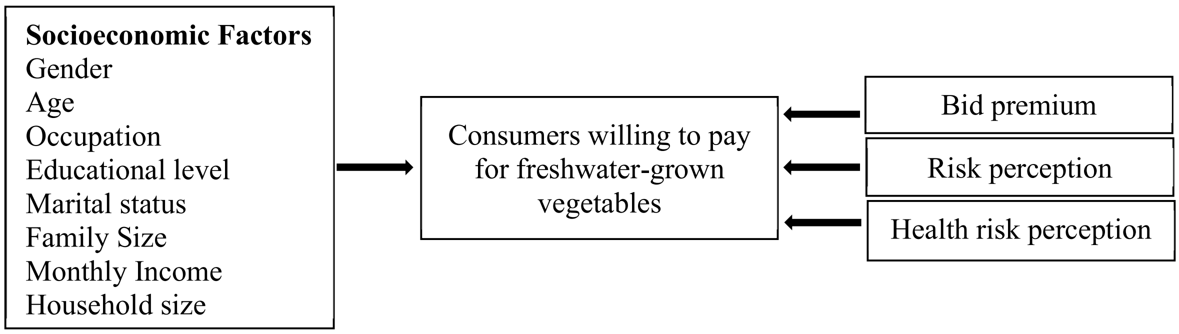
Faisalabad, which has a population of approximately 3.2 million, is the third-largest city in Pakistan and the second largest in Punjab. It is also recognized as one of the major industrial hubs in the nation. However, despite its industrial significance, Faisalabad does not have a proper mechanism to separate industrial and municipal effluents. As a result, individual industries or industrial estates are responsible for discharging untreated industrial wastewater directly into surface water sources. According to a study conducted in 2017, the groundwater in the Faisalabad region is heavily contaminated with high levels of salinity (Daud et al.,2017).

A conceptual framework is a visual representation that outlines the anticipated connections between the variables in a study. It establishes the pertinent goals for the research procedure and charts how they converge to form consistent conclusions (Hughes et al., 2019). A conceptual framework provides a comprehensive understanding of how the variables of interest are interconnected. In the present study, the main objective is to investigate the extent of consumers' willingness to purchase freshwater-grown vegetables.

A random sampling technique was used for the selection of the sample. In this study, data was collected through a survey conducted in Faisalabad, Pakistan, to gain insights into the purchases of freshwater-grown vegetables. A structured questionnaire was developed based on the literature review. Before conducting the actual survey, a pre-survey was carried out using the questionnaire draft. The research group made necessary modifications to create the final questionnaire, ensuring that all essential items were included, and respondents could comprehend each question without difficulty. Data analysis was performed using SPSS software, specifically version 22.

The objective is to assess the extent to which consumers are willing to pay for vegetables grown in fresh water. Two approaches were utilized to estimate this willingness: the productivity changes method and the contingent valuation method. Among the two, the contingent valuation method was the most frequently used to estimate the amount that consumers were willing to pay for freshwater-grown vegetables (Zhang et al., 2018). Proposed conceptual framework of the study is given as:

Figure 1: Conceptual framework of the study



Source: Authors' Drawing

A contingent valuation (CVM) approach was used to evaluate the consumers' response in the absence of a real purchasing scenario. The CVM approach allows a direct estimation of willingness to pay (WTP) using different elicitation techniques (Nandi *et al.,*2017; Pek & Othman, 2010).

Binary logistic regression is a statistical method employed to forecast the likelihood of an individual being classified as a case, based on the values of independent variables or predictors. In this technique, odds are utilized to represent the probability of a particular outcome being a case, relative to the probability of it being a non-case. Specifically, odds refer to the ratio of the probability of an event occurring to the probability of the event not occurring.

The binary logistic model for this study is indicated as:

$$\textbf{Logit } \boldsymbol{(p)} = \left[\frac{\boldsymbol{p_i}}{\boldsymbol{1-p_i}}\right]$$

Where $=[\frac{p}{1-p}]$ is the ratio of the probability that consumers will be willing to pay for freshwater vegetables to the probability that consumers will not be willing to pay. The dependent variable in this scenario is binary. It can take on one of two values: 1 if a consumer is willing to pay or 0 if they are not.

The non-linear expression of the binary logistics model equation can be linear after taking the natural log.

$$\text{Logit } (p) = \text{L1} = L_n\left[\frac{p_i}{1-p_i}\right] = \beta_o+\beta_1X_1+\beta_2X_2+\ldots\ldots\ \beta iXi+\epsilon$$

The following Binary logistic Regression expression

$$Y=\beta_o+\beta_1X_1+\beta_2X_2+\beta 3X3+\beta 4X4+\beta 5X5+\beta 6X6+\beta 7X7+\boldsymbol{\mu}_i$$

Y is the willingness to pay (dichotomous) variable, Xi's are independent variables including age, education level, household size, Income (in thousand RS/. Month), Bid premium, risk perception, and health perception. $\beta 0$ is the intercept, and β's are the coefficients of estimators and $\boldsymbol{\mu}_i$ is the random error term.

3. Results and Discussion

3.1 Descriptive Analysis

Descriptive statistical techniques play a crucial role in analysing data as they enable the review, definition, and meaningful presentation of data. This step is vital in the statistical analysis process as it provides a summary of the data distribution, identifies errors and outliers, and facilitates the detection of patterns between variables, which are essential for future statistical analysis.

The following paragraph summarizes the key findings from Table 1. It reports that the mean age of the respondents was 40.32 years, with the oldest respondent being 60 years old and the youngest being 18 years old. All the respondents were adults. The average level of education among the respondents was 8.46 years, with some respondents being illiterate (0 years of education) and others being literate (up to 18 years of education). The average household size was 5.87 people, with households accommodating a minimum of 2 people and a maximum of 15 people. The average monthly income was 60.49, with the lowest income being 14,000 and the highest being 150,000. The average bid premium was 263, ranging from a minimum of 100 to a maximum of 500. Respondents' average risk perception was 13.73, with the lowest and highest values being 5 and 8, respectively. Finally, respondents' average health perception was 3.86, with the lowest and highest values being 3 and 5, respectively.

Table 1: Socioeconomic characteristics of respondents

Variables	Min	Max	Mean	Standard Dev
Age	18.00	60.00	40.32	0.44
Education level	0.00	18.00	8.46	1.41
Household size	2.00	15.00	5.87	0.850
Income (in thousand Rs. /Month)	14.00	150.00	60.49	0.74
Bid premium	100.00	500.00	263.85	0.836
Risk perception	5	8	13.73	1.186
Health Perception	3	5	3.86	0.455

3.2 Mean WTP for freshwater-grown vegetables:

The study employed an elicitation method to determine the mean willingness to pay (WTP) for freshwater-grown vegetables. Results showed that 74% of respondents expressed interest in freshwater-grown vegetables. The majority of respondents preferred freshwater vegetables over those grown in wastewater and were aware of the negative impacts of the latter.

3.3 Empirical Results:

A binary logistic model was used to estimate the willingness to pay a premium price for freshwater vegetables. The model includes variables such as age, education level, household size, income (in thousand Rs. / Month), bid premium, risk perception, and health perception. The maximum likelihood method was used to estimate the model, with a significance level of 1%, 5%, and 10%. The estimated coefficients and standard errors indicate which factors have a significant impact on the willingness to pay a premium price for freshwater vegetables.

The significance of the variables was also tested using the likelihood ratio at the level of 1%, 5%, and 10%. The Cox & Snell R Square and Nagelkerke R Square were used to assess how much variance in the dependent variable can be explained by the variance in the independent variable (Borooah, 2002). The Nagelkerke R^2 and Cox and Snell's R^2 values show that about 50 percent and 57 percent of the variation in the dependent variable can be explained by the variation in the independent variable.

Our model accurately predicts 64.6% of the outcome. However, the coefficients of the variables in the model do not directly show how changes in the explanatory variables affect the likelihood of consumers being willing to pay a premium price for freshwater vegetables. To understand the odds ratio of this phenomenon, we need to calculate Exp(β), which represents the probability of consumers being willing to pay a premium price for freshwater vegetables and the probability of them not being willing to do so

Based on the analysis, the main factor that influenced consumers to pay a higher price for freshwater vegetables was their perception of risk, which had the highest odds ratio of 2.081. The coefficient value of -3.679 suggests that consumers who believed that safer vegetables were associated with lower risk perceptions were more inclined to pay a premium for freshwater-grown vegetables. The p-value was 1.389. This finding is in line (Rahmawati et al., 2018).

According to the findings of this study, income is identified as a strong explanatory variable, with high-wage consumers demonstrating a greater willingness to pay compared to their low-wage counterparts, as evidenced by positive income coefficients. Specifically, the results indicate that as consumer income increases, their willingness to pay increases by a factor of 1.724, corresponding to a coefficient value of 2.470 with a 95% level of significance. Results confirm previous studies (Xie et al., 2017; Boccaletti & Nardella, 2000).

Our research has revealed that bid premiums have a considerable adverse effect on willingness to pay (WTP). As the premium price rises, the WTP tends to decline. Specifically, we observed that an increase of 1% in the bid premium leads to a reduction of 2.001% in the probability of the WTP for the premium price. Which coincides with (Anjum et al., 2021; Amirnejad & Tonakbar, 2018; Bhattarai, 2019).

Table2: Binary Logistic Regression result of factors affecting the consumer's willingness to pay for freshwater vegetables

Variables	Coefficient	Sign.	Exp(B)
Age	0.355	0.669	0.596
Education level	1.272**	0.134	0.622
Household size	0.767	0.735	0.817
Income (in thousand Rs. / Month)	2.470**	0.166	1.724
Bid premium	-2.001**	0.145	0.357
Risk perception	-3.679***	1.389	2.081
Health risk perception	-3.291*	0.330	1.216
Constant	0.279	0.943	0.001
Model prediction success	64.6%		
Cox & Snell R square	0.578		
Nagelkerke R Square	0.502		
Log-likelihood ratio	60.841		

Level of significance p<0.01at 1 percent*, p<0.05 at 5 percent**, p<0.1at 10 percent***

Consumers of freshwater vegetables exhibit a direct correlation between their perception of health risks and their willingness to pay (WTP), whereby those with lower levels of health risk perception tend to have a higher WTP. The sub-coefficient value linked with this correlation is -3.291, indicating that consumers who believe that freshwater-grown vegetables are safer and pose lower health risks are more willing to pay extra for them (Cobbinah et al., 2018). Although other socioeconomic factors such as age and household size have a positive effect on WTP, the association between these factors and WTP is negligible

4. Conclusion

This study aimed to determine if consumers in Faisalabad are willing to pay more for safer vegetables and to analyze the factors that affect their willingness to pay. The study started by computing the average amount that consumers were willing to pay for vegetables grown in freshwater. According to the findings, consumers perceived freshwater-grown vegetables as being less risky, healthier, and more environmentally friendly than conventionally grown vegetables.

The study results showed that income had a positive impact on consumers' willingness to pay for freshwater-grown vegetables. Furthermore, there was a direct relationship between education level and willingness to pay, with consumers who had higher education being more willing to pay for these vegetables. Interestingly, the study also found that as the bid premium increased, consumers' willingness to pay decreased

significantly. Therefore, a higher bid premium hurt the WTP for freshwater vegetables.

The findings demonstrate that consumers place a high value on their health and are willing to pay a premium price to ensure its protection. This underscores the importance of offering safe and healthy vegetable options in Faisalabad, creating an opportunity for investors to establish businesses that meet this demand. Policymakers and development partners could also play a role by supporting vegetable farmers with a consistent and reliable supply of treated water, as well as educating them on the proper use of agrochemicals to mitigate health risks.

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