

Do Vegetable Attributes Matter? Consumer Choices and Market Implications from District Charsadda, Pakistan

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ABSTRACT

Consumer concern in food safety, pesticide residue and sustainable production has resulted in greater demand for quality differentiated vegetables. This study looks into the consumers' preferences and willingness to pay (WTP) for vegetable attributes in District Charsadda, Khyber Pakhtunkhwa, Pakistan. Data were gathered from 300 consumers by using a structured questionnaire and the discrete choice experiment method was used to assess preferences regarding freshness, chemical-free production, production origin and price attributes. A Random Utility based mixed logit model was used for estimating consumer preferences and the consideration of preference heterogeneity. The results show that price has a negative and significant impact on consumer decision, whereas freshness, chemical-free production and production origin have a positive influence with mean WTP 52, 48, 20, respectively. Various random parameters confirm heterogeneity in consumer preferences where there is a significant amount of. The estimated mean WTP indicates that consumers are willing to pay about an extra monetary unit for desired vegetable characteristics. The results indicate that the food safety regulations, chemical-free production, labeling and information system can be improved to promote market opportunities for producers and to ensure sustainable vegetable markets in Pakistan.

Keywords: Consumer preferences; Willingness to pay; Choice experiment; Vegetable attributes; Pakistan

INTRODUCTION

Consumer awareness of food safety issues and concerns, the rising health risks and environmental awareness have greatly reshaped the preferences of consumers in agricultural markets around the world

(Grunert, 2005; Asioli et al., 2017). Recently, consumers have taken a keen interest in food quality and safety, especially when it comes to food additives, chemical use, and practices that are not sustainable. The concerns have led to the demand for healthier, safer and eco-friendly food products. This has led to a growing interest in the study of consumer preferences for food quality attributes, which is a significant area of research in the field of agricultural economics and is crucial for developing effective marketing strategies and encouraging sustainable agricultural production systems.

Vegetables are an integral part of a nutritious diet and make an important contribution to household nutrition and food security. Vegetable are one of the most consumed vegetables because of their economic value, culinary use, and nutritional value. Traditional vegetable farming, however, may face issues related to food safety, environmental damage, and health risks due to the high reliance on chemical fertilizers and pesticides. The new consumer awareness has presented new market opportunities, particularly for organic and pesticide-free vegetables. Determining consumer preferences for such features and willingness to pay premium prices for safer products is important for producers, marketers and policy makers.

Pakistan is an important agricultural country and vegetables play significant role in the rural livelihood, employment generation and consumption of the household. The market for quality differentiated vegetable products is however not well developed, partly because of lack of information for consumers, the quality control system is still not very strong and market incentives are still not sufficient for producers. Specifically, consumers are uncertain about the production process, quality standards, and safety attributes of fresh vegetables. Hence, knowledge of the vegetable consumer preferences on particular attributes could be useful for designing efficient marketing strategies, enhancing the quality of foods and promoting sustainable production methods.

Vegetables are an essential component of household diets in District Charsadda, Khyber Pakhtunkhwa, contributing significantly to nutritional security and dietary diversity. Due to the district's fertile alluvial soils, favorable climate, and well-developed irrigation system, Charsadda is one of the major vegetable-producing areas in the province. A wide range of vegetables, including tomato, onion, potato, okra, cucumber, bottle gourd, bitter gourd, cauliflower, spinach, and brinjal, are cultivated and consumed throughout the year. The availability of fresh vegetables in local markets encourages regular household consumption and supports local food systems (Pakistan Agriculture Research Council, 2026). Commonly used vegetables are tomato, potatoes, onion, spinach, cauliflower, okra, cucumber, etc.

In previous studies, it has been shown that consumer' price evaluations of food products do not focus solely on price but also on other factors such as production methods, appearance, variety, labeling, freshness and safety information. Improving the health and environmental attributes may be a source of additional utility for consumers as the popularity of organic and sustainably produced food grows. Preference intensities, however, are different for different consumers because of differences in income, education, level of awareness and socio-economic characteristics. Hence, it is important to know about preference heterogeneity to design targeted policies and market interventions.

Previous studies have taken a look at consumers' preference for organic and safe food products in developed countries, whereas in developing countries, especially Pakistan, empirical evidences are still scarce. Previous studies conducted in Pakistan reported on general consumption preferences for food, organic foods awareness, willingness to pay for organic food with pesticide free attributes, but few studies have attempted to value specific attributes of vegetable using sophisticated choice experiment techniques. Further, there is a lack of information on the importance attached by Pakistani consumers to the attributes like organic production methods, vegetable variety, and labeling information. In fact, it is important to fill this research gap as knowledge of consumer demand can offer an incentive for farmers and agribusinesses to change their production and marketing behavior.

Hence, this study is designed to explore consumers' preferences and willingness to pay for the vegetable attributes in district Charsadda, Khyber Pakhtunkhwa, Pakistan, through a choice experiment technique.

LITERATURE REVIEW

In recent years, consumer preferences and willingness to pay (WTP) for food attributes have received a great deal of attention, especially in the wake of growing worries about food safety, quality, and environmental sustainability. In recent years, the use of choice experiments (CE) has become a widely accepted methodological approach in order to assess consumer behavior because the approach enables researchers to estimate the value consumers place on a product's specific attributes in a hypothetical market (Hensher et al., 2015).

Previous studies emphasize consumer preferences for organic and green foods because of the belief that they are healthier foods, and that they are less likely to contain harmful chemicals. In the USA, for example, Van Loo et al. (2011) discovered that consumers were willing to pay a considerable premium for organically labelled chicken, especially when accompanied by a credible certificate. In a similar fashion, Awad et al. (2019) found that the willingness to pay for organic vegetable was positive in Palestine, highlighting the role of health awareness and environment in influencing consumer's decisions.

Consumer preference for food products has also been linked to product attributes including freshness, appearance, taste and packaging. Oltman et al. (2014) found that visual qualities such as color and size were important factors for determining who selects vegetable, and sensory qualities such as flavor and texture were important factors for determining what makes consumers satisfied with the vegetable? Furthermore, labelling is important to consumer trust, as consumer willingness to pay more for more reliable food safety labelling was reported by Wongprawmas et al. (2017).

There is extensive evidence that socio-economic variables such as income, education and household variables affect WTP. Illichmann and Abdulai (2013) and Ramli et al. (2023) have found that consumers with higher incomes and education levels are more willing to pay for quality and safety attributes. Furthermore, several studies have shown that there is consumer heterogeneity, that is to say that different segments of the market have different preferences, depending on their lifestyle, consciousness and purchasing habits.

Generally, the literature indicates that consumers are becoming more accepting of high quality, safe and sustainably produced food products, willing to pay a premium for these. This willingness, however, differs by area and demographic, and does not mean the same level of willingness throughout the country and by demographic group, so studies must be done region by region. The study adds to the current literature by investigating consumer preference and willingness to pay for fresh vegetable attributes over a developing economy, which will help the producers, marketers, and policy makers.

METHODOLOGY

Study Area

This study was carried out in Charsadda District, Khyber Pakhtunkhwa Province, Pakistan. The district is situated in the fertile plain known as the most agricultural district of the city as far as vegetable crop is concerned. Two localities were selected, Dosehra and Dargai, because they have access to the vegetable markets and participate in vegetable production and consumption.

Data collection and sampling

Primary data collected using structured survey with the consumers in the local vegetable markets. The total respondents were 300 people who were selected using simple random sampling. Face-to-face interviews were used to obtain accurate and reliable responses. The questionnaire was structured into three parts: (i) socio-economic and demographic characteristics, (ii) consumer awareness and attitudes towards organic food, and (iii) a choice experiment, which was used to elicit consumer preferences for the vegetable attributes.

Choice Experiment Design

A discrete choice experiment (DCE) was used to investigate consumers' preferences and WTP for selected vegetable attributes. The attributes were freshness, pesticide free, local and hybrid, and price. A series of hypothetical choice sets containing two alternative vegetable profiles and a “no-purchase” alternative were presented to each respondent. In order to reduce bias, choice sets were random and the descriptions of the attributes were clearly explained to the respondents before the experiment.

Theoretical Framework

The study is based on the Lancaster's consumer theory which states that utility comes from product attributes rather than the product itself (Lancaster, 1966). Also, the analysis is carried out under the assumption of Random Utility Theory (RUT) which assumes that the individual selects the option that maximizes their utility (McFadden, 1974). The utility function consists of a deterministic part representing that which can be observed, and a random part representing that which cannot be observed.

Econometric Model

Two alternative models – Conditional Logit and Mixed Logit – were used to analyze consumer preferences. The Conditional Logit model makes an assumption that preferences are homogeneous among individuals and estimates the probability that an individual selects a specific alternative as a function of the attributes of that alternative. The Mixed Logit model, however, was used, as this model was seen as giving flexibility with parameters varying by the respondent (Train, 2009). This way, more flexible and realistic consumer behavior estimates are obtained.

This study uses a discrete choice modeling approach to examine the preferences and willingness to pay (WTP) for vegetable attributes. The analysis is based on Random Utility Theory (RUT) which implies that consumers seek utility from the attributes of a product and select the one providing the greatest utility.

The research adopts a Random Utility Model (RUM) framework, which is estimated using both conditional logit and mixed logit (ML) to estimate consumer preferences for the quality of bottled water attributes. The general utility specification is:

$$U_{njt} = V_{njt} + \varepsilon_{njt}$$

Where U_{njt} is the utility that respondents n obtain while consuming alternative j from a choice set t . V_{njt} is the observed utility term using product characteristics and ε_{njt} is the random error variation? The deterministic utility element is defined as:

$$V_{njt} = \beta_0 + \beta_1 \text{Fresh}_{njt} + \beta_2 \text{Pesticides free}_{njt} + \beta_3 \text{Origin}_{njt} + \beta_4 \text{Price}_{njt} + \text{ASC}_{njt}$$

Where $\beta_1, \beta_2, \beta_3, \beta_4$ represents the consumer's marginal willingness to pay for vegetable attributes. β_1 (Fresh/Not fresh), β_2 (Local/Imported), β_3 , (Pesticides free/ sprayed), β_4 (Price), respectively.

Finally, consumer willingness to pay (WTP) can be written as

$$WTP_k = - \frac{\beta_k}{\beta_{price}}$$

RESULTS AND DISCUSSIONS

Socio-economic and demographic characteristics

The socio-economic and demographic profile of the respondents shows a diverse but predominantly middle aged, male population. The mean age of the respondents is about 36 years, which represents a broad age distribution (from 18 to 70 years) with most of the respondents in a relatively old age group where consumption patterns are relatively stable. There is limited representation of female respondents, the sample is predominantly male (93%). The average respondent's education is 6.58 years which represent the moderately educated population, but education level ranges between no education and advanced education. The average size of households is approximately 6 people, reflecting a large family size and suggesting that it could impact household consumption and purchasing decisions. When asked about income, the responses are in the middle range, with an average annual income of around 43,130, though there is a range of from 19,000 to 180,000. Likewise, average monthly consumption expenditure is approximately 34,000, with food consumption expenditure 23267, and there is a significant amount of spending on a range of household items, including food with notable variability of responses. Overall, the differences in income, education and household size suggest that the sample is rather heterogeneous, and this is sufficient to consider the differences in consumer preferences and willingness to pay.

Table 1: Respondents Socio-economic and Demographic Characteristics

Variable	Mean	Std. Dev.	Min	Max
Age of the respondents	34.17529	10.63947	18	70
Gender status	0.25377	0.205	0	1
Formal Education in years	6.58	3.462	0	18
No of family members	6.15	2.817	3	15
Monthly Income	43130	19000.94	19,000	180,000
Consumption	34191.18	21681.1	18,000	90000
Food consumption	23267.82	13232.47	8000	15000

Maximum Likelihood Estimation and WTP

The results of the mixed logit model estimated using maximum likelihood techniques are presented in Table X. The model is statistically significant, as indicated by the likelihood ratio chi-square value (LR χ^2 = 426.55) with a probability value of 0.000, suggesting that the explanatory variables jointly influence consumer choice behavior.

The coefficient of price is negative and highly significant (β = -0.1467, $p < 0.01$), indicating that an increase in price reduces the likelihood of selecting a particular vegetable alternative. This result is consistent with economic theory, which predicts an inverse relationship between price and demand.

Among the product attributes, freshness exhibits a strong positive and statistically significant effect (β = 4.999, $p < 0.01$), suggesting that consumers place a high value on fresh vegetable. Similarly, the chemical-free attribute has a positive and significant coefficient (β = 3.163, $p < 0.01$), indicating a strong preference for vegetable perceived as free from harmful chemicals. The origin attribute is also positive and significant (β = 2.074, $p < 0.01$), reflecting consumer preference for vegetable with identifiable or trusted sources.

The estimated standard deviations for the random parameters are all statistically significant, confirming the presence of heterogeneity in consumer preferences. Specifically, the standard deviation for freshness (σ = 1.889, $p < 0.01$), chemical-free (σ = 0.997, $p < 0.01$), and origin (σ = 0.254, $p < 0.01$) indicate that individual preferences vary considerably across respondents. This justifies the use of the mixed logit model over simpler models such as the conditional logit.

Overall, the results demonstrate that both price and quality-related attributes significantly influence consumer choice, with strong evidence of preference heterogeneity among consumers.

Table 2: Maximum likelihood Estimation Results

Variables	Coefficients	Stand: Error	Z-statistics	P-Value
Price	-.147	.0111	-12.30	0.000
Freshness	4.994	1.235	4.072	0.000
Pesticides free	3.162	1.475	3.778	0.000
Production Origin	2.073	8.13	8.1368	0.000
SD				
Freshness	4.9995	1.888	2.647	0.000
Pesticides free	2.115	.996	2.123	0.000
Production Origin	2.440	.253	9.61	0.000

LR chi2(3)	426.55			
Prob> chi2	0.0000			

Mean Willingness to Pay

The mean willingness to pay (WTP) for the selected vegetable attributes was estimated using the mixed logit model and the delta method. The results reveal that consumers are willing to pay significant price premiums for all three quality attributes included in the choice experiment. As shown in Table 4, the estimated mean WTP for freshness is 52.32 monetary units (SE = 9.31; $z = 6.59$; $p < 0.001$), indicating that consumers place the highest value on product freshness. Similarly, consumers are willing to pay an additional 48.81 monetary units for pesticide-free vegetables (SE = 9.45; $z = 5.17$; $p < 0.001$), reflecting strong preferences for food safety and reduced chemical residues. The estimated mean WTP for production origin is 20.95 monetary units (SE = 1.55; $z = 13.49$; $p < 0.001$), suggesting that consumers also value information regarding the origin of vegetables, although to a lesser extent than freshness and pesticide-free production.

The positive and statistically significant WTP estimates demonstrate that consumers derive additional utility from quality and safety attributes and are willing to pay premium prices for vegetables possessing these characteristics. Among the attributes evaluated, freshness commands the highest premium, followed by pesticide-free production and production origin, indicating that visual quality and food safety are the primary determinants of consumers' purchasing decisions. The high statistical significance of all estimates confirms that these premiums are not due to random variation but represent consistent consumer valuations across the sample. These findings suggest that producers, retailers, and policymakers can improve market competitiveness by promoting fresh, pesticide-free vegetables and providing clear information on product origin through effective labeling and certification systems.

Table 3: Mean Willingness to Pay Results

Mean WTP	Coefficient	Std. error.	Z	P> z
Freshness	52.322	9.305	6.59	0.000
Pesticides free	48.808	9.446	5.17	0.000
Production Origin	20.945	1.553	13.49	0.000

DISCUSSIONS

The findings of this study provide important insights into consumer preferences for fresh vegetable attributes. The negative and statistically significant coefficient of price confirms that consumers are price-sensitive, and higher prices reduce the probability of selecting a product. This aligns with standard demand theory and previous empirical studies on food choice behavior.

The strong positive effect of freshness highlights that consumers prioritize quality attributes when making purchasing decisions. Freshness appears to be the most influential attribute in this study, suggesting that consumers associate it with better taste, nutritional value, and overall product quality. This result is consistent with earlier research emphasizing the importance of sensory and visual characteristics in fresh produce markets.

Similarly, the significant preference for chemical-free attribute indicates increasing consumer awareness regarding food safety and health concerns. Consumers are willing to favor products perceived as free from pesticides or harmful substances, reflecting a growing demand for safer and healthier food options. This finding supports existing literature on the rising importance of organic and environmentally friendly food products.

The positive and significant coefficient of origin suggests that consumers value information about where the product comes from. This may be linked to trust, perceived quality, or familiarity with local products. In developing regions, such as the study area, origin may serve as an important signal of product authenticity and safety.

The significant standard deviations of the random parameters reveal substantial heterogeneity in consumer preferences. This implies that not all consumers' value attributes equally; instead, preferences vary based on individual characteristics such as income, education, and awareness. The presence of heterogeneity justifies the use of the mixed logit model, as it provides a more flexible and realistic representation of consumer behavior compared to traditional models.

Overall, the results suggest that policies and marketing strategies aimed at improving product quality, ensuring food safety, and providing reliable information about product origin can significantly enhance consumer demand. Producers and marketers should focus on delivering fresh, chemical-free vegetable and effectively communicating these attributes to consumers to capture higher market value.

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