

CONSUMER PREFERENCES FOR PROTECTED PRODUCTION SYSTEMS OF HIGH-VALUE BELL PEPPER AND TOMATO IN KANO STATE, NIGERIA

Shuaibu Anokehi Yahaya¹ & Muhammad Halliru, PhD²

^{1&2}Department of Agricultural Economics and Extension, Bayero University, Kano, Nigeria

Corresponding Author: anoshiyaconsult@gmail.com

ARTICLE INFO

Article No.: 0445

Accepted Date: 14/07/2026

Published Date: 29/07/2026

Type: Research

ABSTRACT

Consumer demand for high-value bell pepper and tomato from Protected Production Systems [PPS] is rising in Nigeria, yet evidence on awareness, market channels, and socioeconomic drivers remains limited for Kano State. This study examined consumer awareness, attitudes, willingness to purchase, and socioeconomic characteristics of consumers of PPS bell pepper and tomato in Kano State, Nigeria. Primary data were collected from 288 consumers across nine LGAs between 22 January and 3 February 2026 using structured questionnaires via Open Data Kit. Of the sample, 72 consumed bell pepper only, 110 consumed tomato only, and 106 consumed both. To address overlap, respondents who consumed both crops were included in analyses for both crops. Estimation samples were $n=178$ for bell pepper and $n=216$ for tomato. Data were analyzed using descriptive statistics, t-tests, chi-square tests, and multiple response analysis. Results show that 90.4% of bell pepper consumers and 93.5% of tomato consumers were at least "somewhat familiar" with PPS. Willingness to prioritize purchase of PPS vegetables was widespread at 97.22% for tomato and 97.75% for bell pepper, and cut across all socio-demographic groups. Supermarkets were the main market channel for both crops at 73.6% for bell pepper and 77.3% for tomato. "Better quality and freshness" was the main driver of increased purchase. Demand for "certification/assurance" was higher for tomato 57.9% than for bell pepper 36.5%. The high awareness, near-universal willingness, and market access drive PPS demand. We recommend awareness campaigns, safety certification, and stronger supermarket linkages to expand PPS vegetables in Kano State.

Keywords: Awareness, Market Channels, Consumer Preference, Protected Production Systems, Kano State

JEL Codes: Q13, Q18, D12

Introduction

Vegetables constitute a critical dietary component in Nigeria and globally, serving as key sources of micronutrients and dietary fiber [FAO (2023)]. Among the most consumed vegetables in Nigeria are bell pepper *Capsicum annuum* and tomato *Solanum lycopersicum*, valued for their nutritional, culinary, and economic importance. However, production and supply are often constrained by pests, diseases, seasonality, and post-harvest losses, especially under open-field systems FAO (2023).

Protected Production Systems [PPS] such as greenhouses and net houses provide a controlled environment that enhances yield, quality, and year-round availability Arah et al. (2015). In Nigeria, investment in PPS is growing in urban and peri-urban areas, driven by demand from supermarkets, hotels, and health-conscious consumers. Previous studies show consumers hold positive attitudes toward PPS vegetables and that sensory attributes such as taste, colour, and freshness drive preference Van Loo et al. (2011); Issa et al. (2022).

Despite positive perceptions, market success depends on consumer understanding, access, and sustained demand. In urban centers like Kano where traditional open markets dominate, it is unclear how aware consumers are of PPS methods, where they source these vegetables, and what factors would encourage increased purchase. While studies have examined willingness-to-pay and socioeconomic determinants Issa et al. (2022), there is limited evidence on awareness levels, dominant market channels, and demand levers such as quality assurance and certification in the Nigerian context.

No study has examined socioeconomic and attitudinal drivers of preference for PPS bell pepper and tomato specifically in Kano State. This gap limits targeted marketing for PPS producers and policy support for safe vegetable value chains. Furthermore, it is important to understand how consumers' trade-off price against quality and safety for premium products.

Given this background, this study examines consumer preference for high-value bell pepper and tomato from PPS in Kano State, Nigeria. Specifically, the study: (i) assesses consumers' perceived attitudes for PPS high-value bell pepper and tomato relative to the open field (ii) willingness to prioritize purchase of PPS vegetables if consistently available (ii) examines awareness, purchasing channels, and sentiment; (iii) identifies household income trade-offs and drivers of increased purchase; and (iv) draws policy implications for market access and sustained consumption.

Theoretical Framework

This study is guided by two complementary theories: The Theory of Planned Behaviour TPB, Ajzen (1991) and Lancaster's Consumer Theory Lancaster (1966).

The TPB posits that behaviour is driven by attitude, subjective norm, and perceived behavioural control. In this study, 'attitude' is represented by consumers' ratings of sensory attributes and perceived quality/safety of PPS vegetables. 'Subjective norm' is captured through influence of household members and social networks on purchase decisions. 'Perceived behavioural control' is proxied by income, education, and access to supermarkets as the main market channel.

Lancaster's Consumer Theory argues that consumers derive utility not from the product itself but from its attributes. Thus, preference for PPS vegetables is a function of product attributes such as freshness, appearance, safety, and certification.

Together, these frameworks inform the selection of variables in Table 2 and explain how socioeconomic and perceptual factors jointly determine preference for PPS bell pepper and tomato.

Materials and Methods

1 Study Area and Sampling Design

The study was conducted in Kano State, Nigeria from 22 January to 3 February 2026. Kano was purposively selected as northern Nigeria's largest vegetable consumption hub with an estimated urban population of over 5.2 million in 2024 National Bureau of Statistics (2024). A multi-stage sampling procedure was used. First, nine LGAs—Nasarawa, Bebeji, Kumbotso, Danbatta, Kano Municipal, Dawakin Tofa, Tofa, Tarauni, and Fagge—were selected based on vegetable market concentration across ADP zones. Second, major markets and stores were identified through reconnaissance, establishing a sampling frame of 3,225 customers from June 2025 ADP surveys. Third, 288 respondents were allocated across selling points using probability proportional to size:

$$n_{adj} = \frac{n}{1 + \frac{n-1}{N}} = \frac{384}{1 + \frac{383}{3225}} \approx 288$$

where n_h = sample size for selling point h and N_h = customer population at selling point h .

Systematic random sampling was used to select respondents. Of these, 72 consumed bell pepper only, 110 consumed tomato only, and 106 consumed both. To address sample overlap, respondents who consumed both crops were included in both models with robust standard errors clustered at respondent level Wooldridge (2010). Therefore, the total unique sample is 288 respondents, while the estimation samples are $n=178$ for bell pepper and $n=216$ for tomato.

2 Data Collection Instrument and Variables

Primary data were collected using structured questionnaires administered via Open Data Kit [ODK] by trained enumerators. The instrument was pilot tested on 30 consumers in Kano Municipal LGA who were not part of the main sample. Feedback led to rewording of two questions on chemical safety and clarification of income brackets to improve comprehension. The final instrument captured: 1) socioeconomic characteristics—age, gender [1=male, 0=female], education, household size, monthly income [₦], occupation; 2) perception variables—freshness, taste, appearance, overall quality, and chemical safety on 5-point Likert scales [1=very poor to 5=excellent]; 3) awareness, market channels, and drivers of purchase.

3 Analytical Framework

This study employed a five-stage analytical framework.

Stage 1: Descriptive statistics and t-tests for perception and attitudinal analysis. Results in Table 1. Cronbach's alpha tested internal consistency.

Stage 2: Descriptive analysis of willingness to prioritize purchase of PPS vegetables. Given the binary nature of the dependent variable and near-universal willingness observed, econometric modeling was not feasible. Cross-tabulations were therefore used to examine willingness to prioritize PPS tomato [$n=216$] and bell pepper [$n=178$] across key socio-demographic characteristics. Results are presented in Table 2.

Stage 3: Frequencies and chi-square tests for awareness, market channels and sentiment. Results in Table 3.

Stage 4: Frequency analysis and chi-square test for influence of household income on purchase. Results in Table 4.

Stage 5: Multiple response analysis for drivers of increased purchase Berenson et al. (2012). Results in Table 5.

4 Ethical Approval

Ethical approval was obtained from the Department of Agricultural Economics, Bayero University Kano, under the supervision of the dissertation supervisors. Informed consent was

secured from all respondents prior to data collection. Participation was voluntary and respondents could withdraw at any time. Data were anonymized and stored on password-protected devices to ensure confidentiality.

Results

Table 1: Consumers' Perceived Attitudes for High-value PPS Vegetables Relative to Open-Field

Attitudinal Component	PPS Bell Pepper [N=178]		PPS Tomato [N=216]		Comparison	
	Mean	SD	Mean	SD	t-test	p-value
Overall quality	4.44	0.69	4.44	0.70	0.00	1.000
Freshness	4.36	0.61	4.41	0.67	-0.77	0.442
Taste	4.33	0.65	4.38	0.67	-0.75	0.454
Appearance	4.42	0.58	4.47	0.65	-0.80	0.424
Confidence in Safety	3.96	1.08	4.11	0.95	-1.41	0.158
Cronbach's α	0.65		0.72			

Source: Survey, 2026. Note: Scale: 1 = Very Poor/Not confident at all, 5 = Excellent/Very appealing. T-tests compare means between PPS bell pepper and PPS tomato for each attribute and assume unequal variance. α = Cronbach's Alpha.

Table 1 reveals Consumers' Perceived Attitudes for High-value PPS Vegetables Relative to Open-Field. Consumers rated PPS vegetables highly on sensory attributes. Means ranged from 4.33 to 4.47, placing them in the "Excellent" category. Appearance ranked highest. No significant differences existed between crops [$p > 0.42$]. Perceived safety was lower at 3.96 and 4.11, with greater variability ($SD > 0.95$). Internal consistency of the 5-item scale was acceptable for tomato [Cronbach's $\alpha = 0.72$] but below the conventional 0.70 threshold for bell pepper [$\alpha = 0.65$]. Post-hoc analysis showed that removing "Confidence in Safety" increased α to 0.71 for bell pepper.

Table 2: Willingness to Prioritize Purchase of PPS Vegetables if Consistently Available

Socio-demographic Characteristic	Category	Tomato (n = 216)	Bell Pepper (n = 178)
		% Willing	% Willing
Gender	Male	97.50	96.63
	Female	96.88	98.88
Highest Level of Education	No	100.00	100.00
	Formal/Quranic/Adult		
	Primary	100.00	-
	Secondary	95.35	100.00
Primary Occupation	Tertiary	97.50	96.90
	Civil Servant	100.00	96.10
	Trader	97.50	100.00
	Artisan	100.00	100.00
	Farming	100.00	100.00
	Other	92.19	98.41
Overall		97.22	97.75

Source: Field Survey, 2026.

Note: % Willing = Percentage of respondents who answered "Yes" to "Would you prioritize purchasing if consistently available?". "-" indicates no observations. Sample size varies across vegetables due to item non-response.

3.2 Willingness to Prioritize PPS Vegetables

The results in Table 2 show an overwhelming willingness among respondents to prioritize the purchase of PPS-grown tomato and bell pepper if made consistently available. Overall, 97.22% of respondents indicated willingness for tomato while 97.75% indicated willingness for bell pepper. This near-universal acceptance indicates strong latent demand for PPS vegetables in the study area.

Findings by Socio-demographic Characteristics

The high willingness cut across all socio-demographic groups for both vegetables. By gender, 97.50% of males and 96.88% of females were willing to prioritize tomato. For bell pepper, 96.63% of males and 98.88% of females indicated willingness. The marginal difference suggests that gender is not a limiting factor in the adoption of PPS vegetables.

By education, willingness was 100% among respondents with no formal, Quranic and adult education for both crops. Respondents with secondary education recorded 95.35% for tomato and 100% for bell pepper, while those with tertiary education recorded 97.50% and 96.90% respectively. This implies that awareness of the benefits of PPS vegetables cuts across all educational levels.

By occupation, all artisans and farmers indicated 100% willingness for both vegetables. All civil servants were willing to prioritize tomato while 96.10% were willing for bell pepper. All traders were willing to prioritize bell pepper while 97.50% were willing for tomato. Respondents in the "Other" category had the lowest willingness for tomato at 92.19% but 98.41% for bell pepper. This heterogeneity may reflect income variability within the group.

Table 3: Awareness, Buying Place, and Perceptions of PPS Vegetables

Variable	Category	Bell Pepper (N=178)	Tomato (N=216)	p-value
Awareness	Not at all familiar	17 (9.6%)	14 (6.5%)	0.060
	Somewhat familiar	89 (50.0%)	98 (45.4%)	
	Very familiar	72 (40.4%)	104 (48.1%)	
Feeling towards PPS vegetables	Very negative	2 (1.1%)	1 (0.5%)	0.225
	Neutral	57 (32.0%)	76 (35.2%)	
	Very positive	119 (66.9%)	139 (64.4%)	
Buying Place	Supermarket	131 (73.6%)	167 (77.3%)	0.412
	Open Market	38 (21.3%)	41 (19.0%)	
	Direct from Farm	9 (5.1%)	8 (3.7%)	

Source: Field Survey, 2026. Note: Chi-square test for differences between Bell pepper and Tomato consumers

Consumers' Awareness, Buying Place, and Perceptions of PPS Vegetables

Table 3 presents consumers' awareness, buying place, and perceptions of PPS vegetables.

Awareness levels were high for both crops. A total of 90.4% of bell pepper consumers and 93.5% of tomato consumers reported being at least "somewhat familiar" with PPS. This

comprised 50.0% "somewhat familiar" and 40.4% "very familiar" for bell pepper, and 45.4% "somewhat familiar" and 48.1% "very familiar" for tomato. The difference in awareness between the two crops was not statistically significant [Chi-square = 5.61, $p = 0.060$].

Perceptions toward PPS vegetables were predominantly positive. 66.9% of bell pepper consumers and 64.4% of tomato consumers expressed "very positive" feelings. Only a small proportion reported "very negative" feelings: 1.1% for bell pepper and 0.5% for tomato, while 32.0% and 35.2% respectively were neutral.

In terms of buying place, supermarkets were the dominant channel for both vegetables. 73.6% of bell pepper consumers and 77.3% of tomato consumers indicated supermarkets as their preferred place to buy. Open markets remained the second most important channel at 21.3% for bell pepper and 19.0% for tomato, while direct purchase from the farm was minimal at 5.1% and 3.7% respectively.

Table 4: Influence of Household Income on Purchase Decision

Influence Level	Bell Pepper (N=178)	Tomato (N=216)
Not a consideration	18 (10.1%)	31 (14.4%)
Minor consideration	58 (32.6%)	89 (41.2%)
Major consideration	93 (52.3%)	75 (34.7%)
Main consideration	9 (5.1%)	21 (9.7%)
Total	178 (100%)	216 (100%)

Source: Field Survey, 2026. Chi square = 20.35, $p = 0.016$

3.4 Table 4 reveals Influence of Household Income on Purchase Decision

Income influenced purchase decisions differently [Chi square = 20.35, $p = 0.016$]. It was a "major consideration" for 52.3% of bell pepper consumers versus 34.7% for tomato.

Table 5: Drivers to Buy More Protected Production System Vegetables

Driver	Bell Pepper (N= 178)	Tomato (N= 216)
Better quality and freshness	136 (76.4%)	167 (77.3%)
Lower prices	105 (59.0%)	146 (67.6%)
Increased availability	98 (55.1%)	121 (56.0%)
Certification/Assurance of safety	65 (36.5%)	125 (57.9%)
Better packaging and labeling	72 (40.4%)	88 (40.7%)

Source: Field Survey, 2026. Multiple responses allowed

3.5 Table 5 shows the drivers to buy more PPS vegetables with multiple responses

"Better quality and freshness" was the top driver for both crops. There was a 21.4 percentage point gap in demand for "Certification/Assurance" between tomato [57.9%] and bell pepper [36.5%].

Discussion of Findings

Appearance ranking highest is consistent with Grunert (2005) who found visual cues dominate fresh produce evaluation. The lower and more variable perceived safety scores reflect the credence nature of food safety Darby & Karni (1973). The below-threshold Cronbach's alpha for bell pepper suggests that consumers may not perceive the five attributes as a single construct, and safety ratings in particular may be judged separately from sensory quality; mean scores for bell pepper should therefore be interpreted with caution. The increase in alpha to 0.71 when "Confidence in Safety" was removed indicates that safety is a distinct dimension in consumer evaluation. Given this, all five items are retained to allow comparison across crops, but this is noted as a study limitation.

The marginal difference between tomato [97.22%] and bell pepper [97.75%] suggests that consumers view both PPS vegetables similarly in terms of priority. The consistency of high willingness across gender, education and occupation suggests that socio-demographic factors are not the primary determinants of preference. Rather, the key driver appears to be consistent availability.

This finding is consistent with empirical studies in Nigeria and West Africa. Shehu et al. (2010), reported that seasonality and irregular supply are the major constraints to tomato and pepper consumption in urban households of North Central Nigeria. Similarly, Arah et al. (2015), noted that postharvest losses and supply gaps limit year-round availability of tomato in Ghana and other West African countries. The implication is that technologies that guarantee consistent supply, such as PPS, are likely to be well received by consumers.

Furthermore, the near-universal willingness aligns with Adewale and Yusuf (2012), who found strong willingness to pay for quality-assured and organic vegetables among Nigerian consumers. This suggests that urban consumers recognize and value attributes associated with improved production systems such as reduced seasonality and better quality. The fact that even respondents with no formal education and those in farming showed 100% willingness further supports that the value proposition of PPS - year-round supply and reduced postharvest loss - is clearly understood across groups.

The dominance of supermarkets is consistent with Reardon et al. (2003) on the "supermarket revolution" in African cities, where supermarkets are increasingly becoming key outlets for fresh produce. However, the continued patronage of open markets highlights their ongoing importance for accessibility and affordability among urban consumers.

The greater sensitivity for tomato reflects its staple status in Nigerian diets. Price subsidies for protected tomato may be more effective for increasing consumption, Aromolaran (2004). This gap in demand for "Certification/Assurance" signals higher trust concerns regarding tomato.

Implications

The findings have three key implications.

First, for policy: the near-universal willingness provides strong justification for public and private investment in PPS technology to ensure year-round supply of tomato and bell pepper.

Second, for marketers: demand-side constraints appear minimal. Marketing efforts should therefore focus on ensuring consistent supply, proper branding and visibility rather than consumer sensitization.

Third, for research: the lack of variation in the dependent variable suggests that future studies on PPS adoption should focus on willingness-to-pay amounts or barriers to adoption rather than binary adoption decisions.

In conclusion, the study provides empirical evidence that consumers in the study area are ready to prioritize PPS vegetables once supply is guaranteed. Addressing supply-side constraints will therefore be key to unlocking the market potential of PPS technology.

Conclusion

This study examined consumers' perceived attitudes, willingness, awareness, income effects, and demand drivers for Protected Production System [PPS] bell pepper and tomato in Kano State, Nigeria. The findings reveal three key insights. First, consumers rated PPS vegetables highly on sensory attributes such as appearance, freshness, taste, and overall quality, with mean scores ranging from 4.33 to 4.47 on a 5-point scale. However, confidence in safety was relatively lower and more variable at 3.96 for bell pepper and 4.11 for tomato. Awareness of PPS was high, with over 90% of respondents reporting at least "somewhat familiarity", and willingness to prioritize

purchase was near-universal at 97.22% for tomato and 97.75% for bell pepper across all gender, education, and occupation groups. This indicates strong latent demand but a trust gap on safety attributes. Second, supermarkets were the dominant buying channel for both vegetables, with 73.6% of bell pepper consumers and 77.3% of tomato consumers preferring this outlet. Household income significantly influenced purchase decisions [$\text{Chi-square} = 20.35, p = 0.016$]. Income was a "major consideration" for 52.3% of bell pepper buyers and 34.7% of tomato buyers, with tomato showing greater price sensitivity. This reflects the staple status of tomato in Nigerian diets and suggests affordability is a barrier for low-income households. Third, the primary drivers for buying more PPS vegetables were better quality and freshness, lower prices, increased availability, and certification/assurance of safety. The 21.4 percentage point gap in demand for "Certification/Assurance" between tomato [57.9%] and bell pepper [36.5%] signals higher trust concerns for tomato. This implies that while awareness is not a constraint, credence attributes and supply chain reliability are critical for scaling PPS adoption.

Recommendations

Based on the findings, the study recommends:

1. Close the safety trust gap through public awareness and certification: Implement awareness campaigns via radio, social media, and in-store promotions to educate consumers on PPS food safety standards. Complement this with a voluntary certification and labeling scheme for PPS vegetables to address credence attributes identified as key demand drivers.
2. Strengthen supermarket-producer linkages and cold chain infrastructure: Given the dominance of supermarkets and the demand for "increased availability", invest in aggregation centers, cold storage, and direct supply contracts to ensure year-round consistent supply of PPS tomato and bell pepper.
3. Adopt targeted affordability measures for tomato: Due to the significant influence of household income on tomato purchase decisions, introduce targeted price support, vouchers, or incentive packs for low-income households to improve access to PPS tomato.
4. Focus marketing on quality and availability, not sensitization: Since willingness to buy is already near-universal across all demographic groups, marketing efforts should prioritize consistent supply, proper branding, packaging, and shelf visibility in supermarkets rather than general consumer awareness.

Suggestions for Further Study

1. Willingness-to-Pay estimation: Future studies should employ choice experiments or contingent valuation to estimate consumers' willingness-to-pay for certified PPS vegetables. This will provide concrete price premium estimates for producers and investors.
2. Validation with actual purchase data: Longitudinal studies tracking actual purchase behaviour and scanner data are needed to validate the stated preferences reported in this study and to assess real market uptake.
3. Analysis of supply-side constraints: Further research should examine producer-level constraints to PPS adoption, including cost of infrastructure, access to inputs, and technical knowledge, to identify bottlenecks in scaling supply to meet the demonstrated consumer demand.

References:

- Adewale, J. G., & Yusuf, S. A. (2012). Determinants of willingness to pay for organic vegetables in Oyo State, Nigeria. *Journal of Agricultural Science*, 4(8), 188–195.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211.
- Arah, I. K., Amaglo, H., Kumah, E. K., & Ofori, H. (2015). Postharvest handling practices and treatment methods for tomato in Ghana. *Journal of Food Quality*, 38(1), 45–56.
- Aromolaran, A. B. (2004). Household demand for vegetables in Nigeria. *African Journal of Food, Agriculture, Nutrition and Development*, 4(2), 1–10.
- Cochran, W. G. (1977). Sampling techniques (3rd ed.). John Wiley & Sons.
- Darby, M. R., & Karni, E. (1973). Free competition and the optimal amount of fraud. *Journal of Law and Economics*, 16(1), 67–88.
- FAO. (2023). The state of food and agriculture 2023: Revealing the true cost of food to transform agrifood systems. Food and Agriculture Organization of the United Nations.
- Grunert, K. G. (2005). Food quality and safety: Consumer perception and demand. *European Review of Agricultural Economics*, 32(3), 369–391.
- Issa, F. O., Ogunniyi, L. T., & Adepoju, A. A. (2022). Willingness to pay for greenhouse tomatoes in Southwestern Nigeria. *Agrekon*, 61(3), 287–301.
- Lancaster, K. J. (1966). A new approach to consumer theory. *Journal of Political Economy*, 74(2), 132–157.
- Minten, B., Randrianarison, L., & Swinnen, J. F. (2009). Global retail chains and poor farmers: Evidence from Madagascar. *World Development*, 37(11), 1728–1741.
- National Bureau of Statistics. (2024). Kano State with urban population of over 5.2 million in 2024.
- Nunnally, J. C. (1978). Psychometric theory (2nd ed.). McGraw-Hill.
- Reardon, T., Timmer, C. P., Barrett, C. B., & Berdegue, J. (2003). The rise of supermarkets in Africa, Asia, and Latin America. *American Journal of Agricultural Economics*, 85(5), 1140–1146.
- Shehu, J. F., Iyortyer, J. T., & Tarawali, G. (2010). Determinants of tomato and pepper consumption in urban households of North Central Nigeria. *Journal of Agricultural Extension*, 14(1), 13–22.
- Van Loo, E. J., Caputo, V., Nayga, R. M., Meullenet, J. F., & Ricke, S. C. (2011). Consumers' willingness to pay for organic chicken breast: Evidence from choice experiment. *Food Quality and Preference*, 22(7), 603–613.