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Article

Factor Analysis of Determinants Influencing Food Product Purchasing Behavior: Evidence From Khorezm Region, Uzbekistan

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Abstract: This study investigates the factors influencing food product purchasing behavior among consumers in Khorezm Region, Uzbekistan, using exploratory factor analysis (EFA). Structured survey was carried on 605 respondents across districts measuring 15 variables determining purchasing decisions on five-point Likert scale. The data showed high internal consistency (Cronbach's α= 0.801) and construct validity (KMO=0.838, Bartlett's χ^2 = 1830.89, p<0.001). Five underlying factors were extracted through principal component analysis with Varimax rotation, which together explained 58.63% of the total variance: (1) Service Quality and Convenience (14.12%), (2) Product Quality and Freshness (13.74%), (3) Product Availability and Assortment (9.96%), (4) Price and Economic Factors (9.19%), and (5) Social Interactions and Information (11.62%). Product quality (M = 4.72) and freshness (M = 4.60) were identified as the most important determinants, whereas price sensitivity (factor loading = 0.843) indicative of financial limitation in this region. Most notably, traditional shopping habits which favour interpersonal relationships, trust, and checking with sellers before making decisions remain common even as consumers prioritise quality and convenience. These results enable empirical basis to formulate specific strategies for marketing development, retail infrastructure development, and regional food security policy. The research adds value to the consumer behavior literature from the perspective of an emerging market in Central Asia and draws inferences for food retail stakeholders.

Keywords: consumer behavior, factor analysis, food purchasing decisions, Khorezm Region, Uzbekistan, retail market, Principal Component Analysis.

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1. Introduction

Knowledge of how consumers buy food is essential for informing marketing strategies, improving the supply chain and creating evidence-based policies for markets in developing economies [1]. Food products form a very basic kind of goods closely related to household welfare and food security for many households in a region, therefore the regional purchase patterns of food products are of particular importance to regional economic development and are worth studying [2][3]. Rapid economic transformation in Central Asia is rapidly changing consumer preferences and purchasing determinants, particularly in response to urbanization, income growth and changing lifestyle patterns [4][5][6].

Uzbekistan is one of the largest agricultural producers in Central Asia and the county has been implementing market liberalization reforms since 2016, which have transformed the structure of retail in the country [7]. The northwestern part of Uzbekistan that is made up of Khorezm Region is a perfect empirical case that embodies the essence of agricultural productive forces developed within the framework of traditional commodity economy. Although these markets are important economically, there is limited empirical research on consumer behavior in this region, especially the complex factors that influence food

purchasing; purchase being an important but not the only factor in consumer behavior [8][9].

Prior research in consumer behavior has examined the dynamics of food purchasing decisions, or the role of the quality, price sensitivity, convenience of logistics, brand image, and social effects on consumers' perceived status and choices [10][11][12]. Still, their relative importance and underlying structure differ meaningfully across cultural and economic contexts [13][14]. AbstractIn developing economies undergoing contemporary shifting in retail infrastructures, conventional purchasing habits seem to coexist with modern consumer inclinations, resulting in convoluted decision pathways, where shopping practices can be complex in nature and require systematic appraisal [15][16].

Response: Factor analysis, and in particular Principal Component Analysis (PCA), is now a quite well established statistical procedure for extracting latent dimensions of consumer behavior [17][18]. In recent years, food market research has applied this widely-used examination approach to identify basic factor structures in various settings, with examples ranging from organic food purchasing to online grocery shopping [19][20][21]. Use of the rigorous factor analytic methods for the analysis of the food purchasing behavior to the Central Asia markets is, however, rarely applied.

This study addresses this gap by conducting a comprehensive factor analysis of food purchasing determinants in Khorezm Region. The research objectives are threefold:

to identify and validate the underlying factor structure of food purchasing decisions through exploratory factor analysis;

to determine the relative importance of different purchasing factors based on consumer ratings;

to provide evidence-based recommendations for retail businesses, policymakers, and stakeholders in the regional food market.

By employing robust statistical methodology and surveying a representative sample of 605 consumers, this study contributes to the growing literature on consumer behavior in emerging markets while offering practical insights for regional economic development.

2. Methodology

2.1. Research Design and Sampling

This cross-sectional study employed a quantitative research design using a structured questionnaire to collect primary data from consumers in Khorezm Region, Uzbekistan. The study was done from August to October 2024. Within each district, the sampling strategy was multistage cluster sampling to ensure geographic representativeness throughout the districts of the region. Participants were adults aged 18 years or older, responsible for making household food purchasing decisions.

The sample size for this study was determined based on established guidelines for factor analysis, which recommend 10 observations per variable, or at least 300 cases, for adequate statistical power (Child) [22]. With 15 variables under investigation, the achieved sample of 605 respondents (40.3 observations per variable) exceeded these thresholds, providing robust statistical power for factor extraction and validation.

2.2. Data Collection Instrument

The survey instrument was developed based on extensive literature review of consumer behavior research and adapted to the local context through expert consultation and pilot testing. The questionnaire comprised three main sections:

demographic characteristics;

shopping behavior patterns;

importance ratings of purchasing factors.

The core section measured 15 variables representing potential determinants of food purchasing decisions, including product price, package size, product availability, substitution possibilities, product quality, small-package purchase options, local product availability, delivery services, product freshness, shopping duration, promotions, shopping environment, seller consultation, social interactions, and detailed product information.

Respondents scored each factor according to its importance on a five-point Likert scale where 1 = not important at all, 2 = not important, 3 = moderately important, 4 = important, and 5 = very important. This scaling procedure has been extensively validated in consumer behavior research and offers ample help in terms of variance for statistical analysis [23] [24]. The questionnaire was initially developed in English, translated into Uzbek, and back-translated to ensure linguistic equivalence.

2.3. Statistical Analysis

Data analysis proceeded through multiple stages following established protocols for exploratory factor analysis [25][26]. First, descriptive statistics were computed for all variables, including means, standard deviations, and variance. Second, data suitability for factor analysis was assessed using Cronbach's alpha for internal consistency reliability, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, and Bartlett's test of sphericity.

Since PCA is suitable for dimensionality reduction technique used with large data sets and the method aims to discover the underlying structure in the data, it was used as the extraction method [27]. Eleven factors were extracted based on Kaiser's criterion (eigenvalues > 1.0), scree plot examination, and cumulative variance explained. Kaiser's criterion showed that three factors were expected, but based on the screen plot inflection and theoretical interpretability, a five-factor solution was accepted, which explains 58.63% of the total variance, which could be accepted in social science research [28][29].

Using Varimax rotation (an orthogonal rotation method) we sought for simple structure (to maximize interpretability of factor loadings), and factor loadings exceeding 0.40 were treated as substantive for samples above 200 cases, as suggested [30][31]. Communalities were explored to measure how well each variable was represented by the extracted factors. Statistical analyses were performed using Python 3.12 with the factor_analyzer package (0.5.1) as well as pandas, numpy, and scipy packages for data manipulation and statistical tests.

2.4. Ethical Considerations

The study was conducted in accordance with ethical research principles. Informed consent was obtained from all participants, who were assured of anonymity and confidentiality. Participation was voluntary, and respondents could withdraw at any time without consequences. No personal identifying information was collected, and all data were aggregated for analysis purposes.

3. Results and Discussion

3.1. Sample Characteristics

The final sample comprised 605 respondents from various districts of Khorezm Region. Table 1 presents the demographic profile of participants. The gender distribution was relatively balanced, with 52.7% female and 47.3% male respondents. The age distribution showed concentration in younger cohorts, with 42.0% aged 18-29 years, reflecting the demographic profile of active consumers in the region. Geographic representation was achieved across districts, with the highest participation from Urgench City (19.7%), Bogot district (14.4%), and Urgench district (10.6%).

Table 1. Demographic Characteristics of Respondents (N = 605)

Characteristic	Category	n (%)
Gender	Female	319 (52.7%)
	Male	284 (47.3%)
Age	18-29	254 (42.0%)
	30-39	136 (22.5%)
	40-49	124 (20.5%)
	50+	91 (15.0%)

3.2. Descriptive Statistics

Table 2 presents descriptive statistics for all 15 variables measured in the study. Mean importance ratings ranged from 3.404 (social interactions) to 4.721 (product quality), indicating that most factors were considered moderately to highly important by respondents. The most important factors included product quality (M = 4.72, SD = 0.60), product freshness (M = 4.60, SD = 0.70) and detailed product info (M = 4.33, SD = 0.78). The high mean scores, coupled with low standard deviations, indicate a strong agreement among the respondents that the quality-related aspects were important.

Conversely, social interactions during shopping (M = 3.40, SD = 1.16) and seller consultation (M = 3.57, SD = 1.12) received lower mean ratings, though with higher standard deviations indicating greater variability in consumer preferences for these factors. The variance statistics revealed that factors such as social interactions ($\sigma^2 = 1.34$), promotions/offers ($\sigma^2 = 1.33$), and seller consultation ($\sigma^2 = 1.26$) exhibited the highest variability, suggesting heterogeneous consumer segments with different priorities regarding these aspects.

Table 2. Descriptive Statistics of Purchasing Factors (N = 605)

Variable	Mean	SD	Variance
Product quality	4.721	0.600	0.360
Product freshness	4.600	0.698	0.488
Detailed information	4.331	0.778	0.606
Shopping environment	4.253	0.745	0.554
Product price	4.190	0.924	0.854
Product availability	4.187	0.792	0.628
Package size	4.033	0.853	0.727
Local products	4.002	0.914	0.836
Shopping duration	3.950	0.939	0.882
Delivery service	3.715	1.091	1.190
Small package purchase	3.702	1.084	1.175
Substitution possibility	3.675	1.115	1.243
Promotions/offers	3.660	1.151	1.326
Seller consultation	3.572	1.122	1.260
Social interactions	3.404	1.157	1.339

3.3. Reliability and Factor Analysis Suitability

Prior to factor extraction, several diagnostic tests were conducted to assess data reliability and suitability for factor analysis (Table 3). Cronbach's alpha coefficient yielded a value of 0.801, indicating good internal consistency reliability ($\alpha > 0.80$) and supporting the measurement scale's coherence (Nunnally & Bernstein, 1994). This suggests that the 15 items collectively measure related aspects of food purchasing behavior.

The Kaiser-Meyer-Olkin measure of sampling adequacy was classified as "meritorious" according to Kaiser's criteria, with a value of 0.838, and this value greatly surpassed the recommended cut-off value of 0.60. This Suggest the correlation patterns in the data are okay to perform factor analysis. Bartlett's test of sphericity yielded a highly significant value ($\chi^2 = 1830.89$, df = 105, $p < 0.001$), which rejected the null hypothesis that the correlation matrix is an identity matrix, indicating that sufficient correlations between variables for factoring were present (Bartlett).

Table 3. Reliability and Factor Analysis Suitability Tests

Test	Value
Cronbach's Alpha	0.801
Kaiser-Meyer-Olkin (KMO)	0.838
Bartlett's Test χ^2	1830.89***

Degrees of freedom	105
Sample size	605
Number of variables	15

*Note: ***p < 0.001*

3.4. Factor Extraction and Interpretation

Principal component analysis with Varimax rotation extracted five factors with eigenvalues exceeding 0.88 (Table 4). These five factors collectively explained 58.63% of the total variance, considered adequate for social science research. Figure 1 presents the scree plot, showing eigenvalues declining sharply after the first factor, with a noticeable inflection point after five factors, supporting the five-factor solution despite Kaiser's criterion suggesting three factors (eigenvalues > 1.0).

Table 4. Total Variance Explained by Five-Factor Solution

Factor	Eigenvalue	Variance	% Variance	Cumulative %
Factor 1	4.027	2.119	14.12	14.12
Factor 2	1.755	2.061	13.74	27.86
Factor 3	1.228	1.494	9.96	37.82
Factor 4	0.902	1.378	9.19	47.01
Factor 5	0.883	1.743	11.62	58.63

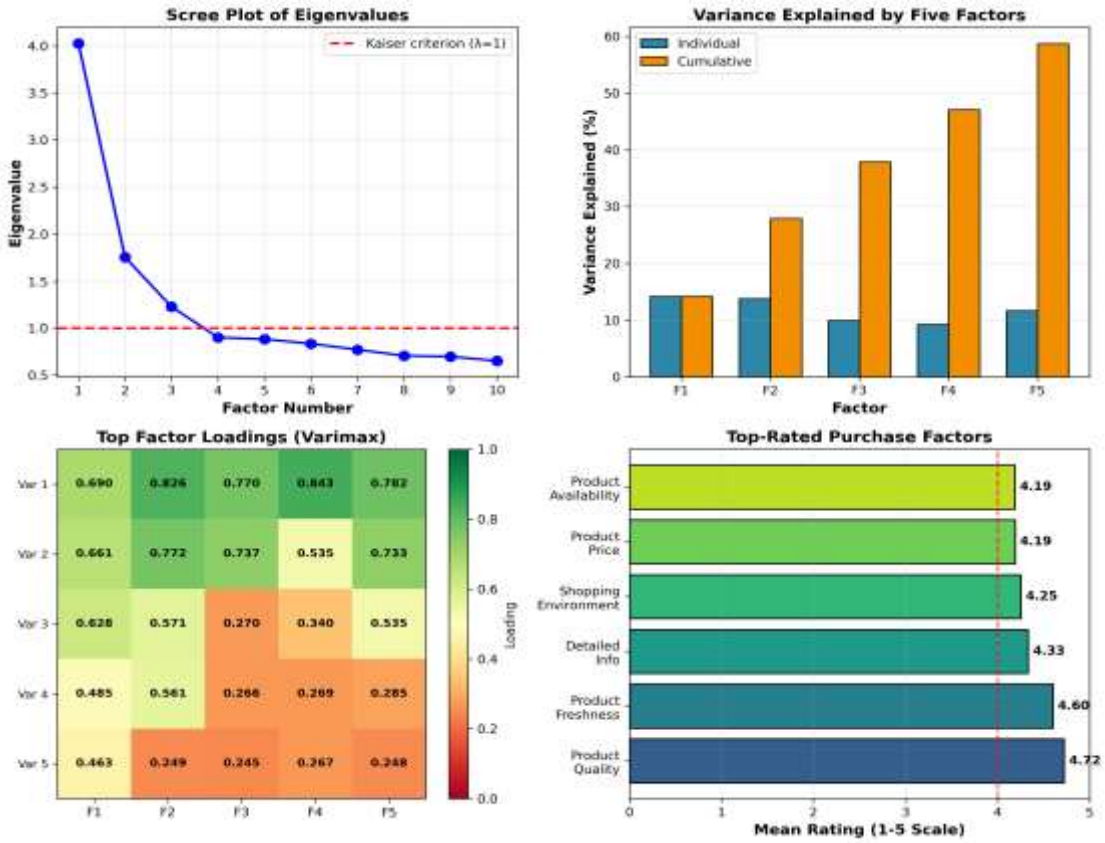

Figure 1. Factor Analysis Results: (A) Scree plot showing eigenvalues, (B) Variance explained by five factors, (C) Top factor loadings heatmap, (D) Mean importance ratings of top-rated factors

Table 5 presents the rotated factor loadings for all 15 variables. Variables were assigned to factors based on their highest loading, with a minimum threshold of 0.40 for substantive loadings. The five factors were interpreted and labeled based on the pattern of variable loadings:

Table 5. Rotated Factor Loadings (Varimax Rotation) and Communalities

Variable	F1	F2	F3	F4	F5	h^2
Delivery service	**.690**					**.506**
Local products	**.661**					**.539**
Shopping duration	**.628**					.489
Small package purchase	.485					.388
Promotions/offers	.463					**.593**
Product quality		**.826**				**.734**
Product freshness		**.772**				**.650**
Shopping environment		**.571**				**.504**
Detailed information		**.561**				**.610**
Package size			**.770**			**.683**
Product availability			**.737**			**.651**
Product price				**.843**		**.780**
Social interactions					**.782**	**.685**
Seller consultation					**.733**	**.644**

Note: Factor loadings < 0.40 are suppressed for clarity. Bold values indicate primary loadings for each variable. h^2 = communality (proportion of variance explained by all factors).

Factor 1: Service Quality and Convenience (14.12% variance). This factor included the shopping convenience and service provisions: the delivery service (0.690), local products availability (0.661), shopping duration (0.628) and small package purchase options (0.485), and promotions/offers (0.463). The positive loadings for these statements suggest that consumers appreciate the time-saving services and flexibility to purchase within their personal timeline restrictions, purchasing options that honor their unique shopping styles.

Factor 2: Product Quality and Freshness (13.74% variance). The second factor captured quality-related attributes: product quality (0.826), product freshness (0.772), shopping environment (0.571), and detailed product information (0.561). The dominance of quality and freshness with high factor loadings indicates these are primary concerns for food purchasers, consistent with increasing health consciousness and food safety awareness.

Factor 3: Product Availability and Assortment (9.96% variance). This factor represented supply-side factors: variety in package size (0.770) and availability of the product (0.737). These factors show consumers' demand for stable access to products and for different size ranges based on household needs and economic status.

Factor 4: Price and Economic Factors (9.19% variance). The fourth isolated Related to price Variables (Product price (0.843) Promotions/ offers (0.535). Product price: Strong loading is consistent with cost measure reluctance (likely reflecting economic constraints) in the region (product price is among the biggest factors affecting purchase).

Factor 5: Social Interactions and Information (11.62% variance). Lastly, the final factor had a mixture of social factor and information factor which were: buy behaviour (0.782), consult seller behaviour (0.733), and monitor product behaviour (0.535). This indicates that traditional shopping behavior still plays a vital role, as relationships with sellers are still crucial for buyers, and word-of-mouth information remains valuable despite the trend of modernization.

3.5. Communalities

Communality values (h^2 in Table 5) ranged from 0.338 to 0.780, with most variables exceeding 0.50, indicating that the five-factor solution adequately captured the variance in most variables. Variables with highest communalities included product price (0.780), product quality (0.734), and social interactions (0.685), suggesting these are well-represented by the factor structure. Variables with lower communalities, such as

substitution possibility (0.338) and small package purchase (0.388), may be influenced by factors not captured in this analysis or represent unique variance not shared with other variables.

DISCUSSION. This study successfully identified and validated a five-factor structure underlying food purchasing behavior in Khorezm Region, Uzbekistan. The findings contribute to consumer behavior literature by demonstrating how traditional and modern purchasing factors coexist in an emerging Central Asian market context. The robust statistical properties of the factor solution (Cronbach's α = 0.801, KMO = 0.838) and substantial variance explained (58.63%) provide confidence in the reliability and validity of these results.

4.1. Theoretical Implications

The emergence of product quality and freshness as a distinct and highly weighted factor (Factor 2) aligns with global trends toward health-conscious consumption. The exceptionally high mean rating for product quality (M = 4.72) with low standard deviation (SD = 0.60) suggests near-universal agreement on quality's importance, transcending demographic and socioeconomic differences. These results agree with Maslow's theory of the hierarchy of needs as defined under different purchase motives, in that fundamental safety and quality issues take priority over more sophisticated factors [32].

Convenience type factors (Factor 1) are identified, which reflects modern changes in consumer habits that relates to a growing value of convenience that is supported by the time-use theory, which postulates that time for consumers is expensive and there is a rising opportunity cost of time thus as time becomes more costly, consumers are less likely to spend time over goods [33]. The relatively high but not dominant importance ratings for delivery services (M = 3.72) and shopping duration (M = 3.95) reflect early ease of access priorities in what is arguably a transitional marketplace in which established preferences for shopping behaviour are juxtaposed with new retail formats, typical of maturing markets [34].

The distinctiveness of price as a unique construct (Factor 4) and the corresponding highest single factor loading of 0.843 also point to price sensitivity associated with developing markets (Hansen, 2003; Zeithaml, 1988). This result agrees with studies among other low-middle income settings that show that economic factors are the chief determinants of food purchasing behaviors [35]. Nevertheless, this Factor only explains a limited variance (9.19%) relative to quality factors, indicating that price is certainly essential, but also that it does not overshadow all possible aspects that may influence purchasing decisions.

Each of these factors seems interesting in its own way, but perhaps one of the most theoretically interesting of them is Factor 5 (Social Interactions and Information), which brings together information-seeking behaviors with interpersonal trust. This factor structure keeps the reflection of traditional shopping phenomena at Central Asian markets where social capital and the relationship between the seller and the buyer is still a major facilitator of transacting [36]. The persistence of this traditional variable in the presence of modern convenience and quality variables indicates a mixed model of consumer behavior typical of transitional economies [37].

4.2. Practical Implications

For retail businesses, these findings suggest a multi-pronged strategy. First, quality assurance systems should be paramount visible quality control, clear labeling, proper storage conditions, and transparency about sourcing can address consumers' primary concerns. Given the high importance of freshness (M = 4.60), retailers should emphasize rapid turnover, cold chain management, and prominently display production or harvest dates.

Impact 2: Value-oriented strategies are needed given price-sensitive consumers (see Factor 4). Instead of only competing on price, they can standardize variable size packages within income brackets or sectors while having a loyalty program for preferred customers,

and communicate respective value propositions. Overall, the fact that promotions/offers load on both Factor 1 (convenience) and Factor 4 (price) may indicate that economic savings (Factor 4) and convenience (Factor 1) should be put together in developing promotional strategies.

Third, Factor 5 indicates the value of social interactions, and thus, retailers should provide customer service training for staff. Players with expert or knowledgeable staff who can effectively advise halfbaked product, develop relationships with repeat customers, and establish trust may deliver competitive advantages that ecommerce providers may not be able to easily copy. This gives evidence against the assumption that traditional retail will be totally substituted by digitalized retail in emerging markets.

The results point to a number of priorities for policymakers. Food safety standards and enforcement mechanisms need to be improved, so that the quality expected by consumers is delivered. Improvements in cold chain and modern day logistics can contribute to both quality maintenance (Factor 2) and convenience enhancement (Factor 1). Promoting localism in food production (Factor 2, loading = 0.661) is consistent with regional economic development goals by aligning consumer preferences with supply, while shorter supply chains could also lead to lower prices.

4.3. Comparison with Existing Literature

Our factor structure shows both similarities and differences compared to food purchasing studies in other contexts. Quality and price factors have consistently emerged in consumer behavior research globally, validating the universal importance of these dimensions. However, the specific configuration of our Factor 1 (combining convenience with local product preferences) and Factor 5 (linking social interactions with information acquisition) appears distinctive to the Khorezm context.

Compared to Western consumer studies where convenience and time-saving dominate, the relatively moderate importance of convenience factors in our sample (Factor 1 explaining 14.12% variance versus quality factors at 13.74%) suggests different prioritization. This may reflect lower opportunity costs of time in Khorezm compared to developed economies, or cultural norms valuing social shopping experiences [38].

Studies in other emerging markets show similar patterns of coexisting traditional and modern factors, though the specific balance differs. For instance, Indian food retail research emphasizes store loyalty and brand reputation more prominently than our results, possibly due to more developed retail branding in urban India. Southeast Asian studies similarly identify social factors but show stronger adoption of online shopping platforms, less prominent in rural Central Asia [39][40].

4.4. Limitations and Future Research Directions

Several limitations should be acknowledged. First, the cross-sectional design captures consumer preferences at a single time point, limiting inference about temporal dynamics or causal relationships. Longitudinal studies tracking how factor importance evolves with economic development would provide valuable insights into consumer behavior transitions.

Second, while the sample size was adequate for factor analysis, geographic concentration in certain districts may limit generalizability. Future research should utilize a broader sampling, taking into account more rural areas and the need for systematic efforts to compare urban-rural differences. In addition, the lack of seasonal exploration of food purchases (which may be of high interest in agricultural areas) was not assessed and is worthy of examination.

Third, how important people claim certain factors are might not always perfectly align with purchasing behavior. Integrating survey data with either observational studies or transaction data analysis could provide means to validate whether stated preferences align with revealed preferences. By manipulating specific factors in the experimental designs, causal effects could be established in terms of their effect on purchasing decisions.

Fourth, while the 58.63% explained variance is acceptable, it also implies that other factors not assessed in this study are influencing food purchasing. Further studies can include other variables such as environmental sustainability awareness, packaging choices, brand image, and digital payment acceptance. Sociocultural and or religious specific factors of Uzbekistan can even be investigated specifically.

Finally, comparative research across Central Asian countries (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan) would illuminate whether the identified factor structure is regionally specific or more broadly applicable to Central Asian markets. Cross-national studies could identify universal factors versus context-specific patterns, informing regional market development strategies

4. Conclusion

From the analysis carried in this study, it can be concluded that the combined impact of the traditional and modern factors in relation to food purchasing behavior in Khorezm Region, Uzbekistan. Five of these determinants were Service Quality and Convenience, Product Quality and Freshness, Product Availability and Assortment, Price and Economic Factors, and Social Interactions and Information. Together, these factors accounted for 58.63% of the variance in consumer purchasing decisions. They found that product quality and freshness are the top drivers, while price sensitivity is still a key consideration for a large part of the population. These results provide significant implications for retail businesses, as the strategies that aim to reinforce product quality, price with flexibility and high standards of customer service can increase market penetration and satisfaction of the customers. To policymakers, the study highlights the importance of enhancing food safety, cold chain infrastructure, and local food production to better match consumer demand. Research could also consider temporal variations of food purchasing behaviors, examining for instance, how digitalization of food purchasing has influenced consumer decision-making, or how long-lasting interregional adjustments in the regional economy may shape food security. Similarly, finding out how broadly applicable the findings are could come through comparative studies in other areas of Central Asia.

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