

## Exploring Factors Influencing Rural Consumers' Selection of Vegetable Market Outlets

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### ABSTRACT

*Rural consumer purchasing behaviour has evolved significantly with the increasing accessibility of diverse market outlets, leading to changes in how rural communities decide where to buy daily essentials such as vegetables. In Langkap, Hilir Perak, rural consumers can choose from supermarkets, wet markets, farmers' markets, and mini markets, yet the factors influencing these choices remain unclear. To address this gap, this study applied the fuzzy VIKOR method to identify and rank the key criteria influencing market outlet selection and to determine the most preferred outlet among 88 primary grocery buyers. Four criteria, which are convenience, freshness, price, and social connection were evaluated across four different natures of market outlets: Econsave Supermarket, Public Market, Pasar Tani, and Fresh Mart. The analysis revealed that convenience was the most influential factor (weightage = 7.818), and the Public Market was the most preferred outlet with the lowest VIKOR index value (0.000). These findings provide valuable insights for retailers, farmers, and local authorities to enhance rural market strategies, improve infrastructure, and strengthen supply decisions to better meet consumer preferences.*

**Keywords:** *consumer preferences, purchasing behaviour, vegetable market outlets*

### INTRODUCTION

Vegetables are vital for maintaining health and supporting rural livelihoods as they provide essential nutrients, prevent diseases, and contribute to local economies through farming and trade. In rural Malaysia, vegetable cultivation ensures food security while generating income and employment. Over time, consumer purchasing behaviour in rural areas has evolved due to improved infrastructure, transportation, and retail expansion, including supermarkets, mini markets, and farmers' markets (Chaiyaphan & Ransikarbum, 2020). Traditionally, wet markets were central to daily life, valued for affordability, proximity, and social interaction that fostered trust and community. However, the rise of modern retail outlets has diversified consumer choices, making purchasing decisions more complex. Today, rural consumers select from various outlets such as supermarkets, wet markets, farmers' markets, and mini markets based on four key factors: convenience, price, freshness, and social connection. Supermarkets offer cleanliness, variety, and long operating hours, appealing to younger,

working consumers (Tambo et al., 2024). While wet markets remain popular for their freshness, affordability, and personal relationships between vendors and buyers. Farmers' markets connect farmers directly to consumers, ensuring fair prices and supporting small-scale farmers (Adanacioglu, 2021). Mini markets, though smaller in scale, are valued for proximity and personalised service.

Consumer preferences vary across demographics and income levels. Supermarkets are perceived as reliable and hygienic; wet markets are favoured for freshness and low prices (Ebukiba & Adamu, 2020); farmers' markets emphasise freshness and fairness; and mini markets attract convenience-oriented buyers. Price strongly influences lower-income households seeking affordable options, while freshness is universally valued for its impact on taste and nutrition. Social connection is the trust and rapport between consumers and vendors, which remains critical in rural communities where interpersonal relationships shape loyalty and purchasing decisions. Generational differences also influence shopping behaviour: older consumers remain loyal to traditional markets for familiarity and interaction, while younger consumers favour modern outlets emphasising hygiene and convenience, reflecting broader rural modernisation.

This study aims to identify and rank the factors influencing rural consumers' choice of vegetable market outlets and determine the most preferred outlets. It focuses on four natures of market outlets in Langkap, such as Eonsave Supermarket, Public Market, Pasar Tani, and Fresh Mart and evaluating them based on convenience, freshness, price, and social connection. Using the Fuzzy VIKOR method, which integrates fuzzy logic and multi-criteria decision-making (MCDM), the study analyses subjective consumer preferences under uncertainty. This approach captures how practical aspects like accessibility and pricing interact with emotional and social factors such as trust and familiarity. The findings are expected to guide retailers, farmers, and policymakers in developing strategies that align with consumer priorities, enhance satisfaction, and strengthen rural market systems. Moreover, the insights can help improve infrastructure, hygiene, and accessibility, promote sustainable economic growth and community well-being in rural Malaysia.

## **RELATED WORKS**

The selection of market outlets to purchase vegetables is based on criteria which include shopping convenience, freshness, and affordable prices, as well as a strong social connection between vegetable vendors and consumers.

### **Criteria in Choosing Market Outlets**

Convenience strongly influences consumers' choice of market outlet, as it affects shopping satisfaction, comfort, and frequency (Ha et al., 2022). It includes factors such as accessibility, environment, layout, operating hours, and service quality. For rural consumers with limited transport, proximity is crucial since shorter travel distance enables frequent fresh produce purchases (Tambo et al., 2024). Supermarkets are preferred for their cleanliness, extended hours, and reliable product supply, offering time efficiency and comfort. In contrast, traditional wet and farmers' markets, though less convenient, provide personal interaction and community connection valued by many rural consumers. Thus, convenience is a multidimensional concept that combines accessibility, hygiene, service quality, product variety, and efficiency factors that together shape consumers' purchasing decisions and determine their preferred market outlets.

The freshness of vegetables is a key factor influencing consumers' choice of vegetables, often indicating quality and safety. Consumers typically assess freshness through visual and sensory cues such as colour, texture, and appearance rather than scientific measures (Ha et al., 2022). As Ostojic et al. (2023) noted, freshness, taste, and origin strongly shape purchasing decisions, reflecting growing health and quality awareness. Proper post-harvest handling, such as temperature, humidity, and packaging control, is essential to maintain freshness and reduce spoilage, especially in humid climates like Malaysia's (Jana et al., 2022). Shoppers evaluate freshness by colour vibrancy, firmness, and

cleanliness. Packaged vegetables in supermarkets are perceived as more hygienic (Yin et al., 2022), though packaging limits direct inspection by touch or smell.

Price is a key determinant of consumer behaviour, reflecting both affordability and perceived value (Anchal Arora et al., 2022). Price sensitivity varies by income, education, and household size. Lower-income families often prefer wet markets for cheaper produce, while larger households seek bulk discounts (Ha et al., 2022; Kabir et al., 2023). Female consumers, as primary grocery buyers, tend to be more price-aware (Kabir et al., 2023). Higher prices are often linked to better freshness and safety, prompting wealthier or educated consumers to pay more for organic or high-quality vegetables in supermarkets. Supermarkets also offer transparent pricing, unlike traditional markets that require bargaining. In rural areas, price remains the main factor influencing market choice, balanced with freshness, trust, and accessibility (Heinsalu, 2021).

The social connection between consumers and vegetable vendors strongly influences purchasing behaviour in rural areas, where trust and interpersonal relationships are highly valued. (Ha et al., 2022) found that consumers prefer wet and farmers' markets because they allow direct interaction, negotiation, and personalised service. Such communication builds trust, as buyers can ask about product sources and farming methods, reinforcing confidence in safety and authenticity. It notes that these trust-based ties encourage loyalty and repeat purchases. Familiar local vendors are often viewed as safer due to minimal chemical use. Word-of-mouth within close communities further strengthens trust and purchasing choices. Thus, social connection acts as both an emotional and relational factor, shaping rural consumers' market preferences.

### **Engel-Kollat-Blackwell (EKB) Model and Customers' Choice of Market Outlet**

The Engel–Kollat–Blackwell (EKB) model is a foundational framework in consumer behaviour research that explains how consumers move through sequential decision-making stages: problem recognition, information search, evaluation of alternatives, purchase decision, and post-purchase evaluation (Zhang et al., 2020). In retail studies, this model has been extended to explain not only product choice but also market outlet choice, which is particularly relevant in Malaysia where consumers choose among wet markets, and supermarkets. In the Malaysian context, problem recognition related to outlet choice often arises from daily household needs such as freshness of food, price sensitivity, convenience, and time constraints. Wet markets are commonly associated with fresh produce and lower prices, while supermarkets and online stores are linked to hygiene, product variety, and convenience (Goldman et al., 2002). Within the EKB framework, such needs shape consumers' initial consideration sets of market outlets.

During the information search stage, Malaysian consumers rely on both internal and external sources. Prior shopping experience strongly influences habitual visits to wet markets or supermarkets, particularly among older consumers. Meanwhile, younger and urban consumers increasingly use external information such as online reviews, price comparisons, and social media, especially when considering online grocery platforms (Sidharta et al., 2021). The EKB model suggests that perceived risk increases such as concerns over freshness. The evaluation of alternatives stage is central to outlet choice decisions. Studies show that Malaysian consumers evaluate outlets based on attributes including price, freshness, distance, cleanliness, service quality, and trust (Gindi et al., 2016). Wet markets are often preferred for fresh food purchases, while supermarkets are favoured for packaged goods and bulk shopping. Consistent with EKB theory, consumers apply different decision rules: compensatory evaluation for high-involvement purchases such as fresh meat or seafood and non-compensatory or heuristic-based rules for routine purchases.

The purchase decision stage reflects the final outlet selection, which may be influenced by situational factors such as promotions, time pressure, or parking availability. In Malaysia's urban settings, convenience and accessibility increasingly shift consumers toward supermarkets and online channels, even when wet markets remain preferred in earlier evaluation stages. Finally, post-purchase

evaluation plays a crucial role in shaping future outlet choice. Positive shopping experiences such as satisfaction with freshness, pricing fairness, or delivery reliability which reinforce repeat patronage and reduce future information search, leading to outlet loyalty (Nurhilalia & Saleh, 2024). Negative experiences, conversely, trigger renewed EKB decision cycles and outlet switching.

### **Fuzzy VIKOR and Its Application**

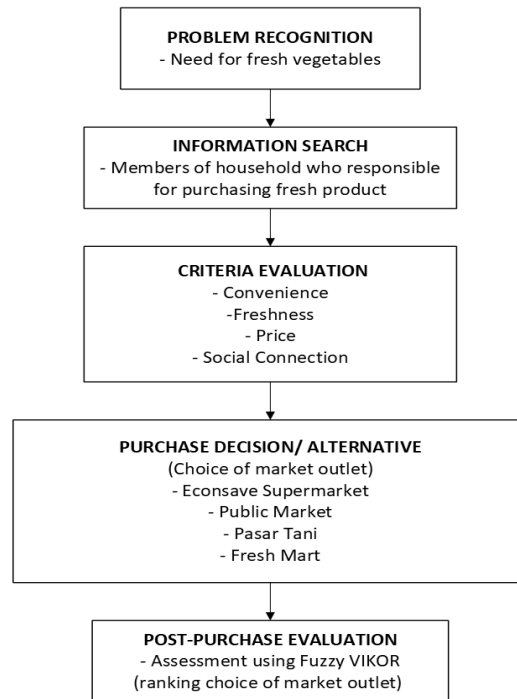
Decision-making in real-world contexts often involves uncertainty and subjective judgment, particularly when multiple criteria must be considered. Multi-Criteria Decision-Making (MCDM) methods help compare and rank alternatives across several factors. Among them, the Fuzzy VIKOR method combines fuzzy logic with the VIKOR (VlseKriterijumska Optimizacija I Kompromisno Resenje) approach to better manage vagueness in human evaluation. Fuzzy set theory, introduced by (Zadeh, 1965), allows assessments using linguistic terms such as “high,” “medium,” or “low,” unlike binary logic that restricts choices to true or false. The VIKOR method, developed by (Opricovic & Duckstein, 1979), identifies a compromise solution that balances group utility (maximising benefit) and individual regret (minimising dissatisfaction). Since traditional VIKOR uses precise (crisp) values that may not reflect real uncertainty, Opricovic & Tzeng (2004) enhanced it by integrating fuzzy set theory, forming the Fuzzy VIKOR model (Ayouni et al., 2021). This hybrid method allows linguistic evaluations to be converted into fuzzy numbers within a decision matrix. Through normalisation, weighting, and index calculation, each alternative receives a VIKOR index value, where the lowest value indicates the optimal choice (Chopra et al., 2022; Kaya et al., 2022).

The Fuzzy VIKOR method has been widely applied across engineering, management, education, and industrial fields to address complex ranking and selection problems involving multiple criteria and uncertainty. Kaya et al. (2022) used it to choose the optimal marine air compressor for shipping companies, evaluating five brands across seven technical and operational criteria. In the leather garment industry, Koppiahraj et al. (2021) applied Fuzzy VIKOR to select the best ergonomics assessment method for enhancing worker productivity. Chopra et al. (2022) utilized the method to determine the ideal maintenance strategy for a paper industry’s deinking plant by assessing five performance criteria, including downtime and failure severity. In higher education, Ayouni et al. (2021) used it to evaluate and rank three Learning Management Systems (LMS) such as Blackboard, Moodle, and D2L which are based on twelve criteria. These applications demonstrate Fuzzy VIKOR’s flexibility in converting qualitative judgments into quantifiable insights, enabling more objective and evidence-based decision-making.

## **RESEARCH METHODOLOGY**

### **Data Collection**

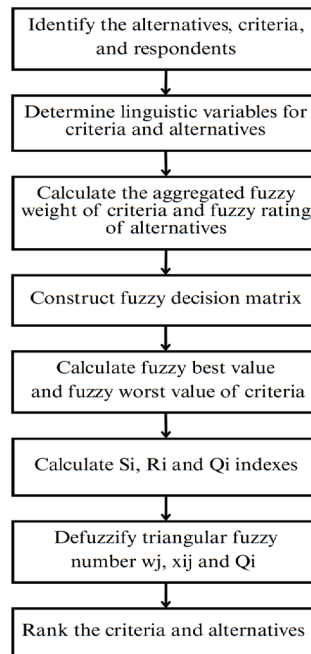
This study aims to find out which market outlets consumers in Langkap prefer when buying vegetables, using the fuzzy VIKOR method. Langkap is a rural town in Hilir Perak District. Primary data were collected through a questionnaire, which was created based on the criteria and the alternative referred to the location. The questionnaires consist of two sections. Section A: Demographic information and Section B: Ranking the criteria that influence rural consumer in choosing market outlets to purchase vegetables. A total of 88 main grocery buyers were selected from 268 households in Langkap, which represents 32.8% of the total population of the 268 households. A small and relatively homogeneous population requires smaller samples which are sufficient to yield reliable and representative findings (Sekaran & Bougie, 2016). The questionnaire included questions on gender, age, occupation, household size, and how often they buy vegetables in Section A. These demographic details are used to understand consumer preferences. The selection of respondents was based on existing household and population data to ensure accurate representation. In section B, the consumer chooses market outlets and ranks based on their satisfaction from 1 (very low) to 5 (very high) for each criteria and alternative. The following Figure 1 shows the conceptual theory based on the EKB model for the study.



**Figure 1: EKB Model for Customers' Choice of Market Outlet**

## Data Analysis

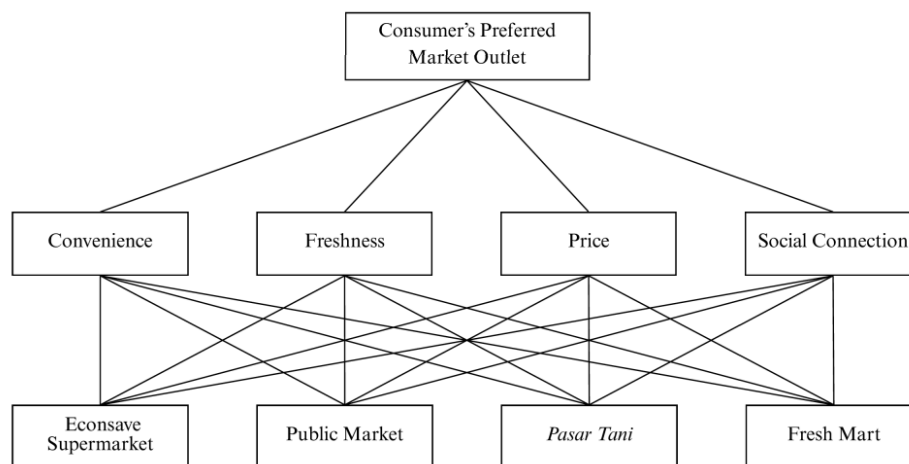
The fuzzy VIKOR method was used to rank different market outlets based on several criteria that may conflict with each other (Kaya et al., 2022). This method helps identify the most preferred outlet among consumers. The process involves eight main steps, as illustrated in Figure 2.



**Figure 2: Steps of Fuzzy VIKOR**

Figure 2 shows the steps involved in the fuzzy VIKOR method. This method provides a clear and logical way to find the best choice when dealing with problems that have many criteria and uncertain data.

In this study, four market outlets in Langkap were selected as the alternatives. Four criteria were also chosen based on Ha et al. (2022). Figure 3 illustrates the main framework used to evaluate these alternatives and criteria.



**Figure 3: Consumer Preferred Market Outlet Selection Framework**

Based on Figure 3, four market outlets were selected as alternatives: Eonsave Supermarket, Public Market, Pasar Tani, and Fresh Mart in Langkap. These outlets represent different types of vegetable markets in the area. Four main criteria influenced rural consumers in choosing where to buy vegetables, such as convenience, freshness, price, and social connection. These criteria were identified from past studies by (Ha et al., 2022). The respondents were the main grocery buyers from 268 households in Langkap. Linguistic variables are words or phrases used to describe opinions instead of exact numbers. They help express how respondents feel about the importance of each criterion and their ratings of the outlets. According to Zadeh (1965) some situations are too complex to describe with exact numbers. Therefore, each linguistic variable was linked to a triangular fuzzy number (TFN) to represent it mathematically.

**Table 1: Linguistic Variables for the Importance Weights of Criteria**

Linguistic variables (Bhalaji et al., 2021)	Triangular Fuzzy Number (TFN) (Bhalaji et al., 2021)
Very Low (VL)	(1, 1, 3)
Low (L)	(1, 3, 5)
Medium (M)	(3, 5, 7)
High (H)	(5, 7, 9)
Very High (VH)	(7, 9, 9)

Table 1 presents the linguistic variables used to measure how important each criterion is, ranging from “Very Low” to “Very High” (Bhalaji et al., 2021). These levels help show consumer preferences clearly.

**Table 1: Linguistic Variables for the Performance Ratings of Alternatives**

Linguistic variables (Bhalaji et al., 2021)	Triangular Fuzzy Number (TFN) (Bhalaji et al., 2021)
Very Poor (VP)	(1, 1, 3)
Poor (P)	(1, 3, 5)
Fair (F)	(3, 5, 7)
Good (G)	(5, 7, 9)
Very Good (VG)	(7, 9, 9)

Table 2 displays the linguistic variables used to rate the performance of each alternative, from “Very Poor” to “Very High.” Each rating was represented by triangular fuzzy numbers within the range [1,9]. Respondents’ opinions for each criterion and alternative were converted into triangular fuzzy numbers (Ayouni et al., 2021). These numbers were then combined to form the overall fuzzy weight for each criterion. If there were  $k$  respondents, the fuzzy weight for each criterion ( $\tilde{w}_j$ ) was calculated using Eq (1).

$$\tilde{w}_j = \frac{1}{k} [\tilde{w}_j^1 + \tilde{w}_j^2 + \tilde{w}_j^3 + \dots + \tilde{w}_j^k] \quad (1)$$

Assuming there were  $k$  respondents, the fuzzy rating of each alternative ( $i$ ) for each criterion ( $j$ ), represented as  $\tilde{x}_{ij}$ , was calculated using Eq (2):

$$\tilde{x}_{ij} = \frac{1}{k} [\tilde{x}_{ij}^1 + \tilde{x}_{ij}^2 + \tilde{x}_{ij}^3 + \dots + \tilde{x}_{ij}^k] \quad (2)$$

All respondents’ opinions about the alternatives were combined into a single matrix, called the aggregated fuzzy decision matrix ( $\tilde{D}$ ), as shown in Eq (3).

$$\tilde{D} = \begin{matrix} & \begin{matrix} C_1 & C_2 & \dots & C_k \end{matrix} \\ \begin{matrix} A_1 \\ A_2 \\ \vdots \\ A_m \end{matrix} & \begin{bmatrix} \tilde{x}_{11} & \tilde{x}_{12} & \dots & \tilde{x}_{1n} \\ \tilde{x}_{21} & \tilde{x}_{22} & \dots & \tilde{x}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{x}_{m1} & \tilde{x}_{m2} & \dots & \tilde{x}_{mk} \end{bmatrix} \end{matrix} \quad (3)$$

From the decision matrix, the best ( $\tilde{f}_j^*$ ) and worst ( $\tilde{f}_j^-$ ) fuzzy values for each criterion were determined using Eqs (4) and (5).

$$\tilde{f}_j^* = \max_i \tilde{x}_{ij}; j = 1 \dots m \text{ (number of criteria)} \quad (4)$$

$$\tilde{f}_j^- = \min_i \tilde{x}_{ij}; j = 1 \dots m \text{ (number of criteria)} \quad (5)$$

$\tilde{S}_i$  measures how far each alternative is from the best value, while  $\tilde{R}_i$  measures its distance from the worst value. They were calculated using Eqs (6) and (7):

$$\tilde{S}_i = \sum_{j=1}^k \tilde{w}_j (\tilde{f}_j^* - \tilde{x}_{ij}) / (\tilde{f}_j^* - \tilde{f}_j^-) \quad (6)$$

$$\tilde{R}_i = \max_j \tilde{w}_j (\tilde{f}_j^- - \tilde{x}_{ij}) / (\tilde{f}_j^- - \tilde{f}_j^*) \quad (7)$$

The overall VIKOR Index,  $\tilde{Q}_i$ , which ranks the alternatives, was computed using Eq (8):

$$\tilde{Q}_i = v \left( \frac{\tilde{S}_i - \tilde{S}^*}{\tilde{S}^- - \tilde{S}^*} \right) + (1 - v) \left( \frac{\tilde{R}_i - \tilde{R}^*}{\tilde{R}^- - \tilde{R}^*} \right) \quad (8)$$

where,  $\tilde{S}^- = \max_i \tilde{S}_i$ ,  $\tilde{S}^* = \min_i \tilde{S}_i$ ,  $\tilde{R}^- = \max_i \tilde{R}_i$ ,  $\tilde{R}^* = \min_i \tilde{R}_i$ , and  $v$  = the strategy weight of maximum group utility.

The fuzzy numbers ( $\tilde{w}_j$ ,  $\tilde{x}_{ij}$  and  $\tilde{Q}_i$ ) were converted into crisp values using the Best Non-Fuzzy Performance (BNP) method to simplify interpretation. The BNP value was calculated using Eq (9):

$$BNP_j = \frac{[(u_i - l_i) + (m_i - l_i)]}{3} + l_i \forall_i \quad (9)$$

where  $l$  is the lower value,  $m$  is the middle value, and  $u$  is the upper value.

Finally, the criteria were ranked based on their crisp importance weights ( $\tilde{w}_j$ ). The alternatives were also ranked according to their  $Q_i$  index values, and the alternative with the lowest  $Q_i$  value was identified as the best option.

## RESULTS AND DISCUSSION

### Demographics of Primary Grocery Buyers

The study collected background information about the main grocery buyers to understand their preferences. The data included gender, age, occupation, household size, and how often they bought vegetables. The largest group was those aged 50–59 years, making up 37% of the total. This was followed by buyers aged 60 and above (19%) and those aged 40–49 years (18%). Meanwhile, 16% were aged 30–39 years, and 10% were between 20–29 years old. These results show that most grocery buyers were from older age groups, suggesting that older individuals are more likely to handle grocery shopping for their families. Most were private or government sector employees (22 buyers). This was followed by farmers (19), self-employed buyers (16), housewives (11), and pensioners (9). In addition, there were six students and five manual workers. This mix of occupations shows that respondents came from diverse economic backgrounds, which may influence their shopping priorities such as price, convenience, and freshness. The majority bought vegetables twice a week (30 buyers). Twenty-five buyers did so once a week, and twenty-one purchased vegetables every two days. Only twelve buyers bought vegetables daily. This suggests that most consumers in Langkap tend to buy vegetables weekly rather than daily, likely due to factors such as accessibility to markets and personal shopping habits.

Table 3 summarises the demographic characteristics of all primary grocery buyers involved in this study. These demographics provide useful insights into the typical vegetable-buying behaviour among Langkap residents.

**Table 3: Summary of Primary Grocery Buyers' Demographic Information**

Demographic Category	Classification	Frequency	Percentage (%)
Gender	Male	52	59
	Female	36	41
Age	20 – 29 years	9	10
	30 – 39 years	14	16
	40 – 49 years	16	18
	50 – 59 years	32	37
	60 years and above	17	19
Occupation	Government / Private Employee	22	25
	Housewife	11	13
	Manual labourer	5	7
	Pensioner	9	10
	Self-employed	16	16
	Farmer	19	22
	Others (student)	6	7
Household Size	Small (1 to 2 members)	22	25
	Medium (3 to 5 members)	44	50
	Large (6 members and more)	22	25
Frequency Of Purchasing Vegetables	Every day	12	14
	Every two days	21	24
	Once a week	25	28
	Twice a week	30	34
<b>Total</b>		<b>88</b>	<b>100</b>

Based on Table 3, a total of 88 primary grocery buyers participated in this study, consisting of 52 males (59%) and 36 females (41%). Half of the buyers lived in medium-sized households with three to five members. About 25% lived in small households with one or two members, while the rest lived in large households with around six members.

## Data Analysis

The respondents' data were analysed in Microsoft Excel following the steps of the fuzzy VIKOR method. From 268 households in Langkap, 88 primary grocery buyers that represent 88 households were selected to evaluate different market outlets. The four outlets analysed were Eonsave Supermarket (A1), Public Market (A2), Pasar Tani (A3), and Fresh Mart (A4). The four criteria used were Convenience (C1), Freshness (C2), Price (C3), and Social Connection (C4). The grocery buyers gave their opinions about the outlets and criteria influencing their choices using linguistic variables. Each linguistic response was then converted into a triangular fuzzy number (TFN) for analysis, as in Table 4.

**Table 4: The Linguistic Variables and Triangular Fuzzy Numbers for Rating of Each Alternative for R14**

Primary Grocery Buyer	Criteria	Alternative			
		A1	A2	A3	A4
R14	C1	VG	F	F	G
		(7, 9, 9)	(3, 5, 7)	(3, 5, 7)	(5, 7, 9)
	C2	G	P	VG	F
		(5, 7, 9)	(1, 3, 5)	(7, 9, 9)	(3, 5, 7)
	C3	VG	F	G	P
		(7, 9, 9)	(3, 5, 7)	(5, 7, 9)	(1, 3, 5)
	C4	F	G	VG	P
		(3, 5, 7)	(5, 7, 9)	(7, 9, 9)	(1, 3, 5)

Based on Table 4, R14 (Respondent no. 14) rated Eonsave Supermarket (A1) and Pasar Tani (A3) the most favourably overall. Eonsave excelled in *Convenience* and *Price*, while Pasar Tani scored highest in *Social Connection*. Also, Eonsave Supermarket (A1) and Pasar Tani (A3) were good in *freshness*. Public Market (A2) was moderate, and Fresh Mart (A4) was the weakest. The opinions of all buyers were then aggregated into fuzzy numbers and converted to Best Nonfuzzy Performance (BNP) values. Separation measures were then calculated to determine each market's overall performance. The calculated maximum and minimum values for separation measures (S and R) showed that the Public Market (A2) consistently performed closer to the ideal criteria, while Pasar Tani (A3) had the poorest performance. The VIKOR index (Q) was computed using Equation 3.8 to determine the final ranking as in Table 5.

**Table 5: Ranking of Criteria for Choosing Market Outlet**

Criteria	$w_j$	Ranking
Convenience	7.818	1
Freshness	7.515	2
Price	6.940	3
Social Connection	4.303	4

The fuzzy importance weights for the four criteria were defuzzified using the Best Nonfuzzy Performance (BNP) formula to produce crisp values (Table 5). Results showed that *Convenience (C1)* was the most important criterion, followed by *Freshness (C2)*, *Price (C3)*, and *Social Connection (C4)*.

**Table 6: Ranking of Customers' Choice of Market Outlets Based on  $Q_i$  Index**

Market Outlets	$Q_i$	Ranking
Eonsave Supermarket	0.509	2
Public Market	0.000	1
<i>Pasar Tani</i>	1.000	4
Fresh Mart	0.923	3

Finally, as presented in Table 6, the ranking of markets based on Q values confirmed Public Market (A2) as the top choice due to its convenience, vegetable freshness, reasonable prices, and strong community ties. It was followed by Econsave Supermarket (A1), Fresh Mart (A4), and Pasar Tani (A3) as the least preferred option.

## **CONCLUSION**

This study applied the fuzzy VIKOR methodology to examine rural consumers' market outlet choices for vegetable purchases in Langkap through the lens of the Engel–Kollat–Blackwell (EKB) consumer decision-making model. The findings indicate that outlet choice is largely driven by the evaluation of alternatives stage, where convenience emerged as the most influential criterion, followed by freshness, price, and social connection. This preference structure reflects the problem recognition stage among older, self-employed, and farming consumers, who prioritise accessibility and efficiency in fulfilling routine household food needs. The Public Market was identified as the most preferred outlet, suggesting that positive post-purchase evaluations related to location, freshness, and community interaction reinforce repeat patronage and habitual behaviour, consistent with the feedback mechanism proposed in the EKB model. The lower ranking of Pasar Tani and Fresh Mart further demonstrates how limited operational convenience and higher prices negatively affect outlet evaluation and purchase decisions. The divergence from prior studies emphasising supermarket dominance highlights the importance of contextual and demographic factors in shaping EKB decision processes in rural settings. Overall, the findings support the applicability of the EKB model in explaining rural market outlet choice and offer practical insights for enhancing retail strategies and rural market infrastructure. Thus, the results demonstrate that rural consumers' market outlet choices in Langkap follow the key stages of the EKB model, with convenience-driven problem recognition and attribute-based evaluation of alternatives playing a dominant role in shaping purchase decisions and repeat patronage.

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## **AUTHORS' CONTRIBUTION**

Mazlan, N. S. and Sharif, N. conceived and planned the experiments. Mazlan, N. S. carried out the experiments and data preparation. Mazlan, N. S, Sharif, N. and Rahim, N. F. contributed to the interpretation of the results. Sharif, N. and Rahim, N. F. took the lead in writing the manuscript and validation. All authors provided critical feedback and helped shape the research, analysis and manuscript.

## **CONFLICT OF INTEREST DECLARATION**

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

## REFERENCES

- Adanacioglu, H. (2021). Factors affecting the purchase behaviour of farmers' markets consumers. *PLoS ONE*, 16(7 July). <https://doi.org/10.1371/journal.pone.0255435>
- Anchal Arora, Nishu Rani, Chandrika Devi, & Sanjay Gupta. (2022). Factors affecting consumer purchase intentions of organic food through fuzzy AHP. *International Journal of Quality & Reliability Management*, 39(5), 1085–1103. <https://doi.org/10.1108/IJQRM-01-2021-0019>
- Ayouni, S., Menzli, L. J., Hajje, F., Maddeh, M., & Al-Otaibi, S. (2021). Fuzzy Vikor Application for Learning Management Systems Evaluation in Higher Education. *International Journal of Information and Communication Technology Education*, 17(2), 17–35. <https://doi.org/10.4018/IJICTE.2021040102>
- Bhalaji, R. K. A., Bathrinath, S., & Saravanasankar, S. (2021). A Fuzzy VIKOR method to analyze the risks in lean manufacturing implementation. *Materials Today: Proceedings*, 45, 1294–1299. <https://doi.org/10.1016/j.matpr.2020.05.123>
- Chaiyaphan, C., & Ransikarbum, K. (2020). Criteria Analysis of Food Safety using the Analytic Hierarchy Process (AHP)-A Case study of Thailand's Fresh Markets. *E3S Web of Conferences*, 141. <https://doi.org/10.1051/e3sconf/202014102001>
- Chopra, A., Sachdeva, A., & Bhardwaj, A. (2022). Selection of appropriate maintenance strategy using fuzzy VIKOR technique: application in paper industry. *International Journal of Quality & Reliability Management*, 39(5), 1226–1248. <https://doi.org/10.1108/IJQRM-03-2020-0070>
- Ebukiba, E. S., & Adamu, S. M. (2020). CONSUMERS' CHOICE OF MARKET OUTLETS FOR FRESH LEAFY VEGETABLES AMONG RURAL AND URBAN HOUSEHOLDS IN FEDERAL CAPITAL TERRITORY, NIGERIA. *Russian Journal of Agricultural and Socio-Economic Sciences*, 104(8), 197–211. <https://doi.org/10.18551/rjoas.2020-08.22>
- Gindi, A. A., Abdullah, A. M., Ismail, M. M., & Naw, N. M. (2016). Shopping drivers of generational cohorts: A comparison between night market and wet market formats for fresh fruit and vegetable purchase in Malaysia. *Australasian Marketing Journal*, 24(2), 165–170. <https://doi.org/10.1016/j.ausmj.2016.05.002>
- Goldman, A., Ramaswami, S., & Krider, R. E. (2002). *Barriers to the advancement of modern food retail formats: theory and measurement*. [https://doi.org/10.1016/S0022-4359\(02\)00098-2](https://doi.org/10.1016/S0022-4359(02)00098-2)
- Ha, T. M., Hansson, H., Abu Hatab, A., Darr, D., & Shakur, S. (2022). A risk-benefit approach to the purchase and consumption of conventional vegetables in wet markets. *Appetite*, 176. <https://doi.org/10.1016/j.appet.2022.106142>
- Heinsalu, S. (2021). Competitive pricing despite search costs when lower price signals quality. *Economic Theory*, 71(1), 317–339. <https://doi.org/10.1007/s00199-020-01247-3>
- Jana, S., Sarkar, B., & Parekh, R. (2022). An Integrated Framework for the Performance Evaluation of Fruits and Vegetable Store Located in a Supermarket. *Trends in Sciences*, 19(3). <https://doi.org/10.48048/tis.2022.2073>
- Kabir, A. N. M. F., Alam, M. J., Begum, I. A., & McKenzie, A. M. (2023). Consumers' preference for purchasing vegetables in Bangladesh: What matters? *Social Sciences and Humanities Open*, 8(1). <https://doi.org/10.1016/j.ssaho.2023.100685>
- Kaya, A., Başhan, V., & Ust, Y. (2022). Selection of marine type air compressor by using fuzzy VIKOR methodology. *Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment*, 236(1), 103–112. <https://doi.org/10.1177/14750902211028791>
- Koppihraj, K., Bathrinath, S., & Saravanasankar, S. (2021). A fuzzy VIKOR approach for selection of ergonomic assessment method. *Materials Today: Proceedings*, 45, 640–645. <https://doi.org/10.1016/j.matpr.2020.02.725>
- Nurhilalia, N., & Saleh, Y. (2024). The Impact of Consumer Behavior on Consumer Loyalty. *Golden Ratio of Mapping Idea and Literature Format*, 4(2), 140–153. <https://doi.org/10.52970/grmilf.v4i2.357>

- Opricovic, S., & Duckstein, L. (1979). Multi-objective optimization in water resources planning. *Proc. of the XVIII Congress of the International Association for Hydraulic Research*, 10–14. <https://doi.org/10.1029/WR016i001p00014>
- Opricovic, S., & Tzeng, G. H. (2004). Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS. *European Journal of Operational Research*, 156(2), 445–455. [https://doi.org/10.1016/S0377-2217\(03\)00020-1](https://doi.org/10.1016/S0377-2217(03)00020-1)
- Ostojić, A., Vračar, L., & Jalić, N. (2023). Consumer attitudes about purchasing and consuming vegetables in the Republic of Srpska. *AGRO3HABE*, 24(2). <https://doi.org/10.7251/agren2303133o>
- Sekaran, U., & Bougie, R. (2016). Research methods for business: A skill building approach. In *John Wiley & Sons*. (Vol. 2, Issue 2).
- Sidharta, S. M., Bagas Adityo, D., Iqbal, P. M., & Gunadi, W. (2021). Customer Loyalty Analysis on Online Food Delivery Services. In *Turkish Journal of Computer and Mathematics Education* (Vol. 12, Issue 3). <https://doi.org/10.17762/turcomat.v12i3.1690>
- Tambo, J. A., Kansime, M. K., Alaganthiran, J. R., Danish, M., Duah, S. A., Faisal, S., Khonje, M. G., Mbugua, F., & Rajendran, G. (2024). Consumer pesticide concerns and the choice of fruit and vegetable markets in five low- and middle-income countries. *Global Food Security*, 42. <https://doi.org/10.1016/j.gfs.2024.100801>
- Yin, Z., Li, B., Li, S., Ding, J., & Zhang, L. (2022). Key influencing factors of green vegetable consumption in Beijing, China. *Journal of Retailing and Consumer Services*, 66. <https://doi.org/10.1016/j.jretconser.2021.102907>
- Zadeh, L. A. (1965). Fuzzy sets. *Information and Control*, 8(3), 338–353. [https://doi.org/10.1016/S0019-9958\(65\)90241-X](https://doi.org/10.1016/S0019-9958(65)90241-X)
- Zhang, J., Xue, Y., Wen, F., Liu, D., Luo, P., & Li, Y. (2020). Extended engel-kollat-blackwell consumption behavior model for residential customers. *Proceedings - 2020 International Conference on Smart Grids and Energy Systems, SGES 2020*, 751–756. <https://doi.org/10.1109/SGES51519.2020.00139>