

## Research

# How knowledge, awareness and perceptions of pesticide residue risks in fruits and vegetables, influence purchase decisions across Malaysian communities

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Received: 7 March 2024 / Accepted: 4 November 2024

Published online: 10 November 2024

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## Abstract

Understanding consumer perceptions and behaviours toward pesticide residues in food is vital for food safety and public health. This study examines the knowledge, awareness, and perceptions of 303 participants from rural, suburban, and urban Malaysian communities regarding pesticide residue risks in their food purchases, particularly fruits and vegetables. Participants completed adapted questionnaires via Google Forms or in-person interviews, covering sociodemographic information, food purchasing habits, and levels of knowledge, awareness, and perception of pesticide residues. Results indicate that urban communities have the highest knowledge about pesticide residues, followed by rural and suburban areas. Awareness levels are even across all community types, with rural areas slightly higher. Urban participants also show the highest perception levels, followed by rural and suburban communities. Rural communities demonstrate a strong positive correlation between knowledge and perception, while suburban areas show a moderately positive correlation. Urban communities exhibit significant correlations between knowledge awareness and perception, with a weaker relationship with awareness. These findings highlight the interplay between community settings and consumer behaviour in purchasing fruits and vegetables. The study emphasises the need for tailored educational and policy interventions to address the varying levels of knowledge and concerns about pesticide residues across different Malaysian communities.

**Keywords** Knowledge · Awareness · Perception · Pesticide residues · Food purchasing

## 1 Introduction

Food, particularly the consumption of fruits and vegetables (FVs), plays a crucial role in maintaining overall well-being. The integral role of FV in promoting human health is well established, with an abundance of phytochemicals, minerals, and other beneficial compounds that are essential for immune system stimulation and human development [1]. Because of its potential to prevent diseases such as cancer and cardiovascular disease, FV consumption is vigorously advocated by health specialists and nutritionists. However, in addition to the benefits, there is growing concern over the extensive use of pesticides in FV production. The increasing global demand for these foods has led to heightened pesticide usage, particularly for crop protection to enhance yields [2]. Therefore, pesticide residue risks refer to the potential health hazards posed by the presence of pesticide residues after they have been treated with chemical pesticides during cultivation. These risks include exposure to harmful chemicals that can affect human health. While these chemicals have been

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pivotal in improving agricultural productivity, their widespread application raises significant health and environmental concerns due to their known toxicity [3].

The predominant exposure route to these chemicals for the general populace has been the dietary intake of pesticide-contaminated FVs, which are often consumed fresh or semi-processed [4, 5]. Studies across various regions have reported that the levels of pesticide residues in FVs often exceed the established maximum residue limits (MRLs) [6–8]. In Malaysia, this issue is particularly pressing, as highlighted by public discussions and media coverage, underscoring the need for a nuanced understanding of public risk perceptions, awareness, and knowledge about pesticide residues in FVs.

Despite the critical role of the agricultural sector in the global food industry, the overwhelming reliance on chemical methods in conventional or industrial farming poses significant challenges. These include ecological imbalances, increased pest problems [9], and health and environmental risks. The disparities to access quality FV, particularly between rural and urban settings, compound these issues [10]. Consumer concerns about pesticide residues are reflected in their willingness to pay for organic products, although attitudes toward organic foods and the impact of price on purchasing decisions vary [11, 12]. Knowledge and understanding of pesticide residues and organic foods are key drivers of consumer behaviour, yet there is a lack of clarity and consensus in this regard [13]. On the other hand, consumer awareness and perceptions, influenced by cognitive, emotional, and behavioural factors, are pivotal in shaping consumption habits toward FV [14, 15]. Additionally, sociodemographic factors such as gender, age, income, and level of education play a significant role in determining attitudes and buying behaviours toward organic foods [16].

Given this background, the present study investigates Malaysian consumers' knowledge, awareness, and perceptions regarding pesticide residues in FVs and how these factors influence their purchasing behaviours. This study examines how sociodemographic factors influence perceptions and behaviours regarding pesticide residues in fruits and vegetables across rural, suburban, and urban Malaysian communities. The findings aim to enhance consumer food decision-making processes and inform effective public health communication and interventions.

## 2 Materials and methods

### 2.1 Research design

This study was designed as a quantitative cross-sectional survey from August 2022 to November 2022, specifically focusing on the assessment of knowledge, awareness, and perceptions related to pesticide residue risks in foods, especially fruits and vegetables. The objective was to investigate how these factors influence food purchasing patterns among different communities in Malaysia, including rural, suburban, and urban areas. This design was chosen for its effectiveness in capturing a snapshot of awareness and perceptions across a wide demographic at a specific point in time.

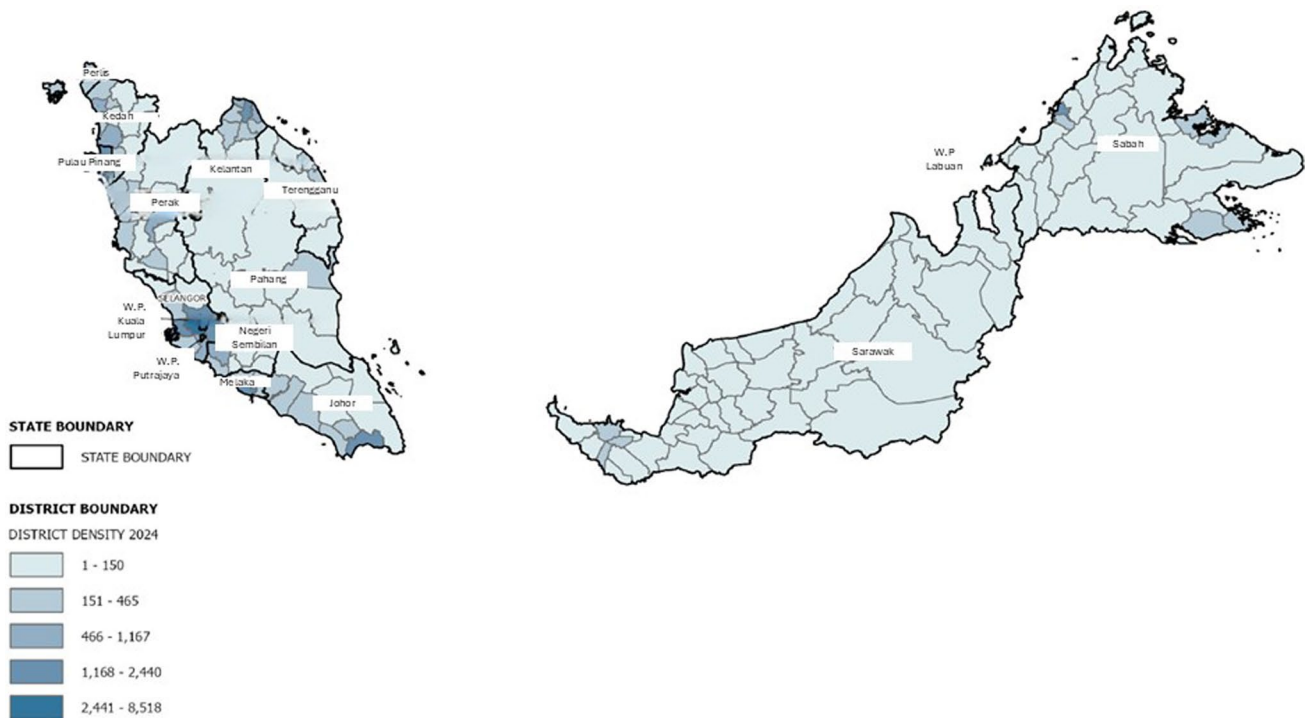
### 2.2 Study location

The research was conducted across Malaysia and included a wide range of demographic data. The study locations, aiming to include a representative sample of the Malaysian population, encompassed diverse geographical areas classified as rural, suburban, and urban. This geographical diversity was crucial for understanding various perspectives and practices concerning pesticide residue risks in different community settings.

As illustrated at Fig. 1, the population density across the 13 states and 3 federal territories of Malaysia, providing a visual overview of the distribution across these geographical zones that we categorized into five (5) zones,

- *North Peninsular*: Perak, Kedah, Perlis, and Pulau Pinang.
- *Central Peninsular*: Kuala Lumpur, Putrajaya, and Selangor.
- *South Peninsular*: Johor, Negeri Sembilan, and Melaka.
- *East Coast Peninsular*: Pahang, Terengganu, and Kelantan.
- *Borneo*: Including Sabah, Sarawak, and Labuan.

Each zone's population size differs, with the Central Peninsular being the most populous, followed by the South Peninsular, North Peninsular, East Coast Peninsular, and Borneo. The number of participants from each zone reflects these



**Fig. 1** Population density in each Malaysia state and federal territory. Source: Current Population Estimates, Administrative District, 2024 (Department of Statistics Malaysia, 2024) [17]

population distributions, thus ensuring that our sample is representative of the varying population densities and living conditions (urban, suburban, and rural) across Malaysia.

### 2.3 Study population

The study received ethical clearance from the Ethics Committee for Research Involving Human Subjects—UPM (JKE-UPM-2022-396), confirming adherence to the ethical standards for conducting research involving human participants. All participants were briefed about the purpose of the study, and informed consent was obtained before their participation.

A total of 303 participants were chosen from all 14 states of Malaysia, representing a mix of rural, suburban, and urban residents. A stratified random sampling was used, dividing the population into distinct geographic subgroups (strata), followed by random selection from each stratum. This approach ensured that the sample was representative of the Malaysian population, facilitating meaningful comparisons and analyses across different community types.

The inclusion criteria comprised males and females aged between 18 and 60 who were actively involved in purchasing and preparing fruits and vegetables. The exclusion criteria encompassed individuals with specific health conditions that could influence their dietary habits, including non-communicable diseases such as food allergies, digestive disorders (e.g., gastroesophageal reflux disease, irritable bowel syndrome, and lactose intolerance), as well as conditions like cancer. However, other diet-related diseases such as obesity, diabetes, and hypertension were not excluded, as these conditions were considered to provide valuable insights into the diverse factors influencing dietary choices.

### 2.4 Data collection

Data collection was conducted through a combination of online and physical methods. Participants were primarily recruited via social media platforms, especially Facebook groups that matched the study's demographic criteria. For the online segment, a comprehensive, self-administered questionnaire was distributed among participants. In rural communities where digital access is limited, physical data collection involves distributing printed questionnaires and conducting in-person interviews. This questionnaire developed based on the frameworks established in prior studies

[18–20] was adapted to align with the objectives of this research. It comprised sections on sociodemographic information, food purchasing habits, and levels of knowledge, awareness, and perception about organic food and pesticide residues.

The questionnaire utilized a Likert scale format for assessing knowledge, awareness, and perception. The scoring system was adapted [21], allowing categorization into high, moderate, or low levels for each construct. This scale was selected for its ability to effectively quantify subjective attributes such as awareness and perception.

A clear explanation of terminologies was added to the questionnaire (both virtual and physical). To ensure all participants, including those who completed the questionnaire online, had a clear understanding of the key terminologies used in the study, the following definitions were provided at the beginning of the questionnaire:

- *Organic Food*: Defined as food products grown without the use of synthetic pesticides, fertilizers, genetically modified organisms (GMOs), or other artificial agents. Participants were informed that organic farming practices emphasize sustainable and environmentally friendly methods.
- *Conventional Food*: Explained as food products are grown using traditional farming methods, which may involve the use of synthetic pesticides, fertilizers, and GMOs. Participants were made aware that these foods are typically produced on a larger scale on an industrial farming basis.
- *Industrial Food*: Described as food products that are mass-produced using industrial processes. This includes processed foods that may contain additives, preservatives, and other synthetic ingredients. Participants were informed that industrial food production often focuses on efficiency and cost reduction.

These definitions were presented to all participants to ensure consistent understanding and to avoid any confusion regarding the terms used in the survey. This approach helped in obtaining accurate responses reflective of the participants' perceptions and behaviours related to different types of food.

## 2.5 Quality assurance and data analysis

To ensure the reliability and validity of the questionnaire, a preliminary pilot study involving 10% of the sample size was conducted. These participants, who were not included in the actual data collection or final dataset, provided feedback that led to revisions for clarity and relevance. The internal consistency of the final questionnaire was established, with an average Cronbach's alpha value of 0.759 across all scales, indicating good reliability. The range of Cronbach's alpha values was 0.759 to 0.866, further clarifying the level of internal consistency achieved. Univariate analysis was used to describe the sociodemographic characteristics, food preferences, and fruit and vegetable purchasing patterns across Malaysian communities. ANOVA was used to compare differences in knowledge, awareness, and perception of pesticide residues in fruits and vegetables across urban, suburban, and rural communities. In addition, the association between pesticide residue knowledge, awareness, and perceptions were investigated.

## 3 Results and discussion

### 3.1 Sociodemographic background of rural, suburban, and urban communities in Malaysia

In this study, we meticulously examined the sociodemographic profiles of our study participants, encompassing diverse geographical regions in Malaysia, including rural, suburban, and urban communities. The demographic distribution closely mirrors the actual distribution of these communities in Malaysia, providing a robust foundation for our study's generalizability and the interpretation of our findings.

Table 1 displays the socio-demographic characteristics of 303 participants from rural, suburban, and urban Malaysian communities. The data include age, gender, state, race, religion, education level, and marital status. Key observations include a varied age distribution with an average age difference across regions, a gender ratio of 1:2 (male to female), and a diverse mix of states, races, and religions, ensuring a representative sample of the population. Educational attainment predominantly spans secondary to bachelor's levels, and marital status varies from single to married, with a few divorced or widowed participants. This table sets the context for analyzing participants' responses to pesticide residue risks in fruits and vegetables.

**Table 1** Sociodemographic background of the rural, suburban, and urban communities in Malaysia (N=303)

Sociodemographic background		Rural (n=100)		Suburban (n=102)		Urban (n=101)	
		Mean	SD	Mean	SD	Mean	SD
		n	%	n	%	n	%
Age (years)		37.97	10.42	31.47	8.46	33.08	8.96
Gender	Male	30	30.0	28	27.5	28	27.7
	Female	70	70.0	74	72.5	73	72.3
State	Johor	21	21.0	18	17.6	14	13.9
	Kedah	17	17.0	1	1.0	2	2.0
	Kelantan	9	9.0	1	1.0	2	2.0
	Melaka	4	4.0	5	4.9	3	3.0
	Negeri Sembilan	5	5.0	7	6.9	3	3.0
	Pahang	7	7.0	8	7.8	3	3.0
	Perak	4	4.0	7	6.9	0	0.0
	Perlis	4	4.0	2	2.0	1	1.0
	Pulau Pinang	4	4.0	9	8.9	6	5.9
	Sabah	1	1.0	0	0.0	2	2.0
	Sarawak	4	4.0	0	0.0	1	1.0
	Selangor	9	9.0	42	41.2	21	20.8
	Terengganu	10	10.0	0	0.0	1	1.0
	W.P. Kuala Lumpur	1	1.0	1	1.0	32	31.7
	W.P. Labuan	0	0.0	0	0.0	0	0.0
	W.P. Putrajaya	0	0.0	1	1.0	10	9.9
Race	Malay	81	81.0	57	55.9	58	57.4
	Indian	4	4.0	12	11.8	16	15.8
	Chinese	9	9.0	33	32.4	27	26.7
	Others	6	6.0	0	0.0	0	0.0
Religion	Islam	82	82.0	59	57.8	61	60.4
	Buddhism	7	7.0	18	17.6	12	11.9
	Christianity	8	8.0	8	7.8	16	15.8
	Hinduism	3	3.0	9	8.8	5	5.0
	Sikhism	0	0.0	1	1.0	0	0.0
Education levels	Others	0	0.0	7	6.9	7	6.9
	Primary school	6	6.0	0	0.0	0	0.0
	Secondary school	28	28.0	8	7.8	12	11.9
	Certificate/Diploma	42	42.0	26	25.5	16	15.8
	Bachelor's degree	20	20.0	58	56.9	57	56.4
	Master's degree	4	4.0	10	9.8	14	13.9
Marital status	Doctoral degree	0	0.0	0	0.0	2	2.0
	Single	25	25.0	55	53.9	41	40.6
	Married	73	73.0	47	46.1	56	55.4
	Divorced/Widowed	2	2.0	0	0.0	4	4.0

Table 2 presents the household backgrounds of the study participants from rural, suburban, and urban communities in Malaysia. It provides a breakdown of monthly household income, smoking habits, vegetable growing practices, and the composition of household members living with the participants including spouse/partner, father, mother, father-in-law, mother-in-law, young children (under 2 years old), children (2–12 years old), youth (13–21 years old), young adults (older than 22 years), and those living alone. Notably, the majority of rural households have a lower monthly income than suburban and urban households. Additionally, a significant portion of the rural community engages in growing vegetables, which could influence their awareness and perceptions of pesticide residues. The composition of household members varies across communities, which might impact purchasing patterns and dietary choices, especially in the

**Table 2** Household background of the rural, suburban, and urban communities in Malaysia (N = 303)

Household Background		Rural (n = 100)		Suburban (n = 102)		Urban (n = 101)	
		n	%	n	%	n	%
Household (total) monthly income (RM)	Less than RM 4,849	71	71.0	21	20.6	21	20.8
	RM 4,850—RM 10,959	28	28.0	71	69.6	71	70.3
	RM 10,960 and above	1	1.0	10	9.8	9	8.9
Smoking habit	Yes	18	18.0	13	12.7	13	13.9
	No	82	82.0	89	87.3	87	86.1
Growing own vegetable	Yes	47	47.0	32	31.4	28	27.7
	No	53	53.0	70	68.6	73	72.3
Household members living with	Spouse/couple	74	74.0	52	51.0	55	54.5
	Father	27	27.0	32	31.4	29	28.7
	Mother	25	25.0	34	33.3	33	32.7
	Father-in-law	3	3.0	0	0.0	0	0.0
	Mother-in-law	3	3.0	0	0.0	0	0.0
	Kid (<2y/o)	22	22.0	20	19.6	16	15.8
	Children (2–12 y/o)	28	28.0	17	16.7	30	29.7
	Youth (13–21 y/o)	26	26.0	15	14.7	17	16.8
	Young adult (>22 y/o)	14	14.0	31	30.4	20	19.8
	Living alone	3	3.0	18	17.6	13	12.9

presence of children and youth, as well as older consumers (parents, in-laws) who may have specific dietary needs due to their health conditions.

### 3.2 Food choices and purchasing patterns of fruits and vegetables among rural, suburban, and urban communities in Malaysia

While the primary focus of this study is on fruits and vegetables due to concerns about pesticide residue risks, it also examines overall food choices to provide a comprehensive understanding of household purchasing patterns. This broader perspective helps contextualize the findings related to fruits and vegetables within the wider scope of dietary habits. The purchasing patterns of fruits and vegetables are influenced by a myriad of factors, including concerns about food safety, economic conditions, and cultural considerations. In the Malaysian context, our study highlights the distinct food preferences and purchasing behaviors of participants across rural, suburban, and urban communities, as detailed in Tables 3, 4, 5, 6 and 7. Table 3 details the consumption patterns of fruits and vegetables among Malaysian communities. The table covers the purchasing patterns, lunch and dinner choices, and consumption preferences of participants from rural, suburban, and urban areas. Organic FV, in this context, are those grown without the use of synthetic pesticides, fertilizers, genetically modified organisms (GMOs), or other artificial agents. Organic farming practices focus on sustainable and environmentally friendly methods, aiming to reduce the impact on health and the environment. Key findings include a high awareness of organic food across all regions, varying preferences for dining locations, and differing rates of consuming organic produce. Urban participants show a greater tendency to eat at cafés or restaurants, while rural participants more commonly consume home cooked products. This data provides insights into how different community settings influence dietary choices daily and the awareness and consumption of organic produce, which are important for understanding food purchasing patterns associated with pesticide residue risks.

Table 4 illustrates the preferences for diverse types of food groups among rural, suburban, and urban communities in Malaysia. The table categorizes diverse food types—grains, meat and chicken, fruits, vegetables, seafood, and dairy—and lists their preference rankings (Rank 1 indicates most preferred; Rank 6 indicates least preferred), represented by percentages, across the three community types. The findings show that there are notable differences in food preferences among rural, suburban, and urban communities. For instance, grains are the most preferred food type in rural areas, meat and chicken are the most preferred food types in suburban areas, and vegetables are most preferred in urban areas. Seafood and dairy are generally less preferred across all communities, but significantly

**Table 3** The purchasing patterns of fruits and vegetables among rural, suburban, and urban communities in Malaysia (N= 303)

Purchasing pattern		Rural (n= 100)		Suburban (n= 102)		Urban (n= 101)	
		n	%	n	%	n	%
Ever heard of	Organic food	91	91.0	102	100.0	101	100.0
	Conventional food	45	45.0	65	63.7	65	64.4
	Industrial food	69	69.0	84	82.4	85	84.2
	Locally grown food	97	97.0	94	92.2	95	94.1
Lunch choice	Homecooked	91	91.0	68	66.7	70	69.3
	Café/restaurant	17	17.0	71	69.6	69	68.3
	Local food stall	44	44.0	64	62.7	51	50.5
	Mamak restaurant/mamak stall	20	20.0	42	41.2	41	40.6
	Fast-food	10	10.0	43	42.2	30	29.7
	Food delivery	18	18.0	32	31.4	26	25.7
	Dinner choice	Homecooked	99	99.0	94	92.2	90
Café/restaurant	21	21.0	51	50.0	59	58.4	
Consumption choice	Local food stall	53	53.0	48	47.1	41	40.6
	Mamak stall#	35	35.0	51	50.0	42	41.6
	Fast-food	14	14.0	37	36.3	28	27.7
	Food delivery	32	32.0	53	52.0	51	50.5
	Consumption choice	Common FV##	96	96.0	96	94.1	92
	Organic FV	16	16.0	51	50.0	47	46.5
	Certified halal FV	60	60.0	53	52.0	39	38.6
	Consume products of own cultivation	41	41.0	20	19.6	19	18.8

#Mamak stalls/restaurants are a type of food culture in Malaysia and Singapore; they serve affordable food, and an unpretentious atmosphere tends to create a casual dining atmosphere

##FV indicated Fruits and vegetables

**Table 4** The daily preference for diverse foods among rural, suburban and urban Malaysian communities (n= 303)

Food choice rank	Rural (n= 100)		Suburban (n= 102)		Urban (n= 101)	
	Food types	Percentage	Food types	Percentage	Food types	Percentage
1	Grains	43.0%	Meat and chicken	34.3%	Vegetables	39.6%
2	Meats and chicken	33.0%	Grains	29.4%	Fruits	39.6%
3	Fruits	23.0%	Vegetables	24.5%	Meats and chicken	29.7%
4	Vegetables	31.0%	Seafoods	32.4%	Seafoods	29.7%
5	Seafood	36.0%	Fruits	33.3%	Dairy	31.7%
6	Dairy	68.0%	Dairy	52.0%	Grains	31.7%

Rank 1 indicates most preferred; Rank 6 indicates least preferred

**Table 5** The preference for grocery food outlets among rural, suburban and urban Malaysian communities (n= 303)

Purchase choice rank	Rural (n= 100)		Suburban (n= 102)		Urban (n= 101)	
	Purchase from	Percentage	Purchase from	Percentage	Purchase from	Percentage
1	Local market	64.0%	Supermarket	29.4%	Hypermarket	27.7%
2	Grocery store	65.0%	Grocery store	38.2%	Supermarket	46.5%
3	Supermarket	64.0%	Local market	33.3%	Grocery store	31.7%
4	Hypermarket	67.0%	Hypermarket	40.2%	Local market	36.6%
5	Food delivery	86.0%	Food delivery	67.6%	Food delivery	62.4%

Rank 1 indicates most preferred; Rank 5 indicates least preferred

**Table 6** The label of concern when purchasing grocery food among rural, suburban and urban Malaysian communities (n = 303)

Concerns Rank	Rural (n = 100)		Suburban (n = 102)		Urban (n = 101)	
	Logo of concerns	Percentage	Logo of concerns	Percentage	Logo of concerns	Percentage
1	Halal	81.0%	Halal	55.9%	Halal	55.4%
2	HACCP	39.0%	Nutritional label	27.5%	Nutritional label	30.7%
3	Nutritional label	31.0%	Organic	36.3%	Organic	25.7%
4	Organic	37.0%	Vegetarian/Vegan	35.3%	HACCP	31.7%
5	Vegetarian/Vegan	36.0%	HACCP	28.4%	Vegetarian/Vegan	22.8%

Rank 1 indicates most preferred; Rank 5 indicates least preferred

**Table 7** Factors determining fruit and vegetable purchasing patterns among rural, suburban and urban Malaysian communities (n = 303)

Concerns rank	Rural (n = 100)		Suburban (n = 102)		Urban (n = 101)	
	Factors of concerns	Percentage	Factors of concerns	Percentage	Factors of concerns	Percentage
1	Food quality	32.0%	Health value	33.3%	Health value	46.5%
2	Diet choice	24.0%	Taste	19.6%	Price	24.8%
3	Product availability	36.0%	Product availability	28.4%	Taste	29.7%
4	Price	23.0%	Price	28.4%	Product availability	25.7%
5	Health value	28.0%	Food quality	27.5%	Food quality	34.7%
6	Taste	31.0%	Diet choice	36.3%	Diet choice	39.6%
7	Environmental concerns	74.0%	Environmental concerns	55.9%	Environmental concerns	61.4%

Rank 1 indicates most preferred; Rank 7 indicates least preferred

more so in rural and suburban areas than in urban areas. These variations in food preferences can provide valuable insights into dietary patterns and potentially influence perceptions and awareness regarding pesticide residue risks in different Malaysian communities.

In this context, grocery food is referred to as the range of food items typically purchased from grocery stores or supermarkets. This includes fresh produce (fruits and vegetables), dairy products, meat, grains, packaged and processed foods, and other household staples. Participants were informed that grocery food encompasses both organic and conventional products available for everyday consumption.

Table 5 outlines the preferences of rural, suburban, and urban communities in Malaysia regarding places where grocery food is purchased. The data indicate distinct preferences: rural participants primarily favour local markets, suburban residents tend to prefer supermarkets, and urban communities show a greater preference for hypermarkets. Grocery stores are consistently popular across all areas, though with varying degrees of preference. The least preferred option for all communities is food delivery services, although they are still utilized to a notable degree. These findings provide valuable insights into the differing shopping behaviours and accessibility of grocery outlets in various community settings, which can influence consumer purchasing patterns, especially for fruits and vegetables potentially affected by pesticide residues.

Table 6 provides insights into the logos of concern when purchasing grocery food among rural, suburban, and urban communities in Malaysia. The table ranks these concerns based on the percentage of participants who prioritized them. Examining these labels and certifications is necessary for understanding how they influence consumers' purchasing decisions regarding fruits and vegetables. In our study, the inclusion of questions related to these logos aimed to capture the factors that guide consumers' choices and perceptions. Recognizing the importance of these labels helps identify the priorities and concerns of different consumer groups, providing valuable insights for policymakers and marketers to develop targeted educational and promotional strategies.

Our findings reveal that the 'Halal' logo is the top concern across all communities, with the highest preference in rural areas. Other significant logos include 'Nutritional Label,' 'HACCP,' 'Organic,' and 'Vegetarian/Vegan,' but their importance varies across different community types. These results suggest that while religious dietary requirements (halal) are universally paramount, other concerns, such as nutrition and organic certification, hold varying degrees of importance based on the community setting.



Table 7 focuses on the factors determining fruit and vegetable purchasing patterns among rural, suburban, and urban communities in Malaysia. The table lists various factors, such as food quality, health value, diet choice, product availability, price, taste, and environmental concerns, which are ranked based on their importance in each community type. The data reveal that rural communities prioritize food quality and the dietary preferences of family members more than health value, and taste, in contrast to urban and suburban communities. Price is a consistent concern across all areas, though it varies in degree of importance. Although it is of greater concern to rural participants compared to suburban and urban, environmental concerns rank as the least prioritized factor in purchasing decisions for all community types. These findings are critical for understanding the diverse factors influencing purchasing patterns in different Malaysian communities, especially in the context of pesticide residue awareness and organic food consumption.

In rural areas, the growing trend of cultivating vegetables can be attributed to heightened concerns about food safety. Homegrown produce, which is perceived as exceptionally safe [23, 24], has gained favour among rural consumers in Malaysia. Cultivating fruits and vegetables in their backyards not only provides a sense of control over the production process but also addresses concerns about pesticide residues and other contaminants. The strong preference for homegrown products underscores the deep-seated apprehensions surrounding food safety in rural communities. Conversely, suburban and urban consumers face space constraints that limit their ability to cultivate vegetables. The compact living conditions in these areas, characterized by high-rise apartments and limited garden space, make home gardening less viable. Additionally, time pressures due to higher-paying jobs, often associated with longer work hours, further reduce their ability to grow their produce. Consequently, these consumers are more reliant on external sources for fruits and vegetables.

Our findings illuminate a noteworthy shift in consumer preferences for organic fruits and vegetables among suburban and urban communities in Malaysia. This trend aligns with a past study [22] in northern Thailand, where urban consumers exhibited a greater inclination toward purchasing organic produce. Geographic location plays a pivotal role in shaping consumers' perceptions of food safety [23]. Urban settings, characterized by greater access to information and diverse food choices, tend to foster more favourable perceptions of food safety than rural areas.

Education, often associated with income levels, significantly influences the purchasing patterns of organic products, which is consistent with findings in Vietnam [24]. A higher level of education equips consumers with the knowledge and awareness necessary to make informed food decisions. In our study, urban and suburban consumers, who were more likely to possess bachelor's degrees, demonstrated a stronger inclination toward organic produce. This finding underscores the role of education in shaping consumer behaviour and suggests that educational campaigns on food safety and organic farming practices may further promote organic food consumption.

Furthermore, our research highlights the impact of religious and cultural factors on purchasing decisions. The Muslim consumers in our study expressed a clear preference for halal-certified fruits and vegetables over organic alternatives. Given the paramount importance of halal food in their dietary choices, the halal logo emerged as a critical factor guiding their purchasing decisions. This finding underscores the need for food producers and retailers to recognize and cater to the preferences of diverse consumer segments, taking into account not only food safety but also cultural and religious considerations.

As the availability of organic food remains limited in Malaysia, which is primarily concentrated in metropolitan areas, rural consumers continue to place a premium on locally grown fruits and vegetables from local markets. Their emphasis on freshness reflects a deep-seated connection to traditional agricultural practices and a reliance on trusted local suppliers. In contrast, the purchasing decisions of urban and suburban communities are shaped by factors such as convenience, accessibility, and the willingness to pay a premium for organic produce. This pattern mirrors the findings of a recent study conducted in Vietnam [25], where urban consumers perceived organic products as superior to conventionally grown alternatives across multiple dimensions, including safety, taste, nutrition, and environmental sustainability.

Our findings also indicate that Malaysian communities are unlikely to relate food choices to environmental concerns. However, it is not certain that rural, urban, and suburban areas universally lack a relationship with environmental concerns regarding food choices. While geographic regions can have distinct characteristics and challenges, environmental concerns are highly individualized and can vary widely within and across these areas. Factors such as access to information, economic considerations, cultural influences, and personal values play pivotal roles in shaping individuals' environmental awareness and its translation into food choices. Overall, these findings emphasize the need for a nuanced approach to marketing and distribution strategies, recognizing the distinct FV preferences and motivations of consumers in rural, suburban, and urban settings.

### 3.3 Knowledge, awareness, and perception of pesticide residues in FV among rural, suburban, and urban communities in Malaysia

Table 8 assesses the knowledge, awareness, and perceptions of pesticide residues among communities in rural, suburban, and urban areas of Malaysia. The table categorizes responses into high, moderate, and low levels for each of these variables, with a breakdown of the number and percentage of participants in each category. At the same time, an ANOVA was used for statistical comparison, indicating significant differences in these factors among the communities.

In this context, knowledge refers to the level of information and understanding [21] that participants have about pesticide residues, their presence in fruits and vegetables, and the potential health risks associated with these residues. This includes information about what pesticide residues are, how they can affect health, and which fruits and vegetables are most likely to contain them; awareness pertains to the degree to which participants are conscious [21] of the issue of pesticide residues in fruits and vegetables. This includes their recognition of the potential risks and their attentiveness to this issue when making food purchasing decisions. Awareness involves both general recognition of the issue and specific instances where participants might encounter or consider pesticide residues; perception relates to the participants' attitudes, beliefs, and subjective judgments [21] about the risks associated with pesticide residues in fruits and vegetables. This encompasses their evaluation of the severity and significance of these risks, how these risks influence their purchasing decisions and their trust in the safety of the food they consume.

The data indicate that urban communities exhibit the highest level of knowledge about pesticide residues, followed closely by rural and suburban communities. In terms of awareness, the distribution is fairly even across all community types, with a slightly greater mean in rural areas. Concerning perception, urban participants again show the highest level, followed by rural and suburban communities. These findings suggest significant variations in knowledge, awareness, and perception levels across different community settings. Higher knowledge and perception levels in urban areas may be influenced by better access to information and education. Additionally, urban respondents tend to have higher levels of formal education, which contributes to their increased awareness and understanding. Understanding these variations is crucial for developing targeted strategies to enhance public awareness and perceptions of pesticide residue risks in fruits and vegetables.

These findings revealed significant disparities in knowledge and perception scores among rural, suburban, and urban communities in Malaysia, shedding light on the intricate interplay of factors influencing consumers' understanding and

**Table 8** Knowledge, awareness, and perception of pesticide residues in fruits and vegetables (FV) among rural, suburban, and urban communities in Malaysia (N = 303)

Variable		Rural (n = 100)		Suburban (n = 102)		Urban (n = 101)		F (df)	p value
		n	%	n	n	%	n		
		Mean	SD	Mean	SD	Mean	SD		
Knowledge	High	51	51.0	48	47.1	64	63.3	6.62 (2)	0.002*
	Moderate	12	12.0	30	29.4	25	24.8		
	Low	37	37.0	24	23.5	12	11.9		
	<sup>a</sup>	6.57	2.36	6.94	1.75	7.53	1.47		
Awareness	High	42	42.0	38	37.3	36	35.6	2.71(2)	0.068
	Moderate	40	40.0	37	36.3	32	31.7		
	Low	18	18.0	27	26.5	33	32.7		
	<sup>a</sup>	6.84	1.51	6.48	1.57	6.34	1.65		
Perception	High	44	44.0	43	42.2	53	52.5	13.01 (2)	<0.001**
	Moderate	16	16.0	36	35.3	31	30.7		
	Low	40	40.0	23	22.5	17	16.8		
	<sup>a</sup>	5.59	2.94	6.70	1.60	7.03	1.42		

<sup>a</sup> ANOVA test

Post hoc test (Tukey's HSD): Knowledge: urban vs. rural, p = 0.001\*\*; Perception: urban vs. rural, p < 0.001\*\*; suburban vs. rural, p = 0.001\*\*

\*p value is significant at the 0.05 level

\*\*p value is significant at the 0.001 level

perception of pesticide residues in fruits and vegetables. First, it is noteworthy that urban communities exhibited notably higher knowledge scores than their rural counterparts, a finding that challenges the conventional belief that rural areas, with their closer ties to agriculture, possess greater knowledge about pesticide residues. This outcome contrasts with the findings [22] who reported higher knowledge scores in rural communities. This discrepancy underscores the complexity of consumer knowledge and the potential influence of regional and cultural factors that transcend the rural–urban divide. Moreover, our study identified significant differences in perception scores between rural and urban communities, as well as between rural and suburban communities, consistent with the observations from a previous study [23]. Urban communities exhibit higher perception scores concerning pesticide residues in fruits and vegetables. The urban living environment, characterized by access to diverse information sources and heightened awareness of health-related issues, likely contributes to these more favourable perceptions of food safety.

Intriguingly, our findings align with previous research [26], which underscores the interrelatedness of knowledge, awareness, and practices regarding pesticide-free products. In our study, awareness emerged as a stronger predictor of consumers' perceptions of pesticide residues than mere knowledge alone. This suggests that consumers' awareness and concerns are key drivers of their perceptions and are often more influential than objective knowledge about the subject. Education levels and income are pivotal in shaping this awareness. Among urban and suburban consumers, those with higher education and income levels tend to exhibit greater receptivity to potential food risks [18]. This paradoxical phenomenon suggests that feelings (subjective) and perceptions may carry more weight than objective scientific information among risk-averse urban and suburban consumers. Consequently, they may exhibit a decreased acceptance of conventionally grown foods, even if the scientific evidence does not necessarily warrant such apprehension.

In contrast, rural consumers, with their longstanding tradition of homegrown fruits and vegetables, demonstrate a notably greater level of awareness concerning pesticide risks. This can be attributed to generations of practical experience in agriculture and the cultivation of their produce. In other words, the increased awareness among rural communities is likely due to their direct involvement in agricultural practices and firsthand experience with pesticide use and its implications. The close connection to the production process fosters a deeper understanding of agricultural practices and pesticide use, thereby distinctly influencing communities' knowledge, awareness, and perception scores. These findings emphasize the profound influence of consumer backgrounds, experiences, and socioeconomic factors on these aspects.

### 3.4 Association of knowledge, awareness, and perception of pesticide residues in FV among rural, suburban, and urban communities in Malaysia

Our study delved into the intricate web of associations regarding knowledge, awareness, and perceptions of pesticide residues in fruits and vegetables within rural, suburban, and urban communities in Malaysia. The findings revealed a nuanced landscape of correlations, shedding light on the factors that underpin dietary practices and the complex interplay of consumer attitudes and knowledge as tabulated in Table 9. This table examines the associations between knowledge, awareness, and perceptions of pesticide residues in fruits and vegetables among rural, suburban, and urban communities in Malaysia. The

**Table 9** Association of knowledge, awareness, and perception of pesticide residues among rural, suburban, and urban communities in Malaysia (N=303)

		r (p value) <sup>a</sup>		
		Knowledge	Awareness	Perception
Rural (n = 100)	Knowledge	1		
	Awareness	0.301 (0.002)*	1	
	Perception	0.812 (< 0.001)**	0.065 (0.522)	1
Suburban (n = 102)	Knowledge	1		
	Awareness	0.090 (0.371)	1	
	Perception	0.588 (< 0.001)**	− 0.064 (0.526)	1
Urban (n = 101)	Knowledge	1		
	Awareness	0.25 (0.012)*	1	
	Perception	0.423 (< 0.001)**	0.124 (0.217)	1

<sup>a</sup>Pearson correlation test

\*p value is significant at the 0.05 level

\*\*p value is significant at the 0.001 level

table uses the Pearson correlation test to analyse these relationships, with findings presented as correlation coefficients ( $r$ ) and their corresponding  $p$  values. The data indicate significant correlations in various aspects across different community types.

For rural communities, there is a strong positive correlation between knowledge and perception. In suburban areas, knowledge shows a moderately positive correlation with perception. Urban communities exhibit significant correlations between knowledge awareness and perception, although the relationship with awareness is weaker. These findings suggest that knowledge about pesticide residues is a key factor influencing perceptions, especially in rural and suburban communities. In urban communities, both knowledge and awareness play important roles. The statistical significance of these correlations, indicated by  $p$  values, underscores the robustness of these associations in the Malaysian context. This analysis is crucial for understanding the dynamics of pesticide residue risk perceptions and their implications for food-related consumer behaviour in different settings.

In the rural community, we observed a significant, fair, and positive correlation between knowledge and awareness, signifying that those with greater knowledge tend to be more aware of pesticide-related issues. Importantly, there was a robust, positive correlation between knowledge and perception in rural areas. This robust correlation underscores the pivotal role of knowledge in shaping not only awareness but also the perception of pesticide residues. This suggests that rural consumers who are well informed about pesticide risks tend to exhibit a more cautious and concerned outlook toward these residues in their food. Similarly, in the suburban community, our findings revealed a significant positive correlation between knowledge and perception. Suburban consumers who possessed greater knowledge about pesticide residues tended to have greater perceptions of the associated risks. This alignment of knowledge and perception suggests that well-informed suburban consumers are inclined to perceive pesticide residues as a notable concern in their food choices.

However, the urban community displayed a unique pattern of associations. While there was a significant, albeit weaker, positive correlation between knowledge and awareness in urban areas, the correlation between knowledge and perception was notably stronger. This disparity highlights the distinct dynamics at play within urban communities. The weaker knowledge-awareness correlation suggests that being well-informed does not necessarily equate to heightened awareness in urban settings. Instead, knowledge appears to have a more direct influence on shaping the perceptions of pesticide residues among urban consumers. This intriguing observation underscores the intricate nature of urban consumers' decision-making processes, where knowledge may serve as a key driver in forming perceptions of food safety.

Furthermore, our study illuminates the potential for knowledge about synthetic pesticides and industrial farming to indirectly influence dietary behaviour and consumption patterns. When individuals are empowered with greater awareness and understanding of the potential risks associated with pesticide residues, it can lead to a more cautious and selective approach to food choices. This, in turn, can shape consumption patterns and dietary practices that align more closely with the concept of consuming safe and nutritious food. The varied association patterns observed among urban, suburban, and rural consumers are reflective of differences in accessing accurate information (objective knowledge), awareness levels, trust in the food and agriculture systems, and perceptions of these factors. These nuanced insights underscore the importance of tailored communication strategies and educational initiatives aimed at enhancing consumer awareness, knowledge, and trust regarding food safety, particularly within distinct community contexts.

#### 4 Study limitation

The sample size, while representative of the Malaysian population, may not fully capture the diversity of consumer behaviours in smaller or more isolated communities. Moreover, the mixed data collection approach, combining online questionnaires and in-person interviews, may introduce response bias. Online participants, recruited through social media, might be more digitally literate and engaged with food safety issues, while rural participants, reached through in-person methods, may have different perspectives. This variability in data collection methods could affect the consistency of responses and affect the generalizability of the findings. Lastly, the study only covered pesticide residues in fruits and vegetables, limiting the generalizability of the findings to other food products that may also pose pesticide-related risks.

#### 5 Conclusions

This study investigated the intricate dynamics of knowledge, awareness, perception, and dietary practices concerning pesticide residues in fruits and vegetables among rural, suburban, and urban communities in Malaysia. Through a rigorous analysis of data collected from diverse geographical regions and sociodemographic backgrounds, our findings illuminate the multifaceted nature of consumer behaviour related to food safety and environmental concerns.

In the sociodemographic context, we observed that participants from different community types exhibited distinct food preferences and socio-demographic characteristics. While rural consumers displayed a penchant for homegrown produce and locally sourced foods, suburban and urban consumers exhibited a growing preference for organic fruits and vegetables. These variations in purchasing patterns were shaped by factors such as access to space, education, income, cultural and religious considerations, and trust in food safety labelling. Recognizing these nuances is essential for stakeholders in the food industry and policymakers as they seek to address the diverse needs and preferences of Malaysian consumers.

Our exploration of knowledge, awareness, and perception regarding FV provided fascinating insights into how these factors intersect with dietary practices. Urban communities displayed higher knowledge and perception scores, challenging conventional assumptions about the influence of rural proximity on agriculture. Notably, awareness emerged as a more influential factor than knowledge, shaping consumers' perceptions of pesticide residues. Education and income played pivotal roles in determining risk awareness, with higher-educated and higher-income urban and suburban consumers exhibiting greater receptivity to potential food risks. Furthermore, our research highlighted the potential for knowledge to indirectly influence dietary practices. The correlations between knowledge, awareness, and perception underscore the complexity of consumer decision-making processes. While knowledge catalyzed heightened awareness and perception in some contexts, its role was more direct in others, particularly within urban settings.

In conclusion, this study provides insights into the interplay of knowledge, awareness, and perception regarding FV, and dietary practices among rural, suburban, and urban communities in Malaysia. These findings have profound implications for policymakers, public health advocates, and educators seeking to enhance food safety awareness and promote safer and informed food choices in diverse community settings. Recognizing the intricate factors that shape consumer behaviour is vital for fostering a food landscape that not only addresses health and safety concerns but also respects cultural diversity and individual preferences. This multifaceted understanding forms the foundation for more targeted and effective strategies aimed at enhancing the well-being of consumers and the sustainability of food systems in Malaysia and beyond.

**Author contribution** The inception of the paper's concept, along with the collection and initial processing of raw data, was spearheaded by Vivien How and Ain Najwa Delaila Binti Omar. Besides, Vivien How, Rozaini Abdullah, Ho Yu Bin, and Maisarah Nasution Binti Waras collaborated to refine the research aims, meticulously analyzed the study data, and engaged in comprehensive discussions. Subsequently, this team diligently crafted and finalized the manuscript for publication.

**Funding** The 2022 Help Malaysia Organic Grow (HMOG) Seed Grant Programme, sponsored by Baba Eco Group Berhad.

**Data availability** Data is provided within the manuscript.

## Declarations

**Competing interests** The authors declare no competing interests.

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## References

1. Donkor A, Osei-Fosu P, Dubey B, Kingsford-Adaboh R, Ziwu C, Asante I. Pesticide residues in fruits and vegetables in Ghana: a review. *Environ Sci Pollut Res Int*. 2016;23(19):18966–87. <https://doi.org/10.1007/s11356-016-7317-6>.
2. Tsagkaris AS, Pulkrabova J, Hajslova J. Optical screening methods for pesticide residue detection in food matrices: advances and emerging analytical trends. *Foods*. 2021;10(1):88. <https://doi.org/10.3390/foods10010088>.
3. Claeys WL, Schmit JF, Bragard C, Maghuin-Rogister G, Pussemier L, Schiffers B. Exposure of several Belgian consumer groups to pesticide residues through fresh fruit and vegetable consumption. *Food Control*. 2011;22(3–4):508–16. <https://doi.org/10.1016/j.foodcont.2010.09.037>.

4. Reeves WR, McGuire MK, Stokes M, Vicini JL. Assessing the safety of pesticides in food: How current regulations protect human health. *Adv Nutr*. 2019;10(1):80–8. <https://doi.org/10.1093/advances/nmy061>.
5. Zaidon SZ, Ho YB, Hashim Z, Saari N, Praveena SM. Pesticides contamination and analytical methods of determination in environmental matrices in Malaysia and their potential human health effects—A review Malays. *J Med Health Sci*. 2018;14(101):81–8.
6. Toptanci S, Kiralan M, Ramadan MF. Levels of pesticide residues in fruits and vegetables in the Turkish domestic markets. *Environ Sci Pollut Res Int*. 2021. <https://doi.org/10.1007/s11356-021-13538-w>.
7. Odewale GO, Sosan MB, Oyekunle JA, Adeleye AO. Human health risk assessment of dichlorodiphenyltrichloroethane (DDT) and hexachlorocyclohexane (HCH) pesticide residues in fruits and vegetables in Nigeria. *Environ Sci Pollut Res Int*. 2021. <https://doi.org/10.1007/s11356-021-12747-7>.
8. Farina Y, Abdullah MP, Bibi N, Khalik WM. Determination of pesticide residues in leafy vegetables at parts per billion levels by a chemometric study using GC-ECD in Cameron Highlands Malaysia. *Food Chem*. 2017;224:55–61. <https://doi.org/10.1016/j.foodchem.2016.11.113>.
9. Rahaman MM, Islam KS, Jahan M. Rice farmers' knowledge of the risks of pesticide use in Bangladesh. *J Health Pollut*. 2018. <https://doi.org/10.5696/2156-9614-8.20.181203>.
10. Sharkey JR. Measuring potential access to food stores and food-service places in rural areas in the U.S. *Am J Prev Med*. 2009;36(4):S155. <https://doi.org/10.1016/j.amepre.2009.01.004>.
11. Smith TA, Huang CL, Lin BH. Does price or income affect organic choice? Analysis of U.S. fresh produce users. *J Agric Appl Econ*. 2009;41(3):731–44. <https://doi.org/10.1017/s1074070800003187>.
12. Gan C, Wee HY, Ozanne L, Kao TH. Consumers' purchasing behaviour toward green products in New Zealand. *Innov Mark*. 2008;4(1):93–102.
13. Gundala RR, Singh A. What motivates consumers to buy organic foods? Results of an empirical study in the United States. *PLoS ONE*. 2021;16(9):e0257288. <https://doi.org/10.1371/journal.pone.0257288>.
14. Lim SAH, Priyono A, Ming CH. An exploratory study of integrated management system on food safety and organic certifications. *Int J Acad Res Bus Soc Sci*. 2020;10(3):882–92. <https://doi.org/10.6007/ijarbss/v10-i3/7111>.
15. Tran AH. Factors of consumers' acceptance of organic food. *Actual Probl Econ*. 2017;150:189.
16. Stobbelaar DJ, Casimir G, Borghuis J, Marks I, Meijer L, Zebeda S. Adolescents' attitudes toward organic food: a survey of 15- to 16-year-old school children. *Int J Consum Stud*. 2007;31(4):349–56. <https://doi.org/10.1111/j.1470-6431.2006.00560.x>.
17. Department of Statistics Malaysia. Labour force survey report, Malaysia, second quarter 2024. 2024. [https://www.dosm.gov.my/uploads/release-content/file\\_20240829154918.pdf](https://www.dosm.gov.my/uploads/release-content/file_20240829154918.pdf). Accessed 4 Oct 2024.
18. Krishna VV, Qaim M. Consumer attitudes toward GM food and pesticide residues in India. *Rev Agric Econ*. 2008;30(2):233–51. <https://doi.org/10.1111/j.1467-9353.2008.00402.x>.
19. Mishra B, Prusty AK. Consumers' perception of pesticide residues in fruits and vegetables. *Int J Bio-Resour Environ Agric Sci*. 2016;2(4):426–9.
20. Ramli M, Albattat A, Abd Hafidz MR, Mohd Nazri SHA. Identify organic food awareness levels among MSU students. *Int J Sci Technol Res*. 2020;9(1):3949–53.
21. Yimer M. Knowledge, attitude and practices of high risk populations on louse-borne relapsing fever in Bahir Dar City, North-West Ethiopia. *Sci J Pub Health*. 2014;2(1):15. <https://doi.org/10.11648/j.sjph.20140201.13>.
22. Sapbamrer R, Chittrakul J. Determinants of consumers' behavior in reducing pesticide residues in vegetables and fruits, Northern Thailand. *Int J Environ Res Pub Health*. 2022;19(20):13033. <https://doi.org/10.3390/ijerph192013033>.
23. Ha TM, Shakur S, Pham Do KH. Rural-urban differences in willingness to pay for organic vegetables: evidence from Vietnam. *Appetite*. 2019;141:104273. <https://doi.org/10.1016/j.appet.2019.05.004>.
24. Hai NM, Moritaka M, Fukuda S. Willingness to pay for organic vegetables in Vietnam: an empirical analysis in Hanoi capital. *J Fac Agric Kyushu Univ*. 2013;58(2):449–58. <https://doi.org/10.5109/27378>.
25. Ha TM, Shakur S, Pham Do KH. Consumer concern about food safety in Hanoi. *Vietnam Food Control*. 2019;98:238–44. <https://doi.org/10.1016/j.foodcont.2018.11.031>.
26. Nicolae I, Corina P. Consumer behaviour on the fruits and vegetables market. *Ann Fac Econ*. 2011;1(2):749–54.

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