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Consumer Perception and Acceptance Across Different Scales of Vertical Farming in Klang Valley

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ABSTRACT

To fulfil specific social and ecological goals, urban planners have started to view cities as sites for food production due to the world's increasing urbanisation and population growth. A large urban population can accommodate a bigger population. However, it is necessary to do so while reducing the expense of essential services. Town zones need the most intensive efforts, but they also provide the advantage of integrating local food production facilities into development owing to the high concentration of consumers. With the Malaysian government promoting urban farming initiatives, urban residents in affected communities will be able to explore vertical farming activities as a source of income. Thus, this study explores consumer insights on the awareness and purchasing habits of vertical farming products and systems. In specific, this study determines the fundamental drivers behind the implementation of three separate vertical farming systems as well as the behavioural intent of consumers to acquire either the items produced by these systems or the systems themselves. A quantitative survey involving 410 respondents from the Klang Valley was carried out. Structural equation modelling was used as the analysis method in this study. The findings reveal that customer acceptability of vertical farming systems is mostly influenced by their perceived usefulness. Greater accessibility and functionality increase the possibility that the technology will be accepted by consumers. This study will accommodate further research into the viability of vertical farms operating at various scales based on the needs and financial capabilities of a region.

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1. Introduction

Food security is a growing concern in Malaysia. The recent COVID-19 pandemic has caused impacts on food security such as food price inflation, and with the combined factor of low income, it has become increasingly difficult for the types of communities mentioned to access enough amounts of nourishing, wholesome, and inexpensive meals. The sustainability of food production is required to develop domestic food production, processing, and distribution, with the important goal of ensuring that healthy food is available to all. In addition, with rising urbanisation and the demand for food security, there is a greater need for innovative farming approaches.

The Department of Economic and Social Affairs (DESA) of the United Nations estimates that the urbanisation rate in Malaysia will reach between 85 and 90 percent during the next thirty years, having already reached 80 percent in the year 2020 (Nazuri et al., 2022). Due to rising rural-to-urban migration as urban economic conditions improve, this situation will continue. As a result of this rural-to-urban migration, urban districts would become densely populated, creating problems with access to housing, food security, education, and supplies.

Urban farming is to be considered a cohesive method that not only does it provide healthy and nutritious food crops, but also provides the opportunity to increase economic development, environmental sustainability, and social integration (Muhammad et al., 2020). Klang Valley is one of Malaysia's significant urban clusters, where the region encompasses Kuala Lumpur's capital city as well as its surrounding cities and urban areas in the state of Selangor (Ivascu et al., 2021). In Klang Valley, 16 urban farming community organisations have been founded that comprise a leader and residential members who worked together to mobilise the urban agricultural programmes where relevant authorities, such as the Dewan Bandaraya Kuala Lumpur (DBKL), Putrajaya Corporation (an agency under the Ministry of Federal Territories), and the Malaysian Department of Agriculture (DOA), oversee monitoring the success of these urban agricultural communities (Muhammad et al., 2020).

A considerable percentage of these urban farms consist of vertical farm systems. The vertical farming technique is considered a very efficient technique as the crops grown vertically can accommodate more crops while using limited land space, making it suitable for urban dwellers that live in strata houses (Ngahdiman, 2017). Thus, the goal of this study is to ascertain how consumers perceive and accept various vertical farming systems and products at various scales. This study will explicitly examine the drivers of customer behaviour toward the purchase of either the system's output or the system itself. This study will accommodate further research into the viability of vertical farms operating at various scales based on the needs and financial capabilities of a region. Furthermore, studies of the same kind in other parts of the region will be able to provide further insights into the prospects of the construction of vertical farms in new housing developments and peri-urban regions as part of the initial plan. As urban farming activities such as vertical farming are gaining more recognition, it is important to have consumer insights and perceptions to further diffuse the knowledge of this topic among farmers.

This paper starts with an introduction, then follows on to a review of the literature in Section 2, the methodologies employed in this study in Section 3, and the data analysis and research findings in Section 4. Concluding thoughts are the last section of the paper.

2. Literature Review

The Sustainable Development Goals (SDGs) are a collection of targets aimed at improving people's well-being. Urban farming is viewed as a construction project that supports sustainable urban development by supplying fresh food as the world population rises and climate change reduces the resources available for food production. The Food and Agriculture Organization of the United Nations recognises several SDG goals that promote urban agriculture, notably Goal 2: ending hunger, achieving food security, improving nutrition, and developing sustainable agriculture (Food and Agriculture Organization of the United Nations, 2022). Promoting sustainable urban agriculture allows food to be grown considerably closer to communities while also teaching food consumers to become farmers.

2.1 Urban Farming

With technical advancements and expanding human understanding, agricultural systems have developed in diverse regions globally. Conventional farming originated when people began to dwell and farm in a particular region. This type of agricultural system is simple and broad and does not utilise other aspects such as technology, chemical fertilizers, or pesticides. Agriculture is essential not just for food production but also for income generation. Twenty to thirty percent of the yearly food supply in Malaysia is imported, whereas China, Taiwan, and Thailand are among the principal providers of most onions, chillies, and leeks to suit the demands of the population (Murdad et al., 2022).

The aspect of urban farming emerged with the transformation of human and health requirements (Muhammad et al., 2020). The population of the globe has rapidly expanded over the course of the last century, reaching over 7.7 billion individuals in 2019, with projections indicating that this number will reach 9.7 billion by the year 2050 (Ivascu et al., 2021). Urban agriculture is a type of agriculture resource used to cultivate food and other crops in urban areas. Urban agriculture is not a single entity, as it includes urban and peri-urban areas, large-acre farmland, small community gardens, self-managed allotments, and home gardens. Parts of parks that used to be buildings include fruit trees along roadside reserves, greenhouses, green roofs and walls, and parts of parks that used to be facilities (Nafisi et al., 2020). Its increasing popularity reflects not just efforts to address food safety and land resource concerns but also a rising desire to offer sustainable living settings that mitigate the challenges presented by increased urbanisation (Wood et al., 2020).

Agriculture in urban areas has the potential to enhance not only the availability of food but also health conditions, the local economy, social integration, and environmental sustainability (Orsini et al., 2013).

Participants in urban farming programmes have direct access to locally produced fresh foods, which increases the variety of foods available while also offering jobs and generating income through the sale of produce.

Urban farming programmes also broaden the scope of the food supply chain (Nazuri et al., 2022). In urban agriculture, urban aspects are integrated with human labour, organic waste, land, and water, where all its inputs are urban and governed by municipal regulations and policies, circumstances, the target market, and land competition. According to Nafisi et al. (2020), urban farming is also impacted by other various factors, such as the cost, deteriorated living circumstances, implications for food security, health difficulties, and ecological conditions. One of the most common types of urban farming systems is known as "vertical farming," which entails the process of growing plants in a system that is constructed vertically in a layered system and can be commonly found in densely populated cities like Singapore, which have limited land resources available to them (Wood et al., 2020).

Vertical farming is an agricultural method that, in theory, involves the production of large quantities of food in high-rise buildings, where this method enables rapid growth and planned production by controlling the environmental conditions and nutrient solutions that are applied to crops grown hydroponically by utilising cutting-edge greenhouse methods and technologies (Kalantari et al., 2018). The development of vertical farming techniques has been an important step forward in the field of urban agriculture.

2.2 Urban Farming in Malaysia

Urban farming in Malaysia has received positive recognition and feedback thus far. The Green Earth Campaign, initiated by Tun Abdullah Ahmad Badawi, was one of the strategies promoting urban farming (Murdad et al. 2002). The main aim of the campaign was to encourage urban residents to cultivate their food by promoting the use of urban farming techniques. Urban farming efforts were carried out as part of this campaign as well as the project known as Pembangunan Keluarga Tani (Farming Family Development), which was the expansion of the Green Book initiative that was launched in 1974 by Tun Abdul Razak Hussein, who was serving as Prime Minister of Malaysia at the time (Murdad et al., 2022). The Department of Agriculture (DOA) is the principal governing body responsible for monitoring the movement as well as collecting statistics and information on activities related to urban agriculture in Malaysia. The Department of Agriculture (DOA) in Malaysia established its division of urban agriculture in 2010 to encourage activities related to urban agriculture to lower the cost of living for the country's urban population (Ibharim & Salim, 2020). The number of urban farming sites in Malaysia increased significantly in the years after the outbreak of the coronavirus disease (COVID-19) pandemic in 2020, reaching 17,320 places as opposed to just 735 locations in 2019 (Murdad et al., 2022). Start-ups such as CityFarm Malaysia, Plant Cartridge, UrbanFarmTech, Urban Hijau, and Sunway XFarms are also pioneering the initiative on a commercial scale and earning recognition (Ivascu et al., 2021).

2.3 Different Scales of Vertical Farming Techniques

2.3.1 Micro-scaled vertical farming model

The micro-scaled model of vertical farming is essentially a notion based on the context of the locality. Miniature farms are designed with cutting-edge technology that is available to anyone. They include the growing of plants in a multi-story system on balconies, terraces, rooftops, or in building corridors that utilise sunlight or establishing modular farms separated from the environment or using a Cubic Farming system (Jürkenbeck et al., 2019). In terms of product, lighting, and nutrient delivery, vertical home farms could be entirely managed by the user through their smartphone. In addition, another micro-scaled vertical farm is an in-store vertical farm, which is a glass cube in a grocery store where customers can see the growing process, examine the product, and load it into their shopping carts from a shelf next to the cubic system.

2.3.2 Medium-scaled vertical farming model

A neighbourhood size where integrated vertical farm structures are to be viewed as medium scale (Zareba et al., 2021). According to Zareba et al. (2021), the multi-level indoor vertical farm project in Singapore called Sky Greens began commercial operations in 2012. The project consists of more than six-meter-tall A-shaped towers with up to 26 tiers of increasing levels that rotate at one millimetre every second to produce consistent solar radiation (Benke & Tomkins, 2017).

2.3.3 Macro-scaled vertical farming model

The macro-scaled vertical farms come in city-scaled sizes. Currently, there are two main types of vertical farming projects being carried out in cities: those that employ resources and capital to implement from the beginning with design concepts, and those that implement initiatives with special design principles in post-industrial buildings and warehouses (Ares et al., 2021).

2.4 Conceptual Framework

The conceptual framework developed is illustrated in Figure 1. The conceptualization process of this framework has been primarily designed based on the study done by Jürkenbeck et al. (2019) and the subsequent research done by Perambalam et al. (2021) based on the technology acceptance model (TAM) and the theory of planned behaviour. The purpose of the conceptual framework is to demonstrate the framework's primary components, which include the independent and dependent variables of this research. The relationship between the independent variables, i.e., perceived sustainability, subjective norm, perceived usefulness, perceived behavioural control, attitude towards buying, and the dependent variable, i.e., behavioural intention to buy, is analysed and quantified to get accurate results.

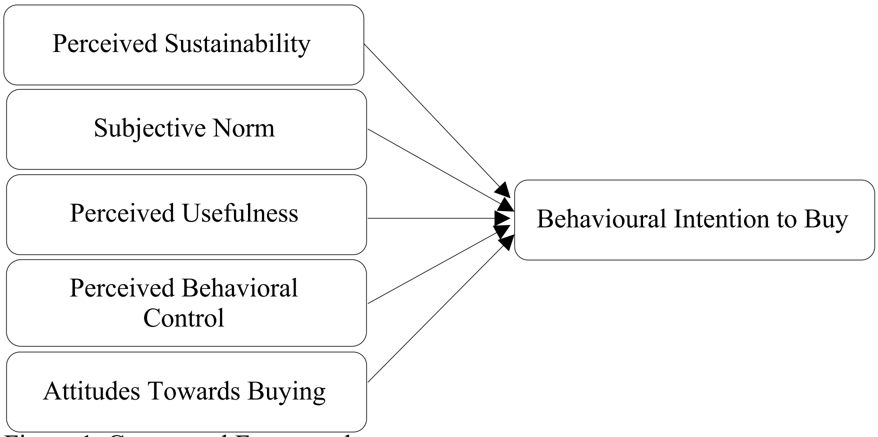

Figure 1. Conceptual Framework

3. Method

Using the quantitative method, this research investigates the awareness and purchasing habits of vertical farming products and systems among consumers in the Klang Valley. The sampling frame of the study is based on the Krejcie and Morgan (1970) schedule, like the study done by Sa'don and Salim (2021), where a total of 400 respondents were targeted. Using a split sample design, each respondent was randomly assigned one of the three systems, i.e., micro, medium, and macro, and asked to evaluate their insights on the selected statements about the provided system.

The study focuses on the Klang Valley region because of its advantageous position as the most urbanised region in the country, with a surface area of approximately 2832 km2 and located roughly in the centre of Peninsular Malaysia's West Coast, which is home to 7.99 million people as of 2020 (Nazuri et al., 2022). According to Nazuri et al. (2022), it is one of the most urban areas in Southeast Asia with the fastest population and economic growth.

The survey instrument was created with Google Forms and included a consent statement as well as a link. A quick response (QR) code was also created for the survey questionnaire. By clicking the provided Google form link or scanning the QR code, respondents received further information about the research study and gave their informed consent. An online survey was carried out from June 2022 to August 2022 and 410 questionnaires were received. Respondents were approached via various social media contacts and groups, including Facebook, WhatsApp, and Telegram. Facebook groups that are private community groups in the Klang Valley region were specifically targeted. The Statistical Package for the Social Sciences, Version 26, and SmartPLS, Version 4, were used for the statistical analysis.

4. Results and Discussion

The findings from the survey are analysed to describe the sample demographic and its characteristics and to investigate the measuring factors of consumer acceptance of vertical farming systems and produce. The tabulated data presents a statistical analysis that is intended to identify the issues and challenges influencing consumer acceptance and perception of different vertical farming systems and produce.

4.1 Descriptive Analysis

The descriptive statistics demonstrate that a majority of 82.2% of respondents value the environmentally friendly aspect of vertical farming systems and production. Meanwhile, a majority of 35.4% demonstrate prior knowledge about urban farming, and 34.4% of respondents have gathered prior knowledge about vertical farming. However, a majority of 36.1% of respondents indicated no prior knowledge about vertical farming. Besides that, 55.6% of the participants demonstrate scepticism on all three scales about the decreased usage of fertilizers. 67.3% of the research participants have also indicated that "the reduction of pesticide usage is good for the environment."

The between-subjects design was developed in three groups: n = 111 for micro-scale (A), n = 127 for medium-scale (B), and n = 172 for macro-scale (C). 55.1% and 51.7% of the survey respondents indicate they will purchase the medium- and macro-scale vertical farming systems or produce from the systems because of their features, while 50.5% of the respondents will buy the micro-scale vertical farming system or produce from the systems because of their features. Besides that, 26.8% of the respondents have been observed to perceive the production of food in the medium-scale vertical farming system to be too artificial, while 26.1% and 20.9% of the respondents from the respective micro- and macro-scales perceive the production of food in the micro- and macro-scales of the vertical farming system to be too artificial. Moreover, a majority of 57.5% of respondents indicate that they will purchase the medium-scale vertical farming system or produce from the system, and 51.7% indicate that they will purchase the macro-scale vertical farming system or produce from the system. Subsequently, if respondents had the option to acquire a vertical farming system, 46.8% of respondents indicated that they would purchase the micro-scale vertical farming system or produce from the system.

In this study, the analysis of variance (ANOVA) was used to determine the differences between the three different scales, i.e., micro-scale (A), medium scale (B), and macro-scale (C), and the perception and acceptance of vertical farming systems (Table 1). Overall, the results indicate a positive perception of usefulness. Moreover, the results indicate that the perceived usefulness between the micro and medium scales shows a significant difference based on the post hoc test criteria in comparison to the macro scale of vertical farming systems and production.

Table 1. ANOVA Results

Constructs	Indicators/Statements	Vertical Farming (Micro Scale) (A)	Vertical Farming (Medium Scale) (B)	Vertical Farming (Macro Scale) (C)
		Mean/SD	Mean/SD	Mean/SD
		n= 111	n= 127	n= 172
Perceived sustainability*	The vertical farming system is useful.	4.20/0.81	4.28/0.87	4.16/0.81
	The vertical farming system is "environmentally-friendly".	4.10/0.86	4.09/1.03	4.16/0.83
	The vertical farming system is questionable.	3.15/1.18	3.20/1.13	2.98/1.14
	The vertical farming system is "trend-setting".	3.68/1.03	3.80/0.87	3.72/1.02
	The vertical farming system represents a sustainable production.	4.03/0.85	4.13/0.98	4.02/0.84
Subjective norm*	My friends will approve of my purchase of the system or product.	$3.34/0.88_{ab}$	3.63/0.91	3.49/0.81
	My family will approve of my purchase of the product.	3.45/0.95	3.67/0.95	3.50/0.90
	My colleagues will approve of my purchase of the product.	3.37/1.05	3.61/0.92	3.51/0.84
Perceived usefulness*	The system contributes to local food production.	$3.55/0.78_{ab}$	3.83/0.79	$3.80/0.75_{ac}$
	Artificial lighting is natural.	3.00/1.04	2.89/1.07	2.79/0.96
	Soil-less production makes sense.	3.41/0.86	3.60/0.86	3.52/0.82
	Nutrient solution is not natural.	3.05/0.94	$3.30/0.90_{bc}$	2.95/0.97

	For me the product represents an added value.	3.44/0.87$_{ab}$	3.75/0.90	3.63/0.82
Perceived behavioural control*	The information label on fresh produce packaging confuses me.	3.06/1.04$_{ab}$	3.26/1.03	2.93/0.98
	I feel I have no control on how the food I eat is produced.	3.29/1.07	3.57/1.02	3.41/1.13
	It is difficult to find vegetables and fruits that meet my needs.	3.05/1.09	2.76/1.15	2.78/1.17
Attitude towards buying*	I will buy the system or product because of its features.	3.49/0.94	3.55/0.84	3.51/0.84
	I feel positive towards purchasing this system or its products.	3.52/0.90	3.65/0.97	3.62/0.81
Behavioural intention to buy*	I will buy the product if there is a chance I can.	3.49/0.84	3.66/0.90	3.61/0.84
	I will recommend the system or product.	3.54/0.88	3.64/0.94	3.58/0.85
	I will most likely buy this system or product.	3.44/0.89	3.64/0.97	3.49/0.91

Notes: *system-specific constructs; scale from 1: "I do not agree at all", 2: I do not agree, 3: I partly agree, 4: I agree, 5: I agree; different letters indicate a significant difference between the systems to Tukey HSD post-hoc test.

4.2 Structural Equation Modelling (SEM) Analysis

In this study, the model was identified with relevant key indicators. Reliability measurements, such as composite reliability, indicate positive results where all values are greater than the 0.60 criteria. The internal consistency reliability was analysed using Cronbach's alpha coefficients to assess the reliability of each respective construct, which is valid. According to Hair et al. (2018), values over 0.5 are valid. Based on the analysis of the average variance extracted, the convergence validity is also greater than the minimum value of 0.50. The results are presented in Table 2.

Table 2. Measurement of The Internal Consistency Reliability and Convergence Validity of The Constructs

Constructs	Items	Cronbach's Alpha			Composite Reliability			Average Variance Extracted		
Systems (N)		A	B	C	A	B	C	A	B	C
		(111)	(127)	(172)	(111)	(127)	(172)	(111)	(127)	(172)
Perceived Sustainability	5	0.626	0.651	0.603	0.759	0.782	0.733	0.464	0.513	0.485
Subjective Norm	3	0.943	0.948	0.900	0.875	0.894	0.876	0.700	0.738	0.702
Perceived Usefulness	5	0.777	0.762	0.578	0.847	0.754	0.724	0.541	0.532	0.462
Perceived Behavioural Control	3	0.699	0.646	0.647	0.810	0.751	0.784	0.587	0.513	0.548
Attitude Towards Buying	2	0.779	0.741	0.662	0.680	0.722	0.855	0.516	0.565	0.747
Behavioural Intention to Buy	3	0.932	0.940	0.927	0.842	0.851	0.889	0.639	0.656	0.727

Note: A = Micro Scale, B = Medium Scale, C = Macro Scale

The discriminant validity of the constructs was determined using the Fornell and Larcker (1981) criterion. The analysis revealed that the discriminant validity of all the constructs was proven. The underlying path coefficients and R2 values were also analyzed. The amount of item variability described by the factor (R2) is obtained by squaring the standardised factor loadings, showing that loadings of at least 0.7 (R2 = 0.72 = 50%) are preferable (Knekta et al., 2019). The R^2 values of the endogenous latent variable, i.e., behavioural intention to buy at the micro-scale (A) and medium-scale (B), are favourable. By contrast, the R^2 value of the macroscale (C) suggests a moderate classification based on the Hair et al. (2011) criteria.

The path coefficient leading to behavioural intention to buy revealed that perceived usefulness has the most influence on all three vertical farming scales at a highly significant level (> 0.001). The path coefficient leading to behavioural intention to buy revealed a significant influence, with the micro-scale (A) being highly significant (> 0.001), the macro-scale (C) being highly significant (> 0.001), and the medium-scale (B) having a low significant result (> 0.05). The path coefficient leading to behavioural intention to buy revealed that the subjective norm is moderately significant in the micro-scale (A) system (> 0.01) and moderately significant in the macro-scale (C) system (> 0.01). Furthermore, the path coefficient leading to behavioural intention to buy revealed that perceived sustainability is only moderately significant with the medium scale (B) system (> 0.01). The path coefficient leading to behavioural intention to buy revealed that perceived behavioural control is only moderately significant with the medium scale (B) system (> 0.01). The path coefficient leading to behavioural intention to buy also reveals that perceived behavioural control indicates no significance across all three scales of the vertical farming system. The results are presented in Table 3.

Table 3. R^2 Values of The Endogenous Latent Variable and Path Coefficients with Significance Levels of The Exogenous Latent Constructs

Endogenous Construct	Behavioural Intention to Buy		
System	A (R^2=0.733)	B (R^2=0.724)	C (R^2=0.566)
Perceived sustainability	0.339	0.005**	0.670
Subjective norm	0.014**	0.002**	0.060
Perceived usefulness	0.000***	0.000***	0.000***
Perceived behavioural control	0.192	0.711	0.759
Attitude towards buying	0.000***	0.015*	0.001***

Notes: ***ρ < 0.001 significance level; **ρ < 0.01 significance level; *ρ < 0.05 significance level

The f^2-effect size criteria are tabulated based on Cohen's (1988) appropriate criteria, with effect sizes classified as small, medium, and large with values of ≥ 0.02, ≥ 0.15, and ≥ 0.35. The f^2-effect size resulting in the perceived usefulness path indicates the largest effect size across all three vertical farming scales, i.e., micro-scale (A), medium-scale (B), and macro-scale (C). The attitude towards the buying path indicates a large $f2$-effect size at the micro- and macro-scales (C), and a medium $f2$-effect size is demonstrated at the medium scale (B). The f^2-effect size resulting in the subjective norm path indicates a medium effect size at both the micro-scale (A) and medium-scale (B). However, a small effect size is indicated on the macroscale (C). The f^2-effect size resulted in the perceived sustainability path indicating a medium effect size at the medium scale (B), although the micro-scale (A) and macro-scale (C) had no effect sizes. The f^2-effect size resulting in the perceived behavioural control path indicates no effect size across all three scales of vertical farming systems. The f^2-effect sizes were all validated across the three vertical farming system groups with the ρ value. The results are presented in Figure 2.

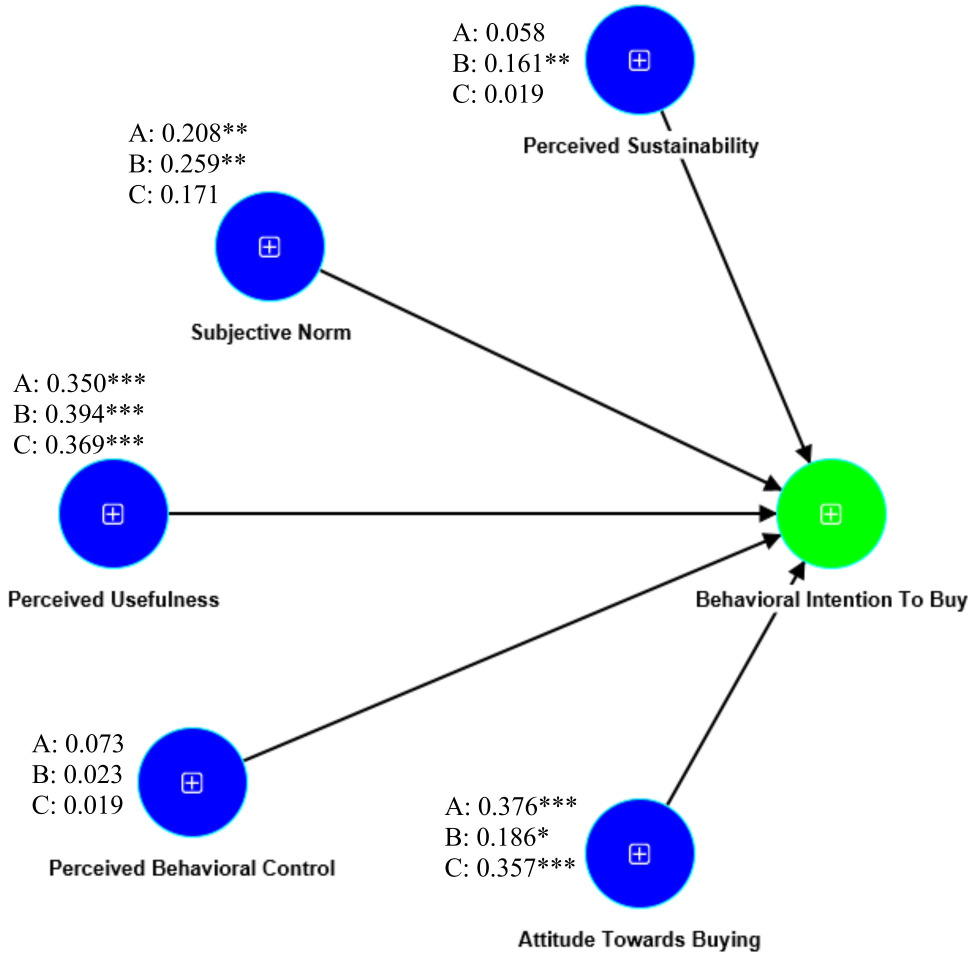

Figure 2: f^2-effect sizes showing the relative effect of the exogenous latent variables on the endogenous latent variable.

Notes: ***ρ < 0.001 significance level; **ρ < 0.01 significance level; *ρ < 0.05 significance level; Micro Scale (A): n = 111, Medium Scale (B): n = 127, Macro Scale (C): n = 172

The pairwise multi-group analysis determines if the path coefficients of the various models contribute to significant differences between the different vertical farming systems. Three systems were considered in this research; hence, three pairwise multigroup analyses were conducted. The results indicate a significant difference between the path coefficients (perceived behavioural control -> behavioural intention to buy) of the micro-scale (A) vertical farming system and produce and the medium-scale (B) vertical farming system and produce (Table 4).

Table 4: Pairwise Multi-Group Analysis

	Micro Scale (A) and Medium Scale (B)		Micro Scale (A) and Macro Scale (C)		Medium Scale (B) and Macro Scale (C)	
	Path Coefficient Difference	ρ-Value	Path Coefficient Difference	ρ-Value	Path Coefficient Difference	ρ-Value
Attitude Towards Buying -> Behavioural Intention to Buy	0.190	0.965	0.060	0.658	0.130	0.338
Perceived Behavioural Control -> Behavioural Intention to Buy	0.096	**0.048**	0.092	0.247	0.004	0.965

Perceived Sustainability -> Behavioural Intention to Buy	0.103	0.984	0.028	0.780	0.132	0.149
Perceived Usefulness -> Behavioural Intention to Buy	0.044	0.470	0.019	0.870	0.024	0.833
Subjective Norm -> Behavioural Intention to Buy	0.050	0.590	0.037	0.784	0.088	0.502

Notes: Two-tailed, bold signifies a significance level of $\rho = 0.05$

4.3 Discussion

The analysis suggests that perceived usefulness across all three different scales of vertical farming is the main driving force for consumer acceptance. Overall, consumers' acceptance of the perceived usefulness factor has the most influence on their behavioural intention to buy vertically farmed produce or the system itself. The comparison between the three different scales of the vertical farming system, i.e., micro scale, medium scale, and macro-scale suggests that the medium-scale system has the most value toward its perceived usefulness by consumers. This indicates consumers may find vertical farming systems placed in indoor hypermarkets, malls, and stores useful and add value to their lives. This can be assumed due to its accessibility in terms of being able to purchase fresh produce in indoor retail settings.

Another assumption is that consumers perceive that the larger scale of the vertical farming system contributes to local food production. Subsequently, the trend in which size impacts sustainability is known as "ecologies of scale," where "ecologies of scale" have the same fundamental concept as "economies of scale" (Jürkenbeck et al., 2019). The scale study indicates that the size of the company or system influences the evaluation of its usefulness as an added value and local food production in this study. It can also be said that consumers recognise vertical farming systems as an alternative to traditional agriculture practices.

From the survey, one of the main barriers affecting consumer acceptance of vertically farmed produce and systems is the perceived behavioural control factor. Perceived behavioural control in this study indicates no influence on the behavioural intention to buy across all three vertical farming systems. Perceived behavioural control, according to Ruangkanjanases et al. (2020), involves self-efficacy or self-competence to support the surrounding situations. Self-competence is characterized, in the context of vertical farming systems or products, as customers have sufficient basic knowledge, skills, and income to select, acquire, or use the system or products. According to descriptive statistics findings, most consumers have previous knowledge of the topic of urban farming. However, a high percentage of consumers have no prior knowledge about vertical farming.

According to the ANOVA findings, the subjective norm factor is where the acceptability of the micro-scale differs from that of the medium-scale and macro-scale. The discrepancies may be because the micro-scale comprises a comprehensive cubic system and not just purchasing fresh vegetables and fruits, unlike the medium-scale and macro-scale systems. Another possible cause is that customers feel vertical farming micro-scaled systems built at homes are associated with an alternative lifestyle and do not desire this involvement. When purchasing items from vertical farming systems, this alternate way of living is hidden from one's friends and peers.

5. Conclusion

The study reveals that consumers' motivation to purchase items for vertical farming depends heavily on their view of the systems' or products' usefulness. Consumers' trend of purchasing vertical farming products or systems views the system or product as an enrichment of their lifestyle. As a result, the success of vertical farming projects in Klang Valley is heavily influenced by retail purchasing trends.

About the vertical farming scale, i.e., the micro-vertical home farm, the medium in-store farm, and the macro-scale large indoor farm, a distinct difference is observed. The medium-scale system has been identified as the most important type of vertical farming system that consumers are drawn to. This correlates with the data analysis finding that the perceived usefulness factor is the most significant. Consumers' interest in the acceptance of vertical farming systems is highly regarded based on consumers' ability to purchase the product.

Overall, the main distinction between the micro-home vertical farm system and the medium retail in-store farming system is functionality. The micro-scale farming systems require consumers to construct and harvest the fresh produce themselves, while the medium-scale systems allow consumers to instantly purchase the products. The data analysis regarding the perceived behavioural control factor indicates that it is the least significant factor, which correlates to this key finding. This indicates that consumers perceive harvesting their fruits and vegetables in vertical farming systems as a challenging activity.

Based on the socio-demographic findings of this study, the socio-economic aspect of consumers in this study accepting vertical farming products is another key finding. The study has found consumers in the age range of 18 to 32 with high household net income and tertiary-educated females with large households in the Klang Valley region to be the majority group of respondents.

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