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Where in the world can we vertically farm: A cross-cultural study on consumer acceptance of vertical farming

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ABSTRACT

Producing food via vertical farming is an efficient and sustainable method of production that involves the combination of agriculture and technology (Avgoustaki, 2020). Such a system can assist in solving major global agricultural issues like population growth, food insecurity, and water scarcity. While there have been thorough investigations conducted on how consumers perceive vertical farming, to the author's knowledge, no research has considered consumer acceptance of vertically farmed foods in a cross-cultural context. This study aims to evaluate consumer acceptance of vertically farmed foods in a cross-cultural context by investigating the relationship between cultural norms and the extent of acceptance of vertical farming, using cultural dimensions (uncertainty avoidance) as a moderator (Hofstede, 2001). Using an extended version of the technology acceptance model (TAM), the acceptance of vertically farmed foods is evaluated through cultural dimensions and cultural norms (Davis, 1989). Results from this study will provide insights into the potential for customer acceptance of vertically farmed foods around the world. This information would be useful in the creation of new strategies to implement vertical farming systems across the world. The results indicate subjective norms play a role in the acceptance of vertically farmed foods; however culture/cultural dimensions do not play a moderating role in this relationship. It was revealed that prior experience with vertical farming, attitudes toward sustainability, and perceived sustainability positively impact people's willingness to consume vertically farmed foods.

Keywords: Vertical Farming • Sustainable Agriculture • Consumer Acceptance • Cultural Norms • Uncertainty Avoidance • Technology Acceptance Model (TAM)

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Chapter 1

INTRODUCTION

Global Agricultural Issues and Background

As the population continues to climb, climate change becomes more tangible, water and arable land become scarcer, and food insecurity increases, alternative methods of farming are being considered around the world to accompany conventional farming methods. Based on the growing concern surrounding global agricultural issues, the vertical farming sector has gained increasing attention to provide a food production system that is both efficient and sustainable. The reduced environmental impact from agriculture by the adoption of vertical farming are drivers for growth in the vertical farming market. According to market intelligence from (Market and Markets, 2022), the vertical farming market was estimated to be 5.1 billion US dollars in 2023 and is expected to reach 15.3 billion US dollars by 2028, growing at a continuous annual growth rate of 24.7% from 2023 to 2028. While there are arguments for and against vertical farming, whether consumers are even willing to accept vertically farmed foods as a sustainable food alternative is a crucial consideration. This consideration is important because disruptive food technologies will be needed to progress towards a more resilient food system (Siegrist & Hartmann, 2020).

Given that vertically farmed foods are produced through technological methods, examining the Technology Acceptance Model (TAM) is necessary to understand whether consumers will accept the technology through which the food is produced. Consumers must first accept the notion of producing food through technology to accept the consumption of the food

produced. Further, technological acceptance has been proven to differ across cultures. Since individuals' attitudes and behaviors are shaped by their social context and social environment, behaviors toward vertical farming technology might be heavily influenced by culture. This leads to the question, do cultural values have an influence on the public's adoption and acceptance of consuming sustainable food produced through vertical farming? To understand this question, culture must be evaluated as a moderator to technology acceptance through extended versions of the technology acceptance model.

Cross-cultural differences between countries and regions of the world could explain varying attitudes towards vertical farming. Internalized cultural and subjective social norms, while often regarded as unspoken rules, dictate appropriate and inappropriate behaviors that govern interactions among people. Cultural and social norms have the same objectives such that through culture, groups of people define themselves, conform to society's shared standards, and contribute to society's expectations. For example, insects are a common source of protein and are regularly consumed in eastern cultures, however, western culture's view eating insects as unsanitary, unhygienic, and an abnormal source of protein (Specht et. Al, 2019). Internalized cultural norms would enable people in western cultures to have an unconditional, automatic reaction to reject the consumption of insects because it violates their norms. Applying the same theory to evaluate how culture moderates the relationship between consumer perspective and the acceptance or rejection of vertical farming would be favorable in this industry's progression.

The vertical farming industry is still in its infancy, and research surrounding attitudes and perceptions of vertical farming is still lacking. In cross-cultural settings, research on consumer acceptance of vertical farms is limited. The subject of this study is thus of vital importance since vertical farms hold promise to be a viable solution to the world's agricultural

issues. Moreover, it is especially important to understand consumers' perspectives cross-culturally, as vertical farming seeks to overcome challenges that affect people globally.

Vertical Farming Overview

Vertical farming is viewed as a technologically sustainable alternative or accompaniment to current food production practices because their production methods critically differ from established foods. The vertical farming method is more sustainable because of the different resources it requires, varying production processes, and thus the resulting lower environmental impact. Vertical farming systems can be found in individual households on small scales, or can be kept in isolated indoor environments, with the purpose of being entirely controlled in terms of temperature, humidity, and carbon dioxide (Avgoustaki & Xydis 2020). These systems also tend to be found in, or surrounding cities and urban areas which can contribute to the fresh supply of perishable products for urban populations (Kalantari et. Al, 2018).

Advantages of Vertical Farming

A body of information on vertical farming exists. This body of information draws attention to the many advantages and disadvantages associated with the young industry. Vertical farming holds significant advantages. First, vertical farming increases food safety measures, by controlling the environment plants are grown in; vertical farming systems can protect against food-borne illnesses and crop failures due to diseases carried by plants pathogens, and pests. Further, issues with seasonality, regionality, or uncontrollable weather patterns, are eliminated, and the shortening of the plant cycle and increase in plant density increases crop yields by allowing year-round growth in any area of the world (Beachem & Vickers).This can be

specifically advantageous in urban areas. In terms of accessibility, vertical farming can shorten the supply chain and reduce transportation, distribution, and storage management expenses, diminishing the overall agricultural carbon footprint (Oh & Lu, 2022). Moreover, production in vertical farms can reduce water usage up to 95% in comparison to greenhouses (Graamans et. Al, 2018). Vertical farming will also reduce the dependency on various land resources, aiding in the regrowth of forests, and less use of equipment will lead to decreased levels of CO2 emissions (Garg & Balodi, 2014). Vertical farming offers consumers improved food security, shorter supply chains, greater food yields and no pesticide usage.

Disadvantages of Vertical Farming

While vertical farming holds promise to resolve the worlds global agricultural issues, there are several challenges threatening the industry. First, the initial investment costs of vertical farming plant factories can be considerably high, factoring in construction costs, operating costs, energy costs, and production costs. Natural resources like sunlight, carbon dioxide and water are supplied to conventional farmers freely by nature. In the case of vertical farming, these resources are supplied at an additional cost, these factors make it very difficult to fund large-scale vertical farms (Banerjee & Adenaeuer, 2014). As the production costs in vertical farming can be high, the variety of plants are often limited to leafy greens, microgreens, and herbs, and it is suggested that many staple crops like potatoes, wheat, and rice will be very difficult to produce (Van Gerrewey et. Al, 2021). Moreover, there are heavy electricity demands facing vertical farms that have significant influence on greenhouse gas emissions. It is required that vertical farms use renewable energy sources like wind, water, or solar instead of fossil-based energy to be considered environmentally sustainable. Further, there is an overall lack of knowledge and skills

required for these farming practices (Garg & Balodi, 2014). Lastly, urban regulations for vertical farms that reuse old buildings are unclear, making it very difficult to integrate into urban areas (Van Gerrewey et. Al, 2021).

It is possible that many of these challenges can be overcome, but at the risk that consumers are still skeptical of the vertical farming process and the food it produces. This is not an improbable scenario considering great concern over novel technologies of food production methods among consumers (Siegrist & Hartmann, 2020). Therefore, it is important to understand consumers attitudes towards consuming vertically farmed foods and the aspects they might consider favorable versus unfavorable.

Consumer Perspective

Despite the dire need for sustainable, environmentally friendly systems that produce food on a larger scale with less square footage, agri-food technologies are not always perceived positively by consumers. While many consumers are open and accepting of new food production methods, the technology used in vertical farming is still unknown to most. Sustainable food methods were meant to replace common foods methods that have larger, more harmful environmental and social impacts. Most sustainable foods and production methods, by definition, deviate from what consumers have internalized as the norm, which might contribute to the reason why some consumers might be skeptical of vertically farmed foods. In many domains, technological progress is perceived positively, however, the food domain is different because human beings tend to be more conservative concerning unfamiliar foods, or foods grown through unfamiliar practices. The tendency to avoid certain foods produced through unfamiliar practices is assumed to be a protective function in a hostile food environment (Pliner & Hobden 1992).

Consumers are more conservative when it comes to unfamiliar foods that do not resonate with their internalized norms, and thus are conservative when it comes to new food technologies.

Overall, there are three categories that consumer attitudes and beliefs toward vertical farming fall under. The first factor is the consumers' sociodemographic characteristics and their prior knowledge of vertical farms. The second factor is the consumers' willingness to accept and pay for locally produced pesticide/herbicide and antibiotic-free products before they understand the practices and methods of vertical farming. The third and final factor is the consumers' willingness to accept and pay for the same products after they understand the practices and methods of vertical farming and it aligns with their values surrounding vertical farming (Hassoun et. Al, 2022). Two studies conducted on vertical farming showed that less than 60% of participants had a prior familiarity with the methods and practices of vertical farming (Milic̆ić & Dos Santos, 2017) (Gilmour & Bazzani, 2018).

On the other hand, an experimental auction including lettuce produced by three different systems (greenhouses, vertical farms, and conventional field farming) conducted in the United States, suggested that consumers view vertical farming as a comparable, and perhaps an acceptable form of agricultural production (Coyle & Ellison, 2017). Regardless of its acceptability, this same study found that the lettuce produced by the vertical farm is perceived as significantly less natural than its counterparts and is less likely to be purchased (Coyle & Ellison, 2017).

Previous research in this area has focused on consumer willingness to pay, social effects, economic effects, and climactic effects of vertical farming. This revealed that locality, perceived naturalness, ethics, and environmental concerns are all important aspects when considering vertically farmed foods (Jürkenbeck, Heumann, & Spiller, 2019). Sustainability is also a major

driver of acceptance for vertical farms. The more positively the sustainability of the system is perceived, the higher the chance to perceive the entire system as useful and acceptable.

Technology Acceptance Model

To evaluate the acceptance of vertical farming systems, it is important to look at the technology acceptance model. Given that vertical farming produces food through technological methods, not only should acceptance of vertically farmed products be evaluated, but also the technology that produces it. The technology acceptance model (TAM) is an information systems model that presents how users might come to accept technology. TAM suggests that the fundamental determinants of consumer acceptance of technology are perceived ease of use and perceived usefulness which measure the attitude towards usage, this in-turn measures the behavioral intention to use a specific technology (Davis, 1989). This model is widely applied to test the usage and acceptance of technologies.

To evaluate the cross-cultural acceptance of vertical farming systems, an extended technology acceptance model that incorporates culture as a moderator will be used. For the sake of this research, the cultural dimension of uncertainty avoidance will be evaluated as the cultural moderator. Culture is important to investigate as a moderating effect because of its key role in defining the social context in which people behave. National cultural values have been shown to influence varying needs and motives for using a product and product use, so the technology acceptance model in this research allows cultural context to be incorporated in technology acceptance. Additionally, national cultural dimensions affect the degree to which subjective norms play a role in influencing an individual's beliefs and behaviors (Srite & Karahanna, 2006).

There are other variables that factor into the perceived usefulness of vertical farming technology. Since the social component of the technology acceptance model is a key mechanism through which cultural values are shared, and impact behavior, norms are included in the extended technology acceptance model (Srite & Karahanna, 2006). Additionally, uncertainty avoidance will moderate the relationship between norms and the overall behavioral intention to consume vertically farmed products or accept vertical farming.

Cultural Dimensions

Collective national characteristics can be attributed to Hofstede's work in national cultures. Hofstede defines cultural norms as "the collective programming of the mind which distinguishes one human group from another (Hofstede 2001)." The major dimensions of national culture are as follows: individualism/collectivism, power distance, uncertainty avoidance, masculinity and femininity, and long term/short term orientation. This research will focus on the dimension of uncertainty avoidance, which is described as the degree to which members of a society feel comfortable with uncertainty and ambiguity. Uncertainty avoidance was chosen as the focal dimension because of its relevance in understanding how individuals perceive and react to novel and uncertain situations, such as the adoption of innovative agricultural practices.

Members in high uncertainty avoidance cultures prefer less ambiguity than those in low uncertainty avoidance cultures, individuals of high uncertainty cultures feel threatened by unknown or uncertain situations (Hofstede, 1983). This is expressed through increased need for predictability through formal rules and structured institutions and relationships. On the other hand, low uncertainty avoidance cultures, like the United States or the United Kingdom accept,

feel comfortable in unstructured situations, individuals tend to be more pragmatic and more tolerant of change (Hofstede, 1983). This is characterized by fewer rules, and less structure. Uncertainty avoidance plays a significant role in determining how different cultures might adopt technology, and thus vertical farming.

National cultural values affect how norms might play a role in influencing an individual's beliefs and behaviors. There are two groups of individuals based on uncertainty avoidance orientation, uncertainty-oriented individuals, and certainty-oriented individuals. Uncertainty-oriented individuals are those who are motivated by uncertainty, in the sense that they strive to resolve uncertainty. Certainty individuals are those who are motivated when there is no uncertainty, these individuals strive to avoid all uncertainty (Sorrentino & Short, 1986). In terms of information processing, certainty-oriented individuals will rely on an indication from their social environment that says the use of a technological system is appropriate and are less likely to make their own cognitive assessments of technology (pros and cons). Uncertainty-oriented individuals will not rely as heavily on their social environment and will be more likely to make their own cognitive assessments of the pros and cons of the technology (Chaiken, 1980). This suggests that high uncertainty avoidance cultures will rely on norms, and social environment to determine whether technology acceptance is appropriate and thus consumption of foods through technology, and lower uncertainty avoidance cultures will be less likely to do so.

In line with this, a review by Leidner and Kayworth showed that people from high uncertainty avoidance cultures were less likely to experiment with or adopt new technologies because of the risk-averseness characteristic associated with high uncertainty avoidance (Leidner & Kayworth, 2006).

Cultural Norms

To understand how cultural values, moderate the relationship between norms and vertical farming acceptance, cultural, social, and internalized norms must be defined. Norms are implicit, shared standards of acceptable behavior that govern behaviors like customs, traditions, standards, rules, diets, and interactions (Cialdini & Trost). People adhere to social norms because they shape the perception of what constitutes accepted moral behavior, and the violation of social norms can lead to negative social sanctions (Gross & Vostroknutov, 2022). The internalization of a norm means the norm has been absorbed so that it becomes a part of one's character, the motivations are no longer external, but instead, internal (Gavrilets & Richerson, 2017). The internalization of such norms supports their stabilization and spread across society and reduces the mental effort of deciding whether to adhere to the social norm or risk social sanctions. Constantly weighing the costs and benefits of following the norm against the latter would be tedious, internalization reduces the cost of having to gather information, process it, and reach a decision. For individuals with strong internalized norms, violating them is psychologically painful, even if the direct benefits of the norm violation are positive (Gavrilets & Richerson, 2017). Ultimately, norms can be a determinant of what is right and wrong in a society.

Food norms are often internalized as societal norms because of their prevalence and importance in society. In line with internalized norms, societal norms have the power to dictate what is and is not considered to be appropriate food. Norms are not universal, what is considered a norm in one society can be considered outrageous and unacceptable in another. Having internalized food norms, people can determine what is considered food or not considered food, or whether a food is appropriate to eat, or inappropriate. If foods share significant qualities like

food perceived as normal, consumers perceive it as in line with their internalized food norms. Although vertically farmed foods might look similar or identical to conventionally farmed foods, the methods deviate drastically. Before consumers understand the methods and practices adopted by vertical farming, they may be more inclined to accept it. After understanding the processes of vertical farming, acceptance is determined by a combination of values and norms.

Although it can be argued that culture is a collective phenomenon and cannot be reduced to the individual, culture manifests itself through the individual aggregates to the collective (Srite & Karahanna, 2006).

Hypotheses

Therefore, it is posited that:

Hypothesis 1: The more consumers view vertical farming to be "in-line" with the norm, the more likely they will be to accept it.

and

Hypothesis 2: Uncertainty Avoidance Factors will moderate the relationship between norms and vertical farm acceptance such that cultures with high uncertainty avoidance will be less likely to accept and adopt consuming vertically grown food and low uncertainty avoidance cultures will be more likely to accept and adopt consuming vertically grown food products.

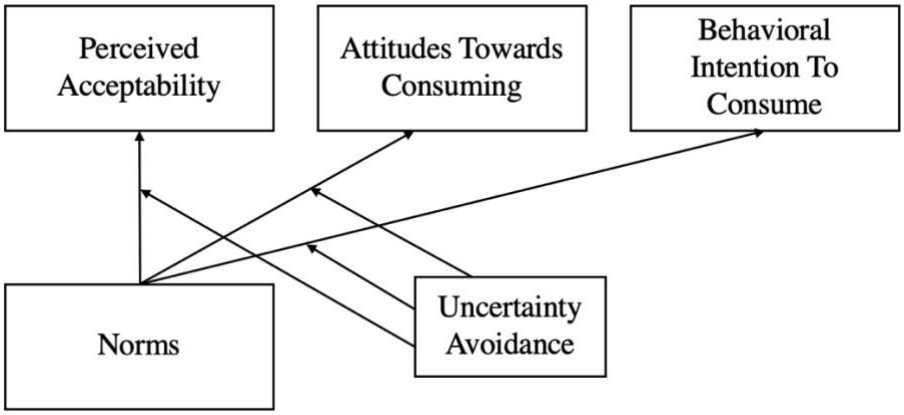

Figure 1. Conceptual Model: Adapted from Davis, F.D. (1986)

Chapter 2

METHODOLOGY

A comprehensive online questionnaire was conducted using Prolific. Quotas were set for age, gender, and education to mirror the population in terms of these characteristics. Individuals that identify with The Netherlands, South Korean, or American cultures were included in this study. These three countries were chosen because of the distribution of uncertainty avoidance scores, The United States has a low uncertainty avoidance of 46 illustrating the country's low uncertainty avoidance. Korea has an uncertainty avoidance score of 85, meaning they are a high uncertainty avoidance score, and the Netherlands has a score of 53 which is a moderate score. Additionally, by value, the vertical farming market is currently the largest in the North America, Asia-Pacific, and European regions (Market and Markets, 2022), and the countries included in the study also represent the market. Quotas were set for each country so that there would be an

even distribution of participants across the countries. Specifically, 33% of participants were planned to be allocated to each country.

Respondents were eliminated as necessary to ensure the validity of the research. Any respondent that was an outlier for the average time to complete the survey was removed, participants who answered in a straight-line pattern (ie; selecting all neutral responses) were removed, and participants who had missing values were removed.

Participants received a brief objective description of a vertical farm plant factory and its advantages and disadvantages. There were approximately as many advantages as there were disadvantages. Additionally, participants saw an image of the vertical farming plant factory as well as a description of how it operates. This was intended to help with the visualization of the farm. Following the introductory texts about vertical farming systems, vertical farming-specific statements that were used to evaluate the general approval of vertical farming were asked in the online survey. The current knowledge of, and general attitudes towards vertical farming were evaluated on a 5-point Likert scale, ranging from 1 (“strongly disagree”) to 5 (“strongly agree”) and the survey instrument also included statements adapted from existing literature (Jürkenbeck, Heumann, & Spiller, 2019; Srite & Karahanna, 2006).

The questionnaire covered a range of topics including behavioral intention to consume vertically farmed foods, attention check questions, previous knowledge, experience with vertical farming, perceptions of vertical farming, attitudes towards sustainability, perceived sustainability, environmental attitudes towards agriculture, subjective norms, perceived usefulness, relationship with technology, uncertainty avoidance, consumption preferences, country of residence, and demographic information which can be seen in Table 1.

The utilization of Likert-scale questions enables the quantification of responses, facilitating statistical analysis to help discern patterns and trends across different cultural contexts. The attention check questions and removal criteria for outliers ensures the reliability and validity of the collected data.

At the end of the survey, there was one binary question asking participants whether they would prefer to purchase/consume food grown through vertical farming methods. This question is important as it provides a direct measure of participants 'stated preferences regarding vertical farming products. By including this question, insight can be gathered into participants immediate inclination towards adopting and accepting vertically farmed foods into their consumption patterns. Additionally, question 49 (See Figure 1) prompted participants to rate their likelihood of consuming foods grown through vertical farming methods on a scale from 1-7, with 1 representing the least likely and 7 representing the most likely. This question offers a more nuanced understanding of participants attitudes towards vertical farming products, allowing for a more detailed assessment and understanding of attitudes. The combination of both a binary and Likert-scale question helps enhance the comprehensiveness of the survey and provide richer insights.

The demographic information questions cover key demographic variables such as age, gender, education, household community size, and income level. The responses to these questions will help facilitate subgroup analysis to explore demographic differences in attitudes and behaviors towards vertical farming. It will contribute to the overall characterization of the study sample. Because the questionnaire will be administered in three different countries with varying currencies, the currency from the demographic section will be adjusted to fit the respondent's culture/country. The same thing will be done for the level of completed education.

Questionnaire

Vertical Farming Blurb: The basic idea of vertical farming is transforming traditional, outdoor, field farming into a method of growing crops and plants by stacking them on vertical, multi-layer platforms inside a controlled environment. The indoor controlled environment regulates growth factors like light, temperature, humidity, and nutrients, producing year-round food production regardless of natural conditions. The primary goals of vertical farming are to increase productivity while minimizing the environmental impact compared to conventional farming methods. Benefits of food produced through vertical farming include sustainability, pest control, reduced water usage, and lower transportation emissions. However, challenges like high entry costs, energy consumption, and limited crop variety exist. Vertical farming often employs soilless methods, relying on nutrient-rich solutions for plant growth.

Questionnaire information from: (Benke & Tomkins, 2017), (SharathKumar et. Al, 2020), & (Avgoustaki, 2020).

Please see the picture below that provides a clearer visualization of a vertical farming plant

production.

Figure 2. Vertical Farming Facility (Worland, 2019)

***Table 1. Vertical Farming Questionnaire-Adapted from: (Jürkenbeck, Heumann, & Spiller, 2019), (Srite & Karahanna, 2006), & (*YeşimAltuncu et. Al, 2012)**

Behavioral Intention to Consume	1. I will consume foods grown through vertical farming if a possibility emerges I will consume foods grown through vertical farming if a possibility emerges 2. I will recommend foods grown through vertical farming

	3. How likely will you be to consume foods grown through vertical farming?
Attitude Towards Consuming	4. I will consume foods grown through vertical farming for its properties. 5. I perceive growing foods through vertical farming as too artificial. 6. I am positive toward consuming foods produced through vertical farming.
Attention Check Questions	7. Vertical farming involves the use of soil and therefore is not different from conventional farming. 8. Vertical farming involves growing crops and plants in a controlled environment.
Previous Knowledge of Vertical Farming	9. I am aware of vertical farming methods prior to participating in this study. 10. I am interested in agricultural topics
Previous Experience with	11. I have purchased foods grown through vertical farming systems previously.

Vertical Farming	12. I have seen products grown from indoor vertical farms while shopping.
Perceptions of Vertical Farming	13. I've already informed myself about vertical farming. 14. The subject of environmental friendliness is important to me. 15. I have the feeling of having no control over the way that the food I consume is generated. 16. Finding the groceries that fulfill my demands is difficult. 17. The reduced use of fertilizers makes me skeptical. 18. The absence of pesticides is beneficial for the environment. 19. I think the production of food grown through vertical farming is too artificial. 20. I would consume products grown through a vertical farming system.
Attitude Towards Sustainability	21. A healthy diet is important to me. 22. Environmental friendliness is important to me. 23. Combating hunger is important to me. 24. I care for eco-friendly and sustainable food products because of health and environmental reasons.
Perceived Sustainability	25. Growing food through vertical farming is useful. 26. I view growing food through vertical farming systems as environmentally friendly.

	27. Growing food through a vertical farming system convincingly demonstrates sustainability. 28. This system is trendsetting. 29. The system stands for sustainable production.
Environmental Attitude Towards Agriculture	30. The use of plant protection products (herbicides, pesticides, and fungicides) in agriculture is irresponsible. 31. The use of fertilizer in agriculture is extremely high. 32. A transition in the current agriculture system must occur.
Norms	33. My friends will approve of my consumption of foods grown through vertical farming. 34. My family will approve of my consumption of foods grown through vertical farming. 35. My colleagues and peers will approve of my consumption of foods grown through vertical farming.
Relationship with Technology	36. I am skeptical about new technology. 37. The age of my technological devices is irrelevant
Perceived Usefulness	38. Growing food through vertical farming systems contributes to regional food production. 39. Artificial lighting is natural.

	40. Nutrient solutions that are used in vertical farming to grow food are not natural. 41. For me, foods produced using vertical farming represents an added value.
Uncertainty Avoidance	42. Rules and regulations are very important to me because they inform people what is expected of them. 43. Order and structure are very important to me. 44. It is important to have requirements and instructions spelled out in detail so that people always know what they are expected to do. 45. It is better to have a bad situation that you know about, than to have an uncertain situation which might be better. 46. Providing opportunities to be innovative is more important than requiring standard procedures. 47. People should avoid making changes because things get worse.
Consumption Preferences	48. Based on the information provided would you prefer to purchase/consume foods grown through vertical farming methods (Yes/No) 49. On the scale below please mark the option that best represents the likelihood that you will purchase/consume foods grown

	through vertical farming methods. (1 being the least likely, 7 being the most likely.)
Country of Residence	50. What country do you currently reside in? Group of answer choices: Japan, Korea, The United States of America, The Netherlands
Demographic Information	51. How do you describe yourself? 52. How old are you? 53. What level of education have you completed? 54. Number of people living in the household 55. Size of your community 56. What was your total household income before taxes during the past 12 months?
End of Survey Message	Thank you for taking part in this study. Please click the button below to be redirected back to Prolific and register your submission.

Chapter 3

RESULTS

At the end of the data collection, 357 people participated in the survey. Out of the 357 respondents, 28 did not give consent and were thus excluded from data analysis. Therefore, n=329 responses were usable for further data analysis. The respondents were distributed by countries as follows: Japan (n=21) (6.4% of the total), South Korea (n=10) (3.0% of the total), United States (n=150) (45.5% of the total), and other countries (n=148) (45.1% of the total). To ensure an even representation across countries, quotas were established through Prolific during the data collection phase. These quotas aimed for each country to contribute approximately 33% of the data, with Japan and Korea collectively contributing another 33%. However, there were insufficient responses from Korea and Japan, resulting in an imbalance in the distribution as seen above. This limitation is discussed further in the limitations section.

Hypothesis 1

To test hypothesis 1 a simple linear regression was conducted to examine the association between individuals' norms and their likelihood of purchasing or consuming these foods. First a reliability analysis was conducted to assess the internal consistency of the three-item scale measuring respondents' perceptions of norms as shown in Table 1. The analysis yielded a Cronbach's alpha coefficient of .902, indicating a high level of internal consistency among the items. These three items were combined to form a composite variable.

Linear regression analysis established that norms significantly associated the intent to purchase/consume vertically farmed foods. The dependent variable was the likelihood of

purchasing or consuming these foods, measured on a scale from 1 being the least likely and 7 being the most likely. The predictor variable was respondent's norms, representing their perceptions of social approval regarding the consumption of vertically farmed foods.

A linear regression established that norms could significantly predict the likelihood of purchasing or consuming vertically farmed foods $F(1,327)=43.713$, $p<.0001$ (See table 3). Norms accounted for a significant amount of variability in individuals' likelihood to purchase or consume these foods, with $R^2=.118$ (See Table 2). The regression equation can be expressed as likelihood to consume = 2.974 + 0.559 × Norms. The intercept term (B = 2.974, SE = .333, t = 8.933, $p < .001$) (See table 4) represents the estimated mean likelihood of purchasing or consuming vertically farmed foods associated with a one-unit increase in norms. The coefficient suggests a moderately strong positive relationship between norms and the likelihood of purchasing or consuming foods grown through vertical farming methods. Individuals with higher perceptions of social approval regarding vertical farming (higher levels of perceived norms) are more likely to express a willingness to purchase or consume foods grown through this method.

Table 2. Hypothesis 1-Linear Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.343[a]	.118	.115	1.217

Table 3. Hypothesis 1-Linear Regression ANOVA Test

Model		Sum of Squares	df	Mean Square	F	Sig.
1.	Regression	64.781	1	64.781	43.13	<.001[b]
	Residual	484.599	327	1.482		
	Total	549.380	328			

Table 4. Hypothesis 1- Linear Regression Coefficient Table

Model		Unstandardized Coefficients		Standardized Coefficients		
1		B	Std. Error	Beta	t	Sig
	(Constant)	2.974	.333		8.933	<.001
	Norms	.559	.085	.343	6.612	<.001

Hypothesis 2

To begin testing hypothesis 2, it was important to determine if uncertainty avoidance factors align with their respective countries. For example, considering that Korea and Japan are known to have high uncertainty avoidance scores, it was predicted that respondents from these countries would exhibit attitudes and behaviors aligned with a preference for stability, structure, and adherence to rules and regulations, and respondents from the Netherlands would score much lower. First, a reliability analysis was conducted to assess the internal consistency of the six-item scale measuring respondents' uncertainty avoidance factors. The analysis revealed a Cronbach's alpha coefficient of 0.459 suggesting potential issues with construct validity as the items in the scale may be measuring different underlying constructs. It was observed that the first three items within the uncertainty avoidance questions exhibited higher internal consistency, yielding a Cronbach's alpha of 0.748. These three items were combined to form a composite variable representing uncertainty avoidance factors, which was used in further analysis.

Next, a one-way ANOVA test was conducted to assess whether there were statistically significant differences in uncertainty avoidance across four countries: Japan and South Korea (combined), the United States, and the Netherlands. Levene's test of homogeneity of variances indicated that the assumption of homogeneity of variances was met, as the p-values ranged from

0.103 to 0.120 (See Table 5). This means the variability in uncertainty avoidances scores was consistent across the four countries. However, the ANOVA results showed that there was no statistically significant difference in uncertainty avoidance scores across the four countries. F(3, 319.631) = 0.828, p = 0.479 (See Table 5 and 6).

This suggests that factors influencing uncertainty avoidance, as measured by the scores are likely to be similar across these countries. While there may be cultural differences between these countries, uncertainty avoidance, as measured in this study, does not appear to be a significant differentiator among them.

Table 5. Hypothesis 2-Tests of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Uncertainty Avoidance	Based on Mean	2.080	3	325	.103
	Based on Median	1.967	3	325	.119
	Based on Median and with adjusted df	1.967	3	319.631	.119
	Based on trimmed mean	1.959	3	325	.120

Table 6. Hypothesis 2-One-way ANOVA Test

Uncertainty Avoidance					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.930	3	.310	.828	.479
Within Groups	121.799	325	.375		
Total	122.730	328			

Since uncertainty avoidance factors across countries were found to be statistically insignificant, this finding already casts doubt on the validity of hypothesis 2. Since there is limited variability in uncertainty avoidance factors across cultures, there is limited evidence to

support the idea that cultural differences in uncertainty avoidance plays a moderating role in shaping attitudes towards vertical farming.

To further investigate this, a multiple regression analysis test was run to examine the moderating effect of uncertainty avoidance factors on the relationship between norms and vertically farmed food acceptance/consumption. To assess the interaction effect, a new variable representing the interaction between norms and uncertainty avoidance factors was created by multiplying the scores together. The interaction term was then added as an additional independent variable in addition to uncertainty avoidance and country of residence.

In the provided regression results seen in table 8, the ANOVA test indicates that the overall model is statistically significant $F(3,325)=15.136$, $p<0.001$. The model explained approximately 12.3% of the variance in the likelihood of vertical farm acceptance, as indicated by the adjusted R squared value of .114 (See table 7). However, upon examining the coefficients, only the predictor, norms, has a statistically significant effect beta=.643, p=0.30 (see table 9). The ANOVA test assessed the overall significance of the model as a whole, rather than focusing on the significance of each individual predictor.

This finding, as proved in Hypothesis 1 results suggests that higher levels of perceived social approval of consuming vertically farmed foods are associated with greater likelihood of accepting and consuming vertically famed foods.

However, neither uncertainty avoidance (beta=.286, p=.234) or the interaction term between norms and uncertainty avoidance (-.408, p=.297) reached statistical significance (see

table 9). Therefore, the results do not support the hypothesis that uncertainty avoidance moderates the relationship between norms and vertically farmed food consumption acceptance.

Even though norms were the only statistically significant predictor of consumption of vertically farmed foods, the combined effect of the predictors was still significant. The collective influence of the predictors, though uncertainty avoidance and the interaction term of norms and uncertainty avoidance were weak, became substantial when considered in a group.

Table 7. Hypothesis 2-Multiple Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.350[a]	.123	.114	1.218

a. Predictors: (Constant), Norms*Uncertainty, Uncertainty Avoidance, Norms

Table 8. Hypothesis 2-Multiple Regression ANOVA Test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	67.346	3	22.449	15.136	<.001[b]
	Residual	482.033	325	1.483		
	Total	549.380	328			

a. Dependent Variable: Please respond to the following question related to your purchasing and consumption preferences - On the scale below please mark the option that best represents the likelihood that you will purchase/consume foods grown through vertical farming methods. (1 being the least likely, 7 being the most likely.)

b. Predictors: (Constant), Norms Uncertainty, Uncertainty Avoidance, Norms

Table 9. Hypothesis 2-Multiple Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.764	1.894		.403	.687
	Norms	1.047	.480	.643	2.181	.030
	Uncertainty_avoidance	.606	.508	.286	1.192	.234
	Norms_uncertainty	-.134	.128	-.408	-1.044	.297

a. Dependent Variable: Please respond to the following question related to your purchasing and consumption preferences - On the scale below please mark the option that best represents the likelihood that you will purchase/consume foods grown through vertical farming methods. (1 being the least likely, 7 being the most likely.)

Attitudes Towards Sustainability

During the data analysis phase, while attitudes towards sustainability were not initially examined in the hypothesis, the examination of this variable revealed its significant impact on attitudes towards purchasing and consuming foods grown through vertical farming methods. First, a reliability analysis was conducted to assess the internal consistency of the four-item scale measuring respondents' perceptions of norms as shown in Table 1. The analysis yielded a Cronbach's alpha coefficient of .757, indicating a high level of internal consistency among the items. These four items were combined to form a composite variable representing attitudes towards sustainability, which was used in this linear regression analysis.

A linear regression analysis was conducted to examine the relationship between attitudes towards sustainability and attitudes towards purchasing and consuming foods grown through vertical farming methods. The regression model demonstrated statistical significance $F(1, 327) =$

21.560, $p < .001$ (see table 11). Attitudes toward sustainability accounted for 6.2% of the variance in consumption preferences, (R^2=.062) with an adjusted R^2 value of 0.059 and a standardized coefficient (beta) of .249 (see table 10).

These findings suggest that individuals with more positive attitudes toward sustainability are more inclined to accept and consume foods grown through vertical farming methods. However other factors not accounted for in this analysis likely play a significant role in shaping preferences for vertically farmed foods.

Table 10. Attitudes Towards Sustainability-Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.249[a]	.062	.059	1.255

a. Predictors: (Constant), Attitudes Toward Sustainability

Table 11. Attitudes Towards Sustainability-ANOVA Test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	33.981	1	33.981	21.560	<.001[b]
	Residual	515.398	327	1.576		
	Total	549.380	328			

a. Dependent Variable: Please respond to the following question related to your purchasing and consumption preferences - On the scale below please mark the option that best represents the likelihood that you will purchase/consume foods grown through vertical farming methods. (1 being the least likely, 7 being the most likely.)

b. Predictors: (Constant), Attitudes Toward Sustainability

Table 12. Attitudes Towards Sustainability-Linear Regression Coefficients Table

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.893	.487		5.943	<.001
	Attitudes Toward Sustainability	.528	.114	.249	4.643	<.001

a. Dependent Variable: Please respond to the following question related to your purchasing and consumption preferences - On the scale below please mark the option that best represents the likelihood that you will purchase/consume foods grown through vertical farming methods. (1 being the least likely, 7 being the most likely.)

Perceived Sustainability

Like the above scenario, perceptions of sustainability were not included in the hypothesis however seemed relevant to the overall research question being asked. Upon further analysis, it was discovered that perceived sustainability of the vertical farming system also has a significant impact on the perceptions and consumption of vertical farming. First, a reliability analysis was conducted to assess the internal consistency of the five-item scale measuring respondents' perceptions of norms as shown in Table 1. The analysis yielded a Cronbach's alpha coefficient of .845, indicating a high level of internal consistency among the items. These five items were combined to form a composite variable representing attitudes towards sustainability, which was used in this linear regression analysis.

A linear regression analysis was also conducted to examine the relationship between perceived sustainability and participants likelihood of purchasing or consuming foods grown through vertical farming methods. Perceived sustainability was the independent variable, while the likelihood of purchasing or consuming vertically farmed foods with the dependent variable.

The results of the regression analysis revealed that perceived sustainability also significantly predicted participants' likelihood of purchasing or consuming vertically farmed foods. $F(1, 327) = 154.362$, $p < .001$ (see table 14). The regression model accounted for approximately 32.1% of the variance in participants' likelihood of purchasing or consuming vertically farmed foods, as indicated by the R^2 value of 0.321 and an adjusted R^2 value of 0.319 (see table 13).

These findings suggests that individuals who perceive vertically farmed foods as more sustainable are more likely to express interest in purchasing or consuming them. Once again, other factors not accounted for in this analysis likely play a significant role in shaping preferences for vertically farmed foods.

Table 13. Perceived Sustainability-Linear Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.566[a]	.321	.319	1.068

a. Predictors: (Constant), Perceived Sustainability

Table 14. Perceived Sustainability-Linear Regression ANOVA Test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	176.174	1	176.174	154.362	<.001[b]
	Residual	373.206	327	1.141		
	Total	549.380	328			

a. Dependent Variable: Please respond to the following question related to your purchasing and consumption preferences - On the scale below please mark the option that best represents the likelihood that you will purchase/consume foods grown through vertical farming methods. (1 being the least likely, 7 being the most likely.)

b. Predictors: (Constant), Perceived Sustainability

Table 15. Perceived Sustainability-Linear Regression Coefficients Table

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.544	.374		1.454	.147
	Perceived Sustainability	1.137	.092	.566	12.424	<.001

a. Dependent Variable: Please respond to the following question related to your purchasing and consumption preferences - On the scale below please mark the option that best represents the likelihood that you will purchase/consume foods grown through vertical farming methods. (1 being the least likely, 7 being the most likely.)

Prior Experience

The third variable that had a significant impact on the perceptions and consumption of vertical farming is prior experience. Through a linear regression it was revealed that prior experience also had a significant impact on the perceptions and consumption of vertical farming. First, a reliability analysis was conducted to assess the internal consistency of the two-item scale measuring prior experience with vertical farming as shown in Table 1. The analysis yielded a Cronbach's alpha coefficient of .837, indicating a high level of internal consistency among the items. These two items were combined to form a composite variable representing attitudes towards sustainability, which was used in this linear regression analysis.

A linear regression analysis was conducted to explore the association between participants' prior experience with vertically farmed foods and their likelihood of purchasing or consuming such products. Prior experience was treated as the independent variable, while the likelihood of purchasing or consuming vertically farmed foods served as the dependent variable.

The results of the regression analysis revealed a statistically significant relationship between prior experience and the likelihood of purchasing or consuming vertically farmed foods, with a significant $F(1,327)=6.734$, $p=0.010$ (see table 17). The regression model explained approximately 2% of the variance in participants likelihood in consuming vertically farmed foods, as shown by the R^2 value of 0.020. The adjusted R^2-value, which accounts for the number of predictors in the model was 0.017 (see table 16).

These findings imply that individuals with greater prior experience with vertically farmed foods are more inclined to express interest in purchasing or consuming them.

Table 16. Prior Experience-Linear Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.142[a]	.020	.017	1.283

a. Predictors: (Constant), Prior Experience

Table 17. Prior Experience Linear Regression-ANOVA Test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11.086	1	11.086	6.734	.010[b]
	Residual	538.294	327	1.646		
	Total	549.380	328			

a. Dependent Variable: Please respond to the following question related to your purchasing and consumption preferences - On the scale below please mark the option that best represents the likelihood that you will purchase/consume foods grown through vertical farming methods. (1 being the least likely, 7 being the most likely.)

b. Predictors: (Constant), Prior Experience

Table 18. Prior Experience Linear Regression-Coefficients Table

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.773	.155		30.842	<.001
	Prior Experience	.219	.085	.142	2.595	.010

a. Dependent Variable: Please respond to the following question related to your purchasing and consumption preferences - On the scale below please mark the option that best represents the likelihood that you will purchase/consume foods grown through vertical farming methods. (1 being the least likely, 7 being the most likely.)

Multiple Regression with Statistically Significant Predictors

Correlation and multiple regression analysis were conducted to examine the relationship between the likelihood to consume vertically farmed foods and other statistically significant predictors. These predictors include norms, attitudes towards sustainability, perceived sustainability, and prior experience with vertically farmed foods. Table 19 summarizes the descriptive statistics. As can be seen, the correlation analysis revealed significant positive correlations between the likelihood of purchasing or consuming vertically farmed foods and perceived sustainability ($r = 0.566$, $p < .001$), attitudes toward sustainability ($r = 0.249$, $p < .001$), norms ($r = 0.343$, $p < .001$), and prior experience ($r = 0.142$, $p = .005$) indicating that individuals who perceive vertically farmed foods as more sustainable, hold positive attitudes toward sustainability, and perceive social norms favoring the consumption of vertically farmed foods are more likely to express interest in purchasing or consuming them (see table 19).

The multiple regression model with all four predictors produced $F(4, 324) = 45.845$, $p < .001$ (see table 21). This indicates that the combination of these variables significantly predicts the likelihood of purchasing or consuming vertically farmed foods.

The regression model explained 36.1% of the variance in consumer preferences for vertically farmed foods, as indicated by the R-squared value of .361 and an adjusted R2 value of .354 (see table 20). Perceived sustainability (beta = 0.347, $p < .001$) and attitudes toward sustainability (beta = 0.193, $p < .001$) emerged as significant predictors of consumer preferences, suggesting that individuals who perceive vertically farmed foods as more sustainable and hold positive attitudes toward sustainability are more likely to express interest in purchasing or consuming them (see table 22).

Table 19. Combined Associated Multiple Regression-Correlation Table

		Please respond to the following question related to your purchasing and consumption preferences - On the scale below please mark the option that best represents the likelihood that you will purchase/consume foods grown through vertical farming methods. (1 being the least likely, 7 being the most likely.)	Prior Experience	Norms	Attitudes Toward Sustainability	Perceived Sustainability
Pearson Correlation	Please respond to the following question related to your purchasing and consumption preferences - On the scale below please mark the option that best represents the likelihood that you will purchase/consume foods grown through vertical farming	1.000	.142	.343	.249	.566

	methods. (1 being the least likely, 7 being the most likely.)					
	Prior Experience	.142	1.000	.144	.091	.080
	Norms	.343	.144	1.000	.166	.333
	Attitudes Toward Sustainability	.249	.091	.166	1.000	.255
	Percieved Sustainability	.566	.080	.333	.255	1.000
Sig. (1-tailed)	Please respond to the following question related to your purchasing and consumption preferences - On the scale below please mark the option that best represents the likelihood that you will purchase/consume foods grown through vertical farming methods. (1 being the least likely, 7 being the most likely.)	.	.005	<.001	<.001	<.001
	Prior Experience	.005	.	.005	.050	.074
	Norms	.000	.005	.	.001	.000
	Attitudes Toward Sustainability	.000	.050	.001	.	.000
	Perceived Sustainability	.000	.074	.000	.000	.
N	Please respond to the following question related to your purchasing and consumption preferences - On the scale below please mark the option that best represents the likelihood that you will purchase/consume foods grown through vertical	329	329	329	329	329

	farming methods. (1 being the least likely, 7 being the most likely.)				
	Prior Experience	329	329	329	329	329
	Norms	329	329	329	329	329
	Attitudes Toward Sustainability	329	329	329	329	329
	Perceived Sustainability	329	329	329	329	329

Table 20. Combined Associated Multiple Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.601[a]	.361	.354	1.041

a. Predictors: (Constant), Perceived Sustainability, Prior Experience, Attitudes Toward Sustainability, Norms

Table 21. Combined Associated Multiple Regression-ANOVA Test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	198.560	4	49.640	45.845	<.001[b]
	Residual	350.819	324	1.083		
	Total	549.380	328			

a. Dependent Variable: Please respond to the following question related to your purchasing and consumption preferences - On the scale below please mark the option that best represents the likelihood that you will purchase/consume foods grown through vertical farming methods. (1 being the least likely, 7 being the most likely.)

b. Predictors: (Constant), Perceived Sustainability, Prior Experience, Attitudes Toward Sustainability, Norms

Table 22. Combined Associated Multiple Regression-Coefficients Table

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-.790	.506		-1.563	.119
	PriorExperience	.112	.069	.072	1.611	.108
	Norms	.254	.078	.156	3.277	.001
	Attitudes Toward Sustainability	.196	.098	.092	2.001	.046
	Perceived Sustainability	.974	.097	.485	10.054	<.001

a. Dependent Variable: Please respond to the following question related to your purchasing and consumption preferences - On the scale below please mark the option that best represents the likelihood that you will purchase/consume foods grown through vertical farming methods. (1 being the least likely, 7 being the most likely.)

Chapter 4

DISCUSSIONS

The global agricultural landscape is undergoing a shift because of global agricultural issues like population growth, climate, change, food insecurity and so on. Alternative methods like vertical farming have emerged as potential complements to traditional agriculture to address many of these challenges. The growing interest in vertical farming is fueled by its potential to provide a sustainable and efficient food production system. The results of this study provide insights into the factors influencing consumer acceptance and willingness to consume foods grown through vertical farming methods. The discussion will focus on the key findings related to the intention and willingness to consume foods grow through vertical farming methods.

Hypothesis 1: The Relationship Between Norms and Intention to Consume

The results of the data analysis for hypothesis 1, which tested the relationship between subjective norms and the willingness/likelihood to consume foods grown through vertical farming methods, indicated a significant positive relationship between subjective norms and the willingness/likelihood to consume vertically farmed foods, thus supporting hypothesis 1.

The analysis revealed a statistically significant relationship between individuals' norms and their likelihood of consuming vertically farmed foods. The linear regression analysis demonstrated that norms could significantly associate the likelihood of consuming vertically farmed foods, with higher levels of perceived social approval regarding vertical farming associated with a greater willingness to consume foods grown through this method.

The moderately strong positive relationship between norms and the likelihood of consuming vertically farmed foods suggests that individuals who perceive greater social approval for vertical farming are more inclined to accept and adopt this food production method. This finding aligns with previous literature on social and subjective norms, as well as norm internalization, positing that individuals are more likely to conform to behaviors and attitudes exhibited by those around them (Gross & Vostroknutov, 2022).

Hypothesis 2: The Moderating Effect of Uncertainty Avoidance Factors on the Relationship Between Norms and Intention to Consume

Contrary to the initial hypothesis, the findings did not support a significant moderating effect of uncertainty avoidance on the relationship between norms and willingness to consume vertically farmed foods. While the foundational literature this study was based in had suggested that high uncertainty avoidance cultures might be less likely to embrace new technologies and

thus foods grown through technological processes due to their risk averse nature, the analysis found no statistically significant differences in uncertainty avoidance scores across the four countries examined (South Korea, Japan, The United States, and The Netherlands) (Leidner & Kayworth, 2006). Despite the theoretical underpinnings suggesting high uncertainty avoidance cultures would exhibit greater resistance to change, Hypothesis 2 was not supported.

The multiple regression analysis ran to determine the interactive effects of norms and uncertainty avoidance showed that neither uncertainty avoidance nor the interaction term between norms and uncertainty avoidance emerged as statistically significant predictors of consumption of vertically farmed foods. While uncertainty avoidance may not moderate the relationship between norms and willingness to consume vertically farmed foods, norms play a consistent role in shaping consumer perceptions and acceptance of consuming vertically farmed foods. The findings highlight the need to consider additional contextual factors beyond uncertainty avoidance and cultural dimensions in understanding consumer acceptance of vertically farmed foods.

One possible explanation for the lack of variability in uncertainty avoidance factors across countries, could be a study associated with challenges measuring cultural dimensions using Hofstede's Theory of Cultural Dimensions (Hofstede, 2001). The findings in this study suggest that the cultural dimension scale may not reliably capture cultural values across diverse populations (Gerlach & Eriksson, 2021). The study highlighted similar issues with the internal consistency and external validity of the cultural dimension scales, indicating that the findings from this study are consistent with broader challenges measuring cultural dimensions. This discrepancy was not apparent during the literature review phase but became evident in the data analysis phase.

In addition to challenges with the scale measuring cultural dimensions, a potential reason for the lack of significant differences in uncertainty avoidance across cultures could be attributed to the globalization of food systems and the increasing connectedness of societies, leading to the convergence of attitudes and behaviors related to certain food production technologies such as vertical farming.

Additional Predictors of Willingness to Consume Vertically Farmed Foods

Although not initially hypothesized, attitudes towards sustainability, perceived sustainability, and prior experience with vertically farmed foods all revealed statistical significance as predictors for the consumption of vertically farmed foods. The findings show that individuals with more positive attitudes toward sustainability, who perceive vertically farmed foods as more sustainable, and individuals with greater prior experience are more inclined to accept and consume foods growth through vertical farming methods. These findings might imply a link between consumers' environmental consciousness and their food choices. This shows the importance of sustainability perceptions and prior experience in shaping consumer preferences for vertically farmed foods.

Studies have consistently shown that sustainability considerations significantly influence consumer acceptance of alternative agricultural practices. Sustainability is a major driver of acceptance for vertical farms. The more positively the sustainability of the system is perceived, the higher the chance to perceive the entire system as useful and acceptable. (Jürkenbeck, Heumann, & Spiller, 2019). The concept of sustainability is one of the principle driving forces behind consumer acceptance of vertical farms (Perambalam et. Al, 2021). Subsequent linear

regression analysis demonstrated the significant influence of attitudes and perception towards purchasing and consuming vertically farmed foods.

The positive relationship between prior experience and the acceptance of vertical farming aligns with existing literature indicating that direct exposure and familiarity can significantly influence consumer attitudes and behaviors. Previous studies have consistently highlighted a general lack of familiarity with vertical farming methods (Milic̆ić & Dos Santos, 2017; Gilmour & Bazzani, 2018). Consumers who have prior experience with vertically farmed foods likely had opportunities to engage with these products, comprehend their benefits, and establish positive associations with them. This firsthand exposure plays a crucial role in fostering greater acceptance of vertical farming as a viable and sustainable method of food production. As consumers become more familiar with these foods through direct experience, they may develop a better understanding of the environmental benefits, quality, and taste associate with these products.

Future Research

Given the challenges in measuring uncertainty avoidance in this study and the lack of variability in uncertainty avoidance across countries, future research could focus on revising existing scales or developing new instruments that better capture the nuances of cultural values in a more globalized society. Qualitative approaches would also serve to richen insights into the underlying motivations and decision-making processes driving consumer acceptance of vertically farmed foods.

Chapter 5

CONCLUSIONS

The emergence of global agricultural issues has led to a growing interest in alternative farming methods like vertical farming. Vertical farming offers a sustainable complement to traditional farming. Despite its potential benefits, understanding consumer acceptance of vertical farming and their willingness/likelihood to consumer vertically farmed foods is an important factor to the longevity of the industry. This study aimed to investigate factors influencing consumer acceptance of vertical farming, specifically focusing on the role of cultural dimensions (uncertainty avoidance) and subjective norms.

Social norms and perceptions shape consumer attitudes toward vertical farming. Specifically, an observed positive correlation between subjective norms and the inclination to consume vertically farmed foods, highlighting the impact of perceived social approval on consumer acceptance. Despite initial expectations, the anticipated moderating effect of uncertainty avoidance on this relationship was not supported leading to the need to consider additional contextual factors beyond cultural dimensions.

A few additional contextual factors were discovered within this body of research. It identified attitudes toward sustainability, perceived sustainability along with prior exposure to vertical farming demonstrate a greater tendency to accept and consumer these products. The results from this study emphasize the importance of sustainability and perceptions in shaping preferences for vertically farmed foods.

This study contributes to the growing body of literature on vertical farming by offering insights into the factors that influence consumer acceptance, thereby informing strategies to

promote sustainable food production. As vertical farming continues to gain momentum as a viable alternative to conventional agriculture, understanding consumer preferences and behaviors is vital to the longevity of the vertical farming industry and sustainable food production for future generations.

Chapter 6

PRACTICAL IMPLICATIONS

In a practical setting, agricultural stakeholders and vertical farming stakeholders can potentially attract environmentally conscious consumers and create a greater adoption of sustainable farming practices. The findings have broader implications for the food industry. It shows the importance of education consumers about the environmental benefits of sustainable farming methods. Efforts to raise awareness about sustainability advantages of vertically farmed foods could lead to increased consumer demand and further investments in sustainable agriculture.

Moreover, the positive relationship that was found between prior experience and acceptance of vertically farmed foods might suggest that efforts to promote consumer education and exposure to vertically farmed products will be effective in increasing acceptance levels. Actively exposing individuals to the idea of vertical farming is a proactive approach to familiarizing people to the idea of vertical farming. Providing opportunities for individuals to witness vertical farming in action, allows them to gain firsthand experience of the technology and its potential impact on food production and sustainability. By providing opportunities for consumers to engage with and learn about vertically farmed foods, producers and stakeholders in

the industry can build trust, breakdown misconceptions, and create a more positive perception for this food production method.

Additionally, effective communication and marketing strategies emphasizing the sustainability aspects of vertical farming could be important in influencing customers perceptions and acceptance of vertical farming. By showcasing the practical applications and real-world benefits of vertical farming through storytelling, visuals, and interactive media, stakeholders can effectively communicate the value proposition of vertical farming.

Chapter 7

LIMITATIONS

The most significant limitation of this study pertains to the uneven distribution of respondents across the different countries. Despite efforts to establish quotas for each country aiming for a balanced representation, there were insufficient response numbers from the collective Korea and Japan accounting for a combined 9.4% of the total respondents. The other 90.6% of respondents were from the United States and the Netherlands. This can introduce sampling bias and limit the generalizability of the findings to a broader global audience. Researchers should exercise caution when interpreting the results of the study, considering the disproportionate representation of respondents from different countries.

Another limitation of the study also lies in the decision to combine respondents from South Korea and Japan into a single group for analysis. This consolidation was done because of an insufficient number of people on the Prolific Platform from Korea to reach a sufficient sample size. This decision was partly driven by the practical constraints, the availability of respondents

from Korea and Japan who were proficient in English. While Korea and Japan have similar uncertainty avoidance scores (Korea=85, Japan=92), cultural norms, values, and consumer behaviors all differ between the countries. By merging the respondents, this study may overlook nuanced cultural differences that could influence attitudes towards consuming vertically farmed foods.

Additionally, a limitation can be found regarding the measurement of uncertainty avoidance factors. The initial reliability analysis revealed issues with construct validity demonstrated by the low Cronbach's alpha score. The uncertainty avoidance scale may not fully capture the underlying constructs across the different cultural contexts.

Lastly, while the uncertainty avoidance scores between the Netherlands and the United States were different, the disparity was not as pronounced as initially expected. The Netherlands had an uncertainty avoidance score of 53, while the United States had a score of 46. This moderate different may not fully capture the extend of cultural variation in avoidance behaviors between these two countries. However, the Prolific survey platform posed constraints in the number of survey respondents needed. While the avoidance scores from the Netherlands and the United States may not have exhibited a significant contrast, comparing them to countries with notably higher uncertainty avoidance scores such as Korea and Japan highlights the spectrum of cultural differences in avoidance behaviors.

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