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Authors: Hsu, Jane Lu, Shiue, Charlene W., and Hung, Kelsey J.-R.

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# Perceptions of Environmental Sustainability in Imported Fruit Purchasing in Taiwan: Insights From Origin Effects

Jane Lu Hsu, Charlene W. Shiue and Kelsey J.-R. Hung

Department of Marketing, National Chung Hsing University, Taichung, Taiwan.

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**ABSTRACT:** This study aims to explore the origin effects of imported fruits, with a particular focus on environmental sustainability. Data were collected in 2021 through in-person surveys administered to primary food shoppers in Taipei. Total valid samples were 199. SAS software was used in analytics in this study. Multivariate analysis was employed to analyze the influences of various origin effects—advertising, environment, technology, pollution, image, and economy—on purchasing decisions. Major findings indicate that production technology has the most substantial positive influence on purchasing decisions, followed by country image and environmental aspects. Kernel density estimation further revealed that perceptions of environmental sustainability are multifaceted, with pollution being a more consistently understood factor compared to the broader environmental impacts. These findings underscore the importance of tailoring marketing strategies and policies to align with consumer perceptions regarding environmental sustainability, fostering trust, and promoting sustainable practices within the fruit import industry. The study provides valuable insights but is limited by its geographic focus on Taipei, the cross-sectional nature of the data, and the specific origin effects examined. Future research should consider broader geographic areas and additional product categories to enhance generalizability.

**KEYWORDS:** Origin effects of fruit imports, fruit purchasing decisions, environmental issues of fruit exporting countries

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**CORRESPONDING AUTHOR:** Jane Lu Hsu, Department of Marketing, National Chung Hsing University, Taichung 402202, Taiwan. Email: jlu@dragon.nchu.edu.tw

## Background

In the highly competitive market of the imported fruits, the country-of-origin effect incorporates the interconnectedness of various influential factors. Economic dynamics play a critical role in shaping the competitiveness of fruit imports. Technological advancements in agricultural practices can significantly enhance the quality, shelf-life, and marketability of fruits.[1] Muder et al[2] state that fruit production systems have gone through significant changes with innovations in planting and trellising, while mechanization for cropping, harvesting, grading, and storage leads to increased productivity and competitiveness in the international market. Adopting innovative technologies and sustainable farming practices boost productivity and product quality, contributing to a competitive advantage in agricultural markets. The integration of advanced technologies in horticultural production has been shown to enhance efficiency and output, thereby offering a competitive edge in the market.[3] By leveraging these marketing tools, countries can highlight unique selling points, such as superior quality or sustainable farming practices, which can attract consumers and create a strong market presence.[3]

Imported fruits from countries with favorable weather conditions often pose significant competition to domestic produce, as evidenced by their superior quality and extended shelf-life.[4] This competitive edge challenges local farmers and influences consumer preferences in the market. However, the increased reliance on fruit imports from climate-vulnerable countries could negatively impact the availability, price, and consumption of fruits in the importing country, which may affect dietary intake and health, particularly among older adults and low-income households.[5]

The EU and US markets prioritize stringent fruit trade regulations to ensure safe consumption, thereby protecting consumer health, animals, plants, and environmental sustainability. These fruit safety regulations, implemented as trade policy measures, impact exporting countries in their ability to achieve economic development with environmentally sustainable conditions.[6] Kan et al[7] assess the economic impacts of climate change on fruit production in a small economy with trade policy scenarios and find that fruit outputs are projected to decline with reduced consumer surplus. In small island economies in the South Pacific, factors such as distance, transport costs, and market volume play a significant role since fresh produce transported using ship-freight containers with lower transport costs are widely available.[8]

Understanding the specific dynamics of Taiwan's fruit import market is fundamental, given its unique position in the global trade landscape. Taiwan, a small island economy, is listed as the fourth highest importing country (following Canada, Mexico, and South Korea) for US fresh fruit and vegetable exports in 2023, with a growth of 15% from 2022.[9] In 2023, Taiwan imported 436 259 metric tons of fruits, worth 1.2 billion US dollars, from 66 different countries.[10] Fruit consumption has been relatively high in Taiwan, with per capita fruit disappearance of 115.21 kg in 2022.[10] In US, per capita availability of fresh fruit was 62.92 kg in 2021.[11] In Japan, per capita supply of fruit was 33.2 kg in 2022.[12] The market of imported fresh fruits in Taiwan has its importance in international trade. Orikasa et al[13] evaluated environmental impact of apples exported from Japan to Taiwan for a post-harvest chain to mitigate the carbon footprint. The country-of-origin effect interacts with a multitude of factors spanning from environmental

sustainability, economic dynamics, technological advancements, advertising strategies, to pollution.[14] Each of these elements plays a substantial role in shaping the perceptions of consumers.

Upon joining the World Trade Organization, tariffs and restrictions on Taiwanese agricultural product imports have been gradually lifted.[15,16] As a result, foreign agricultural products compete with domestic-grown fresh produce in the local market. Consumers have preferences regarding the origins of certain imported agricultural products while making purchasing decisions. Among the imported agricultural products, fruits have long been products with distinguishable characteristics of origins and are often labeled with the names of their exporting countries to differentiate themselves from domestic fruits.[17] In the imported market of Taiwan, there have been a few studies investigating country-of-origin effect on food purchases.[18] This high consumption rate, combined with the diverse sources of fruit imports, underscores Taiwan's critical role in the global market for fresh fruits. Studies like Orikasa et al[13], which evaluated the environmental impact of apple exports from Japan to Taiwan, further emphasize the strategic importance of Taiwan as a major consumer and trading partner in the international fruit market. However, how environmental sustainability is embedded in origin effects of exporting countries has not been thoroughly examined in the literature.

International trade in fruits can lead to other environmental issues such as deforestation, loss of biodiversity, and depletion of water resources in exporting countries. Large-scale fruit production for export often involves the conversion of natural habitats into agricultural land, negatively impacting local ecosystems. The use of pesticides and fertilizers in fruit farming can also lead to soil degradation and water pollution. By understanding these environmental problems, consumers can make more informed choices about the fruits they purchase. Emphasizing the environmental benefits of locally sourced fruits, such as reduced carbon emissions and support for sustainable farming practices, can encourage consumers to opt for local over imported options. This context sets the stage for a deeper examination of the factors influencing consumer preferences for local and imported fruits, highlighting the need for sustainable consumption patterns in mitigating environmental impact.

Research accessing the environmental sustainability issues related to origin effects of imported fruits in Taiwan has not been thoroughly examined in the literature. Research questions in the context of fruit imports in Taiwan regarding origin effects and environmental sustainability perceptions include: (1) How do different dimensions of environmental sustainability influence consumer perceptions and purchase intentions of imported fruits in Taiwan? and (2) What strategies can fruit importers employ to effectively communicate regarding environmental sustainability practices associated with fruit origin? The aim of this study is to reveal how environmental sustainability is perceived in decisions based on origin effects of imported fruits.

This study contributes to the existing body of literature by providing insights into the dynamics within the market of imported fruits, particularly concerning the perceptions surrounding environmental sustainability regarding imported market of fruits in Taiwan. Considering the importance of imported market of fruits in Taiwan, the findings of this study are expected to illuminate key drivers and barriers related to environmental sustainability perceptions in the context of imported fruit consumption, thereby offering valuable implications for stakeholders ranging from producers and distributors to policymakers and consumers. The following sections include literature review, data and methods, results, conclusions, policy and managerial implications, and contribution and limitations of the study.

## Literature Review

The country-of-origin effect is a well-documented phenomenon in the literature, reflecting how the origin of a product can influence consumer perceptions and purchasing behavior.[19] Nagashima[20] first introduced this concept, describing it as the image, reputation, and stereotypes that consumers and businessmen associate with products from a particular country. This effect can be understood as the biases or influences that consumers attribute to products or services based on their country of origin.[21-23] Information about the designation of origin is particularly valuable for food products as it provides quality cues to consumers.[24]

Consumer preferences for fruits are influenced by a range of attributes, including freshness, taste, and knowledge of the producer. Török et al[25] explored these preferences across France, Germany, Hungary, Italy, and Norway, identifying freshness and taste as the most valued attributes. The study of Török et al[25] also revealed that consumers place less importance on knowing the producer, suggesting that other factors, such as quality and sustainability, may play a more significant role in purchasing decisions Török et al[25] identified 3 consumer segments based on socio-demographic profiles, offering insights into European consumption patterns and providing managerial implications for targeting different market segments.

Consumers are more inclined to purchase products, including fruits, from countries with a favorable image.[23,26,27] The hypothesis developed is as follows.

$H_1$: Respondents in the cluster that prioritize fruit characteristics are more likely to consider image of fruit-exporting countries in decisions.

The role of environmental sustainability in consumer preferences has become increasingly prominent, reflecting a broader shift toward eco-friendly practices in agriculture. As Sedghy et al[28] highlight, there is growing consumer demand for fruits produced through sustainable methods. Countries known for their sustainable agriculture practices gain a competitive advantage, aligning

with consumer preferences for environmentally friendly products and meeting stringent environmental regulations. This alignment enhances the perceived quality and safety of imported fruits, making them more attractive to consumers. Consumers who value the intrinsic qualities of fruits tend to show greater interest in the environmental conditions under which these fruits are produced and are more likely to consider the sustainability practices and ecological impact of fruit-exporting countries while making purchasing decisions. The hypothesis developed is as follows.

$H_2$: Respondents in the cluster that prioritize fruit characteristics are more likely to consider production environment of fruit-exporting countries in decisions.

Pollution and environmental impact are critical factors that can undermine the sustainability credentials of imported fruits. The environmental footprint of transportation and agricultural practices associated with fruit production significantly influences consumer trust.[29] Negative perceptions, such as those related to pollution, can deter environmentally conscious buyers.[30,31] High levels of pollution linked to inadequate environmental practices can negatively impact consumer perceptions, particularly among those who prioritize sustainability.[32] Thus, countries exporting fruits must consider the environmental implications of their agricultural practices to maintain consumer trust and market competitiveness. The hypothesis developed is as follows.

$H_3$: Respondents in the cluster that prioritize fruit characteristics are more likely to consider pollution of fruit-exporting countries in decisions.

Marketing strategies like advertising that incorporate country-of-origin effects can significantly influence consumer purchasing behavior. Tsakiridou et al[24] emphasize that designation of origin information serves as a valuable quality cue, helping consumers make informed purchasing decisions. Consumers are more likely to buy products from countries with a positive image, leveraging the reputation of the country of origin to differentiate their products in the market.[23,26,27] This differentiation can be crucial in competitive markets, where consumers have numerous options to choose from. Advertisements highlighting the reputation and quality standards of fruit-exporting countries have a strong impact on consumer decisions. The hypothesis developed is as follows.

$H_4$: Respondents in the cluster that prioritize fruit characteristics are more likely to consider advertising from fruit-exporting countries in decisions.

The economic dynamics of fruit imports are also shaped by technological advancements in agricultural practices. Innovations in planting, trellising, and mechanization for cropping, harvesting, grading, and storage have led to increased productivity and competitiveness in the international market.[2] Adopting these technologies boosts productivity and product quality, providing a competitive advantage in agricultural markets.[3] These advancements not only improve the efficiency and output of horticultural production but also enhance the marketability of fruits, highlighting unique selling points such as superior quality or sustainable farming practices. The hypotheses developed are as follows.

$H_5$: Respondents in the cluster that prioritize fruit characteristics are more likely to consider economic development of fruit-exporting countries in decisions.

$H_6$: Respondents in the cluster that prioritize fruit characteristics are more likely to consider production technologies of fruit-exporting countries in decisions.

The intersection of country-of-origin effects and environmental sustainability offers a nuanced understanding of consumer behavior in the fruit import market. Understanding how these factors interact can help countries develop more effective marketing strategies and improve their competitiveness in the global fruit market.[14]

Cue Utilization Theory[33] provides a robust theoretical groundwork to explain how consumers use various cues, including the country of origin, to evaluate products and make purchasing decisions. When applied to the market of imported fruits, Cue Utilization Theory suggests that consumers use the country of origin as a significant extrinsic cue to infer the quality and safety of products.[34] This inference is influenced by consumers' pre-existing perceptions and stereotypes about the agricultural practices, environmental sustainability, and economic conditions of the exporting country.[35]

Research gap between environmental sustainability issues in agricultural production and country of origin effects is illustrated in Figure 1. This study aims to explore how environmental sustainability influences consumer perceptions and purchase intentions of imported fruits in Taiwan, and how fruit importers can effectively communicate these practices. The findings will provide valuable insights for producers, distributors, policymakers, and consumers, highlighting key implications related to environmental sustainability in the Taiwanese fruit import market.

## Data and Methods

A survey questionnaire was designed based on the relevant literature and suggestions of 5 informants in the in-depth interviews. Two trial surveys were conducted, each with 10 respondents. The formal in-person survey was administered for household primary food shoppers in several districts at traditional markets and supermarkets in Taipei, Taiwan, to gather information about purchasing decisions of imported fruits with considerations of various county-of-origin effects. Data were

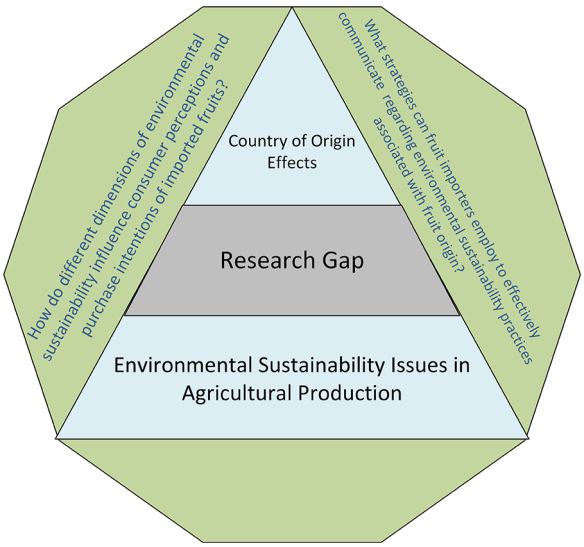


**Figure 1.** Research gap between environmental sustainability issues in agricultural production and country of origin effects for imported fruits.

collected in 2021 and convenient sampling methods were applied. The reason to have the survey conducted in Taipei was mainly because the metropolitan areas in Taipei are where the majority of imported fruits compete for market revenue. The purpose of the study was explained thoroughly to potential respondents, and a gift worth approximately 5 US dollar was provided to each potential respondent. For any reason respondents decided not to finish the survey, the gifts were not retrieved back. A total of 199 valid samples were obtained out of 209 questionnaires answered. Demographics of respondents are listed in Table 1.

Approximately 85% of the respondents were females. Due to the gender roles played in households, females are often in charge of grocery shopping in Taiwan. The average age of the respondents was 40.14 years, and 84.92% of them were married. Slightly more than 6% of respondents had educational levels in elementary schools or less, and 7% had finished junior high schools. About 40% of the respondents had senior high school education, and close to 40% had finished college education. The remaining 6.03% of respondents had graduate levels of education. The household size was 4.07 persons on average, and the household monthly income was USD 2035.18. More than half of household primary food shoppers (54.78%) would buy fruits every 2 to 3 days. Average monthly fruit expenditure was USD 114.42.

On average, respondents allocated 65.31% of fruit expenditures on domestic fruits and 34.69% on imported fruits. All the respondents were capable of distinguishing imported fruits from domestic fruits using methods from sticker labels, price differences, varieties, signs on the shelves, to checking with retailers or store managers. The sticker labels, which was utilized by 63.32% of respondents, appeared to be the most common means for consumers to differentiate imported fruits from

**Table 1.** Demographics of respondents (n = 199).

| DEMOGRAPHICS | |
|---|---|
| Gender (%) | |
| Male | 15.08 |
| Female | 84.92 |
| Married (%) | 84.92 |
| Educational levels of food shoppers (%) | |
| Elementary school or less | 6.53 |
| Junior high school | 7.54 |
| Senior high school | 40.70 |
| College | 39.20 |
| Graduate school | 6.03 |
| Frequency of purchasing fruits (%) | |
| Everyday | 10.05 |
| Every other day | 29.15 |
| Every 3 d | 25.63 |
| Every 4 d | 3.52 |
| Every 5 d | 7.04 |
| Every 6 d | 3.52 |
| Every 7 d | 12.56 |
| 8 d or more | 8.54 |
| Average monthly fruit expenditure (USD) | 114.42 |
| Purchasing imported fruits (USD) | 39.69 |
| Purchasing domestic fruits (USD) | 74.73 |
| Average age of food shoppers (years) | 40.14 |
| Average household size (persons) | 4.07 |
| Average monthly household income (USD) | 2035.18 |

domestic ones. Varieties and signs were also common methods used by consumers to distinguish the origin of imported fruits, and they were utilized by 46.73% and 37.69% of the respondents, respectively.

Variable code, question statement, and response are listed in Table 2. The origin effects are designed using 6 statements asking whether advertising, production environment, production technology, level of pollution, image, and economic development of fruit exporting countries would influence purchasing decisions. Responses of these questions are binary of one if answered yes, and of zero if answered no. Eight attributes measuring importance of fruit characteristics in purchases were listed in the questionnaire using the 5-point Likert scales.

This study utilizes factor analysis, cluster analysis, and multivariate analysis of variance to analyze the underlying dimensions of fruit purchase considerations and influences of cues of origin countries in decisions. The advantage of the factor analysis is that it identifies the underlying uncorrelated dimensions from a set of correlated variables. Results from factor analysis were then used in cluster analysis to segment respondents into groups with different considerations while purchasing fruits. Multivariate analysis of variance was applied to examine the statistical significance of differences in factors of various clusters. The factor analysis was applied in this study using principal

**Table 2.** Question statements of origin effects and characteristics of fruits.

| VARIABLE CODE | QUESTION STATEMENT | RESPONSE |
|---|---|---|
| Origin effects | | |
| origin_advertising | Does advertising for imported fruits from their country of origin influence your purchasing decision? | Yes = 1; No = 0 |
| origin_environment | Does the production environment in the country of origin for imported fruits influence your purchasing decision? | Yes = 1; No = 0 |
| origin_technology | Does the production technology in the country of origin for imported fruits influence your purchasing decision? | Yes = 1; No = 0 |
| origin_pollution | Does the level of pollution in the country of origin for imported fruits influence your purchasing decision? | Yes = 1; No = 0 |
| origin_image | Does the image of the country of origin for imported fruits influence your purchasing decision? | Yes = 1; No = 0 |
| origin_economy | Does the economic development of the country of origin for imported fruits influence your purchasing decision? | Yes = 1; No = 0 |
| Characteristics of fruits respondents value relative importance in purchasing decisions | | |
| fresh | Freshness | Five-point Likert scale |
| nutri | Nutrition | Five-point Likert scale |
| seasonal | Seasonal | Five-point Likert scale |
| price | Reasonable pricing | Five-point Likert scale |
| residual | Residual | Five-point Likert scale |
| certification | Certification | Five-point Likert scale |
| packaging | Packaging | Five-point Likert scale |
| country | Country of origin | Five-point Likert scale |

factoring technique with varimax rotation. Underlying factors were extracted with eigenvalues larger than one using Kaiser's criterion. Cronbach's alpha coefficients of the dimensions need to be above .6 for internal consistency according to Hair et al[36]. The origin effects are examined using chi-squared tests for 6 variables (advertising, environment, technology, pollution, image, economy). SAS software was used for data analytics in this study.

The Kernel density of origin effects is illustrated in this study. Kernel density estimation is a non-parametric way to estimate the probability density function of a random variable. It smooths out data points to create a continuous density curve, providing a visual representation of the data distribution. Kernel density estimation helps in understanding the shape, central tendency, and spread of the data.[37] With 2 identifiable distributions shown in the Kernel density distributions, the results indicate that the origin effect of environment provides a mixed signal to the respondents, while origin effect of pollution is more consistent with the responses (centered around 1.0).

## Results

The factor analysis was applied in this study using principal factoring technique with varimax rotation. Three underlying factors were extracted with eigenvalues larger than one. The first dimension is termed the value-added factor, including packaging, certification, and country of origin. The second factor consists of quality related attributes like freshness, residuals, and nutrition. The third factor is price/season, including seasonal fruits and reasonable pricing (Table 3). Cronbach's alpha coefficients of 3 dimensions are above suggested levels of .6 as mentioned in Hair et al[36]. Total variance explained is 65%. The results of the factor analysis revealed that several underlying dimensions existed in fruit purchasing decisions.

Three dimensions of fruit purchasing considerations extracted from the factor analysis were utilized in the cluster analysis to segment respondents into Exclusive and Essential clusters (Table 4). The Exclusive Cluster consists of 58.79% of respondents, while the Essential Cluster consists of 41.21% of respondents. Educational levels between 2 clusters are not statistically different. Respondents in the Exclusive Cluster are slightly older (41.64 years old) than those in the Essential Cluster (38.00 years old) and living in a larger household with an average of 4.21 persons. Monthly expenditure on imported fruits is higher for respondents in the Exclusive cluster (USD 44.22). Respondents in the Exclusive Cluster pay more attention to characteristics of fruits in purchasing decision. Factor

**Table 3.** Results of factor analysis.

| FACTORS | ATTRIBUTES | LOADINGS | EIGENVALUES | CRONBACH'S ALPHA | VARIANCE EXPLAINED |
|---|---|---|---|---|---|
| Value-added | Packaging | 0.79 | 2.63 | 0.65 | 0.34 |
| | Certification | 0.72 | | | |
| | Country of origin | 0.71 | | | |
| Quality | Freshness | 0.79 | 1.32 | 0.61 | 0.17 |
| | Residual | 0.73 | | | |
| | Nutrition | 0.63 | | | |
| Price/Season | Seasonal | 0.85 | 1.10 | 0.65 | 0.14 |
| | Price | 0.84 | | | |

**Table 4.** Segmentation of respondents in the exclusive and essential clusters.

| DEMOGRAPHICS AND FACTOR MEANS | EXCLUSIVE CLUSTER | ESSENTIAL CLUSTER | TEST STATISTICS |
|---|---|---|---|
| Respondents (%) | 58.79 | 41.21 | |
| Educational levels of food shoppers (%) | | | |
| Elementary school or less | 6.84 | 6.10 | $\chi^2 = 7.28$ |
| Junior high school | 7.69 | 7.32 | |
| Senior high school | 47.01 | 31.71 | |
| College | 35.04 | 45.12 | |
| Graduate school | 3.42 | 9.75 | |
| Average age of primary food shoppers (years) | 41.64 | 38.00 | $t = 2.47^{**}$ |
| Average household size (persons) | 4.21 | 3.86 | $t = 1.78^{*}$ |
| Average monthly household income (USD) | 2088.32 | 1959.35 | $t = 0.79$ |
| Monthly expenditure of imported fruits (USD) | 44.22 | 33.22 | $t = 1.90^{*}$ |
| Factor means | | | |
| Value-added | 3.61 | 2.92 | $F = 56.87^{***}$ |
| Quality | 4.72 | 3.98 | $F = 235.88^{***}$ |
| Price/Season | 4.32 | 3.62 | $F = 61.79^{***}$ |
| Wilks' Lambda = 0.33 $F = 129.85^{***}$ | | | |

***Significant at 1% level. **Significant at 5% level. *Significant at 10% level.

means of value added, quality, and price/season are significantly higher for those in the Exclusive Cluster. Test results of MANOVA (Wilks' Lambda = 0.33, $F = 129.85$ with $P$-value less than .01) and ANOVA F (all statistically significant at 1% significance level) revealed that respondents who are older, living in larger households and spend more on imported fruits are those who emphasize characteristics of fruits in decisions more importantly. Distributions of each factor in the Exclusive Cluster and in the Essential Cluster are illustrated in Figure 2. Factor means are significantly higher for the Exclusive Cluster, indicating that those respondents in the Exclusive Cluster pay higher attention to attributed of fruits in purchasing decisions.

Table 5 lists influences of origin cues of imported fruits by clusters. Primary food shoppers in the Exclusive Cluster are more likely to be influences by the environment, production technology, country image, and economical aspects of imported fruits than those in the Essential Cluster. The environmental effect is considered significantly different between respondents in the Exclusive Cluster and in the Essential Cluster in decisions as expected. On the other hand, origin effect of pollution shows insignificant influence on decisions. Since origin effects of environment and pollution are both related to sustainability, Kernel density estimation is conducted to reveal how these 2 origin variables are interrelated.

Based on the analytical results, hypothesis testing is concluded as follows.

$H_1$: Reject the null hypothesis at the 10% significance level.

Respondents in the cluster that prioritize fruit characteristics are more likely to consider image of fruit-exporting countries in decisions.

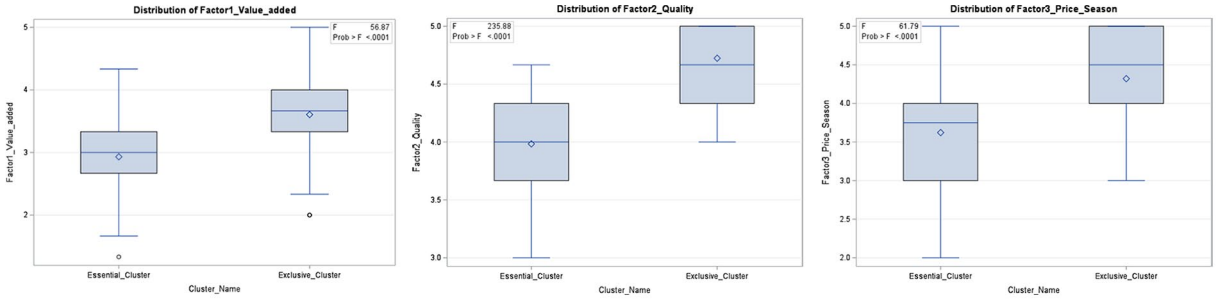


**Figure 2.** Distribution of factors by clusters.

**Table 5.** Influences of origin cues in imported fruits by clusters.

| INFLUENTIAL INFORMATION | EXCLUSIVE CLUSTER (%) | ESSENTIAL CLUSTER (%) | TEST STATISTICS |
|---|---|---|---|
| Origin_Image | 77.78 | 65.85 | $\chi^2=3.47^{*}$ |
| Origin_Environment | 82.91 | 70.73 | $\chi^2=4.15^{*}$ |
| Origin_Pollution | 92.31 | 92.68 | $\chi^2=0.01$ |
| Origin_Advertising | 69.23 | 59.76 | $\chi^2=1.91$ |
| Origin_Economy | 37.61 | 25.61 | $\chi^2=3.15^{*}$ |
| Origin_Technology | 73.50 | 54.88 | $\chi^2=7.44^{***}$ |

***Significant at 1% level. **Significant at 5% level. *Significant at 10% level.

$H_2$: Reject the null hypothesis at the 10% significance level.

Respondents in the cluster that prioritize fruit characteristics are more likely to consider production environment of fruit-exporting countries in decisions.

$H_3$: Fail to reject the null hypothesis at the 5% significance level.

There is insufficient information to support that respondents in the cluster that prioritize fruit characteristics are more likely to consider pollution of fruit-exporting countries in decisions.

$H_4$: Fail to reject the null hypothesis at the 5% significance level.

There is insufficient information to support that respondents in the cluster that prioritize fruit characteristics are more likely to consider advertising from fruit-exporting countries in decisions.

$H_5$: Reject the null hypothesis at the 10% significance level.

Respondents in the cluster that prioritize fruit characteristics are more likely to consider economic development of fruit-exporting countries in decisions.

$H_6$: Reject the null hypothesis at the 1% significance level.

Respondents in the cluster that prioritize fruit characteristics are more likely to consider production technologies of fruit-exporting countries in decisions.

Since origin effects of environment and pollution are both related to sustainability, further analysis is conducted to reveal how these 2 origin variables are interrelated. Figure 3 illustrates the Kernel density of environment and of pollution from origin effects. Kernel density estimation is a non-parametric way to estimate the probability density function of a random variable. It smooths out data points to create a continuous density curve, providing a visual representation of the data distribution. Kernel density estimation helps in understanding the shape, central tendency, and spread of the data. With 2 identifiable distributions shown in the Kernel density distributions, the results indicate that the origin effect of environment provides a mixed signal to the respondents, while origin effect of pollution is more consistent with the responses (centered around 1.0). When respondents were asked how pollution of the fruit exporting countries would influence their purchasing decisions, it is very specific for respondents to think of. On the contrary, when respondents were asked how environment of the fruit exporting countries would influence their purchasing decisions, the situation is rather ambiguous, encompassing both positive and negative environmental issues. This is the reason why the

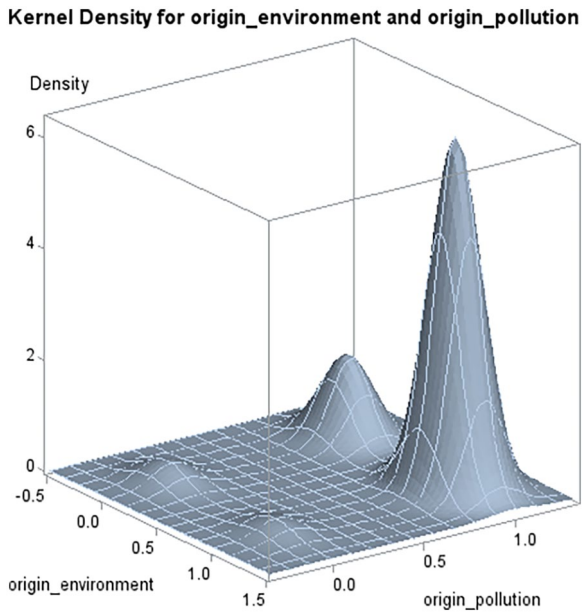


**Figure 3.** Kernel distributions for origins of environment and pollution in analytical results.

distributions in Kernel density for the origin factor of environment have scattered from −0.5 to 1.5.

This outcome suggests that when the origin effect is incorporated into survey questionnaires, environmental sustainability must be approached with specificity regarding its various aspects. While pollution typically carries negative connotations in the context of imported fruit origins, respondents can readily connect with this term. Conversely, when the environmental impact of origin is addressed in survey questionnaires, respondents encounter both positive and negative dimensions in their responses to the situation, as indicated in the Kernel density distributions.

## Discussion

The results of this study provide insightful information on how the origin effect influences purchasing decisions for imported fruits among primary food shoppers in Taipei. Findings suggest that shoppers place significant value on the technological advancements in the production processes of exporting countries. It implies that consumers perceive technologically advanced countries as capable of producing higher quality and possibly safer fruits. The findings coincide with the study of Hayat et al[1] that technological advancements in agricultural practices can significantly enhance the quality, shelf-life, and marketability of fruits. Furthermore, the positive influence of country image highlights the importance of a country's overall reputation in swaying consumer choices. This encompasses perceptions related to cultural values, general quality standards, and global standing.

Conversely, the lack of significance for advertising in influencing purchasing decisions is noteworthy. Despite the potential power of marketing strategies, the data indicate that advertising by exporting countries does not significantly alter purchasing behavior for imported fruits among food shoppers. This could be due to the consumers' focus on attributes of the fruits rather than advertising of the exporting country.

Findings support the hypothesis that environmental sustainability of exporting countries is a critical factor for consumers who pay higher attention to characteristics of imported fruits. This aligns with global trends where consumers are increasingly prioritizing environmentally friendly practices and products. Interestingly, the analysis also revealed that pollution levels, while having a negative connotation, do not significantly influence purchasing decisions. This could be due to the complexity and variability of pollution information and its less direct impact on perceived fruit quality compared to more tangible environmental practices.

The mixed signals from the environmental effects indicate that respondents consider a broad spectrum of issues, from pollution to conservation efforts, when evaluating environmental sustainability. This broader and somewhat ambiguous interpretation of environmental impact could lead to varied responses, as reflected in the scattered kernel density distribution. On the other hand, the more specific and consistently understood concept of pollution results in a more centralized response pattern. These findings suggest that survey instruments addressing environmental sustainability should differentiate between various aspects of the environment to capture more precise consumer perceptions.

Overall, this study highlights the importance of detailed and specific environmental questions in consumer surveys. When addressing the origin effect of exporting countries in future research or marketing strategies, it is crucial to distinguish between general environmental practices and specific issues like pollution. Such specificity will provide clearer insights into consumer preferences and help shape more effective marketing and policy decisions. The implications for exporters are clear: emphasizing advanced production technologies and maintaining a positive country image are likely to enhance marketability. Moreover, focusing on transparent and specific environmental practices can significantly influence consumer preferences, aligning with the global shift toward sustainability.

This study provides valuable insights into the dynamics of the imported fruit market in Taiwan, particularly concerning the perceptions surrounding environmental sustainability. The findings suggest that exporters should emphasize advanced production technologies and maintain a positive country image to enhance marketability. Furthermore, focusing on transparent and specific environmental practices can significantly influence consumer preferences, aligning with the global shift toward sustainability. These insights are expected to offer valuable implications for stakeholders ranging from producers and distributors to policymakers and consumers, contributing to more effective marketing strategies and policy decisions in the context of imported fruit consumption.

## Suggested Practical Strategies for Practitioners

In Taiwan's imported food market, several studies, such as Seo et al[18], have examined the country-of-origin effect on food purchases. Taiwan's high consumption rate and its diverse sources of fruit imports highlight the country's significant role in the global fresh fruit market. Research like Orikasa et al,[13] which assessed the environmental impact of apple exports from Japan to Taiwan, further underscores Taiwan's strategic importance as a key consumer and trading partner in the international fruit trade.

The study highlights the importance of aligning marketing strategies with consumer perceptions and preferences regarding environmental sustainability. This could include promoting eco-friendly agricultural practices and highlighting certifications related to sustainable production methods. Countries and producers that demonstrate a commitment to sustainable agriculture may gain a competitive advantage in the Taiwanese market. Implications based on findings in this study are: (1) Enhancing Country Image - The research underscores the significant positive influence of country image on consumer decisions. Policymakers and businesses may invest in enhancing the positive perception of their countries' fruit exports. This can be achieved through strategic branding, public relations campaigns, and efforts to improve product quality and safety standards. By improving country image, exporters can increase consumer trust and stimulate demand for their products; (2) Environmental Regulation and Certification - Given the strong positive effect of environmental aspects on consumer decisions, policymakers should consider strengthening environmental regulations and certification schemes. These measures can help ensure that imported fruits meet stringent environmental standards and certifications, reassuring consumers about the sustainability of their purchasing decisions; (3) Educational Campaigns - There is a need for educational campaigns to raise consumer awareness about the environmental impacts of fruit production and transportation. By educating consumers about the benefits of choosing environmentally sustainable products, such as reduced carbon footprints and support for sustainable agricultural practices, marketers can influence purchasing decisions positively; (4) Monitoring and Transparency - Establishing mechanisms for monitoring and ensuring transparency in the production and supply chain of imported fruits can help build consumer trust. Certifications and labels that verify sustainable production practices should be promoted and recognized, providing consumers with reliable information to make informed purchasing decisions; (5) Collaboration and Partnerships - Collaboration between governments, producers, retailers, and consumer advocacy groups can facilitate the development and adoption of sustainable practices in the fruit import industry. Partnerships can lead to shared resources, knowledge exchange, and the implementation of sustainable initiatives that benefit both consumers and the environment; (6) Adaptation to Consumer Preferences - Fruit importers and trade companies can continuously monitor and adapt to changing consumer preferences regarding environmental sustainability. This includes conducting regular consumer surveys, gathering feedback, and adjusting product offerings and marketing strategies accordingly; and (7) Long-term Sustainability Goals - Establishing long-term sustainability goals and commitments can demonstrate a proactive approach to environmental responsibility. Businesses and policymakers should work together to set targets for reducing environmental impacts associated with fruit imports, such as carbon emissions and water usage.

## Conclusions

This study aimed to explore how environmental sustainability influences consumer perceptions and purchase intentions of imported fruits in Taiwan, and how fruit importers can effectively communicate these practices. Through multivariate analyses, we examined various origin effects, including advertising, environment, technology, pollution, image, and economy, to understand their impact on consumer purchasing decisions.

The results revealed that 4 variables—environmental practices, production technology, economic development, and country image—positively influence purchasing decisions for imported fruits, with production technology having the most substantial impact. This indicates that consumers highly value the technological advancements in the production processes of exporting countries, perceiving these advancements as indicators of higher quality and safer fruits. The positive influence of country image underscores the importance of a country's overall reputation in shaping consumer choices, which encompasses perceptions related to cultural values, general quality standards, and global standing. The lack of significance for advertising suggests that consumers rely more on intrinsic product qualities and reputational aspects rather than promotional efforts.

The mixed signals from the environmental effects suggest that respondents consider a broad spectrum of issues, from pollution to conservation efforts, when evaluating environmental sustainability. This broader and ambiguous interpretation of environmental impact could lead to varied responses, as reflected in the scattered kernel density distribution. On the other hand, the more specific and consistently understood concept of pollution results in a more centralized response pattern.

This study significantly contributes to the understanding of consumer behavior by elucidating the impact of country-of-origin effects on the decision-making processes of primary food shoppers in Taipei. It highlights those factors such as production technology, country image, economic development, and environmental aspects of imported fruits play crucial roles in influencing purchase decisions. By incorporating a nuanced approach to assessing environmental sustainability, the research provides valuable insights for marketers and policymakers,

emphasizing the need to tailor strategies that resonate with consumer perceptions and preferences regarding environmental impacts. This comprehensive understanding of the interplay between origin effects and environmental sustainability can foster consumer trust, promote sustainable practices within the fruit import industry, and drive positive changes toward more sustainable consumption patterns.

Suggestions for further research include: (1) Geographic scope expansion: Conduct studies in diverse geographic locations to understand how regional differences impact consumer preferences for sustainable agricultural practices. Undertake comparative studies across multiple countries to gain insights into the cultural and economic factors influencing consumer behavior globally; and (2) Longitudinal studies: Implement longitudinal studies to track changes in consumer attitudes and behaviors toward environmental sustainability over time. Analyze data over extended periods to identify trends, changes, and the long-term impact of sustainability initiatives on consumer preferences.

## Author Contribution

Funding acquistion and project administration was mainly handled by JLH; All authors helped to conceptualize the study; CWS and KJRH developed the survey questionnaire and the methodology; CWS and KJRH handled the pilot survey, while JLH administered the follow-up survey; JLH did the writing and visualization.

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