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Ryosuke Horie
Shinichi Kitano
Yayoi Kito

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Faculty/Graduate School of
AGRICULTURE
KYOTO UNIVERSITY

Division of Natural Resource Economics

Kitashirakawa Oiwake-cho, Sakyo-ku, Kyoto 606-8502, Japan

Determinants of heterogeneous consumer preferences for organic vegetables in Japan: A market segmentation approach

Ryosuke Horie^{a*}, Shinichi Kitano^a, and Yayoi Kito^a

Abstract

Organic farming has attracted increasing international attention as a sustainable and alternative production method. To facilitate the transition to organic farming, consumers who drive demand for organic food are essential. This study examines heterogeneous consumer preferences for organic vegetables and their determinants using a market segmentation approach. A choice experiment was conducted among Japanese consumers to estimate their willingness to pay (WTP) for organic vegetables, and a latent class model was applied to analyze how consumers could be segmented. Demographic factors, psychological factors and knowledge were incorporated into this model. The results showed that a large proportion of respondents demonstrated a limited WTP of approximately 14 yen, while a smaller subset exhibited a substantially higher WTP of approximately 169 yen. The latter group tended to be less price-conscious, to prioritize environmental concern in their food choices, and to possess higher levels of subjective knowledge. These findings suggest the importance of incorporating such factors into policy design for increasing demand for organic food.

Keywords: Organic food, Consumer heterogeneity, Latent class model, Vegetable consumption, Willingness to pay

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^a Graduate School of Agriculture, Kyoto University

* Corresponding author, Graduate School of Agriculture, Kyoto University, Kitashirakawa-Oiwake-cho, Sakyo-ku, Kyoto city, Kyoto 606-8502, Japan;
Email: horie.ryosuke.62r@st.kyoto-u.ac.jp

Introduction

Reducing the environmental impact of agriculture has become an urgent issue, and organic farming has attracted increasing international attention as an alternative production method. Compared with conventional farming, organic farming is widely recognized as a more sustainable approach, largely because of its lower environmental impact per unit of the cultivated area (Tuomisto *et al.*, 2012). Despite its expansion mainly in Europe, the importance of organic farming has recently increased in Asia, with many countries introducing policies to promote its development (Willer *et al.*, 2024). With increased policy support, Asia's organic agricultural sector has experienced rapid growth. In 2022, the organic farmland area in Asia increased by approximately 35.9% (23,000 ha) compared to the previous year (Willer *et al.*, 2024).

In Japan, the Ministry of Agriculture, Forestry and Fisheries (MAFF) formulated the "MIDORI Strategy for Sustainable Food Systems" as a medium-long term policy framework, aiming to increase the share of organic farmland to 25% (approximately 1 million hectares) of the total farmland (MAFF, 2021). This strategy reflects Japan's commitment to international trends in sustainable agriculture and food systems and is aligned with global policy frameworks such as the Farm to Fork Strategy of the European Union (EU) and Agriculture Innovation Agenda of the United States Department of Agriculture (USDA) (EU Commission, 2020; MAFF, 2021; USDA, 2020).

However, the transition to organic farming in Japan has been relatively slow, with organic farmland accounting for only approximately 0.3% (15,000 ha) of the total farmland in 2022 (Willer *et al.*, 2024). Previous research has pointed to insufficient demand as a key factor in this slow transition (Hu, 2020). Historically, to promote organic farming, Japan has focused on supply-side measures, such as developing production technologies (Taniguchi, 2016). Because consumer demand is essential for sustaining the

organic food market, consumer behavior must be considered in policy designs. Nevertheless, there is a lack of research on organic consumers in Asia, particularly Japan, indicating the need for further studies to enrich the literature (Hsu *et al.*, 2016; Talwar *et al.*, 2021).

Numerous studies that have investigated the demand for organic food have generally indicated that consumers exhibit a positive willingness to pay (WTP) for organic food (Aoki *et al.*, 2017; Drugova *et al.*, 2020; Hempel and Hamm, 2016; Rossi *et al.*, 2024; Sakagami *et al.*, 2006; Wu *et al.*, 2020). These studies revealed that consumer preferences for organic food are heterogeneous and analyzed the determinants of such preferences. A range of consumer characteristics—demographic (or socioeconomic), psychological, behavioral, and informational factors—have been suggested as potential determinants of consumer preferences for organic food (Hughner *et al.*, 2007; Katt and Meixner, 2020). However, previous studies have predominantly focused on demographic factors, with relatively limited attention paid to psychological and informational factors (Nitta and Tanaka, 2024; Wu *et al.*, 2020). Notably, some studies have suggested that psychological factors explain consumer behavior more effectively than demographic factors (Katt and Meixner, 2020), indicating that a more psychologically oriented approach may yield more generalizable profiles for organic consumers (Hughner *et al.*, 2007). Moreover, although knowledge, particularly subjective knowledge, has been identified as an important factor that explains the choice of organic food (Pieniak *et al.*, 2010), the relationship between WTP and consumer knowledge has not been thoroughly discussed. To address these gaps, we aimed to examine consumer heterogeneity, focusing on psychological factors and knowledge.

Market segmentation, which accounts for consumer heterogeneity, is considered important for effectively stimulating demand for organic food (Nitta and Tanaka, 2024).

It is widely recognized as a fundamental component of effective marketing strategies and provides valuable insights for policymakers (Boxall and Adamowicz, 2002; Wedel and Kamakura, 2000). By dividing consumers with diverse needs into clearly defined segments, marketing strategies can be more precisely tailored to specific target groups (Kotler and Keller, 2012). In addition, understanding heterogeneous consumer preferences and the characteristics of each segment facilitates a more effective formulation and implementation of policy measures.

Identifying latent consumer segments depends on variables and analytical methods employed for segmentation (Wedel and Kamakura, 2000). Recent studies have attempted to segment the organic food market using choice experiments and latent class (LC) models (Drugova *et al.*, 2020; Rossi *et al.*, 2024; Wu *et al.*, 2020). In the LC model, respondents are classified into segments using a membership function, and the preference parameters for each segment are estimated, which explains the preference heterogeneity factors (Boxall and Adamowicz, 2002). The membership function can incorporate various consumer attributes as explanatory variables, facilitating a more comprehensive analysis of the determinants of consumer heterogeneity.

This study conducted a choice experiment with Japanese consumers to examine their WTP for organic vegetables and its determinants. Spinach was selected as the subject of analysis because it is widely consumed and relatively accessible in its organic form in Japan. Furthermore, we analyzed how consumers could be segmented using the LC model. To the best of our knowledge, recent studies have not employed the LC model for the segmentation of the Asian organic vegetable market, which establishes the methodological originality of this study. Into the LC model adopted by this study, we incorporated demographic, psychological, behavioral, and informational factors (knowledge) to comprehensively examine consumer heterogeneity. Based on this

analysis, we identified consumer segments with a higher WTP for organic spinach and clarified the characteristics of consumers in each segment. Finally, we discuss the potential policy measures for promoting organic food consumption.

The remainder of this paper is organized as follows. In Section 2, previous studies relevant to this research are reviewed. Research subjects, survey design, and analytical methods are described in Section 3. The descriptive statistics and estimation results are presented in Section 4. Policy implications and limitations of this study are presented in Section 5. The concluding remarks are provided in Section 6.

Literature Review

Many studies on demand for organic food have estimated consumer WTP through choice experiments. Sakagami *et al.* (2006) estimated that Japanese consumers' WTP for organic spinach was approximately 22.0 yen. Similarly, Aoki *et al.* (2017) found that Japanese consumers exhibited a WTP of approximately 6.48 USD per 5 kg of organic rice. Most of these studies applied the random parameter logit (RPL) model and assumed that specific probability distributions, such as a normal distribution, represent consumer WTP as a continuous variable. However, when consumer preferences for organic food are polarized, these distributions may fail to capture actual heterogeneity in WTP.

Most research on the determinants of the WTP for organic food has focused on demographic factors (Katt and Meixner, 2020). However, the relationship between consumers' demographic attributes and organic food consumption was relatively weak, with inconsistent results across studies (Botonaki *et al.*, 2006; Hempel and Hamm, 2016; Janssen, 2018). Although currently no consensus exists on the effects of demographic factors on organic food consumption, these variables play a practical role in market segmentation by facilitating accessibility to consumer segments (Wedel and Kamakura,

2000). Accordingly, this study controls for key demographic factors used in previous research, including age, gender, household income, education level, and the number of children (Katt and Meixner, 2020; Nitta and Tanaka, 2024).

Previous literature has suggested that psychological factors, such as consumer attitudes and values, are superior to demographic factors in predicting organic food purchasing behavior (Katt and Meixner, 2020). As synthetic fertilizers and pesticides are generally excluded in organic farming, consumers perceive organic foods as safer, healthier, and more environmentally friendly (Padel and Foster, 2005; Zepeda and Deal, 2009). Accordingly, prior research has identified health consciousness (Tandon *et al.*, 2021; Talwar *et al.*, 2021), food safety concern (Michaelidou and Hassan, 2008; Talwar *et al.*, 2021), and environmental concern (Tandon *et al.*, 2021; Wu *et al.*, 2020) as key drivers of organic food consumption.

Health consciousness and food safety concern represent egoistic motives, whereas environmental concern reflects an altruistic motive. Numerous studies have explored which of these motives better predict consumer behavior toward organic food; however, no definitive conclusion has been reached yet. Magnusson *et al.* (2003) argued that egoistic motives of health concern predicted attitudes, purchase intention, and purchase frequency better than the altruistic motives of concern for the environment. In contrast, Monier-Dilhan and Bergès (2016) analyzed a French consumer panel dataset and suggested that organic food consumers prioritized altruistic factors such as sustainable production over egoistic factors such as health and quality.

Organic foods are generally more expensive than conventional alternatives, which often serves as a primary barrier to purchase (Hu, 2020; Janssen, 2018; Tandon *et al.*, 2021). Janssen (2018) identified price consciousness as a significant factor impeding

organic food purchases. Previous studies suggest that consumers who value organic food tend to be less price-conscious (Lusk and Briggeman, 2009; Wu *et al.*, 2020).

Knowledge is a crucial factor in consumer decision-making (Brucks, 1985). Some studies have demonstrated that consumers' knowledge of organic food influences their purchase frequency and intention (Aertsens *et al.*, 2011; Hsu *et al.*, 2016; Pieniak *et al.*, 2010). Conceptually, knowledge can be categorized into subjective knowledge and objective knowledge. Subjective knowledge refers to individuals' perception of how much they know about the product, whereas objective knowledge represents accurate information on the product stored in their memory (Brucks, 1985). Aertsens *et al.* (2011) argued that these two types of knowledge are clearly different. However, many studies investigating the determinants of consumer WTP for organic food have not considered this distinction. Several studies have suggested that subjective knowledge predicts organic food consumption more strongly than objective knowledge (Aertsens *et al.*, 2011; Pieniak *et al.*, 2010).

Furthermore, consumers' purchase frequency shapes their WTP for organic food. Given the premium for organic food, past purchasing experience serves as evidence of consumers' WTP. Some studies have shown that consumers with a higher purchase frequency have a higher WTP for organic food (Botonaki *et al.*, 2006; Van Loo *et al.*, 2013).

Methods

Subject of analysis

We conducted a choice experiment to analyze consumer preferences for organic vegetables and their heterogeneity. In Japan, organic vegetables belong to the category of

the most widely consumed organic food (MAFF, 2024a). Spinach was selected for analysis for two primary reasons. First, from a policy perspective, spinach is one of the "designated vegetables" with particularly high consumption levels in Japan (Sasaki and Ito, 2024). Second, the MAFF conducted a survey and reported that approximately 26.4% of retail stores offered both domestically standard and organic spinach (MAFF, 2017), which indicates Japanese consumers' relative accessibility to it. In this context, we consider spinach as an appropriate subject for analyzing the market of organic vegetables in Japan.

Survey design

The survey was conducted by Intage Inc. [1] from November 13 to 15, 2024. Of the 635 responses, 577 remained after the exclusion of inadequate answers [2]. The target population comprised households across Japan that purchased fresh vegetables, and the respondents were aged 20–69 years. To ensure the representativeness of household purchasing behavior, respondents were constrained to those who were responsible for purchasing at least 50% of the food in their household. The questionnaire comprises four components: general purchasing habits, choice experiments, psychographics and knowledge, and demographics.

Table I lists the attributes and their levels used in the choice experiment. We presented respondents with a bag of fresh spinach with four attributes: "origin," "organic label," "producer name" and "price." These attributes were selected based on previous literature, retail practices, and the findings of preliminary surveys [3]. In accordance with Japanese regulations, the term "organic" cannot be legally used to label agricultural products unless they are certified under the Organic JAS system (MAFF, 2024b). Accordingly, we presented the Organic JAS logo to indicate that the product was organic in the choice experiment. The origin attribute included four prefectures (levels):

"Gunma," "Chiba," "Gifu" and "Fukuoka," based on their shipment volumes and market availability in November 2023 (MAFF, 2024c) [4]. Since product attributes such as freshness and appearance influence consumer choice (Rousseau and Vranken, 2013; Sakagami *et al.*, 2006), respondents were instructed to assume that all other attributes were identical [5]. Furthermore, because supermarkets play a central role in the retail of organic vegetables in Japan (MAFF, 2024a), we set them as the assumed purchase locations in the choice experiment.

To ensure efficient estimation, we generated profiles presented to the respondents using an orthogonal design. We extracted 16 profiles using an orthogonal array and arranged them in eight choice sets. For each question, we asked the respondents to choose between the two profiles and a "neither" option.

We measured psychological variables, including "health consciousness," "food safety concern," "environmental concern" and "price consciousness." These items were evaluated using a 7-point Likert scale. Health consciousness was measured using a scale extracted from the Health Consciousness Scale developed by Gould (1988). Food safety concern was measured using a scale which Michaelidou and Hassan (2008) modified after adapting it from Roddy *et al.* (1996). Environmental concern and price consciousness were measured using scales from the Food Choice Questionnaire developed by Steptoe *et al.* (1995) and later expanded by Lindeman and Väänänen (2000).

We also measured consumers' knowledge, including "subjective knowledge" and "objective knowledge." Subjective knowledge was measured using items from a scale developed by Flynn and Goldsmith (1999) and modified by Pieniak *et al.* (2010). Objective knowledge was assessed using dichotomous-choice questions based on previous studies and scientific findings (Aertsens *et al.*, 2011; Pieniak *et al.*, 2010) [6].

Choice models

A choice experiment is grounded in random utility theory (RUT) (McFadden, 1973) and Lancaster's characteristics approach (Lancaster, 1966). We employed the RPL and LC models to account for preference heterogeneity. A brief overview of these models is provided below.

The RPL model is used to capture heterogeneous consumer preferences by assuming a continuous parameter distribution. Under the RUT, the utility of individual n derived from alternative i at opportunity t is given by:

$$U_{nit} = \beta_n^\top x_{nit} + \varepsilon_{nit}$$

where x_{nit} is a vector indicating the attributes of alternative i at opportunity t , β_n is a vector of the preference parameters for individual n , and ε_{nit} is an error term. Assuming that ε_{nit} follows the Gumbel distribution, the joint probability that individual n makes a sequence of choices $I = \{i_1, \dots, i_T\}$ is expressed as (Train, 2009):

$$P_{nI}(\theta) = \int \left(\prod_t \left(\frac{\exp(\beta_n^\top x_{nit})}{\sum_{j \in C} \exp(\beta_n^\top x_{njt})} \right) \right) f(\beta_n | \theta) d\beta_n$$

where C is the set of all alternatives, $f(\cdot)$ is a probability density function, and θ refers collectively to the distribution parameters.

The LC model is used to discretely capture heterogeneous consumer preferences by classifying respondents into distinct segments characterized by homogeneous preferences. Reformulating the random utility function under the assumption that S segments exist in the population, the utility of individual n derived from alternative i belonging to segment s at opportunity t is given by:

$$U_{nit|s} = \beta_s^\top x_{nit} + \varepsilon_{nit|s}$$

where β_s is a vector of preference parameters for individuals belonging to segment s . Assuming that $\varepsilon_{nit|s}$ follows the Gumbel distribution, the joint probability that individual n makes a sequence of choices I within segment s is expressed as (McFadden, 1973):

$$P_{nI|s} = \prod_t \left(\frac{\exp(\beta_s^\top x_{nit})}{\sum_{j \in C} \exp(\beta_s^\top x_{njt})} \right)$$

However, because segment membership is unobservable, following Boxall and Adamowicz (2002), membership function M_{ns} is defined as:

$$M_{ns} = \gamma_s^\top z_n + \zeta_{ns}$$

where γ_s is a vector of parameters of the membership function, z_n is a vector indicating individual characteristics, and ζ_{ns} is the error term. Assuming that ζ_{ns} follows the Gumbel distribution, the probability that respondent n belongs to segment s can be expressed as follows:

$$\pi_{ns} = \frac{\exp(\gamma_s^\top z_n)}{\sum_{s^*} \exp(\gamma_{s^*}^\top z_n)}$$

This equation is the same as that used in the multinomial logit model. Therefore, the parameters of one segment must be normalized to zero for estimation. Consequently, the unconditional probability of a sequence of choices I in the LC model is specified as follows:

$$P_{nI} = \sum_s \pi_{ns} P_{nI|s}$$

For these choice models, the WTP for attributes is obtained by dividing the attribute parameter by the price parameter. Let β_p be the price parameter and β_k be the parameter of attribute x_k , the WTP for attribute x_k is given by:

$$WTP_k = -\frac{\beta_k}{\beta_p}$$

For segment s , the WTP for attribute x_k is given by:

$$WTP_{k|s} = -\frac{\beta_{k|s}}{\beta_{p|s}}$$

Results

Descriptive statistics

Table II presents the descriptive statistics of data used in the analysis, particularly that of estimating the LC model. The average age of the respondents was approximately 46.2 years, which closely aligned with the national average [7]. The average annual household income was around 5.59 million yen, which is almost the same as the national average of approximately 5.46 million yen (Ministry of Health, Labour and Welfare of Japan: MHLW, 2023). Approximately 60% of the respondents were female, which exceeds the national mean. This may have resulted from the screening criteria, which required that respondents should be responsible for at least 50% of their household food purchases. Approximately 42% of the respondents possessed a university degree or higher. The average number of children per household was approximately 0.22. Additionally, the average number of days per year on which respondents purchased organic vegetables was approximately 43.6 days [8].

Psychological variables and subjective knowledge

Table III shows the descriptive statistics of the items used to measure the psychological variables and subjective knowledge. Within the sample, the items related to price consciousness exhibited relatively high mean scores, whereas those related to subjective knowledge had lower scores. In particular, only items in subjective knowledge items had mean scores below the neutral score of four, which suggests that Japanese consumers tend

to have a low self-assessment of their knowledge of organic produce.

To assess the hypothesized model of psychological variables and subjective knowledge, we performed a confirmatory factor analysis (CFA) and incorporated the estimated factor scores as explanatory variables in the membership function of the LC model. Table III also presents the results of CFA. The model resulted in a good fit: CFI = 0.971, TLI = 0.964, RMSEA = 0.055 and SRMR = 0.052 (Hu and Bentler, 1999). Additionally, Cronbach's α for all constructs exceeded 0.7, indicating acceptable internal consistency.

Objective knowledge

Table IV shows the percentage of correct responses to each item used to measure objective knowledge. The item related to retail prices exhibited the highest accuracy rate, indicating that more than half of the respondents recognized the higher prices of organic vegetables. The next highest accuracy rates were observed for items related to restrictions on the use of synthetic fertilizers, pesticides, and genetically modified technology, although only approximately 40% of the participants responded to these items correctly. By contrast, Aertsens *et al.* (2011) found that the percentage of correct responses in Belgium exceeded 80% for similar questions, suggesting that Japanese consumers have a lower level of objective knowledge regarding the definition of organic farming. Furthermore, items related to the characteristics of organic farming relative to conventional farming and regulations on labeling had even lower accuracy rates. Notably, the lowest accuracy was observed for items related to the environmental benefits of organic farming and the safety and health implications of organic produce, for which the correct response rates generally fell below 30%.

To construct a single composite of objective knowledge (reducing dimensionality), we conducted principal component analysis and incorporated the estimated first principal

component score (*OK*) as an explanatory variable in the membership function. The loadings of the first principal component are presented in Table IV. The first principal component accounted for approximately 48.5% of the variance, with all items exhibiting similar positive correlations. Therefore, we interpreted the first principal component score as a comprehensive measure of respondents' objective knowledge of organic farming and produce.

Estimation results

Table V presents the estimation results of the choice models [9]. Table VI reports the calculated WTP values for the RPL and LC models. In the estimation of the RPL model, we assumed price as a fixed parameter [10] and other attributes as random parameters following a normal distribution. In the LC model, the number of classes S must be determined exogenously based on statistical criteria (Boxall and Adamowicz, 2002). The Akaike Information Criterion (AIC) was minimized at $S = 4$, whereas the Bayesian Information Criterion (BIC) reached its lowest value at $S = 3$. However, because the model with $S = 4$ exhibited convergence instability, we selected the model with $S = 3$ based on BIC. The estimated share of each class was approximately 19.7% for Class 1, 50.6% for Class 2, and 29.7% for Class 3.

Regarding the results of the RPL model, the price parameter was negative and statistically significant, reflecting rational economic behavior. The alternative specific constant (*ASC*), which captures the utility of choosing the base spinach, had a mean WTP of approximately 276 yen. This value closely aligns with the retail price of spinach in Japan, supporting the validity of the model. However, the standard deviation (SD) parameter for *ASC* was also significant, indicating that consumer preferences for spinach varied owing to individual differences in dietary habits and personal tastes. Regarding

origin, using the Gunma Prefecture as the base category, a positive WTP was observed for *Chiba*, while a negative WTP was estimated for *Gifu*. Nevertheless, the SD parameters were large, indicating that approximately 34% of the respondents exhibited a negative WTP for *Chiba* and approximately 26% showed a positive WTP for *Gifu*. This suggests the absence of a consistent preference for specific origins. Although the producer name (*Name*) was associated with a positive WTP, its mean was approximately 6 yen, indicating a limited advantage in marketing.

The organic label (*Label*), the primary focus of this study, significantly impacted respondents' choice probability. The mean WTP for the organic label was approximately 28 yen, which is consistent with the value reported in a previous study (Sakagami *et al.*, 2006). This shows that consumers, on average, positively evaluate organic vegetables. However, the SD parameter was significant as it indicates heterogeneity in preferences. Notably, the estimated SD was relatively large, and approximately 24% of the respondents exhibited a negative WTP based on the theoretical distribution of the estimated parameter. This suggests the need for a more flexible model to capture heterogeneous consumer preferences.

Regarding the results of the LC model, the AIC and BIC values indicated that the LC model provided a better fit than the RPL model, supporting its applicability. The price parameter was negative and significant in all classes, indicating an economically rational result, similar to the RPL model. However, the LC model revealed heterogeneity in preferences for price, with Class 3 exhibiting a notably lower price parameter than other classes. This suggests that Class 3 represents a consumer segment with lower disutility for price when purchasing food.

Referring to Table VI, Class 2 exhibited a negative WTP for all origins, whereas Class 3 showed a particularly strong negative WTP for *Gifu*. By contrast, Class 1 showed

small WTP values for all origins, indicating that origin labeling may minimally influence the purchasing behavior within this segment. Owing to a reduction in the sample size within each class, the producer name was not significant in any segment.

The parameter for the organic label was positive and significant in all classes, yielding results consistent with the RPL model. However, while Classes 1 and 2 showed a WTP of approximately 14 yen, Class 3 exhibited an exceptionally high WTP of about 169 yen. This suggests that a specific consumer segment drives the demand for organic vegetables. According to MAFF (2017), domestic organic spinach is, on average, priced approximately 1.4 times higher than domestic standard spinach in retail stores. Given this price difference, only respondents in Class 3 may have reservation prices that exceed the market price of organic spinach, whereas most respondents (Classes 1 and 2) may not be willing to accept such a premium.

Figure I illustrates the distribution of individuals' conditional mean WTP for the organic label estimated using the LC model. The kernel density estimation showed a bimodal distribution: one group had a modest premium for organic vegetables (Classes 1 and 2), and another group had a substantially higher premium (Class 3). The RPL model suggested that approximately 24% of the respondents exhibited a negative WTP, whereas this proportion was reduced to approximately 12% under the LC model.

Membership function

In this subsection, the three consumer segments identified using the LC model are described. The lower panel of Table V presents the estimation results for the membership function. Among the demographic variables, only gender, household income, and the number of children were significant. By contrast, all psychological variables and knowledge were significant in at least one class, which indicates the importance of incorporating these variables into the segmentation analysis.

The respondents in Class 1 exhibited relatively high food safety concern, but had limited experience in purchasing organic vegetables. Michaelidou and Hassan (2008) demonstrated that, although food safety concern predicted attitudes toward organic food significantly, it did not directly influence purchase intention. The limited impact of this factor among respondents suggests that food safety concern alone may not drive WTP. Additionally, respondents in this class tended to demonstrate high price consciousness and showed the slight effects of attributes other than price on choice probability, suggesting that price is a primary factor in their purchasing decisions. This segment also had a higher proportion of female respondents than other segments.

Class 2, the largest segment, consisted of respondents from relatively high-income households with more children. The respondents in this class exhibited high price and health consciousness, while environmental concern was somewhat elevated but had a limited impact. Although they had some experience in purchasing organic vegetables, their estimated WTP for organic label remained low. This indicates that the respondents are reluctant to pay a premium, and that price is a major barrier to the purchase of organic vegetables in this segment. Furthermore, subjective knowledge was significantly lower in this class than in other classes. This indicates that more than half of the Japanese consumers perceive themselves as having limited knowledge of organic produce. On the other hand, objective knowledge was significant only in this class and positively influenced the probability of class membership. However, the effect of objective knowledge was limited, suggesting minimal variation in objective knowledge levels among Japanese consumers.

Class 3 was most responsive to the organic label. Compared to other classes, the respondents in this class tended to be not price conscious, aligning with their smaller disutility of price. Although health consciousness was relatively low, both environmental

concern and purchase frequency of organic vegetables were significantly higher. These characteristics suggest that this segment constitutes the primary purchasers of organic vegetables, driven primarily by altruistic rather than egoistic motives. Additionally, subjective knowledge was markedly higher in this class than in the other classes, which suggests that subjective knowledge may strongly predict the WTP for organic food. Among the demographic variables, only gender was significant, owing to a higher proportion of male respondents than other classes. While various studies have discussed the relationship between gender and organic food consumption, many studies in Japan have suggested that female consumers tend to value organic food more (Nitta and Tanaka, 2024). By contrast, Tandon *et al.* (2021) analyzed the Japanese organic food market and found that male consumers who value the environmental benefits of organic food exhibit more proactive purchasing behavior, which is consistent with our results.

Discussion

Policy implications

Japanese consumers generally possess limited objective knowledge of organic farming and produce and may insufficiently understand their characteristics and attributes. For instance, while the MAFF promotes organic farming as an environmentally friendly agricultural method, only approximately 30% of the respondents in this study were aware that organic farming can reduce environmental impact (Table IV). This finding suggests that effective communication with consumers remains insufficient, and adequate information necessary for evaluating organic food may not have been provided to them. Although this study did not identify a direct relationship between objective knowledge and consumers' WTP, several studies have demonstrated that objective knowledge influences purchase intention and frequency by mediating attitudes and subjective

knowledge (Pieniak *et al.*, 2010; Van Loo *et al.*, 2013). Additionally, previous research has shown that information provision based on scientific findings can influence consumers' WTP (Rousseau and Vranken, 2013). Given that objective knowledge affects consumer purchasing behavior to some extent, it may be important to ensure transparent and accurate information dissemination for promoting organic consumption.

While many studies have found that consumers evaluate organic food positively, our findings indicate that the WTP for organic vegetables is highly polarized. As illustrated in Figure I, a large proportion of respondents demonstrated a limited WTP of approximately 14 yen, whereas a subset exhibited a high WTP of approximately 169 yen for organic vegetables. This result suggests that organic vegetables remain a niche market, and downstream reforms are necessary for the widespread adoption of organic farming. Additionally, most studies that have applied the RPL model to represent WTP as a continuous distribution have typically assumed a normal distribution of parameters, which is unimodal and symmetric. Consequently, the actual WTP distribution may not have been accurately captured.

The segmentation results from the LC model revealed that the consumer segment that demonstrated sufficiently high WTP and strong demand for organic vegetables (Class 3) tended to be less price-conscious and to have higher environmental concern. In contrast, health consciousness and food safety concern showed weaker associations with WTP for organic vegetables than environmental concern. This finding suggests that Japanese consumers primarily choose organic food for altruistic rather than egoistic motives, which is consistent with the findings of Monier-Dilhan and Bergès (2016). Similarly, Lusk and Briggeman (2009) showed that consumers who prioritized price had a lower WTP for organic food, while those who emphasized environmental impact exhibited a higher WTP. Wu *et al.* (2020) also reported that, in the context of the Chinese milk market, consumers

who were particularly interested in organic certification tended to have high environmental concern and low price consciousness. Our results also align with these previous findings. Therefore, in addition to fostering general environmental concern among consumers, emphasizing the environmental benefits of organic farming may contribute to expanding demand for organic food.

Furthermore, Class 3, the primary organic consumer segment, exhibited no distinctive characteristics in terms of objective knowledge but notably high levels of subjective knowledge. This finding aligns with previous research suggesting that subjective knowledge strongly predicts consumer purchasing behavior than objective knowledge does (Aertsens *et al.*, 2011; Pieniak *et al.*, 2010). Pieniak *et al.* (2010) indicated that objective knowledge influenced purchase frequency only through mediation by subjective knowledge and attitudes toward organic vegetables, whereas subjective knowledge was directly related to purchase frequency, highlighting its effectiveness in promoting organic food sales. In addition to supporting these findings, this study suggests that subjective knowledge may also enhance consumers' WTP for organic food. Moreover, subjective knowledge is significantly influenced by product-related experience (Park *et al.*, 1994). Therefore, beyond providing objective information, policymakers and marketers may consider designing programs that offer hands-on experience related to (organic) agriculture and agricultural products, such as farm visits, tasting events, or participatory farming activities, as a means of enhancing subjective knowledge and, in turn, increasing consumer valuation of organic food.

Limitations

This study has some limitations. First, our analysis focused exclusively on spinach, which limits the external validity of the findings. Although spinach is a representative leafy vegetable, consumer preferences may differ for other types of produce, such as root

vegetables, fruits, and cereals. Therefore, further verification across multiple product categories is required to generalize the findings to a broader category of organic foods.

Additionally, although we estimated consumers' WTP for organic spinach using a choice experiment, these values may be biased. Our analysis relied on stated preference data, and respondents did not have to make actual payments in the experiment. Consequently, hypothetical bias may not have been entirely eliminated, leading to an overestimation of the WTP. To assess WTP values and their distribution more accurately, future research should employ revealed preference methods such as real choice experiments or auction experiments involving actual payments.

Moreover, even among respondents in the segment with a WTP exceeding the retail price of organic spinach, actual purchasing behavior may not necessarily align with stated preferences. Previous studies have pointed out the presence of an intention-behavior gap in organic food consumption (Sultan *et al.*, 2020). This gap indicates that, even if consumers intend to pay a premium for organic food, their intention does not always translate into actual purchases. Therefore, the estimated segment shares in this study may not accurately reflect the actual market share of organic vegetables, necessitating the careful interpretation of results.

Conclusion

We analyzed consumers' WTP for organic vegetables and the heterogeneity of their preferences by conducting a choice experiment and applying an LC model. In the LC model, three distinct consumer segments in the spinach market were identified, and further analysis was conducted to elucidate the factors underlying their heterogeneous preferences.

On average, respondents exhibited a positive WTP for the organic label. However, the majority of respondents' WTP did not reach a level exceeding the retail price of organic spinach. Additionally, the polarized distribution of WTP for the organic label indicates that the current organic vegetable market in Japan remains limited in size. To facilitate the transition to organic farming, consumers who drive demand for organic food are essential. Therefore, in addition to upstream reforms, downstream measures including consumer education and information provision should be considered.

The consumer segment with a sufficiently high WTP, representing the primary purchasers of organic vegetables, was characterized by high environmental concern and subjective knowledge, and had a higher proportion of male respondents. This finding highlights the importance of considering psychological and informational differences in designing policies. Specifically, raising environmental concern and providing opportunities and experiences to enhance subjective knowledge can effectively expand the organic food market. Additionally, a targeted approach to female consumers may be necessary. However, as this study did not examine causal relationships between measures that enhance these factors and the WTP, further analysis is required to determine specific policy measures to change consumer behavior and evaluate their effectiveness. Addressing these issues remains a topic for future research.

Notes

1. Intage Inc. is the largest marketing research company in Japan, with approximately 3 million Japanese monitors and a consumer panel of nearly 15 million across Asia. See <https://www.intage.co.jp/english/>.
2. In the choice experiment, respondents who selected “neither” for all questions were excluded.
3. To determine the attributes and levels of the profiles, we conducted a qualitative interview survey with consumers to identify information they prioritized when purchasing agricultural products. We also conducted a pilot survey to ensure the validity and efficiency of the experimental design.
4. In Japan, sellers of fresh agricultural products have an obligation to indicate their origins, and origin labeling on a scale broader than the prefectural level is prohibited. Therefore, we used prefecture names as the levels of origin.
5. Prior to the questions of the choice experiment, we presented respondents with a picture of approximately 200g of standard spinach per bag, with the objective of aligning their understanding.
6. Respondents were asked whether they already knew each factual statement regarding organic farming and produce at the time of the survey.
7. The average age of Japanese individuals aged 20–69 is approximately 46.0 years (Ministry of Internal Affairs and Communications: MIC, 2024).
8. The median number of days per year on which respondents purchased organic vegetables was 12.0 (approximately once a month).
9. The estimation was conducted using the mlogit package for the RPL model and the gnm1 package for the LC model in R (Croissant, 2020; Sarrias and Daziano, 2017).
10. When the price parameter is set as a random parameter following a continuous distribution, such as a lognormal distribution, the estimated WTP tends to be unreasonably large (Train and Weeks, 2005).

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Table I. Choice experiment attributes and levels

Attributes	Levels
Origin	Gunma (base); Chiba (<i>Chiba</i>); Gifu (<i>Gifu</i>); Fukuoka (<i>Fukuoka</i>)
Organic Label	No (base); Organic JAS logo (<i>Label</i>)
Producer Name	No (base); Yes (<i>Name</i>)
Price (yen)	160; 200; 240; 280

Table II. Descriptive statistics

	Mean	SD
Age of the respondent: <i>Age</i>	46.20	13.45
1 if the gender of the respondent is female; 0 otherwise: <i>Gender</i>	0.61	0.49
Annual household income of the respondent (yen): <i>Income</i>	559.45	377.78
1 if a respondent possessed a university degree or higher; 0 otherwise: <i>Education</i>	0.42	0.49
Number of children under 12 years old in family: <i>Child_Num</i>	0.22	0.58
Number of purchases of organic vegetables per year: <i>Organic_Freq</i>	43.60	64.72

Table III. Results of confirmatory factor analysis

	Items	Mean	SD	Loadings	Cronbach's α
Price consciousness (PC)	It is important to me that the food I eat on a typical day:				
	Is not expensive	5.51	1.20	0.85	0.82
	Is good value for money	5.38	1.14	0.65	
	Is cheap	5.51	1.15	0.82	
Health consciousness (HC)	I'm alert to changes in my health	4.73	1.21	0.80	0.94
	I'm usually aware of my health	4.83	1.24	0.92	
	I'm very self-conscious about my health	4.76	1.27	0.90	
	I reflect about my health a lot	4.80	1.24	0.86	
	I'm generally attentive to my inner feelings about my health	4.58	1.20	0.83	
Food safety concern (FSC)	I'm very concerned about the amount of artificial additives and preservatives in food	4.38	1.33	0.82	0.79
	The quality and safety of meat nowadays concerns me	4.80	1.23	0.82	
	Nowadays most foods contain residues from chemical sprays and fertilizers	4.71	1.15	0.59	
Environmental concern (EC)	It is important to me that the food I eat on a typical day:				
	Has been prepared in an environmentally friendly way	4.61	1.17	0.86	0.87
	Has been produced in a way which has not shaken the balance of nature	4.74	1.15	0.84	
	Is packaged in an environmentally friendly way	4.48	1.25	0.80	
Subjective knowledge (SK)	I know pretty much about organic agricultural products	3.00	1.54	0.87	0.87
	Among people who know me, I'm one of the "experts" on organic agricultural	2.59	1.63	0.82	
	I know a lot about how to judge the quality of organic agricultural products	3.03	1.62	0.80	

Note: All factor loadings are significant at the 10% level. Fit-statistics: CFI = 0.971, TLI = 0.964, RMSEA = 0.055, SRMR = 0.052.

Table IV. The percentage of correct responses for items on objective knowledge

	Correct response (%)	Loadings
In organic farming, the use of synthesized fertilizers and pesticides is, in principle, prohibited	42.5	0.365
In organic farming, the use of genetically modified technology is prohibited	45.9	0.324
The environmental impact of organic farming (per unit area) is generally lower than that of conventional farming	30.3	0.376
The yield of organic farming (per unit area) is generally lower than that of conventional farming	39.0	0.398
The labor hours required for organic farming (per unit area) are generally higher than required for conventional farming	37.4	0.393
In retail stores, organic vegetables are often sold at higher prices than standard vegetables (typically about 1.4 to 1.8 times higher)	53.4	0.349
The safety and health effects of organic produce have not been fully elucidated at present	23.7	0.314
Agricultural products without the Organic JAS logo cannot be labeled as “organic”	23.9	0.297

Note: Loadings column shows the loadings of the first principal component.

Table V. Estimation results of choice models

	RPL		LC							
	Mean		SD		Class 1		Class 2		Class 3	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
<i>ASC</i>	12.3920***	0.4434	3.5081***	0.1643	8.1345***	0.6608	19.6583***	1.7400	3.0408***	0.5256
<i>Chiba</i>	0.3440**	0.1430	0.8321***	0.1939	0.5641*	0.2890	-1.5410***	0.4107	0.3176	0.1969
<i>Gifu</i>	-0.9647***	0.1518	1.4976***	0.1748	-0.0410	0.3646	-1.9826***	0.3246	-0.5115***	0.1557
<i>Fukuoka</i>	0.1424	0.1490	0.0425	0.4513	0.2767	0.2141	-2.0896***	0.4965	-0.2054	0.2189
<i>Label</i>	1.2419***	0.0993	1.7443***	0.1229	0.6451***	0.1583	0.9165***	0.2977	1.1622***	0.1413
<i>Name</i>	0.2767***	0.0930	0.9115***	0.1225	-0.3283	0.2634	-0.4430	0.2922	0.1872	0.1271
<i>Price</i>	-0.0450***	0.0017	—	—	-0.0461***	0.0036	-0.0678***	0.0064	-0.0069***	0.0025
<i>Const.</i>					0	—	1.0084***	0.2142	0.3297	0.2662
<i>Age</i>					0	—	-0.0036	0.0036	-0.0048	0.0044
<i>Gender</i>					0	—	-0.4298***	0.0959	-0.7245***	0.1145
<i>Income</i>					0	—	0.0004***	0.0001	-0.0001	0.0002
<i>Education</i>					0	—	-0.0153	0.0953	0.0705	0.1155
<i>Child_Num</i>					0	—	0.2091**	0.0821	-0.1036	0.1030
<i>PC</i>					0	—	0.0456	0.0580	-0.6749***	0.0815
<i>HC</i>					0	—	0.2896***	0.0804	-0.3403***	0.1190
<i>FSC</i>					0	—	-0.5637***	0.1341	0.2721	0.1830
<i>EC</i>					0	—	0.2201**	0.0988	1.1955***	0.1374
<i>SK</i>					0	—	-0.1259*	0.0670	0.4881***	0.0786
<i>OK</i>					0	—	0.1174***	0.0243	-0.0137	0.0289
<i>Organic_Freq</i>					0	—	0.0028***	0.0011	0.0085***	0.0011
Share (%)						19.7		50.6		29.7
Obs.		4616						4616		
LL		-3133.0						-2927.1		
AIC		6297.1						5948.4		
BIC		6375.8						6250.9		

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table VI. Willingness to pay

	RPL		LC		
	Mean	SD	Class 1	Class 2	Class 3
<i>ASC</i>	275.7***	78.0***	176.6***	290.1***	440.9***
<i>Chiba</i>	7.7**	18.5***	12.2*	-22.7***	46.0
<i>Gifu</i>	-21.5***	33.3***	-0.9	-29.3***	-74.2***
<i>Fukuoka</i>	3.2	0.9	6.0	-30.8***	-29.8
<i>Label</i>	27.6***	38.8***	14.0***	13.5***	168.5***
<i>Name</i>	6.2***	20.3***	-7.1	-6.5	27.1

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

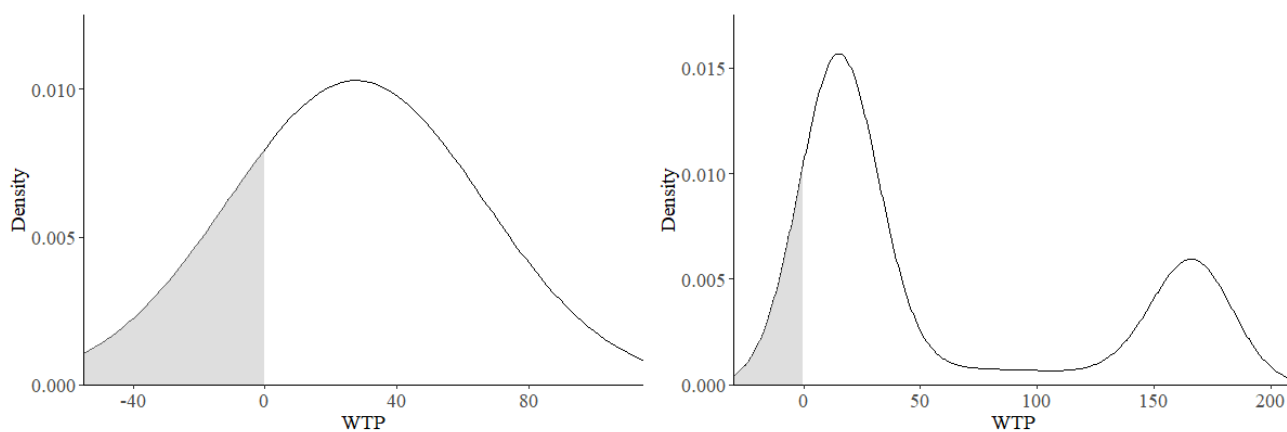


Figure I. Distribution of willingness to pay for the organic label

Note: The left panel shows the results of the RPL model, and the right panel shows the results of the LC model. The grey-filled zone indicates a negative WTP.