Journal of Infrastructure, Policy and Development 2024, 8(15), 9835.
https://doi.org/10.24294/jipd9835

Article

Understanding consumer behavior and strategies for adopting reusable packaging in food delivery

Jungyeon Hong, Jaewan Kim*, Supasini Dusadenoad, Yeji Han

Underwood International College, Yonsei University, Incheon, 21983, Republic of Korea
*** Corresponding author:** Jaewan Kim, jaewankim@yonsei.ac.kr

CITATION

Hong J, Kim J, Dusadenoad S, Han Y. (2024). Understanding consumer behavior and strategies for adopting reusable packaging in food delivery. Journal of Infrastructure, Policy and Development. 8(15): 9835. https://doi.org/10.24294/jipd9835

ARTICLE INFO

Received: 23 October 2024
Accepted: 11 November 2024
Available online: 12 December 2024

Abstract: This study explores the factors that affect consumer adoption of reusable packaging in South Korea's food delivery market. Adopting a mixed-method that includes interviews and an online survey of 137 consumers aged 18 to 30, the analysis, using an ordered probit model, reveals key drivers of the likelihood of switching to food delivery services using reusable packaging. Positive influences include environmental concerns, intention to take action on disposable packaging, willingness to pay extra, and awareness that reusable packaging does not require washing. However, challenges such as hygiene concerns and higher delivery fees deter consumers from switching to reusable package option. Demographic factors like living arrangements and gender show minimal impact. In response to the findings, the study suggests strategic solutions, including a pilot program, to overcome barriers and effectively demonstrate the benefits of reusable containers.

Keywords: reusable food package (RFP); hygiene concerns; environmental awareness; ordered probit model; consumer adoption

1. Introduction

The evolution of e-commerce and improvements in living conditions have significantly transformed the food delivery industry (Jang et al., 2023). Furthermore, the demand for food delivery has particularly escalated since the COVID-19 pandemic began (Dillard, 2021). Although food delivery services are popular for their convenience and time-saving advantages, they significantly contribute to plastic waste, highlighting a lack of responsibility in upholding SDG 12: Responsible Consumption and Production, and SDG 13: Climate Action. In 2020, South Korea produced a total of 72.93 kilotons of plastic through food delivery services (Jang et al., 2023). Reusable packaging was introduced as an option to reduce environmental impacts in the packaging sector and address this problem. For example, in 2021 ReturnIt service was launched as a consumer alternative. ReturnIt operates on a simple yet effective four-step process: providing eco-friendly reusable containers where needed, delivering food in these reusable containers to consumers, collecting all used reusable containers, and thoroughly cleaning the collected reusable containers at a dedicated cleaning center. However, such efforts faced several challenges in adoption due to several reasons. This paper aims to examine the key factors influencing consumer adoption of reusable food packaging options and identify strategies to promote more sustainable practices in the food delivery market. To test our hypotheses, we adopted a mixed method, incorporating both interviews and surveys, targeting consumers aged 18 to 30 in Korea. The paper is structured as follows: after the introduction, a review of relevant literature on reusable food packaging is provided. Section 3 details the materials and methods,

followed by Section 4 results and discussion. Finally, Section 5 presents conclusions including possible limitations of the study.

2. Literature review

There are several factors that affect consumer behavior toward environmentally friendly products, emphasizing the role of environmental concern, government incentives, and perceived convenience in shaping consumer attitudes and practices. Environmental concern has consistently influenced consumer practices toward eco-friendly products. Minton and Rose (1997) initially identified that consumers who are environmentally conscious tend to take specific actions, such as supporting environmental initiatives, paying extra taxes on environmental protection, and boycotting companies that pollute. After a few decades, environmental concern remains a powerful motivator. Long et al. (2022) investigated UK consumers aged 25–44 and figured that the environmental benefits of using reusable packaging foster a sense of personal impact, motivating these consumers to employ sustainable practices. Similarly, Rakesh and Valsalachandran (2024) identified that consumers increasingly display a positive tendency toward eco-friendly practices, reinforcing the lasting impact of environmental concerns on consumer behavior.

In addition, government engagement plays a significant role in shaping consumer behavior. Chen et al. (2022) demonstrated that adjusting incentives can significantly impact adoption rates for energy-efficient retrofits, while environmental impact reinforces sustainable attitudes and values. Similarly, Homonoff (2013) analyzed how financial incentives including tax and bonus, affect consumer choice on disposable bags, suggesting that well-structured policies could encourage the long-term adoption of reusable packaging. Fan et al. (2023) emphasizes optimizing the limited government resources allocation can help mitigate panic-buying behavior- boost public acceptance of reusable food packaging in the context of our study. Obstacles to adopting reusable packaging have been identified as crucial factors that impact consumer willingness. Miao et al. (2023) implemented a study among Dutch participants and found that inconvenience, concerns on contamination, willingness to pay, and the extra effort required in comparison with conventional packaging are significant obstacles. The study underscores that familiarity and convenience with reuse systems are important for translating initial interest into long-term habits. Another research highlights similar challenges are Miao et al. (2024) that investigated how consumers react information on the environmental break-even point (e-BEP) for reusable packaging. They discovered that those who are experienced may show increased skepticism when faced with higher e-BEPs, affecting their perceived effectiveness of reusable systems. Schuermann and Woo (2022) identified three main barriers to reusable container adoption in South Korea: limited knowledge among consumers, limited availability, and cost considerations. Carvalho et al. (2022) in Brazil also highlighted consumers' limited understanding of waste management as citizens hinders the adoption of reusable packaging.

Concerns on safety and hygiene also play a crucial role in determining consumer acceptance of reusable packaging. Mastria et al. (2024) identified that while environmental benefits initially attract consumers, contamination concerns and the

convenience of returning reusable containers strongly affect whether consumers make reusable packaging a habitual choice. Likewise, Noëth et al. (2024) underscored that issues surrounding cleaning and hygiene are paramount in the food industry as reusable packaging is perceived as a more complex and costly option compared to conventional packaging.

Consumer willingness to pay for environmentally friendly packaging varies depending on convenience and cost. Schuermann and Woo (2022) noted that South Korean consumers are willing to pay KRW 2260 for reusable containers if they are easily returned or collected. Carvalho et al. (2022) further indicated that consumers prefer biodegradable packaging and are willing to pay up to 5% more for it, given its perceived safety benefits. Supporting these findings, Rakesh and K (2024) reported that consumers often favor reusable packaging over merely "green" alternatives, showing a readiness to pay extra for practical, reusable options.

3. Materials and method

3.1. Research design and sampling

This study adopts an explanatory research design to explore the factors for employing reusable packaging options in food delivery services. Short-term consumer transition due to green consumption is a significant topic, as few research studies focus on the consumer perspective regarding reusable packaging for food delivery. Since strong initiatives from companies or governments specifically dedicated to reusable packaging are needed, discussing the transition to such systems could provide valuable insights. Initially, desk research was conducted to evaluate the current state of general reusable packaging and food delivery services. The explanatory research helps to describe the consumer's barrier to adopt reusable packaging. To further refine the research question and formulate hypotheses, a series of pre-interviews were conducted with 12 university students in their 20s (See Appendix for interview questions). Insights from these interviews were used to develop the survey questionnaire and support the findings of the literature review. During the data collection, descriptive research was used to explore the consumers' behavior and perception within the sample group and identify the main obstacles and facilitators to adopting reusable packaging for food delivery in South Korea by using a Google survey. A mixed-method approach was adopted, utilizing qualitative and quantitative data collection techniques. The qualitative component involved gathering data on participants' experiences and backgrounds related to food delivery services and reusable packaging. The quantitative component was designed to measure consumer satisfaction and dissatisfaction levels with current reusable packaging options in food delivery.

This study on consumers' willingness to use reusable delivery packaging specifically targeted young adults aged 18 to 30 who are Korean nationals. This demographic was selected due to its significant role as primary consumers in the food delivery market and its potential to adopt new sustainable practices early on. A survey in 2021 by the Korea Consumer Agency revealed that individuals in their 20s had the highest frequency of food delivery app usage, with 88.5% reporting usage at least once a week. This age group also demonstrated a strong preference for mobile ordering, aligning with their tech-savvy lifestyle (Korea Consumer Agency, 2021). Additionally,

a 2020 report by the Ministry of Agriculture, Food and Rural Affairs highlighted that consumers in their 20s and 30s are the primary customers of food delivery services, accounting for over 60% of total orders. This emphasizes the groups' pivotal role in driving the growth of South Korea's food delivery market (Ministry of Agriculture, Food and Rural Affairs, 2020). Existing research indicates that people in their twenties are more attentive to environmental issues (Ballew et al., 2019; Pew Research Center, 2021). By focusing on this group, the study aims to capture the attitudes of those most likely to embrace reusable packaging, potentially influencing broader market trends toward sustainability. The decision to target this demographic is further supported by the concept of "Meaning Out," which describes consumption patterns driven by personal beliefs and values. As Yi states in his study, "Meaning out" represents a growing trend within value-based consumption, encompassing ethical purchasing and eco-friendly practices such as zero waste. This trend is particularly strong among the MZ generation, who are proficient with digital media. It is anticipated that as more individuals express their preferences on social media, these value-driven choices will disseminate more rapidly, increasing their overall impact (Yi, 2024). Furthermore, this demographic is identified as one of the most frequent and heavy users of food delivery services as mentioned. In accordance with a report by Consumer Insight, the usage rate within the last three months was notably high among individuals in their 20s (84%), slightly behind those in their 30s (87%). They are also likely to use a higher number of delivery apps per person (1.9 apps) and frequently compare multiple apps before making a choice (45%), both of which exceed the average figures. This positions them as core consumers who are well-versed in the characteristics of delivery apps and exhibit careful, informed consumption behavior. Considering these factors, the sample size and composition were meticulously designed to reflect the behaviors and attitudes of this key demographic. This approach ensures that the findings are relevant and applicable to ongoing efforts aimed at promoting sustainable consumption within Korea's food delivery sector. This sampling strategy provides insights that are both reliable and aligned with current trends in eco-friendly consumer behavior and the evolving food delivery market.

3.2. Semi-structured interviews and hypotheses

Before formulating the main hypotheses based on the research objectives, an investigation was conducted to understand why reusable container delivery services are not effective from the consumer's perspective. Interviews with 12 participants provided valuable insights into this issue. Regarding awareness of environmental issues, participants expressed varying levels of concern about environmental problems. While not all exhibited profound concern, many reported taking actions to make a difference, such as using tumblers instead of disposable cups and making efforts to recycle properly. As for the experience of food delivery service, participants frequently used food delivery services and disposed of leftover packaging in various ways, often feeling guilty about the waste generated. The cost was a significant factor, with many stating they would not use a delivery service if the fee was considered expensive.

Through the interviews, key barriers and facilitators to adopt reusable container delivery services were identified. Overall, while participants recognized the environmental benefits of reusable containers, concerns about hygiene, costs, limited options, and the inconvenience of returning containers hindered their adoption. Based on these insights from interviews and findings from the literature review, hypotheses were formulated as **Table 1** describes.

Table 1. Key insights from the Interview and hypotheses.

Factors	Interview details	Hypotheses
Environmental concerns	The interviewees showed varying levels of interest in environmental issues, with most expressing moderate concern and some taking small actions like using reusable containers, recycling, and reducing plastic consumption. "I tried to consume less plastic by carrying my bottle while ordering drinks and using fewer plastic."	Consumers with higher environmental concerns of disposable food packages would be more willing to change to reusable packaging delivery service.
Hygiene concerns	Participants were worried about the cleanliness of reusable containers, expressing concerns about insects, odors, and the thoroughness of the cleaning process. "Reusing containers repeatedly raises concerns about their cleanliness," and "I am hesitant to use them due to concerns about the possibility of insects or odors if collection isn't done promptly."	Consumers would hesitate to use reusable packaging delivery services due to concerns about the cleaning and sanitization process before the containers are reused.
Fee issues	The potential cost of using reusable containers was a major deterrent. Many participants indicated they would only consider using the service if there was no price difference from existing options. "If there's no price difference, there's no reason not to use it."	A reusable container delivery service provided without any difference in price from existing options would lead to widespread consumer adoption of reusable container delivery services.
Limited restaurant options	The availability of restaurants participating in the reusable packaging service affected. willingness to use the service "If it is easy to access, I would use it."	The higher number of restaurants participating in the reusable packaging service would encourage regular consumers to use reusable packaging options while ordering food delivery.
Inconvenience of return process	The process of returning reusable containers was considered cumbersome. Many people currently clean disposable plastic food packaging after delivery, so a reusable food delivery packaging service, which eliminates this step, would likely appeal to consumers. Participants expressed a preference for a simpler process, with some noting that it would still be more convenient than managing disposable containers.	The process of returning the reusable containers would come as inconvenient to the consumers and would discourage them from using the reusable packaging service.

3.3. Online survey

The online survey was conducted from 5 June 2024, to 7 June 2024, targeting individuals aged 18 to 30 in South Korea. The survey was distributed through the Everytime application, a popular online community for university students in South Korea, and Pickply, a platform for creating and sharing curated content collections. Everytime allows students to post questions, make contact, and engage in discussions, serving as a key online space for the student demographic. Pickply enables users to create personalized content collections, sharing their interests and expertise with others.

The survey aimed to explore consumer behavior, perceptions, and barriers to adopting reusable packaging for food delivery in South Korea. The key areas covered

by the survey include the usage of delivery app services, motivations, and concerns regarding reusable packaging, potential hygiene issues, delivery fee pricing, the availability of participating restaurants, and the return process for reusable containers. Additionally, demographic questions were included to analyze how factors such as age, income, living arrangements, and life stages influenced responses.

The survey successfully collected responses from the targeted age group, with 31.5% of respondents being male and 68.5% female. The summary of the survey questions is provided in **Table 2**.

Table 2. Summary of the online survey questions.

Section	Details
Usage of delivery app services	The frequency of food delivery app usage, awareness of reusable packaging options, and general attitudes toward environmental impact.
Adoption of reusable food package	The factors that motivate or hinder the adoption of reusable packaging services.
Hygiene concerns	Respondents' concerns about the cleanliness and safety of reusable containers, a key barrier identified in the pre-interviews.
Pricing and fees	Respondents' willingness to pay for reusable packaging services and their sensitivity to pricing differences between reusable and single-use options.
Restaurant availability	The impact of the number of participating restaurants on their willingness to adopt reusable packaging.
Return process	Perceived convenience or inconvenience of returning reusable containers and how it influences adoption decisions.
Demographics	Age, gender, living arrangements, life stage, and monthly expenditure on food delivery.

Each section of the survey was designed to validate specific hypotheses related to the adoption of reusable packaging in food delivery services. The questions were carefully crafted to capture a comprehensive understanding of consumer preferences, concerns, and potential incentives that could encourage a shift towards adapting reusable containers

3.4. Model formulation: Ordered probit model

This paper employs an ordered probit model to examine the factors influencing how likely the consumers to switch to a food delivery service that uses reusable packaging. This approach was chosen because the dependent variable in the study is ordinal, ranging from 1 (Very Unlikely) to 5 (Very Likely). To appropriately analyze a dependent variable with such ordered categories, the ordered probit model is used instead of the standard binary probit to account for the increasing effect associated with higher values of the dependent variable. Ordered models can be categorized into logit and probit based on the assumed probability distribution of the error term (ε_i). The logit model does not assume normality, while the probit model assumes that the error term follows a normal distribution. As noted by Hill et al. (2011), the results produced by logit and probit models are generally very similar. Since most studies prefer the model that assumes normality, this paper employs the ordered probit model (Lee et al., 2021).

Several studies in consumer behavior (Kim and Boyd, 2006; Moras et al., 2024; Priyadharsini et al., 2017) have adopted the ordered probit model due to its ability to handle ordinal data by assuming an underlying continuous distribution of responses,

providing more nuanced insights into the factors influencing consumer decisions. In an ordered probit model, the random error associated with this continuous descriptor is assumed to follow a normal distribution (Greene, 2012). According to Lancaster's demand theory, a consumer's utility for a product is derived from its attributes, which in this context involves the choice to switch to reusable food packaging (Kim and Boyd, 2006). An individual consumer's utility function or preference ranking is hypothesized to be represented by the consumer's likelihood ranking (1 = very unlikely, 2 = unlikely, 3 = neutral, 4 = likely, and 5 = very likely) to switch to reusable packaging options. These rankings are determined by a vector (X) of factors, including environmental, hygiene, cost, convenience, and demographic characteristics of the respondents. By applying the ordered probit model, this study aligns with established consumer behavior research practices, providing a rigorous and reliable analysis of factors influencing consumers' adoption of sustainable packaging.

Equation (1) is the formula for the ordered probit model. y_i^* as a dependent variable indicates how likely the consumers are to switch to a food delivery service that uses reusable packaging and x_i is the explanatory variables, and the factors that affect the dependent variable. ε_i has a normal distribution with an error term (ε_i~N [0, 1]).

$$y_i^* = \beta x_i + \varepsilon_i \tag{1}$$

Also, the dependent variable y_i^* is an optional category and can be represented as in Equation (2). y_i^* is the individual's willingness to use reusable food package delivery service in ordinal order from 1 to 5, and $\tau_1, \ldots, \tau_5$ is the parameter to be estimated in the model with a cutoff point of 1.

$$\begin{aligned} y_i &= 1, y_i^* \le \tau_1 (\text{Very Unlikely}) \\ y_i &= 2, \tau_1 < y_i^* \le \tau_2 (\text{Unlikely}) \\ y_i &= 3, \tau_2 < y_i^* \le \tau_3 (\text{Neutral}) \\ y_i &= 4, \tau_3 < y_i^* \le \tau_4 (\text{Likely}) \\ y_i &= 5, \tau_4 < y_i^* (\text{Very Likely}) \end{aligned} \tag{2}$$

Once the change interval of y_i^* is established, the next step is to map this interval to the discrete variable y_i, and determine the probability of y_i within each interval. The thresholds τ_1 , τ_2 , τ_3, and τ_4 are estimated based on the parameter β. Consequently, the probability that a respondent will choose a food delivery service using reusable packaging, as represented by the observed ordinal data y_i, can be defined by Equation (3) (Gao et al., 2023).

$$P(y_i = j | x_i) = \varphi(\tau_j - \beta x_i) - \varphi(\tau_{j-1} - \beta x_i) \tag{3}$$

Here, φ is represents the cumulative probability function of the standard normal distribution of the error term (ε_i). Using Equation (1), the probability corresponding to the severity of the accident can be expressed as shown in Equation (4).

$$P(y_i = 1|x_i) = \varphi(\tau_1 - \beta x_i)$$

$$P(y_i = 2|x_i) = \varphi(\tau_2 - \beta x_i) - \varphi(\tau_1 - \beta x_i)$$

$$P(y_i = 3|x_i) = \varphi(\tau_3 - \beta x_i) - \varphi(\tau_2 - \beta x_i) \quad (4)$$

$$P(y_i = 4|x_i) = \varphi(\tau_4 - \beta x_i) - \varphi(\tau_3 - \beta x_i)$$

$$P(y_i = 5|x_i) = \varphi(\tau_4 - \beta x_i)$$

4. Results and discussion

4.1. Basic Statistics

Table 3 shows the description and definition of the variables and their descriptive statistics. The dependent variable is consumers' willingness to switch to a food delivery service that uses reusable packaging. The dependent variable is categorized into very unlikely ($y_i = 1$), unlikely ($y_i = 2$), neutral ($y_i = 3$), likely ($y_i = 4$), very likely ($y_i = 5$) according to the participants' responses. The independent variables are the factors that influence consumers' willingness to switch to reusable food package delivery service. The independent variables include respondents' environmental concern, environmental action on disposable package, hygiene concern, delivery fees, willingness to extra-pay for RFP, monthly expenditure on food delivery, available restaurant, awareness of no washing, waiting time for collection, monthly expenditure on food delivery, gender, living arrangement, which have been reviewed in previous studies and semi-structured interviews.

Table 3. Variables and basic statistics.

	Variables	**Definition**	**Average**	**S.D.**
DV	Switch to RFP	1 = very unlikely 2 = unlikely 3 = neutral 4 = likely 5 = very likely	3.53	1.11
	Environmental concern	1 = not at all concerned 2 = slightly concerned 3 = moderately concerned 4 = very concerned 5 = extremely concerned	3.69	1.00
IV	Environmental action on disposable package	1 = not at all necessary 2 = slightly necessary 3 = moderately necessary 4 = very necessary 5 = extremely necessary	4.17	0.83
	Hygiene problem	1 = not at all concerned 2 = slightly concerned 3 = moderately concerned 4 = very concerned 5=extremely concerned	3.69	1.00

Table 3. (*Continued*).

Variables	Definition	Average	S.D.
Appropriate delivery fee	1 = less than 2000 won 2 = 2000 won ~ less than 3000 won 3 = 3000 won ~ less than 4000 won 4 = 4000 won ~ less than 5000 won	1.49	0.62
Willingness to extra-pay for RFP	1 = do not want to pay extra 2 = less than 1000 won 3 = 1000 won ~ less than 2000 won 4 = 2000 won ~ less than 3000 won 5 = 3000 won ~ less than 4000 won 6 = more than 4000 won	1.60	0.94
Available restaurant to increase use of RFP	1 = 1 out of 5 restaurants in my area 2 = 2 out of 5 restaurants in my area 3 = 3 out of 5 restaurants in my area 4 = 4 out of 5 restaurants in my area 5 = all restaurants in my area	3.02	1.15
Awareness of no washing	0 = no 1 = yes	0.50	0.50
Waiting time for collection	1 = less than 10 min 2 = 10 min ~ less than 20 min 3 = 20min ~ less than 30 min 4 = 30min ~ less than 40 min 5 = 40 min ~ less than 50min 6 = 50 min ~ less than 60 min 7 = more than 60 min	3.25	1.83
Monthly expenditure on food delivery	How much money do you spend on meal delivery per month?	153540	164469
Gender	0 = male 1 = female	0.69	0.47
Living arrangement	1 = living with family 2 = living with roommates 3 = living alone	1.73	0.87

Table 4 presents the frequency and percentage of respondents for the question assessing the dependent variable.

Table 4. Response for willingness to switch to RFP.

Willingness to switch to RFP	Frequency	Percent (%)	Cumulative (%)
1 = very unlikely	7	5.11	5.11
2 = unlikely	17	12.41	17.52
3 = neutral	39	28.47	45.99
4 = likely	45	32.85	78.83
5 = very likely	29	21.17	100.00
Total	137	100.00	

4.2. Analysis results and discussion

As **Table 5** represents, the ordered probit model results show the factors influencing consumers' likelihood of switching to a food delivery service that uses reusable packaging. First, for environmental factors, Environmental Concern (0.436) and Action on Disposable Package (0.480) are significant positive predictors. This suggests that individuals already concerned about environmental degradation, climate

change, and plastic pollution are more likely to adopt reusable packaging, as it aligns with their values and desire for a positive environmental impact. In addition, those who act, such as recycling or minimizing single-use items, are significantly more likely to switch to reusable options. Second, for the hygiene factor, Hygiene Problem (−0.171) acts as a notable obstacle, decreasing the likelihood of adopting reusable packaging. Negative perceptions on cleanliness, possible contamination, and the thoroughness of the sanitization process contribute to consumers' hesitation. Reducing this barrier may require businesses to communicate their hygiene practices transparently, ensuring customers that reusable containers meet high standards of cleanliness. Third, regarding the cost factor, Appropriate Delivery Fee (−0.485) as a negative coefficient shows that higher delivery fees decrease the likelihood of switching. A higher delivery charge is a deterrent, as consumers may think of it as an unnecessary premium, especially if they're already paying for convenience. Willingness to Pay Extra for RFP (0.576) is a significant positive factor, indicating that those willing to pay more for RFP are more likely to switch. This positive coefficient suggests a subset of consumers who view the added cost as an investment in environmental responsibility. Marketing reusable packaging as a premium, eco-friendly service may attract such segment of consumers. Monthly Expenditure on Food Delivery (0.099) indicates higher monthly spending on food delivery increases the likelihood of switching. Frequent users may also recognize the cumulative environmental impact of disposable package use, making them more receptive to sustainable alternatives. Fourth, for the convenience factor, Awareness of No Washing Required (0.514) positively impacts the likelihood, suggesting that knowing reusable packaging does not require washing makes consumers more likely to switch. This factor indicates that clear communication about the service's convenience can positively influence consumer willingness to switch to reusable packaging. As Fan et al. (2023) indicates, social media can play a role in contributing to enhance communication transparency by providing timely and accurate information. Available Restaurants (0.091) and Waiting Time for Collection (0.057) were insignificant, indicating they do not strongly influence the decision to switch. Finally, for demographic factors, living arrangement (−0.194) indicates a slight reduction in the likelihood of switching for certain types of living situations. For example, consumers living in shared households or with family may find it inconvenient to manage the storage or return of reusable containers, while those living alone might find it easier to adopt this change. This insight suggests that adoption strategies could be more successful if tailored to individual living conditions. Gender (−0.038) is not statistically significant in predicting adoption of reusable packaging. This finding highlights that, while other studies suggest some gender differences in environmental behavior, the choice to switch to reusable packaging is influenced more by practical and cost-related factors than by gender in this context. Overall, environmental concerns, willingness to pay extra, and awareness of convenience benefits (like not needing to wash the containers) are primary motivators for consumers. These factors highlight the profile of a consumer who is environmentally motivated, values ease of use and is willing to invest slightly more in a sustainable option. Emphasizing these benefits in marketing strategies and ensuring that the process is as convenient as possible could increase adoption. On the other hand, high delivery fees and hygiene

concerns act as the main deterrents. Consumers who perceive reusable packaging as less hygienic or as requiring a high delivery fee are less likely to switch. To overcome these barriers, food delivery services could focus on maintaining competitive pricing and communicating stringent hygiene standards. Educating consumers on the safety protocols for reusable containers may alleviate hygiene concerns.

Table 5. Results of the ordered probit analysis.

Factors	Variables	coefficient	S.E.	t-ratio
Environment	Environmental concern	0.436***	0.132	3.30
	Environmental action on disposable package	0.480***	0.157	3.06
Hygiene	Hygiene problem	−0.171*	0.101	−1.70
Cost	Appropriate delivery fee	−0.485**	0.200	−2.43
	Willingness to extra-pay for RFP	0.576***	0.139	4.15
Convenience	Available restaurant to increase use of RFP	0.091	0.091	1.01
	Awareness of no washing	0.514**	0.210	2.45
	Waiting time for collection	0.057	0.056	1.01
	Monthly expenditure on food delivery	0.099**	0.043	2.32
Demographic	Gender	−0.038	0.217	−0.18
	Living arrangement	−0.194*	0.114	−1.71
Observations		137		
Pseudo-R^2		0.2217		
Log-likelihood		−155.99763		

5. Conclusion

The increasing waste from food delivery has caused significant negative environmental impacts throughout its life cycle (Liu et al., 2020). This packaging typically has low recycling value and is often contaminated with food residues, leading it to be primarily disposed of in landfills or through incineration (Song et al., 2018). Therefore, mounting environmental pressure calls for a reassessment of our economic model to reduce environmental impacts (Coelho et al., 2020). Transitioning to a circular economy can help improve resource efficiency and support this balance (Worrell et al., 2016).

This research investigates the factors that influence South Korean GenZ consumer behavior to use reusable packaging food delivery services by addressing these obstacles and facilitators through business and government roles could enhance the usage of reusable packaging food delivery services. Consumers significantly influence environmental management practices, and as demand for green products grows, organizations make efforts to meet the expectations for environmentally sustainable products (Naqvi et al., 2023). The key findings from the analysis highlight several factors influencing consumers' likelihood of switching to a food delivery service that uses reusable packaging. Environmental concerns, willingness to take action on disposable packaging, willingness to pay extra, and awareness that reusable packaging does not require washing all positively impact this likelihood. It is essential to enhance environmental awareness through active promotion and education, explain

the concept of payment for ecosystem services, and create a more convenient system for returning containers, especially for younger generations to increase public participation. Raising awareness is essential and is closely tied to individuals' belief systems or worldviews regarding sustainability, as well as their development as learning beings (Ong and Pramono, 2023). However, challenges remain in promoting reusable packaging. Hygiene concerns and higher delivery fees discourage consumers from switching. Addressing these issues through legal measures that regulate hygiene standards and control usage fees could facilitate adoption. Although demographic factors like living arrangements and gender have minimal influence, society should implement tailored strategies to accommodate rapid socio-demographic changes, such as the growing number of single-person households.

In light of this study's limitations, future research should aim to increase the sample size to enhance the generalizability of findings within the target demographic of young South Korean adults. Expanding the sample would allow for a broader understanding of diverse consumer behaviors and preferences. Additionally, given the potential variability in consumer attitudes toward reusable packaging based on demographics and food delivery app usage, future studies could further explore these differences by segmenting consumers according to relevant characteristics. This segmentation approach could yield tailored strategies that align with distinct consumer groups' needs and preferences. Furthermore, to address the focus on short-term adoption in this study, additional research should investigate factors that encourage long-term behavioral change and habit formation, identifying service features that can help sustain consumer engagement with reusable packaging beyond initial adoption.

After the further research has been conducted and delving into diverse topics needed, a practical experiment could be conducted for future research by launching a pilot program at Hangang Park. The pilot program would allow for a real-world demonstration of the benefits of the service and convenience in a high-traffic area known for its delivery orders and waste management challenges. The pilot program could effectively highlight the advantages of using reusable containers. Collaboration with local restaurants and Seoul city governance would ensure smooth service integration, addressing both environmental concerns and consumer apprehensions. The lock-in strategy, implemented through the Soup (Forest) Stamp System, aims to retain frequent delivery service users by offering tiered rewards and economic incentives. By providing visual confirmation of their positive environmental impact and offering tangible economic benefits, this strategy seeks to build loyalty and increase the use of reusable packaging.

Author contributions: Conceptualization, JH, SD and YH; methodology, JK; software, JK; validation, JH and JK; formal analysis, JH, JK and SD; investigation, JH, JK, SD and YH; data curation, JH and JK; writing—original draft preparation, JH, JK, SD and YH; writing—review and editing, JH and JK; supervision, JK; project administration, JK. All authors have read and agreed to the published version of the manuscript.

Funding: This research was supported by the Yonsei University Research Fund of 2024-22-0497.

Conflict of interest: The authors declare no conflict of interest.

References

Ballew, M. T., Marlon, J. R., Leiserowitz, A., & Maibach, E. W. (2019). Young adults, especially Millennials, are more engaged with the issue of climate change. Yale Program on Climate Change Communication. https://climatecommunication.yale.edu/publications/do-younger-generations-care-more-about-global-warming/

Carvalho, J. S., De Souza Couto Oliveira, J., & De São José, J. F. B. (2022). Consumers' knowledge, practices, and perceptions about conventional and sustainable food packaging. Food Science and Technology, 42. https://doi.org/10.1590/fst.06722

Coelho, P. M., Corona, B., Klooster, R. T., & Worrell, E. (2020). Sustainability of reusable packaging–Current situation and trends. Resources Conservation & Recycling X, 6, 100037. https://doi.org/10.1016/j.rcrx.2020.100037

Chen, R., Fan, R., Yao, Q., & Qian, R. (2022). Evolutionary dynamics of homeowners' energy-efficiency retrofit decision-making in complex network. Journal of Environmental Management, 326, 116849. https://doi.org/10.1016/j.jenvman.2022.116849

Consumer Insight. (2023). Analysis of Food Delivery App Usage and Satisfaction. 38th 'Mobile Communication Planning Survey. https://www.consumerinsight.co.kr

Dillard, F. (2021). The ongoing impact of Covid-19 on how we shop and eat. BBC. Forbes.

Fan, R., Yao, Q., Chen, R., & Qian, R. (2023). Agent-based simulation model of panic buying behavior in urban public crisis events: A social network perspective. Sustainable Cities and Society, 100, 105002. https://doi.org/10.1016/j.scs.2023.105002

Gao, X., Yu, L., Yu, Q., and Dai, W. (2023) Analyzing Influential Factors of Ship Collision Accidents Severity Using Ordered Probit Model, 2023 7th International Conference on Transportation Information and Safety (ICTIS), Xi'an, China, pp. 1-8, doi: 10.1109/ICTIS60134

Greene, W. H. (2012). Econometric Analysis (7th ed.). Boston, MA: Pearson Education.

Hill, R.C., Griffiths, W.E. and Lim, G.C. (2011), Principle of Econometrics, Fourth Edition. John Wiley & Sons, Inc/New York/United States

Homonoff, T. A. (2018). Can small incentives have large effects? The impact of taxes versus bonuses on disposable bag use. American Economic Journal: Economic Policy, 10(4), 177–210. https://doi.org/10.1257/pol.20170025

Honnold, J. A. (1984). Age and Environmental Concern some specification of effects. The Journal of Environmental Education, 16(1), 4–9. https://doi.org/10.1080/00958964.1984.9942695

Jang, Y., Kim, K. N., & Woo, J. (2023). Post-consumer plastic packaging waste from online food delivery services in South Korea. Waste Management, 156, 177–186. https://doi.org/10.1016/j.wasman.2022.11.036Ketelsen, M., Janssen, M., & Hamm, U. (2020). Consumers' response to environmentally-friendly food packaging - A systematic review. Journal of Cleaner Production, 254, 120123. https://doi.org/10.1016/j.jclepro.2020.120123

Kim, DH., and Kim, YK.(2018). Empirical analysis on the influential factors of the frequency of visit by Chinese foreign independent traveler visiting Korea by ordered probit model, International Journal of Tourism Management and Sciences, 33(3), 193-206. 10.21719/IJTMS.33.3.9

Kim, J., Lee, S., & Park, H. (2023). Analysis of Consumer Behavior in Reusable Packaging. Journal of Sustainability, 15(3), 45-60.

Kim, R., & Boyd, M. (2006). Japanese consumers' acceptance of genetically modified (GM) food: An ordered probit analysis. Journal of Food Products Marketing, 12(3), 45-57. https://doi.org/10.1300/J038v12n03_04

Korea Consumer Agency. (2021). Survey on food delivery app usage among South Koreans. Retrieved from Statista: https://www.statista.com/topics/10147/food-delivery-services-in-south-korea/

Lee, S. Shin, YJ., and Park, SY. (2021). Analysis of Factors Affecting Youth Physical Activity Participation Effect, Korea Society of Innovation Studies, 16(4), 189-214, 10.46251/INNOS.2021.11.16.4.189

Liu, G., Agostinho, F., Duan, H., Song, G., Wang, X., Giannetti, B.F., Santagata, R., Casazza, M., Lega, M., (2020). Environmental impacts characterization of packaging waste generated by urban food delivery services. A big-data analysis in Jing-Jin-Ji region (China). Waste Manag. 117, 157–169. https://doi.org/10.1016/j.

Long, Y., Ceschin, F., Harrison, D., & Terzioğlu, N. (2022). Exploring and addressing the user acceptance issues embedded in the adoption of reusable packaging systems. Sustainability, 14(10), 6146. https://doi.org/10.3390/su14106146

Mastria, S., Vezzil, A., & De Cesarei, A. (2024). Switching to reuse: The impact of information on consumers' choices for reusable food packaging. Sustainability, 16(14), 5937. https://doi.org/10.3390/su16145937

Miao, X., Magnier, L., & Mugge, R. (2023). Switching to reuse? An exploration of consumers' perceptions and behavior towards reusable packaging systems. Resources Conservation and Recycling, 193, 106972. https://doi.org/10.1016/j.resconrec.2023.106972

Miao, X., Magnier, L., & Mugge, R. (2024). How many times should I use my reusable packaging? Exploring the role of an environmental break-even point in shaping consumers' intention to reuse. Circular Economy and Sustainability. https://doi.org/10.1007/s43615-024-00437-8

Ministry of Agriculture, Food and Rural Affairs. (2020). Report on the food delivery service market in South Korea. Retrieved from Statista: https://www.statista.com/topics/6080/foodservice-in-south-korea/

Minton, A. P., & Rose, R. L. (1997). The Effects of environmental concern on environmentally friendly consumer Behavior: an exploratory study. Journal of Business Research, 40(1), 37–48. https://doi.org/10.1016/s0148-2963(96)00209-3

Moras, B. C. K., Humagain, P., & Gkritza, K. (2024). How do the determinants of electric vehicle adoption change over time? A multivariate ordered probit analysis. 2024 Forum for Innovative Sustainable Transportation Systems (FISTS), Riverside, CA, USA, 1-6. https://doi.org/10.1109/FISTS60717.2024.10485536

Naqvi F, Isac N, Badshah W (2023). Factors influencing the implementation of green supply chain management: The case of Pakistan SMEs. Journal of Infrastructure, Policy and Development 7(2): 2222. https://doi.org/10.24294/jipd.v7i2.2222

Noëth, E., Van Opstal, W., & Du Bois, E. (2024). Introducing reusable food packaging: Customer preferences and design implications for successful market entry. Business Strategy and the Environment. https://doi.org/10.1002/bse.3820

Ong Kim Kui D, Pramono R(2023). A conceptual framework combining environmental worldview, organizational learning, and strategic planning contributing to sustainable development. Journal of Infrastructure, Policy and Development 7(2): 2126.doi: 10.24294/jipd.v7i2.2126

Pew Research Center. (2021). Gen Z, Millennials Stand Out for Climate Change Activism, Social Media Engagement With Issue. https://www.pewresearch.org/science/2021/05/26/gen-z-millennials-stand-out-for-climate-change-activism-social-media-engagement-with-issue/

Priyadharsini, S., Kathiravan, G., Thirunavukkarasu, M., Ganpat, W., & Saravanakumar, D. (2017). Ordered probit analysis of consumers' preferences for milk and meat quality attributes in the emerging cities of Southern India. Expert Journal of Marketing, 5(2), 37-43.

Rakesh, R. & Valsalachandran K. (2024). A Study On The Consumer Behavior And Eco-Friendly Packaging In Food Delivery Services. Educational Administration: Theory and Practice, 30(6), 198–208. https://doi.org/10.53555/kuey.v30i6.5149Saari,

Schuermann, H., & Woo, J. (2022). Estimating consumers' willingness to pay for reusable food containers when ordering delivery food: A contingent valuation approach. Journal of Cleaner Production, 366, 133012. https://doi.org/10.1016/j.jclepro.2022.133012

Song, G., Zhang, H., Duan, H., Xu, M., (2018). Packaging waste from food delivery in China's mega cities. Resour. Conserv. Recycl. 130, 226–227. https://doi.org/10.1016/j.resconrec.2017.12.007.

U. A., Damberg, S., Frömbling, L., & Ringle, C. M. (2021). Sustainable consumption behavior of Europeans: The influence of environmental knowledge and risk perception on environmental concern and behavioral intention. Ecological Economics, 189, 107155. https://doi.org/10.1016/j.ecolecon.2021.107155

Worrell, E., Allwood, J., Gutowski, T., (2016). The role of material efficiency in environmental stewardship. Annu. Rev. Energy Resour. 41, 575–598.

Yi, J. (2024). Political Considerations on Meaning Out: Focusing on Foucault's Theory of Governmentality. Trends and Prospects, 121, 215-253.

Appendix

Pre-interview questions

[Awareness of environmental issues]

1. How much are you concerned about environmental problems?
2. Have you taken any actual actions to make a difference in this regard?
3. What benefits do you see in using reusable containers over single-use plastics?

[Experience of Food Delivery Service]

1. How often do you use food delivery services?
2. How do you dispose of the leftover packaging?
3. How much do you consider expensive for the delivery service usage fee?

[Possible Barriers for Reusable Packaging Delivery Service]

1. How do you feel about the process of returning reusable containers after use?
2. Would you be willing to pay extra for food delivery that uses reusable containers? If not, why?
3. Do you believe that using reusable containers could increase the overall cost of your food delivery? How does this affect your decision?
4. What improvements or changes would make you more likely to use reusable containers for your food deliveries?
5. Are you aware that there are reusable packaging delivery services available for you to use?

- (If yes) Have you ever used it? Why or why not?
- (If no) [Explain the ReturnIT Service] Now that you know, do you think you will use it? Why or why not?

Figure A1. Explanatory poster of ReturnIT service—given to all interviewees.

*To ensure that all interview participants received the same information about the reusable container food delivery service, this poster was provided to the interviewers, to explain the ReturnIT service.

Survey questions

[Usage of Delivery App Services]

1. How often do you use food delivery services?
   (Never (0 times a week), 1~2 times a week, 3~4 times a week, 5~6 times a week, more than 6 times a week)
2. Have you ever heard of the reusable packaging food delivery service? (Yes, No)
3. Have you had any experience of using the reusable packaging food delivery service? (*This question is only displayed to respondents who answered "Yes" to question 2.) (Yes, No)
4. On a scale from 1 to 5, how concerned are you about the environmental impact of disposable food delivery packaging waste?
5. On a scale from 1 to 5, how necessary do you think it is to take action on the environmental impact of disposable food delivery packaging waste?
6. To solve such environmental pollution of disposable food delivery packaging waste, what would be the solution? Please write freely.
7. On a scale from 1 to 5, how likely are you to switch to a food delivery service that uses reusable packaging if it were available?

[Reusable food delivery packaging adaptation]

1. What factors would motivate you to switch to reusable packaging food delivery service? (Select all that apply)
   (A: Environmental benefits (e.g., reducing waste from disposable containers),
   B: Convenience of the returning process (e.g., not needing to wash the containers),
   C: High-quality packaging (e.g., better durability compared to disposable containers),
   D: Economic benefits (e.g., lower delivery costs, reward points))
2. What factors would most motivate you to switch to the reusable packaging food delivery service? Please rank your top 3 most important factors from the above choices.
3. What are your main concerns about switching to the reusable packaging food delivery service? (Select all that apply)
   (A: Hygiene and cleanliness issues (e.g., inadequate cleaning processes),
   B: Inconvenience of the return process (e.g., the hassle of making separate return requests),
   C: Service usage costs (e.g., additional costs for using the service),
   D: Accessibility of the service (e.g., delivery options provided only by certain restaurants, limited number of participating restaurants))
4. What are your main concerns about switching to the reusable packaging food delivery service? Please rank your top 3 important factors from the above choices.

[Reusable Food Delivery Packaging's Possible Hygiene Issues]

1. On a scale from 1 to 5, do you think that using a reusable packaging food delivery service could pose a hygiene issue?
2. On a scale from 1 to 5, considering your answer to the question above in the possible hygiene issue, how willing are you to switch to the reusable packaging food delivery service?
3. What possible hygiene issues do you think could negatively impact the use of a reusable packaging food delivery service? Please write freely.
4. On a scale from 1 to 5, if the previously mentioned hygiene issues were well-controlled and prevented by the delivery service providers, how willing would you be to switch to a reusable packaging food delivery service?

[Reusable food delivery packaging's delivery fee pricing]

1. How much is the usage fee per each time of food delivery service that you find appropriate?
   (Less than 2000 won, 2000 won ~ less than 3000 won, 3000 won ~ less than 4000 won, 4000 won ~ less than 5000 won, more than 5000 won)
2. On a scale from 1 to 5, if a reusable container delivery service was available at the price indicated above, how willing are you to choose the reusable option?

3. How much are you willing to pay more for using the service of reusable container food delivery service? Please pick a price range.
   (Not willing to pay more, over 0 won and up to 1000 won, over 1000 won and up to 2000 won, over 2000 won and up to 3000 won, over 3000 won and up to 4000 won, more than 4000 won)

[Reusable Food Delivery Packaging Service's Restaurants Options]

1. Currently, out of 135,182 restaurants in Seoul, only 1290 have implemented reusable containers (less than 1% of the total), and provide the reusable food packaging delivery service. On a scale from 1 to 5, how much do you think that the current restaurant numbers offering reusable packaging are sufficient?
2. On a scale from 1 to 5, how willing are you to use reusable packaging services for food delivery from the current size of the service-providing restaurants?
3. If the number of restaurants in your living area offering the reusable packaging food delivery service increases, will your willingness to use these services increase? (Yes, No)
4. How many restaurants offering the reusable packaging food delivery service in your living area would it take to significantly increase your willingness to use these services?
   (All restaurants in my area, 4 out of 5 restaurants in my area, 3 out of 5 restaurants in my area, 2 out of 5 restaurants in my area, 1 out of 5 restaurants in my area)
5. On a scale from 1 to 5, assuming the number of restaurants in your living area offering the reusable packaging food delivery service increased to your preferred level, how willing would you be to use these services?

[Reusable food delivery packaging service's pickup process]

1. Are you aware that the reusable packaging food delivery service does not require cleaning and recycling processes for returning reusable packages after use? (Yes, No)
2. On a scale from 1 to 5, after learning about the above condition, how willing are you to use this service?
3. On a scale from 1 to 5, please indicate your opinion on using a separate QR code registration or app when returning reusable delivery containers.
4. What is the maximum amount of time you are willing to wait for the reusable packaging pickup service?
   (Less than 10 minutes, at least 10–less than 20 minutes, at least 20–less than 30 minutes, at least 30–less than 40 minutes, at least 40–less than 50 minutes, at least 50–less than 60 minutes, more than 60 minutes)

[Demographic Questions]

1. Please write down your current international age.
2. Please check your gender (Female, Male)
3. What is your current living arrangement?
   (Living alone (e.g., living independently),
   Living with family (parents, grandparents, or guardians),
   Living with siblings or relatives (residing outside the family home without guardians),
   Living with friends, acquaintances, roommates, etc. (dormitories, etc.),
   Living with spouse (and children) (before marriage and after marriage))
4. According to the graph below, which life stage are you currently in?
   (Student Phase, Early Social Life Phase, Family Formation Phase, Child Independence Phase, Retirement Life Phase)

Life Stages:

1. Student Phase (학생기)

- Dependent on parents
- Savings and allowance management

2. Early Social Life Phase (사회초년기)

- Preparing for marriage expenses

- Preparing for deposit and house purchase
- Start of savings
- Insurance subscription, car purchase
- Planning for long-term financial goals

3. Family Formation Phase (가정구성기)

- Preparing for children's education expenses
- Preparing for home expansion funds
- Preparing for pension and retirement funds
- Investment and asset allocation
- Reinforcing contingency plans
- Business preparation, inheritance and gifting

4. Child Independence Phase (자녀성장기)

- Preparing for children's marriage expenses
- Preparing for children's college and education expenses
- Preparing for retirement funds
- Expanding insurance coverage
- Inheritance and gifting

5. Retirement Life Phase (노후생활기)

- Implementing retirement funds and plans
- Execution of inheritance plans
- Asset distribution and liquidity management
- Stable asset management
- Securing liquidity

6. How much do you spend on food delivery per month (please write down the number, in Korean won)