



Research and Analysis on Consumers' Usage of Recyclable Express Packaging

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Abstract. The prosperity of the express delivery industry has brought convenience to consumers while also generating a large amount of packaging waste, which causes resource waste and environmental pollution. In order to protect the environment and respond to government policies, major Chinese domestic logistics enterprises have successively introduced their own recyclable express packaging solutions. Understanding the actual usage of recyclable express packaging and consumers' awareness of it can facilitate the promotion of such packaging and support the green development of the express industry. This study was conducted in the form of an online questionnaire, targeting frequent online consumers as respondents. The findings show that the usage and awareness of recyclable express packaging among consumers remain suboptimal. Consumers pay more attention to the protective performance of packaging and the price of sending parcels over environmental concerns. Moreover, their willingness to use and recycle recyclable express packaging is relatively modest. In addition, comparative analysis reveals that female and non-students' groups respond most positively to economic incentive strategies related to recycling express packaging. These results indicate that recyclable express packaging is still in a trial-and-implementation phase, with significant barriers to widespread adoption.

Keywords: packaging waste; recyclable express packaging; consumer; willingness to use

1 Introduction

With the advancement of technology and the development of the internet, e-commerce has continued to flourish, and its growth has significantly boosted the prosperity of the express delivery industry [1]. As a global leader in the e-commerce market [2], China's postal industry's delivery business volume reached 174.5 billion pieces in 2024 [3]. Express delivery has gradually become a lifestyle and consumption habit that the people can both afford and use well [4]. While bringing convenience to daily life, express delivery has also generated massive amounts of packaging waste. If calculated based on

a standard of 0.2 kilograms per express delivery package, a total of 26.414 million tons of packaging waste was produced in 2023 [5]. The pollution caused by express delivery packaging waste has become one of the most critical environmental issues today [6]. How to reduce the amount of express delivery packaging waste and achieve the green and sustainable development of the express delivery industry has become a hot issue of social concern. If express packaging could be reused multiple times, the amount of waste would be significantly reduced. Therefore, recyclable express packaging has emerged as a solution. In 2021, the National Development and Reform Commission issued the "Action Plan for Plastic Pollution Control during the 14th Five-Year Plan Period", which set a target to deploy 10 million recyclable express packaging units by 2025, aiming to achieve a fundamental green transformation of domestic express packaging [6]. Consequently, numerous enterprises and research institutions have dedicated efforts to developing recyclable express packaging solutions.

2 Implementation Status of Reusable Express Packaging in China

In fact, major Chinese e-commerce platforms and leading logistics companies began to promote and use recyclable express packaging as early as 2017. In April 2017, Suning Logistics launched the reusable shared express box 1.0 (Figure 1), which is used for self-pickup and door-to-door delivery services of some fast-moving consumer goods and fragile items, effectively reducing the use of cardboard boxes [7]. By December 2017, Suning launched the 2.0 version of the shared express box (Figure 2), which is lightweight and strong, has good protection, is environmentally friendly and pollution-free, and can be recycled, achieving significant cost reductions compared to disposable corrugated boxes [7]. Also in December 2017, JD.com implemented its "Qingliu Initiative" and introduced the "Qingliu Box" recyclable express packaging (Figure 3), enhancing the utilization rate of packaging resources throughout the entire logistics chain and achieving energy conservation and environmental protection [8].

In February 2018, Cainiao Logistics also launched its own tape-free and reusable eco-friendly express boxes [9], as shown in Figure 4. SF Express introduced its "Feng·Box" in 2018 (Figure 5), which features easy opening, tamper-proof design, foldability, elimination of filler materials, and the capability of over 100 reuse cycles [10]. By July 2021, SF introduced an innovative " π -Box" (Figure 6) using magic tape closure and single-material PP honeycomb panels for easier recycling, with a self-locking foldable structure and full-body magic tape sealing [11][12][13]. As of the end of December 2021, 720,000 boxes had been deployed [12]. China Post introduced its own foldable recyclable express box in 2019, as shown in Figure 7, boasting an average lifespan exceeding 15 uses [14].



Fig. 1. Suning shared express box 1.0. (Image source: http://www.gov.cn/xinwen/2017-10/31/content_5235878.htm#1)



Fig. 2. Suning shared express box 2.0. (Image source: http://www.sohu.com/a/292406871_100284103)



Fig. 3. JD.com "Qingliu Box". (Image source: <http://w.dzwww.com/p/8375957.html>)



Fig. 4. Cainiao recyclable express box. (Image source: <https://www.baojiabao.com/a238281>)



Fig. 5. SF Express "Feng ·BOX". (Image source: <https://wetuc.com/article/5f168e835a7000158bcd3e2c>)



Fig. 6. SF Express "π-box". (Image source: <https://www.sf-express.com/chn/sc/news/89>)



Fig. 7. China Post's recyclable express box. (Image source: <https://web.shob-server.com/news/detail?id=135762>)

As leading Chinese domestic express delivery companies have successively introduced recyclable express packaging, from then until today, with the continuous and rapid increase in express delivery business volume, has the application of recyclable express packaging met expectations? Therefore, it is necessary to investigate consumers' awareness and practical usage of recyclable express packaging, which will facilitate more effective promotion of the green transformation and sustainable development of the entire express delivery industry.

3 Research Methodology

With the development of e-commerce, online shopping has become an indispensable part of people's daily consumption. Relevant data shows that more than 70% of express delivery packaging in China originates from online shopping [15]. This study will select consumers with a relatively high frequency of online shopping as the research subjects, as these consumers often receive and send parcels in their daily lives and have been using express delivery packaging for a long time. They possess relatively comprehensive knowledge about express delivery packaging, making the survey results more representative and valuable. Therefore, the sampling criteria stipulated that the participant must have an online shopping frequency higher than the average of once per month.

In order to investigate the practical application of recyclable express packaging, a simple, understandable, and easy-to-complete questionnaire was designed based on the principles of minimizing the research time and enhancing the participants' interest in participation. The questionnaire consists of three sections: a) collecting consumers' basic information and online shopping habits, b) assessing consumers' awareness and usage of recyclable express packaging, and c) evaluating consumers' willingness to use recyclable packaging and their personal preferences. The research was conducted through an online survey distributed via WPS Forms, ultimately collecting 299 valid responses.

4 Results & Discussion

4.1 Analysis of Participants' Demographic Characteristics

Table 1 presents the demographic profile of survey participants. The data shows that the proportion of students participating in the survey is the largest. Male participants are approximately 15% more than female participants, and the number of female office workers is significantly higher than that of male office workers.

Table 1. Demographic Profile of Survey Participants

	Students	Office Workers	Freelancers	Others	Total	Percentage
Male	162	5	4	0	171	57.2%
Female	62	53	4	9	128	42.8%
Total	224	58	8	9	299	100.0%
Percentage	74.9%	19.4%	2.7%	3.0%	100.0%	

(Unit: persons)

4.2 Analysis of Consumers' Usage of Recyclable Express Packaging

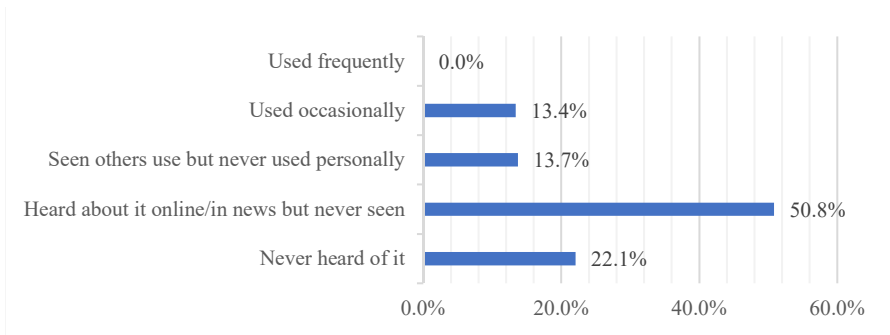


Fig. 8. Consumers' awareness and usage of recyclable express packaging.

Consumers demonstrate low awareness and usage rates of recyclable express packaging: Although the concept of recyclable express packaging has been proposed for a long time and the recyclable express packaging is being promoted in the market, as shown in Figure 8, the research results show that 86.6% of the participants have never used recyclable express packaging, and even 22.1% have never heard of it. Only 13.4% reported occasional usage, as illustrated in Figure 8. These findings clearly indicate that consumers are not very familiar with recyclable express packaging and their usage level is not high.

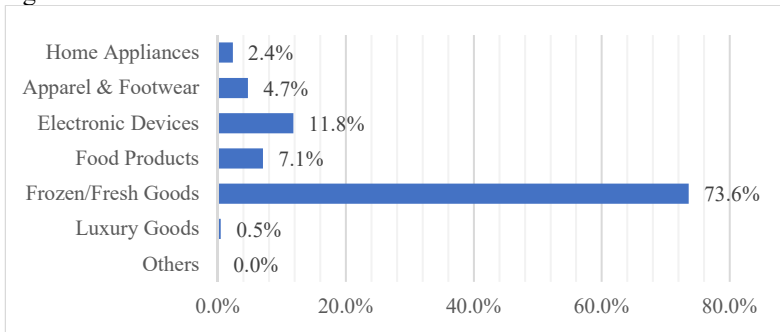


Fig. 9. Usage of recyclable express packaging for goods.

Limited Product Coverage of Recyclable Express Packaging: Survey participants reported rarely receiving packages delivered in recyclable express packaging when shopping online, with most goods still shipped in disposable plastic bags and corrugated cardboard boxes. As shown in Figure 9, which displays the application of recyclable packaging across different product categories during online shopping. It can be clearly seen from Figure 9 that 73.6% of recyclable express packaging is used in goods that need to be refrigerated, while the proportion of other goods is very small. This reflects that e-commerce only uses recyclable express packaging in the delivery of specific goods.

Limited consumer choice channels: 97.3% of consumers reported lacking optional pathways to select reusable express packaging when making online purchases or sending parcels, with no autonomy in choosing sustainable packaging alternatives. The remaining 2.7% of the respondents said that they only had the opportunity to choose recyclable express packaging when sending specific items of fresh produce. This is also consistent with the previous research result that the application scope of recyclable express is not wide.

Low efficiency in packaging recycling: If recyclable express packaging is used, the issue of recycling must be faced. Currently, there are mainly three common recycling methods: a) on-the-spot collection by couriers during delivery, b) consumers place it at their doorstep for scheduled courier pickup, c) consumers send the goods to a dedicated recycling location for unified collection. As shown in Figure 10, the survey data indicates that currently 87.5% of the recycling of express delivery packaging is completed by couriers, among which 50.0% require couriers to visit consumers' residences twice to complete the recycling. This undoubtedly increases the additional workload of couriers and reduces the recycling efficiency of recyclable express delivery packaging.

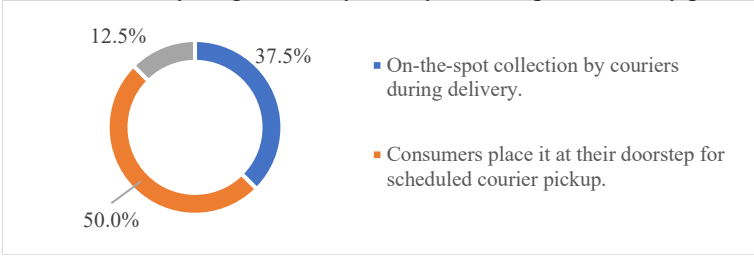


Fig. 10. The percentage distribution of different recycling methods for recyclable express packaging.

4.3 Analysis of Consumers' Personal Willingness and Preferences for Using Recyclable Express Packaging

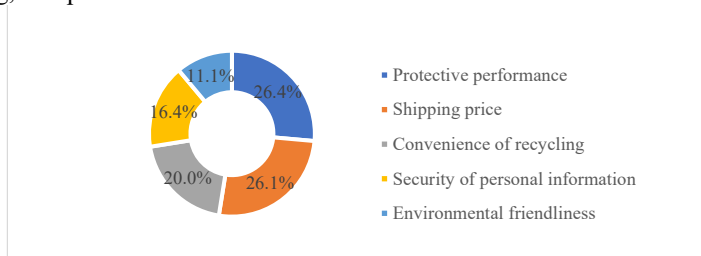
Consumers have a low willingness to use recyclable express packaging. Table 2 shows the survey results of consumers' personal willingness to use recyclable express packaging. From the results, if the use of recyclable express packaging requires an increase in shipping price or consumers have to spend time and energy participating in the recycling of express packaging, the average willingness of consumers is around 3. This indicates that even though they understand that using recyclable express packaging can reduce environmental pollution, the willingness of most consumers to participate in the use and recycling of recyclable express packaging is still average.

However, assuming the use of a reward mechanism, there can be income returns for participating in the recycling of recyclable express packaging, consumers' willingness to use will increase, and the average value will rise to 3.7, with a significant improvement in enthusiasm.

Table 2. Survey Results of Consumers' Willingness to Use Recyclable Express Packaging

	1 Extremely Un- willing	2 Unwilling	3 Neutral	4 Willing	5 Extremely Will- ing	Average value
Q1	22.1%	10.4%	34.5%	13.0%	20.1%	2.99
Q2	16.1%	16.1%	25.8%	19.1%	23.1%	3.17
Q3	7.0%	8.7%	28.4%	19.1%	36.8%	3.70
Note: Q1: If using recyclable express packaging can reduce environmental pollution, but it will increase the cost of sending parcels, would you be willing to use recyclable express packaging? Q2: If using recyclable express packaging can reduce environmental pollution, but it requires you to spend time participating in recycling, would you be willing to use recyclable express packaging? Q3: If you use recyclable express packaging, the shipping fee will be waived based on your participation in recycling. Would you like to use recyclable express packaging?						

Consumers pay more attention to the protective performance of packaging and the price of express delivery. Figure 11 shows the emphasis of consumers on the performance of recyclable express packaging. It can be seen from the figure that the order of consumers' concerns is: the protective performance (26.4%) > the shipping price (26.1%) > the convenience of recycling (20.0%) > the security of personal information (16.4%) > the environmental friendliness (11.1%). From this, what consumers care about most is the product protection performance of the packaging and the shipping price that directly affects their economic interests, while environmental friendliness takes the last place. Overall, consumers are more concerned about the content related to their economic interests. If we want to promote and popularize recyclable express packaging, this point must be taken into consideration.

**Fig. 11.** Consumer preferences for the performance of reusable express packaging.

4.4 Gender-Based Differences in Willingness to Adopt Recycling Packaging

Table 3 presents a gender-based comparative analysis of willingness to use recycling express packaging, measuring attitudinal differences between genders through three questions (Q1-Q3). The analysis employed the Mann-Whitney U test, reporting Means (M), standard deviations (SD), test statistics (U and z values), and significance levels (p -values). The comparative analysis revealed no significant difference between males ($M = 3.00$) and females ($M = 3.00$) in willingness to pay extra costs for reusable

packaging ($z = -0.013, p = 0.990$). Regarding the willingness to spend time recycling recyclable express packaging, males ($M = 3.23$) and females ($M = 3.10$) were similar with no significant difference ($p = 0.815$). Notably, females demonstrated significantly higher support than males ($M = 4.07$ vs $3.41, p = 0.030$) for the "recycling participation fee reduction" incentive mechanism, with a relatively large effect size ($z = -2.165$). These findings suggest that females respond more positively to economic incentives, providing valuable insights for developing differentiated sustainable packaging promotion strategies.

Table 3. Gender-Based Comparative Analysis Results

	Gender	<i>M</i> (SD)	Mann-Whitney U	<i>z</i>	Asymp. Sig. (2-sided)
Q1	Male	3.00(1.21)	564.50	-0.013	0.990
	Female	3.00(1.65)			
Q2	Male	3.23(1.25)	547.00	-0.235	0.815
	Female	3.10(1.59)			
Q3	Male	3.41(1.29)	398.00	-2.165	0.030*
	Female	4.07(1.13)			
Note: Q1, Q2 and Q3 definition see Table 2; *indicates $p < 0.05$					

4.5 Occupation-Based Differences in Willingness to Adopt Recycling Packaging

Table 4. Occupation-Based Comparative Analysis Results

	Occupation	<i>M</i> (SD)	Mann-Whitney U	z	Asymp. Sig. (2- sided)
Q1	Non-student	2.59(1.62)	338.00	-1.396	0.163
	Student	3.14(1.31)			
Q2	Non-student	3.00(1.58)	398.00	-0.514	0.607
	Student	3.24(1.34)			
Q3	Non-student	4.29(0.92)	280.50	-2.258	0.024*
	Student	3.49(1.30)			
Note: Q1, Q2 and Q3 definition see Table 2; *indicates $p < 0.05$					

Due to the limited sample size of freelancers and others, they were merged with office workers, resulting in a final comparison between non-student (working adults) and student groups. Table 4 presents an occupation-based comparative analysis of willingness to use recycling express packaging. The results show that students ($M = 3.14$) exhibited greater willingness than non-students ($M = 2.59$) to pay extra costs for recycling packaging, though the difference was not statistically significant ($p = 0.163$). Regarding time investment in recycling, students ($M = 3.24$) and non-students ($M = 3.00$) showed similar acceptance levels with no significant difference ($p = 0.607$). Notably, non-student groups demonstrated significantly higher support for financial incentive

mechanisms than students ($M = 4.29$ vs 3.49 , $p = 0.024$), with a relatively large effect size ($z = -2.258$). These findings suggest that working adults are more responsive to economic incentives, likely due to their stronger purchasing power.

The survey reveals that recycling express packaging remains not widespread among consumers, with low adoption enthusiasm. On one hand, most consumers are unwilling to bear the potential cost increase associated with choosing reusable packaging. On the other hand, as most consumers have work or study, their spare time conflict with couriers' delivery schedules, face-to-face pickup becomes difficult, creating time and effort barriers for returning packaging - compounded by the limited availability of recycling points which further dampens participation willingness. Additionally, comparative studies show women and working adults respond most positively to economic incentives like fee reductions, suggesting targeted financial motivation for these demographics could effectively boost recycling usable packaging adoption.

5 Conclusions

This study investigated consumers' actual usage of recycling express packaging through an online survey. The results indicate that a) the adoption rate of recycling express packaging remain relatively low, coupled with limited consumer awareness; b) most consumers show low levels of enthusiasm for participating in express packaging recycling; and c) Consumers tend to focus more on issues related to their own economic interests, while giving less consideration to environmental factors. Therefore, improving the adoption rate of recycling packaging requires both enhancing consumers' environmental awareness and increasing the convenience of using and returning such packaging. Additionally, this study employed the Mann-Whitney U test to conduct a comparative analysis of usage and recycling intentions of recycling express packaging between different groups (e.g., male vs. female, students vs. non-students). The results showed that women and non-students (working adults) respond most positively to economic incentive strategies (such as fee reductions) related to recycling express packaging. Consequently, targeted financial incentives for these demographic groups could effectively boost their willingness to use recycling packaging. In conclusion, based on the above analysis, the use of recyclable express packaging is still in the exploratory stage and there is still a long way to go before it can be fully popularized.

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