International Symposium on World Ecological Design
F. Ying et al. (Eds.)

doi:10.3233/FAIA240028

Analysis of Sustainable Takeaway Packaging Design Strategies Based on AHP

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Abstract. The rapid growth of China's takeout sector has given rise to a range of pollution issues stemming from the accumulation of garbage generated by takeaway packaging. These plastic materials pose challenges in terms of degradation and recycling, so contributing to environmental pollution. Hence, the design of takeaway packaging must to be rooted in the principles of sustainability and environmental conservation. This study examines the strategy analysis of sustainable takeaway packaging design. The research process involved the collection of sustainable keywords and interview questionnaire scores. These keywords were then combined with the "3R principles" of sustainability and the AHP to develop an evaluation model for assessing preferences in sustainable takeaway packaging design. Subsequently, the collected data was analysed using the evaluation model through function calculation. The analysis of the data reveals that individuals tend to prioritise the "Reduce" level in their sustainable takeaway packaging design strategy. The weighted average value for this level is 0.449592982, suggesting that individuals prioritise the material itself and demonstrate a willingness to address environmental concerns and reduce resource waste through sustainable packaging design practises. This study proposes optimisation suggestions for sustainable takeaway packaging design by considering preference levels and existing environmental protection issues associated with sustainable packaging. These suggestions are informed by relevant policies and data, and aim to promote sustainable takeaway packaging design and environmental protection.The findings of this study demonstrate that the integration of sustainable keywords and the AHP in the evaluation model can offer a more scientifically grounded representation of individuals' preference indicators. Consequently, this methodology has the potential to furnish users and industry professionals with valuable user evaluations that can effectively inform sustainable packaging design decisions.

Keywords. Sustainable design, takeaway packaging, AHP,3R principles.

1. Introduction

The exponential growth of the Internet has precipitated the emergence and expansion of the food takeaway sector. The substantial influx of orders has resulted in significant financial gains; however, it has also resulted in a multitude of environmental issues stemming from the accumulation of takeaway packaging trash. These concerns have been progressively escalating over time. It is projected that by the year 2023, the

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quantity of plastic trash produced from substantial volumes of takeaway packaging may range from 6 to 10 billion units. According to an analysis conducted by the (UNEP), the issue of plastic pollution extends beyond terrestrial environments. If not adequately addressed, it is projected that by the year 2050, emissions of plastic might escalate to around 6.5 billion tons of carbon dioxide equivalent[1].This paper presents a study on sustainable takeaway package design, focusing on the organization of keyword collecting and questionnaire findings. Additionally, a preference questionnaire is constructed and both offline and online questionnaire surveys are conducted in Guangzhou and several places around China. The subsequent step involves employing the hierarchical analysis approach to determine the weights of preferences for sustainable takeaway packaging design strategies. Subsequently, the analysis results are examined in conjunction with pertinent policy data to provide a comprehensive overview of the optimization recommendations for sustainable takeaway packaging design strategies. This study introduces an innovative approach that utilizes environmental protection background and policy data to pick keywords related to the "3R Principle". These keywords are then used to analyze and optimize the strategy for sustainable take-away package design. The hierarchical analysis method is employed in this analysis. The optimization of strategy should encompass the evaluation of the effects of sustainable takeout packaging design on users, merchants, and the industry as a whole. This evaluation should be approached from a practical standpoint.

2. Sustainable Design and AHP

The origins of sustainable design may be seen in the early 1900s, with a notable surge in interest during the environmental movement of the 1960s and 1970s. This period prompted individuals and designers to recognize the imperative of integrating sustainable design principles into the development of products and structures. The introduction of the "3R principles" emerged alongside the advancement of the sustainability idea and the growing environmental consciousness among customers. This principle encompasses the notions of "Reduce," "Reuse," and "Recycle." The idea in question, which pertains to sustainable design and development, has progressively evolved into a significant policy objective at both the international and national levels.

The utilization of disposable plastic packaging in the context of takeaways is a significant contributor to environmental pollution, mostly owing to its limited recyclability. Alejandro Gallego-Schmid's research findings highlight the adverse effects associated with disposable plastic takeout packaging, particularly in relation to environmental pollution[2].According to Jun Liu, it is imperative to classify, intervene, and control the substantial volume of disposable takeaway packaging in China in order to mitigate the adverse environmental impact caused by this form of waste pollution[3].In a study conducted by Xiaohong Jiang, a binary logistic regression model was employed to examine individuals' inclination towards sustainable takeout package design. The findings indicated that consumers priorities the hygienic aspect of the packaging, whilst companies exhibit a greater concern for cost considerations[4].According to Bojia Zheng, it is argued that the current package design and materials may not adequately meet the fundamental criteria of sustainable packaging design[5].Academic researchers have observed that in light of sustainable development efforts, there has been an increasing focus by the government on

addressing the issue of environmental pollution. Environmental pollution reduction should be considered as a fundamental requirement in the design of sustainable takeaway packaging.

The Analytic Hierarchy Process (AHP) is a systematic approach utilized for addressing intricate decision-making problems. This method involves breaking down a problem into multiple levels, wherein each level comprises a set of interconnected factors or objectives. By systematically comparing these factors at each level and assigning appropriate weights, the optimal decision can be determined. Fan Wang incorporated variable weighting elements into the hierarchical analysis method in order to enhance the efficacy of the new weighting approach, hence enabling a more accurate representation of the environmental index[6].In response to the issue of sustainable design of takeaway packaging in China, Hu Sun employed the hierarchical analysis method and the fuzzy comprehensive evaluation (FCE) method to establish an evaluation model for sustainable takeaway packaging design. The findings of this study demonstrate the applicability of this method for assessing and providing guidance for sustainable takeaway packaging design[7].Seyed Morteza Hatefi conducted an assessment of sustainability criteria using fuzzy hierarchical analysis and enhanced grey correlation analysis[8].It is widely acknowledged among scholars that the utilisation of hierarchical analysis holds significant potential in assessing both sustainable development and sustainable takeout packaging design. Through this evaluative process, it is anticipated that the existing sustainable takeaway packaging design would undergo suitable enhancements based on the outcomes of the assessment.

3. Research based on sustainable takeaway packaging design

3.1. Research Process

The study methodology employed in this paper involved conducting a literature survey to identify keywords that were often used in earlier scholarly works on sustainable design. This preliminary step aimed to get insights into the many preferences and options associated with sustainable takeaway packaging before proceeding with the subsequent analysis. A comprehensive search was conducted in five prominent literature search repositories, namely Web of Science, Google Scholar, ScienceDirect, NCBI, and CNKI, to gather relevant scholarly articles on the topics of sustainable design, sustainable packaging design, and AHP hierarchical analysis. Specific key terms were employed during the search process. Ultimately, a total of 86 references were identified and retrieved, all of which were found to be pertinent to the subject matter.

To identify sustainable keywords aligned with the "3R principles," a keyword preference questionnaire was developed by incorporating high-frequency words from relevant references. Subsequently, field interviews, as well as online and offline questionnaires, were administered in Guangzhou and across the nation between February and April 2023.

A preference questionnaire was developed by integrating the sustainable keywords associated with the "3R Principles" and the design concerns pertaining to sustainable takeaway packaging. Subsequently, field interviews and both online and offline questionnaires were administered in Guangzhou and across the nation. The initial

survey was conducted between April and July 2023, while the second survey took place from September to October 2023.

The scores obtained from the questionnaires were subjected to hierarchical analysis in order to determine individuals' preferences for sustainable takeaway packaging design strategies based on the "3R Principles" at three distinct levels. The results of the hierarchical analysis were then integrated with existing policies and data to identify the deficiencies and propose optimization suggestions for sustainable takeaway packaging in the market.

3.2. Questionnaire design

3.2.1. Keyword Questionnaire

The questionnaires were gathered through both online and offline methods, while offline interviews and questionnaires were completed by individuals such as experts, package design company executives, college students and faculty, workers, and enterprises, among others. The questionnaires were disseminated and completed online by a diverse range of participants, including university students, instructors, office workers, businessmen, and telecommuters. The primary age demographic encompassed individuals between the ages of 15 and 50. The survey instruments encompassed demographic variables such as age, gender, and education level. Additionally, participants were asked about their frequency and average amount of takeaway ordering, willingness to pay a premium for sustainable takeaway packaging, as well as their concerns and suggestions regarding sustainable takeaway packaging. Lastly, respondents were prompted to indicate their level of importance for keyword preferences related to the "3R Principles" of sustainability, which were categorized as very unimportant, unimportant, average, important, and very important.

3.2.2. Questionnaire on Sustainable Takeaway Packaging Design Preferences

The present questionnaire has addressed the limitations of the keyword questionnaire, and the initial offline interview and survey were carried out in the urban area of Guangzhou. Offline interviews and questionnaires have been devised for individuals to comprehend, while internet users have included elucidations of the "3R principles" ("Reduce", "Reuse", "Recycle") alongside essential facts to aid individuals in comprehending the questions. In accordance with the "3R principle" in sustainable packaging design, the relative importance of each "R" is determined by the factors of "acceptance" and "satisfaction". These factors are further categorized into the following dimensions: design (packing performance and functionality), materials, cost and price, environmental efficiency, and environmental effect. Each dimension is assigned a score ranging from 1 to 10 points. In order to enhance the study's dependability, the scope of the second offline interviews and questionnaires was expanded nationwide, employing identical questions as those used in the initial interviews and questionnaires.

3.3. Questionnaire results

3.3.1. Keyword extraction results

Upon thorough examination and careful analysis of the cited sources, the word frequency tool was employed to ascertain the occurrence rate of words within the

literary works. The authors conducted an analysis of the literature, focusing on sustainable design and the "3R principle", in order to identify the most commonly occurring terms. The words are categorized based on their frequency into four distinct categories: sustainable design, sustainable packaging, green design, and takeout food packaging.

Ultimately, the analysis revealed that there was a total of 25 terms belonging to the four subgroups that exhibited the highest frequency of recurrence. These subgroups were identified based on their alignment with the sustainable "3R principle." The individuals in question are: Design; Materials; Reuse; Environmental Impact; Indicators; Cost, Price; Acceptance, Satisfaction; Pollution; Information; Impact; Performance, Functionality; Litter, Waste; Methods; Evaluation; Production; Efficiency; Specialists; Demand; Composites; Environmental Protection; Visualization; Economy; Development; Packaging Design; Packaging Materials.

The four subgroups encompass a set of eight prevalent high-frequency phrases, namely Design; Materials; Environmental Impact; Indicators; Cost, Price; Acceptance, Satisfaction; Pollution; and Information. Notably, the frequency of the terms Design and Materials is observed to be 2037 and 1135 times, respectively, with design exhibiting the highest frequency within each subgroup.

3.3.2. Keyword questionnaire results

Based on the data organization, it has been determined that the total number of legitimate questionnaires collected during this period amounts to 503. According to the data presented in Table 1, the combined percentage of terms categorized as "important" and "very important" exceeded 55%. Acceptance, Satisfaction; Design; Materials; Cost, Price; Environmental Protection; Efficiency; Pollution; Environmental Impact; Indicators; Performance, Functionality; Impact.

Table1. Words with a combined proportion of important and very important exceeding 55%

Keywords	Total proportion of important and very important
Acceptance, Satisfaction	79.2%
Design	76.23%
Materials	74.58%
Cost, Price	70.62%
Indicators	68.97%
Efficiency	68.65%
Pollution	66%
Environmental Impact	65.34%
Impact	62.37%
Performance, Functionality	59.4%
Environmental Protection	55.44%

Certain keywords exhibit synonymous meanings, therefore prompting the consolidation of words with comparable connotations. The terms "pollution" and "indicator" within the context of sustainability primarily pertain to the detrimental effects on the environment. Consequently, these terms are classified under the category of environmental impact. In the realm of sustainability, the concept of design encompasses not only the visual aesthetics of a product, but also encompasses the

structural and functional aspects of the product. Therefore, the terms "design" and "performance, functionality" are consolidated into the term "design (packaging performance, functionality)". Simultaneously, the concepts of "efficiency" and "environmental protection" are conjoined, resulting in the amalgamation referred to as "environmental efficiency." The concluding keywords encompass Design (packaging performance, functionality); Materials; Environmental Impact; Cost, Price; Acceptance, Satisfaction; Environmental efficiency.

3.3.3. Questionnaire results on sustainable takeaway packaging design preferences

The survey conducted for the purpose of assessing the preference requirements of a sustainable takeaway packaging design strategy yielded a total of 721 valid responses. The first collection consisted of 309 questionnaires, while the second collection included 412 questionnaires. The reliability coefficient of the data was determined to be 0.951, indicating a high level of consistency. Additionally, the Kaiser-Meyer-Olkin (KMO) value of 0.918 suggests that the data is suitable for extraction and analysis, as it meets the required standard. The questionnaires were distributed to the following six cities: Guangzhou, Suzhou, Shanghai, Beijing, and Hunan.

4. AHP analysis of sustainable takeaway packaging design

The data obtained from the questionnaire responses were used to extract the scores of six keyword preferences. AHP was employed to calculate and analyse individuals' preferences for sustainable takeaway packaging design, with a focus on the "3R principle". Subsequently, an analysis model was developed, as depicted in Figure 1.

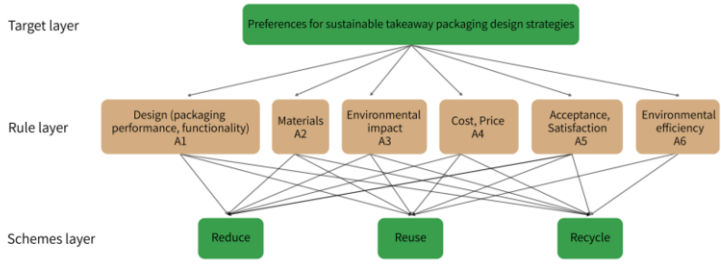

Figure 1. AHP analysis model for sustainable takeaway packaging design strategy preferences (self-made)

The present study involves the computation and examination of the Arithmetical average method, specifically focusing on the sum-product method. As an illustrative instance, the recommended approach for examining the indications and determining the weight value is outlined as follows:

In the initial Arithmetical average method, the first step involves calculating the sum of the vertical columns of the judgement matrix, denoted as SUM. Here, 'n'

indicates the size of the matrix, 'a1' represents the value of the rating for each row and column. The calculation formula for this step is as follows:

$$SUM = a_1 + a_2 + a_3 + \ldots \quad (1)$$

In Equation. The objective is to determine the values of each vertical column in the matrix as a percentage of the total amount. The average value is then computed to derive the Eigenvector (ω), which may be obtained using the following formula:

$$\omega = \frac{a_1/SUM + a_2/SUM + a_3/SUM + \ldots}{n} \quad (2)$$

The symbol λmax represents the Maximum Eigenvector of the given matrix, while Aω denotes the Eigenvector determined by the equation specified.

$$\lambda_{\max} = \sum_{i=1}^{n} \frac{[A\omega]_i}{n\omega_i} \quad (3)$$

To determine the Coherence indicators (CI), it is necessary to calculate the value of λmax. A smaller value of λmax indicates a higher level of consistency. The computation of λmax is performed using the following formula:

$$CI = \sum_{i=1}^{3} a_i \, CI_i, CI = \frac{\lambda_{\max} - n}{n-1} \quad (4)$$

The stochastic Coherence indicators, referred to as RI, is commonly computed using a standardised table of RI values, as seen in the provided table:

$$RI = \sum_{i=1}^{3} a_i \, RI_i \quad (5)$$

The Consistent ratio (CR) serves as a metric for assessing the validity of scoring results. A CR number below 0.1 indicates that the judgement matrix value has successfully passed the one-time test, whereas a CR value beyond 0.1 signifies a failure to pass the test.

$$CR = \frac{CI}{RI} \quad (6)$$

The calculation of the average score for experts' Judgement matrix and people's sustainable takeout package design preference scoring was conducted based on Table 2. The maximum and minimum values were excluded from the calculation. The comparison of size percentages between each value and other values was conducted by calculating the average of each keyword, as presented in Table 1. The outcomes of the AHP analysis are reported below.

Table2. The overall judgement matrix for the preference scoring of sustainable takeaway packaging design strategies

	Design	**Materials**	**impact**	**Cost**	**Acceptance**	**efficiency**	**ω**	**λ**	**CR**
Desi	1	1/4	1/3	2	1/2	2	0.096605897	6.2	0.

gn								341	03
Materials	4	1	2	5	3	7	0.387007178	378 09	71 64
impact	3	1/2	1	3	4	3	0.255227147		73 2
Cost	1/2	1/5	1/3	1	1/3	2	0.070948673		
Acceptance	2	1/4	1/4	3	1	3	0.138333859		
efficiency	1/2	1/7	1/3	1/2	1/3	1	0.051877246		

Based on the obtained result, it can be observed that the CR of the total Judgement matrix is 0.037164732, indicating a value below the threshold of 0.1. Consequently, the outcome successfully satisfies the criterion for a one-time test, thereby substantiating the validity of the entire Judgement matrix. The eigenvector associated with the keyword "Materials" exhibits the highest magnitude, while the Eigenvector corresponding to the keyword "Environmental efficiency" demonstrates the lowest magnitude within the set of six keywords. Next, the weight value of each keyword, namely "Reduce," "Reuse," and "Recycle," is computed. The computed CR values for each term are as follows: Design 0.008854487, Materials 0.003553931, Environmental effect 0.003553931, Cost and Price 0.008854487, Acceptance and Satisfaction 0.003553931, and Environmental efficiency 0.008854487. The computed CR value for each keyword does not exceed 0.1, indicating that all keywords have successfully passed the one-time test.

As indicated in Table 3, in order to ensure the rigour of the entire analysis and calculation procedure, it is necessary to determine the total weight value for each keyword and the weight value for individual analysis. Subsequently, the calculation of the weighted average and the one-time test can be conducted.

Table3. Total weight value and individual weight value judgement matrix

	Total weight value	**individual weight value**			**CR**
		Reduce	**Reuse**	**Recycle**	
A1Design	0.096605897	0.538961039	0.297258297	0.163780664	
A2Materials	0.387007178	0.581263617	0.109586057	0.309150327	
A3impact	0.255227147	0.429776021	0.370487484	0.199736495	0.00213306
A4Cost	0.070948673	0.163780664	0.297258297	0.538961039	1
A5Acceptance	0.138333859	0.309150327	0.581263617	0.109586057	
A6efficiency	0.051877246	0.163780664	0.538961039	0.297258297	
	weighted mean	0.449592982	0.295144294	0.255262724	

According to the data presented in Table 3, the CR value obtained from the computation is 0.002133061, indicating that it is below the threshold of 0.1. This result serves as evidence supporting the validity and effectiveness of the entire AHP analytical procedure. The calculated weighted average value for the concept of "Reduce" is 0.449592982, being the highest value obtained in this calculation. This

outcome indicates that both professionals and individuals priorities the approach of sustainable takeaway packaging design that focuses on minimizing environmental impact.

5. Discussion of AHP analysis results and related policy data factors

Based on the findings derived from the AHP analysis conducted in this study, it is evident that Chinese consumers exhibit a preference for sustainable takeaway packaging design strategies that align with the principles of "3Rs," namely "reduction." Additionally, individuals express a desire to priorities the inherent characteristics of packaging materials during the creation or design process, while also emphasizing the need to address environmental concerns and minimize resource wastage from the outset. Fangni Du conducted a study wherein four distinct categories of disposable plastic takeaway containers were examined. The findings revealed the presence of microplastics in each container, and further analysis indicated that individuals consuming food from these containers might potentially ingest a range of 12 to 203 microplastic particles every week. It is possible for individuals to consume an estimated annual quantity of 2977 microplastic particles via the consumption of takeaway packaging[9].According to the research conducted by Xinhao Wang, it has been shown that the use of plastic packaging in Chinese takeaway establishments may potentially amplify health hazards, particularly when high temperatures and high-fat items are frequently involved[10].The act of subjecting disposable plastic food packaging to hot water results in the release of many metals, which have the potential to constitute a cancer risk when exposed to over an extended period of time[11].According to the official report published by the World Wildlife Fund, there has been a notable escalation in worries regarding environmental contamination due to the increasingly severe issue of plastic pollution. Evaluation models indicate that if no action is taken to address pollution, there is a potential for a twofold increase in the generation of plastic-polluting waste by the year 2040, in comparison to the levels observed in 2016[12].

The present study aims to examine the potential risks associated with environmental pollution resulting from the presence of microplastics in disposable takeaway food packaging commonly used in the Chinese takeaway market. The packaging materials predominantly utilized in this context include polypropylene, polystyrene, polyethylene, polyethylene terephthalate, and similar substances. The degradability of these materials has a remarkably low level, with certain materials demonstrating a complete lack of degradability. By adhering to the principle of "Reduce" and implementing the European Union's policy recommendations on recycling plastic packaging waste by 2025, there will be a projected 55% increase in the recycling rate of polypropylene (PP) plastic packaging. This increase in recycling will result in significant savings in fossil fuels, primary energy, eutrophication, photochemical oxidants, and greenhouse gas emissions, surpassing a total reduction of 38%. Furthermore, there is a notable decrease of 41,000 tons of carbon dioxide equivalent emissions for every 675 million containers utilized annually[13].

The Chinese government has implemented many initiatives aimed at addressing environmental concerns, including the promotion of waste separation, restrictions on the usage of single-use plastic items, and the encouragement of sustainable packaging design. The National Development and Reform Commission (NDRC) and the Ministry

of Ecology and Environment (MOE) have collaboratively released the Action Programme on Plastic Pollution Control for the 14th Five-Year Plan. This programmed aims to tackle the issue of plastic pollution and suggests the integration of various governance concepts pertaining to this matter[14].

6. Sustainable Takeaway Packaging Design Strategies and Optimization Suggestions

Based on the aforementioned analysis presented in this research, together with the inclusion of the Action Programmed on Plastic Pollution Control for the 14th Five-Year Plan, the pertinent environmental protection regulations are also encompassed within the study titled "A big step towards ending plastic pollution" by the United Nations Environment Programme[15].This study aims to enhance and optimize sustainable takeaway packaging by considering the following aspects:

(1) Minimize the utilization of plastics, particularly those that pose environmental challenges, in the manufacturing of takeaway packaging materials, while prioritizing the adoption of starch and cellulose-based alternatives.

Both starch and cellulose are plant-derived materials that possess several advantages in terms of degradability and regeneration, thereby contributing to the mitigation of long-term environmental damage. The utilization of starch-based materials in degradable takeaway packaging has been found to result in a significant reduction of carbon emissions, amounting to a 69.5% decrease when compared to packaging made only from all-fiber materials. Both preferred starch material and sago starch are selected due to their suitability as composite materials for the design of takeaway food packaging[16].Additionally, there should be a reduction in the utilization of printing materials and ink.

(2) The concept of functional design entails the practicality and reduction of superfluous auxiliary functions.

The design of takeaway packaging should adhere to the principle of "Reduce", wherein simplicity is prioritized. The functional design should be practical and aim to minimize extraneous auxiliary functions. This approach facilitates the subsequent processes of "reuse" and "recycling" of the packaging.

(3) Enhance the dissemination of knowledge pertaining to sustainable design.

To enhance public awareness regarding environmental protection and sustainable design in the context of takeout packaging, it is imperative to augment educational knowledge in this domain.

(4) Enhance the level of specificity pertaining to policies, laws, and regulations that are closely associated with the subject matter.

Policies, rules, and regulations pertaining to sustainable takeaway packaging design can play a crucial role in providing support and establishing regulatory frameworks.

(5) It is imperative to strike a balance between the expenses associated with packing materials and design.

If there is a hasty and indiscriminate increase in the cost of packing materials and design, it is likely to result in a disruption of the initial market equilibrium. Consequently, users, merchants, and the entire industry may lose faith in the viability of this sustainable concept. Therefore, it is imperative to establish a collaborative effort

between the government and the market in order to ensure a harmonious implementation.

The takeout packing model depicted in Figure 2-3 has been developed based on the outcomes of the AHP study and subsequent improvement recommendations.

Figure 2. Sustainable takeaway packaging design 1 (self-made)

Figure 3. Sustainable takeaway packaging design2 (self-made)

7. Conclusion

This study presents the development of a questionnaire aimed at investigating the pollution caused by takeout packaging. The questionnaire was designed based on extensive research on sustainable keywords. Additionally, interviews and offline and online questionnaire scoring were employed to gain insights into individuals' preferences for sustainable takeaway packaging design. A hierarchical analysis was employed to construct an analytical framework for determining the relative importance of weight values associated with the six keywords in the "3R Principles". This framework was then utilized to examine the strategic preference for sustainable takeaway packaging design within the context of the "3R Principles". The obtained data was analyzed, revealing a strong inclination towards the "Reduce" level. This study presents optimization proposals for sustainable takeout packaging design methods in China, based on the outcomes of the Analytic Hierarchy Process (AHP) analysis and the examination of policy and statistics.

The proposed evaluation model, which integrates sustainable keywords and the Analytic Hierarchy Process (AHP), offers a more scientifically grounded reflection of individuals' preference indicators. This model is particularly well-suited for evaluating user preferences and can provide valuable user evaluations to guide the optimization suggestions for sustainable packaging design, benefiting users, merchants, designers, and other stakeholders.

This study has several limitations. Firstly, the number of interviews conducted with experts and the sample size of consumer users surveyed in this paper are relatively small. Additionally, the geographical area covered in the study is limited, which may affect the generalizability of the findings. Furthermore, the classification of user groups lacks sufficient detail, making it difficult to determine if the preferences of each age group are consistent. Lastly, the analysis of the data may be biassed due to factors such as variations in geographical dietary habits. It is anticipated that future endeavors would delve further into the investigation of this foundation, aiming to completely study the techniques and methodologies that are appropriate for achieving sustainable packaging in the context of Chinese takeout. There is an expectation for the

development of novel sustainable and biodegradable materials for takeout packaging, with the additional goal of fostering sustainable design practices and environmental conservation in the realm of takeaway packaging.

Acknowledgements

This study received support and funding from the Guangdong Province Education Science Planning Project (No. 2023GXJK315) and the Ministry of Education's Industry-University Cooperation Collaborative Breeding Program (No. 220906195215732).

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