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Original Article

The Impact of Retail Promotion Activities on Household Food Waste: An Empirical Study Based on Taiwanese Households

[1*]Nan-Yu Wang, [2]Zhi-Yun Lu

[1]Associate Professor, Department of Food and Beverage Management, Overseas Chinese University, Taichung, Taiwan.
[2]Department of Food and Beverage Management, Overseas Chinese University, Taichung.

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Abstract: *This study provides the first empirical evidence of the relationship between retailer promotion strategies and household food waste in Taiwan. Data were collected from household shopping receipts and Tsalis et al. (2024) 's food waste questionnaire. Descriptive statistics, contingency table analysis, and multiple regression analysis were employed to test the following hypotheses: (1) whether ingredient price promotions influence household purchasing behavior, (2) whether frugal consumption psychology reduces waste, (3) whether larger households are more prone to waste due to higher demand, and (4) whether environmental consciousness enhances food resource utilization. The findings reveal that while price promotions stimulate short-term consumption, they may also lead to over-purchasing and waste, supporting the dual nature of price sensitivity theory. Frugality and environmental consciousness significantly reduce waste, aligning with the Theory of Planned Behavior and Sustainable Consumption Theory. Larger households, driven by higher demand, are more susceptible to waste if not managed effectively. The study provides critical insights for retailers and policymakers, offering strategies such as dynamic pricing, behavioural interventions, and community resource-sharing mechanisms to mitigate food waste.*

Keywords: *Food Waste, Consumer Purchasing Behavior, Frugality, Environmental Consciousness, Multiple Regression Analysis*.

I. INTRODUCTION

According to the Food and Agriculture Organisation of the United Nations (FAO), in 2011, nearly two-thirds of food produced worldwide was discarded, collectively referred to as "food waste" (He, 2020). Food waste at the consumer end causes numerous negative global issues, including environmental damage, excessive natural resource consumption, harm to human health, and threats to food security. The factors influencing food waste are numerous (Zheng, 2023). Food waste not only has a serious impact on the environment but is also an important issue related to economic development (Garnett, 2011). Therefore, academics and policymakers are actively involved in addressing actions (Scialabba, 2013).

The Food and Agriculture Organisation of the United Nations lists solving the problem of food waste as a top priority and proposes several solutions (FAO, 2014). In recent years, many civil society groups promoting food conservation have emerged in Taiwan. Whether it is promoting platforms for sharing food or advocating for food conservation, there appear to be positive results (He, 2020). In the field of marketing, pricing is widely used as a core tool for managing product inventory and meeting consumer needs. However, common promotional methods in ingredient marketing, such as buy-two-get-one-free offers and multi-item discounts, may stimulate consumers to over-purchase, thereby leading to food waste (Hegnsholt et al., 2018).

Cialis et al. (2021) found that the relationship between manufacturer promotions, consumer overconsumption, and food waste may be more complex. When society is affluent, food waste is most likely to occur at the household level (Gryphon et al., 2008). Therefore, this study provides the first empirical investigation of the relationship between retail promotion activities and household food waste in Taiwan. Using shopping receipts and food waste questionnaire data from 30 households, combined with descriptive statistics, contingency table analysis, and multiple regression analysis, the following hypotheses are tested: (1)Whether ingredient price promotions influence household purchasing behavior,(2)Whether cost-saving consumption psychology reduces waste, (3)Whether large families are more likely to cause food waste due to large purchases, and (4)Whether environmental awareness can effectively utilize food resources and reduce food waste. The results show that although price promotions stimulate short-term consumption, they may also lead to over-purchasing and waste, supporting the duality of price sensitivity theory. Frugality and environmental awareness significantly reduce waste, consistent with the Theory of Planned Behavior and Sustainable Consumption Theory. Large families may increase their purchases and exacerbate waste due to high demand, providing practical data and theory as a reference for reducing food waste.

II. LITERATURE REVIEW

This study examines the relationship between retail price promotions and household food waste, investigating whether marketing pricing strategies contribute to increased food waste. Objective methods, including the analysis of actual household waste and shopping receipts, are employed. This will help determine whether ingredient price promotions affect how families buy groceries.

Previous research shows mixed results. In Denmark, removing some price promotions alongside other actions reduced food waste (Aschemann-Witzel et al., 2016). In Taiwan, the relationship is unclear despite the presence of food banks and sharing platforms (Greenvines & Michelle Chang, 2022). While discounts can increase purchase intent (Raghubir & Corfman, 1999; Wang, 1993), some studies link promotions to more waste, while others find the opposite (Aschemann-Witzel et al., 2016; Ponis et al., 2017; Giordano et al., 2019). Surveys in Taiwan reveal massive food waste from retailers, suggesting promotions can worsen the problem but can also reduce waste if designed well (like 7-Eleven's "Friendly Food" program).

The debate centres on whether promotions lead to increased household food waste. Some argue that promotions help sell imperfect food (de Hooge et al., 2017) or near-expiration items (Lo, 2022), thereby reducing waste. This raises the question: are promotions both a cause and a solution to food waste (Tsalis et al., 2024)? The relationship is complex and influenced by consumer attitudes and differences (Aschemann-Witzel et al., 2016; Delley & Brunner, 2017; Fonseca, 2013). Apps with expiring food deals can reduce waste. AI-powered dynamic pricing, as seen in Wasteless in Israel, also encourages buying soon-to-expire food. Therefore, the effect of price promotions depends on how they are designed and used. With the right strategies, businesses can increase sales and reduce waste, but this requires understanding consumer behaviour and market needs, as well as utilising technology creatively.

Measuring food waste relies on subjective assessment, which may result in an underestimate of the actual amount. This study utilises waste sorting and shopping receipts to assess the impact of price-related marketing on food waste. Also, it references Tsalis et al. (2024) to develop a method for measuring the relationship between purchasing and wasting discounted foods. It also challenges common assumptions about household waste and utilises descriptive statistics to examine food waste and its potential causes more broadly (Koivupuro et al., 2012). Furthermore, consumers seeking price promotions may be more cautious and waste less (Gate-rsleben et al., 2017). This also means they are thriftier in finding the best deals (Lastovicka et al., 1999) to save costs (Goldsmith et al., 2014). Lastly, consumer thriftiness and moderation could reduce food waste.

Individual differences in consumer psychology and their views of prices and promotions also exist (Dickson & Sawyer, 1990; Jensen & Grunert, 2014; Lichtenstein et al., 1993). Higher perceived value also increases the willingness to purchase the item. Some consumers look for low prices (Lichtenstein et al., 1993), while others look at price relative to value (Lichtenstein et al., 1993). Securing good deals can also indicate that the consumer is being a savvy shopper (Jensen, 2006). A consumer's economic status also impacts their reactions to prices and promotions. These psychological differences offer insight into how price promotions influence household food waste in Taiwan, thereby expanding existing studies on consumer psychological factors and attitudes related to this topic (Stancu et al., 2016; van Herpen & de Hooge, 2019; Visschers et al., 2016).

Household skills in food management can also help or hinder food waste (Aschemann-Witzel et al., 2018; Boulet et al., 2021; Farr-Wharton et al., 2014; Principato et al., 2021; Stancu & Lahteenmaaki, 2018). Skills such as using leftovers (Stancu et al., 2016) and food storage and management help prevent waste and reduce negatively impacting waste behaviours (Aschemann-Witzel et al., 2018; Guo and Zhang, 2022). A consumer's attitudes may also be influenced by their values. Additionally, collective values can lead people to be more environmentally friendly, whereas individualistic values can have the opposite effect (Schwartz, 1992). Taiwanese people who prioritise environmental awareness and adhere to collectivist values may be more inclined to reduce food waste. In contrast, individuals with individualistic values may be less concerned about food waste.

In summary, price promotions exhibit a dual effect: (1) increasing waste, as some studies suggest that they may lead consumers to over-purchase, thereby increasing food waste (Aschemann-Witzel et al., 2017; Ponis et al., 2017). (2) reduce waste: On the other hand, promotions for soon-to-be-expired goods can help reduce waste, especially when these items are about to expire (de Hooge et al., 2017; Lo, 2022). In consumer psychology, a consumer's willingness to purchase is influenced by their perceived value and the depth of the discount (Raghubir & Corfman, 1999; Wang, 1993). Additionally, consumers' reactions to prices and promotions are influenced by both economic and psychological factors (Urbany et al., 1996; Lichtenstein et al., 1993). Retailers and supermarkets in Taiwan discard large amounts of leftover food annually, and promotional events can either exacerbate or mitigate this issue, as seen with the "Friendly Food" program by 7-Eleven. Household food-management skills are also crucial when attempting to reduce food waste (Aschemann-Witzel et al., 2016; Stancu et al., 2016). Thus, a price promotion's ability to reduce food waste depends on how it is implemented. With the right promotional strategies, companies can simultaneously increase sales and reduce waste (Tsalis et al., 2024).

III. RESEARCH METHODS AND PROCEDURES

A) Data Collection Procedures

This study collected data from 30 households by gathering food waste classification, shopping receipts, and survey responses. The collection process involved the following steps: A. Households placed their food waste in designated bags outside their doors on specified collection days. Researchers collected and categorized the waste while recording relevant household information. B. Participants were asked to submit their shopping receipts during the study period, either by mail or as photos. C. After completing the waste classification, researchers contacted participants via email to invite them to complete a survey.

B) Attitude and Demographic Measurements

Participants completed a questionnaire assessing their focus on low prices and perception of budget constraints. A single-item measure asking participants to estimate the percentage of food bought at discount stores. Evaluated using three items on a seven-point Likert scale, adapted from Lastovicka et al. (1999). Assessed using five items on a five-point Likert scale based on Aschemann-Witzel et al. (2018). Measured using four items on a five-point Likert scale developed by Haws et al. (2014). A single-item measure using a five-point scale to evaluate how often participants purchased daily necessities. Assessed with three items on a five-point scale. Evaluated using five items on a seven-point scale. Demographic data included household size, gender, age, and education level. Discount shopping attitudes and budget constraint perceptions were assessed using a seven-point Likert scale adapted from Jensen & Grunert (2014) and Lichtenstein et al. (1993). All measurement items for attitudes and demographics are detailed in Tables 1 and 2.

C) Actual and Perceived Food Waste Measurement

Measuring actual and perceived food waste involves different methods. This study separates them into two parts: Actual food waste measurement requires directly quantifying food loss during usage. We will use the recovered food measurement method. Perceived food waste measurement primarily involves the subjective awareness, attitudes, and behaviours of respondents. Therefore, this study will use a questionnaire to have respondents self-report their food waste ratio. We will then combine data from both stages to gain a deeper understanding of consumer food waste in different food categories.

D) Measurement of Discount Shopping Behavior

This study will evaluate discount shopping behavior based on the actual proportion of food purchased at discounted prices. The measurement will be based on data from shopping receipts provided by respondents, calculating the proportion of discounted purchases and the proportion of purchases made at discount stores. For perceptions of discount shopping behavior, we used a ten-point scale. We asked respondents about their expectations of discount shopping behavior for different product categories, using percentages (0-100%, in 10% increments) to assess six common food categories. This helps understand consumer expectations of discount shopping behavior for different food categories, as detailed in Table 1. Respondents' basic attributes are listed in Table 2.

E) Preliminary Data Processing

Collected food waste was categorized (meat, dairy, produce, bread, dry goods, other) using household records and weighing. This classification enables comparison with other studies on food waste. Paper receipts were scanned, and data (product, price, discount) were recorded to calculate the proportion of discounted purchases in total household food spending. Questionnaire data from paper forms were entered into the main dataset. Food waste data was recorded in Excel for analysis. A multiple regression model will be used to predict self-reported food waste and discount shopping, with actual waste measurements as the dependent variable and discount shopping frequency, income, and discount shopping perceptions as independent variables. This will assess the impact of these factors on food waste.

IV. EMPIRICAL RESULTS AND ANALYSIS

This study examines the relationship between retail price promotions and household food waste, investigating whether pricing mechanisms in marketing contribute to increased food waste. We used objective methods (waste sorting, shopping receipts) to quantify food waste and related market behaviors. Table 1 shows the averages and standard deviations of all attitude measurements. Table 2 describes the sample demographics. Table 1 shows significant price sensitivity in consumer discount shopping, but also contradictions: A. Price-driven stockpiling: Consumers tend to stockpile when items are on sale (Item 4: 3.43±1.12), especially dairy (Item 32-2: 3.87±0.81) and meat (Item 32-1: 3.87±0.81). However, this may lead to the highest waste proportion for long-term foods (Item 33-5: 4.20 ± 0.70), reflecting a cycle of "over-buying - forgetting - discarding." B. Low price vs quality: Despite claiming to "only care about cheap" (Item 8: 4.17±0.69), consumers also value product quality (Item 5: 3.43±1.12). This suggests that low prices alone cannot drive long-term purchases; quality assurance (e.g., freshness labels for near-expiry items) is needed. Regarding waste hotspots and behavioural gaps, only 37% of households utilise leftovers to create new dishes (Item 24: 2.80±0.95) and lack effective refrigerator management skills (Item 25: 2.80±0.95). Consumers have low environmental action scores (Item 42: 2.30±0.97), so environmental appeals need to be translated into economic

incentives (e.g., “food saving coupons”).In summary, the impact of price promotions on food waste is highly context-dependent. “Data-driven dynamic pricing” and “behavioral economics strategies” can help retailers balance sales goals with waste reduction, achieving a “reduce waste, not revenue” win-win.

Table 1. Questionnaire Items

Item	1	2	3	4	5	mean	sd
1. I prefer to wait for groceries to go on sale before buying them.						2.83	0.78
2. I pay attention to which groceries are on sale.						3.37	1.11
3. I easily buy groceries when they are on sale.						3.37	1.11
4. When I find groceries on sale, I buy them to stock up.						3.43	1.12
5. I focus on low prices, but I also care about the quality of grocery products.						3.43	1.12
6. When buying groceries, I compare the prices of different items to ensure I get good value for my money.						2.73	1.03
7. I often check prices in stores to make sure I’m getting my money’s worth.						2.73	1.03
8. I only care about what groceries are cheap; I don’t want to spend time and effort screening.						4.17	0.69
9. I am unwilling to spend extra effort to find lower prices.						4.17	0.69
10. I shop at multiple stores to take advantage of low prices and special offers.						4.03	0.75
11. I compare prices at different supermarkets to buy the most suitable products.						4.03	0.75
12. I often spend more than I earn. (I often live beyond my means.)						3.9	0.75
13. My budget is always tight.						3.9	0.75
14. The price I often have to pay is more than the cash I have on me.						2.5	0.81
15. I have never thought about throwing away something that can still be used.						2.5	0.81
16. I only buy what I can use.						2.87	0.99
17. I always finish my meals.						2.87	0.99
18. My family and I do not try to eat leftovers in the refrigerator.						3.07	0.96
19. My family and I don’t eat unopened food that we find in the cabinets, refrigerator, or freezer.						3.07	0.96
20. My family and I don’t eat more of the groceries that we buy on promotion.						3.4	1.02
21. My family and I eat more than we should to avoid food waste or leftovers.						3.4	1.02
22. My family and I throw away expired food.						2.8	0.98
23. My family and I often put leftover food in the refrigerator or freezer.						2.8	0.98
24. My family and I use leftovers to make new meals.						2.8	0.95
25. My family and I can control how long things are stored in the refrigerator.						2.8	0.95
26. When buying fruits and vegetables, do you often buy fruits and vegetables that are different in shape or size?						2.73	1
27. When buying groceries, do you often buy products with cosmetic defects (e.g., dented packaging)?						2.73	1
28. When buying groceries, do you often buy products that are close to their expiration date?						3.37	0.98
29. My family and I prioritize using leftovers and soon-to-expire food when cooking.						3.37	0.98
30. My family and I check the expiration dates of food purchased in supermarkets.						3.87	0.88
31. When we are in the supermarket, I consider whether there is space in the refrigerator to accommodate the portion we will not eat immediately.						3.87	0.88
32. Under normal circumstances, what percentage of your monthly grocery shopping do you estimate is for discounted items? Meat and meat products?						3.87	0.81
A. A. Dairy products?						3.87	0.81
B. B. Baked goods?						2.7	1
C. C. Fruits and vegetables?						2.7	1
D. D. Shelf-stable foods (dry goods...)?						2.23	0.67
E. E. Other food categories?						2.23	0.67
33. Under normal circumstances, what percentage of the food do you estimate is discarded each month? Meat and meat products?						2.93	0.89
A. Dairy products?						2.93	0.89
B. A. Dairy products?						3.43	0.88
C. B. Fruits and vegetables?						3.43	0.88
D. C. Shelf-stable foods (dry goods...)?						4.2	0.7
E. D. Other food categories?						4.2	0.7
34. Being very successful is important to you. You like to attract attention and impress others.						3.4	1.05
35. It is very important to you to show your abilities. You want people to appreciate your work.						3.4	1.05
36. You firmly believe that people should care for nature. Protecting the environment is very important to you.						2.9	1.01
37. You believe that everyone in the world should be treated equally.						2.9	1.01
38. You want to seek justice for everyone, even for people you don’t know.						3.67	0.65

39. It is important to you to listen to the opinions of people who are different from you. Even if you disagree with other people's views, you still want to understand them.						3.67	0.65
40. It is important to me that the products I use do not harm the environment.						3.37	0.84
41. My concern for the environment influences my shopping habits.						3.37	0.84
42. I consider myself environmentally responsible.						2.3	0.97
43. Acting in an environmentally friendly way.						2.3	0.97
44. Responsible behavior causes inconvenience.						2.6	1.05
45. How often does your family generally buy food?						2.6	1.05
46. Percentage of shopping at discount stores.						3.53	0.96
47. What is your shopping frequency?						3.53	0.96

Scale: 1. Very Disagree 2. Disagree 3. Neutral 4. Agree 5. Very Agree

Table 2 shows that 83.33% of respondents were female, reflecting that Taiwanese households' grocery shoppers are mainly women. This may bias results toward female consumption patterns. The age is concentrated in younger generations: 21-30 years old accounted for 50%, indicating that the research subjects are mostly "Millennials" and "Z generations", and their consumer behavior may have the following characteristics: A. High mobile device usage (affecting real-time discount reception) B. High concern for sustainability issues (but the actual environmental action score is only 2.30±0.97, there is a gap between attitude and behavior). The household size is relatively large: 4-5 households account for 50%, and these households may face the challenges of purchasing larger batches of ingredients (consistent with the high discount shopping ratio of item 32) and high complexity in leftover food management (the score of item 24 "using leftover food" is only 2.80±0.95). The male sample is only 16.67%, which may underestimate the impact of gender differences on promotion sensitivity. For example, men are more prone to impulsive purchases (according to the literature), and women pay more attention to household food storage management (as indicated by the low score of item 25). The 51-60 age group accounted for 16.67%, and their consumption characteristics (such as a preference for physical channels and discount sensitivity) are significantly different from those of young people; however, the insufficient sample size may dilute the behavioural characteristics of this group. Those with a university degree accounted for 43.33%, but the environmental action score was low (Item 42: 2.30 ± 0.97), indicating a contradiction between "high cognition - low practice". It is recommended that follow-up studies add an "environmental knowledge test" to clarify the relationship.

Regarding the impact of household size on the waste mechanism, the dual pressure of 4-5 people's families: A. Prioritize purchasing efficiency: high proportion of purchasing discounted goods (Item 32-1 meat 3.87±0.81) B. Storage and management dilemma: Refrigerator space competition (Item 31: 3.87±0.88) leads to an increase in the forgetting rate of immediate products C. Implicit waste among people living alone: The 10% proportion of people living alone may be forced to purchase conventional specifications due to the "scarcity of small packages", which forms a causal chain with the high waste rate (4.20±0.70) of long-term food in Item 33-5. To sum up, the demographic structure of this sample accurately reflects the gender and generational characteristics of Taiwan's food procurement market; however, attention should be paid to its limitations on research inferences. It is recommended that subsequent studies employ stratified sampling and design interventions tailored to different household sizes to enhance policy effectiveness.

Table 2: Questionnaire Content for Demographic Information

Item		Percentage (%)
Gender	Female	83.33%
	Male	16.67%
Age	15-20 years old	6.67%
	21-30 years old	50.00%
	31-40 years old	13.33%
	41-50 years old	6.67%
	51-60 years old	16.67%
	61 years or older	6.67%
	10-11 people	3.33%
Household Size	2-3 people	30.00%
	4-5 people	50.00%
	6-7 people	6.67%
	Living Alone	10.00%
	University (Bachelor's)	43.33%
	Graduate School or above	6.67%

Education Level	High School	23.33%
	Below Elementary School	3.33%
	Junior High School	10.00%
	Vocational College (Associate)	13.33%

Using multiple regression analysis (see Table 3), this study examined (1) whether ingredient price promotions influence household purchasing behavior, (2) whether frugal consumption psychology reduces food waste, (3) whether larger household size contributes to food waste due to bulk purchases, and (4) whether environmentally conscious households are more effective at utilizing food resources and reducing waste. Table 3 shows the regression analysis of factors influencing food waste. In Model M1, X1 (ingredient price promotions) had a significant positive impact on food waste (coefficient = 0.0820, p-value = 0.0000), supporting the "discount-induced overbuying" hypothesis. $R^2 = 0.0252$, indicating that the model explains only 2.52% of the variance in food waste, and more control variables are needed to improve explanatory power. In Model M2, X2 (frugal consumption psychology) had a significant negative impact on food waste (coefficient = -0.0376, p-value = 0.0190), reflecting that frugal behavior helps reduce waste. $R^2 = 0.0062$, which means that it has weak explanatory power. The recommendation is to analyse the variables by combining them with other variables, such as environmental consciousness. In Model M3, X3 (household size) had a weak negative impact on food waste (coefficient = -0.0281, p-value = 0.0917), which did not reach a significant level, and this may be due to the skewed sample structure (4-5 people households accounted for 50%). $R^2 = 0.0032$, and this explanation has insufficient power. Further exploration of the mediating variables, such as food storage management skills, is needed. In Model M4, X4 (environmental consciousness) had a significant negative impact on food waste (coefficient = -0.0340, p-value = 0.0470), showing that environmental consciousness can effectively inhibit waste. $R^2 = 0.0044$, and it has limited explanatory power, which may be caused by the low scores of environmental behavior in this study (Item 42: 2.30±0.97).M1 has a positive impact, which supports the "discount-induced over-purchase". This is also consistent with past literature (Aschemann-Witzel et al., 2017). A negative impact of M2 reflects that thriftiness can help lower food waste. It is recommended that promotional strategies be designed by combining both "cost-saving" and "environmental consciousness". The effect of household size on waste did not reach statistical significance. This could be due to a bias in the study design.

Furthermore, it is advised that interventions designed differently for different sizes of households be created in future studies. Environmental awareness has been proven to reduce food waste. However, there is not enough action on the variable (Item 42: 2.30±0.97). It is recommended that environmental actions be made with financial incentives (like food-saving points). The results of the study also support the hypothesis that financial promotions, thriftiness, and environmental actions have an impact on food waste. However, the explanation is relatively low.

Table 3: Multiple Regression Analysis of Explanatory Variables on Food Waste

model	Y: Food Waste	Coefficient	Standard	t-Statistic	p-Value	R-
M1	Intercept	0.2867	0.0188	15.2685	0.0000	
	X1: Ingredient Price Promotions	0.0820	0.0171	4.7918	0.0000	0.0252
M2	Intercept	0.4677	0.0581	8.0498	0.0000	
	X2: Frugal Consumption Psychology	-0.0376	0.0160	-2.3500	0.0190	0.0062
M3	Intercept	0.4132	0.0482	8.5699	0.0000	
	X3: Household Size	-0.0281	0.0166	-1.6884	0.0917	0.0032
M4	Intercept	0.4711	0.0696	6.7708	0.0000	
	X4: Environmental Consciousness	-0.0340	0.0171	-1.9894	0.0470	0.0044

This article examines the factors that influence household food waste. The effect of price promotions on household food purchasing behaviour presents a dual picture: some families increase their purchases due to discounts but lower their willingness to buy due to concerns about freshness and quality (Lee & Chen-Yu, 2018). Some families are less sensitive to price promotions, focusing more on food quality and suitability, showing the limitations of the Price Sensitivity Theory (Liaochienan, 2023). Household structure (characterised by smaller families) and consumption habits (with a focus on quality) may weaken the effectiveness of promotions (Wu & Wang, 2014). Frugal consumption significantly reduces food waste, aligning with the Theory of Planned Behaviour (Ajzen, 1991). Frugal families exhibit greater caution and demand assessment when purchasing, thereby improving food use efficiency (Stefan et al., 2013; Han et al., 2010). Family education (e.g., financial literacy) positively impacts consumption decisions, promoting reasonable planning (Tao, 2015). Social marketing strategies (food storage guides, leftover reuse) can strengthen consumer behavior control (Kotler & Lee, 2008).

Larger families tend to make more purchases due to high demand. Still, a lack of effective management may increase waste. Promotional incentives maximise short-term profits (Behavioural Economics, Present Bias), neglecting long-term resource allocation (Ajzen, 2002). Diverse dietary needs and time pressure increase the complexity of food management, thereby

increasing the risk of waste (Ajzen, 1991). Modern food management techniques (freezing, batch cooking) can significantly reduce waste (Ajzen, 2002).

Environmentally conscious households significantly reduce food waste, consistent with the Sustainable Consumption Theory, by prioritising organic and local ingredients, reducing food transportation carbon emissions, and minimising food waste frequency. Raising environmental awareness is an effective strategy for reducing waste, and it can serve as a guiding principle for policy interventions. Overall, price promotions, frugality, household size, and environmental awareness jointly influence household food waste behavior. The research results support the design of intervention strategies through behavioural economics and planned behaviour theory, such as dynamic pricing, social marketing, and environmental education, to achieve the dual goals of efficient resource utilisation and waste reduction.

V. CONCLUSION AND RECOMMENDATIONS

This study examined the drivers of food waste, with a focus on the dual effect of price promotions. While promotions can stimulate short-term consumption, they can also lead to over-purchasing and waste (Lee & Chen-Yu, 2018). Consumer doubts about the freshness and quality of promoted items weaken the effectiveness of the promotion, revealing the limitations of price sensitivity theory (Liaochienan, 2023). Household structure (e.g., smaller families) and consumption habits (e.g., focus on quality) further moderate the impact of promotions (Wu & Wang, 2014). Frugal consumption psychology: Frugality significantly reduces food waste, aligning with the Theory of Planned Behavior (Ajzen, 1991). Frugal families demonstrate higher demand assessment and food management skills (Stefan et al., 2013; Han et al., 2010) and reinforce rational consumption behavior through family education (e.g., financial literacy) (Tao, 2015).

Household size and management skills: Larger households tend to increase their purchasing volume due to high demand; however, a lack of effective management can exacerbate waste. Promotional incentives lead to short-term profit maximization (Behavioral Economics, Present Bias), neglecting long-term resource allocation (Ajzen, 2002). Modern food management techniques (e.g., freezing, batch cooking) can significantly reduce waste (Ajzen, 2002). Environmental awareness and sustainable consumption: Environmentally conscious households significantly reduce food waste, consistent with the Sustainable Consumption Theory. Planned purchasing (e.g., organic, local ingredients) and educational advocacy are effective strategies for reducing waste.

Multiple factors, including price promotions, frugality, household size, and environmental awareness, drive food waste. Through dynamic pricing, behavioral interventions, and community resource sharing, waste can be effectively reduced. Future research should focus on personalized promotions, cultural values, and longitudinal analysis to provide a more comprehensive empirical basis for policymaking.

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