Determination of the Amount of Food Waste in the University Refectory and the Effect of Improvements Made to Reduce Food Waste

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Abstract

Determining the amount of food waste is crucial for identifying specific areas needing improvement and for measuring the effectiveness of implemented changes. This study aimed to assess food waste in university cafeterias before and after implementing menu improvements and nutritional awareness initiatives. Data collection included food waste measurements, nutrition knowledge seminars, and surveys conducted from December 2020 to August 2021. Menu improvements involved standardizing recipes and enhancing the texture, color, and flavor of meals. Educational

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initiatives, such as seminars, posters, and brochures, were used to raise awareness about food waste. Overall, food waste decreased significantly after menu changes, particularly in soups, main courses, and second courses ($P < 0.05$), with the exception of salads and desserts. There were no significant differences in participant characteristics before and after the improvements ($P > 0.05$). Satisfaction with menu quality and meal service increased significantly ($P < 0.001$), and participants' awareness of food waste improved ($P < 0.05$). The findings indicate that menu improvements and increased nutritional awareness can effectively reduce food waste, thereby mitigating negative environmental and economic impacts.

***Keywords**: Awareness, food waste, menu improvement, refectory*

Introduction

Food is essential for health and life, and everyone has the right to access it. Food loss and waste occurs throughout the food chain, from cultivation to final consumption. This phenomenon describes the edible portions of plants and animals grown or harvested for human consumption that do not end up being eaten. Significant food loss occurs at each stage of the food chain, exacerbated by the impact of climate change (Ündevli et al., 2019). Studies on food waste and nutritional awareness are crucial as they help identify effective strategies to reduce environmental impact, promote sustainable consumption, and enhance public health through better dietary habits. According to the United Nations Environment Program (UNEP, 2021), approximately 931 million tons of food waste were generated in 2019, with 61% coming from households, 26% from food services, and 13% from the retail sector. This indicates that 17% of total global food production may be wasted. The Food and Agriculture Organization (FAO, 2011) reports that 1.3 billion tons of edible food is wasted annually worldwide, equating to one-third of the food produced for human consumption. High levels of food waste and loss are prevalent at the distribution and consumption stages in high- and middle-income countries (HLPE, 2014). In developed countries, food losses at the consumption stage are higher than at other stages (Caldeira et al., 2021; Kummu et al., 2012; Wang et al., 2017). In Europe and North America, food losses per person are 280-300 kg per year (HLPE, 2014). Irrespective of a country's level of economic development and maturity, food losses must be kept to a minimum to avoid the adverse effects mentioned above (Caldeira et al., 2021).

Mass consumption sites are places where food is processed, produced, and offered for consumption in the same place. The nutrition of people with these prepared meals is referred to as mass feeding (Dölekoğlu & Var, 2016). In mass caterers, waste generated by the consumer stands out, while losses during food preparation and food spoilage due to storage accompany this waste. Consumer-induced waste in HCFs varies depending on factors such as portion size, variety, taste, and presentation of the food, as well as socio-demographic factors (Antasouras et al., 2023). Plate waste is defined as edible food left on the plate from the food served. It is a common cause of food waste for consumers and the food and beverage industry (Akkaya, 2003; Antasouras et al., 2023). In the literature, it is stated that studies to increase consumer awareness on the reduction of plate waste are emphasized (Kamalul Ariffin et al., 2023). Dissatisfaction of the served group with the food and beverage service, lack of awareness about food waste and inadequate nutritional knowledge can also be counted among the factors that lead to increased food waste in the food and beverage industry.

In a research study conducted at a Nigerian university, the composition of solid waste was analyzed to determine the proportions of various components. Food waste was found to be the largest portion, amounting to nearly 140 kg per day. The majority of this food waste was generated by the university's cafeterias and restaurants (Okeniyi and Anwan, 2012).

Gustavsson and friends' study provided a comprehensive analysis of global food waste, emphasizing the role of educational programs in waste reduction. It identified the need for targeted interventions in high-waste areas such as cafeterias (Gustavsson et al., 2011).

Caldeira and friends' study focused on the causes of food waste at the consumption stage in developed countries. It suggested that increasing consumer knowledge and changing eating behaviors are crucial for waste reduction (Caldeira et al., 2021).

Studies on food waste reveal the complexity and multidimensionality of this issue. In literature reviews on the causes and solutions of food waste, certain variables and factors have been examined, usually using systematic reviews and bibliometric analyses. Food waste is influenced by factors such as consumer behaviors, social and cultural factors, economic factors, education and awareness level (dos Santos et al., 2022). The studies conducted reveal that a multidisciplinary approach should be adopted to prevent food waste and comprehensive solutions should be produced at both individual and social levels. In this study designed within this framework, it was aimed to determine the effect of menu improvements and awareness-raising activities.

While these studies underscore the importance of educational interventions in reducing food waste, there is a lack of specific research on the impact of menu improvements combined with nutritional awareness in university settings. Our study aims to fill this gap by assessing the effectiveness of such interventions in a university cafeteria, providing a unique contribution to the existing body of knowledge. This study consists of two parts. One is to measure awareness of the nutritional value of food and awareness of food waste. This was achieved through awareness raising activities such as seminars, posters, and brochures. Another is to determine the amount of waste in the refectory and make improvements in recipes to reduce the amount of waste by establishing a relationship between the amount of waste and the menu.

It can be evaluated as an original study in which the study was carried out with the cooperation of the fields of nutrition and dietetics and gastronomy and culinary arts with the improvement of nutritional knowledge level capacity and food recipes at the same time. The study indicates that efforts to raise awareness and improve menus will help reduce food waste.

Methods

The primary research question of this study is whether increasing nutritional knowledge awareness and improving food recipes will reduce the amount of food waste in university cafeteria lunches. The study involved participants who consistently ate in the main dining hall of the university. The number of participants was limited due to the comparison between pre- and post-intervention groups and the study being conducted during the Covid-19 pandemic.

This study was carried out by comparing before and after studies on food and beverage satisfaction measurement, menu improvement and nutritional knowledge level measurements. To analyze the current situation, the study was first conducted by measuring the amount of food waste. Measurement of refectory satisfaction and nutritional knowledge level was also carried out at the same time without any training

and seminars. After this data was analyzed, improvements were made in the most wasteful meals. Simultaneously, seminars on healthy eating habits and food waste were given to people who eat in the refectory through the nutrition and dietetics program, and brochures were hung in the refectory to raise awareness. After all the studies, the amount of food waste was measured again. The results were compared by reapplying the surveys after all improvements and awareness studies.

The study data were collected between December 2020 and August 2021. The study was carried out under two headings. 1) determining the amount of waste in the canteen and improving recipes, and 2) awareness raising and nutrition training. These two processes were carried out together.

Adaptation of the "food and beverage service satisfaction scale"

The Food and Beverage Service Satisfaction Scale was adapted by the researchers to identify the improvements to be made to the menu.

A systematic search was carried out using the terms nutritional knowledge, eating behavior, satisfaction with meals and meal service, quality of service in the canteen, physical suitability of the canteen and knowledge of food waste. The items were modified from the literature (Arlanda & Suroso, 2018; Batmaz, 2018; Yahia et al., 2016). The researchers analyzed the questionnaires and scales in the food and beverage service literature, including questions about individual expectations, menu quality and food waste, and a pool of questions was created. The Food and Beverage Service Satisfaction Scale consists of 6 sub-headings: Q1 is about the quality of the menus in the institution, Q2 is about the quality of the service provided, Q3 is about satisfaction with the meals served in the institution and Q4 is from a consumer perspective, Q5 is about the physical suitability of the refectory and Q6 is about food waste.

Control questions were asked under the sub-heading of questions from the consumer perspective, but this sub-heading was not included in the statistical evaluation.

The questions are answered on a 5-point Likert scale as (1) Strongly Disagree; (2) Disagree; (3) Neither Agree nor Disagree; (4) Agree, and (5) Strongly Agree. The questionnaire was administered twice during the study, before and after the menu improvement. The sample consisted of participants who ate lunch in the refectory. The questionnaires' contents are indicated in Table 1. The sub-items of this questionnaire were carefully examined by the researchers and menu improvements were made accordingly.

Adaptation of the "nutrition knowledge level scale"

A Nutrition Knowledge Level Scale was adapted by the researchers to measure the participants' level of basic nutrition knowledge.

The Nutrition Knowledge Level Scale, like the Food and Beverage Services Satisfaction Scale, was adapted by the researchers based on a literature review (Aktaç et al., 2018; Nazmi et al., 2019). The dietary knowledge survey consists of 6 main items about the basic macro- and micronutrient content of food groups. The questions are answered on a 5-point Likert scale. At the beginning and at the end of the study, the researchers provided basic nutrition training to all participants. The researchers designed the items (Food and Beverage Service Satisfaction and Nutrition Knowledge Level Scale) specifically for the questionnaires to be administered to the study participants. The questionnaires' contents are indicated in Table 2.

Table 1
The food and beverage service satisfaction questions

	Questions about the quality of the menus issued in cafeteria	Strongly Agree	Agree	Neither Agree nor	Disagree	Strongly Disagree
1	The food served in the cafeteria is fresh.					
2	The menus offered in the cafeteria are sufficient in terms of content.					
3	In the cafeteria, the menu with the same name is always of the same quality (in terms of taste, smell, appearance, etc.).					
4	The quality of the food served in the cafeteria is high.					
5	Cafeteria food is sufficient in terms of variety.					
6	The menus offered in the cafeteria are sufficient in terms of taste.					
7	The menus offered in the cafeteria are open to improvement in terms of taste.					
8	The portion sizes of the meals are sufficient.					
9	The portion sizes of the meals are large.					
	Questions about the quality of the service provided	Strongly Agree	Agree	Neither Agree nor	Disagree	Strongly Disagree
10	The presentation style of the dishes is appropriate.					
11	Service materials (plates, bowls, trays, forks, spoons, knives, etc.) in the cafeteria have been chosen correctly.					
12	The service speed of the food in the cafeteria is sufficient.					
13	Meals are served at a temperature suitable for consumption.					
14	Various improvements can be made in the presentation of the dishes to obtain a more aesthetic appearance.					
15	The menu announced in the menu is the same as the menu offered.					
	Satisfaction of the meals served in the cafeteria	Strongly Agree	Agree	Neither Agree nor	Disagree	Strongly Disagree
16	I leave the cafeteria with my physiological needs satisfied (my stomach is full).					
17	I leave the cafeteria psychologically satisfied.					
18	The cafeteria menu affects my motivation during the day.					
19	Having the food I like in the cafeteria affects my motivation during the day.					
20	The menus offered in the cafeteria are planned to meet my energy and nutritional needs.					
21	The appearance of the food served in the cafeteria is aesthetically pleasing.					
	Questions for the consumer	Strongly Agree	Agree	Neither Agree nor	Disagree	Strongly Disagree

22	I am happy with my decision to eat in the cafeteria.					
23	I mostly eat in the cafeteria, as I love cafeteria menus.					
24	I find the food served in the cafeteria to be tasteless.					
25	The menus offered in the cafeteria are prepared in accordance with the cooking/preparation technique.					
26	The dishes served in the cafeteria complement each other in terms of color harmony and consistency.					
27	Having knowledge about the menus offered in the cafeteria (nutritional content) will increase my consumption of the cafeteria menus.					
28	Problems experienced in the cafeteria menu presentations are improved in a suitable time with corrective actions.					
Physical suitability of the cafeteria		Strongly Agree	Agree	Neither Agree nor Disagree;	Disagree	Strongly Disagree
29	The eating environment is suitable in terms of cleanliness and hygiene.					
30	The layout of the dining hall is appropriate.					
31	Since the cafeteria is noisy, I prefer to eat and leave as soon as possible.					
32	The lighting of the cafeteria is sufficient to see the food consumed clearly.					
33	The temperature of the dining hall is ideal for sitting and eating.					
34	Dinnerware (such as forks, knives) in the cafeteria is visually appropriate.					
35	I can move freely in the table setting in the cafeteria.					
36	Presentation sets (glass, porcelain) in the cafeteria are suitable.					
Questions about food waste		Always	Often	Sometimes	Rarely	Never
37	There is food left on my plate from the food served in the cafeteria.					
38	Do you intervene when the people you eat with in the cafeteria waste food?					
39	Do you think you take effective measures in your life to prevent food waste?					
40	Are the meals served in the cafeteria prepared in accordance with the purpose of preventing food waste?					
41	I am aware of the extent of food waste, and I pay attention to this in my own life.					
42	A significant part of the food served in the cafeteria is thrown away.					
43	I am willing to take part in efforts to prevent food waste.					
44	Since the food is free, I can leave it on my plate without consuming it.					
45	I share the food left on my plate with street animals.					

Table 2
The nutrition knowledge level questions

Questions about nutrition knowledge level		Strongly Agree	Agree	Neither Agree nor	Disagree	Strongly Disagree
1	I consume the food served in the cafeteria knowing the nutritional content (carbohydrate, fat, protein, vitamin, mineral).					
2	Carbohydrates, fats and proteins provide energy.					
3	Fruits are rich in all vitamins and minerals.					
4	Bulgur rice is rich in B group vitamins (such as thiamine) and fiber.					
5	Calcium found in milk and dairy products is important for bone and dental health.					
6	Eggs, red meat, chicken and fish are rich in protein.					
7	I try to learn about the nutritional content (carbohydrate, fat, protein, vitamin, mineral) the meals served in the cafeteria.					
Questions about adequate and balanced nutrition		Always	Often	Sometimes	Rarely	Never
8	I consume fatty and sugary foods.					
9	I add salt to food.					
10	I eat fruits and vegetables.					
11	I consume legumes.					
12	I consume fast food products such as hamburger, French fries, pizza.					

The internal consistency reliability of the scale adapted by the researchers was statistically tested and the reliability value of the questionnaires was found to be higher than the recommended value of 0.70 (Cronbach's Alpha=0.912). There- fore, it can be said that the questionnaires had internal consistency reliability (Ozbiltekin-Pala & Börühan, 2020).

Determination of food waste

The first 6 months of the study were planned as observation and determination of the current situation, and the last 6 months as menu improvement and evaluation of the effects of menu improvement.

In this study, the observation method was used to justify and specify the critical status of the waste generated in the refectory of Cappadocia University's main campus. The observation method was chosen to see the total number of people eating in the university refectory during the research period and how much food was wasted at the end of the lunch period (Payne-Palacio & Theis, 2016). Food waste can occur from preparation to consumption in the refectory. In this analysis, we focused only on the wasted consumption phases at lunchtime. Food waste was identified as the edible part left on the plate after the meal (Wang et al., 2017) and categorized by type of meal.

Field surveys and direct weighing

We measured the amount of food waste over 110 days in two periods. This period was chosen because it matched the rotation of the menus to compare before and after the improvement. The lunch period was chosen because it was

the busiest time in the refectory. Lunch menus consist of 4 types of meal courses, which are soup, main course, second main course, salad or dessert. Before the service, all meal courses were weighed to determine the total weight of food prepared (Ozbiltekin-Pala & Börühan, 2020). All unfinished and leftover meals were then collected and weighed separately. A descriptive analysis of the total and percentage of food waste in different meals was performed.

Menu improvement

The approach to menu planning and development requires all aspects of an operation to be addressed with maximum efficiency and effectiveness (Cichoń, 2020). Therefore, while ensuring cost control is crucial in the menu development process, recipes have been created to standardize the meals on the menu to increase the expectations and satisfaction of university staff and students, reduce food waste and promote sustainable food practices.

The recipes were developed by the Department of Gastronomy and Culinary Arts at Cappadocia University. The meals included in the menu were adjusted based on the results of the survey. In this context, recipes were developed considering characteristics such as texture, color, aroma, spices, and herbs that influence the perception of flavor. Instructors from the relevant departments then trained the chefs to ensure standardization. This training aims to improve the applicability of the recipes.

Data handling and statistical analysis

Data were analyzed using IBM SPSS Statistics 22.0 (Statistical Package for the Social Sciences, SPSS Inc., Chicago, USA). The normality of food and beverage services satisfaction questionnaire and nutrition knowledge level questionnaire results using the Shapiro-Wilk normality test ($P < 0.0001$) . The Shapiro wilk result $P < 0.05$, data is not normally distributed. In addition, the kurtosis and skewness values of the expressions in the scale were also checked. Data were expressed as number (n), percentage (%), mean ($\bar{x}$) and standard deviation (SD). The Chi-square test was used to compare categorical variables. A two-sample dependent t-test was used to compare parametric data, and the Wilcoxon signed-rank test was used to compare non-parametric data. Values were considered significant at $P < 0.05$ with a 95% confidence interval (Baykan et al., 2023).

Ethical approval

Ethical approval was obtained from the Scientific Research and Publication Ethics Committee of Cappadocia University (Decision No: 2020/10, Date: 30.11.2020).

Results

Food waste was identified as the edible part left on the plate after the meal and categorized by type of meal. Data collection included food waste measurements, nutrition knowledge seminars, and surveys.

The demographic characteristics of the participants in the surveys are shown in Table 3 below.

Table 3
The demographic characteristics of the survey participants

		Before the menu development n / %	After the menu development n / %
	Total	172 / 100	177 / 100
Gender	Female	100 / 58.13	100 / 56.49
	Male	72 / 41.87	77 / 43.51
Marital status	Married	95 / 55.20	60 / 33.90
	Single	68 / 39.50	109 / 61.6
	Separated from his/her spouse/Spouse is not alive	9 / 5.20	8 / 4.50
Education Level	Primary	13 / 7.60	9 / 5.10
	Secondary	10 / 5.80	4 / 2.30
	High School	28 / 16.30	28 / 15.80
	Bachelors	62 / 36.00	78 / 44.10
	Graduate School	59 / 34.30	58 / 32.80
Occupation	Academician	63 / 36.60	58 / 32.80
	Administrative Staff	52 / 30.20	50 / 28.20
	Service staff	39 / 22.70	19 / 10.70
	Student	18 / 10.50	50 / 28.20
		Mean ± SD	**Mean ± SD**
	Age	31.68 ± 9.57	29.67 ± 8.51

There were no significant differences in the descriptive characteristics of the participants before and after the menu improvements ($P > 0.05$).

Table 4
The mean amount of food waste before and after the menu improvements

Food	The Meals' Mean Amount of Food Waste		
	Before the menu improvement	**After the menu improvement**	
	Mean±SD	**Mean±SD**	***p***
Soup (ml)	11.35±3.94	5.27±2.12	**<0.001**
Main course (g)	8.73±5.32	4.36±2.65	**<0.001**
Second main course (g)	7.34±4.73	3.55±2.13	**<0.001**
Salads or desserts (g)	1.78±2.06	1.59±1.40	**0.580**
Total Waste (g)	29.21±11.23	14.77±4.72	**<0.001**

Paired t-test results

In general, the amount of waste decreased after the developments (Table 4). With the exceptions of salads and desserts, the decrease in lefto- vers was statistically significant ($P < 0.05$).

The second part of the study assesses food and beverage service satisfaction before and after menu improvement and nutrition knowledge levels.

Table 5
Evaluation of food and beverage service satisfaction before and after menu improvement

Sub-headings	Before the menu improvement Mean±SD	After the menu improvement Mean±SD	*p*
The quality of the menus	20.23±7.83	19.94±7.27	**<0.001**
The quality of the service	11.14±3.82	12.12±5.02	**<0.001**
The satisfaction of the meals served	14.87±5.57	13.72±4.98	**<0.001**
Physical suitability of the refectory	12.36±5.01	13.51±6.47	**0.068**
Questions about food waste	20.02±4.20	19.91±4.44	**0.001**

Wilcoxon test results

The section on the quality of the menus shows a decrease in the score, which means that consumers are satisfied with the quality of the menus prepared in the establishment. There is a statistically significant difference between the satisfaction with the quality of the menus before and after the improvement. After the improvement, the average satisfaction of the participants with the quality of the menus increased significantly ($P < 0.001$).

Questions on the quality of the service provided section, which consists of 6 questions. A decrease in the score means that consumers are satisfied with the service provided. After the improvement, the mean satisfaction of the participants with the quality of the service provided decreased significantly ($P < 0.001$).

A decrease in the satisfaction score of the meals served in the organization means that consumers are more satisfied with the meals served in the organization. After the improvement, it was found that the participants were positively satisfied with the meals served in the institution ($P < 0.001$).

A decrease in the score in the food waste section indicates that respondents are more aware of food waste. It was found that participants' awareness of food waste increased after the improvement ($P < 0.05$).

In addition, two questions from the Food and Beverage Services questionnaire that were considered important for the study were analyzed separately. These are yes/no questions. First question: "Several improvements can be made to achieve a more aesthetic appearance in the presentation of the food" and the second question: "I find the food served in the cafeteria tasteless". However, there was no significant difference in the prevalence of yes and no answers to these questions before and after the improvement ($P > 0.05$).

Table 6
Evaluation of the score obtained from the nutritional knowledge level questionnaire form before and after the training

	Before the training	After the training	
	Mean±SD	Mean±SD	p
Nutrition knowledge level	10.54±3.71	10.90±3.89	**0.06**

Wilcoxon test results

A decrease in the score means that consumers' nutritional knowledge level increases. There is no statistically significant difference between the nutrition knowledge level before and after the training ($P > 0.05$).

Discussion

In the prevention of food waste; government and community-based, individual and household-based approaches come to the fore (Aschemann-Witzel et al, 2025). This study is one of the effective methods to reduce consumer-induced food waste from community-based approaches.

This study analyzed the impact of menu improvements and awareness raising activities on food waste of participants. In this study, the amount of waste decreased due to menu improvement (Table 4). It was found that the reduction in waste was due to the improvements made in a study to reduce food waste in nursery schools (McCray et al., 2018). The results of the studies are consistent. Improving the catering service according to the needs of the group served will help to reduce food waste and increase satisfaction with the food and beverage service (Sönmez, 2020).

The study by Bengül and Güven (2019) found that the amount of leftover food in the canteen was directly related to satisfaction with the food service. Another study examining the relationship between food quality, perceived service quality, customer satisfaction and commitment concluded that food and service quality is a factor that directly affects customer commitment (Eustachio Colombo et al., 2020). Another recent study of school meals, which examined the relationship between menu improvements and satisfaction, also found a linear relationship between meal improvements and consumer satisfaction (Clement et al., 2023). The study found that menu quality and participant satisfaction with menu service increased with menu improvement (Table 5). The results of the studies are consistent with each other and in general it can be said that an increase in satisfaction leads to a decrease in food waste.

When the data on the physical suitability of the canteen were analyzed, no statistically significant difference was found in the opinions of the participants before and after the menu improvement (Table 5). The dining atmosphere may also be a determinant of food waste (Soma et al., 2020). It is known that people do not like to eat in crowded, dark, and physically inappropriate dining rooms and may leave food on their plates to get out of the environment more quickly (Soma et al., 2020). In this sense, it is thought that improving the physical conditions of the dining room (lighting, appropriate table spacing, appropriate ceiling height, etc.) will contribute to reducing food waste. As this was a short-term study, no changes could be made to the physical conditions of the canteen. This situation can be considered a limitation of the study. Future studies on food waste could focus on the physical conditions of refectories.

When evaluating the data on awareness-raising activities, it can be said that the seminars held during the menu improvement process

and the posters and brochures displayed in the refectory were effective in this process (Table 5). Awareness-raising can be done through different methods such as training, gamification, brochures, and posters. A study comparing different educational approaches to raising consumer awareness of food waste reduction found that the gamification approach may be more effective than a passive approach to food waste reduction using leaflets (González-Campos et al., 2022). While approaches such as seminars, posters, and training only appeal to one sense, approaches such as drama and gamification are more effective teaching methods for ensuring the sustainability of the information given, as they appeal to more than one sense. In future studies on food waste, educational methods that appeal to more than one sense can be used to help ensure the durability and sustainability of the information provided.

Nutrition education was provided by the researchers in two different sessions to include basic nutrition information. However, there was no significant difference in the nutritional knowledge level of the participants before and after the training (Table 6). As the study took place during the pandemic, the training was delivered online. Researchers state that face-to-face and repeated training activities are more sustainable (Caldeira et al., 2021; Duman, 2020). These situations are among the limitations of the study. To achieve the desired success in nutrition education, more active participation of the trainees in the process can be ensured, the training period can be extended and/or the training can be repeated.

Conclusions

Sectoral and individual improvement efforts to reduce food waste in mass meal consumption, such as school cafeterias, highlight various strategies and interventions.

Monitoring and Reporting and Training and Awareness are among these practices. In the study, the amount of waste in the university cafeteria was monitored and the meals and dishes that produced the most waste were determined. With the nutrition awareness trainings provid- ed, waste that may arise from healthy products was reduced and conscious consumption was achieved.

In addition to all these applications, systems using smart storage and supply chains can prevent food waste. Composting of wasted organic products also reduces environmental impacts. In future studies, the effects of other factors that will be effective in preventing food waste can also be examined.

For policy makers and regulators: Governments and regulators should develop policies that require educational programs on food waste in educational institutions. These programs should focus on both nutritional knowledge and practical waste reduction techniques.

Incentives for sustainable practices: Provide incentives to institutions that implement successful waste reduction strategies, such as grants or recognition programs.

Academic Implications: Curriculum integration: Universities should integrate food waste education into their curricula, particularly in courses related to nutrition, environmental science and hospitality management.

Further research: Encourage further studies on the long-term impact of educational interventions on food waste, focusing on different types of institutions and demographic groups.

Practical applications: Training for cafeteria staff: Ongoing training programs for cafeteria staff on sustainable food preparation and waste management practices.

Student engagement: Engaging students through interactive workshops and campaigns that highlight the importance of reducing food waste and making informed food choices.

Menu improvements based on the preferences of the group receiving food and beverage services are a very important step in preventing the negative environmental, economic, and human health impacts of food waste and increasing consumer satisfaction. Determining the current expectations of the consumer group is relatively easy and cost-effective through surveys. Leading food and beverage service providers in this direction is one of the most important steps to be taken in terms of economic, environmental, and human health. In summary, reducing food waste and changing the food system could be achieved by changing the operation of food systems, menu planning, collaboration, and differ- ent educational approaches.

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