The Development of Food Waste Reduction Strategy on the Food Service Sector in Indonesia

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Abstract

Research on sustainability has steadily increased in the last few decades, one of them being the food loss and waste issue. Indonesia generated 23 – 48 million tons of FLW per year, whereas most of it was generated in the consumption stage. The consumption stage, especially the HaFS sector, continues to become a key concern because of its contribution to total food waste of around 12%. Therefore, the goal of this study is to provide a set of relevant food waste reduction strategies that could be used in the food service sector in Indonesia. Initially, a literature review was conducted to identify several food waste reduction strategies that could be used in the foodservice sector. Then, the list was validated by a group of experts consisting of restaurant owners and managers, government, non-government, and academics. Content validity index (CVI) method was used to evaluate the list of food waste reduction strategies, and to get consensus from all of the experts that participated. From 24 strategies that were identified, it then became 19 strategies with seven strategies from the literature review discarded, and two additional strategies added from the suggestion of the expert. Further development of this food waste reduction strategy could be done by employing decision-making methods like multi-criteria-decision-making (MCDM).

Keywords
Food Waste, Hospitality and Food Service, Content Validity Index (CVI)

1. Introduction

Research on sustainability has steadily increased in the last few decades, one of them being the food loss and waste (FLW) issue. According to FAO (2017), about one–third of global food production is lost or wasted along the food value chain, or about 1,3 billion tons of food waste per year. FLW is considered an unethical issue, knowing that there's still hunger, food insecurity, and inequality in access to food (Aschemann-Witzel et al. 2018). Moreover, the increase in the global population, makes it a significant issue (Rani et al. 2021). From 2000 – to 2019, Indonesia generated 23 – 48 million tons of FLW per year, whereas most of it was generated in the consumption stage. It's estimated that 1,702.9 million tons CO2 eq of greenhouse gas emission was generated, the economic loss due to FLW generation is around 213 – 551 trillion rupiah per year, and 61 – 125 million people could be fed from it (Bappenas 2021). Therefore, it is necessary to develop a more sustainable food chain to reduce the impact of FLW on humankind.

The reduction of FLW should be implemented across the food supply chain. FLW is estimated to occur at the agricultural stage (11 – 23%), during industrial processing (17 – 19%), at the retail stage (8 – 17%), and more than 50% at the consumption stage (Magalhães et al. 2021). Nevertheless, the drivers of FLW are often dependent on the market and the socio-cultural background of the country (Filimonau and Ermolaev 2021; Teng et al. 2021). At the consumption stage, food waste could be generated from the household and the hospitality and foodservice (HaFS) sector. The consumption stage, especially the HaFS sector, continues to become a key concern because of its contribution to total food waste of around 12% (Dhir et al. 2020). Furthermore, most of the food waste that is generated in the HaFS sector could be avoided, approximately around 75% of it is categorized as avoidable food waste (Vizzoto et al. 2021). Hence, the HaFS sector has been identified as one with a lot of promise for reducing food waste (Papargyropoulou et al. 2019).

Food waste can be associated with the waste of money and resources, therefore the reduction of food waste will have a direct impact on sustainability, decreasing the emission of greenhouse gasses, fulfilling societal needs, giving better economic benefits and ecological balance (Eriksson et al. 2018; Gokarn and Choudhary 2021). Food waste is also considered a complex problem, where its amount and composition differ on each type of foodservice (Beretta and Hellweg 2019). To reduce food waste, it is necessary to understand the problem, where and how the food wastage happens (Eriksson et al. 2019; Lins et al. 2021). On the food service scope, it is also important to understand the different points of the food transformation process (procurement, storage, preparing, serving, etc.), to get appropriate measures to reduce food waste (Vizzoto et al. 2021).

Despite the increasing research on the food waste issue, the study largely focused on the developed countries, whereas the developing countries like Indonesia which also struggles with the food waste issue may have a different perspective and socio-economic background to overcome the issue (Dhir et al. 2020; Filimonau and Ermolaev 2021). Therefore, this study focuses on the food waste reduction issue in the food service sector in the context of Indonesia. The goal of this study is to provide a set of relevant food waste reduction strategies that could be used in the food service sector in Indonesia. Because there are many types of food services that are considered in HaFS, this research focuses on the food service in the business segment which is a restaurant in general, as a research boundary.

The remainder of this paper is structured as follows: In Section 2 the literature review related to food waste, the foodservice sector, and the content validity index (CVI) are present. Section 3 presents the research methodology, meanwhile, Section 4 presents the data collected, and Section 5 presents results and analysis of the findings. Finally, the conclusion and suggestions for future research are presented in Section 6.

2. Literature Review

2.1 Food Waste

The food supply chain consists of multiple stages, starting with (1) pre-harvest, (2) harvest, (3) on-farm post-harvest, (4) transport, storage, and distribution, (5) processing and packaging, (6) retail, and (7) consumption stage. This food supply chain consists of two different terminologies, food loss, and food waste. According to FAO (2019), food waste is the decrease in the quantity or quality of food resulting from decisions and actions at the retail stage and consumption stage. Food waste can be categorized into three different types: (a) avoidable food waste, (b) unavoidable food waste, and (c) potentially avoidable food waste (Dhir et al. 2020).

The impact of food waste on the food supply chain stands out from the others, because of the costs that must be paid across the food value chain during the food production, and is also using a lot of resources (Lins et al. 2021). On the other hand, food waste contributes 15 – 16% to the environmental impact of the entire food chain with an estimation of 88 million tons of food being wasted (Beretta and Hellweg 2019). The waste at the stage of consumption can be generated by the household sector, or the HaFS sector, where 75% of food waste in the HaFS sector is categorized as avoidable food waste (Vizzoto et al. 2021). Furthermore, the HaFS industry is predicted to expand in the future owing to urban population and tourism growth which will likely boost the food waste generation level (Munir 2022).

2.2 Hospitality and Food Service Sector

Based on Dhir et al. (2020), all the outlets that serve food and drinks for immediate consumption in an out-of-home context are included in the HaFS sector. Later it's categorized into three key segments, (1) the business segment, which includes food services like restaurants, hotels, cafés, coffee shops; (2) the education segment, which includes a school or college canteens, and then there is (3) the health care segment, which includes a hospital, and nursing homes.

Solving the food waste problem in the HaFS sector is considered to be difficult, where each type of food service will have a different amount and composition of food waste, thus the problem in each type of the foodservice sector can't be generalized and used on the other food service (Beretta and Hellweg. 2019; Filimonau and Ermolaev. 2021). Furthermore, Filimonau and Ermolaev (2021) reported that most food service businesses are small-to-medium-sized enterprises (SMEs), with limited resources to overcome the food waste problem, this may lead to many food service managers who still prioritize customer satisfaction over the food waste problems.

Many researchers have also tried to find out the drivers/enablers of food waste in the foodservice sector. Wu et al. (2021) conducted a study to analyze the main enablers of food waste in a different type of food service industry. They found out that difficulty in forecasting, strict regulations, large menus, miscommunications, and over-ordering is the

main enabler of food waste in the foodservice sector. In line with that, according to Lins et al. (2021), poor planning and overproduction are two of the main enablers of the excessive amount of food thrown away in the foodservice sector. Whereas Filimonau and Ermolaev. (2021) stated that the factors which contribute to food waste in the foodservices sector are numerous and may be related to both operational and non-operational factors.

The reduction of food waste in the foodservice sector is a critical component of making the global food system more sustainable. As a result, more research is needed to benchmark the food waste in the foodservice sector across the country (Beretta and Hellweg. 2019; Filimonau and Ermolaev. 2021).

2.3 Content Validity Index (CVI)

Content validity is used for validating whether the domain of content for the construct is represented by the items. This can be done by using the content validity index (CVI) which quantifies the validity of several items based on expert judgment (Polit et al. 2007). A minimum of five experts is required to provide sufficient control for changes to occur, but in cases where there are a lot of limitations, a minimum of three experts may be used (Lynn, 1986).

The CVI value can be validating an item on a scale as well the overall scale, by using a four-point Likert scale, that usually goes by 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant. (Susanty et al. 2021). I – CVI (item) value is calculated using the number of agreements divided by the number of experts used as can be seen in Equation 1. Meanwhile, the S – CVI (scale) value can be calculated by averaging all of the I – CVI as seen in Equation 2. Polit et al. (2007) recommended that the minimum value of I – CVI to be categorized as a valid item is 0,78, with the minimum value of S – CVI being 0,80.

$$I - CVI = \frac{Expert\ Agreed}{Number\ of\ Expert} \qquad (1)$$

$$S - CVI = \frac{\sum I - CVI}{Number\ of\ Item} \qquad (2)$$

3. Methodology

This study was done in a five stages procedure. The first stage of this study is carried out to explore research topics and formulate the problem, starting by understanding the problem background, determining the research objectives, and determining the research gap.

In the second stage, a literature review is conducted to identify several food waste reduction strategies that could be used in the foodservice sector. From it, a list of 24 food waste reduction strategies in the foodservice sector was identified, following the different points/level of the food transformation process in the foodservice sector starting from Managerial, Purchasing & Storage, Preparing, Serving, and Customer Behavior as seen in Table 1.

Table 1. List of food waste reduction strategy in the food service sector

Level	No.	Strategy	Definition	Sources
Managerial	S1	Measuring Food Waste	Periodically measure the food waste, from expired ingredient, food trimming processes, as well as plate waste.	Lins et al. (2021), Vizzoto et al. (2021), Wu et al. (2021)
	S2	Identifying Food Preference	Identifying market consumption preferences	Lins et al. (2021)
	S3	Menu Planning	Planning a menu that can reduce the amount of food waste as a whole.	Lins et al. (2021), Vizzoto et al. (2021), Wu et al. (2021)

Table 1. continue

Level	No.	Strategy	Definition	Sources
Managerial	S4	Staff Training	Improve the staff's ability to handle leftover, as well as the ability to process the food with right way.	Filimonau et al. (2020), Wu et al. (2021)
	S5	Enhancing Communication	Improve communication between management and staff to engage staff in food waste prevention and increase employee awareness of food waste.	Vizzoto et al. (2021), Wu et al. (2021)
	S6	Waste Management and Effective Waste Disposal Practice	Implement effective waste management and disposal practice, by having a clear policy (Standard Operation Procedure) on handling food waste.	Bappenas. (2021), Wu et al. (2021)
Procurement & Storage	S7	Forecasting	Implement forecasting practice, by processing and analyzing previous sales history, thereby avoiding overproduction.	Dhir et al. (2020), Filimonau et al. (2020), Vizzoto et al. (2021), Wu et al. (2021)
	S8	Appropriate Storage & Handling Food	Storing and handling food with appropriate techniques and technology.	Filimonau et al. (2020), Lins et al. (2021), Vizzoto et al. (2021)
	S9	Purchasing	Implement purchasing practice, with centralized purchasing door, as well as collaborating with food supplier to get the JIT delivery.	Vizzoto et al. (2021), Wu et al. (2021)
Preparation	S10	Adopting FIFO practice	Using a First-In-First-Out (FIFO) practice, which prioritize the earlier foodstuffs in meal preparation.	Filimonau et al. (2020), Wu et al. (2021)
	S11	Repurposing Leftovers	Reuse leftover food ingredients that can still be used, with taking into account food safety guidelines.	Filimonau et al. (2020), Vizzoto et al. (2021), Wu et al. (2021)
	S12	Reduce Overcooking	Reducing the amount of food produced, but remain responsive to new orders.	Vizzoto et al. (2021), Wu et al. (2021)
Serving	S13	Portion Size (Offering Different Options)	Offers a variety of food portion size that customers can choose.	Lins et al. (2021), Vizzoto et al. (2021), Wu et al. (2021)
	S14	Portion Size (Reduction)	Reducing the size of the food portion.	Filimonau et al. (2020), Vizzoto et al. (2021)
	S15	Reconfirm the number of Food Order	The number of guests in attendance should be reconfirmed to avoid over-cooking	Filimonau et al. (2020)
	S16	Buffet Management	Managing a buffet involves actions such as food positioning, refilling, or separating food.	Vizzoto et al. (2021)
	S17	Doggy Bags	Provide doggy bags or food wrappers, for customers who want to take their leftover home.	Dhir et al. (2020), Vizzoto et al. (2021)

Table 1. continue

Level	No.	Strategy	Definition	Sources
Serving	S18	Make Food More Attractive	Make food looks more attractive that can increase customer acceptance towards the food, which is strongly influenced by taste, appearance, portion, etc.	Lins et al. (2021), Wu et al. (2021)
	S19	Serving Style Adjustment	Use appropriate serving style based on the source of food waste that wanted to be reduced.	Vizzoto et al. (2021)
	S20	Last Minute Market	Products that were not sold during work hours could be offered with cheaper price or via online channels.	Filimonau et al. (2020), Vizzoto et al. (2021)
Customer Behavior	S21	Financial Incentives / Penalties	Giving financial incentives or penalties based on customer behavior towards food waste.	Lins et al. (2021), Vizzoto et al. (2021), Wu et al. (2021)
	S22	Awareness Campaigns	Giving awareness campaigns to customers, so that make them aware with the impact of the food waste.	Filimonau et al. (2020), Lins et al. (2021), Vizzoto et al. (2021)
	S23	Reducing the Amount of Dinnerware	Reducing the number of cutleries such as plates, bowls, etc. given to customers.	Vizzoto et al. (2021)
	S24	Collecting Feedback	Conducting a survey reason customers waste their food, then can be used as input for counter-measures.	Wu et al. (2021)

The next stage is to validate the food waste reduction strategy that could be used in the context of the foodservice sector in Indonesia. This is done by multiple iterations in the content validity effort. In the first round, the items that had been discovered need to be revised, checked, discarded, or added with expert advice. The rating process was conducted through a questionnaire given to experts in the field of food loss and waste, also sustainability. The details of experts that participated in this study are shown in Table 2. Experts then rate each item's relevance to the food waste reduction strategy in the context of the foodservice sector in Indonesia, based on their knowledge and experience using a four-point Likert scale (1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant). Afterward, the second round will be evaluating the relevance of the revised set of items and compute the S – CVI to get consensus from all experts and concluded the final list of strategies.

Table 2. List of experts

Expert	Position	Industry	Experience
A	Restaurant Manager	Café and Restaurant	>20 Years
B	Restaurant Owner	Family Dining	15 – 20 Years
C	CEO	Non-Governmental Organization (Food Bank)	5 – 10 Years
D	Planner	Governmental Organization (BAPPENAS)	5 – 10 Years
E	Lecturer	Lecturer (Environmental Eng. Universitas Indonesia)	5 – 10 Years

4. Data Collection

This section presents the data that had been collected from the CVI questionnaire. Table 3 contains all of the expert ratings on the food waste reduction strategy relevance.

In the first round, the list of food waste reduction strategy evaluated by the expert, given its rating, and then calculate the I-CVI of each item. The item that has a value of I – CVI under 0,8 was then discarded, and the additional item suggested by some of the experts was revalidated in the second round. The additional food waste reduction strategy is shown in Table 4., where Table 5 presents the value of its I – CVI

Table 3. Expert rate on the food waste reduction strategy

Level		A	B	C	D	E	Number of Agreement	I – CVI	Evaluation
Managerial	S1	4	2	4	4	3	4	0,8	Valid
	S2	4	3	3	4	1	4	0,8	Valid
	S3	4	4	4	4	1	4	0,8	Valid
	S4	4	4	4	4	3	5	1	Valid
	S5	3	4	4	4	3	5	1	Valid
	S6	3	3	4	4	4	5	1	Valid
Procurement & Storage	S7	3	3	4	4	3	5	1	Valid
	S8	4	4	4	4	4	5	1	Valid
	S9	3	4	3	4	2	4	0,8	Valid
Preparation	S10	4	3	3	4	4	5	1	Valid
	S11	3	4	4	4	3	5	1	Valid
	S12	3	4	3	3	1	4	0,8	Valid
Serving	S13	4	3	4	3	3	5	1	Valid
	S14	4	2	4	2	4	3	0,6	Invalid
	S15	3	3	2	3	2	3	0,6	Invalid
	S16	3	3	3	3	2	4	0,8	Valid
	S17	2	3	4	4	3	4	0,8	Valid
	S18	3	4	2	2	1	2	0,4	Invalid
	S19	3	3	4	3	3	5	1	Valid
	S20	2	3	4	3	2	3	0,6	Invalid
Customer Behavior	S21	2	2	2	4	1	1	0,2	Invalid
	S22	2	2	2	4	3	2	0,4	Invalid
	S23	1	2	1	1	1	0	0	Invalid
	S24	3	3	2	3	3	4	0,8	Valid

Table 4. Additional food waste reduction strategy as suggested by the expert

Level	No.	Strategy	Definition	Sources
Managerial	A1	Donation to Food Bank	Cooperating with food bank or other food distributor to handle leftover food.	Bappenas. (2021), Vizzoto et al. (2021), Suggestion from Expert
Preparation	A2	Cooking Proficiency	Ensuring the kitchen staff proficient at cooking and know how to retain the restaurant food quality.	Vizzoto et al. (2021), Wu et al. (2021), Suggestion from Expert
Serving	A3	Portion Size (Accurate Control)	Using accurate or standardized serving size.	Vizzoto et al. (2021), Suggestion from Expert

Table 5. Expert rate on the additional food waste reduction strategy

Class		A	B	C	D	E	Number of Agreement	I – CVI	Evaluation

Managerial	A1	1	3	4	4	4	4	0,8	Valid
Preparation	A2	4	4	2	4	2	3	0,6	Invalid
Serving	A3	4	4	1	3	3	4	0,8	Valid

5. Results and Discussion

Besides re-evaluating the item list of food waste reduction strategies, S – CVI was calculated in the second round to obtain the final list of relevant food waste reduction strategies in the foodservice sector in Indonesia as seen in Table 6. The value of the S – CVI is 0,89 which was concluded as acceptable by all experts. Finally, this study resulted in 19 food waste reduction strategies that could be used in the foodservice sector in Indonesia.

Table 6. Result of CVI

Level		Strategy	I – CVI
Managerial	S1	Measuring Food Waste	0,8
	S2	Identifying Food Preference	0,8
	S3	Menu Planning	0,8
	S4	Staff Training	1
	S5	Enhancing Communication	1
	S6	Waste Management and Effective Waste Disposal Practice	1
	S7	Donation to Food Bank	0,8
Procurement & Storage	S8	Forecasting	1
	S9	Appropriate Storage & Handling Food	1
	S10	Purchasing	0,8
Preparation	S11	Adopting FIFO practice	1
	S12	Repurposing Leftovers	1
	S13	Reduce Overcooking	0,8
Serving	S14	Portion Size (Offering Different Options)	1
	S15	Buffet Management	0,8
	S16	Doggy Bags	0,8
	S17	Serving Style Adjustment	1
	S18	Portion Size (Accurate Control)	0,8
Customer Behavior	S19	Collecting Feedback	0,8
		S – CVI	0,89

On the managerial level, which actions are performed or led by the managerial position, all of the strategies were accepted, as they may be the most important and work as the foundation for the other strategies. The lack of accurate data on the amount of food waste is seen as one of the foodservice sector barriers to reducing their food wastage, thus "Measuring Food Waste" is the first thing that foodservice sector could do to reduce its food waste (Eriksson et al. 2019; Filimonau et al. 2020). "Identifying Food Preference" and "Menu Planning" are also accepted and considered valid by the experts, these two strategies may be related to each other, to make food that has less food waste. "Staff Training" and "Enhancing Communication" are also considered valid strategies by the expert, based on the findings of Goh and Jie (2019), where hospitality workers hold a negative attitude towards the food waste, but are inclined to follow the cultural workplace so that they tend to waste a lot of food, "Enhancing Communication" and "Staff Training" could be seen as a solution on reducing the food waste. "Waste Management and Effective Waste Disposal Practice" is also considered a valid strategy. "Donation to Food Bank" is considered a valid strategy, based on Bappenas (2021) field survey, around 8.85% of food waste produced in the foodservice sector is still edible, therefore it could be seen as one of the food waste reduction strategies.

On the procurement and storage level, which actions are concerned with the uncertainty of the customer demand, all of the strategies that had been identified are also accepted by the experts. Demand management is seen as a critical point on this side, where balancing the demand and the production have to be done (Wu et al. 2021). "Forecasting" and "Purchasing" practice is done with the help of analytical tools and processed historical data to increase the accuracy of customer demand, which leads to reducing inventory held and purchased (Vizzoto et al. 2021).

"Appropriate Storage & Handling Food" by improving storage technologies and applying storage–handling management, this strategy could reduce food wastage as a storage waste where food quality and safety are guaranteed for human consumption.

On the preparation level, all of the strategies are accepted by the experts, rejecting one of the additional ones suggested by one of the experts. On this side, activity relates to transforming raw food materials into ready-to-serve food. "Adopting FIFO practice" is one of the ways to reduce the storage waste in the foodservice sector, and a lot of researchers also support the implementation of this strategy (Filimonau et al. 2020; Wu et al. 2021). "Repurposing Leftovers", meanwhile it could be seen as one of the strategies for reducing the food waste, it should be done cautiously, because of the characteristics of food that is easy to spoil (Filimonau et al. 2020; Vizzoto et al. 2021). "Reduce Overcooking" is a strategy that could be related to improving the cooking technique so it could reduce the overcooking but still maintain the level of responsiveness to new orders.

On the serving level, it relates to how food is served to the customer. Four out of identified strategy rejected, leaving four of the strategy, with an additional one strategy from the expert suggestion. "Portion Size (Offering Different Options)" is accepted by the expert, also it is one of the strategies that numerous studies talk about to reduce the food waste in the foodservice sector. "Buffet Management", with appropriate management of buffets, for example, refilling activities, and pre-positioning food items could influence customer behavior and the recoverability of the items that did not consume by customers so it reduces the serving waste (Vizzoto et al. 2021). "Serving Style Adjustment" and "Doggy Bags" could also reduce the food waste that happens at the serving level. There is one additional strategy "Portion Size (Accurate Control)", which helps restaurant staff to serve the food at the accurate serving size.

On the customer behavior level, from four strategies that had been identified, only one was accepted. One of the experts said that these strategies indeed could be used to reduce the food waste that happens in the foodservice sector, but if it is in the Indonesian context, it doesn't seem to be visible of doing that, because of one or two things. "Collecting Feedback" is the only strategy accepted by the experts, where it may seem the easiest and the most convenient way to know more about customer behavior.

6. Conclusion

The finding of this study could provide a valuable reference for reducing food waste in the foodservice sector in the context of Indonesia. From the literature review, we have identified 24 food waste reduction strategies that could be used by the foodservice sector in Indonesia. These strategies are based on different points of foodservice processes, managerial, procurement and storage, preparation, serving, and customer behavior. Then it was validated by CVI methods, with the help of five experts from different stakeholders, restaurant owners and managers, government (Bappenas), non-government (food bank), and also from academics (lecturer). This study resulted in 19 strategies, with seven strategies from the literature review discarded, and two additional strategies added from the suggestion of the expert. The value of S – CVI is 0.89 which is concluded as acceptable by all of the experts.

Further development of this food waste reduction strategy could be done by employing decision-making methods like multi-criteria-decision-making (MCDM), to obtain the key strategy that drives others or evaluate the interrelationship between strategies to obtain the prioritization of the development of food waste reduction strategy.

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Biographies

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