Analysis of Driving and Inhibiting Factors for Managing Food Wastes in Restaurants

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Abstract

One of the problems in a sustainable food supply chain is food waste management. Indonesia is one of the largest food waste producers, and restaurants are one of the largest sources of food waste. This study aims to explore the driving and inhibiting factors of managing food waste in restaurants. By knowing the priority of driving and inhibiting factors for managing food waste in restaurants, it will be easier to control food waste. This study took a sample of 5 restaurants in the city of Yogyakarta. The driving and inhibiting factors for food waste management are obtained from literature studies and field validation. Furthermore, the AHP (Analytical Hierarchy Process) method is used to determine the priority of the factors. The results showed that the driving factor that became the priority for KR and PR restaurants was purchasing. As for the BR and AR restaurants are the storage factor, while in the Rmn restaurant, it is the leftover food management. Analysis of the inhibiting factors shows that in four restaurants, it is found that the priority factor in inhibiting the management of food waste is cost. In contrast, in Rmn restaurants, it is found that customer plate waste is the priority. These results can be used as a basis for food waste management policy-making.

Keywords:
Food waste, Restaurants, Driving factors, Inhibiting factors, AHP (Analytical Hierarchy Process)

1. Introduction
A World Commission on Environment and Development in 1987 confirmed that achieving a balance between economic, environmental, and social impacts are long-term goals. This is conducted to support sustainable development so that the current needs of society can be met, without reducing the portion of human needs in the future (Ocicka and Raźniewska 2018). Food Agriculture Organization stated that one-third of the food produced each year for human consumption, about 1.3 billion tones is wasted (FAO 2016). This represents a loss of US$ 1 trillion in economic costs and about US$ 700 billion in environmental costs, and about US$ 900 billion in social costs. Meanwhile. there are 795 million hungry people out of the 7.5 billion people living on this world. This means that one in nine people is suffering from chronic malnutrition (World Food Programme 2014). This represents contradiction, considering the large amount of food is thrown away every day.

Food waste is a big problem faced by many countries. Food waste management has been carried out well in some developed countries. In Indonesia, food waste management is included in municipal solid waste management to shorten the duration of using the disposal area (Brigita and Rahardyan 2013). Improper management of food waste will have negative impacts on economic, social, and environmental sectors (Aschemann-Witzel et al. 2015, Schanes, Dobernig, and Gözet 2018). The economic impact is shown from the disposal of food waste which is still has economic value. One-third of food is wasted with an economic value of US$ 161 billion (Chrobog 2014). On the other hand, South Korea has implemented the strictest food waste law that turn 93% of wasted food into economic opportunities. The social impact is shown by the fact that food waste occurs in some areas while there are starving in other areas. World Food Program also stated that hunger and malnutrition are the number one risk to health worldwide (World Food Programme 2014). Meanwhile, the impact on environment occurs when the accumulation of food waste in landfills turns into methane. It is one of the greenhouse gases emission and has an impact on climate change (Bisara 2017, Kibria 2017).

The problem of food waste is also related to sustainable food supply chain. Food waste occurs at all stage of food chain (Buchner et al. 2012, Göbel et al. 2015. Marangon et al. 2014). At the consumption stage, food waste usually occurs due to excess purchases or portions prepared (Buchner et al. 2012). Therefore, reducing the quantity of food waste is a key element in developing a sustainable food system (Marangon et al. 2014).

Restaurant is one of the biggest contributors to food waste. Research showed that 20% of the amount of food prepared in restaurants is wasted (Silvennoinen et al. 2015). This food waste is obtained from kitchen waste, service waste, and consumer food waste.

Yogyakarta, Indonesia is a student city and tourist destination so that restaurant is thriving business. According to Licensing Agency of Yogyakarta, the average annual growth rate for the number of restaurants in Yogyakarta is 6.8% from 2014-2018. This indicates that there is escalation of food waste produced. Meanwhile, food waste management which is included in municipal solid waste management will worsen the condition of landfill. The amount of waste disposed of at Piyungan landfill reaches 600 tons/day, with the dominance of food, vegetable, fruit and other (organic) waste is 56.7% (Mustika 2018). Actually, the capacity is only 400 tons/day. Therefore, this research aims to analyze food waste management of restaurants in Yogyakarta.

1.1 Objectives
The research objectives are:
1. To determine the weight of importance between the driving factors for food waste management in restaurants
2. To determine the weight of importance between the inhibiting factors for food waste management in restaurants

So that it can be recommended the right food waste management in restaurants in Yogyakarta.

2. Literature Review
There are several factors can encourage the management of food waste in restaurants, one of which is the purchasing or procurement process. Purchasing is a process since the purchase of foodstuffs, such as planning the amount of foodstuffs, checking ingredients that are still in storage, checking expiration of foodstuffs, and reducing the purchase of foodstuffs that often left over.

Several authors who state that the process of purchasing or procurement is one of the driving forces for food waste management, including Charlebois et al. (2015), Derqui et al. (2016), Filimonau and De Coteau (2019), Kasavan et al. (2017), Linh (2018), and Thyberg and Tonjes (2016). Mentioned in Charlebois et al. (2015), procurement practices are one of the back-of-house food waste determinants in the food service industry. Meanwhile, according to Derqui et al. (2016) rigid specifications at the food procurement stage can cause food waste, so the purchasing process should be managed properly to facilitate food waste management. Furthermore, Filimonau and De Coteau (2019) stated that to reduce food waste it is necessary to pay attention to the pre-kitchen stage. At this stage, it is necessary to optimize the procurement process by implementing accurate demand forecasting. Kasavan et al. (2017) stated that process of purchasing foodstuffs is a preliminary and initial process in sustainable food waste management. As for Linh (2018) states that better ingredient purchase is one way of reducing food waste, so it can be said that the purchase stage can be one of the driving forces in food waste management. Thyberg and Tonjes (2016) mentioned some of mechanisms to prevent food waste including purchasing and planning to prevent over stock.

The second factor that can drive the food waste management is storage the material. According to Filimonau and De Coteau (2019) to reduce food waste it need effective stock management in pre-kitchen process. Meanwhile, to avoid the spoilage of food need to provide a systematic process on storage (Kasavan et al. 2017). Linh (2018) also stated that better storage is one of steps for reducing food waste. Furthermore, Singh and Amandeep (2018) said that proper storage is one of various practices to manage the food waste. Thyberg and Tonjes (2016) mentioned that stock management and knowledge of food storage can prevent the food waste.

Leftover food management is the third factor as a driver for managing food waste. It is a process of managing leftover food as a form of sustainable food waste management for leftover food from buffets and from consumers' plate. Filimonau and De Coteau (2019) mentioned that consumer behavior as one of external enablers in food waste

management, where leftover food behavior is a form of consumers' behavior. Kasavan et al. (2017) clearly stated that management of leftover food and guests' plate waste is one of the practices towards sustainable food waste management. Moreover, Kasavan et al. (2018) stated that business actors' knowledge of leftover food waste is one of the determinants for sustainable food waste management. Linh (2018) mentioned that customers' behavior is one of the challenge for reducing food waste. The right approach to consumers so that they do not leave food is a challenge in managing food waste. Vizzoto et al. (2020) said that the management of plate waste is one of the main strategies to reduce food waste.

The fourth factor as enabler for food waste management is recruitment management. It is a factor related to the process of managing human resources in restaurants, starting with recruitment, training, worker safety and health, personnel files, payroll, and job evaluation. Linh (2018) stated that efficient employee training as a part of recruitment management can create an internal culture and raise awareness among the employee to reduce food waste. Derqui et al. (2016) proposed some actions to reduce food waste including employee training which a part of recruitment management. Meanwhile, training needs for all staff is one of food waste mitigation strategy (V. Filimonau and De Coteau 2019) and staff training is a part of various practices to manage the food waste (Dilbag Singh and Amandeep 2018). Linh (2018) stated that one of the mechanisms to prevent food waste is employee education.

The fifth factor that can affect the management of food waste is knowledge. Which is defined as the knowledge possessed by restaurant owners, managers, and restaurant staff about good and correct food waste management. Kasavan et al. (2018) uses knowledge as one of the factors to measure knowledge about food waste management at hoteliers in Langkawi UNESCO Global Geopark. The knowledge measured includes knowledge regarding storage and purchasing food, preparation of food in the kitchen, serving food and managing leftover food at buffet point, and managing and reducing customer plate waste at dining. Meanwhile, Michalec et al. (2018) states that lag of knowledge is one of the barriers to food waste management, so it can be said that adequate knowledge about food waste and how to manage it is a driving force in good food waste management. Meanwhile, Martin-Rios et al. (2018) stated that one of the determinants of the level of initiative in food waste management is depending on the knowledge of the manager.

In addition to the driving factors for food waste management, there are also management inhibiting factors including food preparation, serving of food, consumer's plate waste, lack of disposal management, lack of regulation, and cost.

Food preparation can be defined as the actions that are performed to prepare food to either ensure that the food is safe to eat or to enhance the flavor. This becomes the main factor in producing food waste. As revealed by the research of UK's Sustainable Restaurant Association-SRA (2010) that most of avoidable food waste in London restaurants was generated during food preparation. Filimonau, Zhang, and Wang (2020) described the food waste resulted from food preparation such as when the chef cooks the dishes, they cut the food into various shapes and only use the best cuts and portions of the food. They will not reuse the rest of the food even if it is still of good quality and they simply choose to throw it away.

The second inhibiting factor in food waste management is serving of food. It is process of serving food to customers which consider the food presentation. There are two kind of food serving style i.e. buffet style and *a la carte*. A study conducted by Papargyropoulou et al. (2019) argued that a hotel would generate high customer plate waste and leftover food waste if hoteliers followed the buffet style food service. On the other hand, a hotel would produce higher preparation food waste if it adopted the *a la carte* food services. In this regard, the selection of food serving style will give the impact to the food waste produced (Pirani and Arafat 2016).

Consumer's plate waste is leftover food left by consumers on their plates. This is one of the obstacles to food waste management, considering that the leftover food on the plate must be managed so that there is no disposal that can damage the environment. Juvan et al. (2018) stated that consumer's plate waste is one of the problems in managing food waste in restaurants, hotels, and catering businesses. This leads to waste in the purchase and production of food. Kasavan et al. (2017) stated that consumers' plate waste is one that must be reduced to prevent food waste. For this reason, food service managers should take possible actions in convincing and encouraging their customers towards plate waste reduction. Papargyropoulou et al. (2019) stated that consumer's plate waste is one source of food waste generation that must be prevented to realize good food waste management.

Lack of disposal management can be translated as the unavailability of food waste management specifically for the management of kitchen waste and food waste. Based on the research of Sakaguchi et al. (2018) at restaurants in Berkeley, California, USA it was found that the unavailability of time and resources is one of the obstacles in managing food waste in the form of composting. Martin-Rios et al. (2018) mentioned several obstacles to the adoption of innovations in food service waste management related to the lack of disposal management in the form of lack of space and infrastructure, lack of time or staff, and lack of motivation/skills among staff. Meanwhile, Michalec et al. (2018) stated the lack of space for bins as one of the barriers to participation in food waste recycling according to the food outlets

As yet, most developing countries have not widely practiced food waste recycling and the regulations for food waste management are quite incomplete. Suchada et al. (2003) stated that the reasons for the poor recovery systems are the absence of an official policy to persuade people to participate in recycling activities, and poor incentives in food waste recycling programs. Moreover, the experiences from developed countries have shown that a country could not solve its food waste issue if a government does not establish the specified objectives for reducing food waste and implement comprehensive legislative regulations (Thi, Kumar, and Lin 2015). In this regard, lack of regulation become one of the inhibiting factor in food waste management.

Cost is one of the obstacles in the management of food waste. Martin Rios et al. (2018) states that cost is one of the constraints to the adoption of innovations in food service waste management. Meager et al. (2020) stated that cost is one of the barriers in implementing green supply chain management in restaurants. Michalec et al. (2018) stated that cost is one of the barriers to participation in food waste recycling according to the food outlets. Meanwhile, Sakaguchi et al. (2018) stated that based on their research on restaurants in Berkeley, California, USA, it was found that to have owning compost production systems require a high initial cost.

3. Methods
AHP is a one of Multi Criteria Decision Making tool which consists of a defined mathematical structure built over consistent matrices and associated Eigen vectors to derive the true weights of compared criteria (Saaty.1987) Although the AHP technique is more than three decades old, its flexibility and robustness keeps it in use as a reliable method (Mathivathanan, Govindan, and Haq. 2017). In this study, the AHP method was implemented to determine the priority of driving and inhibiting factors for food waste management. There are five driving factors and six inhibiting factors for food waste management used in this study as shown in Table 1 and Table 2.

Table 1. Driving factors in managing the food waste

No	Factor	Definitions
1	Purchasing	The procurement process of groceries, i.e. planning the amount of groceries, check the food ingredients that is still in storage, checking for expiration groceries, and reduce ingredient purchases food that is often left over.
2	Storage	The process carried out related to store the groceries, i.e. setting the proper temperature for groceries storage, checking the order of groceries used, labeling the expired date of each groceries, complete the storage instructions, and providing secure storage place.
3	Leftover food management	process of managing leftover food as a form of food waste sustainable management from the buffet that has been served (such as: donations, given to employees, as pet food, etc.).
4	Recruitment management	a factor related to the human resource management process in restaurants; including recruitment, training, occupational safety and health, personnel files, payroll, and job evaluation.
5	Knowledge	knowledge possessed by restaurant owners, managers, and restaurant staff about good and correct food waste management, i.e. knowledge regarding storage and purchasing food, preparation of food in the kitchen, serving food and managing leftover food at buffet point, and managing and reducing customer plate waste at dining

Table 2. Inhibiting factors in managing the food waste

No	Factor	Definitions
1	Cost	The amount that has to be spent in managing the food waste
2	Lack of regulation	There are no regulations that specifically regulate food waste.
3	Serving food	The process of serving food to customers which consider the food presentation. It also include how to store the processed food.
4	Food preparation	the actions that are performed to prepare food to either ensure that the food is safe to eat or to enhance the flavor.
5	Consumer plate waste	leftover food left by consumers on their plates
6	Lack of disposal management	the unavailability of food waste management specifically for the management of kitchen waste and food waste.

According to Saaty (1987), the formulating steps AHP method used were as follows:
1. *Formulation of the aim of work*: evaluating the driving and inhibiting factors in order to identify their relative importance in the food waste management, is defined as the aim of this work.
2. *Formation of the pair wise comparisons*: pair wise comparison is conducted by means of data collection from an expert panel and based on expert judgement, the pair wise comparisons among the factors are attained through a nine point Saaty's scale as shown in Table 3.

Table 3. AHP Judgment scale

Numerical Rating	Verbal judgments of preferences	Explanation
1	Equally preferred of both factors	Two factors contribute equally
3	Moderately preferred of one factor over another	Experience and judgment favor one factor over another
5	Strongly preferred of one factor over another	A factor is strongly favored
7	Very Strongly preferred of one factor over another	A factor is very strongly dominant
9	Extremely preferred of one factor over another	A factor is favored by at least on order of magnitude
2,4,6,8	Intermediate values between two adjacent judgments	Used to compromise between two judgments

3. *Computation of the Eigen values and Eigen vectors and relative importance weights*: the framed pair wise comparisons matrices were operated to determine the Eigen values and Eigen vectors, which are further analyzed to calculate the relative importance weights of the factors (equation 1).
$$W = \lambda max \tag{1}$$
4. *Evaluation of the consistency ratio*: the consistency ratio (CR) is computed to ensure the consistency of pair wise comparisons. The used mathematical expression for finding the CR is given in equation 2.
$$CR = \frac{CI}{RI} \tag{2}$$
where the consistency index is denoted by equation 3.
$$CI = \frac{\gamma_{max} - n}{n-1} \tag{3}$$
(λ_max) is the maximum average value and (n) is the total number of decision criteria. The value of the random consistency index (RI) depends upon value of (n). In this regard, the value of CR should be less than 0.10 to have better level of consistency.

4. Data Collection

Literature studies was conducted to find out the driving factors and inhibiting factors in managing food waste for restaurants. According to the factors obtained through literature studies, field validation was carried out with 2 restaurant managers to determine the appropriate factors. Driving factors chosen from the validation results were purchasing (a1), storage (a2), leftover food management (a3), recruitment management (a4), and knowledge (a5),

while for inhibiting factors were cost (b1), lack of regulation (b2), serving food (b3), food preparation (b4), consumer plate waste (b5), and lack of disposal management (b6). They were compiled into AHP questionnaire which distributed to selected respondents. The selected respondents were experts or restaurant employees who have jobs related to kitchen or have good knowledge of food waste. Experts chosen are managers and HR staff from 5 restaurants, namely Rmn, PR, KR, BR, and AR. Total respondents were 5 experts, with an expert representing each restaurant. The location from each restaurant is shown in Figure 1, marked by green dot.

Figure 1. Location of 5 restaurants

Data collection was carried out from August to September 2020 through distributing AHP questionnaires to respondents. The questionnaire containing questions related to pairwise comparison among factors included in driving factors (a1, a2, a3, a4, a5) and prohibiting factors (b1, b2, b3, b4, b5, b6) in managing food waste. The results of the collected questionnaires are then recapitulated in pairwise comparison matrices. Furthermore, interviews are also conducted to selected respondents related to barriers, knowledge, and implementation of food waste management in each restaurant.

5. Results and Discussion

According to interview conducted, Table 4 shows the results of interviews conducted at each restaurant. Generally, all respondents consider limited facilities, human resources, and time as barriers in managing food waste. The limitation of these factors leads the restaurant unable to manage food waste optimally, especially on the factor of limited human resources. Martin-Rios et. al. (2018) stated that lack of ability from human resources such as lack of skill and motivation from staff are constraints related to managed food waste. Rmn restaurant already has enough knowledge related to food waste management. Therefore, Rmn restaurant have implemented food waste management by using third party service. This is also conducted by PR, BR, and AR restaurant though they have little knowledge about food waste management. Only KR restaurant haven't implemented food waste management properly because there is no knowledge about it.

Table 4. The results of interviews at each restaurant

Restaurant	Barrier(s) of food waste management	Knowledge of food waste management	Implementation of food waste management
Rmn	Limited facilities	Enough knowledge	Using third party for further waste management
PR	Limited human resources	A little knowledge	Food leftovers in good condition will be given to employees, while the rest will be furthered processed by third party
KR	Limited human resources	Have no knowledge	Food waste and residual oil are put in plastic bag then disposed to landfill

| BR | Limited time and human resources | A little knowledge | Using third party for further waste management |
| AR | Limited facilities, time, and human resources | A little knowledge | Using third party for further waste management |

5.1 Driving factors in managing food waste

A recapitulation was carried for all completed AHP questionnaires by building pairwise comparison matrices for each restaurant. Weight calculation for each factor is carried out by using data normalization based on the AHP principle. Table 5 shows an example of a pairwise comparison matrix and weight calculation for driving factors in managing food waste in Rmn restaurant. Pairwise comparison matrices shown in Table 5 represent a scale of absolute values that describe the comparison of the level of importance between 2 factors. For example, the comparison value between factor a1 and a2 is 1. It can be concluded that a respondent considered factor a1 and a2 is equal importance. Data normalization is also conducted to obtain the weight for each factor according to respondent from each restaurant. The weight for each factor is carried out by using equation 1.

Table 5. Weight calculations of driving factors for Rmn restaurant

	a1	a2	a3	a4	a5	Data normalization					Weight
a1	1	1	0.25	1	2	0.13	0.25	0.06	0.18	0.25	0.17
a2	1	1	1	2	2	0.13	0.25	0.24	0.36	0.25	0.25
a3	4	1	1	1	1	0.53	0.25	0.24	0.18	0.13	0.27
a4	1	0.5	1	1	2	0.13	0.13	0.24	0.18	0.25	0.19
a5	0.5	0.5	1	0.5	1	0.7	0.13	0.24	0.09	0.13	0.13

According to assessment from an expert in each restaurant, the weight calculation using AHP is carried out on the driving factors. Figure 2 shows the recapitulation of weight for driving factors in managing food waste from each restaurant.
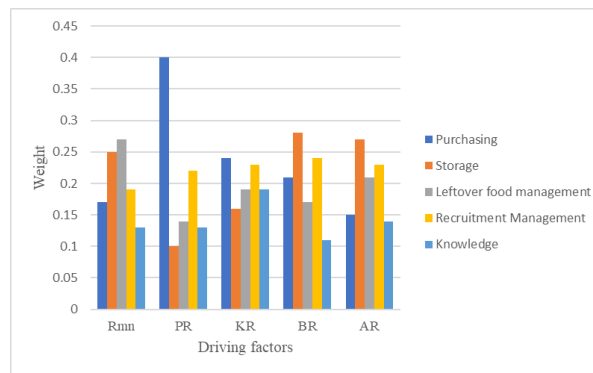

Figure 2. The recapitulation of weight for driving factors

As shown in Figure 2, the highest weight for driving factors according to Rmn restaurant is leftover food management. Leftover food management is defined as process to manage food leftovers from previously served meals (Kasavan et. al. 2017). Rmn restaurant does not have a specific procedure for handling food leftovers from consumers due to over-serving. Even though this restaurant already provided information related to food served that presented into picture on the menu book. Charlebois et. al. (Charlebois, Creedy, and von Massow 2015) stated that poor management in choosing food ingredients can lead to waste. Leftover food also comes from overproduction of food by service providers (Silvennoinen et al. 2015). Meanwhile, PR and KR restaurant consider purchasing has the highest weight. PR and KR restaurant are similar, both of them offer a relaxed and casual atmosphere. Commonly, these two restaurants don't have specific procedures for purchasing food ingredients. Firstly, these restaurants will check the food ingredients needed by the two restaurants. Then, they make a list of food ingredients will be ordered to suppliers. Suppliers will deliver the food ingredients according to their order. Orders arrived will be checked by restaurants to ensure the quality. If there is not proper quality, then the orders will be returned to suppliers. However,

KR restaurant only placed the orders received into the containers provided, without put label contained information about the date of received. Papargyropoulou et al. (2019) explained that labeling food containers and preparing food containers properly can extend the life of perishable foods. This method may be able to prevent food waste. PR restaurant already implemented this method. Nevertheless, these two restaurants don't have a specific procedure for recycling poor quality of food ingredients in storage.

The last two restaurants are BR and AR restaurant, having storage as the driving factor with the highest weight. Storage is defined as a process for storing food ingredients by considering the order the order of food ingredients used, also related to check the temperature of food ingredients (S. Kasavan, Mohamed, and Halim 2017; D. Singh and Amandeep 2018). BR is a family restaurant, while AR is such a buffet restaurant with affordable price. BR restaurant already implemented FIFO (First In First Out) system for food ingredients purchased from suppliers. The available food ingredients will be processed first, while the newly purchased food ingredients will be stored as stock by labeling the date of purchase and the type of food ingredients. Unfortunately, these things haven't been implemented by AR restaurant. In addition, these two restaurants don't check the temperature of food ingredients properly. Food ingredients such as vegetables, fruits, meats, fish, etc. will be stored in refrigerator. Meanwhile, spices are stored at room temperature. Plastic bag will be used for damaged or poor quality of food ingredients due to storage, to be given to third parties.

CR (Consistency Ratio) are also calculated for each restaurant to ensure that the pairwise comparison matrix used is consistent, as well as the resulting model is acceptable (Saaty. 2008). CR is shown in Table 6 and calculated according to equation 2. All CR values 0.1, 0.06, 0.09, 0.07, and 0.01 are under the cutoff value 0.1. This concluded that the model is acceptable. According to average weight as shown in Table 3, the highest average weight of driving factors is purchasing and the lowest is knowledge.

Table 6. Average weight and CR of driving factors

| Restaurant | Weight | | | | | CR |
	Purchasing	Storage	Leftover food management	Recruitment Management	Knowledge	
Rmn	0.17	0.25	0.27	0.19	0.13	0.1
PR	0.4	0.1	0.14	0.22	0.13	0.06
KR	0.24	0.16	0.19	0.23	0.19	0.09
BR	0.21	0.28	0.17	0.24	0.11	0.07
AR	0.15	0.27	0.21	0.23	0.14	0.1
Average	0.234	0.212	0.196	0.222	0.14	0.084

5.2 Inhibiting factors in managing food waste

Weight calculation is also carried out on the inhibiting factors in managing food waste in each restaurant using the AHP principle. Table 7 shows an example of a pairwise comparison matrix and weight calculation for inhibiting factors in managing food waste in Rmn restaurant. Data normalization is conducted to obtain the weight for each factor according to respondent from each restaurant. The weight for each factor is carried out by using equation 1.

Table 7. Weight calculations of inhibiting factors for Rmn restaurant

	b1	b2	b3	b4	b5	b6	Data normalization						Weight
b1	1	2	1	1	1	2	0.23	0.36	0.14	0.29	0.20	0.20	0.24
b2	0.5	1	1	1	0.2	2	0.08	0.12	0.41	0.14	0.10	0.10	0.16
b3	1	1	1	1	1	2	0.23	0.04	0.14	0.14	0.20	0.30	0.17
b4	1	1	1	1	2	1	0.12	0.12	0.14	0.14	0.20	0.10	0.14
b5	1	5	1	0.5	1	2	0.23	0.24	0.14	0.14	0.20	0.20	0.19
b6	0.5	0.5	0.5	1	0.5	1	0.12	0.12	0.14	0.14	0.10	0.10	0.10

The weight of inhibiting factors for each restaurant are also calculated, as shown in Figure 3. According to Figure 3, cost has the highest weight for PR, KR, BR, and AR restaurant. Cost is defined as all the money spent by restaurants to manage sustainable food waste (Michalec et al. 2018, Sakaguchi et. al. 2018). Even though food waste produced by restaurants is often unavoidable. For example, restaurants often suffer losses due to leftovers food from consumers. Other losses are derived from leftovers which processed from the kitchen. These restaurants don't have a particular budget yet intended for managing food waste. According to Michalec et. al. (2018), several restaurants stated that it will be pricey to manage food waste properly. So, it is concluded that cost is the main barrier.

Meanwhile, the highest weight for Rmn restaurant is consumer plate waste. Consumer plate waste consist of inedible (unavoidable) and edible (avoidable) parts from foods. Several things cause consumer plate waste include ordering too much food, doesn't like the dish that has been ordered, perceived value of consumer for money is quality not quantity, and perceived value of food is related to price, such as rice is cheap so it may be waste (Papargyropoulou et al. 2019). Rmn restaurant doesn't have procedure to manage consumer plate waste. When the dish ordered by consumer is leftover, the consumer will ask waiter to wrap it up as take away or even just leave the plate waste. However, Rmn restaurant doesn't ask the waiter to wrap any leftovers and offers to consumer as a take away. This can be conducted to overcome the problem of consumer plate waste. The other things also can be carried out, such us offering small portion to consumers yet they can add more with no extra charge and offering a range of dish, small, regular, big, and also size for kids (Papargyropoulou et al. 2019).
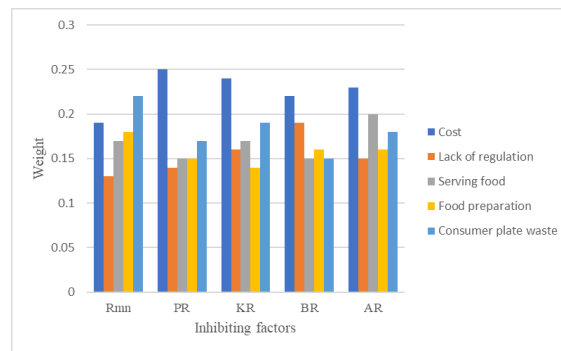

Figure 3. The recapitulation of weight for driving factors

CR (Consistency Ratio) are also calculated for each restaurant to ensure that the pairwise comparison matrix used is consistent, as well as the resulting model is acceptable (T. L. Saaty 2008). CR is shown in Table 8 and calculated according to equation 2 All CR values 0.08, 0.08, 0.09, 0.1, and 0.1 are under the cutoff value 0.1. This concluded that the model is acceptable. According to average weight as shown in Table 8, the highest average weight of inhibiting factors is cost and lack of disposal management.

Table 8. Average weight and CR of inhibiting factors

Restaurant	Weight						CR
	Cost	Lack of regulation	Serving food	Food preparation	Consumer plate waste	Lack of disposal management	
Rmn	0.19	0.13	0.17	0.18	0.22	0.1	0.08
PR	0.25	0.14	0.15	0.15	0.17	0.14	0.08
KR	0.24	0.16	0.17	0.14	0.19	0.1	0.09
BR	0.22	0.19	0.15	0.16	0.15	0.13	0.1
AR	0.23	0.15	0.2	0.16	0.18	0.08	0.1
Average	0.226	0.154	0.168	0.158	0.182	0.11	0.09

5.3 Managerial implications

According to the result obtained, the five restaurants in Indonesia, such as Rmn, PR, KR, BR, and AR restaurant haven't implemented food waste management properly. Analysis using AHP produces a ranking order of the driving and inhibiting factors in managing food waste through the weight of each factor. Therefore, evaluation about the current condition of each restaurant related to the priority of driving and inhibiting factors needs to be conducted. Furthermore, the results of the evaluation can be used as a reference for improvement. For example, the highest weight for Rmn is consumer plate waste. Currently, Rmn doesn't have procedure to manage consumer plate waste. To overcome consumer plate waste, Rmn should offers small portion to consumers yet they can add more with no extra charge and offering a range of dish, small, regular, big, and also size for kids (Papargyropoulou et al. 2019).

Indonesia does not have laws and regulations related to manage food waste produced by restaurants, hotels, households, and others. The efforts made limited to separating organic and inorganic waste which hasn't been implemented in all regions. Even some people still break the rule to dispose waste properly. This condition is very different from other countries such as Germany and Sweden. Germany, has strict regulations such as giving sanctions and letters of reprimand against its citizens who are not disciplined in disposing of garbage properly, while Sweden has a sophisticated waste management system (Hermsdorf et. al. 2017; Rosenlund et al. 2020). To overcome the problem of waste, especially food waste, the role of government is needed in addition to the role of other stakeholders. Ariyani and Ririh (2020) explain that government has an important role to control individual behavior to care about environment issues.

Therefore, several things can be conducted by restaurants, government, and other stakeholders to overcome issues of food waste, such as the government through the local government should provide knowledge related to food waste management and its benefits to all parties such as restaurant, hotels, and households. Furthermore, local governments should have laws and regulations regarding food waste management that must be obeyed all relevant stakeholders. Managing and controlling of food waste can be conducted easier by collaborating between local government and food business providers, such as restaurant. Restaurant as a key actor should conduct some activities to support food waste management, such as arranging management team to manage food waste comes from consumers or kitchen. This team have to check food ingredients which are the main contributor to food waste. In addition, this team also have to investigate food waste management carried out by third parties to ensure they conducted properly. Restaurant should conduct socialization related to food waste issues to their staffs and consumers. Staffs need to be given additional knowledge on how to manage food waste, while consumers need to be invited to participate in reducing food waste in restaurants.

6. Conclusions

Food waste issue is a serious problem due to its negative impact to environment. Restaurant as a source of food waste needs to consider on how to manage food waste properly. AHP is proved able to prioritize driving and inhibiting factors in food waste management for 5 restaurants in Yogyakarta, Indonesia. The highest weight as the most priority for driving factors according to Rmn restaurant is leftover food management by 0.27, while PR and KR restaurant consider purchasing by 0.4 and 0.24. The last two restaurants are BR and AR, with storage as the driving factor with the highest weight by 0.28 and 0.27. In addition, the cost is the most priority of inhibiting factor for PR, KR, BR, and AR restaurants by 0.25, 0.24, 0.23, and 0.22 respectively, while Rmn restaurant considers consumer plate waste by 0.27.

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