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MORALITY BEFORE KNOWLEDGE

Exploring food waste practices and sustainability awareness among vegetable and fruit sellers: A pathway to improved waste management

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ABSTRACT

Background: Food waste has emerged as a global challenge, raising widespread concerns due to its significant environmental impacts. In line with the United Nations Sustainable Development Goal (SDG) 12—particularly Indicator 12.3, which targets global food loss and waste—Indonesia faces an annual food waste level of 115–184 kg per capita, with fruits and vegetables being notably inefficient sectors and major contributors to emissions. Against this backdrop, this study focuses on the knowledge, perceptions, and behaviors of vegetable and fruit sellers at Pasar Minggu Traditional Market, one of Jakarta's oldest and largest traditional markets. **Methods**: Employing a qualitative design, the research conducted in-depth interviews with six participants (three vegetable sellers and three fruit sellers) and utilized both deductive and inductive thematic analysis to construct themes and subthemes. **Findings:** The analysis identified four subthemes: basic understanding of waste, perspectives and awareness toward food waste, food waste management practices, and challenges in food waste management. Most participants demonstrated limited knowledge of food waste and reported feelings of sadness, regret, or frustration when confronted with piles of discarded food. They attempted to mitigate waste through strategies such as redistribution, processing, and, as a last resort, disposal at designated sites. **Conclusion**: he study concludes that vegetable and fruit sellers at Pasar Minggu exhibit limited awareness regarding food waste, underscoring the need for targeted awareness campaigns by relevant authorities to promote sustainable consumption and waste reduction. **Novelty/Originality of this article:** he study concludes that vegetable and fruit sellers at Pasar Minggu exhibit limited awareness regarding food waste, underscoring the need for targeted awareness campaigns by relevant authorities to promote sustainable consumption and waste reduction.

KEYWORDS: behavior; food waste; fruit sellers; knowledge; vegetable sellers.

1. Introduction

Food waste has become a global problem, causing widespread concern in all sectors of society. Food waste refers to the decrease in the quantity of food resulting from decisions and actions by retailers, food service providers and consumers (FAO, 2020). With the global population expected to grow by 3 billion in the next 30 years (World Bank, 2020), there is growing pressure in food supply chains to meet the demand for food, especially for fruits and vegetables (Chen et al., 2020; Kusumowardani et al., 2022). At the same time, the food waste index report 2022 explained that in 2022, 19% of global waste food (1.05 billion tonnes of food), valued more than $400 billion, was wasted, at the retail, food service, and

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household level. That is in addition to the 13 percent of the world's food lost in the supply chain, as estimated by FAO, from post-harvest up to and excluding retail (UNEP, 2024). This big amount of food waste happened while 783 million people suffer from hunger. This problem of food waste would contribute to another food crisis as an increased amount of food needs to be produced to feed the global population. (SDGs United Nations, 2023). Food waste is a complex issue that requires a broad approach of analysis considering several factors simultaneously (Bravi et al., 2020).

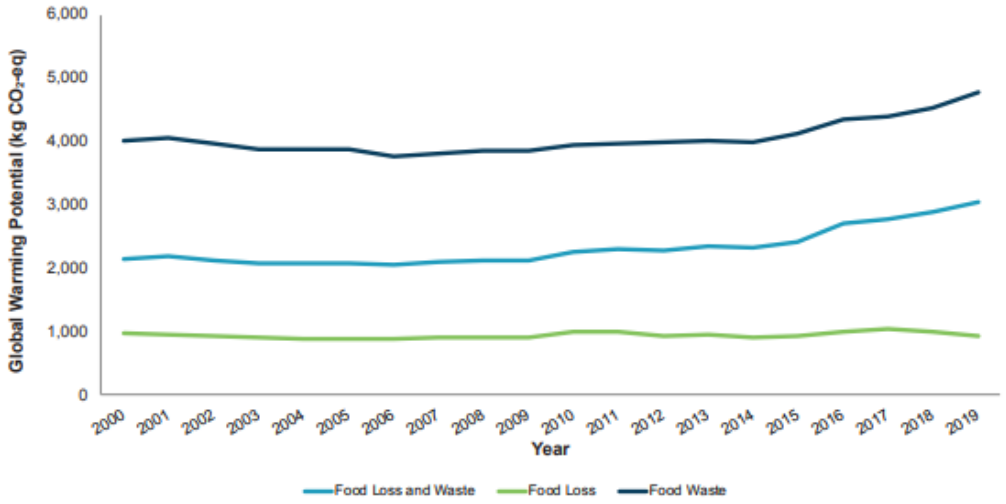

Fig. 1 Greenhouse gas emission per 1 ton FL, 1 ton FW, and 1 ton of FLW (Bappenas. 2021)

This growing amount of food wastes also could cause issues that burden the environment. The impact of food waste threatens the sustainability of human life. It increases greenhouse, waste of land use, water, and energy. Food waste significantly impacts the environment, generating 4.4 GtCO2 eq annually, or approximately 8% of the total anthropogenic GHG emissions based on carbon footprints (FAO, 2020). From figure 1, It is found that the average potential impact per 1 ton of FLW in 20 years is 2,324.24 kg CO2-eq./1 ton FLW, the average emission produced by 1 ton of FW is 4,051.5 kg CO2-eq./1 ton FW or about 4.3 times higher than 1 ton FL, which is 943.29 kg CO2-eq./ 1 tons of FL. The annual food waste generates significant greenhouse gas emissions, costing over $1 trillion annually. It also increases the absorption of infrared radiation and global heat which could worsen the impact of climate change and global warming (UNFCC, 2024).

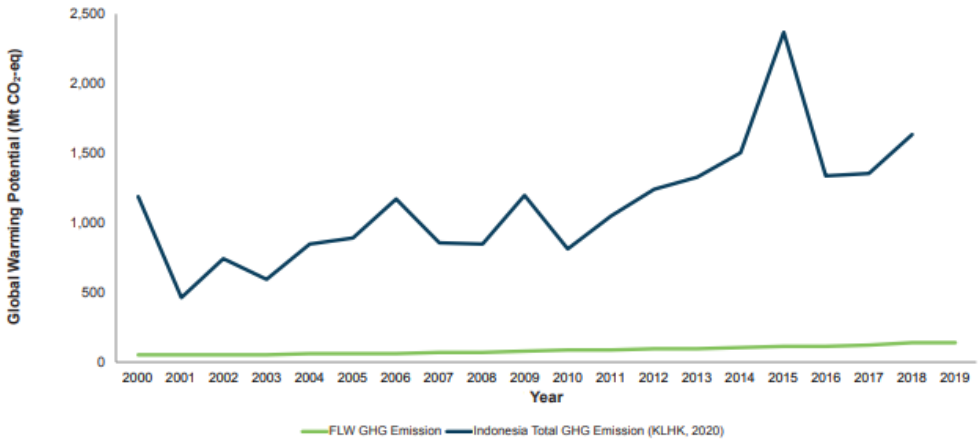

Fig. 2 Comparison of FLW's total GHG emission and Indonesia's total GHG emission (Bappenas. 2021)

Figure 2 shows the GHG emissions generated by food loss and waste compared to total GHG emissions in Indonesia. Based on these data, it shows that the average GHG emission in Indonesia from 2000-2018 is 1,129.12 Mton CO2-eq. Meanwhile, the average GHG emission from FLW from 2000-2018 is 82.26 Mton CO2-eq. or around 7.29% of the total GHG emissions in Indonesia.

Therefore, reducing food waste and loss not only able to decrease the global demand for food production and the pressure on ecosystems and natural resources such as water and land, but also enabling increased availability of food along the supply chain (Zhang et al., 2018). Economic resources also could be saved by reducing food waste by decreasing operational food costs and improving reliability and resistance to other factors, such as climate change (Farahdiba et al., 2023). If food waste is reduced, food will be more accessible, and access to nutrition will increase for individuals (Farahdiba et al., 2023). Therefore, reducing food waste could significantly alleviate hunger, increase incomes, GreenHouse Gases (GHG), climate change, save the ecosystem, and enhance food security.

Aline with this goal, United Nations Sustainable Development Goals 12 urges sustainable consumption and production patterns. Within this goal, Indicator 12.3 focuses on global food loss and waste, stating, "By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses".

Evidently, the problem of food waste is not just a rich country problem. Following a near doubling of data coverage since the 2021 Food Waste Index Report was published, there has been increased convergence in the average per capita household food waste. High-income, upper-middle income, and lower-middle income countries differ in observed average levels of household food waste by just 7 kg/capita/year (UNEP, 2024).

As the upper middle country, Indonesia, produces 28.4% of total waste. Indonesia is also claimed to be the second largest food loss and waste producing country in the world (Bappenas, 2021). Indonesia wastes around 23-48 million tons of food waste per year from 2000 to 2019, or the equivalent of 115-184 kilograms per capita per year. The economic losses due to food waste in Indonesia reach IDR 213-551 trillion/year or around 4-5 percent of Indonesia's GDP per year (Rasyaad A F & Lele, 2023). There are 5 main causes and drivers of food loss and waste in Indonesia based on Bappenas 2021 report : the lack of implementation of Good Handling Practice (GHP), insufficient quality of storage, market quality standards and consumer preference, lack of information/education for food workers and consumers, and excess portion and consumers behavior.

Regarding the food waste problems, Indonesia has committed to advancing food waste management based on The National Strategy Policy Guidelines (Presidential Regulation 97/2017), aiming for a 30% reduction and 70% waste handling by 2025. There are 45 strategies designed and categorized in 5 policy directions of food loss and waste management in Indonesia: behavioral change, improving food support system, strengthening regulations and optimizing funding, utilizing food loss and waste, and development of food loss and waste study and data collection. In the Business-as-Usual scenario, it is estimated that food loss and waste generation in Indonesia may reach 344 kg/capita/year in 2045 (Bappenas, 2021). However, the current food waste regulations and treatments are insufficient to reach these targets (Farahdiba et al., 2023).

Table 1. FLW weight percentage in each food supply chain stage

Category	Production	Post-harvest & Storage	Processing & Packaging	Distribution & Market	Source
Cereals	6%	7%	3.50%	2%	FAO, 2011
Oilseeds	7%	12%	8%	2%	
Vegetable and Fruit	15%	9%	25%	10%	
Meat	5,1%	0.3%	5%	7%	
Fish and Seafood	8.2%	6%	9%	15%	
Milk	3.5%	6%	2%	10%	
Egg	8%	-	0.10%	3%	

Sweet Potato	0.74%	2.34%	1.23%	1.35%	BKP, 2019
Cassava (*Ubi Kayu)*	0.52%	1.64%	0.86%	0.95%	
Cassava (*Gaplek*)	0.09%	0.28%	0.15%	0.16%	
Cassava/Tapioca	0.09%	0.28%	0.14%	0.16%	
Sago Flour	0.09%	0.28%	0.15%	0.16%	

(Bappenas. 2021)

According to table 1 from Bappenas which claims that the most inefficient food sector and category is vegetables and fruits (Bappenas, 2021). Based on this framework, this research suggests that tackling the food waste issue in Indonesia especially in the vegetables and fruits waste management approach is needed. Until recently, food waste prevention intervention has largely offered 'end of pipe solutions' that focus on causes of food waste at specific points in supply chains and on dealing with the physical waste material itself (Messner et al., 2021). The low participation of the Indonesian population in waste separation is a barrier to finding appropriate waste management solutions (Amirudin et al., 2023). Based on the 1st strategy to address the food loss and waste management In Indonesia which is the behavioral change, the study that focuses on food waste behavior is urgently needed. A perception study is very important in understanding the willingness to involve and formulate policies that trigger food waste management behavior.

Several studies have been conducted on driving factors, perspective and behavior toward food waste over the world such as factors most affect food waste and actions are undertaken to prevent it at the household level in Italian, Spanish and English countries (Bravi et al., 2020), the influence of benefits awareness, lack of concern and personal norm on households' food waste reduction intention (Obuobi et al., 2023), consumer perceptions, behaviors, and knowledge of food waste at the household level in Montana United States (Ahmed, et al., 2021), German students' interest, perceived importance, knowledge, and behavior regarding food waste (Gabriel et al., 2021), survey the employees of fruit and vegetable sections in supermarkets to understand their experience and the reasons they believe products are wasted (Ramírez et al., 2021), etc.

In Indonesia, there have been studies themed the perspective, behavior and knowledge toward the food waste such as: how the green campaign on food waste handling in Southeast Asia people (Susilo et al., 2022), the food waste generated by young people in Jakarta (Paruntu & Zakianis, 2023), how environmental knowledge affects the general public in Surabaya (Purwanto, 2023), factors affecting food waste behavior among residents of Surakarta (Saputro & Santoso, 2021), food consumption management practices in urban households during the COVID-19 pandemic across four major Indonesian cities: Medan, Yogyakarta, Surabaya, and Denpasar (Mulyo et al., 2022), factors influencing household food waste management behaviors in Indonesia (Ariyani & Ririh, 2020), etc.

Nevertheless, no research has yet been found that examines the perceptions, knowledge, and behaviors related to food waste specifically among vegetable and fruit sellers. Most existing research studies focus on the perspectives of the general public, or students, or household, and circulate most of the time among scientists and experts. The people who are related, participated, and impacted by the effects of food waste but unable to even grasp the concept of food waste and its impact on their livelihood such as food sellers, vegetable sellers, fruit sellers, are often being marginalized and excluded from discussion.

One of the most crowded in Indonesia is Jakarta. It is not only a large city but also the capital of Indonesia. Located on the northwest coast of Java at the mouth of the Ciliwung (Liwung River), on Jakarta Bay (an embayment of the Java Sea). Moreover, Jakarta is coextensive with the metropolitan district of Greater Jakarta (Jakarta Raya) and nearly coextensive with the daerah khusus ibukota (special capital district) of Jakarta—the latter also including a number of small offshore islands in the Java Sea.

In Jakarta, approximately 45.5 percent of the 7,700 tons of daily waste in Jakarta is food wastage. This means, each resident throws away around 184 kilograms of food per year or 0.5 kilograms per day (Rasyaad A F & Lele, 2023). Pasar Minggu traditional market is the

oldest traditional market, having been established in 1930 by the Dutch East Indies government. It is one of the big five traditional markets in Jakarta (Rafi, 2023) with 469 trained sellers and nearly 1500 sellers (Pemkot Jakarta Selatan, 2021; Hasugian, 2021). The market is crowded 24 hours and located near the waste disposal site (TPS). Consequently, the waste collected at Pasar Minggu market reaches 30–40 tons of waste every day (Izan, 2024).

Based on this framework, this research will focus on perception, knowledge, and behavior in vegetables and fruits sellers in Pasar Minggu Traditional Market, Jakarta. This study aims to contribute to the advancement in understanding vegetable and fruit sellers at traditional market waste management behavior in Indonesia. This research would like to take and understand the determinants of the vegetable and fruit sellers about the food waste, including their perspective, their knowledge, and their behavior. This study will focus on one of the biggest traditional markets in Jakarta : Pasar Minggu Traditional Market.

This research is conducted through a qualitative design through in-depth interviews to explore their perspectives, knowledge and behaviors on food waste.

2. Methods

In this research, a qualitative method was selected to understand the individual perspective of the problem in-depth. It is also more explorative compared to quantitative research. By using the qualitative method, more detailed data with more in-depth understanding was obtained from respondents relating to the study topic. In-depth interviews are considered as an appropriate technique to gain comprehensive information related to gender research. The in-depth interview is also more appropriate when discussing sensitive issues as compared to a focus group discussion (Hadiningrat, 2020).

2.1 Study design and setting

We used qualitative design through in-depth interviews with vegetable and fruit sellers to explore their perspectives, knowledge and behaviors on food waste. This study took place in one traditional market namely Pasar Minggu traditional market in South Jakarta City, DKI Jakarta, Indonesia, from October to November 2024.

We purposely recruited 6 fruit and vegetable sellers from the Pasar Minggu traditional market. Participants mainly work as the fruit and vegetable sellers in the market for 6 months or more. Participants had no relationship or knowledge about the research team. Initially, the interview guides were developed by a female Indonesian environmental science student with qualitative research experience (IAR). The interview guides were then critically reviewed by a qualitative research senior (xxx). Then, a native research assistant from the same area as the participants checked the translation for accuracy, consistency, and cultural sensitivity. The major topics covered sellers' views on the perspective of food waste, their knowledge, including how they manage the waste, their feelings on current food waste in the market, and their expectations of the waste management to their fruits and vegetables leftover they produce. Relevant prompts to facilitate the interview were used.

2.2 Data collection

IAR performed in-depth interviews, assisted by at least one field assistant with a background of undergraduate study who helped during recruitment, recording, and note-taking. All were fluent in Bahasa Indonesia, sometimes mixed with some local terms. None of the research team had relationships with study participants before the study commencement.

The interview team asked for written consent from the study participants before each interview. Each interview finished after reaching data saturation which lasted around 15 - 30 min and was audio-recorded. All interviews were done face-to-face at the market or the participant's stalls. IAR transcribed the data in Bahasa Indonesia. After cross checking them

with the field assistants, the transcripts were transcribed verbatim, then translated into English.

We applied descriptive, exploratory analysis to understand the perspectives of fruit and vegetable sellers in Pasar Minggu traditional market about food waste. We carried out deductive and inductive thematic analysis to construct themes and sub-themes (including coding framework, open coding, axial coding, selective coding), reporting findings (Ahmed et al., 2021a).

3. Results and Discussion

3.1 Pasar Minggu traditional market

Pasar Minggu traditional market is the oldest traditional market, having been established in 1930 by the Dutch East Indies government. It is one of the big five traditional markets in Jakarta (Rafi, 2023). The market is crowded 24 hours and located near the waste disposal site (TPS). Consequently, the waste collected at Pasar Minggu market reaches 30–40 tons of waste every day (Izan, 2024).

Every morning, the trash on the streets is swept and collected using heavy vehicles, then transported to a temporary disposal site. The collected waste requires approximately two 14-tons trucks every morning. The waste, without being sorted, is taken to TPST Bantar Gebang. The waste collected each morning and the heavy vehicles are captured in figure 3.1.

a  b 

Fig. 3 (a) Heavy vehicles moving waste into the truck; (b) Unsorted waste in Pasar Minggu

The cleaning process employed 5 staff members and one driver responsible for cleaning and waste management each morning. However, no waste collection activities were conducted at night, resulting in significantly dirtier conditions during nighttime hours. Plans to implement a waste sorting facility at the market had been proposed but were pending approval and support from local government authorities.

3.2 Participant Characteristics

We interviewed 6 vegetable and fruit sellers located in Pasar Minggu traditional market, South Jakarta. Inclusion criteria were being over 17 years old and having worked as vegetable and fruit seller in the market for more than 6 months. Individual consent forms were supplied for each participant. Participants consisted of 3 vegetable sellers, and 3 fruit sellers. Participants were, on average, 41 years old (range = 25-58). The gender of the respondents was dominated by males, with 83% being male and 17% being females. Nearly most of the respondents were married (83%). About two thirds of the participants had Javanese ethnicity, and 17% had both sundanese, or multiracial ethnicity. Half (50%) of the respondents attained senior educational level, whereas the rest (17%) attained elementary school, tertiary school (17%), and higher school (17%).

Table 2. Socio-demographic characteristics of respondents

Variables		Frequency N=6	Percent %
Age in years	<40	3	50%
	>40	3	50%

Gender	Male	1	17%
	Female	5	83%
Marital Status	Single	1	17%
	Married	5	83%
Race and ethnicity	Javanese	4	67%
	Sundanese	1	17%
	Multiracial	1	17%
Education	Elementary	1	17%
	Secondary	3	50%
	Tertiary	1	17%
	College	1	17%

Table 2 shows the characteristics of occupation of the respondents. Most of the respondents (67%) earned about IDR 150.000 - IDR 200.000 daily. Half of the respondents (50%) were vegetable sellers, and another half (50%) were fruit sellers. We purposively interviewed different specifications of sales to get a diverse picture of perspective, knowledge and behaviors of the sellers. We interviewed 3 fruit sellers ; mango, watermelon, and bananas, and interviewed 3 vegetable sellers ; chilis and onions, greens, carrots. Average years experience in selling was 8 years (range 2 - 15 years), with 50% of the participants having been selling fruits and vegetables for more than 6 years. More than half of the participants (67%) mostly bought the stocks from Pasar Induk, while others bought in Pasar Minggu (33%), and bought stock from a fruit supplier/boss (17%).

Table 3. Occupation characteristics of respondents

Variables		Frequency N=6	Percent %
Daily earnings	IDR 150.00-IDR 200.00,-	4	67%
	>IDR 200.000, -	2	33%
Sales specification	Fruits	3	50%
	Vegetables	3	50%
Duration of Selling	<3 years	1	17%
	3-6 years	2	33%
	>6 years	3	50%
Supplier	Pasar Induk (Main Market)	4	67%
	Pasar Minggu	2	33%
	Supplier	1	17%

The interviews ranged from 15 -33 min in length. In the interviews, we identified 4 primary themes with direct relevance to the knowledge, perspective, behavior, and factors related to food waste

3.3 Open coding

Coding in qualitative research is a program for analyzing data, including asking questions about text and constantly comparing phenomena, concepts, etc. Classification summarizes these concepts into superior concepts and the relationship between categories and superior categories (Flick, 2009). The methods of coding and classification mainly include theoretical coding, open coding, axial coding, selective coding, qualitative content analysis, etc (Glaser & Strauss, 2017). Coding and classification methods are usually used together. Open encoding, axial encoding and selective encoding are the most classical combination methods in analyzing text data, which can accurately compress and simplify the data and classify related concepts. In this study, open coding, axial coding, and selective coding are used together to encode and classify the collected data.

After the interview, the first step involved open coding through the initial organization of the data. Concepts identified during the first interview were categorized, and their relationships and differences were analyzed, leading to the summarization of several categories.

Table 4. Process and results of open coding

Knowledge about food waste	
Source Statement	Category
Food waste? Just Throw it away; it's spoiled	Limited Knowledge
It can cause diseases, odors, pollution	Awareness of impact
There has never been any outreach from the health center	Lack of formal education
Taken to the main market, exchanged with the boss	Traditional management
Attitudes towards food waste	
Source Statement	Category
It's pitiful throwing away food	Sympathy toward wastefulness
I scold them, I remind them, do not dispose of trash here	Assertiveness
Throwing away food waste remind us of people who lack resources	Concern for social impact
Good example for the sorroundings	Moral awareness
Cleanliness is part of our faith	Religious awareness
Waste management practices	
Source Statement	Category
Given to vendors, street children, neighbors	Food redistribution
Rotten fruit is returned to the boss	Return to distributors
Never Thought about making compost	Minimal composting
Trash is thrown public trash bins	Direct disposal
Economic impact	
Source Statement	Category
As many as 15 kg of rotten fruit results in a loss of 180 thousand	Financial losses
Choose good items so they don't spoil quickly	Purchasing strategy
Shopping based on feeling, not making a list	Unplanned shopping
Infrastructure and external support	
Source Statement	Category
No outreach from the government or health center yet.	Lack of socialization
No waste processing facilities like composting	Limited facilities
Dependent on the boss at the main market for waste management	Distribution system
Challenges in waste management	
Source Statement	Category
No ideas for processing into fertilizer or compost.	Minimal innovation
It's the boss's responsibility	Depedency on systems
Plastic, vegetables, fruits—all mixed together	Mixed waste types
The smell of garbage attracts many flies and respiratory diseases	Health impacts
Trade patterns	
Source Statement	Category
If the market is quiet, I buy less	Adaptive consumption patterns
There are warehouse storage options with cooling facilities	Storage in warehouses
Rarely have discounts; shopping according to needs	Limited influence of discounts
Social values	
Source Statement	Category
Items unfit for sale are given to others	Awareness of sharing
Waste management is seen as a role model for those around.	Moral Contribution
Barriers to change	

Source Statement	Category
No significant changes in management practices	Dependence on old habits
No facilities to make fertilizer from spoiled fruit	Lack of access to technology
Already accustomed to garbage in the market	Passive attitude towards waste issues:

3.4 Axial coding

Second level coding, referred to axial coding or associative registration, focuses on identifying potential logical connections among categories. During this phase, the researcher conducts a thorough analysis of one category at a time. This involves exploring related relationships centered around the chosen category and examining whether there are conceptual correlations among the categories. The term “axis” or “spindle” reflects this focus on interconnections.

Table 5. Process and results of axial coding

The Connotation of Category Relations	Corresponding subcategories	The main categories
Understanding that food waste should be thrown away if it is spoiled	Limited Knowledge	Knowledge about food waste
Understanding the negative effects of food waste on health and the environment	Awareness of impact	
Knowledge about food waste tends to be limited to practical experience and is not supported by adequate education, making innovation difficult to emerge.		
Feeling pity when seeing food being discarded, reminding of those who lack food.	Empathy toward wastefulness	Attitude Toward Food Waste
Reprimanding people who throw trash carelessly.	Firmness toward bad behavior	
Viewing waste management as a good example and part of religious teachings.	Moral and religious awareness	
This attitude reflects sellers who possess social and moral awareness, but their management practices remain simple and limited to traditional solutions.		
Absence of outreach or socialization from the government or relevant parties	Lack of formal education	
Giving still-edible food to others (vendors, street children, neighbors)	Food redistribution	Waste management practices
Rotten fruit is returned to the boss at the main market	Return to distributor	
Inedible waste is thrown into trash bins	Direct disposal	
No efforts have been made for composting or converting waste into fertilizer	Minimal processing	
Management practices are more reactive (redistribution, disposal) rather than		

preventive (waste reduction or recycling)		
Rotten fruit causes significant losses, for example, 15 kg of rotten fruit equals a loss of Rp180 thousand.	Financial Losses	Economic impact
Shopping is done based on intuition, without a list or careful calculation	Unplanned shopping	
Choosing quality items to reduce the risk of spoilage	Loss mitigation strategies	
Financial losses due to food waste are often caused by a lack of stock planning; however, mitigation efforts are still made through selecting quality items.		
No waste processing facilities like composting	Limited facilities	Infrastructure and external support
Relying on the boss or main market for waste management	Dependence on distribution systems	
No outreach or training to reduce food waste	Lack of government intervention	
The lack of infrastructure and external support exacerbates waste management issues, leading sellers to rely solely on traditional solutions.		
No ideas for utilizing waste fertilizer or other products	Minimal innovations	Challenges in waste management
Food waste mixed with plastic and other types of waste	Mixed types of waste	
Poorly managed waste leads to odors, flies, health risks.	Health impacts	
The main challenges are the lack of infrastructure, minimal innovation, and deeply rooted habits in waste management.		
Purchasing items based on market conditions, stock and demand	Adaptive shopping decisions	Trade patterns
Utilizing storage facilities with cooling options.	Storage in warehouses	
Discounts rarely affect purchasing decisions	Minimal influence of discounts	
Trade patterns play a role in determining the amount of waste generated. Sellers tend to buy according to needs but sometimes still face surplus.		
Providing still-edible food to help others.	Awareness of sharing	Social values and self-awareness
Waste management is viewed as a positive social contributions	Role model for the surrounding environment	
Social values encourage sellers to share rather than discard food; however, this awareness has not yet fully manifested in sustainable practices.		

3.5 Thematic analysis

From the axial coding and thematic coding, the main themes that emerged are: This theme is divided into 3 subthemes, namely basic understanding of waste, awareness of impacts, and lack of formal education. This theme is divided into 3 subthemes, namely basic understanding of waste, awareness of impacts, and lack of formal education.

"Something that spoiled ?", (N3, 42 years old, vegetable seller)

"Like rotten food needs to be spoiled?", (N2, 40 years old, vegetable seller)

"Is it like the discarded vegetable waste?", (N4, 58 years old, vegetable seller)

"It seems like most of the trash here is vegetable waste, especially at night", (N5, 32 years old, fruit seller)

"I don't know, is it recycled waste or something?" (N6, 25 years old, fruit seller)

The majority of vegetable and fruit sellers have not been exposed to or developed an understanding of the concept of food waste. The participants still lack awareness that the term 'food waste' represents a novel and distinct concept compared to the general waste. They often perceive waste as a singular category, although a minority demonstrate an outstanding of its classifications, such as organic waste and recyclable waste. This lack of awareness is understandable given that most participants have only attained primary or secondary education. This observation aligns with findings from research conducted by Rebecca Busse in 2018 that the lesson plans were effective at increasing student knowledge about the environmental effects of food waste and solutions to food waste (Busse, 2018). Several participants were able to provide answers when asked about the known impacts of food waste, although their responses were not entirely comprehensive.

"*It can cause diseases, such as respiratory illnesses and various other health issues. Maintaining cleanliness is essential",* (N2, 42 years old, vegetable seller)
"It is not ideal, especially in terms of health. The smell of waste as we know is overpowering and unpleasant.", (N3, 40 years old, vegetable seller)

"It leads to pollution, which also has health impacts", (N6, 25 years old, fruit seller)

On the other hand, some participants denied the impact of food waste, as they perceived the market conditions to be fine and did not see the need for preventive actions regarding food waste.

"However, in the morning, vegetable waste is collected by bulldozers, so it cannot have an impact. Moreover, this is a main road, and it must be cleaned by 9am. Therefore, by 8 am, the bulldozer has already cleared the waste, and by 9 am everything is cleaned up", (N4, 58 years old, vegetable seller)

This perception was due to the presence of heavy machinery, such as bulldozers that clear waste from the streets every morning. This cleansing process led the participants to believe there were no issues regarding the waste or food waste in the market. This finding is quite surprising, as it suggests that if vendors in the market do not recognize any issues and feel that everything is fine, their awareness of cleanliness remains low.

As a result, interventions from various stakeholders would likely be difficult to implement or accept. This may also be influenced by the participants' older age. The participants' age could potentially affect their thinking patterns or perceptions regarding cleanliness, waste, and other aspects of personal hygiene. This is consistent with research

conducted by Singh et al. (2023) which examined that age was a significant factor in hygiene practice. The research mentioned that the age group 26 and above had 66.7% reporting bad practice (Singh, et al.2023).

Once again, awareness campaigns from relevant authorities about the importance of preventing food waste, maintaining market cleanliness, and promoting personal hygiene are necessary to improve knowledge among the community and market vendors.

3.6 Lack of formal education

Based on the interview, 87% of participants reported that they have not received any socialization or training from the government regarding food waste or other types of waste while they were selling at the market. This absence of socialization of course impacts the participants' knowledge about food waste, as well as the methods for sorting and processing food waste.

This finding about knowledge and education about food waste can serve as a recommendation for the government and relevant stakeholders to intensify efforts in promoting the importance of preventing food waste, starting from suppliers, vendors, sellers, to consumers. There was a study by Busse (2018) conducted with second and fifth grade classrooms in two Indiana elementary schools which was conducted to increase awareness through education. The research findings revealed that the lesson plans were effective at increasing student knowledge about the environmental effects of food waste and solutions to food waste, indicated by a change in reported behavior which was correlated with plate waste reduction (Busse, 2018). Wang, et al., (2024) also stated that after participating in the labor education, the students' views and practices toward their peer's food waste have improved (Wang et al., 2024)

3.7 Perspective and awareness food waste

Based on the results of thematic coding, 2 sub-themes were identified under this theme, namely empathy towards wasted food, moral awareness and religious values.

3.7.1 Empathy towards

When asked about their feelings, 87% of participants reported experiencing sadness, regret, or frustration when seeing piles of food waste or disposing of leftover food waste/unsold vegetables and fruits.

> *"It is unfortunate to see food being wasted",* (N1, 48 years old,fruit seller)

> *"It does cross my mind (about food waste), especially during difficult times when earning a livelihood is challenging, and the losses are significant",* (N2, 42 years old, vegetable seller)

> *"It is disheartening to see, when we know making a living has become increasingly challenging",* (N3, 40 years old, vegetable seller)

> *"At times, it can be frustrating, especially during the rainy season",* (N4, 58 years old, vegetable seller)

> *"It's unfortunate, but there's nothing else to be done. It's already spoiled*", (N6, 25 years old, fruit seller)

On the other hand, one participant reported feeling indifferent when disposing of food waste.

> *"It feels ordinary because I've been in this market for a long time. It might feel different for those who are new to the market",* (N5, 32 years old, fruit seller)

> *"Spoiled waste is not a concern, but disposing of fresh, good quality items is regrettable. Fresh waste is what truly feels wasteful",* (N4, 58 years old, vegetable seller)

This attitude of feeling indifferent may be attributed to the participant's long-term residence in the market, which has led to a sense of familiarity with the frequent disposal of food waste. Although participants lack basic understanding of food waste, they demonstrate a high level of empathy when observing food waste piles or disposing of food waste. This high level of empathy expressed by participants is a positive indicator that there is potential for reducing food waste among them. This potential needs to be supported by appropriate measures from relevant authorities, such as market managers and the government, to ensure that food waste is not merely discarded but can be processed into something more beneficial. The research conducted by Obuobi, et al., (2023) studied the influence of benefits awareness, lack of concern and personal norms on households' food waste reduction intention. It was found that households' awareness of consequences was established to have a positive effect on ascription of responsibility, and they both impact personal norms positively. Moreover, personal norms influence food waste reduction intentions positively (Obuobi et al., 2023).

3.7.2 Moral awareness and religious values

From the interview conducted, most participants agreed that by not disposing of food waste, they could serve as a good example for others in preventing food waste. The majority of participants also acknowledged that religious beliefs play a significant role in fostering empathy toward the disposal of food waste.

> *"Agreed, it sets a good example and is also emphasized in religious teachings",* (N1, 48 years old,fruit seller).

But still, for some participants, the leaders in higher positions should set an example to follow.

> *"Those in leadership or higher positions should set an example that others can follow. In my religion, cleanliness is part of faith, and if one's faith is not strong, it reflects in their lack of cleanliness",* (N2, 42 years old, vegetable seller)

Based on the interview findings, the motivation to become a role model and the influence of religious beliefs are one of key factors shaping participant's perceptions of food waste. This is consistent with the research conducted by Floriano (2024) which examined the role of emotions in the food waste reduction behavior of Brazilian consumers. In this study, psychological distance moderated the intention behavior relationship, demonstrating that consumers are more likely to engage in sustainable practices when they perceive waste as a problem close to themselves (Floriano, 2024). However, despite this awareness, their implementation of innovative or sustainable practices remains limited. Their awareness is predominantly expressed through the redistribution of food rather than seeking long-term solutions such as waste processing.

3.8 Food waste management practices

Based on the results of the interview regarding their practices in managing food waste, participants' responses were categorized into 3 sub-themes : processed waste, special price and redistribution of lower grade food, and direct disposal.

3.8.1 Proceed food waste

When participants were asked how they managed spoiled products, 16.7% (n=1) of them indirectly demonstrated proper food waste management practices by collecting spoiled fruits and returning them to the supplier. The product being sold is mangoes.

> *"The items were transported by the fruit boss to the central wholesale market (Pasar Induk). About 15 kilograms of the total 185 kilograms mangoes were classified as spoiled",* (N1, 48 years old,fruit seller).

The interviews revealed a unique finding : the spoiled fruits can be collected and exchanged back with the supplier. Additionally, sellers receive discounts when returning spoiled fruits. According to the researchers, this practice of collaborating with the suppliers to manage the spoiled products is highly commendable and could be conducted as a model for other sellers and suppliers. The benefits are the sellers do not incur losses from the spoiled fruits they return, food waste is minimized to zero, as it can be processed and repurposed into valuable products such as compost or animal feed. This practice is also one of the recommendations recommended by the Maryland Department of the Environment, which suggests returning spoiled and off-spec goods to the supplier (Maryland Department of the Environment, 2019).

In addition, one of the participants (17%, n=1) stated that he repurpose unsellable (spoiled) products (vegetables) into fertilizer, as demonstrated by a vegetable seller interviewed during the study. This practice of composting attitude was correlated in various ways with both intent to reduce and reported food waste reduction behaviors (Alattar et al., 2020).

> *"I used to place the spoiled products into a fertilizer. My neighbor has an unused garden, and placed them there, in Jatipadang, rather than being discarded as waste"* (N3, 40 years old, vegetable seller)

Additionally, one participant states that overripe bananas are typically collected by a cake factory to be used as ingredients for making banana sponge cakes.

> *"Yes, there is a regular arrangement for supplying banana cakes (to take the overripe bananas), which will be picked up three times a week"* (N5, 32 years old, fruit seller)

The practice of processing food waste observed in this study (including collecting spoiled fruits and returning them to the supplier, repurposing spoiled vegetables into fertilizer, utilizing overripe bananas as ingredients for banana sponge cakes), is commendable considering that many participants still lack a basic understanding of food waste. However, these practices require support through relevant policies to scale up food waste recycling and reduce the overall amount of food waste in the market. If implemented on a larger scale, these food waste management practices have the potential to significantly decrease food waste.

3.8.2 Special price and redistribution and of lower grade food

Based on the interview findings, several participants also chose to sell fruits and vegetables that were no longer in optimal condition at a reduced price or distribute them for free to the surrounding community.

> *"I give the items (almost rotten products) to friends, passersby, street children, and individuals operating small mobile rides (commonly known as odong-odong)",* (N1, 48 years old,fruit seller)

> *"I prefer to sell at a lower price. This is because at this moment, selling is merely a means of survival",* (N2, 42 years old, vegetable seller)

> *"If there are people interested in taking them (the lower grade watermelons), they are given away for free",* (N6, 25 years old, fruit seller)

The practice of selling at a reduced price or distributing for free is a more sustainable alternative compared to discarding it at waste disposal sites. This finding aligns with the research by Buisman, et al., (2019) which stated that food waste by retailers can be reduced by discounting old products or by applying a dynamically adjustable expiration date (Buisman et al., 2019). However, follow-up interviews indicated that a substantial portion of unsold products remains undistributed, leading to significant quantities still being disposed of as waste.

3.8.3 Direct disposal

The interviews also revealed that fruit and vegetables that can no longer be sold or distributed are disposed of at the waste disposal sites in the market.

> *"Just like chili peppers. if still don't sell, i have no choice but to throw or discarded"* (N2, 42 years old, vegetable seller)

> *"Yes, the spoiled ones (have to be thrown away)"* (N3, 40 years old, vegetable seller)

> *"For vegetables like water spinach (kangkung), if they are not sold, they are discarded. Mustard greens (sawi) that remain unsold and have spoiled are also discarded. However, onions can still be sold the next day, and chili peppers can still be used. Nevertheless, various types of vegetables are often discarded as well"* (N4, 58 years old, vegetable seller)

> *"If the remaining bananas are not claimed or noone take, they will be discarded"* (N5, 32 years old, fruit seller)

> *"They (watermelons) are usually discarded only if they are no longer in good condition. For example, at night when the store is about to close, items like these can no longer be sold are set aside",* (N6, 25 years old, fruit seller).

From the interviews, fruits and vegetables that are no longer of good quality are typically distributed for free or sold at a discounted price. In contrast, fruits or vegetables that are spoiled are usually processed or disposed of in waste facilities. Based on interview findings, fruits can often still be processed into food products or livestock feed due to their relatively longer freshness period. However, vegetables are more challenging to process and, according to the findings of this study, are more likely to remain unprocessed and be discarded.

3.9 Food waste management practices

Based on the results of the interview regarding their challenges in food waste management, participants' responses were categorized into 2 sub-themes : preventing practices and limited facilities.

3.9.1 Preventing practices

In the interviews, we tried to explore the strategies employed to minimize food waste. Most participants reported adopting practices such as purchasing stock in quantities

aligned with depleted inventory, selecting high-quality produce, and storing items in appropriate conditions.

> *"Yes, (I choose) the good ones. Earlier, there were 4-5 stores i selected, and I chose the good one",* (N1, 48 years old,fruit seller)

> *"It depends on the situation. For instance, if the market is quiet, only a small quantity of chili is purchased",* (N2, 42 years old, vegetable seller)

> *"Items that are seemed affordable and potentially profitable are prioritized for purchase",* (N3, 40 years old, vegetable seller)

> *"If my customers place an order by phone, the supply is increased. If not, it is reduced to prevent waste. Managing vegetables is not as straightforward, unlike supermarkets where products remain fresh continuously. Vegetables here deteriorate quickly when exposed to heat, which leading to spoilage",* (N4, 58 years old, vegetable seller)

> *"The allocation for each banana seller is to sell 2 quintals of bananas per day"* (N1, 48 years old,fruit seller)

> *"(I store the fruits) in the warehouse near here",* (N5, 32 years old, fruit seller)

> *"There is a freezer. Mostly, oranges are stored in the refrigerator",* (N3, 40 years old, vegetable seller)

These interview findings revealed that 83% (n=5) of participants independently make purchasing decisions based on their analysis of existing stock, market activity levels, or specific customer orders. In practice, this approach is beneficial as it demonstrates efforts by fruit and vegetable sellers to reduce unsold products, thereby minimizing food waste. However, some mitigation efforts, such as selecting equipment with cooling facilities also helped extend the fresh period of the stocks. On the other hand, 17% (n=1) of participants maintain a fixed daily stock of 2 quintals of bananas. This practice increases the risk of surplus bananas remaining unsold, as the supply is consistent while demand may vary.

3.9.2 Limited facilities

In the interviews, we also tried to explore their expectations regarding food waste disposal facilities available in the market.

> *"Regulations regarding food waste management need to be enforced",* (N2, 42 years old, vegetable seller)

> *"Waste should ideally be separated to facilitate better management. However here, waste is often mixed, including vegetables, plastics, and food waste",* (N5, 32 years old, fruit seller)

The interview findings indicate that half of the participants (50%, n=3) expressed concern over the lack of adequate facilities for disposing of food waste, resulting in food waste being mixed with other types of waste. This issue warrants evaluation by relevant stakeholders to reduce the accumulation of food waste, including vegetables and fruits waste, which already reached quantities exceeding several tons per day.

4. Conclusions

The knowledge of vegetable and fruit sellers about food waste is very limited. Several participants were able to provide answers when asked about the impacts of food waste,

although their responses were not entirely comprehensive. Based on the interview, 87% of participants reported that they have not received any education or socialization from the government or the management regarding food waste or other types of waste while they were selling at the market.

When asked about their perception and awareness about food waste, 87% of participants reported experiencing sadness, regret, or frustration when seeing piles of food waste or disposing of leftover food waste/unsold vegetables and fruits. On the other hand, one participant (13%) reported feeling indifferent when disposing of food waste. Besides, most participants agreed that by not disposing of food waste, they could serve as a good example for others in preventing food waste. The majority of participants also acknowledged that religious beliefs play a significant role in fostering empathy toward the disposal of food waste.

This research revealed the behavior of vegetable and fruit sellers toward food management. The fruits and vegetables that were no longer in optimal condition, several participants chose to sell at a reduced price or distribute them for free to the surrounding community. Some of them were collecting spoiled fruits and returning them to the supplier, repurposing spoiled vegetables into fertilizer in the neighborhood, or utilizing overripe bananas as ingredients for banana sponge cakes.. The interviews also revealed that fruit and vegetables that can no longer be sold or distributed are disposed of at the waste disposal sites in the market.

Most participants reported adopting practices such as purchasing stock in quantities aligned with depleted inventory, selecting high-quality produce, and storing items in appropriate conditions. These interview findings revealed that 83% (n=5) of participants independently make purchasing decisions based on their analysis of existing stock, market activity levels, or specific customer orders. On the other hand, 17% (n=1) of participants maintain a fixed daily stock of 2 quintals of bananas. These interview findings also indicate that half of the participants (50%, n=3) expressed concern over the lack of adequate facilities for disposing of food waste, resulting in food waste being mixed with other types of waste. This issue warrants evaluation by relevant stakeholders to reduce the accumulation of food waste, including vegetables and fruits waste, which already reached quantities exceeding several tons per day.

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