Policies and strategies for reducing food loss and waste in Indonesia

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Abstract. Food loss and waste (FLW) have become one of the targets for Sustainable Development Goals (SDGs), which was agreed to achieve in 2030. This paper aims to provide policy recommendations and strategies to reduce FLW to achieve sustainable food and nutrition security in Indonesia. This paper used secondary data from FAO, BAPPENAS, and various references. Data were analyzed using descriptive analysis. FAO shows that one-third of the food available for human consumption at the global level is lost or wasted during the harvest process and at home. Meanwhile, according to the Ministry of Environment and Forestry, 44% of the landfill in Indonesia is food waste. The EIU report states Indonesia is one of the largest food waste-producing countries globally, with 300 kg/capita/year. BAPPENAS estimates that the amount of FLW in Indonesia during 2000-2019 ranges from 115-184 kg/capita/year. This paper recommends the importance of formulating a national policy on FLW reduction and provision of the national FLW data. The use of technology in the food supply chain from harvested until distributed to the retail level will reduce food loss. The strategy to reduce food waste requires socialization, education, and massive movement. Early education-related culture for not to waste food are essential things to do. Implementing rules and strategies for reducing FLW will significantly increase food availability and realize sustainable food security and nutrition in Indonesia.

1. Introduction

The United Nations Food and Agriculture Organization (FAO) points out that a third of the food produced in the world is lost or thrown away [1]. At the same time, to feed the planet's population of more than 9 billion people by 2050, the world must build a sustainable food future. Food loss and waste (FLW) is an objective of the Sustainable Development Goals (SDGs) in target 12.3, which aims to reduce food loss at the production stage and along the supply chain, including postharvest losses, by halving food waste per capita at the distribution and consumption stages by 2030 [2].

The results of the EIU study state that Indonesia is a country with the second-highest FLW in the world, which is 300 kg/capita/year [3]. Meanwhile, a study conducted by BAPPENAS estimates that the amount of FLW production in Indonesia in 2000-2019 ranges from 115-184 kg/capita/year [4]. From the two references, there are differences in the amount of FLW production in Indonesia, but both show that the amount of FLW is still high. This phenomenon is paradoxical when data indicates that 40% of Indonesian populations are food insecure because they do not consume enough food as recommended to live a healthy, active, and productive life [5].

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In the future, efforts to increase rice production and rice availability face the challenges of decreasing agricultural land area due to land conversion, climate change, increasing population, and rising household income. In this regard, reducing FLW by 25% will increase the availability of rice in Indonesia by around four kg per capita and more than two kg per capita for the world's population [6]. Concerning those constraints, efforts to reduce FLW are possible as an instrument step in increasing food availability, ultimately strengthening food security.

Therefore, a study related to identifying strategic efforts and policy formulation to reduce FLW significantly is essential. This paper aims to identify strategic steps that need to be taken and formulate policy recommendations to reduce FLW concerning achieve sustainable food and nutrition security in Indonesia.

2. Materials and methods
The paper uses the literature review method, studying documents, reports, and research results carried out. The data used are secondary data sourced mostly from FAO and BAPPENAS. In addition, this study also uses data and information from the research results of various previous studies related to FLW.

The FLW discussed covers food loss and waste from harvest, postharvest, distribution, to consumption levels. As an example of using technology to minimize food loss, this paper discusses using postharvest technology for handling chili, corn, and rice. All data were discussed and analyzed descriptively.

3. Results and discussion

3.1. Global definition, measurement, and performance of FLW
According to the FAO, FLW is defined as a decrease in food quantity or quality throughout the food supply chain. Food losses are defined as those that occur along the food supply chain from harvest/slaughter/catch up to but not including retail. Food waste, on the other hand, happens at the point of sale and consumption. It is directly linked with consumer behavior [7].

Two indices to measure FLW are the Food Loss Index (FLI) and the Food Waste Index (FWI) [7]. For the FLI, the FAO estimates that roughly 14% of food produced is lost from postharvest to retail, although not including retail. Food Waste Index covers retail and consumption. According to FAO, five important messages in reducing FLW are (1) one of the SDGs targets is to reduce FLW as well as to achieve food and nutrition security targets as well as environmental conservation; (2) about 14% of food produced is lost at the postharvest and processing stages of the food chain globally; retailers, food service providers, and consumers are not included; (3) addressing the causes of FLW is critical, which needs data on where FWL happens in the food supply chain, as well as the factors that influence it; (4) decreasing FLW can save money, but it comes at a price and will rise when low-cost alternatives to preventing FWL run out; and (5) more detailed analysis of the precise relationship between FLW and food security, nutrition, and environmental resiliency is essential to reduce FLW and generate significant societal advantages.

A previous study Gustavsson [8] estimated FLW at the consumption stage averages 95-115 kg/caput/year in developed countries; meanwhile, in developing countries, including Indonesia, it is around 6-11 kg/caput/year. FLW on certain commodities has even reached 30% of total production. In the United States, FLW at the consumption stage accounts for 27% of the total output [9]. Consumer knowledge and awareness do not fully reflect the efforts of anti-food waste activists, as evidenced by my personal research [10].

For decades, food wastage is one of the obstacles in realizing food security and environment preservation. Moreover, during the COVID-19 pandemic, FLW has become an even worse problem in many countries due to distribution disruptions [11]. There are three categories of FLW: avoidable, perhaps avoidable, and unavoidable. Food or beverages that were completely edible or drinkable but
were rejected for no apparent reason before disposal are considered avoidable waste. Some foods eaten by some but thrown by others are potentially preventable, unavoidable food waste includes inedible food waste such as bones, eggshells, inedible peels, and spent coffee grains [12].

According to the findings of a study conducted in elderly homes, when food is served on white plates, 26% of it is thrown away, compared to only 9% when performed on one of the colored plate options tested. With just one reform, a national solution to the problem of unsustainable food consumption among nursing home residents might save up to 992.6 tons of food each year [13]. The families surveyed expressed a favorable attitude toward purchasing, consumption, and waste, indicating a keen knowledge of food waste and its social and environmental consequences [14]. Food waste in the home is reduced by more than 45% when frozen foods are used instead of fresh foods [15].

FLW prevention and reduction should boost farmer incomes, cut food costs, improve food quality, safety, and security, and reduce the detrimental impact of food production on ecosystems, climate, and water resources [16]. FLW prevention is a potential strategy for better balancing food supply and demand, and it’s crucial for enhancing food security while reducing environmental impact and providing economic benefits to various food supply chain participants [17]. FLW is proven to cause significant economic damage and income loss. Furthermore, reducing FLW has both environmental and socioeconomic benefits [18].

3.2. Performances, problems, and policies for handling FLW in Indonesia

Food waste accounts for 44% of landfills, according to the Ministry of Environment and Forestry [19]. Food waste has happened as a result of a shift in thinking, food’s economic value is undervalued due to culture and a lack of public understanding. As a result, efforts to counteract wasteful food consumption must be carried out through a campaign, with information and knowledge disseminated through local wisdom and religious doctrines [6].

The main finding of the BAPPENAS study shows that Indonesia’s FLW in 2000-2019 was 115-184 kg/capita/year. The number of people who can feed on the loss of nutritional content (energy) from FLW in 2000-2019 is 61-125 million people or 29-47% of the Indonesian population. Referring to the results of this study, if the incidence of FLW can be reduced by 50% from the existing conditions for the 20 years, then every year, there will be an additional about two million people who can feed. Furthermore, the results of the BAPPENAS study have calculated that without control, it estimated Indonesia’s FLW generation in 2045 could reach 344 kg/capita/year. The strategic scenario prepared estimated that the FLW in 2045 reaches 166 kg/capita/year [4].

BAPPENAS’ study also shows the most significant production of FLW occurs at the household level from the food chain stage. In terms of sectors and types of food, the actual production occurred in food crops, the category of grains. Meanwhile, the most inefficient food sector is horticultural crops, precise in the vegetable category [4]. This finding is in line with the analysis at the global level conducted by FAO that food loss for fruit and vegetables ranks second after tubers and roots at the postharvest and distribution stage [7].

Moreover, the BAPPENAS study shows that there are five leading causes and drivers of FLW in Indonesia, namely (1) lack of Good Handling Practice (GHP) implementation; (2) suboptimal storage space quality; (3) market quality standards and consumer preferences; (4) lack of information/education for food workers and consumers; and (5) excess portions and consumer behavior [4].

One of the food waste sources from leftovers is food stalls (warning makan). The average amount of food waste each day at food stalls around campus IPB Darmaga, Bogor was 29,413 kg. Rice, vegetables, and side dishes make up the majority of food waste, accounting for around 70% of total food waste. They claim that food stalls were used to serve rice as a buffet to cut down on food waste [20]. The value of FLW at grocery stores in Indonesia is estimated to be around IDR 40-50 million per month. Fruits and vegetables, which have a short shelf life, were the most significant contributors to FLW [21]. Women had a critical part in the management of food waste in the home. Women in Indonesia are mostly to be responsible for domestic obligations, including food management at home. They are in charge of food-related activities like grocery buying, storing, cooking, and eventually disposing of food waste.
FLW management policies in Indonesia have been described in the results of a study by BAPPENAS into five main steps, namely: (1) building FLW knowledge to all human resources involved in the food supply chain, including changes in community behavior; (2) developing farmer corporations and optimizing appropriate funding for the provision of infrastructure and facilities that support the efficiency of the food processor; (3) developing FLW regulations at the national and regional levels and strengthening coordination between institutions; (4) encouraging the development of food distribution platforms and FLW management that supports a circular economy; and (5) strengthening national and regional databases on FLW through related studies and censuses [4].

Public opinion and education are critical for changing societal practices and reducing FLW. The general public's awareness of food waste is extremely high. Handling food waste must be carried out thoroughly from upstream to downstream along the food chain. Starting from producers, distributors, and food traders, the broader community as consumers and processing food waste to become compost and energy sources [23].

Efforts to reduce food loss also are made by optimizing the use of technology according to the stages in the food chain. Meanwhile, specifically, to minimize food waste at a consumer level, a change in behavior and concern for consumers and food industry players at the retail level and ready-to-consumer food providers is needed on the importance value of food. Intensive and massive education, socialization, and communication by all stakeholders are the determining factors for reducing food waste.

As an example of using technology to reduce food loss, this paper discusses the case of decreasing food loss for chili and rice. ASEAN-PHL report shows critical points of food loss at various stages of postharvest activities for agricultural commodities (Figure 1) [24].

![Diagram](https://via.placeholder.com/150)

**Figure 1.** Critical points on postharvest of chili commodity [24].

In Magelang District, Central Java, the percentage of yield loss for chili commodities ranged from 13.3% to 28.0%, while in Garut District, West Java, the rate of yield loss was 29.60% (Table 1) [24,25]. The amount of yield loss experienced at every step of the supply chain varies by geography. It demonstrates that the management of the fresh agricultural product at every step of the supply chain is determined by the administration. Table 1 reveals that along the red chili supply chain in Magelang District, the most major critical issue of postharvest handling occurs at the collector level. The most
crucial step of loss is the sorting process. Separating tasks include sorting young chilies, broken chilies, and harvesting too-small shelters. Sorting activities include sorting young chilies, broken chilies, harvesting shelters that are too small. At the seller level, losses occur due to the storage process at room temperature. According to the Research and Development Agency of the Ministry of Agriculture [25] results, postharvest technology can reduce the rate of yield loss. The types of postharvest technology that minimize chili yield loss include chili color diagrams for harvesting, plastic crates to store chilies in the field and during transportation, washing chilies using ozone solution as an antimicrobial, and using perforated cardboard. This postharvest technology can reduce red chili losses to less than 10%.

**Tabel 1.** Postharvest losses rate of chili throughout the supply chain (a case study in Garut District, West Java and Magelang District, Central Java) [24].

| Points                                | Losses (%) Magelang | Losses (%) Garut |
|---------------------------------------|---------------------|-----------------|
| Farmers                               | 2.19                | 2.50            |
| - Individual farmers                  | 2.48                |                 |
| - Farmers group                       | 1.52                |                 |
| Transportation 1                       | 1.27                | 9.0 -10.2       |
| Small scale collectors                | 2.66                |                 |
| Large scale collectors (sortation)    | 8.67                | 6.0 -7.2        |
| Retailers                             | 6.93                | 2.7             |
| Transportation 2                       | 2.33                | 3.0 - 7.0       |
| **Total**                             | **13.3-28.05**      | **29.60**       |

One conclusion from the focus group discussion (FGD) conducted by Indonesian Economic Coordinator Ministry stated that the use of mechanization at the postharvest stage for rice plants could reduce food loss from 20.92% to 11-13%. From the same, the FGD also stated that the use of mechanization technology in the postharvest of corn could reduce losses from 8.95% to 2.5-2.79%. In general, technological intervention can reduce losses by more than 60%. So, if these technologies are applied to other agricultural commodities, it is expected that the food loss rate for Indonesian agricultural commodities will decrease significantly.

Everyone must have access to the food they require. Everyone should eat enough food that is diversified, healthy, well-balanced, and safe. For this reason, the availability and distribution of food at affordable prices is a prerequisite so that all people can access and consume food in the amount, type, and composition according to the recommendations for a healthy, active and productive life. Efforts made to reduce FLW are related to efforts to increase the food supply. In a situation where efforts to increase food supply from the production side face various challenges, efforts to reduce FLW with the multiple strategies described previously can be safety valves to achieve sustainable food and nutrition security in Indonesia.

**4. Conclusions**

FLW has become a global issue related to one of the achievements of the SDGs targets. Indonesia is a country with a sizeable FLW production. Even though around 40% of the population has low income, the level of energy consumption is less than adequate standards. A decrease in FLW can increase food availability. Reducing FWL by 25%, the availability of rice food in Indonesia increased about 4 kg/capita and more than 2 kg/capita for the world’s population.

Other aims, such as increasing the efficiency of the food system, promoting food and nutrition security, and improving environmental preservation, should be the focus of the FLW reduction program. These various dimensions should be prioritized by policymakers. The best combination of strategies and policies to minimize FLW will be determined by providing information on how FLW affect them.

Holistic policies are needed to reduce FLW at every stage of the food production and distribution system. The policies include optimizing the use of technology based on every step in the food chain,
campaign for consumer, restaurants and food stores habits in consume and serving methods, and involving all stakeholders, e.g., a housewife in shopping groceries, food stores, cooking, and eating behavior.

This paper recommends the importance of formulating a national policy on FLW reduction and provision of the national FLW data. Food loss will be reduced if technology is used across the food chain, from producers to distribution to sale. Food waste reduction needs socialization, education, and widespread movement. It is critical to instill a culture of not wasting food in children from an early age. Putting in place policies and initiatives to reduce FLW will significantly boost food availability and help Indonesia achieve sustainable food and nutrition security.

References
[1] Food and Agriculture Organization 2011 Global Food Losses and Food Waste – Extent, Causes, and Prevention (Rome: Food and Agriculture Organization)
[2] United Nations Environment Programme 2020 Goals 12 Ensure Sustainable Consumption Patterns United Nation United Nations Environment Programme
[3] The Economist Intelligence Unit 2017 Fixing Food – Towards a More Sustainable Food System Barilla Center for Food & Nutrition
[4] BAPPENAS 2021 Laporan Kajian Food Loss and Waste di Indonesia dalam Rangka Mendukung Ekonomi Sirkular dan Pembangunan Rendah Karbon (Jakarta: BAPPENAS)
[5] Badan Ketahanan Pangan 2020 Direktori Perkembangan Konsumsi Pangan (Jakarta: Badan Ketahanan Pangan)
[6] Kariyasa K and Suryana A 2012 Memperkuat Ketahanan pangan melalui pengurangan pemborosan pangan Anal. Kebijak. Pertan. 10 269–88
[7] Food and Agriculture Organization 2019 The State of Food and Agriculture 2019 Moving Forward on Food Loss and Waste Reduction (Rome: Food and Agriculture Organization)
[8] Gustavsson J, Ciderberg C, Sonesson U, Otterdijk R van and Meybeck A 2011 Global Food Losses and Food Waste (Rome: Food and Agriculture Organization)
[9] Cuéllar A D and Webber M E 2010 Wasted Food, Wasted Energy: The Embedded Energy in Food Waste in the United States Environ. Sci. Technol. 44 6464–9
[10] Radzymińska M, Jakubowska D and Staniewska K 2016 Consumer attitude and behaviour towards food waste J. Agric. Rural Dev. 1 175–81
[11] Shurson G C 2020 “What a waste”—can we improve sustainability of food animal production systems by recycling food waste streams into animal feed in an era of health, climate, and economic crises? Sustain. 12 34 p
[12] Morawicki R O and Díaz González D J 2018 Food sustainability in the context of human behavior. Yale J. Biol. Med. 91 191–6
[13] Hansen K V and Derdowski L A 2020 Sustainable food consumption in nursing homes: less food waste with the right plate color? Sustain. 12 9 p
[14] Portugal T, Freitas S, Cunha L M and Rocha A M 2020 Evaluation of determinants of food waste in family households in the greater porto area based on self-reported consumption practices Sustainability 12 12 p
[15] Martindale W 2017 The potential of food preservation to reduce food waste Proc. Nutr. Soc. 76 28–33
[16] Kowalska A 2017 The issue of food losses and waste and its determinants Logforum 13 7-18
[17] Nicastro R and Carillo P 2021 Food loss and waste prevention strategies from farm to fork Sustain. 13 23 p
[18] Kotykova O and Babych M 2019 Economic impact of food loss and waste AGRIS on-line Pap. Econ. Informatics 11 55–71
[19] Kementerian Lingkungan Hidup dan Kehutanan 2018 Pengelolaan Sampah Sektor Lingkungan Hidup Dan Kehutanan (Jakarta: Kementerian Lingkungan Hidup dan Kehutanan)
[20] Wulansari D, Ekayani M and Karlinasari L 2019 Kajian timbulan sampah makanan warung
makan ECOTROPHIC 13 125–34

[21] Mulyana J, Gunawan I and Tamara V 2019 Studi eksploratif manajemen sampah makanan pada jaringan toko produk pangan di Indonesia Ind. J. Teknol. dan Manaj. Agroindustri 8 95–106

[22] Hadiningrat G 2020 Women’s role in food waste management in Indonesia (study case in Bandung) Proc.1st ISMOPHS (Dordrecht: Atlantis Press) pp 31–5

[23] Rachman I and Septiana A I 2020 Food waste control recommendations in indonesia based on public opinion related to the target SDGs J. Community Based Environ. Eng. Manag. 4 25–30

[24] Purwanto Y, Nurdjannah R, Lamona A and Darmawati F 2013 Packaging of curly chilies during transportation and temporary storage for domestic market in Indonesia Proc. Int. Symp. Quality Manag. Fruits Veg. Human Health pp 167–71

[25] Munarso S J, Kailaku S I, Arif A bin, Budiyanto A, Mulyawanti I, Sasmitaloka K S, Setyawan N, Dewandari K T and Widayanti S M 2020 Quality analysis of chili treated with aqueous ozone treatment and improved transportation and handling technology Int. J. Technol. 11 291–319