

HOUSEHOLD FOOD WASTE POLICY: A LITERATURE REVIEW

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Abstract

Introduction: Food waste (FW) is a serious problem and significantly impacts the environment, economy, and social. Globally, the average FW reaches 121 kg/capita/year, and households are the main contributors to FW. Several countries have implemented various strategies to prevent household FW. This review aims to explore the household FW prevention policies and their potential to be implemented in Indonesia. **Discussion:** Three strategies have been widely applied worldwide, including economic incentives, regulations, as well as FW awareness and behavior campaigns. In this case, the economic incentives include landfill tax, incineration tax, and Pay-As-You-Throw (PAYT). Many laws and regulations have been implemented related to waste management, food, economics, and those regulations are either directly or indirectly related to FW. The awareness and behavior change campaign is the most widely applied strategy to prevent household FW globally. **Conclusion:** Well-designed policies and regulations supported by education and awareness campaigns are the potential strategies for household food waste reduction and prevention in Indonesia.

INTRODUCTION

Food waste has become a global concern. The United Nations Environment Programme (UNEP) estimates that as much as 17% of food produced globally is discarded or not consumed by humans. The average FW globally reached 121 kg/capita/year in 2019. Households were the main contributor to FW, accounting for 61% of the total FW (74 kg/capita/year), followed by food service which is accounted for 26%, and retail which is accounted for 13% (1). In Indonesia, a food loss and waste study found an increasing FW in the last 20 years (2000-2019). Indonesia produced 115-184 kg/capita/year, equivalent to 5-19 million tons/year, and households were responsible for the most food waste, where as much as 80% of FW comes from households (2).

Food loss and waste occur along the food supply chain, from production, post-harvest, processing, distribution, and consumption (3). Food waste refers to uneaten or discarded food at the end of the food supply chain or consumer level (retail, food service, and household) (4). The high level of food waste produced globally and nationally contradicts many people who experience hunger or food insecurity worldwide. On the other hand, 8.9% or 690 million people worldwide experienced malnutrition and 60 million people experienced hunger. This number is expected to rise to 840 million people by 2030 (5).

FW produces 2.7 gigatons of CO₂ and is responsible for 8% of greenhouse gas emissions (GHG). The economic loss was estimated at US \$2.6 trillion a year (6). At the global level, 65 kg/capita/year of FW can

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meet the adequacy of 25 nutrients for a person for 18 days (7).

Furthermore, the environmental impact caused by FW depends on the waste quantity and management. Mismanagement of solid waste contributes to pollution and climate change. The high volume of food waste in the landfill causes an increase in GHG such as methane (CH₄), carbon dioxide (CO₂), and chlorofluorocarbons (CFCs) which can absorb infrared radiation and increase the temperature of the earth's atmosphere, resulting in global warming and climate change. Methane has a shorter lifetime in the atmosphere than carbon dioxide, but it is 25 times more efficient and active at trapping radiation in the atmosphere than carbon dioxide (8). Therefore, reducing GHG emissions can be done by reducing FW. Consumption levels contribute the most to the carbon footprint along the food supply chain. The high carbon footprint happens because one kilogram of discarded food at the consumption stage will have a higher carbon intensity than in the previous stage (production, post-harvest, storage, processing, and distribution). A 50% reduction in FW can reduce GHG emissions by 38%, or about 1.4 gigatonne carbon dioxide equivalent (GtCO₂eq) (9).

The sustainable development goals (SDGs) were adopted by the United Nations and were expected to be achieved by 2030. The SDGs consist of 17 goals and 169 targets. In this case, FW is mainly related to two SDGs: goal 12 and goal 2. In addition, SDG target 12.3 seeks to halve per capita global food waste by 2030. Therefore, numerous strategies have been carried out worldwide to reduce and prevent food waste, particularly at the household level. This review aims to explore strategies to reduce household FW from different countries and their potential to be implemented in Indonesia.

DISCUSSION

The FW reduction policy can refer to the food waste hierarchy. FW's waste hierarchy adapts the waste hierarchy developed in the 1970s to prioritize waste management strategies. Figure 1 shows the 7 stages of the FW hierarchy, namely prevention (reduce), reuse of food for human consumption and animal feed, reuse of FW by-products followed by recycling, recovery of energy, and disposal. Prevention is the preferable option over others. Meanwhile, reusing the FW for human consumption can be done by redistributing food surplus to the groups affected by food poverty (10).

Prevention and reduction of FW can have a significant environmental impact from the greenhouse gases produced and the use of natural resources such as land and water. Data simulations in the European Union and the UK revealed that a 25%-50% reduction in FW can save 0.5% of agricultural land used in the EU (11). Meanwhile, preventing 20% FW in the UK can hinder 3.2 Mt CO₂eq (equivalent to 2.3 million cars on the road each year). Even a 2% reduction in FW could save 0.48 Mt CO₂eq per year or the equivalent of 342,000 cars on the road each year (12). A study in Sweden simulated that minimizing food waste could reduce GHG emissions by 800-1400 kg CO₂-eq/ton (13). In addition, eliminating FW at the household level can also reduce the water footprint by 4% (FW water footprint of 2095 m³ is equivalent to 131 liters/person/day) (14).

The 4R strategy (reduce, reuse, recycle, and recover) is the basis for food wastage policies implemented in many countries. In general, agricultural policy, food supply chain, and food policy interact to each other. A few examples of these policies are policies related to agricultural development, investment, support for actors in the food system, regulations along the food

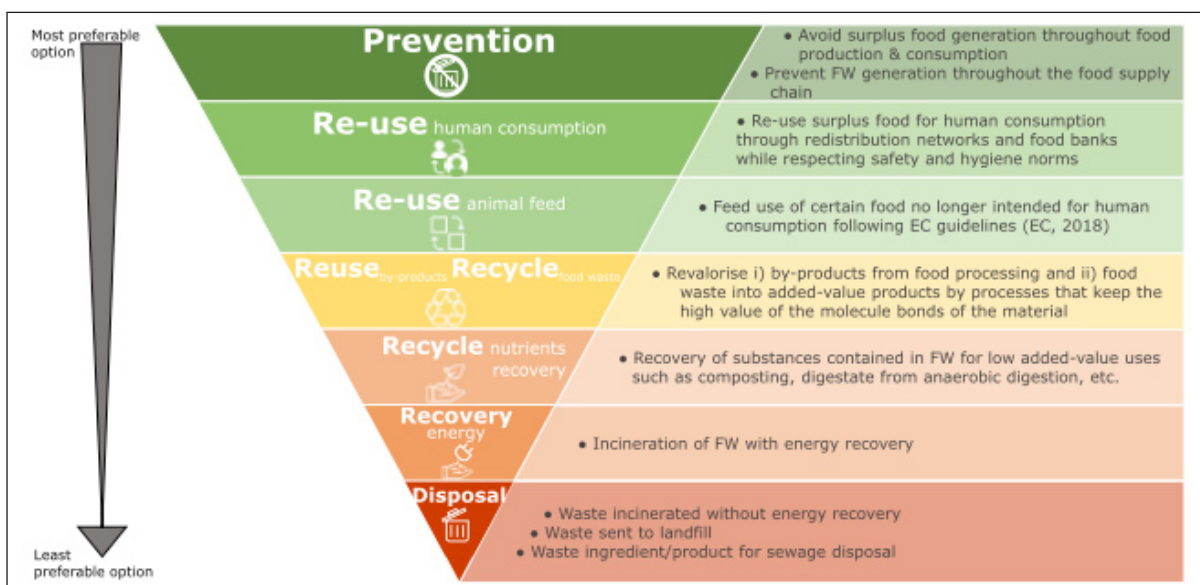


Figure 1. Food Waste Hierarchy (10)

supply chain, fiscal policies, trade regulations, food safety regulations and consumer protection, social protection policies, food security, sustainable development policies, and environmental protection and sustainability policies. At the country level, integrating these various policies to reduce FLW is still very limited. However, there are also few specific policies to combat FLW (15). In this case, this review will focus on 3 types of FW reduction strategies: economic incentives, regulations, and awareness and behavior change campaigns.

Economic Incentives

Economic incentives are carried out through fees/ contributions, taxes, and subsidies. For example, the "Pay-As-You-Throw" (PAYT), is a popular economic incentive implemented worldwide. PAYT can be implemented through volume, frequency or weight-based accounting, with bins assigned individually or collectively, or through the use of a pre-pad sack, tag, sticker, or token (16-17). The PAYT is a system based upon the polluter-pays principle, and it has been carried out in the Europe, United States of America, Canada, and several countries in Asia (17–20). For example, South Korea has successfully reduced food waste at the household level by applying this system (19).

The PAYT does not only reduce food waste but also increases recycling rates and encourages the community to be more active in waste separation at the source (16,19,21). South Korea has had a significant recycling rate in the last 20 years. This increase occurred due to Municipal Solid Waste (MSW) management policies such as (1) VBWF; (2) extended producer responsibility; and (3) Allbaro (e-manifest system). Before 1995, the waste tariff system in Korea was a monthly payment. In the same year, the VBWF policy as the basic policy of South Korea's MSW management was introduced. This VBWF policy is a policy that charges waste processing fees to people who dispose of waste according to the amount of waste they dispose of. In 2005, the South Korean government banned the disposal of FW landfills and implemented separate FW collections. The most significant breakthrough was the introduction of the Radio Frequency Identification Card (RFID) weight method, which uses a weight-rate waste disposal system to weigh food waste (rather than volume). Therefore, South Korea could measure FW quantitatively as part of its waste policy. The changes reduced FW by 10-20% in 2013. In addition, since 2013, the local governments can use prepaid garbage bags, chips or stickers, and radio frequency identification cards to measure FW weight and costs. In this case, it was also regulated that FW must be separated between the

dirty and mixed waste or recyclable waste (19).

South Korea's waste policy includes the Volume Based Waste Fee System (VBWF), prohibiting FW disposal into landfills, and transporting food waste separately from other waste (19). After one year of the VBWS policy implementation (1996), the recycling increased by 27% and food waste decreased by 18%. After implementing the VBWS policy, the resulting FW decreased significantly from 1.33 kg (1994) to 0.95 kg (2011). In addition, the landfilling rate decreased dramatically from 81.1% (1994) to 15.7% (2014). Another success obtained is that the recycling rate increased sharply from 15.4% in 1994 to 59% in 2014 (19). Such success of the PAYT system, however, may vary between regions. Studies in European countries revealed that the PAYT alone did not significantly reduce the total waste generated in the long term. In this case, the PAYT requires other national or regional policies, including regulation and informative policy instruments, awareness campaigns, tax regulations, etc (16,22). Waste pricing is an important component of well-functioning weight-based PAYT systems. However, there are several other important factors to consider: clear communication and perceived fairness of pricing, understanding the geographical differences in waste management systems, and monitoring the system functionality. Furthermore, incorporating weighing and identification technologies into waste management systems presents a multifaceted logistical and administrative challenge that must be addressed. Finally, reliable waste composition and waste generation data are required to compare the output of different collection systems when estimating the effect of the weight-based PAYT system (22).

Several key factors for the success of this policy in South Korea were the campaign to increase public awareness to sort waste, collect FW separately, and encourage FW recycling. The government provides subsidies for government and private waste recycling facilities to process FW into feed, compost, and biomass. The VBWF system is implemented nationally and monitored continuously. However, selling FW processing products such as feed and compost becomes a challenge and efforts still need to be improved (19). There are five lessons learned from the implementation of the PAYT system in South Korea: (1) thorough preparation, (2) cooperation with the civil society, (3) ensuring a disposal route for increased amounts of recyclables, (4) prevention of illegal acts (illegal waste dumping to avoid paying fees), and (5) revision of legislation (23).

Another economic incentive enforced is landfill tax and incineration tax imposed by several countries such as the UK (24), Sweden (25), and other European

countries (26). This landfill tax is a major motivator for reducing food waste disposal in landfills (27,28). Significant economic incentives reduce household FW by 45% without policies and regulations related to food waste, but the impact decreases to 1.5% of policies and regulations are well designed. Well-designed, measurable policies and regulations are more effective than economic (fiscal) incentives (29).

Indonesia currently does not apply economic incentives in the form of PAYT, landfill tax, or incineration tax. The system currently applied is a levy whose tariff is under the authority of the local government (flat-rate fees). There is a need for other policy instruments besides user fees to change people's behavior, so they do not throw FW into landfills (27) and reduce their FW. However, before the Indonesian government implements economic incentives, it is essential to do a thorough preparation such as doing a feasibility study, public hearings and meetings with stakeholders, making PAYT guidelines, revising regulations, and public relations campaigns as South Korea has done (23).

Regulations

Laws and regulations for reducing FW need to include clear standards and targets for waste reduction, management planning, restrictions, or certain agreements directly or indirectly related to FW. Penalties will be given to anyone who does not comply with these regulations (29-30). Japan (31-32), France (33-34), America (35-36), UK (24), and Taiwan (37) are some of the countries that implement laws and regulation related to FW.

Japan has become a role model in handling food waste by recycling. Laws that encourage recycling and activities related to recycling have been implemented in this country since 2001 (Food Recycling Law). The law aims to prevent FW, encourage recycling of FW into compost, feed, biogas, or heat recovery, and encourage recycling loops (31-32). This law initially had a 48% recycling rate target by 2006, but actually reached 60% in 2006, much higher than the target set (48%). Even in just 2 years after this law was enacted, the recycling rate target has been achieved (49% in 2003) (32). In 2006, the recycling rate for manufacturing was 76%, wholesale was 59%, retail was 31%, and food service was 16%. Furthermore, in 5 years, the increased recycling rates for wholesalers reached 30%, manufacturing reached 26%, retail reached 13%, and foodservice reached 7% (31).

In 2007, the Food Recycling Law was amended to further encourage FW recycling. This law amendment requires FW issuers to report the amount of FW recycled and purchase agricultural products cultivated using compost/animal feed derived from FW or its derivative

products. This cycle is called the "recycling loop." This cycle will stop when agricultural products are purchased by the FW emitter (32). These regulations allow the registered recycling facilities and garbage collectors involved in the recycling loop to transport FW across city boundaries. This amendment also recommends that animal feed manufacturers effectively use nutrients from FW. These recycling loops further result in lower GHG emissions and increase economic effectiveness and benefit all stakeholders (31-32). This effort makes recycling business planning improved due to the establishment of clear and safe sales goals for FW derivative products. For example, FW produced by supermarket chain Uny Co.Ltd is collected by Sanko Ltd (a recycling company), which then produces compost and is purchased by the agricultural/forestry/fishery operators to produce vegetables, and fruit, rice, soybeans, and flowers. Some of the crop yields are then also purchased by Uny Co.Ltd supermarket (32).

The Ministry of Agriculture, Forestry, and Fisheries, and the Ministry of Environment of Japan set reduction and recycling targets, develop measures to encourage recycling, provide quantitative data on FW and recycling rates nationally, and develop criteria for evaluating the achievements of food-related industries and businesses. These targets are raised periodically. The recycling rate target in 2020 is 95% for food manufacturing, 70% for wholesale, 55% for retail, and 50% for food service. In addition, the Japanese government has also initiated the "No Food Loss Project" program, which involves 6 ministries and aims to reduce FW at all stages of the food chain (38). In this case, the public and private sectors promote the "*Mottainai*" program to increase public awareness and encourage increased FW-reducing behavior along the supply chain. Some of the activities included in *Mottainai* at the manufacturing/distributor/retail level are pilot projects to review commercial practices related to FW, support food bank activities, and *Mottainai* campaigns. At the food service level, there is a "no leftovers" campaign, changing ready-to-eat sizes, and encouraging the use of doggy bags. At the household/consumer level, there is a communication strategy by shops, mass media, SNS, etc., for example, related to the definition of the expiration date on packaging (39). The Japanese government has succeeded in recycling food waste at the commercial level. However, the FW recycling rate at the household level only reached 4%. Most household FW are handled by incineration or disposed to landfills (38).

The UK and the Netherlands have successfully reduced household food waste substantially. The UK is also the first country to publish FLW data. In 2018,

the UK managed to reduce FW by 27% compared to its baseline in 2007 (40). The UK's FW policy is largely based on the EU policy framework. The UK government has a voluntary-based approach to FW reduction rather than coercive regulation. This voluntary initiative is led by the Waste and Resources Action Program (WRAP), an organization formed by the UK government (Department for Environment Food & Rural Areas/ Defra) and the European Union (24).

The UK government has implemented various policies and programs to reduce FW (40): (1) Setting targets, including adopting the SDGs target of 12.3; (2) Making periodic measurements carried out by WRAP; (3) Promoting cooperation between the public and private sectors including the Courtauld Commitment; and (4) Providing clear directions and guidelines. The Food Waste Reduction Roadmap, initiated by WRAP and the Institute of Grocery Distribution, was launched in 2018. This roadmap aims to help food companies and consumers to reduce FW. Two years after its launch, 210 companies in the UK have committed to a Target-Measure-Act to reduce FW. In 2019, the 45 participating companies reported reducing their FW by 17% and saving more than £300 million (41). The fifth policy is to launch a public behavior campaign. WRAP developed the "Love Food Hate Waste" campaign in 2007 to raise public awareness about food waste. The sixth policy is increasing promotion, labeling, and food design innovation. The seventh policy is involving households during the pandemic. The UK population has reduced FW by 34% during the COVID-19 lockdown due to behavioral changes. However, the current condition of FW has increased again as before the lockdown period (40).

The Netherlands achieved a 29% reduction in FW between 2010 and 2019, where the Household FW decreased from 48 kg/capita/year (2010) to 34.3 kg/capita/year (2019) (42). In this case, there are three policies carried out by the Dutch government, including measurement, public and private sector cooperation, and consumer involvement. First, FLW measurements are carried out regularly every 3 years by Wageningen University & Research. Second is the public and private partnership, where the government issued *Samen Tegen Voedselverspilling* (Food Waste Free United) in 2018. By 2020, up to 100 public, research, and private institutions across the food supply chain had collaborated in this program. This collaboration operates as an ecosystem, implementing efforts to reduce FW in retail and restaurant, increasing food redistribution, and reducing household FW. The third policy is consumer involvement. In this case, the government has launched

a campaign to increase understanding of the expiration date on the packaging and launched a national food waste-free week program (40).

The Dutch government does not have a specific national action plan related to FW. The national strategy and action plan related to FW reduction were incorporated into a policy document called Sustainable Food-Towards Sustainable Production and Consumption of Food which was passed in 2008. The target for FW reduction along the food chain is 20% by 2015 (43). Many strategies have been carried out to reduce FW, including measuring, monitoring, building networks, and cooperation between the public and private sectors, encouraging innovation, improving regulations, increasing awareness and changing consumer behavior, encouraging food donations and research, and actively participating in overcoming FW problems in Europe and the world. In addition, the Dutch government provides subsidies, taxes, and funding to facilitate the FW reduction program. This complex and comprehensive policy targets producers at the processing stage, food service, retail, household, and individual consumer (43-44). In addition, the Dutch government also provides technical reports and research on FW prevention and reduction (43).

The development of a national FW prevention plan must be made to bind all parties. Measurement must be clear and listed specifically by sector and segment, taking into account the needs and characteristics of supply food chain stakeholders. Special attention to consumers also needs to be done because consumers have an important role in reducing FW. Specific FW reduction measures and targets can greatly contribute to FW reduction. Conformity between targets and baseline data must be communicated and agreed upon on their definition, measurement, and evaluation. Creating conditions for monitoring and implementing FW measurements can be challenging for local governments. As a supporter, making FW data reporting mandatory from local governments is necessary. Incentives and special needs related to reporting should also be included in the plans developed (45).

Regulations regarding the redistribution of food to humans are adapted to protect donors and recipients and make it easier for charitable organizations to distribute it (45) such as the regulations in America and Italy. In the United States, the Bill Emerson Good Samaritan Food Donation Act (Good Samaritan Act) (1997) and the Federal Food Donation Act (2008) encourage the donation of food and daily necessities to non-profit organizations that distribute them to people in need. The Good Samaritan Act can prevent recipients of

food donors from filing lawsuits against donors or non-profit organizations because of illness caused by food or products that have been donated (35-36). The Federal Food Donation Act states that food donor agencies and contractors are not responsible for the logistics and costs of collection, transportation, and handling to maintain the safety and distribution of donated food (46). Some examples of Italian laws supporting food redistribution are Law No. 460/1997, Law No. 113/1999, Law No. 441/2005, and Law No. 80/2005. The law states that donations are not part of the company's profits (Law no 460/1997). Donated onions are considered damaged/destroyed to be used for deduction of value-added tax (Law no 113/1999). Donations are included in the value-added tax-free activities or activities (Law no 441/2005) and can be included in the reduction of taxable income (Law no 80/2005) (47).

In general, food loss and waste management policies in Indonesia are part of the low-carbon development policy and management of economic resources policy. According to Waste Management Law No. 18/2008, waste management is divided into two main activities: waste reduction and waste management (48). The Minister of Home Affairs Regulation No. 33/2010 contains a detailed explanation of the waste management guidelines (49). Furthermore, the guidelines for regional regulations on household waste and waste similar to household waste are included in the Minister of Environment Regulation No. 16/2011 (50). In addition, Government Regulation No. 81/2012 ratified the management of household waste and similar household waste (51). The regulations, however, do not mention the measurements, target reduction, monitoring, and evaluation.

Indonesia's national action plan on climate change adaptation was launched in 2007. It states the need to develop and apply waste to energy technology in various food-related industries that produce organic waste that can be used as electricity as a form of energy conservation in the industrial sector. In addition, the potential for methane gas from landfills can be used to generate electricity to diversify energy, emission reduction in the agricultural sector can be done by using organic fertilizers and environmentally friendly pesticides, and agricultural and agro-industrial waste can be processed into compost to reduce GHG emissions. Furthermore, biogas technology can be applied to utilize livestock waste (52). The national action plan is then followed by formulating an action plan in the field of public works. It includes developing environmentally friendly waste management technology and the development of the

concept of domestic waste management following the 3R principles (53).

The national action plan on climate change adaptation was ratified in Presidential Regulation No. 61/2011. This regulation is a follow-up to the agreement at the Conferences of Parties (COP) of the 13th, 15th, and 16th United Nations Framework Convention on Climate Change and the G-20 meeting in Pittsburgh to reduce GHG emissions by 26% (own effort) and reach 41% (international collaboration). According to this convention, activities to reduce GHG emissions cover 6 fields (agriculture, forestry and peatland, energy and transportation, industry, waste management, and other support activities). In waste management, several efforts can be made, such as increasing institutional capacity and regional regulations, reducing waste generation through the 3R (reduce, reuse, recycle), improving waste management processes in landfills, and utilizing waste to produce environmentally friendly energy (54).

Furthermore, the National Medium-Term Development Plan For 2020-2024 mentioned that energy, peatlands, industry, waste, and agriculture are five sectors of priority for low carbon development. However, the waste management targets only cover the quantity of managed waste at the national level, the number of households served by landfills that meet the sanitary standards, 3R waste management facilities, and an integrated waste management system (55). Food waste reduction was not stated explicitly in the document.

The policy directions and strategies of economic resource management stated that managing a sustainable food system, urban food system, and food waste is a strategy for increasing availability, access, and quality of food consumption (55). However, no target of food waste was mentioned in the document.

In the food and nutrition security strategic policy of 2020-2024, the high food loss waste along the food chain has been identified as one of the food and nutrition security challenges. Post-harvest technology has not been optimized and problems related to agro logistics, poor purchasing and supply planning, and food waste behavior are several causes of high FLW. In this case, the policy strategy implemented to reduce FLW is carried out in 3 aspects: food supply, access, and utilization. The food waste control system has been mentioned in the regulation (56). However, in the policy document, there are no indicators listed for the achievement of the FW control system and no FW reduction target either.

This review shows that policies and regulations concerning food waste already exist in Indonesia. However, these policies and regulations have not yet

specified the targets, measurement, monitoring, and evaluation indicators to quantify their contribution to reducing GHG emissions. Furthermore, there is no roadmap or guideline for reducing food waste in all sectors, particularly the household sector.

Education and Awareness Campaign

Education and awareness campaigns are the most widely used strategy to prevent and reduce household FW. "Think.Eat.Save" of the SAVE FOOD Initiative is a global initiative to reduce FLW. This initiative is a partnership between FAO, UNEP, and Messe Düsseldorf. This global initiative aims to increase awareness, knowledge, and behavior change of actors and consumers along the food chain (57). One of the most famous campaigns in Europe is the "Love Food Hate Waste" campaign in the UK. The campaign is carried out by WRAP, which the UK government supports. In 2007, WRAP launched the "Love Food Hate Waste" campaign, which aims to reduce the number of FWs by increasing public awareness about FW and practical solutions to reduce FW at the consumer level. Since 2007, WRAP has also been publishing regular household FW data based on household waste composition analysis (WCA), diary, survey methods, and synthesis from local government WCAs. The WRAP study in 2013 showed that there was a 15% decrease in total FW and 21% avoidable household FW from 2007 to 2012 (58).

Furthermore, the "Love Food Hate Waste" campaign was evaluated in West London from September 2012 to July 2013. Total household FW decreased by 15%. Significant behavioral changes were associated with planning (shopping lists and menu planning), the shelf life of foods, and storage (refrigeration use and unpacked cheese and meat wraps). The decrease in avoidable FW was 14% (significant at 85% confidence interval) and unavoidable FW by 24% (significant at 95% confidence interval). The evaluation results indicate that the decrease in FW occurs mainly due to a decrease in unavoidable FW. Meanwhile, 14% of the total households that changed their behavior after seeing messages related to FW had a 43% decrease in avoidable FW. The evaluation study also emphasizes that other factors such as price increases, seasonal effects, and economic conditions must be considered in interpreting the results (59). In this case, a systematic review by Jenkins et al. revealed that the WRAP UK Love Food Hate Waste program effectively changed behavior by combining four strategies: moral, information-based, material incentives, and community-based approaches (60). The program's name, "Love Food Hate Waste," uses strong emotive

language to appeal to consumers' emotions. Sharing posters, social media advertising, and communicating food waste information on the website are all examples of information-based campaigns. Material incentives are done by providing free compost bins in the food waste reduction challenge. Finally, community-based approaches were also done in the forms of workshops, cooking classes, and zero waste challenges (60).

The awareness campaign aims to increase consumer attention to the issue of FW. Campaigns should be conducted using multiple channels to reach different target groups, be presented attractively, engage consumers, and have a feedback element. In addition, awareness campaigns also need to involve retail and the foodservice industry (61). Consumer education needs to be done early (61-62), and FW topics must be integrated into the school curriculum (61).

Awareness campaigns should focus on addressing the causes of FW in specific target groups. Therefore, it is necessary to have good data regarding the number of FWs and their causes. In addition, it is essential to know consumer motives, communication channels, and effective practices related to FW reduction. Monitoring and evaluation of awareness campaigns are also needed to find measurable reductions in FW and as material for campaign adjustments or improvements. Awareness campaigns also need to involve other actors in the food chain to provide cross-sectoral solutions (63). Information channels such as leaflets, word of mouth, television shows or films, newspapers, and online media effectively convey information (30). Education and communication campaigns should be carried out by using extensive social media (45). In addition, social media has the potential to reach a large number of people, encourage information sharing, and contribute to changes in consumer behavior. However, food waste awareness campaigns that relied solely on social media information did not have the same impact as multifaceted strategies (60).

FW education and awareness campaigns in Indonesia have been carried out by various parties, the community (64), the industry/private sector (65), and the government (66). However, these campaigns are still sporadic, stand-alone, rely only on information-based strategy, and have not been integrated into a single unified awareness and behavior change campaign that are sustainable and have measurable effectiveness. A food loss and waste study in Indonesia in 2019 remarked that behavioral change strategy is a high priority in food loss waste management at the national level. Stakeholders of education and awareness campaigns, in this case,

include (but are not limited to) the Ministry of Environment and Forestry, Regional Government, Non-Government Organizations, and education institutions. Meanwhile, the related policies regarding food waste education and awareness are Law of the Republic of Indonesia No 18 Year 2008 Regarding Waste Management (48) and Government Regulation of The Republic of Indonesia Number 81 Year 2012 about Management of Household Waste and Similar Household Waste (51).

Read and Muth discovered that the environmental cost-effectiveness of consumer education and public awareness campaigns was 16 kg CO₂ reduced per \$1 invested. In addition, the cost of greenhouse gas emissions reduction was \$64 per tonne below the carbon price deemed necessary to meet Paris climate goals (\$200 per tonne). Although the cost-effectiveness of the consumer awareness campaigns was high, no single intervention emerged as clearly more cost-effective than the other alternatives (spoilage prevention packaging, standardization of data labels, and food waste tracking system). All alternatives have both positive environmental and financial benefits that exceed implementation costs. Therefore, multiple interventions will be required to reduce food waste significantly (67).

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CONCLUSION

There are three policies to reduce household FW: economic incentives, regulations, as well as education and awareness campaigns. Education and awareness campaigns are the most widely used strategy to prevent and reduce household FW worldwide. These three policies have been implemented by developed countries synergically. However, Indonesia has not yet implemented economic incentives to reduce household FW. Instead, Indonesia is using flat-rate fees, which have not succeeded in reducing- household FW.

Multifaceted strategies are needed to be able to reduce household food waste significantly. Indonesia has policies and regulations concerning food waste. However, the measurement, standards, target reduction, monitoring and evaluation, roadmap, and guidelines to prevent and reduce food waste in all sectors (particularly household food waste) are not clearly stated.

Various parties in Indonesia have carried out FW education and awareness campaigns. However, these campaigns remain sporadic, stand-alone, rely

solely on information-based strategies, and have not been integrated into a comprehensive awareness and behavior change campaign that is both sustainable and measurable in its effectiveness. On the other hand, behavioral change strategy is already recognized as a high priority in food loss waste management at the national level, and there are already policies that support it. Therefore, well-designed policies and regulations supported by education and awareness campaigns are the potential strategies for household food waste reduction and prevention in Indonesia.

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