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REVIEW

Food loss and waste in the Philippines: a literature review

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Abstract

Malnutrition has been one of the significant challenges the world is facing, with food insecurity as the main driver. However, as strategies focus on increasing production for a more secure food system, food loss and waste (FLW) exist as food is transferred to each supply chain player and even during consumption. The study aimed to provide information on the current state of food loss and waste in the Philippines. FLW during consumption is more detrimental as each step input adds value to the food item. In the Philippines, where every single grain is vital, the Food Waste Reduction Act was introduced. This law aimed to reduce food waste through donations and recycle food as fertilizer or compost. Aside from the staple rice, other agricultural commodities with more than 20% waste at postharvest are bananas, cabbage, calamansi, eggplant, mangoes, sweet potato, and tomato. The food industry also plays a vital role in reducing waste, and some identified recommendations are creating a weekly menu to avoid buying too much, storing food properly and strict practice of first-in-first-out to minimize spoilage, promoting food preservation processing to utilize and extend shelf life of in-season fruits and vegetable and reducing the serving sizes. Other contributors to food waste are the surge of zoonotic diseases such as the African Swine Fever (ASF) and natural disasters. Considering all the players and contributors, FLW is indeed multi-faceted, and to reduce it warrants collaborative efforts of various agencies to continuously launch awareness campaigns, implement the use less of or do without concept to avoid leftovers and improve methods of storing foods and develop FLW measurement protocols whereby targets are set and FLW are regularly monitored. It is high time that FLW is in the spotlight to curb the lack of consistent access to food among the poor.

1. Introduction

According to the United Nations (UN), approximately one-third of all food is lost or wasted worldwide which makes an estimated 800 million people undernourished (Food and Agriculture Organization of the United Nations (FAO), 2011). This has been the existing quantifiable global food wastage statistic for the last 10 years. Since then, this paved the way for several bodies to accurately provide estimates on the amount of food loss and waste and to consequently estimate its impacts. In the recent report published by WWF-UK in 2021, it estimates that 2.5 billion tons of food go uneaten each year, including 1.2 billion tons that never leave the farm. This means that about 40% of all food we grow is wasted. Another report from the latest United Nations Environment Program on Food Waste Index in 2021 estimates that around 931 million tons of food waste were generated in 2019. This suggests that 17% of total global food production may be wasted. These data, in general, strengthen the indication of food loss and waste as a prevailing major issue that the world needs to address, and food wastage in itself poses several social, economic and environmental concerns.

As a social problem, this adds to the continuous concern of the increase in the prevalence of malnutrition in the world. While food produced in the world can feed 10 billion people, one in nine are still undernourished (FAO *et al.*, 2019). A challenge was taken up in 2015 in order to achieve the Sustainable Development Goals (SDG) established by the UN towards eradicating hunger

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by 2030. However, with the continuous growth in the world population, Dora *et al.* (2021) mentioned that simply increasing the production of food will not suffice the hunger of the world, given its high cost and threat to the declining natural resources of the world. SDG target 12 is specifically intended for responsible consumption and production, one of the sub-indicators aims to "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" (United Nations, 2021). In 2012, the Secretary-General of UN, Ban Ki-moon, launched the Zero Hunger Challenge which reflects five elements from within the SDGs as its vision. One of the elements for the Zero Hunger Challenge specifically refers to food loss and waste which is: "Adapt all food systems to eliminate loss or waste of food" (United Nations, 2015a).

Food loss and waste (FLW) refer to the reduction in quantity or quality of food and both occur throughout the course of the supply chain but at different stages (FAO, 2019). In general, the term FLW describes the plant and animal products that were produced for human consumption but not eventually consumed by people (Lipinski *et al.*, 2013). Ishangulyyev *et al.* (2019) mentioned that currently, there is still no commonly approved definition that exists for food loss and food waste and these terms are mostly used interchangeably.

FAO (2011) defined food loss as a decrease in quantity (weight) or quality (nutritional value) that was produced for human consumption. These are usually food that was disposed of or discarded between the farm and the food suppliers in the food chain before reaching the retail level, in which these food losses cannot be reused in any other productive utilization (FAO, 2019). According to Lipinski *et al.* (2013), food loss is the unintentional result of the process of production or limited problems in storage, infrastructure, or packaging. Lucifero (2016) called this the involuntary waste.

By contrast, food waste was defined as food products that were appropriated for human consumption (excluding parts which are not edible), and that are thrown out either before or after it spoils. It occurs at the latter part of the supply chain at the retail stage before being sold to the consumers and as it reaches the consumer. Food waste happens as a result of decisions or actions by retailers, food service providers, and consumers. These are usually food that was disposed of in the settings of restaurants, supermarkets, or the home of the consumer (FAO, 2019). According to Beausang *et al.* (2017), food waste is often associated with conscious action and the decision to throw away food.

Scheviak (2020) reported that the difference in the terminologies of food loss and waste is that food waste could often be easier to solve by educating the latter part of the food chain who are responsible for making those actions such as the retailers, food service providers, and consumers. Food loss could be lessened or prevented through systemic and logical improvements on the part of the farmers to the distributors. Both FLW could be reduced with a multidisciplinary solution wherein everyone who is part of the food supply chain process could make their contribution. Figure 1 shows the flow as FLW occurs in the food supply chain and in Table 1, some characteristics of FLW for each stage.

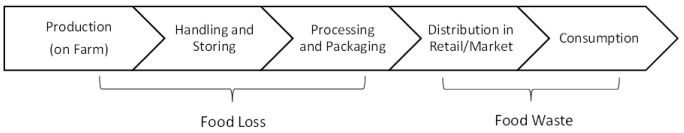

Figure 1. Framework of food loss and waste as it occurs in the food supply chain

It can be seen in Table 1 how massive FLW occurs even before consumption, and this is very apparent in most developing countries like the Philippines. Globally, there is a variation in the sources and amounts of FLW. Shafiee-Jood and Cai (2016) mentioned that FLW can occur at any stage along the food supply chain but the means by which food is lost or wasted vary in different stages. In low- and middle-income countries, food loss largely outweighs the waste, given poor infrastructure and their vulnerability to climate change. Contrary in high-income countries, food waste predominates as it is mainly associated with practices of the food industry and the behavior of the consumers (Neff *et al.*, 2015). The most resource-intensive stage in the food supply chain worldwide is the production stage. 29% of FLW occurs during the first two stages for the developing countries while food loss during the production stage is lesser for the developed countries, moreover, the food loss for the developed countries happens due to the extreme loss of the embedded resources. At the consumption stage, food waste is significantly lower in developing countries due to limited access to food, with poverty as a factor (Wunderlich and Martinez, 2018).

The Philippines is an agricultural country with a land area of 30 million hectares, 47% of which is agricultural land, where a majority of the population in rural and urban areas depends heavily on food production for consumption and livelihood. In 2020, the agricultural sector accounted for 10.18% of GDP (Philippine Statistics Authority (PSA), 2021). Thus, the issue of FLW is very critical, especially to the Philippine farmers who are the main food producers in terms of agricultural products and who are most affected by food loss during the earlier stages in the food supply chain. Moreover, with over 2.7 million Filipinos who have experienced

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Table 1. Characteristics of FLW in each stage of the food supply chain.

Stage	Characteristics of FLW
Harvesting – handling at harvest	• Edible crops left in the field, ploughed into the soil, eaten by birds, and rodents, the timing of harvest not optimal: loss in food quality • Crop damaged during harvesting/poor harvesting technique • Out-grades at the farm to improve the quality of produce loss through poor technique
Threshing	• Loss through poor technique
Drying – transport and distribution	• Poor transport infrastructure, loss owing to spoiling/bruising
Storage	• Pests, disease, spillage, contamination, natural drying out of food
Primary processing – cleaning, classification, de-hulling, pounding, grinding, packaging, soaking, winnowing, drying, sieving, milling	• Process losses • Contamination in the process causing a loss of quality
Secondary processing – mixing, cooking, frying, molding, cutting, extrusion	• Process losses • Contamination in the process causing a loss of quality
Product evaluation – quality control: standard recipes	• Product discarded/out-grades in the supply chain
Packaging – weighing, labelling, sealing	• Inappropriate/ poor packaging damages produce • Grain spillage from sacks • Attack by rodents
Marketing – publicity, selling, distribution	• Damage during transport: spoilage • Poor handling in the wet market
Post-consumer – recipes elaboration: traditional dishes, new dishes product evaluation consumer education, discardshttps://doi.org/10.26656/fr.2017.7(6).127	• Plate scrapings • Poor storage/stock management in homes: discarded before serving • Poor food preparation technique: edible food discarded with inedible • Food discarded in packaging: confusion over the labeling of 'best before' and 'use by' dates
End of life – disposal of food waste/loss at different stages of the supply chain	• Food waste discarded may be separately treated, fed to livestock/poultry, mixed with other wastes and landfilled

Source: Parfitt *et al.* (2010)

involuntary hunger at least once in the past three months (Melo-Rijk, 2021), we could explore how FLW also contributes to the burden of food insecurity and how its reduction could potentially help in eradicating hunger and malnutrition. Despite the substantiality of the issue, there are considerable local information gaps that exist. The absence of basic and collective data on the amount and extent of FLW per agricultural commodity and by sector was observed.

The purpose of this review is to provide information on the current state of food loss and waste in the Philippines and the interventions done to address it as well as to identify specific areas of research on FLW.

2. Methodology

A rigorous scan of literature whereby articles which mention food loss and waste were identified. The contents were analyzed with regards to the concepts and issues of (i) definition, (ii) characteristics of FLW and (iii) cause of loss.

Peer-reviewed articles and gray literature (reports from expert groups and international development agencies) were the targeted search criteria. Each piece of literature was evaluated relative to the aforementioned concepts and issues.

3. Impacts of food loss and waste

According to the United Nations (2015b), food systems are at the heart of the 2030 Agenda for Sustainable Development with a global commitment to eliminate poverty and hunger along with ensuring the reduction of environmental and socio-economic impacts. Provided that an estimated one-third of food produced all over the world never reaches the consumers' plate every year (FAO, 2011), it indicates that FLW has serious repercussions not just on the costs allotted for its production but also on its impact on the conservation of the environment, and significantly on the food security of the global population. According to Santeramo (2021), the three dimensions of sustainability are impacted by the inefficient use of resources within the food systems: from the environmental perspective, FLW

plays a major role in the exhaustion of natural resources and contributes to environmental pollution; at the economic level, there is a significant impact of FLW at the consumption and retail stages, and cost wasted from non-productive use of natural resources; and from the social point of view, FLW challenges the food security by reducing the access and availability of food.

3.1 Impacts of food loss and waste on the food system

Food systems involve the overall food supply chain starting from farm to production, distribution, retail, consumption, and waste production (UNEP, 2016). According to Sala *et al.* (2017), environmental and socio -economic impacts are greatly associated with food supply chains. The size of the impact is rising together with the level of processing of the food products, and the stage in the food supply chain at which the food is lost or wasted (FAO, 2015). That is why when looking into FLW, it is essential to regard the entire supply chain and investigate areas of connections and interaction instead of analyzing each step separately (National Academies of Sciences, Engineering, and Medicine, 2019). The food supply chain includes several stages wherein food moves from production to consumption. Throughout this system, millions of tons of food are produced to feed the global population, but millions of tons of food are also lost and wasted which is caused by various deficiencies throughout the food supply chain (Zhong *et al.*, 2017).

According to Ishangulyyev *et al.* (2019), the occurrence of food waste during the last stage of the food supply chain, which is the consumption stage, is considered more harmful. Since more resources were used as food travels across the food supply chain, then FLW that occurred during the last stage has used more resources and thus wasted more as well. The reduction of FLW along the food supply chain starting from production to consumption is important in improving the issues of food insecurity and lessening the burden on natural resources (Santeramo, 2021), but targeting food waste interventions at the final stage of the food supply chain may lead to a significant reduction in wastage and may even reduce the environmental impacts of food waste.

However, in the case of the Philippines, Mopera (2016) mentioned that the stages of production and postharvest handling and storage were identified with relatively high food losses with more than 40% of food losses occurring during these first three stages in the food supply chain. Furthermore, PhilRice (2013) reported that an estimated 15% of rice was lost during postharvest due to a lack of good facilities and poor postharvest practices. This impact affects the overall output of food production not just because of the loss of embedded and economic resources used, but also because it could have increased the availability of food.

3.2 Impacts of food loss and waste on the environment

According to Muth *et al.* (2019), the effects on climate, water, and air and those associated with land use for food production are some of the potential environmental impacts of FLW. During a workshop on Reducing the Impacts of Food Loss and Waste, Dr. Bojana Bajzelj, a technical specialist in international food sustainability, mentioned that the most crucial environmental issue in the world greatly contributed to food production. Such issues mentioned were biodiversity loss, nutrient overloading, land conversion, and global warming, and they were all worsened by FLW (NASEM, 2019).

As food is produced and travels along the food supply chain, it requires various resources such as land, fertilizer, pesticides, water, and energy. Moreover, the production of food also leads to the emission of greenhouse gases and causes more damage to the environment (Muth *et al.*, 2019). In a study conducted by Medina and Forten (2015), they investigated the alarming rate of methane production in landfills in one area of the Philippines. They found that the most waste generated by the residents in the area was from yard waste followed by food waste which accounted for 0.143 kg/capita/day (39.07%) and 0.113 kg/capita/day (30.87%) respectively. Furthermore, the largest methane emissions from the biodegradable waste generated come from food waste with 203.22 metric tons of carbon equivalent, which is due to the decomposition of food waste producing more methane as compared to other waste. Thus, the reduction of food waste will greatly contribute to the reduction of methane emissions.

However, not only is the environment affected by FLW through inefficiencies in food production but also because every available disposal option for wasted food also has a considerable impact on the environment. In a study conducted by Salemdeeb *et al.* (2017), they investigated the environmental and health impacts of food waste when used as animal feed. Since most of the food waste is disposed of in landfills which produce large amounts of greenhouse gases, some are disposed of via incineration and composting which also produce greenhouse gases, and food waste disposed of via anaerobic digestion causes eutrophication and acidification of local ecosystems (Oakes, 2020; Whiting and Azapagic, 2014), the European Union (EU) provided guidelines stating that most food waste should be used as animal feed in order to reduce the bad impacts of disposing of it. Although of all the other food waste disposal practices, using it as animal feed is currently

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illegal due to disease control concerns.

Salemdeeb *et al.* (2017) investigated the potential benefits of food waste when converted into animal feed, specifically pig feed, in the United Kingdom. They compared four food waste disposing methods (conversion into dry pig feed, conversion into wet pig feed, anaerobic digestion, and composting) using a hybrid consequential life cycle approach and ranked which of the four has the most impact on the environment and health. It was concluded in their study that converting food waste as wet pig feed had the best score (lower impacts) for environmental and health impacts while composting and anaerobic digestion scored as the two with the worst environmental impact. To avoid disease control concerns in using food waste as animal feed, they emphasized that food waste can only be used in animal feed if it is segregated properly from other wastes and is suitably fresh, thus its use as an animal feed is also about accessibility and the quality of food waste. Moreover, the potential benefits of using food waste as animal feed, include reduced impacts on the environment, better quality and taste of meat, and a much-improved profitability for the farmers.

In the Philippines, the Department of Agriculture (DA) issued memorandum number 22 series of 2018 that prohibits the use of food waste and left-overs from airports and seaports as swine swill feed due to the alarming threat of African Swine Fever (ASF) and Foot-and-Mouth Disease (FMD). This may cause more food waste to end up in garbage and landfills, conversely, this memorandum only intends to protect the poultry farms from the disease which will eventually protect the health of the consumers. This emphasizes the need to reduce FLW so as to not endanger both the health of the consumer and the environment.

3.3 Impacts of food loss and waste on the economy

According to FAO (2015), the annual value of food that is lost and wasted at the global level is estimated at US$ 1 trillion. The economics of FLW becomes more tangled and complicated as a result of the interconnected and vast number of producers, retailers, and consumers in the food supply chain. de Gorter *et al.* (2021) mentioned that the reason for this is that in equilibrium, every actor that is part of the food supply chain requires compensation for their effort and input utilized, even including those that are wasted. Thus, FLW up and down the food supply chain impact the availability of the food product and its price in the market. A sample scenario provided by Spang *et al.* (2019) wherein FLW can result in a loss in profit to the producers due to unsold food products or consumer expenses on food items that were never eaten due to spoilage or choice. Seberini (2020) mentioned in his study that pricing policy is affected by food waste, most especially in developed countries. Higher waste is associated with influencing the demand for food products thus resulting in increasing its price level. This leads to an individual with minimum earnings who cannot afford to spend more money on food being more at risk of attaining it.

Globally, the amount of economic losses accounted for 991.9 million EUR while lost revenue was 2224.5 million EUR. According to Kotykova and Babych (2019), the economic damage and lost revenue result of FLW in Ukraine in 2016 for grain amounted to 90.5 and 300.6 million EUR respectively; for vegetables, it amounted to 187.4 and 410.0 million EUR respectively; for fruits, 73.4 and 191.2 million EUR respectively; for meat, it was 344.4 and 607.7 million EUR respectively. It was noted that those amounts mentioned were totally unacceptable which showed how some of these food products were generally unprofitable as a result of the FLW, with meat as the main source of economic damage and lost revenue due to FLW. In conclusion to their study, FLW results in significant economic losses and revenue loss which then reduces the economic well-being of all actors who are part of the food supply chain.

In the Philippines, P41 million worth of rice is being wasted daily using the price of the well-milled variety at P42/kg. Annually, Filipinos waste an estimated 360.602 million kg of rice which accounts for an estimate of P15.145 billion. This waste in rice could have fed at least 3.281 million Filipinos (Arcalas and Orinario, 2018). Hanson *et al.* (2016) reported that FLW is a cost that does not result in food consumption. This type of financial loss is manifested across the whole food supply chain from producers to distributors, to retailers and up to the consumers. In some scenarios, direct financial costs may also be incurred when disposing of FLW.

3.4 Impacts of food loss and waste on society

Given an estimated 815 million people who are hungry and undernourished (United Nations, 2018), escalating demand for food becomes a serious concern in terms of adequate and sustainable global food supply. The UN noted that while these figures partly reflect unequal food distribution, by 2050 it is estimated that the world will need an additional 60% more food than it currently has. Gunders (2012) noted that reducing the FLW by 50% would be able to feed an additional 100 billion people which shows how massive the amount of food that is lost and wasted. If the same level of FLW practices persists, it might pose serious threats to the destruction of the world's natural resources (Wunderlich and Martinez, 2018). Spang *et al.* (2019) pointed out that even though reducing FLW will not directly eradicate

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world hunger, which is predominantly a problem of food distribution and income, not of food supply, still, a considerable amount of food nutrients is lost each year as FLW.

Nicastro and Carillo (2021) mentioned that the equilibrium of the entire food system is compromised due to the continuous increase of FLW, which then affects the food supply, in terms of quantity and quality, and food prices. Reducing FLW can have both negative and positive impacts on society. The benefits of reducing FLW, include an increase in food availability and therefore may improve food security. Conversely, negative impacts of reducing FLW may include quality losses of food items due to lowering the standard of food grading. They also mentioned that overproduction is often necessary in order to maintain the stability of food availability and ensure accessibility to healthy and nutritious food, although this would definitely lead to more waste since most of the more nutrient-rich foods have a shorter shelf life. However, it has been mentioned that overproduction is a significant aspect of FLW (Neff *et al.*, 2015; Raak *et al.*, 2017).

According to the Philippine Statistics Authority (PSA), the current population of the Philippines stands at 109 million and almost a quarter of them live below the poverty line. Moreover, 13.5 million of the economically poor do not have the ability to eat meals thrice a day, with 2.7 million families who have been involuntarily hungry at least once in the past three months. Even with the situation of hunger and food insecurity, it has been estimated that Filipinos waste up to 308,000 tons of rice every year. Moreover, 2,175 tons of food in Metro Manila end up in trash bins daily (Melo-Rijk, 2021). In addition, according to the Department of Science and Technology - Food and Nutrition Research Institute (DOST-FNRI) (2016), a total of 13 g of other food items were wasted in a Filipino household wherein 6 g accounted for fish and fish products while meat and poultry products accounted for 1 gram each and the other 5 g were accounted for vegetables. All these amounts of wasted food products if reduced and prevented could have fed more hungry Filipinos and helped alleviate food insecurity.

4. Food wastage in terms of different commodities, households, food service industry

4.1 Food loss and waste per commodity

According to the studies commissioned by FAO, yearly global FLW by quantity were estimated at approximately 30% of cereals, 40-50% of root crops, fruits, and vegetables, 20% of oilseeds, meat and dairy products, and 35% of fish (FAO, 2015). In terms of fruits and vegetables, the losses at harvest and during sorting are higher in developed countries which is possibly due to discarding food products that do not meet the quality standards set by the retailers. Moreover, in developing countries, while losses are also high at harvest and during sorting, the losses during the processing are much higher when compared with developed countries (FAO, 2011). This is most probably due to poor processing practices and technologies in developing countries. The level of FLW also differs from the distinct stages of the food supply chain which also depends on the type of crop, level of economic development, and even the social and cultural practices in a certain region (Rezaei and Liu, 2017).

In the Philippines, rice is a major commodity and is the staple food for the Filipino. According to PhilRice (2013), the overall percentage of loss in the postharvest operation of rice reached an average of 14.8%. in general, it is estimated that 1.13 to 31.9% were lost in paddy in the following operations: harvesting (1.8%); piling (0.5%); threshing (2.2%); drying (4.5%); storage (2.7%); milling (3.1%). It can be noted that the process of drying contributes the greatest loss. As mentioned by Chupungco *et al.* (2008), grains such as rice and maize are traditionally sun-dried in the Philippines. However, improper drying of grain can result in severe loss in quality and quantity during storage. There are many types of drying methods in the Philippines. Some of the common methods are field drying and sun drying. In field drying, losses are incurred due to the consumption of animals such as rats and birds and the shattering of grain. If the grain is left in the field for too long, its quality deteriorates due to overheating. On the other hand, sun drying, and losses occur due to spillage, consumption of animals, or damage by rain.

Furthermore, other crops were being produced and consumed in the country, given that it is an agricultural country. A large percentage of losses in these agricultural crops are caused by problems in production and poor post-handling practices during storage handling and transport. As shown in Table 2 are some of the major crops produced in the Philippines, their estimated per cent losses, cause of losses, and interventions used to assuage the losses.

4.2 Food waste in terms of household

It was estimated that at the consumption stage of the food supply chain, a large amount of food is wasted (Kummu *et al.*, 2012). Around 61% of food waste is generated by households (UNEP, 2021). According to Fami *et al.* (2019), several studies indicate that the amount of food wasted at the household level varies between 25% in the UK, 42-50% in some European

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Table 2. Agricultural crops in the Philippines with estimated losses, associated causes, and postharvest interventions.

Agricultural crops	Estimated percentage loss	Cause of loss	Technology/ intervention
Banana[1]	3-30%	Premature ripening, weight loss, mechanical damage, disease and rotting	Use of ethylene adsorbents, careful handling, alum
Cabbage[1]	29%	Disease, mechanical damage	Use of refrigerated trucks for transport, careful handling, passive cooling using block ice or evaporative coolers
Calamansi[1]	5-32%	Disease, oleocellosis, yellowing	Curing, map (modified atmosphere package)
Carrot[1]	7-12%	Crack/cut, soft rot/rot diseased, punctures, abrasion, cuts, forking, disease, damaged top/leaves	Use of plastic crates as packaging material, surface drying or air-drying of carrots after washing, use of refrigerated trucks for transport
Eggplant[1]	10-40%	Insect damage, shrinking	Careful handling
Mango[1]	2-33%	Cracking, disease, latex damage, immaturity	Hot water treatment (HWT), careful handling, alum
Onion[1]	20-50%	Disease, mechanical damage	Curing, careful handling, use of cold storage
Papaya[1]	27-44%	Disease, mechanical damage	Wrapping of fruits, HWT
Sweet potato[3]	26-38%	Inefficient soil, mechanical damage	Modification and improvement of equipment
Tomato[1]	11-38%	Rotting disease, weight loss	Use of map and ethylene adsorbents, careful handling, use of plastic crates
Rice[2]	9-37%	Mechanical damage, disease	Drying, hermetic storage

[1]Aquino-Nuevo and Apaga (2010), [2]Parfitt *et al.* (2010), [3]Salvador (2016)

countries, and even 60% in one US country. In the Philippines, the DOST-FNRI (2020) reported a total of 57g (73.8%) of household plate waste of cereals and cereal products, followed by fish, meat, and poultry with 9g (11.1%) and vegetables with 8 g (10.8%).

To further supplement this claim, the national solid waste management report of the Department of Environment and Natural Resources (DENR) in 2018 emphasized that overall municipal solid wastes (MSW) mostly came from households at 56.7% followed by commercial, institutional and industrial sources. In terms of the type of waste, Figure 2 shows that biodegradable wastes comprise about half (52.31%) of MSW although primary data suggest that figures can range from 30% to as much as 78%. Typical bio-waste consists of kitchen or food waste and yard or garden waste. From the available information, it could be estimated that 86.2% of compostable waste comes from food scraps.

In a study conducted by Limon and Villarino (2020), they assessed the knowledge, attitudes and practices (KAP) on food waste of selected households in the northern province of the Philippines. It was found that the respondents practice the proper way of storing food and leftovers avoiding food wastage however, one of the inevitable practices resulting in food waste is the failure to consume all the food on their plates thus, leading to throwing them. It was also found in their study that household size contributed to household food waste as well as household income which showed that the wealthier a household, the more waste they generate. Moreover, poor household planning for the menu also showed a significant increase in food wastage. Porat *et al.* (2018) mentioned that attitudes of consumers toward food-wasting behavior including the notions that it is negative or harmful to the environment have a lesser impact on food waste as compared to having developed better food-provisioning routines and habits. Hence, it is possible to avoid household food waste by an average of 35% wherein the majority comes from poor food preparation practices (Schott and Andersson, 2015).

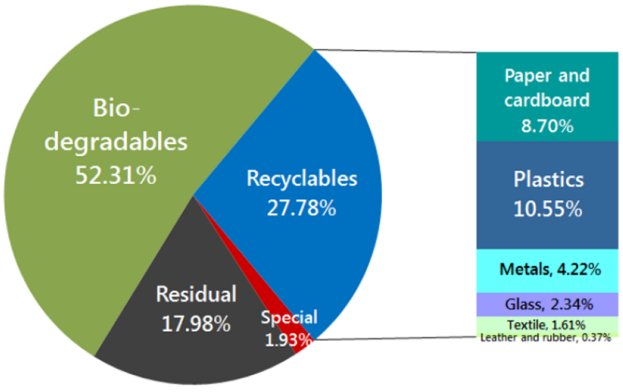

Figure 2. Composition of municipal solid wastes in the Philippines, 2008-2013.

4.2 Food waste in terms of the food service industry

Considered to be one of the largest and most profitable sectors in the Philippine economy is the food service industry. According to the Philippine Statistics Authority (PSA), 2018 census, restaurants and accommodation services comprise 75.2% and 13.4% of the food service industry, respectively.

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However, one of its critical and urgent concerns is food waste (Manala-O and Aure, 2019). Food waste has been deemed a constant challenge in the hospitality industry, particularly in the food service sector. It is estimated that 40% of food waste happens in customer-facing businesses like restaurants, supermarkets and hotels. It has been estimated that around 26% of food waste is generated from the food service sector (UNEP, 2021).

Currently, Republic Act No. 9803, otherwise known as the Food Donation Act of 2009, specifically looks at the food service sector- restaurants, hotels, bakeries, and retail establishments such as supermarkets for surplus food to ameliorate the vulnerable segment of the population from poverty and hunger and contribute to attaining the sustainable production and consumption (SCP) goals. Under R.A. 9803, the government, led by the Department of Social Welfare and Development (DSWD), and other identified national offices, will collect surplus or excess food (not leftovers) from parties, buffets from restaurants and fast-food chains. Section 5 of the said law specifically states that the donor/s shall not be subject to civil or criminal liability through a donation in good faith for charitable purposes. To further support the existing legislation, the Philippines recently passed a bill known as the Food Waste Reduction Act which states that restaurants are free from liability on donated food and are free from donor's tax. This bill encourages the food establishments to donate food rather than throwing them as garbage although this comes with a greater responsibility to ensure the cleanliness of food waste that they will be donating and the safety of those who will be receiving it.

To provide an initial quantification of food waste generated by the food service sector in the country, a pilot study facilitated by The Sustainable Diner project of the World Wide Fund for Nature Philippines in 2018 was conducted. In this study, two (2) hotels underwent a food waste management system, and they were able to measure their food waste. It has been found that almost 100,000 kg of food waste were generated by the hotels collectively in only a span of four (4) months. A comparison of the baseline food waste monitoring data and two (2) months after showed an average of 10% decrease in food waste per cover. Evidently, results show that initiating a food waste management system in food service establishments is a win-win solution to address this problem affecting businesses, people, and ultimately, the planet (Melo-Rijk *et al.*, 2021).

In a study conducted by Angchua *et al.* (2020), they investigated the factors behind food waste from dining establishments and their accompanying diners across Katipunan Avenue in the Philippines. They found that factors such as serving size, quality of taste and price, and customers' knowledge, expectations, and familiarity with the menu all affect the establishment's food waste. Fast food chains were observed to have the least food waste which may be due to the standardized ingredients which were already prepared before they received them. Food waste from fast food restaurants mostly comes from the customers rather than from their kitchens. On the other hand, fine dining restaurants produce more food waste from their kitchen. This is because they prepare the food from scratch, have stricter quality measures, therefore higher standards with the ingredients and have smaller portion sizes which in turn does not produce that much food waste from the consumer. Moreover, the food establishment that produces the most food waste were the bulk-preparation restaurants such as buffets and cafeterias, since they mass produce and estimate only from their forecasted customers the amount of food they will be preparing. Customer familiarity is also a significant factor in the establishment of food waste. Their familiarity with the portion size, menu, quality of taste and price affects the amount of food waste they produce. Food waste in restaurants mostly occurs due to customers' over-ordering and distaste for take-out bags in some establishments.

5. Food loss and waste in the Philippines

In the 2020 Agricultural End Report of the Philippines, the DA (2020) reported some of the FLW that the country has occurred in terms of agriculture. In January 2020, the Philippines experienced a calamity caused by the eruption of the Taal Volcano which resulted in P3.06 billion worth of losses to agricultural crops such as coffee, cacao, rice, coconut, and other crops. Moreover, the fisheries sector surrounding Taal Lake occurred the biggest loss with P1.6 billion. In February 2020, African swine fever (ASF) penetrated the country and caused a total of P56 billion loss due to the animal disease with an estimated 350,000 pigs culled since the ASF outbreak. The Philippines, being a tropical country, is used to several typhoons yearly. DA reported an estimate of 322,041 metric tons of loss of unmilled rice due to the typhoons which is equivalent to eight days of rice consumption. In 2021, through the Rice Competitiveness Enhancement Fund (RCEF) mechanization program, hundreds of farm machinery and equipment were provided to the farmers which have contributed to farm operations' timeliness and postharvest losses, including those caused by typhoon damages (DA Communications Group, 2021).

The pandemic has also added stress to the burgeoning concern on FLW. In a policy brief titled "Urban Food Systems and the Pandemic," the UN Food

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and Agriculture Organization (FAO), United Nations Development Programme (UNDP), World Food Programme, and the International Fund for Agricultural Development (IFAD) found issues and gaps in food systems in Metro Manila, especially at the height of the lockdowns. Challenges identified were food supply bottlenecks, especially at the onset of the lockdown; ineffective ICT systems resulting in information gaps; and capacity gaps in food provisioning. There were also transport and logistical disruptions leading to massive food losses and an oversupply of highly perishable products. With this, farmers and fisherfolk are at the losing end. (Ordinario, 2021).

There is very limited data on the DA report regarding food losses. This is also the case for food waste. At the end of the report, some key strategies were enumerated in strengthening Philippine agriculture and food production one key strategy related to FLW mentioned that "DA is working on the use of satellite technology to expand coverage of crop insurance and estimation of crop damages and losses due to typhoon and other natural disturbances". There are no other strategies mentioned regarding the reduction of FLW in the food supply chain, specifically in the production stage and even about managing FLW data. In terms of food waste, various opportunities are seen for the food service sector, retail and households to be forefront of reducing food waste in the country. Launching awareness campaigns, implementing the use less of or do without concept to avoid leftovers, improving the methods of storing foods and developing FLW measurement protocols whereby targets are set and FLW are regularly monitored are recommended in various agencies and sectors to pick up the phase on this pressing issue. Research on measuring FLW in various sectors and commodities is deemed vital in providing data on the extent of the problem and setting up appropriate interventions to reduce FLW. The consumer's knowledge, attitude and practices on the issue may also be determined to identify strategies for building awareness and implementing doable measures to sustain the practice of saving the food supply.

6. Conclusion

The concerns on FLW are multifaceted and affect all aspects of the food system, and its reduction would help alleviate a lot of issues in terms of hunger, malnutrition, and food insecurity. However, data on FLW in the Philippines is very limited making it hard to create interventions and solutions for managing it. The DA and Philippine Center for Postharvest Development and Mechanization (PhilMech) provide data on FLW on rice and some crops which were damaged by calamities, and some data were also provided on postharvest loss, but no data was provided for other agricultural crops that were loss in other means along the stages of the food supply chain such as storage, transport, and distribution. The DA has also provided some data on poultry loss because of diseases and fisheries damaged by the calamity but no data have been provided on livestock loss. The DOST-FNRI provides data on household plate waste conducted on their Dietary Survey but is limited due to the categorization of food groups. Moreover, other data and studies including FLW in the food service industry, supermarkets, and households are also very limited. Thus, multidisciplinary action is needed to reduce FLW. Government interventions play a big role in resolving this concern such as providing better technologies for production harvesting to storage, handling, transport, and distribution would be one step closer to reducing FLW. Moreover, behavior change is an important aspect in the journey towards reducing FLW and this starts with continuous education of all the actors involved across the food supply chain as well as consumers on the harmful impacts of FLW on the environment, economy, and society, and properly storing, planning and consumption to avoid generating FLW would also be necessary. In today's modern society, practical tips such as planning meals ahead, buying only what is needed, regularly checking food stocks, patronizing ugly produce, and repurposing leftovers can be good starting points to reduce food waste at the individual level. Donations of surplus food are also recommended in cases such as overproduction and overestimation. Lastly, in the case of unavoidable food waste, it must be diverted away from landfills through composting. This will not only reduce our methane emissions and dependence on landfills but will also improve soil health and promote regenerative agriculture. Setting up measures and targets for reducing FLW for each commodity and sector may be studied to provide baseline data for establishing interventions to minimize FLW in the country and help achieve food and nutrition security. Moreover, a study to determine the knowledge, attitude and practice of the different consumers may also help identify means to effectively create awareness on the subject matter and force the public to participate in the interventions that will minimize the amount of food wasted.

Conflict of interest

The authors declare no conflict of interest.

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