



Concerns and Challenges Related to Food Waste Governance in Malaysia

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Abstract. Food waste is a significant problem for the economy, environment and food security. The amount of waste created everyday by the retail sector is phenomenal. In the retail industry, food waste is largely caused by demand uncertainty – the retailer stocks inventory without knowing demand, and the unsold stock then becomes waste. Government efforts thus far have focused on managing waste disposal through regulation and public awareness. There is very minimal effort put into waste monitoring and reduction. This study aims to address the issue of food waste governance by the retail sector by focusing on monitoring and control mechanisms to reduce food waste. The focus is to investigate how stock and waste are being monitored and controlled in a retail setting, and how they interact with other mechanisms for reducing waste (i.e., food donation, waste separation, waste management and waste disposal). Thus, the study aims to investigate the concerns and challenges of food waste governance in Malaysia. Although the research focuses on developing a food waste monitoring and control governance model, analysis of existing relevant laws in Malaysia will also be carried out despite the legal framework not being the primary aim of the research. The research employs a library-based approach, focusing on the laws and policies governing food waste in Malaysia, as well as a qualitative approach that involves a review of the available literature on the subject as a means of data gathering. The governance model will provide significant input to the retailer and government in developing a management system of food waste governance towards environmental sustainability.

Keywords: Food Waste, Environmental Sustainability, Solid Waste, Waste Governance Model.

1 Introduction

Food waste is globally recognised as one of the problems faced by developing countries. Equivalent to 1.3 billion tonnes and worth, an estimated one third of all food produced annually ends up decaying in the receptacles of consumers and retailers [1]. The prevalence of mass-produced food retailing is one of the primary causes of food waste in developed countries. Particularly, retail chains are accountable for food waste due to ineffective forecasting techniques with suppliers, too strict aesthetic standards for produce, ineffective marketing and operational strategies inside the store [2]. Acknowledging this trend, the United Nations has decided that among the objectives in Goal 12 of Sustainable Development Goal I, namely to "Ensure Sustainable Consumption and Production Patterns," lowering food losses along the production and supply chains and cutting global food waste per capita in half at both consumer and retail levels by 2030 [1].

This is not a problem exclusive to Malaysia. Although it is widely recognised that household food waste is the primary source of the issue, large retail establishments, such as supermarkets, hypermarkets, and chain stores, also contribute to the mounting food waste problem in Malaysia [3]. According to a 2012 National Solid Waste Management Department (JSPSN) study, the commercial sector, institutions, and industry account for 31.4% of food waste contributed overall, as stated by the Malaysian Ministry of Housing and Local Government [4]. The environment and government spending are significantly impacted by food waste, in addition to causing financial loss. The government must set aside land for landfills and provide resources for their management because food waste must be properly processed and disposed of.

Research made in 2017 by the Khazanah Research Institute found that Malaysia has 296 solid waste landfills, with RM 2 billion set aside for their management. In several Malaysian states, solid waste management requires an annual expenditure of RM1.3 billion. Environmentally speaking, retailers (wet market and hypermarket) were responsible for 24% of the nation's 16,650 tonnes of food waste [5]. Food waste disposal and decomposition in Malaysia account for 12% of greenhouse gas (GHG) generation, which finally fuels global warming. Additionally, waste landfills in Malaysia constitute a major source of the release of methane gas, which is a primary pollutant that impacts the ozone layer [6].

Under the Solid Waste Management and Public Cleaning Corporation (SWCorp), JSPSN, local authorities, and private concessionaires, the Ministry of Housing and Local Government manages solid waste, which includes food waste in Malaysia [7]. The Solid Waste and Public Cleansing Management Act (SWMA) in 2007, the Solid Waste Corporation Strategic Plan (2009-2013), the Solid Waste Management Policy in 2016, the National Strategic Plan for Solid Waste Management Department (2016-2020), the Action

Plan for a Beautiful and Clean Malaysia in 1988, the privatisation of waste management initiative in 1993, the National Strategic Plan for Solid Waste Management in 2005, the Master Plan on National Waste Minimisation (MWM) in 2006, the National Solid Waste Management Policy in 2006, the Solid Waste Management Policy in 2006, the Solid Waste Management Policy in 2016, and the Solid Waste Management Policy in 2005 have all been implemented at the national level [8].

The Solid Waste and Public Cleansing Management Act of 2007, the Solid Waste Public Cleansing Corporation Act of 2007, the Local Government (Amendment) Act of 2007, the Street, Drainage and Building (Amendment) Act of 2007, and the Town and Country Planning (Amendment) Act of 2007 were all passed by the government to support the initiatives. Unfortunately, these laws exclusively govern the handling of solid waste, which encompasses food waste and public cleaning. It is still lacking in the authority to limit or control solid waste [9]. Additionally, it contains no clause requiring retailers to track, reduce, and dispose of their food waste appropriately. Therefore, the concern in regard to food waste produced by the retailers persists even after the initiatives, policies, and regulations that have been introduced thus far.

For example, Tesco Malaysia reported that 7,048 tonnes of food surplus (food not sold to customers) were produced in 2018/19, which is equivalent to 1.70 percent of the food sold on their shelves. Even though 610 tonnes of this excess were given to needy families, schools, community organisations, and charity homes through Tesco Malaysia food bank partners, 6,438 tonnes still end up in the trash. In 2019/20, 5,179 tonnes of surplus food (1.25% of food sold on shelves) were generated. 465 tonnes of surplus were managed to be redistributed and 4,714 tonnes went to waste [10]. Although Tesco Malaysia is the first and only retailer in Malaysia thus far to make such a declaration, it is a reasonable assumption that other retail outlets are also generating an abundance of food that goes to waste [11]. Food waste that breaks down in landfills releases methane and carbon dioxide, which are the main gases that cause the ozone layer to thin. This is bad for the economy and the environment.

The Food Waste Management Development Plan for Industry, Commercial, and Institution Sector (2016-2026) was created by the Ministry of Housing and Local Government in recognition of this [4]. The plan outlined the broad tactics for achieving efficient and successful waste management in the commercial (including retail), institutional, and industrial sectors. Two regulations have been introduced as a result of this plan: Solid Waste and Public Cleansing Management (Licensing), (Undertaking or Provision of Collection Service for Commercial, Industrial, and Institutional Solid Waste) Regulation 2018 (PU (A) 181/2018), and Solid Waste and Public Cleansing Management (Scheme for Commercial, Industrial, and Institutional Solid Waste) Regulation 2018 (PU (A) 181/2018). The regulations however, focus more on managing waste, ie, separation of waste, waste storage, appointing a licensed waste collector, prohibition against spillage, etc. There is still no provision for controlling or limiting the waste. Specific guidelines on

this are very important as source reduction is said to be the most preferred food waste management mechanism [12].

In light of the aforementioned, the issues and difficulties surrounding food waste management in Malaysia are the primary objective of this study. This paper begins with introducing the key concepts engaged in this study, such as food waste, governance, retail outlets, environmental stability, as well as perceptions and food waste regulatory frameworks or policy. The following sections are the discussion of the food waste governance model in Malaysia, the methodology undertaken for the study, and the findings of the concerns and challenges of food waste governance in Malaysia. The paper concludes with recommendations for improvement.

2 Literature Reviews

2.1 Food Waste

Food waste is regarded as a social problem that has an impact on people's health. The food that is thrown away could be used to fight malnutrition or hunger. Food availability is therefore a critical issue given the anticipated rise in the world's population [13]. Because humans are living creatures, food waste is thrown out every day as a result of domestic, industrial, and agricultural activities. Food waste sources can be classified into three main categories, namely food losses, inevitable food waste, and avoidable food waste. According to one of the researchers, there is currently no universally acknowledged definition of food waste [14]. Their proposal defines food loss and waste as the degradation of the nutritional value (qualitative) or mass (quantitative) of consumable food components intended for human consumption throughout the supply chain. Additionally, food that is safe for sustenance but is discarded as a result of spoilage is considered food waste. Overconsumption leads to products expiring before they are consumed, increasing the amount of food waste. Given its great organic content, food waste has several negative environmental consequences. Landfilling food waste is expected to generate a 50% rise in greenhouse gas emissions by 2020 [7].

2.2 Governance

The Food and Agriculture Organisation (FAO) of the United Nations claims that most sustainable development problems are related to political economy and governance; these constraints on policy decisions also result from their neglect or misinterpretation. Policy design has to be closely related to governance analysis and fit to institutional and political economy reality, as well as national preferences and priorities. Basically, government is the use of authority or power by political leaders for the welfare of the people living in their nation. It is the complicated process by which some sectors of society exercise influence, implement and spread public policies directly influencing institutional and personal interactions as well as economic and social progress. Since it is necessary to

demand respect and cooperation from the people and the state, the power used by the involved sectors of society is always for the common good. Thus, a lot of governance is the proper and efficient use of resources, which will include the methodical food waste management system itself [15].

2.3 Retail Outlet

Retailers of various sizes and organisations make up the food retail market [16]. Retailers may operate a single store or a chain of stores. Superstores, hypermarkets, convenience stores, food boutiques, internet stores, and vending machines are among the various categories of food retailers. One often finds that one retail chain runs several kinds of outlets. Some researchers claim that the retail industry generates significant volumes of food waste from mass-produced food in developed countries, mostly contributing [17]. Particularly through ill-informed supplier forecasts, too strict production standards, and wasteful store operations, supermarket chains in particular help to generate food waste. She emphasised that the majority of food loss and waste in both developed and developing regions occurs at distinct phases of the food supply chain. The retail and consumption sectors are responsible for the majority of food waste in industrialised countries. Beginning with the perishable character of food products, the food retail industry faces many difficulties in its supply chain. Among the other problems food stores all around are facing include waste management, constant food supply, quality management, returns control, and stock forecasting. Grocery stores, convenience stores, supermarkets, and hypermarkets make up the split form of the Malaysian food retail scene. Thanks to globalization, increasing disposable income, and needs from a mixed population, it is also among the sectors with the fastest growth in Malaysia [18].

2.4 Environmental Sustainability

Financial, environmental, and social sustainability are some of the various meanings of the term "sustainability" [19]. Social, environmental, and economic sustainability should all be incorporated into sustainable development (SD) in order to begin making development sustainable. The objective of environmental sustainability is to ensure the perpetual operation of the worldwide life-supporting systems, with a particular emphasis on those that sustain human existence. The source capacities of the global ecosystem provide the basic materials, including food, water, air, and energy, while the sink capacities absorb waste products or outputs. The primary objective of anthropocentric humans is to safeguard human existence through environmental sustainability. Waste emissions from a project or action under consideration should be maintained within the local environment's assimilative capacity, without unacceptably degrading its future waste absorptive capacity or other crucial services, as the "maintenance of natural capital" is the definition of environmental sustainability [20].

2.5 Malaysian and International Legal Perception and Policy on Food Waste

Numerous environmental issues have arisen in Malaysia as a result of the increasing quantity of food waste in recent years, which has a significant impact on the nation's solid waste management system. It also becomes a growing concern in Malaysia. Moreover, a 2017 statistic from SWCorp, a government agency responsible for solid waste management in Malaysia, indicates that food waste accounts for approximately 15,000 tonnes of the 38,000 tonnes of waste produced daily by Malaysians. Approximately 60% of that was avoidable food waste, while 40% was still acceptable. The food spoilage could have provided sustenance for at least two million individuals.

In Malaysia, the Ministry of Urban Wellbeing, Housing, and Local Government's National Solid Waste Management Department handles food waste management. The department is fulfilling its responsibilities, which include the development of plans, strategies, and policies that pertain to the administration of solid waste and public cleansing. The department is tasked with the development of solid waste management plans, which encompass the specification of the location, size, and type of new treatment facilities, as well as the coverage areas of the current solid waste management facilities. In order to carry out the regulatory duties outlined in the Solid Waste and Public Cleansing Management Act 2007 (Act 672), it must also establish standards, specifications, and codes of practice pertaining to any facet of solid waste management services and public cleansing management services. In order to carry out the act's implementation, this act contains a regulation that permits the granting of licenses and approval to engage in such additional activities. The Solid Waste and Public Cleansing Management Act of 2007, the Solid Waste Public Cleansing Corporation Act of 2007, the Local Government (Amendment) Act of 2007, the Street, Drainage and Building (Amendment) Act of 2007, and the Town and Country Planning (Amendment) Act of 2007 grant and regulate these authorities.

In any event, violations pertaining to the dumping of solid waste might be properly handled and addressed under the Environmental Quality Act of 1975. One example of this is the case of *Pendakwa Raya [2010] 3 AMR 3368 v. Malaysian Vermicelli Manufacturers (Melaka) Sdn. Bhd.* The accused discharged wastewater into inland waters (the Malacca River) without a licence, in violation of Regulation 8(1)(b) of the Environmental Quality (Sewage and Industrial Effluents) Regulations (the Regulations) [21]. This was a violation of section 25 (1) of the Environmental Quality Act 1975 (EQA), and it was punishable under section 25(3) of the same Act. The accused was found guilty and sentenced to a year in prison and a fine of RM75,000 in default. Examining the sentence, however, suggests that it is insufficient to insist on the entire situation of saving the food. Supermarkets, restaurants, and households all contribute to food waste, a problem that has never been addressed or subject to legislation. In actuality, no Act addressed the problem of food waste. Therefore, food waste is not intrinsically

wrong; instead, it just becomes more morally required to prevent squandering any food [9].

One of the initiatives Malaysia has started to address the difficulties of attaining effective and efficient food waste management is the Food Waste Management Development Plan for the Industrial, Commercial and Institutional Sectors (2016-2026) (PPPSM ICI). The Food Waste Management Development Plan for Industry, Commercial and Institutional Sector (2016-2026) (FWMDP ICI) was another step the Department took to achieve an effective and reliable food waste management system.

Development of FWMDP ICI is in line with the Strategic Plan of the National Solid Waste Management Department (2016-2020) and Solid Waste Management Policy (2016). Six main strategies and thirty-one action plans and performance targets from 2016 to 2020 help to shape this FWMDP ICI. Globally, environmentally, socially, and economically, food waste management is quite important. Focused on controlled solid waste as defined in Act 672, the Food Waste Management Development Plan for Industry, Commercial and Institutional Sector (FWMDP ICI). Three main sectors of food waste generators, which are the commercial, institutional, and industrial, are the emphasis of this FWMDP ICI.

According to the Food and Agriculture Organisation (FAO) of the United Nations, if food waste were a nation, it would occupy the third position in terms of total carbon footprint, following the United States and China [22]. FAO's work on measurement, which also actively supports numerous activities and duties related to the prevention and reduction of food loss and waste on a global scale, is essential for monitoring progress in reducing food losses in relation to the 14% Global Food Loss Indicator. The larger vision of sustainable food systems and food and nutrition security for all drives FAO's approach of preventing and lowering food loss and waste. From production, post-harvest, storage and processing to distribution and end consumers, FAO is engaged along the whole food supply chain. Through regulatory systems and incentives, FAO is promoting policies that are appropriate for the global, regional and national levels, as well as technical interventions and outcomes.

3 Problem And Challenges Of Food Waste Management

Globally, the control of food waste offers a complicated range of legal issues and obstacles. These difficulties stem from the multifarious character of food waste, which interacts with social, financial, and environmental aspects. Many times, fragmented and lacking the thorough scope required to properly handle the problem are legal frameworks. This complexity is further exacerbated by the necessity of harmonising multiple countries and the integration of multiple stakeholders in the food supply chain. The subsequent sections address the primary legal concerns and challenges associated with the management of food refuse.

Governance of food waste is distinguished by a patchwork of national, regional, and international rules. This fragmentation can cause disparities and ineffective handling of food waste. For instance, the European Union has several regulatory acts aiming at food waste but often without a coherent guiding effect, particularly the Circular Economy Package and the Common Agricultural Policy [23],[24]. Different member states apply EU rules, including Directive 2018/851, which can result in possible differences in the management of food waste. Comparative research, such as that carried out in Poland and Lithuania, underlines these difficulties with implementation [24].

From manufacturers to consumers, assigning accountability among the several players in the food supply chain is difficult. This sometimes causes an emphasis on "low-hanging fruit" instead of structural reforms [25]. Food law's junction of public and private obligations produces a complicated terrain of governance. This is seen in the EU, where food waste control is governed in great part by public policies as well as commercial standards [26]. From the environmental and financial points of view, food waste is suggested to be addressed with economic policy tools like pricing policies and quantity management. These tools must be properly crafted, nevertheless, to prevent unanticipated effects such as rising food costs that can aggravate food poverty [23]. Food waste greatly aggravates environmental damage, including loss of biodiversity and greenhouse gas emissions. To properly offset these effects, legal systems must combine environmental targets, including those specified by the Paris Agreement [23], [27].

Furthermore, thoughts about improving food waste management would be the integration of IoT, big data, and blockchain. Nevertheless, problems with cost, scalability, and stakeholder cooperation abound [28]. Effective food waste management is hampered by inadequate public knowledge and inadequate waste treatment facilities. Developing nations especially show these problems since resources for constructing improved waste management systems are limited [29].

To complicate matters, the globalization of food law brings fresh governance structures challenging conventional hierarchies. This includes the acceptance of worldwide agreements and norms impacting national policies [26]. Food waste management is starting to move toward circular economy ideas. These models stress resource reuse and recycling, but they need strong legal frameworks to let them be used [30].

The growing amount of food waste in Malaysia during recent years has resulted in several environmental problems within the nation, which influences the solid waste management system. Actually, social and environmental sustainability heavily rely on the developed regions, including cities. Developed areas need additional space to grow adequate plants and animals for food, renewable energy for operating, and space for absorbing in air, water, and waste of their people. Today, food waste is just one of the major problems solid waste disposal presents for municipal governments all around the

country. One of the instances is the activities carried out in Johor Bahru. Johor Bharu has experienced fast economic development and has also been named as one of the most competitive cities. The findings reveal difficulties applying zero-waste ideas in the framework of enforcement, management, finance, and public opinion.

Four factors or aspects can be used to classify the challenges: financial, management, enforcement, and societal behaviour [31]. Some researchers state that some of the current solutions relate to organisational strategies, such as tying corporate social responsibility and food waste reduction together [32]. It was discovered that many retailers, for instance, had made it a legal requirement to reduce their food waste by rerouting their waste to be used for the production of biofuel or donating food to food banks and charities, as has been done voluntarily in some European countries. The UN has also set a Sustainable Development Goal to cut food waste in half per capita by 2030 [33]. To reach this target, all major retailers and their suppliers must commit to showing that they can decrease the amount of waste.

3.1 The Need For Governance of Food Waste Model

In most developed and industrialised nations, food waste now reaches vast proportions. It is estimated that approximately one-third of the food produced globally is discarded during the food supply chain. One of the researchers asserts that the current Sustainable Development Goal (SDG) of the United Nations is to reduce the global food waste at the consumer and food retail levels by 50% by 2030 [34]. In order to address the issue sustainably, it is necessary to implement an interdisciplinary policy strategy that prioritises the prevention of food waste rather than its treatment.

Therefore, food waste governance has the potential to influence current cultural attitudes towards food waste in a manner that promotes more environmentally responsible behaviour and increased awareness. Moreover, national governments control food waste in quite different ways. While some laws support other causes only, others help to reduce food waste. Food laws typically focus more on food safety and population health than on lowering food waste [14]. Again, he underlined that most rules and educational initiatives on food waste originate in developed nations such as the EU, the US, South Korea and Japan. Furthermore, as has been discussed in the previous sections, most food waste in developing nations results from inadequate infrastructure. Hence, the government can inspire investors to help to build the infrastructure by giving them further subsidies. Consequently, a framework of specific actions that stores could implement to reduce waste throughout the entire food supply chain will be established. The causes of food waste will be identified through the essential behaviours of specific actions at various stages [16].

Given the growing interest in solid waste management and the issue that retailers are facing in managing food waste, one waste stream that has not gotten enough attention

is that produced by commercial buildings. Additionally, because of the diverse needs of the population, rising disposable income, and globalisation, the Malaysian food retail industry is one of the fastest-growing in the country. The perishability of food products is the first of many issues that the food retail industry faces in its supply chain. Other issues that food retailers around the world deal with include waste management, quality management, returns management, stock forecasting, and continuous food supply. Due to the issue, some researchers conducted a study to ascertain the extent to which Malaysian retailers have adopted reverse logistics [18]. The findings emphasised the situation of reverse logistics procedures for waste and return management, factors that influence the adoption of reverse logistics, advantages that retailers derive from reverse logistics, and obstacles to reverse logistics adoption. The study focused on food waste management among the retailers in the industry but specialised the focus on logistic matters only.

In the other study, food waste produced in households was among the highest in Malaysia when compared to other sources, like food courts, restaurants, hotels, and retailers, as well as wet and night markets [35]. The goal of the study was to improve food preparation routines and household planning abilities. Food waste produced from homes, like trash from residential homes or private domestic lodgings, is crucial to the food chain. This is because the largest portion of Malaysia's food waste is produced by households. Furthermore, a study found that households throw away more food than other sources of waste such as the industrial, commercial and institutional [36]. The recommendations say that the government should have a big and powerful role in making rules about food waste in homes and building infrastructure that could help reduce food waste in homes while also teaching people about how bad food waste is for the economy and the environment. Research has been conducted on the management of food waste but they appear to focus on other things instead of how to deal with food waste in retail. However, the studies that have been conducted will help the researchers to come out with a good output as findings in this study by looking into the gaps themselves, especially in retailing industries.

3.2 Relevance to Government Policy

In general, the research is in line with KEGA 12- Green Economy of the Shared Prosperity Vision 2030, as well as SDG 12 - Responsible Consumption and Production of the 2030 Agenda for Sustainable Development Goals. To be specific, the research will support the Food Waste Management Development Plan for the Industry, Commercial and Institutional Sector (2016-2026).

The Food Waste Management Development Plan for Industry, Commercial and Institutional Sector (2016-2026) was implemented in 2016. While the Plan outlined the primary approaches for implementing effective and efficient waste management throughout the three specified sectors, the proposed governance model will focus more on the retailers which are included in the commercial sector.

Taking into consideration the six main strategies and thirty-one action plan laid out by the Food Waste Management Development Plan for Industry, Commercial and Institution Sector (2016-2026), the proposed governance model will provide proper regulation and guidelines for retailer in respect to managing their expired food, contaminated food as well as wasted (unsold) food. This includes: 1) the establishment of a food waste generated database. The data will show how much food waste is generated by a specific retailer, thus providing baseline information for future plans. 2) Food waste recycling. A systematic, controlled and sustainable food waste management. The regulation shall emphasise the responsibilities of retailers in food waste minimisation, management, segregation and disposal. 3) Using licensed waste contractors for food waste disposal. 4) set food waste reduction targets, and 5) incentives for food waste management and disposal.

The outcome and benefit are as follows: a mandatory database for retailer-generated food waste, retailer-specific food waste management and disposal rules, and retailer-specific incentives for excellent food waste management and disposal

3.3

The Food Waste Governance Model

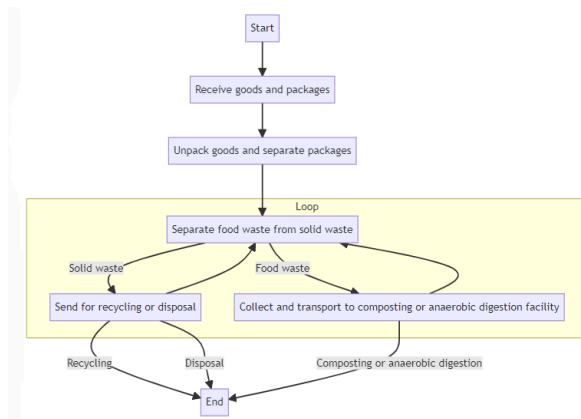


Figure 1. Food waste governance model for the study.

The diagram illustrates that with more waste being created daily, waste management has emerged as a major global concern. Waste is being disposed of carelessly, which has resulted in pollution, environmental damage, and health risks. As a result, it has become crucial to manage trash by separating food waste from solid garbage at the point of

formation. In actuality, 60% of the entire garbage was made up of organic waste. Source reduction is critical in separating food waste from solid waste, but there are no acceptable words to describe its importance.

Source reduction entails reducing the quantity of waste generated through reducing, reusing, and recycling. Given that it deals with the underlying causes of the waste problem, it is the most successful waste management strategy. Segregating food waste from other forms of solid waste at its point of origin is essential for source reduction. Separating leftover food, fruit peels, and vegetable peels helps one separate food waste from other kinds of solid waste including paper, plastic, and metallic material. This segregation reduces the volume of waste that is directed to incinerators and landfills.

The fact that food waste may be turned into compost is one of the prime reasons why it is crucial to separate it from solid waste. The decomposition of organic waste into compost, a nutrient-rich substance, is a natural process known as composting. Food waste composting increases soil quality, lowers the demand for synthetic fertilisers, and lowers greenhouse gas emissions. We can produce a useful resource that can be used to improve soil and advance sustainable agriculture by separating food waste from solid waste.

It is important to keep food waste separate from other solid waste because it lowers the amount of trash that is being disposed of in the landfills and incinerators. Greenhouse gases, which are a significant contributor to climate change, are released by landfills. When food waste breaks down in a landfill without oxygen, it emits methane gas, a greenhouse gas that is 25 times more potent than carbon dioxide. Conversely, incinerators let out harmful chemicals and pollutants into the air that can be bad for individuals' health and the public environment.

Moreover, the circular economy is supported when food waste is separated from solid waste at the point of generation. An economic system that promotes waste reduction and resource conservation is known as a circular economy. By separating food waste from solid waste, we can create a closed-loop system that turns trash into a valuable resource. Compost generated from food waste can be employed to cultivate food, which can subsequently be ingested and broken down to produce more food waste, continuing the cycle.

A key component of source reduction is separating food waste from other types of trash at the source of generation. It aids in lowering the volume of garbage sent to landfills and incinerators, encourages the circular economy, and produces a priceless resource that can be utilised to improve soil and support sustainable agriculture. We can make a big step toward a more environmentally friendly and sustainable future by segregating food waste from solid waste.

3.4 Punishment for Failing to Separate Food Waste and Solid Waste

Given the rising amount of garbage and the lack of available disposal choices, waste management is a crucial issue in contemporary civilisation. Among the most effective ways to cut waste is to separate food waste from solid waste at the source. However, many people do not, which increases environmental damage and waste going to landfills. Fostering awareness and behaviour change as well as significantly improving the environment depends on punishing those who neglect to separate food waste and solid garbage at the source.

To increase awareness and improve behavior, those who fail to separate food waste from other solid waste must be penalised at the source. Simply put, numerous individuals are unaware of the repercussions of neglecting to segregate food waste from other varieties of trash and how important it is to do so. Authorities can raise awareness of the problem and encourage individuals to treat it seriously by enforcing severe penalties. As people take more ownership of their waste and actively seek to lessen their environmental impact, this may eventually result in a cultural change toward better waste management techniques.

Punishing those who do not separate food waste and other types of waste at its point of source might have major environmental advantages in addition to raising awareness and reshaping behaviour. When food waste is dumped in landfills along with other solid waste, it decomposes and releases methane gas, a strong greenhouse gas that accelerates global warming. Methane emissions can be greatly reduced by separating food waste and putting it in composting facilities. By reducing the amount of waste delivered to landfills, this not only aids in reducing the consequences of climate change but also promotes a more sustainable and effective waste management system.

There are a number of ways to penalise people who don't separate food waste from solid waste at the source. One typical type of punishment is a hefty fine for anyone found combining food waste with solid garbage. To guarantee that individuals take the matter seriously, though, harsher penalties might be required. For instance, depending on the gravity of the offense, repeat offenders may be subject to community service or even criminalisation. Although these penalties may appear harsh, they can be very successful in raising awareness and altering behaviour.

To encourage awareness, behaviour change, and environmental sustainability, people who fail to separate food waste from solid trash at the source must be punished. Authorities can compel people to take waste management seriously and seek to mitigate their environmental impact by increasing awareness of the issue and implementing severe penalties. Even though fines can serve as a strong deterrent, there are some situations where more severe penalties are required. The ultimate objective should be to establish a

culture of responsible waste management, where individuals actively work to reduce their waste and safeguard the environment for future generations.

4 Data Collection

4.1 Data Gathering Via Interviews

This interview took place with a technical engineer and an assistant engineer. It was carried out to compile information on how Malaysia's northern area has fared in terms of waste management. The interviewee has been an engineer for the last three years. Given their breadth of knowledge and depth of experience, they might have dealt with a variety of difficulties. After weighing the advantages and disadvantages of landfills, these were their answers. One advantage is that landfills are inexpensive to operate and maintain. Landfill maintenance and operation do not require a lot of expertise. The tipping rate is also low because no cutting-edge technology is used. On the other hand, they retorted that the increase in rubbish each year would reduce the lifespan of the landfill and, to a certain extent, obstruct government plans for the building of new facilities.

The limited amount of land that has been classified as a landfill contributes to the nation's increasing requirement for landfill space. Due to the high cost of land, the acquisition procedure necessitates a large investment in time and money. A properly closed landfill is worthless because it cannot accommodate long-term construction. In response to a question about whether alternative treatment was required for the landfill disposal of wet waste or biodegradable waste, they said that there are no specific treatment requirements for the disposal of biodegradable waste in a landfill. It is customary to cover trash with earth or other materials to control the decomposition process and reduce odors. Although food waste and other wet waste are routinely dumped in landfills, it is crucial to control the moisture content of the landfill to prevent leachate generation and to reduce methane gas emissions, a strong greenhouse gas. Usually, this is achieved in contemporary landfills by including leachate collecting systems and liners.

It is true, they said, that in the landfills, wet and dry garbage must be handled differently when asked if there are distinctions in how they are treated there and whether waste separation is done or not. Dry and wet organic waste should be treated in different ways. Wet waste is typically composted or converted to biogas, whereas dry waste is typically landfilled. To enable the effective management and processing of various waste types, waste is often separated at the site of waste generation, such as residences, retailers or waste processing facilities. This reduces the amount of waste that ends up in landfills and the damage that landfills cause to the environment.

These two separate kinds of waste are disposed of in different cells at landfills. Cell inerts will be utilised for disposing of bulk waste, and household cells will be utilised to dispose of household waste. Prior to dumping the residual garbage, composting may be

done in landfills that include Anaerobic Digester units. In the areas with incinerator facilities, household waste will be burned there, while in other districts, landfills will handle the majority of waste. One of the questions also includes whether the amount of waste that can be gathered from producers and dumped in a landfill has a limit or objective. The fact is that the government had not established any limit or target for the quantity of waste that should be produced.

When asked whether they knew that illegal dumping still occurs in Malaysia nowadays, they pointed out that the 2007 Solid Waste Management and Public Cleaning Act was implemented to stop the illegal dumping (ACT 672). Additionally, there are regulatory frameworks that can be enforced to prevent the continuation of unlawful waste operations. Solid Waste Management and Public Cleaning (Licensing) (Employment or Supply of Collecting Services for Commercial Solid Waste, Industrial and Institutional) 2018 [P.U. (A) 180/2018]. Below are some of the regulations.

Also asked for their opinions on Malaysia's extensive usage of incinerators. They replied that incineration plant operators needed to keep up with contemporary technological developments. Technical research must be done thoroughly before selecting a technology for the facility. Also, people need to be more open-minded about accepting this incineration facility. If the waste-to-energy technology gets selected, the cyclical economy of Malaysia will benefit. With the help of the solid waste it burns, the incinerator will generate power, opening up new economic opportunities. Land scarcity, high land costs, and landfill life expectancy will all be solved through the incinerator plant. Overall, environmental pollution can be decreased by using an incinerator, particularly pollutants related to air quality and odour.

What issues and challenges arise from using the incineration method in Langkawi, Kedah, were also discussed. The main issue with the incinerator plant, they responded, is the precise and proper selection of technology in accordance with the content and components of solid waste in Malaysia. By carefully selecting its technology, a plant can efficiently manage solid waste while avoiding the production of gases that are harmful to the public and the environment. Additionally, Malaysia must develop native experts skilled in operating incineration facilities. The general public needs to be informed and provided with an explanation in order to promote the adoption of these cutting-edge technologies. When asked, are there any attempts being made to recycle the dust (e.g., by collaborating with MARDI for commercial uses, or using it to make bricks, etc.)? In response, they stated that before the dust is disposed of at approved locations, it will be inspected by the Department of Environment. As a result, not much can be made from the dust.

Also, do you believe that our country has an infrastructure that is completely operational for waste handling activities? They observe that Malaysia is committed to establishing the most advanced solid waste management facilities. Many new

technologies, such as the Anaerobic Digester composting machine, have transformed all once unclean landfills into sanitary ones. Are you of the opinion that our nation has a waste management infrastructure that is fully functional? The Anaerobic Digester composting machine, MRF (Materials Recovery Facilities), and LTP (Leachate Treatment Plant) have been employed to transform all previously polluted landfills into sanitary ones. Malaysia is presently investigating methods to enhance technology and transition to waste-to-energy in order to ensure that the infrastructure for solid waste facilities is available.

Furthermore, the topic of whether they were aware of the government's adequate support for and cooperation with businesses that successfully manage their waste. They said that SWCorp urges residents to practice waste segregation in order to ensure efficient waste handling through the Industrial, Commercial, and Center for Waste Division. Winners in all three categories are recognised by SWCorp as having the finest waste management. Are they also aware of any government incentives available to companies that effectively manage their waste? Effective solid waste management is highly valued by SWCorp for individuals or organisations. Initiatives to value people and bodies are numerous. Numerous competitions and activities were conducted in their honour. SWCorp was founded with the objective of promoting effective waste segregation methods through outreach initiatives and public awareness campaigns. Various commercials, 3R competitions, and initiatives are developed and displayed. The projects were rewarded with money, certificates, and awards from 3R and Hero Cleanliness.

However, it appears that what they were stating was not supported by the actual situation. This issue may not have received much attention or support from the government. The separation of wet and dry solid waste is merely one aspect of the issue that requires attention. Environmental sustainability is highly improbable in the absence of sufficient education and knowledge. They reluctantly acknowledge that Malaysia's poor environmental practices have been exacerbated by a lack of coordination among the country's waste management governing bodies, such as the Local Authority, SWCorp, and JKR.

4.2 Follow-Up Data Gathering

A follow-up interview was conducted with an enforcement officer and a technical engineer at SWCORP to learn more about the gap that was identified in the initial interview. The first query was why Kedah in particular had so few recycling bins. They contend that Kedah lacks a strong recycling culture. Rather than recycling their solid waste, they deposit mixed waste in the recycling container. Subsequently, the container was eliminated from the vicinity. For example, recycling receptacles are no longer available at Jitra. Recycle receptacles are being removed in seven states where the Solid Waste and Public Cleansing Management Act 2007 (SWMA 2007) is in effect due to a lack of public support, as they claim.

They offer evidence to substantiate their assertion that they will locate a replacement. Instead of placing recyclables in recycling bins, the public abused them by dumping waste of all kinds into them. Location plays a huge role in this issue. Given the high levels of environmental consciousness in middle-class and affluent neighbourhoods, recycling bins may be ideal for placement there. For instance, recycling is quite important in Putrajaya and other major cities. The recycling facility in Putrajaya is well-liked and well-engaged by the general population since it may create income through exchanging recycling materials for money.

The second question is, given that it is known that the landfill is full, why were alternative trash disposal strategies not developed? SWCorp acknowledged that the landfill is at full capacity and recommended the development of an effective waste management strategy. By creating a circular economy, SWCorp hopes to keep 40% of its waste out of landfills. Today, the country manages waste through anaerobic digestion (AD), composting, and incineration. Incineration, which involves both burning and transforming waste into energy, is another technique for doing this.

Despite the fact that this assertion is made, it is exceedingly challenging to execute as a result of a regulatory framework that is inadequately developed to effectively penalise pollutants and a lack of public awareness. Other enquiries were as follows: Why can't food waste be processed, considering the issue of inadequate waste management? And how do they deal with such a large volume of waste in such a setting? They retorted, "Yes, there are waste treatment procedures, like composting and AD (anaerobic digester) devices." Use of either method could result in the conversion of food waste into electricity. Prioritising needs, be they gas generation or something else. It is possible to repurpose the gas as cooking fuel. However, gas can also be used to generate electricity. They asserted that they had partnered with the Japan International Cooperation Agency (JICA) on composting technology.

Waste is also turned into organic fertilizer by composting. Fertilizer is used on rice fields in Japan. With the purpose of turning food and plant waste into fertilizer, SWCorp has partnered with hotels in Malaysia and Cameron Highlands. Yet, awareness levels in Malaysia are still quite low. The location of the composting equipment is in the School Precinct 18 area of Putrajaya. Although we tried our best to comply with the study's requirements, not all locations could be supported. At the Ampang food court, an AD machine is situated next to it. We support the activities of manufacturers and retailers (such as Mydin, Lotus, etc.), but they are required to comply with the ICI Rules 2018 because they employ a separate contractor to collect their waste, which means that Environmental Idaman Sdn. Bhd., as one of the concession companies, does not monopolise the industry and only collects domestic waste.

For example, under other regulations, the waste collected by Mydin must be segregated, delivered to a landfill in Jabi, the vehicle needs to have a licence, and they

must ensure that their waste is managed appropriately and not mixed with domestic waste. Failure to comply will result in the accumulation of their debt. There will be an enforcement inspection by the SWCorp.

Why not also separate wet and dry garbage as well? The operator separates the waste into the suitable household and hazardous cells as soon as it gets to the dump. Inert cells are designated for construction trash under the construction waste plan. The amount of waste that is dumped there by the contracted contractors is minimal because the majority of trash can be recycled. There isn't any dumping or spillover as a result. For the remaining waste, however, domestic cells are heavily utilised. In response to questions, they asserted that the strategy for penalising polluters was already in place and only needed the necessary parliamentary approval. Unfortunately, because of the state of our economy and the change in government, it has been put on hold. This is one of the enforcement methods that could benefit society because failing to segregate rubbish at the source has costly repercussions. Singapore can be examined to discover how they handle waste. Singaporeans do not litter everywhere like Malaysians due to the strong enforcement there, spurred on by the installation of various fines and compounds.

They clarified that high expenses, an absence of sufficient information, and the type of waste contribute to the failure of the incinerator to operate at full capacity (waste that is too wet). Contrary to what happened in developed countries, the rubbish is not separated into dry waste and moist waste at the source. Unseparated household waste that has accumulated within the house is currently being mixed with solid waste. The lack of restrictions on waste production, particularly for businesses and retail establishments, was another urgent issue. This causes spillage, which makes it harder to handle waste. The response was that we are unsure of the quantity at issue for each merchant or company. As every retailer produces waste that varies in quantity and composition, it is difficult to regulate diverse business types. For example, some stores manufacture massive items in minimal numbers that are already weighty. Usually, it is unfair to impose severe weight limits on waste. We can enforce specific laws using the 2018 Industrial, Commercial and Institutional Sectors (ICI Regulations).

According to Industrial, Commercial and Institutional Sectors (ICI rules), they have to separate their trash (Industrial, Commercial and Institutional Sectors). Shops are easier to handle than homes since they have to follow licensing regulations, source segregation, etc. or they must be fined. Many ICI-related lawsuits have also reached a verdict. Consequently, it is effortless to enforce, as they are required to adhere to the regulations, in contrast to household waste, which is subject to change in response to political circumstances. Prior to this, they were on the brink of enforcing a fee on residents for neglecting to separate their refuse but this was stopped by the change in government.

When questioned, they also mentioned that there are other garbage disposal methods available, but regrettably, they have not been properly used to sufficiently clean the area. What causes that? As a result, they said, although SWCorp has implemented a variety of technologies and has already implemented the appropriate procedures, we were unable to influence the opinions and attitudes of others. Everyone must abide by the guidelines outlined in the manuals, license agreements, etc. For instance, the detailed guidelines on how to properly clean the space are included. Since the illegal disposal of waste has become embedded in people's daily routines, it will reappear the day after the removal of an illegal dumpsite. Yet, if there are political intrusions from outside sources or if other agencies are involved, the enforcement is still constrained (off record). While it is challenging to prosecute someone without evidence, installing CCTV is one action we may take. We can present those defendants in court once we have the required evidence. Even though SWCorp has followed the waste disposal regulations from Canada, Germany, Korea, and Japan, the implementation is difficult due to cultural prejudices, an absence of understanding, and insufficient education. Malaysia only began to change its mindset in 2008, whereas the Japanese took fifty years to transform their way of thinking.

We can say that some of the efforts made by SWCorp have been successful because the recycling rate has risen to 33% and we are on target to reach our goal of 40% in 2025 (according to RMK 12). This shows that people are becoming more aware. Recycling centers can be found even in landfills, indicating that recyclable material is being sorted close by. From there, the recycling data are derived.

Regarding the use of an incinerator, they acknowledged its benefits but opined on its lack of use. They replied that problems include high expenses and waste qualities that result in ineffective burning. Among the components of the waste are wet waste and food waste. Relevant to this is public knowledge of the program aiming at separating waste at the source. The EIA criteria of the Department of Environment (DOE) demand that the ideal burning take place at least 850–1000 C or more. The new initiative, which aims to convert trash into electricity, was initiated with an incinerator in Rawang and Ladang Tanah Merah in Port Dickson. The electricity might be sold to Tenaga Nasional Berhad (TNB).

The high expense and upkeep, however, also contribute to additional issues. Because maintenance is mechanical in nature and because contact with leachate's (high ammonia content) damage affects metal (could not stand). People's waste disposal practices also matter; for example, throwing away old clothes that are not recyclable could clog the machine. Too much moisture prevents the waste from burning completely. Diesel was also necessary, but it is pricey now due to the escalating cost of diesel. The incinerator's high purchase price and little use posed the next question. What is blocking it? They answered, actually, this is based on the waste qualities. Waste is combined in its entirety. If waste is separated at the source, the problem won't arise.

Since dust will be produced throughout the burning process, the next concern was how to use the ashes as efficiently as possible. They answered that since the ashes from the incinerator are considered scheduled trash, they must be treated according to the DOE's guidelines. For instance, Tapak Belanga Pecah in Langkawi is the location where the DOE requires that it be disposed of. SWCorp won't just throw it away at random. As soon as the ashes have been gathered, they will refer to DOE, and DOE will select where to dispose of them and create a certificate indicating the site. As per their order, the ashes are not currently used again. Scheduled waste is not under SWCorp's control. Nevertheless, despite prior assertions of completing the necessary tasks, the effectiveness of waste management remains insufficient. Observation indicates numerous disorganised areas that are inadequately maintained and detrimental to the environment.

Is the failure to cooperate by the aforementioned parties, the Municipal Council, JKR, DOE, SWCorp, etc, the cause of the flawed system? They said that the local government has established a One Stop Centre (OSC). Each Local Authority can access it. SWCorp, JKR, PBT, and other departments concerned will be contacted by the OSC to discuss specific issues that could have an impact on everyone's domains. Even while they are collecting trash, some regions are outside of their scope. For instance, if electronic trash has been collected, they will refer to DOE. The management of garden trash is also different; because there is a financial incentive, it is important to contact the Department of Agriculture or any other parties involved.

To come up with a solution, all stakeholders will give their views. Because they cannot unilaterally infringe upon one another's sovereignty, each side must follow its own set of rules. The OSC will host a total of twenty-four meetings, two of which will be held each month. Inferring that the pertinent authorities always cooperate is quite misleading. In response to the inquiry regarding the extent to which it would be challenging to operate without the coordination and cooperation of other stakeholders, they responded that there is a need for external assistance in completing the task assignments. For example, they are not responsible for the waste collection or drainage of Terusan Wan Mohd Saman. In order to manage the refuse, SWCorp must obtain authorisation from the Department of Irrigation and Drainage. In the event of a flood, they are required to collaborate with the Department of Drainage. OSC was established as a result so that all pertinent groups could offer their opinions in searching for a solution to any case of disagreement.

The procedure could take longer if each agency insists on acting on its own rules and legislation without any compromise. In the case of ignoring the rules and just crossing the lines without sufficient negotiation, the consequence could be different. For example, the Local Authority is not accountable for the landslip disaster at Batang Kali since no involved parties have made any applications for a licence or permit that allows for the activity conducted at the site. Accordingly, if the complaint is about something that we can fully authorize and instantly handle, we will answer shortly. We might need to

seek clarification, obtain authorisation, or consult with other authorities if the garbage relates to other jurisdictions.

They indicated that SWCorp values individuals who manage their waste properly when referring to sustainable practices. The inquiry also includes the fact that there are not enough incentives applied and who should be in charge of promoting these accepted environmental behaviors? According to them, they have done every promotion that can be offered on radio, TV, social media, and other platforms. The level of awareness within a society is determined by the society as a whole. If you visit our Facebook page, you'll see that we frequently post advertisements for recycling events and other products. Meanwhile, we only conduct business in jurisdictions where the SWMA 2007 is applicable. There might be constraints on that aspect, given that the other states are not engaged. On the other hand, they stated that they have really maximised their efforts when it comes to offering incentives in the seven states (Kedah, Perlis, Kuala Lumpur, Pahang, Negri Sembilan, Melaka and Johor). They recently presented certificates to recyclers in Perlis. There is also participation from the universities, schools, etc. The items relating to appreciation, recycling, and other themes can be seen in the SWCorp headquarters. SWCorp and the Department of Environment (DOE) collaborate frequently to encourage ethical behaviour that influences the environment, as well as raise public awareness among the local citizens.

The inquiry relating to the poor condition of waste handling is because of the absence of sufficient coordination. While SWCorp, MADA, and KEDA are just a few of the stakeholders involved in the waste in the drain, it is rarely obvious who should address or resolve a specific issue. Each has its own set of laws, regulations, and restrictions. That may in some way obstruct development and collaboration.

4.3 Use of an incinerator

The process usage of an incinerator for managing food waste is shown in **Figure 2**.

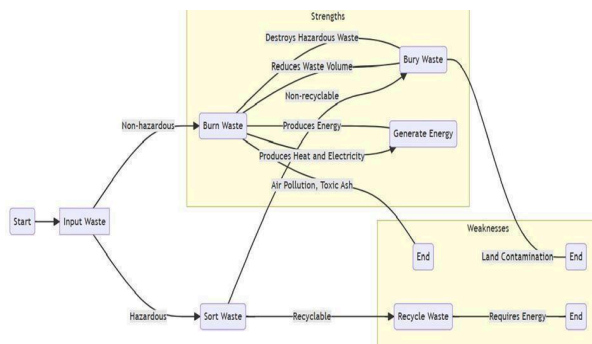


Fig 2. Flowchart of the incinerator process for managing food waste.

Garbage was first shown on the flowchart in several categories: organic and inorganic waste, hazardous and non-hazardous materials, recyclable and non-recyclable materials, and so forth. Following that, the garbage is pre-treated to get it ready for burning; this means that any harmful or toxic elements are eliminated and the waste is shrunk.

The trash is subsequently burned in a controlled environment at high temperatures, where it is converted to ash, gas, and heat. The ash created during the process is collected and disposed of, while the contaminants released during incineration are controlled and monitored to minimise pollution. The benefits of incineration are demonstrated by its by-products, such as waste reduction, energy recovery, reduced landfill demand, and energy generation. The cycle, on the other hand, emphasises the drawbacks of incineration, such as the impact on the environment, limitations imposed by the kind of waste, the expense, and public attitude. These cycles illustrate the potential for these errors to persist and result in problems.

5 Conclusion

The core issue with managing food waste has been covered in the literature review. More fines should be imposed by the law as punishment for offenses involving food waste. Food waste that is not separated may incur penalties comparable to those enforced in Japan. In Malaysia, the landfill issue has also become unmanageable. It is imperative that this legislation be enacted to guarantee a favourable environmental outcome. Clean, intelligent measures in regard to the handling of food residue are the primary objective in Malaysia. Food waste is not being dumped appropriately, despite the fact that it contributes up to 60% of municipal solid waste. It is important to strengthen the law and specifically address the issue of food waste in order to encourage people to reduce their waste and protect the environment and all aspects of human life for the long term. The courts must take strong action to hold businesses and other polluters accountable for the pollution they cause in order to get the most out of the best environmental practices.

It is important to protect the environment, even if the law fails to explicitly state so. One way to stop it is to make sure that every stakeholder is educated about it. Along with making the policy stronger, we need to teach people more about how important it is to protect the environment and how bad it can be for our quality of life. Updating the infrastructure for processing food waste is necessary in addition to the guidelines, which must be accessible to all stakeholders. In the same way that vaccination is advocated to the general public, intensity should be employed to minimise food waste. Then, and only then, would it be feasible to preserve sustainable development on the economic, environmental, and other fronts while simultaneously averting the degradation of the following generation. Tipping the scales in the correct direction requires government understanding, commitment, action, and cooperation from all key partners.

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