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MUNICIPAL SOLID WASTES AN OVERVIEW OF PLASTIC WASTE MANAGEMENT SYSTEM

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Abstract

Plastic waste comprises of a quarter of total municipal waste generation including in Malaysia. This type of waste generation increases annually and is largely fuelled by rapid urbanisation and industrialisation, population increase and shifts in lifestyle as well as changes in patterns of consumerism. These phenomena have created significant pressures on local governments especially local authorities who have to fork out nearly half of their annual expenditure for waste disposals. This paper reviews global and local plastic waste generations and current practice of waste disposal methods undertaken by local governments and authorities. The reviews are based on available literature on municipal waste generations in general, and plastic waste generations and disposals in particular, as well as challenges faced by local authorities in dealing with the ever-increasing issues of waste treatment and disposal and the associated economic, social and environmental consequences of plastic waste dilemma. It is found that local authorities are facing increasing challenges in not only to dispose of these plastic wastes in a safe manner but also to look for practical and economic measures to reduce plastic waste generations by its residents. The Federal government, in cooperation with all local governments in the country has embarked on concerted efforts to strengthen its waste planning and management approach towards the next century. However, significant changes in consumer behaviour are detrimental to the success of these efforts to ultimately reduce plastic waste generation in the country.

Keywords: *municipal solid waste; plastic wastes; plastic wastes management system; waste minimisation*

1.0 INTRODUCTION

Municipal solid waste management (MSWM) becomes one of the most crucial health and environmental problems facing authorities around the world, especially in developing Asian countries. Many factors have contributed to this end such as rapid urbanisation and industrialisation, population increase, rural-urban migration, per-capita income increase and shifts in lifestyle and patterns of consumerism (Othman et al., 2009; Agamuthu et al., 2009; Dhokhikah and Trihadiningrum, 2012). Generally, the local municipal councils are responsible for the waste management systems.

Current commonly practiced disposal methods such as open burning and sanitary landfill can cause dire detrimental health and environmental consequences such as diseases, air pollution, surface and groundwater pollution from smoke, Greenhouse Gases (GHGs) emissions and leachate caused by waste decomposition process (Ogawa, 2000). In Malaysia anaerobic waste decomposition at landfill sites contributed up to 90% of the overall emission of GHG (Tan et al., 2015). The quantity and the composition of the municipal solid waste are critical for the determination of the appropriate handling and management of these wastes (Abdel-Shafy and Mansor, 2018). Recycling is conducted by formal and informal recyclers.

The amount of municipal solid waste stream generated in Malaysia has increased at an alarming rate that is by 28% between 1997 and 2007, thus outstripping the capacity of waste management and landfill facilities with many of them reaching their critical operating levels (Othman et al., 2009; Tan et al., 2015).

This also put a heavy burden on the local authorities since it consumed a handsome proportion of their operating budgets. For example, in developing countries between 20% and 50% of municipal budgets were utilised towards waste management alone but they could only handle about half of the total solid waste stream produced throughout their urban areas (Peter et al., 1996; Budhiarta et al. 2012). However, solid waste management in these countries are faced with an array of technical, financial, institutional, economic and social issues such as ageing infrastructures and equipment, irregular and low collection coverage, inadequate legal frameworks and enforcement, outdated crude disposal methods and lack of awareness (Ogawa, 2000; Abd Manaf et al., 2009).

Since 2007, solid waste in Malaysia is managed under the purview of the Ministry of Housing and Local Government (MHLG) through the Solid Waste and Public Cleansing Management Bill, 2007 (Act 672), an act which shares some similar traits with successful waste management policies in Japan and Singapore. The Act allows a federal take-over of the management of waste management. The Act led to the creation of a private business entity, the Malaysian Solid Waste Management Corporation to handle solid waste management nationwide from the local authorities. Among the main provision of Act 672 is the responsibility for waste generators to conduct pre-collection waste separation to encourage recycling and retrieval of valuable components from the waste stream and a failure to abide to the waste separation regulation will incur a fine of RM1,000 (Agamuthu et al., 2007). However, as of this writing not all the states in Malaysia have fully gazetted the Act. Only Pahang, Johor, Melaka, Negeri Sembilan, Perlis, Kedah and the Kuala Lumpur and Putrajaya Federal Territories have fully adopted the Act when it came into force 1 September 2015, covering about 10 million of the population. Furthermore, the Borneo states of Sabah and Sarawak were excluded from the Act as they have their own sets of laws governing solid waste management.

Prior to the adoption of Act 672, solid waste in Malaysia was a function of the local authorities as stipulated in Section 72 of the Local Government Act 1976 (Act 171). However, the function put a heavy burden on the local authorities, with some of them allocating more than 50% of their operating budget on MSWM issues. The waste collection and disposal services provided were not efficient and more resources were needed to find and construct new replacement landfills. This was essentially due to financial resources, lack of organization and complexity (Burntley, 2007). The budget for waste collection ranged from 20% to 70%, according to the size of the municipality (Hassan et al. 2000). Vacant lands are becoming a very scarce commodity and land prices are at a premium, competing for other urban development purposes such as residential, commercial, industrial, transportation and public utilities. In 1996 the government opted to privatise the solid waste management function and three solid waste management concessionaires were awarded separate operation zones: Idaman Bersih Sdn. Bhd., Alam Flora Sdn. Bhd. and Southern Management for the northern, central and southern region, respectively (Latifah et al., 2009).

Foods, papers, and plastics are found to be the major components of Malaysia MSW where it covers 80% of overall weight. These characteristics reflect the nature and lifestyle of Malaysian. As the economy and urbanization of a country keep on growing, waste composition changes. Significant increase in paper and plastic composition is the most obvious change (The International Bank for Reconstruction and Development, 1999).

This paper attempts to review the situation of the Plastic Waste Management System. With this aim, this paper seeks to: (i) identify definition, composition, sources, and management system, (ii) the current practices of Plastic Waste Management System, and (iii) identify the problems and challenges that arise. The results obtained from this paper are the ways in managing plastic wastes and the challenges in adopting the concept of sustainability into waste management from both literature review.

2.0 PLASTIC WASTE

Being lightweight, relatively cheap, durable, and versatile, plastics have been highly incorporated into a diverse range of applications. From household to automotive, aviation and even aerospace products, they are a crucial part in almost every facet of our world we live in. In recent years the environmental, social and economic impact of plastics has been the topic of

the political agenda, with a focus on both sustainable productions, and the decoupling of adverse environmental effects from waste generation.

Since 1950, nearly 8.3 billion metric tons of virgin plastic have been produced andm6.3 billion tons of plastic waste have been generated, of which 9% has been recycled, 12% incinerated, and 79% accumulated in landfills or abandoned in the environment (R. Cole, 2018; J. Amos, 2017; R.A. Meidl, 2018; R. Geyer, 2017). Figure 1.1 confirms that packaging (40%) is the main source of waste plastics, but other sources such as waste building and construction (20%), waste automotive (10%), waste electronic and electrical equipment (6%) are becoming significant sources of waste plastics (UNEP, 2018).

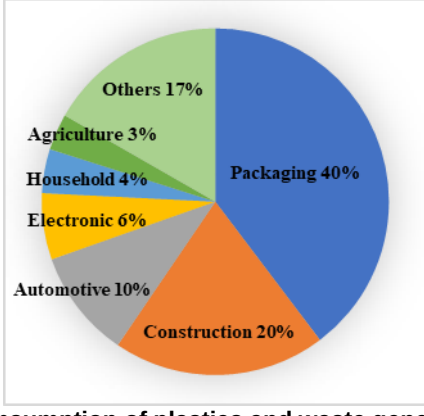

Figure 1.1: Consumption of plastics and waste generation by sector
(Source: United Nations Environment Programme, (2018)

Improper disposal of plastic waste can cause detrimental damage to the environment. Open incineration of plastic waste releases various toxic pollutants and gases such as dioxins, furans, mercury, and polychlorinated biphenyls (PCB) as well as carcinogenic agents into the atmosphere (Verma et al., 2016). Indiscriminate plastic disposal practices also cause increasingly serious marine pollution, and some plastic and micro-plastics (less than 2mm) have made their way into European, North American, and Asian freshwater systems and into the oceans (Singh and Sharma, 2016).

2.1 Categories of Plastic Materials

The American Society for Testing and Materials (ASTM) provided identification coding codes on plastic in 1988 with a seventh category created for all other types (Table 1.1). There are various categories of plastics but only 6 (six) types of plastics are the most common and they are required to be recycled differently (Table 1.2). Waste composition in Malaysia is dominated by organic waste, (45%) followed by plastic (24%) and paper (7%). The top countries producing plastic waste are the Philippines (25%), Japan (20%) and Hong Kong (15.7%).

Table 1.1: Categories of plastic wastes

Name	Codes/ Symbol	Product Applications	Sources	Name	Codes/ Symbol	Product Applications	Sources
Polyethylene Terephthalate **Commonly recycled**		Plastic bottles, food packaging, medicine jars, rope.	Wastes Storage Recycling program Recycling Centres	Polypropylene **Occasionally recycled**		Lunch boxes, plastic cup, automobile parts, yogurt pots, syrup bottles, prescription bottles.	Wastes Storage Recycling program
High Density Polyethylene **Commonly recycled**		Milk containers, motor oil, shampoos, liquid soap bottles, detergents, shopping bags and bleaches.	Wastes Storage Recycling program Recycling Centres	Polystyrene **Commonly recycled**		Coffee cups, plastic food boxes, plastic tools.	Wastes Storage Recycling program
Polyvinyl Chloride **Sometimes recycled**		Plumbing Pipes, electrical cable, roof sheeting.	▪ Synthetic timber or plastic timber makers Construction dump	Polycarbonate, Styrene Acrylonitrile, Acrylonitrile Butadiene Styrene. **Difficult to recycle**		Baby bottles, compact discs, construction industry, compact disc and medical storage containers.	Wastes Storage Recycling program
Low-Density Polyethylene **Sometimes recycled**		Cling-film, sandwich bags, squeezable bottles, storage box, toys and plastic grocery bags.	Wastes Storage Recycling program Recycling Centres				

(Sources: M. Tsakona & I. Rucevska, (2020); ASTM (2020); Ministry of Housing & Local Government Malaysia (MHLGM), (2011)

Table 1.2: Wastes composition in Asian Countries

	Waste Types [%]					
Country	**Organic**	**Paper**	**Plastic**	**Glass**	**Metal**	**Others**
Malaysia	45.0	7.0	24.0	3.0	6.0	15.0
Singapore	44.4	28.3	11.8	4.1	4.8	6.6
Thailand	48.6	14.6	13.9	5.1	3.6	14.2
China	35.8	3.7	3.8	2.0	0.3	54.3
Hong Kong	37.2	21.6	15.7	3.9	3.9	17.6
Indonesia	70.2	10.9	8.7	1.7	1.8	6.2
Japan	17.0	40.0	20.0	10.0	6.0	7.0
Laos	54.3	3.3	7.8	8.5	3.8	22.5
Myanmar	80.0	4.0	2.0	0.0	0.0	14.0
South Korea	31.0	27.0	6.0	5.0	7.0	23.0
Philippines	50.0	12.0	25.0	3.0	5.0	5.0

(Source: 9th Malaysian Plan (2005), Mendes & Imura (2004), ADB (2003); NSWM (2011)

According to MHLGM, (2011), four plastic wastes separation should be taken before recycling: the first actions are *Easy Plastics to Recycled* - the easiest and most common plastics to recycle are made of polyethylene terephthalate (PETE) and High-Density

Polyethylene (HDPE) and are assigned the number 1 and 2. ii) *Plastics Less Commonly Recycled* -Polyvinyl chloride commonly gets number 3, 4 (low-density polyethylene) and 5 (polypropylene). Few municipal recycling centres will accept it due to its very low rate of recyclability. iii) *Useful Plastics to Recycle* - Number 6 goes on polystyrene (Styrofoam) items. It is widely accepted because it can be reprocessed into many items, including cassette tapes and rigid foam insulation. iv) *Hardest Plastics to Recycle* - Last, but far from least, are items crafted from various combinations of the plastics or from unique plastic formulations not commonly used with assigned a number 7 and instead put the burden on the makers to recycle or dispose of the items properly.

2.2 Plastic Wastes Management System

Beginning in 1950-1980, the main practice for the plastic waste management was either waste disposal in landfills or open burning. In the 80's, recycling and incineration were introduced as a treatment method for plastic waste minimization to address the environmental and health effects of unregulated waste. Accordingly, the plastic waste minimization has steadily increased and has already reached 19%, and 25% (M. Tsakona and I. Rucevska, 2020).

Geyer (2020), has estimated that globally around 343 million tonnes of plastic waste is generated every year. According to M. Tsakona and I. Rucevska (2020), 12% has been incinerated, 9% recycled, and about 60% were disposed of in landfill. Depending on the place of origin, plastic waste constitutes a significant proportion of solid waste composition. In the UK, plastic made up 7% of the MSW while in the USA it was 11%. In the Gulf and East African regions, the average composition of plastic wastes was 11.4% and 10%, respectively. (Al-Maaded et al., 2012; Oyake-Ombis et al., 2015). Amongst Asian countries Japan generated 20% of Japan's solid waste consisting of plastic, China 13% and 6% in Korea. Malaysia is the highest Asian generator of plastic waste with 24 % (Visvanathan et al., 2007). The use of plastics in Asia reaches 20 kg per person/year and is expected to continue to increase from year by year. Compared to other continents, Asia consumes about 30% of plastic in the world followed by the United States and Europe.

The three common forms of waste collection include curbside collection, drop-off recycling and buy-back centres. The most widely accessible, collection method is curbside collection of recyclables. Communities that provide curbside collection generally request residents to separate designated recyclables from their waste generated. The second collection method is known as drop-off recycling. In this method, containers for designated recyclable materials are placed at central collection locations throughout the community, such as parking lots, commercial areas, housing areas or schools. MHLG provided every participant with special drop-of containers for recyclables and these containers must be placed at strategic locations of the municipalities. The next collection method is buy-back centres. Most buy-back recycling centres are operated by private companies to pay for recyclable materials that are bought from consumers.

The waste collected consists of several components such as aluminium, minerals, glass, paper, stone, etc., which are basically required separation techniques that can effectively distinguish plastics. In Malaysia, there are three types of recyclables such as paper, plastics, and bottles, but very little of the waste is recycled.

Plastic segregation is the first step in recycling plastic waste after waste generated, waste collection and waste separation. They will be shredded, agglomerated, extruded, granulated and cleansed of non-plastic impurities after done their segregation. Plastic segregation is necessary for recycling; because we need to clean and prepare materials and is also often a cheaper and easier method to apply before going to landfill. Each type of plastic such as Polyvinyl Chloride (PVC), High Density Polyethylene (HEPE); Polyethylene Terephthalate (PETE) must be segregation because mixing will make the reprocessed plastics unusable, maintaining the integrity of the product or have a negative impact or will be of lower grade than the original.

The most challenging task during the plastic waste management is the waste separation from the municipal waste because it is better for the environment and human health. The Ministry of Housing and Local Government (MHLG) re-launched the recycling programs in December 2000. Basically, the 3'R concept refers to reduce, reuse and recycle on how to

manage plastic waste properly. Waste reduction includes the reuse of materials, refusing to provide bags at stores, using cloth diapers, and stopping junk mail deliveries, there is an evident need of reducing our usage of plastic. This is when products/items are still useful and have a utility or value for being used (Agamuthu, 2001) again instead of being disposed of. Many components of MSW can be recycled for use as recycled materials and remanufacturing.

Plastic recycling is a process to change plastic waste materials into new products by increasing waste minimization. Before any plastic waste is recycled, it needs to go through several processes; i] Sorting: Each plastic waste must be sorted by types, for easily processed according to the convenience of the shredding machine; ii] Washing: After sorting, the plastic waste should be properly washed to remove all impurities to maintain product quality before they are further processed; iii] Shredding: After washing the plastics waste, the next step is shredding the plastics into tiny small chunks or pieces, preparing for recycling; iv] Classification of Plastic: The separation process helps in ensuring that the different plastics are not put together or mixed up in the final product because to determine their quality and class. Remember that different plastics are used to make different items; v] Extruding: This involves shredded plastic so that it can be extracted into pellets and thus the product; vi] Making of pellets: The plastic pieces are then compressed into tiny pellets known as nurdles. In this state, the plastic pellets are ready for reuse or be redesigned into new plastic products.

Waste that is not recyclable is disposed of either through landfill or incineration. Incineration is an efficient way to reduce the waste volume and demand for landfill space. Incineration refers to the combustion of waste in the presence of oxygen at a very high temperature of about 8000°C and above (Avinash A. Patil, et al., 2014). Net energy yield depends upon the density and composition of the waste. The heat generated during this process is utilized for the electricity production via steam generation. 'Smart incineration' of plastic waste, such as done largely in developed countries including the UK, Sweden and the Netherland, would bear a lower burden in terms of its CO2 emissions and would prevent dirty incineration (burning plastic in the open air) that may take place in developing countries (B. Heubl, 2019). However, in terms of global warming potential researchers have found that incinerations of plastic waste packaging are hazardous to the environment, exhibiting the highest pollution (K.N. Yogalakshmi & S. Singh, 2020; Hussein I, et al., 2018; R.K. Singh & B. Ruj, 2016).

Landfill site also known as dumping ground is a site for the last method of waste management technique to dispose of plastic. Plastic is going into landfill in enormous amounts. Although landfill is the most widely used method, it will lead to groundwater and release of gas emissions that will threaten the environmental quality due to the formation of toxins. The rate of decomposition is dependent on the amount of moisture that enters the land fill. While this happens, this method is still used as a cheaper disposal method.

However due to high volume to weight ratio, appropriate landfill space is becoming scarce and expensive, so other methods of plastic waste management should be preferred. Similarly, for example, data observed from a Bakri (in southern state of Johore) area landfill revealed that the composition of disposed waste comprises of 9-12% volume of various type (film, foam and rigid) of plastics, while solid waste stream in Kuala Lumpur and Penang contain 15 and 11% plastic waste volume, respectively (Saeed et al. 2009; Kalanatarifard & Yang, 2012). A more recent investigation revealed that the content of plastics in the solid waste stream of Kuala Lumpur was as high as 21% (Budhiarat et al., 2012). It was estimated that if current of solid waste streams persists, plastic will make up to 24% of Malaysia's MSW content (Abd Manaf et al. 2002; Zena et al., 2014). Figure 1.2 shown summary of narration solid waste management.

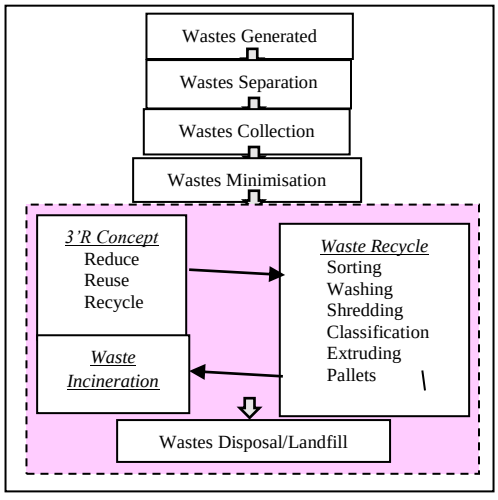

Figure 1.2: Plastic wastes management system

Malaysia, like every other developing country, is facing the problem of waste management. However, an integrated and organised recycling programme in Malaysia is still lacking (Sakawi, 2011). The main objectives are to reduce the costs of solid waste management/operation as well as to conserve resources. Despite the government's efforts the implementation of 3'R (Reduce, Reuse, Recycle) policy in Malaysia was considered as a failure due to weak households' commitment (Abas and Wee, 2014). Even the 'No Plastic Bag Day Campaign' to reduce plastic bag consumption and save the environment were met with mixed lukewarm reactions and scepticisms by the public, retailers, and the plastic industry as being not consumer friendly despite their high self-claim awareness of the campaign (Zen et al., 2013). Nationwide, only 17.5% of Malaysian households were practicing recycling (Dinie and Mat Don, 2013).

In Malaysia, the wastes disposal method practiced is through landfill (Manaf et al. 2009; Yusof et al. 2009) and most of the sites are open dumping areas (Manaf et al. 2009). Open dumping landfill is preferable due to it being the cheapest cost (Ngoc and Schnitzer. 2009). As a result of practicing landfill methods in Malaysia, leachate could affect the quality of river water (Yusof et al. 2009). Waste collection almost covers all communities in urban areas, but only about 66% of the populations in rural areas of Malaysia are covered (Hamatschek 2010). As a consequence, in rural areas, wastes being dumped on the streets and drains. This situation brings serious environmental and social threats like flooding, breeding of insects and rodent vectors and the spread of diseases (Zurbrugg, 2002). There are many ways to beat the plastic pollution such as reduce single-use of plastic in daily life especially straws and plastic wrap, use recyclable shopping bags, avoid products containing plastic microbeads by looking for "polyethylene" and "polypropylene" on the ingredient labels of your cosmetic products and recycle recyclable plastics (Abdullah, 2018).

3.0 DISCUSSION

Due to its versatility and low-cost features, plastics usage has increasingly replaced glass, metal and natural fibers in becoming the material of choice for most modern households (Ghayebzadeh et al (2020). In Malaysia for example the packaging segment used 48% of plastic, an increase of 8% over a decade earlier (Khazanah Research Institute, 2019). This is attributed partly to the increase in consumption of processed foods and consumer preferences for online shopping. This unfortunately will result in more plastic ending up as wastes in municipal landfills and dumpsites and increasingly found their ways into waterways and the ocean.

Critical of this issue is the impact of plastic waste disposal to the environment and human health, notwithstanding of the disposal methods. High income countries export plastic wastes to low income countries as part of their solution to reduce plastic waste. However, research

suggests that this is not a viable and sustainable solution, rather it has become part of a global problem of encouraging plastic consumption in the exporting countries (Barnes, 2019).

Malaysia's capability to recycle plastic waste is generally limited to only three of the seven types of plastic wastes namely polyethylene terephthalate (PET/PETE), high-density polyethylene (HDPE) and polypropylene (PP). The huge amount of low-quality plastic wrappers and packaging, however, are not recycled and end up in landfills. Another challenge to combating plastic waste is attributed to the poor law enforcement in a number of areas. These include enforcement on illegal recycling factories, household waste segregation and the plastic straw ban (Khazanah Research Institute, 2019). Prior to 2007, there are no established provisions in the legislations that specifically manage solid waste including waste recovery and recycling and this posed a challenge to waste management in the country (Moh & Latifah, 2014). It is only after the enforcement of Act 672 which introduced mandatory waste separation at source that the nation saw gradual improvements in recycling rate in the country. Even though recycling rates in the country have improved annually (28% in 2018, the rate is still low compared to developed countries such as Singapore (61%) and the United Kingdom (44%). What is more worrying is the fact that plastic recycling contributed to less than half of recycling rate in the country (Figure 1.3). Added to these woes is the still low environmental awareness and mentality among Malaysians. In 2000, the National Recycling Program, in which the 3R – "Reduce", "Reuse" and "Recycle" theme was introduced and an annual event was held to encourage recycling among Malaysians. This however proved a critical challenge as the programme failed to inculcate 3R habit (Moh & Latifah, 2014; 2017).

Table 1.3: Recycling rate in Malaysia, 2013-2018

	2013	2014	2015	2016	2017	2018
Plastic Recycling Rate	3.0%	4.5%	7.4%	8.0%	11.4%	-
Total Recycling Rate 1	3.2%	15.7%	17.5%	21.0%	24.6%	28.0%

(Source: Khazanah Research Institute (2019)

In line with the United Nation's Sustainable Development Goals which aimed at promoting sustainable development by balancing economic growth with environmental protection, the Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC) has introduced the country's policy guideline 'Roadmap Towards Zero Single-Use Plastics 2018-2030' (MESTECC, 2018) (see Table 1.3). This guideline aims to guide all relevant stakeholders to promote environmental sustainability by eliminating the use of single-use plastic by 2030 and encouraging the plastic industry to transition to eco-friendly products. The highlight of this roadmap is the introduction and ultimately the large-scale implementation of biodegradable alternatives to plastic use among Malaysians. This programme if implemented successfully, could become the cornerstone to guide Malaysia to become a more environmentally sustainable nation.

Table 1.4: Summary of MESTECC's roadmap towards zero single-use plastics 2018-2030

	Initiatives and Plans
Phase 1 (2018-2021)	Review existing laws and develop legal frameworks. Nationwide implementation of pollution charge at a minimum of RM 0.20 for plastic bags. No straws given to customers by default. Plastic straws only given on request. Communication, education & Public Awareness (CEPA), Programs nationwide.
Phase 2 (2022-2026)	Biobag to replace plastic bags. No straw by default practice continues. Expand to more biodegradable and compostable products (food packing, cutleries). Research & Development (R&D) funding on eco-friendly substitutes. Introduction of legal framework on single-use plastic. Levy to be imposed on plastic bag manufacturers.
Phase 3 (2026-2030)	Substantially increase the volume of production of biodegradable and compostable alternatives. In 2030, an implementation report will be published.

(Source: Adapted from Khazanah Research Institute (2019), MESTECC (2018)

The government has gazetted adequate laws and regulations to strengthen the waste management system in the country, including on waste recycling. Critical to the success of waste recycling, including plastic waste however, is strict enforcement by the state and local authorities of Act 672, especially those involving source separations. This would entail proper enforcement and assignment of responsibilities to the relevant authorities and agencies (Khana et al, 2019). Additionally, it also requires good cooperation and coordination between agencies and service providers to ensure effective implementation of the Act at all levels of waste management operations from the governments to recycling center operators to the households.

Nevertheless, implementation of stringent laws and enforcement seems effective for the short run. Stronger emphasis should be placed on environmental awareness among citizens to ensure the longer-term success of the fight against the mounting plastic waste in the country. Previous research acknowledged this where the level of awareness and understanding on recycling household waste is positively influencing citizen participation in taking up recycling waste, including plastic waste (Moh & Latifah, 2017; Mwanza & Mbohwa, 2017). To complement the awareness programme, continuous waste recycling education among consumers and citizens from all age categories should be made an important long-term agenda in the waste management program. This way, the recycling habit would be expanded to citizens across the socio-demographic spheres.

4.0 CONCLUSIONS

To date, plastic is always seen as the preferred material in the years to come for household and industrial products and packaging due to its versatility and inexpensive features. It is however causing mounting global pollution problems that need to be addressed in a sustainable manner. Being a global player in the plastic industry, Malaysia is taking the plastic waste problem seriously through a combination of measures (regulations, awareness, and education) to effectively minimise plastic waste impacts to the environment. The implementation of these measures requires the cooperation and participation from all stakeholders including the government, private sectors, and more importantly the public who are the end-users of most plastic products. Continuous commitment from these stakeholders are essential to achieve Malaysia's advancement towards a zero-waste nation.

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