Sanitary Landfill is a Solution in Solid Waste Management or a Silent Threat to Environment: Malaysian Scenario

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Abstract

In Malaysia, the population is increasing at a rapid rate reaching 32.6 million in 2019. This has resulted in a tremendous amount of solid wastes being generated which was estimated as about 38,200 tons per day (1.12 kg/cap/day), in 2018 enough to fill the Twin Towers every seven days. 82.5% of which is disposed of in landfills. If not managed properly landfills can cause detrimental effects to environment, humans and aquatic world. Most of the landfills in Malaysia are lagging with adequate facilities. This paper encompasses the sections of history of solid waste management in Malaysia from 1970 to present, followed by some alarming and dreadful cases of pollution due to ill management of landfills and lastly some of the substantial measures to combat with the acute problem of solid waste focussing on the responsibilities of government, manufacturer and user. Whether it be creating awareness among people and implementing laws,3R strategy or thinking before throwing all play vial role in solid waste management. Collective and consistent effort is essential to achieve Malaysia's targeted recycling rate of 22% by 2020 and hence achieving Malaysian vision with greater advancement towards a zero-waste nation.

Keywords: *solid waste; landfill; leachate; pollution; recycling*

1. Introduction

The transformation in economic globalization and emerging technologies has resulted in the increasing amount of solid waste with urbanization and population increase. The facts which illustrate the magnitude of challenged associated with waste shouldn't be overlooked. Every year an estimated 1.3 billion tonnes of solid waste are collected worldwide. The quantity of solid waste was expected to reach 2.2 billion tonnes per year by year 2025 with almost the increasing were from developing countries [1]. Malaysia is not excluded in this transformation era; hence this broad transformation is changing the ways how Malaysians live, think and act.

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In Malaysia, the population is increasing at a rapid rate reaching 32.6 million in 2019. This has resulted in a tremendous amount of solid wastes being generated which was estimated as about 38,200 tons per day (1.12 kg/cap/day), in 2018 enough to fill the Twin Towers every seven days. 82.5% of which is disposed of in landfills.The tremendous trend on the increasing of solid waste generation led to the potential threat to the environment, society and economic losses as the dependence on the landfill as the main disposal method which is particularly causing serious environmental problems such as soil contamination, leachate, gas emission, and air pollution [2]. Proper solid waste management present an opportunity not only to avoid the detrimental impacts associated with waste, but it can recover resources, environment, economic, social benefits which towards to the sustainable future. National development plans and solid waste management plans in Malaysia are compiled (figure 1) to provide a timeline of Malaysia's solid waste management from the late1970s to the present.

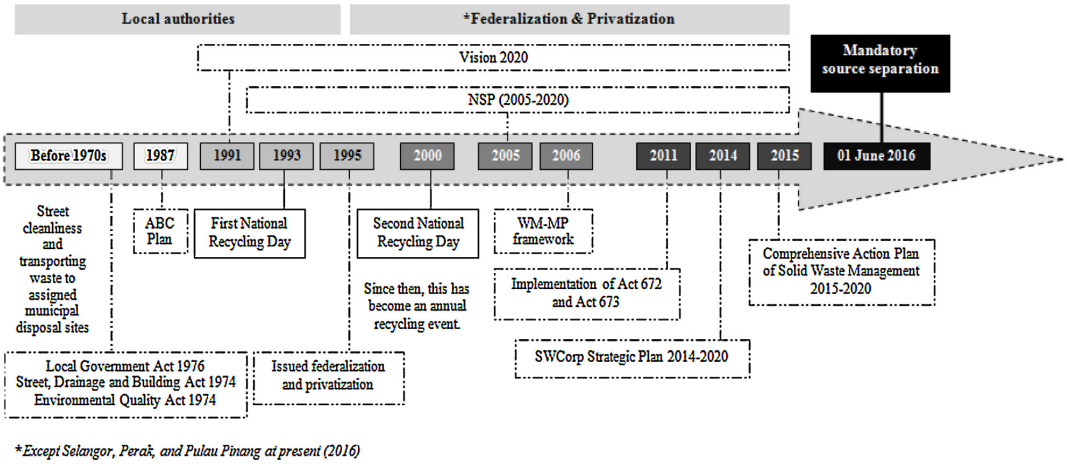

Figure 1. Solid Waste Management Policies and Plans Transformation in Malaysia.

In the recent years, solid waste minimization strategies particularly in recycling has seem to be noticed as a solution in reducing the solid waste generation. Thus, the Malaysian government has taken initiative by force the Solid Waste Management and Public Cleansing Act 2007 (Act 672) [3] by mandatory of solid waste separation at source in September, 2015 in order to reduce the solid waste at the disposal site and encourage solid waste separation at source among the householders. However, Malaysians are still sporadic and sceptical on the benefits of recycling practices as the recycling rate in Malaysia was 17.5% in 2016 which still far from the target of 22% by year 2020 [4]. Solid Waste Corporation (SWCorp) report has stated that the recycling rate was still lower compared to other developed countries which have reached more than 40% such as Singapore 59%, Korea 49%, Taiwan 60% and developing countries within Asia where recycling rate about 30% to 47% [5],[6].

1.1. Landfills

Landfill is the most common MSW disposal method due to the simple disposal procedure, low cost, and landscape-restoring effect. The primary objective of the landfill site design is to provide effective control measures to prevent negative

effects on surface water, groundwater, soil and air. For final dumping of solid waste, the landfill is the most efficient way to settle the collected waste.

Approximately 82.5% of waste collected is disposed at these dumping sites and the other negligible portion is treated, reprocessed, or dumped illegally [7]. There are issues related to lack of funding to upgrade the landfill sites, lenient enforcement in issuing contravention licenses as well as lack of compliance in the Housing and Local Government Ministry's 1990 Technical Guide-lines on Sanitary Landfills, Design and Operations, which proposed that all new landfills are at Levels III and IV with anti-pollution features, as shown in Table 1.

Table 1. Classification of landfill sites in Malaysia *(Moh & Manaf, 2017)* [8]

Levels		Available facilities
I	Controlled dumping	Minimum infrastructure (fencing and perimeter drains)
II	Sanitary landfill with daily cover	Class I facilities (with gas removal system, separate unloading and working area, daily cover and enclosing bund (divider constructed as the embankment of different waste cells)
III	Sanitary landfill with leachate circulation	Class II facilities (with leachate recirculation system allowing the collection, recirculation and monitoring of landfill leachate)
IV	Sanitary landfill with leachate treatment	Class III facilities (with leachate treatment system)

Table 2 reveals the current number of operating and non-operating solid waste disposal sites in Malaysia. Non-sanitary landfills are constructed without proper engineering plan and land-fill bottom liner system. While operating open dumps are being phased out, since 2007, the operating controlled dumps undergoes upgrading to Class IV category with respect to the Solid Waste and Public Cleansing Management Act 2007 [3].

Table 2. Number of operating and non-operating solid waste disposal sites in Malaysia (*Moh & Manaf, 2017*) []

Size	Operating non-sanitary landfill sites	Operating sanitary landfill sites	Non-operating landfill sites	Total
Johor	12	2	23	37
Kedah	8	1	6	15
Kelantan	13	0	6	19
Melaka	2	0	5	7
Negeri Sembilan	7	0	11	18
Pahang	16	0	16	32
Perak	17	0	12	29
Perlis	1	0	1	2
Pulau Pinang	2	0	1	3

Sbah	19	0	2	21
Sarawak	46	6	14	66
Selangor	5	4	14	23

Table 2. (*Contd.*) Number of operating and non-operating solid waste disposal sites in Malaysia (*Moh & Manaf, 2017*)[8]

Size	Operating non-sanitary landfill sites	Operating sanitary landfill sites	Non-operating landfill sites	Total
Terengganu	8	0	12	20
Federal Territory of Kuala Lumpur	0	0	7	7
Federal Territory of Labuan	1	0	0	1
Total	157	13	130	300

2. Waste management acts and regulations in Malaysia (Historical background)

1970s, the government had introduced a series of acts, ranging from the street cleanliness to waste management transportation and to municipal disposal sites assignation. The acts that were early introduced consist of the Street, Drainage and Building Act 1974, Environmental Quality Act 1974 and Local Government Act 1976.Next, in the year 1988, Malaysia established the Action Plan for Beautiful and Clean (ABC Plan) country, a management system for solid waste that includes every state of Malaysia. Moreover, this ABC Plan is economically and environmentally friendly and should be easily accepted by the community [9]. Under the supervision of Tun Dato Seri Dr Mahathir bin Mohamad as the 4th Prime Minister the Sixth Malaysian Plan was introduced in 1991. He also structured Malaysia to come out with the Vision 2020, a vision that plans for the nation by the year of 2020 to be a fully developed country. Respectively, the ABC Plan leads to the recycling program first in the year 1993 and secondly in the year 2000. Started from November 11, 2000, the National Recycling Day was proclaimed to be an annual event for Malaysia. The recycling program encourages households to practice 3Rs habit, that comes with the tagline "*Think before you throw*".

From the year 2000, the government had started to govern the management of solid waste by federalisation and privatisation. As privatisation was considered it consisted of three fundamental private bodies, that were Environment Idaman Sdn Bhd (E-Idaman Sdn. Bhd.), Southern Waste Management Environment Sdn. Bhd (SWM Env Sdn. Bhd) and Alam Flora Sdn. Bhd. These three private bodies respectively covering Peninsular Malaysia which E-Idaman Sdn Bhd responsible in managing Kedah and Perlis, meanwhile SWM Env Sdn Bhd covering Negeri Sembilan, Melaka, and Johor and lastly, Alam Flora Sdn Bhd for Kuala Lumpur, Putrajaya, and Pahang that eventually take over the states of Kelantan and Terengganu. Besides Sabah and Sarawak, the states of Selangor, Perak, and Pulau Pinang still managed by the local authorities for the management of solid waste. National Strategic Plan (NSP) that was formulated in 2002 and implemented in

2005, planned to be used until the year 2020. NSP adapted the Waste Management Hierarchy concept, that started from the most desirable option to the least desirable option, which is first to reduce, secondly re-use, thirdly recover, fourthly treatment, and last option disposal. The NSP Plan considers the solid waste management facilities that stated under the NSP framework.

In 2006, as a part of NSP framework, the Waste Minimization Master Plan (WM-MP) was introduced. WM-MP focus was to standardise the government, private, and public level waste management. The Solid Waste Management and Public Cleansing Act [3] was introduced in the year 2007. This act applies to Peninsular Malaysia and the territories of Putrajaya and Labuan. The member of the Solid Waste Management and Public Cleansing Corporation will appoint a Head Director that will be assigned to be the leader for each department. Head Director have the authority to come out with new policies, plans and strategies about the management of solid waste especially regarding Act 672. Head Director will perform Act 672 and provide license and approvals for respective corporation to manage solid waste such as the SWCorp and Alam Flora Sdn. Bhd. The Solid Waste Management and Public Cleansing Act 2007, Act 672 stated that nobody can manage the solid waste facilities without the approval of Head Director. Further explanation of the roles of the Head Director is stated in Act 672, Part II.

Malaysia also established The Waste Management Association of Malaysia (WMAM), a professional association founded in March 2005. WMAM plays the role to maintain towering standards in waste management services in Malaysia. The WMAM is a non-profit organization that provides a technical and educational forum that serves as the platform in discussing issues regarding management of waste. The objective of this association is to keep the relationship between the international and local waste management related organisations. In fact, Malaysia has put waste management as a priority action when the government, through The Solid Waste Management and Public Cleanliness Corporation by launching the Separation at Source Initiative (SSI) under Solid Waste and Public Cleansing Management Act 2007 (Act 672), that started to be effective by September 2015. This act aiming for the residents and retailers to separate waste in their dwelling. The household now is compulsory to separate waste in their dwelling. There are two federal territories and six states where SSI policy being implemented, that include Kuala Lumpur, Putrajaya, Pahang, Johor, Melaka, Negeri Sembilan, Kedah and Perlis. This is because the three major private concessionaires that manage the federal territories and states which are E-Idaman Sdn Bhd, SWM Env Sdn Bhd, and Alam Flora Sdn Bhd all have agreed on the Separation at Source Initiative (SSI) programs that falls under Act 672. As stated by National Solid Waste Management Department (NSWMD) under the Ministry of Urban Wellbeing, Housing and Local Government, the implementation of SSI is part of the government efforts to improve the recycling behaviour which will significantly decrease the amount of solid waste delivery to the landfills. The practice of waste separation at source by households is very helpful in decreasing the amount of solid waste delivered to landfill, thereby helping to expand the life of the landfill[10].

3. Case studies at distinct locations directly or indirectly related to ill management of solid waste disposal or landfills

3.1. Landfill pollutants leaching into sea (*The Star Online*, 16 Sep 2019)

Fish farmers near Penang's Pulau Burung sanitary landfill are blaming the facility for emitting pollution that harms their cage-bred fish. There are about 150 fish farms, forming one of the largest clusters of floating fish farms in Malaysia, and they are located 2km from Penang's only sanitary landfill.

The fish farms produce 20,000 tonnes of fish yearly, including for export to Singapore and Hong Kong. Fishermen are blaming the landfill for recent fish deaths in their nets and cages and are accusing the landfill which is managed by the Seberang Prai Municipal Council of illegally discharging leachate into the sea. Blackish water was found flowing into the sea, believed to be leachate from the landfill. Shortly after that tonnes of fish floated belly up. The fishermen want the department of environment (DoE) and the fisheries department to conduct an urgent investigation into the effects of the Pulau Burung landfill, which is located 6km northwest of Nibong Tebal, on the coastal waters. The fault likely lies on the material used in the perimeter drains or "bunds", which he claimed were constructed using primitive materials, like red earth, this has led to breeders with fish farms off the waters of Nibong Tebal discovering "tonnes" of dead fish since July. It was reported at least 1,700 to 1,800 tonnes of rubbish is dumped at the landfill on daily basis and at the time of rainfall, the drains are not able to contain the leachate and it leaks out to the sea. If the bund was built using concrete, it could have held back the leachate.

3.2. Johor landfill site's burning causing health alarm to surrounding villagers (*Malay Mail*, 09 Nov 2018)

Dust and smoke from fire at a waste disposal landfill site in Kampung Bukit Dagang Ulu Tiram in Ulu Tiram have been a bane for villagers for the past two weeks. It was learnt that the fire was deliberately carried out by the landfill site operators to eliminate the solid waste collected. Even when it's raining, smoke from the landfill continues to come up as the fire is not easily extinguished, affecting the health of surrounding residents due to the constant burning in the soil of the landfill. *Malay Mail* reported that 2,000 metric tonnes of scheduled waste containing arsenic from Singapore, brought in by a Johor waste disposal company, is being dumped at a landfill in the Sungai Tiram area on monthly basis. The illegal activities were earlier uncovered by a team from the Johor Department of Environment (DoE), where the source was traced to the solid waste disposal company here. There are more than 60 homes in Kampung Bukit Dagang Ulu Tiram that are affected by the burning at the landfill.

3.3. Leachate contamination must be addressed (*The Star Online*,10 Jul 2017)

The serious and recurring issue of leachate contamination needs to be addressed with an improvement in the design specifications and location of landfills in the country. *Bernama* reported that six solid waste landfills were found to have serious and recurring leachate contamination issues. The six are the former ones at Taman Beringin, Kuala Lumpur; Pajam, Negri Sembilan; Sungai Udang, Melaka; Pulau Burung, Penang; Tanah Merah Estate, Negri Sembilan; and CEP Simpang Renggam Estate, Johor. Monitoring by the DOE revealed that the pollution was due to the design of the landfill and existing leachate treatment system that was less efficient

compared to the increasing volume of solid waste received. The collapse of retention ponds caused the sediment discharged to flow into nearby rivers and damage the equipment or components at the landfill, which is part of the pollution control system. The DOE had taken enforcement action in 74 instances against those responsible for managing the six landfills, including issuing directives, compounds and taking court actions. Cases of non-compliance were investigated under the Environmental Quality Act 1974, involving a fine not exceeding RM500,000.

Also a jail term of not more than five years or both, and an additional fine of RM1,000 for each day the offence was continued, in accordance with the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015.The penalty for violations of the Environmental Quality (Control of Pollution From Solid Waste Transfer Station And Landfill) Regulations 2009 is a RM100,000 maximum fine or jail term not exceeding five years, or both, and a subsequent fine of up to RM1,000 for each day the offence is continued, upon conviction. The Government would not compromise, and stern action will be taken against those found to have polluted the environment.

3.4. Greenpeace Malaysia: Country has become the world's rubbish bin (*The Star Online*, 27 Nov 2018)

Malaysia has become the world's rubbish bin. The US, Japan and the Britain are the three biggest plastic waste exporters to Malaysia, accounting for 53% of the 754,000 tonnes of plastic waste the country imported from January to July 2018 which is equivalent to approximately "*100,000 large elephants"*. However, only 9% of this plastic waste are clean plastic that can be recycled the remaining 12% of plastic waste are incinerated and 79% end up in landfills or dumped in natural environment. According to data from the National Solid Waste Management Department cited by Greenpeace Malaysia, the US is the highest plastic waste exporter, followed by Japan, Britain, Germany, Hong Kong, Australia, Belgium, Spain, Estonia and France. Greenpeace Malaysia revealed the data in its "*The Recycling Myth*" report uncovering regulation violations in plastic waste disposal. Working with Kuala Langat Environmental Protection Association (KLEPA), Greenpeace Malaysia's investigation of plastic recycling factories in Kuala Langat found plastic waste from over 19 countries. KLEPA reported that illegal plastic recycling factories are producing solid waste, and its water pollution has forced fish and prawn farms to stop operations. Even if we avoid the dumping grounds and install water filters, we cannot avoid the acid smell in the air, reported by environmental NGO Peka (Pertubuhan Pelindung Khazanah Alam Malaysia). Villagers are developing chronic respiratory diseases from the open burning of unrecyclable waste. In its report, Greenpeace Malaysia welcomes the government's decision to permanently ban the import of plastic waste but urge for stronger policies to also control the import of clean plastic waste and also that instead of fixing the plastic waste imports regulations, the government should encourage domestic recycling industry and promote circular economy.

3.5. Malaysia is overflowing with waste and we're running out of options (*The Star Online*, 16 Jul 2019)

Malaysia has become a dumping ground for all sorts of wastes. The media is littered with reports of illegal dumping, whether of plastic, chemical or construction

waste, e-waste or even plain old rubbish. One must go to illegal landfills in towns like Jengjarom, Kulim and Sg Petani to see the severity of the problem and pictures of the mounds of trash in these small towns in Selangor and Kedah have made their way to international media. The scandal of plastic waste being dumped by First World nations in Malaysia and other developing countries dramatically grabbed world headlines earlier this year. However, it overshadows the fact that we Malaysians have been dumping our own waste into drains, rivers, empty plots of land, the sea or even other people's backyards for decades.

This isn't to say that Malaysia lacks laws; we enacted the Environmental Quality Act all the way back in 1974, and it's being amended with heftier penalties of up to RM5mil in some pollution cases.

3.5.1. Cheaper to dump than recycle

An expert in solid and hazardous waste management at Universiti Malaya's Science Faculty, Prof Dr P. Agamuthu, says a combination of reasons leads to dumping. Some of the wastes are expensive to recycle or there is no technology for recycling it, especially chemical waste. As for construction waste, it is bulky and costly to throw into a landfill and hence, the way out is to dump illegally. Similarly, cost is also one of the reasons why foreign waste has been arriving on our shores in increasing amounts. It is simply cheaper to send plastic waste to developing countries than process it within, this is why countries like Japan, the United States and Germany, as well as the rest of the European Union, which supposedly have better technology, send plastic waste thousands of kilometres away by ship to be dumped into Third World landfills. And then there's the problem of exposing workers in developed countries to health risks from recycling processes and we know that *Asian lives have always been cheaper*. Another reason for the dumping is these countries' small market for recycled plastics; by law, recycled plastics cannot be used to manufacture medical equipment or food containers. What's more, oil's current low price means that it's often cheaper to produce virgin plastics than to recycle. Ultimately, only 9% of the 4.9 billion tonnes of plastic produced since the 1950s has been recycled, according to a study by the University of California, Santa Barbara; 12% has been incinerated.

3.5.2. No more room

Even waste that is correctly disposed of in landfills is becoming an issue now because Malaysia's landfills – the legal, properly managed ones, anyway – are already nearly full, laments Prof Agamuthu. We simply generate too much waste ourselves, while the imported waste just exacerbates problem. "*Bata*" (buy and throw away, not the shoe brand) culture that has evolved as we grow richer and more developed. Recent studies show that 11% of the (38,000 tonnes of) waste generated in Malaysia daily comprises diapers alone. Imagine, more than 4,000 tonnes of diapers generated and thrown away, when compared with less wasteful ways of the previous generation when cloth diapers would be washed and re-used for babies, and drinks came in glass bottles that were collected back by retailers. We throw trash out without giving it much thought, so long as it gets collected by the garbage collectors. Where does the trash go? Landfills? Malaysia only has a handful of landfills which are classified as sanitary. The rest are dumpsites with little or no treatment for leachate or the capture and destruction of landfill gas which

is 50% methane (a greenhouse gas); they don't even have a soil cover to prevent odour and disease vectors like rats and flies. Also, these sorts of landfills catch fire due to the methane gas, especially during hot weather. Many of these dumpsites have been closed and the rest have a remaining lifespan of between three months and three years. New landfills are not welcomed by the public due to the "*Nimby"* (Not In My Back Yard) syndrome as well as the problems associated with foul odours and flies.

3.5.3. The '*Tidak Apa*'(uncaring) attitude

While the recycling rate across the country has gone up to 24.6% in 2018 from 21% in 2017, this is still far below world leader Germany where the rate is between 52% and 56%. In fact, a recent YouGov poll showed that Malaysians continue to lap up plastic straws: one in five respondents used at least one daily and one in 10 admitted to using straws several times a day. Waste management infrastructure and its maintenance is just as important as any other basic public amenity and an appropriate budget must be set aside for it. Appropriate policies and regulations must be established to facilitate the development of sound waste management practices, adding that there must be incentives support recycling and it should be sustainable. At the end of the day, a sense of responsibility and environmental awareness is also important. Malaysians tended to be lackadaisical about cleanliness, particularly if an area or a river is already considered polluted or dirty. If the river is already dirty, (there is a) just throw-lah attitude. Lack of environmental consciousness coupled with weaknesses in enforcement has led to a "tidak apa" (uncaring) culture among Malaysians when it comes to dumping. It is believed that myriad factors, from human behaviour to greed and a sheer disregard for Mother Nature, have contributed to the poisoning of our water courses and environment,"

3.6. Jalan Gombak residents claim illegal landfill in KL causing air pollution (Malay Mail,17 Jun 2019)

About 1,000 residents in Kampung Kuantan, Jalan Gombak near here must endure air polluted by a nearby landfill believed to have been operating illegally for almost two years. It was reported that after an illegal factory was demolished at the end of 2017 the debris were not thoroughly cleaned, causing irresponsible parties to dump rubbish such as construction waste, old furniture and food waste there. As an outcome the foul smell came from the place also smoke emissions took place because of open burning at the site. Such dumping and burning near a residential area is really alarming for the residents as well as authorities.

4. Substantial measures to be taken to control solid waste ill effects

4.1. Solid Waste Minimization through Recycling

Recycling is one of the fundamental parts of the solid waste minimization plan which the most desirable approach in reducing the amount of solid waste generation dumped in the landfill [11]. However, to attain the recycling targets, the solid waste management essentially requires an involvement from the local community as it

largely depends on the household awareness regarding the solid waste recycling issues rather than focused on the local authority responsibility services [12].

4.1.1. Buy back centre/ Drop-off centre

According to Malaysian Standard MS 2303:2010, buy back centre is an initiative whereby recyclables materials are purchased from any person in exchange for an incentive. In this type of recycling centre, the residents are paid for their recyclables either directly or indirectly through a reduction in monthly collection [13].

In addition, there are increasing of accessible recyclables centre in the country which addition 15 recycling centres in Kuala Lumpur, 22 in Selangor operated, and 56 in Pahang operated by Alam Flora Sdn. Bhd in 2009 (NSWMD, 2010)[14]. Meanwhile, drop off centre requires residents to separate recyclables at source and transport them to a specified drop-off or collection centres (MS 2303:2010) [15]. To encourage recycling participants, drop-off centres or collection centres are usually located at convenient places, such as at shopping centres or supermarkets. There are 38 drop off point were introduced to the public with 2,567 recycling cages were provided for high rise residency [16].

4.1.2. Curb side Collection

In this system, source separated recyclables are collected separately from curb side, alley or commercial facility. Using these ways, household do not have to transport the recyclables any further than the curb, and participation in curb side collection centre is normally much higher than drop-off centre. Curb side collections vary greatly within communities which require the residents to separate several materials which are then stored in their own container and collected separately. Thus, there are 599 communities recycle centre or buy-back centre in whole Malaysia and as an effort to encourage household to practices recycling. Statistical records showed that 62 and 1000 recycle bins were distributed respectively in Kuala Lumpur and in the other 13 states of Malaysia as part of the recycling campaign [17].

4.2. Role of Government

The role of local government act as the central steering mechanism brings together government; manufacturer and society viewed as important contribution in reducing the solid waste generation. The local government take the leadership role in develops and support the goal. Solid waste is one of the most principal issues for local government in the country, where most money and efforts are spent in the collection and disposal of solid waste. Thus, the role of local government was crucial as the regulators of waste practices by setting the rules and regulations on how waste was managed efficiently and effectively. In Sabah, municipal solid waste is under the jurisdiction of the respective municipalities' council based on the Local Government Ordinance, 1961 which responsible for the collection, treatment and disposal of solid waste (Anti-Litter By Laws, 1984; Conservancy and Hygiene By-laws, 1984). The municipal council has enforced the Municipal Council (Anti-Litter) By-Laws enacted in 1976 [18], which allows for a maximum compound of RM100.00 as low as RM5.00 to RM 10.00. The enforcement is intention to raise

the people awareness to throw their waste in a proper place and in proper manner. It can be simply stated that *people who pollute will be punished.*

4.3. The Role of Manufacturer

Manufacturer, industrial designer, business sector has significant roles in solid waste management system. It is the industrial responsibility in creating and designing long lasting, easily maintainable and repairable products by reducing packaging and redesign products that are recyclables which encourage their suppliers to use minimal packaging, provide systems for consumers to recycle, and promote products that are environmentally sustainable. The manufacturer should implement the "cradle to cradle" concept in their manufacturing product.

"*Cradle to cradle*" concept describes that a material that begins with resource extraction, moves to product manufacturing then the product recycle into a new product at the end of its life which ultimately there is no waste. Besides that, the manufacturer can invest in innovative design technology which create minimal waste.

4.4. The Role of people/society

Community engagement and participation is the key factor for the success of any solid waste management plans. Society should become an active participation in the resource management system towards solid waste minimization. Solid waste minimization is influenced by the motivated people to change their attitude, behaviour and lifestyle. Society needs to apply *3R (Reduce, Reuse, Recycle)* practices in handling their waste and actively involves in recycling programmes. Limit the consumption of buying new product as it helps to reduce solid waste generation effectively. The community itself needs to change their practice and attitude. It is important that the effort is initiated by the community itself and not depending on the leader or the local government. Their attitude and passion will lead to a better environment in their community.

5. Conclusion

This paper provides brief introduction about the current solid waste management practices and disposal method implemented in Malaysia and the Malaysian history of solid waste management policy and plan strategies since the late 1970s to the present, followed by some alarming incidents reported in different Malaysian regions with their detrimental effects to the environment and the people. Lastly, we have incorporated substantial measures to minimize the solid waste. The most significant transformation in the solid waste management system in Malaysia is the implementation of mandatory source separation under Act 672. Despite the newly launched Separation at Source Initiative (SSI) under the Solid Waste and Public Cleansing Management Act 2007 (Act 672) effective in 2015, Malaysian households still resist in practising waste separation. One of the reasons to explain this matter is the lack of awareness by households towards the significance of waste separation and recycling activities. Substantial efforts by the shareholders such as government, local authorities, manufacturer and society in combat with the solid waste issues. If the regulations are implemented and the attitude of people changes then hopefully landfills can become a solution instead of a threat. Malaysia is

making serious commitment towards solid waste minimization particularly source separation and recycling. Continuous commitment and participation from the government, private sector, and public are essential to achieve Malaysia's targeted recycling rate of 22% by 2020 and hence achieving Malaysian vision with greater advancement towards a zero-waste nation.

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