

Review on Current Municipal Solid Waste Management in Malaysia

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Abstract

Increasing amount of municipal solid waste has causes several issue to communities and environmental. The tributary factors that cause the staggeringly increasing of waste are population growth, speedy urbanisation and industrialization. This paper is to analyse studies on municipal solid waste management within the territory of Malaysia and its impact on implementation of efficient solid waste management. With an increasing of the world population of over 33.4 million in 2020, Malaysian is estimated to generate more than 25,000 metric tonnes of domestic waste per day. To manage the waste effectively, a few SWM legislation and policies been used in Malaysia. This study is to provide an overview of solid waste policy and program in Malaysia in terms of recycling, composting, incineration, landfill and biogas. This study was done by conducting case study approach. The outcomes from this study shows potential, challenges and the benefits for the current municipal solid waste management systems to improvise the current technology applied in Malaysia.

Keywords: Recycling; Composting; Incineration; Landfill; Biogas; Municipal solid waste management; Malaysia

Introduction

Malaysia is a tropical country situated in the central part of Southeast Asia with a total landmass of 328,550 km². The current population is 32,271,546 which is equivalent to 0.42% of total world population. The country is distinct into two regions which are west Malaysia and East Malaysia and consists of 14 states. Malaysia is experiencing speedy evolution on urbanization and population increase. Increase in population has contribute in the rise of the number of solid wastes in Malaysia and has develop into a vital problems (Sin et al. 2013). A quick moving of urbanization and industry modified the characteristics of solid waste generated. Increase in industry, urban migration, affluence, increase in number of population, the travel industry, and a high influx of outside staff or understudies have prompted a tremendous organic procedure that meets up with the improvement of the latest development of the most recent structures for private and mechanical structures, development of open interstates, tourer resorts (Aja & Al-Kayiem 2014).

As urbanization continues, the population is predicted to succeed to 33.4 million by year 2020 and 37.4 million by year 2030 (Chien Bong et al. 2017). Waste composition in Malaysia is consists of municipal solid waste (64%), industrial waste (25%), commercial waste (8%), and 3% of construction waste (Moh & Abd Manaf 2014). The section for MSW generation is directly associated with economic development, rate of industry and public practices of the region has proved that a higher amount of MSW production (Fazeli et al. 2016). As a result, the solid waste management system (SWMS) must be refreshed to suit the waste quality, and the total amount of the waste composition (Manaf et al. 2009).

Generally, solid waste are generated from household, commercial areas, industries, institutions and other municipal services (Alias et al. 2013). The average amount in a day for a person to produce a solid waste is about 1kg in Malaysia which is relatively 26 million people in the country generate 26 million kilos of solid waste in a day (Desa et al. 2012). With an anticipated populace of more than 31 million in 2016, Malaysian creates in excess of 25,000 metric huge amounts of local waste every day. At present, the normal per capita generation of municipal waste in Malaysia is about 0.85 kg/person/day relying upon the financial and topographical status of a region. In significant urban areas, for example, Kuala Lumpur, it is assessed that the waste produce in a day is about 1.5 kg/person/day (Zaipul & Ahmad 2017). Malaysia creates about 0.5–1.9 kg/capita/day of MSW; a sum of the waste generated is about 25,000 tonnes/day of MSW is as for now produced and is evaluated to surpass 30,000 tonnes/day by 2020 (Aja & Al-Kayiem 2014).

Municipal solid waste management (MSW) has turned into a conflict in the advancement of the system around the earth, particularly in the fast developing countries. Reduction of the waste generation is the vital objective as it will cut down the price for clearance of the waste and lower the effect to the earth system and natural resources (Samsudin & Don 2013). Solid waste management is admittedly a global issue. The global cost to manage all the waste is rising from \$205 billion a year in 2010 to \$375 billion by 2025 (Cohen et al. 2015). As an example, most of the waste in China is sent to the landfills but, as the China's landfills are filling up, all the cities have shifted to burning the waste to generate electricity (Cohen et al. 2015). It shows due to the increase in the volume of waste, people in Republic China have taken various initiatives to develop solid waste reduction projects.

The primary obstacle Malaysia needs to deal with is the according of what efficaciously and environmentally to handle the successively piling up waste. These difficulties incorporate deficient assortment, reusing or treatment and uncontrolled removal of waste in the standard dumps, prompting serious dangers and natural contaminations (Johari et al. 2014). Municipal solid waste consists a large comprise of waste of around 20 distinct classifications which are food waste, paper (mixed), cardboard, plastics (rigid, film and foam), material, wood waste, metals (ferrous or non-ferrous), diapers, newsprint, high grade and fine paper, fruit waste, green waste, batteries, construction waste and glass; these classifications can be gathered into natural and inorganic (Moh & Abd Manaf 2014).

Solid waste management (SWM) includes different advances related with controlling waste production, taking care of the capacity, transportation, procedure and last removal of waste. The organization of SWM was presented since 1970s, a few advancement, totally various variants of waste treatment progressions exist (Tan, Hashim, et al. 2014). It clarified that the most of SWM goal is to treat the waste that has created. Also, vitality and recyclable material are regularly recouped as results to achieve sustainable waste management that is environmentally friendly, economically affordable and socially worthy (Tan, Lee, et al. 2014). Actions to accomplish the sustainability in waste management, needs the assistance from each specialist to attach the appropriate mechanism or technology. In a nutshell, the waste management operation should be applied in the entire business (Sin et al. 2013). This paper is to review the current practice and issues of MSW management in Malaysia. This study will provide a better insight on the aspects to improve solid waste management in Malaysia.

Solid Waste Management Background in Malaysia

The first attempt in Malaysia to encourage household recycling activity was initiated in January 1993 through the National Recycling Campaign. The campaign initiated by The Ministry of Housing and Local Government (MHLG) and the objectives of this campaign was to divert valuable resources in the waste stream from disposal and to help control the cost of managing the waste (Jereme et al. 2014). Correspond to the report from the launch of the program, 23 Local Government of peninsular Malaysia had volunteered to become participants of the program. In the year 1998, the total number of the person who take part in the program has decrease to 10 Local Government due to the lack of arrangement and support from the society to sustain the recycling project (Jereme et al. 2014).

Then the second nationwide recycling and awareness campaign was propelled on the second of December 2000 with the contribution of a few partners' local specialists, business enterprises, commercial centres, educational institutions and the private solid waste concessionaires with the end goal of upgrading network-based interest. The main objective of this program are to lessen the price of solid waste management in conjunction to preserve the natural resources (Jereme et al. 2014). This program is actually a program that was re-launched by MHLG to produce other program that distinct from the previous unsuccessful program (Jereme et al. 2014). In this program the participants was chosen by the MHLG, 29 Local Government of Peninsular Malaysia was chosen based on several criteria. One of the criteria was the volume of waste produced by the regions. MHLG gave each member an extraordinary special drop-of-containers for recyclables and these compartments must be set at the key areas of the districts.

According to Mustafa M. (2019), the proclamation in the year of 1974 of the Environment Quality and Act is to provide the legislation for the conservation and control of the environmental pollution and quality. This is actually a very thoughtful struggle to protect the Malaysia environment. Besides, this Act is continuously being amended to include new regulations to incorporate the objective of sustainable development. This includes the amendment in 1996 to include legal measures that can reconcile economic and environmental objectives which are central to the achievement of sustainable development. The Act was incorporated by the Federal Town and Country Planning Department, under the Ministry of Housing and Local Government, Malaysia through the Town and Country Planning Act 1976. In 1995, this act was amended in order to incorporate sustainable indicators within land-use planning (Jereme et al. 2014).

In 2005, the first thorough strategy on waste management was distributed. It was entitled National Strategic Plan for Solid Waste Management in Malaysia (NSP 2005). The approach proposed an integrated municipal solid waste management that will practice a waste management hierarchy prioritizing waste reduction through the 3R's i.e., reduce, reuse and recycle at both pre and post-buyer stage. One feature of the policy is the enacting of the Solid Waste and Public Cleansing Management Act 2007 (Noor et al. 2013). In the year 2007, Solid Waste and Public Cleansing Management Act 2007 is established while there are two federal establishments has enforced the policy which are National Solid Waste Management Department and Solid Waste Management and Public Cleansing Corporation (Sin et al. 2013). The 3R programme: reduce, reuse and recycle has been promoted by Malaysia government, however, it is said to be still in an infant stage (Moh & Abd Manaf 2014). The overview of solid waste minimization in Malaysia from the year 1993 to 2020 are shown in the figure 1.

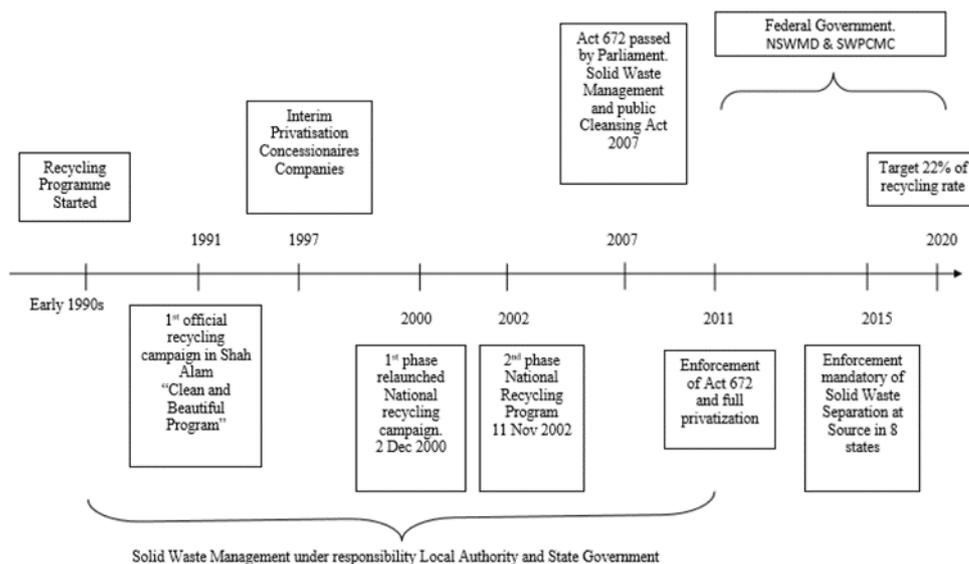


Figure 1: Overview of Solid Waste Minimization in Malaysia

Source: (Alias et al. 2018)

From the Act 2007, section 102 enforce manufacturers to bring back the product or merchandise after being consume by shoppers at their own cost. In order to make sure the community recognize with the solid waste segregation method, the ‘penalty for not separating solid waste is not mandatory’. The Act also additionally authorize the management of solid waste into three concessions: Environment Idaman Sdn Bhd, Alam Flora Sdn Bhd and SWM Environment Sdn Bhd to manage solid wastes in the northern, central and southern parts of Peninsular Malaysia (Noor et al. 2013).

The Solid Waste and Public Cleansing Management Act (SWPCMA) is the existing SWM enactment in Malaysia. This legislation are to demonstrate to be inferred and applied for the best solid waste management practices of some developed nations, for example, Japan, Denmark, Switzerland, Germany and the United States of America. It primarily thought about the administration of open

tidiness and sanitation (Agamuthu & Fauziah 2011). The fundamental ways for practice the Act incorporates source division, effective solid waste treatment, interim treatment and final disposal of solid waste altogether through landfills. The dynamic presentation of this Act began in September 2011.

The Local Authorities that were in charge for solid waste management and public cleansing were then converted to the Federal Government. As a result, new federal institutions, together with the Department of National Solid Waste Management and the Solid Waste Management and Public Cleansing Corporation or these days known as Solid Waste and Public Cleansing Corporation (SWCorp) were built up. In any event, two statements were joined which legitimately embrace 3R technique. Clause 101 explained on the reduction, reuse and recycling of controlled solid waste though, Clause 102 concentrated on framework and deposit refund framework. This demonstration professes to bring solid waste management (SWM) in accordance with world practices at no extra expense to the people. It incorporates guideline and authorization apparatus to force a higher duties among the partners. The act additionally empowered the privatization of SWM. Since its execution initiated, the administration of MSW was accounted to have immensely improved everywhere throughout the nation (Fauziah & Agamuthu, 2012).

Malaysia's Solid Waste and Public Cleansing Management Act of 2007 outline MSW as controlled solid wastes that embody commercial, household, institutional and public solid wastes (Act 672). Malaysian's MSW production in Malaysia has a late moved toward the best way to manage the amount and the composition of waste (Tan, Hashim, et al. 2014). According to the Deputy Urban Wellbeing, Housing and Local Government Minister Datuk Halimah Mohd Sadique, by the year 2020, the waste produce by our country will increasing to 30,000 tonnes in one (Agamuthu & Fauziah 2011). It has shown that Malaysian continuously produce waste without implement the right system that can bring benefit to the environment. This occur because of the reliance to the landfill as the primary method to dispose the waste without realising that the system can actually bring a negative impact to the surroundings (Agamuthu & Fauziah 2011).

The Act 672 conjointly took into consideration waste minimisation, reuse, recycling, energy recovery and landfill. The waste to energy production facilities (WTE) is mention in the 9th Malaysian Plan as an approach that is actually has the capability to manage the waste with the facilities such as thermal treatment plant and transfer stations (Alias et al. 2018). Solid Waste and Public Cleansing Management (Act 672) and Solid Waste and Public Cleansing Management Corporation (Act 673) are enacted in the Ninth Malaysia Plan (9MP) to associate in the action to obtain a competent solid waste management practices in Malaysia. The act has contribute the solid waste management in Malaysia are known by other countries. Besides, the revolution of the solid waste management has influence in a broad responsible to the shareholders that leads to many issues that emerged among the agencies and its stakeholders (Abas & Wee 2014).

As the outcome of this system, a replacement department, known as the National Solid Waste Management Department has come upon below under the Ministry of Housing and Local Government (Victor & Agamuthu 2013). A replacement account of charges has been periodical to put into action the new Solid Waste and Public Cleansing Management Corporation Act 2007 (SWPCMC Act 2007). The issue regarding the municipal waste management will be covered by the authority of the recent department. The main target of this department is regarding Solid Waste Management (Zaipul & Ahmad 2017).

Current Practices for Malaysia Municipal Solid Waste Management

The dominant waste management approach or system in Malaysia are landfilling and recycling whereas composting and incineration are done in a small scope (Aja & Al-Kayiem 2014). The greater regarding the environmental problem the increase in the number of people will contribute to the increase in the waste produce and the improvement of the financial. It involve the convenient of municipal solid waste (MSW) management which contain of the atmospheric emissions and aqueous effluents coming from landfills, waste collection, transportation, and processing of waste (Yong et al. 2019).

3R (Reduce, Reuse and Recycle)

Reduce, Reuse and Recycle or known as 3R concept are a method that are well known by the world community. This method is increasingly being accepted as one of the disposal processes in the municipal solid waste management. Recycling is a more economical and more environmentally friendly alternative than seeking new landfill sites because it can improve the senility of the existent landfill. Recycling is a process of converting the waste materials into valuable products, and it is a method that commonly prefer by the public others than burning or dumping waste (Dawda Badgie et al. 2011).

The purpose of 3R actions are to encourage 3R activities which comprise of reduction, reuse and recycling. The concept of 3R has been brought in as the most applicable approach that can be used to manage the waste. Waste reduction were the most favourable treatment other than reuse, recycling and the conversion of energy (Mallak et al. 2016). SWM in Malaysian is at the phase where the conversion of the system to more efficient and greener way. A weak waste management may cause degeneration of the natural resources, rising of the price and create long-term environment difficulty. Sustainable and progressively productive waste management systems are expected to lessen the overwhelming on landfills (Tan, Lee, et al. 2014).

Reduction is a good step towards minimizing the generation of solid waste at its root. The Environmental Protection Agency (EPA 2007) defines waste reduction as the design, manufacture of materials to reduce the quantity or toxicity before purchasing or using it. This includes minimizing waste production at every step in the process of making or using a product (Ali et al. 2012). Most types of discarded materials consist of recyclable materials such as papers, bottles and furniture. Despite our effort to reuse the waste, it also can lead to many process and method. For example, a reduction in the amount of solid waste at the landfill can be achieved. However, there are studies that suggest that the process of reusing waste requires a lot of energy such as collecting, cleaning and sterilizing glass bottles before use (Sakawi et al. 2010).

The municipal solid waste that being dumped in the landfill consists around 65% of recyclable materials in one day (M. D. M. Samsudin & Don 2013). Based on Samsudin & Don 2013, by the year 2020, the aim for the waste from recycling is to achieve 22% of the waste generated in Kuala Lumpur. According to a study done by SWCorp, the Malaysian recycling rate in 2019 are 28%. This is actually shows that the number of recycling practices are increasing and the previous target has been accomplished. However, some people in Malaysia are still left behind in terms of knowledge and awareness about recycling practices. Therefore, concreted efforts such as recycling campaigns and offering financial incentives to the public are necessary to increase the knowledge and to boost waste segregation practices (Fazeli et al. 2016).

Composting

Composting has many benefits which can be used to help nourish crops on the yard or in the garden while reducing waste (Ali et al. 2012). Although this method has long been introduced, it is still poorly applied as one of the disposal processes in the Malaysian municipal solid waste management hierarchy. The use of landfills as a means of gradually disposing of waste will be minimized to prevent contamination of the surrounding area. It can also make the landfill area more economical (Ali et al. 2012). The obstacle for the fast developing countries are that the senility of the current existed landfill sites are approaching the closure status, while the new landfill space are insufficient (Tiew et al. 2011). Composting is one of the method that can be applied in Malaysia to treat organic waste. This practice is aimed at improving the structure and pH of the soil. In addition, it is also important to provide nutrients to the soil.

There are two types of composting which are anaerobic and aerobic. The anaerobic composting is a method that can be done without the presence of oxygen whereas the aerobic composting need the presence of oxygen. The anaerobic composting is do not require a person to perform the system as it is

not labour intensive as it does not need a specific time to turn the composting pile (Fazeli et al. 2016). Anaerobic composting will produce a strong odour and decompose at a very slow rate. The next composting method is an aerobic composting that relies on the population of the microorganism. The process takes place by switching the biological substances of wastes into stable humus and fewer complicated compounds by breaking down the organic residues of plants and animals, helpful nutrients, destroying weeds, seeds and pathogens, similarly as dominant attainable toxins or diseases (Vakili et al. 2014). Aerobic composting needs an extreme temperature because to oxidize the compounds need a lot of energy (Fazeli et al. 2016). Aerobic composting produces a less unpleasant odour compared to anaerobic and the process of decomposing is much faster.

Composting is suitable approaches to independently gathered leaves, yard and food waste. It is the natural disintegration of the biodegradable natural portion of MSW under controlled conditions to a state adequately stable for disturbance free stockpiling, taking care and for safe use in land application (Dawda Badgie et al. 2011). Composting can overcome the amount of municipal solid waste volume that expected for land disposal and yields. Composting has many benefits. The resulting compost can be used to help or nourish crops on the yard or in the garden while reducing domestic organic waste. There are some of the composting methods that have been developed for large scale composting such as windrow, aerated static pile and compost bin. According to the National Engineering Handbook (2002), the composting method is divided into five types which are onsite composting, vermicomposting, aerated windrow, aerated static pile and in-vessel composting (Dawda Badgie et al. 2011).

Landfilling

For many decades, landfilling is main disposal approach in Malaysia as the country is facing serious landfill problems like used beyond its capacity, overflowing of landfill site, no facility for venting gas, no leachate treatment, unsuitable of landfill site, and shortage of land (Abas & Wee 2014). The customary technique of MSW disposal in Malaysia is through landfilling practices however its reliance is step by step being constrained because of the intense land deficiency, tasteful factors just as contamination emerging from smells and vermin. Landfill is a zone of land (normally derelict) where waste deposited and thought for as long as 20 years before permanently 'sealed'. Because of the absence of accentuation on landfill continuation and inappropriate waste removal practice; the last is considered as one of the three principal of natural issues looked by most districts, other than water and air contamination. As of late, new issues from both dynamic and closed landfills that is cause by the water source contamination have constrained the administration to shape a unique bureau board to propose a progressively thorough waste administration structure for the nation, particularly inside thickly populated areas (Abd Kadir et al. 2013).

Landfills are used to dispose of non-recyclables and inorganic materials only. However, nowadays landfills are increasingly filled with various types of solid waste that should not be disposed at landfills. Many people think that dumping solid waste at a landfill is a necessary step because it is far from the view and is managed daily with proper management. About 80% of the solid waste in Malaysia are being dumped in the landfill and this method however, turn into a challenging to operate it correctly. This happens due to the space for a new sites are difficult to discover and the volume of the waste are increasing over the period of time (Aja & Al-Kayiem 2014).

At the start, the landfills in Malaysia were under the Local Authorities (Section 72, Local Government Act 1976) and been set under the Ministry of Housing and Local Government (MHLG). In Action Plan 1988, the administration has attempted stepwise increment in the effectiveness of disposal sites by making four focused on levels improvements for sanitary landfill (Noor et al. 2013). These levels are:

Level 1: Controlled dumping.

Level 2: Sanitary landfill with daily cover.

Level 3: Sanitary landfill with leachate circulation.

Level 4: Sanitary landfill with leachate treatment.

Malaysian Technical Guideline for Sanitary Landfill, Design and Operation (2004), provides a brief explanation about the four targeted levels of sanitary landfill. Level 1 is the most important level to be received by any sanitary landfill system. The target for this level is to make sure waste is dumped in an orderly manner. Then, for level 2 of sanitary landfill will be furnished with the solid waste retaining structure, clearly characterized cells and surface water seepage. The target for level 2 is the sanitary landfill with a bund and daily cover soil. Level 3 is an improvement from the level 2 sanitary landfill by the arrangement of leachate collection and distribution framework. The leachate is gathered through a progression of assortment funnel will be recycled back to the waste layer with the goal that it might be reprocessed and additionally decay to improve leachate quality. Recirculation will likewise advance a quicker dissipation and in this matter diminishing the amount of the effluent. Next, level 4 is the improvement from level 3 sanitary landfill by the arrangement of the leachate treatment facilities and liner system. The liner system will be as the boundaries to give fixing capacity by forestalling the leachate from entering further into the ground. The leachate will flow to the assortment channels and occupied to the leachate maintenance lake for the further treatment. Aerators or air diffusers will be given to upgrade and rush the treatment procedure for the effluent to be released.

The majority of landfills in Malaysia include a small scope of activities in controlled or uncontrolled open dumps with negligible or non-existent environmental control. In 2007, there were around 291 waste removal landfill in Malaysia, yet just 3% of them are sanitary landfills. (Tan, Hashim, et al. 2014). There are more sanitary landfills are been planned in the future either to replace or to upgrade the current dumpsites. The dumpsites can treat the waste and it can be applied for electricity generation or direct heating if not being flared. Besides manufacturing biogas, landfill needs vast land space and it additionally releases unpleasant odour and leachate that need further treatment. A number of the sanitary landfills in Malaysia are Bukit Tagar Sanitary Landfills in Selangor and Seelong Sanitary Landfill in Johor (Chua et al. 2005).

Incineration

Incineration indicate the combustion of wastes and materials at a very high temperature. This method is done to reduce and minimize the amount of waste. Therefore, the needs of a proper machinery, infrastructure, and skilful labour are necessary to be able to take care the incinerator plant. In order to diminish the possible of damaging the waste that usually being treat and transform to produce energy, incineration also can be used to help in reducing the waste (Dawda Badgie et al. 2011). Thermal MSW treatment diminishes the volume of waste through heat vitality and produces biofuels including syngas, char or bio-oil. The typical thermal treatment of waste involves the burning (incineration), gasification and pyrolysis. Biochemical treatment is also the natural agreeable technique for waste disposal which depends on enzymatic deterioration of natural issue by microbial activity to create methane (CH₄) or liquor. Waste deposits through both thermal conversion and natural change is then landfilled (Tan, Hashim, et al. 2014).

Waste-to-energy (WtE) is still under development in Malaysia. The objective of WtE method are to decrease the amount of waste generate and minimize the usage of landfill. Incineration has been exist in Malaysia in the year 1996, but only with a limited scale which are in Labuan, Langkawi, Pangkor and Tioman. Presently, the Langkawi incineration plant is the one that is now still working in Malaysia. The Langkawi incinerator usually generate about 1 MW of electricity from 100 t/d from the solid waste. According to Tan, Hashim, et al. (2014), previously there are a few incinerator plant in Malaysia that need to terminate the production activity because of the expenses which is too high in order to continue the operation. Besides, there are also a difficulty to manage the moisture content of the MSW which is extremely high. The incinerator that is already not in service are Semenyih, Cameron Highland, Pangkor Island and Tioman Island. MSW management at these touristy islands is under the jurisdiction of the local authorities. Tioman Island, a well-known vacation spot on the east of Peninsular Malaysia, presents a fairly intriguing contextual investigation regarding MSW incineration. The Tioman Development Authority (TDA) is the local authority of Tioman Island liable for gathering,

transporting and burning the solid waste. It subcontracts assortment of solid waste to five nearby town heads and their village committees within the island (Abd Kadir et al. 2013).

Malaysia's first refused-derived-facility (RDF) pilot plant owns by a Malaysian company, Core Competencies Sdn Bhd was in Semenyih, Selangor, Malaysia. This WtE plant is nearly 8MW/day of electricity daily from RDF which has the capacity to process 1,100 tons of MSW per day (Bashir M. J. K. et al. 2019). Incineration method can lessen the amount of waste by 95%, this is the reason why the of incineration method is a choice to handle the MSW (Abd Kadir et al. 2013). Analysis for the year 2010 to the year 2030 has been done to plan the the future production of WtE in Malaysia which demonstrate that electricity production of the incineration plant will rising from 5000 Gwh/year in 2020 to 6200 Gwh/day in 2030 (Tan et al. 2015). However, a strategic guide is needed as a reference to implement a waste-to-energy conversion program.

Biogas

The latest and new emerging wastes to energy (WtE) ideas are empowering as far as offering power energy, heat, transport, and fuel. Gathering biogas from landfill gas created from the anaerobic process of municipal solid waste may have potential as a substitute elective for the vehicle fuel and as a critical methods for rewarding natural sources from the solid waste. The advantage of the biogas is the chance to utilize natural constituents from the waste portion and produce electrical energy, which is generally sensible and clean. The best preferred position to use this type of innovation is to protect the earth by adopting this advance technology. This include the potential of reusing of minerals, nutrients, and fibrous (cellulosic) materials (Khairuddin et al. 2015).

Anaerobic digestion is one of the waste technique that guarantee an adequate for decreasing and balance out the OFMSW volume preceding feasible landfill management. Anaerobic treatment is likewise named a strong biochemical change instrument and is widely rehearsed. Recently, the act of anaerobic digestion for the treatment of natural waste has developed astoundingly and the measure of anaerobic-digested substrate from natural waste has expanded at a yearly development pace of 25%. The changes in order to maintain the sustainable renewable energy practices ought to be urged preceding the improvement in landfill management, particularly in regard to the anaerobic digestion of Organic Fraction of Municipal Solid Waste (OFMSW) to advance the biogas creation. (Khairuddin et al. 2015)

Malaysia existing electricity separated into 5 types of sources; oil, coal, natural gas, hydro and others (biomass, biogas and solar). In ensuing years natural gas expected to be a step by step process supplanted by coal in the electricity generation. Efforts were attempted to decrease the high dependence on gaseous by expanding the utilization of coal. Malaysia National Energy Policy had presented 3 head vitality goals that are instrumental in directing the future vitality improvement (R. Ali et al. 2012), Which are:

- (1) Supply objective – to guarantee the arrangement of satisfactory, secure, and financially savvy energy supplies through creating indigenous energy resources utilizing the least cost alternatives and expansion of flexibly sources both from inside and outside the nation;
- (2) Utilization objective – to advance the effective use of energy consumption; and
- (3) Environmental objective – to limit the negative effects of energy creation, transportation, conversion, usage and utilization on the earth.

In Malaysia, biogas is usually covered under the anaerobic conditions utilizing the waste management. According to a research that has been done by Clean Development Mechanism (CDM), it shows that the best method that has the higher ability to manage the waste are when the anaerobic degradation can be develop inside the landfill. Ahmad et al. (2011), states that in July 2009, a total of 4.45 MW of the biogas station is still under construction and the targeted possibility for the achievement of waste to energy concept of biogas are 410MW by the year of 2028.

Methodology

The case study approach was chosen in this study of the overview of municipal solid waste management in Malaysia. This paper used systematic review and intensive literature review. The systematic review

involves the checking of existing reviews and protocols that existing in Malaysia. Then a clear and focused on the specific research questions was formulated. This is to design the applicable strategy for this research. With the medium of an excellent literature review, the summary of the present municipal solid waste management can be determined. The analysis was compassed by investigate the present approaches and advances utilized in Malaysia. Furthermore, through the intensive literature review in this paper, it gives a solid instruction of difficulties in creating economical waste management. When searching for the article, the technique used for this research are by identified the title of the article supported by the keywords. A few keywords has been use to urge the relevant articles. For the reviewing process, the procedure to get the vital elements are by listing out all the output from the previous research. In order to avoid any duplication, all article title are listed and scanned using Mendeley Reference Manager to discover papers with an equivalent title in order to minimize the number of searches.

Findings and Discussion

a. Challenges in Waste Management

The challenges in implementing solid waste management ought to be determine in order to implement it effectively. The main challenges in achieving sustainable waste management are insufficient technologies and facilities. A sustainable waste management technology continues to remain because the main challenges towards the implementation in developing countries. Aside from that, several users still lack in terms of understanding regarding the effectiveness of waste management. In Malaysia, a greater number of biogas engineer have not receive a sufficient guidance regarding the biogas technology therefore it is troublesome and causes the unusual problems regarding the system (Patinvoh & Tahezadeh 2019).

Moreover, the shortage of technical capability for the construction is also one of the demand in order to implement solid waste management. The common type of method to treat the waste which is landfilling incapable to hold the rising of the waste. A review discovered the thought that the increase in human population and activities successively will arise the amount of waste produce (Khairuddin et al. 2015). The number of the population are increasing as time goes by. As proclaimed by Khairuddin et al. 2015, the Ministry of Housing and Local Government (MHLG) is confronting issues and troubles with respect to having efficient and sustainable strategies for MSW disposal.

The increase of solid waste management cost is additionally an obstacle that users or stakeholders ought to handle in order to practice an efficient approach of waste management. As described in the MHLG report, absences of budgetary assets in Malaysia keep businesses from applying new innovations for maintainable waste administration (Mallak et al. 2016). The expenses of MWM administrations per premise is around RM 15.00 and the privatization of the MWM had cost the Malaysian Government more than RM 300 million. Capital expenditure (Capex) for another landfill will be more than RM30 million whereas the operating expenditure (Opex) of a landfill is around RM30.00 - RM40.00/tonne in average (Zaipul & Ahmad 2017).

Waste assortments exercises are an expensive practice in waste management systems. The expenses of waste assortments comprises of two sorts which are direct and indirect cost. Direct costs exemplify all immediate that brought inside the management of solid waste in an area. It also incorporates the assets used in the organization, advancement and activities of waste administration directly from capacity to assortment, transportation and disposal. On the other hand, indirect expenses refer to outside expense acquired in working on existing waste management systems. These expenses include the environment harm cost of hazard storage, and collection disposal practices (Sakawi 2014).

Besides, lack of awareness among the trade practitioners. This is because they are not aware of the important to implement solid waste management occupying on several policies that has been establish in Malaysia. Lack of a well recycling market also will hinder the effective in implementing waste management. A review by the Solid Waste Management and Public Cleaning Corporation's, Recycling

& Public Awareness Division in 2012, indicated that 89% of respondents knew about reusing programs, however only 68.8% said they would incorporate in the practice (SWCorp, 2012). It shows that, the awareness among the public with the respect of recycling and solid waste management is still low. Nadzri (2012) expressed that, public is increasing intrigued in segregating at the source and selling of recyclables that can get a significant expenses. As these days, the most expensive recyclables materials are aluminium, public are more likely to collect it compared to plastic. The behaviour of Malaysian towards the waste management is still low.

In Malaysia, solid waste analysis and knowledge in research have not efficiently recorded. A few studies have been initiated on the waste composition, however they were not tried using proper sampling techniques and this is often an aspect which does not make a good strategy in specifications of handling solid waste (Dawda Badgie et al. 2011). The potency of the information assortment might have an effect the finding result. Attainable barriers that might delay or prevent any of the research work such as money related, specializes, administrative, institutional and data information as far as instructive obstructions which ought to be tended to for practical advancement in Malaysia (Yong et al. 2019).

Taking into account that practically all of the waste administration innovation and items are still new, the market costs of the frameworks can particularly high to repay the expense of R&D and awards that were given on the specialists. For instance, the loss to energy projects for most part confronting challenges to get the monetary help from banks and lenders as restitution time of the tasks may surpass their desires and confined of innovations reference to make sure about the credit (Ali et al. 2012). Aside from that, the environmental conditions for the operation of certain system in Malaysia might not acceptable to a tropical country. A loads of try to error need to be contemplate to urge the simplest system that applicable (Sakawi 2014).

b. Potential of MSW Management in Malaysia

The accumulation of municipal solid waste in landfill has become the major concern in health and environmental. It is actually a struggle that need to be outlined and managed accordingly. In order to manage it effectively, a proper strategies is needed so that it alleviate the municipal waste that will end up to the landfills. As stated by Zaipul and Ahmad (2017), the operational budget that has been consumed to clarify the municipal solid waste issues by the local government are about 40% - 80, the commitment of a critical talents and expertise in waste management must not be undermined. Stakeholders should be appointed from among the relevant experts in the solid waste management fields (K. S. Samsudin et al. 2019). The relevant stakeholders must acquire and develop expertise to manage the various municipalities of waste management effectively and efficiently.

Based on the existing policies that been used in Malaysia, the system used for waste generation, assortment and disposal system are being outlined severally. In order to update the system, our government need to produce a new approach that combine the three systems into one. This is because the three system is actually linked to each other. It will help the authorities or person in charge to manage the solid waste effectively. As stated by M. D. M. Samsudin & Don (2013), to plan a better operations, it has to readjust the subsystem of assembling, transport framework, land use, urban development and public health.

Malaysia has to continue updated regarding the technology that has been used for waste management. Other than that, the elements that has to be taking care are the sustainability and its impact to the environment. When allowing new technology or technique into any systems, the biggest concern is the environment. As for now, natural gas and fossil fuels is the main energy sector that Malaysia industry reckon on. A new develop technology are still discovered by the researcher to substitute the energy sector towards a more practical system. Anaerobic absorption of OFMSW for biogas creation has become an overall focal point of research, since it produces energy that is green, and a sustainable power resource as opposed to diminishing reliance on petroleum products (Khairuddin et al. 2015).

The increase of waste has led to the increasing of the total waste being dumped in landfill. Thus, to avoid an environmental impacts regarding this issues, the open dumping landfill is require to be improved to a more advanced technologies. The new technologies such as sanitary landfill will help to control the gas produce from the waste and help to treat leachate. By improving the system that is widely used in Malaysia, an important features for landfills can be plan competently by considering the aftercare procedure that can be use after the certain landfill has been closed.

Besides, waste reduction practice in Malaysia are the potential that can be accomplished at numerous levels. Decrease per capita of waste generation through awareness creation, government arrangement activities, detachment and separate collection for reusable, and recovery of recyclable materials at the disposal sites. This is because in order to utilize and reusing a fabric, material or a item to be utilize more than once. This training is an additional practice that can be implement due to its advantages. Reusing materials and items saves energy and water, decrease contamination, and diminishes the public utilization of characteristics assets contrasted with the use of a solitary use items and materials. Reusing of a materials and item is believed to be additional socially fascinating than exercise an equivalent materials. For instance, each plastic and glass bottles can be reuse for several times. Other than that, cardboard boxes that are utilized for delivery items can be sent back to the producer to be reused for transportation the equivalent or different items.

c. Benefits of Municipal Solid Waste Management in Malaysia

The benefits of efficient MSWM in Malaysia can decrease the amount of waste. A study has been conducted in East of England, it is regarding the acceptance of waste minimization techniques in the beverage and food industry. When using the technique, the consumption of natural resources has deteriorated and the number of solid waste has decrease to 1370 tones (Mallak et al. 2014). Besides, waste management practices that reduces the waste such as landfilling and incinerations has taken by recycling practice. The benefit of using a recyclable material in industry will reduce the raw material that obtained or fabricated and it also can convert it as a source of income (Behzad et al. 2011).

As declared by Budhiarta et al. (2012), supported the data taken in 2010, it stated that the market price for a one kilogram of plastic in Kuala Lumpur is RM 0.45. The price of recyclable plastic for one day in the year 2009 is RM 179,280 with the number of population is 1.66 million. It shows that from the price of recyclable plastic, it will allow for the government sector to produce an integrated utilisation opportunity for plastic industry and market. Recycling also can benefit many parties by lessen the amount for the industry to operate and maintain its quality.

A well planned in managing solid waste also can increase the Malaysian awareness against the proper waste management. Behaviour and environmental attitudes is highly influenced by the knowledge to accomplish a sustainable waste management system. Therefore, the possibility to increase the public awareness is higher when a proper system was created. This will help public to minimize the waste that will end up at the landfill as the will use different method in order to manage and minimize the waste. Preventing and reducing the price for waste generation is one of the advantages to ensure the public take part in managing the solid waste (M. D. M. Samsudin & Don 2013).

Conclusion

The overall approach for this paper is interpretive. According to study that has been done in this paper, it can be identify that the government policies are still not sufficient to be use in this modern era. The policies in Malaysia is still not enough to comprise whole concept of sustainability of solid waste management.

This paper acknowledge that most of the practitioners still do not have a decent waste management system. Improper technologies in managing wastes may bring other consequences and it should be handle with the best method to ensure the waste is manage sustainably. The main technique that is widely been used in Malaysia is landfill. Disposing the waste is actually a method that is not relevant

nowadays. Therefore, Malaysia government need to consider to explore the issues and method in improving the waste management techniques, collaborate with particular sectors in awareness of sustainable municipal solid waste management.

In managing the waste, each of us including government sectors, public and private sectors needs to participate to achieve a sustainable waste management. All the sectors ought to add action to boost public environmental awareness and information. This is not only to improve existing condition for the environment, but it can also help in economic. A cumulative effort from all the association is the key of fortunate to implement waste management. The issues can be adjust by using a more effective technologies as the municipal solid waste is constantly increase.

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