



Mini Review

Food waste handling in Malaysia and comparison with other Asian countries

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Abstract

The increasing amount of food waste in Malaysia in recent years has brought many environmental issues in the country where it affects the nation's solid waste management framework. At the moment, the government is limited to other alternatives of food waste disposal besides the conventional landfill and incineration methods. This paper provides information on the current status of food waste handling, management, regulations, and policies in Malaysia. It helps to draw the problem and challenge to a clearer view in efforts of achieving sustainable and integrative food waste handling in the country.

Keywords

Anaerobic digestion

Asian Countries

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Introduction

Food waste is discarded on a daily basis due to living nature of human beings via agricultural, industrial and domestic activities. Generally, food waste sources can be sorted into three groups which are food losses, i.e. food materials lost during preparation, processing and production phases in the food supply chain, unavoidable food waste, i.e. the inedible parts of food materials lost during consumption phase (pineapple peel, fruit core, etc) and avoidable food waste, i.e. the edible food materials that were lost during consumption phase (surplus and wastage) (Thi *et al.*, 2015).

Food waste disposal is categorised under disposal of solid waste, which under the Malaysia Solid Waste and Public Cleansing Management Act 2007 (Act 672), it can be any methods from destruction, incineration, deposit or decomposing (Ngapan *et al.*, 2012). Landfill and incineration are the more common methods for food waste disposal. Landfill is a general and widely accepted method for managing food waste as it is cost effective and simple to be applied. However, food waste management via landfill has become more difficult as many landfills have reached their capacity in Malaysia (Moh and Manaf, 2014). Contrarily, incineration method is costly and requires

high energy usage and technology. Incineration method is rarely applied for food waste treatment as it creates air pollution (Zhang *et al.*, 2014). Both of these methods are unsustainable for managing food waste as they bring significant environment impacts. Therefore, there is a need to have a cost effective and environment friendly food waste handling and management system.

In Malaysia, the authority is facing strenuous challenges in food waste handling and treatment. Food waste imparts the current environmental issue due to its improper separation with municipal solid waste and that it attributed to the production of greenhouse gases in landfills. Thi *et al.*, (2015) reported that food waste might emit greenhouse gases that bring negative impacts to climate changes. To increase general awareness, campaigns like the 3R (Reduce, Reuse and Recycle) through education and incentive policy have been implemented. A good food waste management will help to reduce food waste amount efficiently. This paper draws information on food waste status in Malaysia and regional countries which include current issues like knowledge, practices and regulations. The adoption of good food waste management in developed countries could be taken as model in the process of development of successful food waste management policies.

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Generation of food waste

Food waste is a putrescible and recyclable material in dominant composition of 40% to 64% in municipal solid waste in Malaysia as shown in Table 1 for years 1975 up to 2005 as representative of the trend of waste composition with absence of newer data. Malaysia with a population of more than 30 million in 2014 produced up to 8,000 tonnes of food waste in a day (The Sun Daily, 2014), which increase is 760% from 930 tonnes/day of food waste in year 2011 (The Star, 2013a). The reasons of this escalating quantity of food waste are because of the changes in eating habits as living standards have improved through the years where people can afford more food products than before (Abdul, 2010) and the rapid population expansion and urbanisation (Zamali *et al.*, 2009). The expanding population in the country has contributed to the enormous food waste increment. At present, it is observed that the rate of food waste reuse and recycle is relatively low (5%) in comparison with paper (60%) and plastic (15%) (Moh and Manaf, 2014). Unlike paper and plastic, there is no specified disposal method for food waste in the country. Consequently, food waste source separation is limited and composting of food waste is not practised at larger scale (Moh and Manaf, 2014). The fact that over 90% of food waste is biodegradable (Abdullah and Chin, 2010) and easy to recycle, the awareness of recycling and food waste reduction among Malaysians is still poor. As such, it may be described that Malaysia still has a long path to go in handling food waste issues until a successful food waste management is established (Zamali *et al.*, 2009).

Efforts in managing food waste in Malaysia

The food waste management and policy for food waste treatment is considered less efficient in the country due to limited budget for food waste management (Thi *et al.*, 2015). The information of food waste management is restricted due to no regular and periodic analysis and documentation at national level from any local authorities, resulting in inaccurate database (Nasir *et al.*, 2000; Moh and Manaf, 2014). Despite several efforts introduced publicly at national level such as the National Solid Waste Management (2002-2020) (MHLG, 2006), National Recycling Program (2000-2005) (MHLG, 2006), and Waste Minimization Master Plan (2005) (MHLG, 2006), food waste treatment strategy was less sustained due to existing waste management practice did not improved significantly. Although Solid Waste and Public Cleaning Management Act 2007 was promulgated to emphasize 3Rs, which

brought positive effect to food waste management strategies (Abdul, 2010; Thi *et al.*, 2015), but food waste management is still under development due to inadequate fund for food waste management works (Alzahrin, 2010). The number of food waste recycling and reduction activities are also low as lack of participation from the public (Moh and Manaf, 2014).

The National Strategic Plan for Food Waste Management in Malaysia (NSPFWMM) was planned and proposed by the Ministry of Housing and Local Government of Malaysia with collaboration with the Japan government's Ministry of the Environment in 2010. It contains six main strategies (Table 2) which aim to inculcate public with a good habit of food waste disposal including food waste segregation for reducing greenhouse gases emission and reducing land utilization. In 2015, it was reported awareness and responsibility of segregating food waste from other wastes for every household resident in the states of Pahang, Johor, Malacca, Negeri Sembilan, Perlis, Kedah and Federal Territory of Kuala Lumpur and Putrajaya following the Solid Waste Management and Public Cleansing Management Act 2007 (The Star, 2014). This was a good start for every resident to take responsibility in the sophisticated handling of food waste in alignment of coherent efforts from the government. The commitment from the government in food waste management is viewed as a paradigm shift from a conventional food waste disposal model to a sustainable food waste management framework.

The Petaling Jaya Municipal Council (MBPJ) has a high initiative in launching several food waste management programs under Agenda Petaling Jaya 21 in alleviating food waste issues in Petaling Jaya. The MBPJ has a significant achievement in food waste treatment with strong supports and fund assistants from the National Solid Waste Management Department (MBPJ, 2010). The program of home composting with food waste was implemented among household community by MBPJ in June 2008 to November 2009 (MBPJ, 2010). In 2013, the MBPJ has established a pilot scale composting facility in association with Shence Greentech Sdn Bhd (The Star, 2013b). The food waste treatment model by MBPJ probably could be a model for other councils in Malaysia. At research capacity, local tertiary institutions such as Universiti Malaya and Universiti Putra Malaysia have set up a pilot scale food waste digester (Cowtech CTM-100, CH Green Sdn. Bhd., Kuala Lumpur, Malaysia) which is able to process food waste into liquid fertilizer and biogas at a capacity of 100kg/day for its Zero Waste Campaign (The Star, 2015) and efforts towards sustainable agricultural farming, respectively.

Nature-friendly food waste handling methods

The more prominent and nature-friendly food waste handling methods include composting, anaerobic digestion or animal feeding. These are possible options of sustainable food waste management system which are suitable for future implementation in Malaysia instead of incineration or landfill which pose detrimental effects to the environment (Thi *et al.*, 2015). The discussion on incineration and landfill has been omitted in this article.

Composting

At research scale, food waste composting is usually implemented through two different practises, which are the in-vessel system and the windrow system (Cekmecelioglu *et al.*, 2005; Chikae *et al.*, 2006; Kumar *et al.*, 2010). Table 3 lists the differences between these two methods. The in-vessel system involves covering of food waste in a closed system such as silo, drum, agitated bed, closed or batch container for composting (Rudnik, 2008). This system is an effective composting system instead of windrow system since it requires less area and offers a better management in term of gas and leachate discharge (Cekmecelioglu *et al.*, 2005). This system also helps to reduce retention time of food waste in the mesophilic phase and thermophilic phase (Cekmecelioglu *et al.*, 2005). Kim *et al.* (2008) developed a pilot scale in-vessel system for food waste treatment and suggested that ways essential effort is needed to improve the efficiency of this in-vessel system. The windrow system is an open composting system constructed in the form of a triangular pile. The optimum size of this pile is very subjective due to its constraints of weather condition and physical properties of substrates. The base of pile can be of any length from 2 to 6 m in width and 1 to 3 m in height as long as the pile achieves optimum condition for composting (Kulman, 1990). Cekmecelioglu *et al.* (2005) constructed a pile with 11 m length, 2.5 m width and 1.2 m height using the conventional layering and mixing methods. However, leaching and odour problem occurred thus this system is considered not environmental friendly although it is popularly practised in rural area as it is an easy method and requires less capital cost.

Composting of food waste coupled with municipal solid waste is extensively implemented in India which has more than 70 composting facilities (Ranjith, 2012). Every year, there are approximately 4.3 billion tonnes of compost produced from the food waste which stands at 5.9% of their municipal solid waste in India. The Taiwan government also

practises composting to utilise food waste to produce bio-fertiliser through their national program named "Total Recycling for Kitchen Garbage" (Chang *et al.*, 2008; Chen *et al.*, 2008). In Thailand, 15% of food waste from municipal solid waste was decomposed into bio-products such as biogas and bio-fertilizer (Pollution Control Department, 2010). However, it is noted that composting of food waste is less effective in developing countries due to reasons of improper segregation of food waste from other solid waste and poor food waste management framework (Thi *et al.*, 2015). As a result, this causes predicament for investment in composting projects.

Anaerobic digestion

Anaerobic digestion of food waste is a biological process involving biodegradation of putrescible organic substrate into biogas via four main steps, i.e. hydrolysis, acidogenesis, acetogenesis and methanogenesis (Zhang *et al.*, 2014). Thailand has a noteworthy implementation of food waste anaerobic digestion technology. For instance, Rayong municipality has established a full scale biogas plant utilising food waste which include vegetable and fruit wastes coupled with night soil waste for producing biogas and electricity supply in rural areas (Juanga *et al.*, 2006). In China, there is no full scale developed and operational anaerobic food waste digestion plant yet but there are over 20 national projects under development phase comprising anaerobic digestion and composting of main substrates of food waste, manure and municipal solid waste (Christian and Dubendorf, 2007). In spite of many development project of food waste anaerobic digestion in India, most of the projects have been hampered due to technical failure, poor management and incomplete regulation and policy (Christian and Dubendorf, 2007). Vietnam and Philippines have an integrative technology where anaerobic digestion and composting are combined for food waste reduction in landfill areas (Thi *et al.*, 2015). In Sri Lanka, many small scale food waste anaerobic digestion plants are established through cooperation between government and non-government organisations (Christian and Dubendorf, 2007).

Animal feeding

South Korea and Taiwan are countries which have great demand for animal feeds from food waste. It is legal to use up to 81% and 72.1% of food waste in animal feed in the respective countries (Kim *et al.*, 2011; EPA, 2013). Food waste as feedstock for animal feeding is not suitable in developing countries as loading and separation of food waste

from municipal waste is scarcely implement there. In Malaysia, following FEED ACT (Act 698) (Law of Malaysia, 2009), not all food waste is suitable for use as animal feed for livestock except for the more commonly practised of harvesting of carcass bone and egg shell. Food waste contribution on animal feed is mostly from bone meal, eggshell, sea shells as they are major mineral supplement sources of calcium, phosphorus, etc.

Policies and regulations of food waste management

Many countries including Malaysia do not have a comprehensive food waste management framework although some of the frameworks are underway of planning and in development phases (Thi *et al.*, 2015). Malaysia could probably adopt good models of food waste management from other countries such as Japan, Taiwan, Thailand and South Korea in efforts of solving food waste generation problems. Table 4 illustrates and compares the food waste management policies of selected countries.

Taiwan is an example of a country which is successful in food waste management strategy as the concrete efforts by the government in enforcement is coupled with comprehensive technologies. Their food waste management strategy could be used as a model in other countries (Chang *et al.*, 2008). Their national program known as the “National Development Plan-Green Industry-Resource Recycling and Reuse Program between years 2003 to 2008 encouraged active industrial and private sectors participation in food waste reduction works (EPA, 2013). In Thailand, food waste management policy was incorporated in their National 3R strategy (2011). Their new target for food waste reduction is 30% in 2016, 62% in 2021 and 90% in 2026 (Alice and Janya, 2012). The pertinent regulation of food waste management in Japan is known as the “Food Recycling Law” with aim to reduce food waste by 1 to 2% every year. This law requires food industries or food waste emitters in Japan to recycle their food waste into useful products such as composts, animal feedstocks and biogas (Takata *et al.*, 2012). In South Korea, landfilling of food waste was prohibited in 2005 due to environmental issues (Kim *et al.*, 2011). Ministry of Environment of South Korea has implemented a volume based food waste fee system at household level in 2013 where household residents pay the disposal costs according the quantities of food waste they produce (Ministry of Environment, 2015). Although the implementation of food waste management system has been initiated in many countries, most countries still face main

obstacles of incomplete legislations and policy, inadequate management, weak enforcement and lack of allocation budget (Thi *et al.*, 2015). As food waste issue will become more severe with time, it is necessary to pay more attention to establish concrete food waste strategies.

Conclusion

Food waste generation in Malaysia is relatively high and may become severe problem in the future. As food waste is biodegradable and recyclable, it is recommended that relevant institution or authorities put more focus on developing food waste reduction and recycling program. The current knowledge of food waste management, policies and regulation in other countries could be used as preliminary model for in our country in the process of the development of a successful food waste management system, moving from a conventional food waste disposal model to a sustainable food waste management framework.

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