

Assessment of Municipal Solid Waste Composition in Malaysia: Management, Practice, and Challenges

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Abstract

Malaysia is faced with daunting challenges related to solid waste management. Due to an increase in population, economic growth, inadequate enforcement of waste legislation, infrastructure, and public attitude among others, solid waste management is considered a crucial issue in Malaysia, particularly in urban settings. This paper gives an overview of solid waste management in Malaysian with the aim of presenting the state of waste generation, composition, management practices, and problems with regards to environmental, economic, and other ramifications from previous records. In general, the total waste generated in Malaysia is estimated to be 7 million tons in 2000, with an annual increase of 3%. This is due to many factors such as urban migration, affluence, and rapid development. This circumstance requires greater focus to be placed on managing solid waste and mitigating the negative public and environmental effects. Presently, management of solid waste is carried out by the Ministry of Housing and local government, with the support of the private sector. This new holistic approach initiated addressing the solid waste issue, taking into account public health and environmental concerns with an emphasis on reduction, reuse, and recycling before reaching final stage – disposal at landfill, and this to certain extent has a greater potential in addressing SWM problems in Malaysia.

Keywords: waste composition, solid waste management, pollution, environmental implications, Malaysia

Introduction

The quality of the environment in many developing countries, particularly in urban areas, is rapidly deteriorating. Inadequate municipal solid waste management is certainly one of the major contributing factors to the degradation of environmental quality [1]. In most developing countries, local governments have the authority and responsibility for

planning and operating municipal solid waste management in their respective areas of jurisdiction [2]. Studies have shown that solid waste management in these countries is still highly underdeveloped. Although composition of solid waste in these countries is virtually similar, there exist economic, cultural, climate, geographical, demographic, and social dimensions that differ from one nation to another. These variables have been reported as deciding factors of the quantity and composition of solid waste generated [3]. Each year, governments spend a substantial amount of resources on the

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collection and disposal of solid waste, yet still the management system remain inadequate and expensive [2].

In general, to improve the solid waste management service in developing countries, there is the urgent need to modernize the solid waste management system through the application of the 3Rs [4]. Furthermore, a holistic and integrated effort must be made to minimize the quantity of solid waste generated, and this requires the cooperation and full participation of those who generate the waste, which includes the general public [4]. Invariably, this can play an important role in coping with the ever-increasing problems of solid waste in developing countries, particularly urban settlements [5].

This paper discusses Malaysia's waste management system with emphasis on the generation and composition, practices and challenges regarding environmental and economic ramifications.

Municipal Solid Waste Management

Country Background

Malaysia is a tropical country in South East Asia with a land area of 329,847 km². The country is separated into two regions (West and East Malaysia) by the South China Sea. West Malaysia is the Peninsula, which constitutes 11 states, while East Malaysia comprises two states of Sabah and Sarawak that are situated on the island of Borneo. Kuala Lumpur is the capital city while Putra Jaya is the seat of the federal government.

Malaysia has a tropical climate that is generally warm and humid throughout the year with temperatures ranging from 21 to 32°C and a relative humidity of 80 to 90%. Rain usually occurs between November and February in eastern Peninsular Malaysia, western Sarawak, and north-eastern Sabah, while on the west coast of the Peninsula, the rainy season occurs in April-May and October-November. The country is a multi-ethnic, multi-racial, and multi-lingual society with a population of 26.6 million as of February 2007, comprising 62% Malays, 24% Chinese, and 8% Indians with other minorities and indigenous people [6]. It is endowed with natural resources in areas such as agriculture, forestry, and minerals. The economy is exclusive based on agricultural commodities and now is one of the world's largest producer of rubber, tin, palm oil, and timber, among others. Currently, the government has aspired to diversify the economy to manufacturing and service-based industries with the former emerging as one of the largest components of the country's economy, while recently tourism has served as a major source of revenue for the nation as well [7].

Malaysia National Environment Policy

Malaysia's overall environmental policy objectives, since the Third Malaysian Plan (1976-80), have always intended to balance the goals of socio-economic development and the need to bring the benefits of development to a

wide spectrum of the population, keeping in mind the maintenance of sound environmental conditions. Furthermore, the National Development Policy of the Second Outline Perspective Plan (1991-2000) categorically states "adequate attention will be given to the protection of the environment and ecology so as to maintain the long-term sustainability of the country's development." Malaysia's vision 2020 is that in the pursuit of economic development, she will ensure that her invaluable natural resources are not wasted.

In line with the above, the Malaysian Government through the Department of the Environment (DOE) has formulated its vision, that is to contribute towards nation building in attaining a better level of health, safety, and quality of life through conservation and preservation efforts, prevention and control of pollution, and protection and promotion of wise use of natural resources toward sustainable development for present and future generations.

In order to achieve the national environmental objectives, the DOE has adopted a strategy based on pollution control and prevention. The pollution control strategy or remedial approach is implemented through the enforcement of the Environmental Quality Act, 1974. The act is the most comprehensive legislation to date for pollution prevention, abatement, and control, as well as for environmental enhancement. The enforcement of this act and the accompanying 16 sets of Regulations and Orders have played a significant role in the management of the environment and, in particular, with respect to pollution control.

Therefore, in relation to waste management systems, the emphasis is on the control and regulation of scheduled wastes, while control of the management of non-schedule solid wastes rests with local authorities. The DOE, however, has powers to impose controls on solid waste management facilities, particularly where it involves incinerators or landfills, through the EIA provisions. The DOE has issued the EIA guidelines for municipal waste management, sewage, and disposal. Thus, this code and the other existing regulations provide advice to the local authorities on the development, location, and operation of landfills and incinerators. Though the EQA (1974) provides for measures to encourage recycling, the DOE has not embarked on programs related to this matter [8].

Fig. 1 shows policy decisions for SWM at the decision makers' level in consultation with the states. The council for SWM at the federal level and the committee on solid waste management at the state level can be the platform for consultative discussions between the various stakeholders to derive appropriate policies and strategies for an implementation program. Therefore, the operational and implementation plans on waste collection shall be undertaken by concessionaires, while the local authorities have the responsibility for monitoring performance and enforcement [8].

Perspective of Solid Waste Generation in Malaysia

Solid wastes generation in Malaysia has recently approached a crucial perspective, especially in terms of the amount and composition. Annually, waste generation

Table 1. Waste generation in peninsular Malaysia.

States	Population (2000)	Waste generated (tons/day) (2000)	Population (2001)	Waste generated (tons/day) (2001)	Population (2002)	Waste generated (tons/day) (2002)
Johor	2,252,882	1,915	2,309,204	2,002	2,366,934	2,093
Kedah	1,557,259	1,324	1,596,190	1,384	1,636,095	1,447
Kelantan	1,216,769	1,034	1,247,188	1,081	1,278,368	1,131
Melaka	605,361	515	620,495	538	636,007	562
N. Sembilan	890,597	757	912,862	791	935,683	827
Pahang	1,126,000	957	1,154,150	1,001	1,183,004	1,046
Perak	1,126,000	1,527	1,841,489	1,597	1,887,527	1,669
Perlis	230	196	235,75	204	241,644	214
Penang	1,279,470	1,088	1,311,457	1,137	1,344,243	1,189
Selangor	3,325,261	2,826	3,408,393	2,955	3,493,602	3,09
Terengganu	1,038,436	883	1,064,397	923	1,091,007	965
Kuala Lumpur	1,400,000	2,52	1,435,000	2,635	1,470,875	2,755

Source: [8].

increased by 3% due to many causes such as urban migration, affluence, and rapid development [9]. Therefore, early management of solid waste involved very little effort since the waste was generated at a manageable level and generally consists of organic materials such as food leftovers, paper, wood, and others [10]. Malaysia, being a developing country, also encounters problems in term of technology, manpower, and land scarcity, as well as facilities that are insufficient to cope with the ever increasing rate of waste generation [11].

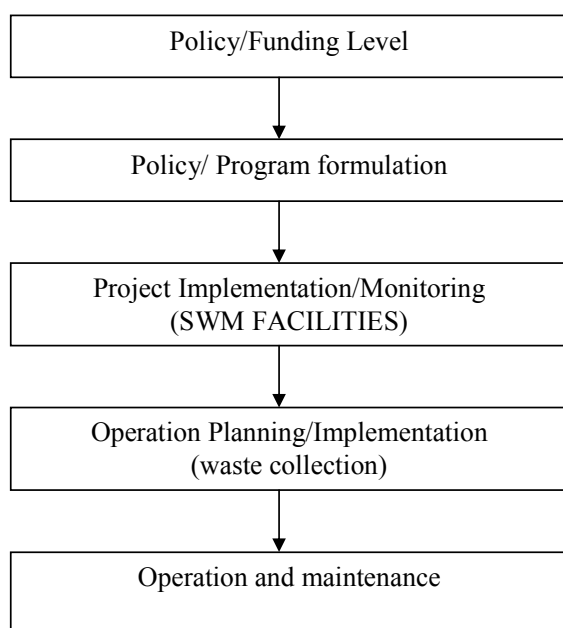


Fig. 1. Proposed institution arrangement for SWM.
Source: [8].

In 1995 Malaysians generated about 5.5 million tons of domestic and commercial waste (including non-toxic or non-hazardous wastes produced by industries), approaching 13,500 tons per day, and this amount is growing every year. Industrial toxic and hazardous wastes are scheduled wastes and are treated separately and cannot be disposed of in municipal dumpsites [12]. The total waste generated is estimated to have been 7 million tons in 2000 [8]. Previous reports asserted that total waste generated was estimated to be 7 million tons in 2000 [8].

According to reports by the Ministry of Housing and Local Government, waste generation in Peninsular Malaysia has been increasing gradually since 2000. This circumstance requires greater focus to be placed on managing the solid waste and mitigating the negative environmental effects. Table 1 shows the waste generation rate (population in the area by local authority) in Peninsular Malaysia.

The management of waste is a global problem. In Asia, the management of waste materials requires immediate attention, especially in countries such as China, South Korea, and Malaysia, which have been categorized as emerging industrialized countries. By 2025, this figure is estimated to increase up to 1.8 millions tons of waste per day (or 5.2 million m³ per day). ASEAN countries are among those contributing to higher rates of municipal solid waste. Table 2 indicates the municipal solid waste generation in 1995 among ASEAN and the estimates and projection in 2025 by countries and GNP categories.

Countries with low income (Myanmar, Vietnam, and Laos) have the lowest waste generation rates, averaging 0.64 kg per capita per day, while for the middle income countries (Indonesia, Philippines, Thailand, and Malaysia) this rate averaged 0.73 kg per capita per day in 1995.

Table 2. Municipal solid waste generation in ASEAN (1995 and 2025).

Country	GNP Per Capita (1995 US\$)	GNP Per Capita in 2025 (1995 US\$)	Current Urban Population (% of Total)	2025 Urban Population (% of Total)	Current Urban MSW Generation (kg/capita/day)	2025 Urban MSW Generation (kg/capita/day)
Myanmar	240	580	26.2	47.3	0.45	0.6
Vietnam	240	580	20.8	39.0	0.55	0.7
Laos	350	850	21.7	44.5	0.69	0.8
Indonesia	980	2,400	35.4	60.7	0.76	1.0
Philippines	1,050	2,500	54.2	74.3	0.52	0.8
Thailand	2,740	6,650	20.0	39.1	1.10	1.5
Malaysia	3,890	9,400	53.7	72.7	0.81	1.4
Singapore	26,730	36,000	100.0	100.0	1.10	1.1

Source: [38].

High income countries like Singapore tends to have higher waste generation in comparison to other countries. The amount of waste generated in Singapore is lower, but that is also due to the fact that the data do not include all municipal waste generated in the country. The characteristic of municipal solid waste varies from one country to another and it is significantly different from those of large cities, having more organic but few plastics from packaging or food waste. Therefore, Malaysian solid waste contains a high concentration of organic waste and consequently has high moisture content and a bulk density above 200 kg/m³. The waste characterization study in Table 3 describes the main components of Malaysia's waste such as food, paper, and plastic, which comprise 80% of overall weight.

Integrated SWM in Sustainable Development and Waste Management Option

Integrated solid waste management (ISWM) can be defined as the selection and application of suitable techniques, technologies, and management programs to achieve specific waste management goals and objectives [14]. The selection of programs to reduce solid waste management problems within the community can be ranked according to solid waste management problems and taking into account the solid waste management hierarchy as described in the EPA's Agenda for Action [12]. The ISWM hierarchy comprises the following elements: source reduction, recycling, waste combustion, and landfilling. This hierarchy is a useful conceptual tool for goal setting and planning at national, state, and municipality levels [12].

The goal of sustainable solid waste management is the recovery of more valuable products from waste with the use of less energy and a more positive environmental impact [15]. The practice of the three R's (reduce, reuse, recycle) fits very well within the sustainable development concept. Integrated solid waste management suggests optimization of the system, and the concept of integrated waste can be applied to both hazardous and nonhazardous wastes [16].

With the strong aspiration to achieve vision 2020, Malaysia is aiming soon to join the rank of developed countries [16]. Thus, solid waste management has evolved as the most challenging task and this problem is further compounded by the rapidly increasing amounts and complex nature of waste composition that results from growth in urban population and changes in their consumption patterns. Generally, the greater the economic prosperity and the higher percentage of urbanization, the greater the amount of solid waste produced [17].

SWM should be viewed as an entity in order to optimize all available waste management options, which would eventually reduce the burden on the need for landfill. SWM considers both immediate and long-term action and management strategies, incorporating aspects of public health, economic, engineering, conservation, aesthetics, and environmental protection in all the functional elements [14]. It must be emphasized that the primary concern of ISWM is planning the availability of landfills, space, and the cost of the option combination. The second fundamental requirements for a waste management system are waste reduction and an effective system for managing the waste that is still produced for improving environmental performance while keeping them economically affordable and socially acceptable [18].

While developed countries are busy in developing and implementing waste-to-energy technologies associated with energy recovery, composting for waste avoidance, and recycling and reuse, developing countries are still struggling to decide on the best options to treat and dispose of waste. Thus waste characteristics provide essential data for planning waste disposal facilities and for formulation of waste management strategies [19]. Malaysia's solid waste management challenges could be reasonably addressed by the adoption of the following waste management options [4].

Source Reduction and Reuse

Source reduction is the most preferred option in waste management strategy to achieve a cleaner technology [20]. It focuses on reducing the volume and/or toxicity of

Table 3. Average composition percentage of MSW in Kuala Lumpur, Malaysia.

Sources	Residential high income (%)	Residential medium income (%)	Residential low income (%)	Commercial (%)	Institutional (%)
Food/Organic	30.84	38.42	54.04	41.48	22.36
Mixed paper	9.75	7.22	6.37	8.92	11.27
Newsprint	6.05	7.76	3.72	7.13	4.31
High-grade paper	0	1.02	0	0.35	0
Corrugated paper	1.37	1.75	1.53	2.19	1.12
Plastic (rigid)	3.85	3.57	1.9	3.56	3.56
Plastic (film)	21.62	14.75	8.91	12.79	11.82
Plastic (foam)	0.74	1.72	0.85	0.83	4.12
Diapers	6.49	7.58	5.83	3.80	1.69
Textile	1.43	3.55	5.47	1.91	4.65
Rubber/leather	0.48	1.78	1.46	0.80	2.07
Wood	5.83	1.39	0.86	0.96	9.84
Yard waste	6.12	1.12	2.03	5.75	0.87
Glass (clear)	1.58	2.07	1.21	2.90	0.28
Glass (colored)	1.17	2.02	0.09	1.82	0.24
Ferrous	1.93	3.05	2.25	2.47	3.75
Non-ferrous	0.17	0	0.18	0.55	1.55
Aluminium	0.34	0.08	0.39	0.25	0.04
Batteries/hazards	0.22	0.18	0	0.29	0.06
Fine	0	0.71	2.66	0.00	0.39
Other organic	0.02	0	0	1.26	1.00
Other inorganic	0	0.27	0.25	0	8.05
Other	0	0	0	0	6.97
Total	100.00	100.00	100.00	100.00	100.00

Source: [13].

waste generated, including the switch to reusable products and packaging [21]. However, the option is often opposed by consumer society, where the consumption of products is encouraged [22]. It is important that we reduce the amount of garbage dumped in municipal landfills for a number of reasons: landfills are increasingly short of space and construction of new landfill sites is vehemently opposed due to their undesirable nature. All items in a landfill are effectively lost to society and a waste of natural resources. Lastly, landfills produce vast amount of pollution, both methane to the atmosphere and leachates to the soil [23].

Source reduction involves decreasing waste prior to its generation through the design of packaging materials and the reuse of products [24]. For instance, a consumer can reuse plastic grocery bags for lining small waste cans. On the other hand, use of a canvas bag by a shopper to carry

groceries eliminates the need for a new plastic grocery bag entering the waste stream [15]. Waste reduction can be achieved at several levels such as reduction of per capita waste generation through public education, government policy initiatives, source separation of recyclable and separate collection for recyclables, and recovery of recyclable materials at the disposal site [25].

Recycling and Composting

Recycling is the reprocessing of discarded materials into new useful products, and it is usually a better alternative compared to burning or dumping waste [26]. Composting is applicable to MSW or separately collected leaves, yard, and food waste. It is the biological decomposition of the biodegradable organic fraction of MSW under controlled conditions to a state sufficiently stable for nuisance-free stor-

age, handling, and for safe use in land application [27]. The benefits of recycling are two-fold. First, recycling cuts down the need for disposal capacity and lowers emissions from landfills and incinerators as well as reducing litter. Second, the use of recycled materials in industry reduces energy use and emission; lessens impact when raw material is extracted or manufactured, and conserves raw materials [9]. Recycling also provides a supplementary income source for the lower income group. Presumably, it is difficult to obtain accurate income estimates from scrap dealers; it is likely that they earn relatively high income from the business [17]. Composting can thereby reduce the municipal solid waste volume destined for land disposal and yields a valuable product that can be used for soil amendment and mulch [15].

Incineration

Incineration, which refers to the controlled burning of wastes at a high temperature, sterilizes and stabilizes the waste in addition to reducing its volume, and may be used as disposal option, when land filling is not possible and the waste composition is highly combustible. An appropriate technology, infrastructure, and skilled workforce are required to operate and maintain the plant [28]. Incineration is one of the most effective means of dealing with many wastes, to reduce their harmful potential and often to convert them to an energy form. It reduces volume up to ten-fold and thus is becoming particularly attractive in metropolitan areas. Some of the municipal managers are looking to the development of municipal incinerators around the periphery of their cities as a first solution in many countries [29].

Landfill

Landfill is the physical facility used for the disposal of solid waste and residuals on the surface of the earth [14]. Landfilling is the ultimate waste disposal method that can deal with all materials in the waste stream [22]. Solid waste disposed in a landfill usually is subjected to a series of complex biochemical and physical processes that lead to the production of both liquid and gaseous emissions [30]. This particular option of waste disposal is suitable when the land is available at an affordable price and adequate workforce and technical resources are available to operate and manage the site [31].

Usually, waste management authority efforts are more concentrated on collection, transportation, and open dumping. The need to develop ways and adopt means in turning our waste into resources is crucial and worth consideration. Recycling, reuse, and recovery of energy is essential as an integrated approach toward waste management [31]. However, in developed economies the environmental benefits of waste recovery are more emphasized than the developing countries, which tend to focus on economic benefits [32].

Improvements of the current situation on recycling in developing countries can be attained by enacting enforceable waste legislation and emphasizing the application of a resources conservation concept in waste management [33]. It is necessary for the local authorities to identify and prior-

itize action to minimize waste generation and maximize waste recycling and reuse, and to formulate and implement appropriate policies to support those actions [33].

The Role of Integrated Solid Waste Management and Environment

In order to get environmental sustainability, the implementation of integrated solid waste management with regards to the environment needs to be coordinated. The approach between economics and technology is very important because a country with a good economy can afford to acquire state-of-the-art technologies to make the process of waste management more efficient, thus reducing pollution and environmental degradation. Furthermore, the decision-making process plays a pivotal role in ISWM, since decision-makers decide on the appropriate technologies in addressing waste management issues. These arrays of considerations prior to any undertaking must get opinion from stakeholders with respect to public health, plus social and cultural dimensions from the community to ensure that new technology is appropriate and there will be no potential future problems with regards to public health and the environment (Fig. 2).

Assessment Waste Management Criteria

In assessing waste management criteria, a community considers all types of municipal solid waste management options available and chooses the most appropriate. Many factors can influence the selection process, such as waste generation and waste composition, and both of these factors are major players in determining for planning waste management. Thus, community can assess management options such as source reduction, reuse, recycling, composting, combustion, incineration, energy recovery, and landfilling that reflect the needs and goals of the community. The criteria for assessing management options are detailed in Table 4.

Environmental Implications of Solid Waste

Despite the lack of expression in monetary terms, there are many important non-financial impacts of solid waste

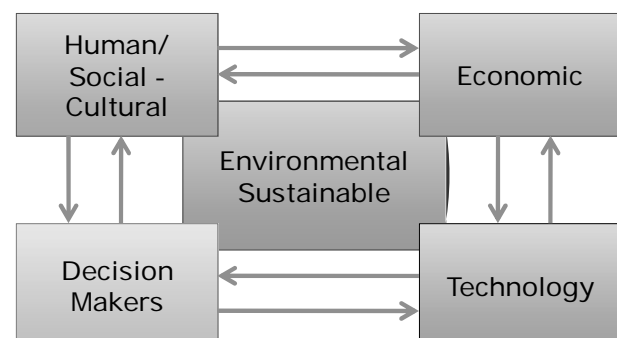


Fig. 2. Role of integrated waste management and environment.

Table 4. Criteria for assessing management options.

Criteria for assessment			
1.	Cost	1.	Cost-effectiveness
2.	Potential to divert waste from disposal	2.	Potential risks
3.	Technical capabilities	3.	Ability to fund
4.	Ability to maintain local control	4.	Potential of options as a regional opportunity
5.	Compatibility of the option with the current system	5.	Level of change to the existing system required
6.	Flexibility	6.	Public acceptance

Source: [37].

when not properly managed. These are extremely difficult and perhaps impossible to value in a monetary perspective, but they should be given consideration alongside the financial impacts in policy formulation and decision making [34]. Waste management strategies generally involve avoidance, reduce, re-use, recycling, composting, and disposal [34]. The environmental impact will be reduced if more waste is avoided, reduced, re-used or recycled rather than disposed. Environmental impacts related to improper management of solid waste from a Malaysian perspective will include *inter alia*:

- Damage or loss of biodiversity.
- Air, water, land and noise pollution
- Loss of recreational amenities
- Loss of aesthetic landscapes and scenery
- Explosion hazards

An effective solid waste management system is necessary to avoid environmental and health-related impacts that invariably will lead to undesirable consequences for the country's citizenry and the ecosystem in general [35].

Economic Implications of Solid Waste

The Malaysian population has been increasing at a rate of 2.4% or 600,000 on a yearly basis, and this has a corresponding increase of waste generation of 1.7 kg/person/day in big cities as well, which makes municipal solid waste management very pertinent [13]. Consequently, these increases in waste generation invariably increase the cost of managing waste by municipalities concerned, and the government in that local government spends on average 50% of their operating budget on municipal solid waste management [36].

Furthermore, it will lead to the acquisition of necessary equipment, infrastructure, institutional, and capacity building to accommodate the situation, which is very expensive. In that situation, local government authorities are in most cases incapable of responding to these demands since the necessary resources to implement adequate solid waste management systems are generally underestimated. The absence of these consequently leads to inadequate waste management with far-reaching ramifications to both public health and the environment, among other factors [4].

Future Challenges

Current solid waste management in Malaysia is a challenge that must be planned and handled properly. Strategies to control the generation of solid waste are among the best and most appropriate methods. Control over the production of solid waste can help reduce solid waste being sent to landfills. The production of solid waste can also be addressed by various means, such as enforcement of waste legislation, recycling, waste control at source, the design of an intelligent system for controlling the composition of solid waste, and a continuous awareness campaign on waste-related issues, among others. The attainment of the above mitigating waste management system could be a daunting task with regards to the peoples attitude toward waste generation in Malaysia, as the country's socio-economy growth and affluence is inversely proportional to public awareness on environmental issues, particularly with regard to solid waste. Therefore, it is essential for the government of Malaysia and other stakeholders to have good knowledge about the quantity, content, and characteristics of the different wastes produced in urban settings, such as households, waste resulting from economic activities, shops, institutes, and anybody who is directly or indirectly involved in solid waste management.

In Malaysia, solid waste analysis and data for major towns basically have not been well documented [7]. Several studies have been undertaken in the past on waste composition, but they were not undertaken using proper sampling techniques and this is a factor that cannot make good strategy in terms of managing solid waste in this country. In that regard, there is a need to understand the urbanization trend in the country to anticipate the implication of urban growth on waste generation, the spatial distribution of such generation, land required to accommodate the facilities necessary to manage solid waste, and the distribution and location of future waste management facilities.

Furthermore, successful waste management in any given country depends on reliable information about quantities, types, and the amount of material that can be captured and expected to envisage prevention mechanism. In other words, accurate up-to-date information about the community's waste profile is a crucial step in a successful waste management system and strategy. This also identifies large

weight and volume waste items to target for source reduction and recycling programs and gives baseline data for assessing whether goals and objectives set are achieved and also for the future forecasting within the waste management sector of the country.

Discussion

The increase in solid waste generation in Malaysia, particularly in urban settings, calls for urgent adoption of adequate and better waste management techniques in order to avoid negative effects on the public, environment, economics, and social issues that could emerge based on the present management systems. If the country strives to improve on the current waste management practices, it would be an urgent necessity to adopt a holistic approach in addressing waste management challenges through proper planning and implementation of management strategies as indicated in EQA 1974 and other subsequent related regulations of the country. Moreover, any desirable achievement in this sector should include collective participation of all stakeholders, which includes local government authority, and state and federal levels, as well as the private sector and the general public.

In general, meaningful progress has been made in Malaysia in terms of developing SWM infrastructures, but the desired goal of a clean and green nation is yet to be attained as enough awareness on waste management issues for the public to make informed decisions with regards to SWM is yet to be realized. Published data on SW generation, sources, composition, and characteristics indicates a vivid manifestation that the quest for advocated sustainable SWM being driven at policy level is still a long way to reach.

This invariably needs urgent and concerted effort from policy level to implementation stages with the view of adopting the ISWM. Solid waste management is a complex problem that requires a complex approach to fix it and it is apparent that there is no one way that has all the approaches and solutions to these management challenges and ramifications with regards to public health, the environment, and socio-economic aspects. In view of these, it is highly envisaged that future solid waste management plans should take into consideration an integrated waste management approach that takes into account appropriate technologies, public health, socio-economic, and environmental factors.

Despite the fact that local governments spent almost 50% of their operational budgets on solid waste management-related issues, the need to develop capacity that will deal with waste cannot in any way be under-estimated. These are necessary to acquire expertise to carry out the task of waste management in the various municipalities effectively and efficiently. The proper enforcement of existing waste legislation across all sectors of society in Malaysia is long overdue, because to a certain extent it will help to address the problems of wanton waste generation and disposal by the public. It is common knowledge that laws become effective when implemented to address their desired intended purposes.

In any given municipality, decisions related to solid waste management should be tabled out to the public from a grass roots level that signifies the participation of all concerned. This approach will involve people at all levels and further serve as an educational forum for the public, thereby making informed decisions in relation to waste management, as well serve as learning from all issues related to solid waste and its implications if improperly managed.

The successful implementation and attainment of any government policy requires the participation and cooperation of key stakeholder departments in all sectors. This is fundamental as the development strategies require the endorsement of sectors that will implement the set plans and programs on a coherent platform with regards to waste. It is equally important to make the general public aware of the causes and ramifications of generated solid waste articulated to them by all arms of government and private sectors charged with the SW management in their respective regions.

Therefore, it is pivotal for government to advocate for waste management programs that concentrate on waste reduction at the source, reuse and encourage more industrial processes through economic incentives that promote the recycling of recyclable materials, as well as proper enforcement of existing waste-related legislation. Moreover, the achievement and failures of any action taken depends on public awareness with regards to their surrounding environment and practical involvement.

Conclusion

By all accounts, Malaysia's solid waste management strategies have to a certain degree improved significantly on environmental quality, public health, and socio-economic development as detailed in the country's Vision 2020. This is mainly attributed to growing interest of the government on environmental issues, particularly solid waste, and therefore it is given the necessary attention it deserves in the management mechanism for a clean and healthy nation. However, a fundamental requirement for more efforts to increase effectiveness and efficiency in achieving the set objectives on solid waste from a holistic perspective is absolutely a necessity by the local, state, and federal governments for a clean, green, and beautiful Malaysia for all to cherish.

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