

Issues and Appraisal for Better Waste Management in Malaysia

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Abstract: Waste issues in Malaysia are similar to those faced by many rapidly developing countries in the region. There were a number of problems which many local authorities encounter when trying to implement an efficient MSWM System. These problems were related to the lack of national policies, insufficient assistance from the state governments, lack of basic law, weak organisational structures, no consideration given to MSW problems while approving plans, inadequate or no coverage of under serviced areas, insufficient finances, shortage of manpower, little or no training opportunities for MSWM personnel, insufficient research activities not enough enforcement personnel and little not enough final disposal areas use of inappropriate technologies, no proper management of equipment and no proper co-ordination among MSWM related agencies. The purpose of this study is to determine the recommendation to appraise regulations or guidelines as mandatory, develop solid waste management plans for municipalities, encourage public communities and municipalities to increase recycling programmes and decrease the amount of waste to be brought to disposal site.

Key words: Waste management, integrated solid waste management, waste management diagram, disposal site Malaysia, law

INTRODUCTION

In Malaysia, Municipal Solid Waste (MSW) problem is one of the most debatable environmental issues. Other issues that have received extensive public attention are the problem of haze and air emissions from anthropogenic sources having enough water and its quality and indiscriminate dumping of toxic and hazardous wastes (Sakawi, 2011). Malaysia needs to deal with the existing municipal solid waste problem to have cleaner streets, get better collection services and reduce criminal acts of midnight dumping. These activities result in waste of one type or other. The types of waste and the quantities produced vary according to the size of and the activities in the communities, performed and the natural resources consumed. Problems have been debated, plans elaborated and developed, studies implemented and examined to ensure improvements are made to correct inappropriate situations. However, the most fundamental aspect that is the basic information of waste generation rate and the problem of waste collection routing and scheduling is still unsolved.

The problem stems from the fact that the amount of MSW generated in the country is increasing at a geometric rate especially in large cities like Kuala Lumpur

and this has created an increasing awareness among the general public on the environmental issues (Hassan *et al.*, 1998). In the past, the Malaysian public were not so concerned with the impacts of open dumps in the environment. The attitude of the public was as long as my waste is collected, I don't care where and how that waste disposed of. Important earlier issues on solid waste that have not been resolved are the problem of getting consistent and reliable data, an efficient service level for storage, collection and disposal and accounting or budgeting systems for MSW services. The issue of recycling has never been resolved and equally important is the issue of privatisation which has not taken off since its introduction in 1994.

Development in Malaysia is implemented according to 5 years development plans. Although, MSWM is the most expensive part of operation cost of local authorities, it still has not been given due consideration in the 5 years Plans. A request was made to establish a National Solid Waste Management Development Programme in the Fifth Malaysia Plan but it was turned down due to shortage of funds. Only a cursory evaluation was made of the situation regarding waste disposal in the country. It was also because the initiative was not supported by concrete policies, plans and programme which were vital to sustain

long term environmental cleanliness. This is the reason why the formulation of predictive modelling for waste generation and development of waste database is necessary in the planning of new townships.

MATERIALS AND METHODS

The data obtained from the literature and initial documentation was used to discuss the current issues and problems faced by the local authorities and state Government in Malaysia. All of the information from the research was used substantially in the discussions. The information obtained from site visits and observations was also used. The officer who was directly involved with municipal solid waste management was interviewed to obtain the information on issues related to MSWM. Private contractors and the officer in charge of waste management of the disposal site were also interviewed. All information obtained during these interviews was recorded and transcribed for discussion purposes.

Municipal solid waste management issues in Malaysia:

Most municipalities face major environmental problems. According to a study by the Ministry of Housing and local government with the co-operation of the Ministry of Science, Environment and Technology, the current status of MSWM is a discouraging one. The study identified the waste generation rate, existing systems of storage, collection systems and disposal sites as problematic (Ministry of Housing and Local Government, 1999). A significant amount of MSW generated in the urban centres is uncollected, either burned in the streets or ends up in rivers (Sakawi, 1996, 2011), creeks, marshy areas and vacant lots. Collected waste is mainly disposed of in open dumpsites. Many of them are not properly operated and maintained and thereby pose a serious threat to public health. Wilson (1998) noted, the challenges of waste management issues in low-income countries needed to be addressed. Issues included fragmentation of management control, the lack of centralised planning or monitoring of service provision, low productivity, untrained staff, poor pay scales and lack of incentives to do a good job. Inadequate supervision was often due to supervisors not having any means of transportation to move about in their service areas. Poor maintenance of vehicles and inadequate financing of the services were problems in MSWM programmes.

There were a number of problems which many local authorities encounter when trying to implement an efficient MSWM System. These problems were related to the lack of national policies, insufficient assistance from the state governments, lack of basic law, weak

organisational structures, no consideration given to MSW problems while approving plans, inadequate or no coverage of under serviced areas, insufficient finances, shortage of manpower, little or no training opportunities for MSWM personnel, insufficient research activities not enough enforcement personnel and little or no public health education for the public in generating awareness with regard to littering, not enough final disposal areas, use of inappropriate technologies, no proper management of equipment and no proper co-ordination among MSWM related agencies.

Descriptive of the collection system and issues arising:

Waste collection is one of the most expensive activities in the waste management system. According to Jabatan, the operation and maintenance cost for MSWM is very high compared to other environmental expenses. For example in Selangor, the monthly budget of the local authority for solid waste management is approximately RM1 4,287,047 (€2,198,007.20) but the real cost is RM15,511,912 (€2,386,448) per month (Ministry of Housing and Local Government, 1999). Research done by Ministry of Housing and Local Government (2000) also showed between 30-70% of the budget went to MSWM. In some cases, the actual cost for operation and maintenance was more than annual budget. Operating efficiently is essential in waste management programmes. This will have an impact on the level of MSWM services in an area. Poor collection affects public confidence in the service. Most complaints received by local authorities were related to the quality of the collection services provided. A study of local authorities by three mainstream local newspapers namely Utusan Malaysia, The Star and The New Straits Times between March and June, 1999 revealed that the quality and cleanliness of environment had been chosen as top priority by the respondents. The public was very sensitive to waste collection services. The field observation showed that the collection of MSW was carried out three times a week for households in most areas. The collection routes were widely varied (Sakawi and Gerrard, 2000). Which route to be taken was left at the discretion of the driver. As revealed by the fieldwork observation, it was therefore not unusual for the truck to arrive at the disposal site only partially loaded due to inefficient routing. Waste collection contractors did not stick to the collection routes assigned to them hence it was not unusual to leave out one or two roads.

According, to the Ministry of Housing and Local Government (1999), only 70% of waste generated was collected and disposed at municipal dumpsites. The remaining uncollected 30% were probably dumped

illegally or diverted to other locations for recycling. Sparsely populated areas or those not easily accessible were among those not serviced. The lack of service can cause negative environmental problems, due to illegal dumping and open burning. This is the result of the failure of the MSWM Programme. According to a private contractor and Alam Flora Consortium officer (observation during fieldwork), the lack of enforcement by the local authority officers and lack of clear guidelines are among the reasons for illegal dumping. Even though illegal dumping is common in many countries, the scenario is more prevalent in Malaysia, especially in open spaces close to housing areas or storage places. The indifferent attitude of certain people towards a clean and healthy environment leads them to dump their waste by roadsides, on vacant lands, hill slopes, rivers and drains.

Disposal and landfill sites: In 1988, there were approximately 230 official dumping sites in Malaysia whereas 49 were landfills and another 181 were open dumping sites. These landfills were divided into 3 classifications, i.e., open dumping, controlled tipping and sanitary landfill (Ministry of Housing and Local Government, 1999). More than half of the landfill site operators did not register incoming waste or measure groundwater quality and gas generation levels. The majority of the existing landfills were dumping grounds without proper management. Management of leachate, measurement of gas emission and earth covering of the daily pile were virtually absent. Most landfills in Malaysia were small scale operations with varying levels of design sophistication. Majority of them were poorly managed dumpsites while a few of the landfills had facilities equipped with leachate collection systems.

Most of the disposal sites are almost reaching full capacities and have only a few operational years left. The local authorities realise the unsanitary method of crude dumping and therefore those with many operational years left have been or are being upgraded to controlled tipping dumpsites where the waste pile is covered at every alternate day. Most municipalities in Malaysia are having serious problems in getting new landfill sites as most of the existing landfills are nearly exhausted and are located outside the economical distance from waste generation areas. Since, early 90's approximately 75% of the landfills were deemed not viable for continued use by the local authorities. Some of the existing landfill sites are facing threat of closure due to development of new residential and commercial projects for example, the development of the new township near the Air Hitam Sanitary Landfill (Ministry of Housing and Local Government, 1999).

Scavenger problems: Scavengers actually help reduce MSW disposed at landfill sites. However, in some cases the activities create problems for the landfill management. For example, allowing scavengers to do their activity on the landfill site has interfered with the management and operation of the landfill. Poor maintenance of equipment used at sites result in short lifespan of the equipment resulting in high maintenance costs. Inadequate and unsuitable cover material used could result in the creation of breeding grounds for mosquitoes, flies and rats. Diaz *et al.* (1997) in their studies referred the scavengers as itinerant problem because they roam the streets looking for items that can be recycled. In some municipalities, the solid waste collection crew do their job and scavenge for materials as well. According to Hassan and Chong (2000), the money earned from the recovered recyclable waste material provides additional income for the collection crew. Since, the crew have prior access to recyclable materials collected from households than the scavengers at the disposal sites, the recyclable materials they collect have higher value.

Limited financial resources and lack of planning: Malaysian municipalities faced severe financial constraints due to the lack of planning of the limited financial resources where necessary funds needed competed with other projects. Waste management was further weakened by the fact that it was almost entirely the responsibility of local government. Many local authorities in Malaysia only collected waste from the urban centres within their districts and therefore did not have any statistics on rural areas which were not serviced. Illegal dumping also made statistics gathered at disposal facilities not representative of true statistics.

Therefore, it is the responsibility of every citizen to play his or her part in the effort to keep the country clean. The lead role in transforming MSW has been played by the state and local authorities. Government must increase its enforcement of current laws, regulations, guidelines and create new legislation to ensure effective and efficient services (Sakawi, 2001). Manufacturers and distributors of products need to play active roles in the management of waste they create. Private contractors are important and active players involved in the collection of waste (Sakawi and Gerrard, 2000).

Privatisation issues and problems: Since, the Government of Malaysia issued an invitation to the private sector to tender for the privatisation of municipal solid waste management in the whole country of Malaysia in 1994, the current state of the privatisation system is still under interim agreement. During the interim period, a few

significant issues and problems persist were directly faced by the consortia. The implication of these issues and problems will directly influence the overall performance while implementing the municipal solid waste management systems. The first important issue is the lack of funds. This is entirely different from when the municipal solid waste system was under the management of municipalities. Municipalities usually have their own funds from the assessment tax to fund the municipal solid waste management service. In addition the state and federal government would also fund municipalities through grants, loans or subsidies. During the interim period the consortia had to manage their own capital. The government no longer subsidises or provides loans to the consortia. It is not possible for the consortia to secure financing for capital expenditure because all waste activities are not covered by the management fees agreed upon by municipalities.

The length of contract between municipalities and the consortia is on a yearly basis. A year is not a suitable duration for consideration to apply the bank loan. Thus, the consortia faced problems obtaining the loans from bank for financial needs. During the interim, the consortia do not have any reliable financial resource or recovery cost system such as direct billing. This is due to the payment service being directly paid to the municipalities (service arranger) by the customer (service recipient). The payment system is through the assessment tax. Therefore, the consortia only receive payment from the municipalities on a monthly basis based on the service provided.

Late payment for service provided is also the main issue during the interim period. Due to this phenomenon, the consortia also faced the problem of paying the sub-service provider. This phenomenon will affect worker performance and financial performance will affect both the sub service producer and the service provider. Generally, the problem existing during this interim period will have a negative effect on the municipal solid waste system. Basically, the implication of this situation causes the consortia to be unable to improve their facilities and equipment such as purchasing of landfill equipment or to purchase transfer trucks and collection vehicle. Currently, the consortia only maintains the existing management systems without making any changes particularly to improve facilities and old equipment unless a few administration changes for example as done by AFSB, such as rescheduling the private contractor under their supervision.

RESULTS AND DISCUSSION

Discussion and findings will focus on previous and current issues related to problems of waste management

in Malaysia such as waste arising, the difficulty of obtaining data in particular about business waste and it is difficult to obtain data to monitor waste reduction. Apart from this for efficient waste management, the Government of Malaysia, state government and local authorities must have an accurate and systematic database for waste management. To reach this target, several decisions must be considered and proper planning carried out to help the municipalities to develop an excellence database. This section will explain Malaysia's need to form a municipal solid waste management system in the coming future.

Full privatisation of municipal solid waste management:

According to the problems existing during the interim period, it seems that full privatisation is the answer to obtaining improvement plans and a significant number of benefits. It was found that full privatisation of national municipal solid waste management system in Malaysia would be a good alternative for the private contractor. For full privatisation, the payment system for municipal solid waste management service is through the billing system or user charge directly to customer (service recipient). In this case, the service recipient directly will pay the tariff to the service producer (service provider or service arranger).

Full privatisation also seems easier for the consortia to lay out plans and plot a long term program in order to improve the quality of services and efficiency of municipal solid waste management. Due to this, full privatisation is necessary to help the consortia to accumulate funds in forms of cost recovery system through user charge. The longer length of the contract will enable the consortia to applying for bank loans for the purpose of working capital, capital expenditure and investment in municipal solid waste management equipment and facilities, for example, purchasing vehicles for collection, maintenance facilities and investing in waste disposal facilities and equipment.

Full privatisation also gives the opportunity to the consortia to have their own autonomy and be free to manage their own financial systems and plan their programmes. Generally, full privatisation with financial autonomy and fixed financial resources can improve the quality of service, promote efficiency and fulfil the customer needs for a better municipal solid waste management system. Full privatisation with managerial autonomy can increase competitiveness through competitive tendering in determining the contractors as the service provider. Theoretically, this competitive tendering concept will reduce the cost of service because the actual cost for municipal solid waste management service can be traced by the bidding proposal prepared by the contractors.

Creation of new policy and act for municipal solid waste management in Malaysia: Currently, there is no national policy on municipal solid waste management in Malaysia. Nonetheless, the Action Plan for a Beautiful and Clean Malaysia (ABC) has become the de facto guideline for municipal solid waste management activities by the state and local authorities. The ABC, however was formulated on the basis that action plans would be executed by the local authorities with guidance from federal agencies. The success of the Federal Government privatisation programmes has shown that the private sector can play a key role in rejuvenating sectors for the economy which have been retarded when under government control. With the increased participation of the private sector, through privatisation, various aspects of the ABC will require amendment. Furthermore, the creation of a new policy for municipal solid waste management in Malaysia is important as a part of the legislative approach to support an integrated approach for better municipal solid waste management.

The objective to setting municipal solid waste management systems must be clear and should cover the whole of Malaysia. It should have the features of uniformity, cost-effectiveness, be environmentally sound and socially acceptable. The national municipal solid waste management policy should focus on the five R's. Namely; reducing the production of waste, reusing items, recycling waste, recovering useable material or energy from waste and residue management. As mention by Cheeseman and Philips (2001), waste minimisation is regarded as one of the best ways to reduce the impact of waste on the environment. Might be by introducing the waste minimisation project club like the Northamptonshire Resource Efficiency Project (NREP) can help Malaysia (local authorities) to decrease solid waste generation rate in future.

The Government of Malaysia should implement the legislation system relating to the municipal solid waste generation, collection, treatment and disposal as mandatory. The laws that will be implemented should be implemented as mandatory and fines imposed should be honest and continuous. The implementation of the legislation by mandate is an effective approach to ensure that the municipal solid waste management system can be successfully implemented. For example, when the government of Malaysia through the Ministry of Housing and local authority launches the recycling campaign in 1993, there was no support from all groups (state government, local authorities and public) and this campaign failed to achieve the required objective. Recently, the same campaign was launched to involve all society's levels to take part for a second time. However,

a campaign that is launched without the existence of enforceable law will not give a good result. The best example for the implementation of legislation approach is a study by the region of Halifax, Nova Scotia (Bauld and Hickman, 1998).

With the existence of government action to ban materials such as glass, plastic, paper, organics and others to disposal sites, this will encourage the community to practice recycling and composting. When people start to take part in any activities related to recycling and composting, this will be like very good strategy for Malaysia in future to decrease the total municipal solid waste generation to the disposal site.

At the moment, the new law related to management of municipal solid waste in Malaysia has not been gazetted. However, some of the fundamentals that this law needs to address are suggested. The objective of the Municipal Solid Waste Act would be to consolidate and rationalise laws relating to municipal solid waste management in Malaysia. Municipal solid waste activities involve generating, storage, cleansing, collection, transportation, sorting, recycling, recovery, treatment and disposal. There would also be a need to regulate privatised entities and educate the public. It is proposed that the Act encompass all of these activities. Then, the laws would also require the following activities to be licensed:

- Collection services for municipal solid waste
- Transportation of municipal solid waste
- Transfer station and operation
- Facilities for treatment of municipal solid waste and operation (composting and incineration)
- Facilities for the disposal of municipal solid waste and operation (landfills)
- Recycling and waste recovery activities
- Competency certificates for key personal

The form of support required by the private contractors will entail a new regulatory structure driven at the federal level. This will give rise to the necessity of establishing a federal regulatory body under an act of parliament and the role which has to be played by all levels of government including the local authorities.

Model for municipal solid waste management: This Model will give a general view for waste managers, local authorities and government to understand the problems, challenging management for better and more efficient MSWM in Malaysia in the future. This model was created based on the earlier waste management experience and issues which failed to find an efficient waste management. Basically, Malaysia has a problem with waste database.

There is no available data on waste generation and waste composition. Also, the data on treatment and disposal were not compiled in a systematic way. This model consists of four levels, namely Level 1-4. Figure 1 shows the model for MSWM in Malaysia. In this case, the development of strategies for waste management is called bottom up management suggested by Wilson (1998) which involves the informal sector, community based organisations and NGOs. In many cases however, often there was a tendency for municipalities and the private sector to focus on solutions from the top down approach.

Level 1 (Waste management audit): This level is very important for local authorities and government to develop a database and information on waste in the future. Waste audit is one of the first steps in starting a waste reduction programme and to find an effective MSWM System for local authorities or municipalities. Conducting a waste audit is a good way to identify problems and correct them before they become more costly to correct which makes sense both environmentally and economically. For that reason, it is very important to employ waste audit as the first step to establish a good database and efficient MSWM in future.

The auditing process consists of three parts. The first part will start with the organisation, administrative and legislation sections. It will identify the vision, policy and target of any organisation and laws related to waste management in the country.

The second part of waste audit involves field visits. Waste audit process needs a consistent and systematic monitoring and enforcement system. Monitoring and collection of information on waste generation is crucial in order to implement pollution and waste reduction measures. Moreover, sharing of such information and creating awareness on issues will enable all stakeholders including communities, to gain a better understanding of the relationship between pollution, waste management and the quality of life. Monitoring must be done on a regular basis to check consistent waste collection routes and scheduling and regular maintenance of waste vehicles and collectors. When collection of waste is privatised, the contractors should put in order a systematic waste database. The third part of the waste audit focuses on waste generation and composition which should be recorded on daily basis. The weekly and monthly total generation of waste must be reported to municipalities.

Level 2 (Community involvement): According to Huong (1999), there are no programmes or policies which can be successful without the involvement of the public and grass-root leaders. The public generally do not understand the serious consequences of environmental degradation because they are not well informed about environmental problems and their causes. Community involvement in MSWM and the use of adapted technologies was duly recognized for improving the MSWM System. It is very important to understand what

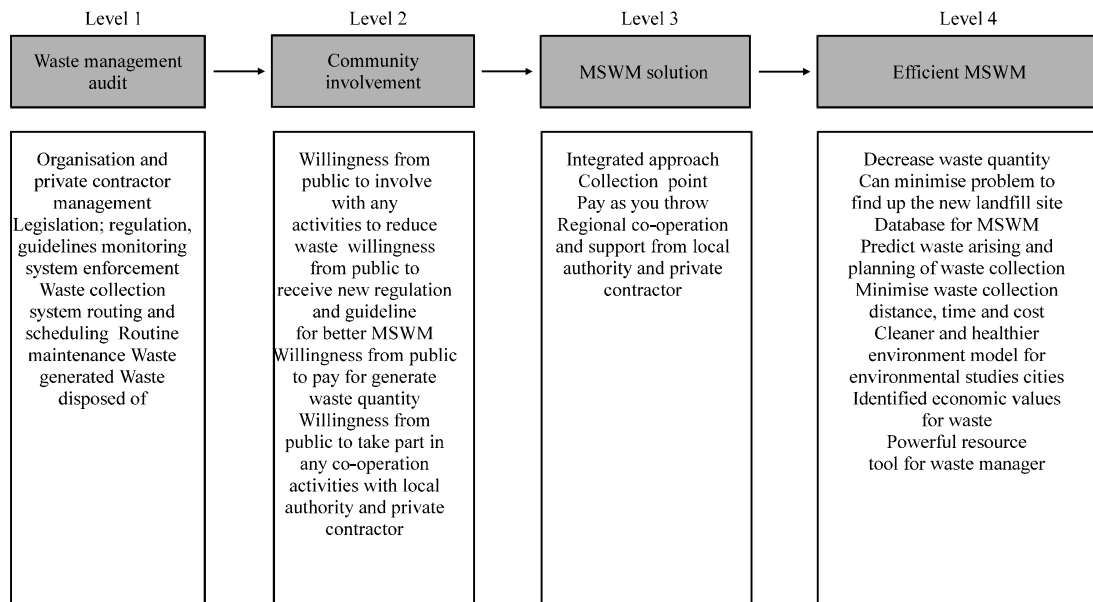


Fig. 1: Model for municipal solid waste management in Malaysia

components exist in the waste stream and how much waste is generated before one can devise appropriate intervention methods to tackle the problem.

Deficiency in community awareness and unwillingness to pay is a global issue. The participation of the community in every relevant activity is very important. To achieve a good involvement of community and public awareness, several strategies were highlighted as follow:

- Creating awareness through proper communication strategy
- Involving local schools by inclusion of solid waste management curriculum
- Raising the problem: Why the issue needs to be discussed through mass media
- Making user charge mandatory for house to house solid waste collection but allowing community to choose service provider

Level 3 (MSWM planning): A system for waste collection as part of planning should be suggested (Fig. 1). It is very important that waste is collected and transported in accordance to the collection schedule. Therefore, it is critical to have an effective and efficient collection system for different premise types and waste classification to ensure compliance is met. To meet the service standard requirements, an efficient collection system encompassing collection schedule, routing, vehicles, crew and collection method will be carried out as in the following:

- To inform the public about the collection schedule and educate them to put out bins or dispose into bin at bin points on collection days only
- To properly plan the collection routing using GIS to ensure all premises receive collection services. Several trial runs will be conducted prior to distributing the collection schedule to the public in order to determine the average collection time, distance and truck capacity. Re-routing will be carried out based on transfer station location once the facility is in place
- To ensure that each route complies with the following requirements; one truck shall travel a minimum of two trips a day; one truck is expected to collect from approximately 1000-2000 houses per collection trip
- To optimise the total crew provided for each route based on collection method and type of vehicles used. Currently, the crew size is four; 1 driver and 3 workers. However, once the system is fully mechanised, the target for crew size will be reduced to 1 driver and 2 workers

Level 4 (Efficient MSWM): To achieve this level, there should be a decrease of waste quantity by tons to disposal sites in Malaysia (Fig. 1). Municipalities in Malaysia can minimise the problem of finding new landfill sites based on waste generation prediction used. Using the developed predictive model, a database for waste in Malaysia can be established. A waste database is crucial in identifying, planning and managing waste problem in future. The waste database can be used to explain the waste hierarchy of resource recovery, recycling, composting, waste to energy (combustion) or incineration and landfill and hence solve the problem of developing an integrated MSWM concept. As noted by Tchobanoglous the principal reason for measuring the quantities of MSW generated, separated for recycling and collected for further processing or disposal is to obtain data that can be used to develop and implement an effective MSWM programmes (Tchobanoglous *et al.*, 1993).

Currently a database for waste is also extremely important for the planning of new housing areas and the development of new townships. Through the existing data, the planners can monitor and calculate the total of MSW that will be generated. This will facilitate the MSWM to implement the method of collection that will be used as well as the method for treatment for reducing the MSW quantity in landfill site.

National waste management strategy: The strategy is very important for future planning of waste management in Malaysia, especially with the presence of the systematic and fully funded one. The success of the federal government privatisation programmes has shown that the private sector can play a key role in reviving sectors for the economy which have been slow when under government control. With the increased participation of the private sector through privatisation and due to current issues on waste management, this research suggests the following approach in the formulation of national MSWM policy.

The objective of National MSWM should cover the whole of Malaysia. It should have the features of uniformity, cost effectiveness, environmentally sound and socially acceptable. In addition to the National MSWM Plan, the government of Malaysia should make it mandatory for the local authorities to produce their own MSW master plan. Findings show that out of 145 local authorities in Malaysia only two municipalities have a master plan for their solid waste operations whereas the others are simply on ad-hoc basis.

Intensive education: The public information programme is another extremely important element for effective MSWM.

Residents must be informed about the various components of the system including the unbundled costs, disposal and recycling and the environmental benefits of alternative programme options. A well-informed public is also vital in its approval of unit pricing for the collection service. Ongoing education keeps the public informed on imperative waste management goals. Residents must have a clear understanding of the waste management programme in order to meet these goals. An informed public can research in tandem with the waste management agency and increase levels of source reduction and waste diversion.

A successful education strategy required administrative support at the district and municipal levels. The responsibilities of these positions would include organising publicity campaigns and designing flyers and pamphlets promoting available diversion options and methods of source reduction. These positions would be responsible for keeping the public informed of the amount of waste the community produces, the amount paid to have waste removed and the revenues gained from recycling. No matter what efforts are made to inform the public, effective results may not be realised immediately. It takes time for people to familiar with the new system and its problems.

For this reason, Malaysia government and local authority should consider introducing waste minimisation club to every education institution from preschool to tertiary. As mentioned by Coskeran *et al.* (2007) waste minimisation clubs have been important sources of information for industry in the UK on clean technology and sustainable waste management practice. Philips *et al.* (2006) also pointed that waste minimisation programmes must be considered as a management technique and not merely a public relations exercise on the part of a range of players. It is also agreed that waste minimisation programmes are much more than mere reuse or recycling campaigns. Therefore, the Malaysian government should follow suit from the examples given to start developing waste generation and management database via these clubs.

Single ministry: There are many institutions that are directly or indirectly involved with the waste management system in Malaysia. From the writer's viewpoint, a single governance body in MSWM is very important to avoid overlapping and avoiding responsibility. Waste management is currently under the Economic Planning Unit of the Ministry of Housing and Local Government. On the other hand, issues related to pollution by waste generation are the responsibility of the Department of Environment in the Ministry of Environment, Science and

Technology. Past and successful experience with single governance body has been practiced in and enjoyed by developed countries such as the United States of America, the United Kingdom, Germany and Japan.

Landfill tax: The government also can plan and introduce the landfill tax scheme in Malaysia. The implementation of this scheme by the local authorities can help solve the waste disposal problem. As mentioned before, Malaysia has problems with landfills of which about 90% are almost closed. It has been proven that the implementation of The Landfill Tax Scheme in UK helped reduce waste disposal to the landfill directly.

CONCLUSION

From the beginning to the end of the MSWM chain makes one of the most problematic subjects in the scope of environmental quality in Malaysia. From homes to the final destination via collecting and transport operations and treatment processes, each one of the elements is important and the technical systems deserve a detailed and correct analysis. Generally, MSWM problems are due to non-effective and unsuitable handling. Some problems have reached a critical level and need urgent action for planning, designing and implementation. These problems are closely related to the problems of inadequate funds, manpower, management system and expertise. To obtain systematic and accurate data for each area for waste generation several procedures must be observed. The collector must register and be under the control of the local authorities or else be fully privatised. The management must come from one administrator (mono administration). In this case, every local authorities or private collector can monitor the quantity and source of daily waste collected. This will make it easier to identify waste composition and develop database.

Local authorities must introduce and implement specific mandatory guidelines or regulations for every private contractor registered with the municipalities. Using the integrated and centralised management, it is easy for local authorities to systematically implement monitoring and so the effort to develop a waste database. Local authorities can privatise collection areas based on the source of waste generation. The privatisation of waste management to waste consortium focuses on the collection and clearance of waste, specifically in housing and commercial areas. But in the small industry area, more than one waste management companies undertook the responsibility for waste collection. This has affected the management of waste collection which in turn making the road to efficient MSWM difficult. Few of the private

contractors are registered with the local authorities; they instead dealt directly with the factory management itself. Therefore in future, it is imperative that these factories register the private contractors for waste collection at municipalities. This can help reduce the illegal dumping problem which normally comes from unregistered private contractor. Illegal dumping is also done by factories that carry out their own waste collection and disposal. In this case, these factories must register with the local authorities and also submit their report either monthly, twice yearly or annually according to the tonnage and composition of waste, waste activities and recycling programmes.

All in all, the development of this predictive model for waste generation based on different types of houses and various waste demographic variables is to facilitate federal government, state government, local authorities and the planner (developers) develop and to plan a new township and to understand the scenario of waste generated in future. After understanding the quantity and the scenario of waste generation, this will help them predict the life of the disposal site. This scenario at the end can help local authorities solve the problem of identifying a new future disposal site.

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