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Solid Waste Management in Malaysia – A Move Towards Sustainability

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“Make less, buy less, use less, throw away less”
Akkiko Busch

1. Introduction

Waste management is a crucial area related to the economic status of a country and the lifestyle of its population. Solid waste management can be defined as a discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of solid wastes (Tchobanoglous 1993) and in spite of the aggressive economic development in Malaysia, the solid waste management is relatively poor (MMHLG 1988; Nesadurai 1999). The main objective is to improve waste minimization strategy and control. Modern waste management is shifted to a more flexible waste hierarchy concept, also called as 3R (reduce, reuse, recycle) policies (Tanaka 1999; Wilson 2007). The developing Asia counts as the fastest and largest waste generator globally and a closer inspection reveals a mix of general and specific elements of policy dynamics in the evolution and adoption of waste management policies (UNCRD et al. 2009).

Global 3R Initiative aims to promote the "3Rs" (reduce, reuse and recycle) globally in order to build a sound material-cycle society through the effective use of resources and materials and it was agreed upon at the G8 Sea Island Summit as a new G8 initiative and the UN Millennium Development Goal (MDG) aims to ensure environmental sustainability because of the prevalence of unsustainable production and rapid consumption of virgin raw material/ natural resources. It is achievable through effective and efficient 3R programmes which are vital to reverse the trends of environmental unsustainability. 3R initiatives in Asian regions were officially launched at the 3R Ministerial Conference hosted by the Government of Japan in April 2005 (Visvanathan, Adhikari, & Ananth, 2007).

Today, waste and waste management has given rise to many pressing issues (Björklund, 1998; Japan International Cooperation Agency, 2006) such as expensive land prices, strict environmental regulations (Fullerton & Kinnaman, 1995), health and safety issues, improper management of waste disposal sites (Ministry of Housing and Local Government Malaysia, 2005), landfill spaces becoming limited (Bartelings & Sterner, 1999), policy problems (Choe & Fraser, 1999), and the unwillingness of local communities to accept new technologies and facilities in 'their own back yards' (Petts, 1995). Failing in managing solid waste leads to increased operation cost and damaging the environment (Agamuthu, 2001; United Nations Development Programme Malaysia, 2008; Weitz, Thorneloe, Nishtala, Yarkosky, & Zannes, 2002). In Malaysia, waste management and waste minimization is not the sole responsibility of Local authorities but most government agencies like the Ministry of Housing and Local Government, Ministry of Environment, Ministry Of Health, the various academic institutions and NGOs should work together to achieve this.

2. Integrated solid waste management –Problems and issues

An integrated solid waste management involves a combination of techniques and programs to suit their local needs specifically. In Malaysia, until the late 1960s, city streets were cleaned by the local district health office and the Local Government Act 1976 and the Street, Drainage and Building Act 1974 were passed for public cleansing services and sanitary disposal. Malaysian laws were too general and were far from satisfactory due to lack of resources and faced municipal budget constraint. The budget for waste collection was ranging from 20% to 70%, according to the size of the municipality (Hassan et al. 2000). Dumping of wastes in open fields and rivers are common even until today and a study of waste disposal behaviour in Kuala Lumpur indicated that 31.9% of waste were disposed by open burning, while 6.5% were dumped into the river system (Murad & Siwar 2007). Hence the environmental safety concern in Malaysia was secondary and most municipalities had a tough time in finding new disposal sites as, the existing disposal sites were nearly exhausted (Hassan et al. 2000).

Kuala Lumpur, is on dire need to reduce its dependence on landfills due to its population density and an alternative solution such as incinerator is difficult to implement. Hence managing solid waste in Malaysia is still a big challenge. Malaysia is looking towards innovative solutions to the problems of inadequate and inefficient services provided by local authorities as far as waste management practices are concerned. A waste audit is a formal process which quantifies the amount and types of waste generated. Audits can be performed on office waste, municipal waste, commercial and industrial waste and construction waste through different means like visual waste audits, waste characterization, and desktop audits. Waste audits are a key to establish waste and source reduction programs and should be understood by the Government. Table 1 shows solid waste composition of selected locations in peninsular Malaysia (Wahid 1996). Table 2 shows the predicted results of total solid waste generated (per day and per year) (Nasir 2004). Table 3 shows the prediction of SWG of various sectors (Fauziah 2003).

Waste Composition	Kuala Lumpur	Saha Alam	Petaling Jaya
Garbage	45.7	47.8	36.5
Plastic	9.0	14.0	16.4
Bottles/Glass	3.9	4.3	3.1
Paper/Cardboard	29.9	20.6	27.0
Metals	5.1	6.9	3.9
Fabric	2.1	2.4	3.1
Miscellaneous	4.3	4.0	10.0

Table 1. Solid Waste Composition of Selected Locations in Peninsular Malaysia(Wahid 1996)

Year	Population of K.L. city Millions	MSWG Kg/Cap./day	MSWG Tons/day	MSWG Tons/year
2009	2.43	1.66	4029.85	1470895.25
2011	2.63	1.72	4534.78	1655194.70
2013	2.85	1.79	5102.97	1862584.05
2015	3.08	1.87	5742.35	2095957.75
2017	3.33	1.94	6461.85	2358575.25
2019	3.60	2.02	7271.50	2654097.50
2021	3.90	2.10	8182.59	2986645.35
2023	4.21	2.19	9207.84	3360861.60

Table 2. Prediction of Total MSWG of Kuala Lumpur (Nasir,2004)

Year	Residential (48%)	Street Cleansing (11%)	Commercial (24%)	Institutional (6%)	Construction & Industry (4%)	Landscape (7%)
2009	1934.33	443.28	1025.97	241.79	161.19	282.09
2011	2176.69	498.83	1088.35	272.09	181.39	317.43
2013	2449.42	561.33	1224.71	306.18	204.12	357.21
2015	2756.33	631.66	1378.16	344.54	299.69	401.96
2017	3101.69	710.80	1550.84	387.71	258.47	452.33
2019	3490.32	799.86	1745.16	436.29	290.86	509.00
2021	3927.64	900.09	1963.82	490.96	327.30	572.78
2023	4419.77	1012.86	2209.88	552.47	368.31	644.55

Table 3. Prediction of Sectoral SWG of Kuala Lumpur (Tons/day)(Fauziah 2003)

3. Government initiatives and milestones

Over the past 20 years, a wave of decentralisation has swept the globe, as national governments have handed responsibilities to lower levels of government and if state and provincial governments are given correct incentives, decentralisation can stimulate greater competition and efficiency(Francis 2010). Federal Cabinet as early as 6 September 1995 had

decided to privatise responsibilities of the Local Authorities (LA) in 1998. Since 1 January 1997, the solid management responsibility of 48 LA has been privatized to 2 concession companies i.e. Alam Flora for the Central Region and Southern Waste for the Southern Region while the North was under interim regime for a year. Legislation to streamline the strategies and measures in the Strategic Plan were to be enacted. Solid Waste Management was under Local Government Act, 1976; Street, Drainage and Building Act 1974 and now it is under National Solid Waste Management Department and Solid Waste and Public Cleansing Management Corporation Act 2007(www.kpkt.gov.my). 3Rs in Malaysia was first launched in late 1980s and the campaigns were focused mainly on the recycling activities but unfortunately it failed to improve the existing waste management practice. Policy for Integrated Solid Waste Management in Malaysia – 2001, National Strategic Plan for Solid Waste Management in Malaysia – 2005 and Master Plan on National Waste Minimization - 2006 were introduced. According to the report of the Government for the UN Conference on Human Environment “Solid waste collection is satisfactory but the disposal of solid waste is a problem like those in any countries and an organized programme in this direction is needed. The local authorities in many cases are hampered by lack of trained personnel, financial resources, and knowledge.”

3.1. Action plan for a beautiful and clean Malaysia

Ministry of Housing and Local Government(MHLG) produced the Action Plan for a Beautiful and Clean Malaysia (ABC) document in 1988 which had outlined the following:

- Local authorities should be strengthened to be able to establish efficient and effective systems of MSWM in their areas.
- A regional approach for MSWM should be encouraged, to improve the economic and technical level.
- All urban centres should prepare and implement MSWM plans extending into the future including periodical revisions.
- All MSW generated in urban and semi-urban areas should be collected and disposed of adequately in such a manner that would not create public health, workers' health and environmental problems and would be technically and financially viable.
- The generator of waste who is supported by the Rural Environmental Programme of the MHLG should dispose of all municipal solid wastes generated in rural areas adequately.
- Reduction of solid waste generation especially that of packaging wastes and household chemical wastes should be encouraged involving the producers and distributors of consumer goods as well as consumers themselves.
- MSW should be treated as a resource and all efforts must be made to recycle and recover most of the materials that are presently burnt and buried.
- MSWM services should be self-financing and an appropriate user charge or any other methods to attain the self-financing objective should be imposed on beneficiaries of the service.

- The private sector should be encouraged to be contractors for MSW collection and disposal services. In addition, the national automobile industries and other related industries should be encouraged to produce locally all the vehicles and the equipment necessary for MSWM.
- The public should be continuously educated on cleanliness and resources recovery through health and environmental education, cleanliness campaigns and strict enforcement of the anti-litter by-laws.
- Land for MSWM disposal should be identified and reserved for the purpose.
- Research and development about MSWM should be strengthened to cope with the ever changing environment(Zaini 2002)

3.2. Solid Waste and Public Cleansing Management Corporation Act 2007

SWMPC Act 2007 was approved by Parliament on 17 July 2007 and gazetted on 30th August 2007 by vesting executive power to the Federal Government to implement solid waste management and public cleansing. The corporation viewed the issue on the overall basis and not merely collection of garbage and construction of dumps and is responsible to monitor, supervise and enforce solid waste management and public cleansing in the country. It also inculcates public awareness for sustainable management of public waste and cleansing and is also responsible for recycling technology.

Department of National Solid Waste Management was created to propose policies, plans, and strategies along with setting standards, specifications and codes of practices and to enforce the law and regulations, set guidelines, monitor and give approval. The Act defines Solid Waste as, any scrap material or other unwanted surplus substance or rejected products arising from the application of any process; any substance required to be disposed of as being broken, worn out, contaminated or otherwise spoiled. The Act focuses on recycling and has a special allocation for separation of wastes at the source. With the staff count of 900 at 52 district and state offices nationwide, the corporation is optimistic towards making Malaysia a clean country in line with its vision with the support of the citizens.

Improper disposal of household hazardous wastes like pouring down the drain, on the ground, into storm sewers, or putting them out with the trash can pollute the environment and pose a severe threat to mankind. Services of SWM are separation, storage, collection, transportation, transfer, processing, recycling, treatment and disposal of controlled solid waste which are classified into 8 categories namely commercial, construction, household, industrial, institutional, imported, public and others which can be prescribed from time to time. The act provides power for Federal Government to enter into agreement with any person to undertake, manage, operate and carry out solid waste management services or public cleansing and to establish PSP Tribunal. The key aspects are:

- Local Authority will not be responsible on SWMPC.
- Local Authority staff to be given options to join concession companies.
- Integrated system of solid waste management – concessionaires vs others
- Priorities to 3R

3.2.1. Reasons for federal take over

- Lack of human and financial resources to manage solid waste and public cleansing
- Integrated system and holistic approach for solid waste management
- Interim Privatisation Period Too long – difficult to secure loans
- Environmental Degradation

3.3. 3rd outline perspective plan (2001-2010)

The government considered the adoption of a comprehensive waste management policy including the installation of incinerators for efficient disposal of waste and to formulate strategies for waste reduction, reuse and recycling. 3Rs were re-launched in 2001 by Ministry of Housing and Local Government (MHLG) and the current recycling rate is 5%.

3.4. 8th Malaysian plan (2001-2005)

- “The adoption of a comprehensive waste management policy to address the issues of waste reduction, reuse and recycling;”
- The conduct of “relevant studies and demonstration projects to ascertain the viability and the acceptability of a waste recycling industry”; the introduction by local authorities of “various initiatives and appropriate economic approaches such as incentives and collection charges to reduce the amount of household waste;” and
- “A clearing house mechanism be established to facilitate industrial symbiosis, whereby one industry’s waste could be another’s resource.” (8thMP:550)

3.5. 9th Malaysia plan

National Strategic Plan for Solid Waste Management was implemented and it upgraded the unsanitary landfills and constructed the construction of new sanitary landfills and transfer stations with integrated material recovery facilities. It also aimed at establishing a comprehensive, integrated, cost-effective, sustainable and socially acceptable SWM based on waste management hierarchy that give priority to waste reduction through 3R, intermediate treatment and final disposal by providing comprehensive, standardized and efficient quality services. They also aimed at establishing legal, regulation and institutional bodies and adopt a much environmentally friendly, cost-effective, proven SWM technology (9th MP).

3.6. 10thMalaysia plan

The Ministry of Natural Resources and Environment is to develop an environmental performance index(EPI) to gauge the environmental management performance of every state in collaboration with Universiti Teknologi Malaysia (UTM) under the 10th Malaysia Plan (2011-2015). The cabinet has agreed to the ministry’s proposal which also had the support of the various federal agencies. Malaysia is at 54th position among 163 countries worldwide under the Global EPI 2010 based on quantitative data obtained from the World

Health Organisation, United Nations Global Environmental Monitoring System, government agencies, NGOs and academia. Solid waste is one of the three major environmental problems in Malaysia. It plays a significant role in the ability of Nature to sustain life within its capacity. Currently, over 23,000 tonnes of waste is produced each day in Malaysia. However, this amount is expected to rise to 30,000 tonnes by the year 2020. The amount of waste generated continues to increase due to the increasing population and development, and only less than 5% of the waste is being recycled.

Despite the massive amount and complexity of waste produced, the standards of waste management in Malaysia are still poor. These include outdated and poor documentation of waste generation rates and its composition, inefficient storage and collection systems, disposal of municipal wastes with toxic and hazardous waste, indiscriminate disposal or dumping of wastes and inefficient utilization of disposal site space. Rivers represent the lease of life which pulses through the earth. It is a finite and only source of water.

In Malaysia, there are almost 1800 rivers. Sadly, more than half of these rivers have been polluted and destroyed. Improper solid waste management contributes greatly to river pollution. Improper solid waste management (SWM) also contributes to climate change – decomposing waste produces methane and production of new products to meet demand emits greenhouse gases and utilizes natural resources(10th MP).

4. Management strategies

The strategies were formulated for immediate Safe closure of 16 landfills in critical areas; and to upgrade non sanitary landfills and to build new sanitary landfills and incinerators. It also concentrates on enhancing quality of services through Key Performance Indicators, monitoring and quality control, courses and training and to improve delivery system – inventories and database, clear guidelines and regulations. They have given more emphasis to bring public awareness and information dissemination through dialogue, seminar and mass media.

The climatic changes have made garbage disposal dumps as the only method for efficient garbage disposal in Malaysia. Incinerator is unable to meet the disposal and government has upgraded 30 of the 175 existing waste disposal dumps into sanitary facilities by 2010. The implementation of solid waste management strategy based on 'waste hierarchy' is practised by emphasising reuse and improving the quality of products that can be recycled. Government promotes the private sector to invest in green technology in order to boost the efficiency of environmental-friendly products.

At the United Nations Organisation Conference On Climate Changes in Copenhagen, Denmark (COP 15), Prime Minister Datuk Seri Najib Tun Razak stated Malaysia's commitment to cut the percentage of carbon dioxide emissions by 40 per cent by the year 2020 with the help of developed nations. The government has started a pilot project on waste separation in Putrajaya in order to create public awareness on recycling and the joint-venture effort by Solid Waste Management Department, Putrajaya Corporation, Alam Flora and Konsortium SSI-Schaefer is aiming at reducing 40 per cent of the volume of garbage

sent for disposal. Every household was provided with two garbage bins, one for organic waste and the other for non-organic waste that can be recycled and this facilitates the respondents to recycle and reduce the amount of rubbish sent to disposal sites. The organic waste can be turned into compost and can be used for other purposes and lengthening garbage disposal lifespan (Syed, 2009).

5. Waste minimization in Malaysia (1995 – present)

The ever increasing per capita waste generation gave rise to a doubt on whether disposal is a sustainable solution and hence an alternative thinking based on the principles of waste hierarchy 3R, became more popular as a policy goal. As a policy objective, the waste minimization goal requires socialization of the 3R idea on a larger scale and this urged the government to focus on waste hierarchy. Information campaigns were staged to promote 3R aiming to increase awareness and to change attitude and behaviour. Malaysia prefers a State-led approach to waste management. Waste minimisation usually requires knowledge about the production process, cradle-to-grave analysis (the tracking of materials from their extraction to their return to earth) and detailed knowledge of the composition of the waste. The two effective ways for waste minimization are through firms' production system and technical changes and through a regulatory system that may finance the modification of internal organization .

5.1. Waste minimization, resource recovery and climate benefits

In Malaysia, waste minimization programs cannot be carried out effectively without a reliable data on waste composition and generation (Hassan et al. 2000)¹. The amount of Malaysian solid waste being separated at source for recycling purposes was less than 2% in the year 1992 but the senior government officials believe that the actual rate could be as high as 15%. The 'National Recycling Program' was initiated in 2000 and in 2005, Malaysia released the 'National Strategic Plan for Solid Waste Management (2000-2020)' and waste minimization is recognized as one of the priorities. Article 102 of the Act stipulates that the government can place responsibility for the collection of products on the manufacturer, assembler, importer, or dealer (Pedersen 2008).

5.2. Waste minimization hierarchy

It is everyone's legal and moral responsibility to minimize the amount of waste produced and to dispose waste in a fashion that has the least impact on the environment. The aim of a Waste Management Hierarchy is to minimize the amount of waste from entering the landfill/dump sites. Three top initiatives in the waste management hierarchy is the 3Rs initiative, i.e. Reduce, Reuse and Recycle. To cultivate a 3R culture in a society, it is important to train groups of people by creating an awareness programme towards implementing 3Rs initiative (Hashim,2011). The 3Rs principle helps to improve waste management system and to reduce human ecological footprint. It paves way to improve the economic activities, tend to reduce environmental impacts from waste disposal and

prevents the loss of resources and lengthen the operating lifespan of landfills. 3Rs is more successful in developed countries than among the developing nations (Agamuthu *et al.*, 2001).

The hierarchy of MSWM is an internationally accepted and practised concept in many countries throughout the world especially in developed countries. For example, study by Cooper (1996) and Clarke (1993) indicates that the concept is used as a guideline for planning modern MSWM facilities. Under full privatisation or concession period, contractors will roughly try to match the hierarchy of MSWM starting with waste minimisation, waste separation and recycling, waste processing such as incineration and composting and finally disposal to the landfill. This integrated strategy requires participation at all levels: government, industries, public and the waste management concessionaires (Zain 2002).

'Waste hierarchy' is being established to help the government manage their waste according to a sustainable agenda. Waste management hierarchy is 'a concept that promotes a cyclical approach to waste management' (Challenger, 2007). The main objective of the waste management hierarchy is to minimize the environmental effects of waste disposal (Rasmussen *et al.*, 2005; Wolf, 1988). This hierarchy is used as a main framework to develop waste management policies. Waste hierarchy which has been developed in the 1970s (Challenger, 2007; Rasmussen *et al.*, 2005), was placed in the following order (Challenger, 2007; Kirkpatrick, 1993; Rasmussen *et al.*, 2005): waste minimization/prevention/reduction, reusing, recycling, composting, incineration and disposal. Barr (2007) defines waste hierarchy order as a *waste management behaviour* which relates to recycling, reusing and reduction. Refer figure 1 for solid waste minimization. Table 4 depicts the Goal-attitude-outcomes of waste minimization hierarchy.

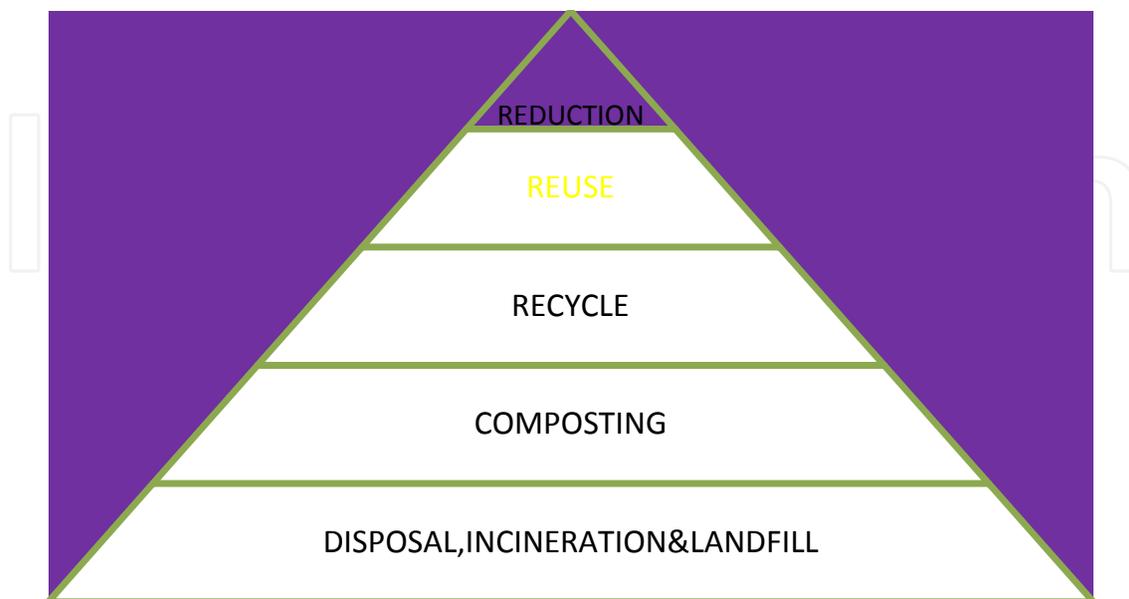


Figure 1. Waste minimisation hierarchy

Goal	Attribute	Outcome
Reduce	Preventive	Most Desirable
Reuse	Predominantly ameliorative, part preventive	
Recycle	Predominantly ameliorative, part preventive	
Treatment	Predominantly assimilative, partially ameliorative	
Disposal	Assimilative	Least Desirable

Table 4. Waste Minimization Hierarchy (Gertsakis & Lewis, 2003)

Waste management hierarchy is undergoing several changes. Incineration, which has been in the hierarchy in the first stage of the evolution, has been criticized due to the cost (Rasmussen et al., 2005) and impact to the environment (Connett & Sheehan, 2001). Therefore, in the recent hierarchy, incineration has been pulled out from the hierarchy and replaced by treatment (Gertsakis & Lewis, 2003); or thermal treatment (Sarifah Yaacob, 2009); or recovery (Pongrácz, Phillips, & Keiski, 2004); or waste to energy (Ministry of Housing and Local Government Malaysia, 2005). It is essential to start by educating people with knowledge. It reduces the amount of wastes through the following steps:

5.2.1. Source reduction/Waste reduction

It is also known as waste prevention, means reducing waste at the source. It can take many different forms, including reusing or donating items, buying in bulk, reducing packaging, redesigning products, and reducing toxicity. Source reduction is also important in manufacturing and can save natural resources, conserve energy, reduce pollution, reduce the toxicity of our waste; and save money for consumers and businesses alike. It includes any activity that reduces or eliminates the generation of waste. Waste reduction helps to create less waste in the first place - before recycling. Since it avoids recycling, composting, landfilling, and combustion it helps to reduce waste disposal and handling costs. Waste reduction can be achieved at several levels, such as reduction of per capita waste generation through public education and government policy initiatives. Separation of recyclable materials can be very useful.

5.2.2. Reuse

It is defined as re-employment of materials to be used in the same application or to be used in lower grade application. To **reuse** is to use an item more than once. This includes conventional reuse where the item is used again for the same function, and new-life reuse where it is used for a different function. In broader economic terms, reuse offers quality products to people and organizations with limited means, while generating jobs and business activity that contribute to the economy (wikipedia).

5.2.3. Recycling

It includes using a waste material for another purpose, treating and reusing it in the same process. Recycling is a series of activities that includes the collection of used, reused, or unused items that would otherwise be considered waste; sorting and processing the recyclable products into raw materials; and remanufacturing the recycled raw materials into new products. Consumers provide the last link in recycling by purchasing products made from recycled content. Recycling also can include composting of food scraps, yard trimmings, and other organic materials. Recycling prevents the emission of many greenhouse gases and water pollutants, saves energy, supplies valuable raw materials to industry, creates jobs, stimulates the development of greener technologies, conserves resources for our children's future, and reduces the need for new landfills and combustors.

Recycling includes the reuse or recovery of in-process materials or materials generated as by-products that can be processed further on. It also improve production efficiency, profits, good neighbor image, product quality and environmental performance. At the moment there is no organised programme for recycling in Malaysia. Efforts are made to come up with their own programme and objective with a single recycling programme with both short-term and long-term perspectives. The short-term measures will mobilise the stakeholders towards active recyclable generators and enhance their participation whereas long-term measures will aim towards an increased diversion of waste for recycling, and a collection system.

Annual allocation for awareness creation among public reached RM70 million (US\$18 million). Poster, pamphlets, bulletin, and electronic medium such as television, radio, websites, school busses, Light Rail Transit(LRT) billboards were used and exhibition were conducted and carnivals and seminar were held. Awareness among the public was high but only few were practicing. Recycling facilities were insufficient and inappropriately located. The available facilities were recycling bins, recycling centers, silver boxes, centers, recycling lorry and mobile collection unit (van) and charity recycling boxes. Improvement in recycling practices was possible by bringing awareness, but the task involves huge cost. It can create many job opportunities and calls for a policy that can effectively handle the issue.

5.2.4. Composting

It includes elementary neutralization and composting achieves the microbiological degradation of organic matter to produce an organic product for use in agriculture, etc. Even though the technology of composting MSW is well established, only a few of the refuse composting plants around the world are economically successful. The drawbacks commonly experienced with composting are its high cost and low value of the compost products. Subsequently, composting in Malaysia is not pursued as a solution to MSW disposal problems because the quality of product depends on the waste and hence waste separation is very important. Composting can play a key role in diverting organic waste away from disposal facilities. A compost plant also requires more area. Lack of suitable markets for compost and lack of economies of scale for quantities for the recyclable market is also a

major problem. Apart from the above, a landfill disposal will still be required for component of waste that is not suitable for composting.

5.2.5. Disposal/Landfill operation/Incineration

The final product that cannot be recycled, reduced, reused or energy recovered goes to the land field for disposal. In Malaysia landfill is more preferred way of disposal than incinerator because again of the demographic behaviour. Landfilling manage the waste that cannot be reduced or recycled. Disposal decisions depend on the cost, land availability, population characteristics, and proximity to waterbodies. They include a large disposal area which contains numerous smaller cells and the solid waste is deposited in these cells daily, using specially designed bulldozers, and covered with a thin layer of soil or some alternative cover. There is abundant unused land and ex-mining ponds which needs to be refilled for development purposes. Hence Malaysian govt prefers landfills to inceneration. It is cheaper to operate and maintain compared to incenerators. It may be feasible where landfill is scarce and located in a very remote area from the actual MSW generation centre. Modern incineration and flue gas cleaning technologies make waste incineration an environmentally viable method.

5.2.6. Implications of waste minimization

It helps to cut down the operational cost of waste management and act as an indicator to show that the country is a developed nation. It increases the lifespan of landfills and gives greener environment and improves the climatic changes (green technologies) by preventing the pollution.

6. Barriers to 3R implementation

The 2007 law had provided for the ‘federalization’ of waste management, and this is a devolution of authorities to the lowest possible level, which is highly essential for waste management. 3R implementation in Malaysia was privatized and this had created more problems than a effective solutions (Milne 1992; Sun & Tong 2002). The awareness of public on 3Rs is low, in spite of the Malaysian government’s funding for public information campaigns. There is a lack of policy to promote 3Rs and a low public participation. In 1988, the Action Plan for a Beautiful and Clean (ABC) Malaysia was introduced but had only minimal responses from the general public (Hassan et al 2000). In April 2009, the Ministry of Energy, Green Technology and Water was established to handle green technology development in Malaysia, and the government has encouraged the private sector to invest in green technology to promote the usage of more environmentally sound waste management towards facing the changes in the global environment.

7. Tips for effective practice of 3R’s

- Avoid purchasing items that are over packed
- Reduce the amount of waste created by the household by shopping smartly

- Reuse items around your home
- Recycle all paper, cardboard, rigid plastic, aluminum, steel cans and glass bottles and jars
- Compost the household's green and organic waste

8. Conclusion

Policy makers in the developing countries must develop the institutional capacity to respond in long-term policy development by integrating the goals and objectives of the state, community, and business. Developing countries may want to combine basic strategy of developing waste management capacity along with the promotion of international cooperation to upgrade it into a effective 3R-based policies. The demographic pattern, the life-style and behaviour of the citizens as well as the foreign workers with different culture and life-styles should be taken into consideration before forming the blue print or the master plan for waste minimization. Since the waste management system is privatised, it will be able to improve the quality of service and it's efficiency. Currently, the privatisation of the waste management system in Malaysia has not reached full privatisation. The system is still in an interim period, and is not running as expected due to some problems arising from the lack of funds, the length of the interim period, and the unavailability of financial resources. Problems faced by consortia have led to the inefficient operation of the waste management system. These problems affect the future planning for waste management in Malaysia, and frustrate the implementation of privatisation. Government incentives, the NGO's contributions through their social community obligations, assistance from Danida from Netherlands, Jica from Japan, UNICCEF, UNEP, WHO and other world bodies should contribute to help developing nations like Malaysia to keep up with their level of waste minimization plans and programmes. These Earth-loving actions will certainly allow us to reduce the negative impact on the earth by adding deeper meaning and joy to our lives.

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9. References

- Agamuthu, P. (2001). *Solid waste: principles and management: with Malaysian case studies*. Insitute of Biological Sciences, University of Malaya, Kuala Lumpur.
- Barr, S. (2007). Factors influencing environmental attitudes and behaviors: A UK case study of household waste management. *Environment and behavior*, 39(4), 435.
- Bartelings, H., & Sterner, T. (1999). Household waste management in a Swedish municipality: Determinants of waste disposal, recycling and composting, *Environmental and resource economics*, 13(4), 473-491.

- Björklund, A. (1998). Environmental systems analysis waste management. *Licentiate thesis, KTH*.
- Cashore, B., and M. Howlett. 2007. Punctuating Which Equilibrium? Understanding Thermostatic Policy Dynamics in Pacific Northwest Forestry. *American Journal of Political Science* 51:532-551.
- Challenger, I. (2007). Can we fix it? Lets hope so! Turning the waste management hierarchy the right way up. *WasteMINZ Annual Conference*.
- Che Mamat, R., T.L. Chong, Public's Role in Solid Waste Management: In IMPAK, quarterly DOE update on environment, development and sustainability. Issue (4), 2007, pp. 5-7.
- Choe, C., & Fraser, I. (1999). An economic analysis of household waste management. *Journal of Environmental Economics and Management*, 38(2), 234-246.
- Cooper. J. 1996. Integrated waste management in Vienna. *Journal Waste Management.*, 16-17.
- Clarke. M. J. 1993. Integrated municipal solid waste planning and decision-making in New York City: The citizen's alternative plan. *Journal Air and Waste Management*. 43 (4) : 453-462.
- Fauziah, S.H. and P. Agamuthu, A Comparative Study on Selected Landfills in Selangor, Kuala Lumpur Municipal Solid Waste Management, Institute of Biological Sciences, Faculty of Science, University Malaya, 2003.
- Francis, H.(2010).Malaysia's federalism-a good thing going to waste,Penang Economic Monthly, November.
- Fullerton, D., & Kinnaman, T. C. (1995). Garbage, Recycling, and Illicit Burning or Dumping. *Journal of Environmental Economics and Management*, 29(1), 78-91. doi:10.1006/jeem.1995.1032
- Gertsakis,J.,&Lewis,H.(2003).Sustainability and Waste Management Hierarchy.
- Hashim, K. S.M, Abdul, H and Mohamed S.R. , Haneesa ,Z. (2011) *Developing conceptual waste minimization awareness model through community based movement: a case study of Green Team, International Islamic University Malaysia*. In: Persidangan Kebangsaan Masyarakat, Ruang dan Alam Sekitar (MATRA 2011) , 16-17 November 2011, Pulau Pinang.
- Hassan, M. N., R. Abdul Rahman, L. C. Theng, Z. Zakaria, and M. Awang. 2000. Waste recycling in Malaysia: problems and prospects. *Waste Management & Research* 18:320-328.
- Hezri, A. A., and M. N. Hasan. 2006. Towards sustainable development? The evolution of environmental policy in Malaysia. *Natural Resources Forum* 30:37-50.
- Japan International Cooperation Agency.(2006,July).The study on National Waste Minimization in Malaysia.
- Kirkpatrick, N. (1993). Selecting a waste management option using a life-cycle analysis approach. *Packaging Technology and Science*, 6, 159–159.
- Kraft, M. E., and N. J. Vig. 1994. Environmental policy from the 1970s to the 1990s: continuity and change in N. J. Vig, and M. E. Kraft, editors. *Environmental policy in the 1990s: toward a new agenda*. CQ Press, Washington, D.C.

- Malaysia, (1971), Government of , Report for the United Nations Conference on Human Environment. April 1. 22p.
- Malaysia, Statement of, (1972), UN Conference on Human Environment, Stockholm, 1-5 June. 4p.
- Malaysia, (2001). Eighth Malaysia Plan (2001-2005) (8MP). Kuala Lumpur: Percetakan Nasional Berhad. p.550.
- Malaysian Ministry of Housing and Local Government (1988), Action plan for the beautiful and Clean Malaysia (ABC Plan) Kuala Lumpur.
- Malaysia, (2001). Eighth Malaysia Plan (2001-2005) (8MP). Kuala Lumpur: Percetakan Nasional Berhad. p.550.
- Ministry of Housing and Local Government Malaysia. (2005). National Strategic Plan for Solid Waste Management.
- Milne, R. S. 1992. Privatization in the ASEAN States: Who Gets What, Why, and With What Effect? *Pacific Affairs* 65:7-29.
- Murad, M.W. and C.Siwar, Waste Management and Recycling Practices of the Urban Poor:A Case Study in KaulaLumpur city,Malaysia.Online Journal of Waste Management Research,ISWA,UK,2006.
- Murad, W., and C. Siwar. 2007. Waste management and recycling practices of the urban poor: a case study in Kuala Lumpur city, Malaysia. *Waste Management & Research* 25:3-13.
- Nasir, M.H., Lecture notes. Faculty of Environmental studies, UPM, 2004.
- Nesadurai, N., 1999, The 5R Approach to Environmentally Sound Solid Waste, Paper presented in Seminar on "Local Communication and the Environment" organized by EPSM, 24-25th Oct., 1998 Shah's Village Hotel, 1999.
- Pedersen, A. 2008. Exploring the clean development mechanism: Malaysian case study. *Waste Management & Research* 26:111-114.
- Petts.J.(1995).Waste management strategy development :a case study of community involvement and consensus-building in Hampshire. *Journal of Environmental Planning and Management*,38(4),519-536.
- Pongracz, E., Phillips, P.S., & Keiski, R.L.(2004).Evolving the Theory of Waste Management-Implications to waste minimization. *Proceedings of the Waste minimization and Resources Use Optimization Conference*, June 10th(pp.61-7)
- Rasmussen, C., Vigso, D., Ackerman, F., Porter, R., Pearce, D., Dijkgraaf, E., & Sarifah Y.(2009).Solid waste management Hierarchy-application towards the concept of green technology. *Green technology on waste management: current knowledge and practices*.Presented at Green Technology on waste management:current knowledge and practices,Kaula Lumpur.
- Syed. A(2009) Bernama <http://www.epa.gov/waste/nonhaz/municipal/hierarchy.htm>
- Sun, Q., and W. H. S. Tong. 2002. Malaysia Privatization: A Comprehensive Study. *Financial Management* 31:79-105.
- Tanaka, M. 1999. Recent trends in recycling activities and waste management in Japan. *Journal of Material Cycles and Waste Management* 1:10-16.

- Tchobanoglous, G., H. Theisen and S. Vigil, *Integrated Solid Waste Management- Engineering Principles and Management Issues*, published by Mc Graw- Hill, New York, 1993.
- United Nations Development Programme Malaysia. (2008). *Malaysia developing a solid waste management: model for penang*.
- UNCRD, UNEP-RRCAP, and IGES. 2009. *National 3R Strategy Development: a progress report on seven countries in Asia from 2005 to 2009*. United Nations Centre for Regional Development, Institute for Global Environmental Strategies, Nagoya.
- Visvanathan, C., Adhikari, R., & Ananth, A.P. (2007). *3R Practices for municipal solid waste management in Asia*.
- Vollebergh, H. (2005). *Rethinking the Waste Hierarchy*. Environmental Assessment Institute.
- Wahid, A.G., Mohd Nasir Hassan, Muda, *Domestic and Commercial waste: Present and Future Trends*. CAP-SAM National Conference on the State of Malaysian Environment, Penang: RECDAM,1996.
- Weitz, K. A., Thorneloe, S. A., Nishtala, S. R., Yarkosky, S., & Zannes, M. (2002). The impact of municipal solid waste management on greenhouse gas emissions in the United States. *Journal of the Air & Waste Management Association*, 52(9),1000-1011.
- Wilson, D. C. 2007. Development drivers for waste management. *Waste Management & Research* 25:198-207.
- Wolf,K.(1988).Source reduction and waste management hierarchy. *J.AIR POLLUT. CONTROL ASSOC.*, 38(5),681-686.
- Zaini, S., Gerrard, S., A, Jones, P., and Kadaruddin, A. 2002. Policy, challenges and future prospect of solid waste management in Malaysia. *Proceeding on International Sustainable Development Research Conference*. University of Manchester. 8-9 April 2002. 391-398.
- <http://irep.iium.edu.my/id/eprint/8655>
- http://www.fayette.k12.il.us/isbe/science/pdf/sci_8.pdf
- <http://www.epa.gov/tribalcompliance/wmanagement/wmwastedrill.html>
- <http://www.gecnet.info/index.cfm?&menuid=83>
- http://www.eria.org/pdf/research/y2009/no10/Ch11_3R.pdf
- <http://www.epa.gov/wastes/nonhaz/municipal/hierarchy.htm>
- <http://www.gecnet.info/index.cfm?&menuid=83>
- <http://www.gecnet.info/index.cfm?&menuid=83>
- <http://irep.iium.edu.my/id/eprint/8655>
- <http://irep.iium.edu.my/id/eprint/8655>
- http://www.fayette.k12.il.us/isbe/science/pdf/sci_8.pdf
- <http://www.epa.gov/tribalcompliance/wmanagement/wmwastedrill.html>