

**ATTITUDE OF MALAYSIAN ON RECYCLING OF MUNICIPAL SOLID WASTE:
CASE STUDIES IN THE MAJOR TOWNS OF THE EAST COAST AND NORTH
MALAYSIA**

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UNIVERSITI SAINS MALAYSIA

2008

**ATTITUDE OF MALAYSIAN ON RECYCLING OF MUNICIPAL SOLID WASTE:
CASE STUDIES IN THE MAJOR TOWNS OF THE EAST COAST AND NORTH
MALAYSIA**

BY

ABDELNASER OMRAN ALI

Thesis submitted in fulfilment of the
requirement for the degree of
Doctor of Philosophy

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Dedication

To my father and my mother, whose love, support and enduring dedication and devotion to us inspired me and the trajectory of my life.

To my brothers and sister, brother's wives whose loving support and prayers had made this possible.

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

أَقْرَأْ بِاسْمِ رَبِّكَ الَّذِي خَلَقَ ﴿١﴾ خَلَقَ الْإِنْسَانَ مِنْ عَلَقٍ ﴿٢﴾ أَقْرَأْ وَرَبُّكَ
الْأَكْرَمُ ﴿٣﴾ الَّذِي عَلَّمَ بِالْقَلَمِ ﴿٤﴾ عَلَّمَ الْإِنْسَانَ مَا لَمْ يَعْلَمْ ﴿٥﴾

سُورَةُ الْعَلَقِ

In the name of Allah, The Most Beneficent, The Most Merciful

***Read! In the name of your Lord who created - Created the
human from something which clings. Read! And your Lord is
Most Bountiful - He who taught (the use of) the Pen, Taught the
human that which he knew not.***

AL-ALAQ [96:1-5]

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LIST OF ABBREVIATION

3Rs	-	Reduce, Reuse, Recovery
ABC	-	Action Plan for Beautiful and Clean Malaysia
ANOVA	-	Analysis of Variance
BVPIs	-	Best Value Performance Indicators
CFR	-	Code Federation Regulation
DEFRA	-	Department of the Environment., Food and Rural Affairs
DSWM	-	Department of Sanitation and Waste Management
HWRC	-	Household Waste Recycling Centres
JICA	-	Japan International Cooperation Agency
Kg	-	Kilogram
LAs	-	Local Authorities
MHLG	-	Ministry of Housing and Local Government
MORI	-	Market & Opinion Research International
MPI	-	Majlis Perbandaran Ipoh
MPK	-	Majlis Perbandaran Kangar
MPKB	-	Majlis Perbandaran Kota Bharu
MPKT	-	Majlis Perbandaran Kuala Terengganu
MPPP	-	Majlis Perbandaran Pualu Pinang
MSW	-	Municipal Solid Waste
NEP	-	New Environmental Paradigm
NGOs	-	Non-Government Organizations
NOP	-	National Opinion Poll
NREP	-	National Recycling Education Programme
NST	-	New straits Times

NVP	-	National Vision Plan
OPP3	-	Third Outline Perspective Plan
RM	-	Ringgit Malaysian
SPSS	-	Statistical Package for Social Science
TPB	-	Theory Planned Behaviour
WMD's	-	Waste Minimization Strategies
WTE	-	Waste To Energy
WTP	-	Willing To Pay

**SIKAP RAKYAT MALAYSIA TERHADAP KITAR SEMULA SISA PEPEJAL
PERBANDARAN: KAJIAN KES DI BANDAR-BANDAR UTAMA DI PANTAI TIMUR
DAN UTARA MALAYSIA**

ABSTRAK

Pengurusan sisa pepejal di Malaysia menjadi satu tugas yang amat mencabar kebelakangan ini akibat pertambahan penduduk dan perindustrian serta peningkatan dalam kuantiti dan kepelbagaian jenis sisa. Mendapatkan tapak pelupusan sisa baru untuk menggantikan tapak sediada yang telah hampir penuh menjadi amat sukar. Kerajaan Malaysia berusaha menggalakkan kitar semula di kalangan penduduknya melalui kempen-kempen namun usaha ini gagal kerana kurangnya sokongan dan penyertaan dari isirumah. Satu kajian telah dijalankan untuk mengenal pasti sikap isirumah terhadap kitar semula serta faktor-faktor yang berkaitan dengannya. Kajian yang dijalankan melalui pendekatan kuantitatif dan kualitatif ini bertujuan mengenalpasti situasi semasa kitar semula, penyertaan isirumah serta persepsi mereka terhadap kempen kitar semula yang dijalankan oleh kerajaan Malaysia pada tahun 1993 dan 2000. Soalselidik secara pos dijalankan melibatkan 3750 isirumah di bandar utama dalam kawasan pantai timur dan utara semenanjung Malaysia antara Ogos 2005 hingga Januari 2007, dengan kadar respons 99.3%. Temuduga dengan wakil dari Kementerian Perumahan dan Kerajaan Tempatan, Pihak Berkuasa Tempatan dan pihak swasta (Alam Flora Sdn Bhd) juga dijalankan. Analisis statistik dijalankan menggunakan perisian "Statistical Package for Social Sciences" (SPSS), (Versi 11.5). Hasil kajian menunjukkan isirumah peka terhadap kitar semula sisa pepejal. Walau bagaimanapun sebahagian besar isirumah, (92%) di pantai timur dan 87.3% di kawasan utara tidak bersetuju dengan kempen yang dijalankan oleh kerajaan Malaysia dan sebahagian

besar (89.7%) berpendapat kempen berkenaan tidak berkesan untuk mengubah sikap mereka. Satu dari alasan utama yang diberikan ialah “kekurangan kemudahan kitar semula” atau “tidak pasti lokasi pusat kitar semula”. Sehubungan dengan itu, sebahagian besar (93.8%), isirumah dikedua-dua kawasan menanggapi “menyediakan tong kitar semula di semua kawasan kediaman” adalah satu langkah yang berkesan untuk meningkatkan kitar semula. Mesej yang jelas dari penemuan ini ialah, penglibatan isirumah boleh ditingkatkan secara signifikan sekiranya kemudahan yang secukupnya disediakan. Kemudahan-kemudahan ini perlu ditempatkan dilokasi yang strategik bagi memudahkan isirumah menggunakannya. Berhubung cadangan menguatkuasakan undang-undang bagi meningkatkan kitar semula, satu penemuan yang menarik telah didapati dimana lebih 80% isirumah di kawasan pantai timur menyokong berbanding hanya 41% bagi kawasan utara. Selari dengan pandangan pihak Kementerian Perumahan dan Kerajaan Tempatan, Pihak Berkuasa Tempatan dan Alam Flora Sdn Bhd, penguatkuasaan undang-undang dicadangkan sebagai salah satu strategi utama untuk meningkatkan kitar semula dimasa akan datang. Matlamat yang jelas, program kesedaran dan kempen yang lebih efisien, penyediaan kemudahan dan khidmat yang lebih baik dan berkesan, serta penguatkuasaan undang-undang diperlukan. Langkah yang menggembeng penglibatan dan kerjasama semua pihak, penduduk dan pihak berkuasa perlu ditekankan kerana ia merupakan parameter utama kearah kejayaan kitar semula di Malaysia di masa akan datang.

ATTITUDE OF MALAYSIAN ON RECYCLING OF MUNICIPAL SOLID WASTE: CASE STUDIES IN THE MAJOR TOWNS OF THE EAST COAST AND NORTH MALAYSIA

ABSTRACT

Solid waste management in Malaysia has become a challenging task in recent years due to population growth, industrialization and an increase in quantity and variation in the types of waste generated. Suitable disposal sites are becoming difficult to obtain and most of the existing ones are nearly exhausted. The government has promoted recycling programmes through various campaigns however little has been achieved due to the lack of participation and lukewarm attitudes of the households. This research identified the attitudes of Malaysian towards recycling of solid wastes and factors associated with these through quantitative and qualitative approaches. The main objectives were to determine the current situation of solid waste recycling and respondents' participation as well as perception about the recycling campaigns carried out by the Malaysian government in 1993 and 2000. A postal questionnaire survey was administered to 3750 households in the major towns of the east-coast and the northern part of Peninsula Malaysia between August 2005 and January 2007, yielding a response rate of 99.3%. This was followed by personal interviews with representatives of the Ministry of Housing and Local Government, Municipal Councils as well as private sector (Alam Flora Sdn Bhd). Data were analysed statistically using the Statistical Package for Social Sciences (SPSS) software programme (Version 11.5). Results indicated that most respondents in the major towns of the east-coast and the northern part of Malaysia were aware of the recycling of solid wastes. However, the study found that an overwhelming proportion of the respondent (92%) in the east-coast and 87.3% in northern part disagreed with the current recycling campaigns and 89.7% considered that the

campaigns were ineffective in changing respondents' attitudes. One main reason given for not recycling was "the lack of facilities" or the "inability to locate the recycling centres". Thus, a large percentage of respondents (93.8%), in both part ranked "provide recycling bins in every residential area" as one of the most effective way of boosting recycling activities. A clear message from the study was that respondent participation can significantly be improved if adequate recycling facilities are provided. These facilities must be strategically located and be within easy reach. With regard to enforcement of law to increase recycling activities an interesting result was obtained. Whilst more than 80% of the east-coast respondents supported the idea, only 41% in the northern part agreed to it. In line with the views of the Ministry of Housing and Local Government, Municipal Councils and Alam Flora Sdn Bhd who also agreed to it, the imposition of law was proposed as one of the key strategies to promote recycling in the future. Clear goals, more efficient awareness programmes and campaigns, enhanced and more reliable recycling services and facilities, and enforcement need to be established. It is suggested that concerted efforts by all parties, people and authorities have to be established as they are the key parameters to the future success of recycling in Malaysia.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

The management of solid waste continues to be a major challenge in urban areas throughout the world, particularly in the rapidly growing cities and towns of the developing world. In fact, the lack of an effective and efficient solid waste management system has had a negative impact on the environment. Malaysia, with a population of over 25 million in 2007 generates approximately 18, 000 metric tonnes of domestic waste daily, making it one of the highest waste generators in the world (Ong, 2007). These wastes are disposed off at 230 disposal sites in the country. Of these, only 7 are sanitary landfills (NST, 2002) while the rest are open dumps. However, about 80% of these dumps have reached full capacity and are expected to be shut down over the next few years.

At present, the average per capita generation of solid waste in Malaysia varies from 0.5 to 0.8 kg/person/day depending on the economic and geographical status of an area. For instance, it is 1.7 kg/person/day in major cities (Kathirvale *et al.*, 2003). Currently, the waste management approach being employed is the landfill approach but due to rapid development and the lack of space for new landfills, authorities in most major towns in Malaysia are looking at other waste management approaches. One such approach is waste recycling as attested by the Malaysian government's adoption of this approach as a long-term strategy for solid waste management (MPPP, 2003). Apart from this, Federal and State governments are also planning to build incinerator plants in major towns throughout the country in its attempt to devise and implement a systematic waste management plan. In fact, under the Seventh Malaysia Plan (1995-2000), the government

had spent RM17 million to purchase 7 mini-incinerators with a capacity of 5 to 20 ton/day for use in the resort islands of Langkawi, Labuan, Tioman and Pangkor (MPPP, 2003). But in the 8th Malaysian Plan (2001-2005), the government has included “waste minimisation”, “promotion of reuse”, “developing a recycling-oriented”, and “implementation of pilot projects for recycling” as some of its main policy goals. The 9th Malaysian Plan (2006-2010) further emphasised the continuation of reduce, reuse, recovery and recycling of waste as well as greater use of environmentally friendly products. Recently, a new department, known as the “Jabatan Pengurusan Sisa Pepejal” (National Solid Waste Management Department), has been set up under the ministry of Housing and Local Government after the bill is gazetted to implement the new policy (MHLG, 2007). All matters relating to solid waste management will be under the jurisdiction of this new department.

The Malaysian government has also enacted new laws on solid waste management as well as drafted a Strategic Plan for Solid Waste Management in Peninsular Malaysia. The principle processes options available for integrated waste management as classified in a top-down hierarchy include waste minimization, reuse, material recycling, energy recovery and landfill. Under the plan, waste treatment facilities such as transfer stations, thermal treatment plants and waste to energy production facilities (WTE) have also been earmarked as alternative treatment methods of solid waste management in the near future.

The Government of Malaysia, through the Ministry of Housing and Government (MHLG) launched a national recycling in 1993. But the campaign was not successful due to lack of support and participation from the public. It was re-launched its recycling campaign on 2nd December 2000. At the launch, it projected that by 2020, 22% of all

waste would be recycled (Table 1.1). In tandem with government initiatives, several community groups and NGOs have launched numerous recycling programmes as well as spearheaded waste management efforts such as the collection of re-usables. Apart from this, they are also lobbying for more stringent legislation and a commitment from the government that it phases out and ban hazardous household products, minimize packaging, prevent the generation of waste at source, and promote environmentally friendly initiatives such as reuse, recycling and composting. Nevertheless, more needs to be done in order to reduce the generation of waste in order to attain the ideal target of zero waste generation (Ong, 2002).

Table 1.1: Projection of recycling rate in Malaysia from 2001 until 2020

Year	Total Waste generated (tonnes/ year)	Recycling rate (%)
2001	160,600	3.0
2002	164,615	4.0
2003	168,730	5.0
2004	172,949	6.0
2005	177,272	7.0
2006	181,704	8.0
2007	186,247	9.0
2008	190,903	10.0
2009	195,676	11.0
2010	200,567	12.0
2011	205,582	13.0
2012	210,721	14.0
2013	215,989	15.0
2014	221,389	16.0
2015	226,924	17.0
2016	232,597	18.0
2017	238,412	19.0
2018	244,372	20.0
2019	250,481	21.0
2020	256,743	22.0

Source: Implementation of the semi-aerobic landfill system (Fukuoka Method) in developing countries: A Malaysia cost analysis by Chong *et al.*, (2005)

As noted above, Malaysia generates approximately 18, 000 tonnes of solid waste daily, of which only 70% is collected and disposed. The remaining 30% is either disposed of illegally or is recycled. However, it is estimated that only 3-5% of the waste is actually recycled implying that at least 25 % is dumped into unauthorized dumping sites. This deplorable state of affairs is due to the general apathy of the Malaysian public towards proper waste disposal and the lack of a proper policy on solid waste management. In fact, there is a dire need to educate the public on the profound ramifications accruing from improper disposal of solid waste into the environment. Such educational initiatives should focus on effecting attitudinal change amongst the local populace.

In view of the foregoing facts, this study will attempt to identify desirable future attitudes of households with regard to recycling solid waste as well as evaluate current recycling campaign practices and intensity levels in the east coast and northern regions of Malaysia. The prime aim is to gain an insight into the factors determining the general failure of such campaigns and reasons for non-participation of the general populace in recycling initiatives.

1.1 Problem Statement

Prior to 1993, Malaysia's urban population generated about 5.2 million tonnes of waste or between 0.34-0.85 kg/capita/day. By 1997, the total solid waste generated throughout Malaysia totaled 5.6 million tonnes or 15,000 million kg /day, of which 80 % comprised of domestic waste (about 12,100,000 kg/day), the rest (about 3,100,000 kg/day) being commercial waste (Agamuthu, 2001). Municipal solid waste (MSW) increased to 6.0 billion kg in 1998, with an average of 0.5 to 0.8 kg/capita/day. Overall, average per capita waste generation increased from 0.70 kg/person in the 1990s to 1.2

kg/person in 2000. In general, waste generation rates in Malaysia are closely related to the activities carried out in the respective communities be it domestic, commercial, institutional, or industrial in nature. They are also closely linked to the economic status of the respective communities such as squatters, low, medium and high-class residential dwellers as waste generation among the different segments of the population varies greatly. Depending on the economic status of the area, the per-capita generation rate varied from 0.45 to 1.44 kg/capita/day (Hassan *et al.*, 1998) which by 2003, had increased to about 1.7 kg/capita/day.

The collection system of municipal solid waste is currently experiencing certain problems such as littering around communal bins and the existence of different bin sizes and bin weights which makes collection difficult (Hassan *et al.*, 2000). The only method of waste disposal currently being practiced in Malaysia is the landfill method. In 2000, there were about 230 waste disposal sites in Malaysia with each area, on average, measuring 15 hectares. More than 80 percent of these sites have a remaining operating lifespan of 2 years (Noor, 2005). Solid waste landfill sites have a number of negative environmental impacts, especially if these sites are not properly managed. This situation has become especially critical in recent times due to the increasing amounts of wastes being generated and due to the inadequacy of present waste management techniques to prevent serious environmental pollution.

The main problem wrought by the rapid increase of solid wastes is its detrimental effect to both humans and the environment. Currently, the waste management approach being employed is the landfill method but due the increasing lack of space for new landfills, authorities in the major towns of Malaysia are studying other waste management approaches.

One of the measures proposed is the adoption of recycling as a long-term strategy for solid waste management. The aim is to transform the "throw-away" culture of its population to that of a "conserving" one. In line with this paradigm shift in waste management, the Malaysian and Singaporean governments have invested massive amounts to subsidize their recycling initiatives. However, the results thus far have been far from impressive. A system of door-to-door purchasing of recyclables was introduced in Malaysia in 1993. However, the lack of knowledge and expertise related to recycling on the part of the authorities have rendered these programmes generally ineffective (Noor, 1997).

The cool reception to such campaigns was again reflected in the public's lukewarm response to the re-launched campaign in 2000 which involved the participation of NGOs and community groups as well as the launch of an extensive public education and publicity campaign. The failure of these campaigns is attested to by Omran and Mahmood (2004). The overall failure of the campaign has been succinctly noted by the Minister of Housing and Local Government, The Star (12, August 2003):

"I am unhappy with the results; the government can only plan and advice, the rest is up to the people. After more than two years of recycling campaigns, only 2% of waste is recycled and it takes only nine and a half days to fill the Petronas twin towers with garbage"

Source: The Star (12, August, 2003)

In fact, the figures quoted above are way below the government's target of increasing the nation's recycling rate to 22% by 2020 which would require a drastic transformation in habits and attitudes, The Star (18 January 2003).

In the major towns of the east-coast and northern states of Malaysia, it is common to see household throwing litter from cars or motor vehicles into the streets whilst traveling and to see household in the parks or shopping centers leaving litter on the benches even though rubbish bins are situated within easy walking distance. This is really an indication of a lack of social responsibility by these people and one that has a negative impact on the cleanliness of the major towns in general. In more serious cases, in some areas in these towns, especially lower and medium income areas; household deliberately dump their waste into open manholes or drains thinking that it will be carried away with rainwater, not understanding the clogging and pollution problems this causes.

In other areas, especially higher income areas, the situation is better. Household do not throw their wastes in the street, but leave their plastics bags of waste on the streets where the waste becomes sorted and scattered by scavengers; only just better than the direct dumping of waste into the drains.

Despite the relative lack of success and receptivity to the concept of recycling, the government has initiated several measures to burnish the image of recycling amongst the general public. For instance, in order to consolidate recycling's role as a cornerstone in waste management policy initiatives, a new law on solid waste management has been introduced and a Strategic Plan for solid Waste Management in Peninsular Malaysia is being drafted. Recycling is receiving increasing attention today as the nation grapples with the problems caused by Municipal Solid Waste (MSW). In fact, quadrupling recycling efforts is a key goal for many state and local governments, private companies, and public interest groups as current methods of solid waste management have been hindered by financial, spatial and technological constraints.

1.2 Research Questions

This research aims to study the attitude of the Malaysian on the recycling of municipal solid wastes particularly in the major towns. Despite the vast public expenditure expended on recycling campaigns, less than 5% of the total solid waste generated in the country is actually recycled with the remaining ending up in landfills or open dumps (MHLG, 2007). The study attempt to answer the following:

1. Why these campaigns have failed to engender Malaysian participation in recycling activities?
2. What are the factors which prevent people from recycling?
3. If these reasons could be determined and effort made to remove it, Will more people be recycling their wastes?
4. To determine whether the failure is due to the "Malaysian attitude" or it is due to other factors such as "the lack of understanding of the importance or due to the failure of the camping itself?
5. Why did some people do recycle their waste?
6. What motivates them to recycle? and;
7. Is there any difference between those who recycle and those who do not recycle?

1.3 Research Objectives

The major objective of this study is to analyze the attitudes of Malaysian to the recycling of municipal solid wastes. Consequently, the research seeks to affirm five objectives, which are:

1. To identify the attitude of Malaysian's in the major towns of the east-coast and north Malaysia towards recycling.
2. To identify the factors that shape participation in recycling of municipal solid wastes and its campaigns.
3. To investigate the level of awareness and understanding towards recycling among the respondents in 5 major towns of the east coast (Kota Bharu and Kuala Terengganu towns) and northern States which included (Pulau Pinang, Ipoh and Kangar towns).
4. To ascertain whether the implementation of laws on recycling is agreed by the respondents.
5. To propose effective strategies that can be implemented by the government to increase the rate of recycling in Malaysia.

1.4 Research Methodology

In order to evaluate the efficacy of local recycling campaigns, it was decided to investigate the approach adopted by Malaysian authorities and the attitude and responses/receptivity of households towards recycling campaigns. The methodology of this research will basically involve the analysis of two sources of data which are outlined as follows:

1.4.1 Primary Data

This will consist of obtaining the most current data needed to carry out this research. The data thus obtained will then be analyzed and commented. Recommendations derived from the conclusions will then be proffered. The primary data will be collected through the distribution of a questionnaire to glean the attitudes of household on the recycling of solid waste. The questions will focus on:

- their attitudes towards recycling.
- their views as to what can be done by the authorities to encourage households to recycle.
- their knowledge of the facilities available and how they knew about the existence of these facilities.
- their need for information on facilities they would like to be informed about.
- their opinions of the Local Authority (LA) operating in their areas.

Primary data will be collected from:

- a) Households in the 5 major towns.
- b) Ministry of Housing and Local Governmnet (MHLG) and every Municipal Council in each major town of the east-coast and northern part of Malaysia.

Overall, the survey will be divided into two sections (A and B) which are outlined below:

- i) Section A will consist of a set of questionnaires designed to investigate the attitude of households on the recycling of solid wastes in the study area.

ii) Section B will comprise interviews with Ministry of Housing and Local Government (MHLG), Municipal Councils (MCs) in the east-coast and northern States and private sector companies involved in the recycling of solid wastes such as Alam Flora Sdn Bhd.

1.4.2 Secondary Data

Secondary sources that will be used include articles and extracts, from newspapers, magazines, reports, journals, government documents, proceedings and internet websites on:

- The management of solid waste by the municipal councils namely Majlis Perbandaran Pulau Pinang (MPPP) in Pulau Pinang, Majlis Perbandaran Kangar (MPK) in Perlis, Majlis Perbandaran Ipoh (MPI) in Perak, Majlis Perbandaran Kuala Terengganu (MPKT) in Terengganu and Majlis Perbandaran Kota Bharu (MPKB) in Kelantan. It is necessary to carry out these studies across all socioeconomic strata (lower, middle-class, and upper) in order to see their attitudes towards the recycling of solid wastes, in order to facilitate the comparison of results so as to verify whether recycling campaigns are a success or a failure.
- The recycling campaign efforts conducted by the government bodies in these towns.
- The infrastructure provided by the Ministry of Housing and Local Government to support recycling in the towns surveyed.
- Report of study on waste minimization by the Ministry of Housing and Local Government (MHLG) and Japan International Cooperation Agency (JICA).

1.5 Analysis of Data

Analysis of data will focus on data gained via the questionnaire pertaining to the various sources mentioned in the above sections. All data will be analyzed using the SPSS software (version11.5).

1.6 Research Scope

The scope of the research is as follows:

1. The area of this study is confined to the major towns in the Northern part of the peninsular namely Pulau Pinang, Perak and Perlis and the major towns on the East-coast namely those located in the states of Kelantan and Terengganu. The focus of the survey in each state will be on residential areas as well as on villages and rural areas etc. The study will also encompass primary and secondary schools as well as universities.
2. Primary data will be collected through questionnaires mainly through postal and electronic mailing addressed to a selective group of respondents as mentioned in section 1.4.2. Besides, data will also be compiled via interviews conducted in households located in the major towns in east coast and northern states of Peninsular Malaysia.

Organization of the thesis

Chapter 1 commences with some basic information on solid waste generation and its management in Malaysia followed by a brief overview of the recycling problem in Malaysia. Issues of concern, which served as input for this research, are also elaborated upon. The research objectives, research questions and the general flow of the whole research program are also outlined.

Chapter 2 elaborates on the definition of solid waste and its management in Malaysia and abroad.

Chapter 3 explicates on the household attitude towards recycling abroad with special focus on the success and failure as well as the lessons learnt. The importance of recycling is also explicated upon. Subsequently, a literature review on various published works on the recycling of solid wastes and household attitude towards recycling follows.

Chapter 4 details step-by-step the theoretical procedures employed in this research. Descriptions of the questionnaire survey and interviews used as well as other data generation techniques used in the research are further elaborated.

Chapter 5 presents the results of the data analysis and its interpretations.

Chapter 6 discusses the results of the findings.

Chapter 7 presents some concluding remarks on the present work as well as some suggestions for further study.

CHAPTER TWO

AN OVERVIEW OF MUNICIPAL SOLID WASTE MANAGEMENT IN MALAYSIA

2.1 Solid Waste and its Management

A precise definition of solid waste should be first preceded by a definition of what constitutes waste. Essentially, waste is defined as “any substance which constitutes scrap material or an effluent or other unwanted surplus substance arising from the application of a process, or any substance or article which requires to be disposed of is being broken, worn out, contaminated or otherwise spoiled” Environmental Protection Act (1990). In contrast, Gandy (1994) defined waste as any substance or object which the holder discards or intends to discard while Read (1999a) regarded waste irregardless of its origin as the imperfect utilization of raw materials, fuel, water, and hence constitutes a financial loss for somebody (Read, 1999a). It can be implied from these definitions that waste generally refers to garbage that accrues from household, commercial, industrial or agricultural activities and processes that has no economic or utilitarian value for the disposer. Having thus broadly defined of what constitutes waste, it is now pertinent to consider the nature of solid wastes.

The literature is replete with definitions on what is considered to be solid waste. Solid waste is defined as solid material possessing negative economic value, which suggests that it is cheaper to discard than use (Pichtel, 2005). A more precise definition is provided by the U.S. Code of Federation Regulations (40 CFR 240.101) which defines solid waste as:

“Garbage, refuse, sludge, and other discarded solid materials resulting from industrial and commercial operations and from community activities. It does not include solids or dissolved materials in domestic sewage or other significant pollutants in water resources, such as silt, dissolved or suspended solids in industrial wastewater effluents, dissolved materials in irrigation return flows or other common water pollutants”.

Other definitions have been proffered by numerous researchers as to what constitutes solid waste. Tchobanoglous *et al.*, (1993) broadly defined solid wastes as wastes arising from human and animal activities that are discarded as useless or unwanted while Read *et al.*, (1998) opined that solid wastes arose from unusable residues in raw materials, leftovers, rejects and scraps from process operations, used or scrap packaging materials and saleable products themselves when they are finally discarded.

Basically, it can be implied from the above definitions that solid waste encompasses the more solid types of refuse, such as garbage, old newspapers, packaging materials, yard waste, and other items that are discarded by the typical household. Other constituents of solid waste comprise bulky appliances, old furniture, dead trees, junked automobiles, street sweepings, construction rubble, and demolition debris. Besides this, commercial and industrial refuse materials, such as waste paper, damaged or discarded products, scrap metal, and food processing residues can also be regarded as solid wastes (Lund, 2001). Thus, it can be inferred that solid waste basically consists of the non-liquid and non-effluent component of rubbish emanating from household, industrial or commercial activities.

2.1.1 Waste Hierarchy and 3R's

The origins of the waste management hierarchy can be traced back to the 1970s, when the environment movement started to criticize the practice of disposal-based waste management. These movements argued that 'rubbish' should not be considered to be a homogenous mass that should be buried. Instead, they propounded that it was made up of different materials that should be treated differently i.e., either reused, recycled composted, burnt or buried (Schall, 1992).

The waste hierarchy as shown in Figure (2.1) was first introduced as a waste management policy initiative through the promulgation of the European Union's Waste Framework Directive in 1975. In 1989, it was formalized as a hierarchy of management options by the European Commission's Community Strategy for Waste Management and was re-endorsed in the commission's subsequent review of the strategy in 1996. The underlying principle of the concept revolved around the "3Rs" strategy – Reduce, Reuse, Recover – followed by unavoidable disposal. Based on the precautionary principle, the waste hierarchy prioritized prevention and source reduction of waste then its reuse and recycling as well as the optimization of its ultimate disposal. In other words, the waste management hierarchy (Figure 2.1) states that waste generation should be prevented or reduced at the source whenever feasible with safe disposal being the option of last resort. Basically, the first option i.e., source reduction or waste prevention is primarily designed to reduce the amount of trash being discarded and to promote the reuse of containers and other similar products. Recycling, including such techniques like composting, should be the second option that should be considered in waste disposal. If waste cannot be recycled, incineration or sanitary landfilling were prescribed as the third option of

treatment. Finally, the safe disposal of waste was recommended as the final option due to the technological complexities and costs involved.

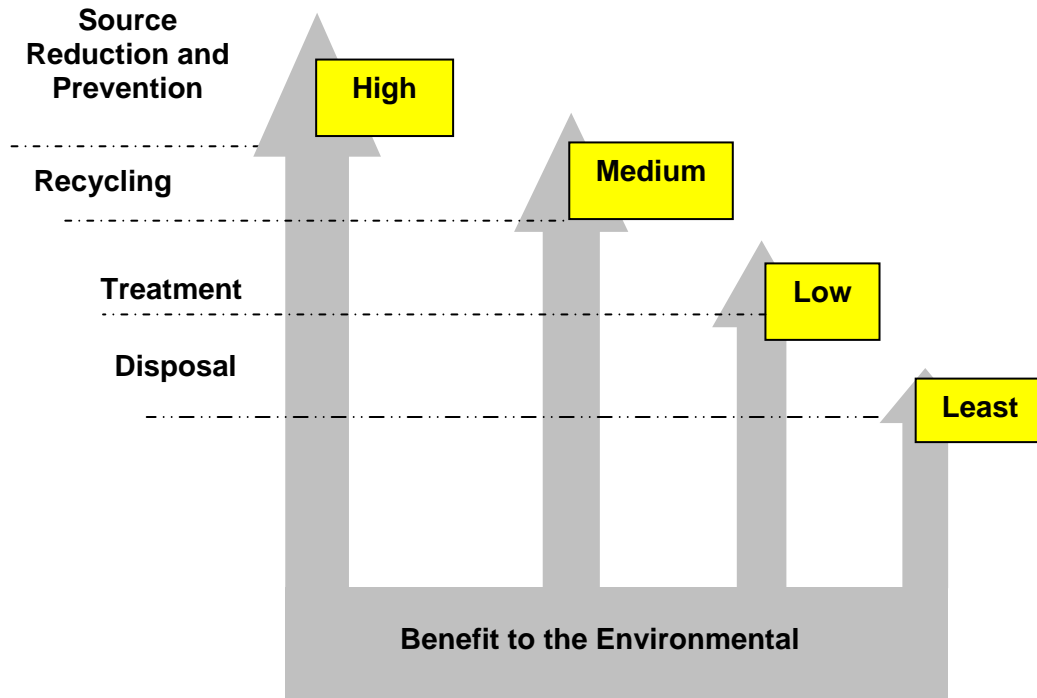


Figure 2.1: The Waste Hierarchy

The hierarchy has been the cornerstone of the UK waste management policy since the early 1990s, a fact emphasised in a report entitled *Waste Not Want Not* (2000) in which a more detailed version of the waste hierarchy was elucidated. The report surmised that waste reduction is the most preferred option, while landfill without energy recovery was deemed to be the least preferred option.

The waste generation and disposal scenario in Malaysia is in many ways similar to the situation prevailing in other Third World countries. Table 2.1(refer to page19) shows the urban municipal solid waste generation in Asia for the 1995- 2025 period. It can be surmised that waste generation has increased exponentially due to a burgeoning

population and a concomitant increase in the per capita rate of waste generation. This scenario is especially prevalent in the major towns of Malaysia where both the local population and local economies have expanded rapidly due to a combination of industrialization and urbanization.

Table 2.1: Urban Municipal Solid Waste Generation in Asia in 1995 and 2025

Country	GNP per capita (1995 US\$)	GNP per capita in 2025 (1995 US\$)	Current Urban	2025 Urban	Current Urban MSW Generation (Kg/capita/day)	2025 Urban MSW Generation (Kg/capita/day)
Low income	490	1,050	27.8	48.8	0.64	0.6-1.0
Nepal	200	360	13.7	34.4	0.50	0.6
Vietnam	240	580	20.8	39.0	0.55	0.7
Mongolia	310	560	60.9	76.5	0.60	0.9
India	340	620	26.8	45.2	0.46	0.7
China	620	1,500	30.3	54.5	0.79	0.9
Sri Lanka	700	1,300	2.44	42.6	0.89	1.0
Middle income	1,410	3,390	37.6	61.1	0.73	0.1-1.5
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
High Income	30,990	41,140	79.5	88.2	1.64	1.4-4.5
Korea Republic	9,700	17,600	81.3	93.7	1.59	1.4
Hong Kong	22,990	31,000	95.0	97.3	5.07	4.5
Singapore	26,730	36,300	100.0	100.0	1.10	1.1
Japan	39,640	53,500	77.6	84.9	1.47	1.3

Source: World Bank. What a Waste: Solid Waste management in Asia May (1999).

2.2 Recycling of Solid Waste

Recycling in the context of solid waste may be defined as the reclamation of material and its reuse which could include repair, remanufacture and conversion of materials, parts and products. Reclamation of materials from solid waste is not something new (Kaseva & Gupta, 1996). Generally, recycling can be defined as “the process through which materials previously used are collected, processed, remanufactured, and reused” (Schultz *et al.*, 1995). In general, recycling is widely perceived to be “the beneficial reuse” of products that would otherwise be disposed off. Moreover, recycling diverts waste from overloaded landfills besides providing raw materials that consume less fuel during the manufacturing process. As such, recycling is often viewed to be an important aspect of an efficient and effective solid waste management system.

The recycling of municipal solid wastes basically involves the collection of waste generated by people in their daily lives and its subsequent sorting for either commercial or manufacturing purposes (Kreith, 1994). As recycling involves the reuse of certain products, it constitutes a way of preserving our natural resources through reduced demand for raw materials such as tin, aluminum, paper and glass. Besides this, recycling also helps in reducing pollution and energy consumption. This view regarding recycling concurs with that of Waite (1995) who defines recycling as referring to the conversion of waste as discarded material with no worth into useful materials (resource with an economic value). Omran and Mahmood (2004), on the other hand, extends the definition to encompass the things normally given to others for use once it is no longer needed for one’s personal use.

2.3 Solid Waste Disposal in Malaysia

In general, Malaysia adopts a variety of waste disposal methods which will be elaborated in the following subsections.

2.3.1 Landfill

Generally, the landfill method is the least preferred (see Fig. 2.1) method of waste disposal as prior to land-filling, wastes should be subjected to physical, chemical and biological treatment and segregation which are both costly and time consuming (Grodzinska-Jurczak, 2001). Like most developing countries, solid waste landfill sites in Malaysia comprise of either open dumping or controlled dumping sites as proper sanitary landfill concepts are not fully implemented due to technological and financial constraints (Chong *et al.*, 2005). Approximately 230 landfill sites are currently in operation. The list of existing landfill sites as prepared by the Ministry of Housing and Local Government (MHLG) is summarized in Table (2.2), (refer to page 24) while the list of closed landfill sites is summarized in Table (2.3). In general, the classification of a landfill is based on the decomposition processes that occur in a landfill: (1) anaerobic landfill, (2) anaerobic sanitary landfill with daily cover, (3) improved anaerobic sanitary landfill with buried leachate collection pipes; (4) semi-aerobic landfill with natural ventilation and leachate collection facilities; (5) aerobic landfill with forced aeration (Idris *et al.*, 2004). However, for operational purposes, a second classification system is used: Level 1, controlled tipping; Level 2, sanitary landfill with a bund (embankment) and daily soil covering; Level 3, sanitary landfill with a leachate recirculation system; Level 4, sanitary landfill with a leachate treatment system (MHLG, 2002). The characteristics of landfill sites using the second classification system are summarized in Table 2.2. Idris *et al.*, (2004) used the second classification system to assess and classify landfill sites in

Malaysia. Based on the assessment, the landfill sites were categorized into four types: (1) dumping into water bodies; (2) open dumps (3) controlled tipping (Level 1, 2, and 3 landfills); (4) sanitary landfill (Level 4 landfills). The results of this assessment indicated that 25% of landfill sites under the purview of municipal councils and 59% of those under the purview of district councils are open dumps (Table 2.4, page 25). The major problems associated with these sites encompassed the insufficient application of cover material, odor from waste decomposition, flies and other vermin, as well as smoke and open burning which were either set spontaneously or purposely by scavengers. A subsequent review conducted in 2002 indicated that there has been not much improvement in the state of the open dumps (Table 2.2, page 23). In total, there were 77 open dumps (level 0), 49 controlled tipping landfills (Level 1), and only 35 landfill sites of levels 2, 3, and 4 status. The results also showed that the largest numbers of open dumps were located in Sarawak, followed by Johor, Sabah and Kelantan (Table 2.5, page 25).

Table 2.2: Existing Landfill Sites in Malaysia

No.	States	Number of Landfill	Average area (ha)	Waste received (ton/day)	Landfill Level				
					Level 0	Level 1	Level 2	Level 3	Level 4
1	Johor	18	5.6	1,082	10	6	2	1	0
2	Melaka	4	18.5	1,065	2	0	1	1	0
3	Negeri Sembilan	11	10.9	727	7	3	1	0	0
4	Selangor	14	10.6	2,285	0	7	1	1	5
5	Pahang	14	8.7	895	5	3	2	3	1
6	Terengganu	8	5.6	707	2	4	1	0	1
7	Kelantan	12	5.6	424	10	1	1	0	0
8	Perak	19	10.3	1,450	9	6	3	1	0
9	Kedah	10	7.7	893	3	2	4	0	1
10	P. Pinang	2	22.3	1,400	0	0	1	1	0
11	Perlis	1	4.0	100	0	0	0	0	1
12	Sarawak	36	2.9	1,000	20	14	2	0	0
13	Sabah	20	21.7	851	15	4	1	0	0
14	KL	1	12.0	600	0	0	1	0	0
15	Labuan	1	12.1	12	0	1	0	0	0
Total		171	9.1	13,491	83 48%	51 30%	21 12%	8 5%	9 5%

Notes: Level 0: Open dumping
 Level 1: Controlled tipping
 Level 2: Controlled landfill with bund and daily cover soil
 Level 3: Sanitary landfill with leachate recirculation system
 Level 4: Sanitary landfill with leachate treatment system

Source: MHLG, (2002)

Table 2.3: Closed Landfill Sites in Malaysia

No.	States	Number of closed landfills	Average operation period (years)	Operations commenced in			Landfill closed in		
				1970	1980	1990	1994	1995-1999	2000
1.	Johor	7	7	2	2	3	0	4	3
2.	Melaka	4	20	2	2	0	1	0	3
3..	N. sembilan	1	n.a.	0	1	0	n.a.	n.a.	n.a.
4.	Selangor	9	8	0	4	5	1	7	1
5..	Pahang	9	8	0	2	7	0	1	8
6.	Terengganu	7	13	1	3	3	2	4	1
7.	Kelantan	5	12	0	3	2	0	2	3
8..	Perak	4	9	1	1	2	1	2	1
9.	Kedah	5	8	3	1	1	3	0	2
10.	P. Pinang	0	-	-	-	-	-	-	-
11.	Perlis	0	-	-	-	-	-	-	-
12.	Sarawak	5	12	1	4	0	1	2	2
13.	Sabah	5	13	2	2	1	3	1	1
Total		59	9.3	12 20%	25 41%	24 39%	12 20%	23 39%	24 41%

Source: MHLG, (2002)