MANAGEMENT OF HAZARDOUS & SOLID WASTES IN JAMAICA

Sustainable Development and Regional Planning Division
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Introduction

The Barbados Plan of Action for Small Island Developing States (SIDS) identifies the management of wastes as a critical issue in achieving sustainability. Worldwide, waste production is growing with significant increases in developing countries. Over the past 30 years, the generation of solid waste per capita in Latin America and the Caribbean (LAC) has doubled, increasing from 0.2-0.5 kg/day to 0.5 to 1.0 kg[1]. In Jamaica, for instance, there has been a 50 per cent increase in the per capita generation of solid waste in the last 5 years alone, moving from 1 kg to 1.5 kg[2] . There has also been a change in the composition of waste with more non-biodegradable and hazardous waste which are detrimental to human and environmental health. In general the country's changing socio-economic and demographic variables have been influencing both the type and quantity of waste being produced. These factors include population size and structure; consumption patterns and lifestyles; changes in household size and composition; changing gender roles; urbanization and shifts and expansion of economic activities.

Researchers contend that there is a positive relationship between economic activity as measured by Gross Domestic Product (GDP) and the volume of waste produced. The higher the per capita GDP of a country, the higher the quantity of waste produced (Stanners and Bordeau, 1995; European Environment Agency, 2000). Generally middle to high income countries have a higher per capita waste generation than low income ones. In the case of Jamaica, per capita GDP has been on an upward trend and is expected to continue in light of the Government of Jamaica (GOJ) plans for the country to achieve developed country status by 2030. The type of development path chosen will also influence the type and volumes of waste produced.

Currently, the proper management of waste is posing a serious challenge to Jamaica's sustainability. One of the main problems is that like many other developing countries, Jamaica lacks the technical and financial resources to adequately manage waste. This has

[1] UNEP Global Environment Outlook, 2000
[2] Estimated from Waste Characterisation Study at the Riverton Landfill, National Solid Waste Management Authority, 2006.

resulted in inefficient and inadequate collection, treatment and disposal. This problem is further exacerbated by the lack of a comprehensive and integrated waste management policy. Another challenge relates to the complexities brought about by the different types and nature of wastes with which the country has to contend.

Although there have been a number of initiatives to improve the management of wastes, these have been inadequate and fragmented. The purpose of this paper is to provide a brief review of solid and hazardous waste management within the country and assess future challenges, especially in light of the Government of Jamaica's (GOJ) plans for the country to achieve developed country status by 2030 and the impact this will have on the generation and management of wastes.

Section 1 describes the solid and hazardous waste management system. Section 2 identifies factors affecting solid waste generation. Section 3 discusses economic, social and environmental dimensions of waste management. Section 4 discusses the future challenges and management goals for solid and hazardous waste management.

1. Overview of Waste Management System

Jamaica produces all types of wastes which include gaseous emissions, solid and hazardous waste and sewage. This paper focuses on the management of solid and hazardous waste in Jamaica.

Solid Waste

Solid waste is broadly defined as non-hazardous, industrial, commercial and domestic refuse including household organic trash, street sweepings, hospital and institutional garbage, and construction wastes. In 2006, approximately 1 463 905.5 tonnes[3] of solid waste were produced from residential, commercial and institutional sources. Over the past decade there has been a 150 per cent increase in per capita generation of solid waste from 0.6 kg/person/day (Treasure, 2002) in 1996 to 1.5 kg/person/day in 2006. This means that the total volume of solid waste has more than doubled over the period moving from approximately 549 690 tonnes.

Characterisation of the Solid Waste Stream

A Waste Characterisation Study carried out by the National Solid Waste Management Authority (NSWMA) in 2006 reported that 69 per cent of the solid waste produced in Jamaica is organic and represents approximately 1.01 million tonnes by volume (Tables 1 & 2). Between 2000 and 2006, data show that organic waste generation increased by 14 percentage points. The high content of organics in solid waste is similar to other Caribbean countries such as Trinidad & Tobago and Barbados (Table 3). This high organic content is probably due to the consumption patterns of developing countries.

[3] This is a crude estimate based on 1.5 kg per capita per day and a population size of 2,673,800 in 2006.

Table 1. Percentage of Waste Generation by Type, 2000 and 2006

Type of Waste	Percentage (Yr 2000)	Percentage (Yr 2006)
Compostables (Organic)	55	69
Paper	13	5.9
Plastic	12	13.9
Metal/ Tin	5	2.3
Cardboard	4	3.7
Glass	4	2.4
Textile	3	2.3
Wood Board	1	0.3
Other	3	0.2
Total	100	100

Source: Waste Characterisation Study, NSWMA, 2006

Table 2. Solid Waste Generation by Volume, 2006

Category	Percentage	Volume (tonnes)
Compostables (Organic)	69	1 010 094.8
Paper	5.9	86 370.5
Plastic	13.9	203 482.9
Metal/Tin	2.3	33 669.8
Cardboard	3.7	54 164.5
Glass	2.4	35 133.7
Textile	2.3	33 669.8
Wood Board	0.3	4 391.7
Other	0.2	2 927.8
Total	**100**	**1 463 905.5**

Source: Compiled by the Planning Institute of Jamaica

Developed countries have less organics in their solid waste streams and have a higher quantity of plastic and non-biodegradable material (Table 3). This is probably related to the wealth and consumption patterns and the higher level of processed foods in developed economies. The generation of waste plastics in Jamaica and Trinidad & Tobago were almost as high as in the United States of America which means that the countries are almost on par with developed countries in consuming plastic products.

Table 3. Comparison of Percentage Solid Waste Composition, 1999, 2000

	Jamaica	Trinidad & Tobago	United States
Category	**2000**	**1999**	**2000**
Organics	55	46	19.5
Paper	13	13	32.8
Plastics	12	12	14.3
Cardboard	4	7	
Glass	4	6	5.7
Textile	3	4	3.9
Metal	5	7	6.9
Wood Board	1		9.3
Other	3	5	7.6
Total	100	100	100

Source: Waste Characterisation Study, NSWMA, 2000; SWMCOL, 1999, Trinidad & Tobago

A high content of organics and inert material (dust, sand, dirt) in the waste stream results in high waste density (weight to volume ratio) and high moisture content. High waste densities and moisture content influence the feasibility of certain treatment options (Zurbrugg, 2003). For example, incineration would not be a feasible option for waste streams with high moisture content but composting would probably be a better option.

Managing Waste

The NSWMA was established in 2001 and has the sole jurisdiction for solid waste management in the country. Prior to the establishment of the NSWMA, garbage collection was vested under the respective Parish Councils within each parish. The NSWMA was given its legal mandate with the enactment of the National Solid Waste Management Policy and the National Solid Waste Management Act (2002). The Authority currently collects, treats and disposes of domestic solid waste while simultaneously regulating the sector. This has proven to be difficult in light of the inadequate capacity of the NSWMA. Hence, the Authority is transitioning to a regulatory mode while contracting out collection, treatment and disposal services. The NSWMA is not responsible for the collection, treatment and disposal of commercial, agricultural, industrial or hazardous waste; however, most non-domestic wastes end up at the disposal sites operated by the Authority.

Figure 1 shows the elements of domestic solid waste management. Generated waste is stored and picked up by curbside collection (primary collection) or this waste is transferred to temporary storage or transfer points (skips etc.,) to be taken by secondary collection. Being high in organics, some of the waste is composted while some recyclable, reusable and valuable material are sorted and removed from the waste stream and sold or used by individuals (informal waste pickers or formal employees within the solid waste management system). Most of the solid waste produced in Jamaica ends up at the landfills. Information on quantities of solid waste recycled or re-used is not known.

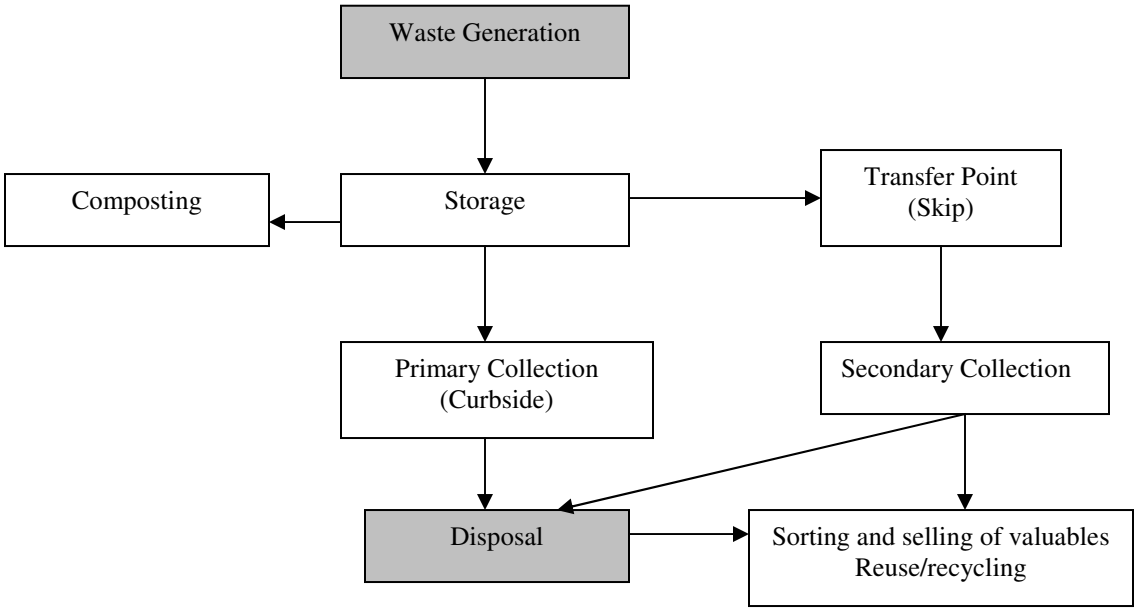


Figure 1. Elements of domestic solid waste management in Jamaica

Collection and disposal of solid waste is organized around wastesheds. A wasteshed is all the areas in a region from which waste is collected and hauled to a common disposal site. There are four wastesheds comprising a total of eight dumpsites around the island (Table 4). The wastesheds (including the parishes they cover) are North Eastern Parks and Markets, Metropolitan Parks and Markets (Riverton), Southern Parks and Markets and Western Parks and Markets (Appendix 1). Domestic solid waste represents

approximately 70.0 per cent[4] of the estimated total solid waste generated while commercial/industrial solid waste represents about 30 per cent (Figure 2)

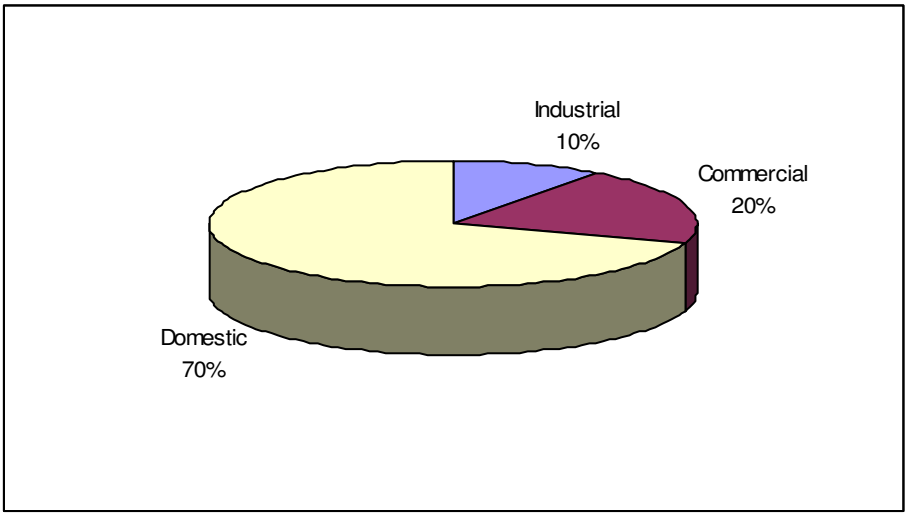


Figure 2. Percentage of Solid Waste by Source

Table 4. Active Disposal Sites Island-wide, 2006

Name	Disposal Site	Size (hectares)
Riverton	St. Catherine	43.50
Church Corner	St. Thomas	1.21
Martin's Hill	Manchester	7.82
Myersville	St. Elizabeth	3.7
Retirement	St. James	10.96
Tobolski	St. Ann	4.94
Hadden	St. Ann	3.88
Doctors Wood	Portland	n/a

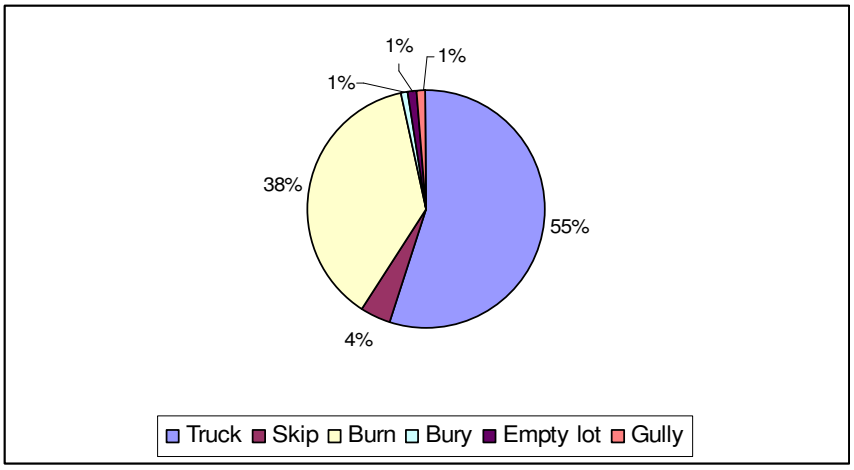
Source: National Solid Waste Management Authority

About 20.0 per cent of the solid waste collected (mainly domestic) is handled by private collectors (SoE, 2001)[5] and approximately 10.0-20.0 per cent of solid waste is not collected by any formal system. It is an increasing trend for some upscale town-house

[4] Estimate based on discussion with the NSWMA.
[5] State of the Environment Report, 2001

and apartment complexes, especially in the Kingston Metropolitan Area (KMA), to pay private contractors for efficient and reliable waste collection. Most uncollected waste ends up in drains, streams, wetlands (contributing to flooding), rivers, sea, open lots and illegal dumpsites.

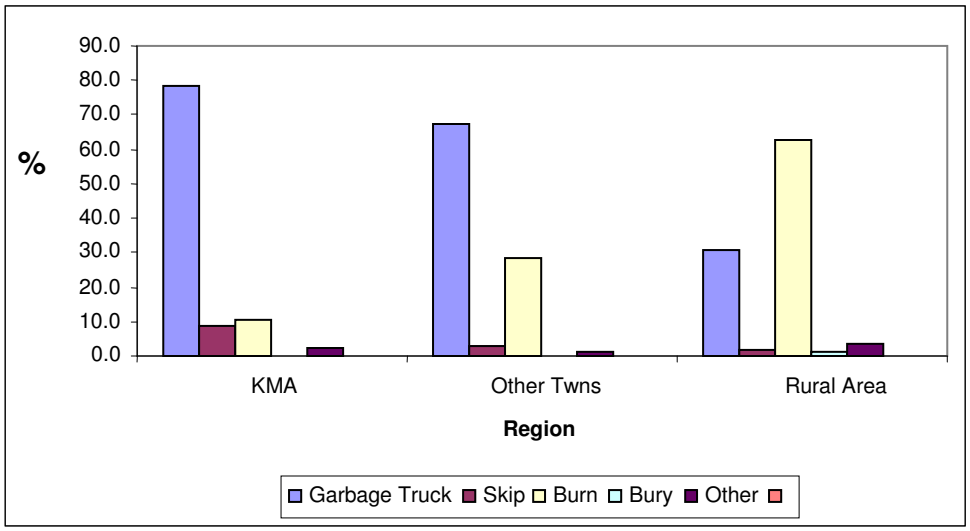
Collection by garbage trucks and burning are the predominant methods of garbage disposal and treatment (Figure 3). In 2006, approximately 55.0 per cent[6] of Jamaican households disposed of their garbage via garbage trucks while 38.0 per cent burn their garbage. However, the frequency of pickup by the trucks was not determined. Garbage collection in the KMA and Other Towns has been more efficient than in other areas of the country. Collection is particularly low in rural areas where the main method of treatment and disposal is burning (Figure 4). Other disposal methods include burying and dumping on open lots and in gullies. While burying garbage may improve aesthetics, depending on the type of garbage, it can be detrimental to groundwater, soil and terrestrial organisms.



Source: Jamaica Survey of Living Conditions, 2006.

Figure 3. Waste Disposal by Jamaican households, 2006

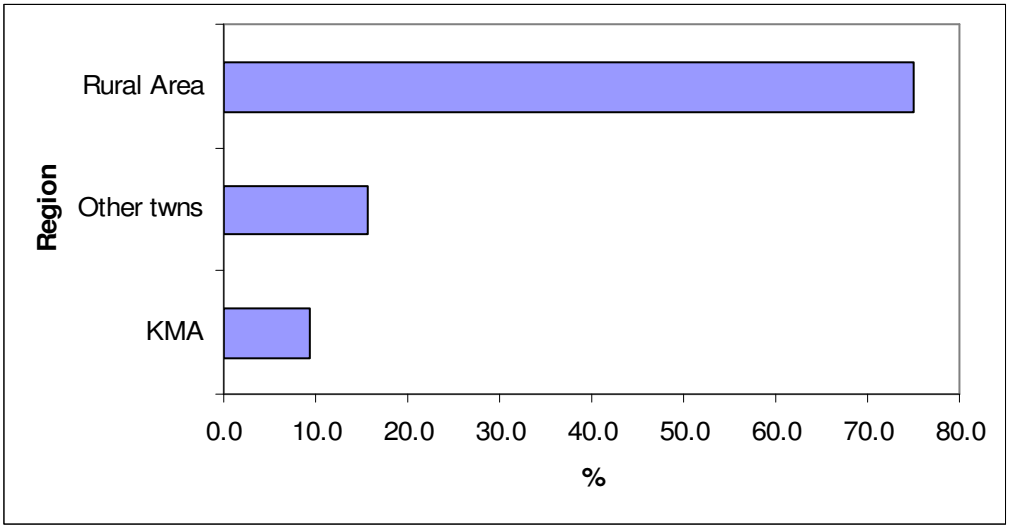
[6] Survey of Living Conditions 2006



Source: Jamaica Survey of Living Conditions, 2006

Figure 4. Main method of garbage disposal by region, 2006

As much as 75 per cent of those households that burn garbage are found in rural areas (Figure 5). Burning has implications for environmental and human health as burnt wastes contain substances that give off toxic, carcinogenic gasses and substances.



Source: Jamaica Survey of Living Conditions, 2006

Figure 5. Households that burn garbage by region, 2006

Solid Waste Management Challenges

Despite efforts at improvement, the current capacity (institutional, personnel, financial, technology, equipment) of the NSWMA is inadequate to efficiently and effectively manage the increasing generation of solid waste and the changing waste stream (Table 5). Additionally, the Authority is burdened by the dual and conflicting role it has to play as collector and regulator.

Table 5: Initiatives in Solid Waste Management in Jamaica

Solid Waste	
Actions Being Taken	***Actions Already Taken***
Draft Sanitation Policy Draft NSWMA Business and Cost Recovery Plan Training of relevant staff in landfill management techniques Exploring new sites to relocate some landfills Use of biodegradable garbage bags	Enactment of Solid Waste Management Act and Policy Establishment of NSWMA to manage domestic solid waste Two Waste Characterisation studies done in Riverton Wasteshed IDB Waste study done. Recommends closure of waste disposal sites in environmentally and socially sensitive areas. Improved infrastructure at Riverton (access roads, office, perimeter fencing) through IDB Solid Waste Project

Source: Compiled by the Planning Institute of Jamaica

Judging from the size of the fleet and volume of waste to be moved, NSWMA's capacity for transporting waste is limited. An estimated 4010.7 tonnes of solid waste are generated daily in Jamaica. One garbage truck carries approximately eight tonnes[7] of garbage per trip and makes an average of two trips to the disposal site per day. Hence, an average of

[7] Estimate based on data from the NSWMA.

250 trucks[8] would be needed to efficiently dispose of garbage across the island on a daily basis. The estimated number of trucks needed by the NSWMA to collect and dispose of domestic solid waste would then be about 175. Currently, the number of trucks available to the NSWMA (both government owned and contracted) total 145 (Table 6). This is 30 trucks less than the estimated effective fleet (Figure 6).

Table 6. Number of trucks by Wasteshed, 2006

Wasteshed	Parish	Number of trucks
Metropolitan Parks & Markets	Kingston & St. Andrew St. Catherine Clarendon St. Thomas	73
Southern Parks & Markets	Manchester St. Elizabeth	17
Western Parks & Markets	Westmoreland Trelawny Hanover St. James	39
North-Eastern Parks & Markets	St. Ann Portand St. Mary	16
Total		**145**

Source: National Solid Waste Management Authority, 2007

The inadequacy of the fleet size is significant in the MPM Wasteshed. It is estimated that the Riverton Disposal site receives about 60.0 per cent of the solid waste generated which is about 2406.4 tonnes per day. Therefore, it requires approximately 150 trucks to adequately collect and dispose of solid waste within this wasteshed. The MPM would need approximately 105 trucks to move domestic garbage within the KMA but currently the fleet size is 73 (Figure 6). The inadequate fleet size has affected the frequency of garbage collection and the problem is compounded by the long downtime (for repairs) of many of the trucks. Another problem is the sometimes long distances the trucks have to

[8] This figure represents a crude estimate of the total trucks needed to collect both commercial and domestic waste. Operational aspects are not taken into account.

travel to pick up garbage. This increases the cost of collection and disposal, as well as maintenance cost of the fleet.

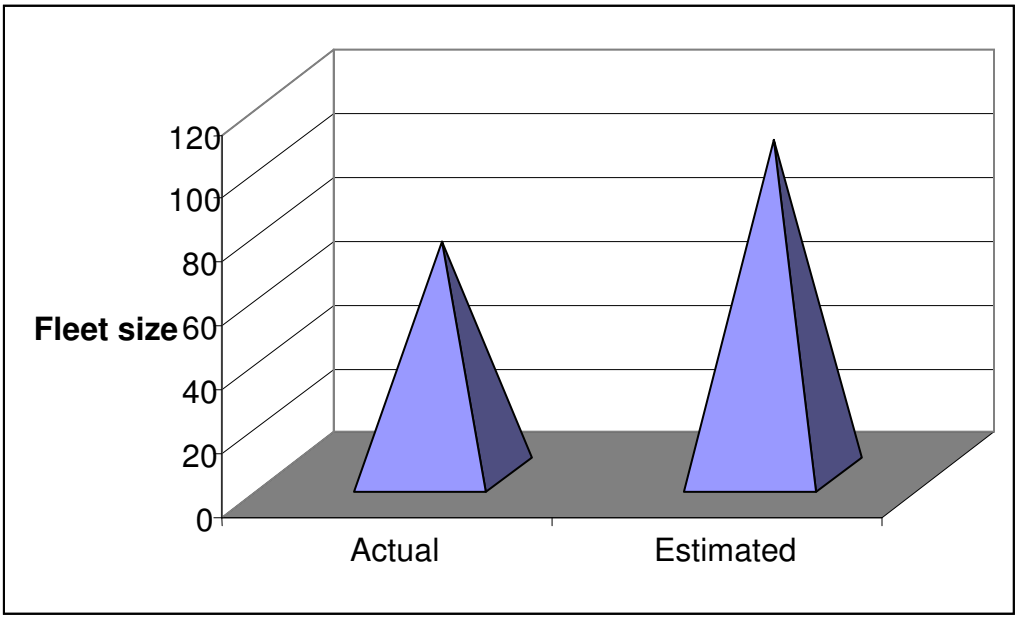


Figure 6. Comparison of Actual and Estimated Fleet Size for Domestic Solid Waste in the KMA

Many communities, especially informal ones, are without curbside collection. This is compounded by the fact that there has been a proliferation of squatter communities especially in urban areas. In areas lacking curbside collection, skips are often provided but these are sometimes insufficient to collect the volume of solid waste being generated.

Although the NSWMA has the legal mandate to enforce proper garbage disposal methods, inadequacy in enforcement has been a perpetual problem. The absence of proper methods/technology to deal with certain wastes such as electronic waste (e-waste) makes enforcement of legislation difficult. Additionally, the Authority lacks adequate technical personnel to effectively manage wastes. Also the inability of the Authority to effectively manage its landfills and control illegal ones has lead to increased informal dumping of solid waste. For example, commercial entities are responsible for the collection and disposal of their own solid waste. However, weak capacity to police them results in illegal dumping being a prevalent problem.

Poor location of disposal sites is another major challenge in waste management. According to a study conducted by IDB in 1999 most of the official dumpsites are located in socially and environmentally sensitive areas and there is a proliferation of illegal dumpsites across the country. The problem is made worse by the inadequate enforcement of relevant legislation pertaining to littering and disposal of solid waste. Furthermore, there are no sanitary landfills in Jamaica (National Solid Waste Policy, 2001) which have socio-economic and environmental implications.

Since the most common method of waste treatment and disposal in Jamaica is landfilling, the availability of land to deal with increasing volumes of waste becomes an important issue. Currently, the level of compaction at the disposal site is quite low due mainly to lack of equipment and this has resulted in a greater need for land space to store garbage (NSWMA, 2007). This is compounded by the increasing volumes of non-biodegradable waste which can persist at disposal sites for a very long time. The KMA produces about 50.0-60.0 per cent of the quantity of solid waste which is deposited at the Riverton City Landfill (IDB, 2000). It is estimated that within five to seven years this site will reach its maximum capacity (by 2014). This has implications for the deposition of municipal waste given the difficulty to find suitable land for an alternative site.

Apart from the operational factors directly related to the NSWMA, social practices also impinge on the efficiency of waste management. For example, there is negligible separation of solid waste which often has recyclable and re-useable (valuable) materials mixed with other types of garbage. The crushing together of garbage in this manner has the potential for hazardous materials to get dispersed through thousands of tonnes of garbage at the landfill site.

Hazardous Wastes

Waste that is hazardous has properties that make it dangerous or potentially harmful to human health or the environment (United States Environmental Protection Agency, 2006). Hazardous waste can be liquids, solids, contained gases, or sludges or by-products

of manufacturing processes or simply discarded commercial products like cleaning fluids or pesticides (Table 7).

The volume of hazardous waste generated bears some relationship to the level of industrialization in a country (National Research Council, 1985). With modernization and diversification of the Jamaican economy and increasing mechanization of processes in sectors which were once driven manually (such as in agriculture), there has been a steady increase in the generation of hazardous wastes (SoE, 2001). While, comprehensive data is lacking on the actual quantities and types being produced, the SoE Report, 2001 noted that about 10,000 tonnes of hazardous wastes are produced annually with waste engine oil comprising as much as 80.0 per cent. The Ministry of Local Government and Environment (MLGE) estimates that about 500,000 lead acid batteries are generated annually with only about 30.0 per cent being collected and exported for recycling. The increasing generation of waste oil and lead acid batteries are directly related to the increased importation of motor vehicles into the island.

Table 7. Sources and Types of Hazardous Waste in Jamaica

Sources	**Main types of hazardous waste**
Industry	Solvents, thinners, toxic gasses, heavy metals, asbestos, glues and resins, e-waste, waste oil, particulate matter
Agriculture	Pesticides
Commercial	E-waste, toners, waste oil, paints, asbestos
Household	Cleaners, disinfectants, paints, drugs, batteries, e-waste
Medical	Drugs, radioactive material, contaminated needles, syringes, bandages, bodies

Source: Compiled by Planning Institute of Jamaica

Among the categories of hazardous waste which are likely to pose a significant challenge in the near future are medical and e-waste. The former is defined "as any waste that is generated in the immunization, diagnosis, treatment and disposal of human beings or animals or parts thereof, in research pertaining thereto, or in the production or testing of biologicals". Medical waste is generated as a result of activities relating to the practice of

medicine and sale of pharmaceuticals. This type of waste may be radioactive, toxic or infectious or similar in nature to normal domestic waste. Increasing incidents of chronic illnesses relating to lifestyle are resulting in the generation of more hazardous medical waste due to the type of treatment required. Government policies involving free healthcare could lead to increase in medical waste and site-specific concentration of this waste due to increased influx of people to public healthcare facilities. This poses potential challenges for the management of medical waste by healthcare facilities.

Electronic waste (e-waste), for example used electronic and electrical appliances, consist of a variety of different parts made from hundreds of different substances including plastics, metals, glass as well as organic and inorganic compounds. While some of these parts can be recycled, others need special treatment and disposal systems. More potentially hazardous and diversified e-wastes are being generated with the liberalization and continued expansion of the Information and Communication Technology (ICT) sector. The magnitude of the impact of growth of waste for this sector is demonstrated by the change in the profile of this sector. For example, Jamaica's mobile penetration stands at 93.3 per cent (Economic and Social Survey Jamaica, 2006) representing a ten fold increase in the number of cellular phones over 2000. Apart from changes in cell phone technology, the cell phone is for some a fashion item to be discarded and replaced. There being no formal facility for the treatment of hazardous waste, the country has a serious challenge in dealing with used instruments.

There is currently no comprehensive mechanism or policy for the management of hazardous wastes in Jamaica although some initiatives have been and are being taken to establish such a system (Table 8). The absence of facilities for the treatment and disposal of hazardous waste means that most hazardous waste is deposited in the normal waste stream ending up at landfills or in the sea. For instance, chemicals, waste paints and waste oil are usually poured down drains, gullies and in some cases just thrown on land. Inadequate regulation of garages has made this problem worse with the inappropriate disposal of waste oil and other toxic substances. Some of these garages are found close to residences.

It is uncertain how much of hazardous wastes are recycled by industry and while some companies take back used cell phones (especially as a marketing strategy) the extent of recollection schemes are unknown. It is also not known how these companies dispose of used instruments.

Table 8. Current Initiatives in Hazardous Waste Management in Jamaica

Hazardous waste	
Actions Being Taken	Actions Already Taken
National programme for chemicals and Waste management in Jamaica started. Initiation of Integrated National Programme (INP) for the sound management of hazardous wastes Development of an Inter-ministerial Coordination Mechanism (ICM) Development of policy framework for the management of hazardous wastes Inventory of hazardous chemicals Ongoing development of guidelines for storage of batteries, computer waste, agro-waste and phosphates Increase in the number of workshops given to industries on clean technologies. Draft Policies on Medical Waste and Sanitation	Jamaica signatory to Basel, Rotterdam Conventions and the Stockholm Convention on Persistent Organic Pollutants (POPs) Creation of a National Information exchange mechanism in the form of a website Used Lead Acid Battery (ULAB) project completed. About 50,000 batteries have been exported for recycling Registration of importers of pesticides and licensing of pest control operators

Source: Compiled by the Planning Institute of Jamaica

2. Factors Affecting Waste Generation

A number of socio-demographic, economic and environmental factors affect the volume and type of solid and hazardous waste generated. These factors include population growth and urbanization, consumption patterns and lifestyles, household size, changing gender roles, size of the working age group of the population, economic expansion, globalization, government policy, and urbanization.

Socio-demographic Factors

Population Growth & Urbanization

The quantity of solid waste increases with population growth. As mentioned before, with a 6.5 per cent increase in population from 1996 to 2006, Jamaica's solid waste production has more than doubled. While the overall population has been growing at less than one percent per annum, most of the growth is being experienced in urban centres and towns (urbanization) through urban in-growth and urban-urban and rural-urban drift. The regional distribution of the population can also determine the quantity and type of solid waste produced. For example, urban areas may produce different types of wastes than rural areas. The predominantly agricultural base and lower economic status of most rural areas result in a high proportion of organics and biodegradable waste.

The mass movement of people from rural areas to urban areas results in the generation of more wastes (municipal wastes) in urban centres. Urbanization is a global phenomenon and is especially occurring in developing countries. It is estimated that by 2008, 3.3 billion people will live in urban centres and increase to 4.9 billion[9] by 2030. Throughout Jamaica, the urban population has jumped from 30 per cent in the 1960s to 52 per cent in 2006, totalling 1.39 million people. Major towns such as Santa Cruz and May Pen and the parish of St. Catherine, have seen exceptional growth.

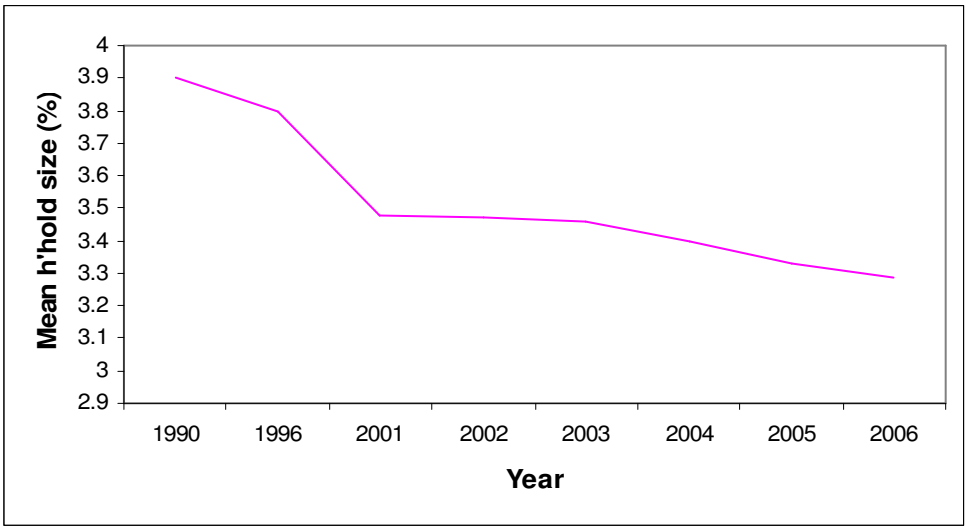
[9]United Nations World Population Fund, State of World Population 2007

The growth in urban population has also coincided with a rise in informal settlements due to scarcity of housing and unregulated developments. This puts further burden on the solid waste management services offered by government. Often these settlements are constructed in such a way that makes access by garbage trucks difficult. Some of these settlements lack certain amenities like proper sanitation that create more wastes. Due to competing priorities for land use in urban areas, finding adequate and suitable disposal facilities is very challenging and often leads to social conflicts. Urbanization trends are not expected to abate. However policymakers must be aware that that while urbanization can cause negative impacts; it may offer sustainable opportunities in adequate solid waste management by allowing greater access and ease of providing efficient services to densely populated areas.

Household Size

There is some evidence that smaller households generate more wastes per person (per capita) than large households due to more per person consumption (Orians & Skumanich, 1997; Beigl et al, 2004). Also, the demand for convenience has increased with the increasing numbers of single person households, especially in urban areas resulting in more packaging waste and the demand for convenience food. The average household size in Jamaica has decreased from four to three over the past 10 years (1996-2006)[10] (Figure 5). The number of households containing no more than three persons rose by approximately 9 percentage points for the same period and single persons household represented the largest distribution in 2006 (24.2%). It is expected that average household size will continue to decrease in the future, especially with effective family planning, education and increasing standard of living. Decreasing household size coupled with population growth and improved economic status could lead to a greater demand for housing resulting in the generation of greater volumes of construction waste.

[10] Jamaica Survey of Living Conditions 2006



Source: Jamaica Survey of Living Conditions, 2006

Figure 5: Mean household size in Jamaica, 1996-2006

Age Structure

Studies have shown that there is a positive relationship between the working age group of a population and the volume and type of solid waste produced (Lindh, 2003; Beigl et al, 2004). The larger the working age population, the more they will consume different types of products providing they have access to income. Persons within the age group 15-64 (working age) represented approximately 63.4 per cent[11] of the population in 2006 and this relative proportion is likely to remain for some time into the future. In fact projections using the Threshold-21 (T-21) model show that persons of working age will represent 66.0 percent of the total population in 2030. The unemployment and poverty rates are also falling being 10.3 per cent and 14.3 per cent respectively in 2006. This could fuel increased consumption for the future and lead to the generation of more and varied solid waste.

Changing gender roles

Research has found a link between increasing proportion of women in the workforce and solid waste generation mainly linked to convenience consumption (Orians & Skumanich,

[11] Economic and Social Survey, Jamaica, 2006

1997). Increasingly, more women are being educated and opting to join the workforce. Women currently make up approximately 42.0 per cent [12] of the Jamaican workforce and with increasing education many are employed in professional and technical occupations. It is expected that the proportion of women in the working force and their associated purchasing power will increase in the future as Jamaica aims for developed country status.

Globalisation, Consumption patterns and lifestyles

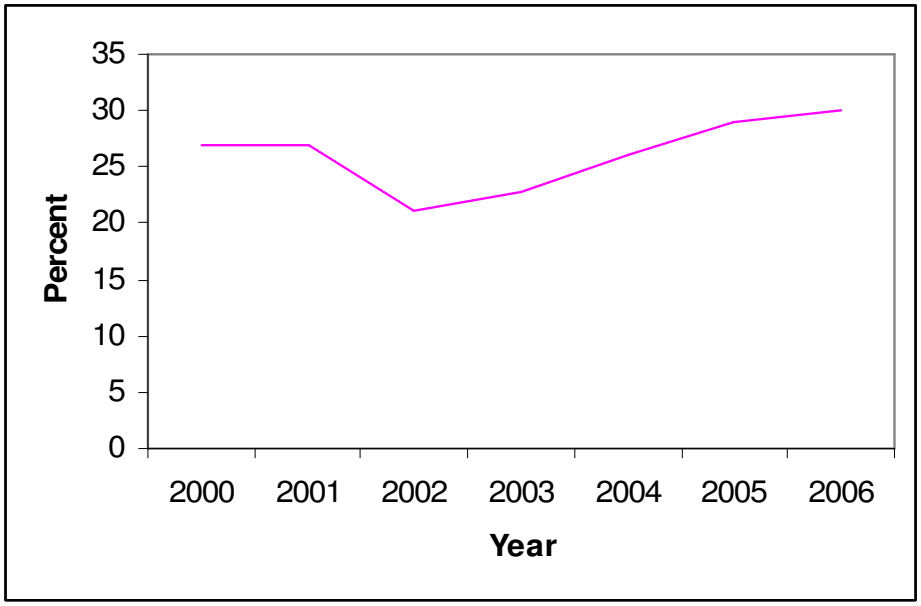
Lifestyles influence consumption patterns. Through globalization and other factors such as increased standard of living, the consumption patterns and lifestyles of the population have changed. Globalization has shrunk the world, creating open markets and making a wide variety of products available to Jamaicans. This has resulted in a change in the composition of wastes with more packaged products, e-waste and other non-biodegradable waste which present challenges for management. Changing trade regimes also allow access to a plethora of products which contribute to the significant increase in packaging material such as styrofoam and tetrapacks, PET bottles, plastic bags etc. which have worsened solid waste problems in the country (Treasure, 2002).

Changes of lifestyles from a slower to a more fast paced society has resulted in the consumption of 'on-the go' convenience products and fast food diets which generate more solid waste. Home Meal Replacement (HMR) has become a global trend satisfying the cravings of time-pressed and cooking-shy consumers who may want a change from traditional to fast food. Jamaican supermarkets, in capitalizing on this trend, stack pre-cooked meals, seasoned meats and other 'ready to go products. The trend in HMR is driven by "time poverty" and convenience and is not expected to change anytime soon.

Another important consumer trend is having meals away from home. For example, in Jamaica, there was an overall increase in the per capita expenditure on meals away from home over the last six years (Figure 6). In general this has represented the highest

[12] Economic and Social Survey Jamaica 2006

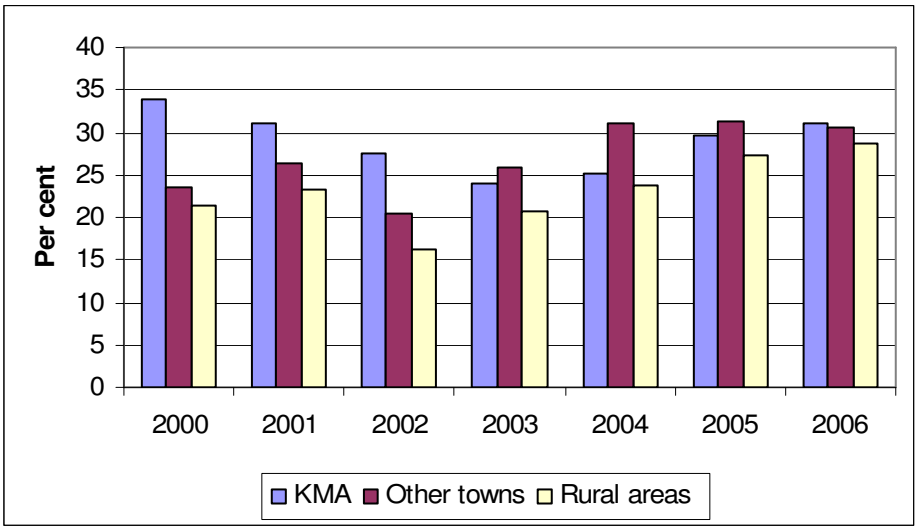
proportion of household food consumption across all quintiles and in the KMA and Other Towns (Figure 7).



Source: Jamaica Survey of Living Conditions

Figure 6: Percentage Mean Annual Per Capita Food Expenditure on Meals Away from Home, 2000-2006

Having meals away from home generates solid waste as a lot of these meals are not necessarily consumed in restaurants but are bought in disposable packages. As expected, persons with higher income spent a higher percentage of food expenditure on meals away from home.



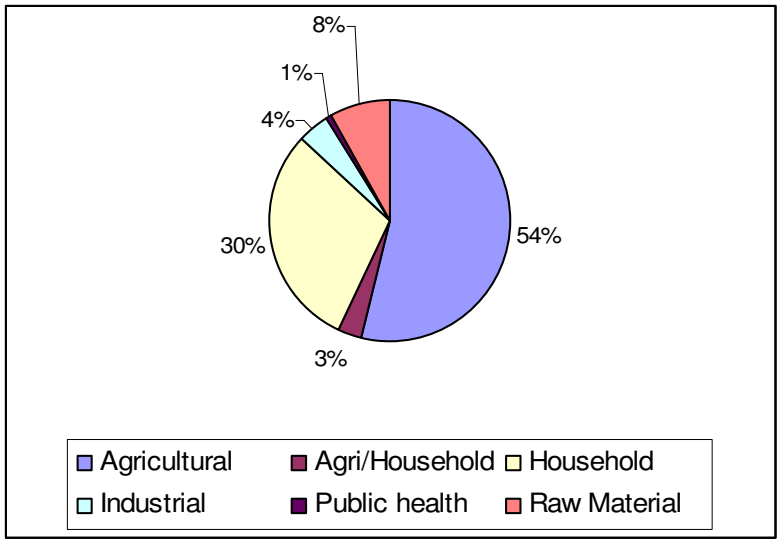
Source: Jamaica Survey of Living Conditions

Figure 7: Percentage Mean Annual Per Capita Food Expenditure on Meals Away from Home by Region, 2000-2006

The current "bottled water fad" is a good example of how both convenience and changing lifestyles can contribute to the generation of waste. For example, in 2006 Jamaica imported over seven million[13] bottles of water. Although continuous statistics are lacking on bottled water consumption in Jamaica, it is believed that such consumption is increasing. There is also a common perception in some sections of the population that bottled water is now healthier than piped water. The Bureau of Standards Jamaica (BSJ) and the National Water Commission have not proven this and stated that the country continues to enjoy one of the highest quality of tap water in the world.

With the continued need to boost production in agriculture, Jamaica imported 2 512 tonnes[14] of pesticides in 2006 with the agricultural sector accounting for 54.0 per cent of imports followed by households (Figure 8). The active ingredients in pesticides make them detrimental to health and the environment if not used properly in terms of contributing to high residue content. A major problem is the disposal of empty pesticide containers which usually have some 'full strength' residue remaining. These containers are usually discarded in the normal waste stream.

[13] Statistical Institute of Jamaica
[14] Pesticides Control Authority, Annual Report, 2006.



Source: Pesticides Control Authority, 2006

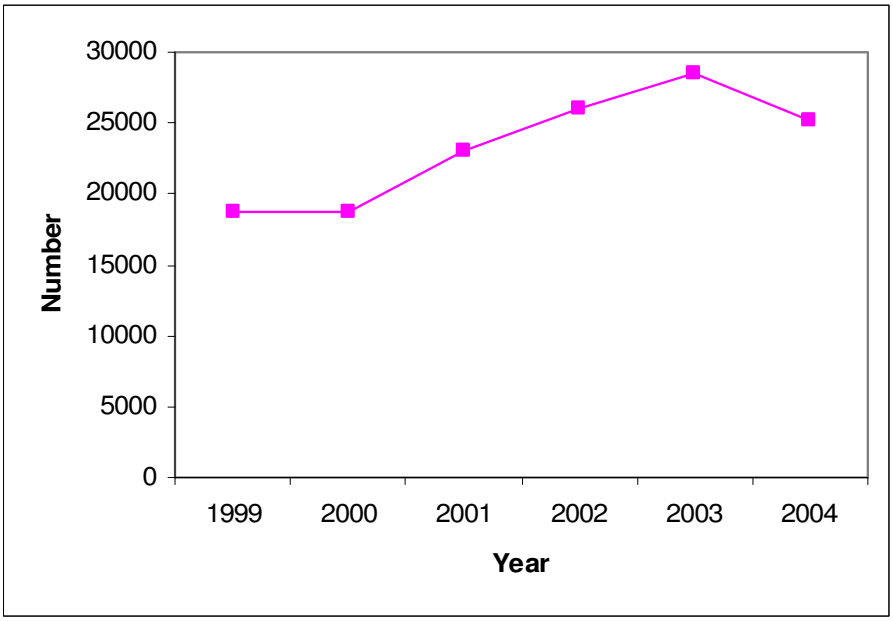
Figure 8. Percentage of Pesticide Imports by Use

Economic Factors

Changing Technologies

Rapid changes in technology drive the demand for technology-based products (e.g. machinery, equipment, telecommunication devices) and at the same time increases the rate of obsolescence of existing technology. The result is expansion in waste generated. There has been a significant increase in the number of computer imports (Figure 9) and in the replacement of old technology to newer versions. For example, conventional cathode ray tubes (CRT) are being replaced with High Definition Liquid Crystal Display (LCD) Screens. The proportion of Jamaican households with a computer was 13.7 per cent[15] in 2006, with 55 per cent of those living in the Kingston Metropolitan Area. The proportion of households with computer is expected to rise as the country's socio-economic status improves and consistent with the GOJ's policy to bridge the digital divide.

[15] Jamaica Survey of Living Conditions, 2006



Source: Statistical Institute of Jamaica

Figure 9. Computer Imports, 1999-2004

Table 9 shows a comparison of major electrical appliances in households in 1997 and 2006. There were large increases in microwaves, televisions, washing machines and component sets/stereos. Presently, there are no established procedures for the disposal of electronic equipment and appliances; it is fair to assume that these appliances are being disposed of by inappropriate methods in unsuitable areas including dumpsites and wetlands at the end of their lives. In the absence of a proper system of e-waste disposal, there are increased risks to the environment and human health and safety.

Table 9. Percentage of Households with Major Electrical Appliances, 1997 and 2006

	% of Households	
Appliances	**1997**	**2006**
Radio	74.5	73.9
Component set/stereo	16.8	42.0
Television	74.0	93.1
Refrigerator	69.6	82.0
Electric clothes iron	74.2	88.0
Microwave oven	6.9	34.6
Washing machine	6.4	23.1
Electric stove	3.2	4.1
Electric water heater	2.9	6.4
Air conditioner	1.7	3.0

Source: Residential Consumer End use Survey, 2007

The current drive to create a knowledge based economy and make Jamaica the regional hub for ICT will require concerted focus on the management of e-waste. Additionally, the substitution of incandescent bulbs with compact florescent lamps (CFLs) is an important measure being promoted by governments worldwide to reduce energy consumption and stem global warming. Through the Jamaica/Cuba Bulb project, Jamaica is expected to receive 4 million CFLs from Cuba to replace incandescent bulbs and also consumers are being encouraged to buy CFLs to replace incandescent bulbs. While CFLs are beneficial in terms of reducing energy consumption, each one contains about 5 mg of mercury, a toxic element. The Bureau of Standards, Jamaica (BSJ) has been reporting that sub-standard CFLs are being imported into the country with short life spans thereby increasing the volume of bulbs to be replaced and safely disposed of. Presently there are no adequate plans or facilities in place to store and dispose of CFLs in an appropriate manner.

Government Policy

The whole matter of waste generation is influenced by government policy. Often policies are formulated without addressing the management of waste. The Motor Vehicle Liberalization Policy introduced in 1989 (revised in 2004) has caused a shift from public to private transportation. This is evident in the significant increase in the number of motor vehicles over a 10 year period, moving from about 184 000 in 1994 to approximately 450 000[16] in 2004. During this period, Jamaica imported 210 460 motor vehicles at an average rate of 26 308 per year (Table 10). The increase in the importation of used/reconditioned vehicles from countries such as Japan has in turn created demand for motor vehicle accessories/components such as lead acid batteries and tyres. More often than not, these items end up as the waste stream at the end of their usefulness.

Between 1994 and 2004, over five million lead acid batteries[17] were imported into Jamaica (SoE, 2001). The quantity of lead acid batteries, waste oil and tyres is increasing with the importation of motor vehicles. The improper disposal of lead acid batteries increases exposure (especially children) to lead contamination. Post-use tyres are often discarded in normal garbage and end up at the dumpsites where they are often burnt. This releases carcinogenic toxins in the atmosphere.

Table 10. Motor vehicle imports, 1997-2004

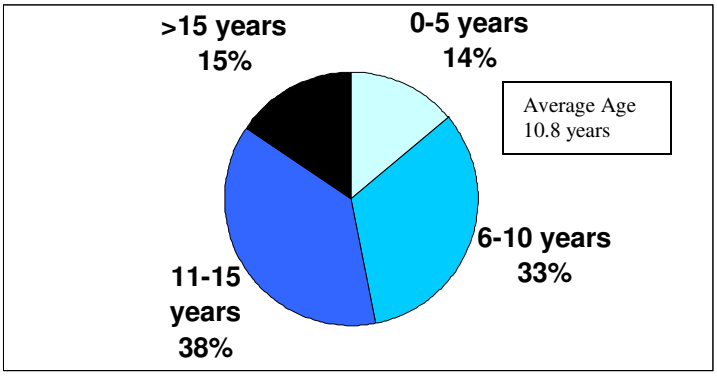
Year	1997	1998	1999	2000	2001	2002	2003	2004
Number	39457	30867	23235	26660	23592	19080	22917	24652

Source: Statistical Institute of Jamaica

Figures 10 and 11 show that in 2006, 53.2 per cent of motor cars and 75 per cent of pick-ups were over 10 years old (Residential Consumer End Use Survey, 2007) compared with the USA where the mean age of motor cars in 2005 was 8.4 years; pickups, 9.4 years and vans, 7.0 years (US National Automobile Dealers Association, 2001). The implication is that the country has a relatively large fleet of ageing vehicles which will need disposal

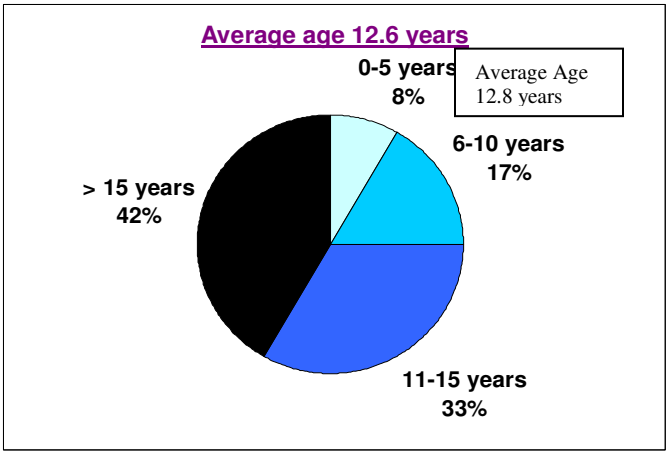
[16] Jamaica Energy Policy Analysis, 2005
[17] Figure includes all types of batteries containing lead

and at present there is no formal mechanism for the disposal of end of life vehicles (ELVS) although some metal parts from ELVs are being exported as scrap metal. Newer fleet circulates for a longer time in a country shifting from one owner to the next and reducing the rate of disposal.



Source: Residential Consumer Energy End-Use Survey

Figure 10. Average Age of Motor Cars in Jamaica, 2006



Source: Residential Consumer Energy End-Use Survey

Figure 11. Average Age of Pick-ups in Jamaica, 2006

End of life vehicles and tyres pose social and environmental risks mainly through storage of water which causes generation of pathogens (such as bacteria, viruses, mosquitoes). For example, solid waste capable of storing water (such as ELVs and tyres) was believed to have contributed to the recent outbreak of malaria in Jamaica.

Of importance also is the gradual shift from public or mass transport to private transportation and route taxis. In the recent Residential Consumer Energy End Use Survey, 2007, it was estimated that 48.9 per cent of persons used route taxis for leisure travel, 26.3 per cent used them to get to work and 37.2 percent of students use them to get to school compared to 15 per cent, 14 per cent and 18.7 per cent taking public busses respectively. The use of route taxis for transportation is more dominant in rural areas. This trend could also increase the number of ELVs.

Tourism is a major industry whose growth has been associated with the expansion in the construction and installation sector. Growth of the construction sector also associated with housing and commercial development has resulted in the generation of construction and demolition (C&D) waste which sometimes contain asbestos and other toxic substances. Unfortunately, there is little testing for asbestos in old buildings before repair or demolition.

Economic expansion

The quantity of solid waste generated increases with economic growth. In general, the higher a country's GDP, the more the per capita generation of waste (Table 11). Improvement in standard of living, hinged on economic advancement, often translates into demand, consumption and use of more products that are often non-biodegradable. This suggests that should Jamaica achieve the goal of being 'developed country' by 2030, the shift in economic status will compound the effect of the projected increase in population. Figure 12 shows that there has been an overall increase in waste per capita generation with GDP per capita growth in Jamaica between 1996 and 2005.

Table 11. Waste Generation rates as a function of GDP

Country category	Waste generation rates (kg/capita/day
Low income	0.5-0.7
Mid-income	0.7-1.5
High-income	0.9-2.2

Source: Cointreau-Levine, 2000

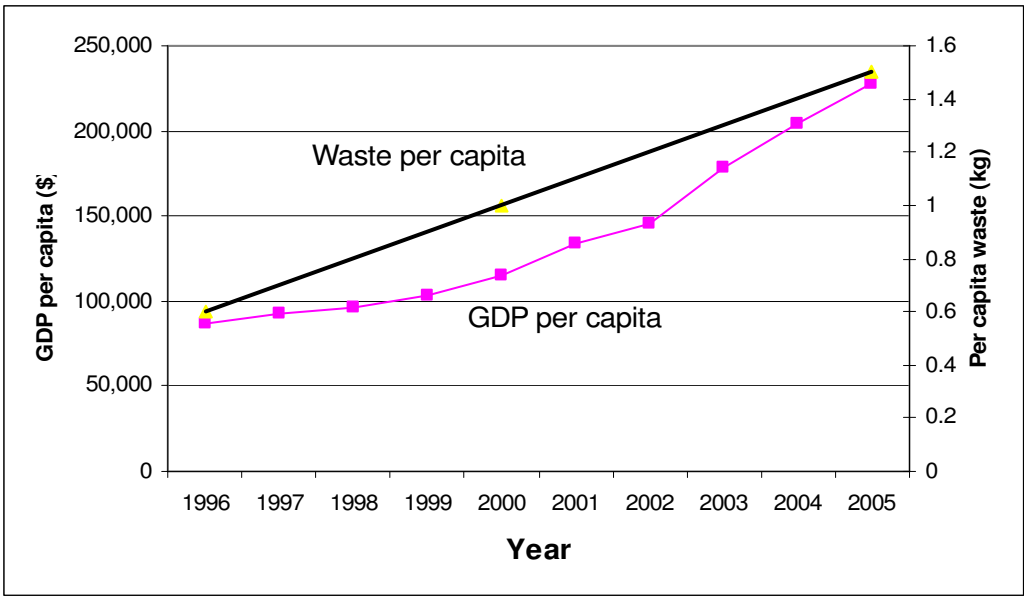


Figure 12: Waste per capita generation with growth in GDP per capita

It is expected that waste generation will continue to increase as a result of increasing economic growth if stringent and effective management measures are not put in place. The type of industries also influences the type and quantity of waste that is produced. Sectors such as tourism have the potential to generate significant quantities of waste, especially non-biodegradable waste. Thus, if tourism continues to play a major role in the country's economy and developmental policies, the expectation is for the country to produce solid waste of the order of high income countries and this will affect the facilities needed to manage waste. Growth in tourism will also have implications for the composition of the waste, driving down the proportion of organics, and increasing paper

and plastics used for packaging. The proportion of hazardous waste is also expected to increase attendant on the projected expansion in mining and quarrying. The expansion of the ICT sector, as Jamaica strives for a knowledge-based economy, will also impact the capacity of the country to manage waste.

Environmental Factor(s)

Frequency of Storm Events

Another important factor contributing to the generation of solid waste is the frequency of storm events. Jamaica is vulnerable to natural hazards including: hurricanes; earthquakes; landslides; floods; droughts and tsunamis. Between 2004 and 2007, six storm events have impacted the island, two of which has been major. Storm events not only affect public finance but results in significant clean-up costs for solid waste. For example, the clean-up cost for Hurricane Dean in 2007 was estimated at $120 million. Due to the inadequacy in fleet size the clean-up process usually takes a long time which contributes to the increase threat of diseases such as leptospirosis. The frequent occurrence of such storm events is not expected to abate given the projected impacts of climate change.

3. Solid Waste Management Dimensions

An effective waste management system hinges on an integrated, sustainable approach. This means assessing the economic, social and environmental aspects of waste management.

Economic Dimension

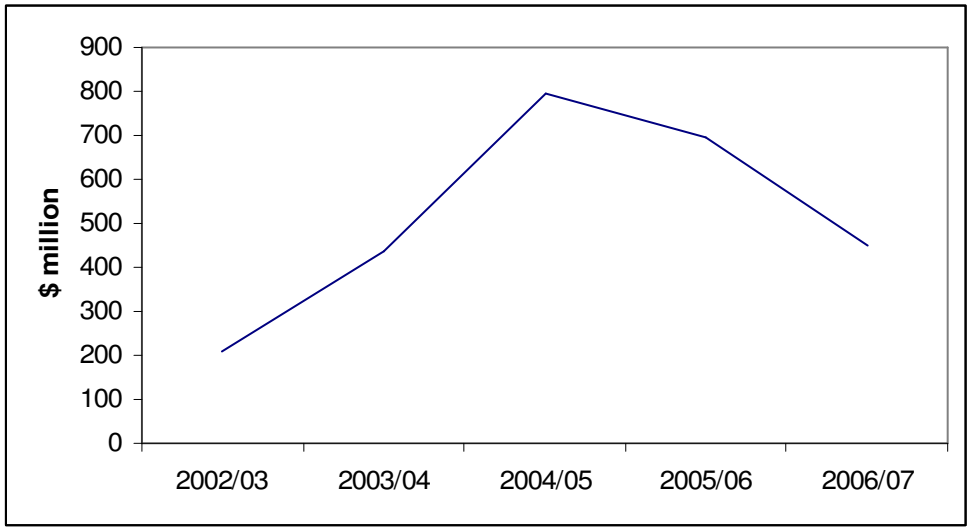
For the purpose of this study the economic aspect of solid waste management is limited to Cost and current financing of solid waste management.

Cost and Financing of Solid Waste Management

Collection treatment and disposal of waste is an expensive process. Although there has been an overall increase in budgetary allocation for the management of solid waste from

2002 to 2006, this is still inadequate for the NSWMA to carry out all its functions effectively and efficiently (Figure 13). The allocation for FY 2006/07 of $ 450.6 million represented approximately 0.1 per cent of the gross national budget for the same period.

According to the NSWMA, it takes about US$100 per tonne to collect and dispose of solid waste in Jamaica. A large part of the cost is related to the distances the trucks have to travel. Applying the per tonne rate, the estimated cost to manage (collect, transfer and dispose) solid waste on an annual basis is US$146.4 million or about $10.3 billion[18], approximately US$ 400,000 ($28 million) per day. It would cost the NSWMA approximately US$102.5 million annually to effectively manage domestic solid waste alone. The shortfall between required expenditure (for domestic collection) and budgetary provision is determined by comparing the allocation for FY 2006/07 (Figure 14).



Source: Estimates of Expenditure for relevant Financial Year

Figure 13. Budgetary allocation for Solid Waste Management, 2002-2007

This significant financial gap handicaps the Authority in carrying out solid waste management adequately. Cointreau-Levine, 1999 expressed the cost of solid waste management as a percentage of the Gross National Product (GNP) of a country and

[18] Using and exchange rate of $70:US$1

reported that effective waste management in middle income countries would cost about 0.5-1.3 per cent of their per capita GNP. For Jamaica this works out to approximately $5.6 billion[19] using the GNP. Although this is about half of the previously calculated figure of $10.3 billion it still represents significant expenditure on solid waste.

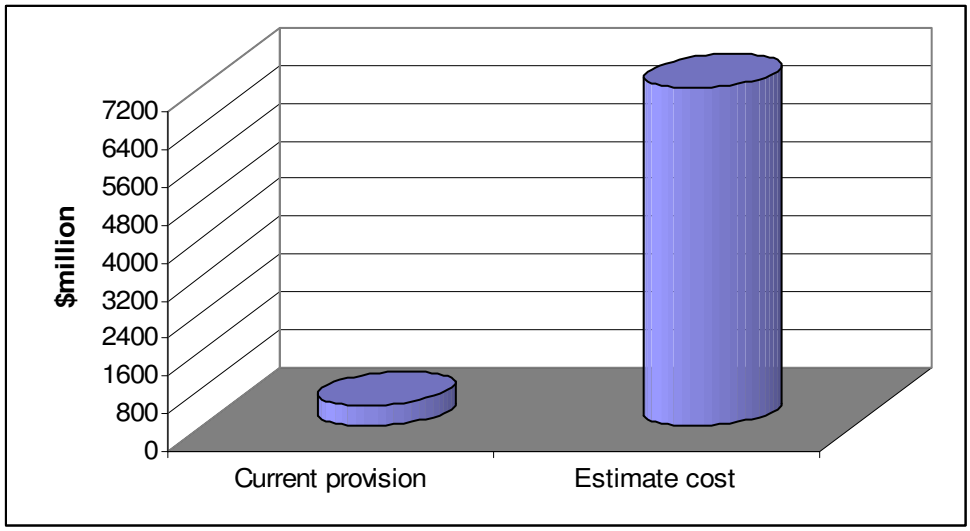


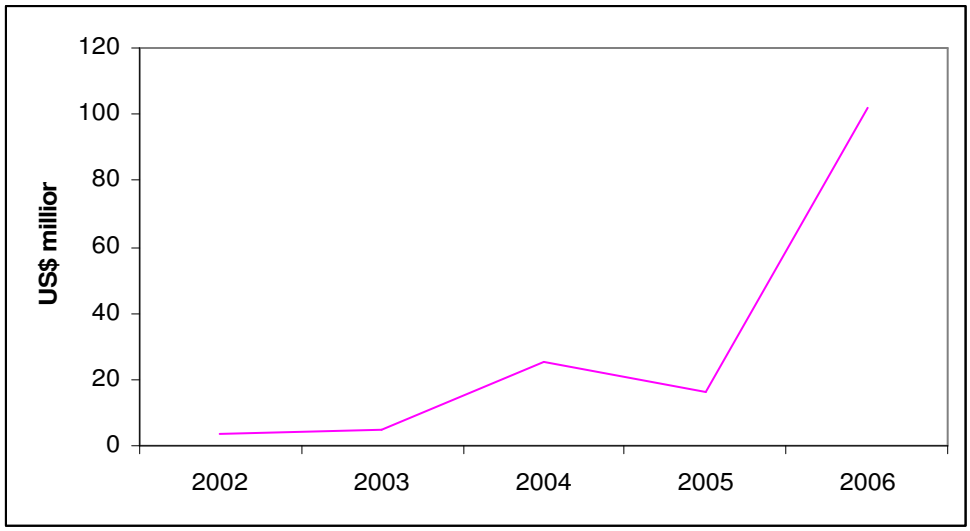
Figure 14. Comparison of Budgetary Provision and Estimated Cost for Solid Waste Management, 2006

Social Dimension

The social dimension of solid waste extends beyond the aesthetic and the obvious links to health. In fact, one often under-explored area of solid waste relates to livelihood. The disposal sites in Jamaica provide significant social and economic benefits for some people living in communities surrounding the dumps although the number of individuals is not known. These individuals are called 'scavengers' or 'waste pickers'. Scavenging is a typical informal activity and not only provides economic benefits but environmental benefits as well. Scavengers in Jamaica supply raw materials for artisans and industry (such as scrap metal) and recover organic materials to be used as fertilizer for crops or as feed for livestock. They significantly assist with the sorting and recycling of wastes which enter the disposal sites.

[19] The figure was calculated based on a GNP per capita at current prices of $208,743 and a population of 2.7 million.

It could be argued that the local scrap metal industry has its genesis as much in the inadequate management of solid waste as in the need for some persons to eke out a living. Scrap metal exports have been increasing rapidly valued at US$102 million in 2006 (Figure 15). This avenue for livelihood creation, however, has a negative side as despite the potential for recycling and ridding communities of unsightly and potentially hazardous waste, trade in scrap metals is posing a threat to some of the country's important infrastructure (with metallic components) due to theft. The evidence points to the loss of telephone and traffic light cables; removal of drain and manhole covers; and removal of bridge rails and road sidings. At the time of this paper, the GOJ is in the process of formulating strategies aimed at formalizing, regulating and improving this industry for the benefit of local communities and the country in general.



Source: Economic and Social Survey Jamaica 2006

Figure 15. Scrap metal exports, 2002-2006

Besides societal benefits, scavenging can incur social costs through health risks. These risks are associated with the nature of the waste or the process of collecting, processing, recycling and disposing of it (Wilson, Velis & Cheeseman, 2005). Scavenging in open dumps which is common in Jamaica is considered to be the most detrimental to health. Often waste pickers lack protective clothing and are in direct contact with the waste, sometimes these waste may be hazardous or infectious. Children, commonly seen on

dumpsites, are especially vulnerable. Common health problems experienced scavengers/waste pickers are backaches, general weakness, respiratory illnesses and persistent coughs, eye and skin infections and frequent diarrhea (Eerd, 1996). Strategies to manage solid waste need to be cognizant of the important role scavengers play in waste management and that their livelihoods are dependent on waste.

The proliferation and disposal of solid waste has also caused the clogging of major waterways and drains contributing to flooding of roads, houses and other infrastructure and increases the vulnerability of many communities, especially informal ones. This has resulted in increasing government expenditure annually on drain cleaning and millions of dollars on rehabilitation efforts from floods.

Inappropriately managed solid waste also threatens human health through the generation and proliferation of pathogens and disease causing vectors (resulting in malaria, dysentery, dengue typhoid and cholera and leptospirosis). The continued burning of solid waste whether deliberately by households or spontaneous combustion at dumpsites (many times due to unsorted waste) introduces significant quantities of hazardous gasses and particulate matter that contributes to escalating cases of respiratory illnesses. Diseases of the respiratory tract have consistently been among the top six conditions presented during curative visits to primary healthcare facilities over the past five years (Economic & Social Survey Jamaica, 2006) The high organic content of the waste stream produces significant quantities of methane which often self-ignite landfills.

Another issue of ineffective solid waste management is the use of large, bulky solid material such as ELVs, old appliances (refrigerators, washing machines), tyres to block roads and restrict movement of civilians and security personnel in some communities. The presence and access to these materials pose a challenge to effective crime management and civil order.

Environmental Dimension

Solid Wastes

Improper solid waste management significantly lowers ecosystem functions necessary for social well-being and economic development. Some negative impacts include:

- Pollution of the soil, ground and surface water and air by leachate. Already over 60 per cent of the groundwater in the KMA is contaminated by high nitrate concentrations (UNCED 1992 report).
- Growth of algal blooms in the marine environment due to eutrophication (too much nutrients resulting from high organic content). This increases Biological Oxygen Demand (BOD) and can result in stunted growth or death of marine organisms due to oxygen depletion
- Suffocation of freshwater and marine species from plastic bags, PET bottles and other non-biodegradable waste
- Persistence of non-biodegradable substances in the environment increasing the need for space
- Reduction in aesthetics
- Production of methane which is a greenhouse gas contributing to global warming and climate change

The impacts are exacerbated because some of the designated disposal sites are situated in environmentally sensitive areas such as Doctor's Wood in Buff Bay, Portland which is located in a wetland close by the sea.

Hazardous Wastes

Hazardous wastes pose serious threat to the terrestrial (especially groundwater contamination) and marine environments thus affecting the natural capital of the country. Usually an inventory of hazardous wastes should include waste contaminated sites but this is often not the case. The Water Resources Authority (WRA) has reported that groundwater contamination has lead to the closure of about 25 per cent of ground water

sources. The loss in groundwater caused by contamination could be made worse by frequent and longer periods of drought.

Human health may be threatened directly through poisoning, respiratory problems, and even birth defects and death caused by exposure to hazardous substances. Increasing healthcare costs puts a strain on the national budget. There have been numerous cases of lead poisoning in Jamaica. For example, The International Centre for Environmental and Nuclear Sciences (ICENS) tested 61 children in Kyntyre, St. Andrew in February 1996 and found that all of the children in the sample had blood lead levels over the threshold (10 ug/dL).The high concentrations of lead in the blood of the children were attributed to lead mine waste from the Old Hope Mine. Many types of hazardous wastes such as asbestos are carcinogenic and the general public is often exposed to such types of wastes, especially with the destruction of old buildings. While the Chemistry Department, University of the West Indies (UWI) is currently carrying out clean up of asbestos in Succaba Pen, Old Harbour, St. Catherine, a more concerted effort is needed to minimize health threats from hazardous materials.

The burning of hazardous wastes and seemingly inert substances like plastics releases compounds such as dioxins and furans which are highly carcinogenic. Usually burning takes place in or near low income communities where the inhabitants lack the financial resources for proper healthcare and therefore increase their vulnerability.

Failure to effectively manage hazardous waste can have negative economic impacts as the government will have to spend more to correct human health and environmentally related problems caused by such wastes. It is believed that the fish, for instance, in Kingston Harbour are contaminated with heavy metals. ICENS also found that Jamaican soils exhibit high levels of a number of heavy metals, especially cadmium, considered to be a very toxic substance and for which levels in some of Jamaica's major agricultural areas are extraordinarily high. These could have detrimental effects on the country's agricultural exports since the food quality standards of importing countries are becoming increasingly stringent. The continued expansion of the tourist sector also hinges on the availability of clean water. Increased contamination of groundwater resources could

affect the expansion programme. Toxic leachate from metals etc. can introduce heavy metals in the soil which can threaten agricultural exports. Jamaica must be cognizant of this given the increasingly demanding trade standards such as ISO 14001 and Hazard Analysis and Critical Control Points (HACCP).

4. Future Challenges and Management Options

Key Issues/ Future Drivers of Change

A number of issues will help to shape the waste landscape for the future. These include:

Costs: The increasing cost to manage waste will dictate the types of treatment and disposal methods employed. Landfilling and burning of garbage are the most common and cheapest methods but these have significant environmental and social costs. Competing land uses especially in urban areas will make landfilling a less attractive option. Although incineration can actually reduce the volume of waste, air pollution is a drawback and maintenance costs are high. However, incinerating waste presents the opportunity for waste to energy conversions.

Environmental Protection: Reducing impact on the environment is paramount in waste management. Globally, countries are not only trying to reduce the amount of waste produced but they are exploring methods of waste management that have little or no effect on the environment. The need to achieve sustainable development goals coupled with stringent trade regulations will force countries to make the management of waste a priority.

Access to Reliable Data: A successful waste management system hinges on accurate and reliable data in order for waste managers, planners and policy makers to make informed decisions. Data on wastes is sparse in Jamaica and this makes calculating the true cost to manage waste difficult. Even more so, a comprehensive waste management strategy cannot be formulated without data on all types of wastes.

Population Growth: With the population projected to reach approximately 3.3 million[20] by 2030, the associated solid waste generation is estimated to be 2.4 million tonnes[21] with a per capita production of 1.5 kg – 2kg[22]. This would represent a 64 per cent increase in solid waste generation from 2006 to 2030. With effective solid waste management the country could maintain present levels of solid waste or seek to lower it so by 2030, generation would be around 1.8 million tonnes.

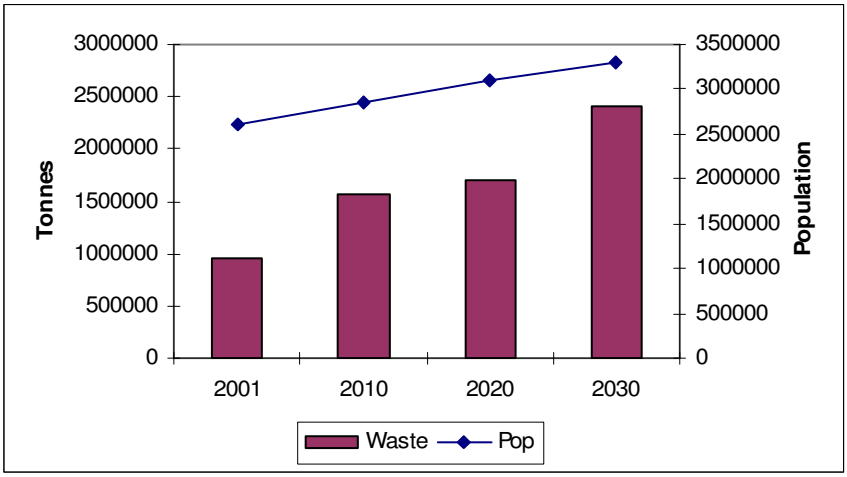


Figure 16. Projected Waste Generation and Projected Population, 2001-2030

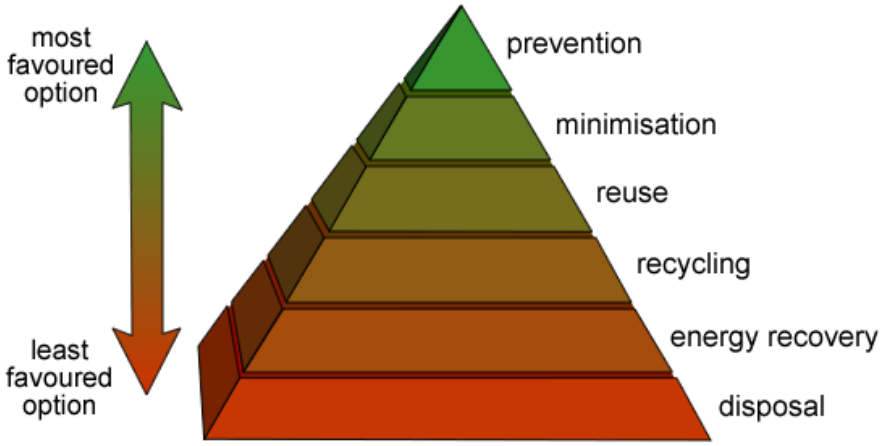
The projected population change and associated waste generation is given in Appendices 3 and 4. Two scenarios are presented; one with per capita solid waste generation remaining at 1.5 kg/person/day and the other with 2 kg/person/day by 2030. The greatest changes in volumes of solid waste generation are projected to take place in urban centres with the largest change population. The greatest projection is seen in Old Harbour (using 2 kg/per person/day by 2030) with a six fold increase in population and a 13 fold increase in the solid waste volume. The town is currently challenged with the present volume of waste being generated; hence projected increases of this magnitude by 2030 could be detrimental. The challenge arises not only in terms of actual increased volume but in the

[20] Planning Institute of Jamaica
[21] Given current waste production trends 1.5 kg/person/day was used for waste generation for 2010 and 2020 and 2 kg/person/day for 2030.
[22] Estimate based on typical per capita generation of solid waste in developed countries.

potential negative impact on the environment, especially in areas where the water table is close to the surface.

Management Options

An established hierarchy exists for waste management and is based on the principle that avoiding waste is the preferred option and the least preferred is disposal (Figure 13). Thus, waste management systems should be designed in this way to be sustainable. Prevention and minimization require changes in development policies, consumption and lifestyle patterns.



Source: www.wikipedia.org

Figure 17: Ideal Waste Management Hierarchy

As the country's socio-demographic, economic and environmental factors change coupled with the drive to attain developed country status, it is important that policy makers embrace a thinking of converting waste to resources. Ultimately, the goal should be to have a waste free[23] society within a practical timeframe. Achieving this status will require a culture shift and a comprehensive package of strategies including community involvement, waste prevention and reduction, and resource recovery discussed below.

[23] A waste free society is one that uses all waste generated as resources.

Community Waste Management

Given the increasing cost for managing waste it is important to get the community involved in order to reduce cost and increase efficiency. Communities could be integrally involved in waste prevention, separation and final disposal. For waste management policies to work it is important that the community knows and accepts them. Acceptance by the community reduces conflicts emanating from the Not-in-my-backyard (NIMBY) thinking. Each community needs to be educated on the importance of an integrated solid waste management system and the adverse impact of poor disposal practices. Also engaging the community will not only make the system more efficient but can provide socio-economic benefits in the form of recovery and sale of valuable waste materials. Community-based organizations (CBOs) and Non-governmental organizations (NGOs) can play a vital role in waste management due to their resources, on the ground capability and influence with the people.

Prevention and Reduction

The GOJ could establish incentives and/or disincentives to encourage waste prevention. For example, if the costs to use certain hazardous substances in industry are very high industries might be forced to recycle these substances or switch to less harmful substances. Waste avoidance can also be increased through a change in consumption patterns and this could be encouraged as part of the healthy lifestyle campaign. Given the high organic content of domestic waste, home composting of such wastes could be linked to the composting waste management approach as an effective measure in waste prevention. With increasing use of electronic media, it is expected that less paper will be consumed in the future, but more packaging material will be necessary with increasing e-commerce. The use of multi-usage packaging and refund systems could prevent the consumption of high volumes of packaging material.

Resource Recovery

Future trends in waste management favour closed systems which aim to produce zero waste. Countries such as Switzerland, Austria and Germany are recycling almost half of

their waste. However, successful resource recovery requires efficient collection and separation of waste. Resource recovery therefore requires clear policies on recycling and re-use and an informed population on the benefits of such efforts. In this regard, our waste management, especially collection systems, should begin to promote sorting to facilitate recovery. Components of the waste stream such as paper, wood, metal, glass and C&D waste are good 'candidates' for recycling and re-use.

With the rising cost and environmental impacts of fossil fuels more environmentally friendly energy sources are being explored. Waste fractions with high calorific values such as paper, wood and cardboard can be explored for energy recovery. Although being discussed, energy recovery by incineration is not believed to be a feasible option in Jamaica at the moment given the high organic content and overall lower calorific value of the waste stream. However, energy recovery from biomass could be explored and the organics from the waste stream can be used for composting and production of organic fertilizer.

Innovation in biogas production from waste, such as the Biodigester created by the Scientific Research Council, is already being done in Jamaica. Significant quantities of methane are also produced as a result of the high organic content in the waste stream. Future waste management systems could explore collection and use of this gas.

Finally, due to the high cost of waste management, governments around the world are implementing measures for cost recovery where possible. Given the shortage of funds to adequately finance waste management, the GOJ must move with alacrity to recover at least some of the cost of managing waste through the collection of tipping fees and other strategies.

Specific Recommendations

Having reviewed the status of waste management and identified some possible options for improved management, the following additional recommendations are made. These relate to the need for:

1. Development of a comprehensive waste management policy to deal with all types of wastes and reflecting the waste management hierarchy. The policy should call for an integrated approach and harmonization with other policies to minimize waste generation. A strategic environmental assessment of all policies could help in this regard. Jamaica should also take into account the opportunities that urbanization affords to provide adequate and efficient sanitation services.
2. Strengthening of the NSWMA to effectively and efficiently manage solid waste involving the creation of strategic partnerships with the private sector and communities.
3. Provision of proper facilities for collection, storage and disposal of hazardous waste (including exporting such waste to other countries for treatment) and the promotion of product stewardship (extended product responsibility - EPR) to engage each player within the product life cycle (especially the manufacturer) in the management of hazardous materials.
4. Public awareness campaigns should seek to inform the public about proper waste management, change consumption patterns and lifestyles, and encourage participation in the management of wastes (such as sorting and recycling).

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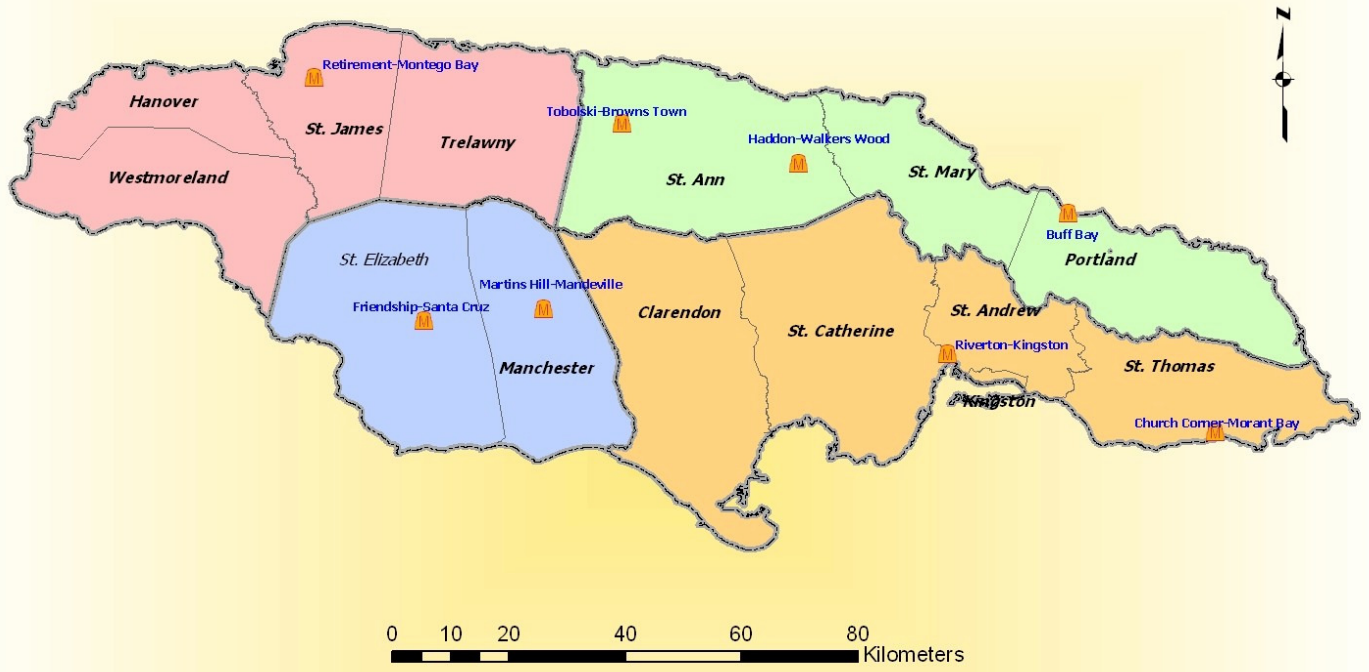
APPENDICES

APPENDIX 1: SOLID WASTE MANAGEMENT WASTESHEDS



Legend

- Existing Operational Site

Wasteshed

- NPM/North Eastern
- WPM/Retirement
- MPM/Riverton
- SPM/Southern

Planning Institute of Jamaica
Sustainable Development and Regional Planning Division
March, 2008
Source: National Solid Waste Management Authority

Appendix 2: SWOT Analysis of Waste Management System

Strengths	**Weaknesses**
Presence of an agency for the management of solid waste	Inadequate policy and regulatory framework Under-capacity to manage all types of waste Inadequate enforcement of existing legislation No sanitary landfills; inappropriate techniques being used at disposal sites No facilities for storage, treatment and disposal of hazardous waste
Opportunities	**Threats**
Jamaica is signatory to relevant international conventions on waste (MARPOL, Basel, Rotterdam etc.,) High biodegradable, organic content of waste: production of compost and organic fertilizer High population densities due to urbanization offer opportunity for providing more efficient service Potential viability of converting waste to energy Potential viability of concerting waste to business ventures e.g. organic fertilizer from organic waste Access to global knowledge on best practices and management failures Access to diverse products offers opportunity to promote the consumption of low waste products	Culture of operational rather than strategic planning Inability to deal with volumes and changing composition of waste stream Inadequate and inappropriate waste management solutions

Appendix 3: Projected Waste Generation (tonnes) with Population Increase for Major Towns, 2001-2030

	2001		**2010**		**2020**		**2030**		**2001-2030**
Main Towns	Population	Waste	Population	Waste	Population	Waste	Population	Waste	waste change(%)
Ocho Rios	15769	5755.7	20308	11118.6	25229	13812.9	28358	15526.0	**169.8**
Montego Bay	96477	35214.1	108014	59137.7	122459	67046.3	133447	73062.2	**107.5**
Savanna-La-Mar	19893	7260.9	23400	12811.5	27688	15159.2	31532	17263.8	**137.8**
Santa Cruz	10785	3936.5	13442	7359.5	16859	9230.3	20136	11024.5	**180.1**
Mandeville	47467	17325.5	53952	29538.7	59779	32729.0	64774	35463.8	**104.7**
May Pen	57334	20926.9	69658	38137.8	83804	45882.7	95419	52241.9	**149.6**
Spanish Town	131515	48003.0	148367	81230.9	169637	92876.3	189410	103702.0	**116.0**
Portmore	156469	57111.2	171555	93926.4	190029	104040.9	210493	115244.9	**101.8**
Old Harbour	23823	8695.4	78577	43020.9	146300	80099.3	167498	91705.2	**954.6**
Old Harbour Bay	6344	2315.6	17502	9582.3	20565	11259.3	24165	13230.3	**471.4**
KMA	579137	211385.0	597637	327206.3	618888	338841.2	640895	350890.0	**66.0**

Assumptions:
(i) 1kg of garbage produced per person/per day for 2001
(ii) 1.5 kg of garbage produced per person per day from 2010 to 2030

Appendix 4: Projected Waste Generation (tonnes) with Population Increase for Major Towns, 2001-2030

	2001		2010		2020		2030		2001-2030
Main Towns	Population	Waste	Population	Waste	Population	Waste	Population	Waste	waste change(%)
Ocho Rios	15769	5755.7	20308	11118.6	25229	13812.9	28358	20701.3	**259.7**
Montego Bay	96477	35214.1	108014	59137.7	122459	67046.3	133447	97416.3	**176.6**
Savanna-La-Mar	19893	7260.9	23400	12811.5	27688	15159.2	31532	23018.4	**217.0**
Santa Cruz	10785	3936.5	13442	7359.5	16859	9230.3	20136	14699.3	**273.4**
Mandeville	47467	17325.5	53952	29538.7	59779	32729.0	64774	47285.0	**172.9**
May Pen	57334	20926.9	69658	38137.8	83804	45882.7	95419	69655.9	**232.9**
Spanish Town	131515	48003.0	148367	81230.9	169637	92876.3	189410	138269.3	**188.0**
Portmore	156469	57111.2	171555	93926.4	190029	104040.9	210493	153659.9	**169.1**
Old Harbour	23823	8695.4	78577	43020.9	146300	80099.3	167498	122273.5	**1306.2**
Old Harbour Bay	6344	2315.6	17502	9582.3	20565	11259.3	24165	17640.5	**661.8**
KMA	579137	211385.0	597637	327206.3	618888	338841.2	640895	467853.4	**121.3**

Assumptions:
(i) 1kg of garbage produced per person/per day for 2001
(ii) 1.5 kg of garbage produced per person per day from 2010 to 2030