

**ECONOMIC INSTRUMENTS AND THE ENVIRONMENT WITH
SPECIAL REFERENCE TO
SOLID WASTE MANAGEMENT IN BARBADOS**

by

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SECTION 1:

OVERVIEW AND CONTEXTUAL FRAMEWORK

INTRODUCTION

Environmental problems have their origins in the development process, in its failures and its inadequacies. Environmental costs are typically not incorporated into the prices of goods and services consumed by society. Instead much of the environmental progress of the last two decades was the result of governmental regulations, targets and compliance monitoring. The end result has been the development of a body of legislation and regulations governing environmental stewardship. Notwithstanding the success of these policy instruments in improving environmental quality, societies the world over continue to face major environmental challenges, at national, regional and international levels.

Solutions to environmental problems require better management of the developmental process, with greater emphasis on internalizing environmental costs. Policy makers are faced with the challenge of identifying policies and strategies that make it everyone's economic interest to utilise environmentally sound products, services and lifestyles. Market based systems of incentives and disincentives which motivate economic behaviour are emerging as powerful, cost effective methods of achieving environmental goals.

The internalization of environmental costs in sustainable development and the role of economic instruments in this process is recognised in the Rio Declaration on Environment and Development. Principle 16 states that "National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment" (United Nations, 1992). The use of economic instruments is recognised in Agenda 21 as a tool in managing solid wastes and sewage. Chapter 21 of Agenda 21 encourages government to "Apply economic and regulatory instruments.....to support the principle that generators of waste pay for their disposal" (United Nations, 1992).

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The use of economic instruments as a policy tool in waste management issues is also recognised in the Programme of Action on the Sustainable Development of Small Island Developing States which encourages countries to "Develop fiscal and policy incentives and other measures to encourage environmentally sustainable imports and local products with low waste or degradable waste content" (United Nations, 1994).

Scope of Study

The economic crisis of the early 1990s served to remind Barbadians of the constraint on Government expenditure, which is limited to tax revenue and prudent borrowing. In managing solid waste Government must seek to contain its own expenditures on waste disposal, provide strong economic incentives for efficient waste management, and create a stronger social consciousness of careful environmental management. As far as possible the cost of environmental services should be built into the prices of goods and services and environmental policies should be reflected in government's budget for expenditure and revenue. Government may influence this process through the use of economic instruments, the allocation of expenditure or through control-and-command approaches. For any environmental objective it may be necessary to combine each of these approaches.

This paper provides an analysis of the current status of solid waste management in Barbados, including the existing situation with respect to volume, waste characterization and final disposal. It discusses options and their costs, effectiveness, spill-overs and side-effects. A solid waste management strategy is suggested for Barbados including a range of command-and-control approaches and economic instruments designed to influence behaviour. The fiscal implications of actual and potential waste management policies are examined within the context of the Government's 1995-96 Budget.

SECTION 2

SOLID WASTE: MAGNITUDE OF THE PROBLEM

Factors Influencing Waste Management Planning Process

A number of factors - physical, economic and demographic - influence the solid waste management planning process in Barbados.

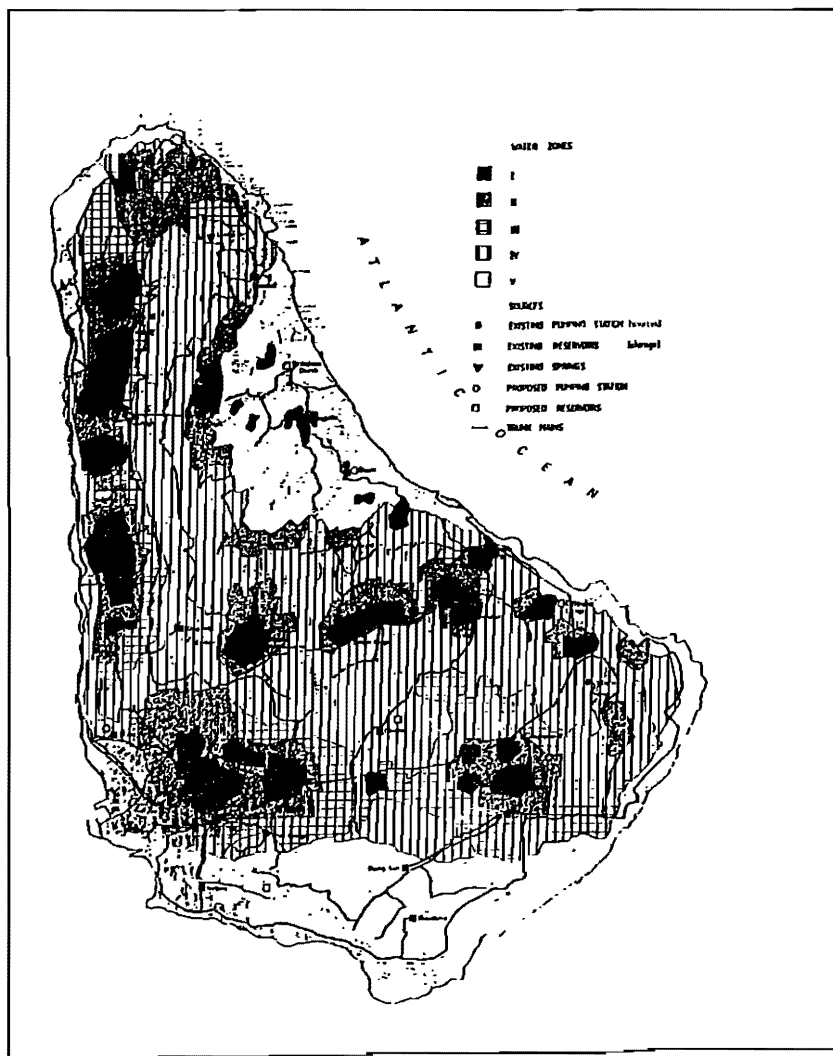
Physical Characteristics

Barbados, a small island developing state (SIDS) of 430 km² has an inherent characteristic of a limited land resource base, a feature which has and will continue to influence waste management options, particularly methods of disposal. The availability of land, particularly for waste management disposal options is further constrained by the existing water resources zoning system (Figure 2.1.). The scheme, designed in 1963 to protect the water supply sources from contamination comprised of five Zones, with Zones 1 and 2 being most critical. Another factor which until recently, further constrained the availability of land for waste management disposal options was the "designation" of the north-eastern section of the country as a National Park (Figure 2.2.). Though not "protected" by specific legislation, its boundaries are clearly demarked in the Physical Development Plan of Barbados. As a consequence, the Chief Town Planner through the powers vested in him by the Town and Planning Act "controls" the change of use in the designated area. Most of Barbados consists of porous limestone, which does not provide the impervious base needed for sanitary landfills.

Demographic Characteristics

Demographic characteristics are very important in determining waste management options, as waste generation quantities are usually determined by estimates based on current and future population trends and the character of households (i.e. average number of persons; single- or multi-family units etc.). In addition, other characteristics of the population such as level of education and incomes levels are important in designing policy options for solid waste management.

Figure 2.1



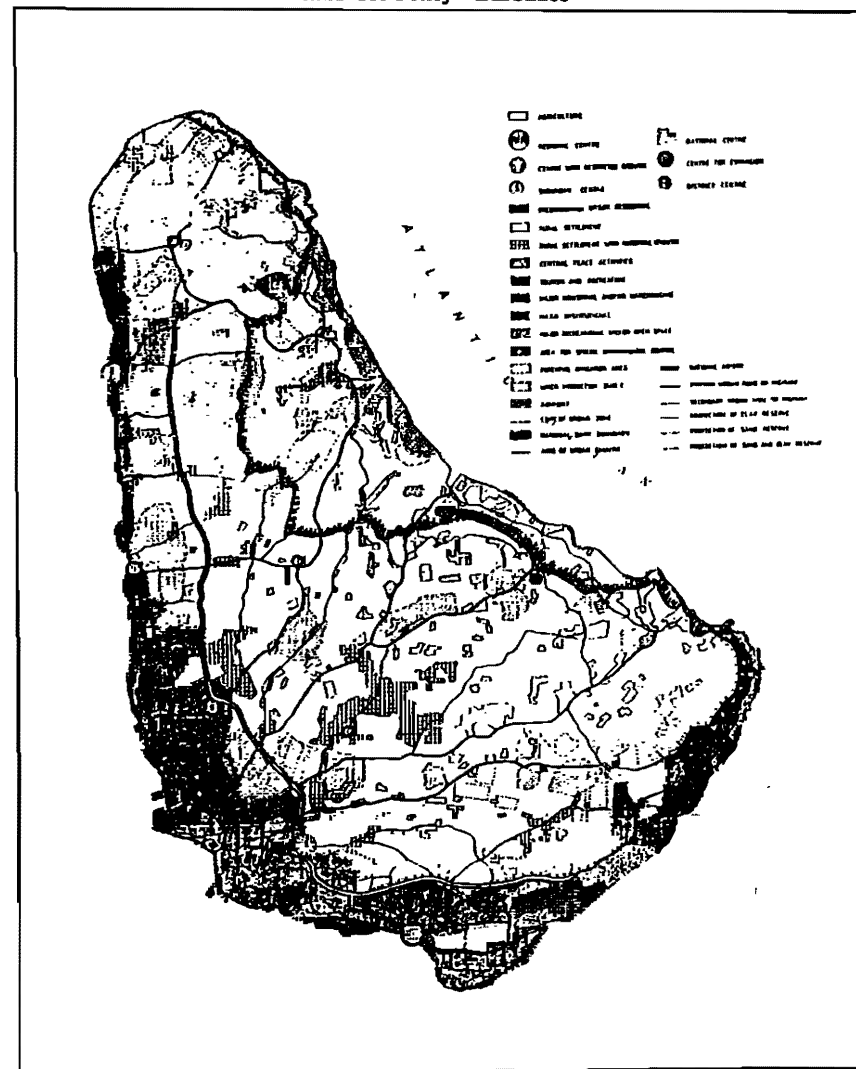
Source: Government of Barbados, 1988

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Figure 2.2



Source: Government of Barbados, 1988

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A demographic profile of Barbados, namely population by parish, occupied dwelling units and the average persons per household is presented in Table 2.1. Of a population of 260,491 in 1990, approximately 55 percent or 144,566 persons are concentrated in two parishes; St. Michael which accounts for 38 percent of the total population and Christ Church 18 per cent. There are approximately 76 000 occupied dwelling units in Barbados with an average person per household of 3.46. Of the occupied dwelling units approximately 90 percent are separate houses as against apartments and/or group houses.

Table 2.1 **Total Population, Occupied Dwelling Units and Average Persons Per Household, 1990**

PARISH	POPULATION	PERCENT OF TOTAL	OCCUPIED DWELLING UNIT	AVERAGE PERSONS PER HOUSEHOLD
St. Michael	97,516	37	27,712	3.52
Christ Church	47,050	18	15,063	3.12
St. George	17,905	7	4,702	3.81
St. Philip	20,540	8	6,039	3.40
St. John	10,206	4	2,662	8.83
St. James	21,001	8	6,688	3.14
St. Thomas	11,590	4	3,077	3.77
St. Joseph	07,619	3	2,030	3.75
St. Andrew	06,346	2	1,519	4.18
St. Peter	11,263	4	2,970	3.79
St. Lucy	09,455	4	2,749	3.44
TOTAL	260,491	100	75,211	3.46

Source: (1) Statistical Services , 1990 Census

Tourist Arrivals

In addition to the resident population, Barbados has a transient tourist population of approximately 450,000 and cruise ship passengers of about 350,000 (Table 2.2.). The average length of stay for the former is 7.5 days. To compare with the resident population we may use the concept of tourist days, multiplying the number of tourist by the average length of stay. Assuming that cruise passengers are in Barbados for one day, the ratio of tourist days to resident days (the resident population x 365) is 4%.

Table 2.2 **Tourist and Cruise Passenger Arrival and Average Length of Stay for Barbados (1989 to 1994)**

	1989	1990	1991	1992	1993	1994
Tourist Arrivals	461,259	432,092	394,222	385.5	395.979	425,630
Cruise Passenger Arrivals	337,100	362,111	372,140	399.7	482,611	449,002
Total	798,359	794,203	766,362	785,094	878,590	874,632
Average Length of Stay (nights)	7.1	6.8	6.9	6.9	7.0	-

Source: Ministry of Foreign Affairs, Tourism and International Transport

Waste Generation and Characterization

Generation

A major constraint in attempting to quantify solid waste generation in Barbados is the lack of weigh data for a reasonable length of time (i.e. three years) generated by a fixed scale. Two studies however, exist on the quantification of waste generation in Barbados. The first was executed by the Sanitation Service Authority (SSA) based upon three studies carried out on domestic refuse between 1982-1984 (Griffith, 1993). An analysis was made of the generation of waste by residents of houses with varying values (Table 2.4.) in the parishes of St. Michael, St. James, Christ Church and St. George.

The methodology employed in the SSA study involved the collection from each house participating in the study by category, by a specific refuse collection vehicle and crew on the regulation for collection. Vehicles were weighed at the Pulverisation Plant and subsequent analysis determined daily per capita generation and composition of waste. The per capita generation of waste varied from 0.34 kilograms in the lower economic group to 1.7 kilograms in the higher income groups.

The second study conducted by Stanley Associates Engineering Ltd in 1994 was a gate survey at the Mangrove Pond landfill for a six day period (June 22 to June 28, 1993). There were three elements, namely a survey of private vehicles; a survey of vehicles entering the bulk disposal area (primarily to identify pure loads of yard trimmings) and a vehicle count with estimation of the percentage of full load on SSA vehicles (Stanley Associates Engineering Ltd. et al, 1994)^b.

For the private vehicles, the raw data from the gate survey was compiled to determine total volume entering the landfill each day of the survey. The volume data was then converted to weigh data based on assumed densities for each waste component. For the SSA vehicles, the survey data combined with existing capacity and density data compiled by the SSA for each vehicle was used to estimate total tonnage quantities during the period of the gate survey (Stanley Associates Engineering Ltd. et al, 1994)^b.

Based upon data collected during the gate survey, total municipal solid waste (MSW) disposed was estimated to equate to 265 tonnes per day, of which approximately 56 percent was generated by the residential sector and 44 percent from commercial, industrial and institutional sectors. The total estimated disposal MSW, 265 tpd, equates to about 1.0 kilogram per capita per day, excluding bulky waste disposed which equaled 134 tpd (Table 2.5.).

An examination of the methodologies employed in the two surveys would seem to suggest that the SSA study would yield more accurate results particularly with respect to waste generation. This is because the weight of the solid waste was determined by weighing, rather than by estimation, as was done by the Stanley Study. The SSA study focused only on residential refuse however and did not consider waste generated by the commercial, industrial and institutional

sectors. A sector which generates a considerable amount of the waste found in the waste stream bulky waste was not addressed by the SSA study.

Gate surveys of the type undertaken by Stanley Associates Engineers Ltd. et al for the estimation of the quantities of waste generation have a number of limitations. Stanley Associates Engineering Ltd. et al (1994) list the limitations of their survey as:

- : the net generation quantities are based on estimates developed by multiplying the size of the collection vehicle times a percent full factor times a volume to weight conversion factor;
- : the extrapolation of the results of the gate survey to represent an annual average allows room for error due to the short duration of the gate survey; and
- : the gate survey is most representative of current conditions and not multi-year conditions.

Drawing on the results of both the SSA 1983 and Stanley 1993 surveys, this study estimates solid waste generation in Barbados as follows.

- : *Using the upper limit derived from the SSA study of 1.7 kilograms of solid waste generated per person per day for residential refuse and assuming that since 1983 solid waste generation per person has remained constant and will remain so until 2010, an estimate of residential waste is derived.*
- : *Using Stanley's findings we assume that the residential waste is 56% of the total, from which we estimate the waste produced by the commercial, industrial and institutional sectors.*
- : *It should be noted the percentage breakdown between commercial and residential net generation is in line with similar results in cities and states in the U.S.A.*
- : *We assume bulky waste (excluding yard waste and materials such as mould, ash, rubble used for covering) reaching the final disposal site represents approximately 10 percent of MSW (residential + commercial, industrial and institutional). It should be noted that bulky waste represented approximately 50 percent of MSW in the Stanley Survey.*

TABLE 2.3

**A STUDY OF DOMESTIC REFUSE COMPOSITION GENERATED PER PERSON PER DAY
IN BARBADOS AND THE QUANTITY**

GROUP NO.	LOCATION	COLLECTION GENERATED	NO. OF HOUSES	DAYS SINCE LAST COLLECT	AMT KG	KG PER DAY	POP	KG PER CAPITA	COMPOSITION							
									METAL	GLASS	PAPER	PLASTIC	PETRUSCIBLE	WOOD	CLUT H	GRASS LEAVES ETC.
1	Reynolds Pl. St. John's Pl. Wentworth Rd.	8-12-20 Tuesday	120	4	2053	513.2	468	1.09	9.37	12.5	54.38	23.44	18.16	.75	6.25	3.12
2	Lodge Terrace	8-12-19 Monday	30	3	750	250.3	172	1.43	6.23	3.12	23.5	20.0	8.00	.50	1.0	7.8
3	Lodge Terrace Ch. Cl.	8-12-21 Wednesday	30	6	510	85.0	165	1.70	14.85	2.13	31.25	25.6	14.08	2.34	1.56	7.5
4	Hicksville Wentworth Trc.	8-12-20 Tuesday	100	3	800	266.6	360	0.74	10.54	4.69	30.46	25.0	14.54	.00	3.13	10.94
5	Hyndville	8-12-19 Monday	120	3	1430	472.3	546	0.86	6.23	3.12	40.63	24.12	15.43	.00	1.56	3.12
6	Frenchville Green	8-12-21 Wednesday	240	6	1051	178.1	1051	0.34	17.19	12.50	18.75	25.00	12.50	1.56	2.13	9.37
7	North Chase Wilkey H/Ave	8-12-21 Wed	120	2	560	280.0	540	0.51	9.39	7.8	37.50	25.00	12.50	.00	1.56	6.25

Source: Griffith 1993

TABLE 2.4

ESTIMATED TONNAGE DISPOSED

	TOTAL DISPOSED MSW (TPD-7)	PERCENT MSW (%)
MSW		
SSA- Residential Collection Service (1)	150	56
SSA - Commercial Collection Service	10	4
Private (2) (3)	105	40
TOTAL MSW	265	40
BULKY (Excluding yard waste (4) (5))	134	
TOTAL (MSW + BULKY)	400	100

- (1) Includes some commercial waste
 (2) Includes a small percentage of bulky yard waste handled by SSA
 (3) Includes a small quantity of residential waste handled by self-haulers
 (4) Gate survey for bulky material only conducted for two days
 (5) Materials such as mould, ash, rubble used for cover excluded

Source: Stanley Associates et. al., 1994(b)

Based upon these assumptions, an estimation is made of solid waste generation in Barbados (Table 2.5). The results suggest that the generation of solid waste in Barbados is about 650 tonnes a day (excluding bulky materials) rather than the official estimate of 450 tonnes per day. This large discrepancy has very serious implications for the formulation of solid waste management strategies in Barbados, particularly the design characteristics of the proposed landfill. Undertaking a careful, comprehensive survey is now a matter of great urgency. Faulty estimations of solid waste generation in Barbados will cost the country significantly in the future.

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Further evidence of the underestimation of waste generation is the fact that in 1992 Phase 1 of the new Mangrove Pond Landfill was designed on a waste generating capacity of between 250 to 270 tonnes per day with a life span of 18 months; the landfill was exhausted in less than seven months and waste began to pile up, marking the birth of what was to become "Mount Stinkeroo". The controversy resulting from that debacle has made for decision-making in a highly charged emotional atmosphere, which threatens to divert attention from critical elements of a comprehensive programme for waste management and closes the door on viable options of considerable merit¹.

From the above estimate, approximately 694.5 tonnes of solid waste (including bulky material) was disposed of at the Mangrove Pond landfill, Phase 1. This correlates reasonably well the projected waste generation of 648.7 tonne per day of MSW (excluding bulky materials) in 1992 presented in Table 2.5. Even if a margin of error is built in for inadequate compaction at the landfill during its life span the estimate would still be way off. It seem to reason that if any landfill in Barbados is designed on the basis of the current official estimate for was generation in Barbados, what occur in 1992 is likely to be repeated.

From all the evidence there seem to be too much uncertainty about the amount of waste been generated in Barbados. For example, Griffith 1993 states that "the refuse generation rate in

¹ Based upon the above design characteristics of Phase 1 of the new Mangrove Pond Landfill an estimate is made of the amount of waste likely to have been generated during the life span of that cell of the landfill.

$$\begin{aligned} \text{Total Landfill Capacity (TLC)} &= (\text{Solid Waste Generation (tonnes per day) (SWG)} \times \text{Projected Life of Landfill (days) (PLOL)}) \\ \text{TLC} &= \text{SWG} \times \text{PLOL} \\ \text{TLC} &= 270 \times (18 \times 30) \\ \text{TLC} &= 270 \times 540 \\ \text{TLC} &= 145,800 \text{ tonnes} \end{aligned}$$

$$\begin{aligned} \text{Actual Generation Rate per day (AGR)} &= \frac{\text{Total Capacity of Landfill (TCL)}}{\text{Actual Life of Landfill (days) (ALL)}} \end{aligned}$$

$$\text{AGR} = \frac{\text{TCOL}}{\text{ALL}}$$

$$\text{AGR} = \frac{145,800}{210}$$

$$\text{AGR} = 694.5$$

Table 2.5 POPULATION AND SOLID WASTE GENERATION PROJECTIONS (1994 - 2010)

YEAR	POPULATION PROJECTION (000)	SOLID WASTE PROJECTIONS				
		MUNICIPAL SOLID WASTE (MSW)			BULKY MATERIAL	TOTAL WASTE
	(a)	Residential	Commercial	Total	Estimated at 10% of MSW	Generation
1994	264 379	449.4	197.8	647.2	64.72	711.92
1995	265 173	450.8	198.4	649.2	64.92	714.12
1996	265 918	452.2	199	651.2	65.12	716.32
1997	266 613	453.2	199.4	653.1	65.31	718.41
1998	267 259	454.3	199.9	654.2	65.42	719.62
1999	267 854	455.4	200.4	655.8	65.58	721.32
2000	268 402	456.3	200.8	657.1	65.71	722.81
2001	268 909	457.2	201.2	658.4	65.84	724.24
2002	269 308	458	201.5	659.5	65.95	725.45
2003	269 818	458.7	201.8	660.5	66.05	726.55
2004	270 225	459.4	202.1	661.5	66.15	727.65
2005	270 610	460	202.4	662.4	66.24	728.64
2006	270 972	460.7	202.7	663.4	66.34	729.74
2007	271 304	461.1	202.9	664	66.4	730.4
2008	271 603	461.7	203.2	664.9	66.49	731.39
2009	271 870	462.2	203.4	665.6	66.56	732.16
2010	272 112	462.6	203.5	666.1	66.61	732.71

(a) Based on Statistical Services, 1990 Census

Barbados, at approximately 1 kilogram (2.2.lbs) per person can be considered as too high". Stanley et al 1994, on the other hand concedes that "the total net generation rate of roughly 1 kg/day is low compared to net generation rates in the United States". In addition, Stanley Associates Engineering Ltd 1994c concedes that "the gate survey will not be adequate for the design of future waste disposal facilities in Phase II of the Programme".

Characterization

Both the 1983 SSA and the 1993 Stanley surveys undertook a characterization of solid waste in Barbados. The results of the SSA survey are presented in Table 2.3. Since the 1983 survey was undertaken, considerable changes have occurred in the waste stream. For example, disposal dippers which form a regular part of "today's" waste stream were almost non-existent at the time of the study in 1983. The same applies to beverage cans and the 1 litre and 240 ml beverage containers (Griffith, 1993). For the purpose of this paper, therefore, the Stanley results are considered.

Based upon the Stanley Study, the largest items in the waste stream in Barbados were paper, which constitutes 20.4 percent of total MSW; organics (non-yard waste), materials which account for 32.7 percent and appeared high for all generator types; yard waste, which was particularly high for residential and private commercial generator types, constituting 26 percent and plastics 8.6 percent, respectively. Glass accounted for 5.2 percent; ferrous metals 3.9 percent and non-ferrous metals 0.7 percent. Hazardous and special waste appearing in the waste stream was very low and consisted mainly of paint containers, aerosol containers containing insect and hair spray and car batteries.

APPROACHES TO SOLID WASTE MANAGEMENT

The treatment of solid waste in Barbados has traditionally been addressed as a public health issue on the premises that improper handling, storage and disposal can lead to disease. As a consequence, regulations governing solid waste management in Barbados are administered by the Ministry of Health. Under the Health Services Act, 1969, the Minister the Health Services

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Table 2.6 Approaches to Solid Waste Management in Barbados

Command-and-control Regulatory Approaches Administration of Solid Waste	Fiscal/Market-Based Policies Financing Solid Waste
: Health Services Act, 1969 - Addresses solid waste in the context of public health - Establishes regulations for the containment, collection and disposal of refuse : Sanitation Service Authority Act - Establishes the Sanitation Service Authority - Carries out any functions confer to it by any regulations made under the Health Services Act, 1967 relating to collection and disposal of refuse. <u>Containment</u> : Collection and Disposal of Refuse Regulations - owners - provision of sites and placement of containers to facilitate communal disposal <u>Collection</u> : Collection and Disposal of Refuse Regulations - SSA obligated to remove refuse from any premises in accordance with Health Services Regulation - collection service to be provided to all dwelling houses and other building on a weekly basis - Alternative arrangements to be made by owners - Responsibility of the owner for disposal if not collected. <u>Disposal</u> : Collection and Disposal Regulations - General provisions regulating disposal - Prescription of "suitable sites" - Prohibition of abandonment of automobiles and appliances : Disposal of Offensive Matter Regulations - Regulates the disposal of filth Waste Minimization : Sale of Metal Act and Old Metal Dealers Act - Minimization of Resale of Stolen Items : The Returnable Containers Act, 1985 - Prohibits the sale of beverages in containers that are not returnable - Mandates all beverage dealers to accept empty containers	: Government Subvention - Subsidies The Returnable Containers, 1985 - Establishes a deposit-refund system

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Act, 1969, is responsible for "(a) the prevention, treatment and suppression of disease, including the conduct of investigations and inquiries in respect thereof..... (c) the abatement of nuisances and the removal or correction of any condition that may be injurious to the public health".

Two basic approaches may be used to influence behaviour with respect to containment, storage, collection and final disposal of solid waste in Barbados (Table 2.6). These are control-and-

command regulatory approaches in which uniform measures and regulations are set in legislation and market-based environmental policies in which incentives or disincentives are established to influence behaviour and thereby achieving the desired result. The latter approach - market-based environmental policies - has not been utilized to any great extent in solid waste management in Barbados.

Command-and-Control Regulatory Approaches

The focus of the existing regulations on solid waste management in Barbados is on public health concerns and not the environment as a whole. The same is true of the Sanitation Service Authority (SSA) in Section 4 (2) of the SSA Act. Notwithstanding the current regulations, problems can be identified at every phase of the waste cycle. For example, the provisions set out in the Collection and Disposal of Refuse Regulations with respect to containment are largely ignored; the prescribed collection by the SSA is not achieved in many part of the country and problems have been experienced at the Mangrove Pond landfill, the sole legal disposal site in Barbados.

Fiscal and Market-Based Policies

Subsidies are the main fiscal instrument employed for solid waste management. They distort the true cost of waste management in Barbados. Subsidies are in the form of government subventions channelled to the SSA. Between 1991 to 1994 the SSA received subventions from the Government of Barbados totaling Bds\$78.5(Table 2.7). The subventions are never sufficient to cover SSA operational needs. One of the most commonly mentioned problems confronting

SSA is the unavailability of refuse collection vehicles due to equipment abuse, neglect of repairs and maintenance and unavailability of parts.

Furthermore, between April 1993 and October 1994 in excess of Bds\$3 million approximately was spent by the Ministry of Health on preparation of the landfill and between October 1994 and March 1995 an additional Bds\$ 2 million approximately was spent to rectify the problems experienced at the Mangrove Pond landfill. In an era of increasing fiscal constraints the government will find it increasingly difficult to allocate the required level of subsidies for the effective management of solid waste in Barbados.

TABLE 2.7 **SANITATION SERVICE AUTHORITY**
TOTAL EXPENDITURE 1988 - 1994
Bds\$ 000

	^a 1989-1990	^a 1990-1991	^b 1991-1992	^b 1992-1993	^b 1993-1994
Administration	537.30	569.30	5 420.96	4 942.42	5 428.52
Refuse Collection	5 688.80	6 262.80	59 026.05	50 926.42	51 256.42
Mechanical Division	2 258.40	2 604.70	25 702.03	20 518.44	22 208.92
Refuse Disposal	1 156.40	1 251.80	12 702.26	17 208.19	18 255.97
Public Baths & Conveniences	310.10	319.40	3 101.30	2 736.20	2 823.44
Cemeteries	1 148.50	1 254.20	12 013.49	11 699.22	11 699.22
Commercial	366.60	373.80	3 714.70	3 662.02	4 034.02
Miscellaneous	3 824.80	3 790.80	36 764.38	37 189.97	36 409.05
New Expenditure	7.60	31.40	0.00	0.00	0.00
Total	15 798.50	16 461.20	15 847.17	148 871.16	150 159.33

Source: (a) Stanley Associates Engineering Ltd¹ 1994(a)
(b) Sanitation Service Authority 1995

The subsidization of solid waste disposal by the Government of Barbados has facilitated the growth of a commercial waste collection service. Stanley Associates Engineering Ltd et al 1994(b) estimates that there are approximately 202 privately run waste collection companies in

Barbados hauling about 1 066 tonnes to the landfill each week. Of that amount it is estimated that about 324 tonnes are delivered by two companies alone.

The only market-based policy which is in operation for solid waste management in Barbados is the deposit-refund system established by the Returnable Containers Act. Prior to its enactment in 1985, a deposit-refund system was in operation for bottles considered by the beverage manufacturers as returnables. As a consequence, beverage manufacturers enjoyed an excess of 95 per cent return rate for returnable beverage bottles. A similar system also existed for other containers, primarily rum bottles which have a market value. This had the effect of inducing the growth of "bottle collecting" business persons who traversed the country collecting bottles from small business establishments for resale at a profit.

The Returnable Containers Act, 1985, was enforced in 1992, not in response to any desire to improve solid waste management, but to pressure from some elements of the private sector because of concern about increasing competition on the local market from a range of beverages brewed regionally. The deposit-refund system establishes a mechanism whereby soft drinks, mineral water, beer and other malt beverage containers are returnable. It prohibits the sale of beverages in containers that are not returnable (Section 3), and requires that all persons who sell beverages must accept the empty container and pay the refund in the Statutory Instrument (Section 4), currently \$.20 for bottles and \$.10 for other containers. Dealers are then entitled to receive a refund rate plus at least 20 per cent from the bottlers or dealer.

The enforcement of the deposit-refund system for beverage containers had the effect of facilitating a return rate of about 30 percent for PET bottles. It also had the effect of providing "employment" for a new type of "bottle collector". The major weakness of the system however was that there were no built in incentives to facilitate packaging and preparation of the returned PET bottles for recycling. As a consequence, the PET bottles were disposed of in the landfill at a cost to society.

IMPACT OF COMMAND-AND-CONTROL REGULATORY APPROACHES ON ALTERNATIVE STRATEGIES FOR WASTE MANAGEMENT IN BARBADOS

Market incentives have not been sufficient to significantly encourage alternative ways of managing waste, for example by driving recyclable and compostable materials from the waste stream to other forms of treatment. The subsidization of final disposal remains a very strong factor keeping these materials in the waste stream. Waste reduction is urgent in light of projections, by Griffith (1987), that by the turn of the century Barbados would have exhausted its existing landfill potential.

Waste Brokerage/Recycling

Highly visible problems of waste disposal in Barbados have heightened awareness about the need for recycling as one means of reducing the amount of waste for disposal at the country's lone landfill. For the purpose of this study *recyclable materials are those which can be removed from the waste stream, processed (i.e. cleaned, packaged etc.) and made available as raw materials in the manufacturing of new products. Only when the new products are used is the recycle loop completed.*

The recycling industry in Barbados exhibits a number of characteristics which are summarised in Box 2.1. Recycling operations in Barbados are essentially "waste brokers" who collect materials, consolidate them and export to other countries. Brokers exist for a range of materials including glass, metals, paper and special waste such as car batteries (Table 2.9.). As a consequence, the industry is subjected to erratic price fluctuations on the world market, a factor which significantly inhibits the growth of the industry in Barbados.

Of the "waste brokers" operating in Barbados, the companies exporting non-ferrous metal have had the longest experience: some two decades and a half. Because of the relatively high value of the material it is purchased from the consumer, processed and exported. Materials purchased from the commercial sector represent in excess of 90% of the materials recovered. For example, in 1989 Tropical Batteries Ltd. was able to secure the price of US\$168 per metric ton CIF for scrapped batteries, in 1994 the price fell to US\$54 FOB. In early 1995 this price had

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slumped significantly by more than 50 percent. Until recently scrapped batteries were bought back from the consumer at US\$5.00. There is no economic incentive to collect and prepare the waste product for export; the company does so out of a sense of corporate responsibility and public spiritedness.

**Box 2.1. Characteristics of the Recycling Industry
in Barbados**

- * Recycling operations are essentially brokers (materials are consolidated and exported to other countries).
- * The industry is based on export of waste materials and not use as raw materials in the manufacturing of a new product in Barbados.
- * The export product (waste) is subject to market fluctuations, similar to commodities.
- * Existing infrastructure to support recycling is almost non-existent and rudimentary where it exists.
- * Public/commercial recycling ethic very weak
- * Incentives/Disincentives and regulations to encourage and support recycling are non-existent.
- * Small size of the market makes it un-economical for a classical recycling industry to develop, unless a regional approach is contemplated, and even then its economic viability may be doubtful.

The industry is also constrained by the absence of infrastructure to support recycling; a weak recycling ethic both on the part of the general public and business; the lack of incentives/disincentives and appropriate regulations to influence behaviour with respect to waste management; relatively high handling and shipping charges and a limited national market. Because recyclers have not been provided with infrastructure and high profile official promotion the costs of collection and sorting are very high, over 90% of total costs in some instances. In addition, it is estimated that less than 2 per cent of all recyclable materials are taken out of the waste stream.

Composting

Presently, little or no MSW is used in the composing industry, which utilises only the by-products of the sugar industry, namely bagasse and mud, along with mixtures of animal dung (i.e. chicken and horse). Existing composing operations are not equipped to take MSW, with the exception of yard debris. In addition, no regulations or guidelines exists dealing with land application of fertilizers, soil supplements, organics or inorganics. Economic incentives are not sufficient at the present to influence behaviour toward composting.

Because Barbados' soils are low in organic matter, the use of compost in the agriculture sector has great potential benefit provided controls are exercised to monitor the level of trace metals which might find themselves in the soils. Compost would significantly help in improving soil structure, water holding capacity and weed control.

**TABLE 2.8 WASTE BROKERAGE/RECYCLING OPERATIONS
IN BARBADOS**

RECYCLING OPERATIONS	FOCUS OF OPERATION	MARKETS
Dicebed Barbados Ltd.	Newsprint	Local
Caribbean Waste Recycling (Barbados) Ltd	Paper Products Plastics	Latin America India USA
BB Environ-Tech	Plastics Glass	Trinidad & Tobago USA
RPI Recycling Preparations Inc	Non-ferrous Metal	USA Europe
JMI (Caribbean) Ltd	Non-ferrous Metal	USA Europe
Tropical Battery Ltd.	Batteries Scrapped cars	Venezuela USA

SECTION 3

TOWARDS A COMPREHENSIVE SOLID WASTE MANAGEMENT STRATEGY

As the quantity of solid waste increases, the scarcity of landfilling sites becomes more acute. fiscal constraints limit Government subsidies, the public becomes more environmentally sensitive and greater productivity and efficiency are required of Government. Different strategies and approaches will be required to address solid waste management issues in Barbados. Solid waste management must be considered in the broader context of the current and future physical, socio-cultural and economic environment of the country and influenced by a combination of both control-and-command regulatory approaches and market based incentives and disincentives, thereby internalising the cost of waste Management.

Elements of a Comprehensive Solid Waste Management Strategy

Figure 3.1. outlines the elements of a comprehensive waste management strategy for Barbados including a range of command-and-control approaches and economic instruments which could be employed as strategic tools in influencing behaviour with respect to waste management options.

Any comprehensive solid waste management strategy for the future must of necessity be guided by the principle of incorporating waste management costs into prices of goods and services. This involves changes in legislation, the treatment of waste at source, its collection, post-collection treatment and final disposal. Strategic interventions will be required at all phases of the waste cycle either through command-and-control regulatory mechanisms or market based incentives and disincentives.

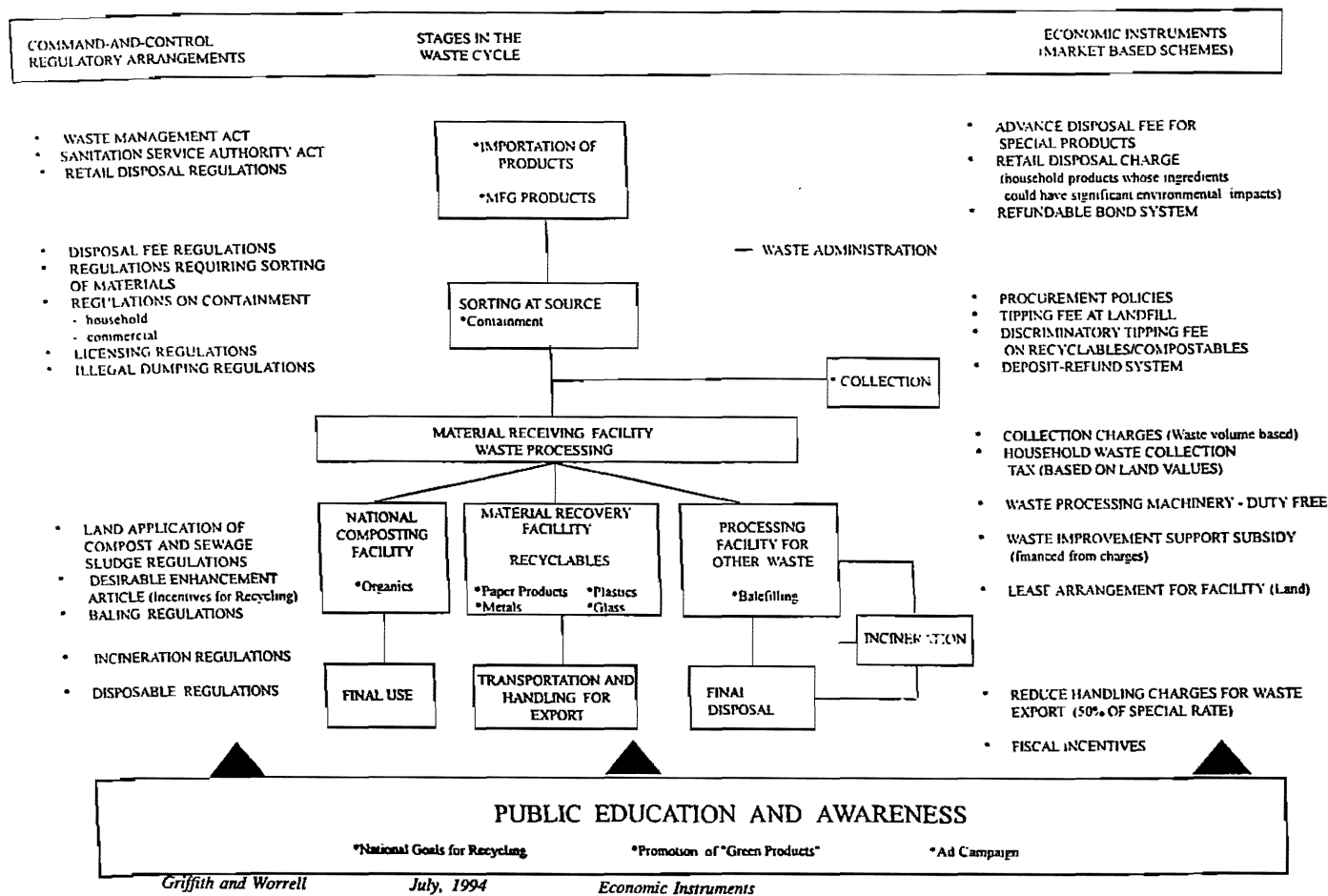
Sorting of waste is a *sine qua non* of any comprehensive solid waste management strategy for Barbados. This will require changes in habit and organization. Difficulty in implementation

may result because of inertia and the difficulty of changing ingrained practices. The most effective way of influencing a change of behaviour is through the use of a combination of regulations and incentives. For example, the introduction of a tipping fee at the site of final disposal, if implemented properly, encourages the removal of recyclables and compostable materials and the use of improved packaging, thereby reducing the volume of waste for which fees must be paid.

The public must be provided with a menu of convenient options including recycling, composting, improved techniques in waste preparation (i.e. baling) before final disposal, all supported by a strong public awareness and education programme. In addition, other techniques processes such as bale filling and incineration must be considered as part of the menu of options. None of these options by themselves can address solid waste management issues in a cost effective and efficient manner; together they make for a feasible economic system, for firms, institutions and households.

Since the infrastructure for most of these activities is not presently in place more effective mechanisms must be found to finance their implementation. For example, to facilitate a national composting programme will require investment at least in National Composting Facility, supported by the research and regulations governing soil application and use; recycling will require a Materials Processing Facility which will process recyclables as well as undertaking baling operations either before final disposal (i.e. landfill) or incineration. A waste management administrative structure will also need to be put in place to oversee, give direction and monitor the overall waste management programme. A National Education and Awareness Programme will need to be formulated and implemented. Such a strategy should include guidelines on national goals for recycling and the promotion of "green products".

FIGURE 3.1 ELEMENTS OF COMPREHENSIVE SOLID WASTE MANAGEMENT STRATEGY FOR BARBADOS HIGHLIGHTING THE COMMAND-AND-CONTROL REGULATORY AND MANAGEMENT AND MARKET BASED MECHANISMS



The technology of solid waste baling (See Box 3.1 on the benefits of baling and compacting) should be made an integral part of solid waste management in Barbados. It could reduce solid waste to a quarter of its original volume. Waste is uniformly compacted to densities approaching fifty-five pounds per cubic foot before entering a landfill. A properly managed waste baling programme offers the potential to triple the life of a landfill through greater compaction densities, improved waste to cover ratios, and the use of vertical bale fill expansions.

Strategies For Achieving the Goals of A Comprehensive Solid Waste Programme

Command-and-control Regulatory Approaches

To facilitate the implementation of a comprehensive solid waste management strategy for Barbados the existing regulations governing the containment, collection and disposal of solid waste in Barbados will need revision to make them more consistent with current and future socio-cultural and economic environments. The focus must change from a public health orientation to a broader environmental focus, which is sensitive the impacts of solid waste generation, containment, collection and disposal on other sectors of society (i.e. tourism, agriculture etc.). This will imply a fundamental restructuring of the current institutional and infrastructural requirements for solid waste management in Barbados. In this regard Stanley Associate Engineering Ltd. et al, 1994c have recommended the establishment of a Waste Management Authority.

The main regulatory arrangements envisaged are a new Waste Management Act and a revised Sanitation Service Authority Act. As the main legislative arrangement for solid waste management in Barbados the Waste Management Act would be expected to outline the operating procedures for the management of solid waste in Barbados.

The regulations which could be included in a new Waste Management Act are outlined in Figure

3.1. and can be summarised as follows:

- * **Licensing Regulations** which set out the licensing and operating procedures (i.e. issue of licenses, renewals, suspensions, revocation etc.) of private solid waste collectors.

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BOX 3.1

ADVANTAGE OF BALING VERSUS COMPACTING

BALING

- * Reduced leachate because of the bale density.
- * Reduced amount of loose waste to blow off the fill site.
- * Reduced odor, dust, noise, gas and vectors.
- * A real advantage in fill density over roller compacted loose waste.
- * Ease of shipment.
- * Potential strip mine for a waste to energy operation (above ground locations).
- * Cost-effective (low labor requirements).
- * Baler's output density 2,000 - 2,500 lbs/cu.yd. on average.
- * The greater-density of baled waste will slow migration of water through the fill (clay liner versus polyethylene).
- * Require much less cover (20:1 or greater refuse to cover ratio).
- * Interface between cover and refuse is minimized thus mixing is held to a minimum.
- * Recycling efforts improved.
- * No refuse trucks in landfill.
- * Decomposition of wastes will be slowed, reducing the quantity - but probably extending the lifetime of gas and leachate production.
- * More aesthetic.
- * Long life (20 years with proper maintenance versus 6 years with compactors at high volume facilities).
- * Permits easier inspection of all waste entering the baling facility (better control over the environmental risks).
- * Reduces the operation of internal combustion engines (gasoline and diesel) that must operate in a conventional landfill to compact and cover waste.
- * The reduced time needed for landfilling equipment to cover the landfill is significantly reduced.
- * Solid waste baling contributed positively to saving fuel as it reduces air pollution.
- * Baled recyclables demand a higher price due to greater density of materials, and ease of handling (Materials Recovery Facility).
- * The balefill equipment operator does not have to deal with the plasticity of waste and soils (conventional landfill operator must continually work compacting equipment to reduce).
- * Not as susceptible to water infiltration.
- * The cost efficiency of baling is enhanced by its in-place stability. This stability of baled waste enables controlled vertical expansions. A vertical expansion may be carried out above an existing cell's environmental footprint.

BALING VERSUS COMPACTING

- * During this new age of recordkeeping, baling offers potential to track the location of certain waste within the balefill.
- * Better densities per cubic foot (58.6 pounds per cubic foot for baled waste versus 40 pounds per cubic foot with conventional compacting equipment).

CONVENTIONAL COMPACTING METHOD

- * Once the soil overburden is added to the equation, the open landfill's density may approach that of a balefill.
- * Even packing at open landfills (balefills can still develop holes - as decomposition rates may vary from load to load).
- * Must roll and compact refuse repeatedly to achieve a desired compaction density. Even after repeated compaction, a conventional landfill will have soft spots and seams due to varying densities of waste.
- * Conventional compaction equipment often pierces the top cover barrier (weather seal), permitting water to migrate into and through waste. If not properly handled, leachate and methane are generated.

Source: Moseley Machinery Company Ltd. Inc. Waco, Texas

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- * **Disposal Fee Regulations:** to make provisions for the introduction of a tipping fee at the final disposal site (i.e. landfill). Such regulations would establish the fee structure for disposal and the conditions under which recyclables and compostables may be disposed of at the landfill. The fee structure should be designed to divert recyclables and compostables away from the landfill, by penalising the final disposal of items containing such materials.
- * **Retail Disposal Regulations:** to outline the products on which a special deposit must be made at the time of importation or purchase.
- * **Refundable Performance Bond System Regulations:** to make provision for the establishment of Refundable Performance Bonds for a range or specific products.
- * **Sorting Regulations:** to make provisions for the mandatory sorting of solid waste at source.
- * **Regulations on Containment:** to set out the guidelines on containment both at the individual and communal levels.
- * **Land Application of Compost and Sewage Sludge:** to make provisions to regulate the content of the material being applied to the soil.
- * **Desirable Enhancement Article:** to provide the legal framework for the establishment of an incentive scheme for the recycling and "waste brokerage" industries.
- * **Incineration Regulations:** to provide guidelines for the operation of incinerators, materials to be incinerated, screening processes, emissions and disposals of residuals.
- * **Illegal Dumping Regulations:** provide penalties for illegal dumping.
- * **Baling Regulations:** Outline the conditions under which baling would take place, particularly with respect to pre-and post processing of waste.
- * **Disposal Regulations:** Establish criteria for liners, leachate collecting systems, methane control system, drainage and ground water monitoring and post closure monitoring of the disposal site.

Economic Instruments

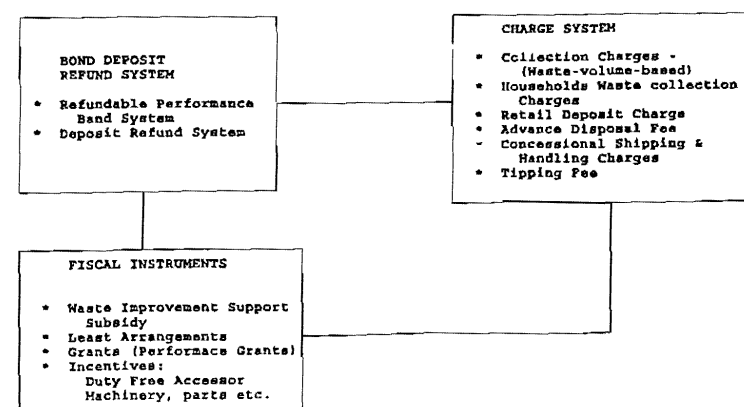
Economic instruments are strategic tools which should be used to influence behaviour in the direction required for integrated solid waste management by incorporating the cost of waste management in pricing and costing systems. Economic instruments in three major categories (Figure 3.2.) are suggested for Barbados, not as a solution to solid waste problems in themselves, but as part of a comprehensive solid waste management strategy for the country.

Charge Systems

A number of charges and fees could be introduced at various stages in the waste cycle to influence economic decisions with respect to solid waste generation, containment, collection and final disposal.

At the "front-end" charges could be imposed on products that pose special waste management problems. In the Barbados context, large household appliances, cars and car batteries are good examples of such products. The charge is imposed on the manufacturer and/or the importer of the product.

FIGURE 3.2 ECONOMIC INSTRUMENTS FOR SOLID WASTE SOLID WASTE MANAGEMENT



Retail Disposable Charge:

In order that the final disposal system (i.e. landfill) is efficient and cost-effective with a life span as long as is technically feasible users must be discouraged from disposing material which can be used again. A number of economic instruments can be used to accomplish this objective. These are summarised below.

- * **Tipping fee at the landfill:** The introduction of a tipping fee at the landfill would provide an incentive to the private sector for reducing the amount of waste being generated. This would send a signal to the market that there is a cost attached to the disposal of products and that cost should be internalised. If incineration is an option in the waste management strategy an incineration fee would be appropriate.

The tipping fee should be high enough to discourage the disposal of recyclables and compostables at the landfill. It should also discourage disposal of recyclables and compostables by placing a higher fee for unseparated refuse.

Revenue generated from the tipping fee could be used to finance the operation of the disposal site. Any excess could be used to encourage initiatives in recycling and composting or the institution of a "reward mechanism", whereby the collector purchases recyclables and compostables from users. This encourages the separation of waste at source and creates opportunities for "waste brokerage" composting industries. Resources released as a result of the introduction of the tipping fee would now be available to the Government to undertake other high priority social programmes.

At the collection phase of the waste cycle a number of charges could be introduced aimed at internalising the cost of waste management.

- * **Household waste collection charge:** A nominal charge could be instituted to finance the cost of collection and the investment in the infrastructure which will be required to facilitate both recycling and composting. Such a charge could be a percentage of the improved values of residential properties in Barbados. By linking the charge to improved values of properties, persons at the lower end of the economic spectrum would not be adversely affected.
- * **Collection charges:** The private sector will be required to meet collection charges for the removal of solid waste from their establishments. This could be done on a waste volume basis. Such a charge will not constitute a new expense for the private sector since most of them already have an existing charge for the containment and removal of solid waste. Instead it may constitute a saving since the sorting and processing of waste at source would increase storage efficiency.

Performance Bonds and Deposit-Refund Systems

Environmental performance bonds and deposit refund systems are economic instruments that aim to shift the responsibility for controlling pollution, monitoring and enforcement to individual producers and consumers who are charged in advance for the potential damage (Panayotou, 1993).

- * **Refundable Environmental Performance Bond System:** A fund is established from the "front-end" charges collected on products that pose special waste management problems. The charges are refundable on proof that the products in question have been collected and disposed of in an acceptable manner or "processed" for recycling. For example, all companies importing car batteries and / or manufacturing them for the local market would be required to pay an up-front bond on each battery imported or manufactured for the local market. The importer/manufacture could in turn institute a buy back system thereby giving the consumer a monetary incentive to return used batteries. Until recently a buy back system was in place for used car batteries. This service was considered by the company as its contribution to the environment.

These bonds would be refundable on demonstration by the importer and/or manufacturer that used batteries have been collected and sent for recycling. Resources from the bonds could be used to offset the handling and shipping costs associated with exporting old car batteries.

Presently, less than 30 per cent of used car batteries are collected and exported for recycling by the lone battery manufacturer in Barbados, which controls approximately 80 percent of the local market. The very low market price for the used batteries makes it uneconomical to collect them and prepare them for export because of the relatively high handling and shipping charges.

The institution of such a mechanism would force companies to take adequate measures to reduce the impact of their activities on the environment; it would make available resources for clean up in the event that the companies renege on their responsibility and could be used to offset the handling and shipping charges associated with export.

- * **Deposit Refund System:** The existing deposit refund system should be expanded to include all beverage containers.

The Government Response

The current problems confronting Barbados in solid waste management has forced the Government to look for urgent solutions. The Government committing itself to the closure of the lone landfill - at Mangrove Pond- by mid 1995 (subsequently this was changed) and is faced with the task of constructing a new landfill at Greenland, St. Andrew. This is estimated to cost about Bds \$5.0 million (Arthur, 1995).

As a policy measure the Government has decided that the cost of constructing and maintaining the landfill should be met from a stream of income through a levy imposed on those items which create a need for such a facility as well as from a tipping fee. These measures are:

- i. a tipping fee of Bds \$40 per will be charged at the landfill
- ii. a levy will be imposed on all plastics, glass bottles, fridges, stoves, paper board boxes cartons, tyres, washing machines, motor vehicles, car batteries, T.V sets, mattresses;
- iii. businesses engaged in recycling activities will receive the same concessions as those granted to manufacturers on machinery, spare parts and equipment.

In the case of imports the Environmental Levy will be collected by the Comptroller of Customs at the point of entry. In the case of locally manufactured items, the levy will be paid to the Comptroller of Customs along with the consumption tax.

SECTION 4

FISCAL IMPLICATIONS OF ACTUAL AND PROJECTED WASTE MANAGEMENT POLICIES

The 1995/96 Government Programme for Solid Waste Management

Waste management programmes in the 1995-96 Government of Barbados Estimates of Expenditure include the start of construction for the South Coast Sewerage Project, the operation of the Solid Waste Disposal Unit and a subvention to the Sanitation Services Authority. There is no provision for the treatment of what are known as "special" wastes, or the proposed National Waste Reduction Programme. There is no provision for the construction of a new landfill, for which funding is being sought from the Interamerican Development Bank (IDB). Local counterpart funds, and bridging finance for initial work on the landfill pending IDB loan approval, are to be provided from the proceeds of the 'environmental levy' proposed in the Minister of Finance's April Budget.

The waste management programmes provided for in the 1995/96 Government Expenditures as approved by Parliament are shown in the top part of Table 4.1. The largest amount is for capital works on the South Coast Sewerage Project, scheduled to begin by mid-year. There is a small amount for preparatory work on the West Coast Sewerage System, whose construction is to follow closely on that of the South Coast. There is no subvention for the operation of the existing sewerage facility for Bridgetown. It is operated by the Barbados Water Authority, which is expected to cover its expenditures. (Over the past six years the Barbados Water Authority had surpluses in three years and deficits in the remaining three. A surplus of about \$2 million was accumulated between April and December 1994 but a deficit of \$4½ million is estimated for 1994/95 fiscal year, which ended in March.) The less densely populated areas will not be covered by sewerage systems. In these areas there is provision for an on-going programme to construct toilets for the poor.

Actual and Projected Financial Costs of Waste Management (\$M)

Measures Included	FY 94/95	FY 95/96	Comment
Sewerage			
Construction			
S. Coast	14.5	20	
W. Coast	0.6	1	
Operation	-	-	Cost recovery, BWA
Environ. Sanitation Unit	0.6	0.6	Toilets for the poor
Environ. Engin. Unit	1.1	1.7	Monitors and controls sewerage treatment, etc.
Solid Waste Management			
Solid Waste Project	0.3	3	Feasibility studies & final designs
Sanitation Service Authority (SSA)	20.1	18	
Solid Waste Disposal Unit	-	2.3	Operations at Greenland
TOTAL Measures in Effect	37.2	46.6	
Additional Measures Required			
Special Wastes	...	1.0	Collection, storage, processing (extraction of recyclable & exportable materials), compacting, disposal
Composting	...	6.0	Of yard waste, sludge, blood, septage, grease (Output for landfill cover)
Landfill Construction	...	14.8	

Stanley Report, let yr cost (Tech. Addendum #11, Table 9)
 Composting (Stanley Report Tech Add. #11 Financial Analysis App. A "Capital, Renewal & Replacement Costs")
 Civil Works 1.5
 Equip. 1.7
 Start-up & Replacements 0.7
 Renewal & Replacements 6.0

Landfill Construction Costs (Stanley Report, same as "...")

Source: Government of Barbados, Estimates of Revenue & Expenditure, 1995/96; Stanley & Associates et al., 'Integrated Solid Waste Management Programme, Government of Barbados', Ministry of Health, Mar. 1994.

The subvention for the operation of the Sanitation Services Authority, the largest single item of ongoing Government expenditure, covers collection and disposal of solid waste. No specific allocation is made for the operation of landfills, which are subsumed under this item. The inadequacies of the present arrangements, which have provoked intense public debate on the options for waste disposal, indicate that this is insufficient to ensure effective and environmentally friendly disposal. There is provision for feasibility studies and designs for a new landfill and an allocation for its operation. The new environmental levy is projected to yield \$2 million towards construction costs estimated in the region of \$5 million. The Stanley Report (1994) estimates the construction cost for a landfill as almost \$15 million initially; it is unclear why current estimates are so much lower.

Government expenditures make no provision to remedy the unsatisfactory treatment of yard waste, sludge, offal, septage, blood and grease. The Stanley Report recommends composting at a capital cost of approximately \$6 million for the establishment of the facility. This is a further expenditure Government would need to provide for. The volume to be handled may be reduced if private sector interests build a rendering plant to absorb offal and blood but this may not reduce the establishment cost. Once the composting facility is established a small provision will be needed in future years for its operating expenses. The Stanley Report advises that this facility might be operated jointly with the landfill.

The Stanley Report proposed that a Waste Management Authority to replace the SSA and manage the landfill would also be responsible for the collection, storage, processing and disposal of so-called "special" wastes such as metal, tyres, batteries, etc. The cost for the first year is projected at \$1 million. There would be provision for the extraction of recyclable materials - in many cases by commercial operators - and for the compaction of bulky material. Provision would be made for the proper treatment of hazardous wastes.

A national waste reduction plan (outlined in Table 4.2) is a vital and cost-effective element of national waste management that has so far received little popular attention. The Stanley Report suggests measures for waste reduction and recycling would require Government expenditure of

only \$2.6 million in the first year - remarkable value for money in terms of the overall improvement it would make in environmental conditions. The programme includes: tax and other incentives for private recyclers; provision of systems for convenient sorting of wastes; regulations and monitoring of waste disposal; fees imposed on the import and consumption of goods which produce hazardous and other special wastes; financing of pilot schemes to popularize backyard composting; guidelines for Government purchases that set an example of environmentally-friendly choice of products; establishment of a service to provide evaluations for private firms of their waste management practices and recommendations on improvement; a database of valuable waste available for sale or purchase; an intensive public education and outreach programme to shift national habits of waste disposal into desirable patterns; and better enforcement of environmental regulations. The programme also includes an element of cost recovery including charges for the use of the landfill.

In his Budget of April 1995 the Prime Minister introduced the principal revenue measures in this package, including the environmental levy, imposed on imports of selected items, and 'tipping fees' for disposal at the landfill. There is as yet no word on the implementation of the other measures in this comprehensive programme. They are essential if the revenue measures are to have the intended effect. For example, if tipping fees are not accompanied by a vigorous national recycling campaign they will result in higher costs to producers and consumers, with no reduction in the volume of waste. Unless more resources are allocated to regulation and monitoring, the incidence of illegal dumping and malpractice may increase.

The cost of waste management programmes for which Government has made provision in Fiscal Year 1995/96 is \$46.6 million, i.e., 4% of Government expenditure and almost one-quarter on spending on health services. Health is second to education in terms of Government expenditure with 17% of spending compared to education's 19% (See Table 4.3). To this must be added the items in the second part of Table 4.1 and the cost of a National Waste Reduction Programme.

Table 4.2
National Waste Reduction Programme
(+): Increase (-): Reduction

	Government Expenditure	Government Revenue	Regulation
Private Recycling	Incentive Payments, Subsidies (+)	Tax Rebates, Exemptions (-)	...
Containment	Provision of Receptacles (+)	Fees & Fines for Non-Compliance (+)	Compulsory sorting of waste by companies and households
Advance Disposal Fees	...	(+)	...
Backyard Composting Scheme	Subvention to NGOs (+)	...	...
Government Procurement	...	...	Revision of Procedures, introduction of guidelines for environmentally sensitive purchasing
Waste Audits	Provision of Waste Audit Service (+)	...	...
Waste Exchange	Provision of Service	...	...
Tipping Fees	...	(+)	...
Public Education & Outreach	(+)	...	...
Enforcement of Regulations on Disposal	Introduction of Modern Methods (+)	...	Modernize Regulations

\$2.6m (Source reduction & recycling, 1st yr. cost: Stanley Report Tech. Addendum #11, Tables 6 & 7).

Source: Stanley et al, 1994

Government should allocate an additional \$10 million for national programmes to reduce the volume of waste, promote recycling, establish composting facilities and deal with special wastes.

In order to meet these new commitments Government has the following choices:

1. to close down or scale back other Government expenditure to that extent.
2. to borrow the required amount.
3. to impose additional taxes and levies.

Table 4.3 Government Expenditure Estimates, FY 95/96

	\$M	% of Total
General Public Service	175	15
Defence and Security	19	2
Education	225	19
Health	199	17
Waste Management	47	4
Other	152	13
Social Security and Welfare	119	10
Housing and Community Amenities	22	2
Other Social Services	29	2
Economic Services	191	16
Other	190	16
TOTAL	1169	100*
*Discrepancy due to rounding		

Source: Government of Barbados, Estimates 1995/96, Revenue & Expenditure

Table 4.4 gives some indication of the difficulty of diverting \$10 million from other allocations to financing waste management programmes. The extent of reduction that would be required in any programme could only be effected by curtailing services, eliminating some altogether, and/or the introduction of fees or other charges. The demand for social services already exceeds the supply to which Government is committed. Cutbacks have been made to accommodate to the limits set by the expenditure approved by Parliament. Any efficiency gains that are possible will be absorbed in maintaining levels of service. Government's commitment not to repeat wage reduction policy means that expenditure on the public service as a whole may be reduced only by lowering employment in the Government service - a course which Government is committed to avoid.

Borrowing to meet the additional environmental expense is not a good option. Barbados' economic growth strategy is based on maintaining a fixed exchange rate through market

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intervention by the Central Bank of Barbados. To maintain public confidence in the Central Bank's ability to intervene, ample foreign exchange reserves must be maintained to meet any contingency. Government has set a target that foreign exchange reserves should attain the equivalent of about 13 weeks of imports. At the beginning of the 1995/96 Fiscal Year foreign exchange reserves were a little below that target. To attain the target by the end of the fiscal year Government must repay existing credit to the Central Bank.

Table 4.4 Opportunity Cost of Environmental Spending

	(1) Exp. Est. 1995/96(\$m)	(2) No. of Beneficiaries/Employees	(1)/(2) Avg. Exp.(\$)	\$10m Reduction	
				% of Exp. in Col (1)	Avg. Exp. after Reduc.(\$)
Education	225	61,000 (students)	3,700	4.4	3,525
Health	152	20,000 (patients)	7,600	6.6	7,100
Pensions & Social Services	148	30,000 (beneficiaries)	4,900	6.8	4,600
Public Services	175	15,000 (employees)	11,700	5.7	11,000

*Excl. environment

*Excl. employees in Health, Education, Social Services (estimate)

Sources: Table 4.3, Estimates based on Official Reports of Chief Medical Officer, Chief Educational Officer, B'dos Statistical Services, Labour Force Survey

If existing borrowing is rolled over foreign exchange reserves are likely to remain below the target at the end of the fiscal year and if Government borrows more, foreign exchange reserves may decline, pushing the target even further away.

Nor will Government be able to borrow more from domestic sources such as commercial banks, insurance companies, the National Insurance Scheme or the general public. Forecasts have been made of the surpluses available for Government finance from these sources and these surpluses have already been allocated to finance the projected Government deficit with the existing approved levels of expenditure. While there will be errors in the forecast it is as likely that there will be less finance as that there will be more.

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It would be worthwhile for Government to explore the prospects of medium to long-term foreign funding for capital works such as the establishment of a composting facility. The new-found focus on the environment by the IDB, the Caribbean Development Bank and other international financial institutions enhances the prospects of attracting financing if the proposed expenditures are properly justified. Government is confident that an IDB loan will be forthcoming to cover most of the cost of setting up a new landfill. However, the completion of such financing arrangements is always protracted and there is little possibility that finance will become available in Fiscal 95/96 for anything other than the landfill.

The final consideration with respect to borrowing is that interest payments have been steadily rising as a percentage of Government revenue and now stand at 16%. Additional foreign borrowing threatens to raise that proportion. Borrowing merely postpones the pain of reducing expenditure; instead of making room for environmental spending in the current period, sacrifices will have to be made in the future in order to meet interest payments.

A further increase in taxation is the least undesirable means of financing the additional environmental spending. A \$10 million increase in personal income tax receipts is equivalent to 5% of the expected receipts from personal income tax. Government would probably wish to avoid a higher income tax which would be seen as reversing recent policy to reduce its burden. If the consumption tax and stamp duties were to be raised, the required increase is 2%, insufficient to raise the ratio of these two taxes to overall consumption from its projected 19% for the fiscal year.

Implications of the Use of Economic Instruments

The inability of Government to totally finance a comprehensive waste management strategy will necessitate the use of a series of measures aimed at internalising the cost of waste management to the generators. In addition, with increasing incentives it is likely that the private sector will play a more active role in waste management. As a consequence, the downsizing of government's involvement in waste management will be inevitable.

Overall, careful environmentally conscious management of wastes will lead to additional costs to firms and households which are so small and widely dispersed they will hardly be noticeable. The most important changes are those involving habits and organisation. We expect they will be the most difficult to execute because of inertia and the difficulty of changing ingrained practices.

The use of economic instruments as outlined in Figure 3.1, if implemented effectively could have significant implications in altering behaviour with respect to solid waste management in Barbados. For example, the various charge systems, particularly the tipping fee at the landfill could result in the internalization of waste disposal. Careful attention must however be paid to affixing the level of the tipping fee if it is to achieve the desired effect. In addition, a discriminatory element would need to be factored into the tipping fee in favour of recyclables and compostables, thus creating a disincentive to take such materials to the landfill. This in turn should serve as an incentive for establishments to commence the sorting of waste at source.

This in turn would necessitate the provision of waste audit to the enterprise to survey their waste management systems and advise on best practice. This service would be provided at the expense of the enterprise. In so doing additional opportunities will result for further private sector involvement (i.e. environmental consultancies). It is not a function in which Government should seek to undertake or finance as is implied in some quarters.

Environmental fees that increase the cost of using items containing materials that give rise to special wastes is a justifiable means of remedying a situation where the entire community suffers environmental degradation from the improper disposal of special wastes. The fees would ensure that those of us responsible for creating the problem make a substantial contribution to its solution. However, if they are to have the intended result the receipts should be used to finance suitable measures of recycling and disposal. The proposals of the 1995 Budget should be implemented in such a way as to secure this objective.

Recycling has emerged as a new and important services industry offering opportunities for entrepreneurs and a contribution to the growth of employment. The efforts of recyclers in Barbados account for only a very small percentage of solid waste (between 1% - 5%) and most are too young for us to pass judgement on their viability. Notwithstanding this, however, the waste brokerage industry have emerged without appropriate incentives at the national level to foster their development. Their growth are the direct result of enterprising entrepreneurs; together with improving market prices for recyclables, particularly paper, glass and plastic. The latter is of considerable interest to the waste brokerage/recycling industry given their dependence on external markets and the volatility of the recycling market. For example, in 1990, prices for recyclables, particular waste paper were low. It was not uncommon for mills in USA to pay US\$11 to US\$22 per ton for ONR and processors US\$3 to US\$7 per ton; polyethylene terephthalate (PET) processor prices ranged from 6.6 cents to 8.5 cents per pound and aluminum used beverage cans (UBCs) ranged from 38 cents to 54 cents per pound (Rabasca, 1995). This trend continued until for the next few years. In October, 1993 the recycling industry received a boost from the Federal Government when President Clinton signed an executive order directing every agency of the Federal Government to purchase printing and writing paper containing 20% post-consumer materials by the end of 1994 and 30% post-consumer material by the end of 1998 (Rabasca, 1995).

Scarce supplies, new technology and burgeoning processing capacity marked the recycling industry in 1994, resulting in an unprecedented series of booming prices; not only for paper but also other commodities such as glass and plastics.

If recycling is to make its contribution to waste management in Barbados; then it must take place within a holistic and comprehensive framework comprising of adequate regulations together with the necessary incentives and disincentives, including the establishment of a mechanism such as a Waste Improvement Support Subsidy. Figure 3.1 outlines some of these measures.

The measures outlined in the 1995 Budget should be critically evaluated in the context of the requirements of the waste brokerage/recycling industry and revised where necessary. The type

of incentive/disincentive scheme which is put in place could have a significant impact on the amount of financial resources Government directly allocate to waste management. For example, an innovative incentive/disincentive scheme could easily influence the private sector to invest in the establishment and operation of a Materials Recovery and Waste Processing Facility (See Figure 3.1), of which baling could be an integral part. The same also applies for incineration which remains an option for the medium and long-term. Given the relatively high capital investment of incineration however, a more direct government/private sector collaboration will be necessary.

Measures to reduce the volume of waste and separate waste streams to facilitate recycling incur very little additional cost to the private sector but involve internal reorganization of waste management in firms and households. They require expenditure by Government to gain commitment to separating waste, to give voice to the evolving social conscience on proper waste management and to regulate and monitor the implementation of modern waste collection techniques. Opportunities for private firms arise in manufacturing and distribution of new kinds of waste receptacle.

An important contribution to waste reduction might be made by backyard composting. It will be difficult to engineer only because it requires a change in habits. Also, unfamiliarity means that initially there will be deficiencies in the system. The proposed "master composter" programme to initiate the process is essential. We would start with a group of highly motivated personnel who can help to identify and resolve the teething difficulties with the system. They would extend the process to the community through their own example as well as the training they could provide. The cost to households would be trivial.

Fundamental to the success of any incentive/disincentive scheme for waste management in Barbados will be a sustained and effective public education and awareness programme. Such a programme should be designed and implemented jointly by the public and private sectors, particularly those in the recycling industry. Such a programme should highlight the natural goals for recycling, waste reduction and the promotion of 'green products'.

SECTION 5

CONCLUSION

Solid Waste Management has emerged as one of the leading environmental issues facing the Barbadian Society. The Barbados case underscores the nature of the problems faced by small islands, with a limited land space; inadequate resources and a growing population.

Although the Government of Barbados has taken major steps to improve waste management systems with the establishment and extension of sewerage and the opening of sanitary landfills, it has become clear in recent years that the problem has not been tackled with sufficient urgency. Government now has available to it perspectives on the elements of what should constitute a comprehensive solid waste management strategy for the island. Unfortunately, so far, the public attention has focussed only on one aspect of such a programme -landfilling. Because of Barbados' peculiar soils there is no good option for siting a landfill - only a choice among the bad. The greatest urgency attaches the measures for reducing volumes reaching the landfill.

For Barbados to effectively address the waste management issues confronting it, considerable changes in way solid waste is perceived and approached institutionally will need to change. Instead of being perceived as a public health issue; it ought to be seen in the broader context of environmental management. In addition, changes in the handling and processing of waste will be necessary to bring it in line with modern technologies and methods.

In addition, the historical role the Government has played as the subsidizer of final disposal must be changed and a systematic and sustained effort made to internalise the cost of waste management. In this regard the use of economic and market based instruments are likely to increase in importance, as demonstrated by the measures contained in the 1995 Financial Statement and Budgetary Proposal. These measures though generally in the right direction requires further evaluation and unless are incorporated as elements of a comprehensive solid waste management strategy they may well make matters worse.

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The use of economic and market based incentives/disincentives, will not however by themselves address the solid waste issue in Barbados; but will need to be complemented by a revised and update command-and-control regime.

It is evident that any comprehensive solid waste management strategy for Barbados must be multifaceted in character, including a combination of options; namely recycling, composting, improved techniques in waste preparation (i.e. baling) before final disposal, landfilling and/or balefilling and incineration in the medium and long-term. Incineration though considered as relatively high cost option; in a country where the social cost of wastes disposal are so high it may well be a cost-effective element of the national waste management strategy, particularly in the medium and long term. All of these must be influenced by a strong public awareness and education programme.

Fundamental to the formulation of any comprehensive solid waste management strategy for Barbados is the urgency necessity to undertake a more reliable survey to determine the waste generating capacity of the society. Not to do so could prove to be very costly in the future. As observed by Stanley, the gate survey carried out during the first Phase of the Comprehensive Solid Waste Management being undertaken by the Government of Barbados will not be adequate for the design of future waste disposal facilities.

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