

# Instruments for sustainable solid waste management in Botswana

Sustainable solid waste management is a strategy for achieving environmental quality in both the developed and the developing world. Environmental quality is a necessary condition for an increase in per capita welfare over time. The paper suggests alternative instruments for solid waste reduction, re-use and recycling. But to be able to apply the suggested economic instruments, the quantities and composition of the waste must be known. Having identified the current instruments of Botswana's solid waste management (regulatory measures, environmental education, and economic instruments of property rates, service levy, and sanitation fees), the paper argues that these do not go far enough in enhancing environmental protection. Alternative instruments such as solid waste collection and disposal levies, deposit refund schemes, and product levies are suggested. It is also suggested that public environmental education and regulatory measures should be strengthened.

## Introduction

Solid waste, in the broadest sense, includes all the discarded solid materials from municipal, industrial, and agricultural activities. However, in this paper, solid waste refers to waste streams that are collected by municipalities. Our point of departure is that inefficient collection and disposal of municipal solid waste is a problem that needs serious attention in a developing country such as Botswana. Rapid urbanisation in developing countries has been one of the contributory factors to the problem of waste disposal because the amount of solid waste increases with urbanisation, leading to adverse effects on human health and the environment (Tolba *et al.* 1992).

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A closer look at material flows in society shows that the first generation of solid waste is from the production of raw materials. Thereafter, solid wastes are generated at every step as raw materials are manufactured and converted into goods and services. One of the ways to reduce the amount of solid waste disposed of is to reduce the consumption of raw materials, and to increase the rate of solid waste recovery and re-use. Traditionally, municipal solid waste management was regarded as a matter of getting rid of things that were unwanted. In recent years, however, there has been an increasing recognition that municipal solid waste may have an economic value, for example the use of waste as energy and

the recycling of beverage cans (Langerkvist 1996; Matiza *et al.* 1994).

Sustainable solid waste management implies that the solid waste collection and disposal services are provided without adverse effects on economic efficiency, social equity, and the environment. There is a need for a comprehensive environmental policy in Botswana which is consistent with the ideals of sustainability (see Becker & Jahn 1999; Turner 1994; Henry & Heinke 1996). The Government has recognised the need for such a policy as demonstrated by the formulation of the National Conservation Strategy in 1990 (Government of Botswana 1990). Botswana is also a signatory of the Rio declaration on the protection of the natural environment. In the sphere of solid waste, attempts are being made to devise appropriate policies in order to achieve sustainable solid waste management. The guidelines for landfills have already been prepared, and are intended to assist the Department of Sanitation and Waste Management in issuing licenses for landfills (National Conservation Strategy Agency (NCSA) 1997). Other achievements include the drafting of a national waste-management strategy and promulgation of the Waste Management Act of 1998 (National Conservation Strategy Agency (NCSA) 1998).

With the rising cost of waste management, there is an urgent need to develop a policy framework that will lead to better management of solid waste. The general thinking in Botswana is that there is a need to combine regulatory, economic, and environmental education instruments to solve the waste management problem. Although economic instruments have a long history of academic research, their application to environmental problems has a very short history (Kosobud & Zimmerman 1997).

This paper attempts to devise appropriate instruments for sustainable solid waste management in Botswana. The second and third sections of this paper discuss background issues on waste management in Botswana such as solid waste collection, disposal, recycling, and re-use. The fourth and fifth sections review the existing legal, economic and environmental education instruments for solid waste management in Botswana, and also suggest alternative strategies. The strategies suggested are not necessarily novel as they are already being applied in other countries, especially in the developed countries. The last section concludes the discussion.

## Solid waste quantities and characteristics

Knowledge of the sources and types of solid waste, along with data on composition and generation rates, is basic to the management of solid waste. The methods of input, secondary data, and generation analysis are used to estimate solid waste quantities and composition (Dorhman *et al.* 1991 and Vesilind *et al.* 1994).

In Botswana, there is very little information on the quantities of solid waste generated. The latest estimates, which are currently far from being reliable, indicate that the total amount of solid waste disposed of at landfill sites is around 325 000 tons per year, excluding mining waste (NCSA 1998). Hazardous clinical waste is estimated to be about 2 500 tons per year (NCSA 1998). This waste is not safely segregated, or stored, and is burnt in poorly operated incinerators. Almost all dry cell batteries are disposed of with domestic waste at landfill sites. About 46 000 lead acid batteries are either disposed of at landfills, stored, or dumped indiscriminately in the environment every year. Motor vehicle scrap metal production is estimated to be 20 000 tons per year (NCSA 1998).

One of the major difficulties in estimating the amount of solid waste generated in Botswana is that smaller villages do not have collection services and disposal sites where the waste brought in can be weighed. Collection in larger villages is erratic and not properly coordinated. Waste collection is more frequently done in urban than rural areas. For instance, 60 per cent of households in large villages receive a collection service as compared to 7 per cent in small villages (NCSA 1998). This inequality in solid waste provision between urban and rural areas is probably based on the reasoning that the rich, who consume more goods and services, tend to generate more solid waste than the poor, who consume less goods and services. It is estimated that 38 per cent of the 250 000 tons of household waste is actually delivered to disposal sites and the remainder just 'disappears' into the environment (NCSA 1998). The tendency to throw away waste anywhere is still prevalent in most communities in Botswana, and we argue that this problem can be addressed by introducing appropriate instruments for waste management.

Information on the composition of solid wastes is important for evaluating alternative equipment needs, systems, and management programs and plans, especially with respect to the implementation of disposal,

Table 1. Components of municipal solid waste in Gaborone

Component	Quantity (percentage by mass)
Refuse	59.32
Garden trimmings	33.70
Ash	3.31
Paunch	0.78
Metal scrap	0.71
Tyres (rubber)	0.66
Paper	0.61
Tin cans	0.48
Steel	0.26
Glass	0.17

Source: Gaborone City Council (1997)

resource, and energy recovery options. Composition of solid waste for Gaborone (Botswana's major urban centre) by type is summarised in Table 1. A large proportion of the landfilled waste is refuse and garden trimmings (93%), which makes composting an attractive waste management strategy. Waste streams such as metal scrap, tires, paper, tin cans, steel and glass constitute a small percentage (3%) of the landfilled waste. This may be due to local efforts in reuse and recycling of these categories of waste. The remaining waste streams (ash and paunch) account for only 4% of the landfilled waste.

## Systems of waste management

### Introduction

Solid waste management is going through a dynamic and innovative phase in Botswana, as in other developing countries. Botswana is a semi-arid country with an area of 567, 000 km<sup>2</sup>, and an estimated population of 1.5 million (1997). Its per capita income is among the highest in Africa, estimated at USA \$3 260 in 1997. The economic growth rate for 1996/97 was 5.7% (World Bank 1997). This suggests that the growth in the generation of solid waste is also rapid, as there is a positive correlation between incomes and the generation of municipal solid waste (World Bank 1999). Increasing attention is being paid to the reduction of solid waste deposited in the environment by adopting strategies of waste reduction, re-use, and recycling. The concern to reduce the amount of solid waste deposited in the environment stems from the realisation that land for the establishment of landfills is scarce, and the fact that there is a rapid increase in financial and environmental costs of landfilling.

The strategy of reducing, recycling, and re-using waste

is usually referred to as the 3R's strategy of environmental conservation. What do the three concepts mean? Briefly, reduction of solid waste in the context of the industrial sector refers to the process of reducing the amount of waste produced per goods produced (Pearce *et al.* 1994). In the context of the household sector, reduction of solid waste simply refers to the minimisation of waste produced in the household (NCSA 1998).

Recycling, on the other hand, refers to the process of separating and collecting waste materials for use in the re-manufacturing of goods and services. This concept should be distinguished from re-use, which means the use of collected waste materials after their primary use and before they undergo a re-manufacturing process (Vesilind *et al.* 1994). Policies of waste management should try to achieve the ideals proposed by Figure 1, which are the declaration of product content, reduction of consumption of goods and services, increased recycling and re-use, separation of solid waste at source, and optimisation of the sorted waste materials.

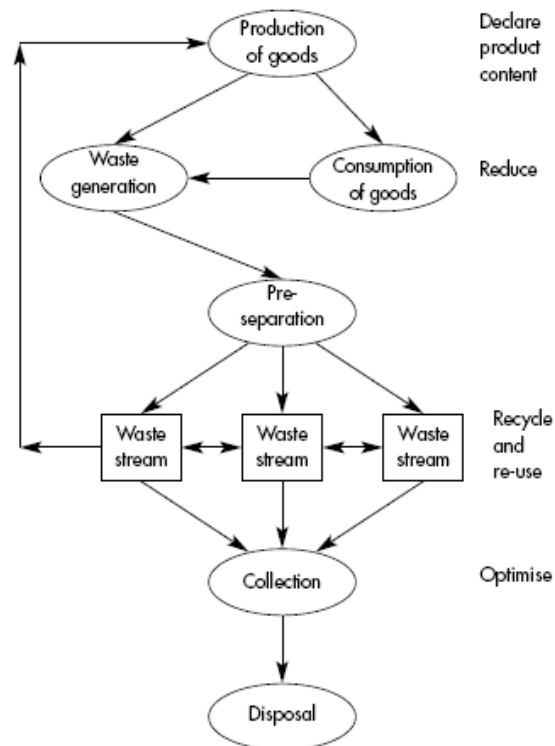


Fig. 1. Waste management strategies. Source: Developed by the authors using a framework by Svedinger (1991)

In conceptualising waste management programs, many countries use the 3R's strategy that aims at achieving sustainable environmental management. The document for the Botswana Waste Management Strategy recognises the importance of adopting the 3R's strategy (NCSA 1998). Figure 1 is utilised as a framework for the discussion on policy instruments in this paper.

#### Waste disposal methods

Disposal of solid waste in Botswana consists of open dumping, burning, incineration, composting, uncontrolled landfilling and engineered sanitary landfills (Segosebe & Van der Post 1991; NCSA 1998).

#### *Sanitary landfilling*

Sanitary landfilling is the compaction of refuse in a lined pit and the covering of the compacted refuse with an earth cover (Vesilind *et al.* 1994). Typically, refuse is unloaded, compacted with bulldozers, and covered with compacted soil. The sanitary landfill has become the most common method of disposal because it is reasonably inexpensive and is environmentally sound. Unfortunately, landfilling is not the ultimate solution to the solid waste disposal problem. Although modern landfills are constructed so as to minimise adverse effects on the environment, experience has shown that they are not fail-safe (Peavy *et al.* 1985). Moreover, the cost of landfilling is increasing rapidly, as land becomes scarce and refuse has to be transported further and further from where it is generated.

Uncontrolled landfilling is common in large villages and some urban centres such as Bobonong, Selebi-Phikwe, and Francistown. Land is usually set aside by District councils for tipping and burning of refuse. These facilities are usually fenced and operated by the councils. There are no engineering designs and operation procedures that guide these operations and the location of the sites is also arbitrary.

Engineered sanitary landfills are in Lobatse and Gaborone, and there is also one currently being constructed in Francistown. Engineered and uncontrolled landfills are classified as official waste disposal sites. There are currently  $\pm 127$  official waste disposal sites countrywide. About 38 per cent of the estimated 250 000 tons of household waste actually reach official disposal sites (NCSA 1998).

#### *Open dumps*

Open dumps are the commonest mode of waste disposal prevalent in small villages, large villages and small towns. Waste is normally dumped along the major corridors and/or in some excavated depressions where earth materials have been removed. This form of waste disposal differs from uncontrolled landfilling in that dumping is done haphazardly, usually in areas not reserved for waste disposal.

#### *Crude burning and incineration*

Crude burning usually takes place in rural and low-income household communities and at open dumps (Khupe *et al.* 1998), the rationale being to reduce the amount of solid waste disposal. In Botswana, it is even promoted by community health workers by encouraging households to dig rubbish pits and burn the waste inside. Medical wastes are usually incinerated. Most clinics, primary hospitals and major hospitals have incinerators. The major problem of incineration of medical waste is lack of properly trained personnel to operate and maintain the incinerators. While crude burning and incineration are acceptable methods of disposing of solid waste, the resulting effects of pollutants thereof, and their health effects are unknown (Segosebe & Van der Post 1991).

#### *Re-use and recycling*

Re-use of solid waste has been practiced in Botswana for sometime. However, there is no policy on re-use of waste materials. Recycling is at an early stage of development. The waste streams that are recycled include beverage cans and paper (Environmental Watch Botswana 1995). This section reviews the re-use of such waste streams as beverage bottles and cartons, and the recycling of beverage cans and paper in Botswana.

#### *Glass bottles and cartons*

These are some of the solid streams that are being re-used in Botswana. Glass bottles are imported from South Africa for use in the packaging of soft drinks and beer manufactured by Kgalagadi Breweries. The brewery has been mainly packaging its products in cans rather than glass bottles. This was mainly because cans were preferable to bottles as they are suitable for use in areas where the roads are in a bad condition, as was the case in Botswana in 1978 when the brewery, then known as

Table 2. Beverages packaging by Kgalagadi Breweries

Packaging	Beer	Soft drinks
Type of packaging material	Steel and bottles	Steel and bottles
Type of bottle packaging	Returnable bottles	Returnable bottles
% of glass bottle packaging	15	20

Source: Josiah (1999) and Phoi (1999)

Prince Brau, was established. Bottles tend to get broken in transit as a result of poor roads.

As far back as 1982, beverage returnable bottles accounted for 13 per cent of soft drink packaging, whereas the rest of the packaging (87 per cent) was in non-returnable cans and plastic bottles (Matsoga 1989). According to O'Donovan (1995), Kgalagadi Breweries is now increasing packaging in returnable bottles for soft drinks and beer, as the condition of the roads in Botswana and the scarcity of water in Gaborone have improved. It is currently (April 1999) estimated that returnable bottles account for 20 per cent of the total packaging of soft drinks, and 15 per cent of the total packaging of beer (Table 2). Beverage cartons are mostly used by the low-income households as a source of energy. For instance, Kgathi (1992) revealed that *chibuku* cartons were used as a source of energy for heating water in the peri-urban area of Old Naledi in Gaborone.

#### Beverage cans

The recycling of beverage scrap cans in Botswana is promoted by a South African-based company known as Collect-A-Can. This company was established in 1976 to recover scrap beverage cans. The company operates in countries such as Botswana, South Africa, Lesotho, Swaziland, Namibia, and Mozambique. It pays cash for beverage cans that are delivered to the Gaborone Depot, collected by its agents from the source, or delivered to its depot in South Africa. The cans are either sold in a loose or crushed form in bales. As Table 3 indicates, the price

Table 3. Prices of scrap beverage cans

Forms the cans sold	Price (P)
a) Loose cans delivered to Gaborone depot	0.27/kg
b) Loose cans collected from household or commerce/industry	0.10/kg
c) Crushed cans bail delivered to Gaborone depot	0.30/kg
d) Crushed cans bail sold in Republic of South Africa	0.43/kg

Source: Sekate (1999)

of loose cans delivered to the Collect-A-Can depot in Gaborone was P0.27/kg in April 1999, whereas that of crushed scrap cans was P0.30/kg.

People of low socio-economic status, including the unemployed, usually collect the cans in various parts of the urban areas. The Councils concerned usually charge those who collect such waste at landfills and other disposal sites. For instance, the Gaborone City Council charged P50 for 25 to 30 tons of scrap metal collected from the Gaborone landfill in 1997 (Gaborone City Council 1997a). The practice of selling separated materials at landfills should be done in a manner that minimises interference with proper landfilling operations. The price charged for such materials should not be too high to discourage the development of recycling. Scholars such as Pearce *et al.* (1994) are of the opinion that recycling should be subsidised in view of the avoided external costs associated with waste disposal. They correctly recommend that those who recycle waste should attract what they call "recycling credits".

Collect-A-Can claims that it recovers 62 per cent of all the cans sold in the country, including those imported from South Africa, which account for a very small proportion of the total demand for beverages (Sekate 1999). Collect-A-Can concentrates on the collection of steel beverage cans from Kgalagadi Breweries in Botswana, although it also collects aluminium cans from imported packaged beverages. According to Matiza *et al.* (1994), the South African experience has shown that the recycling of aluminium cans is more economic than that of steel cans, due to higher scrap value of the former. They further contend that in countries where beverages are mainly packed in steel cans, and "a low recycling ethic exists", there is a tendency for littering to occur due to lack of an incentive to collect the cans as the payment for collection is low. Table 2 shows that beverage packaging is mainly in the form of steel cans in Botswana as opposed to aluminum ones. According to Josiah (1999), Kgalagadi Breweries does its packaging in steel cans because they are cheaper than aluminum ones, and also because the company does not have the equipment to handle the packaging in aluminum cans.

#### Paper

Waste paper, except one coated in plastic, is collected in Botswana by a company known as Waste Paper Recovery, and then sold to Swazi Paper Mill in

Swaziland. Waste Paper Recovery was established in 1983 to address the litter problem in Botswana as well as to use a resource that would otherwise be thrown away. The company's headquarters are in Gaborone, where a total of 80 people are currently (April 1999) employed. There is also a branch in Francistown that has employed 20 people. This company collects waste paper from the commercial/industrial sector on a daily basis. The Gaborone Depot currently has 10 vehicles to undertake this task, whereas the Francistown Depot has four vehicles.

### Instruments for solid waste management

The instruments for solid waste management can be broadly categorised into regulatory, environmental education, and economic instruments. Regulatory instruments are usually legal in nature, and they set standards which polluters are supposed to honour, failing which a punishment may be imposed on them (Bernstein 1993; Kosobud & Zimmerman 1997). Environmental education involves the sensitisation of the public about environmental problems in an attempt to make them more environmentally responsible. Economic instruments, on the other hand, aim at changing environmental behaviour by the application of market-based incentives. These instruments are increasingly being advocated, worldwide, for waste management. The current thinking in waste management is that high subsidies on waste collection and disposal will have an adverse effect on economic and financial sustainability of waste management in the long run, hence it is argued that they should be reduced (Ministry of Local Government Lands and Housing (MLGLH) 1997).

In Botswana, the instruments for waste management do not have a long history. The newly-introduced waste management Act of 1998 has introduced a number of regulatory measures for waste management in Botswana. In addition, the Waste Management Strategy also advocates the introduction of economic instruments of waste management.

#### Regulatory measures

In most developing countries, the environment is an open access resource for free disposal of solid waste as there are no property rights for the environment (Panayotou 1993). In Botswana, there is a growing

recognition that the environment is not an open access resource as there are a number of regulations for solid waste collection and disposal. These regulations are embodied in the Waste Management Act of 1998, and they aim at controlling various types of waste so that it does not have an adverse effect on human, animal and plant life (NCSA 1998). The implementation of the Act is the responsibility of the Department of Sanitation and Waste Management in the Botswana Ministry of Local Government, Lands and Housing.

The Act also provides regulations for solid waste collection, disposal, and recycling. It states that local authorities will make arrangements for the collection of household solid waste, and households will pay a prescribed fee for this service. Those who request the local authorities to collect non-household waste will also pay a stipulated fee (NCSA 1998). The Act has designated local authorities to be responsible for the cleaning of public roads and streets. They will also ensure that littering is not done by the public as required by the Act, and those who contravene this section of the Act are charged a fee by the authorised officer or police officer (NCSA 1998). Regarding recycling, the Act states that local authorities should make arrangements for solid waste recycling with the relevant bodies in the private sector.

In conclusion, it is important to note that the Act is silent on regulatory standards relating to solid waste minimisation and recycling. These standards, may, for instance, set targets on recycling or ban the packaging of beverages in certain types of containers.

#### Environmental education

Environmental education is still at an early stage of development in Botswana. A number of environmental education programs are emerging. They are mostly spearheaded by non-governmental organisations such as Somarelang Tikologo (Environment Watch Botswana). The initiatives for these organisations include, *inter alia*, the promotion of the use of re-usable cloth bags as opposed to plastic bags, and the raising of awareness about environmental problems through panel discussions. Nationwide campaigns are conducted to prevent littering and promote environmental awareness. Clean-up-the-environment campaigns are conducted under the auspices of the National Conservation Strategy Agency (NCSA) to commemorate the World

Environment Day. There are also some posters in major towns and along major routes that are meant to educate the public not to litter. Recently, there was a concerted effort to make environmental issues part of the school curriculum, an idea that is welcome by many.

#### Economic instruments

This section reviews the types of economic instruments used for waste management in Botswana, with particular reference to their impact on economic efficiency, environmental sustainability, and social equity. The instruments include taxes for solid waste collection and disposal such as council rates, service levy, and sanitation fees.

#### Property rates

Council rates are a property tax paid by all plot holders in urban areas of Botswana (except in Self Help Housing Areas) for the service provided by the councils, such as refuse collection, street lights, roads, sewage system, fire brigade, sanitary landfilling, and primary education (Gaborone City Council 1997b). There is a proposal, however, to introduce property rates in district councils (Ministry of Local Government and Housing 1998). However, plots, which are used for public library or museum, religious worship, schools, students' hostels, and public hospitals, are exempted from the payment of rates (Gaborone City Council 1997b). The property rates are calculated and recommended to cabinet by the Ministry of Local Government, Lands and Housing. They are charged as shown on Table 4. The table shows that households who own expensive plots tend to pay more than those who own cheaper plots.

The plots for commercial/industrial buildings cost more than those for households. Undeveloped plots are also more expensive than developed plots, the idea being to provide an incentive for developing the land and a disincentive for speculation in land (Gaborone City

Council 1997b). It is important to note that property rates were last increased by 10 per cent in 1995 in Gaborone and Francistown. In other urban centres, they have not been increased for several years. In the financial year 1994/95, property rates accounted for 26% of the total recurrent costs in the six urban centres of Gaborone, Francistown, Selebi-Phikwe, Jwaneng, and Sowa.

This tax has no relationship with the quantity of solid waste collected and disposed of in landfills as it is a flat rate. This suggests that the marginal cost of solid waste collection and disposal by households and commerce/industry is zero. The private marginal costs of waste collection and disposal are not reflected in the tax, let alone the external and user costs of waste disposal. The failure to relate the price of waste collection and disposal to the marginal private cost is one form of policy failure, whereas the failure to relate such prices to the external costs of waste disposal is another.

As a result of the failure to base the price of solid waste services on the marginal pricing principle, households and the commercial/industrial sector have no incentive to reduce the amount of solid waste they generate since they do not pay for its marginal increase. The result of this is that the recurrent costs of waste collection and disposal are not recovered in Botswana, let alone capital costs. There might also be an increase in environmental problems associated with waste disposal as there is no incentive for solid waste producers to minimise, re-use, and recycle solid waste. The charges for waste collection and disposal should, in principle, not only reflect the costs of labour and capital, but they should also reflect the social opportunity cost that includes the external and user costs. However, it is not always possible to implement these ideas as a result of the possibilities of increased illegal dumping of solid waste, and adverse effects on equity.

#### Service levy

Service levy is a payment made to meet the costs of supplying services to site and service areas of urban Botswana. These are low-income areas where only basic services are provided. The services include waste collection and disposal, water provision, and street lighting. Unlike property rates, this is not a property tax, but a tax based purely on the type of services provided.

Table 5 shows the charges for service levy in the years 1978, 1980, 1983, and 1992, which were P1.00, P5.00,

Table 4. Property rates in Gaborone

Category of plot	Rates for 1996-97 as percentage of value of plot
1. Residential-developed	1.07
2. Residential-undeveloped	4.28
3. Commercial and industrial-developed	1.3
4. Commercial and industrial-undeveloped	5.2

Source: Gaborone City Council, 1997b

Table 5. Service levy and solid waste management

Year	Service levy	Solid waste component*
	P	P
1978	1.00	0.12
1980	5.00	0.62
1983	8.00	0.25
1992	15.00 (12.00, in Gaborone)	1.86 (0.26)

(Source: Maendelo-Botswana 1992)

\*Calculated using the proportion for the costs of service levy as prepared by Euro Consultants in Maendelo (1992). The proportion of these costs may vary from year to year, but in this table we assumed that the proportions do not vary in order to get a rough estimate of the service levy component of solid waste

P8.00 and P15.00 (Gaborone, P12.00), respectively. (P = Botswana currency known as Pula. It is also denoted as BWP)

Although the Councils are supposed to calculate service levy every year in order to ensure that the levy charged is an economic one, this has not been done in the past (Maendelo-Botswana 1992). The levy has only been increased four times since it was introduced. The main problem with the service levy is that it is much lower than the economic service levy, and this means that solid waste collection in the site and service part of the urban sector is subsidised in Botswana.

For instance, the economic service levy was estimated to be over P30.00 in 1991, when the service levy in urban areas was P15.00 (Gaborone, P12.00) in 1991. The second problem is that the levy does not vary with socio-economic status. According to Maendelo-Botswana (1992), the socio-economic status of the SHHA plot owners varies a lot, implying that there are those who can afford to pay the economic service levy, and those who cannot. The other problem is that there is an inter-and-intra variation in the quality of the services provided in the site and service areas, and this has resulted in some resistance in the payment of the levy in areas where the provision and quality of the services is poor. The third problem is that this levy, like property rates, does not take into account the marginal cost of disposing of an additional unit of solid waste even though this has a cost to society.

#### *Sanitation fees*

These fees are charged for the provision of environmental services provided by the District Councils in rural

areas. The fees vary from district to district, and they are flat rates. In the Southern District, households pay the Council P2.50 per month for collection of solid waste, and they provide their own waste receptacles. In the commercial/industrial sector, sanitation fees range from P6 to P30 per month, depending on the amount of waste generated. In order to arrive at these fees, a survey was carried out by the District Council to estimate the average amount of waste generated, and this information was used to estimate sanitation fees of different commercial/industrial enterprises. According to Olerilwe (1999), sanitation fees are very subsidised in the Southern District, and there is a need to increase them in order to recover the costs of collection. The charges have not been adjusted for inflation since 1990 when they were reviewed.

In the South-East District, the fees are as highly subsidised as in the Southern District. Households provide their own waste receptacles, and pay P2 per month to the Council for solid waste collection from their homes, irrespective of the amount of refuse collected. The fee for collecting solid waste in bars, liquor restaurants, and bottle stores is P25 per month, whereas it is P15 per lorry load for bakeries, wholesalers, hotels, and supermarkets. The sanitation fees in this district were last increased in 1996 (South East District Council 1995).

#### **Alternative strategies**

There is need for an alternative strategy that will improve the efficiency of waste management policy in Botswana. The current policy is to a large extent based on traditional regulatory measures. These measures need to be improved and also supplemented by environmental education and economic instruments. Economic instruments are usually more effective since they create incentives for producers and consumers to find ways of reducing the amount of solid waste they generate. In this section, a number of regulatory, public education, and economic instruments for waste management are proposed for implementation in Botswana.

#### **Regulatory measures**

There is a need for local authorities in urban areas to promote source separation of municipal waste to stimulate recycling. It might be necessary for local authorities to introduce bye-laws for this purpose. The implementation



of source separation of solid waste will take a long time as it will be necessary to change the institutional framework of solid waste management in urban areas. In addition, local authorities, particularly in urban areas, should introduce targets for recycling and re-use of waste streams.

#### Environmental education

Even though there are attempts to promote environmental education in Botswana, the efforts are still very fragmented to achieve any meaningful results. A comprehensive environmental education program should address waste generation at source and be geared towards reduction, recycling, and re-use of solid waste. It should also be conceived broadly to incorporate the training of development planners on environmental sustainability issues, including those on solid waste management.

The public should be made aware of the importance of changing their consumption patterns, for example, buying sugar packaged in biodegradable materials rather than in plastic bags. This will also motivate companies to change their packaging methods if they experience declines in their sales due to such campaigns. The efforts to sensitise the public about the need to pre-separate their solid waste must be encouraged by municipalities through the provision of separate containers for pre-separation of and collection service for the separate materials.

#### Economic instruments

The economic instruments proposed by this study are in line with the polluter pays principle. They are solid waste, packaging, and product levies as well as deposit refund schemes. The service levy should be at least about 75% of the economic service levy in view of the poor socio-economic status of plot-holders in the site and service areas. An attempt could be made to cross-subsidise this levy by the solid waste levies. The sanitation fees should be at least be 50% of the economic fees in the household areas, and 100% in the non-residential sources. The aim should be to achieve sustainable waste provision that is self-financing in the long run. While it is necessary to achieve this goal, the equity considerations should not be underestimated.

#### Solid waste levies

A solid waste disposal levy should be introduced for institutional, commercial, and industrial solid waste gen-

erators. In addition, research should be undertaken to assess the possibility of imposing a solid waste levy on high income households in urban areas, which could perhaps replace the solid waste component of the property rates.

The solid waste disposal levy should take account of the costs and benefits associated with the disposal of solid waste in landfills. It may be calculated by adding all the marginal external costs of waste disposal, and deducting the marginal external benefits. The external costs include water pollution, emission of greenhouse gases (methane and carbon dioxide), and conventional pollution resulting from the emission of sulphur dioxide, nitrogen oxides, and particulates (see Pearce *et al.* 1994).

The levy should be designed in such a way that it varies positively with the amount of solid waste collected from the institutional, commercial, and industrial sources. The waste should be weighed as it enters the landfill, like it is already done in the Capital City of Gaborone. The price of the first  $x$  tons could be  $P_x$ , and additional tons could be charged at  $P_{x-1}$ ,  $P_{x-2}$  and so forth. In other words, this levy should be a decreasing rather than an increasing block tariff. The latter usually helps to conserve such resources as water and energy (Arntzen & Kgathi 2000), but it is not suitable for application to solid waste management, as it is likely to encourage illegal dumping of solid waste. The fees collected can be used to promote environmental protection, particularly in landfills as they are at present in a chaotic situation. The Government should also channel more funds to Councils in order to improve the status of landfills. The role of collecting solid waste from the non-residential sources should be assigned to the private sector, and the councils should continue to collect solid waste from households.

The experience of other countries suggests that the amount of solid waste collected from non-household sources tends to decrease when tipping fees are introduced (World Bank 1999). The amount of solid waste collected reduces because waste generators usually introduce waste-reducing practices such as increased recycling and production of waste-saving commodities (World Bank 1999). It is also possible that solid waste disposal fees may encourage illegal tipping. The local authorities in Botswana should, therefore, ensure that this does not happen by fully enforcing the Waste Management Act.

The residential areas should continue to pay for waste through property rates and service levy. However, a pilot project should be undertaken to determine the applicability of the solid waste levy to high income areas such as Phakalane in Gaborone. The levy should in principle, reflect the marginal social cost of waste collection and disposal. These costs should include the private marginal costs of waste collection and disposal, and the external costs resulting from sanitary landfilling. It is not possible to take into consideration all the costs when fixing a waste levy due to the possibility of increased littering. However, the levy should be designed in such a way that it varies positively with the amount of solid waste collected from households for disposal in sanitary landfills. This form of payment for solid waste services is usually referred to as "pay-by-the-bag system" as each additional unit of solid waste is charged (Tietenburg 1992, and Repetto 1997). This differs from the current system whereby the marginal cost of collecting and disposing of one more unit of waste is zero even though the cost to the society is not.

#### *Deposit refund schemes*

Another instrument for waste management could be deposit refund schemes for packaging. This system is already slightly used in Botswana for encouraging consumers to return their waste bottles to traders. A charge is added to the cost of commodities in order to take account of waste disposal, and also to provide consumers with an incentive to return the waste to shops or recycling centres. The deposit refund instrument is used, worldwide, to avoid littering, and also to conserve energy needed to manufacture the products using raw materials. It is usually applied to products with polluting containers which are "durable or reusable" such as bottles and car batteries (Bernstein 1993). The higher the deposit, the more efficient this instrument is.

In Botswana, there is no policy on the use of the refund deposit system, though the instrument is only marginally applied to waste streams such as bottle beverages and car batteries. Botswana's Strategy for Waste Management indicates that the deposit refund scheme for beverage bottle containers has just been re-introduced in Botswana, and about 70 per cent of all bottles sold are returned to the traders. This document further suggests the refund deposit scheme should be introduced for other beverage waste streams.

We recommend that the efforts of Collect-A-Can should be augmented by Government policy on deposit refund schemes. An attempt could be made to charge consumers a packaging tax on beverage cans in view of the litter problem (see next section). The funds from the tax may be used to assist Collect-a-Can to pay consumers a higher price. This will give people an incentive to collect more cans, and hence alleviate the litter problem in Botswana.

#### *Product levies*

There is also a possibility of charging firms product levies, which are charges added to products or their inputs (Bernstein 1993). The levies may be imposed on packaging waste, which is difficult to re-use and recycle. A good example of this levy or tax is a levy on plastic bags, which are a serious litter problem in Botswana. The tax should be imposed on consumers rather than on traders as the latter may respond by increasing the price of other goods rather than that of the plastic bags. There should be a regulation to ensure that the consumers pay the price of plastic bags. Such a levy on plastic bags may lead to a switch to re-usable paper bags. Before implementing the levy on plastic bags, Botswana could learn from the experience of other countries that are known to have imposed a tax on supermarket plastic bags such as Italy (Pearce & Warford 1994).

Other levies could be introduced on products that produce waste streams such as non-returnable bottles, beverage cartons and returnable bottles as discussed in the previous section. Though there are regulatory measures for controlling packaging waste, such measures are inadequate, as they do not give households an incentive to introduce technologies that will lead to increased recycling. According to Pearce *et al.* (1994), such a levy should be positively related to the weight or volume of the waste, and negatively related to the rate of recycling. The tax should take into consideration the costs of waste disposal, littering, and user costs of landfills (Pearce *et al.* 1994).

#### **Concluding remarks**

The idea of sustainable solid waste management is still new in Botswana. However, there are initiatives by the Government to put environmental issues to the fore. This is witnessed by the formulation of a National

Conservation Strategy in 1990. A lot still needs to be done. Data on the composition and quantities of municipal solid waste is scarce and/or unreliable. This is mainly because most waste disposal sites in small villages, major villages, and small towns is not properly disposed of. There are no engineered landfills, and this makes it difficult to carry out solid waste generation analysis. There is a need to spend more effort in constructing properly engineered disposal sites. Reliable and cost effective collection services should be provided in major villages and urban areas.

The costs of landfilling are increasing very rapidly as land is scarce and refuse has to be transported further and further away from where it is generated. This calls for appropriate policy instruments that will lead to the reduction of the amount of solid waste disposed of in sanitary landfills. The promotion of source separation of waste materials should be done as it will lead to increased recycling and re-use of solid waste materials, thus reducing the amount of solid waste deposited in landfills.

Alternative instruments for solid waste management are necessary in Botswana. For instance, there is need for a comprehensive and coordinated environmental education program which should include issues on solid waste management. People should be educated about the need to reduce, recycle, and re-use solid waste streams. This environmental education should be conceived in a broader perspective to include the education of development planners about the principles of environmental sustainability, including those of solid waste management. There is also a need for the introduction of the following economic instruments: solid waste disposal, packaging, and product levies.

The solid waste disposal levy should be imposed on the institutional, commercial, and industrial waste generators. It should be based on the amount of solid waste

collected, and should be a decreasing block rather than an increasing block tariff. The levy will contribute more significantly to cost recovery, as it will result in an increase in the revenue collected by the local authorities. In addition, it will send signals to the waste generators to reduce the amount of solid waste produced, and this will reduce financial and environmental costs associated with solid waste collection and disposal. As the imposition of this levy may encourage illegal dumping of solid waste, it is necessary that the local authorities should effectively enforce the Waste Management Act to ensure that illegal dumping of solid waste is reduced.

The second levy suggested is a product levy on plastic bags. This is aimed at discouraging littering, a serious environmental problem in Botswana. The levy should be imposed on consumers so as to discourage them from using plastic bags. This levy may encourage people to switch to re-usable paper bags, which are less of an environmental problem. The third tax is a levy on products associated with waste streams that have low recycling rates, or are neither re-usable nor recyclable, such as non-returnable beverage plastic and glass bottles, and beverage cartons. The revenue from the taxes should be collected by the Government and used for subsidising recycling or waste recovery centres. For instance, Collect-A-Can may be assisted to pay the collectors of cans a higher price for beverage cans so as to increase the incentive to collect the cans.

Finally, it is important to note that service and sanitation levies should continue to finance solid waste in the site and service parts of the urban areas and rural areas, respectively. However, an attempt should be made to increase these fees so that some of the costs may be recovered. An attempt should be made to use cross subsidies from the higher income areas to finance solid waste management in the site and service and rural areas.

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