

TOWARD SUSTAINABLE SOLID WASTE MANAGEMENT IN BENIN CITY USING THE BORAS WASTE MANAGEMENT APPROACH

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Abstract

The city of Boras in Sweden runs on the motto: 'no waste goes to waste' whereas in Benin City wastes are causing problems such as environmental pollution, flooding of streets, roads and houses as well as breeding grounds for rodents and mosquitoes. This study aims to present a more sustainable solid waste management method suitable for Benin City by highlighting the Boras solid waste management approach. The study involved field visits to some companies involved with waste management in Boras and Boras waste collection stations and centres. Classroom learning at the University of Boras and desk research on Boras solid waste management approach were carried out. A field observation and review of literature on current solid waste management method and possible uses of solid wastes in Benin City was also carried out. The results from the study showed that through aggressive awareness campaign and creating an economic system to convert solid wastes into value-added products, Boras is successfully managing their solid wastes in a sustainable manner. Having achieved a zero waste city (i.e. a city where 0% waste is sent to landfill), Boras Municipality through collaboration with University of Boras and local companies involved in waste management is now transferring knowledge and technology on waste management to other countries. In Benin City the 'throw-away' method of waste management is not sustainable. Implementing the Boras solid waste management approach in Benin City will certainly enhance sustainable solid waste management in the city.

Keywords: Benin City, Boras, Solid waste, Sustainable solid waste management.

1.0 Introduction

Solid wastes could be a blessing or a menace depending on how they are managed. Developed countries (like Sweden, USA and Germany, etc.) have been able to effectively manage their solid waste over the years by developing technologies and facilities to harness energy and materials from solid wastes. Solid wastes management is so advanced in these countries that solid waste is considered as resources rather than as

useless substances to be discarded. Through effective and efficient solid waste management, these countries have not only been able to collect, store, transport and dispose solid waste with little or no effect on the environment, they have also been able to recycle solid wastes into new value-added products. Furthermore, heat, electrical energy and environmentally friendly fuels have been produced from the combustion or processing of solid wastes. The aforementioned activities have led to

the establishment of clean and healthy environment for their citizens to live in. These practices which constitute sustainable solid waste management entail various activities that encourage the efficient utilization of material resources to reduce the amount of waste produced. The waste generated are managed in such a way that the economic, social and environmental goals of sustainable development are largely achieved (Pianosi, 2012).

Despite the huge gains made hitherto from sustainable solid waste management by developed countries, many developing countries are still huffing and puffing in their attempt to manage solid wastes. Nigeria, a developing country in Africa, has been in a quandary of how to efficiently manage the municipal solid waste her population generates. Many states in the country lack adequate plans and infrastructure required for efficient and sustainable management of municipal solid waste. In Benin City, the capital of Edo State in south west Nigeria, rapid urbanization and population growth have led to increased solid waste generation, thereby magnifying the necessity for adequate solid waste management in the city. A study by Igbinomwanhia (2010) showed that waste typology in Benin metropolis varies and those unable to decompose become pollutants and create unsightly appearance in the environment (Ikelegbe and Ogeah, 2003). The Local Government Authorities saddled with the responsibility of waste management have not been able to handle the amount of solid waste generated in the city. Hence, indiscriminate dumping of waste in street corners, by the road sides, medians of road, in open spaces, around residential buildings or drainage systems is a common practice in the city (Igbinomwanhia and

Ohwovoriole, 2011). These practices pose several environmental and health problems in the city such as dirty environment, land and air pollution, contamination of ground water sources through leachate, breeding of rodents and disease vectors and notably flooding.

Policies formulated on waste management at the state level provide the dumpsite option as the end point for solid waste in Edo State (Edo State, 2010). The formulation and implementation of such incoherent policies with respect to standard practice in the waste management sector has made solid waste management to be commonly seen in the city as simply "pick up the waste and dump it in the dumpsite" whether it is approved dumpsite or illegal dumpsite. Waste disposal trucks collect wastes from households and business premises and transport them to the dumpsite. At the dumpsites open air incineration without pollution control is carried out on the waste to reduce the volume. This is not sustainable as it does not bring financial returns at the end point of the waste. If a sustainable solid waste management must be actualized in Benin City, a waste management mix which incorporates material recycling and energy recovery at the end point of the waste is the best option, as had been proven over the years by the City of Boras in Sweden. This paper therefore examines the solid waste management practice in the city of Boras and advocates the implementation of such waste management practices in Benin City.

2.0 Method

The study originated from the urgent need to adopt a new and more sustainable waste management approach in Benin City. The study involved field visits to several

companies involved in waste management in Boras as well as Boras waste collection stations and centres. These companies include Ryeverket, Sobacken, Swerec, Stenna etc. A tour of these companies was done and interviews were conducted about their operations in relation to waste management. The waste management approaches adopted by these companies are outlined in Section 3.1. Furthermore, classroom learning at the University of Boras and a desk research of existing data on Boras waste management approach were carried out. A field observation and a review of related literatures on the current waste management approach and possible uses for waste in Benin City were also conducted.

3.0 Results and Discussion

3.1 The Boras Approach

The city of Boras is the second largest municipality in western Sweden with an area of about 910sqkm and a population of about 110,000 (Boras Stad, 2015). The policy makers in the city perceive wastes as valuable economic resources instead of mere useless materials to be discarded. This instigated the implementation of an economic system in the mid 1980s to convert wastes into value-added products such as biogas, electricity and heat while creating a clean environment for the citizens in the process. In Boras the waste management operations are owned by the community and managed through the city council. The community runs on the motto: 'No waste goes to waste'.

In the early 1990s, over 40% of wastes were sent to landfill in Boras, Sweden (Bjork, 2012). However, with implementation of innovative and integrated new technologies for waste collection, storage, sorting and treatment

(both biological and thermal), the quantity of waste sent to landfill reduced drastically to 10% and then gradually approached 0% (Karthik et al., 2013). In Boras the household wastes are sorted into 30 different fractions, including batteries, glass, paper, plastics, metals and packaging, etc., which are either recycled or converted into electricity, heat or transportation fuels. A key factor behind this success is the cooperation of the citizens secured through aggressive awareness campaigns. Children are taught in schools how to sort and manage waste while regular sports and social activities are organised to create awareness among adults. Policies are enacted, for example, to create incentives such as tax reduction for citizens when sorting rate goes higher and vice versa. At the University of Boras, several research programmes are conducted to utilize wastes into innovative value-added products. In Boras, a booklet which contains how to handle different wastes is given to every household by the municipality. Approximately 130 different materials are listed in the booklet to inform the citizens what to do with a particular waste. For example, white glass bottles are sorted separately from coloured bottles. The lamps are sorted into bulb, fluorescent, halogen and other low energy lamps which are treated separately. Recycling containers are provided close to each household around the city to collect the sorted wastes. These are sent to the appropriate companies for further processing. The municipality also provides free black and white bags for every household. Organic wastes are collected in black bags, while combustible wastes are collected in white bags. The black bags and other organic waste flows are sent to biological treatment plants for

biogas production. More than 3 million m³ of biogas is produced annually, which is enough to run all the city's buses, waste collecting trucks and about 300 cars in the city (Karthik et al., 2013; Taherzadeh, 2010). The white bags and other industrial

wastes are sent to thermal power plants where they are converted to heat and electricity daily (Karthik et al., 2013; Taherzadeh, 2010). The complete block diagram of household waste flow is shown in Figure 1.

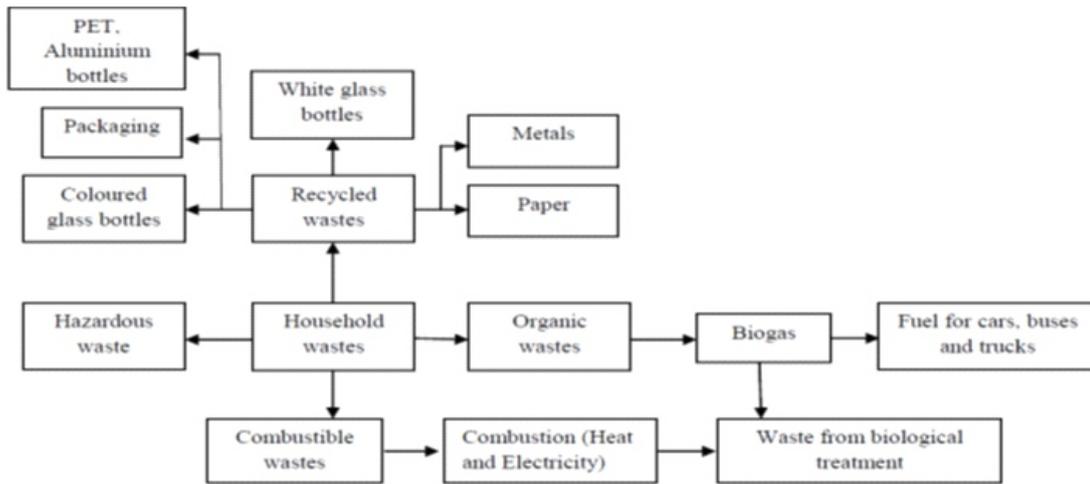


Figure 1: Block diagram of household waste flow in Boras (modified from Karthik et al, 2013)

A deposit system called “Pant” is another interesting way of recycling wastes in Sweden. The system involves recycling polyethylene terephthalate (PET), aluminium and some glass bottles in supermarkets using collection machines. Every time a PET or aluminium bottle is bought by consumers, an additional fee of 1-4 Swedish Krona (SEK) is charged depending on the size of the bottle. The additional fee is refunded when the empty bottle is returned

to the collection machines. More than 90% recycling of PET and aluminium bottles have been achieved in Sweden (The Swedish Institute, 2015). This system is very attractive and innovative as managing the wastes is easier, efficient and economic. Quantity of waste generated in Boras municipality, fraction of waste recycled, sent for biological and thermal treatments, as well as outputs from such treatments are shown in Table 1.

Table 1: Annual waste generation, fractions sent for various processes and outputs from the processes (modified from Bjork, 2012; Purac, 2016)

Quantity of waste generated per year		46,200 tonnes			
Biological treatment		Thermal treatment		Recycled	
30%		43%		27%	
Output	Quantity	Output	Quantity	Energy savings from recycling	
Biogas	3.5million Nm ³ /year	District heating	632GWh/year	Aluminium	95%
Heating	25GWh/year	District cooling	10GWh/year	Paper	40%
Fertilizer	2500 tonnes/year	Electricity	132GWh/year	Glass	20%
				Plastics	66%

Having achieved a zero waste city (i.e. a city where 0% waste is sent to landfill), Boras municipality set up a non-commercial organization called Waste Recovery – International Partnership (WR), to transfer knowledge and technology about sustainable waste management to other countries in order to improve the global economy and convert waste to wealth. The organization is a public, private partnership involving politicians, citizens, industries and the university. The politicians discuss with the partner country about formulating better waste management policies, while the industry implement the technologies developed by the university. Specifically, WR includes Boras city council, Boras Energy and Environment Ltd, University of Boras, SP Technical Research Institute of Sweden and about 20 different companies involved in waste management. The international collaboration was started in 2006 and it is now operational in Africa, Europe, Latin and North America and Southeast Asia.

3.2 Waste Management Method and Utilization Potential in Benin City

Existing policies on waste management in Edo state stipulates discarding of waste in dumpsites as the only waste management option in the state. Waste disposal trucks collect wastes from households, markets

and business premises with their trucks and discharge them in dumpsites. At the dumpsites the trucks drive in through the access roads and dump their wastes. Other vehicles that deliver waste to the dumpsite simply dump their waste indiscriminately by the road sides after closing hours. The workers at the dumpsites use shovel to manually push the wastes from the access road and try to spread them as much as they can. Thereafter, open air incineration without pollution control is carried out to reduce the volume of the wastes. This “throw-away” method of waste management has proven over the years to be ineffective, uneconomic and problematic as indiscriminate dumping of wastes in public places especially in drainages and in flood waters during rainfall are still common practices in the city. These practices have led to massive flooding of streets, roads as well as residential and commercial buildings whenever it rains. In some cases, the flood persists for days after the rains are gone rendering these facilities inaccessible to the citizens. The situation is so dire in some areas of the city that some citizens are either locked in or out of their homes whenever it rains. Figure 3 shows open burning of waste at a dumpsite and a drain filled with wastes and Figure 4 shows flooding of streets and residential houses in Benin City.



Figure 3: (a) Open air burning at a dumpsite in Benin City;
(b) a drain filled with wastes in Benin City.



Figure 4: Flooding of streets and houses in Benin City.

Table 2 shows the estimated quantity of waste generated in Benin City and the fractions that could be harnessed through biological and thermal treatments as well as recycling.

Table 2: Estimated quantity of waste and the possible treatment processes (modified from Igbinomwanhia, 2010; Itoje et al, 2015).

Quantity of waste generated per year		141,865.3 tonnes
Biological	Thermal	Recyclable
42%	25%	33%

Several works have been done to highlight the potential utilization of waste generated in Benin City (Akhator et al., 2016a; Akhator et al., 2016b; Ebunilo et al., 2015; Itoje et al., 2015; Ebunilo et al., 2012). According to Akhator et al., (2016a), Ebunilo et al., (2015) and Ebunilo et al., (2012), organic wastes generated in Benin City can be treated biologically to produce biogas. Specifically, Akhator et al., (2016a) reported that about 28 thousand cubic metres of biogas can be produced from about 305 tonnes of food waste generated in Benin City. This estimated quantity could provide cooking gas for about 24 thousand families per month in the city or alternatively can be utilized to generate about 49MW of electricity per day. Akhator et al., (2016b) reported that about 20.7MW of electrical power could be generated daily from about 53 tonnes of combustible solid waste generated per day in Benin city. Itoje et al., (2015) observed that about 52% of the waste stream in Benin City can be processed to produce Solid Waste Derived Fuel (SWDF), which can be used as supplementary fuel for cement industries and power companies in Nigeria.

However, lack of sufficient technical know-how and adequate funding has hindered the translation of these findings into physical gains. Like in City of Boras, the local and state governments in Benin City need to collaborate with the various researchers and research institutes to implement the findings of these works and encourage the development of technologies to convert wastes into economic products in order to enhance sustainable waste management in the city.

4.0 Conclusion

This study has examined the solid waste

management practices in Boras, Sweden and Benin City, Nigeria. The Boras waste management approach which has proven to be highly successful in Boras Municipality could be adopted and applied to address the issue of poor and largely ineffective waste management strategy in Benin City. The key success factors of the Boras approach, which are educating the citizens on waste management strategy and creating an economic system to convert solid wastes into value-added products, will be paramount to achieving sustainable waste management practice in Benin City.

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