

Impact of Sustainable Solid Waste Management on Economic Development – Lessons from Enugu State Nigeria

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Abstract

Solid waste management system in Enugu State, Nigeria is inefficient and unsustainable largely due to the crude and unscientific methods employed. The current practice, process and programme of waste management in the state do not in any way conform to what is obtainable in other modern cities of the world. It is against this background that this study sought to find out the current state of solid waste management system in the state, and to identify factors that influences waste management and the type of solid waste management system that will aid economic development of the State. These objectives were addressed primarily using structured questionnaire administered to a cross section of people in three selected local government areas (Enugu East, North and South LGAs respectively). Personal interviews were also conducted to augment the questionnaire. It was observed that the solid waste management system in practice in the state is unscientific, unsustainable and at the prerogative of people in power. It was discovered that the current waste management system has no room for waste recycling, reuse and repair. There was also no provision for waste segregation and reduction at source technology. Majority of the waste is dumped at open landfill. The study also analyzed the newly proposed solid waste management system in the state and found that the proposed system will be better than the existing one if efficiently implemented. The proposed system outlined a framework of waste segregation, recycling, reuse, reduction, repair and abolition of certain polythene bags with less or no economic value. The authors recommend that a massive enlightenment campaigns should be embarked upon to sensitize the people on the proposed waste management system so that they can key in to it and contribute meaningful to its sustenance.. There is need also to encourage the reuse of plastic bags, reduce litter, raise public awareness about environmental issues and encourage recycling as thicker bags will make recycling more economically viable The state government should also consider the option of public-private partnership which has been adopted with huge success in other climes.

Keywords: Solid waste management, Sustainable, Recycling, Reuse, Reduce, Repair, Economic development.

1. Introduction

Municipal Solid Waste Management (MSWM) refers to the collection, transfer, treatment, recycling, resource recovery, and disposal of solid waste in urban areas (Alabastor, 1995). The first goal of MSWM is to protect the health of the urban population, particularly those of low-income groups who suffer disproportionately from poor waste management. Secondly, MSWM aims to promote healthy environmental condition by controlling pollution including water, air, soil and cross-media pollution and ensuring sustainability of ecosystem in the urban region. Thirdly, MSWM supports urban economic development by providing waste management services and ensuring the efficient use and conservation of valuable materials and resources. Finally, MSWM aims to generate employment and income in the sector itself.

To achieve the goals of MSWM, it is necessary to establish sustainable system of solid waste management which meets the needs of the entire urban population including the urban poor. The essential condition of sustainability implies that waste management system must be absorbed and managed by the society and its local communities. The system must be tailored to the particular circumstances and problems of the city and locality, employing and developing the capacities of all stakeholders, including the households and communities requiring the services (Diap, 1995).

Sustainable solid waste management system should be approached from the perspective of the entire cycle of material use; which includes production, distribution and consumption as well as waste collection and disposal. Whilst immediate priority must be given to effective waste collection and disposal, waste reduction at production and recycling should also be pursued as equally important long-term objectives.

The principles of sustainable solid waste management system strategies are (i) to minimize waste generation (reduce); (ii) to maximize waste value by recycling, repair, reuse and (iii) to ensure safe and environmentally sound disposal of waste. Sustainable solid waste management depends on the overall effectiveness and efficiency of urban management and the capacity of responsible authorities. The overall economic effectiveness of waste collection and disposal services depends on one hand, upon the life-cycle costs of facilities, equipment and services and on the other hand, on the long-term economic impact of waste management system. Economic impacts may include such factors as the reduction of illness and healthcare costs, enhancement of environmental quality and property values, reduction of disturbances and increase of business volumes (Andrew et al, 1993).

The economic evaluation of such factors is in principle an important input to strategic plans and investment programmes for developing effective and sustainable MSWM system. Beside their use in the appraisal and justification of investment decisions, economic evaluations may be employed to demonstrate the externalized costs of waste pollution and thus to build popular support for improved waste management. In most cases however, municipal or local government authorities do not have the capacity to conduct economic evaluation or to tackle the methodological issues involved.

It is therefore important to empirically assess the impact of sustainable solid waste management on economic development drawing some lessons from the experience of Enugu State, Nigeria. The rest of the paper is structured as follows: Following this introduction in section 1, section 2 would briefly review the literature on municipal solid waste management (MSWM) with analytical spotlight on Enugu State Waste Management Authority (ESWAMA). Section 3 would focus on the data and research methodology while section 4 presents the results of the study. Section 5 will conclude the work with a brief remark on policy implications of the study and recommendations.

Section 2: Review of Related Literature

Sustainable solid waste management has emerged as one of the greatest challenges confronting urban cities especially in the developing countries. In Enugu State like other modern cities in a developing country, government and agencies established to manage waste are hamstrung in delivering sustainable waste management. It is a fact that solid waste management in Enugu urban and its environs is characterized by inefficient collection methods, improper disposal, and inadequacy of solid waste transportation. Other factors inhibiting efficient waste management in the state are lack of waste reduction technology at source, non recycling of waste, lack of repair and reuse of waste, legislative bottleneck, inadequate waste disposal vehicles and poor town planning coupled with rapid growth of population and urbanization have all conspired to add to the waste congestion in the streets with grave implication for environmental sustainability and economic development (Ogwueleka, 2003).

According to Medina (2002), improper handling and disposal of solid waste has contributed to the high level of mortality and morbidity witnessed in most urban cities in developing countries of the world. In addition, urban cities in developing countries face challenges in solid waste management in terms of their non-sustainability status in solid waste management. More often than not, solid waste management stands as a major threat to the fragile ecology of human environment which has both short and long term effect on environmental development (Jain, 1994). The quantity of solid waste generated in urban cities in industrialized countries is unarguably higher than that of developing countries; yet sustainable solid waste management remains a problem in the later. Solid waste management processes in the latter also differ remarkably than those of developed countries in terms of composition, density, management, waste quantity, access to waste collection, legislation, awareness and attitude.

In developing countries, the waste is heavier, wetter, and more corrosive than that of developed nations. Again, in most developing countries, local authorities (local government) spend 20 -50% of their revenue on collection and balance on disposal but can only collect and dispose 50 -70% of the municipal solid waste (Ogwueleka, 2003). These problems can only be solved if there is a framework for turning 85% of solid waste generated in developing countries into materials of economic value which will earn income and make the environment very inhabitable for human population and reduce hazards posed by waste to agricultural land and farm animals.

2.1 Solid Waste Management in Enugu Urban: An Overview

Enugu became the administrative capital of the then Eastern Region in 1938 with a population of 6,000 people and with very little of biodegradable waste generation. In 1948 the population rose to 8,000 with a mixture of very little bio and non-biodegradable waste due to the advent of coal. In 1958, the population was 62,000. By 1991, it was 1,913,917 and at the 2006 census it was 3,267,837 (National Population Commission, 2006). As the population increases the waste generated and accumulated also increases. The industries currently in the city includes; urban markets, educational institutions, automobile assembly plants, bottling companies, hospitals and banks, aviation, and many others. These industries generate waste of very high quantity which when combined with the ones generated by individual households' account for the present difficulty in waste collection and disposal.

In recognition of the quantum leap in the population and the challenges posed by solid waste generation and management, the state government through the act of the State Assembly enacted a law in 2004 to establish the Enugu State Waste Management Authority (ESWAMA). The agency is saddled with the responsibility of waste collection and disposal and other matters pertaining thereto. It must be noted that before the establishment of ESWAMA, the state government had tinkered with various methods and systems of solid waste management as outlined in the table below:

Table 1: Waste Management Systems

System	Description	Advantages	Disadvantages
SHARED: Residents can bring out waste at any time			
Dumping at designated location	Residents and other generators of waste are required to dump their waste at a specified location or in a masonry enclosure.	Low capital costs.	Loading the waste into trucks is slow and unhygienic. Waste is scattered around the collection point. Adjacent residents and shopkeepers protest about the smell and appearance.
Shared container	Residents and other waste generators put their waste inside a container which is emptied or removed.	Low operating costs	If containers are not maintained they quickly corrode or are damaged. Adjacent residents complain about the smell and appearance.
INDIVIDUAL: The waste generators need a suitable container and must store the waste on their property until it is collected.			
Block collection	Waste collector sounds horn or rings a bell and awaits at specified locations for residents to bring waste to the collection vehicle.	Economical. Less waste on streets. No permanent container or storage to cause complaints.	If all family members are out when collector comes, waste must be left outside for collection. It may be scattered by wind, animals and waste pickers.
Curbside collection	Waste is left outside property in a container and picked up by passing vehicle or swept up and collected by sweeper	Convenient. No permanent public storage.	Waste that is left out may be scattered by wind, animals, children and waste pickers if collection serve is delayed, waste may not be collected for some time causing considerable nuisance.
	Waste collector knocks on each door or rings doorbell and waits for waste to be brought out by.	Convenient for residents. Little waste on street.	Residents must be available to hand waste over. Not suitable for apartment buildings because of the amount of walking required.
Yard collection	Collection laborer enters property to remove waste.	Very convenient for residents. Not waste in street.	The most expensive system, because of the walking involved. Cultural beliefs, security considerations or architectural styles may prevent laborers from entering properties.

Figure1 source: www.mit.edu/urbanupgrade/issues-tools/issue/waste-collection-html#Anchor-collection 45656.October16,2013, 12:45:07

It should be noted that none of these methods was sustainable because certain factors like waste segregation and recycling was not put in place. It is also important to note that efficient waste management is capital intensive. To this end, for any method to work effectively and efficiently, the idea of turning wastes into monetary value must be seriously considered. In all, making waste a scarce commodity will only be possible if recycling of waste receive the desired attention

Section 3: Data and Methodology

The study adopted survey design method. Purposive sampling technique was used in selecting 3 local government areas out of the 17 local government areas (LGAs) in Enugu state. The 3 selected LGAs were selected based on level of urbanization. They are Enugu East, Enugu North and Enugu South local government areas. A sample size of 400 respondents was determined from the population of 717,291 drawn from both male and female population of the three LGAs as published by National Population Commission (NPC Census, 2006). Taro Yamane's statistical formula was used to arrive at the sample size. The study was undertaken from December 2013 to March 2014. For administrative convenience, three distinct but interrelated steps were followed:

Step 1: Documents, records and academic literatures relating to sustainable solid waste management in both developed and developing countries were reviewed.

Step 2: Staff of the state agency for waste management (ESWAMA) were interviewed to complement the data and records studied

Step 3: Over 40 streets dump sites were visited within Enugu urban to ascertain the true position of collection and disposal of solid waste. The final dump site at Agu-Owor in Ogui Nike along Port Harcourt Express was also visited.



Figure 1 Source: field work 2013. The state of most dump sites in the streets as at December 30, 2013



A sectional view of ESWAMA landfill at Agu-Owor, Ogui Nike

Section 4: Results and Data Analysis

1. Waste collection and disposal in Enugu State

The severity of waste problem in Enugu urban can be analyzed from the angle that currently, Enugu urban generates about One hundred and fifty (150) metric tons of solid waste every day. On the average, ESWAMA collects and disposes about 105 metric tons per day. The balance (45) metric tons litter the streets, houses,

causing blockage to drainages not because the authority want it so but because the method is not efficiently organized. The wind, animals, children, waste pickers are dispersal agents. The collection lag time create vacuums leading to waste congestion and littering. The non segregation of waste makes the job of collection more cumbersome and some wastes are left behind intentionally.

The slums like Obiagu, Abakpa, Ikirike village, Gariki, Ugbo-Odogwu, Ugbo-Okonkwo, Coal Camp and some other satelight areas in Enugu urban constitute the greatest nuisance. Poor infrastructures like access road, waste dump, and pressure of over-growing population clearly overwhelms the little services provided by the government waste management agency. Some disgruntled people also dump waste indiscriminately thereby making the work of waste collection more cumbersome for the agency. The agency (i.e. ESWAMA) on their part has not done so well in areas of waste collection and collection of tolls. The body is alleged to charge arbitrary fees and uses thugs to intimidate people into paying these arbitrary fees or their properties will be impounded by the thugs. These allegations, to some extent, unfounded, have earned the agency some notoriety in the eyes of the public.

Table 2: Selected ESWAMA Performance Indictors

Total waste Generated daily (tons)	150 metric ten tons	Per capita waste generated per tons/day	150
Waste collected (tons)	105 metric ten tons	Collection performance	105
Number of vehicles	Functional Compactors 19 Tippah (10 tons) 03 Keke 04 Tricycle 02 Mail cycle 04 Exotic vehicle 07	Vehicle capacity	-
Number of labour engaged in-Conservancy	TOTALWORKFORCE 400 Core staff 50 Seconded staff 10 Ad-hoc staff 360	Per cent age of waste disposed	105
Number of disposal sites	1	Road length/ conservancy	Ten kilometers
Number dumpsters	1,000 (within Enugu urban)	Capacity	550kg each

Source: Field work Jan.2014. Data from Head Effluent and Special waste unit ESWAMA

It is obvious from the table that the agency lacked the human resources needed to prosecute an effective war against waste in the state. Of the 400 workforce, only 50 are core staff while the rest are people called upon on ad-hoc basis. Apart from the integrity issues involved in using ad-hoc staff, the loyalty of these classes of workers is seriously in doubt. The lack-lustre performance of the agency and the aggressive and coercive method employed in fees collection which has given the agency the bad image may be the handy-work of these elements. Moreover, these ad-hoc staffs have been known to work at cross-purposes and for their selfish ends.

Table 3: Capacity disposal chart of ESWAMA

S/N	Location	Morning	Evening	Intermittent	Total	Period	
1	Abakpa main	3	2	1	6	Weekly	
2	Ogwuagor	2	--	1	3	„	
3	Trans-Ekulu	4	2	2	8	„	
4	City Layout	-	2	2	4	„	
5	Thinkers corner	2	1	1	4	„	
6	Nkpologwu	-	1	1	2	„	
7	Emene	2	1	1	4	„	
8	Ugbodogwu	2	1	1	4	„	
		TOTAL = 35					

Source: Field work Jan.2014. Data from Head Effluent and Special waste unit ESWAMA

Table 4: Enugu North, Quantity measurement is in Ten tons

S/N	Location	Morning	Evening	Intermittent	Total	Period	
1	Ogui Nike	3	1	-	4	Weekly	
2	Asata	2	2	-	4	„	
3	New Haven	2	1	-	3	„	
4	Ind. Layout	2	3	1	6	„	
5	GRA	2	2	-	4	„	
6	Ogui N/L	1	1	-	2	„	
7	Ogbete Market	7	3	2	12	„	
		TOTAL = 35 (Ten tons of Waste)					

Source: Field work Jan.2014. Data from Head Effluent and Special waste unit ESWAMA

Table 5: Enugu South Quantity measurement is in Ten tons

S/N	Location	Morning	Evening	Intermittent	Total	Period	
1	Garriki	3	2	1	6	Weekly	
2	Uwani	4	3	2	9	„	
3	Achara Layout	3	2	1	6	„	
4	Mary Land	3	2	1	6	„	
5	Ikiriki	1	1	2	4	„	
6	Idaw River	2	1	1	4	„	
		TOTAL = 35 (Ten tons of Waste)					

Source: Field work Jan.2014. Data from Head Effluent and Special waste unit ESWAMA

Summary for the entire waste collect and disposed by ESWAMA in Enugu urban

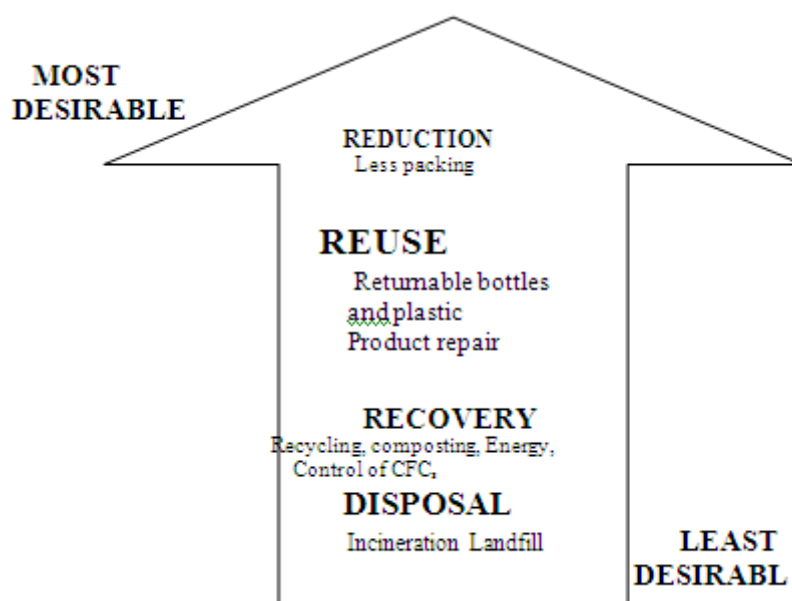
1 day = 35 + 35 + 35 = 105x10 = 1050 Metric tons per day

1 week = 1050mt x 7 = 7350 metric tons

Note: This amount is only about 70% of the waste generated in one day or a week. The remaining 30% is untouched and it litters along the streets. The quantity of waste generated and disposed varies depending on whether it is rainy or dry season. Some areas like Gariki and Abakpa generate more waste during rainy season because of agricultural wastes like maze, vegetables etc

2. Reduction of Waste Generation

“Prevention is better than cure” so goes an old adage. It is the best method of dealing with the problem of solid waste. By preventing (reducing) the generation of waste itself other problems associated with waste management are also minimized. In developed nations waste generation is often a function of culture and affluence. While in developing ones, the primary drivers of waste generation includes demographic change coupled with sudden and rapid urbanization, high frequency of political change, insurgence of war, economic crisis or boom (Scientific Committee on Problem of the Environment, 2005). Other reasons include inconsistency in policies including high turnover of principal actors in the policy-making and mass illiteracy resulting in indifference to the environment. The strategy for waste reduction which is synonymous with waste prevention is that of managing waste and is uppermost in the solid waste management hierarchy;



Figur2 Solid Waste Management hierarchy

Source: Upendra (2008) Thesis on sustainable solid waste management in a mountain Ecosystem; Darjeeling, West Bengal, India

In order to reduce waste, several methods and tools can be applied;

- 1) Enacting public policies that discourage the production, sale and consumption of products containing unnecessary packaging material. Where flow of production cannot be controlled, appropriate policy measure (extended to producer's responsibility, taxes, and economic incentives) should be put in place to discourage unnecessary waste generation.
- 2) Promotion of local grown products and less reliance on packaged food products will go a long way in reducing waste.
- 3) Education can play a critical role by creating awareness regarding the waste and related matters among the masses. For instance, appealing to the masses to use a reusable bag for shopping rather than rely on goods being bagged in numerous thin poly bags can significantly reduce the use of poly bags which are main source of waste in Enugu State.

3. Waste Reuse

Reuse is using an object or material again, either for the same original purpose or for a similar purpose without significantly altering the physical form of that object or material. In this way, reuse in all spheres prevents objects and materials from becoming waste and can be considered as a waste prevention mechanism.

4. The Case of Plastic Bags in Enugu State

As at the time of this study, companies in Enugu State can manufacture, import and distribute thin film (14-17 microns) plastic bags. In a recent study conducted by Foraminifera, a marketing Research Company based in River State, "the annual production of polythene materials, which is the most widely used plastic material in Nigeria, is currently about 80 million metric tons. Indeed, in the last five years, annual production of plastic increased by over 30 million in Nigeria and over 8.33 million metric tons in Enugu state". Most of these thin plastic materials are non-reusable. The thin reusable plastic carrier bags freely supplied by retail stores litters the streets of the city and kills domestic animals indiscriminately to such an extent that it is in line of earning a nickname 'national flower' as it was in South Africa and Kenya before May 9, 2003. This type of plastic bags are not collected for recycling or disposal because of their little or no commercial value, either as cost to consumers, or a raw material for recyclers (Nhamo,2003:39). This situation is aggravated by the inadequate waste collection and disposal in areas with high population density. This has contributed to the environmental degradation in Enugu state.

To deal with this problem, the Government of Enugu State should through an act of the State Assembly enact a very strong law as is the case in South Africa where government introduced the Plastic Bags Regulation under section 24 (d) of the Environment Conservation Act (South Africa, 2003) which came into effect on May 9, 2003. According to Nedlac (cited by Nhamo, 2003:39), it is estimated that prior to the Plastic Bags Regulations, an average of about eight billion plastic shopping bags circulated in South Africa each year.

The purpose of the proposed regulation should be to address the problem of plastic bag disposal which is particularly severe in the low-income but highly populated areas where waste collection services are inadequate. The proposed legislation should require manufacturers to produce thicker plastic bags which must have a minimum thickness of 45 micrometers (microns) amongst other characteristics. Consumers may be mandated to pay for plastic shopping bag which hitherto is free. The proposed law will encourage the reuse of plastic bags, reduce litter, raise public awareness about environmental issues and encourage recycling as thicker bags will make recycling more economically viable.

According to the United Nations Environment Programme (2005a:38), the resultant effect of the regulation introduced by the South African government was that by November 2003, there was a drastic reduction of plastic bag litter, reduction in the manufacture of plastic bags and growth of alternative sectors, particularly canvas bags and plastic recycling.

5. Waste Recycling

“Recycling is a process whereby discarded products and materials are reclaimed or recovered, refined or reprocessed and converted into new or different products”. There are two types of recycling: primary or close loop recycling, in which wastes discarded by consumers (post consumers wastes) are recycled to produce new products of the same type (example, newspaper into newspaper, and aluminum cans into aluminum) and secondary or open loop recycling in which waste materials are converted into different other material and usually lower quality products (Miller 2005:535). According to Miller (1994:284) primary recycling is more desirable than secondary recycling. The reason being that, primary recycling reduces the use of virgin materials in making a product by 20-90% whereas secondary recycling reduces it by 25% at the most.

Although recycling is one of the most important aspects of waste management in both developed and developing nations, due to the composition of waste and other factors, recycling may not be much of an option in a developing country if not thought out well. According to Williams (2005:130 cited in Taiwo, 2009), separation of waste materials at the household level is perhaps a universal phenomenon, but not so in developing countries where separation of anything valuable is difficult in terms of waste which makes valuables and reusable materials being discarded. The existence of waste pickers, scavengers etc to recover valuable materials from entering the waste stream become imperative. For a developing country, itinerant buyers play a vital role in recovering materials for recycling; they buy every material that has some monetary value, newspapers, plastic bottles, old shoes etc. It is however, imperative that some improvement in these traditional systems can be turned into a formal waste recycling or recovery system supported by local authorities.

Benefits of Recycling: Economic Benefits

- 1 Recovered materials use less energy in the process plant compared to that needed for products obtained from virgin materials. This conserves energy in terms of electricity or fuel.
- 2 If materials such as metals, paper, glass and plastics are recovered from solid waste, they become source of valuable raw materials to industries, thereby reducing foreign importation for countries dependent on those materials, while excess production could be exported.
- 3 Recycling reduces the waste collection and disposal costs.
- 4 Recycling prevents the emission of many greenhouse gases and water pollutants. It also helps to reduce greenhouse emissions that affect global climate.
- 5 Recycling practices helps to reduce the amount of waste that requires disposal by landfill, thereby conserving scarce landfill space and reducing the need for new landfill and combustors.
- 6 Recycling reduces litter

Social Benefits

- 7 Recycling if properly organized can be a source of livelihood to unskilled workers in a developing country, as it creates employment
- 8 Vegetables and food matters recovered from solid waste can be used after preparation as animal feeds. Society at large can benefit from this concept.

Ecological Benefits

- 9 Recycling conserve natural resources such as trees, and animals, for example, smaller amount of water is needed if the preparation is from recycled raw materials than from virgin raw materials.
- 10 Composite material used as fertilizer increase nutrients to the soil and controls erosion which makes ecological environment more harmonic for balanced growth.

6. Waste Segregation

One of the core proposal of this study is the emphasis on developing a system that will promotes segregation of the waste at the household level, which is not a regular practice in Enugu State. Segregation of waste as proposed here, at the source itself is a very important feature of waste reduction. Segregation of waste at source greatly

reduces the amount of waste going to the landfill (Sudhir et al., 1997, Medina 2002). Segregation of waste can save valuable resources in the form of saved man hours required to deal with the un-segregated waste. In addition to this, environmental damage and filth associated with un-segregated waste poses a health threat to the people, which can be avoided by following proper segregation method (Medina, 2002). The absence of a mechanism for dividing the waste into bio-degradable, recyclable and garbage is one of the main drawbacks of the current solid waste management in Enugu State.

Section 5: Conclusion and Recommendations

The sustainability of any solid waste management system depends on numerous factors. However, the most important is the will and commitment of the people to change the existing system and develop something better. The people of Enugu State appear willing to contribute positively and to participate in a solid waste management system so long as the approach will set the people free from bondage of waste congestion that causes infections and illnesses. It is on this premise, that recommendations for developing of a sustainable solid waste management system below are very vital:

- 1 At present, waste management policy and development is the prerogative of those in power. Given the complexity of issues and problems associated with solid waste management, it is apparent that the top-down solutions and management strategy will not be sustainable rather; sustainable solid waste management system will depend on the participation of the citizens in the system. That is, public consultation and involvement is imperative for developing and sustaining efficient waste management system.
- 2 Long-term sustainability of solid waste management system will also depend on the level of segregation of waste. Segregation of waste should be in three streams i.e. bio-degradable, recyclables and garbage waste.
- 3 Emphasis should be on the four R's of reduction, reuse, repair and recycle. This will help in creating less waste and increasing material recovery.

The advent of sustainable solid waste management in Enugu State will certainly have a salutary effect on other sectors of the state economy. It will bring a paradigm shift from the current '**rudderless-approach**' in the operation of ESWAMA to a more generally acceptable method of managing waste in Enugu State. The status of scavengers, waste workers and waste pickers will be elevated. The people of Enugu State will pay their bills willingly because it is the decision and choice of the people. The right of the general public will be respected. The notorious arm-band worn by the waste management agency in the eyes of the public will be a thing of the past. In all, it will bring better democracy dividends to the people of Enugu State and its environs.

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REFERENCES:

- Agunwamba, J.C., Egbuniwe, and N, Ogwueleka, T. C. (2003), Least Cost Management of Solid Waste Collection. *Journal of Solid Waste Technology and Management*, 29 (3):154-167.
- Ball, J and Associates (2003), *Status quo Report on the Current Waste Generation and Management in the City of Johannesburg*. Final Draft Report no 1:20-27
- Ball, J, Novella, P., Fiehn, H. and Tlhoale J.B.A. (2005), *The Future of landfill in South African* (Online). Available from: www.geosynthetica.net/tech-docs/landfill2005/ballinovella.pdf. [Accessed]: 26/01/2014.
- Bartone, C. (2000), *Strategies for Improving Municipal Solid Waste Management: Lessons from World Bank Lending Activities*. Workshop on Planning for Sustainable and Integrated Solid Waste Management, Manila, 18-22 September 2000. Washington, DC: Urban Management Division, World Bank. www.undp.org/pppue/pppueoled/library/files/barton0i.doc. Accessed Jan. 3, 2014.
- Blight, G. E and Mbande, C. M. (1960), Some Problems of Waste Management in Developing Countries. *Journal of Solid Waste Technology and Management*. 23(1):19-27.
- Chakrabarti M. (2002), *Towards an Operational Definition of Sustainable Development*. Available online at www.indiana.edu/workshop/papers/chakrabarti022502.pdf. 27/04/2012.
- Chakrabarti Snigdha and Prasenjit Sarkhel (2003), *Economics of Solid Waste management: A Survey of Existing Literature*. Economic Research Unit Indian Statistical Institute.
- Clarke, M.J. and Maantay, J.A. (2006), Optimizing Recycling in all New York's neighborhoods: using GIS to develop the REAP index for improved Recycling Education, Awareness and Participation. *Resources, Conservation and Recycling*, 46:128-148.
- Clarke, M. J., Read, A. D and Phillips, P.S. (1999), Integrated Waste Management, planning and Decision-Making in New York City. *Resources, Conservation and Recycling*, 26:125 -141.

- Dauda M and Ssita, O.O. (2003), *Solid Waste management and reuse in Maidugri, Nigeria*. 29 WEDC International Conference Towards the Millennium Development Goal, Abuja
- Ellam, J, Chimamanda N.A".(2008) Biography British Council On Environment
<http://www.contemporarywriters.com/authors/?p=auth5181C8790ed231B8ACjvmPF45C3B>. Accessed December 10, 2013
- Enugu State Local Government Service Commission Year Book, 2009 -2011.
- Ikejiofor, U., Nwogu, K. C., Nwanunobi, C. O. (2004), Informal Land Delivery Processes and Access to Land for the Poor in Enugu, Nigeria. University of Birmingham
- Medina Martin (2002). *Globalization Development, and Municipal Solid Waste Management in ThirdWorldCities*.www.gdnet.org/pdf/2002AwardsMedalsWinners/outstandingResearchDevelopment/martin_medina_martinez_paper.pdf> 28-12-2014.
- Ogwueleka, T.C., (2003), Analysis of Urban Solid Waste in Nsukka, Nigeria. *Journal of Solid waste Technology and Management*, 29(4): 239-246.
- Ogwueleka, T.C., (2004), Planning Model for Refuse Management. *Journal of Science and Technology*; 3(2):71-76.
- Oluwatoyin, E.T. (2009), Integrated Solid Waste Management as a Solution to Dwindling Landfill Capacity. PhD Thesis Tshwane University, Johannesburg, South Africa
- US EPA. (2008),. Paper and Paperboard Products. {online} www.Epa.gov/garbage/paper.htm. accessed May3, 2012
- U.S EPA. 2008b. Plastics. [Online] www.epa.gov/msw/plastic.htm. Retrieved May 3, 2012.
- Upendra, M.P. (2008), Sustainable Solid Waste Management in a Mountain Ecosystem: M.Sc. Dissertation, Manitoba University, India: 1-154.
- World Bank: World Development Indicators 2006 accessed
www.siteresources.worldbank.org/DATASTATISTICS/Resources/table3-10.pdf. Retrieved October 29, 2013.
- Yin R.K, (2003), *Case Study Research-Design and Methods*. Sage publications, Thousand Oaks, CA.
- Zerbock Olar, (2003), *Urban Solid Waste Management: Waste Reduction in Developing Nations*. Michigan Technological University.
- Zurbrugge, C., (2003), *Urban Solid Waste Management in Low-income Countries of Asia*, How to cope with the Garbage Crisis. Available at www.sandec.ch. Retrieved December 18, 2014

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