

# Treating Waste as Resource in the Cities Of Lagos and Johannesburg

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## ABSTRACT

Urban waste is a growing concern in many metropolis and large cities in Africa including Lagos (Nigeria) and Johannesburg (South Africa). The expanding economy and rapid urbanisation gives rise to rapid population growth resulting in increased amounts of Municipal Solid Waste (MSW) been generated. The resultant effect is increasing pressure on waste management resources and the environment. Steps need to be taken to mitigate this situation by viewing waste as a potential resource and not a problem. The Cities of Lagos and Johannesburg have similar problems, for instance they are densely populated with a lot of informal settlements and acute shortage of land for waste disposal. In addition, residents hardly bother about issues pertaining to environmental care. This paper compares the composition of the waste streams of Lagos and Johannesburg and explores how both cities utilise waste as a resource and finally examines what both cities can learn from each other.

KEYWORDS: waste, resource, waste composition, City of Lagos, City of Johannesburg

## 1. INTRODUCTION

Waste is a growing concern in many metropolis and large cities of Africa including the Cities of Lagos (Nigeria) and Johannesburg (South Africa). Municipal Solid Waste (MSW) is mostly perceived as unwanted material constituting nuisance to the environment (Figure 1). It is waste collected by or on behalf of municipalities, originating from households, commerce and trade, small businesses, office buildings and institutions such as schools, hospitals and government buildings. Synonymous to MSW are terms such as "garbage", "trash", "refuse" and "rubbish" (Zurbrugg, 2002). Various components of MSW are classified as biodegradable waste, recyclable material, inert waste, composite waste, household hazardous waste and toxic waste (Wikipedia, 2008).

Rapid population growth, use of high-tech materials and the tendency to congregate in large cities have resulted in increasing amounts of Municipal Solid Waste (MSW) being generated (Taiwo, Otieno and Venter, 2008). The resultant effect is increasing pressure on waste management resources such as landfills, collection and disposal services and the environment. According to the Organization for Economic Co-operation and Development (OECD) (cited by Williams, 2005), as people search for a better life and a higher standard of living, there is a movement away from the rural to the urban areas. This tends to increase the per capita generation of waste since urban populations tend to have higher incomes, consume more goods and, consequently generate more waste when compared to rural populations.



Figure 1: Municipal Solid Waste

Solid Waste Management challenges facing developing cities of Lagos and Johannesburg are real; where residents hardly bother about issues pertaining to environmental care. Both cities are densely populated with a lot of informal settlements and acute shortage of land for waste disposal. It is difficult to find suitable land to develop new landfill sites in the nearby vicinity which does not conflict with residential and other planned developments. With limited disposal facilities available to dispose of the current and future waste generated, the Cities of Lagos and Johannesburg have no choice other than look for alternative methods for managing its waste.

This paper compares the composition of the waste streams of Lagos and Johannesburg and explores how both cities utilise waste as a resource and finally examines what both cities can learn from each other.

## 2. SOLID WASTE MANAGEMENT

The role of solid waste practitioners would be to find new ownership for or give a new purpose to the waste, or both. A paradigm shift away from logistical and technological issues of collection, disposal and treatment is necessary towards more social and cultural issues of value, use and ownership is required. The issue of ownership encourages reuse, recycling and recovery measures and encourages the public to develop better attitudes and ethics towards waste production and management. Waste management methods must be chosen carefully to suit local conditions in order to move towards sustainability.

Various concepts have been developed over the years to provide the basis for improving the management of Municipal Solid Waste in developing cities. Among these is the concept of Integrated Solid Waste Management (ISWM). ISWM means the selection and application of suitable techniques, technologies and waste management programmes to achieve specific waste management objectives and goals (Eisa and Visvanathan, 2002). The waste hierarchy (Figure 2) is an accepted key element of ISWM and can be used to view waste as a potential resource. It is within the framework of the waste hierarchy that waste minimisation strategies emerges as a tool to integrate the 3R's, Reduce, Reuse Recovery (Recycling, Composting, Energy Recovery), then disposal (Incineration, landfills) (Taiwo, 2009).

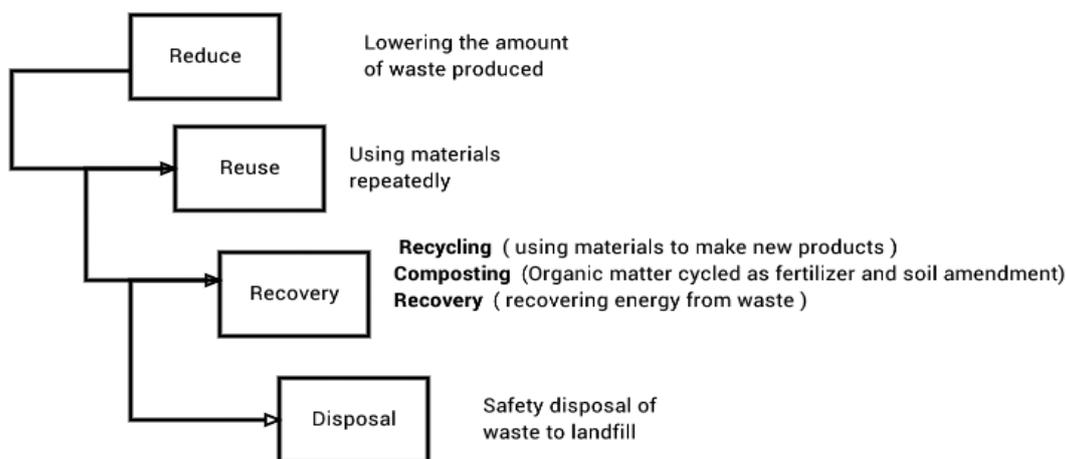


Figure 2: Definition of Waste as a Resource (ECSIP Consortium, 2013)

FIGURE 1 : Definition of waste as a resource

## 3. STUDY AREAS

### 3.1. City of Lagos

Lagos, located on the south-west coast of Nigeria, is the most populous city in Nigeria and one of the most industrialised in the country even though it is the smallest in terms of land area, with a land mass of 3,600 square kilometres and a population of about 18 million people (LAWMA, 2013). The City has an annual growth rate of 6 - 8% and a population density of 2,957 persons/km<sup>2</sup> (LAWMA, 2013). Enormous pressure is

put on the environment due to huge amounts of solid waste generated in the state. There has been a tremendous increase in MSW generation over the years, principally as a result of rapid population growth as well as economic and industrial development in the country. Waste generation in the state is about 10,000 metric tons per day with per capita waste generation of 0.65 kg per day (LAWMA, 2013). Lagos State Waste Management Authority (LAWMA) is presently charged with the responsibility of waste management in the state. The state has eight landfill sites managed by LAWMA.

### 3.2 City of Johannesburg

The City of Johannesburg Local Municipality is situated in Gauteng province and covers an area of 1 645km<sup>2</sup>. Also known as Jozi, Jo'burg, or Egoli it is the largest city in South Africa, and the provincial capital of Gauteng, the wealthiest province in South Africa (<http://www.localgovernment.co.za>). At 4,434,827 people, the CoJ is the largest municipality in the Gauteng Province, in terms of population numbers however, is the smallest municipality, in terms of area at approximately 1,645 km<sup>2</sup> (StatsSA, 2011). This estimates to a population density of 2,696 people per km<sup>2</sup>, which is significantly higher than any other municipality in South Africa. This is approximately 1000 more people per km<sup>2</sup>, than the second highest densely populated municipality, which is Ekurhuleni Metropolitan Municipality, also located in Gauteng, with 1,652 people per km<sup>2</sup> (StatsSA, 2011).

The CoJ's population is expected to steadily grow at an annual rate (year on year) of 2.2% (The growth of the population and further increase in the population density will place constraints on the resources and land available for Pikitup to efficiently manage the waste generated.

The expanding economy and rapid urbanization have given rise to continued high population growth rates exacerbated by an influx of jobseekers, often seeking shelter in informal settlements (City of Johannesburg, 2010; Integrated Regional Information Networks, 2006). The consequence is an increase in the volume of Municipal Solid Waste (MSW) generated annually. The per capita waste generated per person per day is approximately 1.6 kilograms. The City fulfils its obligations with respect to waste management through its waste utility, Pikitup which performs all operational duties with respect to general waste which includes collection and disposal while the Council performs a regulatory, planning and strategic function.

The City has four operating landfill sites and two recently closed landfills. These landfill sites simply cannot cope with the volumes of waste generated (Liebenberg and Van Aswegen, 2006). The closure of any of these landfill sites means that all the waste that used to be disposed there has to be transported further through the densely populated areas of Johannesburg to reach other landfill sites outside the City. This would increase the social, environmental and economic cost of waste management in Johannesburg (for instance, creating traffic congestion and increasing the emissions from collection vehicles), reducing the sustainability of the system.

### 3.3. Waste Generation and Waste Composition of the Cities of Lagos and Johannesburg

Solid waste generation varies between countries, cities and part of cities in Africa. The main drivers of waste generation are demographic change coupled with sudden and rapid urbanisation and high frequency of political change (Scientific Committee on Problems of the Environment, 2005). Other reasons include frequent policy changes (including high turnover of principal actors in policy-making), insurgence of war, economic crisis or boom and mass illiteracy resulting in indifference to issues concerning the environment (Scientific Committee on Problems of the Environment, 2005). Information about waste generation is important for the planning of appropriate and sustainable solid waste programmes in addition to making correct decisions on the selection of appropriate technologies for handling the waste generated (Taiwo, 2009).

The composition and characteristics of waste in a particular city is depended on factors such as socio-economics, types of industry and industrialisation, geographical location, climate, level of consumption, collection system, population density, extent of recycling, legislative controls and public attitudes (Williams, 2005). Household waste composition is directly affected by a variety of factors, including socio-economic status of households, food habits, season, geographical location, cultural conditions, etc.

### 3.4. City of Lagos

The composition and properties of the MSW in Lagos State is shown in Table 1.

Table1: Composition of Lagos Waste Stream

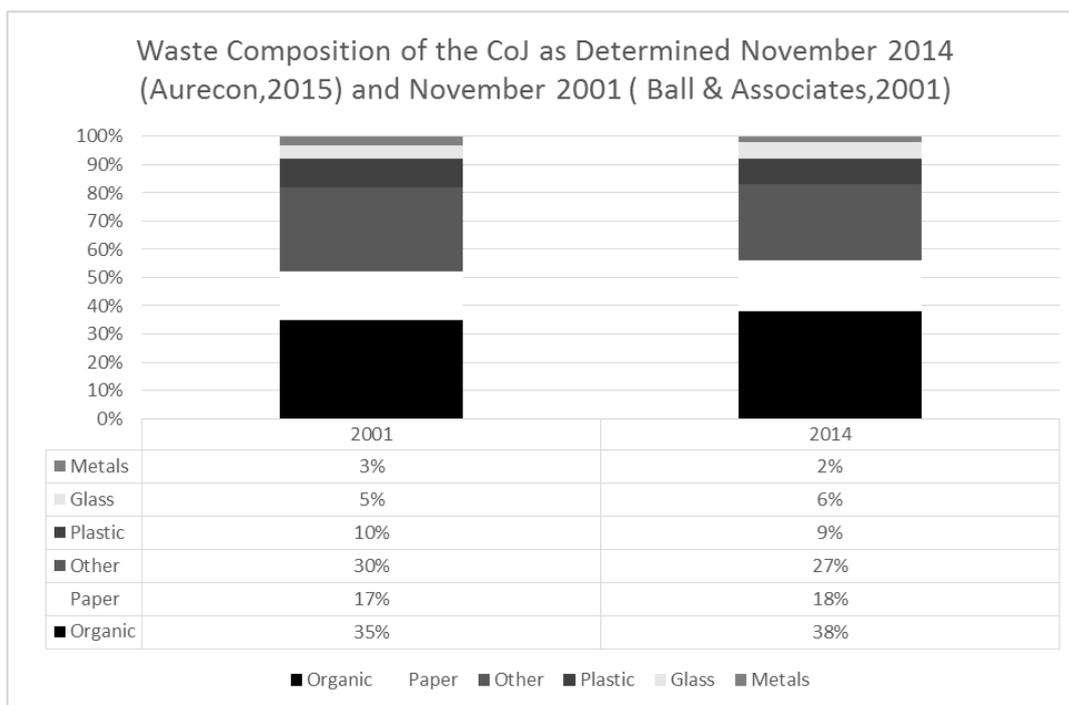
Component of waste stream	Composition (%)	Properties	Mode of disposal	Potential uses
Paper	6	Combustible, biodegradable and recyclable.	Recycling	Paper products
Plastic	6	Combustible and recyclable	Recycling	Plastic products
Glass	8	Rigid but recyclable	Dumping	Glass products
Metal	10	Mostly corrosive, recyclable	Recycling	Recycled metallic and non-metallic products
Textile	6	Combustible	Dumping	
Putrescibles	4	Biodegradable	Dumping	Compost
Fines/Residue	10	Non-combustible	Dumping	Landfill
Vegetables	50	Biodegradable	Dumping	Compost

Source: LAWMA, 2013

From the waste composition data shown in Table 1, Vegetables, metal and fines/Residue are the main components found in the waste stream.

### 3.5. City of Johannesburg

Table 2: Composition of Johannesburg Waste Stream



(Source: Ball and Associates, 2001; Aurecon 2015; Jeffares and Green 2016)

The results of the waste characterisation study based on the methodology of Ball (2001) carried out by Aurecon South Africa Ltd 2015 were found to be similar to the results obtained by Ball. Conclusion was reached that the similarity in the overall waste composition in the city between 2001 and 2014 is indicative that no significant changes impacting on the composition occurred in the city over this 14 year period (Aurecon South Africa Ltd, 2015). From the waste composition data developed by Ball (2001) on the Johannesburg waste stream, the yearly average estimates for Johannesburg's waste stream is shown in Table 2. Organics, paper, fines/residues and plastics are the main components found in the waste stream. The fine/residue fraction is the waste remaining after all fractions had been separated out and includes soil, yard sweepings, wet ash, undefined waste, mashed putrescibles, etc (Ball, 2001).

#### 4. UTILISATION OF WASTE AS A RESOURCE

##### 4.1 City of Lagos

LAWMA in partnership with PSP operate a waste – to - wealth programme that works with the concept of Integrated Solid Waste Management (ISWM) and involves the recycling of solid waste into various new products including clean energy (Chibueze, 2012). The waste to wealth programme also includes nylon buy-back programme, recycling banks, recycling plant at the Olusosun recycling centre; collection of PET bottles, aluminium cans, cardboard, cullet and other materials; and compost facility in Ikorodu in collaboration with Messrs Earthcare. Others are the establishment of the recycling village for waste paper collection, tyres and waste to energy projects.

##### 4.1.1 Waste Reduction and Separation

Waste reduction is mostly carried out at the point of use of resources by domestic users or industrial users. Some wastes are sorted as materials to be reuse for domestic or industrial purposes. These wastes for reuse are sorted at point of waste generation (i.e. homes, schools, industries etc.) by users or by waste pickers at point of disposal for resale as secondary raw materials to be recycled by end users like industries.

##### 4.1.2 Recycling / Buy-Back Programme

Recycling of materials such as paper, plastics, glass and metals considered to have high market value are usually carried out by waste pickers who separate them from the waste either at source or at landfill sites and then sell them.

Out of the various types of recyclables – nylon, metal, paper, plastics, bottles, PET bottles – LAWMA recycles plastics. LAWMA has established Resource Recovery plants in several parts of Lagos State based on the type of solid waste sorted at landfill sites. A Recycling plant for water sachets and PET bottles is in operation at Olushosun landfill site. Some non-governmental organisations are also into recycling of water sachets and other polyethylene waste in to polyethylene bags.

The City of Lagos has established a "Buy-Back programme" that enables unemployed youths to earn money from recyclable waste collection like PET bottles (Plastic bottles), water sachets (commonly known as nylon), waste papers, card board, metal scraps and aluminium. An individual picker can gather and supply 100kg to 300kg of plastic waste daily and earn a minimum of sixty thousand naira (N60,000) a month, which is about three thousand five hundred rand (R3,500). This amount is higher than the country's minimum wage of eighteen thousand Naira (N18,000).

##### 4.1.3 Private Sector Participation (PSP) Programme.

The feasibility study conducted by Agboje *et al* (2014) revealed that most PSP contractors' waste pickers earn salaries between seven thousand to twenty thousand Naira (i.e., from ₦ 7,000 to ₦ 20,000) depending on the area. The low income area PSP waste pickers earns between ₦ 7,000 and ₦ 14,000, in medium income area they earn between ₦ 10,000 and ₦ 18,000 while in high income area they earn between ₦ 10,000 and ₦ 20,000. Other benefits that accrue to PSP waste pickers may include daily food, stipends, free accommodation, and holidays in low income areas. In middle income areas, benefits such as allowances,

opportunity for loan, and holidays while in high income areas PSP waste pickers may be offered benefits such as allowance, daily food, stipends, loans, and free accommodation.

#### 4.1.4 Composting

Lagos state established a Compost plant at Odogiyian (Figure 3) at Ikorodu where 250 bags of 25kg of compost are produced daily. There is a potential increase in market demand due to rise in non-organic fertiliser prices. Small scale farmers in suburbs of Lagos engage in composting farm wastes to further enrich their crop lands. These small scale farmers carry out composting on small scale level.



Figure 3: Compost plant at Odogiyian, Ikorodu

#### 4.1.5 Waste to Energy Source in Lagos

Lagos is moving ahead to use its abundant waste to create wealth and enhance the environment through the Landfill Gas Recovery and Utilisation Project. The project which is being executed by LAWMA in partnership with the United Nations Environment Programme (UNEP) and the African Carbon Asset Development is expected to capture methane gas from waste and use it to generate electricity (LAWMA, 2013). According to the Managing Director of LAWMA, gas wells have been developed to manage and recycle MSW into clean energy (LAWMA, 2013). Waste to Energy project is on pilot scale at Olushosun landfill site. This project has the Clean Energy Regulator (CER) potential of 1,000,000 units over 10 years. (LAWMA, 2013). The immediate benefit are that it will prevent the release of greenhouse gasses, which endanger the environment, create jobs, reduction in urban poverty, small business enterprise development and provide infrastructure through public-private-partnership (PPP).

#### 5.2 City of Johannesburg

The City of Johannesburg has already embarked on waste minimisation strategies, recycling programmes and Separation @ Source campaigns targeting households and commercial buildings.

##### 5.2.1 Waste Separation @ Source

Pikitup provides residents with recycling bags on a weekly basis. These can be collected, or dropped off at Pikitup Garden Sites found across the city. Pikitup works with co-operatives and small enterprises to collect, and sort the recyclable waste (such as paper, plastic, cans, bottles and electronic waste) collected from households and businesses. These initiatives create additional jobs, businesses and income for the unemployed residents within the City (Pikitup Business Plan 15/16), Waste Minimisation Initiatives)



Figure 4: Waste Separation at Pikitup Garden Site

### 5.2.2 Recycling/Buy-Back Centre

The COJ and Pikitup promotes recycling through the establishment of drop-off facilities at garden sites and the provision of suitable land that is leased for buy-back centres (Figure 4). At present, COJ/Pikitup has 42 garden refuse sites, 20 of which are operated by SMMEs (Davie, 2014). Waste materials with an economic value are bought from the community at these waste sorting facilities and resold to markets outside for a small profit (Pikitup Business Plan 15/16, Waste Minimisation Initiatives). For example, the city has established sorting, recycling and waste buy-back centres (Figure 5) such as Zondi in Soweto and Diepsloot (Climate Leadership Group c40, 2014). In addition to the benefits derived from recycling, the advantages of these centres are that it provides employment and entrepreneurial opportunities to the unemployed. The buy-back centres are privately operated but are supported by Pikitup.



Figure 5: A buy-back centre

### 5.2.3 Food for Waste

Pikitup provides 108 individuals across the City with food packages. In exchange, they are required to keep designated areas clean. This project is meant to encourage recycling (Figure 6) as a viable means of income generation in the poorer communities. To date, this project has been successfully piloted in Orange Farm, and five illegal dumping sites have been converted into community food gardens. The project is run in partnership with the City's Community Development department (Waste Minimisation Initiatives)



Figure 6: An Informal Recycler/Reclaimer

#### 5.2.4 Composting

Composting is a biological process which entails the decomposition of the organic biodegradable fraction of waste to produce a stable product such as soil conditioners and growing materials for plants. The main benefit of composting is that it greatly influences the condition of the soil. It has the ability to help regenerate poor soils. Garden waste contributes a significant amount of household waste (about 20%) disposed to garden waste sites and landfills (Taiwo, 2009; Ball, 2001). Composting of garden waste is a means of reducing waste disposed to landfill sites, generate income and create jobs. Compost is sold to either the agricultural sector or to city homeowners for use in suburban gardens.

#### 5.2.5 Waste to Gas

Landfill gas, mostly methane, generated by the decomposition of the organic fraction of waste, such as domestic waste, can be extracted from landfills in a controlled engineered way and burnt to generate power. Pikitup has introduced the Waste to Gas initiative to extract gas from waste generated by the people of Johannesburg to produce electricity as an alternate source of energy. At the top of Johannesburg's largest landfill site, Robinson Deep sits the city's first methane gas-to-power project. It will initially pump 4MW of energy to national energy supplier Eskom (Davie, 2014). Infact the city is converting all five landfill sites from methane gas flaring to power generation. These are expected to produce approximately 19MW of electricity, which can supply 12,500 households over 20 years and beyond (Climate Leadership Group C40, 2014). The income from the sale of power to ESKOM will amount to R800-million a year (Davie, 2014). Producing energy from our landfill sites will also alleviate pressure on the national grid.

#### 5.2.6 E-Waste

Pikitup annually receive and collects approximately 10% of e-waste. E-waste also accounts for 70% of the overall toxic waste that is disposed of in our landfill sites which can pollute the environment. Pikitup's e-waste recycling initiative allows residents to dispose of broken and unwanted items such as computers, cell phones, white goods (toasters, microwaves), batteries and other kinds of electronic equipment. E-waste can be refurbished and recycled through the recovery of materials and unique components, leading to the creation of job opportunities or development of skills (Davie, 2014).

#### 5.2.7 Construction, Demolition waste/Builders rubble

Construction and demolition waste (C&D) forms a large part of the COJ's waste composition. Small and medium construction operators are the most likely source of illegally dumped construction and demolition (C&D) waste, with home renovators being responsible to a lesser degree. (Venter, 2014)

Research shows the unwillingness of offenders to pay or cost avoidance as the main reason for illegal dumping of C&D waste. An uncaring attitude and convenience (access to a convenient disposal location)

are also important reasons. Pikitup has introduced a monthly bulky waste collection service to stop some of the illegal dumping, Private initiatives can also be found where builders waste is crushed and reused in construction.

## 6 DISCUSSION AND CONCLUSION

Solid Waste Management is an issue every society has to deal with. Both Cities are committed to dealing with the enormous waste it generates in an integrated way. The City of Lagos has a lot to learn from the good environmental education programmes and information campaigns the City of Johannesburg offers its citizens. This is very important to spread knowledge and awareness to different target groups such as students, housewives and office/factory workers so that they are better informed to separate the wastes they generate in their homes. Householders must be encouraged to reduce, reuse and recycle waste because it is an integral part of achieving sustainable waste management. The key is a change in mind-set and behaviour, a complete rethinking of waste, which calls for waste to become wealth, refuse to become resource and thrash to become cash.

## REFERENCES

- AURECON SOUTH AFRICA (PTY) LTD. (2015). *Waste Characterisation Study for City of Johannesburg*. August: 1 – 88.
- BALL, J. & ASSOCIATES (2001). A waste stream analysis of the general waste stream: *Current waste management in the city of Johannesburg*. Danced environmental capacity building project, Report 1A. Johannesburg. December: 1 – 30.
- CHIBUEZE, J. (2012). *Waste to Wealth: The Lagos Example* [Online]. Available from CITY OF JOHANNESBURG. (2009). *Consolidated Group Annual Performance Report for the Year Ended 30 June 2009*. City of Johannesburg: 1 – 244.
- CITY OF JOHANNESBURG. (2010). *Integrated Development Plan Revision 2010*. Volume 1, pp1 – 337.
- CITY OF JOHANNESBURG. 2005. *Integrated development plan for the City of Johannesburg*. City of Johannesburg: 1 - 37.
- CLIMATE LEADERSHIP GROUP C40. 2014. *Waste Management a Priority for C40's African Cities*
- DAVIE, L. 2014. *Joburg to Produce its own electricity from Landfill*. Media Club South Africa.  
<http://www.mediclubsouthafrica.com/tech/3941.joburg-to-produce-its-own-electricity-from-landfill#>
- ECSIP CONSORTIUM, 2013, SIP Conference, 27 May 2013, Brussels.
- EISA and VISVANATHAN. 2002. *Municipal Solid Waste Management in Asia in Africa: A Comparative Analysis*. March: 1 – 69. United Nations Industrial Development Organisation (UNIDO).
- INTEGRATED REGIONAL INFORMATION NETWORKS (IRIN). (2006). *South Africa: Hope for residents of informal settlements* [Online]. Available from: <http://www.irinnews.org/print.asp?ReportID=42783> [Accessed: 08/03/2006].
- LAWMA, 2013. *Waste Management in Lagos State: The Journey so Far*. Lagos State Waste Management Authority (LAWMA).
- LIEBENBERG, C.J. & VAN ASWEGEN, F.P. (2006). *Striving towards zero waste to landfill in Johannesburg: dream or attainable goal?* Proceedings of the Biennial Conference of the Institute of Waste Management of Southern Africa held in Somerset West, Cape Town on September 5 – 8, 2006. Johannesburg: Shorten Publications (Pty) Ltd.
- PIKITUP BUSINESS PLAN 2015/2016.

- SCIENTIFIC COMMITTEE ON PROBLEMS OF THE ENVIRONMENT. (2005). *Urban solid waste management* [Online]. Available from: <http://www.icsu-scope.org/projects/cluster1/uswmp.htm> [Accessed: 24/11/05].
- STATISTICS SOUTH AFRICA. (2007). *Community Survey: Basic Results* [Online] Available from: <http://www.statssa.gov.za> [Accessed: 23/07/2010].
- TAIWO, O.E. (2009). *Integrated Solid Waste Management as a Solution to Dwindling Landfill Capacity in Johannesburg. D.Tech thesis*. Pretoria: Tshwane University of Technology. July: 1 - 419.
- TAIWO, O.E., OTIENO, F.A.O. and VENTER, C. (2008). Towards attaining the Polokwane waste reduction goals - where are we? *Town and Regional Planning Journal*. Issue No 53. November: 26 – 32. Bloemfontein, South Africa: Department of Urban and Regional Planning, University of the Free State.
- VENTER, C. 2014. Keep our Planet Clean: Morsjors, Litter bug Illegal dumping and littering – The Clean up
- WIKIPEDIA. (2008). *Municipal solid waste* [Online]. Available from: [http://en.wikipedia.org/wiki/Municipal\\_solid\\_waste](http://en.wikipedia.org/wiki/Municipal_solid_waste) [Accessed: 21/04/2008].
- WILLIAMS, P.T. (2005). *Waste treatment and disposal*. 2nd edi. England: John Wiley & Sons, Ltd.
- ZURBRUGG, C. (2002). *Solid waste management in developing countries* [Online]. Available from: [http://www.eawag.ch/organisation/abteilungen/sandec/publikationen/publications\\_swm/downloads\\_swm/basics\\_of\\_SWM.pdf](http://www.eawag.ch/organisation/abteilungen/sandec/publikationen/publications_swm/downloads_swm/basics_of_SWM.pdf). pp1 - 4 [Accessed: 10/04/2007].