

Waste Management Challenges to Opportunities in the West Rand District Municipality, Gauteng, South Africa: Initiatives

Bongekile Ginindza and Edison Muzenda

Abstract—The increased waste management and minimisation developments have placed enormous pressure on the West Rand District Municipality (WRDM) considering the rapidly shrinking airspace of the 5 landfill sites, rapid economic and population growth, lack of proper separation facility, which have led to waste management challenges in 4 Local Municipalities (LMs) of the WRDM i.e., Randfontein, Mogale City, Merafong City and Westonaria. Other waste management challenges faced by WRDM include recycling that is mostly done by unregistered informal recyclers/scavengers, shortage of waste transportation services, illegal dumping, in appropriate final waste disposal, generation of greenhouse gases at landfill sites such as methane gases that contributes to air pollution/global warming and water pollution through leachate migration. However, these challenges can be turned into useful resources and opportunities if properly managed and can provide employment for WRDM personnel including the conversion of waste into energy through thermal combustion and bio-gasification.

Keywords— Green house gases, Illegal dumping, Informal recycling, Landfill site, Population growth, Waste challenges, Waste generation, Waste to energy.

I. INTRODUCTION

Waste generation and management challenges increases under the pressure of rapid population growth and industrialization within the areas of mining in WRDM. The requirement of an effective waste management system in WRDM is high to prevent detrimental health and environmental issues including blocked drains, rodent and insect infestations, contaminated ground water and in some cases constitute fire and explosion hazards. More to this, improperly managed waste also increases the emissions of greenhouse gases [1].

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WRDM is predominantly active in trade, manufacturing and community service. Industrial and domestic waste types are the

highest generated and most challenging in terms of management and containment due to their large quantities. This is further made difficult because of industrial expansion and large residential areas leading to increased waste generation. These waste types are generated through households, offices, restaurants, water and sewage works, shops, construction and demolition, public institutions, industrial installation and markets. Fig. 1 shows the relationship between population and waste generation for Mogale City LM, where the linear correlation coefficient, R^2 value is equal to 1, which means their linear relationship is stronger thus waste generation is dependent on population. Waste generation and population growth is increased in Mogale City LM and thus there are increased demands for proper waste management and handling. The population increase is a result of natural growth, immigration for employment and urbanisation. Effective integrated waste management planning systems include proper storage, collection, transportation, treatment and disposal although, minimisation and recycling initiatives will best eliminate these problems.

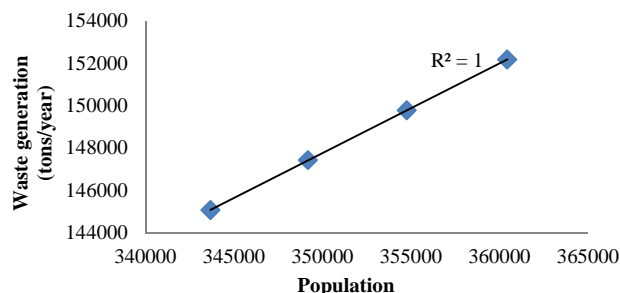
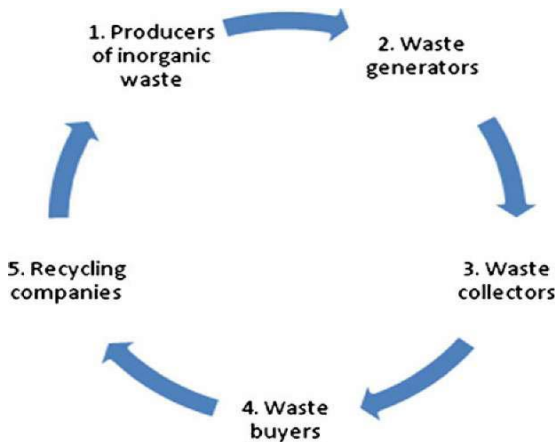


Fig 1: Mogale City waste generation variation with population

Recycling is a resource and energy saving activity which offers great return for many including salvagers. Recyclable materials being recovered from the landfill sites consist of plastics, bottles, waste paper, tins and light scrap. Municipalities should incorporate waste pickers into the formal waste management sector program. Municipality has a mandate to provide health and safety protective wear for informal recyclers on site. Informal salvagers or waste pickers earn a living by salvaging and separating waste on landfill sites prior to disposal and they

have also developed settlements at landfill sites [2]. Fig. 2 shows a typical waste cycle experienced in Mogale City.



II. RECYCLING

On WRDM landfill sites there is little or no control of informal recyclers as most of the fencing have been uprooted by scavengers to gain easy access onto the sites and also due to the fact that the informal recyclers have established informal settlements in close proximity to the landfill sites. Various small recycling businesses currently buy recyclable materials from informal salvagers. Fig. 3 shows a number of informal recyclers recovering recyclables on the Westonaria LM landfill site. It is therefore important that the municipality look into setting up material recovery facilities where recyclables will be separated prior to disposal [3].



Fig. 3: Waste picking in Westonaria LM landfill site

WRDM landfill sites are challenged by operating above their designed capacities leading to reduced lifespans. There is an undersupply of landfill airspace for all the LMs and the current available airspace is being rapidly depleted. About 1.5-2% of recyclables of the total waste sent to landfills are reclaimed from WRDM landfill sites while 98% is landfilled monthly as shown in Fig. 4. Recyclable material reclaimed on site consist of plastic, waste paper, metal, tins, pet bottles and many more.



Fig. 4: Reclaimed and landfilled waste at WRDM landfill sites

The West Rand Development Agency has also started an initiative whereby plastic is recycled. They are also investigating the establishment of two buy back centers. Presently, there is one plastic recycling plant in Westonaria as shown in Fig. 5 where black plastic for refuse collection is produced from recycled plastic waste collected from the landfill site. This initiative has provided employment for many people in WRDM.



Fig. 5: Plastic recycling plant in Westonaria LM

There is presently no formal waste recycling programs within the Merafong City LM. A few business and private companies actively separate waste at source for recycling purposes and no records are kept. A recycling company based in the Welverdiend industrial area recycle waste paper collected in the municipal area. The Municipality does however, encourage recycling and is in the process of establishing a buyback centre which they plan to lease to a private contractor. Buy back centers are best located close to industrial and commercial centers where there are large amounts of recyclables from packaging waste. They provide good income for recyclers who exchange their recyclables for cash [4].

III. COMPOSTING

Composting of garden waste as shown in Fig. 6 is the only waste strategy practiced in WRDM by Mogale City LM at Luipaardsvlei landfill site. Composted waste is only used by Mogale City Parks and no other companies buy it. This is caused by little or no knowledge on compostable waste. Hence, the municipality has a task of hosting a campaign towards

enlightening the general public on the importance and usage of compostable waste. Grass, kitchen waste i.e. fruits and vegetables, tea bags, coffee grounds, egg shells, leaves, woodchips and sawdust are currently mixed with collected waste and other biodegradable products which are then composted.



Fig. 6: Composting at the Luipaardsvlei landfill site

Organic waste from landfills can be diverted through composting. This includes waste such as grass, fruit, vegetable, kitchen or food waste, leaves and weeds. Composting provides an important opportunity for waste reduction initiative for municipal solid waste. It can also be carried out at household level. Composting can be used in place of chemical fertilizers and can be very useful in helping plants grow when added to the soil. This will also lead to the reduction of methane and carbon emission at landfill sites [5].

IV. WASTE STORAGE AND TRANSPORTATION

The biggest challenge in waste collection and transportation in WRDM is that spare parts used for repairing the equipment are not readily available and the vehicle fleet are old and require maintenance and replacement. Illegal dumping of waste is also common due to the use of small containers (240L bins) for households and the lack of larger ones as shown in Fig. 7. As a result, these bins get filled up before refuse is collected and people illegally dump waste in open spaces. Regardless of street clean-up campaigns, the illegal dumping of waste continues to grow as WRDM has failed to provide waste containers for backyard houses. It is therefore important that WRDM also make available larger storage containers for industrial areas where they are currently lacking [6].



Fig. 7: 240L Waste Storage bins [5].

Table 1 outlines that a 40% clearing of illegally dumped waste is planned by the municipality but an excess of 30% which totals to 70% is achieved. More waste is recovered from illegally dumped waste which constitutes a major problem and a serious concern in Merafong City LM especially in the areas of Khutsong and at the transfer station in Welverdiend. There is a semi-formal initiative in Khutsong to convert illegal dumping spots to parks but this programme seems to lack drive and commitment. Due to the lack of access to the informal residential areas in Khutsong, residents dump and litter communal spaces with waste for collection.

TABLE I
WASTE MANAGEMENT PERFORMANCE TARGETS AGAINST
ACTUAL

	Planned	Actual
Provide Environmentally Acceptable Waste Management		
100% access to council's waste collection service through kerbside collection service	100%	100%
Door to door service in formal towns	100%	100%
Waste entering landfill	2.9%	2.9%
Illegal Dumping		
Clearing of illegal dump refuse	40%	70%

Waste is removed in the afternoons by waste transportation trucks particularly at Bekkersdal Township in Westonaria LM. Residents are exposed to odours, flies, including spillages caused by workers in the process of waste collection. Municipal vehicles experience a lot of breakdowns during collection. The inconsistent waste collection pattern results in waste being illegally dumped in open spaces and around waste skips. 70% of the collection and transfer equipment are older than ten years and the equipment require replacement due to recurring breakdowns, overloads, lack of routine maintenance and poor road infrastructure. The biggest challenge is that spare parts used for repairing the equipment are not readily available. Existing waste collection and transportation systems cannot handle the amount of waste generated by fast growing municipalities [7].

V. LANDFILL GAS

Carbon emissions to the atmosphere occur from the landfill sites in WRDM causing air pollution since no methane capturing facility is available in all LMs landfill sites. Mogale City LM Luipaardsvlei landfill site is undergoing a project of

collecting and monitoring their methane from the landfill cells as shown in Fig. 8 although, this is a trial project. Landfills are the source of methane generation at 50-60% from landfill gas remainder being carbon dioxide and has greenhouse gas effects. Methane has a global warming potential that is 23 times more than carbon dioxide. It is generated under anaerobic conditions through the decomposition of organic waste [8].



Fig. 8: Methane gas monitor at Luipaardsvlei landfill site

Sustainable waste management complements the green economy concept especially in the waste sector in creating a low carbon, circular economy whereby generation of waste and harmful substances is minimised. The materials being re-utilised, recycled or recovered are maximized and disposed waste is minimised thus, all of these processes are managed to avoid damage to the environment and human health [9]. Landfill gas generator as shown in Fig. 9 capture methane for energy conversion. It is often used for electricity production or used for cooking in gas stoves and for water heating. It can also be used as fuel source for vehicles when concentrated. [10].



Fig. 9: Electricity generator

VI. ENERGY CONVERSION

Table 2 shows the 2013 projected waste figures for WRDM waste to energy conversion. Mogale City LM has the highest tons of pyrolytic waste sent to Luipaardsvlei landfill site. This is followed by Merafong City LM's Roipoort landfill site, Uitvaalfontein landfill site in Randfontein LM and finally Lebanon landfill site in Westonaria LM. Pyrogenic waste is calculated from domestic, business, industrial, illegally dumped and street cleaning waste streams. Biodegradable waste quantities suitable for anaerobic digestion are high in Randfontein LM followed by Merafong City LM, Mogale City LM and Westonaria LM.

TABLE II
WASTE TO ENERGY QUANTITIES IN WRDM

Local Municipality	Biodegradable Waste Quantity (Tons per annum)	Pyrolytic Waste Quantity (Tons per annum)
MOGALE CITY	7994	91705
WESTONARIA	1506	26434
RANDFONTEIN	9339	17860
MERAFONG CITY	8508	62821

VII. CONCLUSION

This paper has addressed some WRDM waste management challenges and highlighted approaches towards resourceful conversion of these challenges into sources of job and revenue creation through waste treatment, recycling and energy recovery. Landfill airspace will be prolonged, reduction of greenhouse gases emitted into the atmosphere and provision of business opportunities for many unemployed youths.

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