Solid Waste Management in West Rand District, Gauteng, South Africa

Jefrey Pilusa and Edison Muzenda

***Abstract*—**This article reflects on West Rand District Municipality's integrated waste minimisation plan. Effective implementation of this plan will give effect to the objectives of the National Environmental Management Waste Act and other relevant legislations, while ensuring that sustainable and cost effective, solutions are developed, implemented and monitored. General solid waste management and minimisation strategies in the district were investigated. The district is currently experiencing a major development challenges on sustainable solid waste management in its four local municipalities which are Randfontein, Mogale City, Westonaria and Merafong City. This has subsequently resulted in the pollution of air, soil and groundwater resources

***Keywords*—**Solid Waste, Environmental, Waste Minimisation, Pollution, Recycling, Separation**.**

I. Introduction

POPULATION and economic growth are the major drivers of increased waste generation. At the same time environmental infrastructure and services are inadequate to serve the resulting increases in population and waste generation. The inevitable congestion causes environmental hazards and degradation [1]. Waste streams deposited into West Rand District Municipality (WRDM) landfills consist of general waste from households, commercial businesses, institutions, industry, building and garden services. Waste management is currently afforded a low priority resulting in failing waste management services impacting negatively on environmental health. Local government is obliged to provide waste management services to realize this right of society in their area of jurisdiction [2]. WRDM has its overall waste management policy objective, "to reduce the generation of waste and the environmental impacts of all forms". Table I shows the status quo of WRDM landfill sites for 2012. Magaliesburg landfill site is not permitted and has reached its full capacity [3]. Luipaarsdvlei landfill site has 3 years remaining designed lifespan but operationally it has less than 20 months of air space remaining. WRDM landfill sites are operating above capacities and their lifespan are reduced. Therefore any deviation of waste from landfills will extend their life span; hence the need for waste minimisation and utilization processes i.e. anaerobic digestion of the biogenic waste fractions and pyrolysis of the pyrogenic waste fractions for waste to energy technology [4] and other recycling technologies. Waste to energy technologies present, not only from their energy generation potential, but also from their potential to reduce greenhouse gases.

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TABLE I
STATUS OF GENERAL WASTE LANDFILL SITES IN WRDM

Municipality	Site Name	Status	Remaining Capacity	Recycling Activities
Mogale City	Luipaarsdvlei	Permitted	3 years	1
	Magaliesburg	Non-Permitted	0 years	0
Merafong City	Roipoort	Permitted	5 years	0
Randfontein	Uitvaalfontein	Permitted	5 years	0
Westonaria	Lebanon	Permitted	4 years	0

II. Waste Generation

Due to increased population growth and urban development of WRDM i.e. mining employment opportunities, tourism, agriculture, business, economic sectors, retail, manufacturing services and industrial; waste generation is increased as people migrate to WRDM for a better life and employment. There are increased demands for waste management i.e. waste service provision in terms of storage, collection facilities and services, handling and transportation, treatment, disposal services and facilities.

TABLE II
POPULATION GROWTH AND WASTE GENERATION FOR WRDM

Local Municipality	Population	Growth Rate	Waste generated tons/year
Mogale City	360 425	1.6%	152 171
Merafong City	209 877	0.8%	74 482
Randfontein	131 997	0.3%	34 088
Westonaria	120 666	0.5%	30 122

Based on the results for statistics South Africa census 2001, community survey 2007 & 2010) [5], the average population growth rate for Mogale City local municipality is higher than other municipalities in the district as shown in table II. The population increase is a result of natural growth, immigration for employment and urbanisation.

This is accelerated by the fact that the municipality is surrounded by two rapidly growing metropolitan municipalities, the Johannesburg Metropolitan Municipality in the east and the Tshwane Metropolitan Municipality in the

north. These municipalities have a great influence on the urbanisation and population growth of the municipality due to the edge effect. Mogale city local municipality houses most of the people working in these edge municipalities [6]. Due to the closure of mines in Mogale city, the focus has shifted to tourism, manufacturing and agri-business.

Fig. 1 shows waste generation rate per different socio-economic levels for WRDM. The highest volume of generated waste is 0.365 kg/capita/annum, this account for people with high and very high income level. This shows a more affluent society, but it is also due to greater commercial, business and industrial development contributing to waste disposed to WRDM landfill sites. These areas need special attention especially on collection frequency as their waste bins fill up quickly. The employment status and income levels of the WRDM directly correlate with the ability of households to pay for municipal services. Waste generation rates reflect the economic status of society, the more affluent the society the greater waste produced per capita. People in low income groups and informal settlements generally generate less waste as compared to high income high groups.

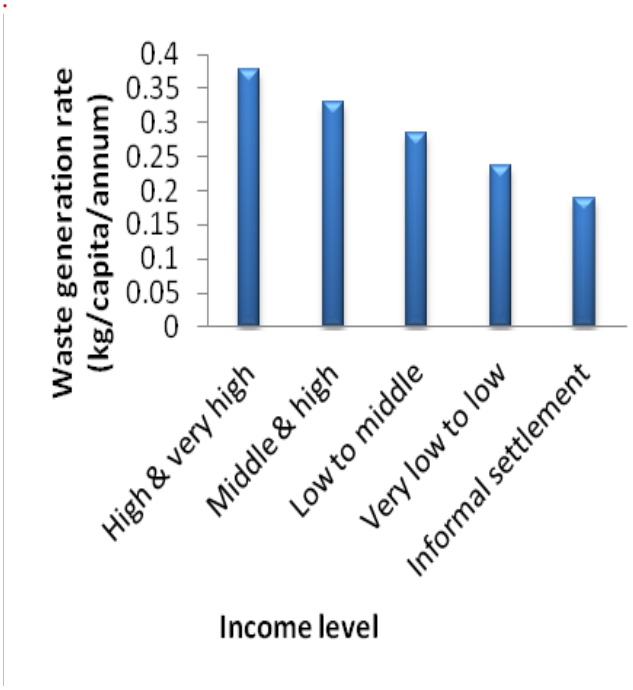

Fig. 1 Waste generation per income level

Waste stream categories generated in WRDM disposed in WRDM landfill sites consist of domestic waste, 49% due to the large residential areas, which constitutes the bulk of the disposed waste, Fig. 2. This is followed by building rubble 34%, industrial waste 12% and garden refuse 5%. Other available waste categories found on the waste streams are; iillegally dumped waste, street, cleaning waste, recyclable waste, problematic waste (waste containing hazardous material), food, sewerage and notifiable waste.

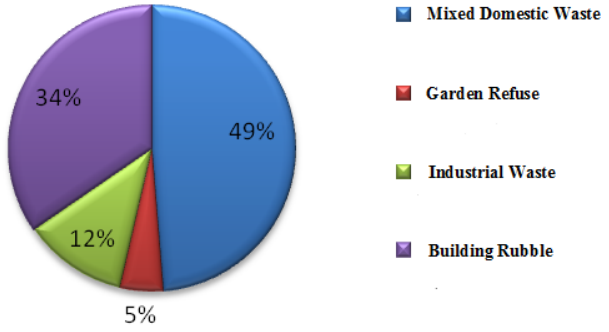

Fig. 2 Percentage waste generated per category

III. Waste Management Strategies

The most sustainable way to deal with waste is to eliminate it entirely. Reducing the amount of waste generated, reusing discarded items, and recycling and composting are fundamental principles in achieving zero waste [7]. Municipalities should strive to achieve this goal. Fig. 3 shows that 97% of disposed waste in WRDM is sent to landfill while 3% is recovered for recycling. As a result, natural resources are currently depleted together with the environmental impacts of waste and the diminishing capacity of landfill sites has prompted the need for reduced waste generation. The 2020 vision of reducing by 50% the amount of waste going to landfills by 2012 and to zero waste by 2022 is currently a big challenge for WRDM and not yet met.

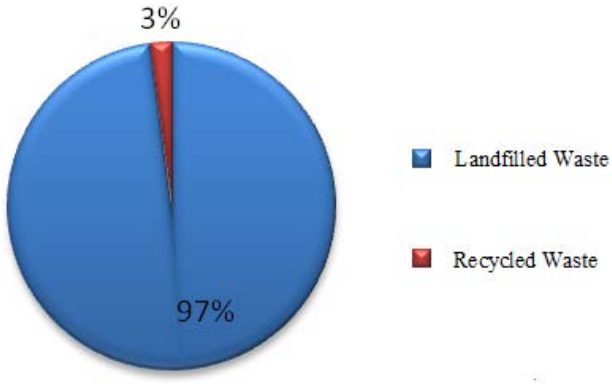

Fig. 3 Waste Disposed at WRDM landfill sites.

Most WRDM landfill sites are nearing their end of life with the Luipaarsdvlei landfill site having less than 20 months of air space remaining. Competition for land is high with housing taking up most of the available land. Finding suitable land for landfill sites is increasingly difficult. Therefore, ways of extending the life spans of existing landfill sites is important. Willingness to pay for waste services will also improve with increased awareness as a result of increased insight into the benefits of waste services, as well as the actual cost thereof. WRDM has ineffective and inaccurate waste data collection systems in place due to inconsistent operation of the weighbridges. Therefore, availability and easy access of accurate data and information is a common problem in

WRDM. This leads to misinformed planning processes and ultimately the formulation of Integrated Waste Management Plans (IWMP) that are not useful to the Local Municipalities.

Due to lack of control over the past years of the landfill, airspace requirement will never be accomplished and that will lead to the site's life span being shortened and therefore compelling the local municipality to start investigating on the design of new landfill sites. More emphasis is required on awareness creation relating to the implementation of the waste hierarchy. As such, waste minimisation and waste separation at source needs to be encouraged to enhance reuse and recycling activities. Lack of awareness creation campaigns in communities has change people's behavior to ensure a cleaner environment. The landfill sites are currently operating above capacity limits, as there is a height restriction on the development of the landfill. It is therefore essential that waste minimisation be built into waste management plans and that the municipality put pressure on communities, business and industry to avoid and minimise waste wherever possible. Every citizen will have to take responsibility for minimising and managing the waste that they generate.

Awareness and education campaigns play an important role in the success of any reduce, re-use and recycling initiative. The socio-economic conditions prevailing in a specific municipality must be taken into consideration when establishing waste management programmes, as well as when deciding on the type of communication campaign to use. Incentives, together with awareness creation, have the potential to change consumer behavior. Incentives for minimising waste can include Pay-As-You- Dispose charges, where the waste management charges correlate with the amount of waste being disposed. Participation in source separation of recyclables without any significant financial benefit can be challenging as it is considered to be time consuming. Separation at source is a relatively new concept, which needs to be practiced in WRDM. The bulk of the re-usable and recyclable waste is thus disposed to landfill and largely lost to the recycling industry.

Fig. 4 provides an outline of the actual recycled waste material from the Luipaarsdvlei landfill site. The recycled waste stream constitutes pet coke bottles, making up the bulk of recycled material waste product. This is followed by scrap metal, white plastics, hard plastics, milk bottles, white paper, K4 card board, news paper, books & magazines, bottles and aluminum. Fig. 4 shows that there is a drop in recyclable waste products from year 2010 – 2012. This could be a result of the current lack of waste minimisation initiatives or incentives to promote waste minimisation and separation in industrial and residential areas and thus increasing amount of disposed waste at the landfill site. In addition, this contributes to the diminishing capacity of available landfill airspace. Compliance to permit conditions is critical in mitigating the impacts of landfill sites. WRDM permitted landfill sites do not operate according to their permit conditions thus these poorly operated landfill sites impact on the environment and causes nuisances to communities living close-by.

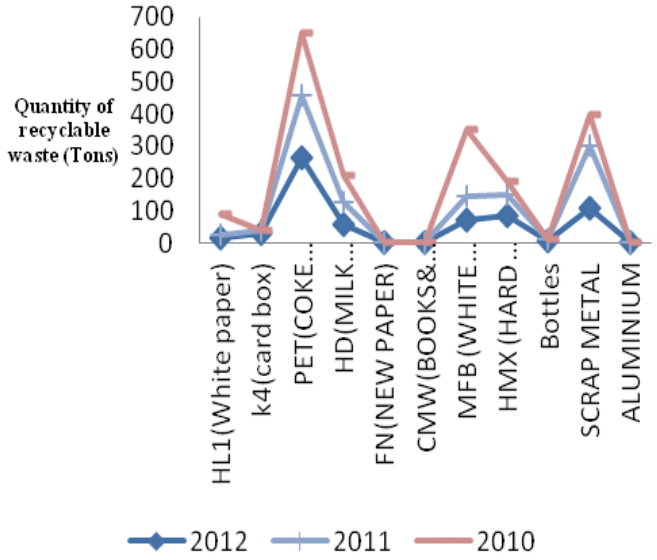

Fig. 4 Type of recyclables available in WRDM

There are presently no other formal waste recycling programs within WRDM. Local Municipalities do not have the required resources to establish the necessary facilities to support recycling, especially separation at source. A few business and private companies i.e. buy back centers and private recycling companies actively separate waste, at source, for recycling purposes and no records are kept.

IV. Waste Recycling

Due to the large quantities of recyclable materials in the waste streams arriving at landfill sites, informal salvaging is widespread in WRDM. Compliance to permit conditions is critical in mitigating the impacts of landfill sites. Magaliesburg landfill site in Mogale city is the only non permitted site in WRDM [8]. Scavengers pick through the waste and sell the recyclables to agents on the site. This practice leads to unacceptable health and safety risks for the reclaimers, as well as operating problems for the landfill personnel. Salvaging on landfill sites often goes against the permit conditions that apply to the sites [9]. Attempts by municipal authorities to stop the activity have been sometimes met with great opposition from the salvagers with threats of violence. They earn a living from this practice and are now living on landfill site and at proximity of the sites; they are creating a security problem and liability for the management of the site.

This is undesirable based on health and safety risks. Scavengers are exposed to diseases as they contact directly to decomposed highly mixed waste streams with organic materials. Workers should be provided with personal protective equipment.

Fig. 5 Scavengers settlement onsite at Lebanon Landfill site

The use of heavy machinery in landfill operations also poses safety risks to pickers and thus uncontrolled salvaging on landfill sites must be phased out. It is recognised that some families rely on salvaging for their livelihood. In addition, the role of informal recycling activities forms a significant part of the WRDM recycling industry. It contributes significantly to the diversion of waste from landfill.

Fig. 6 Scavengers searching for valuables at Roipoort landfill site

Reclamation activities on WRDM landfill sites highlight the value of disposed materials. Ideally, re-usable and recyclable waste should be reclaimed before the waste reaches the landfill site. Diverting reusable and recyclable waste away from landfill can be done by sorting through mixed waste at Materials Recovery Facilities (MRFs) or separation at source combined with further sorting [10]. MRFs deliver "clean" recyclables which fetch higher prices. Clean MRFs also provide more human working conditions adding to the dignity of workers. The volumes and types of waste sorted at these facilities will dictate the level of sophistication required in the machinery used. Conveyer belt systems are well suited to dirty MRFs while less costly table-top sorting systems can be employed at clean MRFs. Cost effectiveness and efficiency is not guaranteed by having more mechanised systems. High capital investments versus labour intensive practices need to be considered.

Technologies are likely to be more complex at clean MRFs due to the need for cleaning and more advanced sorting (e.g. different types of plastics and metals). The type of plant influences the quality of the recyclables. It may be difficult to find markets for contaminated recyclables. A new initiative is being proposed at Lebanon landfill site. Westonaria Local Municipality will need to provide licensed salvagers with protective clothing, such as gloves, masks, heavy duty aprons and boots to reduce the risk associated with direct contact with the waste while sorting.

V. National Environmental Management: Waste Act, 2008

National Environmental Management: Waste Act, 2008 (Act N0. 59 of 2008) came into effect on 01 July 2009. This Act aims to consolidate most of the previous waste legislation into one framework Act and has been developed as part of the law reform process enacted through the white paper on integrated pollution and waste management and the national waste management strategy [11]. However, current legislation will have to be complied with. The underlying government policy is implemented with the general aim of complying with the following requirements: (i) Provide waste management services and the management of waste disposal facilities, (ii) Compile and implement integrated waste management plans, (iii) Compile and implement a waste management policy and (iv) Develop and implement by-laws and ordinances in line with the national waste management policy and within provincial legislation and policies.

VI. Waste –to Energy

Utilizing waste-to-energy technology reduces the amount of waste disposed into landfills and reduces the amount of methane being released into the atmosphere from landfills. Energy recovery and finally disposal, is applied internationally to reduce the waste ultimately disposed to landfills and encourage waste reduction across all levels of society, including household. Table III and Fig 7 show 2013 predicted waste generation figures as potential feedstock for waste to energy.

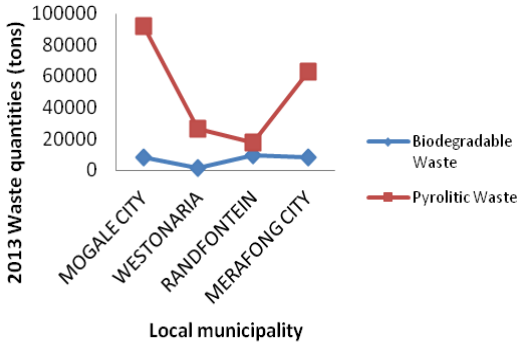

Fig. 7 Biodegradable and pyrolitic waste quantities per local municipality

Table III
WASTE-TO ENERGY QUANTITIES

Municipality	Biodegradable Waste (Tons per annum)	Pyrolitic Waste (Tons per annum)
Mogale City	7994	91705
Westonaria	1506	26434
Randfontein	9339	17860
Merafong City	8508	62821

When organic waste decomposes without the presence of oxygen, anaerobic fermentation slowly produces landfill gas. Landfill gas contains 40-60% methane, with the remainder being mostly carbon dioxide. Methane is 23 times more potent than carbon dioxide when it comes to its properties as a greenhouse gas, making it a key climate change gas to address [12]. Burning methane produces energy, carbon dioxide and water. This is a very useful outcome as besides being an energy source, the hugely potent methane is replaced by the considerably less potent carbon dioxide. Biodegradable waste quantities suitable for anaerobic digestion are high in Randfontein followed by Merafong, Mogale and Westonaria. Biodegradable waste quantities were obtained from garden waste, sewerage waste, carcasses and food stuff waste streams. Landfill gas energy facilities capture the methane and combust it for energy. It can be used to produce electricity, or used directly for cooking and for space and water heating. When concentrated and compressed, it can also be used as a vehicle fuel source.

VII. Conclusion

Based on the waste stream analysis of the four local municipalities, it is evident that there is a potential for recovery, reuse, and recycling of waste. It is therefore important that the communities be made aware of initiatives, waste recycling activities and the advantages of waste minimization and recycling by all citizens in the WRDM. This can either be achieved by, advertisements and notices in the local newspapers, or by providing information regarding these initiatives on the municipal bills distributed each month. Local municipalities can also inform the public of the potential income and Job opportunities that can be made from recycling. Local municipalities can also conduct a road show to all areas to demonstrate and inform people of waste related challenges.

Acknowledgment

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