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Full Length Research Paper

Capacity constraints in the waste chain in South Africas secondary towns

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The study was carried out in order to describe the capacity constraints in the waste chain of South Africa's secondary mining towns. The municipalities selected were Matlosana in the North West Province, Merafong in the Gauteng Province, eMalahleni in the Mpumalanga Province and Matjhabeng in the Free State Province. A typical solid waste management system in a developing country displays an array of constraints. These centre on low collection coverage; irregular waste collection services; crude open dumping; burning without air and water pollution control; the breeding of flies and vermin; the handling and control of informal waste picking and scavenging activities. The intensity of these constraints vary from different areas and across different cities. At a second level, the waste chain itself is both a physical-technical system and a social system. To this end, particular constraints relate to material flows along the chain and to the management and personnel components of service delivery. The results of this study indicate that these constraints directly talk to concerns in public health, environmental and waste management systems and can be categorised into technical, financial, institutional, economic, and social constraints. These factors have negative effects on the development of effective solid waste management systems.

Keywords: Capacity constrain, economic constraints, financial constraints, institutional constraints, social constraints, waste management.

INTRODUCTION

The following waste minimisation challenges were identified at the provincial recycling workshops held in Pretoria in 2013 (DEA, 2014). Limited access to markets remains a challenge for recyclables like glass, newspapers and magazines, paper and cardboard. The Free State, North West and Mpumalanga provinces are disadvantaged by their location far from recycling plants in Gauteng. Government does not encourage recycling since it does not specify the purchase of recycled products through its procurement procedures (Tam, 2009).

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Prices for recyclables have also fluctuated significantly and as a result many recycling ventures have gone under. There is concern about the lack of competition in the recycling field which may result in monopolistic practices (Hunga, 2009). There is a need to create new markets for recyclables, over and above the dominance of existing large recyclers such as SAPPI, Mondi and Collect-a-Can. There is limited capacity at local governments to support sorting at source. This is because such a programme requires the restructuring of designs for receptacles, street waste bins, specialised waste trucks and even high bulk skip bins (NEMA, 2002). Most local authorities do not have the necessary infrastructure to recycle waste at their landfill sites. But

even if this was possible, it does not make economic sense because of distortions such a practice brings into pricing. There is a lack of skills and capacity at the local municipality level in the area of waste management and specifically waste minimisation, recycling and re-use. Capacity constraints across municipalities can squarely be blamed on the recruitment practices in the public sector and not on the lack of skilled people in the country. Environmental health departments can possibly assist with appropriate training by utilising their health inspectors to assist with the process of waste management (Kinnaman, 2013). Public and private partnerships with industry and the larger recycling companies should be explored. There is also the safety aspects involved where some recyclables such plastics, rubber, textile off-cuts are flammable and recycling companies need to ensure the safety of their workers (Manning, 2013). There are no direct tax incentives for recycling, as is the case in certain overseas countries such as in Canada where such tax incentives are provided to producers who recycle commodities. But some of the provinces already have industrial buildings which since the collapse of homeland industrialisation following the withdrawal of incentives in 1995, have remained vacant. Given that these belong to provincial governments, they could be used as incentive to attract potential investors.

BACKGROUND

After the Second World War, landfilling was still the principal waste disposal method and rapid growth in consumption from 1960 onwards resulted in a larger municipal waste stream with a higher plastics content (Wolsink, 2011). Finally, the environmental movement of the 1960s and 1970s brought waste disposal onto the political agenda in industrialized countries (Wilson, 2010) which created a significant shift in policymakers' perspectives on how to approach SWM. New legislation addressing water pollution and SWM emerged, initially targeting the elimination of uncontrolled disposal and subsequent SWM legislation increasingly raised environmental standards to reduce the contamination of land, air and water (Bingemer et al, 2011). The environmental movement acted as a primary driver of the policy stages from the 1970s onwards. SWM policy from the 1970s to mid-1980s focused on waste control, and was therefore characterized by measures such as the daily covering and compacting of landfills and retrofitting incinerators for dust control. In the 1990s, integrative policy gained much attention because it had become evident that advocating for ever-increasing environmental protection was not enough - an integrative regulatory approach was needed that encompassed not only the technical and environmental but also the political, social, financial, economic, and institutional elements of waste management if environmental protection were to be realized (McDougall et al., 2011).

In pre-industrial times, resources were relatively scarce. Anything vendible in the waste stream was scavenged and consumer goods were reused and repaired rather than tossed into the waste stream. As cities grew in size during the industrial revolution, the resource value of waste rose again, and waste pickers collected, used, and sold materials from the waste stream - an activity that continues today in many developing countries. However, recycling rates plummeted from the high levels of pre-industrial times to single digits (Wilson, 2007), as this was a period of immense increase in consumption, strong marketing of commodities, and little regard for resource utilisation. Thus, the availability of land and its value as a resource somewhat acted as a driver for the move away from landfilling, though land scarcity primarily led to new treatment options, such as incineration. The waste hierarchy sparked a massive transition from end-of-pipe to preventative thinking, which emerged with a multitude of new terms and phrases.

Climate change has acted as an environmental driver since the early 1990s, leading to a shift away from landfilling biodegradable waste, which is a major source of methane emissions, and a strengthened focus on energy recovery from waste (Oelofse, 2012). This driver was brought on by the global concern about climate change issues, which led to pressure and advocacy around the world. This driver led to a policy stage focused on waste prevention and target achievements characterized by a series of preventative policy measures, including laws and targets for compost and recycling goals, diversion from landfill, extended producer responsibility, and landfill bans for recyclable materials (Wilson, 2007). Policies such as the EU Landfill Directive require reductions in levels of biodegradable material sent to landfill as a method to recover valuable materials and reduce methane emissions. This has further increased recycling and composting rates which is on the rise in cities that are modernising their waste systems. However, since climate change measures can only have significant impact if most countries adhere to this objective, there is no immediate national gain from reducing greenhouse gas emissions. This is the primary weakness of this driver and one of the primary reasons it is so difficult to gain consensus for a post-2012 convention for reducing carbon dioxide levels.

Public concern and awareness have also acted as SWM drivers in high-income countries. Poor practices in the past, such as burning dumps and polluting incinerators, have left the public with negative perceptions of new SWM strategies (Wilson, 2007). In line with this, negative perceptions of past facilities have led to community opposition to proposals for any new waste management

facility. Unsustainable behaviour also inhibits movement towards better SWM. Therefore, strategies that include more recycling, repair, reuse, home composting, sustainable consumption, require behavioural change (Wilson, 2007), which Jackson (2005) believes is becoming central in any sustainable development strategy. The systems that shape patterns of the public's activities create complex barriers to sustainable behaviour. Many people are unable to exercise deliberate choice because they find themselves locked into unsustainable patterns caused by habits, routines, a lack of knowledge, institutional structures, and inequalities in access, social expectations, and cultural values (Jackson, 2005).

METHODOLOGY

Population and data sources

The selected areas were Matlosana in the North West Province; Merafong in the Gauteng Province; eMalahleni in the Mpumalanga Province and Matjhabeng in the Free State Province.

Data for this subject matter was derived from the waste management directorates of each study area. This was further reinforced with data obtained from the following sources: Integrated Development Planning (IDP); Integrated Waste Management Plan (IWMP); Annual Reports (AR) and The Local Economic Development Plan (LEDP).

RESULTS AND DISCUSSIONS

SWOT Analysis

SWOT Analysis is an assessment of system viability based on its strengths, weaknesses, opportunities and the threats to it. Table 1 summarises the results of the SWOT Analysis as regards the identification of constraints in the waste streams for the local municipalities in the selected study areas. A Gap Analysis then follows which helps in the grouping of the challenges being experienced.

Gap Analysis

Table 2 further describes the gaps that were identified as a result of the SWOT analysis. The weakness aspect of the SWOT analysis was selected and gaps identified as flagship objectives and target to improve the waste management services. This is further elaborated and tabulated in Table 3 which was simplified to highlight the more common characteristics for the local municipalities in the study areas.

Technical Constraints

Table 3 represents the technical constraints facing each of the selected study areas. From analysis on Table 3 we can deduce that the Klerksdorp municipality has approximately 120 442 households and 219 available vehicles to collect waste. The ratio for this area is thus one vehicle for every 549 households or one vehicle for every 1920 people. This results in a weekly refuse removal rate of 89% for the Klerksdorp Local Municipality. This refuse removal rate is worked as the number of times the refuse is successfully collected at the specified times. In times of general picketing, vehicle breakdown or any other foreseen and unforeseen circumstances this rate then drops.

For the Carletonville local municipality 102 624 households are relying on 132 vehicles for their waste removal. This gives a ratio of one vehicle for every 777 households or one vehicle for every 1625 people. This results in weekly refuse removal rate is at 79.7% for Carletonville Local Municipality. The Witbank local municipality has approximately 119 874 households being serviced by 149 vehicles giving it a ratio of 804 households for every one vehicle or one vehicle servicing 2796 people. The weekly refuse removal rate is 67.2% for Witbank. The Welkom local municipality has a rate of one vehicle for every 1079 households as 194 336 households are relying on 180 vehicles giving a ratio of one vehicle for every 2375 people and a weekly refuse removal ratio for this area is at 86.3% for Welkom.

The significance of this section is that it gives an understanding on the transportation segment of the waste system. It is evident that vehicles play a crucial part in the waste system and ultimately in waste minimisation. The result of an efficient transportation system for the collection, sorting and diversion of waste is that waste is able to be minimised at a fast pace while at the same time providing effective service delivery to the local municipality. A lacking transportation system gives little or no priority to waste minimisation as the focus is on collection and landfilling. This is due to the fact the pressure is being placed on the drivers and on the waste management directorates. As a result the vehicles are constantly breaking down, hence the low weekly refuse removal rates and the turn over time for their service and repairs is time costly.

Financial Constraints

Figure 1 represents the overall budget for the local municipality versus the allocated budget towards the waste management services. The values from Figure 2 represent the 2014/2015 financial year and has been selected to describe the significance of the budget meant for waste services. We can appreciate that the allocated

Table 1. SWOT analysis to identify constraints within the waste streams.(Source: Author).

STRENGTHS	WEAKNESSES
Integrated spatial development • Land use management • Spatial planning **The provision of basic services** • Municipal services **Good governance** • Corporate governance • Broaden local democracy • Local government accountability **Financial viability and management** • Financial viability • Financial management	**Integrated spatial development** • Infrastructure master planning • Environmental management • Rural development planning • Human settlements management **The provision of basic services** • Physical infrastructure aging and backlog • Water and electricity losses **Financial management** • Procurement practice and system **Local economic development** • Economic development • Social development **Business management and leadership** • Strategic positioning to influence key stakeholders • Organisational culture • Stakeholder relations management & • Communication **Resource management** • ICT management • Record / knowledge management • Human resource management • Asset management • Office accommodation • Interdepartmental collaboration (lack of internal customer care) • Organisation performance management
OPPORTUNITIES	**THREATS**
• Alternative sources of funds • Inter- governmental relations framework / stakeholder alliances • ICT developments • Economic diversification in the municipality • Tourism opportunities • Mining related opportunities • Job creation opportunities • Agriculture development opportunities • Transport opportunities • Strategic partnerships • Availability of land for development • Carletonville Urban Renewal	• Non-payment culture in community • Inadequate resources to deal with increasing demands • Poverty % unemployment impacting negatively on available resources • Illegal connections leading to risks • Vandalism of infrastructure. • Long lead times on EIA's; Pollution (air, land, water) • HIV / AIDS pandemic; Fraud / corruption • Infrastructure backlogs • Declining mining sector • Electricity tariff escalation • Urban sprawl • High crime rate

budgets towards waste management services in the municipalities are small compared to the overall budget of the municipality. For the Klerksdorp local municipality, 16% of its overall budget is allocated towards waste management. For the Carletonville local municipality 13% of its budget is allocated towards waste management. For the Witbank local municipality 6% of its overall budget is allocated towards waste services and 8% of the Welkom local municipality budget is allocated for waste management services. The budget allocated for waste management services is utilised towards human resources management (e.g. salaries, education and development of personnel) vehicles, tools and equipment, maintenance of the landfill sites and permits. The significance of section 4.4 is to highlight the fact the budgets play a very important role in the entire waste chain.

Table 2. Gap analysis for the local municipalities in the selected study areas. (Source: Author).

Area	Objectives and Targets	Gap Analysis	Outcomes
All LM,s	Render a sustainable, equitable and cost effective refuse removal service to all domestic and business premises	Personnel to assist with roles and tasks as set out in the waste management section structure.	Ensure that recruitment procedures are followed when interviewing new candidates. Staff employed should have all the relevant qualifications required. Criteria and job descriptions to be reviewed.
All LM,s	Improve refuse collection in informal settlements.	Lack of service and or sustainable initiatives.	Detail evaluation of existing waste collection relating to the proposed collection system in the informal areas. Alternative collection systems and methodologies to be investigated.
All LM,s	Decrease the volume of illegal dumping.	A lack of proper public dumping/disposal facilities.	Implement proper public dumping/disposal facilities for residents to dispose of various waste types.
Carletonville	Ensure that a proper mass container rental system is implemented	Rates currently charged for mass container service is not market related.	Evaluate proposed collection system for informal areas. Purchase additional equipment if required, based on the outcome of the evaluation. Consider utilising SMMEs and one-person-contractors for primary and secondary collection.
Carletonville	Implementation of recycling initiatives at both domestic and commercial service points.	A proper recycling plan and programme is lacking, this also includes aspects such as composting.	Develop a proper recycling action plan and programme. Establish a formal partnership with recycling companies. Discuss implementation of the proposed plan with the preferred company. Benchmark with other municipalities on waste reusing Programmes and/or involve the public/ communities.
All LM,s	Decrease illegal dumping	Lack of enforcement of by-laws and legislation. Lack of Formalised service to the informal areas in particular is creating illegal dumping in those areas.	Implement proper public dumping/disposal facilities for residents to dispose of various waste types. Conduct a proper investigation into the need for such facilities. Determine best locations for such facilities. With the new By-laws in place, the introduction of active enforcement must be done. Implement formal collection services to informal settlement areas.
All LM,s	Comprehensive street cleaning service.	Only CBD and surroundings receive street cleaning service	A plan of areas which require street cleaning needs to be developed. Based on this, the required personnel to provide the more comprehensive street cleaning service should be allocated.

*LM's....Local municipalities.

The allocation of funds to waste services enables the effective and efficient operation of that system. The implication of a low budget is that challenges cannot be resolved timeously. Investments in resources such as the development of personnel by providing educational opportunities, the servicing of vehicles and equipment, the purchasing of new equipment and asset and the recruitment of qualified and experienced personnel and the initiation of suitable waste minimisation programmes cannot take place. Lower budgets allocated towards waste

Table 3. Technical constraints in the study area (Source: SAWIS, 2013).

Area	Households	Vehicles	Ratio	Population	Vehicles	Ratio	Weekly refuse removal
Klerksdorp	120 442	219	1: 549	420 545	219	1: 1920	89%
Carletonville	102 624	132	1: 777	214 553	132	1: 1625	79.7%
Witbank	119 874	149	1: 804	416 625	149	1: 2796	67.2%
Welkom	194 336	180	1: 1079	427 640	180	1: 2375	86.3%

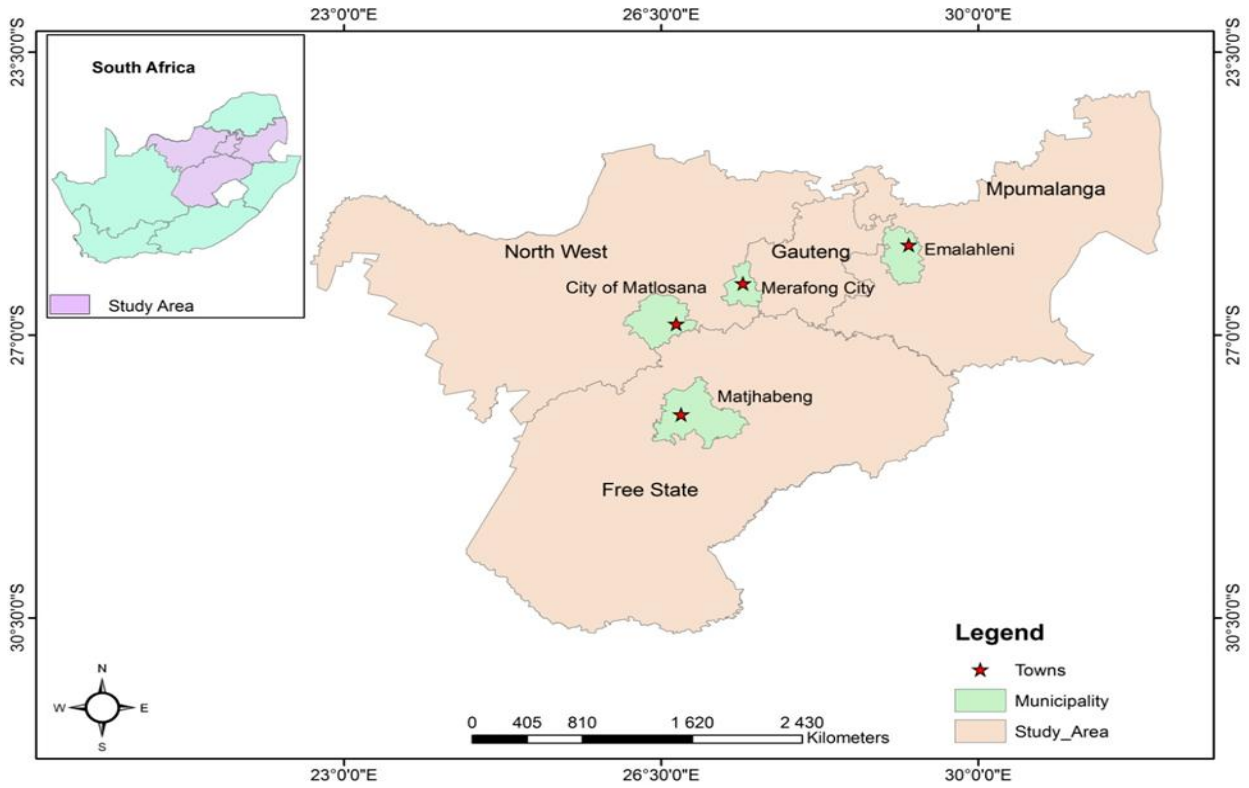


Figure 1. Selected study area (Source: Author).

services have an impact in minimising waste because resources cannot be effectively transferred or relocated.

Institutional Constraints

Figure 3 represents the current organogram for the waste management directorates which fall within the community services structures. This structure consists of community services (e.g. library services and parks and recreational services), waste management services and traffic safety services. The constraints fall within the command and control channels, where the waste management directorates have to report to the community services general or manager. And so the challenges arise when proper support in terms of resources required for waste management services has to be obtained.

The importance of this section 4.5 is that it provides a view of the current organogram for the waste directorates reporting and management systems. The limitations of such an organogram is that reporting is to none subject matter experts. The implication is that challenges being experienced cannot be satisfactorily addressed and resolved. This usually is the result when higher management and senior management don't have the necessary skills

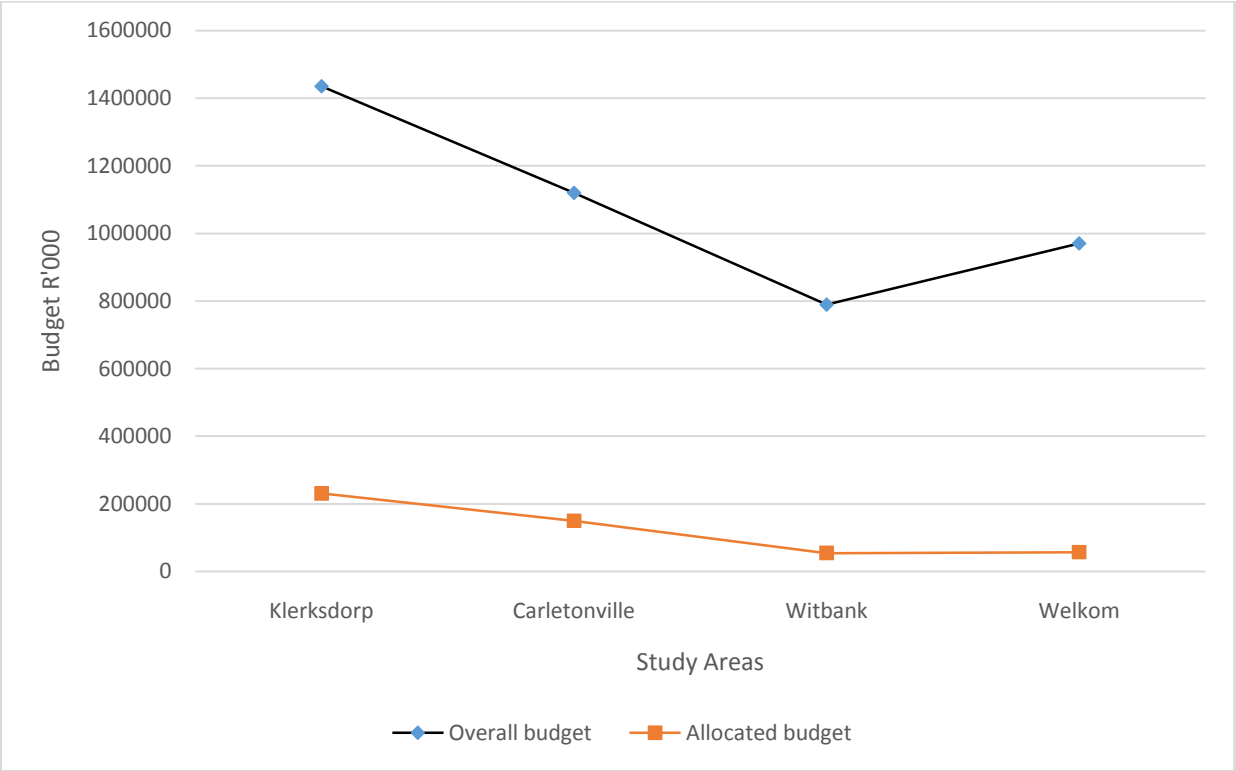


Figure 2. Overall budget vs the allocated budget in study areas in 2014/2015.(Source: Author).

and understanding to deal with challenges pertaining to a different environment from what they know. There are often no clear roles and functions of the various departments defined in relation to solid waste management and also no single person or committee designated to coordinate their projects and activities. It should be also noted that legislation is only effective if it is enforced. Therefore, comprehensive legislation, which avoids the duplication of responsibilities, fills in the gaps of important regulatory functions, and is enforceable is required for sustainable development of solid waste management systems.

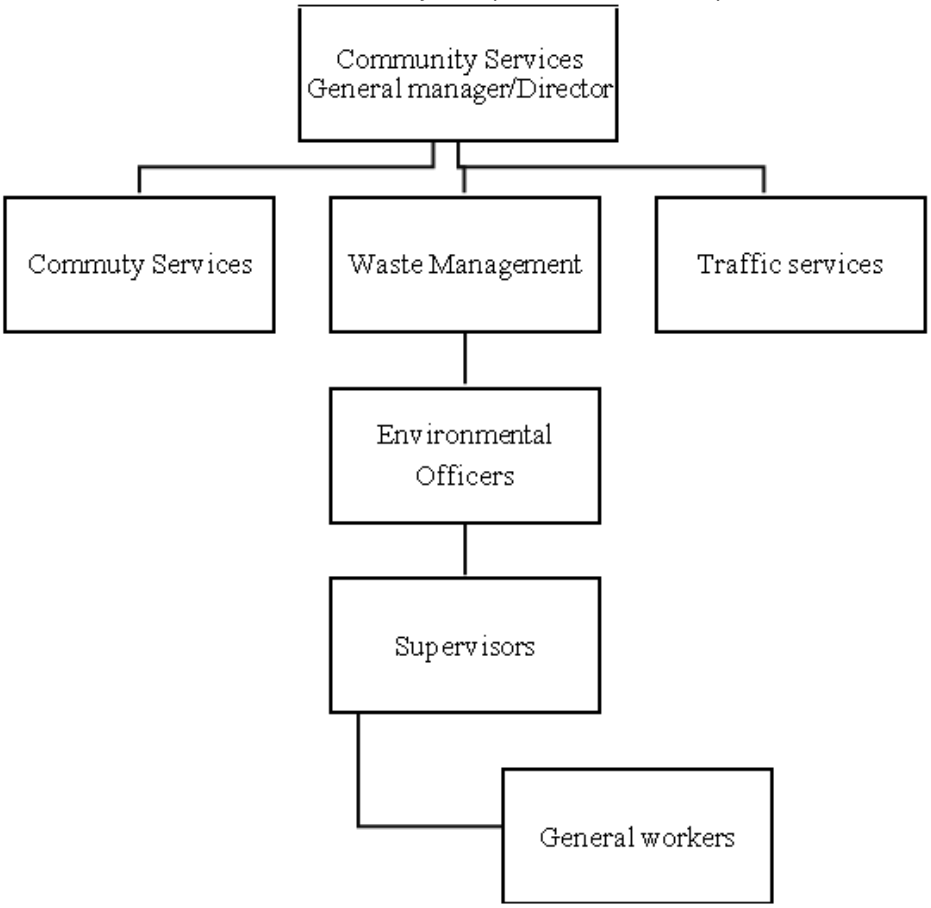
Economic Constraints

Economic and industrial development play key roles in solid waste management. Obviously, an enhanced economy enables a better financial climate for allocation of funding for sustainable solid waste management in a sustainable manner. However, secondary cities have weak economic bases and hence insufficient funds for sustainable development of solid waste management systems. Local industry could be encouraged to produce relatively inexpensive solid waste equipment and vehicles to reduce and in some cases totally eliminate the need for importing expensive foreign equipment for solid waste management (Walker, 2004). Such local industry can also supply associated spare parts, lack of which is often responsible for irregular and insufficient solid waste collection and disposal services. However in secondary cities, the lack of industry manufacturing solid waste equipment and spare parts and a limited foreign exchange for importing such equipment and spare parts are the rule rather than exception. Waste recycling activities are affected by the availability of industry to receive and process recycled materials. For instance, the recycling of waste paper is possible only when there is a paper mill within a distance for which the transportation of waste paper is economical. The weak industry base for recycling activities is a common constraint for the improvement of solid waste management in developing countries (Hanson, 2014).

Social Constraints

The social status of solid waste management workers is generally low in both secondary cities and metropolitan areas. There exists a negative perception work which

Table 3. Technical constraints in the study area (Source: SAWIS, 2013).



involves the handling of waste or unwanted material. People employed in such industry tend to have low esteem because of the work they do. Because of insufficient resources available in the local government sector, collaborative projects often have attempted to mobilize community resources and develop community self-help activities. Results of such collaborative projects are a mixture of success and failures. Failed projects with inactive communities usually did not provide people in the community with economic as well as social incentives to participate in activities. The social incentive is based on the responsibility of individuals as part of the community for the improvement of the community, and is created by public awareness and school education programmes (StatsSA, 2011). The lack of public awareness and school education about the importance of proper solid waste management for health and well-being of people severely restricts the use of community-based approaches in developing countries. At dump sites, transfer stations, and street refuse bins, waste picking or scavenging activities are common scenes. People involved have not received school education and vocational training to obtain knowledge and skills required for other jobs. They are also affected by limited employment opportunities available in the formal sector. The existence of waste pickers/scavengers often creates an obstacle to the operation of solid waste collection and disposal services. However, if organised properly, their activities can be effectively incorporated into a waste recycling system. Such an opportunistic approach is required for sustainable development of solid waste management programmes in developing countries (Renou, 2014).

External Waste Factor Constraints

External factors have an impact on waste management systems. External factors are the issues that arise from outside the local government institutional activities as shown in figure 3.

a. Public Interest

Interest is one of the fundamental driving forces that push individuals to take action and pursue particular goals. The lack of public interest in waste management denotes the absence of a desire to comply with the municipal waste management by-laws (Spengel, 2014). People who lack interest tend to be very negative and have excuses for not attending waste awareness campaigns. People who have interest tend to be positive and are very eager and energetic in giving attention to waste awareness issues. It was observed that most people in the study area have no interest whatsoever regarding waste. This was evident when the turnaround to waste outreach programme was poorly attended. The organisers at the Welkom local municipality has anticipated approximately 200 people when only 50 arrived (SAWIS, 2013). It has also been observed that a lack of emphasise on waste minimisation is being placed by the municipalities.

b. Ignorance

The level of ignorance for waste minimisation, the concept of re-uses, reduce and recycle, displayed by people is very discouraging. There is a basic awareness of waste service and waste management but a lack of adherence to it. For example, there is official signage in particular locations clearly marked; 'Do not dump – Offenders will be prosecuted' (SAWIC, 2013). Yet, dumping continues at that very site. Even though there is a lack of awareness amongst people in the selected areas, there is a national drive for waste minimisation and recycling. Ignorance is a very critical factor because even if funds are allocated for awareness, nothing will materialise in ignorance.

c. Demand

The specific factors affecting system performance include the demand for a specific action and the system's response to the demand. Urban growth is outstripping municipal capacity and it is one of the major problems resulting in inadequate waste management (Shen, 2013). Achieving equity in service level to previously disadvantaged communities is also recorded as a persistent problem. Therefore the demand for waste services by the increase in population has far exceeded the ability to provide services.

d. Social and Economic Status

The drive for providing waste service to communities is dependent on their social and economic status. For example in Klerksdorp and Witbank it was observed that priority is being given to more affluent residential neighbourhoods. Such neighbourhoods hardly struggle with their refuse collections. However it was observed in the Welkom and Carletonville areas that less priority is given to the poorer communities. These communities always have a backlog and a pile up of waste in their areas.

e. Physical Environment

When waste is not being collected in a specific area, residents tend to find the nearest open area and dump their waste there. This is how many areas tend to have illegal dumping sites. It was observed in the Henneman area that a lack of service from the waste directorate has caused the sporadic opening of illegal dumping sites. In Klerksdorp dumping illegally also take place in the closest available land. Normally garden waste and construction waste make up the bulk of illegal waste in these areas.

CONCLUSION

According to the weekly waste collection rates presented earlier, waste collection is generally effective in the local municipalities in the selected areas. However, in the same areas, service provision strains are showing. None of the municipalities has a 100% service record due to various inefficiencies and cost constraints. The causes of these inefficiencies and cost constraints should be addressed. Waste collection should be further investigated in smaller communities and farmland to consider sustainable waste removal systems that could be applied to these communities where waste removal services cannot be rendered. Little or no effort is made to reduce or recycle waste in the municipalities. Recycling centres are available at some landfills but these are not being utilised. There is however a need for recycling stations when the large numbers of waste pickers on landfill sites are taken into consideration. Due to the distances to the landfill sites in the municipalities, waste transportation is an area of concern and historically waste has not been transported long distances. Transportation vehicles are in most cases not in good condition and are in need of repair or replacement. Consequently a few, often inefficient landfills are developed in each town. Given that the resource requirements for managing landfills have been increasing with increased public awareness and legislative changes, these resources should be re-visited to achieve maximum efficiencies with regards to waste disposal.

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