Municipal Solid Waste Management in Grahamstown, Republic of South Africa

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Abstract

The studies investigate ways to improve the sanitation system of Grahamstown. It analyses public opinions and the underlying factors impacting effective solid waste management. The research methods used in the studies were: a structured questionnaire with closed ended questions, a review of published materials, informal interviews and physical observations. The following key findings were identified as factors affecting solid waste management in the municipality: poor methods of waste disposal, lack or inadequate incentives for waste recycling, inadequate public awareness, and poor enforcement of bylaws underpinning waste management.

The studies suggest that bylaws to this should be strengthened. Public education awareness on solid waste management should be intensified by the council, a Public Incentive to encourage waste recycling should be implemented and landfill operation should be improved. In addition, simulation of successful solid waste management models in other developing countries could be implemented in the town. If the aforementioned factors are well implemented, no doubt the municipality would be proud of a clean environment.

Key words: Solid waste, Sanitation, Environmental degradation, Bylaws

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1 Introduction

1.1 Background

According to the South African context of waste management, waste is defined as any product – liquid, gaseous, solid, or a combination of the above, that is unwanted or superfluous for someone, business entities and organizations (Environmental Conservation Act 73 of 1989). Municipal solid waste management (MSWM) is the management process of solid waste - generation, collection, transportation, recovery, and disposal in the best applicable or suitable manner (policy and technology) to ensure that public health, socioeconomic, aesthetic and environmental values are not jeopardised. (Daskalopoulos et al., 1999).

In recent decades the rapid growth of economic activities and population in the developing countries has caused an increased consumption of natural resources that has led to much waste generation in some areas. And because of insufficient or lack of human and financial capacities to remedy the situation unacceptable waste disposal has become a challenge in Africa and other developing countries. About 20 to 80 percent of the solid waste in African cities is disposed of by dumping in open spaces, water bodies, and surface drains as a result of inadequate infrastructure and awareness. Municipal waste management should be properly disposed of in order to safeguard the environment and human health as well as the preservation of natural resources (United Nations Environment Programme, 1999).

Solid wastes have both a direct and an indirect impact on our environment and welfare. Direct effects include the impact on animal and plant life and the effects on human health and the environment. Indirect impacts are mostly long-term such as climate change and ecosystem contamination that may have a profound impact on some regions in the world, because people in these areas depend on some of the natural systems for survival (Woodwell GM, 1970).

Unacceptable waste disposal leads to unsanitary environmental conditions that are detrimental to human health. In situations where sanitary facilities, such as toilets, do not

exist or are inadequate, the health situation becomes exacerbated, when human faeces are mixed with discarded waste. (Kjellen, 2001). Thus better management of municipal solid waste can significantly curb green house gas emissions (EEA report, 2011).

2 Aims and objectives

What simply started as an interest to build a relationship with a festival town in South Africa turned into a Cooperative government relationship between the municipalities of Raseborg in Finland and Makana Municipality in South Africa (Makana Municipality, 2010). Inter alia that were concluded in the partnership agreement, waste management was recognised as an important subject for cooperation. Indeed Makana municipality would benefit from the win-win cooperation because waste management is well implemented in Raseborg municipality, and the knowledge and technical know-how could be extended to Makana municipality as well.

The objectives of the cooperation, Youth development, the fight against unemployment and marginalisation in Makana would be achieved through education awareness in the area. Fortunately Raseborg municipality hosts the prestigious Novia University of Applied Science that offers multidisciplinary higher education programmes with practical orientation and the training of skilful men. The institution also supports international education and sustainable development, and, indeed, this would not only help in the exchange of academic studies for both municipalities, but it would also contribute to the implementation of some of the projects that were agreed in the friendship accord. As quoted by the Municipal Manager, Ntombi Baart in (Grocott's Mail Online Wed, 23, Nov, 2011) "Currently three students from Novia University in Finland are in Grahamstown to carry out feasibility studies on water provision and sanitation management. They would visit the different water generation and purification sites and share common knowledge with relevant authorities in the departments".

The aim of this study is to find out ways to improve the current solid waste management practices in Grahamstown the capital of Makana Municipality, Eastern Cape, South Africa.

The objectives are:

- to identify factors that influence solid waste management practices in Grahamstown and
- to propose suggestions for effective and sustainable municipal solid waste management in the town.

3 Study area

Indicated in figure 1, Grahamstown is located in the Eastern Cape Province of the Republic of South Africa. The city is situated almost in the middle of Port Elizabeth (to the East) and East London (to the West) on the N2 highway, and is the seat of Makana municipality council. The city's geographical area is about 27.28 square kilometres. It boasts itself with recognised educational institutions - the Rhodes University and other colleges. Grahamstown also has some historical significance, a number frontier wars were fought here in the old days (Draft annual report, 2007 – 2008).

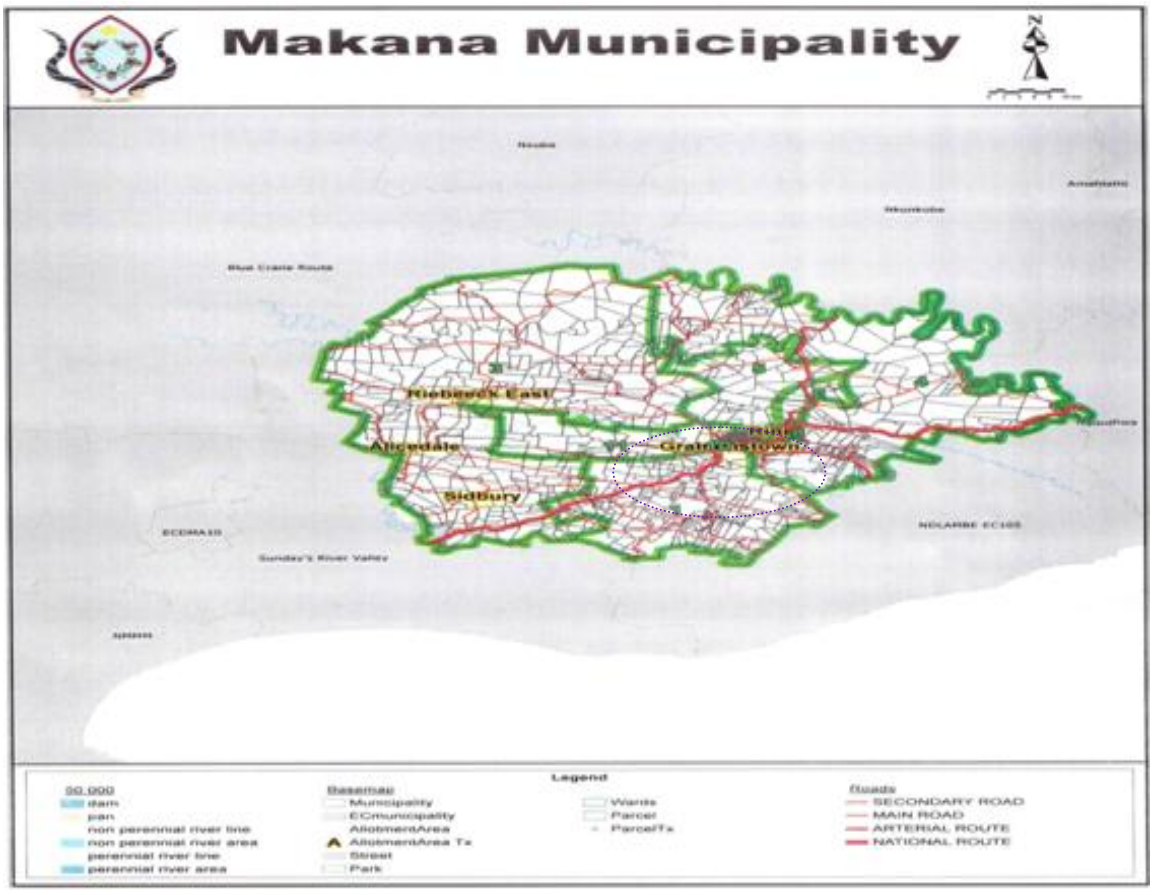

Figure 1 *Location of Grahamstown and nearby towns - Alicedale, Reibeeck East, Sidbury, Rini. Source: Municipal department of town planning, 2010,*

3.1 Population

In 2003 the population figure for Grahamstown was estimated at 124,758 people. The number of households in the entire municipality was about 18,864, 88.1 percent for formal dwelling and 7.3 percent for informal dwelling respectively. Housing is one of the basic human needs that have a profound impact on the health, welfare, social attitudes and economic productivity of an individual. It is also one of the best indicators of a person's standard of living and of his or her place in society. To achieve the millennium development goals, South African government policy is to ensure that its citizens live in good housing conditions. (Statistics South Africa, 2007).

3.2 Climate

The climatic conditions in Grahamstown vary extreme temperatures are recorded throughout the year with minimum temperatures of - 4°C and a maximum of 42°C. Light frosts and occasional snowfall are also witnessed sometimes during the year. The mean annual precipitation (MAP) rate is about 550 mm, in the years (GG Antrobus & RR Antrobus, 2008). The climatic condition of the city indicates that discarded waste in the environment could easily decompose because of favourable temperatures.

4 Legislations underpinning municipal solid waste management in the Republic of South Africa

In South Africa there are series of legislations and declarations that have been enacted to guide waste management activities in the country. The South African Constitution states that the people of South Africa have the right to live in an environment that is not detrimental to their health, and ensures that this law is respected and made known to every South African citizen. According to the constitution, local governments are responsible for waste management activities in the various regions of the country, and, therefore, they are compelled to keep their environment clean. For example, waste recovery and disposal are the responsibility of the local government. (South African Constitution 1996).

4.1 Environmental Conservation Act (73/1989)

The Environmental Conservation Act was enacted in 1989. The objectives of the Act are to ensure that the environment is protected and used sustainably. The operations of landfill facilities in the country are defined in the Act. According to the Act landfill establishment must conform to state standards - the construction or active phase, the post-active or closure, and the monitoring phase, should be considered in the whole lifecycle of the facility. In addition litter and waste dumping of any kind is forbidden and punishable. The local government or other state authority is in charge and responsible for the provision of public waste containers where necessary. Every person is compelled to clean up the environment after any activity that may lead to waste disposal in the surroundings (Environmental Conservation 1989).

4.2 National Environmental Management Act (107/1998)

The National Environmental Management Act advocated for the various government departments to support and collaborate on environmental issues. Inter alia the Act includes open information, cradle to grave management, polluter pay principle, waste minimisation, sustainable development and environmental protection. The Act also compelled state departments in charge of environmental management to develop and implement a plan for environmental management, and also ensures that local government Act is in accordance with the plan (National Environmental Management Act 1998).

4.3 The National Waste Management Strategy (1999)

In 1999 the National Waste Management Strategy plan was enacted by the Department of Environmental Affairs and Tourism and the Department of Water Affairs and Forestry in South Africa. The National Waste Management Strategy presents a government plan to integrated waste management activities in the socio-economic and political life of South Africa. The plan seeks to address key issues related to waste management in the country and also reiterate the South African bill of rights which states that the people of South Africa have the right to live in an environment that is not detrimental to their health. The

objectives were to look for ways to prevent and minimize waste generation. To guarantee waste management services to the South African people there should waste collection, transportation, treatment and disposal services in all communities as well as the introduction of public education awareness programs on waste management in all localities in the country. (National Waste Management Strategy, 1999).

4.4 National Environmental Management: Waste Management Act (207)

The National Waste Management bill was passed in 2007. The bill reviewed and strengthened current bylaws pertaining to waste management in the country and emphasized environmental awareness and sustainability. In addition, equitable and sustainable use of natural resources, waste minimisation and generation, recycling, waste disposal, pollution prevention, waste services improvement, prevention of land degradation, and integrated waste management were also articulated in the bill. (National Environmental Management: Waste Management, 2007).

4.5 White Paper for Integrated Pollution and Waste Management for South Africa (Notice 227 of 2000)

The white paper on integrated pollution and waste management for South Africa was published in March 2000. The policy advocated for a holistic and integrated management system for pollution prevention and minimisation of waste at point sources, in order to stop pollution on the environment. The cradle to grave management, in other words, waste generation, recovery, transportation, treatment and disposal were to be incorporated in waste management activities. Amongst other things, in order to achieve the objective of the policy state legislations have to be strengthened, the integration of environmental management, waste management and pollution in the spatial development plan of the country as well as public education awareness of integrated pollution and waste management should be strengthened (White Paper on Integrated Pollution and Waste Management for South Africa 2000).

4.6 Polokwane Declaration on Waste Management (2001)

In September 2001 the national waste summit was held at Polokwane, in the Northern Province of the country. The aim of the summit was to review waste management activities in the country. In the meeting it was reiterated that waste management is a priority for all South Africans and the need for urgent action to reduce, reuse and recycling is a priority in order to safeguard the environment. The vision of the summit is to implement a waste management system that can contribute to sustainable development and also improvement in living standards, and this is only possible if everyone is committed to the course. The goal is to reduce waste generation and disposal by 25 percent and 50 percent respectively by 2012, and develop a plan for zero waste by 2022. Inter alia the important declarations in the summit include: Implementation of a national waste management system, waste reduction and recycling, waste information and monitoring. Engagement of private persons to initiate innovative waste management programs, promote and participate in safe and healthy waste recovery programs. **(**Polokwane declaration on waste Management 2001).

5 The physical composition of solid waste in Grahamstown

Municipal solid waste is a heterogeneous mixture of products with different physical and chemical properties. Its composition varies and depends on the nature of the products, the customs of the population, the quality of individual lifestyle, and the type of city. Having the knowledge of municipal solid waste composition is important because this would determine the management option when necessary (Sanneh. E. S et al., 2011). Solid waste in Grahamstown was generally composed of two categories, biodegradable and non-biodegradable, and is being divided into 12 categories. The waste sample comprises boulders, garden waste, metals, plastics, papers, residues, tires, etc. In the city the daily waste generation is estimated at 1 kg per day, 124.75 tonnes per day and 32.435 tonnes per annum. (Makana municipality, Integrated Waste Management Plan, 2008).

6 The current status of Solid Waste Management in Grahamstown

The waste management service in the city is masterminded by the Makana municipality council. Approximately 13,179 households receive a kerb side waste collection service while

1,999 households receive a municipal waste collection service. According to the waste management laws of the country it is the responsibility of the municipal council to ensure that the solid waste management process in every community is effectively carried out. Street cleaning (litter picking, sweeping, and cleaning of ablution facilities) should be done where and when ever necessary in order to give the environment a nice look. Nevertheless, this is not the case in Grahamstown. The waste management service is irregular and ineffective. (Makana municipality, Integrated Waste Management Plan, 2008)

6.1 Waste receptacles

In Grahamstown generated garbage from households and commercial premises is stored in black plastic bags that are provided by the municipal council. However some households and business places do not rely on the council to support them with waste receptacles because these individuals are capable of acquiring such facilities. When the bags are full of garbage, they are placed on curb sides at designated locations for collection by the municipality. A single bag is provided to the residence of Grahamstown once a week, and unfortunately to some households it is not enough commensurate to their weekly waste generation. Garbage that cannot be contained in the bag is illegally dumped elsewhere or left to litter at curb sides. In the townships littering and disposal is quite common and normal because these areas are not served with adequate disposal facilities. The truth is that indiscriminate dumping of solid waste raises serious environmental concerns - loss of renewable resources such as metals, plastic, and glass, loss of potential resources such as compost from organic waste, and energy from burnable waste (Martin Oteng-Ababio, 2010)

Figure 2 *Household and commercial waste dumped at curb side for collection. Photo: Etengeneng, 2011.*

6.2 Waste collection

Currently the labour force for waste management in Grahamstown is inadequate – street sweepers, service men in the collection and transportation department as well as those involved in landfill operations are inadequate, and this has rendered the waste management system to be ineffective. Garbage bags are left on curb sides as well as designated collection points for several days before evacuation and as a result scavengers make their way into the bags in search for food and other valuable items. After this informal act the bags are closed and flying trash becomes the order of the surroundings. Some starts to decompose accompanied by stinking smell as well as harbouring disease vectors such as rats, cockroaches, flies and mosquitoes that are harmful to human health. Indeed, uncollected refuse disposal spoils the beautiful nature of the city environment. In Grahamstown not all households are included in the reconstruction and development program (RDP sanitation standard). Families that are not entitled to this use the bucket and other containers to get rid of metabolic waste. The major environmental problem of this system is that when collections are late many people dispose of sewage on streets or in storm water drains. This leads to poor human health and environmental degradation (Makana LEAP, 2005).

Figure 3 *Human beings craving for food from partly decomposed garbage. Photo: Etengeneng 2011*

6.3 waste sorting

In Grahamstown more than 90 percent of the waste that goes to the landfill is unsorted. The method of handling, storing and processing of solid wastes at the sources plays an important role in public health, aesthetics and efficiency of municipal solid waste management system (Abdoli MA, 1995). Separation of the wastes at the source will not only bring economic benefits, but will also make the recycling of other components more efficient (Aydin GA & Kocasoy G 2004). Unfortunately the situation in the municipality is different. Waste generated in most households and commercial places are mixed in one plastic bag, before taken to the curb side for collection. There is no separation at the point source. Nevertheless, some households try to separate what they could, but unfortunately it all ends up in the landfill as unsorted waste. At the landfill there is no treatment, except partial separation of plastics and glasses from the main stream by a locally owned recycling firm.

6.4 Domestic animals and waste

In the city people live side by side with domestic animals - dogs, goats, cows, donkeys, etc. Unfortunately more than 70 percent of these ruminants are not properly confined by their owners. They are left to roam the streets in search of food, water and shelter, and in the course of their movements for survival they defecate on the streets and make the environment unpleasant and harmful. Animal droppings are known to impair environmental beauty as well as causing sickness to human beings, such as diarrhoea, intestinal disorder, kidney problems, etc. Animals deserve the right to have food and shelter.

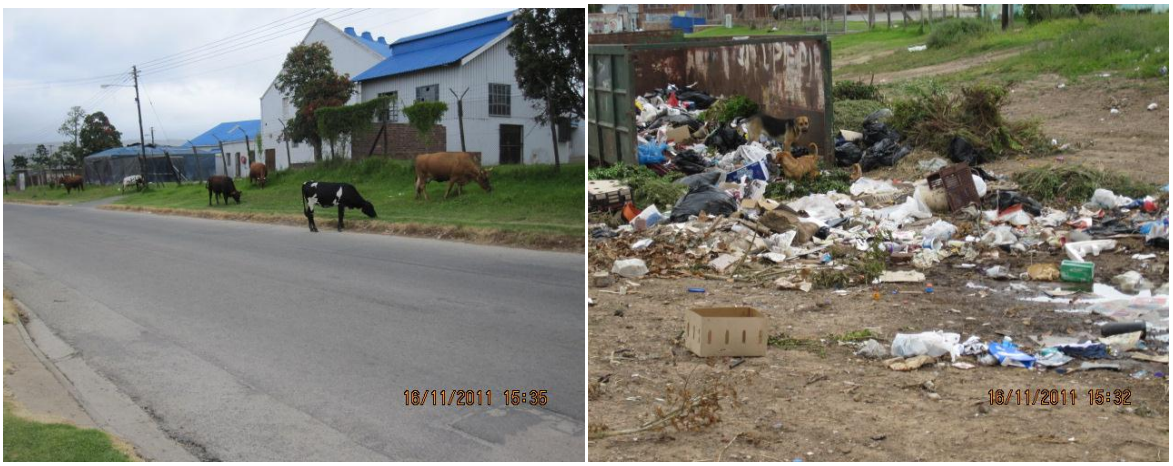

Figure 4 *Fending for food by ruminant animals. Photo: Etengeneng, 2011.*

6.5 Recycling

Local recycling businesses operate in Grahamstown – Grahamstown Recycling and Eastern Cape Bottle Buyer (ECBB). Unfortunately these businesses are not fully encouraged in the municipality. Subsidies from the municipality council are vital for the firms to stay in business. Nevertheless, they are left on their own to survive and without enough capital they find it difficult to operate. Also composting of biodegradable waste is neglected. More than 75 percent of the waste generated in the townships and farm settlements is biodegradable which ends up in the landfills, is dumped or burnt.

Many cities in developing countries aspire to have modern waste management systems, which are associated with relatively high recycling rates of clean, source-separated materials. Most cities already have informal sector recycling systems, which are run solely by the revenues derived from selling recovered materials. There is a clear potential for'win–win' cooperation between the formal and the informal sectors. Providing support to the informal sector, to introduce recycling measures and to address some of the social issues could reduce the overall costs of waste management for the formal sector. The presence of a waste material with a positive value represents a potential source of livelihood for the urban poor (Sanneh. E. S et al., 2011), and this was true for medieval cities and rapidly industrializing cities of Europe and North America in the 19th century. It also applies to the developing countries today (Wilson, 2007).

6.6 Landfill

The landfill site in Grahamstown was permitted by the Department of Water Affairs and Forestry on 10 September 1996 as a standard landfill (Class G: M: B+) for waste disposal. The site is located 2 km away from the city at co-ordinates: S 330 17' 28'' and E 260 29' 32''. The expected lifetime of the site is approximately 20 years (Makana municipality, integrated Waste Management Plan, 2008). The site is an old quarry that does not fulfil the standards of a proper landfill. The absence of a cell system indicates that the landfill contain all types of waste. The waste is not covered all year round and this causes air pollution, which is dangerous to human health. There is no strategy for monitoring activities on the site. The absence of a weigh bridge signifies that there is no proper recording of incoming waste.

Occasionally a bulldozer is employed to compact the waste. The absence of a good fence has encouraged scavengers to have access to the site in search for food and valuable items. From time to time the waste volume is reduced by burning the trash, exacerbating global warming and health effects.

Figure 5 *Scavengers in search of food and valuable items from Grahamstown landfill site. Photo: Etengeneng 2011.*

6.1.1 Impacts of landfill

Landfill facilities are very important in modern day societies. Proper management of municipal solid waste ensures human health and a clean environment. However, in situations where landfills are poorly managed, it becomes a nuisance to the environment. South Africa is an example of a country where the shortage of water is an incentive driver for effective waste management – 75 percent of the land area is classified as desert or semi-desert. A key requirement in the country has thus been surface and groundwater protection, which led to the establishment of Minimum Requirements for Waste Disposal by Landfill (1994, now in its third edition: Department of Water Affairs & Forestry 2005).

6.1.2 Impact on water

In the city accessibility to clean water is a huge challenge. Water is naturally scarce in the area and not every household has access to portable drinking water. Poor management of

the municipality landfill may aggravate the situation. Leachate discharge from the landfill site may contaminate surface and ground water aquifers further exacerbating the problem. Storm runoff and a Poor drainage system in the area may also contain leached out substances that can also impact water tables as well as soil. In addition trampling on soil surface by workers and movement of heavy duty equipment such as trucks and bulldozers could also cause soil erosion in the surrounding area (M.P.Papadopoulou et al., 2006).

6.1.3 Impact on health

An improperly managed landfill could have far reaching consequences to human health. If the landfill site is located close to a settlement and not covered daily, it may lead to air pollution that is harmful to human health and the environment. Air pollution causes diseases such as asthma, tuberculosis, eye malfunction, etc. A poorly managed landfill also serves as a breeding ground for disease vectors, such as rats, flies, mosquitoes, and cockroaches, birds, etc. These vectors cause diseases such as typhoid, malaria, etc. Dust, odour, noise and flying waste from such facilities are also a nuisance to human wellbeing (Ramarjit Riat et al., 2006).

6.1.4 Landfill fires

An improper management of a landfill could spark off spontaneous surface and subsurface fires. If the landfill is not covered daily, the waste is exposed to air and biological decomposition begins, with a resulting release of heat from the waste, and this could lead to the outbreak of a spontaneous fire. Such fires are very dangerous because they contain mixtures of dioxins that are harmful to human health and the environment as well. (U.S. Fire Administration 2001).

7 Ideal example of Municipal Solid Waste Management – Curitiba

In 1970 people were massively migrating into Curitiba, which led to a rapid increase in the city's population within a limited time. The establishment of new industries and commercial activities in the city attracted people to migrate in to the area, and between 1970 and 1980 the metropolitan region had one of the highest rates of population growth as compared to other parts of Brazil. Waste generation and disposal are connected to human and economic activities, intense economic activities lead to more waste generation as well as the wealth

level of people. The rich compared to the poor generate more waste because they can afford to pay for goods and services. In Brazil each household generates about 500 g to 1 kg of waste per day and this depends on the location and financial status of the family or individual. The challenge for the city council was to guide population and economic growth so that the social and environmental aspects of the city were not jeopardised by the development. In order to guide the development vis-à-vis waste generation the city council came up with a plan for effective waste generation management in the Curitiba metropolitan region (Thayane Vitola Rohn, 2007).

The plan includes:

- regular waste collection service and disposal
- "green exchange" program
- garbage purchasing program and
- public education awareness of municipal solid waste management.

7.1 Regular waste collection service and disposal

In Curitiba one of the most expensive municipal services is the management of waste, and this must be done in order for the municipal surroundings to stay clean. According to the council, more than 80 percent of all households in the region have access to regular waste collection services provided by the municipal council. The garbage buyer's scheme, which is also run by the council, is responsible for the purchase of part of the generated waste and the council employs regular workers who sweep the streets. Collected trash around the municipality is sent to the recycling plants and some is incinerated or land filled. In each day about 500 tonnes of waste is recovered by waste collectors, and the pickup trucks collect about 1,300 tonnes daily to the landfills and incineration facility (Prefeitura Municipal de Curitiba, 2007).

7.2 Garbage purchasing program

In Curitiba not all the areas have access to motorable roads. In some parts of the metropolitan region the presence of undulated landscape and narrow streets makes it

difficult for garbage collection trucks to pick up the waste. In order to solve the problem the council decided to introduce the “garbage purchase” program, whereby a local association of residents in the area was formed and this body takes charge of the waste generation and collection in the area. The association ensures that waste from households is collected and brought to designated areas to be picked up by waste collection trucks. It ensures that waste bags are collected from the council and distributed to households as well as making sure that residents have sufficient waste bags. Indeed, the program recorded much success as the streets were kept clean and free from vector diseases such as flies, mosquitoes and rats. Other communities saw the benefits of the program and emulated and in 2006 about 41 communities in the region were deeply involved in the program. In addition, where the big trucks could not pick up the waste either due to the narrow nature of the road or undulated nature of the resident area, the small trucks are used.

7.3 The “green exchange” program

In Curitiba, as well as in most cities in Latin American countries, most of the poor people live in squatted settlements, such as in hill tops and flood plains, because they cannot afford to pay for accommodation in normal residential quarters. The high population density found in these areas generates waste that is harmful to health and the environment, and in order to put the situation under control, the council decided to launch the “green exchange” program in these areas. A kind of trade by batter is being done whereby wastes from households in these areas are exchanged for food. The money the municipality uses to acquire the food comes from the sales of recyclable materials. The program encouraged people to sort their waste in exchange for basic food items, such as carrots, rice beans, bananas that they could not buy. (Thayane Vitola Rohn, 2007).

According to the council for every 5 kg of waste that was sorted by any one, the person receives in exchange a bag of different kinds of food items and this help to enhance the poor living condition of those living in these areas, because most of them could not even afford daily bread. In 1991 with the aid of the “green exchange” program about 45,125 tonnes of waste was recycled and this contributed to the saving of 195,252,646 litres of water, which would have been used for the manufacture of new products that were not

made from recovered materials. 15,793 tonnes of recovered scrap iron was also recycled which contributed to a save of 63,172,000 litres of water as well as the recycling 4,523 tonnes of paper, which represent a save of 132,080,646 litres of water and 90,263 cuttings of trees that would have been used for the manufacture of new papers. In addition, 10.379 tonnes of plastic was recycled, which contributed to saving of 5,190 tonnes of oil, and by 2006 about 2.6 thousand tonnes of cans, plastic, paper, cardboard and other materials were successfully recycled through the program (Prefeitura Municipal de Curitiba, 2007).

7.4 Public education awareness

To deeply involve the residence of Curitiba in the waste management process of the metropolitan region, the city council embarked on public education awareness. Residents were taught how to sort their waste, for example, biodegradable from non-biodegradable and the valuable items were taken to the municipality recycling facility. Homeless people and recovered alcoholics were taught how to separate the waste as well as school children. In Curitiba the expression that “waste is not waste” is because items that have been used before and discarded are recycled into other usable products and this has lead the people to ensure that almost all of the generated waste is recovered and recycled because they have witness how important is it to the environment and their daily life.

In 2006 3,581,409 tonnes of waste was recycled by the facility which contributed for a save of 30 days of land area in the landfill that would have been occupied, if the trash was not separated. In the landfill the waste is properly handled according to the landfill standards set by the municipality. The revenue generated from recycling activities is further used to fund educational and health programs for the poor and the homeless. Abandoned buses and transportation containers on road sides were remodelled into mobile classrooms and pupils were capable to study inside. Thanks to the program, many families that could not afford to pay for education were opportune to have basic education as well as learning a trade, since it was subsidised by the municipality out of money generated from recycling activities (Thayane Vitola Rohn 2007).

The residence of Curitiba takes it as an obligation and pride for everyone to be involved in waste management activities in the municipality, because they understand it is for the utmost benefit of everyone who lives in the city and of the environmental wellbeing. If you ask the people what the solution to waste management is, they will respond separation and recycling. Indeed effective waste management practices in Curitiba have contributed to changing the life of so many people in the area as well as Curitiba's status. (Nicolas S. Mang 2009). In 2010 Curitiba won the world prize of being one of the most sustainable and liveable cities in the world and, many international institutions and scholars have recognized it as an "Ecological Capital" of the developing countries, due to it environmental and social improvement. The environment is just too awesome (Mertanen S.T. ,2011).

8 Scope and limitation

The study is focused on solid waste management practices in Grahamstown. It investigates ways to improve the sanitation system of the town, thus in the studies the percentage of solid waste generation is not accounted for. Nevertheless, the percentage of waste generated in 2008 was highlighted from published sources.

9 Research methods

In the studies the qualitative research method was used in information gathering. A structured questionnaire with closed ended questions was randomly distributed in Grahamstown, the capital of the municipality, where unorganised and illegal waste disposal is a common practice. The objectives of the random method of survey were to ensure that there is no biased feedback in the findings, and, in addition, it would also explore public opinions and perceptions of solid waste management practices in the town. A total of one hundred questionnaires were distributed in November 2011 and 52 persons responded to the questions. In a structured questionnaire, participants respond to prompts by selecting from predetermined answers (e.g. Likert scales, multiple choice responses) and these data is typically analysed quantitatively (Lois R. Harris & Gavin T. L. Brown, 2010).

In addition to the questionnaires, informal interviews and discussion with some of the residence and municipal solid waste management workers was also carried out. In situations

where the interviewee could neither read nor write a third party facilitated the discussion by interpretation and translation. Information was also gathered through physical observations. Field visits were made to the landfill sites as well as the local recycling firm, which is located close to the landfill. An extensive review of published material was carried out on the Internet. The questionnaire and the analysis are attached in the appendix of the studies. The questions that were asked to the public include the following;

- *Please tick the type/ types of waste you produce?*
- *Do you agree that littering creates jobs?*
- *Do you have a waste /recycling container that are provided by another entity (private)?*
- *If you do not have a waste and recycling collection service, how do you dispose of your household refuse?*
- *Have you ever participated in a recycling program at home/at work/ school, etc? If yes, what did you do?*
- *Are there ways/measures you use to try to reduce the amount of solid waste-home/ in your work place/ school?*
- *Do you agree that the municipality has fully t measures to fight against illegal waste disposal?*
- *What current solid waste services would you like the municipality to improve upon?*
- *What new solid waste services would you like the municipality to improve upon?*
- *Do you believe illegal dumping in your neighbourhood or at specific locations is problematic? (health/environment/ethical)?*
- *Are you aware of the fact that the state /municipal legislation that prohibits illegal disposal of waste to the environment?*
- *Do you visit government, municipality websites or journals, articles, news papers and TV programs for information about solid waste handling?*
- *Do you agree that the municipality has done enough to raise public awareness on waste management?*
- *Please share any additional comments, concerns or suggestions you may have regarding the municipal solid waste management?*

10 Results

In the final analysis of the studies not all the questions in the questionnaire were accounted for, only the most significant ones were critically examined, the reason being that, since it was difficult for those living in the townships to comprehend the subject matter, the structure and content of most questions was not taken into consideration. Questions were poorly formulated to avoid complexity. In other words, the questions were made simple so that the layman in the public could understand the purpose of the research findings, and to get an in-depth response of waste management practices from the public. The questions selected for detail analysis includes the following: *If you do not have a waste and recycling collection service, how do you dispose of your household refuse? Are there ways/measures you use to try to reduce the amount of solid waste-home/ work place/ school? What current solid waste services would you like the municipality to improve upon? Do you believe illegal dumping in your neighbourhood or at specific locations is problematic (health/environment/ethical)? Are you aware that the state /municipal legislation prohibits illegal disposal of waste to the environment? Do you agree that the municipality has done enough to raise public awareness on waste management? Have you ever participated in a recycling program at home/at work/ school, etc? If yes, what did you do?*

Despite the fact that the questionnaire was anonymous as well the interview, some participants did not respond to questions that dealt with how household waste is disposed of because they were afraid that they may be punished for illegal disposal and this partly contributed to the poor results in some of the question. The interview participants were not happy with the sanitation conditions in the town. Fingers were pointed at both the council and the public for the poor sanitation management in the town. The workers acknowledge that it would be hard for the community to be perfectly clean, because the council has not made full provision to this, for instance, the number of workers involved in waste collections services is not enough commensurate to the daily job task vis *à* vis waste collection. As a result of this part of the disposed garbage in some areas is untimely and or deliberately not collected because of the inadequate labour force.

Although the waste management department has other smaller trucks that assist in the collection and transportation of garbage, the department has just a single standard garbage

collection truck that services the whole municipal area. Collections are bound to fail if the truck has some technical problems and this often happens. Besides that, a single truck slows down the collection and transportation process. The absence of motorways in some parts of the city has also made it difficult for all the garbage to be effectively collected. It was also quite strange to learn that some residents deliberately litter. Job opportunities are scarce in the area and some people have the conception that, if they litter this will create jobs to some unemployed people, and the city council would have no choice rather than to employ people to do the cleaning. The workers and some other residents were also concerned about this misconception, and were keen to see that the council punishes anyone caught in such activities. One of the workers even said he believes that littering is embedded in the culture of some people, for example, most of those living in townships would never stop littering even if they are told that it is not good for their health and the environment.

Other residents that were also interviewed had almost similar views as those of the workers. They blamed fellow residents for the unacceptable waste disposal in the neighbourhoods. Some said the council has indirectly promoted this because it has not provided enough waste bags, garbage containers, etc. to the public, and also the delay in collecting the waste in due time. Suggestions like waste education awareness, promulgation of environmental management legislations, timely collection, improvement of the waste management labour force, adequate facilities to contain generated waste were highly recommended by both the workers and the people to be carried out by the municipal council.

The study results indicate that much work is required to be carried out as for solid waste management in the town. Most of the residents are not informed on how to handle municipal solid waste, and because of this exorbitant amount of recyclable materials finally goes to the environment and landfill. Figure 8 shows the detailed result analysis of solid waste disposal practices in the town. In regard to how the residents dispose of household garbage, more than 5 percent of the population prefer to burn or dump unwanted household remains and 6 percent endeavour to compost and recycle. As for what current solid waste management services the public would prefer the council to ameliorate, 9 percent favours the increase of public waste bins in specific corners in residential quarters,

11 percent desired the provision of trash bins to every household, 14 percent supported timely collection of garbage from curb side dumps, 17 percent overwhelmingly supported the enhancement of public sensitisation campaigns on solid waste management practices in the municipality, and 12 percent preferred that the current labour force in solid waste management should be increased.

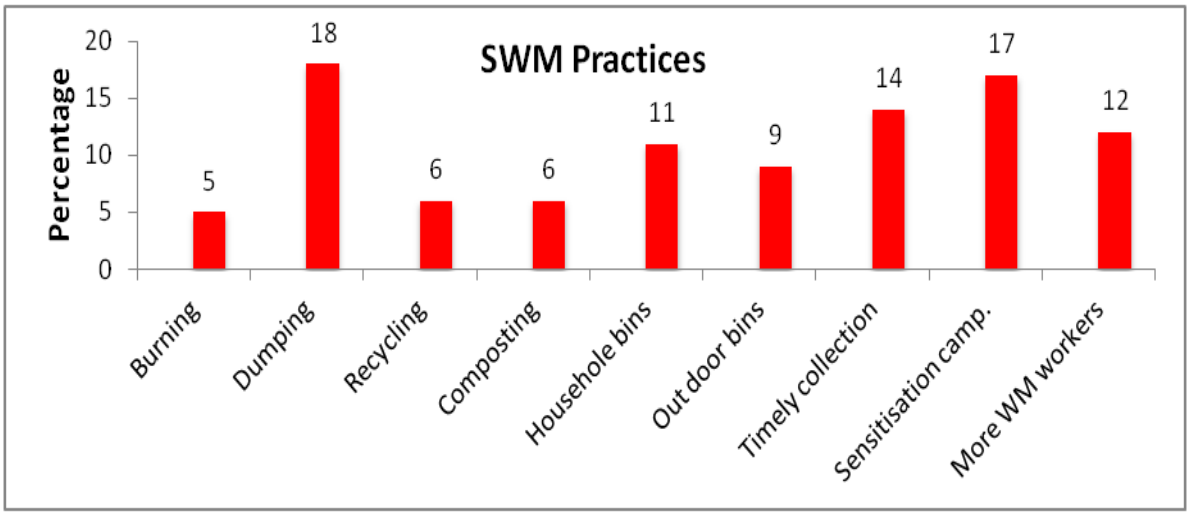

Figure 6 *Current methods of solid waste management practices in Grahamstown*

Furthermore, as shown in figure 9, the question that dealt with whether people endeavour to reduce garbage generation, 55 percent indicated that they do this in situations where they could and 44 percent do not have any clue about waste minimisation. The findings regarding public involvement in recycling programs, 29 percent indicated that they have participated in such programs, while 71 percent never have. The question that dealt with whether the public is aware of the legislation binding waste management activities of the country, 39 percent is aware of the laws, while 61 percent indicated is ignorance. In relation to the question on whether the public is satisfied with the idea that the municipal council has fulfilled its responsibility to keep the public informed about effective waste management practices, 28 percent indicated that the municipal council has carried out this, while 72 percent revealed that the councile has partially fulfilled its obligation. In terms of the impact awareness of illegal waste disposal to the environment and health, 92 percent of the population is conversant of the pros and cons of illegal waste disposal, while 8 percent have no idea of waste disposal effects.

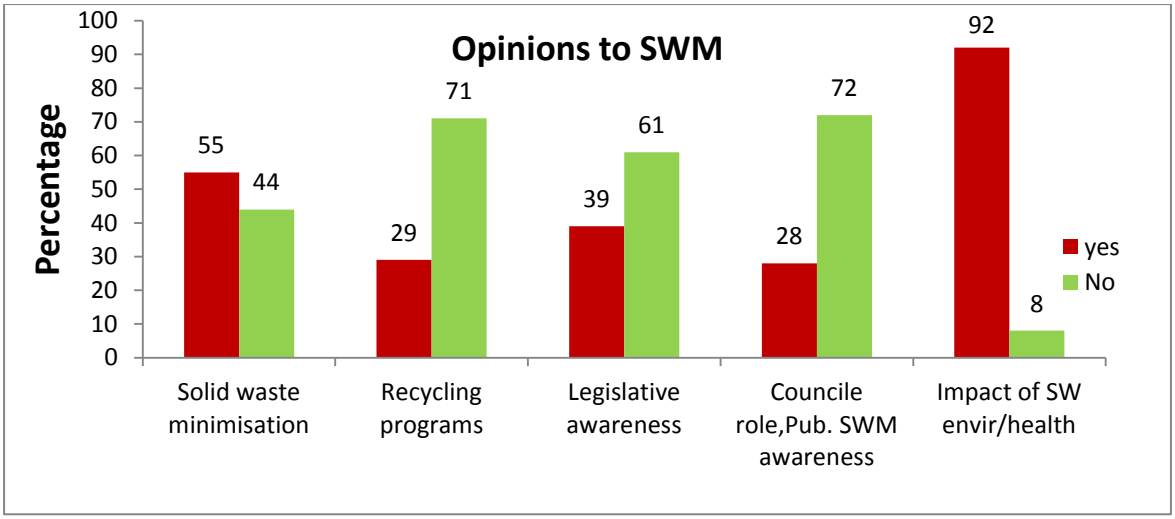

Figure 7 *Public opinions of solid waste management practices in Grahamstown*

11 Discussion

Although different responses and opinions were gathered from both the interview and the questionnaire analysis, the final result indicates that a majority of the population desires waste management services to be improved in the town. And this could be done by increasing waste management facilities, such as giving out enough waste collection bags to households, increasing public waste bins, timely collection and emphasizing waste handling education awareness. 71 percent have never been involved in recycling programs of any kind, and this may be because the council has not initiated such programs and the lack of knowledge to handle generated garbage. 72 and 61 percent respectively acknowledged the fact that the council has partially fulfilled its obligation to organise the cleanliness of the city, because more than 50 percent of the public are not conversant with the regulations pertaining to solid waste management in the country. Despite that 55 percent of the respondents try to minimise the amount of waste generation where they could, a majority of the sorted waste ends up in the landfill due to the absence of recycling facilities.

Nevertheless, 92 percent of the respondents are conversant with the effects of waste disposal on the environment, but the unanswered question is why the city surrounding is still unclean? Perhaps a paradigm shift in management strategy that would let the public understand that it is a civic responsibility to look after the environment could improve the situation? In Curitiba the city council takes it as an obligation to implement management

services, programs and incentives (regular waste collection and disposal of “green exchange” and garbage purchasing programs respectively) for the public and that have immensely contributed to the awesome nature of the municipal environment. The studies suggest that Grahamstown municipal council could copy from this outstanding example as well and also integrate waste management activities in the socioeconomic and even cultural life of the community area. Today waste separation and recycling are considered as a culture of the people living in Curitiba, and it is deeply embedded in the society which was not the case some decades ago. It takes time to commit people to a course of something, and you have to begin from somewhere.

Detail examination on how solid waste management is carried out in Grahamstown and Curitiba indicates that both municipalities have different strategies and methods to keep their environment clean. Curitiba becoming a sustainable and liveable society today portrays that good policy measures and hard work were undertaken by the council as well as the integration of the Curitiba residents in the waste management system of the city council.

In Grahamstown not everyone is involved in the waste management process. Waste management in the municipality is focused mostly around the major towns of the area and other areas are completely neglected. The garbage generated in these areas directly goes to the environment which is not acceptable. The council has failed to initiate programs that could get people involved in effective waste handling. Waste separation and recycling is to the utmost discretion of the residence. People are neither aware of how to handle generated waste or conversant with the legislations binding waste management in the community. The generated waste from households is abandoned on the kerb side for several days before collection, and even during the collection process not all is collected, some is deliberately not collected or forgotten. The municipal landfill does not conform to the standards (Environmental Conservation Act 73 of 1989)**.** The facility is poorly constructed and no pipe system to trap leached out substances. The facility is not covered throughout the year either.

In Curitiba it is the responsibility of the city council and the people to look after their environment. The council has initiated waste management programs that most people are happy and proud to be part of, for example the “green exchange” and the garbage buyer programs. Through these forums nearly all waste generated in Curitiba is recovered and recycled. Children and recovered alcoholics are taught how to handle waste and of the importance of keeping the environment clean. Incentives that encourage people to separate waste are also given by the municipality, for example, sorted waste is exchanged for food items, such as fruits, vegetable and rice. Sweepers and cleaners who regularly keep the street clean are employed by the municipality and they are happy and proud of their job.

Although both municipalities use plastic bags for generated trash, in Grahamstown some households are not provided with bags at all. There have been complaints that a single bag per week is not sufficient for containing weekly generations and because of this the excess waste ends up in the environment. The provision of adequate waste receptacles in the town as well as timely garbage collection could however ameliorate the situation. In Curitiba households are provided with sufficient bags. Everyone in Curitiba is involved in the waste management process in one way or another. The waste in the suburbs and areas of difficult terrain is collected by small trucks and taken to the recycling facility. There are also private garbage collectors who are in charge of the waste in the suburbs and turn in the trash at the recycling centre, and they are paid by the council. Garbage is collected daily, or twice or three times a week depending on the city activities. The council landfill is well constructed and covered daily to avoid environmental pollution (Prefeitura Municipal de Curitiba, 2007). No wonder Curitiba won the international prestigious award for being a sustainable and liveable city.

12 Conclusion

There are no doubts that solid waste management would continue to be a challenge in the municipality, as long as the population continues to thrive. Based on the analysis more than half of the population is not conversant with the bylaws governing solid waste management and also not fully informed about waste treatment methods. The final analysis indicates that a majority of the respondents are fully aware of the effects of waste disposal, yet the

environment is still not sanitary. Neglecting to strengthen bylaws pertaining to waste management and lack or inadequate awareness of waste management handling would only be tantamount to an increase in quantity generations. Thus the need to upgrade current solid waste management practices in the municipality is very vital due to the effects on human health and the environment.

Bylaws governing solid waste management should be strengthened and fully expressed to the community. Education awareness campaigns on solid waste management handling should be carried out by the municipal council via radio, local newspapers, posters, workshops, schools, work places, nongovernmental organisations (NGOs), etc. The campaigns should address issues, such as waste reduction methods, separation at generation points as well as encouraging recycling and composting. Incentives for recycling initiatives could be implemented because this would serve as a motivation and get the community more committed to the course. Landfill operations should be carried out in accordance with state regulations. In addition, successful examples of municipal solid waste management in other developing countries could be emulated as well. Finally, the full implementation of an integrated waste management system would effectively solve the problem of poor waste management in the municipality.

13 Suggestions

On the basis of the results of the study these are suggestions for an improvement of waste management in the municipality:

- strengthening of current solid waste management legislations
- education campaigns on solid waste management
- composting
- recycling.
- provision of adequate collections bags 2-3 per/week
- increased garbage collection points/containers/-glass, plastics, and cardboards
- timely collections of trash by trucks
- easy access (tracks) for truck collections
- control of domestic animals

- support of (incentives) recycling initiatives/local environmental organisations
- improvement of landfill
- outsourcing partly municipal solid waste management services to a private firm

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15 Appendices

Appendix l *Questionnaire Research on waste management in Grahamstown*

Please tick the type/ types of waste you produce	a. Paper	
	b. Plastic and rubber	
	c. Organic or vegetables	
	d. Glass and ceramic	
	c. Others	
Do you agree littering creates jobs?	Yes	No
Do you agree that littering creates jobs?	Yes	No
Do you have a waste /recycling container that is provided by another entity (private?)	Yes	No
If you do not have a waste and recycling collection service, how do you dispose of your household refuse	a. Burning b. Dumping c. Recycling d. Composting	
Have you ever participated in a recycling program at home/at work/ school, etc.	Yes	No
If yes, what did you do		
Are there ways/measures you try to reduce the amount of solid waste- Home/ Work place/ school	Yes	No
Do you agree the municipality has fully taken measures to fight against illegal waste disposal?	Yes	No

What current solid waste services would you like the municipality to improve upon	a. Provision of waste container to households b. Provision of waste containers to specific locations c. Timely collection of waste. d. Sensitisation campaigns e. Employ more workers	
What new solid waste services would you like the municipality to improve-upon		
Do you believe illegal dumping in your neighbourhood or at specific locations is problematic? health/environment/ethical	Yes	No
Are you aware of the fact that the state /municipal legislation that prohibits illegal disposal of waste to the environment?	Yes	No
Do you visit government, municipality websites or journal, articles, news papers and TV programs for information about solid waste handling	Yes	No
Do you agree that the municipality has done enough to raise public awareness on waste management?	Yes	No
Please share any additional comments, concerns or suggestions you may have regarding the municipal solid waste management		

Appendix II

Respondent's analysis, solid waste management practices in Grahamstown (%)

	Methods of SW disposal					Solid waste service improved			
	Burning	Dumping	Recycling	Compost	H. Bins	P. Bins	T. Collect.	S camp.	M. workers
1	✓							✓	
2	✓	✓	✓	✓	✓	✓	✓	✓	✓
3	0	0	0	0	✓	✓	✓	✓	
4		✓					0	0	0
5		✓			0	0	0	0	0
6		✓						✓	
7		✓							✓
8							✓		
9		✓							✓
10	✓							✓	
11		✓			0	0	0	0	0
12		✓					✓		
13		✓				✓			
14		✓					✓		
15		✓					✓		
16		✓					✓		
17		✓					✓		
18		✓			0	0	0	0	0
19	0	0	0	0			✓		
20	0	0	0	0	0	0	0	0	0
21				✓	✓			✓	
22		0			✓				
23	0	0	0	0	✓				
24				✓				✓	✓
25	0	0	0	0				✓	
26	0	0	0	0	0	0	0	0	0
27			✓	✓	✓		✓	✓	
28			✓	✓	✓	✓	✓	✓	✓

29			✓		✓	✓		✓	
30			✓						✓
31		✓	✓	✓		✓		✓	✓
32	0	0	0	0	0	0	0	0	0
33	✓								0
34		✓							✓
35	✓								✓
36			✓						✓
37	✓								✓
38	✓				✓				
39		✓			✓	✓		✓	
40	0	0	0	0				✓	
41	0	0	0	0		✓	✓		✓
42		✓					✓		✓
43	0	0	0	0	✓	✓		✓	
44		✓				✓	✓	✓	
45				✓	✓	✓			
46		✓		✓			✓	✓	
47			✓				✓		✓
48	0	0	0	0	✓	✓	✓	✓	✓
49	0	0	0	0			✓		
50		✓			✓			✓	
51		✓						✓	
52		✓						✓	
	13%	44%	15%	15%	26%	23%	34%	40%	29%

	W.minimi		Recycling. p		Legis. A		P. Education.		H. Impact	
1				x		x		x		x
2	✓		✓			x		x	✓	
3	✓	0		x		x		x	✓	
4	0	0	✓		✓		0	0	✓	
5	0		0	0	0	0	0	0	0	0
6	✓		✓			x		x	✓	
7	✓		✓			x		x	✓	
8		0	✓		✓		0	0	✓	
9	0			x		x	✓		✓	
10	✓	0				x		x	✓	
11	0		0	0	0	0	0	0	0	0
12	✓	0		x	✓			x	✓	
13	0		✓		0	0	0	0	✓	
14	✓			x	✓			x	✓	
15	✓			x	✓			x	✓	
16	✓			x	✓			x	✓	
17	✓			x	✓			x	✓	
18	✓	0	✓		✓		✓		✓	
19				x		x		x	✓	
20	✓	x		x	✓			x		x
21				x		x		x	✓	
22	✓	0		x		x		x	✓	
23	0			x		x		x	✓	
24	✓			x		x		x	✓	x
25	✓	0	✓		✓		✓		✓	
26	0		✓		✓		✓		✓	
27	✓		✓		✓		✓		✓	
28	✓	x	✓		✓		✓		✓	
29		x		x		x	✓		✓	
30				x		x	✓		✓	
31	✓	0	✓		✓		✓		✓	
32	0	x				x		x	✓	
33		x		x		x		x	✓	
34		x		x		x		x	✓	
35		x		x	✓			x	✓	
36		x		x		x		x	✓	
37		x		x		x		x	✓	

38				x		x	✓		✓	
39	✓	x		x		x		x	✓	
40				x		x	✓		✓	
41	✓	x		x	✓		✓		✓	
42		x		x		x		x	✓	
43		0		x		x		x	✓	
44	0		✓			x		x	✓	
45	✓			x	✓			x	✓	
46	✓	x		x	✓		✓		✓	
47				x		x		x	✓	
48	✓	x	✓		✓			x	✓	
49		x		x		x		x	✓	
50		x		x		x		x	✓	
51		x		x		x		x		x
52				x		x		x	✓	
	55%	44%	29%	71%	39%	61%	28%	72%	92%	8%

✓= Yes
x = No
0 = No respond