

Waste management practices in the Theewaterskloof Municipality, Grabouw, Western Cape

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Abstract— Waste management is one of the challenges facing municipalities over the world, in Africa and in some parts of South Africa. The study evaluated waste management practices in Grabouw, Theewaterskloof Municipality. A waste management practices survey (using questionnaires and interviews) was carried out in Grabouw for the duration of 8-months. Four (4) residential areas were selected in Grabouw for undertaking the study. The selected residential areas were Rooidaka, Smarty Town, Zola and Marikana. These residential areas were selected based on the initial visit to Grabouw, where piles of waste on the streets and within the river systems were observed. Additionally, certain organizations were randomly selected based on their involvement in waste management. The selected organizations were Community Development Workers (CDW), Community Workers Programme (CWP), Theewaterskloof Municipality (TwK), and the Community Members (CM). The study used both qualitative and quantitative methods. The study revealed that waste management practices in the study area are misunderstood, inefficient and fragmented. Furthermore, the study showed that community members were not involved in waste management planning, waste receptacles allocated to households were too small and only two trucks were servicing the Theewaterskloof Municipality for waste collection. The waste management practices applied within Grabouw were limited to collection, transportation and disposal. The major issues that affected waste management practices in Grabouw, Theewaterskloof included organizational structure, insufficient waste management investment i.e. financial and human resources, lack of waste management planning, education and awareness that included uncoordinated political interference on the application of waste management practices. The study discussed and provided waste management practices applied globally, in Africa, and in other parts of South Africa as well as within the study area, which are

misunderstood and finally recommended sound and sustainable waste management practices.

Keywords— Grabouw, Sustainable Waste Management, Theewaterskloof Municipality, Waste Management, Waste Management Practices, Waste Management Services Planning.

I. INTRODUCTION

Waste is any unwanted material left over from an industrial process, community and household activities. The material may be discarded or accumulated, stored, or treated (physically, chemically, or biologically), prior to disposal or recycling. Waste management is generally understood as the management of waste collection, transportation, recycling, disposal and or monitoring of waste. Waste materials are managed to avoid any adverse effect over human health and environment [1].

Waste management practices are defined as any techniques, innovations and/or methods used to reduce, handle and manage any streams of waste. These are often referred to as waste innovations, used to turn waste materials into usable products or help make sound decisions on waste handling and disposal [1, 2]. Waste management is perceived to be problematic in different parts of the world due to piling of waste on the streets with poor to no proper waste management practices in place to manage the waste. As the result of increasing population and the environmental related pressures, reliable provision for waste control and waste disposal improvement is necessary [1, 2]. Globally, in the last decade of the 20th century, it became clear that waste management practices were seen as a technical problem, but with time it becomes a management problem, which must be dealt with by all concerned stakeholders. If steps are not taken to properly monitor and control the application of waste management practices across all sectors, and provide well-managed disposal and recycling facilities, the problem of waste will continue to

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pose an increasing threat to human and environmental health [1-3].

Different factors influence municipal waste management practices and the frequently debated are income type, education levels, type of house i.e. individual or rented property, availability of waste collection workers, household maids and the family member's knowledge of the harmful effects of improper municipal solid waste management practices. These factors do influence waste management practices in different cities. Within the Theewaterskloof Municipality (TwK)- Grabouw, the problems facing waste management practices were observed. The observations showed piles of waste in the streets and on open areas being used as dumping sites. No waste recovery initiatives were observed except for a metal scrap yard. Waste management practices were only focused on collection, transportation and disposal. This raised questions on the understanding of resident's role in waste management and additional waste management practices that could be applied in the study area. The perception was that various communities in Grabouw, formal and informal settlements could be the highest contributor to waste management issues [3, 39].

Residents in poor urban communities usually must cope with heaps of waste which are left lying uncollected. Despite the abundance of studies on waste management, relatively little attention has been given to the evaluation of waste management practices. This could explain why residents adopt environmental unfriendly practices such as the dumping of waste onto the streets, public areas, lowlands and into rivers and streams which can have dire public health and environmental consequences. Residents have a role to play in waste management and observations made in Grabouw of the Theewaterskloof Municipality do not present a different overview of residents and municipal involvement in dealing with waste management [4].

An inspection of the study area revealed that some of the waste generated in Theewaterskloof Municipality (TwK), Grabouw is finding its way into the local rivers and streams resulting in changes of the watercourse characteristics. This could be attributed to poor waste management practices. Therefore, an evaluation of waste management practices is an essential element for efficient and successful management of waste in the Theewaterskloof Municipality of Grabouw. Hence a study was undertaken in Grabouw, Theewaterskloof Municipality, Western Cape to evaluate current waste management practices in the residential areas of Grabouw, Theewaterskloof Municipality [3-5].

II. BACKGROUND TO WASTE MANAGEMENT SERVICE DELIVERY, SUSTAINABLE WASTE MANAGEMENT AND WASTE MANAGEMENT PRACTICES

1. WASTE MANAGEMENT SERVICE DELIVERY

Waste management service delivery amongst others includes the collection, transportation, recovery and disposal of waste, the supervision of such operations and management of disposal sites. Waste management service delivery also, entails strategic planning, prescribing options, prevention of contamination of the environment and conservation of resources, minimizing the amount and toxicity of waste creation [5-12]. Waste management service delivery is generally understood by most citizens abroad and in South Africa, as a precise name for waste collection, transportation, recycling, disposal and/ or monitoring. It appears that waste management service delivery has improved at local government, but the perception is that local municipalities are still faced with many real challenges [13].

Local government have a critical role to play in waste management service delivery. The local authorities should consider establishing long-term goals and objectives, develop a plan which indicates how and when waste is collected as a method for delivering waste management services to respective communities. Through its role in waste management, municipalities should ensure that communities are protected from the risk of injury, illness, and disease through appropriate application of waste management practices [10-13].

On the other hand, the South African Constitution requires local government to provide communities with fair, affordable and sustained basic services, which include waste management. Most municipalities and cities in South Africa including the Theewaterskloof Municipality (TwK) in Grabouw are faced with serious economic, social and environmental challenges related to solid waste management. The waste disposal methods, which the municipalities currently rely on such as landfills, are not environmentally sustainable and municipalities are facing difficulties in complying with regulations and other environmental laws. Additionally, the depletion of available landfill space, particularly in the large cities and metros increases the current challenges of municipalities. The South African waste management strategies requires spheres of government to take a different approach to waste management and call for an integrated approach to waste management that adopts the following waste hierarchical principles: avoid, reduce, recycle, re-use and (only as a last resort) of waste's disposal [14].

However, municipalities generate revenue through user charges (tariffs), levies, rates and taxes. In most cases, the revenue sources are inadequate because they are mainly taxes, and are becoming unaffordable for communities, especially poor and impoverished households. Many South African municipalities in general and the Theewaterskloof Municipality, Grabouw in particular, contains of a large, impoverished population who cannot afford to pay for basic services. Government's policy on Free Basic Services (FBS) provides these impoverished households with basic services that include refuse removal [10, 27, 30, 32, 35, 39]. Refuse removal is perceived as one free basic service that is expensive, and most municipalities do not have the resources to offer it. For municipalities with excessive number of impoverished households, generating revenue from refuse tariffs, rates and levies is not sustainable and or adequate to sustain waste management services [14 - 30].

2. SUSTAINABLE WASTE MANAGEMENT

Sustainable waste management are options or techniques that employ environmental friendliness. Such techniques are believed to be effective, efficient and less costly than many available and applicable options. Solid waste management is a difficult task in most developing countries due to factors like poverty, education, population growth, urbanization and lack of proper funding by government which is also the current scenario in South Africa. Composting is one of the waste practices that is not costly to apply, when properly managed. It is sustainable with various advantages such as production of bio-fertilizer and generation of income, which are important in low-income areas [15, 40].

Recent debates on waste management governance show a complication within government structures with a potential for conflicting targets and frequent shortfall of practices compared to policy requirements. Although waste is regulated within spatial defined units, its composition and quantities are determined by economic processes operating at different scales to that of municipal waste governance. Local authorities consider the composition and quantity of the municipal waste stream as an independent variable [15, 16, 18, 23].

Waste reduction and waste separation are viewed as the two preferred practices in sustainable solid waste management (SSWM) [16]. These two practices are impossible to implement without community members' awareness as well as a strong commitment and support from city authorities. Cleanliness of communities is strongly connected to participation by community members in waste reduction and

separation. This proves that if community members are involved in waste separation and reduction, there would be visible results in terms of the cleanliness of surrounding environments and in communities [16 – 30]

The increase in population, economic growth, wellbeing, and rapid urbanization are significant factors that contribute to waste generation. Integrated and sustainable waste management should not only be a top priority but must go beyond technical aspects to include several key elements of sustainability to ensure success of any solid waste project. Excessive waste generation is driven by a rapid population growth in urban areas, which therefore possess a challenge for integrating waste management services into sustainable urban planning. Urbanization has become a major issue in the sustainable development debate, mainly because of the challenges associated with planning and development for unpredicted influx of people. Same to the case of urbanization, waste management services require careful planning and integration into spatial planning [16].

Transitioning to a sustainable waste management system requires an identification and application of leverage points which affect change. A sustainable waste management system has:

- A particular focus on the process and not the products, and
- Links the three pillars of sustainable development i.e. social, economic and environmental aspect, to ensure that none of the sustainable development pillars are negatively impacted.

The process to transition to a SWMS is achieved by using increased powerful leverage points to change the parameters of a WMS to become a more effective system. Thus, the best example of an effective WMS is the recycling of solid waste which has the potential to create direct, indirect and induced 'green' jobs. For example, direct jobs can be created at public and private waste recycling facilities, while indirect jobs can be created through businesses that purchase recyclable commodities such as processors (compost manufacturers and scrap metal dealers) [17, 40].

3. WASTE MANAGEMENT PRACTICES

Waste management practices are viewed as any techniques, innovations and or methods used to reduce, handle and manage any streams of waste. These are often referred to as waste innovations used to turn waste materials into usable products or help make sound decisions on waste handling and disposal. There is still controversy regarding the understanding

of waste management practices and its applications to deal with the piling of waste in our residential areas. Also, there is no political direction in terms of a preferred method for waste treatment. Interactions between changes in land filling, incineration and recycling are not well understood. The benefits and impacts of investing in different approaches to be employed to achieve reduction in land filling are uncertain and this demonstrates high dependency on land filling [2, 19].

The problems of waste management are a result of the increasing population and yet political institutions, and administrations fail to manage massive amounts of waste resulting from new developments and packaging materials. Increasing waste volumes beyond the current infrastructural and organizational, institutional and financial arrangements can trigger challenges for the application of waste management practices. The participation of community members in waste management is seen as an effective tool for waste management and it is believed that community members with higher education are more likely to participate in waste management initiatives and/ or activities compared to the illiterate. There is an increasing concern in the understanding of the waste management concepts, practices and the application of waste management practices in South Africa and within the Theewaterskloof Municipality, Grabouw [19]. Therefore, there was a need to determine current waste management practices at Grabouw residential areas and to identify potential shortcomings, weaknesses and failures of the present waste management practices [30, 39].

III. METHODOLOGY

A. STUDY AREA

The study was undertaken in Grabouw, Theewaterskloof Municipality (TwK), Western Cape Province, South Africa. Grabouw is classified as the second highest town in the Theewaterskloof Municipality and is predicted to experience continued growth within its central business, industrial and residential areas. Grabouw experienced very high levels of population growth over the last 5 to 10 years [5, 38]. Grabouw is located along the N2 as the main point of entrance or exit to the Cape Metropolitan Region, the Overberg and the Southern Cape and as the point of convergence of routes serving the agricultural production areas (economic base of the sub-region) and of towns and rural centers, in the sub-region. Grabouw is a mid-sized town located in the Western Cape Province of South Africa, 65 km southeast of Cape Town along the N2 highway. Grabouw is the commercial center of the Elgin Valley and the largest single export fruit producing area in Southern Africa [6, 38]

B. STUDY RESEARCH DESIGN

The approach used to evaluate current waste management practices in Grabouw, Theewaterskloof draws on the initial observations to the study area. As such, qualitative and quantitative research-based tools (mixed method approach) were selected to provide meaningful contribution to the research. This method involves collecting both qualitative and quantitative data, integrating the two forms of data and using distinct designs, which incorporate philosophical assumptions and theoretical framework. The qualitative and quantitative approach aided the researcher to provide a complete understanding of the study problem. A qualitative research-based tool was best suited for this study because it assisted the researcher to identify current waste management practices in the Theewaterskloof Municipality, Grabouw. While a quantitative research-based tool aided in determining the sequence of waste management services, amount of waste generated and collected as well as the number of trucks used to collect waste [24, 38].

Grabouw possesses two different settlements, formal and informal settlements which were considered for this study. To provide precise comparison of waste management practices in the study area, two informal settlements and two formal settlements were selected. A set of questionnaires were developed for identified community organizations involved in waste management, for community members in both selected formal and informal settlements and for municipal representatives. Questionnaires and personal interviews were used to gather required data over an eight-month period to complete this study. The study has dealt with a range of forms of evidence such as available documents and publications, interviews, research questions completed and observations. The variety of evidence obtained in this study made it more feasible to provide meaningful answers to the study questions [24].

Collection of qualitative data was designed in such a way that the answers were open ended without predetermined responses while, collection of quantitative data was designed in such a manner that the responses included closed ended responses. The questionnaires were designed to provide responses for both qualitative and quantitative data from the waste management organization employee's, community members and representatives from Theewaterskloof Municipality [25-38].

A total number of 100 households were targeted for data collection, due to unavailability of some household's members and unwillingness to participate, a total number of 30 community household was obtained. A number of households were randomly selected per residential area for completion of questionnaires. Ten community members per each formal residential area i.e. Smarty Town and Roodaka were given a

questionnaire to complete, except for a few household members who were unable to write and were assisted by the researcher. Five community members per each informal residential area i.e. Marikana and Zola were also provided with the questionnaires to complete. This made up a total of 30 households from which data was collected from; 20 from the formal residential area and 10 in the informal residential area. An interview was held with one (1) municipal representative using a set of questions specifically formulated for the municipality. A focus group of 16 community workers programme (CWP) was interviewed and four representatives of the Community Development Workers (CDW) involved on waste management in the study area. This amounted to a total of 51 participants consulted during data collection process [26, 38].

C. DESCRIPTION OF VARIABLES

In this study, independent and dependent variables were identified and the relationship between them is calculated to test the correlation coefficient. A variable is an observed phenomenon which takes on diverse values [13, 22, 31, 42]. It is a logic grouping of attributes and attributes are characteristics that describe an object such as age and environmental beliefs amongst other things. The following variables were established for this study:

- Waste Management Practices Budget (WMPB) = **Independent variable (X)**
- Availability of Waste Management Practices (AWMP) and
- Understanding of Waste Management Practices (UWMP) = **Dependent Variables (Y)**

Waste management practices budget was identified as an interdependent variable for this study, while availability of waste management practices and understanding of waste management practices were identified as dependent variables. Independent variable (X) is manipulated to determine the possible effect or brings about a change in an observed occurrence which creates the relationship with the dependent variable [30 – 32, 42]. Dependent variables (Y) are variables which the effect is focused and are assumed to depend on independent variable. It observes and measures the affected independent variable [30–32, 42].

The relationship and dependability between two variables are essential. Where there is no relationship between two variables, the effect is rejected. The availability of waste management practices and the understanding of waste management practices by community member's is determined by the budget allocated to waste management practices which then clarifies the cleanliness and or dirtiness of the city [30].

a. Variable Correlation Test

A correlation analysis was determined by correlation coefficient test, where correlation coefficient of +1 indicates a positive relationship, correlation coefficient of 0 indicates no relationship and correlation coefficient of -1 indicates a negative relationship. WMPB (X) was assigned numerical values indicating the budget for waste management practices leading to the cleanliness of the town [31].

AWMP (Y) was assigned numerical values showing the impact caused by limited waste management practices budget. UWMP (Y) was assigned numerical values indicating resultant effect from unavailability of waste management practices [31].

Limited waste management practices budget, results in unavailability and or limited number of waste management practices and poor understanding of waste management practices by community members and those involved in the waste management sector. The numerical values assigned to both independent and dependent variables illustrate the correlation coefficient between variables. The correlation coefficient was calculated using Microsoft Excel. A correlation coefficient of 1 was observed which indicates positive correlation between variables. As variable X increases, variable Y increases. As variable X decreases, variable Y decreases. A correlation coefficient of 0 indicates no correlation [13, 22, 42]. Figure 1 illustrates the correlation analysis using R square value [31, 42].

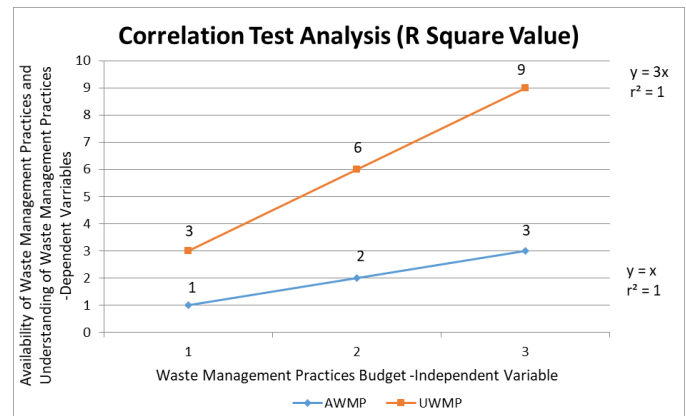


Fig. 1: Variable (s) correlation analysis test graph

The correlation analysis Figure 1 above shall be read in conjunction with Table 1 below which indicates correlation coefficient between the independent and dependent variables for this study. The correlation coefficient (CoE) is 1 which indicates a positive relationship between variables [32].

TABLE I Variable (s) correlation coefficient test

Variable (s)	Value (s)			Coefficient (CoE)
Waste Management Practices Budget (X)	1	2	3	1
Availability of Waste Management Practices (Y)	1	2	3	
Waste Management Practices Budget (X)	1	2	3	1

b. Data Analysis

Primary data obtained through questionnaires was presented in tables and graphs developed to show trend patterns with regard to waste management practices on both formal and informal residential areas in Grabouw. Both discrete and continuous variables were used to present data obtained from the study area to determine current waste management practices in Grabouw residential areas as well as the shortcomings in waste management.

Data obtained from interviews (primary data) was analyzed using content analysis, which includes recording of themes. Each of the recorded interviews had been reviewed three times: firstly, to identify common themes; secondly, to highlight all parts of the text that matches identified themes; thirdly, to verify that no major theme categories have been missed and all parts of the text that matches identified themes are marked. The researcher was interested in any recurrent themes, which could assist in the formulating of conclusive arguments and recommendations.

For this study, secondary data was examined to determine relevance of the available data by looking at the data's original purpose, when it was collected, population, sampling/sample strategy, data collection protocols, questions asked, and the form of data. Through interpretation of available data, the researcher was able to identify common themes and data relevant to the study.

Examining secondary data was intended to provide answers to the study questions other than the questions for which the data was initially collected for.

IV. RESULTS AND DISCUSSION

The results of this research are from the data collected using research methods explained above to respond to research questions and objectives regarding the evaluation of waste management practices in Grabouw, Theewaterskloof Municipality (TwK). The work is structured in the following sub-headings:

1. WORK EXPERIENCE

Work experience here refers to the number of years each representative from the selected organizations had been involved in waste management. Work experience has been included in this study to verify the number of years each representative has been involved in waste management (Table 2). This was selected to determine the knowledge of representatives on waste management practices, including their understanding and participation in waste management practices [14, 37].

It could be argued that the increased years of experience of representatives contribute to the understanding of waste management and the participation in waste management practice. Therefore, representatives with more experience would be more knowledgeable in waste management and participation in waste management than those representatives with less years of experience [14, 37].

TABLE II: Work experience of the selected organizations

#	Community Development Workers	Theewaterskloof Municipality	Community Workers Programme
No of Years	3 years	7 years	2 and 8 years
Working arrangement	Contract	Full Time	Contract

The role of waste collectors in Sustainable Waste Management is often under-recognized. In most South African towns and suburbs, some residents are using trolleys for collection of paper, plastic, scrap metal and cardboard boxes, intended for recycling by selling it to recyclers and waste merchants. Currently, the role these residents play in the recycling industry has not been researched and analyzed. The relevant experience of waste collectors being incorporated in municipal waste programs is unknown. The study reveals that CDW representatives were involved with the organization for three years. While the Theewaterskloof Municipality (TwK) representative had 7 years of involvement with the municipality. However, the years of involvement with the organization of the CWP ranged between two to 8 years. The experience of waste collectors alone on waste collection programs cannot be viewed as a complete tool to deal with current waste management issues in Grabouw. However, the number of years of experience presented by TwK and CWP presents reasonable grounds for the representatives to understand waste management and participate in waste management practices. While CDW had the least years of experience/involvement with the programme, the representatives presented an adequate understanding and

participation in waste management. There appears to be little support provided to the waste collection programs from Theewaterskloof Municipality in terms of finances, guidance through education levels or capacity building. Financial and capacity building support in existing waste collection programs in Grabouw is seen as one of the tools which could assist to improve the municipal solid waste system [37-39].

Members of the CDW focus group indicated that the organization was established between 2011 and 2012, but since then, the organization has not shown growth in terms of human resources. This was mainly due to limited funds invested in the CDW waste management programme. Since the organization was established, only four members have been actively involved. This proves that too often; the waste management sector is neglected. Unavailability of funds invested in waste management programmes is one of the immediate challenges facing the waste management sector. Increasing waste volumes beyond the current infrastructural, organizational, institutional and financial arrangements can trigger challenges for the application of waste management practices [37 – 39].

The study also revealed that the TwK representative was responsible for several sectors which included water, sewage and solid waste. The work experience of the TwK representative proved that he was experienced enough to handle the waste sector, however, the combination of different sectors and lack of supporting professionals within these sectors suggest a challenge in managing waste within TwK. Increasing waste volumes that exceed the capacity of existing organizational structures pose challenges in the management of waste. Given the current waste management challenges in Grabouw, an additional responsibility on the TwK official will pose more deficits on resources allocated for waste management. A well-structured waste sector has responsibilities allocated to each personnel for a purpose of achieving waste reduction and collection targets. The researcher's perception is that each of these sectors should have a responsible person if the waste management sector is to improve [39].

CWP representatives presented a different view when asked how long they were involved with the programme. Based on Figure 2, the majority of respondents have been involved with CWP from year 2011. This shows that the programme is sustainable, even though some of the longest serving employees did leave due to the working arrangements, such as contract and limited funds invested in the CPW programme. The monthly stipend provided to CWP members range between R1000.00 to R2000.00 depending on the number of years serving within the program. Thus, the limited funds invested in the programme, resulted in the longest serving members of the programme seeking new opportunities. Unavailability of funds is one of the immediate challenges

facing the waste management sector. Compared to the CWP stipend, the CDW stipend is even lower, as it is estimated between R1000.00 and R1500.00 per month [39].

There are many factors that influence waste management practices and the more debated are income types, education levels and type of household for example low-income households as in the case of Grabouw, Theewaterskloof. It is perceived that respondents with higher education levels are more likely to participate in waste management activities compared to the illiterate. The study presented a different scenario, where it was found that illiterate community members are more willing to participate in waste management. However, the waste management information is not shared with or among them. This is a matter of concern when trying to sort out waste related issues within the municipality because environmental awareness of communities is an important tool that can be used to reduce the negative impacts of poor waste management on the environment [38 – 41].

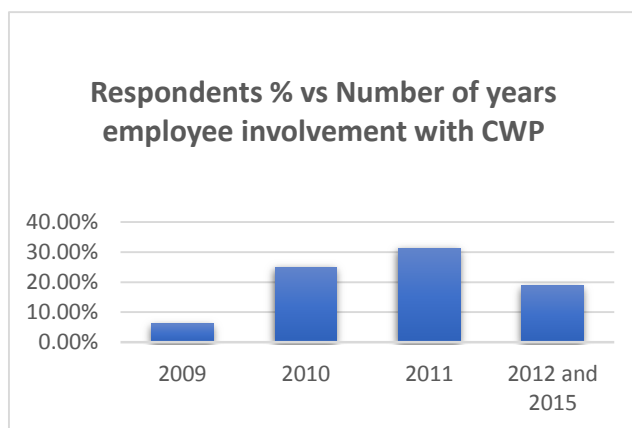


Fig. 2: CWP respondents in waste involvement (Percentages vs. number of years)

2. WASTE MANAGEMENT PRACTICES

The National Waste Management Strategy (NWMS) published in 2011 and amended in 2020 requires, government department's i.e. national, provincial and local government to take a different approach to waste management, which is stipulated in the promulgated National Environmental Management Waste Act, Act 58 of 2008 [39]. The NWMS calls for an integrated approach to waste management that adopts waste hierarchical principles: avoid, reduce, recycle, re-use and (only as a last resort) disposal of waste. As stipulated by legislation and being part of the waste hierarchy principles, appropriate application of waste management practices is of vital importance to deal with piles of solid waste which lands in the streets and in open areas [39]. Table 3 shows the organization's responses on current waste management practices in Grabouw.

Table III: Waste management practices in Grabouw

#	Community Development Workers (CDW)	Theewaterskloof Municipality (TwK)	Community Workers Programme (CWP)	Community Members (CM)
Number of plastic bags collected per day	30 plastic bags collected per day	± 2000 tons of waste collected per month	100 packed and collected per day	Only waste bins used
Who collects waste and How often is waste collected	TwK collects waste every day at working areas	TwK collects waste once a week in every community	TwK collects once a week at working areas	TwK collects once a week

Data obtained from CDW shows that there are 30 plastic bags collected per day. The waste collected by the programme is not quantified in terms of the number of tons of waste collected per day. The most important aspect of solid waste management is the quantity of waste to be collected, transported and managed. The quantity of waste determines the size and the number of waste collection areas and equipment required for managing waste. The waste quantities are measured based on weight and volume. The weight remains the same for a given set of rejected objects whereas volume is highly inconsistent. Therefore, no quantification of waste collected by CDW leads to poor or no available data for proper analysis, to determine which areas generate more waste and the type of waste generated [38-40].

CDW respondents pointed out that the two trucks which collect packaged waste; at specific times do not come to collect waste according to the schedule. This leads to wind-blown waste that ends up in the river system as shown in Figure 6 [39]. Responses show that 100% of CDW employees have no idea of where the collected waste is taken to. CDW highlighted that there is no waste recycling facility in Grabouw. However, TwK pointed out that there is one waste recycling facility in TwK. This indicates that most waste generated by the TwK is disposed of at Karwyderskraal landfill site [39].

The current waste disposal methods, such as landfills, are not environmentally sustainable, and municipalities have difficulty complying with regulations and other environmental laws. Waste generation, reduction, collection, re-use, recycling and disposal should be properly analysed in order to make

meaningful decisions. Analysis of waste provides a platform for development of waste management concepts, a proper recycling design, treatment and disposal facilities. A successful waste management plan relies on consistent data on current waste amounts and composition, including relevant physio-chemical properties, and accurate prediction of solid waste generation for the relevant planning period. A good waste management plan must consider and ensure that there were adequate public review and consultation during development before approval. In addition, it must be able to promote the 3 R's of the waste management hierarchy for example reduce, reuse, and recycle for its sustainability purpose [38 - 41].

There are only two trucks used to collect and transport waste to a landfill site in TwK Municipality. The number of trucks used for waste collection is not sufficient for handling the amount of waste being generated and ultimately ends up in open areas. The current waste management practices in Grabouw need to be reviewed and integrated in the spatial development framework and a separate integrated waste management plan should be developed. This will assist the municipality to save costs used to clean open spaces which are used as dump sites by communities. About ±2000 tons of waste is collected per month by the TwK, using two trucks (5 to 6 years old) which are believed to be in good working condition. For a municipality of this size, the trucks being used to collect waste are not sufficient. At least four to five trucks should be used to collect waste within TwK. The waste collected by the organizations (CDW and CWP) should be quantified to determine the impact of these programmes on the total number of tons of waste collected per day/month in Grabouw and TwK. Waste is only collected once a week in TwK which is a standard practice in South Africa [27, 30, 39]. Data obtained from the CWP organization indicates that 100 plastic bags are packaged per day and temporarily stored along the road for collection by the municipal trucks. Similarly, as the waste collected by CDW, CWP's collected waste is not quantified. The packaged waste by CWP is only collected once a week, which agrees with findings from the TwK (Table 3). It is also evident that the two trucks which collect waste in the TwK sometimes do not come to collect packaged waste from CWP, due to mechanical breakdown and repairs which result in piling of uncollected waste on the streets.

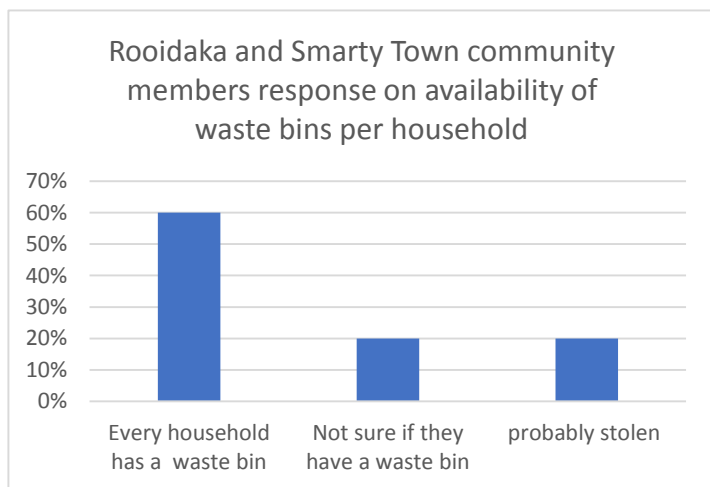


Fig. 3: Rooidaka and Smarty Town community members' response on availability of waste bins per household.

Based on Figure 3, sixty (60%) percent of the community members from the two developed residential areas (Smarty Town and Rooidaka) believe that every household has a waste bin. Twenty (20%) percent of the respondents indicated that they were unsure and the other twenty (20%) percent pointed out that if a household did not have a waste bin, then it must have been stolen. Moreover, all the respondents casually mentioned that the waste bins issued to them are too small (they fill up quickly) referring to a 120-litre container as shown in Figure 4. The prominent waste bin size issued to communities is 240-litre in size. Therefore, based on the fact that TwK municipality only collects waste once a week, the researcher recommends that the municipality should issue each household with a 240-litre waste bin, to ensure that there is no waste being disposed of in the streets or overflowing waste in the household's yard.



Fig. 4: Example of a 120-litre waste bin issued in Grabouw residential areas

Findings from the study area show that there is no coordinated system in place to manage waste and that the three pillars of sustainable development are not mutually prioritized. The social and environmental pillars are neglected as shown in Figure 5. The understanding and knowledge of waste management practices amongst the community members is also limited. However, it appeared that the municipality (TwK) is willing to adopt new practices such as waste composting and waste to energy strategies in areas such as Grabouw, which have high levels of waste generation. The challenge is that there is limited information available about alternative waste management practices which could be adopted in Grabouw. Also, it seems that there is no available budget to incorporate other waste management practices such as composting. A significant obstacle in the study area to achieve sustainable waste management practices was the lack of opportunity to segregate waste at the point of its generation such as at households, schools, public halls and in town. The other prevailing challenge to effectively and efficiently manage waste is the issue of small, zoned areas for the latest landfill sites development. The latest landfill sites have a limited capacity of three to four years. Landfill development requirements are often neglected in many instances and this poses difficulties in managing waste. Construction and demolition of waste which cannot be recycled is increasing and the only solution at present is disposal to a landfill site and this further reduces the capacity of the landfill sites.

Based on Figure 5, 80% of CWP employees are not aware of the waste disposal facility when waste leaves the working areas. While 20% assumes that it's being disposed of at landfill site. On numerous occasions CWP noticed their packaged waste not collected by the municipality and the plastic bags which they use to package waste torn apart. Waste management practices in Grabouw are largely dependent on waste disposal. The benefits and impacts of investing and employing different approaches to achieve reduction in land filling are uncertain and this demonstrates the high dependency on land filling which is not a sustainable waste management practice [39].

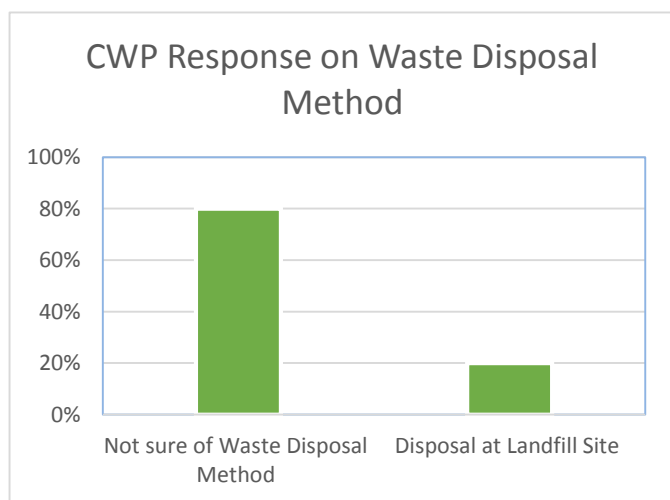


Fig. 5: CWP response on Waste Disposal Method

Attaining sustainability in waste management requires an option that employs environmental friendliness. Such techniques must be effective, efficient and less costly than many options available for application. Composting is one of the environmentally friendly techniques which can be employed within Grabouw and the composting being produced could be utilized by the farmers in the area. It is also, one of the waste practices that is not costly to apply when properly managed. Composting is sustainable with various advantages associated with it such as production of bio-fertilizer and generation of income. These factors are key for poverty alleviation and enhancing the community's standard of living. Data obtained from quantifying waste collected in the residential areas would be useful to undertake decisions on whether a composting facility would be feasible in Grabouw and what other waste management practices could be applicable.

Waste characterization is a better option to assist municipalities to understand waste generation patterns, which should stimulate the basis for a better decision on the sustainable strategies to manage waste in Grabouw. Additionally, similar studies can be carried out in the TwK, particularly at Grabouw to determine which immediate waste reduction practices can be employed to manage waste, as the current practices is not environmentally friendly. Having conducted waste characterization, municipal waste governance should engage private sector entities that determine the composition of products and challenge them to design and develop environmentally friendly products to ensure that municipalities do not encounter difficulties of having to deal with piles of waste which poses difficulties for recycling. It is evident that industries have also failed to manage waste, with manufacturers primarily determining the material composition of their products and packaging; forcing them to manage the waste problem. Waste is increasingly privatized and there is a

lack of a coordinated state effort to regulate waste generation. Solid waste generation and management has become a prominent issue in local municipalities including TwK and one that often lacks clear political direction on how it should be managed [39].

The respondents from the two informal settlements, Zola and Marikana indicated that they do not have waste bins and this is a common practice in South Africa. If the municipality is unable to provide waste bins for the informal dwellers in the two informal settlements, centralized waste skips should be provided. Four (4) waste skips for each informal settlement would be preferable and should be collected on a weekly basis. Samples of waste generated from each informal settlement can be taken from the full skips to perform a waste characterization study. This will enable determination of waste management practices which can be implemented.

Additionally, visual observations also confirmed that there are no waste bins provided in the two informal settlements, as the dwellers were using plastic bags to dispose of their waste. When the plastic bags are full, they are taken closer to the road to be picked up by the municipal truck. Despite all the effort taken by some individuals, there are dwellers who still dispose of their waste in open spaces due to waste bins not being provided. For this reason, waste ends up in the river systems as shown in Figure 6.



Fig. 6: Waste lying in a river stream near the Zola informal residential area

3. WASTE MANAGEMENT SERVICES PLANNING

Waste management services' planning is of importance to determine barriers to sustainable waste management and devise strategies to combat waste management issues. Table 4 highlights responses of the two organization (CDW and CWP), Theewaterskloof, and community members on availability of a waste management plan (WMP) which indicates how waste management services are planned as well as their participation in its development.

CWP representatives agreed with findings obtained from CDW regarding the availability of a waste management plan which would define the working areas and the entire waste management process. In both organizations, the responses indicated that there is no available waste management plan which the programme use to operate in Grabouw residential areas. This shows that the respondents did not participate in

the development of the WMP. However, the CWP organization manager selects working areas on a weekly basis and informs the organization representatives on areas where work will be undertaken [38-40].

Waste management is still problematic in different parts of the world with disagreement regarding the understanding of waste management practices and its applications to deal with the piling up of waste in residential areas, as evidenced by Figure 8. This resulted because the CWP's is not aware of other waste management practices which can be employed to deal with piles of waste ending up on the streets, except by collection and transportation. This proves that there are no documented waste practices, waste management services planning, and no waste innovations introduced within TwK. Waste management requires proper planning and research. The situation in Grabouw presents a clumsy picture of how waste is being planned, managed and this should be improved by developing a clear waste management plan indicating the problematic areas in Grabouw and Theewaterskloof. The waste management plan should include the following minimum requirements: waste collection points; collection times; quantification of waste collected per area; practices to be employed to reduce, recycle and recovering waste which are almost non-existent at this stage.

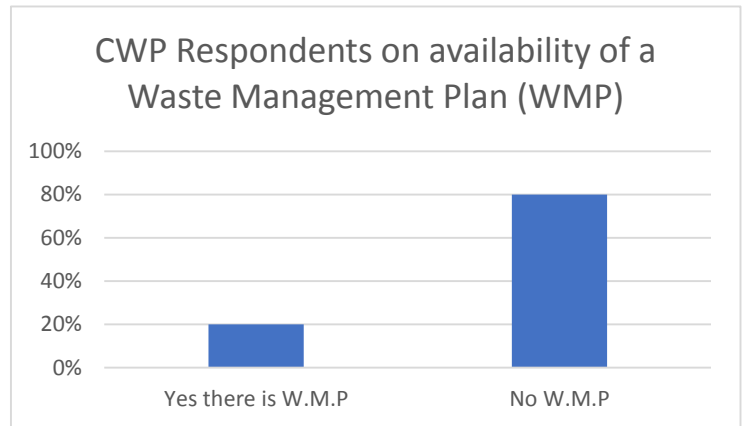


Fig. 7: CWP response on availability of a Waste Management Plan (WMP)

Based on Figure 7, 20% of CWP employees believe that a WMP is being kept by management. While 80% argued that there is no such thing as a WMP. This provides an indication that employees were not trained on waste management practices nor involved in the development of a WMP. The findings from the study area indicated that the way waste is handled is not sustainable and TwK management needs to reconsider how waste can be managed in a sustainable manner. This can only be attained when the connection between sustainability planning, institutional governance and municipal finances are realized and uniform targets are developed and implemented.

On the other hand, community members from the four selected residential areas noted that they were never involved in the waste management planning. This statement concurs with findings obtained from the TwK, suggesting that the IWMP was only developed by a consultant and no members of the community were involved in its development. No copy of the IWMP was found on the municipal website, while an adopted Integrated Development Plan of 28 March 2013 for the period 2012 to 2017 showed little commitment to waste management. Community involvement in waste planning, waste reduction and waste separation is strongly related to a sense of cleanliness in the community. Therefore, communities should be involved in waste management planning. Moreover, an average of 30% of the interviewed community members in both developed residential areas indicated that if the municipal truck did not come to collect waste or certain households missed collection times, then that waste frequently ends up in the open spaces. Observations by the researcher proved that these open spaces are located close to flowing river streams. Such issues can be avoided if community members are involved in waste management planning. CDW and CWP should receive training related to waste management practices to provide them with more exposure on the opportunities that exist in waste management services. Knowledge shared with CDW and CWP could spread through the entire communities,

Table IV:

Responses of Theewaterskloof Municipality and community members on the availability of a waste management plan and participation in the development of WMP

#	Community Development Workers (CDW)	Theewaterskloof Municipality (TwK)	Community Workers Programme (CWP)	Community Members (CM)
Availability of a WMP and representatives participation on its development	No specific WMP in place. Therefore, no participation in its development	IWMP drawn up by consultants. IWMP was not available on municipal website. Community members were not involved in its development	No specific WMP in place. Organization manager selects working areas and informs the representatives	Community Members are not involved in the development process of a WMP

as most of the members are from the selected communities for this study. This would potentially reduce incidents of waste disposal on open spaces as shown in **figure 8**.



Fig. 8: Waste in an open space between Smarty Town formal residential area and Zola informal residential area

Waste management practices are more of a management problem than a technical problem and must be borne by all concerned and affected parties. Moreover, a waste management plan outlines how waste management services are planned i.e. collection points and trucks to be used, recovery process, recycling initiatives, and disposal of waste if it cannot be recovered. As shown in Table 4, CDW representatives highlighted that there is no waste management plan used in the organization. However, the organization members, during weekly meetings, collectively decide which days to work, working areas and who will be working at which area. The organization manager informs the municipality of the working areas decided upon to ensure that packaged waste by the organization is collected. Even though CDW has a great strategy working for them, a proper waste management plan is still required and when developed it should be shared with the municipality, so that packaged waste is quantified, collected and managed.

Waste management practices are based on environmental sound criteria in order of preference and they consist of prevention/minimization at source, which is the first preference on waste management criteria followed by waste re-use, recycling, energy recovery and lastly disposal which is the least desired criteria option. The situation at TwK presents a different view to the environmentally sound criteria. Waste management practices in the TwK are dominated by collection and disposal. A good practice though is that the waste collection points are recorded, and a route is determined based on recorded collection points. When new development patterns are found, they are incorporated into the recorded waste collection points. The above findings prove that waste management practices at TwK show little effort in adopting the environmental sound criteria and no sound measures on how waste management services are planned. This can be attributed to insignificant waste management practices commitment in the TwK [39].

A daunting challenge facing cities in sub-Saharan Africa is the inefficient management of waste. Figure 8 proves that waste in the TwK is not efficiently managed. This is demonstrated by the lack of a well thought waste management plan/practices. Also, community members who are involved in waste collection, should be involved at the inception phase of the waste management system which would detail the waste practices to be employed in the study area. The TwK therefore, needs to urgently adopt appropriate waste planning and efficient practices to manage waste. Waste management practices are any techniques, innovations and or methods used to reduce, handle and manage any streams of waste. These are often referred to as waste innovations used to turn waste materials into usable products or help make sound decisions on waste handling and disposal. Based on findings obtained from CWP, waste is only collected, transported and disposed of; no other innovations are being employed to reduce the generation of waste and prevent disposal at landfill.

In relation to the findings from the community members, the National Environmental Management Act (NEMA) (Act No. 107 of 1998) requires everyone who has caused or may have caused significant pollution or degradation of the environment to take reasonable measures to prevent and remediate that pollution. Unavailability of the WMP proves that employees of the organizations and community members were never involved in its development and as such the community members are not aware of such requirements as stipulated by NEMA. Certainly, the state cannot expect community members to take reasonable measures to prevent and or remediate any pollution which they may have caused if they are not aware of the national environmental management act requirements.

4. IMPLEMENTATION OF WASTE MANAGEMENT SERVICES

Waste management is a required basic service to be provided by municipal authorities in South Africa. However, the present scenario rather provides a deferring perception in terms of service delivery as shown by the absence of adequate overall waste management practices. The present level of services in the TwK is so low that there is a threat to environmental quality and possibly public health. Refuse removal is one free basic service that is expensive and most municipalities do not have the resources to offer it.

CDW organization representatives noted that the organization has played a tremendous role in waste management services in the study area. They argued that the communities used to have lots of waste piling up on the streets which is now less compared to the time the organization was non-existent, but no evidence to support the assertion was obtained. However, they admitted that there is still waste which ends up on the rivers/streams as shown in Figure 6,

citing that this is caused by a lack of environmental education in the community. This can be viewed as a lack of a coordinated effort by TwK to manage waste. Solid waste generation and management has become a prominent issue in local municipalities and one that often lacks clear political direction on how it should be managed.

One of the positive factors indicated by the organizations representatives is that the organizations can provide jobs to a few community members. This is despite that some community members do not stay long in the organization due to the fact that the stipend is too low to sustain some community members. The CDW organization representatives also believe that households place waste in the designated waste receptacles in the formal settlements. However, they intentionally dispose of waste in the river or open spaces when they have missed a collection truck, without knowing the impacts it may cause.

The TwK representative received waste management training and the candidate has seven years of experience in the field which makes the candidate competent enough to handle the waste management sector. However, the opportunities and benefits of implementing efficient waste management practices are not realized in the TwK. The waste management sector has potential to create important and sustainable jobs, or jobs in sectors, which generate less carbon emissions. Poor and previously disadvantaged people are likely to be employed in the waste management sector for street cleaning, refuse collection, sorting and in recycling initiatives. However, the abundance of organic waste used in the waste to energy process is unknown, that poses risks to failure of waste to energy investments, and the solution to this would be waste characterization studies. Job creation can be stimulated by municipal interventions such as sustainable management of solid waste and turning waste products into usable resources. This can only be attained when the connection between sustainability planning, institutional governance and municipal finances are realized and identical targets are developed and implemented. Also, ensuring that the composition and quantity of the municipal waste stream are not seen as an independent variable.

TwK's current situation suggests that the municipality has not invested enough in waste management practices and or services. This is evidenced by two trucks collecting waste in the TwK municipality, unavailability of waste recycling facilities and non-existence of waste management interventions such as composting. Also, the findings show that inclusion of community members can be achieved through the addition of financial and human resources, which are not currently committed to by the municipality to remove the barriers to successful implementation of waste management services. TwK highlighted the incorrect use of services issued for example waste receptacles and/waste bins, as one of the factors

which hinders the implementation of waste management services. Local authorities including TwK need to table objectives indicating how, when, and who will manage waste and what other interventions and/ or innovations will be added to help manage waste. Through its role in waste management, the municipality must ensure that communities are protected from the risk of injury, illness, and disease through appropriate regimes of collection, processing and disposal of household waste [27, 30, 38, 40, 41].

The study area is characterized by high levels of seasonal migration linked to farming and other agri-industrial activities which resulted in high population growth rates, in turn creating increasing demands for provision of basic services such as water, electricity, sanitation and housing. High levels of poverty are also singled out with 78% of the population earning less than R3500 per month. Expansion of informal settlements could contribute to the difficulties to implement waste management services in Grabouw as noted by CDW. Since informal settlement dwellers at Zola and Marikana are not issued with waste bins, plastic bags and or waste skips; it proves to be an additional challenge on how waste services are implemented in Grabouw. Waste management practices are also affected by rural to urban migration, where certain towns or municipalities find it difficult to deal with the rapidly increasing population. The expansion of informal settlement dwellers in Grabouw is caused by urbanization which triggers difficulties to manage waste in urban areas more especially in informal areas. Urbanization directly contributes to waste generation, and unscientific waste handling causes health hazards and urban environmental degradation. On the other hand, urbanization is a major driver for increasing municipal solid waste (MSW) generation rates within cities.

Excessive waste generation is being driven by an increase in population growth in urban areas, which leads to a great concern for waste management services integration in sustainable urban planning. This is linked to the situation in the Theewaterskloof Municipality where census results for the year 2011 proved that the population of the area has increased to 30,337. Urbanization has become a major issue in the sustainable development debate, mainly because of the problems associated with planning for expansion of residential areas. As with the case of urbanization, waste management services require careful planning and integration into spatial planning. The increase in population, economic growth, wellbeing and quick movement of people from rural to urban areas are important factors that directly contribute to increased waste generation. Therefore, integrated sustainable waste management must not only receive top priority but must go beyond technical aspects to include several key elements of sustainability to ensure success of any solid waste project. Waste management training is viewed as one of the aspects which enhances implementation of waste management

services. Table 5 highlights organizations' response when asked about waste management training.

Table VI:
Organizations responses regarding waste management training

#	Community Development Workers (CDW)	Theewaterskloof Municipality (TWK)	Community Workers Programme (CWP)	Community Members (CM)
Do you feel that your organization has done enough to capacitate you about waste management?	No Waste Management Training received by CDW	The respondent has received waste management training	Respondents believe that the programme has not done enough to capacitate them on waste management practices	No Waste Management Training received by CM

CDW organization noted that no waste management training was received by its employees. On the other hand, the CWP organization representatives believe that the organization has not done enough to capacitate its employees on waste management. Only one (1) CWP employee received waste management training and the training did not address the daily challenges of employees within the working areas and was not facilitated in a language that they understand. Waste reduction and waste separation are the two preferred practices and methods in sustainable solid waste management (SSWM). These methods are perceived to be impractical to implement without the presence and awareness of community members as well as a strong commitment and support of city authorities. TwK must ensure that waste management training becomes a priority to the local community and any waste management organizations. There is no waste reduction and waste separation practices taking place in Grabouw and waste management training would ensure that there is immediate separation of waste and waste generation would be reduced. The presence of community involvement on waste reduction and waste separation is seen as a vital tool for keeping communities clean. This shows that if communities are involved, there would be clear results in terms of the cleanliness of communities.

TwK admitted that community involvement is one of the factors which enhance implementation of waste management services. However, the current findings do not reflect community involvement in waste management except for a few individuals who are part of CDW and CWP organizations. Even though these individuals have limited or no training in the waste management field. It must be noted that

environmental awareness of entrepreneurs and communities is a tool that can be used to reduce the negative impacts of poor waste management on the environment.

It is believed that waste management has improved at local government level; however, local municipalities are still faced with many challenges, such as the lack of funds invested in waste management services and waste management programs, well thought waste management plans, waste management education and the unavailability of waste receptacles in some residential areas. These challenges have been noted as the main issues which hinder successful implementation of waste management services in the study area.

V. CONCLUSION AND RECOMMENDATIONS

1. CONCLUSION

The study findings show that the CDW representatives were involved with the organization for an average of three years, while the Theewaterskloof Municipality (TwK) representative had seven years of involvement with TwK's solid waste management department. However, the CWP had representatives with two years of involvement with the programme and some had been involved with the programme for eight years. The number of years of involvement for TwK and CWP representatives proved that they have adequate understanding of waste management and are active participants in waste management practices. While CDW had the least years of experience/involvement with the programme, the representatives presented a satisfactory understanding of waste management and participation in waste management practices. However, the Theewaterskloof Municipality appeared to have provided little support to the waste collection programs in terms of finances, guidance and through education or capacity building. This is demonstrated by the stipend amount the organizations representatives are receiving per month. If adequate support could be provided by the municipality, this would mean that the whole municipal solid waste management system would be improved. Over and above that, the municipal representative seemed to be responsible for a number of sectors, which each sector should have one responsible person, if waste management is to be improved. The work experience of the TwK representative proved that he is experienced enough to handle the waste sector. However, it appeared that there is no well-structured waste sector or waste management organizational structure.

Data obtained from CDW shows that the waste collected by the organization is not quantified in terms of the number of tons of waste collected per day. The quantity of waste collected determines the size and number of functional units and equipment required for managing the waste. This poses difficulties in managing current streams of waste in the study area. CDW indicated that there are two trucks collecting

packaged waste. This is in agreement with the findings obtained from TwK and there are times that these trucks do not collect waste as per schedule, leading to wind-blown waste which ends up in the river. The number of trucks used for waste collection is not sufficient to handle the amount of waste generated and ultimately ending up on open areas. It appeared that the waste receptacles issued to the community members of the formal settlements are too small and they fill up quickly.

Waste management practices in the study area are only limited to collection, transportation and disposal. The other practices are absent; however, recycling is perceived to be one of the practices that exists in the study area but, that was not observed at the time of data collection and there is no evidence to support its existence. Although the municipality is willing to adopt new practices such as composting and waste to energy amongst others. The challenge to this is, insufficient information about alternative waste management practices, which could be applied in Grabouw. Additionally, the understanding and knowledge of waste management practices amongst community members perceived as a tool for waste reduction is limited and this result in waste piling up in the streets. Composting is one of the environmentally friendly techniques, which can be employed within Grabouw, and the farmers in the area could utilize the product (compost). Waste characterization can assist the municipality understand waste generation patterns which should stimulate the basis for a better decision on the sustainable strategies to manage waste in Grabouw.

Waste management services planning is underpinned by a well thought planning process of how waste will be managed for example from temporary storage at houses/homes, collection times, collection vehicles, waste recovery facilities, recycling facilities / initiatives and disposal of waste streams which cannot be recycled further. In the study area both CWP and CDW indicated that there was no available waste management plan used in Grabouw. The CWP organization is not aware of other waste management practices, which can be employed to deal with piles of waste ending up on the streets, except collection and transportation. This further proves that there are no documented waste practices, waste management services planning, and no waste innovations introduced within TwK.

Waste management requires proper planning and research. The situation in Grabouw reflects poor planning of waste management services, and improvements could be borne by a development of a clear waste management plan which would indicate problematic areas in Grabouw and Theewaterskloof for example waste collection points, collection times, quantification of waste collected per area including practices to be employed to reduce, recycle and recover waste which are almost non-existing at this stage. The findings from the study area indicate that the way waste is handled does not represent a

planned process for its management. The community members from the four selected residential areas were never involved in the waste management planning. This is supported by findings obtained from the TwK, which suggest that the IWMP was only developed by a consultant and no members of the community were involved or were given an opportunity to participate in its development. A certain percentage of interviewed community members on average 30%, in both developed residential areas indicated that at times the municipal waste collection trucks do not collect waste, some households also miss collection times causing piles of waste on open spaces. Observations proved that these open spaces are near flowing rivers. Such issues can be avoided if community members were involved in waste management planning.

The present level of implemented waste management services in the study area is very low suggesting a potential for poor environmental quality and health related risks. The CDW organization appears to play a significant role in waste management services in the research area, as the amount of excessive waste piles on the streets are now less than before the organization was established. There is still waste that ends up in the rivers and the CDW believes that this is caused by lack of environmental education within the community. The CDW organization also noted that households place waste in the designated waste receptacles in the formal residential areas, however, some residents intentionally dispose of the waste receptacles in the river or open spaces when they have missed a collection truck, without knowing the impacts it may cause.

The examination of TwK's current situation reveals that the municipality has not invested enough funds in waste management practices and/or services. This situation would need to be improved if the implementation of sustainable waste management services is to be achieved. The inclusion of community members and or community-based organizations involved in waste management can be achieved through the addition of financial resources, which are not currently made available by the municipality. TwK highlighted the incorrect use of services issued for example waste receptacles, which hinders implementation of waste management services. Waste management training is viewed as one of the critical measures for effective and efficient implementation of waste management services.

2. RECOMMENDATIONS

The current waste management practices in Grabouw needs to be reviewed and integrated into the spatial development framework and a separate integrated waste management plan should be developed if the government wants to save on costs used to clean open spaces currently being used as dumping sites. Proper planning and management should be considered by TwK management. This can only be attained when the

connection between sustainability planning, institutional governance and municipal finances are realized and then uniform targets are developed and implemented. The provincial government should engage and support the municipality to improve the poor waste management practices in the study area, which could ultimately draw the attention of investors, increase tourism and provide job opportunities. The collected waste by CDW and CWP should be quantified in order to determine the impact caused by these organizations on the total number of tons of waste collected per day/month in Grabouw and TwK. Additionally, for the municipality of this size, at least four to five trucks should be used to collect waste.

Waste characterization is seen as a solution for waste to energy investments. Similar waste characterization studies can be carried out in the TwK, particularly at Grabouw to determine which waste reduction practices could be employed to minimise waste generation. On completion of studies such as the waste characterization, an integrated waste management plan should be developed and published for a certain public comments period so that communities are informed and able to provide their views. Members of the CDW and CWP should be trained on waste management practices as they are involved in the management of waste in the study area. The knowledge shared with them could spread through the community, thus reducing the incidents of waste disposal on open spaces. Waste reduction and waste separation at source are viewed as the preferred practices and/ or methods in sustainable waste management. However, these practices are impractical to implement without proper training, awareness of community members as well as a strong commitment and support by city authorities. TwK must ensure that waste management training becomes a priority for a local community and to any organization involved in waste management.

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INFORMED CONSENT

Prior to answering the questionnaires, participants were presented with an informed consent form, which explained what the study was about; answers will be anonymous, right to withdraw etc. The informed consent which the participants agreed to before completing research questions.

All information will be kept in the structured component and no one will ever know who said what to the researcher. Would you kindly complete the interview questions below?

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