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Household Waste Management Practices and Challenges in a Rural Remote Town in the Hantam Municipality in the Northern Cape, South Africa

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Abstract: Waste management in rural areas poses a major challenge to local governments in developing countries. Municipalities face limited budgets and obstacles with the collection of waste, as well as a lack of proper equipment, infrastructure, and treatment centres. These obstacles lead to further problems, such as littering and illegal dumping, contributing to the knowledge base regarding remote and rural towns in South Africa. This study aims to assess the waste management practices and challenges of households in a Municipality in the Northern Cape, South Africa. The study investigates the household waste management practices, identifies the challenges experienced by households regarding their waste management, and explores their willingness to participate in a separation-at-source program. A cross-sectional research design was used along with a mixed methods research methodology. A sample of 160 interviews was completed over the period 16 to 20 September 2019. Descriptive statistics and a thematic analysis were used in the data analysis. The results indicate that municipalities, and households, will have to collaboratively search for solutions towards effective waste management in rural areas. Financial constraints also necessitate the investigation of alternative ways of managing household waste through cooperation with surrounding towns.

Keywords: household waste management; municipality; remote; rural; waste separation



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1. Introduction

Waste management in rural and remote areas poses major challenges for governments of developing countries [1]. The waste management budgets of local municipalities are limited [2] and even more so in rural and remote areas. Municipalities in such areas usually face obstacles with the collection of waste. They also lack proper equipment, infrastructure and treatment centres and experience difficulties accessing treatment centres elsewhere [3]. The unequal distribution of infrastructure in South Africa's waste management is also a concern and stems from the politico-socio-economic inequalities of the past [4]. These obstacles contribute towards other problems, such as littering and illegal dumping. (The differences between littering and dumping are the type and volume of waste improperly disposed of [5]. Littering means throwing small, individual pieces of garbage where they do not belong (candy wrapper, plastic cup, chewing gum, empty beverage bottle, take-away packaging). Dumping refers to throwing large or large amounts of garbage on a pile (old sofa, clothes, household items)).

Waste refers to anything that the owner does not want anymore and wants to discard or dispose of, whether it can be re-used, recycled, recovered, or not [6]. Municipal Solid Waste (MSW) includes predominantly household waste (domestic waste), as well as some

commercial waste [7]. Household waste is generated through household activities, such as cooking, sweeping, cleaning, fuel burning, repairs, and gardening. It also includes used products or material, such as old clothing, old furnishing, retired appliances, glass, paper, metal packaging, and old books and newspapers [8].

MSW encompasses several activities: the planning, financing, and implementation of programs to control the generation and storage of solid waste, the collection and transportation of waste from the source where it is being generated to the treatment facilities, and the final disposal in an environmentally and socially acceptable manner [9].

The common objective of most waste managers is to transition from landfill-based waste management to resource recovery-based waste management solutions [3,10]. The transition away from landfill-based waste management encourages the reduction in waste generation, re-use, recycling, and composting practices [11].

In South Africa, the fast-tracking of a circular waste economy is part of a major innovation focused socio-economic development program with an emphasis on resource efficiency [12]. The circular economy approach in waste management is to keep the available resources in use for as long as possible (re-use), before recovering and recycling them [12].

A specific objective of the South Africa's National Development Plan (NDP) is to achieve the sustainable development goal Number 12 (SDG 12.5) that include the absolute reduction in the volumes of waste disposed of at landfills and an increase in the re-use, recycling, recovering, and development of green products [5,13].

Municipal waste management is positively influenced by the proper handling of waste at the household level [14]. Proper waste handling includes re-use, recycling, and composting practices and can only be achieved if households separate and sort their waste. However, separation-at-source programs in rural communities are usually non-existent due to a lack of facilities [15]. South Africa, however, aims to achieve a 50% household separating-at-source rate by 2023 and aims to introduce materials-recovery facilities—'a specialised plant that receives, separates and prepares recyclable materials for marketing to end-user manufacturers' [16] (p. 5), and pelletisation plants to increase plastic recycling rates [6,16]. Waste management is, therefore, not only the responsibility of the municipality but also that of households.

The key starting point to enhance the 'reduce, reuse and recycle approach' is to analyse waste management practices of households. Most previous research in South Africa on household waste management focused on urban areas. To contribute to the knowledge base of rural and remote towns in South Africa, this study aims to assess the waste management practices and challenges of households in the municipality of a rural and remote town in the Northern Cape. The objectives of the study were to:

- investigate the waste management practices of the households,
- identify the challenges experienced by households regarding their waste management,
- explore the willingness of households to participate in a separation-at-source program,
- explore ways in which the municipality can contribute to good household waste management and waste disposal practices,
- make policy recommendations towards a more sustainable household waste management system in the area.

Any decision on the management of waste in a rural and remote town needs public participation of all stakeholders who will be affected, as they will impact the outcome of such decisions, as mentioned by Birhanu and Barisa (2015) [14].

The following section provides a conceptual framework to aid the understanding of the waste management practices of households, as well as an overview of the literature on household waste management practices in addition to the empirical results from previous studies. The research methodology used in the study, the analysis of the data, and the discussion of the results will be followed by conclusions and recommendations.

2. Conceptual Framework and Literature Review

The conceptual framework and related concepts discussed are applied in the context of a rural, remote area where the management of waste is more challenging than in urban areas. The literature supporting the conceptual framework is summarised in three major categories, namely on-site, off-site, and curb-side household waste management practices.

2.1. Concept of Household Waste Management

The government's new waste management approach sees waste as a valuable resource and emphasises strategies, such as reducing, re-using, and recycling waste [16,17]. The types of solid waste generated by households vary according to economic circumstances, seasons, as well as the demographic landscape and location of the areas [14]. In higher-income areas, for example, more inorganic waste is generated whereas in low-income areas more organic waste is produced. The population density and socio-cultural, as well as seasonal, factors (e.g., fluctuations in garden waste) affect waste volumes [14].

This study follows the conceptual framework of Ferrara (2008) [18] in which the waste/recyclables disposal practices available to households are on-site, off-site, and curb-side waste disposal [18]. These three categories of household waste management are depicted in Figure 1.

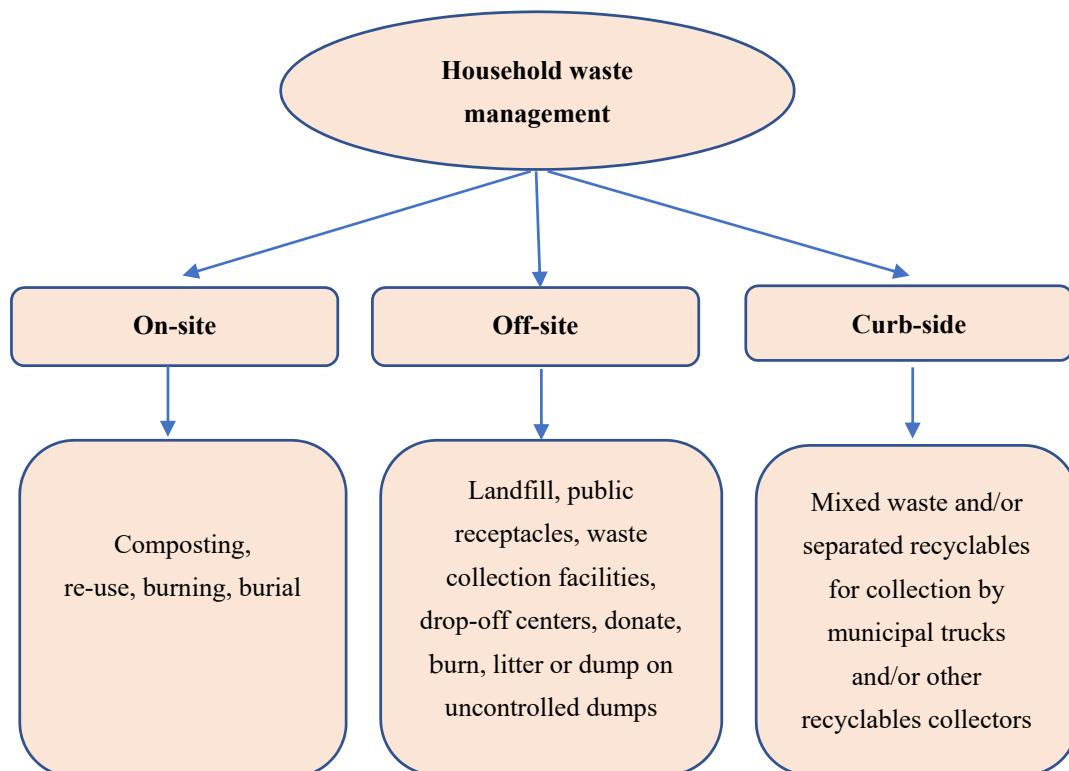


Figure 1. The waste management options available to households. Source: Adapted from Serret and Ferrara (2008) [19].

On-site household waste management entails household composting, recycling, re-use, and burning or burying of waste in their own yards [18]. Off-site household waste management equates to disposal at a landfill or in public receptacles, donations, or delivery of separated recyclables to drop-off centres [18]. Off-site waste/recyclables disposal also includes 'conventional' environmentally unfriendly waste disposal practices [15,20–24], such as open-burning and the dumping of waste in uncontrolled environments (for instance, on streets, in empty spaces, and on riverbanks). The latter practices pollute the environment, pose community health risks, and involve costly clean-ups of such sites by the local government [25]. Curb-side household waste management includes curb-side disposal of mixed waste or separated/sorted recyclables of households for collection by

the municipality and/or other recyclable collectors. After collection, the waste becomes the responsibility of the municipality or collector who can either recycle, landfill, or compost it. A literature overview with empirical results of each of these solid waste management options available to households will be outlined below.

2.2. Literature Overview and Empirical Evidence

2.2.1. On-Site Household Waste Management

Composting of waste has great potential as a waste management strategy since the solid waste of municipalities consists mostly of organic material [26]. Organic waste can be composted at residential, community, and municipal levels. In developing countries, residential composting works well while high failure rates are reported for composting at municipal level [14]. Reasons provided for the failures at municipal level include high operational, management, and transportation costs, the poor quality of products received due to improper waste sorting, and poor understanding of the composting process [14]. Evidence recorded by Ziraba et al. (2016) [11] shows that waste sorting is rare or absent in most developing countries, making recycling or composting difficult. Hidalgo (2015) [3] also found that the habits of rural populations to use biodegradable material as feed for animals complicate centralised composting. Household and community level composting work best in isolated rural areas [3,27]. Using organic materials as compost (plant nutrients) at the residential level can benefit households.

To re-use waste, it must be cleaned and used in its original form repeatedly for the same or a new purpose (e.g., bottles, clothes, and books) [14]. Rural households, especially in low- and middle-income countries, tend to re-use much waste, such as dung, crop residues, wood, sawdust, paper, and cardboard as an energy or heating source [2]. Food waste, such as meat and bones, is re-used for animal feed [14].

The re-use of recyclables is preferable over composting and recycling as it reduces pollution, decreases natural resource use, and saves the energy costs involved with producing new products from recyclables [14]. Re-using, re-distributing, and/or re-manufacturing strategies are the preferred approaches in a circular economy '... as they are less costly in the long-run as repairing a product made to last is always less expensive than producing it from scratch' [28] (p. 1).

2.2.2. Off-Site Household Waste Management

Previous studies have shown that the distance between residences and waste collection facilities has a significantly negative impact on waste management as practised by households in the rural areas of China [15]. Serret and Ferrara (2008) [19] also noted that access to drop-off recycling facilities increases the recycling efforts of households. However, according to Jenkins' (2003) [29] study in the United States of America, it does not hold for all types of recyclables.

Many other factors also play a role in the success of environmentally friendly off-site household waste management. Wang, Chen, Reisner, and Liu (2018) [15], for example, stress the importance of multiple collection points close to residences to ensure proper waste disposal. These authors, as well as Abel (2014) [20] and Niyobuhungiro and Schenck (2020) [4,20], found that insufficient waste collection facilities in rural, remote and under-developed areas will increase the probability of dumping in open areas; they also point out that a lack of information is a concern. When people are not aware of the location of the nearest landfills or waste collection facilities the likelihood of dumping and littering increases.

Both drop-off facilities (off-site waste management) and curb-side recycling programs (curb-side waste management) were found to reduce the time and storage costs of recycling. However, curb-side recycling programs increase recycling rates more due to their lower transport cost for the households [7,19]. Door-to-door collection of recyclables has been proven to achieve the best results in rural communities [3].

Environmentally unfriendly off-site waste management practices of households, including burning practices, open-dumping, and littering, pose challenges to local authorities

across countries, cultures, and languages as seen by studies in developed countries, such as Japan [22,24] and Australia [21], and developing countries, such as China [15], South Africa [20], and Nigeria [23]. In developing countries, agricultural, as well as household waste is often disposed of through open burning practices and open dumping [2,30]. Rural residents in developing countries usually do not follow recommended waste collection practices out of habit or due to a lack of facilities and knowledge of these practices [15].

Poor waste management infrastructure and facilities, low quality of waste management services, lack of funds, poor environmental awareness, the limited markets for recycled materials, and the lack of separation of waste at source recycling programs contribute to the dumping of waste [31]. Remote and rural areas are often characterised by poorly managed domestic waste with inadequate waste management facilities and infrastructure [1,32]. This, in turn, leads to higher levels of littering and the illegal dumping, burying, burning, storing, and uncontrolled abandoning of waste and unused resources [3,33].

2.2.3. Curb Side Household Waste Management

The curb-side waste management practices of households include putting out mixed household waste/recyclables on the curb for collection by the municipality/recycling company. The participation of households in curb-side waste collection services, whether it is mixed waste and/or recyclables, is responsive to changes in the frequency of the collection [34]. If waste is put out for curb side collection and it is not collected, it is inclined to be burnt or dumped [2]. Dur and Vollaard (2012) [35] also added that littering increases significantly in areas where regular cleaning is not done. In South Africa, the collection of households' waste decreased from 66.4% households in 2018 to 61.5% households in 2019. There are major differences across geographic areas and municipalities in the access to waste services and service levels [36].

Households can participate in the recycling process by putting their recyclables on the curb separately from other wastes for collection by recyclables collectors who, in turn, recycle those themselves or sell them to recycling companies. Recycling encompasses turning recyclable solid waste materials into other useful products and can be divided into primary and secondary recycling. Primary recycling takes place when the original recyclable material is subsumed in the same type of material; for example, when newsprint is produced from recyclable newspapers. Secondary recycling refers to the production of products different to the original recyclable product. An example of secondary recycling is newsprint produced from recyclable cardboard [14]. The recyclables need to be re-processed before new products can be made. However, the costs and environmental, and health-related, impacts of using recyclables instead of virgin products on people's health and the environment is usually lower, which makes recycling valuable [16,37].

Curb-side recycling programs, according to Jenkins et al. (2003) [29], increase the efforts of households to engage with the recycling process. Although curb-side recyclables collection is the costliest collection system, it is the most convenient for households [37]. A compulsory curb-side recycling program will, however, not automatically have a positive effect as the recycling behaviour of households differs across all types of recyclables [29]. Furthermore, the waste management and willingness to participate in the separation of recyclables among households in rural towns also differs from that of households in urban towns. In the absence of a curb-side recycling program, the separation of wastes at the household level will be lower in poor rural areas as people usually lack entrepreneurial skills and the drive to produce potentially marketable items from their waste—which is important given the long distances to large recycling companies [38,39].

The willingness of households to participate in the waste separating programs depends on a range of factors, including awareness, people's attitude towards pro-environmental behaviour, perceptions of littering and illegal dumping in their area, age, household income, education, availability of waste collection facilities, the geographic location of households, and environmental health [40,41]. Ferrara and Missios (2016) [42] further reported that the frequency of collection of recyclables has a positive effect on the recycling behaviour

of households. Moreover, greater knowledge, and enough information about recycling programs, also positively influence the participation in recycling programs [19,43]. Age is found to be a significant predictor of the willingness of a household to participate in waste separation programs [41].

Evidence regarding the link between education and separation behaviour differs. Levels of education have a negative impact on separation behaviour in Kampala [44]. People with higher education are assumed to hold higher-paying jobs earning enough income to be able to pay for their refuse removal. Paying for their refuse removal makes them feel that it is not their responsibility to participate in waste separation programs. Conversely, results in South Africa [43,45] and Nigeria [23] show that higher educational levels led to higher participation rates in waste separation programs. Wang et al. (2018) and Han, Duan, Fei, Zeng, Shi, and Li (2017) [15,46] also found that the educational level of rural households in China has a significantly more positive effect on their recycling behaviour. Similarly, people in China with higher education levels were also more prone to pro-environmental behaviour.

Higher-income earners in the Tshwane Metropolitan area of South Africa are more likely to separate their waste than the medium and lower-income earning groups [45]—contradicting the results from Kampala [44]. The same pattern is observed in the USA, where pro-waste separators have higher incomes than those who are not willing to participate in waste separation programs [47]. Household income directly and significantly impacted disposal behaviour—and even more so in rural and remote areas [15,46]. Previous studies by Matete, (2009) [37], Borland et al., (2000) [48], and Fiehn, (2007), [49] postulate that, in a low-income area, recycling of waste takes place if there are monetary benefits attached to it.

According to Momoh and Oladebeye (2010) [23], the geographic location of households in Nigeria also impacts the way individuals feel about participating in separation activities: households in the rural areas indicated a greater willingness to participate than those in residential areas. Conversely, Zeng et al. (2016) [41] showed that, although the majority of households in a rural area in China indicated their willingness to participate in separation programs, almost 25% admitted that they cannot commit to continued participation in the long run. Households will participate in the separation and sorting of waste if the point of collection of recyclables is convenient and frequent, and if it is easy and not too time-consuming [19]. More sustainable waste management practices are achieved if households pay a fee for non-separated waste collection based on the weight of their waste, size of the waste bin, or frequency of collection rather than on the property value of the household, or size of the property/household [3,7].

The re-use and separation of waste for recycling have the potential to reduce the improper disposal of waste [2], save energy, conserve resources, save cost to collect and dispose of the waste and reduce environmental damage. To work towards a more sustainable solid waste management system for a town, that strives towards resource efficiency and the recycling and re-use of the waste/recyclables, it is important to understand the current waste management practices of its households, as well as the challenges that they experience.

3. Materials and Methods

3.1. Research Context

The data for this paper were collected over the period 16 to 20 September 2019 as part of a Clean Cities Project. During the data collection period, data were collected on various aspects regarding waste management and disposal practices of different research populations, including street traders, businesses, and households. This study concentrates only on the waste disposal practices of households and the challenges they experience in this regard.

3.2. Research Design

A cross-sectional research design was used, and the data were collected at a given point in time. To estimate the prevalence of certain behaviours amongst a research population, a cross-sectional study is suitable [50,51]. Cross-sectional studies help to determine the prevalence of the aspects under investigation without the distinction between cause and effect, but rather to infer causation [50].

3.3. Research Population

The research population consists of the households in a very small rural and remote town in the Hantam Municipality in the Northern Cape, South Africa. The town has a total population of 9680 people (4634 males and 5046 females) [52] and approximately 2509 households [52]. The vast majority are Coloureds (83.0%) followed by Whites (11.8%), Black Africans (3.6%), Indian/Asian (0.8%) and others (0.9%) [52]. Afrikaans is the main language spoken by 96.9% of the residents.

The Hantam municipality is far from the markets and the main buyers of recyclables, which makes recycling activities challenging. The town is situated approximately 400 km from Cape Town, Springbok, Upington, and Beaufort West. The town is comprised of three distinct areas: the central neighbourhood in the business area, the informal settlement located at the outskirts of the town where people live in, approximately, 200 self-built structures, and the western neighbourhood situated between the two afore mentioned areas. (Figure 2 shows the informal settlement and western neighbourhood of the town).



Figure 2. (a) Informal settlement, (b) Western neighbourhood. Source: Own field research.

A sample of 162 households was interviewed, but Case Numbers 27 and 45 were dropped as the respondents were younger than 18, bringing the total number of cases used to 160. This sample size constitutes a 90% confidence level with a 6.5% margin of error [53]. The respondents were representatives of their households. A non-probability sampling method was used in the form of convenience sampling [54] to gather primary data from the representatives of all households in the three areas that were willing and available to participate in the study at the time of the fieldwork. The findings also include researchers' observations and information gathered from key informants in the town.

3.4. Data Collection

A mixed methods research methodology was used. A questionnaire with qualitative (open-ended) and quantitative (closed) questions was used as the data collection tool. Open-ended questions were used to yield in-depth and additional data and information to complement the quantitative data. The qualitative information can also be used to explain the quantitative data. The data collection was managed by the researchers who also participated in the collection of data, assisted by a team of well-trained field workers who have previous experience in data collection of this nature. Ethical clearance for the

project was obtained and adhered to in the study, and the municipality's permission was granted for the project.

3.5. Data Analysis

The data were captured and analysed in Excel and STATA version 15. The analyses include descriptive results with frequencies, percentages, means, and medians, as well as thematic tables and qualitative responses from the respondents. The thematic analysis was used to identify the challenges that households experience with their waste management activities and ways in which the municipality can encourage households to keep the town clean. The validity of the data was assured by restricting the household representatives' age to 18 and older and by using well-trained field workers to ensure an accurate representation of the households' responses by the persons interviewed.

4. Findings

The findings of the study were presented according to the objectives of the study. The first section presents the personal background of the respondents and household characteristics. The second section provides the waste management and waste disposal practices of the households according to the conceptual framework followed by the challenges experienced by households regarding their waste management. The environmentally unfriendly waste disposal practices will be outlined, as well as the willingness of the households to participate in a separation-at-source program. The paper will end with a discussion of the results, as well as policy recommendations towards a more sustainable household waste management system in the area.

4.1. Personal Background of the Respondents and Household Characteristics

The demographic background of the respondents and the characteristics of their households are summarised in Table 1.

Table 1. Demographic background of respondents and household characteristics, 2019.

Personal Background of the Respondent	Percentage
Gender (<i>n</i> = 156)	
Male	37.2
Female	62.8
Race (<i>n</i> = 154)	
African/Black	0.6
Coloured	78
White	21.4
Age Category (<i>n</i> = 153)	
18 to 24	10.5
25 to 34	15
35 to 44	20.9
45 to 54	17.7
55 to 59	11.7
60+	24.2
Household Characteristics	
Language (<i>n</i> = 155)	
XiTsonga	0.7
Afrikaans	98.7
IsiXhosa	0.6

Table 1. Cont.

Personal Background of the Respondent		Percentage		
Dwelling Type (<i>n</i> = 155)				
	House	76.1		
	Flat	6.5		
	Commune	0.6		
	Informal Dwelling	16.1		
	Wendy house	0.6		
		<i>n</i>	Mean	Median
	Months in the same dwelling	154	187	120
	Age	153	47	47
	Household size	154	4	4
	Generations in household	156	2	2
				SD
	Months in the same dwelling			183.0916
	Age			16.58636
	Household size			2.407159
	Generations in household			0.717384

Source: Research data.

The respondents' demographic characteristics can be regarded as a good representation of the composition of the population—when compared to the latest Census data from Statistics South Africa [52].

Table 2 provides a summary of the person(s) primarily responsible for the waste management of their household.

Table 2. Person(s) in the household primarily responsible for waste management, 2019.

Person(s) Primarily Responsible for Household Waste Management (<i>n</i> = 155)	<i>n</i>	%
Mother/Wife	60	38.7
Father/Husband	54	34.8
More than one household member	18	11.6
Child/Children	16	10.3
Grandfather/ Grandmother or both	6	3.9
Caretaker	1	0.6
Total	155	100

Source: Research data.

The waste management of each household is mostly the responsibility of adult females (mothers/wives) and adult males (fathers/husbands) in 38.7% and 34.8% of households, respectively.

The next section provides the results of the waste management and disposal practices of a household according to the conceptual framework.

4.2. Household Solid Waste Management Practices

4.2.1. On-Site Household Waste Management

As illustrated in Table 3, very few households make use of on-site (composting and re-use) waste management and disposal practices. Food waste is the most common waste product that is re-used as animal feed (in this case, dogs) by 32.4% of households, 6% re-use their paper, whereas only one household re-uses plastic products and another separates its food waste for making compost.

Table 3. Waste management and disposal practices of households, 2019 (% in brackets).

	On-Site		Off-Site				Curb-Side		
	Compost	Re-Use	Donate/Give It Away	Take to a Drop-Off Centre	Sell	Dump	Burn	Mixed in Black Bags	Separate Bag
Paper (<i>n</i> = 149)		9 (6)	4 (2.7)				2 (1.3)	127 (85.2)	2 (1.3)
Plastic (<i>n</i> = 150)		1 (0.7)						126 (84)	
Old clothes (<i>n</i> = 150)			49 (32.7)			1 (0.7)	4 (2.7)	80 (53.3)	1 (0.7)
Electronics (cell phones, tv's (<i>n</i> = 150))			8 (5.3)	1 (0.7)	2 (1.3)	1 (0.7)		121 (80.7)	
Glass (<i>n</i> = 150)			5 (3.3)			1 (0.7)		126 (84)	
Batteries (<i>n</i> = 148)						1 (0.7)		125 (84.5)	
Food (<i>n</i> = 148)	1 (0.7)	48 (32.4)	7 (4.7)					78 (52.7)	1 (0.7)

Source: Research data.

4.2.2. Off-Site Household Waste Management

Table 3 further shows that very few residents participate in off-site waste management activities. None of the households indicated that they take the waste directly to the landfill. Only one household takes its electronics (cell phones and televisions) to a drop-off centre (shop), another sells its electronics while eight households donate theirs. Donations also include other items, such as paper (4 households), old clothes (49 households), food (7 households), and glass (5 households). Old clothes are, therefore, the most donated item.

Comments from respondents regarding off-site waste management indicate that old clothes frequently go to other family members, whereas one respondent indicated that they give their electronics, glassware, batteries, and food to their gardener.

Although only one household makes use of a drop-off centre, some respondents mentioned that a drop-off centre would work for rubble and yard waste (garden waste) if it is well managed.

From the above comments regarding a drop-off centre, it seems that residents have a habit of dumping their waste. Only two households put paper out, in a separate bag, for anyone who wants to take it while two households put old clothes and food out respectively. The low level of separation of recyclables for collection comes as no surprise as there is no organised curb-side collection program for recyclables in place.

Very few households acknowledged that they use conventional environmentally unfriendly household waste management and disposal practices as captured in Table 3, despite the many dumping sites in undesignated spots observed by the researchers throughout the area (see Figure 3). This raises the issue of the possible disconnect between residents and the waste that they produce—a key area for further research. Paper is burned by two households, four households indicated that they burn old clothes, while some households dump paper, electronics, glassware, and batteries. (Figure 3 shows one of the undesignated spots where electronics and e-waste are dumped).



Figure 3. Dumped electronics and e-waste. Source: Own field research (2019).

4.2.3. Curb-Side Waste Management

The majority (more than 80%) of the households participate in curb-side waste management where all wastes (recyclable or not) are placed in the same bag or bin for collection by the municipal trucks. These recyclables are thus, disposed of in the bags or bins that are mostly paper (85.2% of households), plastic and glass (84% of households each), batteries (84.5% of households), and electronics (cell phones, TVs) (80.7% of households). Many food left-overs (52.7% of households) and old clothes (53.3% of households) are also added to the same bag or bin. Only two households, however, indicated that they place paper in a separate bag next to the mixed waste for collection by anyone who wants it, while one does the same with food and old clothing.

A relevant comment of one respondent is:

‘Put everything together except the old food we give to animals.’

To a question asking the respondents to indicate whether they know when to put their waste out for curb-side collection by the municipality, the majority of households (141 of 157, or 89.8%) responded positively. In another question, the respondents had to evaluate whether the refuse collection by the municipality is usually on time (once a week as scheduled). The results for each neighbourhood are shown in Table 4 to illustrate which areas are better serviced than others, according to the respondents.

Table 4. Timely collection of household waste by the municipality as scheduled, 2019.

On-Time Collection	Informal Settlement (n = 37)	Western Neighbourhood (n = 68)	Central Neighbourhood (n = 50)	Total (n = 155)
Always (n) %	25 67.6	52 76.5	42 84	119 76.8
Often (n) %	3 8.1	13 19.1	6 12	22 14.2
Seldom (n) %	8 21.6	3 4.4	1 2	12 7.7
Never (n) %	1 2.7	0 0	1 2	2 1.3

Source: Research data.

It seems that the municipal waste collection services in the informal settlement are less trustworthy than in the other areas, with 21.6% of the households in the informal settlement indicating that these services are seldom on time.

4.3. Perceptions of Uncontrolled Dumping and Littering of Households

The results generated by the questions that tested the perceptions of households regarding illegal dumping and littering show that, despite very few households admitting to practising these waste disposal methods as captured in Table 3, many are very concerned about it. The amount of littering is alarming, but the high percentage of concern should be praiseworthy as 66.9% of all households are very concerned about littering in their area, whereas 48.7% are very concerned about uncontrolled dumping in their area. Figure 4 presents the results with respect to the levels of concern regarding littering and illegal dumping in the different neighbourhoods.

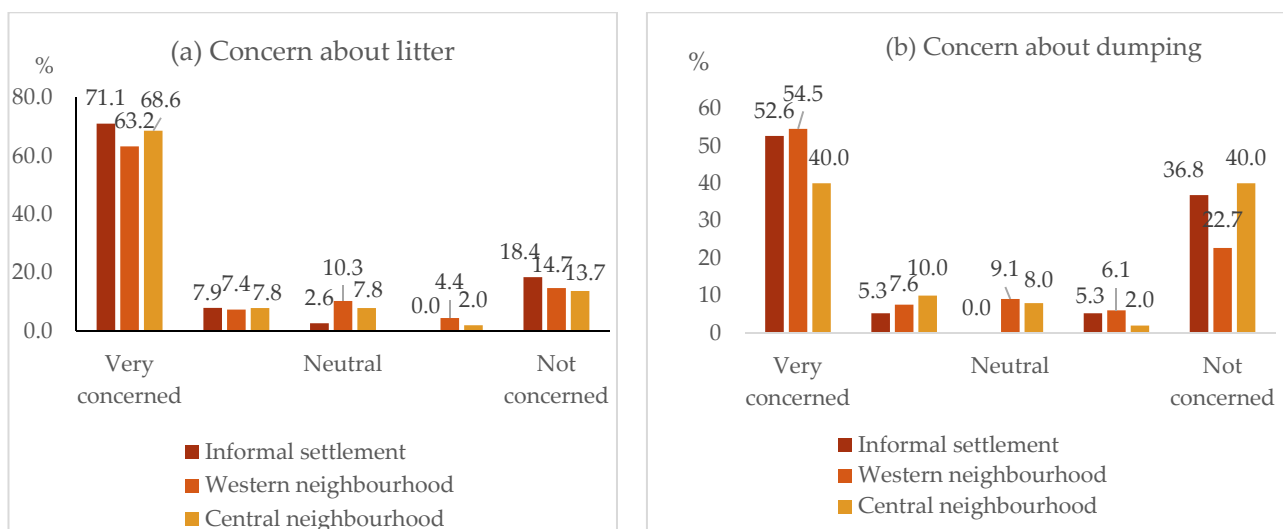


Figure 4. (a) Littering concern per area, (b) Dumping concern per area. Source: Research data (2019).

Of the 38 respondents in the informal settlement, 71.1% are very concerned about littering in their area, whereas 52.6% are very concerned about uncontrolled dumping. In the western neighbourhood, 63.2% of the 66 respondents see littering as a great concern, while 54.5% of the 68 respondents who answered the question on uncontrolled dumping admitted to being very concerned. Of the 51 respondents in the central neighbourhood, 68.6% are very concerned about littering in their area, and of the 50 respondents to the question on uncontrolled dumping, only 40% indicated a concern.

These results are very much in line with the observations of the researchers that uncontrolled dumping and littering are concerns. Although the uncontrolled dumping sites are not large, there are many of such designated locations throughout the town. At the time of the study, the uncontrolled dumping sites were mapped. The municipality also acknowledged that uncontrolled dumping of waste in the municipal area is a challenge and recommended that the Council consider a recycling program [55].

The observation was that the informal settlement located on the outskirts of town was cleaner (see Figure 2a) than the other two neighbourhoods, although the latter are blaming the dumping and littering on the former.

These dumps are located opposite to houses and in open spaces and cause environmental pollution, serving as breeding ground for insects, pests, and infectious diseases. Some dumping sites are located at the very spots where signs were erected warning households that illegal dumping is an offence, and that trespassers will be prosecuted and fined. (Figure 5 shows the dumping site where dumping is prohibited).



Figure 5. Dumping site where signs were erected prohibiting illegal dumping. Source: Own field research (2019).

These signs are usually erected on sites where something has already been dumped, and it is therefore very important to attend to dumping sites at an early stage, as stated by Matsumoto and Takeuchi (2011) [25]. If the law and penalties for illegal dumping are not enforced, dumping will continue, as reported by Mihai (2017) [2].

The observed presence of littering and dumping is more prevalent in the Western neighbourhood, causing serious public health issues and posing a high risk to the community—especially to the children who are playing on the uncontrolled dumping sites. The habit of uncontrolled dumping might partly be attributed to challenges that the households experience with the waste management services of the municipality.

One respondent said: ‘... we throw it behind the house’, explaining that they do not receive black bags from the municipality.

‘A black bag system’ has been implemented by the municipality for the removal of solid waste [55]. However, the municipality does not provide these black refuse bags. Many households have garbage bins in their yard that they buy or obtain themselves, and in which they store the waste. (Figure 6 shows a garbage bin in a yard, bought by the household itself.)



Figure 6. Garbage bin in a yard. Source: Own field research (2019).

The implication of being poor is that many of the respondents cannot afford to buy these bins nor their refuse bags. Therefore, poverty also seems to play a role in waste management practices. One respondent admitted that poverty in the area is a major cause of the environmentally unfriendly waste disposal practices. He stated that, for many of the poor, waste management is not their number one priority, as they only care about their immediate survival and where they will get their next meal. The results in Figure 7 show that dumping seems to be less of a concern for households in lower-income groups.

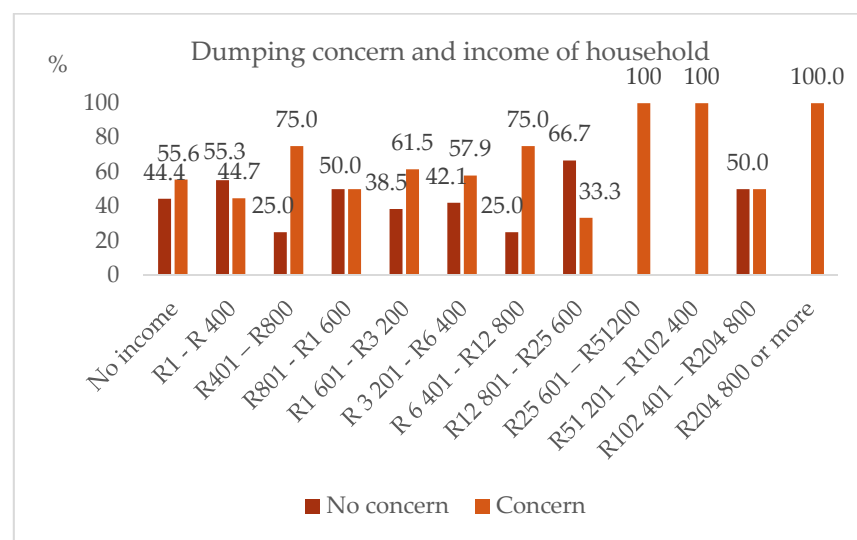


Figure 7. Dumping concern and household income ($n = 154$). Source: Research data (2019).

4.4. Challenges Experienced by Households Regarding Waste Management

The majority of households experience challenges with the waste management services provided by the municipality. A thematic analysis of these challenges, as captured in Table 5, shows that the dominant challenge is linked to the municipal waste pick-up services (37.5%): the municipality does not collect dumped waste, does not clean the streets, is not always on time, does not communicate pick-up arrangements during holidays, and does not enforce the law against people who add their waste to uncontrolled dumps. The second ranked challenge was the behaviour of the community and the cleanliness of the neighbourhood. Some of the respondents are concerned about health issues, such as dog carcasses that are left to rot anywhere, especially as children are playing in the dumps. Another challenge highlighted was the parents' lack of responsibility to keep their

children off the dumps. Moreover, respondents were also concerned about the fact that households often lack the transport to ‘clean up,’ especially yard waste that is not removed by the municipality.

Table 5. Thematic analysis of challenges with waste management, 2019.

	<i>n</i>	%
Municipal Waste Pick-Up	30	37.5
Not always on time/not sure when truck will come/does not always come weekly	16	
Skips houses if the truck is too full	4	
Does not fetch/remove/collect dumped waste/clean streets	4	
Municipality does not give notice to/punish dumpsters	1	
Weak management/ weak communication during holidays/ municipality does not have money/neglects area during busy times	5	
Community behaviour and cleanliness of neighbourhoods	20	25
People pile dirt/are dirty	3	
All streets are very dirty—especially over the weekend	4	
Illegal dumping hotspots are a concern	3	
Uncollected waste and yard dirt is dumped close to homes/in ditches/in others’ yards	6	
The wind blows waste against the wire fences	3	
Dogs tear open bags not collected by the municipality	1	
Health concerns	7	8.8
Enough space is needed to bury dead animals	1	
Waste dumps and landfill are health risks/dangerous for children playing in the dumps	4	
Burning of waste and medical waste causes smoke	2	
Outside town	5	6.3
Landfill not managed/ big problem at dumping site/dis- gusting	3	
Dirt outside town	1	
Plastic bags are a concern	1	
No infrastructure	11	13.8
Bins and black bags needed	10	
Provide recycling services	1	
Provide jobs/ EPWP jobs	5	6.3
Employ more people to clean more thoroughly	5	
Educate people	2	2.5
Teach people about composting and recycling	2	

Source: Research data.

The researchers observed parents dumping discarded items in front of the pre-school and saw children playing on uncontrolled dumps (see Figure 8).



Figure 8. (a) Dumpsite in front of a preschool, (b) Child playing on an uncontrolled dump. Source: Own field research (2019).

Some respondents also mentioned problems at the landfill site and plastic bags that are blown all over the area. The municipality maintained that the issue regarding paper and plastic bags stems from the formal landfill site being located too close to the residential area and the fence being vandalised/stolen [55]. Five respondents asked that more people be employed to clean the town, and two respondents asked for more information on composting and recycling.

4.5. The Willingness of Households to Participate in a Separation-At-Source Program.

To a question on whether their household would be willing to participate in a separation-at-source program if the municipality implemented one, the responses were overwhelmingly positive in all three neighbourhoods as indicated in Table 6.

Table 6. The willingness of households to participate in a separation-at-source program per neighbourhood, 2019 ($n = 133$).

Willingness to Separate	Yes		No	
	<i>n</i>	%	<i>n</i>	%
Informal settlement	29	90.6	3	9.4
Western neighbourhood	58	89.2	7	10.8
Central neighbourhood	46	90.2	5	9.8

Source: Research data.

A question was posed to the participants to assess the distance that households are willing to travel to drop off their waste/recyclables. A summary of the results is captured in Table 7.

Only 75 respondents answered the question and more than half of them indicated that they would not be able to travel further than 1 km to drop off their waste or recyclables. The most common reason given was the lack of transport. The responses included:

‘Not far, does not have transport’

‘Not far, will opt for dropping off waste in open spaces’

‘One mini drop-off per unit’

‘A dumping hole would be easier’

Table 7. Distance willing to travel to drop off waste/ recyclables, 2019 (n = 75).

Distance	N	%
Less than 100 m	19	25.3
101 to 500 m	9	12
Walking distance	12	16
1 km	6	8
2 to 3 km	13	17.3
Further than 3 km	16	21.3
Total	75	100

Source: Research data.

The results further support the findings of Wang et al. (2018) [15] that the distance from a residence to a waste collection facility matters and has a negative impact on waste management in rural areas. Rural and remote municipalities should therefore have multiple collection points for residents to ensure proper waste disposal by households. Only 21.3% of the 75 respondents feel that the distance to drop off their waste/recyclables should be far away (further than 3 km) for the following reasons:

‘should not be close—children will play in waste’

‘I am willing to drive far so that the smell of dirt is not around’

‘Far because our complaints are in vain, dead animals are also a problem’

The respondents were also asked how the municipality could encourage more households to keep the town clean. Table 8 reflects the thematic analysis of these results.

Table 8. Ways in which the municipality could encourage households to keep the town clean, 2019 (n = 129).

Themes	N	%
More education on environmental clean-ups/recycling programs and awareness campaigns	96	74.4
Provide empty bags	97	75.2
Incentives as encouragement, such as giving food parcels	82	63.6
Launch competitions to keep the community clean	76	58.9
Create jobs (use the unemployed to pick up waste so that they can earn an income)	16	12.4
Provide bins (to households/along the streets)	15	11.6
Drop-off sites	2	1.6
The community must all take responsibility for cleaning their areas	6	4.7
Fine people for dumping	3	2.3
School projects	4	3.1
Better waste management and communication from the municipality	7	5.4

Source: Research data.

Municipal provision of empty bags was the most frequent suggestion to assist households with keeping their town clean, followed by more education on environmental clean-ups/recycling programs and awareness campaigns. More than half of the respondents also mentioned incentives, such as food parcels, as encouragement, as well as competitions. Other comments were:

‘Create jobs, we won’t work for free’

‘Stop giving the same people work’

‘CDW does not work’

The last two comments indicate that the performance of CDW responsible for town clean-ups is perceived as inadequate. Moreover, they also point to perceived unfair employment practices in this sector. (CDW is a provincial job creation programme to support service delivery in communities. It requires employment of community members on a rotation basis.)

5. Discussion of the Results

The fact that few households subscribe to on-site waste management and disposal practices, and only one household makes compost from food waste, might be an indication that the community lacks the knowledge and/or never received information on how to use their biodegradable waste for composting and how to re-use other recyclables. It might, however, also be attributed to the fact that almost a third of the households re-use food for animal feed, which supports the finding of Birhanu and Berisa (2015) [14] that rural populations have a habit of using biodegradable waste as animal feed.

Although the re-use of recyclables is preferable over composting, the re-use is restricted to food waste with very few households re-using paper and plastic products. The very low number of households in this study, who re-use paper, contradicts the view of Mihai (2017) [2] that paper and cardboard are frequently re-used by rural communities for heating purposes. This might be because the largest part of this town has electricity.

Off-site waste management and disposal practices are also very low with donations most commonly used for disposal of old clothes and some paper, electronics, glass, and food. Only one household takes its electronics to a drop-off facility (shop), and some respondents commented that a drop-off facility would be convenient, especially for rubble, which indicates that there is a need for a place to discard household rubble. Another respondent, however, believes that a drop-off facility would not work as people would still dump waste outside into the open. Therefore, although Serret and Ferrara (2008) [19] and Jenkins et al. (2003) [29] reported that recycling efforts of households would improve if drop-off facilities were provided, it might not work in rural and remote towns.

One of the main challenges for the waste management of households is their lack of transport. The results regarding the distance that households will travel to drop off their wastes and recyclables show that the distance to waste receptacles/drop-off facilities/recycling collection points matters. Distance might not positively influence the recycling behaviour if the recycling facilities are too far away. More than half of 75 households would not be willing/able to travel further than 1 km to drop off their waste or recyclables due to the lack of transport. Many residents transport their waste with wheelbarrows. These results agree with the findings of Wang et al. (2018) [15] that the distance, from the residence to a waste collection facility, has a significantly negative impact on waste management in rural areas.

The problem of transport seems to create major challenges that call for more drop-off facilities or informed waste practices. None of the respondents transport their waste to the landfill. This indicates that there is a need for more effective waste practices—not only for recyclables but also for other waste not collected by the municipal trucks. This is evident from the comments of respondents who asked for drop-off facilities for yard waste. One respondent said it would work if it was well managed, and another suggested one mini drop-off per unit (block). The transport problem was mentioned repeatedly. Another respondent said that the drop-off point should not be far, otherwise, they would opt for

dropping waste on open spaces. The suggestions of Wang et al. (2018) [15] that multiple collection points should be provided closer to the residences, therefore, seems valid for this town.

Comments of the respondents, regarding the landfill, are that it is not managed well and that there is a serious problem at the dumping site. Other terms used were ‘disgusting,’ ‘health risk,’ and ‘dangerous for children.’ This issue calls for further investigation.

Findings indicate that very few households admitted that they dump waste/recyclables or litter. Their recorded perceptions of illegal dumping and littering showed that many households are, indeed, very concerned about these unhealthy and illegal activities in their area. These results also match the researchers’ observations of many small, uncontrolled dumping sites spread throughout the town and a few large dumps, as well as the results of the mapping of dumping in the town. (Figure 9 represents the map of uncontrolled dumpsites). In the neighbourhood, at the bottom right-hand corner, where there are no dumpsites, was also mapped. The residents there are more affluent and receive adequate refuse collection, as the dumpsites were mostly found in the western neighbourhood.

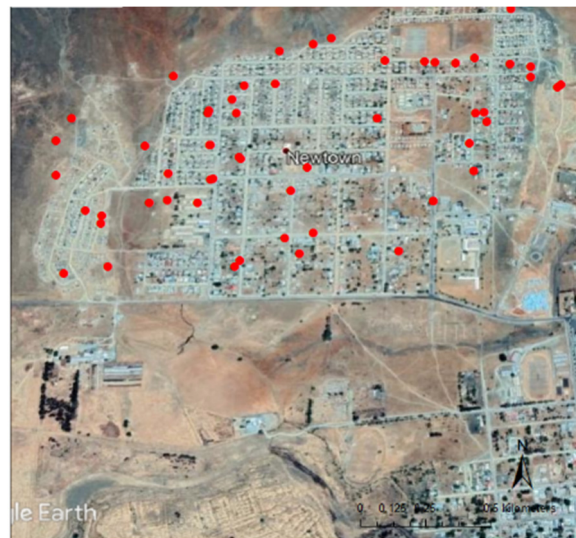


Figure 9. Map of uncontrolled dumpsites. Source: Alex Kimani (2019) [56].

The highest percentage of households concerned about littering in their area is located in the informal settlement, and those most concerned about dumping are located in the Western neighbourhood where more dumping takes place.

Some uncontrolled hotspots are in front of other peoples’ houses, in ditches, and on the streets. The respondents are aware of the negative consequences of littering and uncontrolled dumping. These negative effects pointed out were health issues for nearby houses where waste is dumped on street corners and in open spaces. This causes environmental pollution and serves as breeding grounds for insects, pests, and infectious diseases, which also produces toxic gasses and blocks drainage channels, thereby putting the households in the neighbourhood at risk. Children playing in the dumps are subjected to danger and health risks. The fact that dumping takes place on sites where there are already signs warning that dumping is prohibited indicates that these sites have been identified as dumping hot spots.

The results reflect that all households receive curb-side waste collection services from the municipality, but more than a third of the responding households experience challenges with mixed waste collection services. The responses that collection is not always on time and not always provided weekly, houses are skipped if the truck is too full, weak services and communication, and certain neighbourhoods that are neglected during holidays and times when more waste is generated, should be further explored. Literature suggests that this may lead to a habit of burning or dumping waste/recyclables not collected [2]. This

is confirmed by Taherzadeh and Rajendran (2015) [57], who states that low-quality waste management services may lead to increased illegal dumping.

Curb-side waste management services are limited to mixed waste collection. Yard waste seems to be a concern, as it is not removed with the mixed waste. Moreover, yard waste is not frequently collected, causing the dumping of yard waste. This matches the findings of Mihai (2017) [2], stating that households are inclined to burn and/or dump uncollected waste.

Although, no program for the curb-side collection of recyclables is in place, an overwhelming majority of households in all neighbourhoods indicated their willingness to participate in such a program if the municipality implemented one—which is viewed by the residents as worth their while.

Ways to Improve the Cleanliness of the Town

Local poverty levels and waste transportation problems are emphasised by requests to the municipality for empty waste bags (three-quarters of 129 respondents) and waste bins for homes and in streets, as well as multiple collection points closer to homes (some respondents). The limited financial means, and resultant challenges for municipalities in rural and remote areas to provide regular town cleaning and waste collection services, increases the probability of dumping, as mentioned by Hidalgo et al. (2017) [3]. The results confirm the statement, regarding the irregular collection of waste and cleaning of the town, with 37.5% of households indicating that they experience challenges with the municipal waste collection services. On the other hand, the municipality is of the opinion that one of the reasons for not providing bins is that bins are stolen, vandalised, or used for other purposes than waste management.

The results of this study, therefore, confirm that rural areas are prone to inadequate waste management facilities, poor infrastructure, and a palpable lack of treatment facilities, which all contribute to the littering and dumping, as well as the uncontrolled abandoning of waste and improper storage of unused resources, as highlighted by Han et al. (2018) [1], Hidalgo et al. (2017) [3], and Apostel and Mihai (2012) [32].

A large percentage of households (74.4%) indicated that some ways in which the municipality could encourage households to keep the town clean would be to provide education on environmental clean-ups/recycling programs, as well as awareness campaigns. This confirms Serret and Ferrara's (2008) [19] assertion that more knowledge and enough information should be provided to the community on waste management and recycling programs to influence their perception and positive participation. However, the municipality supports youth programs that would train young people as managers/administrators/educators in the fields of environmental and waste management [55]. The employment of an environmental education coordinator to assist and capacitate communities, with respect to environmental issues, was also mentioned in the municipality's new integrated development plan [55].

6. Topics for Further Research

Research on waste dumping is limited, due to lacking data [25], and the following studies could make a significant contribution towards understanding the waste management practices in rural/remote areas:

- Exploring more deeply, with the help of the community, the challenges they experience with managing waste.
- Exploring the reason for dumping in rural/remote areas and ways to reduce uncontrolled dumping.
- Analysing the obstacles faced by municipalities in rural/remote areas, as well as ways in which they can be overcome.
- Investigating the viability of recycling, as well as ways in which the communities in rural/remote areas can be mobilised to increase the re-use of recyclables.

- Exploring different and innovative alternatives to manage the solid waste of remote municipalities on a regional level.

7. Conclusions and Recommendations

To move towards a more sustainable household waste management system, the commitment of the municipality, households (community), businesses, shop-owners, as well as producers, is essential. Although the removal of waste in South Africa is the legal responsibility of municipalities, the participation of communities in waste management is becoming more relevant, and even critical, in keeping most towns clean.

To move towards a more sustainable household waste management system, not only recycling, but also the re-use of recyclables and the composting of organic waste, should be encouraged. To achieve these, the commitment of the municipality, households, and the community, as well as the producers of products that generate recyclable products, are essential.

The challenges, as experienced by the households, ask for the commitment of the municipality to:

- strive for frequent and timely collection of waste from all collection points as it plays an important role in the management of waste and the prevention of uncontrolled dumping and littering.
- locate, map, and monitor uncontrolled dumpsites and make it more costly for people to dump their waste/recyclables. This requires law enforcement and penalties for dumping. The community can be mobilised to monitor and report uncontrolled dumping.
- provide the community with information, and encourage and educate them to:
 - understand the composting process at household and community level.
 - re-use their recyclables. Experts from the different recyclable product streams can be invited to make presentations on recyclable product re-use and life extension.
 - return empty containers that can be re-used by other community members. Drop-off facilities can be provided for this—maybe as a funded project.
- provide bins/skips, drop-off facilities, receptacles, and frequent collection services at multiple collection points nearby residences for mixed waste, yard waste (garden rubble), and recyclables. These collection points should be managed, kept clean, and emptied regularly as the presence of litter is an incentive for further littering.
- implement a curb-side recyclables collection program to encourage and increase households' efforts to separate their waste.
- The households and community should also be committed to:
- attend meetings and information sessions to learn more and participate in the decision-making process of household waste management best practices, the process of household composting, and ways in which to re-use recyclables. Experts from the different recyclable product streams can be invited to make presentations on recyclable product re-use or life-extension. Community members can share their ideas on the re-use of recyclables with other community members and the municipality.
- participate in recyclable collection activities and support other community members that can use the recyclables.
- use bins/skips, drop-off facilities, receptacles, and recycling collection points for their intended purpose, keep it clean, and report the misuse of waste facilities.
- refrain from using environmentally unfriendly household waste management practices, such as uncontrolled dumping and littering and report trespassers.
- use vegetables and biodegradable organic waste for composting at the household level.
- increase the re-use of household waste and recyclables and separate recyclables from other household waste.

Producers of different recyclable product streams should also reach out to the rural and remote areas with sponsored recycling facilities, educational programs, awareness

campaigns, and teach the community innovative ways to re-use recyclables or to convert it into high-quality tourist souvenirs.

It is acknowledged that financial constraints, similar to that in many rural and remote areas, can restrict the municipality's efforts in providing the needed facilities and services to move towards sustainable waste management. Additional investments are therefore needed. The remoteness of the town (far from markets for recyclables) should encourage the municipality to explore alternative municipal level household waste management options and collaboration with surrounding areas.

This article highlights the fact that effective municipal actions and positive household waste behaviour are needed. It would take participatory discussions and actions between the municipality and the town's households to co-create unique waste values, correct behaviour, as well as waste structures and systems that can address not only the needs of the municipality to enable it to fulfil its responsibilities but also to address the waste needs of the households.

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