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RESEARCH ARTICLE:

Modernisation of Rural Communities: Solid Waste Management Implication

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Abstract

Solid waste management is a global challenge, particularly in economically developing countries due to their growing population, urbanisation, and increasing waste generation. Municipalities in South Africa are responsible for general waste management in both residential areas and industrial sites. However, waste management is not implemented in all rural areas of South Africa, even against the background of socioeconomic improvement and increased consumption patterns in these communities. This study aims to examine the relationship between rural socioeconomic conditions and solid waste generation and management. The target population of this study is five rural communities of the Vulindlela area, which is situated west of Msunduzi Municipality in Pietermaritzburg, KwaZulu-Natal. A total of 50 households were randomly selected as sample sites as the result of a detailed field survey in 2022 and 50 respondents participated in the study for interview through cluster sampling technique. The study uses a mixture of qualitative and quantitative methods. Primary data about the socio-demographic characteristics of respondents were gathered through close-ended questions. Open-ended questions in the semi-structured interviews were utilised to gather data on Vulindlela residents' perceptions of waste pollution effects and strategies implemented in their area. Microsoft Excel version 2305 was used to perform basic descriptive statistics (frequencies and percentages) to examine the socio-economic characteristics of respondents. While a thematic content analysis was undertaken to analyse the open-ended question data which was on respondents' perceptions of waste pollution in their area. The study findings suggest that Vulindlela is a socioeconomically diverse rural community, with households earning between 500 and 31,000 Rand per month. In addition, grocery expenditures range from 800 to 3100 Rand per month. Communities characterised by lower income generation dispose of their waste inside their households, apart from certain waste such as nappies that are disposed of in freshwater ecosystems and open spaces, while those who earn more money have diverse waste types and dispose of their waste at illegal dump sites.

Keywords*: solid waste; urbanisation; municipality; rural communities; socio-economic*

Introduction

Solid waste management (SWM) in developing countries like Malaysia and South Africa is predominantly characterised by open dumping due to its lower operational, capital, and maintenance costs compared to alternative disposal methods. This practice is particularly widespread in rural and semi-urban areas (Fadhullah *et al.*, 2022). Among the various services provided by local governments, SWM holds the highest significance and requires the largest portion of the budget allocation (Hoornweg and Bhada-Tata, 2012). However, the rapid growth of urban populations has put immense strain on local government resources, making it challenging to meet the daily service requirements. Consequently, SWM has become a pressing issue that demands immediate attention. Remarkably, South Africa is the third-highest producer of municipal solid waste in the Sub-Saharan region, as Kawai and Tasaki (2016) highlight. South African rural areas are regarded as the poorest communities in this country (Ncube *et al*., 2014). Therefore, rural communities have a lower consumption pattern compared to their urban counterparts. This, according to Hoornweg and Bhada-Tata (2012), makes rural communities' waste

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generation much lower. The authors further state that the rural populace has a proclivity of producing organic waste that degrades quickly, while also engaging in the reuse and recycling of materials such as plastics and glass (Hoornweg and Bhada-Tata (2012). As a result, rural regions exhibit minimal to no pollution. However, rural areas situated closer to bigger cities and towns are economically developing (Ndabeni, 2016). The author further states that such areas or regions are referred to as 'Rurban'. These areas are described as rural socio-geographic spaces where lifestyles and the standard of living has changed to resemble that of urban areas (Ndabeni, 2016). Thus, their economic situation is different from those rural areas that are far from the urban environment. This means that their consumption patterns and waste generation are higher. This corroborates ideas posited by Tsheleza *et al*. (2019) and Hoornweg and Bhada-Tata (2012) who claim that consumption patterns and solid waste are inextricably coupled with economic development.

In some of the rural communities of South Africa, local government activities are very limited compared to urban environments. This is because rural areas are less populated, some fall under the traditional authority and some municipalities do not have the financial capacity to render services such as waste collection (Statistics South Africa, 2016). Areas that fall within the traditional authority lack basic service deliveries due to not being financially capable of conducting activities like the local government. This is because traditional authorities do not collect taxes from the rural populace and are not financially supported by the political government. In the overall municipality, the local government has more power and functions, except for waste collection, potable water provision, and electricity (Dlungwane, 2004; Poswa, 2019). The latter two services are usually provided by the agencies that produce them; for example, Umgeni Waters provides water services in some parts of KwaZulu Natal and Eskom provides electricity nationally, both to municipalities and directly to households. However, waste has no specific agency aside from the municipality which sometimes does not have the authority and resources to manage this service in rural areas (Statistics South Africa, 2016).

Solid waste management research is highly concentrated in urban areas, whilst neglecting rural areas which are economically developing coupled with medium to high consumption patterns. Therefore, this study aims to examine the relationship between rural socioeconomic conditions and solid waste generation and management. The study's aim will be achieved through the following objectives:

a. to determine the Vulindlela rural community socioeconomic conditions
b. to characterise the current state of solid waste management in the Vulindlela rural community, including the type of waste generated
c. the impacts of improper solid waste management on the environment and well-being of residents
d. to determine solid waste management strategies used in Vulindlela

Literature Review

Rural areas are areas that are open country and characterised by small and sparse settlements (Morton *et al.,* 2019). The rural community of Africa is different from that of developed countries in that most residents are not involved in commercial farming. However, these communities are involved in subsistence farming and others survive on government social grants and remittances (Ncube *et al.,* 2014). In South Africa, rural areas have the poorest population compared to their urban counterparts (Ncube *et al*., 2014). This assertion corroborates the ideas of Moseya (2021) and Msunduzi Municipality (2016) who claim that Vulindlela is the poorest community in this municipality compared to townships and urban communities. Therefore, rural–urban migration is something that one would expect to happen in the Vulindlela area, and rural population shrinkage is something that mostly characterises poor rural communities (Donev *et al*., 2021).

However, the Vulindlela population has been steadily increasing over the years (see Figure 2). The population growth has been attributed to both natural growth and the inward migration of people from other areas into this area. The latter are attracted to this area due to the low cost of sizeable parcels of land, an exemption from municipal taxes, the opportunity to plant crops and have livestock, and the liberty of performing burials within the property (Msunduzi Municipality, 2016).

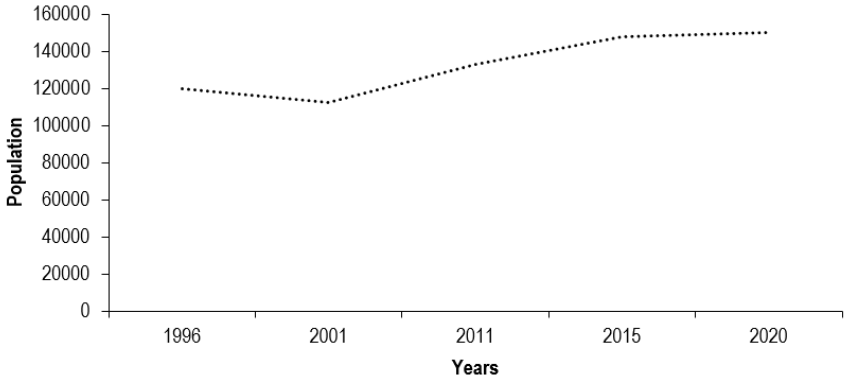

Figure 1: Vulindlela areas population growth from 1996 to 2020 (StatsSA, 2022)

According to Buhaug and Urdal (2013) and Torrey (2004), population growth is coupled with an increase in housing units. In Vulindlela there has been a notable increase in housing units mostly in crop fields and open pastures. Some of these properties are valued at millions of rands. In terms of property designs, people are also moving away from traditional buildings which were rondavels to more modern designs. Such developments in rural areas, even in Vulindlela, indicate that this community is economically developing from being a lower-class community to a middle-class community. This is consistent with the reporting of Burger *et al.* (2015) and Zwane (2019) that the Black middle class has grown from 2.2 million in 1993 to over 6 million in 2018. Middle-class consumption patterns are high and diversified compared to the lower class whose main spending is food (Gupta and Singh, 2016). According to Nieftagodien and Van der Berg (2007), the Black middle class is compared to other middle-class racial counterparts. These authors state that the Black middle class has a high consumption pattern, especially in terms of household assets such as stoves, microwaves, TVs, and other appliances. This economic liberty of this group affords it more money for food and other items. Thus, this increase in consumption patterns is coupled with waste generation (Liu *et al*., 2019). Solid waste management is an activity of the local government, however, in the South African context, this activity in rural areas is not conducted.

Solid waste management is a global challenge, especially in economically developing countries due to their growing populations, lifestyle changes, rising community living standards, and increasing waste generation (Hassan *et al*., 2016). There are major gaps in waste collection coverage between larger cities and rural regions across all developing countries. A recent study estimates that 1.9 billion people lack waste collection services in rural areas (Mihal 2017). Poor institutional practices are a major challenge to municipal waste management in developing countries; this problem has been exacerbated by increasing population and rapid urbanisation. The National Waste Management Strategy acknowledges that there is a historical backlog of waste services, especially in urban informal areas, tribal areas, and rural formal areas. Prior to the adoption of the 1996 Constitution in South Africa, local government administrations were a creation of the apartheid statutes; They were racially segregated to supply unequal services to different communities (Nyalunga, 2006). The 1996 Constitution was created to bring about transformation in local government administration to remove disparities in services. Consequently, The South African Constitution, Act No. 108 of 1996 (Schedule 5, Part B) states that waste management service delivery is a municipal function. (Fakoya, 2014). Consequently, municipalities are responsible for general waste management, both in residential areas and industrial sites. Waste management activities by municipalities include the collection of garbage, rubbish, and trash; the transportation and disposal by incineration or by other means; and the removal of human waste products either through drains, sewers or by other means. However, the waste management budgets of local municipalities are limited and even more so in rural and remote areas. Municipalities in such areas usually face obstacles with the collection of waste. They also lack the proper equipment, infrastructure, and treatment centres and experience difficulties accessing treatment centres elsewhere. This unequal distribution of infrastructure in South Africa's waste management remains a major concern and stems from the politico-socio-economic inequalities of the past (Viljoen *et al.,* 2021).

There are diverse settlements that occupy peri-urban environments in South Africa, such as informal, traditional, and township settlements. This diversity in settlement type poses a challenge in terms of waste management services as there are different authorities to consider when attempting to access these communities, such as tribal leaders (chiefs, indunas) and councillors (Hlahla *et al*., 2016). Local municipalities must create partnerships with these authorities before implementing waste management services (Kubanza and Simatele, 2020). The issue of

SWM (Solid Waste Management) is more critical in the metropolis of many low-income countries, which are confronted with rapid and unplanned urbanisation as well as a high incidence of poverty (Coban *et al*., 2018). Residents in developing countries, especially the urban poor, are more seriously affected by unsustainably managed waste due to the lack of adequate urban services (Kubanza and Simatele, 2020). Indiscriminate dumping has become a common method of waste disposal in many cities of Sub-Saharan Africa (Simatele and Etambakonga, 2015); solid waste is now a common feature of the urban landscape, visible along roadsides, rivers, and in open and public spaces.

Human activities exert a detrimental influence on the ecosystem, as noted by Manisalidis *et al*. (2020). These activities contribute to the contamination of essential resources such as potable water, the air we breathe, and the soil that sustains plant life. Pollution, defined as the introduction of hazardous substances into the environment, further exacerbates this situation. These pollutants, which can take the form of toxic solids, liquids, or gases, are generated in excessive quantities and degrade the overall quality of our environment. It is crucial to recognize that pollution is not confined to specific areas or settings. As Kankaria *et al*. (2016) emphasize, it occurs both in urban and rural regions due to the rapid processes of industrialization and urbanization. This highlights the pervasive nature of pollution and underscores the urgent need for comprehensive measures to mitigate its effects and protect our ecosystem. Patel *et al*. (2022) reveal that environmental pollution is gradually increasing and having a negative influence on living species, including people. Microorganisms or plants with biosynthetic pathways for the breakdown or buildup of environmental contaminants from soil and water can, however, lessen it. Environmental pollution is not a new occurrence, according to Ukaogo *et al*. (2020), but it remains the world's greatest problem facing humanity, as well as the primary environmental cause of disease and mortality. Furthermore, despite the global focus on pollution, the ramifications of its severe long-term consequences are still being felt.

Solid waste pollution causes a lot of negative impacts on people, especially in terms of health. Solid waste attracts pests such as rats and insects which can spread various diseases (Alam and Ahmade, 2013). For example, rats are known to spread diseases such as Hantavirus, Lassa fever, Leptospirosis, Monkeypox, Rat-bite fever, and salmonellosis, to name a few (CDC, 2023). Whilst insects like mosquitoes are known for transmitting the malaria virus. In areas where solid waste is dumped into freshwater ecosystems, pathogens in waste may cause gastroenteric diseases (Alam and Ahmade, 2013; Chadar and Keerti, 2017). According to the United Nations, 4,000 children die every day because of drinking contaminated water.

Methodology

Vulindlela lies in the western part of the Msunduzi Local Municipality in the KwaZulu-Natal province of South Africa (see Figure 1). The Msunduzi Municipality forms part of the larger uMgungundlovu District Municipality, is the largest economic contributor, and has the largest population (61%) of all the local municipalities within the district. The Msunduzi Municipality covers an area of 590.6 km2 and consists of 37 wards (Msunduzi IDP (Individual Development Plan), 2017/22).

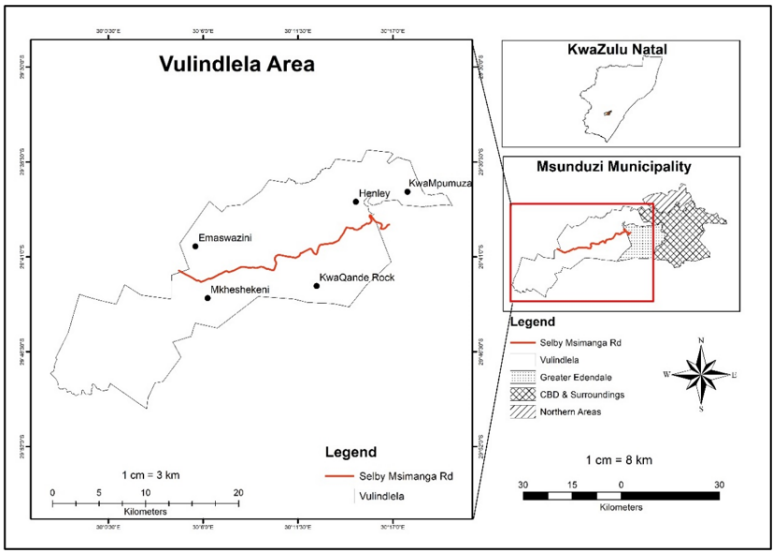

Figure 2: Map of Vulindlela in relation to the Msunduzi Municipality

Most land in Vulindlela is owned by the Ingonyama Trust Board (Msunduzi Municipal, 2016). The five Traditional Councils in and around Vulindlela are responsible for land allocation while the Msunduzi Municipality is responsible for land use management (Msunduzi Municipality, 2016).

The target population of this study is the five rural communities of the Vulindlela area, which is situated west of Msunduzi Municipality in Pietermaritzburg, KwaZulu-Natal. A total of 50 households were randomly selected as sample sites as a result of a detailed field survey in 2022 and 50 respondents participated in the study for interview through cluster sampling technique. The Vulindlela rural community housing structures depict a transitioning design from being more urban to more traditional rural housing structures (Figure 2). For example, the Henly dam area, which is part of Vulindlela, that is closest to the urban environment of Pietermaritzburg has urban-like housing structures and patterns, whilst Emaswazini, which is located further west and deep in Vulindlela, has more rural traditional housing structures and patterns.

Figure 2: Urban-like housing structure and pattern of Henly Dam area (left) and rural traditional housing structure and pattern of Emaswazini (right)

The study used a mixture of qualitative and quantitative methods. Primary data about the socio-demographic characteristics of respondents were gathered through close-ended questions. Open-ended questions in the semi-structured interview were utilised to gather data on Vulindlela residents' perceptions of waste pollution effects and strategies implemented in their area. Also, the image-based method was used to capture the extent of visual pollution, in particular the illegal dumpsites. The collected information has been properly arranged and dealt with for analysis. Microsoft Excel was used to perform basic descriptive statistics (frequencies and percentages) to examine the socio-economic characteristics of respondents. While the thematic content analysis was undertaken to analyse the open-ended question data which was on respondents' perceptions of waste pollution in their area.

Presentation of Results

Below, we reproduce respondent's personal, and household socio-economic background information as summarised in Table 1 below:

Table 1: Respondents' socio-economic characteristics, 2022

Respondents' socio-economic characteristics (*n* = 50)	**Percentage**
Family head	
Male	36
Female	64
Household individuals	
1 – 3	14
4 – 6	32
Table 1. *Cont.*	
7 – 9	30
10 – 12	80
13 – 16	2
Educational level	
No education	0
Primary school	3
High school	56
Undergraduate	42

Postgraduate	0
Employment	
Not employed	57
Self-employed	7
Employed part-time	2
Employed contract	7
Employed full-time	26
Respondents' sociodemographic characteristics (*n* = 50)	**Percentage**
Sources of income	
Salaries and wages	40
Business	9
Remittances	0
Social grants	51
Household total income	
500-3000	56
4000-10000	22
11000-15000	10
16000-20000	2
21000-30000	5
31000+	5
Grocery expenditure	
800-1500	46
1600-2000	20
2100-2500	10
2600-3000	5
3100+	20

Respondents stated that waste pollution contaminates river and fountain water quality. Since they also use these systems for water consumption when there is reduced or no water supply, they stated that waste pollution leads to waterborne diseases. This community mentioned that these freshwater ecosystems are also important for fulfilling some of their traditional and religious rites. Moreover, respondents stated that the improper disposal of nappies (diapers) contributes to river system contamination, which directly affects traditional activities held in these ecosystems. This pollution undermines practices such as cleansing after funerals, cleansing of people by traditional healers, and Christian baptisms. They also mentioned that waste pollution leads to aesthetic loss. Respondents further stated that waste pollution has significant impacts on the natural environment, as outlined in the following points. Firstly, it makes the environment dirty as improper waste disposal leads to the accumulation of trash and debris in various areas. This can include litter on streets, garbage in public spaces, and waste dumped in natural habitats. Secondly, waste pollution contributes to land pollution, thus, leading to a less aesthetically pleasing environment. The sight of litter and garbage-filled landscapes and polluted environments can be visually unappealing and diminish the overall beauty of natural surroundings. Thirdly, waste pollution can result in an intolerable stench in certain areas. Respondents also intimated that illegal dumpsites lead to pest infestation, especially rats and mosquitoes. This problem is more prone at the Henly dam area where most of the respondents dump their waste outside of their properties. The mosquito problem was noted in areas where people were dumping their waste in freshwater ecosystems. This waste clogs streams and contaminates wetlands.

The image-based method results indicate that there are illegal dumping sites, especially along the roads. However, there is a distinction between areas when it comes to the type of waste that is found in these dumping sites. Dumping sites of areas situated in the transitional zone, between urban and rural areas, are characterised by a range of waste materials (see Figure 4 and 5). Waste materials such as beer bottles, cardboard, refuse bags, and household materials. Whilst dumping sites situated deeper in the Vulindlela area have a lesser variety of waste material but are dominated by baby disposable nappies (see Figures 6 and 7).


Figure 4 and 5: Roadside dumping site in the urban–rural transitional zone used by the Vulindlela community


Figure 6 and 7: Open field dumping in deeper situated Vulindlela community

When it comes to waste management at a household level, 98% of respondents stated that they do not have access to waste disposal infrastructure such as a landfill. As a result, most respondents (83%) manage their solid waste on-site by burning their waste within the yard/property. Other respondents stated that they throw their waste in the bush (10%), dump it in the central business district bins (2%) and others stated their waste is collected by waste recyclers (10%). When asked whether they are concerned with illegal dumping or pollution. Most (80%) said they are concerned and 68% are aware of the impacts of waste on the environment. A substantial number of respondents (78%) asserted that there are no waste management initiatives at a community level. However, 18% said there are initiatives. This means initiatives are not in every subsection of the Vulindlela area. When asked about the need for a landfill, 88% of respondents said there is a need for a landfill specifically for this community, whilst 13% did not see the need for this infrastructure as they still manage their solid waste. Amongst those who saw a need for a landfill, 53% said they are willing to pay for this service and waste collection, whilst 48% said they will not be able to pay for this service due to financial constraints.

Discussion

Solid waste is said to be an 'urban' problem and is linked to economic development (Hoornweg and Bhada-Tata, 2012). However, this study depicts that solid waste pollution is also becoming a rural problem. Overall, the Vulindlela area is a low-income community that is characterised by unemployment, a considerably high level of dependency on social grants, a high number of family members per household, and high expenditure on food which runs up to 50% to 80% of the total household income. These findings corroborate with the idea of the Msunduzi Municipality (2016) that Vulindlela is one of the poorest communities in the municipality. Due to the link between the economic condition and solid waste generation of a community, one would expect this area to have fewer solid waste issues. However, due to population growth, an increasing population density, and minimal buying power, the Vulindlela area is having issues with solid waste management. However, it should be noted that solid waste issues differ between areas. For example, the Henly Dam area, which is a community characterised by people who are highly educated, some who own businesses and some who have jobs that earn them ten times what other respondents from other communities are earning, have greater solid waste issues. This community litters in the bush, especially along the road, and these sites have become noticeable dumpsites. Also, solid waste composition in these dump sites is highly diverse, ranging from organic material to papers, plastics, bottles, and metal material.

Whilst other areas of Vulindlela, which are characterised by a population that has a somewhat high school qualification, high unemployment rates, and reliance on social grants, have fewer solid waste issues. These areas

are characterised by a high number of children under the age of 3 years and, as a result, they have disposable nappy problems. These communities mostly use a pit latrine, which one would expect to be used to dispose of these nappies. However, respondents said these nappies fill pit latrines much quicker and as a result, they either dig holes or throw these nappies into the river. Some of the respondents said that these nappies are causing social and environmental problems as they contaminate river systems which they rely on for their washing and sometimes for water consumption, especially on days when they don't have a tap running water. These river systems are also important for traditional activities. For example, according to the Zulu culture, after the burial of the family head (husband), a wife and other women who are from the family must go to the river to cleanse themselves. Rivers are also used by traditional healers and Christians for cleansing and baptisms, respectively. Thus, these nappies are affecting religious and cultural activities. One respondent said there was a group of traditional healers who took the responsibility of cleaning these rivers, but the problem became too much and, as a result, they stopped due to the lack of support of the community. This assertion corroborates ideas posited by Ntekpe *et al*. (2020) that disposable nappies contaminate and damage the environment and ecosystem services that people depend on.

Across the Vulindlela area, respondents stated that a solid waste problem is affecting the community. They asserted that solid waste also affects their livestock which ends up being sick which also affects them financially as they must buy medicine. Another issue around solid waste management is the burning of waste, which sometimes causes conflict between neighbours when one neighbour burns his/her waste whilst the other has laundry on the laundry line. Others mention that their landscape has become less and less aesthetic due to visual pollution. Most respondents stated that there is a need for a landfill, whilst others felt that there is no need for this infrastructure as they can manage their own waste. Those who wanted a landfill said this infrastructure will be of great use and importance for both the environment and for them as a community. They asserted that the landfill would aid them in keeping their community clean, controlling the illegal dumping on roadsides, keeping their rivers clean, and maintaining a clean and aesthetically pleasing environment. It is noteworthy that the community is not indifferent to poor waste management and pollution, but the lack of better and sustainable alternatives remains a concern. The lack of municipal involvement in providing solid waste management services and infrastructure as well as environmental awareness programs all contributes to the existing open dumping and incorrect disposal practices observed.

Conclusion

Based on the findings, it is evident that there is a need for improved waste management infrastructure and practices in the Vulindlela community. Findings further underscore the importance of improved waste disposal facilities, public awareness about the environmental impacts of waste pollution, and the promotion of community-based waste. There is a significant need to address waste management infrastructure gaps within rural communities. The dearth of easily accessible waste disposal facilities as well as the prevalence of on-site waste disposal methods pose challenges in ensuring efficient waste management processes. Efforts should be made to establish communal landfills to meet the demands of the community and reduce the burden of waste management at an individual level. Furthermore, addressing the financial constraints that some members of the community face is critical for ensuring equal access to waste management services. This could include exploring funding possibilities or providing subsidies to make waste collection and landfill services more reasonable and accessible to all residents, resulting in a more sustainable household waste management system. Within the context of this rural community, where waste management is not done by the municipality, collaborative efforts need to be strengthened between the traditional authorities, ward councillors, businesses, and households in the community to deal with waste and pollution.

Notwithstanding that solid waste management remains the responsibility of the municipality, to be successful it requires the support of all the stakeholders to actively participate in waste management systems that are proposed to keep their communities clean. The study also notes the importance of clarifying the role of municipalities in rural areas that are under traditional administrations to ensure that roles are defined and resources are assigned to relevant parties to ensure effective service delivery. Traditional and modern leaders alike need to take active roles in ensuring and enforcing environmental cleanliness within their communities. Considering the socio-economic status of Vulindlela and other similar communities, if community municipal waste collection services are to be supplied, they would need to be provided at no cost to the local communities. Hence, this study recommends effectively managed and serviced landfill sites that will be easily accessible to all community members. There is also a great need for education programs focusing on recycling and minimising household waste. Furthermore, a

community-led solution such as a community environmental forum is suggested to communicate and educate community members on solid waste management practices.

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