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Analysing the challenges of solid waste management in low-income communities in South Africa: a case study of Alexandra, Johannesburg

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ABSTRACT

Solid waste constitutes one of the most pressing environmental problems, requiring urgent action from urban managers to find appropriate management mechanisms. The rapid increase in municipal solid waste generation is undoubtedly due to the accelerated population growth rate triggered by massive rural-to-urban migration. This paper analyses solid waste management challenges in low-income communities in South Africa, using a case study from Alexandra, Johannesburg. Using qualitative and quantitative research approaches, findings revealed that solid waste is not reliably collected and transported in low-income communities in South Africa. The main obstacles include the scarcity of resources and equipment necessary for waste treatment. To widely involve residents of Alexandra Township in the waste management process, the municipal council should embark on a public awareness campaign. The findings further encourage effective waste sorting techniques, such as separating biodegradable from non-biodegradable waste, so that valuable goods can be taken to the local government recycling centre. The results further encourage the involvement of the homeless and unemployed in the recycling and waste management process, thereby reducing the shortage of human resources and creating jobs. These issues are analysed within the context of evolving arguments that focus on developing a pro-poor approach in solid waste management that may present an opportunity for achieving sustainable solid waste management in Johannesburg, South Africa.

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1. Introduction

Solid waste can be described as any undesirable solid product or junky materials that have no further use in production or primary undertakings, mostly produced due to human actions (Oyekale, 2015). It can arise from various sources categorized from different land uses such as households, commercial, industrial, or construction sites. According to Bundhoo (2018), when a community does not use appropriate management systems, waste usually leads to environmental degradation and health effects are

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triggered. Abul (2010), supported by Njoku et al. (2019), confirmed that poor management of waste presents several health challenges. Where management systems are adequate and effective, the generation of solid waste can be reduced, thereby alleviating the costs of waste management relating to collection, storage, disposal, and treatment burdens. This effective management of solid waste should take centre stage, as it is vital since it results in guaranteeing a healthy and clean environment (Pattnaik & Reddy, 2010).

Solid waste management (SWM) is a growing concern in most developing countries (Adeleke et al., 2021). Globally, it is anticipated that the amount of garbage produced worldwide will double by 2025, rising to 6 million tonnes per day (Hoornweg & Bhada-Tata, 2012). Most developing countries struggle to implement efficient waste management systems (Kubanza, 2019), which results in mismanagement of the solid waste generated (Adeleke et al., 2021). The upsurge in population growth, following the increased effects of urbanization and economic developments, amongst other factors, has heightened solid waste production in many nations (Dlamini et al., 2019; Farah, 2019).

Municipalities are required to offer a minimum standard of fair and reasonable garbage collection, transportation, and disposal services, which presents difficulty in managing solid waste (D. Wilson et al., 2014). Despite spending 20 to 50% of their revenue on waste management strategies, many municipalities in developing countries only collect 50 to 80 % of the waste produced, and send it to landfills (D. Wilson et al., 2014). MSW collection, disposal methods, and sites remain challenging and complex challenges for many large cities (Hassan, 2004). The pressing issue for this complexity found in least-developed countries is infrastructural inadequacy and a lack of funding to implement effective waste management systems (Kubanza, 2019). Both of these challenges are caused by socio-economic and political constraints; as a result, the waste generated has been mismanaged (Adeleke et al., 2021). Furthermore, Bolaane (2006), and Dlamini (2016) noted modernization and urbanization processes are connected to the unremitting waste generation increase in African cities.

Cities in least-developed countries are struggling to effectively contain the increasingly generated solid waste (Adeleke et al., 2021). For example, observed poor practices of solid waste in Bahawalpur City, Pakistan, due to inadequate waste collection services. Pierre and Naik (2016) reported a rise in open dumpsites in Nyagatare city in Rwanda, because of a poor management system, as solid waste is discarded indiscriminately in public spaces. Similar problems were observed in Abia state, Nigeria, where poor waste management systems have resulted in the common practice of illegal disposal (Ndukwe et al., 2019). Like the situation in Nigeria, a rapid increase in mismanagement of solid waste due to constraints in municipal waste collections was observed in Zalingy town in central Darfur State, Sudan (Adam et al., 2016). The above observations are no different from the state of solid waste management, particularly in Johannesburg, South Africa (Kubanza, 2010; Muzenda et al., 2012). Most cities in developing countries have similar challenges relating to waste management. It is, therefore, a serious issue that needs a holistic approach.

The major contributor to this increase in waste generation is urbanization and rapid population increase (Dlamini et al., 2019; Karuku & Kathula, 2021). This increase in large quantities of waste presents a burden on the already overstretched waste management

systems (Bundhoo, 2018). Simply put, because the increasing volumes of waste generated are poorly managed from their sources, with little or no efforts of waste minimization, landfilling becomes the primary option for most of the waste, demanding more collection, storage, and disposal services (Adeleke et al., 2021). Solid waste management was discovered to be a cause for concern in various countries like Myanmar, Cambodia, and all developing countries (Adeleke et al., 2021). Deficiencies in SWM exert a range of challenges due to pressures that involve financial outlays. These kinds of pressures are experienced by local governments and encourage tendencies to concentrate on short-term management strategies and ignore longer-term strategies. However, these tendencies will in less time lead to a crisis (Bundhoo, 2018; Coffey & Coad, 2010; Rasmeni & Madyira, 2019).

Notwithstanding efforts made by the South African government to improve waste management and have progressive legal frameworks that ensure citizens' rights to a clean environment, solid waste is unreliably collected and transported in lower-income communities (Kubanza, 2019). The main obstacles leading to this mismanagement are the scarcity of resources and equipment for handling waste. Nevertheless, in a broader view, waste management is still a significant environmental issue that needs a revisit now and again until it is addressed.

1.2. Solid waste management (SWM) challenges in the context of South Africa

SWM is a massive environmental issue that many municipalities in South Africa have yet to effectively address (Kubanza & Simatele, 2019). Notwithstanding government efforts to maximize waste collection services in urban and semi-urban areas, the success of SWM in South Africa has been hampered by the lack of a comprehensive management and planning strategy. Fragmented and misinterpretations of legislation, institutional infrastructure inadequacy, and maladministration have hampered the effectiveness of SWM in South Africa.

Waste management in South Africa is based on (Godfrey & Oelofse, 2017; Pewa, 2019) among other legislation and policies. The waste management mandate approves the waste management grading in ascending order of preference, where waste prevention is followed by waste recycling, reuse, minimization, recovery, and lastly waste disposal. The focal objectives of the environmental policies are to reverse the policies of the repressive apartheid regime while integrating marginalized communities when providing services (Pewa, 2019). Current solid waste problems can be attributed to these outdated laws and policies due to their fragmentation (Guerrero et al., 2013; Pewa, 2019). Institutional capabilities to develop and include urban dwellers are limited (Simatele & Etambakonga, 2015). Townships in low-income communities are often left out of development programmes (Jürgens et al., 2013), leading to inadequate service delivery with erratic or non-collection of waste.

Waste-related institutions, policies, and programmes, for the most part, fail to include communities and assess gender perspectives in the implementation and evaluation of waste programmes (Muchengetwa, 2019). Even if a community has sufficient facilities and infrastructure, people's perceptions and beliefs significantly shape SWM (Brown, 2015). In most cases, waste production and management are gendered due to cultural values and beliefs, and it is predominantly women who handle waste. A study conducted

by Poswa (2001) in Umtata and Northcrest, Durban, showed that in most households, women are responsible for household chores, such as emptying trash and other household waste management methods. Although women differ and are influenced by their historical and material context, observations show that in general, women view waste disposal as an act of caring for their family. These statements reflect the extent to which gender divisions within society are based on gender. Environmental policies and governments, however, remain blind to how waste production and management are shaped by gender roles within communities. On the other hand, gender plays an important role, as assigned gender roles could influence levels of awareness about the environment, as well as health and sanitation. There is growing awareness of the social impacts on service delivery, and much more needs to be done to raise awareness of the neutral idea of waste management.

The majority of South Africans still struggle to access regular garbage collection services, particularly in low-income areas. Garbage collection services are reportedly unavailable to 38% of the population (Stats, 2011). Generally, without formal waste collection, people look for autonomous methods, which may not be the most suitable strategy (Khumalo, 2016). Additionally, the unavailability of waste management systems forces people to adopt unsustainable methods of solid waste disposal, such as open burning. The Department of Environmental Affairs (DEA, 2018) reported in 2018 that only 10% of South Africa's solid waste is recycled, with 90% going to landfill. The 10% contribution from recycling activities is mainly made up of illegal waste collectors. According to the DEA (2018), more than 60,000 informal waste collectors sort and recycle waste on the streets and in landfills (Godfrey & Oelofse, 2017).

Olukanmi et al. (2016) found that most solid waste dumped in landfills in South Africa is recyclable. Godfrey and Oelofse (2017) argue that significant financial investment is required to reduce waste disposal in landfills. Despite the challenges of financing SWM, other researchers argue that low community participation hinders sustainable SWM efforts because single municipalities work with limited resources. Therefore, community involvement and participation are important to increase recycling, reuse, and safe disposal of solid waste. Rodney and Ruhliga identified financing, institutional capacity, and the country's socio-economic status as important constraints hindering waste management in South Africa.

Tsheleza et al. (2019) report that approximately 90% of solid waste generated is recyclable and that household size, income status, awareness, and participation in recycling determine the rate of waste generation. This is consistent with the report on the solid waste situation in South Africa, which indicated that socio-economic status and household structure influence solid waste generation (DEA, 2018). The major problem is the lack of an effective solid waste management system. Naidoo (2009) found that illegal practices occur due to a lack of awareness and the government's inability to monitor compliance with SWM policies and legislation. Community participation is the missing link to achieving sustainable SWM (Masood et al., 2014). This has led to ineffective SWM legislation and government policies.

Nyika et al. (2020) argue that South African SWM is weakened by the absence of holistic planning and management at the governance level. Poor urban areas face problems with solid waste disposal (Rasmeni & Madyira, 2019). This has harmful consequences for the environment and the health of human populations, affecting the

overall standard of living. Report that poor solid waste management has adverse effects on human health and the environment. Oyekale (2015) used general household survey data on waste management to analyse solid waste disposal practices in Limpopo and Mpumalanga provinces. He discovered a common culture of littering and disposal on roadsides or in open fields. Sikhulile and Mudau (2014) report that lack of knowledge within communities about SWM has negative impacts on the environment and that community health is a barrier to changing attitudes towards SWM.

There is a growing public outcry in many low-income regions around the world for effective waste management and a habitable environment, and South Africa is no exception. Although promoting a sustainable environment is the primary goal of waste management and public protection (Department of Environmental Affairs, 2011), poor communities nevertheless face waste management needs daily (Gutberlet et al., 2017). The private sector then participates in the sustainability of waste management (Masocha et al., 2005) in many municipalities. However, national governments have significant influence on how policies are developed and the extent to which private companies can participate and have given powers to control solid waste management spending (Coffey & Coad, 2010). Nonetheless, privatization resulted in misuse of funds that hindered effective service delivery in low-income communities. In most cases, it is unclear where funds to combat poor waste management are spent.

2. Research approach

This paper is based on data which was gathered through two research phases. The first phase involved a comprehensive review of archival records, and peer-reviewed journal articles on solid waste management challenges, both in the global, regional, and local contexts. The reviewed literature was accessed through a search of archival records and other sources, such as different library databases of universities in South Africa (i.e. Witwatersrand, Pretoria, Johannesburg, Cape Town, KwaZulu-Natal, and Stellenbosch). In addition to this, web-based search engines, such as Google, Yahoo, and Google Scholar, were employed to search for both historical and recent journal articles on topics of a similar nature. Both library and internet searches yielded an estimated 80 journal articles and 8 textbooks focusing on solid waste management in a global and regional context. A rapid appraisal and meta-analysis of these pieces of literature resulted in the selection of a total number of 40 peer-reviewed articles focusing on solid waste management issues in the global North and 15 in the global South being selected for inclusion in informing the argument presented in this paper. Other grey literature from the print media: newspaper articles, reports of workshops, and press conferences were also engaged with to gain a comprehensive understanding of local issues about the state of solid waste management in South Africa. The systematic review process adopted in this study commenced with the establishment of a set of inclusion and exclusion criteria (Table 1) for screening- both peer-reviewed 'academic' and non-peer-reviewed 'grey literature' publications to be included in the study. Table 1 presents the systematic review methodology process adopted in the study.

Further to the above, a set of possible search strings was piloted initially over two weeks using both the ISI Web of Knowledge (WOK) database for academic literature as

Table 1. The systematic review process adopted in the study.

Peer-reviewed article	Criteria	Non-peer-reviewed
Level 1: Paper identified through initial database search using various search strings yielded: 280	Inclusion Criteria: Documents that focus on answering the research questions/ achieving the research objectives. Documents that analyse the solid waste management challenges in the study area Documents that emphasize more on solid waste management strategies and practices. Documents on the awareness of solid waste management policies The barriers that influence solid waste policy implementation, etc.	Level 1: Paper identified through initial database search using various search strings yielded: 120
Level 2: Initial screening of paper titles and abstract using criteria yielded:120		Level 2: Initial screening of paper titles and abstract using criteria yielded: 50
Level 3: Full-text screening included:80		Level 3: Full text screening included: 58
Level 4 documents included for thematic analysis consist of:40		Level 4: Documents included for thematic analysis consist of: 40

well as Google Scholar for grey literature. Around 280 papers were downloaded (peer-reviewed articles, reports, blogs, chapters in books, and technical reports) and then screened with criteria such as solid waste, solid waste management challenges, and Africa. After the first initial screening only 120 papers met the criteria (see Table 1). Further screening was done using criteria such as policies, South Africa, and solid waste management practices. A full-text screening was done, which led to 80 papers being retained. Forty documents were utilized for the thematic analysis, which consisted of criteria, namely solid waste management challenges, legislation, awareness, and practices.

The second phase was a survey, which was conducted in Alexandra Township, situated approximately 13 kilometres from Johannesburg, on the north-east outskirts of Johannesburg Central Business District (CBD) (Stats, 2011). Alexandra has witnessed rapid population growth over the past few decades (Mafasa, 2019). This has been influenced by the desire to live closer to the Johannesburg and Sandton central business districts (CBDs), driven by jobs and other economic opportunities. It has also emerged as an alternative for cheaper accommodation for labour immigrants. The development of shacks over the years made the township a densely populated and very congested area (Mbanjwa, 2018). Intense socio-economic and political activities have resulted in increased solid waste generation, further burdens the available infrastructure (Mafasa, 2019). The composition of the housing structure in Alexandra created a situation whereby providing services is difficult due to limited access caused by congestion (Mafasa, 2019). The upsurge in population has also caused the growth of illegal settlements on riverbanks and within the floodline. These are high density informal dwellings with poor access to social services and environmental conditions (D. C. Wilson et al., 2013). Alexandra being one of the peri-urban areas in South Africa, has witnessed environmental injustices that exist in poor townships (D. C. Wilson et al., 2013). Despite the township containing a large population and being adjacent to the affluent and well-maintained neighbourhood of Sandton, the service delivery approach in Alexandra is rife with inefficiency and inadequacy (Mbanjwa, 2018). Water supply is insufficient, and overflow of sewage and solid waste disposal in the streets is common (Mafasa, 2019). Large amounts of waste can be seen on roadsides, in cemeteries, and in the Jukskei River (Evans, 2022). Alexandra exhibits evidence of the government's incapacities to afford efficient and sufficient service delivery that meets the rising needs of the

Participants from these organizations were crucial for this study because they offered invaluable data regarding SWM to answer the research questions.

Further, 20 participants from Johannesburg Municipality and Pikitup were recruited to participate in this research using purposive sampling. Their involvement or participation in this study was important because they regulate waste and environmental management issues in the study area. Participants from local municipalities and relevant NGOs were intentionally selected based on their status and how it can benefit the research project.

Residents of Alexandra were recruited to participate in this study to obtain the community's perspectives. Therefore, 50 households were sampled, considering that participants' opinions will likely be similar. This research study used a simple random sampling method (probability sampling). Probability sampling is a technique where participants are chosen randomly from the study population. There is equal opportunity for selection for each participant, unlike in non-probability sampling. In this study, each residence in the research region was located and given a unique number using a geographic map, considering that Alexandra has an estimated number of 7500 households. Thereafter, random numbers were generated to select representative households using a number table.

3. Results

A total of 50 questionnaires were distributed, of which 37 were completed, amounting to a 74% response rate for the household sample. However, 5 (10%) questionnaires were not fully completed, meaning they had invaluable information. The remaining 16% (8 questionnaires) were not returned by the heads of household due to varying reasons. Most of the questionnaires having been returned enabled the researcher to answer the research questions satisfactorily as all required information was at hand. [Figure 2](#) below illustrates the household questionnaire responses.

To gain a greater appreciation of the participant's understanding of SWM, the researcher also inquired about their level of education. Thus, [Figure 3](#) below shows the participants' Level of Education.

Of the 37 respondents, 23 had at least completed high school ([Figure 3](#)). This shows that the respondents are literate, and as such provide well-informed responses to the questions posed. The results also show that only 7/37 of the household participants completed primary school. Participants in this category failed to comprehend SWM though they had a glimpse of what they encounter in everyday life. It can be deduced from the results that the largest proportion of participants attained at least a high school certificate and understood well the impact and challenges of SWM. A combined 14% attained tertiary education and articulated an undoubted knowledge of the study area ([Figure 3](#)).

The employment status of the participants affects their willingness to participate and pay for service delivery of SWM. Results showed that most of the locals in Alexandra are either self-employed or unemployed ([Figure 4](#)). However, when asked about their employment status, some said:

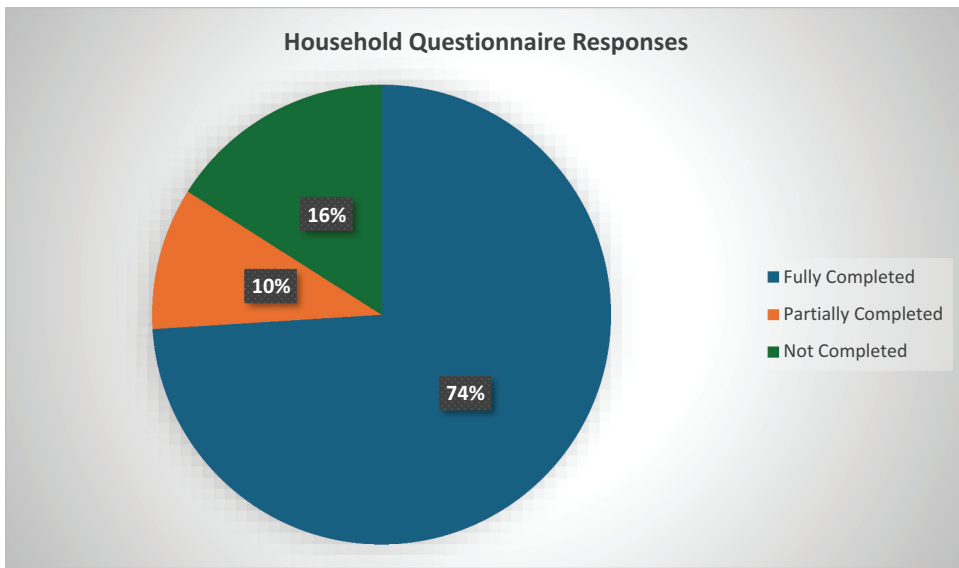


Figure 2. Household questionnaire responses.

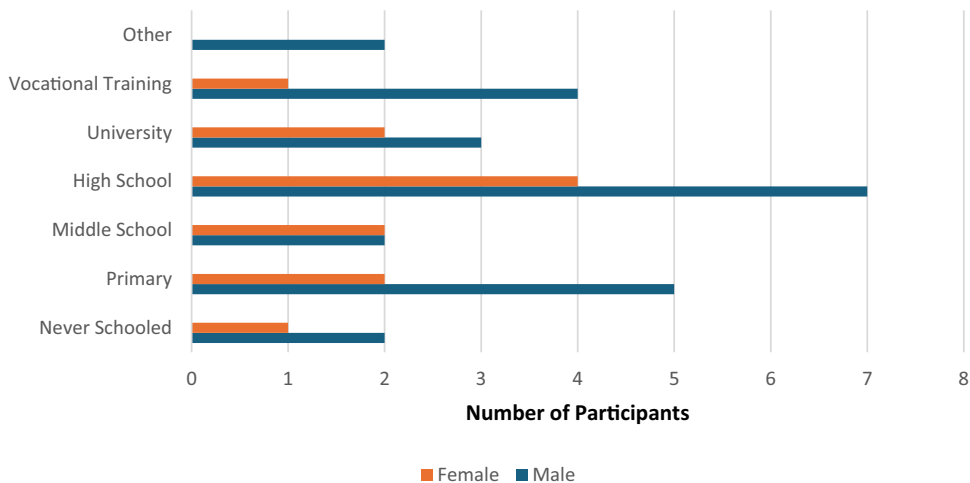


Figure 3. Participants' level of education.

The municipality should employ us and give us waste services jobs or any other jobs to improve our livelihoods, and that we don't participate because we are not paid for these services, we need employment.

It is evident from the above that residents in Alexandra are willing to aid a better cause for their well-being, but the municipality is not doing much to improve the SWM. Figure 5 below shows participants' SWM awareness of issues.

Figure 5 shows that 46% of the participants lacked SWM awareness whereas 42% knew what SWM is, however, they lacked waste receptacles, and 12% knew about proper solid waste management. This translates to a huge number of the population wrongly

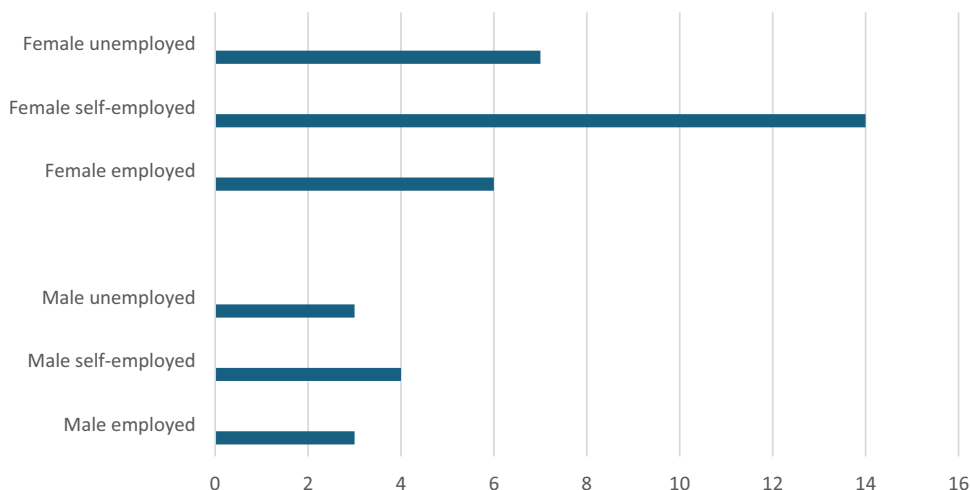


Figure 4. Participants' employment status.

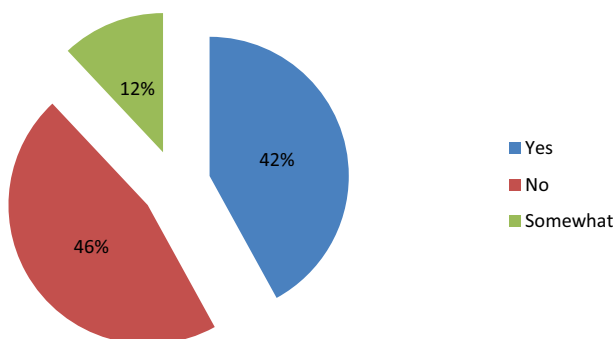


Figure 5. Participant's awareness of SWM issues.

managing solid waste due to a lack of awareness. SWM awareness affects people's perceptions of garbage. Humans were raised to believe that trash had no worth and should be thrown away (Paghasian, 2017). Previously, they believed that all rubbish ought to be placed in a single container (Sarino, 2012). However, to execute viable, effective, and correct solid waste management procedures, participation and awareness are crucial elements of the waste management programme (Punongbayan et al., 2014). Figure 6 below shows the type of solid waste generated in Alexandra.

Figure 6 identifies the type(s) of waste produced by the population of Alexandra and how frequently they produce such waste. The waste generated varied from degradable to non-degradable, recyclable, and non-recyclable. A majority 60% of respondents agree that they always throw out food waste whilst 35% indicated often or seldom. In the analysis, paper and plastics were similar, with 45% and 40% respectively highlighted as always. The waste generated is also comprised of glass and ceramics, which also represent recyclable materials, with 10% of respondents citing they never have these items as part of their garbage. Fabrics, comprised of torn clothes, blankets, carpets, and other forms of

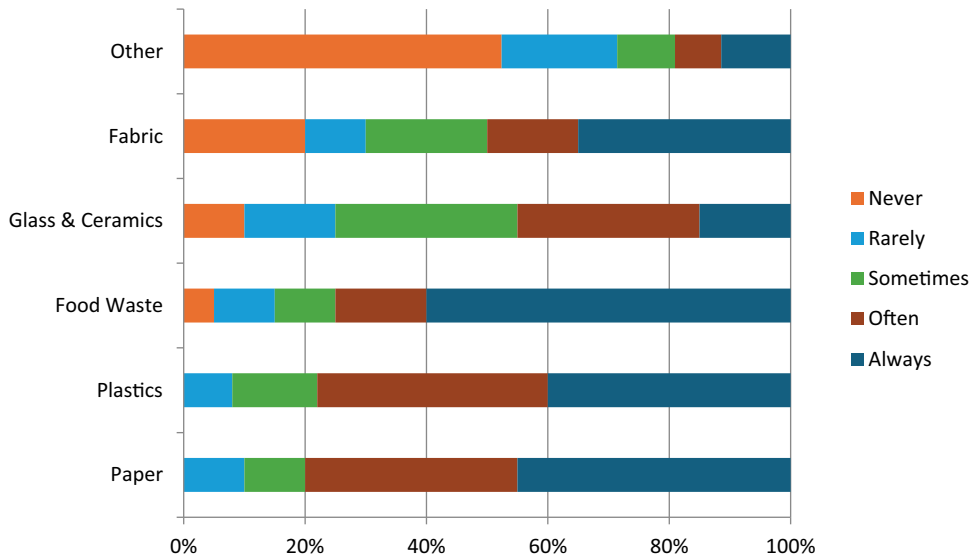


Figure 6. Types of solid waste generated in Alexandra.

textile also form generated waste, where 20% of the respondents cited, they never have these as waste. 35% of respondents showed they always throw out fabric, with 20% and 15% showing they sometimes and often have fabric as garbage. The category 'other' represented waste that could not be classified; this included old appliances, household hazardous materials, oils, and paints amongst others. 55% of respondents showed they never have these as waste, whilst 20% rarely have. 10% of respondents indicated they always have such items. The chart above shows the residents of Alexandra have a varied composition of waste. [Figure 7](#) below shows the regularity of domestic waste collection by the municipality as indicated by participants.

[Figure 11](#) shows that most of the supposed waste is collected once a week through waste containers, and there are numerous role players involved in waste management in Alexandra.

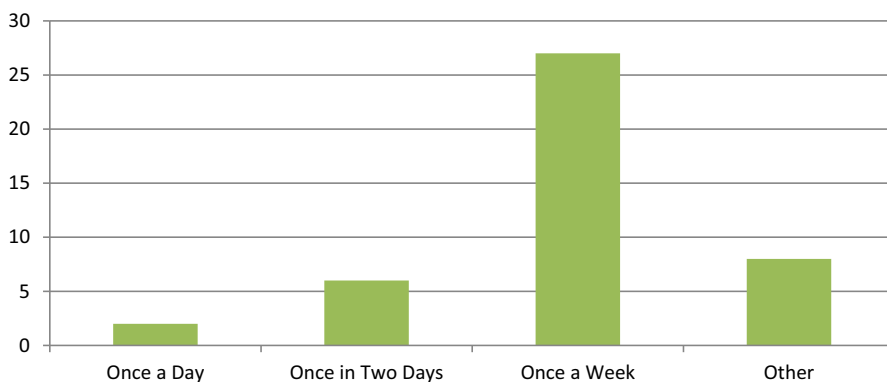


Figure 7. Waste container disposal frequency.

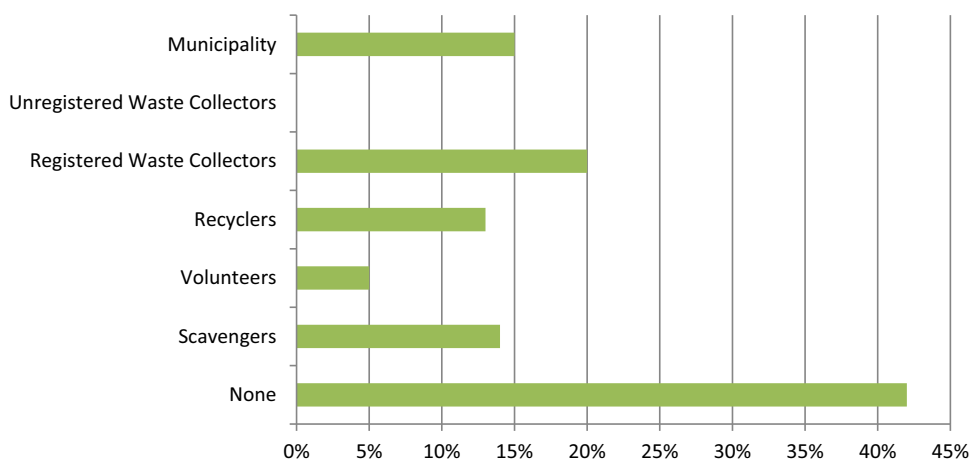


Figure 8. Solid waste collectors.

Figure 8 presents solid waste collectors and assesses how often and who collects waste from the locale. The information gathered indicated that the Municipality (responsible authority) and Pikitup (mandated authority) are incapacitated, relying on hiring garbage collectors from private players. This is one of the major reasons behind the SWM problem in Alexandra Township as the responsible authorities are overwhelmed to carry out their duties.

Metal local community bins posted at different sites are used as common collection points for the garbage trucks. However, due to the inadequate frequency of collection, waste ends up spilling over. Figure 9 shows solid waste spilling over the bin at the drop-off point.

Uncollected waste has resulted in several players wanting a piece of dirt: Figure 9 highlights the major waste collectors in Alexandra. There is a rising number of scavengers and recyclers collecting waste, with 15% and 13% respectively. Most of the waste is not collected, with a greater amount of 40%. Registered collectors and the Municipality command a combined 35% of the volume of waste, which is not sufficient to clear all the garbage. The community has set up voluntary teams who also collect waste in plastic bins, helping in eradicating the waste pandemic. Figure 10 below shows local volunteers from Alexandra Water Warriors Volunteers collecting waste.

The results of this study suggest that the locals have a basic understanding of the management of solid waste. It showed that out of 37 households, 21 had knowledge of solid waste recycling because they had been taught, and some practice recycling to eke out an income; 11 participants lacked solid waste recycling awareness, and 5 had a low understanding of recycling. This implies that residents of Alexandra Township need SWM awareness. In terms of the management of solid waste, waste segregation should begin by addressing the waste's source collection points. Figure 11 below shows the participants' understanding of solid waste management by recycling.

As shown in the pie chart above (Figure 12), the highest number, 73% of homes, are ready to take part in SW recycling. However, the reasons for participation are due to remuneration; the residents are willing to participate provided they are paid for their



Figure 9. Solid waste spilling over from the communal bin due to infrequent collection in Alexandra township (Source: author).

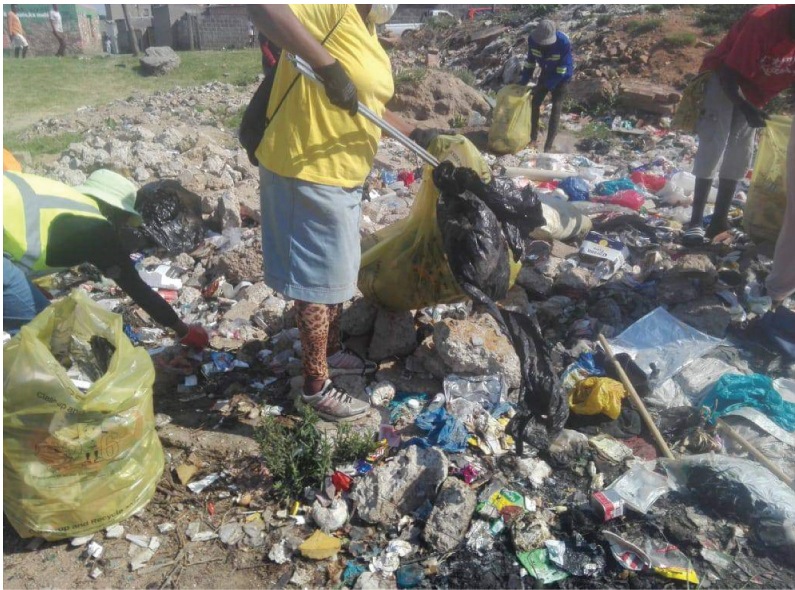


Figure 10. Local volunteers collecting garbage (Source: author).

participation. The lowest number, 11% of participants, interpreted as a fair number, were not sure of their will to participate in recycling. In addition, 16% of participants were clear that they were not willing to participate in recycling due to different reasons.

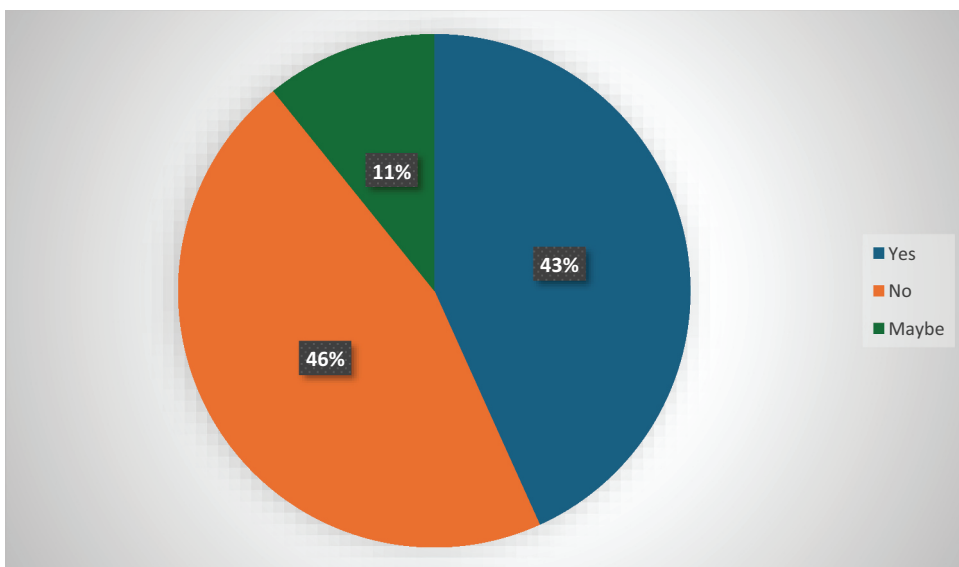


Figure 11. Participant's knowledge of recycling.

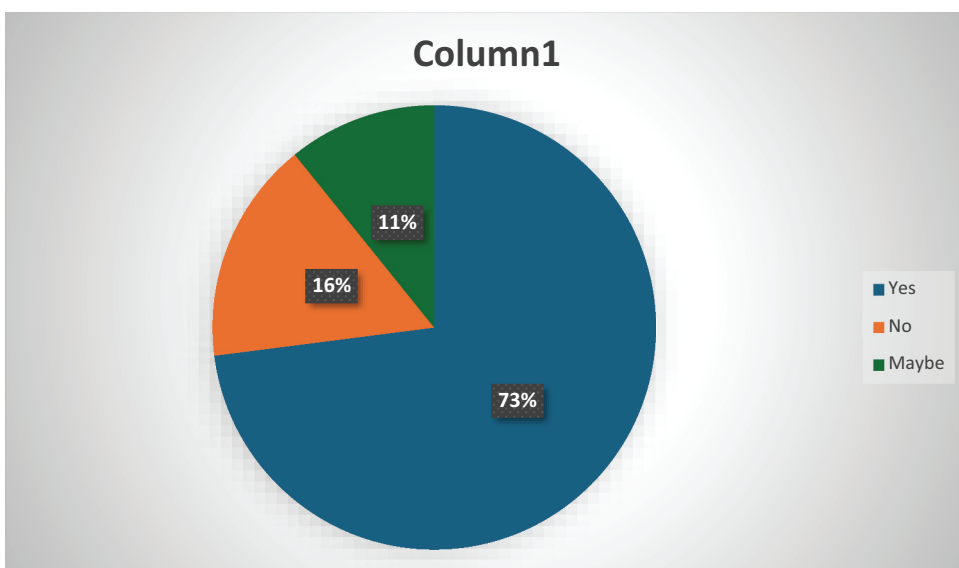


Figure 12. Participants' willingness to recycle.

Figure 13 indicates participants' satisfaction with the municipality's waste management service delivery.

Figure 13 indicates that over 50% of residents are dissatisfied with collection services in Alexandra. Only a few of the participants, who amount to 10%, were satisfied and 8% were fairly satisfied with the services for collecting and disposing of waste with waste collection and disposal services, as they have bucket bins in their compounds.

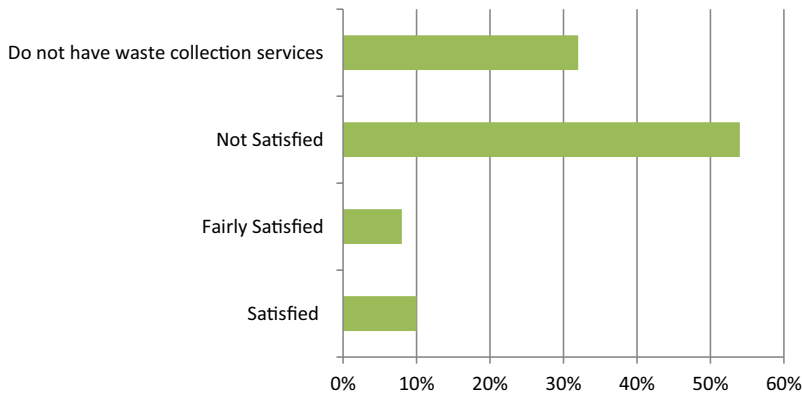


Figure 13. Participant's solid waste disposal satisfaction.

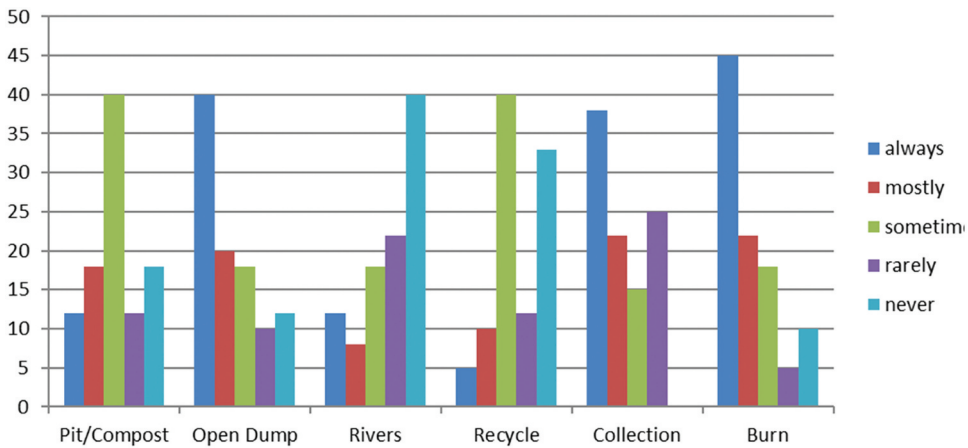


Figure 14. Waste disposal practices.

Nonetheless, the MSW collection and disposal services are generally unsatisfactory for most households such that when asked, 50% of the participants said that:

Collection of rubbish in this area is irregular and sometimes waste is picked up once every week and sometimes no waste collection happens for 2 weeks, and when we ask the municipality, they will tell us that the collection vans are out of service and waste will be overflowing from the communal bins... the skips will be full, so we resort to burning and dumping.

The research results further indicate that much work needs to be conducted in the community to establish a successful SWM. Most of the residents lack SWM awareness (how to handle MSW); due to this, exorbitant amounts of waste (bio-degradable and recyclable) are dumped in landfills and the environment. Thus, [Figure 14](#) below shows waste disposal practices.

[Figure 14](#) illustrates a detailed analysis of SW disposal practices in Alexandra. More than 45% of the population choose to burn or dump their unwanted domestic solid waste as a method of waste disposal among the locals, and some remain on the roadsides or in watercourses, and 12% endeavour to compost and recycle as a source of income. To

answer the question as to what additional solid waste management services the public would prefer the council to implement, more than 40% were in favour of increasing the number of public trash cans on specific residential neighbourhood corners, 22% wanted to see trash cans provided to every home, 15% favoured prompt garbage collection from kerbside dumps, and 30% strongly favoured increasing public awareness campaigns on SWM practices in the municipality.

For instance, the municipal authorities agreed that waste collection services in Alexandra are offered daily, that is, from Mondays to Sundays, at the designated points and times. Nonetheless, the departmental head commented:

We used to offer services from Monday to Saturday; however, that changed because Alexandra is overpopulated and generates more waste; a day without collection in the locality would imply more waste mismanagement and municipal costs. . . therefore we changed the schedule to a daily basis. . . however, the residents do not dispose of waste in the communal bins at the agreed times and that the challenge we have, we cannot collect waste twice a day in the same area.

However, responses from the household survey showed that refuse is collected mostly once a week through waste containers (See [Figure 7](#)). Moreover, through fieldwork observations, it was established that solid waste was left uncollected for days, to the point where waste spilled over from the bins because they were full (See [Figure 9](#)). Solid waste was also discarded on the roadsides, which the residents said was caused by infrequent waste collection services.

Regarding the inconsistency of municipal authorities and hired services, insufficient municipal assistance and a lack of service delivery were the issues that participants highlighted the most, accounting for 48% of the participant's comments. While the neighbouring communities rely primarily on government services, the township depends on 20% of private waste collection and transportation services that are done by Pikitup. According to the 2018 State of Waste Report, one of the key challenges to effective refuse management in South Africa is inadequate municipal services (DEA, 2018). The lack of waste collection services encourages illegal dumping and littering of rubbish in neighbouring areas. It causes greenhouse gases through burning and unfavourable visual effects, which negatively affects residents' quality of life. It was noted that 20% of all waste disposed of is collected regularly by the municipal department, which is not very consistent due to the lack of trucks and refuse compactors.

4. Discussions

Although NGOs, and their enactment of bylaws, have made great strides in addressing environmental issues in South Africa, the township of Alexandra remains plagued by a range of challenges, particularly relating to solid waste. While legislative frameworks work in hand with NGOs to combat SWM challenges, the lack of proper interpretation and enforcement of these existing SWM legislations, SWM baseline information, finance, planning, and in provision of waste receptacles prohibits a soundly functioning SWM system. Nonetheless, these challenges can be divided into the following four categories: financial, institutional, labour, and equipment management. Given that in South Africa, local governments are outgrowing their

landfill capacity, and this continues to be a major solution for waste management, these regulations should be strengthened to improve waste services and collection. However, this is complex because no clear strategies have been developed by the municipality. Waste management is a multifaceted issue involving social, economic, cultural, legal, environmental, and institutional factors. Therefore, connecting these elements to the working system, while engaging the community and all relevant authorities as key stakeholders in South Africa, is the best method for determining the sector's needs at all government levels in the present and the future.

With the deficiency of institutional and financial support, most participants identified inadequate institutional and financial support for waste management as the biggest obstacle to SWM. This correlates with other studies by Rodríguez-Rodríguez (2012) and Przydatek (2019) who indicate that, for low-income areas, lack of budgets and inadequate funding are some of the main obstacles to SWM. It can therefore be concluded that lack of financial support is a constant hindrance to SWM, hence it remains a problem for many residents not only in South Africa but also in Africa. The cost of waste management was a sensitive topic for the interviewees from offices of authority, especially considering the financial strains caused by increased living expenses and high unemployment rates.

Additionally, Wilson (2014) says 'Institutional responsibility issues are often taken for granted, which makes it difficult for municipalities to carry out their waste management duties'. Therefore, the study results and literature identification suggest that the functionality of institutional frameworks can create a sound waste management system. Uncollected trash can be seen accumulating on the ground in public areas.

As for the lack of viable infrastructure, PIKITUP is a private firm by the City of Johannesburg to deliver SWM services in Johannesburg. One of this study's objectives was to establish the challenges of SWM in Alexandra Township. It finds that the biggest problems for SWM in Alexandra are poor service delivery and inadequate understanding of SWM issues. Participants were asked if there was a SWM crisis in Alexandra Township. Many respondents confirmed the presence of a crisis and said it was because service delivery had been horrendous for a long time. Poor service delivery was indicated to have existed for more than a decade.

From an NGO perspective, the SWM challenges in Alexandra Township emanate from the lack of formality in the informal areas. NGO officials emphasized that the lack of navigable streets makes it impossible for Pikitup trucks to navigate the settlement street to collect waste. Both the participating NGO officials reiterated that the lack of town planning presents major challenges to Pikitup in its efforts to deliver the municipality's constitutional mandate. There are informal structures in between which are narrow roads that waste collection trucks cannot navigate. To mitigate the navigation issues, Pikitup created communal waste disposal areas where residents are mandated to dispose of their waste once their plastic bags are full. In theory, this sounds strategic, but in practice, the organizational inadequacies are further exposed. The designated disposal sites are far away from some community members. A long distance to disposal sites discourages willing residents and encourages littering and dumping in undesignated places. Furthermore, the NGO officials laid blame on Pikitup because they do not issue plastic bags to all residents but only to those who occupy formal houses, and yet most community members live in shacks. This encourages indiscriminate dumping of waste.

A question arises about who is responsible for town planning to avert such crises. However, this would be beyond the scope of this study.

5. Conclusion

This paper analyses solid waste management challenges in low-income communities in South Africa, using a case study from Alexandra, Johannesburg. Using qualitative and quantitative research approaches, findings revealed that solid waste is not reliably collected and transported in low-income communities in South Africa. The main obstacles include the scarcity of resources and equipment necessary for waste treatment. To widely involve residents of Alexandra Township in the waste management process, the municipal council should embark on a public awareness campaign. The findings further encourage effective waste sorting techniques, such as separating biodegradable from non-biodegradable waste, so that valuable goods can be taken to the local government recycling centre. The results further encourage the involvement of the homeless and unemployed in the recycling and waste management process, thereby reducing the shortage of human resources and creating jobs. For a successful waste management programme, community participation, behaviour, and attitudes are important, as these determine how solid waste is handled. This is essential to establish appropriate waste management practices in an efficient and long-term manner.

By contrast, emphasis should be placed on the principles of proper solid waste management practices like reducing, recycling, reusing, composting, and segregating waste at the source. This aids in waste reduction and further encourages sensitivity to and action for the environment among the citizens. Although the analyses of both the questionnaire responses and the interviews produced a variety of responses and perspectives, it is clear from the data that most people in Alexandra Township want to see waste management services enhanced. This can be accomplished by offering waste management services, including ample domestic waste collection bags, more public trash cans, prompt collection, and a focus on waste handling knowledge and education. The fact that 60% of the sample has never participated in recycling initiatives suggests that there is a lack of awareness programmes by the council that would improve the status of solid waste (sanitation standards).

The communities are seen as mere people rather than primary solid waste management stakeholders. Because more than 60% of the populace is unaware of the rules governing solid waste management in the township, 25% of respondents admitted that the council has partially accomplished its duty to organize the cleanliness of the town. Even though 40% of the respondents try to reduce waste generation when they can, the absence of recycling infrastructure causes most of the sorted garbage to wind up in landfills. To extensively involve the residents of Alexandra Township in the waste management process, the city council should embark on public education awareness. People should be educated on proper waste separation techniques, such as separating biodegradable waste from non-biodegradable waste, so valuable goods can be brought to the local government's recycling centre. Homeless people and the unemployed could be involved in the recycling and SWM process thereby reducing the human resource deficiency and creating employment.

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