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Unraveling the factors behind illegal waste dumping in townships: A study of Ngwelezana Township, KwaZulu-Natal, South Africa

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Abstract

In many urban areas of the global South, the proliferation of domestic waste poses a growing challenge, exacerbated by rapid urbanization and the expanding world population. Townships and slums, typically characterized by underdevelopment and limited government services, find themselves grappling with escalating volumes of waste, leading to an increase in illegal dumping practices. This study focuses on Ngwelezana Township in South Africa, aiming to delve into the root causes of illegal domestic waste dumping. Employing qualitative research methodology and purposive sampling, key informants were identified for semi-structured interviews, supplemented by a cross-examination of primary findings with secondary data. The outcomes reveal that waste management practices are constrained by various factors, with illegal dumping emerging as a prominent challenge. While some waste finds its way to designated landfill sites, a substantial portion is disposed of illicitly. Efforts toward waste prevention, minimization, reuse, recycling, and recovery are observed on a modest scale, and the segregation of waste at its source remains inadequately implemented. The absence of robust law enforcement, non-compliance, poor information, and education on waste management are major concerns. Limited awareness regarding proper waste management practices emerges as a key factor to be addressed for illegal dumping concerns.

Keywords: Waste Management; Recycling; Illegal Dumping; Domestic Waste; Township

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1. Introduction

The persistent rise in domestic waste volumes, coupled with the pervasive issue of illegal dumping, constitutes a significant environmental challenge, particularly in townships and slums, notably in the global South (Grobler et al., 2022; Polasi, 2018; Grangxabe et al., 2023). As the global population continues its upward trajectory, the corresponding surge in waste generation exacerbates the prevalence of illegal dumping practices (Grobler et al., 2022; Ferronato and Torretta, 2019). Public spaces, green belts, and areas with low visibility become susceptible to illegal dumping activities (Wright et al., 2018). Current estimates indicate a staggering 98,996,672 tons of refuse being illegally dumped globally (Ferronato and Torretta, 2019). The volume of municipal solid waste generated is significantly influenced by socioeconomic status (Dlamini et al., 2019). Countries such as Brazil, India, and South Africa, face a similar predicament, lacking effective preventive strategies against illegal dumping in their townships (Grobler et al., 2022). For instance, Sao Paulo township in Brazil experienced inappropriate waste disposal, contributing significantly to refuse dumping into rivers and green belts (Brinklow, 2018). India witnesses a continuous annual increase of approximately 1.3% in solid waste generation (Haywood et al., 2021).

In regions like the Caribbean country of Tobago, the waste management policy takes a backseat to more pressing social and economic issues such as education, unemployment, and climate change, thereby fostering the spread of illegal dumping (Ferronato and Torretta, 2019). The resurgence of townships further intensifies the problem of illegal waste dumping, placing additional strain on waste management operations (Grangxabe, 2023). In many Indian townships, approximately 90% of municipal solid waste is illicitly dumped instead of being appropriately disposed of in designated landfill sites (Kumar et al., 2017). Even in countries with well-established waste management systems like Australia, illegal dumping of domestic waste on the kerb has become normalized behaviour (Comerford et al., 2018). Shockingly, Shanghai's central district in China accumulated over 61,404.5 tons of illegally dumped refuse in just eight months (Yang et al., 2019).

On the African continent, merely a quarter of the generated solid waste undergoes proper collection, with a staggering 75% being unlawfully dumped, thereby posing a significant threat to the environment (Rasmenia and Madyirab, 2019). This waste management dilemma is further exacerbated by rapid population growth in Kampala township, Uganda, where the mounting waste and illegal dumping challenges have become a pressing concern (Aryampa et al., 2019). South African townships are not immune to this predicament, and the issue of illegal dumping has become a growing concern, presenting a formidable challenge for municipalities to deliver effective waste management services (Rasmenia and Madyirab, 2019). According to the National Waste Information Baseline (NWIB), South Africa generated a staggering 108 million tons of waste in 2011, with over half (59 million tons) classified as general waste. Alarmingly, approximately 3.67 million tons of this waste are inadequately collected and disposed of, bypassing formal landfill sites (Polasi et al., 2020). Globally, there is a dearth of academic studies addressing illegal dumping in townships, including South Africa, where the issue has been inadequately investigated within a township context. Existing studies predominantly focus on general municipal solid waste challenges, with a disproportionate emphasis on towns and inner cities, leaving townships significantly under-researched.

Illegal dumping of domestic waste has been identified as a serious challenge in Ngwelezana Township (Ramsamy, 2017). Ngwelezana residents and businesses have complained about the continuous illegal dumping of domestic waste in the area. The volume of solid waste disposed of in vacant spaces is growing daily

and sometimes such waste is burnt in open spaces (Abrahams, 2020). Such malpractice creates problems in the waste management system and disturbs normal activities of waste management (uMhlathuze Integrated Waste Management Plan - IWMP, 2019). Most scholarly research conducted in South Africa has focused mainly on general solid waste management which leaves the issues of illegal dumping of domestic waste under-researched. Given the insufficient attention to illegal dumping in townships, this paper focuses on Ngwelezana Township in South Africa, aiming to delve into the root causes of illegal domestic waste dumping. The township is situated on the outskirts of Empangeni Town under uMhlathuze Local Municipality in northern KwaZulu Natal, South Africa. The uMhlathuze Local Municipality (KZ282) is situated under King Cetshwayo District Municipality (uMhlathuze Integrated Development Plan - IDP, 2019/2020).



Figure 1. Map showing the location of Ngwelezana Township in South Africa (Source: Google Maps, 2024)

On average of 110 503 total households, about 68% (74856) had access to basic solid waste removal service in 2018 in the entire uMhlathuze Local Municipality, 32578 low-income (indigent) households receive free basic service delivery including 275 skips that are placed in rural communities and schools (IWMP, 2019). Despite the township having some level of service delivery, unlike many townships in South Africa, illegal dumping of domestic waste is a challenge. It is therefore crucial to examine the factors behind the illegal dumping of domestic waste. The findings of such a study may serve as a case in assisting local municipalities in identifying shortcomings in waste management practices. Within the above context, this paper is divided into several sections including this introduction. The next section examines the literature on illegal dumping of domestic waste in Africa and South African townships. This will be followed by the materials and methods before presenting the results. The last section will present the conclusion and recommendations.

2. Illegal dumping of domestic waste in African and South African townships

Countries of the African continent, just like any other developing countries, have been facing the challenge of solid waste management and illegal dumping since the nineteenth century, this exacerbates demand for municipalities to provide waste management services, especially in townships (Simelane and Mohee, 2015). Most municipalities in Sub-Saharan countries cannot deliver adequate waste management services and cover all areas in the townships for waste collection (Dlamini, 2016). Illegal dumping is a predominant issue in Nigeria and occurs regularly in townships, whereby undeveloped lots and abandoned structures are converted into dumping grounds (Ichipi and Senekane, 2023). According to the National Policy for the Provision of Basic Refuse Removal Services to Indigent in South Africa, municipalities are obliged to deliver waste collection service every week to all households including low-income settlements and informal settlements even if they cannot afford to pay for the service (Department of Environmental Affairs - DEA, 2011). Poor infrastructure and non-compliance of society to municipal by-laws contribute to poor waste management service and illegal dumping. Insufficient provision of waste bins and the location of skips are contributing factors to increased illegal dumping in South African townships (Grobler et al., 2022). In Lamontville Township, in Durban, KwaZulu-Natal where illegal dump sites and uncollected refuse are scattered throughout the area. Waste is deliberately dumped in the green belts. Illegal dumping is associated with the attitude and inability of the municipality to enforce by-laws in this township (Pewa, 2019).

Factors such as the lack of reliable waste management service facilities in the municipalities, rapid population growth, and limited waste management awareness campaigns may result in illegal dumping in most townships. Thus, the quantity of illegally dumped waste is low where there is a formal waste management service, especially in the inner cities as illegally dumped waste is quickly recovered to enter the formal waste stream. A lack of communication on waste-related information at an early phase and poor environmental education especially in the school's syllabus is viewed as one of the factors contributing to inadequate waste management and illegal dumping in townships (Haywood et al., 2021). The open spaces that are scattered in most townships are regularly targeted for illegal dumping, as they are usually accessible to the public, which makes them more vulnerable to illegal dumping (Niyobuhunguru and Schenck, 2020). Inadequate resources in the municipalities also have an impact on waste management operations which results in illegal dumping challenges (Polasi et al., 2020).

The lack of law enforcement officers responsible for environmental issues including illegal dumping contributes significantly to illegal dumping challenges (Grobler et al., 2022). Weak institutional frameworks and economic decline contribute to poor waste management in many townships in developing countries (Polasi et al., 2020). Collaboration between stakeholders such as volunteer groups, municipalities, Non-Governmental Organisations (NGO), industries, and local communities can work very well to minimize illegal dumping (Mandikiana, 2021). The establishment and formalization of waste management structures in townships are vital for an efficient solid waste management system (Yuan et al., 2023). Success in eliminating illegal dumping lies in stakeholders' engagement and support, as a lack of cooperation between the operators and the public, is bound to cause the system to fail (Mandikiana, 2021). Strengthening and enforcement of by-laws is one of the potential solutions to combat illegal dumping in townships. Intensive anti-illegal dumping campaigns can be a solution to curb illegal dumping in townships. Municipalities should consider using clean rubble as daily cover material in the landfill sites or to fill up eroded roads in the informal settlements.

3. Materials and methodology

A qualitative research method was employed as it is considered the most suitable method to examine the root causes of illegal waste dumping at Ngwelezana Township. A qualitative method consists of an investigation that probes and seeks answers to the research questions, collects evidence, and produces findings that are applicable beyond the immediate boundaries of the study (Busetto et al., 2020). This method was essential as it connected the researcher with people who were knowledgeable and familiar with the study area. The study employed semi-structured interviews with key informants to effectively understand and get relevant information on the causes and factors contributing to illegal dumping in Ngwelezana Township. Interviews were conducted with municipal officials responsible for solid waste management, waste management officials from the Provincial Department of Economic, Development, Tourism and Environmental Affairs (KZNEDTEA), community leaders, business owners, and other community representatives (Refer to Table 1). These were appropriate key participants for this research as they deal with waste management and are knowledgeable about waste activities in the area. Their understanding of the research problem allowed these participants to provide a valuable context surrounding the nature of the research problem. Community leaders were considered privileged, as compared to general community members, as they have the potential to be valuable sources of information.

Table 1. Informants interviewed during data collection

Participant	Type of participant	Place of interview	Company	Date of interview	Position
A	Provincial Government	Richards Bay	Department of Economic Development, Tourism and Environmental Affairs (EDTEA)	25 July 2022	Senior Environmental Officer (Waste Management)
B	Provincial Government	Richards Bay	EDTEA	25 July 2022	Environmental Officer (Waste Management)
C	Provincial Government	Richards Bay	EDTEA	25 July 2022	Environmental Officer (Waste Management)
D	Provincial Government	Richards Bay	EDTEA	25 July 2022	Senior Environmental Officer
E	Local Government	Empangeni	uMhlathuze Local Municipality	06 October 2022	Operations Manager: waste management section
F	Local Government	Empangeni	uMhlathuze Local Municipality	03 August 2022	Senior Waste Management Officer

Table 1. Cont.

Participant	Type of participant	Place of interview	Company	Date of interview	Position
G	Local Government	Empangeni	uMhlathuze Local Municipality	03 August 2022	Waste Management Officer
H	Local Government	Empangeni	uMhlathuze Local Municipality	03 August 2022	Labor (Waste collector)
I	Local Government	Empangeni	uMhlathuze Local Municipality	06 October 2022	Waste collection: truck driver
J	Local Government	Ngwelezana	uMhlathuze Local Municipality	06 October 2022	Labor (Street cleaning) and resident
K	Local Government	Ngwelezana	uMhlathuze Local Municipality	02 August 2022	Ward Councilor and resident
L	Local community	Ngwelezana	Unemployed	05 August 2022	Leader of Youth Group (Green Charter Foundation) and resident
M	Local community	Ngwelezana	Unemployed	07 October 2022	Member of Youth group (Green Charter Foundation) and resident
N	Local community	Ngwelezana	DoE	07 October 2022	Teacher and resident
O	Local community	Ngwelezana	DoE	05 August 2022	Teacher and resident
P	Local community	Ngwelezana	DoE	05 August 2022	Teacher and resident
Q	Local community	Ngwelezana	DoE	05 August 2022	Teacher and resident
R	Local community	Ngwelezana	Self employed	04 August 2022	Business owner and resident
S	Local community	Ngwelezana	Self employed	02 August 2022	Business owner and resident
T	Local community	Ngwelezana	Ngwelezana Shopping center and the garage	02 August 2022	Store Manager
U	Local community	Ngwelezana	Unemployed	02 August 2022	Emerging recycler and resident
V	Local community	Ngwelezana	Unemployed	07 October 2022	Emerging recycler and resident
W	Local community	Ngwelezana	Local Church	07 October 2022	Pastor
X	Local community	Ngwelezana	Self employed	02 August 2022	Business owner and resident

Table 1. Cont.

Participant	Type of participant	Place of interview	Company	Date of interview	Position
Y	Local community	Ngwelezana	uMhlathuze Local Municipality	05 August 2022	Ward Councilor and resident (this councilor requested to represent community)
Z	Local community	Ngwelezana	Unemployed	05 August 2022	Member of Youth group and resident
AA	Local community	Ngwelezana	DoE	05 August 2022	Teacher and resident
BB	Local community	Ngwelezana	DoE	05 August 2022	Teacher and resident
CC	Local community	Ngwelezana	Self employed	07 October 2022	Business owner and resident
DD	Local community	Ngwelezana	Self employed	04 August 2022	Business owner and resident
EE	Local community	Ngwelezana	Self employed	03 August 2022	Director of event and entertainment local NGO
FF	Local community	Ngwelezana	Self employed	04 August 2022	Business owner and resident
GG	Local community	Ngwelezana	Self employed	04 August 2022	Business owner and resident
TOTAL					33

All interviews were conducted on a one-on-one approach, using open-ended questions. The one-on-one type of interview is useful because it gives insight into people's opinions and understandings of the topic under research (De Jonckheere and Vaughn, 2019). This type of interview allowed for an open discussion with the interviewee to get detailed information on the research problem. Purposive sampling was also employed to identify key informants based on the judgment made by the researcher/s. A snowball sampling technique was also used to identify more informants from the relevant government institutions and communities and to complement purposive sampling. Snowball sampling is a technique where potential participants are identified with the help of known informants (Dlamini, 2016). The study used primary and secondary data, including observation techniques. A digital recorder was also used to collect data from participants, including a notebook to collect field notes to back up to digital recording. A digital camera was used to capture people's behaviour regarding illegal dumping to support evidence collected during observations. Data analysis involved transcription of interviews and applying a grounded theory approach to code and identify major themes. Data was examined and important points and themes such as illegal dumping challenges and factors contributing to illegal dumping were marked during data analysis. Data coding, pattern identification, and summaries of themes behind textual data were made. Data validity and reliability were checked after the whole data set was coded. Common themes were identified and categorized into units of meaning to explore factors contributing

to illegal dumping in Ngwelezana Township. Themes were compared and refined until strong categories remained and conclusions were drawn (Saunders et al., 2019). These themes are presented below.

4. Results

Three main themes emerged from the results. However, themes are discussed independently, although there are links and overlaps between them. Theme one discusses factors contributing to illegal dumping in Ngwelezana Township and its sub-themes, which assisted the researcher/s to understand factors behind illegal waste dumping in Ngwelezana Township. Theme two presents poor waste management and a lack of recycling initiatives in Ngwelezana Township. Theme three describes illegal dumping preventive measures in Ngwelezana Township.

4.1. Factors contributing to illegal dumping in Ngwelezana Township

Several aspects contributed to illegal dumping in Ngwelezana Township including non-compliance with waste regulations, waste collection frequency lack of resources, weak and lack of law enforcement, and poor public education. Although the municipality had tried to render effective waste management service to the township, study results established that much needed to be done to capacitate the community in terms of proper waste management. Most illegal dumping offenders did not understand the impact caused by illegal dumping. Hence, there is a need to strengthen strategies to minimize illegal dumping in Ngwelezana Township.

4.1.1. Non-compliance with waste regulations and poor enforcement

Although it was found that waste management regulations were in place, enforcement of these laws and policies was a challenge in the municipality. The absence of law enforcement officers for environmental issues in the municipality contributed to illegal dumping in Ngwelezana Township. The study by Polasi et al. (2020) found that the nonexistence of enforcement of by-laws resulted in several waste management challenges such as illegal dumping. There were no fines for illegal dumping offenders in Ngwelezana. Some participants suggested that municipalities conduct frequent monitoring of illegal dumping hotspots and that law enforcement officers be deployed permanently in Ngwelezana Township. Respondent O suggested that there must be a monitoring system in place to ensure the enforcement of the regulations. Furthermore, respondent E, emphasized the need to re-enforce solid waste by-laws in Ngwelezana Township. As the informant noted:

Countries like Singapore have strong law enforcement hence it is always clean. Despite, most people know that it is unacceptable to dump illegally, but they continue doing it. Most people purposely dump waste illegally knowing exactly that there will be no consequences. Instead, the municipality will clean after their mess. Some people tend to dump and litter everywhere claiming that they are creating job opportunities. Therefore, municipalities need to do something about law enforcement on illegal dumping offenders and to stop this unacceptable behaviour.

This suggested that law enforcement alone cannot solve the problem if people are not willing to change their actions and the way they perceive waste. Since only wheelie bins were collected by the municipality for kerbside waste collection in Ngwelezana Township. The results showed that some Ngwelezana residents

continued to use trash bags to store their waste. Few respondents stated that they were using refuse bags because wheelie bin capacity was limited and could not take the excess waste they generated. Respondent E indicated that some residents implemented projects such as building, renovations, and gardening without proper planning. Thus, they had no means to transport their waste for disposal in the landfill site after the project was completed. Eventually, this waste was dumped in the open spaces. The households can also remove and transport waste on their own and properly dispose of it in the designated landfill site, if it is a small project, which seems to be a problem for the Ngwelezana community. The study conducted by Grobler et al. (2022) found that compliance with waste management regulations is high where there is higher visibility of enforcement agencies in the USA, and this could serve as a lesson for South Africa.

The results indicated that the non-existence of law enforcement on environmental issues, including waste and illegal dumping, was a challenge in the municipality and contributed significantly to illegal dumping in Ngwelezana Township. The findings indicated that the municipality has waste bylaws and IWMP in place, and it is their responsibility to ensure the implementation and enforcement of these policies to discourage illegal dumping practices in Ngwelezana, which was not the case in Ngwelezana Township. The study conducted by Fuldauer et al. (2019) indicated that poor planning, lack of regulations, and poor enforcement delay proper waste management and contribute to illegal dumping. According to the local government respondent (informant E), the municipality used traffic corps as an interim arrangement to deal with all law enforcement issues within their jurisdiction as they did not have law enforcement officers or the capacity to enforce waste by-laws and environmental issues were not given attention to this arrangement. As the informant noted:

Although the law provides that it is a responsibility of the municipality to enforce environmental laws, uMhlathuze Municipality does not have law enforcement officers. Instead, they are using traffic corps when the need arises. Previously, the municipality was using nuisance inspectors to enforce the law on environmental management issues, including waste, which is no longer the case. Waste by-laws are in place but there is a lack of implementation due to inadequate human resources. As a result, this has a negative impact on waste management operations in the municipality. It also does not assist to have regulations in place that cannot be implemented. Thus, there is a need to strengthen law enforcement to prevent illegal dumping.

Some people were observed dumping in broad daylight during the research. Even though there were illegal dumping signs in some of the illegal dump hot spots, it seemed like people ignored them and continued dumping. However, the signs were only few throughout the township, and the number of illegal dumps surpassed them. The study by Wu et al. (2018) discovered that signs consisting of pictures of permitted items improved sorting and recycling performance in the City of Vancouver as compared to signs containing only words.

4.1.2. Waste collection frequency and inadequate waste management resources in the municipality

Dissatisfaction with waste collection frequency was also apparent throughout the study in Ngwelezana Township. Waste was collected once a week in the township. However, communal skips were collected almost every day or when they became full. Respondent T argued that once-a-week refuse collection was not enough probably for the entire township and recommended that the municipality consider collecting waste at least twice a week. As the informant noted:

The municipality must consider collecting waste at least twice a week. Some households produce a lot of waste and once a week collection schedule does not work for them, as during the collection day they would have accumulated piles of waste. Residents are expected to keep waste in their homes for about six days while waiting for a collection day. The municipality must consider factors such as odours caused by decomposition and the accumulated quantities of waste when determining waste collection frequency. Sometimes bins are overturned by dogs, especially if the house is not fenced. As a result, waste is spilled all over the yard and beyond and causes pollution which is a challenge that the municipality must take into consideration when deciding on the frequency of waste collection.

The UN-Habitat (2020) study highlighted the importance of assessing waste collection frequency by a suitably qualified waste engineer and being stated in the municipal Waste Management Plan. Respondent T further indicated that some households produced a lot of waste and once a week collection schedule did not work for them, as during the collection day they would have accumulated piles of waste. This situation caused people to dump garbage in open spaces as they could not keep waste for more than 5 to 6 days while waiting for the collection schedule. Zondi et al. (2023) argued that waste volumes do not depend only on the collection frequency, but the capacity of bins can also pose a challenge. This suggests that the municipality should explore the number of bins to be issued per household, especially, the distribution of communal skips.

The findings also indicated that the scarcity of waste management resources was one of the challenges faced by uMhlathuze Municipality, which disturbed waste management operations in Ngwelezana Township. Some barriers to proper implementation of waste practices such as waste reduction included a shortage of resources such as infrastructure and finances (Derhab and Elkhwesky, 2023). There was only one waste collection truck that serviced Ngwelezana Township for kerbside collection and one truck that was dedicated to skip collection. There were no standby trucks that assisted in case of emergency. As a result, when the truck had a breakdown, the entire collection schedule was affected. The findings established that the municipality used the same waste collection truck to clean illegal dumping in Ngwelezana and that disturbed the waste operation schedule. Dlamini et al. (2019) argued that the capacity of the municipalities to deliver adequate waste management service is overwhelmed due to limited resources and infrastructure.

4.1.3. Lack of education and awareness campaigns on waste management in Ngwelezana Township

Lack of information, education, and awareness campaigns was identified as one of the problems contributing to illegal dumping in Ngwelezana Township during the research. The findings revealed that most residents were not satisfied with the extent to which education and awareness campaigns were conducted in the township. The results also established that some people in Ngwelezana were not aware of the educational campaigns conducted in the township. One respondent identified that there was a need to educate Ngwelezana Township residents about domestic waste management in general and the impact caused by illegal waste dumping. Another respondent argued that he never participated in or heard anything about awareness campaigns conducted in the township, and another respondent claimed that nothing was going on in their ward regarding education and awareness campaigns which displayed a communication gap between the municipality and Ngwelezana community. The findings of the study conducted by Fredrick et al. (2018), found that education and awareness campaigns can play a significant role in changing the community's attitude

towards waste management and the impact caused by illegal dumping. Hence, the municipality needs to intensify awareness and educational campaigns in Ngwelezana. However, the study by Polasi et al. (2020) found that many awareness campaign initiatives lead to visually cleaner areas in the short term, but do not encourage sustainable practices that reduce litter and illegal dumping in the long run.

Grobler et al. (2022) believe that education and awareness are transitional stages to encourage public participation in decision-making and support in terms of implementation of waste management policy. Thus, all spheres of government must strengthen public education through various platforms on waste management and illegal dumping prevention. The lack of education campaigns is not only affecting general the community in Ngweleana Township but, according to some respondents, some of the schools also need an intensive educational campaign as some learners still dump waste on the floor instead of using receptacles provided in the school premises, argued informant O.

4.2. Poor waste management and lack of recycling initiatives in Ngwelezana Township

Some waste management challenges in Ngwelezana Township emanated from limited recycling initiatives and waste collection methods stemmed from settlement arrangements. The local government respondent (informant G) revealed that waste collection provision is twofold in Ngwelezana Township, as the township is divided into two sections. There is a formal township with account and lot numbers, their levies are linked to their accounts. Within the township, there is a community that falls under tribal authority without lot and account numbers with the municipality. As a result, they are serviced with a free communal skip. The respondent pointed out more challenges in the tribal community and indicated that roads are very narrow in this community, while in other parts they do not exist as town planning processes were not followed during their placement, and the municipality was not involved in the plan. Thus, it posed a challenge for the municipality to provide services such as kerbside collection in this community, which resulted in illegal waste dumping. Grobler et al. (2022) agree that illegal dumping is prevalent in areas that lack waste storage facilities and good roads, which complicates access in terms of waste collection. Some respondents indicated that skips are always full, and some are far from the households they are intended for. The study by Grobler et al. (2022) concurs that underdeveloped infrastructure delays progress in terms of waste management service and contributes to inequality in waste management systems. The situation was worsened by some residents who dumped the garden and building rubble into the receptacles, which were meant for domestic waste.

The Ngwelezana Township exhibited poor waste management practices. Most waste was still disposed of in the dumping site and most respondents were not satisfied with how waste issues were handled in the township. Informant E, the municipality employee indicated that the kerbside waste collection method, where households put their waste on the pavement was used in Ngwelezana Township and only wheelie bins were permitted for waste collection. Whereas communities residing within the township under tribal authority were provided with the communal skip for waste disposal as they were not part of the kerbside collection. The municipality introduced a street cleaning project to supplement kerbside collection in all townships, for litter picking. Small street bins were also placed in some parts of the township to allow residents to dispose of small items of waste. Despite the provincial government's support to the municipality to improve waste management services in their jurisdictions, including Ngwelezana Township, the effort was proven ineffective as poor waste management and illegal dumping challenges persist in Ngwelezana. Moreover, EDTEA introduced the

Expanded Public Works Programme (EPWP) waste project as additional support to the local municipality. However, the results established that litter and illegal dumping were still a challenge in Ngwelezana Township.

Waste collection practices in Ngwelezana align with the settlement structure of the township. This alignment is evident through a formal township segment that possesses an assigned account number with the municipal authorities. Additionally, there exists a community under the Madlebe Tribal Authority situated within the broader township. Notably, residents in this community lack individual lot numbers and municipal accounts, posing challenges for the municipality in delivering waste collection services to this specific group. Another challenge that was faced by the municipality was poor planning by the households when they were performing domestic projects such as gardening and renovating their homes. The municipal waste skip must be organized and be at the gate before such work commences. However, most people in Ngwelezana did not comply and they only planned to dump their waste when it was piled up already.

There were only two formal recycling companies throughout the township, with waste prevention, waste minimization, reuse, recycling, and recovery employed on a small scale. There was no waste segregation at the source in Ngwelezana. Recycling in Ngwelezana Township occurred at a suboptimal rate, contributing minimally to waste reduction efforts. The absence of waste separation at the source exacerbated the problem of illegal dumping, as various types of waste were indiscriminately combined in a single bin. The study conducted by Strydom (2018) found that most people are not involved in recycling initiatives because they lack knowledge, have no time, insufficient space, and lack of resources. According to respondent D, a significant portion of the waste generated in Ngwelezana Township consisted of materials with considerable potential for recycling. One community respondent (Informant O) highlighted the pervasive issue of plastic waste litter visible throughout the township, indicating a lack of effective recycling practices for plastic materials in Ngwelezana. Additionally, respondent H, a local government official, concurred, emphasizing that a substantial portion of the illegally dumped waste was due to a lack of segregation. As the informant noted:

Lack of waste segregation at the source is one of the contributing factors to illegal dumping challenges at Ngwelezana Township, as waste that could be recycled is sent to the landfill or possibly dumped illegally. Most illegal dumps are dominated by recyclable waste such as papers, plastics, and bottles. Besides, the separation of waste at source [this] needs cooperation and dedication from the community. Maybe the municipality needs to introduce incentives, competitions, and rewards for recyclers to encourage the Ngwelezana community to participate in recycling initiatives and to instil waste separation at source behaviour.

The Department of Forestry, Fisheries, and the Environment (DFFE) underscored in 2020 that public awareness and education are pivotal in addressing the environmental repercussions of improper waste handling and the absence of source-separated waste. Presently, Ngwelezana Township hosts only two formal recycling companies, whose impact on waste reduction in landfills and open spaces remains relatively modest. Some respondents indicated that sometimes waste is blown from illegal dumps to their homes and are expected to clean it with their bare hands. One respondent (informant O) expressed concern about waste receptacles placed next to their household, causing a nuisance to the affected residents. While informant E argued that most offenders were aware that their behaviour was improper since they normally dumped away from their houses, but next to other people's houses. As the informant noted:

Waste from the skips is blown to the nearby households, including my house when it is windy and causes litter. Sometimes waste contains pampers and we are expected to clean them with bare hands. It was worse for me as the skip was adjacent to my house. As a result, we demanded the municipality to remove it from our vicinity as affected households. However, people continue to dump on the floor even though the skip is removed, and the spot becomes an illegal dump hotspot.

The waste recycling trends were concerning within uMhlathuze Municipality from 2020 to 2022. Although a need for improvement, wastepaper emerged as the most recycled material during this period, highlighting a lack of progress in diversifying recycling projects in the municipality. Addressing the issue, Pretorius et al. (2023) assert that recycling practices can be significantly influenced by various factors, including a lack of knowledge and inadequate access to essential recycling equipment. This was notably observed in Ngwelezana Township, where participants expressed interest in recycling but cited barriers such as limited awareness and the absence of starter recycling equipment as impediments to their active involvement. The findings highlighted attention to the prevalent issue of glass bottle dumping throughout the township, indicating a need for concerted efforts to establish effective recycling measures for these materials. Additionally, one respondent (informant A) highlighted the economic incentive of scrap metal recycling, emphasizing that individuals receive compensation when disposing of metal, in contrast to domestic waste, where disposal typically incurs costs. This economic disparity could discourage proper disposal of domestic waste in favour of more lucrative alternatives like scrap metal recycling. Sadan and De Kock (2020) also indicated that recycling is an economically and technologically viable strategy to address the increasing rate of illegal dumping and litter.

4.3. Illegal dumping prevention measures in Ngwelezana Township

According to Grangxabe et al. (2023) most countries, including South Africa, currently do not have appropriate sustainable prevention strategies for illegal dumping. The results revealed that green belts were scattered throughout Ngwelezana Township, and they were accessible to the public which resulted in them being most targeted for illegal dumping. Hence, some respondents stated that the municipality must consider closing all open spaces in the township and converting them into projects that could add value to the community such as parks and community vegetable gardens. Kimani (2020) indicated that open spaces contributed significantly to illegal dumping in Mbekweni, in Paarl as they are often targeted as sites for prohibited waste disposal. Respondent V also emphasized a need to fence all green belts off once they were cleared to prevent the recurrence of illegal dumping.

The study assessed the level of community awareness of factors contributing to illegal dumping in Ngwelezana Township. The results indicated that awareness campaigns are a good platform to raise awareness about illegal dumping in Ngwelezana Township. The results also established that awareness campaigns were not as intensive as they could have been in Ngwelezana Township, and most residents were not satisfied with the extent to which education and awareness campaigns were conducted in the township. Niyobuhungiro and Schenck (2021) argued that consistent awareness campaigns can contribute positively to the illegal dumping problem. Most respondents indicated that they never participated in any environmental awareness and educational campaigns in the township. Most respondents believe that awareness campaigns can assist in influencing attitudes and mindsets toward waste management for the Ngwelezana community if they are frequently conducted. Informant GG claimed that nothing was going on in their ward regarding education and

awareness campaigns. This suggested insufficient knowledge in the Ngwelezana community and a communication gap between the municipality and the Ngwelezana community. Whereas respondents A and L noted the importance of intense education and awareness campaigns about illegal dumping to address illegal dumping challenges in Ngwelezana Township. Niyobuhungiro and Schenck (2021) also think that consistent awareness campaigns could curb illegal dumping problems. Whereas Kumar and Kumar (2020) study found that waste management improved in Latium, Italy after the environmental information and awareness campaign was conducted. Respondent M argued that no one would do something that would hurt their lives. According to respondent B, these awareness campaigns should also educate the community about waste regulations:

The municipality must ensure that all waste generators under uMhlathuze, including Ngwelezana Township, are aware of waste legislation and policies as that will assist them to manage their waste properly. Though, the clean-up campaigns are one of the strategies that the municipality, together with other interested stakeholders is currently employing to resolve the illegal dumping problem in Ngwelezana. However, environmental education must be intensified even in schools as the message is conveyed easily through kids.

Lack of recycling initiatives was noted in Ngwelezana Township during the study as only two official recycling companies were operating in Ngwelezana Township. Respondent X reported having no knowledge of any recycling projects within the township. Similarly, respondents DD and FF highlighted the prevalence of recyclable waste being dumped indiscriminately throughout Ngwelezana Township, indicating a lack or limited presence of recycling initiatives. Recyclable materials such as paper and cardboard were notably present in illegal dump sites, underscoring the negligible impact of recycling practices in the township. Gorobets (2019) advocates for incentivizing waste segregation to foster a culture of waste minimization and deter illegal dumping, emphasizing the need for community engagement. While there were emerging recyclers operating within the township, conducting their activities in backyard settings, they remained largely invisible. These entrepreneurs expressed challenges in sustaining their businesses, attributing their struggles to a lack of knowledge and support from relevant stakeholders. Respondent G asserted that the absence of waste segregation initiatives at the source in Ngwelezana Township contributes to the persistence of illegal dumping.

The findings also revealed a deficiency in governance related to waste management in the study area. Despite sporadic awareness campaigns conducted by the municipality and the Department of Economic Development, Tourism, and Environmental Affairs (EDTEA) in Ngwelezana Township, there was a notable lack of coordination among stakeholders involved in waste management issues, particularly in Ngwelezana. Respondent B stressed the importance of involving all government departments, particularly the Department of Education, in combating illegal waste dumping, emphasizing the pivotal role of early childhood environmental education in shaping lifelong attitudes. Stakeholder collaboration emerged as a potential avenue to enhance the community's ability to identify and collectively address waste management challenges. However, the results indicated the absence of dedicated standing committees for waste management and illegal dumping in Ngwelezana. Despite the existence of a green committee under uMhlathuze Municipality responsible for general environmental issues, its impact on waste management in the community was found to be limited.

Respondent B highlighted the significance of involving external stakeholders in environmental forums, stressing the importance of public awareness. Budget constraints were identified as a contributing factor hindering the effective planning and execution of waste management activities by the municipality. Respondent E drew attention to the correlation between municipal waste management operations, illegal dumping, and budget allocation. In line with this, respondent G recommended an increase in budget provisions for the municipality to enhance waste management quality and minimize illegal dumping in Ngwelezana Township. Kimani's study (2020) further supports the idea that funding is linked to the maintenance and procurement of fleets in the municipality, emphasizing the need for a balanced approach between budget allocation and effective service delivery, particularly in waste management.

5. Conclusions and recommendations

The primary objective of this paper was to investigate the factors contributing to illegal waste dumping in Ngwelezana Township. It was found that waste minimization, reuse, recycling, and recovery practices were limited in Ngwelezana Township, with only two formal recycling companies operating within its boundaries. The absence of waste segregation at the source led to the mixing of domestic waste in a single bin. The survey identified poor implementation of awareness and educational campaigns in the township, exacerbating the issue. Additionally, communication gaps between the municipality and the Ngwelezana community were recognized as a significant factor contributing to illegal dumping. Open spaces scattered throughout the township were found to be susceptible to illegal dumping due to their accessibility to the public. Despite existing waste by-laws, the lack of law enforcement officers and inadequate human resources hindered their effective implementation.

The results also highlighted the municipality's poor efforts to prevent or minimize illegal dumping in Ngwelezana Township. Ad hoc awareness and clean-up campaigns, while conducted, were deemed short-term and insufficient for addressing the problem sustainably. A lack of a cohesive and sustainable strategy further compounded the challenge. This study emphasizes the urgent need for strong governance and collaboration among relevant stakeholders to combat illegal dumping effectively as the results identified a lack of governance amongst various stakeholders in the study area. Though there are similarities between previous studies and this research, regarding the factors responsible for illegal dumping, the results for each study must be treated differently in line with the study area. The municipality needs to understand the root causes of illegal dumping in Ngwelezana Township to align the results with the implementation of the recommendations. Based on the results of this study, the researcher concludes that the findings of the study provide enough evidence of the factors contributing to illegal dumping in Ngwelezana Township which will inform the municipality's resolutions to the problem. In light of these findings and the root causes identified, the following recommendations are proposed:

- *Intensify recycling initiatives and waste segregation* – Given the findings of the study, waste minimization, reuse, recycling, and recovery were very limited in Ngwelezana Township as there are only two formal recycling companies throughout the township. Lack of waste segregation at source was also apparent in Ngwelezana. Thus, there is a need to expand waste recycling initiatives in the township to capacitate communities about the importance of recycling. The introduction of a waste segregation at the source initiative is required to promote responsible waste disposal practices within

the community. There is also a need to introduce buyback centres in the township to promote a recycling attitude in the community.

- *Intensify Awareness Campaigns and Stakeholder Involvement* – The results revealed poor implementation of awareness and educational campaigns in the township. There is a need to increase awareness campaigns on environmental issues in Ngwelezana, targeting not only the community but also schools as a pivotal platform for community education about the impacts of illegal dumping. This could ensure that interventions to address waste issues are sustained and long-term. However, there is a need to enhance the involvement of stakeholders to foster proper waste management in Ngwelezana Township. The complex challenge of illegal dumping requires a robust partnership and inclusive strategies involving all relevant stakeholders as the study identifies gaps in stakeholder collaboration in Ngwelezana.
- *Enhanced Waste Collection Frequency and Enhanced Enforcement* – Most respondents were not satisfied with waste collection frequency in the township as waste was only collected once a week. There is a need to implement more frequent waste collection, to alleviate illegal dumping challenges. Bi-weekly or more regular collections could be explored and ease of access for communities to also dispose of waste if required. Considering the lack of resources that were identified during the study. The municipality must introduce other waste disposal facilities in the township such as drop-off centres in addition to the kerbside where people can be able to deposit waste any time of the week while waiting for kerbside collection. Additionally, a lack of law enforcement was identified as one of the contributing factors to illegal dumping in Ngwelezana Township. Therefore, there is an urgent need to reinforce waste laws and introduce fines. Fines should be substantial enough to deter illegal dumping and not lower than waste disposal fees to avoid creating perverse incentives. The municipality should consider putting public waste skips strategically to be easily accessible by residents who are using them, especially in the Tribal Society as it was apparent that poor waste management was significant in this community.
- *Fence off Green Belts* – Considering that there has been widespread illegal dumping of waste in open spaces, there is an urgent need to take measures to fence off the green belts scattered in the township, repurposing these open spaces for constructive purposes such as parks, thereby reducing opportunities for illegal dumping.

By implementing these recommendations, the municipality can take significant strides toward stopping illegal dumping and fostering a cleaner and more sustainable environment in Ngwelezana Township. However, it must be emphasized that a robust partnership to work with communities will be needed for the success of any interventions.

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References

- Abrahams, E. (2020), "Illegal dumping remains a serious problem for Empangeni", *Zululand Observer*, 16 November, p. 1.
- Aryampa, S., Maheshwari, B., Sabiiti, E., Bateganya, N.L. and Bukenya, B. (2019), "Status of Waste Management in the East African Cities: Understanding the Drivers of Waste Generation, Collection and Disposal and Their Impacts on Kampala City's Sustainability", *Multidisciplinary Digital Publishing Institute Journal*, Vol. 11 No. 19, p. 5523.
- Brinklow, A. (2018), "Some SF streets filthier than world's poorest slums, says UC Berkeley professor", *Voxmedia*, 16 January, p. 1.
- Busetto, L., Wick, W. and Gumbinger, C. (2020), "How to use and assess qualitative research methods", *Neurological Research and Practice Journal*, Vol. 2 No. 14, pp. 1-5.
- City of uMhlathuze Integrated Development Plan Review (2019/2020), Available from: <http://www.umhlathuze.gov.za/index.php> (Accessed 24 April 2021).
- Comerford, E., Durante, J., Goldsworthy, R., Hall, V., Gooding, J. and Quinn, B. (2018), "Motivations for kerbside dumping: Evidence from Brisbane, Australia", *International Journal of Integrated Waste Management, Science and Technology*, Vol. 78, pp. 490-496.
- Department of Environmental Affairs (DEA) (2011), National Policy for the Provision of Basic Refuse Service for Indigent Households. Notice 413. Pretoria, South Africa. Available at: https://www.gov.za/sites/default/files/gcis_document/201409/34385gen413.pdf (Accessed 9 May 2024).
- Department of Forestry, Fisheries, and the Environmental (DFFE) (2020), National Waste Management Strategy (NWMS). Pretoria, South Africa.
- De Jonckheere, M. and Vaughn, L.M. (2019), "Semi-structured interviewing in primary care research: A balance of relationship and rigour", Vol. 7 No. 2, pp. 1-8.
- Derhab, N. and Elkhwesky, Z. (2023), "A systematic and critical review of waste management in micro, small and medium-sized enterprises: future directions for theory and practice", *Environmental Science and Pollution Research*, Vol. 30 No. 6, pp. 13920-13944.
- Dlamini, S.Q. (2016), "Solid waste management in South Africa: Exploring the role of the informal sector in solid waste recycling in Johannesburg", Master of Science, University of Witwatersrand.
- Dlamini, S., Simatele, M.D. and Kubanza, S. (2019), "Municipal solid waste management in South Africa: from waste to energy recovery through waste-to-energy technologies in Johannesburg", *The International Journal of Justice and Sustainability*, Vol. 24 No. 11, pp. 1-9.
- Ferronato, N. and Torretta, V. (2019), "Waste Mismanagement in Developing Countries: A Review of Global Issues", *International Journal of Environmental Research and Public Health*, Vol. 16 No. 6, pp. 1060.
- Fredrick, M., Joseph C., Oonyu, J.C. and John Sentongo, J. (2018), "Influence of education on the solid waste management practices of communities in Kampala City", *Journal of Environment and Waste Management*, Vol. 5 No. 1, pp. 261-274.
- Fuldauer, L.I., Ives, M.C., Adshead, D., Thacker, S. and Hall, J.W. (2019), "Participatory Planning of the Future of Waste Management in Small Island Developing States to Deliver on the Sustainable Development Goals", *Journal of Cleaner Production*, Vol. 223, pp. 147-162.

- Google Maps (2024), Map showing the location of Ngwelezana township in South Africa. Available at: <https://www.google.com/maps/search/ngwelezana+township+map/@26.2279993,13.7776329,5.51z?entry=tту> (accessed 22 April 2024).
- Gorobets, A. (2019), "Urban Waste Recycling in Developing Countries Should Be Improved", *Current Science Journal*, Vol. 117 No. 2, pp. 173-174.
- Grangxabe, X. S., Maphanga, T., Madonsela, B. S., Gqomfa, B., Phungela, T.T. Malakane, K.C., Thamaga, K.H. and Daniel Angwenyi (2023), "The Escalation of Informal Settlement and the High Levels of Illegal Dumping Post-Apartheid: Systematic Review", *Multidisciplinary Digital Publishing Institute Journal*, Vol. 14 No. 3, pp. 38.
- Grobler, L., Schenck, R. and Chitaka, T.Y. (2022), "Waste Management, Littering and Illegal Dumping: A Literature Review: Clean cities and towns: Understanding societal behaviour in order to reduce and divert waste going to", available at: <https://www.researchgate.net/publication/361223487> (Accessed: 04 September 2023).
- Haywood, L.K., Kapwata, T., Oelofse, S. Breetzke, G. and Wright, C.Y. (2021), "Waste Disposal Practices in Low-Income Settlements of South Africa", *International Journal of Environmental Research and Public Health*, Vol. 18 No. 8176, pp. 1-3.
- Ichipi, E.B. and Senekane, M.F. (2023), "An Evaluation of the Impact of Illegal Dumping of Solid Waste on Public Health in Nigeria: A Case Study of Lagos State", *International Journal of Environmental Research and Public Health*, Vol. 20 No. 22, p. 7069.
- Kimani, A. (2020), "GIS mapping of community perceptions of illegal waste dumping in Mbekweni, Paarl", Master of Arts, University of the Western Cape.
- Kumar, S., Smith, S.R., Fowler, G., Velis, C., Kumar, J., Arya, S. Kumar, R. and Cheeseman, C. (2017), "Challenges and opportunities associated with waste management in India", *Royal Society Open Science Journals*, Vol. 4 No. 3, pp. 1-11.
- Kumar, P. and Kumar, A. (2020), "Role of Education in Waste Management", *Iconic Research and Engineering Journals*, Vol. 4 No. 2, pp. 68-70.
- Mandikiana, L.T. (2021), "Comparison of knowledge, Attitude and Practices on Waste Management Among Formal and Informal Residents in Edendale, KwaZulu Natal, South Africa 2019-2020", Master in Public Health, University of Johannesburg.
- Niyobuhungiro, R.V. and Schenck, C.J. (2021), "The dynamics of indiscriminate illegal dumping of waste in Fisantekraal, Cape Town, South Africa", *Journal of Environmental Management*, Vol. 293 No. 1, pp. 1-6.
- Pewa, M.K.P. (2019), "Household Waste Management in a South African Township", Doctor of Philosophy, University of Hull.
- Polasi, T., Matinisa, S. and Oelofse, S. (2020), *South African Municipal Waste Management Systems: Challenges and Solutions*. [Online] Pretoria: CSIR, pp. 1-7. Available from: <https://www.researchgate.net/publication/346025379> (Accessed 16 January 2022).
- Polasi, L.T. (2018), "Factors associated with illegal dumping in the Zondi area, City of Johannesburg, South Africa", paper presented at the Waste Conference (WasteCon), 18-19 October, Johannesburg-Emperors

- Palace, available at: <https://researchspace.csir.co.za/dspace/handle/10204/10511> (Accessed 15 September 2022).
- Pretorius, A., Blaauw, D., Schenck, R. and Grobler, L. (2023), "Towards a circular economy: A cross-case analysis of recycling in three South African towns", *Development Southern Africa Journal*, Vol. 40 No. 57, pp. 1-7.
- Ramsamy, R. (2017). "Put a stop to illegal dumping nonsense", *Zululand Observer*, 17 April, p. 2.
- Rasmenia, Z.Z. and Madyirab, D.M. (2019), "A Review of the Current Municipal Solid Waste Management Practices in Johannesburg City Townships, Johannesburg, South Africa", *Procedia Manufacturing Journal*, Vol. 35, pp. 1025-1031.
- Sadan, Z. and De Kock, L. (2020), "Plastics: Facts and Futures: Moving beyond pollution management towards a circular plastics economy in South Africa", WWF South Africa, Cape Town, South Africa.
- Saunders, M., Lewis, P., Thornhill, A. and Bristow, A. (2019), "Research Methods for Business Students Chapter 4: Understanding research philosophy and approaches to theory development", pp. 128-171, 8th Edition, Chapter: 4, Pearson Education, available at: <https://www.researchgate.net/publication/330760964> (Accessed 08 March 2023).
- Simelane, T. and Mohee, R. (2015), "Comparative Analysis of Solid Waste Management in Developed and Developing Countries", in: Mohee, R. and Bundhoo, M.A. (Ed.s), *Future Directions of Municipal Solid Waste Management in Africa*, Africa Institute of South Africa, Pretoria, pp. 6-35.
- Strydom, W. (2018), "Barriers to Household Waste Recycling: Empirical Evidence from South Africa", *Recycling*, Vol. 3 No. 41, pp. 2313-4321.
- UMhlatuze Integrated Waste Management Plan 2nd Review (2019), "KwaZulu Natal. Waste Management services", available from: <http://www.umhlatuze.gov.za> (Accessed 10 April 2021).
- UN-Habitat (2020), "Working for a better urban future: Annual progress report", available at: <https://unhabitat.org/sites/default/files/documents/2019-05> (Accessed 14 March 2022).
- Wright, B., Smith, L. and Tull, F. (2018), "Predictors of illegal dumping at charitable collection points", *International Journal of Integrated Waste Management*, Vol. 75, pp. 30-36.
- Wu, D.L.W., Lenkic, P.J., DiGiacomo, A., Cech, P., Zhao, J. and Kingstone, A. (2018), "How does the design of waste disposal signage influence waste disposal behaviour?", *Journal of Environmental Psychology*, Vol. 58, pp. 77-85.
- Yang, W., Fan, B. and Desouza, K. (2019), "Spatial-temporal effect of household solid waste on illegal dumping", *Journal of Cleaner Production*, Vol. 227, pp. 313-324.
- Yuan, H., Du, W., Ma, X., Liu, J. and Li, L. (2023), "Critical factors to influence the illegal dumping behavior of construction and demolition waste: An ISM-DEMATEL analysis", *Developments in the Built Environment Journal*, Vol. 14, pp. 1-9.
- Zondi, N., Qwatekana, Z. and Dube, S. (2023), "Modernisation of Rural Communities: Solid Waste Management Implication", *African Journal of Inter-Multidisciplinary Studies*, Vol. 5 No. 1, pp. 1-11.