

Challenges and Opportunities Associated with Solid Waste Management in Chililabombwe District, Zambia

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Abstract

The management of municipal solid waste (MSW) is a serious challenge facing major environmental challenges associated with waste generation and inadequate waste collection, transport, treatment, and disposal. The paper wishes to highlight on the current waste management practices by the district, also highlighting on challenges and opportunities in order to remedy the current problems and how best to address future opportunities for a better sustainable solid waste management in the district. The district has no capacity to overcome the amplification of the increased generated waste with the increased population, and this has impacted on the environment and public health. The current district aims to move away from the reliance of the open dumpsite that does not offer any environmental protection to a solid waste system that is of more useful that will retain useful resources within the economic zone through recycling. Waste sorting and segregation at the source that provides separation of the recyclable materials is actually key to waste management. Most of the extracted materials from the disposal residuals require proper landfill management with waste sorting facilities. Obviously, challenges and barriers are significant so are the opportunities in the district. Shortage of qualified manpower, lack of technologies, and proper solid waste equipment to deliver improved waste management systems remain the authority concern. Landfill plays a significant role in energy generation if well managed, thus poses a greater opportunity for local empowerment and job creation for the youths that need further study.

Keywords: *Challenges, Chililabombwe, Opportunities, Solid waste management, Zambia.*

Introduction

Throughout history, man has continued to generate waste in every activity of his life. Failure to have a strategic system in waste management has caused improper disposal of waste.

As humanity development has continued to evolve so is the increase in waste generation, which has significant consequences on both the people and the environment and what it's in it. Human well-being and the quality of both water

and air have equally been affected by the indiscriminate of solid waste [1-2].

On the other hand, improper management of municipal solid waste (MSW) has been represented by a low collection rate of waste, waste accumulation on roadsides and around containers, and the illegal dumping or burning of waste in spaces [3-5]. The situation can cause severe environmental effects that poses a high risk to public health [6] and many other socio-economic challenges.

The major activity in the district is mining being a Copperbelt zone, and the informal sector is into the business of which street-vending and market trading have hugely contributed to the high generation of waste in the district. Industrialization and urbanization, and other social and economic growth have impacted negatively on the increased municipal solid waste generation per person and per capita [7-8].

Solid waste management (SWM) as an essential service for urban society has attracted significant attention of experts; local and national authorities [9-12]. Solid waste services ought to be available to all communities as they have public health and environmental aspects. Consequently, such a situation increases the number of waste pickers whose safety and working conditions are not guaranteed and requires the political and legal framework to ascertain the safety at the operating premises noted fact of this scenario. Further, the concern about the immediate environments controlled by individuals and designated dumpsites determined by the municipal authorities have attracted a lot of interest both locally and abroad.

It can be concluded that the business houses and those in the informal sector equally have an important role to play in value addition through the extraction of valuable materials that can easily be recycled into valuable one, as it stands around 90% of the residential generated waste is dumped in drainages, along the roads and in open spaces rather than being landfilled. This, therefore, requires an urgent move to a robust and more sustainable SWM that will encompass waste management systems and waste management facilities [13-18].

The article, therefore, gives a view on the challenges, barriers, and of course the anticipated opportunities that come with the improved and sustainable waste management system in the district.

1. To assess the inadequacies of waste disposal facilities.
2. To evaluate the lack of human resources in waste management in the council.
3. To determine whether there was a political influence on solid waste disposal options on solid waste management.
4. To determine factors that improve solid waste management in Chililabombwe district.

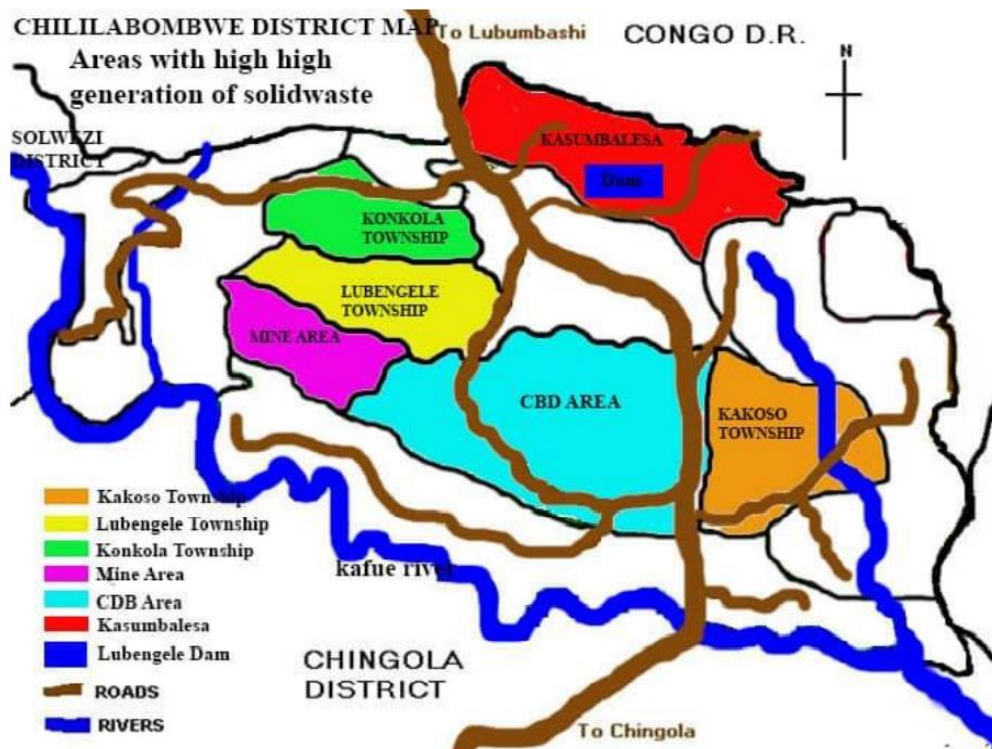
Methods/Methodology

This is descriptive research that looks at issues such as possible behaviour, attitudes, values, and characteristics. Open-ended questionnaires self-administered and observations on the business activities were used to select samples for observation and analysis. Both qualitative and quantitative data were obtained, which was required for statistical techniques to analyse and present the results and provide a solution to the problem under study.

The study dealt with personal interviews on the views regarding waste management in the District, Focus Group Discussions [FGDs] were used to discuss matters regarding waste management and the views on how best waste can be managed as a district. The self-administered questionnaires enabled the researcher to interact with the participants being interviewed, whereas structured questionnaires were administered to the institutions and other business houses.

The participants were given informed consent forms assisted by the trained research assistants to enable understand the concept of the research as most of the traders could not properly understand the official language, and the trained research assistants were able to interpret and record the data with the full consent of the participants themselves.

Study Area [Geographical Map of Chililabombwe District]



Source. Chililabombwe Municipal Council Integrated Waste Management Strategic Plan [CMCIWMP]

Figure 1. Chililabombwe Map on Areas with High Waste Generation

Results

Our results of the study are presented in the tables:

Table 1. Respondents Rates

Categories of questions	Frequency	Percentage
No. of Return	364	95
No. not Return	19	5
Total Supplied	383	100

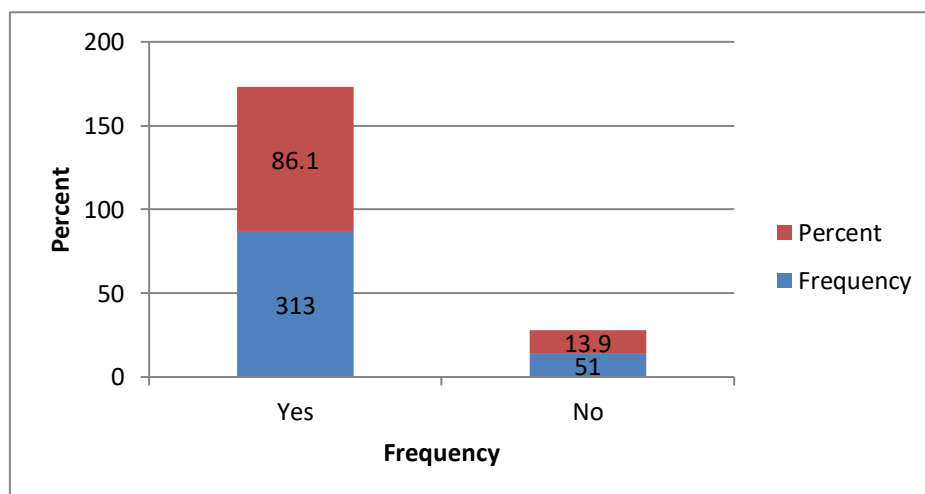


Figure 1. Knowledge Levels on Health Impact Regarding Waste Collected and Well Managed Solid Waste

Lifestyle Related Factors Practiced on Waste Management

The graphs represent respondents' knowledge levels of the health implications and aesthetics effects of un-collect municipal waste. Most of the respondents 313 (86.1%), responded "Yes,"

implying that they were knowledgeable while the minority, 51(13.9%) responded No, indicating that their level of understanding on solid waste management had been construed of not understanding the implication of the aforementioned as a health factor.

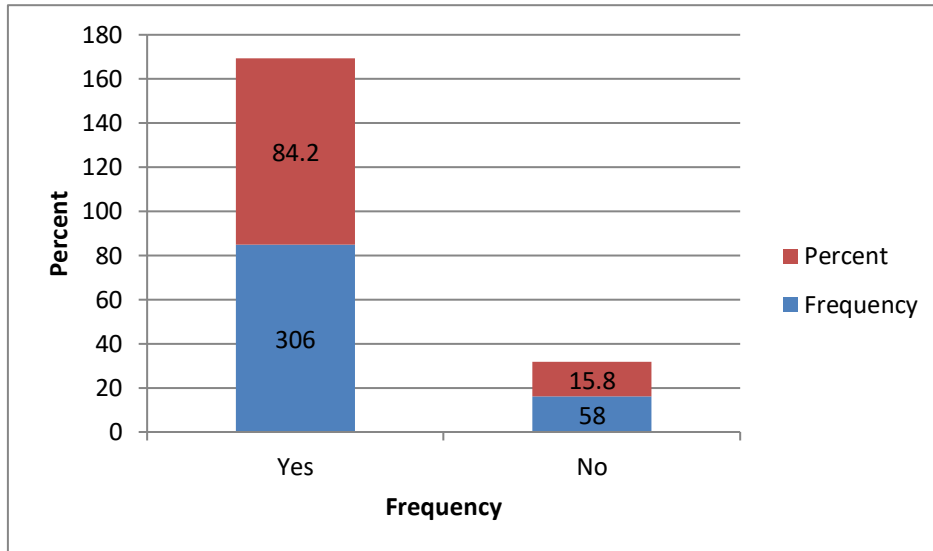


Figure 2. Attitude of the Community Members towards Waste Management

The above graph shows a summary of respondent's attitude toward a reduction of escalating levels of municipal waste. The majority of the respondents, 306(84.2%) showed a negative attitude and linking their reasoning on the economic side than the health-associated

complications, while 58(15.8%) were on the positive side and demonstrated some concerns about the accumulation of solid waste in the district and its immediate impact on the environment and the people at large.

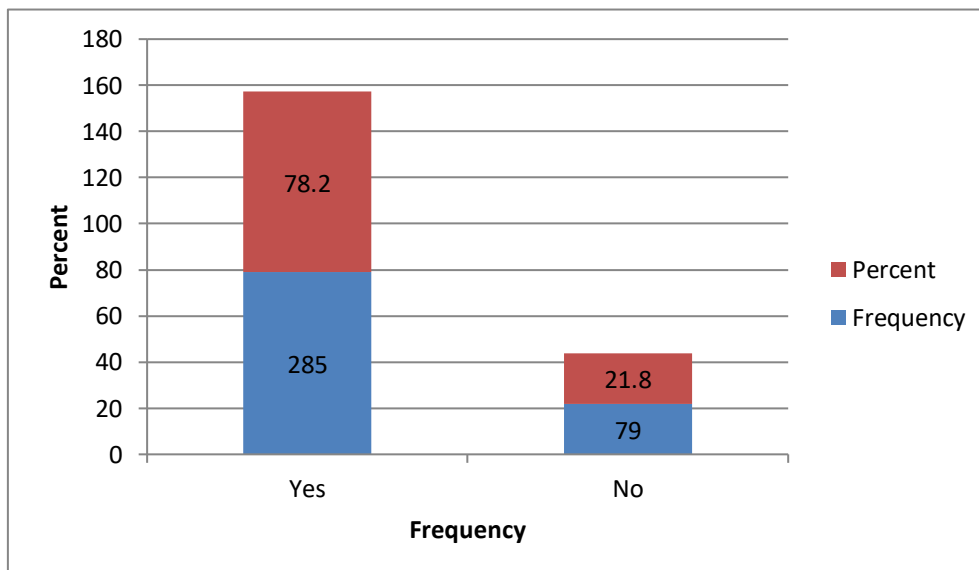


Figure 3. Understanding the Negative Health Impacts on Waste Management

The above diagram represents the impact of the native or traditional indigenous ways of disposing of waste on escalating levels of municipal waste. The majority, 78.2% (285), responded yes, while the minority, 21.8% (79), responded not, respectively.

Statistical Tests for the Hypotheses

This section presents an account of the outcomes of the statistical tests performed on the hypotheses. The data were analyzed at a 95% confidence level or $p = 0.05$. Fisher's Exact Test for the hypothesis.

Discussion

The Magnitude of the Solid Waste Management Problems

According to the findings of the study, the magnitude to the problem of solid waste management in the district of Chililabombwe has been deteriorating or worsening due to a shortage of expertise specialized in waste management, lack of modern waste equipment, financial resources from the local authority, legal and administrative enforcement of environmental regulations and lack of community willingness to the polluter pay principle [19].

Together with these issues, this study established the lack of public awareness and environmental ethics that result in un-sustained solid waste management and disposal. This was found cutting across all the townships of the district, rather than a small area or place, due to the weakness of the law enforcers and little financial resources to undertake vigorous patrols within the district; the study and the people themselves.

In order to understand well the danger of solid waste management, the study established that in the outskirts of the district centers, solid waste is hardly or is never collected as it's either burnt or buried in the yards. The findings are in congruence to the findings from the study [20] a case of Lusaka District where the magnitude to which the solid waste is a problem can be found

in the outskirts of the cities, towns, urban areas, and municipalities, from which this study found that solid waste are found on outskirts of the urban areas, turning into the child sources of contamination due to the that affect the population.

Respondents also impinged diseases and suffering among the people in Chililabombwe district related to solid waste, and the study found that there is bad ordure arising from these illegal dumping sites which has mushroomed the Townships of Chililabombwe district. These attract dogs, cats, and much more street children scavenging food around the district.

[21] Solid waste and uncleaned drainages in the district have been implicated in high incidences of malaria cases with high malaria attack positivity in the district. Besides, solid waste dumping was associated with the incubation and proliferation of flies' mosquitoes, and rodents; in turn, they transmit diseases that affect the population's health such as malaria, diarrhea, cholera, and typhoid now with the embattlement of Covid-19 and many other public health concerns.

Respondents' knowledge levels of the health implications and aesthetics effects of increased sold waste management indicated that most of the respondents, 330 (86.1%), responded Yes, implying that they were knowledgeable, while the minority, 14(13.9%) responded No, indicating that their level of reasoning had not beyond the aspect of understanding the implication of the aforementioned.

Out of a study of 383 respondents who were representing the same number of households, a total number of 364 questionnaires by respondents were returned and analyzed, representing a 95% turnout of the total of 383 questionnaires administered, and 19 questionnaires were not returned, representing 5% of the total administered. 300 were males representing 78.34% of the sampled population, while 83 were females representing 21.67% respectively. The age range of respondents

indicated that the minority were 53 aged between 21-30 years representing 13.9% 99.

The median range was aged between 31-34 years, amounting to 25.7%, while the majority was 231, aged 35 years and above, representing 60.4%. Most of the respondents were married, with children represented at 86.1%, with the minority being either single, divorced and on separation, respectively.

Academic distribution of the sampled population indicated that the minority who were 11, representing 3%, had attained tertiary education, 65(16.8%) were the median group who had reached at least primary school, 27(6.5%) had never stepped in a classroom while the majority 280(73.3%) had attained either a school certificate or General Certificate of education.

Respondent's altitude towards a reduction of escalating levels of municipal waste also indicated that the majority of the respondents, 306(84.2%), showed a negative altitude and linking their reasoning on the economic side than the health implications of this waste, while the minority 58(15.8%) were on the positive side [22].

The impact of native or indigenous traditional ways of disposing of waste on escalating levels of solid waste showed most of the respondents, 78.2%(280), still think it is the duty of the local authorities to collect and dispose of the solid waste without any condition while the minority 21.8%(103) responded no implying that the traditional way of burying and burning of waste within their yards or homes is no longer a factor, as it contributed to the high level of solid waste accumulation and the burning has continued to pollute the air hence the vice is retrogressive and is a likelihood of many public health diseases [23].

Waste Generation in the District

Chililabombwe district like most districts in the country is experiencing rapid urbanization, being a mining town has continued attracting many people for employment purposes and also

business opportunities, especially at the border town with Congo. The population of Chililabombwe district was 125,233 in 2010 and was estimated to be at 198,287 in 2020, with a population growth of 3% per annum. The district hosts many foreign nations who trade at the border post with DR Congo at Kasumbalesa border town.

Infrastructure Development for Public Health and Protection of the Environment

As the population continues to grow in size and number so is the need to improve modern and quality infrastructure to meet the increasing challenges of solid waste management in the district to safeguard and protect the environment. Proper management of the environment is quite fundamental to achieving effective economic growth. Modern solid waste management infrastructure plays an integral role in service delivery that acts as a catalyst to sustainable development of the district, as this will create job opportunities which is in line with the UNDP under sustainable development goals integration #9 on "Industry, Innovation and Infrastructure".

The increased population growth in the district has led to the depletion of natural resources and the district being a copper zone. Solid waste is no longer perceived as trash but rather a money-spinner if well vested into with proper infrastructure in place. This case easily addresses the job discrepancies, especially among the youths that always idle in their time waiting for handouts for their livelihood. Modern waste infrastructure can easily turn around the fortunes of most business opportunities through recycling to finished goods that came back on the market, especially the plastics goods.

The movement from what is seen to be waste into resources can only be realized through strategic investment in solid waste management by ensuring that the council is heavily equipped with modern solid waste machinery, and

qualified resource personnel [24]. The raw materials for plastic making and plastic papers can be recovered from the dumpsite using waste pickers and other technologies. As it stands, Chililabombwe district has no recycling tradition making it difficult to recover anything at the disposal site. The 'scrap dealer' systems that exist in the district have got no capacity to recycle materials as they depend on poor children to pick some of these materials before they are supplied to them.

Environmental and Health Impacts of Waste Dumping

Solid waste, like any other waste, has direct or indirect negative impacts on the environment and its inhabitants. This has an adverse effect on the environment and the health of the general public. Indiscriminate disposal of waste has the potential to contaminate the surface and underground water meant for human consumption that can cause water-borne diseases such as Cholera and other food-borne diseases. Further studies have implicated indiscriminate disposal of waste around the drainages and other opened areas as a source of mosquito and other vermin breeding sites. Open dumps release methane from the decomposition of biodegradable waste under anaerobic conditions [25]. As the world is grappling with climate change and global warming, methane from the dumpsite that is not managed can cause fires and explosions that will continue to raise the temperatures high by affecting another biodiversity, also affecting the fauna and the flora. The more the decomposition takes place in so many areas affecting the quality of area through leachate and other gases produced thereof.

Odour is a serious problem, particularly during the rainy season, that attracts a lot of flies that play a vectoral role in disease transmission. Disposed tyres and other plastic containers discarded at the dumps collect stormwater and other disposed of liquids creating mosquito breeding sites. The district is recording more

2000 clinical malarial cases and has continued to claim the lives of the residents of Chililabombwe, and the finding shows that there are too numerous dumping sites around the district.

The uncontrolled burning that continues to take place in the district on the dumpsites by the waste pickers pollutes the air by causing air pollution that when inhaled, has the potential to cause respiratory infections and suffocating of members of the general public [26]. The burning of tyres, plastic materials, and other hazardous materials in the dumpsites poses a health hazard to the health of the people. The burning of solid waste and other materials emits an estimated 3000 tonnes of pollutants into the atmosphere around the district every year. Improper waste management and disposal have the likelihood of causing health threats such as nose and throat infections, breathing difficulties, inflammation, and bacterial infections, also can cause reduced immunity, allergies etc.

Financial Challenges in Waste Management

Chililabombwe municipal council spends an average of 40% of its annual budget on waste management which makes it constrain on finances that are locally generated and had low revenue generation due to covid-19. Most municipalities in Zambia are still struggling to effectively meet the challenges posed by the ever-increased waste generation due to financial constraints coupled with a lack of proper solid waste management systems in place. [27] These sentiments are in line with the findings by Norbu,2008 where he mentioned that 'most municipalities in especially developing in countries face similar challenges such as financial factors to effectively manage solid waste'. He further highlighted those finances determined the context of MSWM as it comprises mainly of capital investment cost, operation and maintenance costs, cost reduction and control measures etc.

Local authority's operations are performed with the locally generated revenue, Chililabombwe council, like any other councils in Zambia, depends on its local revenue to execute its service delivery to the local people [28]. Currently, the council does not receive any financial support either from the central government or any other partners or well-wishers in the area of waste to cover and cater on the increased generated solid waste. The unwillingness of the residents to pay for waste management services makes it difficult for the council to commit itself into entering in a PPP or rather get loans to procure machinery even when the banks were to be flexible to offer loans. This has even been indexed in the report by Zambia Environmental Management Agency (ZEMA) on the challenges faced by local authorities in Zambia in managing municipal solid waste. However, Medina 2010 in his assessment on challenges facing local authorities in the country, deduced that many councils mainly relied on the stream of funding from central government in the form of grants to the councils that didn't attract any rate at all.

In as much as the municipalities are obligated by law to manage, monitor, and supervise solid waste management in their jurisdictions, with the mandate to prompt every household or business house to subscribe and pay for solid waste management, the revenue being collected to give the adequate service to the district is usually inadequate with an insignificant revenue baseline and also with poorly administered collection systems [29]. In other words, municipal councils are limping financially with the wage bills for employees of. Which some councils have gone some months without any pay for their employees due to insufficient funds in the book balances making it difficult to achieve proper waste management, this has led to a demotivated workforce, and this has negatively affected the service delivery. The cost of service and maintenance of these heavy waste equipment incurs a huge sum of money, with other running costs for fuel and other lubricants

are other obstacles to achieving sustainable waste management in the district [30].

A number of scholars included [31-32] also noted the costly financial in the operation and management of waste. It then required sustainable financial management systems by the municipalities to continue giving this service, hence forcing the municipalities to outsource contracted services. Unfortunately, in developing countries Zambia inclusive there is apathy towards payment of fees by the service users as per polluter pay principal.

Furthermore, in developing countries, solid waste revenues flow into general municipal accounts, this bureaucratic accounting procedure tends to be absorbed by the overall expenditures instead of being used for the intended purpose of solid waste management [33].

[34-35] noted that in as much service delivery was needed, there were other facets of operations that needed attention, such as capacity building, improved waste handling capacities, and well equipped with modern waste management equipment was a priority in sustainable waste management. But the scenario for the Chililabombwe district where the residents are not willing to pay for waste management but prompt the local authority to collect the generated waste at no fee and making it difficult for the authority as the equipment requires fuel and maintenance.

Engineered Landfill in the District

The district operates without a sanitary landfill, making it difficult to manage solid waste effectively, UN Environmental Programme defines a landfill as the controlled disposal of MSW on land in such a way that contact between waste and the environment is significantly reduced, with waste disposal concentrated in a well-defined area.

[36] Engineered landfill allows the safe disposal of residual MSW on land but protects ground and surface water from pollution and avoids air emissions, wind-blown litter, odour, fire hazards, problems with animals, birds, and

other pests/rodents, and reduces greenhouse gas (GHG) emissions and slope instability issues.

[37] Properly managed engineered landfills should replace illegal and mushrooming dumps around the district. Municipal waste if not well managed, can easily despoil the beauty of the town that will have a huge environmental impact. Not until an engineered landfill waste is constructed for the purpose of waste management within the district can easy service even the nearby districts like Chingola and Solwezi.

Waste-to-energy in the District

The district currently does not benefit anything from the municipal waste generated, as it does not have the technologies to convert waste into any form of energy. Even when the problem propagated improper waste disposal could be reduced by recycling and recovering of the materials could be realized. [38] Waste management begins from the source where the 3Rs are put to good use in the process of waste management. Waste to energy technologies though widely used in developed countries can equally be adopted in the developing countries since it produces energy, can recover materials and free land that would be otherwise used for dumping. The land can easily be reclaimed for other commercial land use or turned into a residential area for settlement [39]. A significant increase in the use of waste-to-energy technologies has been proposed, but this depends on location, climate, demographics, and other socioeconomic factors. The most widely used waste-to-energy technology for residual waste uses combustion to provide combined heat and power. Adopting model of integral and sustainable waste management systems would significantly reduce the indiscriminate disposal of waste in the district [40].

Barriers to Improved Waste Management in the District

The current status core solid waste management in the district is not quite

impressive on the account that methods and modalities of proper waste collection, transportation and final disposal are never put to use. The district lacks qualified resource personnel that are trained professionally to handle all kind of waste in the district, although the local authority has officers under the department of public health managing waste currently lacks the expertise in the field of waste management. Though the district has the Integrated Development Plan (IDP) still lacks the integrated solid waste management plan to answer most of these challenges faced by the district, the lack of such an integral regulatory framework are the major barriers to achieving effective and sustainable waste management in the district.

Limited environmental awareness, low motivation, and lack of capacity building are among many reasons inhibiting anticipated the probable and needed technologies that could transform waste management in the district. Public attitudes and behaviour toward waste are also a major barrier to improving and achieving a clean environment in the district [41].

Improvement towards Solid Waste Management

Solid Waste management needs to be regarded throughout Zambian society as an essential service requiring sustainable financing for sustenance. The scenario for Chililabombwe district requires proper financial funding with huge and sound investment in the sector of waste management.

Chililabombwe district has continued to engage the citizens on the importance of waste management and how best it can be addressed through PPP with the business houses that can work closely with the council. The district is further undertaking the weekly clean-ups and also the Keep Zambia Clean, Green, and Healthy campaign that aims at cleaning the environment in all its 24 wards and in the schools to promote cleanliness. Every waste generator is encouraged to be responsible for the waste generated and that

its disposed of in a safe way than the traditional way of disposal, and also apply the polluter pay principal for people to be responsible for their acts [41].

Our advocacy is that the cleaning aspect be included in the learning curriculum in schools so that the mind of cleanliness is induced in the mind of the learners at the very age of primary school to the university level. Capacity-building among council employees is paramount to the service to be delivered to the people if the officers are equally equipped with knowledge on how to handle even the equipment and other machinery on waste management. The district ought to improve on the waste management through the collection, transportation, and the disposal of waste on time and in a designated place to avoid indiscriminate disposal in the environment [42].

Conclusion

The study demonstrated that solid waste management was a multi-dimensional issue. Local authorities in general, seek equipment as a path to find solutions to the diversity of problems they face in terms of solid waste management. The study showed that the district lacked a technology system that can effectively manage waste, only when these systems are adopted will the district continue to have these problems of improper disposal of wastes. Effective waste disposal system is not only based on modern technological solutions but also includes socio, cultural, environmental and economical lineages that permit the entire system to either function or malfunction.

The study underscored the inadequate waste infrastructure in Chililabombwe district, the informal sector, and waste dumping. There are major issues associated with public participation in waste management, and there is generally a lack of responsibility toward waste in the district [43].

The local authority needs to continue sensitizing the community and begin to cultivate in the mind of the people on the importance of proper disposal of waste and the health benefits it comes with a clean and safe environment. There is need much of community awareness and a change of attitude in the manner we manage our waste towards sustainable waste management in the district.

Economically, sustainable, and viable waste management requires consolidated efforts from both government and the private sector, for it requires resources, political will, community participation, and expertise on waste management worse still that the district has got no landfill nor practices safe waste disposal is yet another setback to achieve sustainable waste management [44-45].

Chililabombwe district is outlined by many challenges, some of which include unavailability of trained professionals in waste management and lack of compliance to the roadmap incorporated in the IDP for the district on MSW. Not until these fundamental requirements are well followed the district will continue grappling with the mentality of improper and poor disposal of waste.

Data Accessibility

The data content was generated from the main research report under the assessment of factors contributing to un-collected municipal waste: A case study of Chililabombwe District, Copperbelt Province –Zambia.

Competing Interests

The authors declare no competing interests.

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