

# Solid Waste Management Systems in Bungulu and Mulekera Municipalities in Beni Town, North-Eastern Democratic Republic of Congo: Evidence from the PPSSP NGO for Community Advocacy

Amuda Baba Dieu-Merci<sup>1</sup>; Gabriel Moliso<sup>2</sup>; Sikuli Lombard Micheline<sup>3</sup>;  
Mosika Sembu Dieu Merci<sup>4</sup>

<sup>1</sup>Associate Professor, <sup>2,3,4</sup>Independent Researcher

<sup>1</sup>Institut Supérieur des Techniques Médicales de Bunia (ISTM-Bunia), RD Congo  
<sup>2,3,4</sup>Programme de Promotion de Soins de Santé Primaires (PPSSP), RD Congo

Corresponding Author : Gabriel Moliso<sup>2\*</sup>

Publication Date: 2026/03/07

**Abstract:** Solid household waste management has become one of the major concerns for cities in the Democratic Republic of Congo (DRC). In Beni, one of the cities in eastern DRC, solid household waste management is a real environmental and health problem. The purpose of this study is to evaluate the system for collecting, transporting, and disposing of solid household waste in the working-class neighborhoods of Bungulu and Mulekera in the city of Beni. The methodology used combines documentary research and field surveys. To achieve this objective, a quantitative research methodology was implemented. For the selection of research participants, multistage sampling was used. The questionnaire was administered in five of the 17 neighborhoods in the two municipalities covered by the study, and 384 people responded to our questions. The results show that 53% of households do not subscribe to waste disposal companies. More than 76% of waste comes from kitchens, 12.5% from animals, and 8.1% from economic activities. 37.5% of households dispose of their waste once a week, and 85% of households do not sort their waste before disposal.

Ordinary operators (56.7%) are the main managers of household waste transport to landfill sites, with 18.8% transported by households themselves, 15.4% by private companies, and 9.1% by state-owned companies. For those who do not subscribe to waste disposal services, the main destinations for waste are ravines or rain erosion sites (36%), waterways (35%), and the plot itself (24%).

67% and 64.1% of households surveyed reported, respectively, that there were no awareness-raising services on waste management in the two municipalities and that there were households that dumped their waste on public roads. 57.6% of households are dissatisfied with the waste disposal system in their households, and 57.8% know nothing about what happens to waste at the landfill site.

The poor management of solid household waste observed in the working-class neighborhoods of Bungulu and Mulekera in the city of Beni not only contributes to environmental degradation but also exposes the population to various diseases. There is therefore a need to consider innovative strategies for raising community awareness about household waste management.

**Keywords:** Management System, Solid Household Waste, Municipalities, Beni, DR Congo.

**How to Cite:** Amuda Baba Dieu-Merci; Gabriel Moliso; Sikuli Lombard Micheline; Mosika Sembu Dieu Merci (2026) Solid Waste Management Systems in Bungulu and Mulekera Municipalities in Beni Town, North-Eastern Democratic Republic of Congo: Evidence from the PPSSP NGO for Community Advocacy. *International Journal of Innovative Science and Research Technology*, 11(2), 2761-2770. <https://doi.org/10.38124/ijisrt/26feb963>

**I. INTRODUCTION**

Solid household waste management is a major challenge facing many African families today. With a constantly growing population, rapid urbanization, and changing lifestyles, household waste is a complex and significant issue for the continent. While African countries such as the Democratic Republic of Congo face numerous socio-economic, environmental, and health challenges, effective solid waste management is emerging as an essential priority. Indeed, most cities in developing countries are overwhelmed by urban waste, and cities in the DRC are no exception, especially a rapidly expanding city like Beni, with its 1,347,725 inhabitants. It should be noted that human activity has always generated waste, and each era has had its own methods of collection, transport, treatment, and disposal. The issue of household waste management is increasingly present in current environmental issues. Since the Earth Summit in Rio in 1992, environmental protection has been considered a collective concern. Throughout Africa, human activities are concentrated in cities. However, these cities generate waste (Tini, 2003). With population growth and rigid urbanization, the massive and uncontrolled production of waste has become a reality in African cities. This situation causes a real problem for the governance of urban areas (Bangoura 2017).

In the town of Beni, in the municipalities of Bungulu and Mulekera, there are no efficient and dynamic policies for managing solid household waste. Household waste is dumped in the open without any treatment. Sometimes it ends up in the most unexpected places, such as open gutters and ditches. This unsanitary situation poses a real public health problem, resulting in the degradation of the urban environment, which is a source of many disease risk factors. According to the World Health Organization, environmental degradation results in air pollution, surface water and even groundwater pollution, and an increase in the prevalence of endemic and epidemic diseases such as typhoid fever, yellow fever, malaria, and cholera (WHO, 2012). Added to this is the proliferation of rodents, harmful insects, and disease vectors.

The purpose of this article is to analyze the system for collecting, transporting, and disposing of solid household waste in the working-class neighborhoods of Bungulu and Mulekera in the city of Beni. After presenting the geographical context of the study, the article discusses the research methodology, results, and discussion.

**II. MATERIAL ET METHODS**

This study took place in the city of Beni, in North Kivu Province, in the northeast of the Democratic Republic of Congo. It is located north of Goma, the provincial capital, approximately 400 kilometers away (Beni City Hall, 2024). The city of Beni has four municipalities: Bungulu (378,811 inhabitants), Mulekera (507,823 inhabitants), Beu (252,595 inhabitants), and Ruwenzori (202,309 inhabitants). However, it should be noted that Bungulu and Mulekera, the two municipalities targeted by our survey, are the largest and most populous of all (Beni Town Hall Report, 2024).

This study used the survey method for its implementation. As the number of households in the municipalities covered by the study was estimated at 117,183, the Dépelteau (2000) method was applied to determine the sample size of 384 households. Multi-stage sampling was used to select the sample of households in the municipalities of Bungulu and Mulekera. In the first stage, after numbering the 17 neighborhoods that make up the municipalities of Bungulu and Mulekera, five neighborhoods were selected by simple random sampling. In the second stage, in each selected neighborhood, 77 households were selected by simple stratified random sampling.

With regard to data collection, the survey questionnaire was administered to adults (aged 18 and over) living in the households. The questionnaire consisted of four sections: sociodemographic characteristics, household solid waste collection, transport, treatment/disposal, and the population's level of satisfaction with the household solid waste management system. Before beginning the actual data collection, the questionnaire was pre-tested in two neighboring municipalities that were not selected for the survey.

The data were analyzed and processed using SPSS 27.0, which enabled the collected data to be coded for digital processing. Tables and graphs were then created in Excel.

**III. RESULTS**

The results mainly address the socio-demographic characteristics of respondents, the collection of solid household waste, transportation, disposal, and the level of satisfaction of the population with the solid household waste management system in the two municipalities.

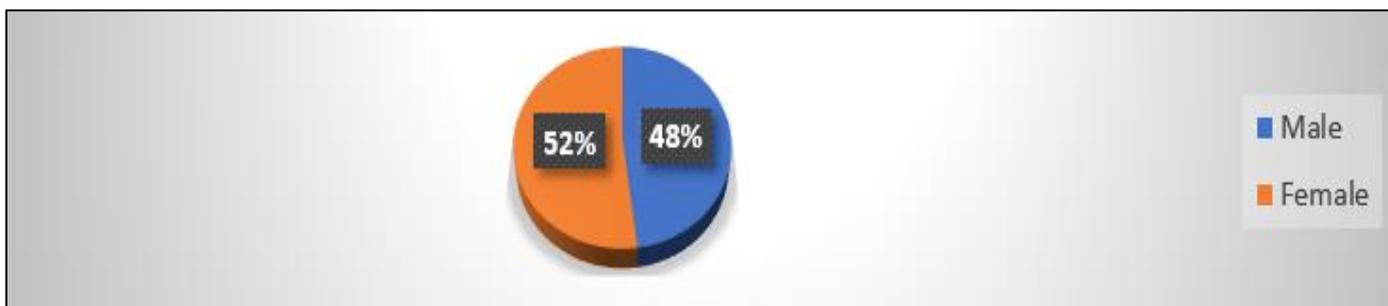


Fig 1 Distribution of Participants by Gender

This graph shows that 52% of respondents are female.

Tableau 1 Ages of Research Participants

Indicator	Frequency	Percentage
18-28 years	181	47.1
29-38 years	153	39.8
>= 39 years	50	13.0
Total	384	100.0

This table shows that nearly half of those surveyed (47.1%) were between the ages of 18 and 28.

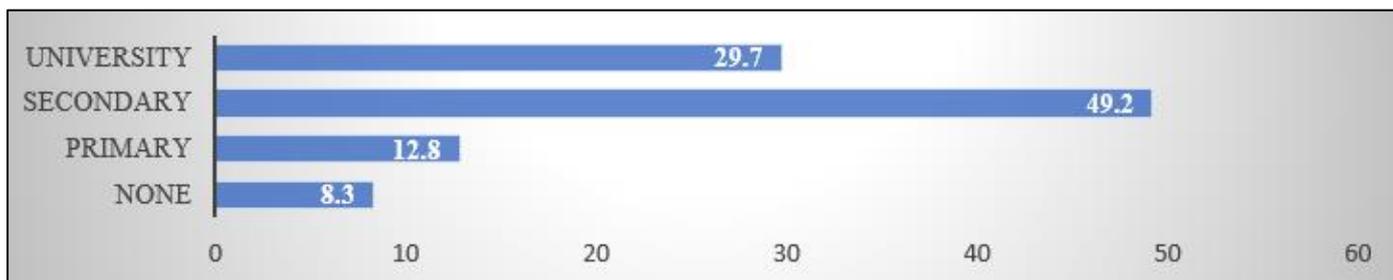


Fig 2 Distribution of Respondents According to Their Education

This graph shows that nearly half of those surveyed have a high school education (49.2%).

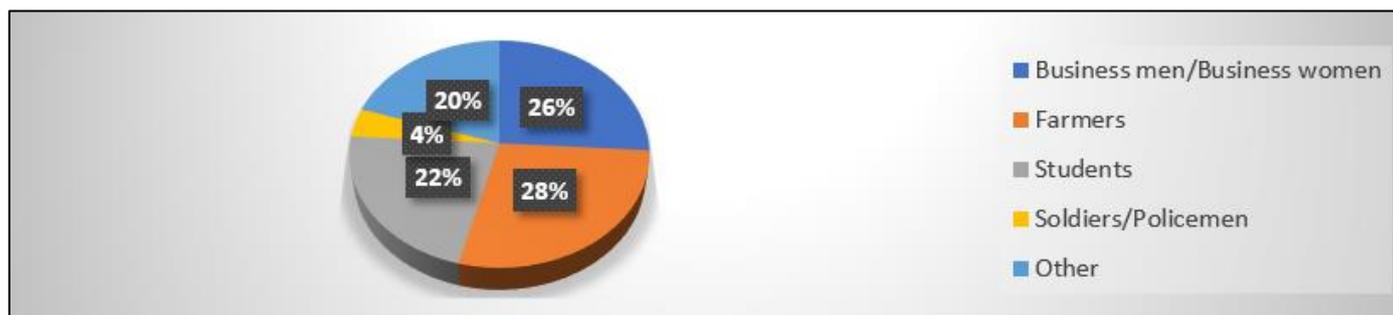


Fig 3 Distribution of Respondents According to Their Primary Occupation

More than a quarter of respondents are farmers (28%), followed by business men and women (26%).

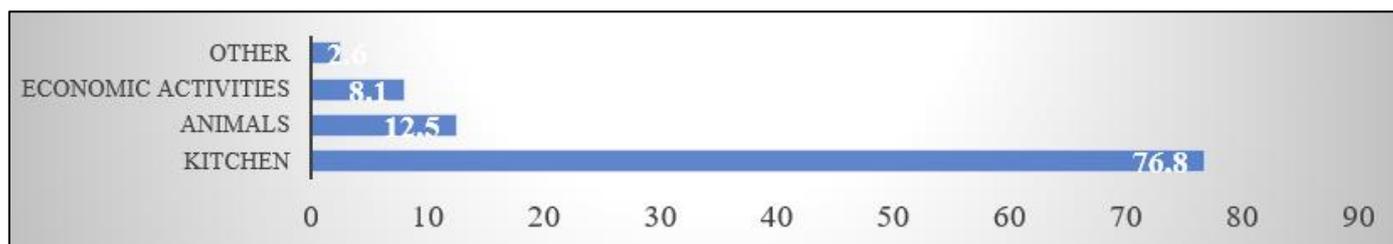


Fig 4 Breakdown of Waste Sources in Households

This graph shows that most solid household waste comes from kitchens (76.8%).



Fig 5 Distribution of Primary Waste Managers at the Household Level

The main waste managers at the household level are parents (37%) and children (35.7%).

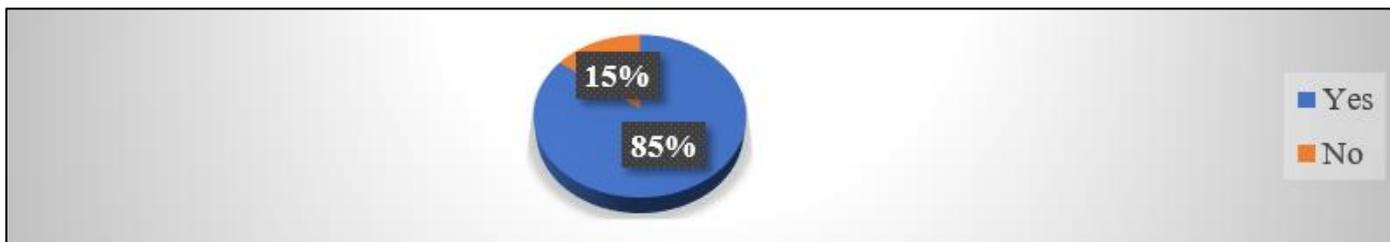


Fig 6 Distribution of the Existence of Trash Cans in Households

This graph shows that most households (85%) have a trash can.

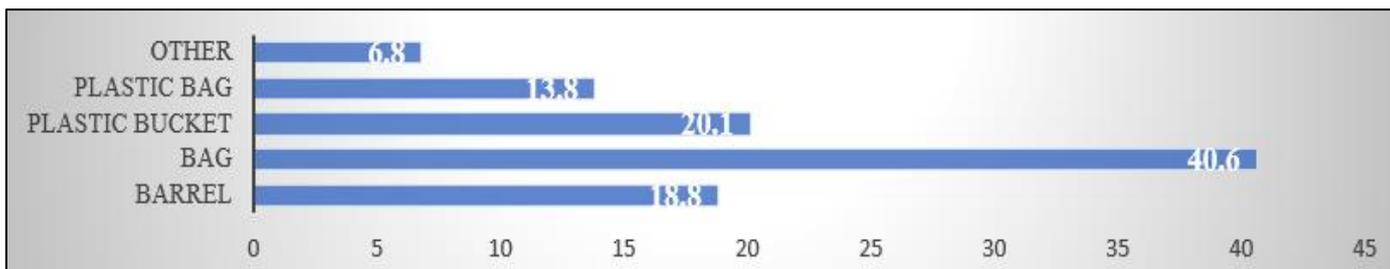


Fig 7 Distribution of Trash Can-Type Containers at the Household Level

The trash cans used in households are bags (40.6%) followed by plastic buckets (20.1%).

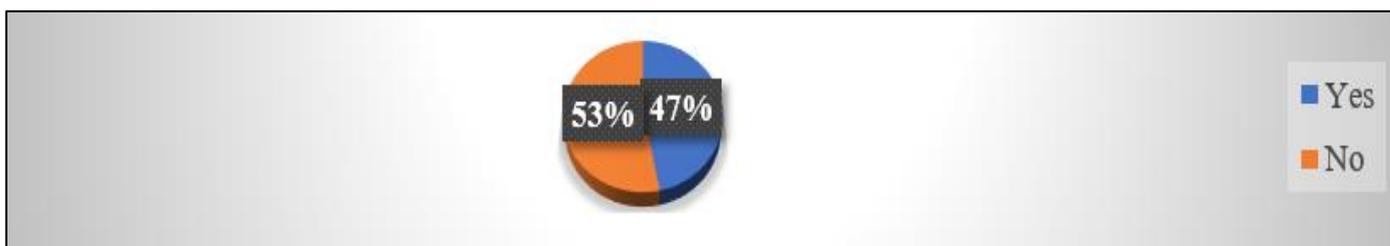


Fig 8 Distribution of Households According to Subscription to the Waste Collection Company

More than half of households (53%) do not subscribe to a waste collection service in both municipalities.

Table 2 Waste Management for Non-Subscribers in Neighborhoods

Indicators	Frequency	Percentage
Erosion/Gullies	138	35.9
Waterways in the neighborhood	134	34.9
Manages waste on the plot	92	24.0
Other	20	5.2
Total	384	100.0

More than a third of households (35.9%) dispose of their waste in erosion sites or ravines, followed by 34.9% in neighborhood waterways, and 24% manage their waste in a corner of their plot.

Table 3 Frequency of Waste Collection/Disposal in Households

Indicators	Frequency	Percentage
everyday	37	9.6
Once a week	144	37.5
Every fortnight	48	12.5
Once a month	14	3.6
Do not empty	15	3.9
Do not know	126	32.8
Total	384	100.0

This table shows that 37.5% of households dispose of their household waste once a week.

Table 4 Estimated Average Quantity of Waste Collected/Disposed of

Indicators	Frequency	Percentage
Less than 10 kg	54	14.1
Between 11 and 20 kg	80	20.8
More than 21 kg	20	5.2
Don't know	230	59.9
Total	384	100.0

This table shows that 59.9% of households surveyed do not know the average amount of waste collected/diposed of.

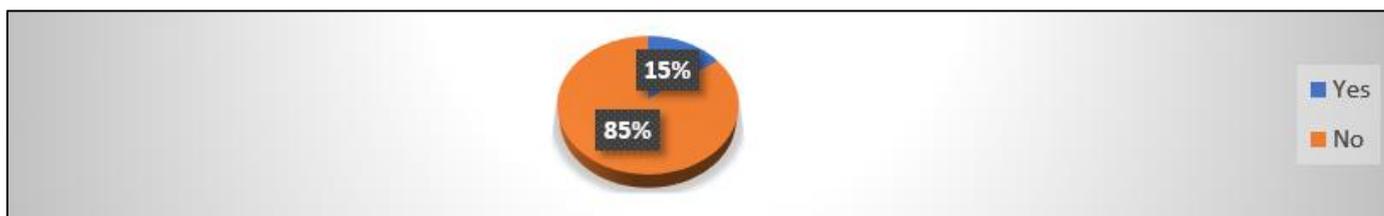


Fig 9 Distribution of Households According to Waste Sorting

This graph shows that 85% of households surveyed do not sort their waste before collection.

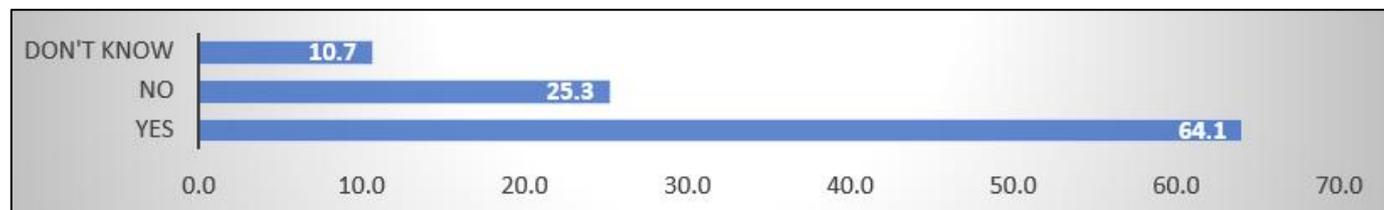


Fig 10 Distribution According to the Existence of Households that Dump Waste on the Streets

This graph shows that 64.1% of households surveyed reported seeing waste discarded on the streets.



Fig 11 Distribution of Household Waste Transport Managers to the Landfill Site

This graph shows that 56.7% of household waste transport to landfill sites is carried out by ordinary laborers.

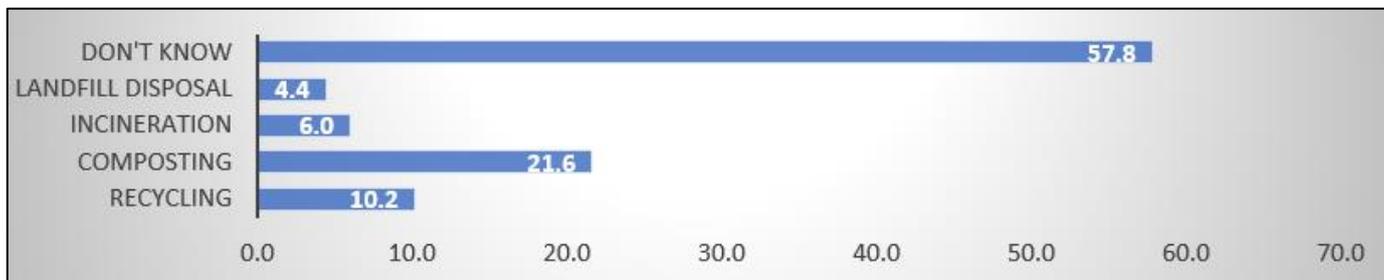


Fig 12 Distribution of Households on the Fate of Waste Disposed of in Households

This graph shows that 57.8% of households surveyed do not know what happens to the waste collected from their homes.

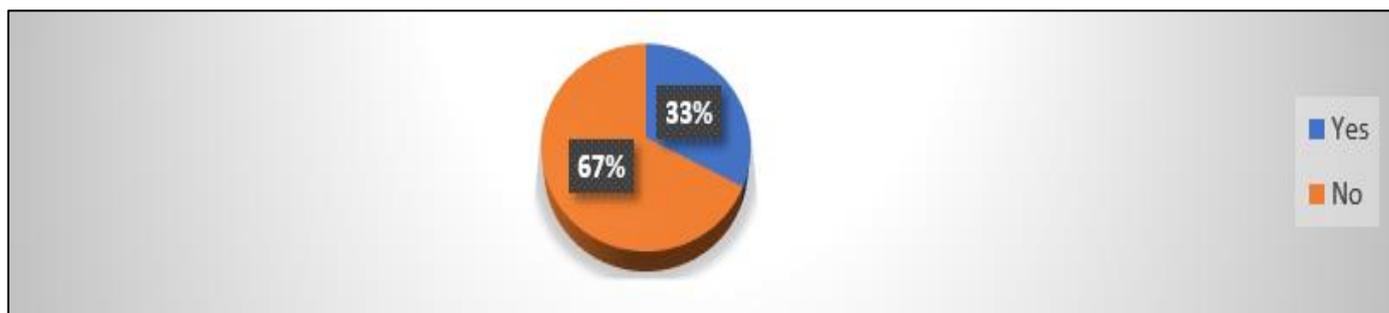


Fig 13 Distribution of Information About Waste Management Awareness Services in Both Municipalities

This graph shows that 67% of households surveyed report that there are no awareness-raising services on waste management in their municipalities.

Tableau 5 Satisfaction de ménages sur le système d’élimination de déchets

Indicators	Frequency	Percentage
Pas satisfait	221	57.6
Satisfait	114	29.7
Totalement satisfait	49	12.8
Total	384	100.0

This graph shows that 57.6% of households surveyed are dissatisfied with the system for disposing of household waste.

#### IV. DISCUSSION

##### ➤ Sociodemographic Characteristics of Respondents

Analysis of the results reveals that the majority of respondents were women, accounting for 52% of the sample, compared to 48% men. This can be explained by the fact that women spend slightly more time at home during the day taking care of household tasks, while men go out to earn a living for their families. These results corroborate those of Bernard (2022) and Onesphore (2019), where women represent 60% and 69% of respondents, respectively. Our results are also similar to those of Fatoumata (2023) in a study conducted on solid household waste management in the Sokalakono neighborhood of the city of Ségou in Mali, where analysis of the results showed that the majority of respondents were women, representing 90% of the sample. The gender variable in household waste management can help analyze and understand how men and women differ in waste production, sorting, collection, decision-making, and even in the overall waste management system. Gender can reveal disparities in the commitments of men and women and, moreover, can help to design waste management systems that take into account domestic workloads and inequalities in access to information.

The results of the study show that nearly half of those surveyed (47.1%) are aged between 18 and 28, followed by those aged 29 to 38 (39.8%). This result is similar to that found by Mumujuya (2022) in his study on solid household waste collection in the city of Bukavu in the Democratic Republic of Congo, where 95% of respondents were aged between 18 and 30. The fact that the respondents were mature would explain the thoughtful nature of their responses in this area of daily life. In household waste management, age is a

socio-demographic factor that determines sectoral behavior and even defines environmental awareness. In most cases, it could influence the ability to adopt sustainable practices throughout the waste management chain.

Nearly half of those surveyed have a secondary education (49.2%), followed by university graduates (29.7%). Intellectuals have a deeper understanding of waste management issues, so their behavior towards waste management should be different from those who have not studied. This is also confirmed by Kidiambuta et al. (2022) and Nkula et al. (2023) in their studies. Evina (2005) also shows that “education gives individuals an open mind and an ability to accept so-called modern cultures.” Level of education is a key socio-economic determinant that can influence the waste management system. A higher level of education is generally correlated with greater environmental awareness, promoting selective sorting, composting, and the use of formal collection services, thereby reducing illegal dumping.

A profession is a regular activity carried out to earn a living. In terms of profession, farmers were the most numerous (28%), followed by traders (26%), students (22%) and other categories. Our results are similar to those of Fatoumata (2023), where the majority of respondents were housewives (66.36%), followed by traders (18.18%), teachers (11.82%) and students (3.64%). In the city of Beni, this could be explained by the culture of local communities, where the true living conditions are permanently veiled. Households with a particular professional activity may generate more or less waste than others and may sometimes have better or worse access to collection services than others, thus influencing the overall management of the system. As the majority of respondents are women, they are more active in the agricultural sector in line with local culture, alongside other informal activities.

➤ *Collection of Solid Household Waste*

• *The Origin of Waste in Households*

The study shows that the main source of waste in households is the kitchen (76.8%), followed by animal waste (12.5%) and economic activities (8.1%). This is also confirmed by Kaudu and Kilewa (2021), who found 57.2% in their study. Our results are also consistent with those of Lounas (2017) in a study conducted in Tunisia on the management of household and similar waste in the municipality of Timizart, where, based on the samples taken, the following results were recorded: 69.86% organic matter, 19.67% plastic, 9.1% paper, and 2.36% glass. Organic matter predominates over other waste components. These materials include kitchen waste (peelings, leftovers, etc.) and garden waste (leaves, grass clippings, wilted flowers), as well as other products such as paper tissues and egg cartons. Our results are also similar to those of Fatoumata (2023), where solid household waste from the Sokalakono concessions in Mali has three sources of production: households (68.18%), economic activities (30%), and intra-urban livestock farming (1.82%). The origin of waste allows it to be categorized according to activity (cooking, animals, economic activities, and others) in order to optimize the management system in households.

Given the realities in both municipalities, there appears to be a causal link between the source of household waste (kitchen) and the main occupation of those surveyed (farmers).

• *Primary Waste Managers in Households*

Although waste management is everyone's responsibility in households, the survey shows that parents are the primary waste managers in households (37%), followed by children (35%) and domestic workers (22.7%). These results are similar to those of Kaudu and Kilewa (2021) and Onesphore (2019), who found in their studies that married people were in the majority (64.8%) and (57%) among respondents, respectively. This should have a positive impact on household solid waste management, given that married people, as parents, have a high sense of responsibility because they take care of their families, and they should also have the same concern for proper waste management in their households. Parents play an important role in the main management of waste in households by educating children about eco-friendly behaviors, introducing selective sorting at home as far as possible, and adopting responsible consumption (reduction, reuse). By acting as role models and as the main waste managers in households, they can pass on sustainable habits, promoting environmental awareness from an early age.

• *Presence of Waste Bins*

With regard to waste bins, it was found that most of the households surveyed (85%) have waste bins. This is also confirmed by Sombo (2021), Mindele (2016), and Bernard (2022) in their respective studies on solid waste management, where 66%, 67.5%, and 91% have trash cans. The existence of trash cans in households is a key variable that can structure the pre-collection of solid waste. It can also determine the

ability to store, sort, and preserve waste before collection, directly influencing cleanliness, domestic hygiene, and the efficiency of recycling or disposal.

• *Types of Waste Bins*

In terms of the type of waste bins used, 40.6% of households use empty bags, followed by plastic buckets (20.1%) and metal drums (18.8%). These results are similar to those of Fatoumata (2023), where most households (52.33%) collect their solid household waste in plastic or straw buckets and/or basins, while those that use grain bags, old animal troughs, and a small basin built into the wall behind the household walls account for 25.58%, 10.70%, and 3.25%, respectively. The results obtained in the study area can be explained by the permanent availability of bags and even plastic buckets in the area and by the fact that the management of these types of waste bins is easy and common in the area.

• *Household Subscriptions to Waste Collection Companies*

In both municipalities, 53% of households do not subscribe to waste collection or disposal companies, compared to 47%. These results are consistent with those for the city of N'Djamena (33%) in Chad, according to the work of Wari (2012). However, they are lower than those in the city of Nairobi (90%) in Kenya (Henry et al, 2006). The existing structures do not cover all households in the city; only a few households subscribe to them (33.72%). The results of this study are consistent with those found by Mumujuya (2022), where 61% of households do not subscribe to waste collection and/or disposal services. The fact that the majority of households do not subscribe to waste management companies can be explained by economic constraints and a lack of information about the need to subscribe to these companies.

• *Waste Management for Non-Subscribers*

For those who do not subscribe to the waste collection service, the main destination for waste is ravines or rain erosion sites (36%), followed by waterways (35%), with the remainder managing their waste on their own land (24%). These results are similar to those of Nkula et al. (2023) and Onesphore O., (2019), who found that 84% and 78% of households dispose of their waste in erosion or ravines. Simply owning a family trash can is not enough to manage solid waste; it is what happens to the waste after the trash can is full that poses a problem. In the same vein, the work of Epoh-Mvaboum and Moussinga (2003) reveals that 40% of the population of Yaoundé who do not have access to waste collection services tend to use their immediate environment to dispose of their waste. The same assertion was shared by Segbeaya (2012), Koledzi and Baba (2014). According to these authors, people dump household waste directly into gutters, streams, and rivers. The results of this study are also consistent with the study conducted in Kinshasa on waste management by Holy Honelu (2020), which showed that more than half of respondents reported using unauthorized locations as waste disposal sites, compared to 26.4% of respondents who reported disposing of their waste at a collection point. The results of this study can be explained simply by the ignorance of the effects of these practices among the households surveyed.

- *Frequency of Disposal or Collection*

Analysis of the results reveals that 37.5% of households empty their trash cans only once a week, 36.7% do not empty them at all, every two weeks (12.5%), every day (9.6%), and once a month (3.6%). At the household level, this is influenced by the amount of waste produced, standard of living, and the performance of collection services. The frequency of waste collection is determined in order to optimize collection, limit nuisances (odors, pests), and manage the volume generated. These results already point to a deficit in the solid household waste management system in the two municipalities covered by the survey.

- *The Average Amount of Waste Collected or Disposed of*

As for the results relating to the quantification of solid household waste disposed of, nearly 60% do not know the amount of waste disposed of, while 21% estimate that the weight of waste disposed of varies between 11 and 20 kg. This is also confirmed by Mumujuya (2022) in his study. According to Ngambi (2015), whether in Cotonou, Douala, Yaoundé, Accra, or Conakry, the ratio between the amount of household waste produced and the amount collected does not exceed 60%. Quantifying and characterizing solid household waste makes it possible to know what needs to be managed (disposal, treatment, etc.), but in both municipalities, nearly 60% know nothing about the amount of waste disposed of, which even has an impact on the future of the waste. Solid household waste is not only a source of pollution but also a secondary material that can be processed, generating income and jobs after sorting and recovering the materials and energy it contains.

- *Waste Sorting in Households*

Regarding the results related to solid waste sorting at the household level in the municipalities of Bungulu and Mulekera, the majority (85%) of respondents never sort their waste. This result is consistent with those found by Nkituahanga (2019), Bernard (2022), Kamole (2013), Kaudu and Kilewa (2021), and Nkula et al. (2023). These results are also similar to those found by Bangoura (2017) in the city of Conakry, where waste collection generally takes place without separation, even though it is necessary to choose the type of collection for each type of waste in order to facilitate its sorting at treatment centers. The results of this study can be explained by the lack of information available to the population on the various waste sorting techniques used in households, but also by the validity of this sorting.

➤ *Transporting Waste to the Landfill Site*

- *The Existence of Households That Dump Waste on Public Roads*

In both municipalities, 64.1% of households report the presence of household waste on public roads. This result is consistent with that found by Issa et al. (2021) in a study conducted in Bamako, which showed that in Bamako's neighborhoods, waste is generally dumped on vacant lots, in gutters, sometimes deposited on public roads, or incinerated in the open air, subsequently generating negative externalities. In Kramo's work (2024), the results show that 39% of solid household waste is dumped in the street, 25% is

dumped in the bush, 19% in unoccupied houses, and 7% is burned. Waste management is a major problem in African cities.

Indeed, one need only travel through a few African cities to witness the dismal spectacle they present: piles of waste along public roads, waste clogging drains or buried in open dumps next to homes, etc.

Our results are also similar to those of Fatoumata (2023), where 33.34% of respondents use the corners of their yards as dumping grounds, compared to 25.00% who dispose of their waste in the waterways. Those who use the street and gutters as dumping grounds account for 25.00% and 16.66% of respondents, respectively. The results of this study can be explained either by household negligence or ignorance.

- *Waste Transport Manager*

Waste transport is mainly carried out by ordinary laborers (56.7%), followed by households themselves (18.8%), a few private companies (15.4%), and government services (9.1%). This is also confirmed by Bernard (2022), Tizié (2018) and Mumujuya (2022). The results of this survey are justified by the fact that this practice has been common in the community for generations.

➤ *Waste Treatment or Disposal at the Landfill Site*

- *Waste Disposal*

As for what happens to household waste at the landfill site, our results show that 57.8% do not know what happens to it. 21.6% say that the waste is used for composting, followed by recycling (10.2%), incineration (6%), and landfill (4.4%). Our results are similar to those of Fatoumata (2023) in a study conducted on household solid waste management, where 72.7% of respondents were unaware of proper solid waste management despite recognizing the danger posed by solid household waste. On the other hand, 14.55% preferred incineration, 2.72% considered landfill to be the solution, and 10% did not make any suggestions. These results can be explained by the fact that households are not sufficiently aware of what happens to household waste.

➤ *The Level of Satisfaction Among the Population with the Waste Management System*

- *The Existence of Awareness-Raising Services*

67% of respondents are unaware of the existence of waste management awareness services in both municipalities. This result is similar to a similar study conducted by Kidiambuta et al. (2022) and Nkula et al. (2023), who found that 77% of the heads of households surveyed were not familiar with the laws on solid household waste management, compared to only 23%.

The existence of waste management awareness services is a binary indicator (yes/no) measuring the presence of educational campaigns, workshops, posters, or field agents. It assesses the commitment to changing behaviors, increasing sorting, reducing waste, and promoting ecology. For the two municipalities in the survey, the fact that households are not

aware of these services reflects a weakness in the communication approach used by the service.

- *Household Satisfaction with the Waste Disposal System*

According to the survey data, most respondents (57.6%) are dissatisfied with the system for disposing of household waste. Our results corroborate those of Bangoura (2017) in a study conducted on household solid waste management and socio-spatial segregation in the city of Conakry (Guinea), where 89% of households expressed dissatisfaction, compared to 8% who were satisfied and 3% who did not give an opinion. Analysis of these results shows that, in general, households are aware of the failure of waste disposal services and consider waste management in the municipalities of Bungulu and Mulekera to be poor and ineffective. Satisfaction with the waste management system is a key variable that helps us assess households' perceptions and/or social representations of the quality, reliability, and efficiency of waste collection and treatment. The fact that the majority of households are dissatisfied would indicate a willingness to change behavior, but there is a lack of a framework approach.

## V. CONCLUSION

The services responsible for waste disposal in the municipalities of Bungulu and Mulekera are experiencing great difficulties in carrying out their work. This is confirmed by the widespread practice of households disposing of their solid household waste in inappropriate places (ravines or rain erosion sites, watercourses, and even on their own land), using largely manual methods.

Households use bags to dispose of this waste, followed by plastic buckets and metal drums. The majority of households do not subscribe to a household waste disposal service and dispose of their waste without sorting it. There is a problem with the lack of awareness-raising services on waste management in both municipalities and the existence of households that dump their waste on public roads.

Households are dissatisfied with the waste disposal system in their homes and know nothing about what happens to waste at the landfill site. Poor management of solid household waste in the working-class neighborhoods of Bungulu and Mulekera in the city of Beni not only contributes to environmental degradation but also exposes the population to major health problems.

In light of these results, innovative and context sensitive strategies for raising community awareness about household waste management in these two municipalities should therefore be considered.

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