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CHARACTERISATION AND MANAGEMENT OF SOLID HOUSEHOLD WASTE IN THE MUNICIPALITY OF ZINIARÉ, BURKINA FASO

Abstract: Solid household waste management is a major concern for the commune of Ziniaré. It is faced with a significant increase in waste due to its strong demographic growth and proximity to the capital Ouagadougou. The municipality is faced with the abandonment of waste collected by operators in abandoned quarries or waterways, the proliferation of illegal dumps in the town and the absence of a treatment and recovery system. Yet waste management is only sustainable if we have precise knowledge of the types of waste produced. Hence the need to analyze the characteristics of the waste generated in the commune of Ziniaré, the subject of this study. The methodology consisted in collecting quantitative and qualitative data, combined with direct observation in the field; collecting waste in the various sectors of the town and characterizing it according to the 13 main categories listed by ADEME in the MODECOM and taken up in the French standard XP X 30-408. The results of the study show that household solid waste (HSW) management is of little interest to the main players, i.e. the municipality, the pre-collection associations and the households themselves. The types of waste produced in the town of Ziniaré are mainly fine materials (52%), plastic waste (12%), complexe (9%), paper (6%), miscelleneous inerts (4%) and fermentable waste (3%). This inventory enables us to define a HSW management strategy and create the conditions for improving the living environment of the population.

Keywords: characterization, management, household solid waste, Ziniaré

Introduction

Waste management can only be sustainable if we have precise knowledge of changes in the flow of waste and, above all, its composition. So what are the characteristics of the waste

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produced in the municipalities of developing countries? How is it managed? Knowing these two parameters will enable us to optimise the way they are managed and create the conditions for improving people's quality of life.

Unfortunately, in the light of a large number of waste management scenarios in all developing countries, and without wishing to be exhaustive, the overall conclusion is as follows: i) a lack of data on waste: typology, flows, composition, spatial and temporal distribution; ii) chaotic management of the waste elimination sector, which rarely calls on the private sector; absence of a national master plan and a local plan to plan for the medium and long term; iii) technology that is not mastered and often unsuited to the local context, especially for the design and installation of industrial processes; iv) insufficient and unplanned funding; v) insufficient and unenforced regulation; vi) uncertainty as to the assessment of the environmental impacts avoided or generated. (Mindele Ukondalemba, 2016). In developing countries, waste pre-elimination is often limited to primary collection by associations, NGOs or SMEs. Secondary collection, which is often the responsibility of municipal technical services, is poorly organised due to a lack of suitable, operational rolling stock. The collection site on the outskirts of neighbourhoods is then the final outlet which, given the expansion of the city, finds itself in the middle of new residential areas. Despite this, some West African capitals have benefited from international aid to set up final waste treatment centres combining sorting, composting of the fermentable fraction and technical landfill (Ibidem, 2016). Bras (2010) has shown that official statistics on the production and composition of household waste in developing countries are not only difficult to obtain but also approximate. They are produced on the basis of non-exhaustive population censuses and a rough assessment of the quantity and quality of waste collected. Waste collection is irregular and the means of weighing waste at the entrance to landfill sites are not controlled. Determining the nature and composition of waste must be assessed in accordance with strict sampling criteria, which require a methodological approach based on actual measurements and analyses in order to avoid extrapolating biased results (Ben Ammar, 2006; Bras, 2010). To this end, Bras (Bras, 2010) has summarised the causes behind the gap between the objective of household waste management services in developing countries and reality, using a functional analysis tool. The author was able to identify the main causes, grouped into four main categories: the interplay of players, organisation, service operation and user practices.

According to a study by Gbilimou et al. (2022), four groups of HSW are capable of being recovered or recycled: waste that can be recovered by composting, methanisation, recycling and storage. These recovery strategies could reduce household solid waste landfill by 80%. In addition, NgNikam (2006) has pointed out that the traditional collection system is the most common in African cities, and its main feature is the use of rudimentary equipment, which has an impact not only on the efficiency of the service but also on the type of pollution generated by the waste. For Mindele Ukondalemba (2016) the recovery of municipal solid waste by partial anaerobic digestion and co-digestion followed by composting and co-composting is an approach that has proved interesting. It is possible to produce biogas, a renewable energy source, from municipal solid waste (household refuse) and faecal matter, which is an environmental and health hazard, and to produce good-quality organic manure, which is essential for fertilising and restructuring soils.

Despite these initiatives, sixty years after independence, African cities, institutions and governments have not found appropriate solutions for collecting, treating or disposing of

solid household waste (SSW) in urban areas. The various approaches advocated and tried have not produced the desired results. Most African cities south of the Sahara are experiencing strong demographic and spatial growth, which is making household solid waste management more complex. Keeping African cities clean is a matter for all those who, at different levels and in different capacities, are responsible for the future of these cities, i.e. ultimately the citizens. Depending on whether one is a producer or a manager, a taxpayer or a user of the service, expectations are different and sometimes irreconcilable in the context of cities with uncontrolled demographic and spatial growth (NgNikam et al., 2006). Knowledge of sanitation services in developing countries is situated in a context marked by problems of governance. Good governance depends on solid formal and informal institutional structures and high-quality human resources. However, a glaring lack of capacity hampers all aspects of waste recovery and management in most developing countries, particularly in sub-Saharan Africa. There is a shortage of human resources in all the key sectors: waste risk management; sanitation services; wastewater treatment, recycling and reuse techniques; and desalination. This is not a new phenomenon, and for decades it has been a major source of concern and a brake on development in the field of sanitation (United Nations, 2018). But despite these problems, these services face the dual challenge of meeting the population's primary needs while respecting the limits of what resources can offer in order to preserve their integrity (Fourneaux, 2009).

Since its return to democratic life in the early 1990s, Burkina Faso has adopted decentralisation as one of the main links in its development process. It was with the adoption of the Code Général des Collectivités Territoriales (CGCT), a law passed in December 2004 under no. 055 Ŕ 2004/AN, that the decentralisation process was given a boost with the full communalisation of the national territory. Since the adoption of the decree transferring powers and resources in the field of drinking water supply and sanitation in 2009, the communes have had full control over the sanitation sector. As a result, municipalities are responsible for the collection, treatment and elimination or recovery of waste; participation in the drafting and application of waste management regulations; and the drafting and implementation of the municipal sanitation plan and/or action plan. However, human and financial resources are slow to be transferred. As a result, mayors have no technical or financial resources to meet their waste management responsibilities. There is a total absence of local standards in this area, and users' expectations of waste vary: for producers (households, businesses and industry), the aim is to get rid of household waste and miscellaneous waste, and to keep it as far away as possible from homes and workplaces to avoid nuisance; residents of neighbourhoods or villages where waste is dumped are less and less tolerant of the establishment of a household waste treatment plant in their locality (NgNikam et al., 2006).

A number of studies have been carried out on household and municipal solid waste management. On the other hand, very little data exists on the characteristics of household waste, and when it does, it sometimes concerns the national level. As far as the nature of municipal waste is concerned, the data currently available is relatively empirical. The general aim of this study is to contribute to knowledge of the waste produced in the municipality of Ziniaré in order to ensure its sustainable management. Specifically, the aim is to analyse the characteristics of the waste produced in this municipality and how it is managed.

In the Commune of Ziniaré, the collection and disposal of solid waste is one of the management difficulties faced by the municipal authorities. Although waste is so pervasive in the urban landscape that it poses serious environmental problems, the urgency of eliminating it

has not always been perceived. Priority is given to other sectors such as water, housing, electricity, etc. This study will make it possible to define the composition of the waste generated in the municipality and guide stakeholders towards the most appropriate treatment method. To achieve this, the methodology used comprises three stages: collection of socio-economic data and waste in the commune's sectors; characterisation of the waste according to the 13 main categories listed by ADEME in the MODECOM in 1993 (MODECOM, 1993) and included in the French standard XP X 30-408 (AFNOR, 1996) with a breakdown of the fine fraction into a single category (< 8 mm) (not into two categories 20-8 mm and < 8 mm) and 4 sub-categories of plastic; analysis and interpretation of the data.

Presentation of study areas

The town of Ziniaré, as the capital of a commune, province (Oubritenga) and region (Plateau Central), is located in central Burkina Faso. It is subdivided into five sectors, each comprising several districts (Fig 1). The town of Ziniaré is located 35 km from the capital Ouagadougou and 60 km from Kaya to the north, on National Road (NR) n°03. Asphalted, this road is passable in all seasons and facilitates rapid access to the town. Also, at given its geographical position (proximity to the capital), the town of Ziniaré is heavily influenced by the development of Ouagadougou (Ministry of Housing and Urban Planning, 2012).

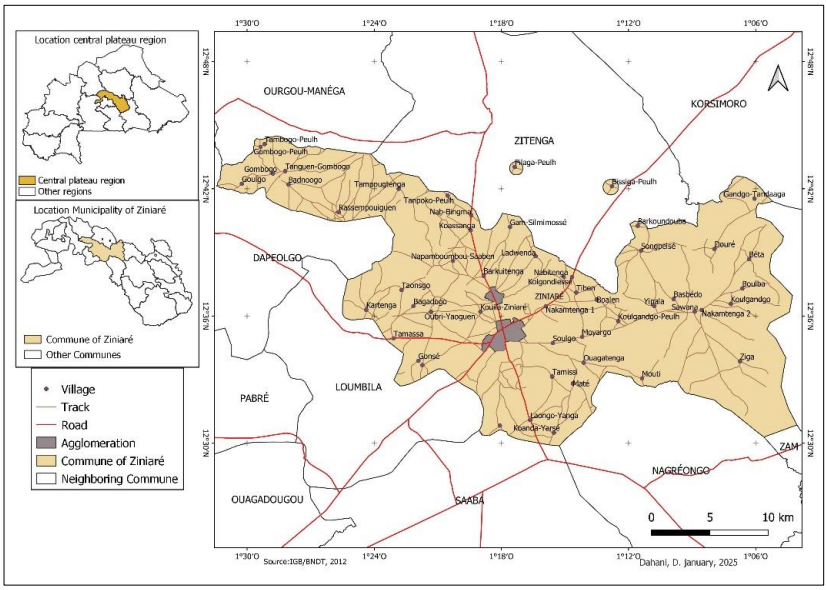

Fig.1. Administrative situation of the Municipality of Ziniaré

The urban population was estimated at 6,581 in 1985. This population almost doubled in the space of ten years, reaching 11,153 in 1996 and 18,619 in 2006. At the latest general population and housing census in 2019, this population was estimated at 33,296 (National Institute of Statistics and Demography [NISD], 1985; 1996; 2006; 2019). These population figures indicate a slight increase in the urban population growth rate between the 1985 and 2019 periods (Fig 2). This growth has direct and indirect consequences on access to sanitation. It increases waste production and modifies established waste management methods. This calls for concrete action to improve living conditions.

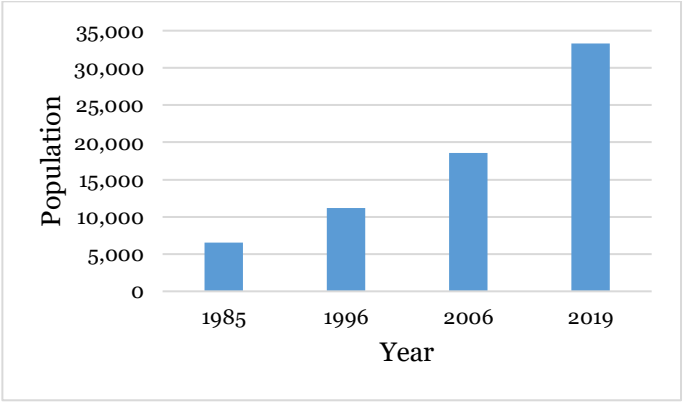

Fig. 2. Changes in the Commune's population from 1985 to 2019

Material and Method

Data and waste collection

To determine the composition and characteristics of managerial waste in the town of Ziniaré, all sectors the residential area were selected. For waste collection, bags were deposited in the sectors over a period of 07 days. The study took into account location, urban density and socio-economic criteria. Household waste was collected and transported to the sorting site by agents of an association operating waste collection services in the commune of Ziniaré. The measurement campaign was preceded by contacts with the commune's officials and waste collection associations.

Quantitative and qualitative data collection combined direct observation in the field. The observations enabled us to gain an insight into the living environment of local residents, on the one hand, and to characterize potential waste disposal sites, on the other. A survey was carried out to gather quantitative data. The results of the latest general population and housing census (INSD/RGPH, 2019) were used to extract information on demographic phenomena in the Commune of Ziniaré.

Sorting description

The results of waste sorting should provide essential information to guide the relevant public authorities in their decision-making. The lack of such data to date largely explains the country's considerable backwardness in terms of waste management. This mainly involves knowing the quantities generated in public places, per household and per day in the various socio-economic categories of the population, the proportions recovered at household level, the physical composition of the household garbage can, the breakdown of HSW by size, and the potential for recovery and storage.

In response to these various questions, the characterization is based on the 13 main categories listed by ADEME in the MODECOM in 1993 (MODECOM, 1993) and taken up in the French standard XP X 30-408 (AFNOR, 1996), with a breakdown of the fine fraction into a single category (< 8 mm) (not into two categories 20-8 mm and < 8mm) and 4 plastic sub-categories. In this study, we adapted the categories and sub-categories to the local context. This gave us 17 categories and three sub-categories for plastic.

Sorting began with setting up the equipment. The sorting site is a fenced-in yard, but not protected from the wind. This necessitated the use of a tarpaulin spread over the ground and laid out in such a way as to catch any light particles such as plastic, paper, sand or dust that might blow away during sorting.

Equipment set-up: two 3m x 2m and 2m x 2m tarpaulins are installed side by side, and brooms, shovels, weighing scales and garbage cans are made available. Sorters are equipped with gloves and masks. A supervisor is on hand to record data and help sorters in case of indecision. Sorting was carried out successively by visually-identified coarse or heterogeneous elements such as cans, large bags, large cartons, etc., followed by the averages after sieving and then the fine fraction (Fig 3).

Three types of waste with different particle sizes were sorted: COARSE: Ø > 100 mm, MEDIUM: 100 mm > Ø > 08 mm, FINE and EXTRA-FINE Ø < 8 mm

Constitution of the sample to be sorted

Once on site, the waste contained in numbered bags corresponding to the sectors of each town (Ziniaré, Boussé) is weighed before sorting. Each bag weighed contained waste from one sector X of one town. We did not create a sorting sample, as the entire contents of the bags were sorted. Each bag weighed between 13 and 26 kg. The waste was sorted by sector so as to have the composition of the waste produced by sector.

Coarse sorting (screen diameter >100 mm)

The contents of each bag are sorted as follows:

The entire contents of the bag are dumped onto the sorting bin.

Large items are sorted by category and sub-category and placed in assigned plastic bags (name of category or sub-category indicated on each bag). Sorting was limited to 17 categories and 3 sub-categories for plastic.

Once all waste >100mm on the tarpaulin has been sorted, it is sieved to obtain the averages.

Each category and sub-category of this fraction (coarse) obtained is weighed and the weight is noted in the card.

Medium sorting (100 mm < screen diameter > 8 mm)

Waste > 8 mm is placed on the 8 mm screen.

They are stirred until only waste > 08 mm in size remains.

The entire fraction of averages is poured onto the tarpaulin and sorted into categories and sub-categories. Each category and sub-category of averages obtained is weighed and the weight is recorded on the sheet.

Fines sorting (screen diameter < 08 mm)

The fraction < 08 mm is recovered from the tarpaulin and the weight is recorded.

This fraction of fines < 08 mm is more or less poorly categorized. It consists largely of sand, gravel, green waste and animal dung.

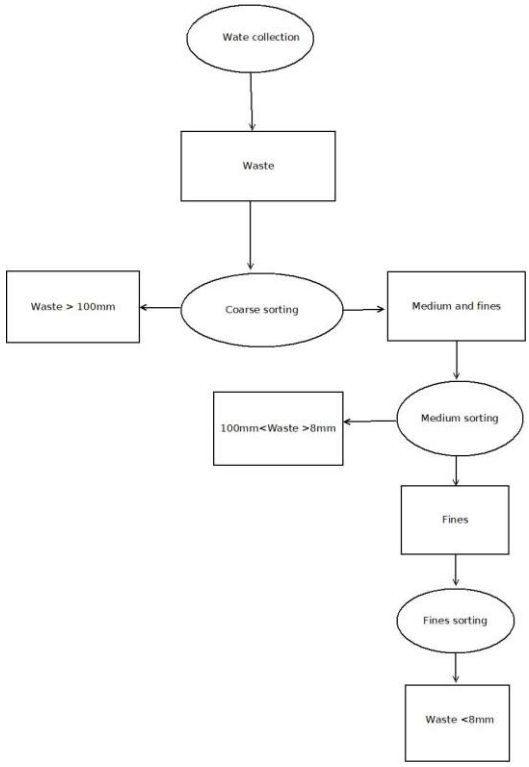

Fig. 3. Waste sorting process according to granulometry

Results

Governance of wastewater services

The exercise of project management by the municipal administration presupposes the involvement of all stakeholders, such as local authorities (councillors and civil servants), municipal organizations, PTFs, WASH service providers, municipal representatives, local associations and citizens. The aim is to ensure that the commune's sanitation needs and decisions on development and solid waste management are properly taken into account. With this in mind, the main findings are as follows: i) the organization of the Commune of Ziniaré includes a department in charge of sanitation; ii) in terms of technical skills, the Commune of Ziniaré in its current structure is not in a position to fully carry out the mandates assigned to it. In fact, the person in charge of running the sanitation department is only a middle manager. This situation reflects the lack of human resources to carry out the tasks assigned to them. In addition to the inadequacy of human resources in terms of qualifications and numbers, there is also the lack of financial resources available to the sanitation department. Although the Communal Development Plan (CDP) and the CDP/WASH are used to plan needs and investments, the activity programs of the structures in charge of sanitation are poorly taken into account in the communal budget.

The disposal of household waste in illegal dumps seems so obvious to local authorities, given the negative environmental and health consequences it can have. However, this is

rarely done, and more often than not in a restrictive manner. In fact, it may be carried out in response to complaints from local residents, to a clear desire to enhance the land on which the illegal dump is located, or on the occasion of an event to be held there. What's more, HSW management is of less and less interest to the main players: the municipality, the pre-collection associations and the households themselves. As far as the municipality is concerned, this lack of interest is characterized by their low involvement in the identification of illegal dumpsites, the mobilization of financial resources for the water and sanitation sector at to the detriment of the HSW sector, the low remuneration of the structures or associations in charge of HSW pre-collection, and their low commitment to HSW pre-collection. In the case of pre-collection structures, the lack of interest is linked to a lack of resources and support from the municipality to enable them to undertake their activities in the best possible conditions. As for households, their disinterest is observed at the level of subscription to pre-collection structures, which remains intrinsically related to under-information, the non-intervention of HSW pre-collection structures in their area and the high cost of subscription. Households are one of the potential actors in the proliferation of HSW in the town of Ziniaré. This situation is linked to the abandonment of large quantities of their waste in inappropriate sites, characterized by low use of pre-collection infrastructures such as dustbins or garbage bins, and poor sanitation practices.

The commune has no waste management system. As far as complaints are concerned, the town hall has received several from residents living near the HSM dumps. Convinced of the health and environmental nuisance, these residents express their dissatisfaction to the people or structures responsible, which can lead to conflicts involving the municipal police.

Waste characterization

Waste production in Ziniaré

The study of household waste did not take into account the heterogeneous category of waste, which is highly random and represented only a tiny fraction of all household production during this campaign. The types of waste produced in the town of Ziniaré are mainly fine materials (52%), plastic waste (12%), complexe (9%), paper (6%), miscelleneous inerts (4%) and fermentable waste (3%). Fig 4 shows the waste generated in the commune of Ziniaré.

Fig. 4. Heaps of waste produced in Ziniaré

The main reason for this relatively large difference is the fact that a large proportion of household waste in Ziniaré, and particularly the fermentable fraction (2.7%), is recycled at household level as fodder or essential animal feed, and therefore does not enter the evacuated waste circuit.

This recovery is more important in sectors 1, 4 and 5, where the rates are practically zero. This organic fraction at household level is often collected separately and given to garbage collectors or to households domesticating livestock. These households may be located in other parts of the city. The same applies to the cardboard fraction and part of the green waste.

In most of the country's towns and cities, households often recover and recycle certain fractions of their waste. However, it can be seen that the amount of waste generated in a given city increases with the population's standard of living or standing, and this increase in waste production in one standard of living compared with another is not a function of the locality's overall economic level.

Ratios by sector in Ziniaré

Analysis of these results, which do not take into account the fraction of fermentables recovered at household level, shows low waste generation in general during the campaign at all levels, with the lowest ratio per household recorded in sector 1 (6.89kg). On the other hand, the highest production per household was observed in sectors 4 and 5 (13.07kg and 13.67kg) for the same campaign (Table1). This probably reflects the influence of housing on OM generation, and particularly on the fines fraction. Buildings in the middle and upper standing are designed in such a way that they are easy to maintain (fencing, concrete or tiled floors) and are well protected, unlike those in the lower standing, which are exposed to the wind and the vagaries of the weather. The fine fractions are generally made up of sand and dust blown in by the wind. As a result, the more protected the concession, the lower the fines content. This could explain the high production of fines in sector 5 (32%) and the low production in sector 3 (10%).

Table 1. Waste production by sector and household during the campaign

Sectors	Quantity produced	Ratio per household	Percentage
1	13,79	6,895	13%
2	15,83	7,915	15%
3	20,35	10,175	20%
4	26,14	13,07	25%
5	27,35	13,675	26%
Total	103,46	10,346	100%

Source: Dahani, D., 2024.

Specific household waste production

The study focused on the evaluation of household waste production according to a number of considerations, in particular those that could provide essential data for the implementation of a comprehensive waste management strategy in the town of Ziniaré. Waste generation was considered from three angles: production by category and sub-category, by waste class and by granulometric fraction.

In order to provide a detailed characterization of household waste in the commune of Ziniaré, and to highlight the influence of the population's standard of living on its composition, we carried out a quantitative and qualitative analysis of waste according to a relatively complete

inventory comprising the 17 categories described above, plus fines <8 mm (or sand). Plastic is sorted into three sub-categories (plastic bags, hard plastic and plastic drums).

The breakdown of waste shows that the fines fraction (<8 mm or sand) represents the largest share by weight composition, with an average of 52% in Ziniaré. This fraction is followed by plastics (12%). The other constituents vary slightly from one to another, in low proportions, with a minimum of 0.14% for batteries (Fig 5). It should be noted that the calculations made in this work do not take losses into account.

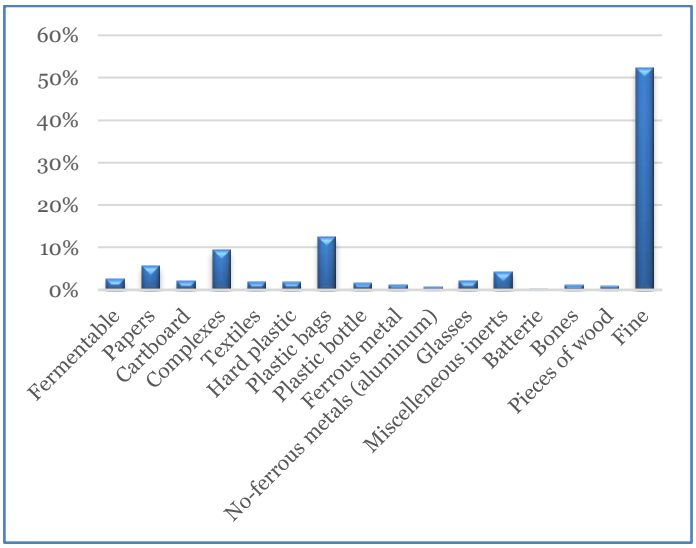

Fig. 5. Distribution of OM in Ziniaré by category

The breakdown of waste by category and sub-category varies slightly according to the standard of living, with very small differences between low and medium standard for all categories except plastics. This average variation is most noticeable for the categories of fines and fermentables, as well as plastics (especially sanitary plastics). As far as fines are concerned, their contribution to the waste of the high standard is very limited, thanks to the very design of the housing, which is often well protected from the sandy winds, while fermentables are almost absent in the OM evacuated from the low and medium standard, as this fraction is valorized at the level of families, as explained above. Domestication of livestock is relatively rare in the upper class.

After the fraction of fines, <8 mm (sand)), complex production represents the biggest difference between sectors. In sector 3, this fraction reaches 25.6%, compared with 3% and 4.6% in sectors 2 and 4 respectively. On the other hand, the plastics category is generated more by households in sectors 1, 3 and 4 (Fig6). There are several reasons for this high level of plastic waste generation. Indeed, 60.79% of the population believes that plastic waste is part of everyday household life. Most of it occurs when households purchase goods and merchandise in supermarkets, street stores, markets, retail outlets and so on. As a result, they are used to contain household products. For 26.14% of the population, the high production of plastic waste is linked to the fact that plastic packaging or bags are easily accessible by households. Their acquisition is less costly or even free. As for the 13.07%, plastic packaging or bags are very practical for households.

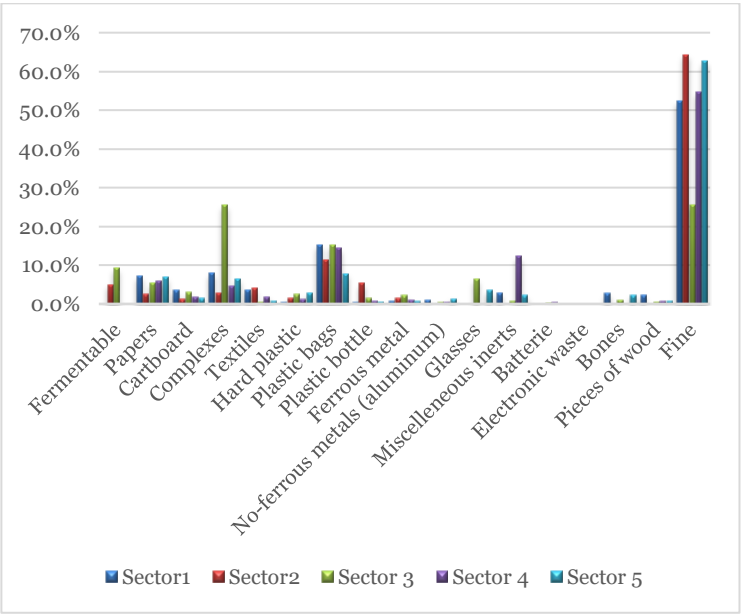

Fig. 6. Average distribution of waste by category and sector

Despite the existence of a national policy aimed at reducing plastic flows, most of which come from packaging, the presence of this waste fraction, which has become a scourge in developing countries, and in Burkina Faso in particular, is linked to the very design of people's housing. These are generally unprotected shantytowns, exposed to the wind, which can carry large quantities of plastic packaging into the streets. From another point of view, this waste seems to be related to people's standard of living, which may explain why it is less prevalent in other sectors.

Waste generation by waste class (by management method)

The breakdown of waste by type of management provides essential information on possible approaches to managing the different classes of waste (Table 2).

Table 2. Distribution of waste by management method in Ziniaré

Valuable	Compostable	Fuel	Stockable
Fermentable Paper Cardboard Plastic Glass Ferrous metals Aluminum	Fermentable Paper Cardboard	Fermentable Paper Cardboard Complexes Plastic Textiles Wood	All 17 categories of waste identified in ziniaré can be stored

Source: Dahani, D., 2024.

Recyclable waste

The recovery of HSW is still at an embryonic stage in the town of Ziniaré, and essentially concerns the composting, waste recycling and storage processes. Composting involves the conditioning of HSW, notably food residues and plant debris (cereal stalks such as millet

and corn) during the dry season, to enrich the soil and boost agricultural yields. As for recycling, this concerns plastic and metal household objects such as kitchen utensils, old rechargeable batteries, cans, etc. In addition, the efficiency of the recovery operation requires suitable equipment capable of facilitating the sorting of pre-collected HSW. The eventual development of waste recovery channels could reduce the quantities to be managed by the Commune Urbaine de Ziniaré by almost 1/5 of their total mass. The recovery of fermentable waste, paper and cardboard into compost is one possible route. This would involve a deposit of over 6.37 tonnes. The viability of composting would necessarily require the organization of a sorting system at source.

Recycling of glass, aluminum and ferrous metals is already practiced by some populations. It can be strengthened through awareness campaigns and the promotion of outlets such as the reuse of packaging (juice bottles, cans, etc.). Plastic recycling, with a production of 4.18kg/household (during the campaign), is more uncertain. It is difficult to sort. Plastic consists mainly of packaging bags, which are highly volatile, especially during the harmattan season. Its recovery is complicated and difficult to sustain. This is mainly due to the cost price of raw materials, which is likely to be very high, notably because of collection, sorting and processing (washing and drying). This requires the construction of infrastructure (sorting and composting centers, warehouses, landfill sites), the recruitment of permanent staff, equipment and an operating budget. However, this is no easy task for medium-sized communes, which often find it difficult to mobilize operating resources. But it could be of interest to the private sector if it exists in the commune and is dynamic, with likely outlets for the outputs. Compost could already be of interest to market gardeners in Ziniaré and Loumbila if there's a good marketing campaign.

Incineration does not appear to be an option in the short term, not least because of the cost of the technology. However, in the long term, this treatment method could be an interesting choice, with energy recovery thanks to the relatively high ICP of household waste. Fig 7 shows the distribution of waste by management method in the Commune of Ziniaré.

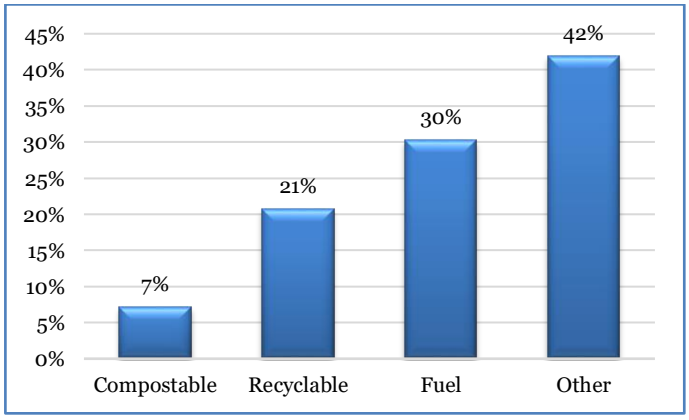

Fig. 7. Breakdown of waste by management method

Compostable waste

Compostables make up around 11% of household waste. Although still relatively small, this quantity can be recovered through composting. Apart from its positive impact on the environment, this would play a significant role in complementing or even competing with the

fertilizing products normally used (wastewater, manure, dung, etc.) in agriculture, and particularly in market gardening in Loumbila, for example. However, the compost production process requires large quantities of water, which could be a drawback in a Sahelian context where water is scarce and expensive.

To utilize the organic fraction of municipal solid waste for soil fertilization through the composting process, primary waste segregation at the source is essential. This is how Pandey et al. (2019) claim that segregation at the source is the key in solid waste management, especially when we have limited economical resources. If solid waste is sorted at source, it can be recycled very efficiently. According to Trushna et al. (2024) waste sorting involves some or all of the following: sorting the household waste produced into categories, for example into dry waste (non-biodegradable, recyclable and combustible) and wet waste (biodegradable, including food, agricultural and dairy waste); separate storage of the different categories of waste (in suitable bins/bags) for collection at the kerbside or close to properties; subsequent recovery of the sorted waste, for example, taking dry recyclables to landfill sites and composting wet waste.

Combustible waste

Combustible components account for 29.5% of OM produced in Ziniaré. The low moisture content of the waste, the high "volatile solids" content and the high plastics content of this class will be an asset for any management by incineration, not forgetting the landfilling of final waste (bottom ash and slag, around 30% of incinerated waste). However, the costs inherent in this method of treatment, as well as the need to protect health and the environment, are all factors limiting the choice of incineration as a treatment technique for the Commune.

Stockable waste

All the household waste produced in Ziniaré can be landfilled with little risk to the environment and no difficulty in operating landfill sites: low humidity and few degradable fermentables, favorable rainfall and temperature.

Household waste generation by size

Sorting by size revealed another aspect of the characteristics of household waste in Ziniare. The results of this characterization (Fig 8) by size show that the dominant average fraction in Ziniaré is that of fines with 46% of the mass on raw waste, followed by coarse 45% and the medium fraction with around 9% of the total weight.

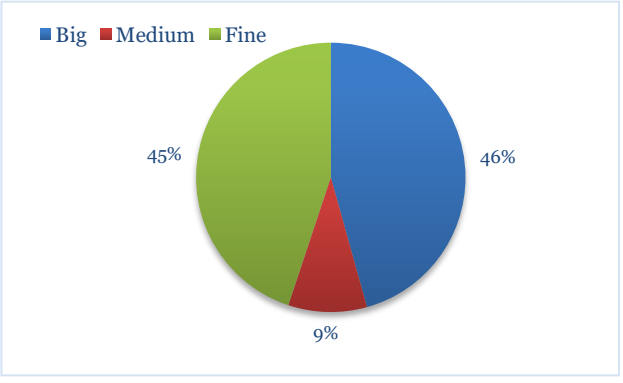

Fig. 8. Breakdown of waste by size

The "coarse" fraction consists mainly of plastics, cardboard from packaging and bones. Textiles are also present at a relatively low level. Fines < 8 mm consist almost exclusively of sand and dust, gravel, shells, plant debris and animal dung, as the case may be.

However, this breakdown of OMs by size varies significantly according to standing.

Discussion

More than forty years after African independence, cities, institutions and governments have yet to find appropriate solutions for collecting, treating or disposing of HSW in urban areas in Africa and many countries of the South (Ngnikam et al., 2006). Despite the complexity of HSW management, this sector is in most cases relegated to the background by communal authorities.

A comparison of the composition of urban waste in developing and developed countries shows that the percentage of organic matter is much higher in cities in developing countries than in developed countries. On the other hand, for the paper, glass and plastic fractions, the percentage is much higher in developing countries. The example of the paper and cardboard fraction is very edifying: it represents 38.1% and 21.5% respectively for the United States and France, while for Côte d'Ivoire and Lebanon it is only 5.8% and 11.3% respectively. This reflects the difference in consumption patterns between the populations of developing and developed countries (Guermoud et al., 2009). In a study carried out in the Commune of Fada N'Gourma in Burkina Faso, Dahani (2018) shows that HSW is largely made up of household waste, packaging waste from commercial products and crop residues. Nor does garbage management seem to be a priority concern for urban populations. It's not uncommon to find heaps of rubbish in the city. Other households compost around 11% of the waste they generate, while burning accounts for 29.5%. According to Barro (2000), plastic waste is the most widespread, unlike other HSW. Plastic bags disposed of in the environment account for ninety-nine percent (99%) of the plastic bags used). Three types of plastic waste recovery can thus be distinguished. These are material recovery through recycling or regeneration, energy recovery and chemical recovery (Nikiema, 2012). Recovering this waste enables fermentable materials to be composted (Bonnah, 2018). In most African countries, land-use planning operations are carried out without providing any space dedicated to waste management, which remains an obvious priority in view of its impact on the current development of these countries. This is due to a lack of political will (Kouassi, 2006). Consequently, controlling the management of HSW remains a major challenge, given the level of proliferation. Municipalities are also faced with management and organization problems, given their inability to meet the high demand for waste disposal and collection, and the lack of material means, financial resources and municipal policy (Zahrani et al., 2006). As a result, sanitation needs are rarely satisfactorily met in cities, as urbanization overwhelms the capacity of urban authorities to manage and control it (Fofana et al., 2020). As a result, the collection and disposal of their waste is rarely ensured, and is an aggravating factor in the degradation of the urban environment.

Conclusion

The management of solid household waste (SHW) is a real and permanent problem for local authorities. This study analyzed the governance of sanitation services in Ziniaré, characterized by the municipality's lack of interest in the HSW sector. It enabled us to characterize the waste

produced in the municipality in order guide decision-makers towards treatment and recovery options. The types of waste produced in the town of Ziniaré are mainly fine materials, plastic waste, paper and fermentable waste. The recovery of HSW is still at an embryonic and informal stage in the town of Ziniaré, and essentially concerns the composting, waste recycling and storage processes. Composting involves the conditioning of HSW, particularly food residues, during the dry season to enrich the soil and boost agricultural yields. As for recycling, this concerns plastic and metal household objects such as kitchen utensils, old rechargeable batteries, cans, etc. However, this study has limitations, because it does not address the physico-chemical characteristics of the waste in question, which are important for predicting potential risks, treatments and possible solutions for discharges. The study also does not deal with the impact of this waste on the environment. Despite these limitations, the main objective of the study has been achieved. The community therefore needs to reduce the large quantities of household waste produced each year in the city by setting up a treatment and recovery system.

Conflicts of Interest: The authors declare no conflict of interest.

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