Journal of Emerging Trends in Economics and Management Sciences (JETEMS) 14(1):21-27

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A Diagnostic Study of Household Solid Waste Management in Kollo, Niger

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Abstract

Household solid waste management is one of the most prevalent problems in urban areas. The aim of this study is to provide a diagnosis of household solid waste management in the Kollo urban district of Niger. This study aims to identify household waste types, understand their management methods at the household level, and estimate the amount of waste produced on a daily basis. A survey of 200 households was conducted as part of the study. As a result of the study, four types of household waste were identified, namely sand, organic matter, plastics, and others. At the scale of an urban municipality, waste production is estimated to be 9.44 tons per day or 0.72 kg per inhabitant per day. Additionally, only 47% of households have garbage cans for storing waste. Most households use trash cans with a capacity of 0.015 m3, with 27.5% evacuating waste daily, 50% twice a week, and 22.5% once weekly. 35 % of households dispose of waste in wild dumps, 30% dig pits to bury waste, 15% burn it openly, 15% use the waste to fertilize their fields, and 5% make other uses of it. Waste management is handled by the municipality. However, it lacks the financial and technical resources to fulfill its mission. However, Kollo's urban municipality must put in place strategies for sustainable and ecological waste management.

Keywords: Management, Solid Waste, Household, Urban Municipality, Kollo

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INTRODUCTION

The production of waste is a natural consequence of all aspects of human activity, be it domestic, agricultural, industrial, or commercial, which is an unavoidable by-product of everyday life. The practice is not considered a public issue in Africa until it reaches urban areas (Alouemoune, 2006.). Despite being universal in nature, this problem manifests differently in different parts of the world. Solid waste is produced in Africa on a daily basis in thousands of tons. Most of these wastes are disposed of in open landfills and wetlands, which can contaminate surface and groundwater and pose serious health and environmental risks. It is estimated that some cities and regions produce between 0.5 - 0.8 Kg of waste per person per day (Babalola et al., 2010b; Sotamenou, 2018).

However, even though it seems modest compared to 1 - 2 Kg of waste per person and per day in developed countries, the majority of waste in Africa is not collected by municipal collection systems due to poor management, irresponsibility, embezzlement, equipment failure, or inadequate waste management budgets (Saidou & Aminou, 2015a). In general, household waste refers to all materials that are generated within a household. Food waste, journals and papers, small metallic packaging, bottles, paper or plastic packaging, chiffons, and other textile residues. Garden and other plant waste can be included in this category. Cities in developed as well as developing countries face a significant challenge as population, prosperity, and urbanization increase. It is becoming

increasingly difficult to collect, recycle, treat, and eliminate solid waste and water (Holenu Mangenda et al., n.d.; Tchuikoua, Louis Bernard, n.d.-a). To achieve sustainable development in developing countries, effective, affordable, and genuinely eco-friendly waste management practices are required. Sustainable development requires effective, efficient, and long-term waste management practices in developing countries. Along with the cultural dimension, long-term management of solid waste should take into account the poverty of the population.

The cost of disposing of waste in Niger, as in most southern countries, has become increasingly unaffordable for municipal authorities. As far as the sustainability and effectiveness of interventions are concerned, economic and financial factors play a key role. Each strategy should consider the ability of citizens to contribute to the collection and disposal of household solid waste. This is because of the economic difficulties that these populations face. There is no doubt that financial issues account for a lot of Maradi's failures(Saidou & Aminou, 2015a). It is estimated that the city's budget is very limited, and the royalties collected are low.

Penda (2015) reports that the urban population in Niger is overwhelmingly poor, has very low incomes, and is largely analphabetic. Often, green spaces, school fronts, health centers, or market surroundings are used as dumping grounds for trash. People are forced to seek alternative methods of disposal of their waste when garbage collection is unreliable or nonexistent, with the sole aim of removing them from their homes. In some cases, waste is disposed of in natural disposal facilities. Some people burn, bury, or spread their waste on open spaces or use it to repair roads that have been damaged by flooding (Adamou, 2014).

The result is chronic insalubrity in the cities of Niger due to the lack of systems for pre-collection, storage, collection, and treatment of solid household waste. Even though these tools are available, the Niger government's waste management system does not meet the needs of its citizens. In this regard, Kollo's urban community is no exception. African cities have conducted studies in order to address all of the inadequacies and poor practices associated with the management of solid waste (Babalola et al., 2010a; Holenu Mangenda et al., 2020; Saidou & Aminou, 2015b; Solomon, 2009; Topanou et al., 2021). This paper provides an overview of the management of household solid waste in the Tillaberi region of the Niger Republic's western region, Kollo, one of the largest urban communes.

MATERIALS & METHODS

Zone of study

This study was conducted in the municipality of Kollo, which is located in the Kollo district of the Tillabéri region in Niger. A semi-urban community covering an area of approximately 146 km² located between latitudes 13°11' and 13°25' north and longitudes 2°17' and 2°27' east (Figure 1).

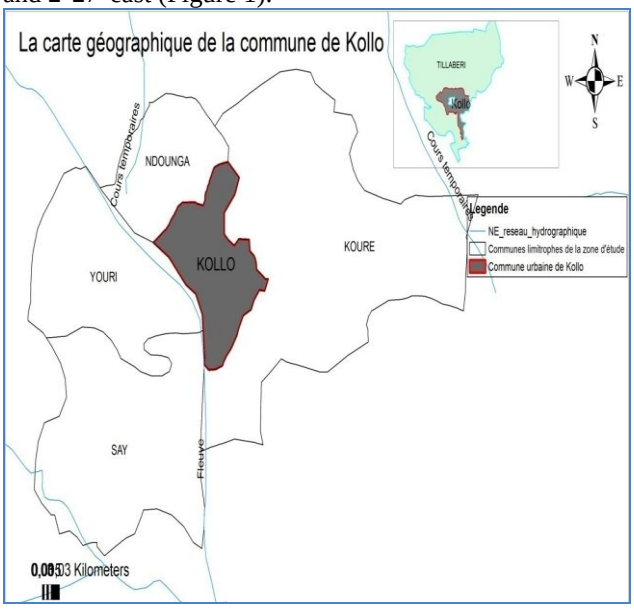

Figure 1. Kollo municipality location map (PDC, 2012)

In 2022, it is expected to have 44,550 residents based on a 3.1% annual growth rate (INS, 2012). Agriculture, livestock, irrigated crops, and fishing are the principal economic activities of the commune (PDC, 2012). This study was descriptive and cross-sectional, with households as the unit of analysis. Participants must be at least 20 years of age and reside in one of the selected communities. Furthermore, they must have lived in the area for at least one year. The selected individuals were enrolled after giving their consent.

Sampling

Data were collected through a household survey and field observations. In this study, we only looked at the urban population of the municipality, which is 17,867 residents [OLM1] (about 2,620 households). From 2,620 households, 200 were sampled and distributed in six (06) districts of the urban center of the commune, which are considered to be the most densely populated residential areas. The number of households in each neighborhood is calculated based on the weight "**P**" of each neighborhood. The table below shows the distribution of household surveys by district, as well as the distribution of households by district and the number of inhabitants.

$$\mathbf{P = n/N} \quad \ldots\ldots(1)$$

$$\mathbf{Nm = P \times E} \quad \ldots\ldots(2)$$

P: neighborhood weight, **N**: total number of households in the neighborhoods considered, **n**: number of households per neighborhood, **Nm**: number of households to be surveyed in the neighborhood, and **E**: Sample size

Table 1: Distribution of households surveyed by neighborhood, type, number, and size

Neighborhoods	Populations	Number of households	Neighborhoods weight	Sample	Number of persons	Average size of households
Kollo Sahara	2550	364	0.14	28	357	8,5
Kollo Fandou	4595	656	0.25	50	230	8,2
Kollo Carré	4000	571	0.22	44	95	7.9
Kollo Madina	1105	158	0.06	12	203	8,1
Aoula Koira	2095	322	0.12	25	420	8,4
Sirignéré	3521	549	0.21	42	370	8,4
Total	**17866**	**2620**	**1**	**200**	**1675**	**8,25**

Survey data collection Methods

To collect survey data, individual interviews are conducted based on questionnaire sheets. Randomly selected households were surveyed in each district. To ensure a representative sample, each household had the same probability of being picked for the survey. It is known as the "step" method. Step 4 is selected to cover a substantial portion of each neighborhood. Thus, if house N°1 is the first house observed in the street, the fifth house will be the next to be examined. Following the survey of four houses, a change in direction is made.

Estimation of Waste Amount

In this context, measuring the amount of waste produced per day and per resident is difficult since most waste is not stored in bins. Therefore, three parameters were taken into consideration: (i) the average capacity (volume) of the bins identified, (ii) the number of households with bins per storage capacity, and (iii) the frequency of trash disposal.

Analysis of results

Microsoft Office Excel spreadsheets and SPSS version 22 were used to enter and process the survey data. To assess respondents' knowledge, attitudes, and practices regarding waste management, proportions were calculated and compiled into a table and figures.

RESULTS

Waste typology

Based on the surveys, four types of waste have been identified, including sand, organic matter, plastic, and others, which are grouped together with textiles, metal, glass, ceramics, etc. The following figure shows the percentage of respondents who answered questions about household waste's physical characteristics. The response modes are independent of each other, so a respondent may select several responses simultaneously (Figure 2a). According to this figure, 42.14% of households describe their waste as being composed of organic matter, plastic, sand, and others. It is followed by 27.27% with organic matter and plastic, 15.06% with organic matter, plastic, and others, and 15.53% with plastic and others. The most common household wastes are organic matter and plastics.

Identification of households with or without bins

As shown in Figure 2b, 53% of the households surveyed do not have trash bins to store their waste; instead, they pile them up on the ground (Figure 2c&d)

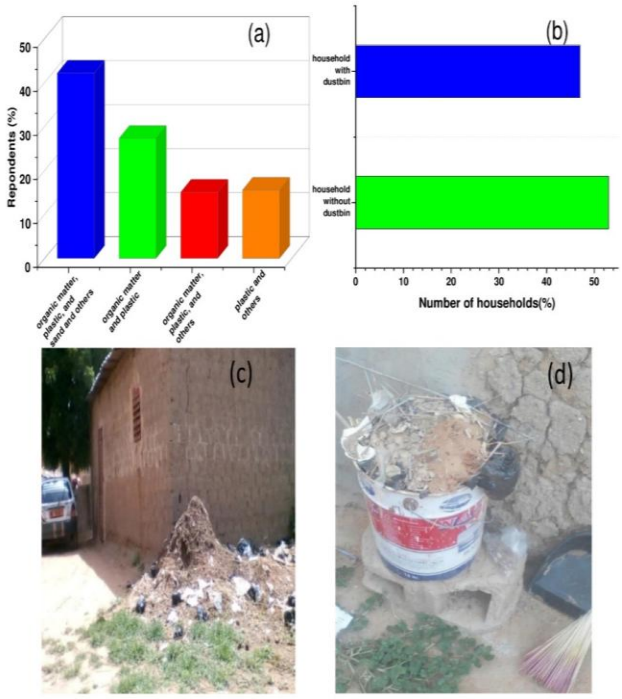

Figure 2: (a)-Household waste characteristics, (b)-Households with or without trash cans, waste storage at the household level: (c)-Households without trash cans, (d)-households with trash cans

Volume of Trash can

As shown in Figure 3, three types of trash cans are used in households to collect and store solid waste. In general, 70% of households use 0.015m^3 containers, followed by 24.56% using 0.06 m^3 containers and 5.44% using 0.15m^3 containers.

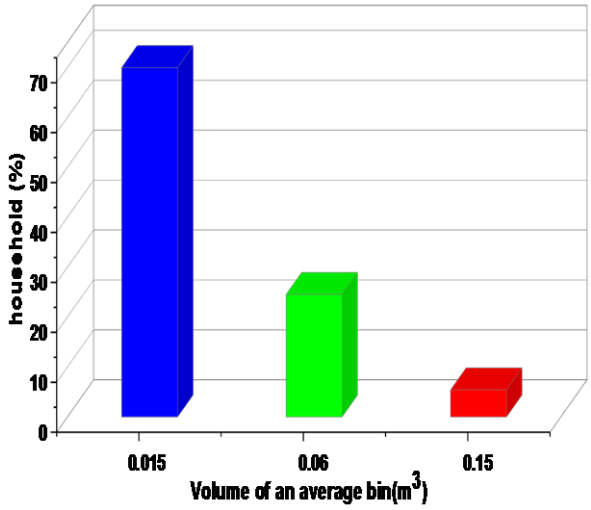

Figure 3: Volume of trash cans

Frequency-based waste production estimation

Table 2 presents waste volumes evacuated by households with bins of 0.015m^3, 0.06m^3, and 0.15m^3 per day and week. The results show that 27.50% of households with 0.015m^3 bins dispose of an average volume of 1.155m^3 daily. Additionally, 50% of households dispose of their waste twice a week, i.e., 0.6m^3, and 22.50% once weekly, i.e., 0.135m^3. A total of 1,890m^3 of waste was disposed of. In the case of households with 0.06m^3 bins. Over-identified households disposed of 1.680m^3 daily; 42% disposed of twice a week, i.e., 0.720m^3; and 29% once a week, i.e., 0.240m^3. A total of 2.640m^3 of waste was evacuated. Lastly, for households with 0.15m^3 bins. As a result, 100% of households with bins containing an average of 0.150m^3 remove their waste once a week, resulting in an average of 0.450m^3. Using the volumes evacuated and the density of the waste, daily waste production can be estimated. Approximately 0.47 kg of waste per liter is generated in Niger's households (Devant, 2003). In this way, we were able to estimate the average individual production per day at 0.72 kg.

Table 2: Weekly and daily waste disposed of by households with bins with average capacities of 0.015, 0.06, and 0.15m^3.

0,015 m^3 trash cans			
Frequency	Chaque jour	2 fois/ semaine	1 fois /semaine
Proportion of households	27,5%	50%	22,5%
Volume /week (m^3)	1,155	0,600	0,135
Total volume / week (m3)		1,890	
0,06 m^3 trash cans			
Frequency	Chaque jour	2 fois/ semaine	1 fois /semaine
Proportion of households	29%	42%	29%
Volume /week (m^3)	1,680	0,720	0,240
Total volume / week (m3)		2,640	
0,15 m^3 trash cans			
Frequency	Chaque jour	2 fois/ semaine	1 fois /semaine
Proportion of households	0	0	100%
Volume /week (m^3)	-	-	0,450

Practices for Waste Disposal and Evacuation

In most households with children, waste disposal is prevalent. Field waste is evacuated with carts, while waste intended for pits or wild dumps is evacuated with wheelbarrows. According to survey results (Figure 4), landfilling is the most commonly used waste disposal method among households (35%). Approximately 30% of households buried their waste, 15% incinerate it in the open air, 15% use it as agricultural amendments, and 5% dispose of it otherwise. 5% of households fill rainwater gullies with waste. Garbage is accumulated and abandoned by households in the urban commune of Kollo near housing, on vacant lots, in public places, and in open gutters. Most households are satisfied with their practices, especially those who live near ravines or in areas where rainwater stagnates. In contrast, others are not. These are households that use garbage dumps and uncontrolled dumps that are installed next to homes. Families living next to food shops with garbage. The waste left in landfills and pits emits foul smells and attracts flies and mosquitoes.

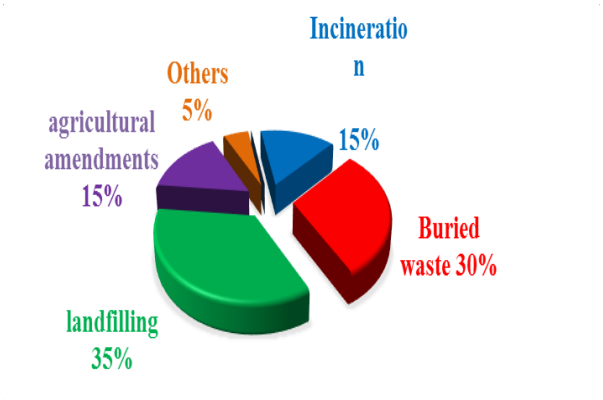

Figure 4: Household Solid Waste Disposal Practices

DISCUSSION

As a result of the survey, 38% of the population is illiterate. However, 42% have a primary level of education, 17% have a secondary level, and only 3% have a higher level of education. Clearly, the population of Kollo is undereducated and cannot adopt proper waste management behaviors. Education is based on eco-citizenship, according to Tchuikoua (2010) (*Tchuikoua, Louis Bernard*, n.d.-b). As future citizens, we need to be responsible and have a positive attitude toward life, the land, and the environment. A large amount of waste is also accumulated in this municipality. Wild deposits of these wastes can be found in habitat zones, ravines, gutters, and abandoned wells.

A similar situation has been described by Soro *et al*. in the district of Abidjan, Côte d'Ivoire (*Soro, N et Al.*, n.d.). Kollo's household waste composition is not unique, but it is similar to that of other African cities that also produce household waste. In Niamey, household waste consists mainly of organic matter, plastics, and sand, according to Penda (2015) (Adamou, 2014). In their diagnostic study of household solid waste management in Abidjan, Soro *et al*. (2010) reported plant waste as 23.7%. Plastics, bags, textiles, paper, animal waste, stones, glass and ceramics, metals, hospital waste, and toxic waste accounted for 23.2% (*Soro, N et Al.*, n.d.). Managing household solid waste is dependent upon household collection. The majority of households in Kollo do not have waste collection bins in their homes but keep them in a corner or in front of the house. However, this is not a widespread problem.

In Tillabéri, Niger, Mohammed reports that 76% of households possess trash cans within their concessions (Akbari et al., 2020). In addition to the urbanized nature of Tillaberi, which is the capital of the Region, there are several explanations for this situation. Almost half of the households evacuate their waste twice a week, others once a week, and the rest daily. The waste production ratio in the municipality of Kollo is close to that of Penda (2015), estimating the average daily production per inhabitant in Niger at 0.75 kg (Adamou, 2014). Household waste disposal is entrusted to the children of the household. This is consistent with the observation of Sotamenou, (2018), who reports that it is women and children who are mainly involved in transporting waste from their homes to a landfill or a garbage bin. He adds that in Morocco, for example, 50% of women and 20% of children are responsible for transporting waste outside homes. The problem that arises here is, above all, to know whether the children who are responsible for evacuating the waste receive the necessary instructions from their parents or the persons in charge of the services in charge of hygiene and sanitation to dump garbage in the right place (Sotamenou, 2018). This does not seem to be the case because, in some neighborhoods that have collection infrastructure, garbage is sometimes dumped on the ground near housing and along roads, while the dumps intended to receive them are empty despite their proximity to households.

This situation is similar to that experienced in Kinshasa, described by Likoli (2007), more precisely in the Commune of Limete. According to this author, in almost all the markets of this commune, mounds of rubbish litter the aisles of the places where foodstuffs are sold. However, households that do not dispose of their waste mostly correspond to large concessions at the corner of which waste is piled up, as reported by Lelo (2008) (Benoît et al., 2021b; Lelo Nzuzi, 2008). In the commune of Ngaliema, 91% of households have plot gardens where they bury household waste. According to Mohamed (2019), 64% of households in Tillaberi dispose of their waste through landfills and wild animals, 15% through incineration, 4% through private service providers, and 1% through burial (Akbari et al., 2020). Many of the waste disposal practices used in the commune are hazardous to the health of the residents, including malaria and diarrhea. However, Niger has enacted a framework law on environmental management and quality of life. As part of this law, municipalities are able to delegate all or part of their responsibility for solid waste management.

In addition, they can define responsibilities and establish the principle of integrated and environmentally sound waste management. Other African cities are also experiencing the same problem. Indeed, Benoît *et al*. found that waste management in the Mambanda district of Douala, Cameroon, is very similar to that of Kollo. As per Benoît *et al.*, 50% of households have mosquitoes running rampant, 33.23% have mice, 10.7% have cockroaches, and 5.9% have flies (2021a). It is the poor management of waste that causes such diseases as malaria, typhoid fever, cholera, diarrhea, etc., to spread. Abidjan's yellow fever

epidemic that struck the city in 2005 led to victims in precarious neighborhoods, including Yopougon, according to Dongo et al. (2008) (*Dongo*, n.d.). Towards the settlement of Kollo, according to the head of the hygiene and sanitation service (SHA), the management of household solid waste there is characterized by a lack of financial means, materials, and equipment, as well as by the inadequacy of the SHA, which is exacerbated by the incivility of some households in the evacuation of waste.

CONCLUSION

In the study, poor practices in solid waste management were revealed at the household level, as well as their shortcomings. A key point to note is that waste collection and disposal are not appropriate. As a matter of public health and the environment, this should be of concern. In light of this situation, the population and the public authorities are under pressure to develop practical and lasting solutions. In addition to creating a pleasant living environment, effective waste management can provide socio-economic and energy opportunities for the future through the recovery of material and/or energy from waste streams. It is therefore necessary to integrate the management of this resource into the planning of municipalities.

ACKNOWLEDGMENTS

The authors would like to extend their appreciation to the Department of Environmental Sciences, Faculty of Agronomic Sciences, Boubakar Bâ University of Tillaberi.

CONflICT OF INTEREST

The authors have declared no conflict of interest.

FUNDING

This study was supported by the Department of Environmental Sciences, Faculty of Agronomic Sciences, Boubakar Bâ University of Tillaberi.

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