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RESEARCH ARTICLE

A Case Study on Household Waste Management in an Urban Commune

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Abstract

This case study assessed household waste generation and management practices in the Urban Commune of Faranah, Guinea, with the aim of proposing measures to improve the current system. Data were collected between 15 January and 25 February 2020 through a literature review, socio-economic surveys (85 household and authority questionnaires), and field investigations in two neighbourhoods, Abattoir II and Faranah-Koura. In each neighbourhood, waste generated by three household-size categories (1–5, 6–10 and more than 10 members) was weighed and characterised (biodegradable and non-biodegradable fractions) daily over one week. Waste originated mainly from families (45%), runoff water (25%), the wind (15%), workshops (10%) and passers-by (5%). Nearly half of respondents (46.25%) admitted to dumping waste directly in the environment, 35% relied on open burning, and only 18.75% used waste bins. Waste production increased significantly with household size ($P < 0.05$) in both neighbourhoods, reaching a city-wide average of 0.284 kg per person per day, equivalent to an estimated 22.18 tonnes of household waste generated daily across the commune's 78,108 inhabitants. Six characterised dumping sites were located close to residential areas (0.3–1.5 km) and were mostly managed by open burning, raising concerns over air quality and vector-borne disease. These findings point to weak institutional engagement, limited equipment, and low public awareness as the main drivers of poor waste management in Faranah. Strengthening public dumping infrastructure, promoting composting and recycling, and involving local authorities and NGOs are recommended as priority actions.

Keywords: Household waste, Solid waste management, Biodegradable waste, Urban sanitation, Faranah, Guinea.

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Highlights

- Household waste management in Faranah relies mainly on informal dumping and burning, which is the case study in this work.
- 46.25% of Households abandon waste in the environment; only 18.75% use bins.
- Waste production scales significantly with household size ($P < 0.05$).
- Per-capita production of 0.284 kg/day implies about 22.2 t of waste generated daily city-wide.
- Informal dumpsites near homes are linked to vector proliferation and malaria risk.

1. Introduction

Since the early 1990s, environmental protection has become a major, collective concern [1]. The destruction of the ozone layer is one of the fundamental causes of global warming, and the greenhouse gases responsible for it are emitted in part through the poor management of waste and chemical products. Globally, municipal solid waste generation is projected to rise from 2.01 billion tonnes in 2016 to 3.40 billion tonnes by 2050, with the fastest growth expected in Sub-Saharan Africa, where waste collection and disposal infrastructure remains the least developed of any region [2].

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Issues relating to the management of urban waste, and, by extension, to the planning and management of the urban environment, are among the most complex challenges facing urban managers today, owing to their effects on human health and sustainable development [3]. Across West Africa, household waste collection systems have historically been under-resourced and poorly institutionalised, leading municipalities to rely on informal or community-based collection arrangements of variable effectiveness [4]. Specialists and observers generally agree that Guinean communes suffer from notable insalubrity: waste is a daily issue that affects every individual, whether as a consumer, a discarder, a collector of household waste, or a sorter of recyclable material.

Despite the existence of every link in the household waste management chain, support for this vital activity remains markedly insufficient in many Guinean towns, a pattern also documented in other West and Central African cities where organisational capacity, resources and enforcement remain the principal constraints on effective solid waste management [5], [6]. This study was undertaken to contribute to improving waste management in the Urban Commune of Faranah. In this work, general objective is to study existing household waste management systems in order to propose improvement measures. The specific objectives were to: (i) identify the sources of waste production; (ii) identify collection methods and the nature of household waste dumping sites; (iii) carry out a quantitative and qualitative assessment of household waste production; and (iv) propose a strategy for improved household waste management.

2. Literature review

Household waste management in Faranah should be treated as a service-system problem, not only as household behaviour. Generation, storage, collection, transport, recovery, and disposal are interdependent; failure at one stage shifts costs and risks to the next. A Global-South review describes uncontrolled dumping, open-air incineration, air and water pollution, land degradation, methane emissions, and hazardous leachate as major waste-management concerns [7]. A developing-country review also describes open burning, open dumping, informal recycling, and collection as major themes in the field [8]

The available evidence does not provide a commune-specific estimate for Faranah. Findings from Ghana, Nigeria, and Ethiopia therefore guide hypotheses and measurement design, not Faranah-specific statistics.

2.1. Household practices and the waste stream

2.1.1. Disposal choices under constrained services

In three Ghanaian communities, burning was the most common reported disposal method (44%), followed by public bins (30%) and open dumping (9%) [9]. In Ife Central, Nigeria, residents recognized health problems from poor waste management, but cost, inadequate methods, weak cooperation, and indifferent attitudes constrained improvement [10]. These findings suggest that unsafe disposal may be a practical response to service gaps as much as a knowledge deficit. A Faranah survey should therefore record distance to collection points, collection frequency, fees, and seasonal accessibility alongside stated preferences.

2.1.2. Composition and separation

The Kebridehar study identified plastics, food waste, paper or carton, tins or cans, and glass as major household waste categories; 45% of respondents identified plastics as dominant [11]. In the Ghana study, 76% reported no separation of plastics and organic matter [9]. Faranah should measure organic, plastic, paper, metal, glass, ash, and potentially hazardous fractions separately rather than import percentages from other settings.

2.1.3. Awareness and behaviour

Awareness does not automatically produce safe disposal. In Ife, households were aware of health-related consequences yet still faced cost and cooperation barriers [10]. In Kebridehar, 76.2% had not received information about waste effects on health and the environment, and residents lacked public bins within walking distance [11]. The contrast implies that Faranah interventions should distinguish information, motivation, affordability, and physical access rather than treating "awareness" as a single explanatory variable.

2.1.4. Household-level measurement priorities

A Faranah baseline should combine a household questionnaire with observation of container type, storage duration, repeated waste mass or volume, separation, burning, dumping, burial, reuse, payment, and service reliability. Kebridehar associated waste-management practice with distance from the town centre and reported that public bins were not within walking distance [11]. The Ghana study reported blocked drains, flooding, and land pollution as environmental issues [9].

2.2. Collection, governance, and service design

Collection coverage and reliability

Collection is not equivalent to access to a bin. Harare's review illustrates the importance of measuring generation, collection efficiency, recovery, and final disposal as separate system indicators; it reported 0.38 ± 0.1 kg per person per day, about 72.4% collection efficiency, and low recovery, with most recovery performed by waste pickers [12]. Faranah should therefore map households to routes, service days, missed collections, transfer points, and disposal destinations rather than report one "coverage" figure.

2.2.1. Municipal capacity and finance

Evidence from Arua Municipality found that population growth and resident behaviour were negatively associated with waste management, whereas funding had a positive significant relationship; the study also identified inadequate equipment, weak legislation, absent segregation, and poor enforcement [13]. A Liberia review similarly argues that policy is insufficient without finance, technical capacity, skilled personnel, education, participation, and resource recovery [14]. Faranah planning should cost fuel, labour, maintenance, protective equipment, supervision, and disposal-site management.

2.2.2. Community and informal-sector roles

Community participation can improve legitimacy and local monitoring, but it cannot replace regular collection. In Mettu, 87.5% of respondents were dissatisfied with municipal services, and residents often treated street and frontage cleaning as the municipality's responsibility [15]. Regional evidence also shows that informal recyclers can perform substantial recovery functions; in Harare, most recovered material was handled by waste pickers [12]. A Faranah model should define responsibilities among households, municipal staff, private collectors, community groups, and recyclers, with transparent payment and safety arrangements.

2.2.3. Service models suited to Faranah

The appropriate model is likely to be incremental rather than technology-led. A historical synthesis argues that controlled disposal requires solutions that are institutionally appropriate, technically applicable, legally achievable, financially affordable, and environmentally acceptable, with participatory planning [16]. For Faranah, this favours covered household storage, handcart or small-vehicle pre-collection where roads limit access, scheduled transfer points, controlled disposal, and pilot separation of organics and recyclables before expensive treatment infrastructure.

2.3. Environmental health and intervention evidence

2.3.1. Environmental pathways

A Global-South review associates unsustainable waste practices with air and water pollution, land degradation, methane emissions, and hazardous leachate [7]. In Ahafo, blocked drains and flooding were reported by 28.5% of participants and land pollution by 28.1%; irregular collection and weak enforcement were associated with greater risk of clogged drains [9]. These are plausible pathways for Faranah, but local drainage, rainfall, topography, and waste composition must be measured rather than assumed.

2.3.2. Health evidence and its limits

Asella's household survey reported perceived environmental impacts of water pollution (34.2%), air pollution (31.6%), soil pollution (13.4%), and environmental deterioration (20.8%), alongside reported respiratory, diarrheal, protozoan, asthmatic, and cancer outcomes [17]. Because the design was cross-sectional and relied on household data, these figures should be interpreted as reported conditions and associations, not causal estimates attributable to waste. Faranah research should use clinical or surveillance records, exposure indicators, and comparison neighbourhoods if it seeks health effects.

2.3.3. Segregation and behaviour-change interventions

A 2024 systematic review included 82 household waste-segregation interventions but found high methodological heterogeneity, with most conducted in high-income countries; information provision predominated, while comparisons with incentives and infrastructure remained underdeveloped [18]. This limits direct transfer to Faranah. A practical pilot should combine information, containers, reliable collection, feedback, and modest incentives, measuring observed separation and contamination rather than stated intention.

2.3.4. Integrated intervention logic

The intervention literature supports bundling. Ghanaian evidence points to community action but also inadequate collection, weak oversight, and limited recycling infrastructure [9]. A synthesis reports that separating organic waste at source can facilitate cleaner recycling and higher recovery rates [16]. Faranah should pilot one or two neighbourhoods, publish schedules, monitor missed collections and drain hotspots, and review performance with residents.

2.4. Research gaps

The priority gap is a Faranah baseline covering quantities, composition, seasonal variation, collection geography, costs, disposal sites, and willingness to pay. Evidence does not establish which municipal, private, community, or mixed arrangement would be sustainable there. The segregation review also identifies limited comparisons of information, incentives, and infrastructure [18]. Research should use repeated mixed-method measurements, spatial mapping, transparent costing, and pre-specified service and environmental outcomes.

Faranah's likely challenge is not simply improper household behaviour; it is the interaction of household constraints with unreliable collection, weak infrastructure, limited finance, and uncertain institutional responsibility. The soundest pathway is to measure the local system first, then build a reliable basic service around storage, collection, transfer, and controlled disposal. Separation, recycling, and community participation should be added where the municipality can sustain them. Claims about health improvement should wait for stronger local exposure and outcome data.

3. Materials and methods

3.1. Case study

The Urban Commune of Faranah is one of 12 local authorities of Faranah Prefecture, Republic of Guinea, and hosts the seat of the Prefecture and Governorate of the same name. It covers an area of 47 km^2 and lies 450 km from Conakry. It is bordered to the east by the Rural Communes of Beindou and Nialia, to the west by the Rural Communes of Sandenia and Hérèmakono, to the north by the Rural Commune of Passayah, and to the south by the Rural Communes of Tindo and Songhoyah. The case study of the work is the household solid waste dumping sites in the Urban Commune of Faranah, Guinea (10.0400° N, 10.7500° W): and which are shown in Figure 1(a) and (b). The dumping sites managed by open burning and located within 0.3–1.5 km of residential areas.

The commune has a total population of 78,108 inhabitants (40,616 women and 37,492 men), divided into 12 neighbourhoods, 12 districts, 115 sectors and 4,762 households. Approximately 80% of the population is rural and relies mainly on agriculture, livestock farming, crafts, fishing and small-scale trade. The climate is Sudano-Guinean,

with a six-month dry season (November-April) and a six-month rainy season (May-October). Waste management in the commune falls under the technical oversight of the Prefectural Directorate of the Environment, Water and Forests, which operates a dedicated Sanitation and Living Environment Section under the administrative authority of the Prefect.

3.2. Data collection

Field work was conducted between 15 January and 25 February 2020. Data were collected through (i) a literature review using internet resources, the university library and ISAV archives; (ii) individual, face-to-face socio-economic surveys of households and of communal and environmental authorities, using structured questionnaires (85 forms administered in total, comprising 80 household questionnaires — 40 in each of the study neighbourhoods — and 5 questionnaires administrated to communal and environmental authorities); and (iii) field investigation in two purposively selected neighbourhoods, Abattoir II and Faranah-Koura. These two neighbourhoods were selected to contrast differing population density and the known presence of uncontrolled household waste dumping sites, identified during preliminary reconnaissance visits.

In each neighbourhood, three household-size categories were sampled: 1–5 members, 6–10 members, and more than 10 members, with three households selected per category (n = 9 households per neighbourhood; 18 households in total across both sites). Waste generated by each household was collected and weighed daily for seven consecutive days, and separated into biodegradable (OBD) and non-biodegradable (ONBD) fractions using a mechanical scale. To avoid pseudoreplication arising from repeated daily measurements on the same household, each household's seven-day mean waste weight — rather than each individual daily weighing — was used as single data point in the statistical analysis, so that each size category was represented by three independent household means per neighbourhood. All dumping sites identified in the two neighbourhoods were located and characterised in terms of waste type, burning practice, and distance from households.

3.3. Data analysis

Data were compiled and organised in Microsoft Excel, then subjected to descriptive and comparative statistical analysis using SPSS version 20. Graphs were produced with Origin 8. Differences in mean waste production (biodegradable, non-biodegradable and total fractions) between household-size categories were tested using one-way analysis of variance (ANOVA), with household-size category as the fixed factor and each household's seven-day mean waste weight as the unit of analysis. Pairwise comparison among household-size categories were performed using Tukey's honestly significant difference (HSD) post-hoc test; in Figures 3-5, bars sharing a different letter differ significantly at $P < 0.05$.

4. Results

4.1. Waste collection and management methods

Household waste in the study area originated from several sources: families (45%), runoff water (25%), wind dispersal (15%), workshops (10%), and passers-by (5%). Waste collection in the Urban Commune of Faranah relies on sweeping and manual pick-up.

Table 1: Materials used for data collection.

Material	Quantity	Use
Notepads	4	Note-taking
Pens	4	Note-taking
Survey forms	85	Data collection
Pencils	3	Filling in survey forms
Gloves	4	Protection
Scale	1	Weighing waste
Camera	1	Photographic documentation
Ream of paper	1	Report preparation
Computer	1	Data entry and processing

Table 2: Average household and per capita waste production (kg/day) in the two study neighbourhoods.

Neighbourhood	Unit	Mean (kg/day)
Abattoir II	Household	4.262
	Individual	0.244
Faranah-Koura	Household	4.277
	Individual	0.285
Overall	Household	4.270
	Individual	0.284

4.2. Quantitative and qualitative waste production

Waste production at Abattoir II increased with household size for both waste fractions ($P < 0.05$). Households of more than 10 members produced significantly more waste of all categories than households of 5–10 or 1–5 members (Figure 3 a–c).

A similar pattern was observed at Faranah-Koura. Biodegradable waste production was highest among households of more than 10 members (6.12 ± 0.39 kg), intermediate for 5–10-member households (4.16 ± 0.70 kg), and lowest for 1–5-member households (1.66 ± 0.35 kg; $P < 0.05$). Non-biodegradable waste followed the same trend, averaging 0.43 ± 0.02, 0.32 ± 0.05 and 0.14 ± 0.02 kg, respectively ($P < 0.05$). Total waste production averaged 6.60 ± 0.09, 4.40 ± 0.10 and 1.81 ± 0.09 kg for the same categories ($P < 0.05$).

When data from both neighbourhoods were pooled, the same household-size effect was confirmed: biodegradable waste averaged 6.09 ± 0.40, 4.07 ± 0.69 and 1.71 ± 0.34 kg for households of more than 10, 5–10 and 1–5 members, respectively ($P < 0.05$); non-biodegradable waste averaged 0.43 ± 0.03, 0.35 ± 0.06 and 0.14 ± 0.02 kg ($P < 0.05$); and total waste averaged 6.65 ± 0.09, 4.42 ± 0.20 and 1.85 ± 0.07 kg ($P < 0.05$).

4.3. Per capita and city-wide waste production

Based on a mean per capita production of 0.284 kg/day, measured in two of the commune's twelve neighbourhoods, and a total population of 78,108 inhabitants, the Urban



Figure 1: Photographic views of household solid waste dumping sites in the Urban Commune of Faranah, Guinea (10.0400° N, 10.7500° W): (a) and (b) illustrate the prevailing waste disposal conditions at the selected case study locations. Photographs were taken in February 2020.

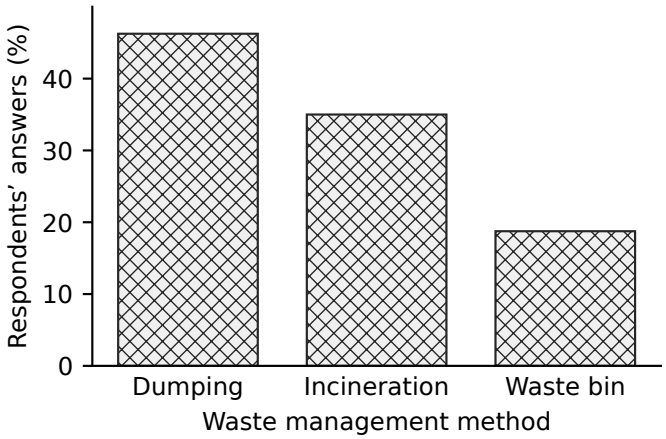


Figure 2: Waste management methods reported by surveyed households in the Urban Commune of Faranah.

Commune of Faranah is preliminarily estimated to generate 22,182.7 kg (22.18 tonnes) of household waste per day. This figure assumes that per-capita production in Abattoir II and Faranah-Koura is representative of the commune as a whole and should therefore be regarded as an approximate, commune-wide extrapolation rather than a directly measured city-wide value.

5. Discussions

This study confirms that household waste management in the Urban Commune of Faranah remains largely informal, with abandonment in the environment and open burning together accounting for over 80% of the waste management practices reported by residents, and only a minority of households using bins. This pattern is consistent with observations from other West African cities, where weak institutional capacity, limited equipment, and insufficient enforcement of regulations result in a heavy reliance on uncontrolled disposal rather than formal collection systems [3]- [6].

Household size was consistently the strongest determinant of waste generation at both study sites, with the largest households (more than 10 members) producing significantly more biodegradable, non-biodegradable and total waste than smaller households. This finding mirrors evidence from other developing-country settings, where household size and income are established predictors of solid waste generation [19]. It suggests that any waste-reduction or collection strategy in Faranah should account for household size when planning bin capacity or collection frequency.

The preliminary estimate of 22.18 tonnes of household waste generated daily city-wide, extrapolated from per-capita production measured in two of the commune's twelve neighbourhoods, represents a substantial daily management burden for a commune of this size, particularly in the absence of a functioning formal collection and disposal system. This figure should be treated as an approximate, first-order estimate for the whole commune, pending confirmation across additional neighbourhoods and seasons, but it is broadly consistent with the wider trend of rising per-capita waste generation projected for Sub-Saharan African cities [2]. The six dumping sites characterised in this study were all informal, located close to residential areas (as near as 0.3 km), and managed principally through open burning. This practice is likely to expose nearby residents to smoke and other air pollutants, while the proximity of untreated waste to housing may to favour the proliferation of flies and mosquitoes; studies elsewhere in Africa have associated residence near uncontrolled dumpsites with a higher prevalence of malaria and other vector-borne diseases [20], [21]. However, this study did not collect clinical, entomological or vector-surveillance data, so no causal relationship between the dumpsites identified here and malaria transmission can be established from the present finding, this pathway therefore remains a plausible hypothesis drawn from the wider literature, warranting dedicated local investigation rather than a demonstrated outcome of this study. These findings nonetheless underline the potential public-health as well as environmental, dimensions of the waste management deficit identified in Faranah.

The main constraints identified limited state engagement, insufficient equipment, and a shortage of specialised administrative and technical capacity mirror constraints reported elsewhere in the sub-region and point to structural, rather than purely behavioural, barriers to improved waste

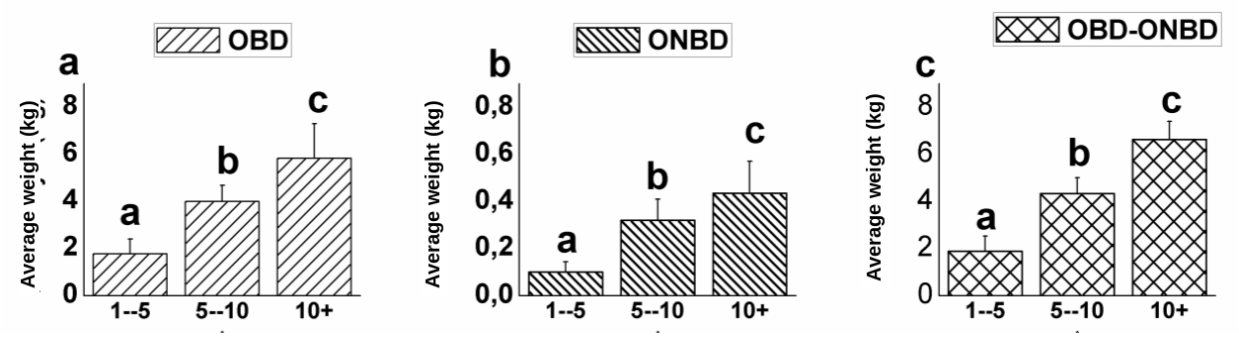


Figure 3: Mean weight (± SE) of biodegradable (a), non-biodegradable (b) and total (c) waste produced per household size category at Abattoir II. Bars sharing a different letter differ significantly ($P < 0.05$).

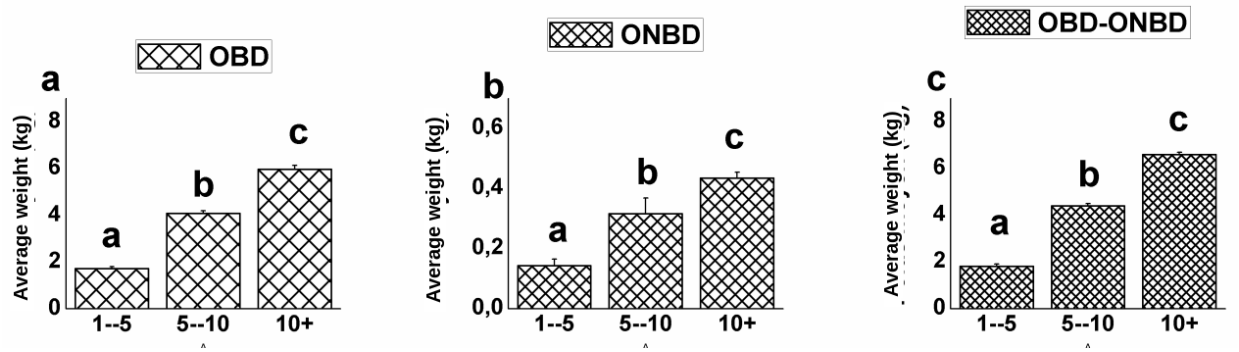


Figure 4: Mean weight (± SE) of biodegradable (a), non-biodegradable (b) and total (c) waste produced per household size category at Faranah-Koura. Bars sharing a different letter differ significantly ($P < 0.05$).

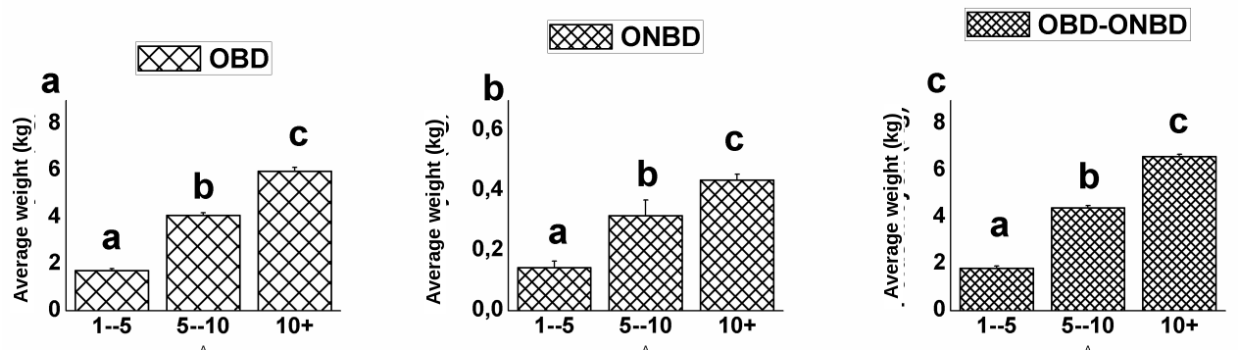


Figure 5: Mean weight (± SE) of biodegradable (a), non-biodegradable (b) and total (c) waste produced per household size category, pooled across both study neighbourhoods. Bars sharing a different letter differ significantly ($P < 0.05$).

Table 3: Characteristics of household waste dumping sites identified in the two study neighbourhoods.

Neighbourhood	Site	Location	Medical waste	Metal	Plastic	Biodeg. waste	Distance from households (km)	Incineration
	A	River bank	+	+	+	+	0.5–1	+
Faranah-Koura	B	Behind ISAV compound	–	+	+	+	0.5–1	+
	C	Niger River bank	+	+	+	+	1–1.5	+
	D	Abandoned lot	–	+	+	+	0.3–1	+
Abattoir II	E	Behind Babylon compound	+	+	+	+	0.5–1	+
	F	Behind a residence	–	+	+	+	0.3–1	+

(+) = present; (–) = absent.

management [5], [6]. Nonetheless, the results also suggest that targeted, low-cost interventions could meaningfully reduce the reliance on open dumping and open burning observed here. In particular, the introduction of covered bins and designated public dumping sites, together with the promotion of composting of biodegradable waste for agricultural use, could substantially reduce the volume of waste requiring uncontrolled disposal, while formal or informal recycling of plastic and metal waste has been shown elsewhere to be a viable, low-cost complement to municipal collection in low- and middle-income settings [22].

This study is subject to several limitations. The survey and weighing programme covered only two of the commune's twelve neighbourhoods and a single seven-day sampling period, which may not capture seasonal variation in waste generation (e.g., between the dry and rainy seasons) or full spatial heterogeneity across the commune. Future work should extend sampling to additional neighbourhoods and seasons, quantify the health burden associated with the identified dumpsites more directly (e.g., through vector surveys or morbidity records), and evaluate the feasibility and uptake of the composting and recycling interventions proposed here.

6. Conclusions

Household waste management in the Urban Commune of Faranah is characterised by a heavy reliance on informal disposal practices, chiefly open dumping and open burning driven by limited institutional support, inadequate equipment, and low public awareness. Waste production scales markedly with household size, and the commune as a whole is preliminarily estimated to generate approximately 22.18 tonnes of household waste per day, based on an extrapolation from two of its twelve neighbourhoods, most of which is channelled to informal, uncontrolled dumping sites in close proximity to housing. Addressing this problem should be treated as a priority within the planning and implementation of sustainable urban development in Faranah.

Based on these findings, the following measures are recommended:

- Raise community awareness of the importance of proper household waste management.
- Establish adequate, managed public dumping sites, and provide households with covered waste bins;
- Promote the recovery of biodegradable waste through composting for agricultural use, and the recycling of plastic and metal waste.
- Encourage the involvement of NGOs and local authorities in waste collection and management.
- Strengthen enforcement of environmental regulations governing waste disposal.
- Support further research and student training on urban waste management, including partnerships between ISAV-VGE/Faranah and technical institutions.

Declarations and ethical statements

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Availability of data and materials: Supplementary Tables S1 and S2, presenting the complete daily waste-weighing records for the three replicate households in each size category at Faranah-Koura and Abattoir II, respectively, are available from the corresponding author on request.

CRediT authorship contribution statement

Mamadou Barry: Conceptualization, Investigation, Methodology, Data collection, Visualization, Writing – original draft, review & editing. **Alexandre Konate**: Conceptualization, Investigation, Data collection, Visualization, Writing – review & editing.

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