



(RESEARCH ARTICLE)



HOUSEHOLD SOLID WASTE MANAGEMENT IN THE URBAN COMMUNE OF DIFFA, NIGER: PRACTICES, PERCEPTIONS AND GOVERNANCE CHALLENGES

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ABSTRACT

Rapid population growth, urbanization and changing consumption patterns are increasing the quantity and complexity of household solid waste generated in low- and middle-income cities. In Niger, solid waste management remains constrained by limited infrastructure, weak institutional coordination, predominantly informal collection practices and very limited source separation. In the urban commune of Diffa, these constraints are particularly important because household waste is largely managed individually and disposed of at nearby uncontrolled dumpsites. This study assessed household solid waste-management practices, knowledge and perceptions, as well as selected governance and willingness-to-pay dimensions in the urban commune of Diffa, Niger. A cross-sectional household survey was conducted from August to September 2026 using a structured questionnaire administered through Kobo Collect. Simple random sampling was used to select 152 households distributed across 13 neighbourhoods. Data were exported to Excel for organization and graphical presentation, while descriptive statistical analyses and willingness-to-pay calculations were performed using Minitab 18. Kitchen waste was reported by 89.47% of households and packaging waste by 60.53%. A majority of households (58.55%) had no waste container, while 41.45% used a container. Source separation was completely absent (100% of surveyed households). Children were reported to empty household waste containers in approximately 79% of households, and waste was mainly transported by hand (about 73%). Nearly three-quarters of households (73.03%) used dumpsites located within 100 m of their homes. Although 70% of respondents

reported knowledge of waste management and 80.92% recognized recycling as an opportunity for waste recovery, 89% did not know the applicable waste-management rules and regulations. Moreover, 54.61% expressed willingness to pay a sanitation tax, with an estimated conditional willingness to pay of 283.13 FCFA per household per month and an adjusted average of 154.61 FCFA. The findings reveal a substantial gap between general awareness of waste-management issues and the availability of effective services, infrastructure, and regulatory knowledge. Strengthening participatory municipal governance, environmental awareness, source separation, organized collection and local waste-recovery initiatives could improve household waste management in Diffa.

Keywords: Household Solid Waste; Municipal Waste Management; Source Separation; Waste Disposal; Willingness To Pay; Diffa; Niger

1 INTRODUCTION

Accordingly, the objective of this study was to assess household solid-waste management in the urban commune of Diffa by examining household waste-generation and storage practices, disposal and transport pathways, source-separation behaviour, knowledge and perceptions concerning waste-management consequences and recovery opportunities, awareness of relevant rules and regulations, and willingness to pay for improved sanitation services. The study also seeks to identify the principal governance and service-delivery challenges that should be addressed to move Diffa towards a more organized, participatory and resource-efficient household solid-waste management system.

Despite the importance of these issues, there is limited empirical information describing how households in Diffa manage waste from generation to final disposal, how much they know about waste-management practices and regulations, and whether they are willing to contribute financially to improved services. Understanding these dimensions is essential for designing realistic interventions that combine infrastructure, environmental education, municipal regulation, organized collection and resource recovery. The present study therefore focuses on the household level, where waste-management decisions are initially made and where practical improvements can have direct effects on the urban waste stream.

The urban commune of Diffa provides a particularly relevant case for examining these challenges. Located in the extreme southeast of Niger, the commune is characterized by a predominantly Sahelian environment, a growing urban population and economic activities based mainly on agriculture, livestock, fishing, trade and craftwork. Local municipal information indicates that waste management is handled through existing municipal services, while household waste management is largely undertaken individually. The absence of systematic source separation and the widespread use of nearby disposal areas create conditions that may favour the proliferation of uncontrolled dumpsites and increase exposure to environmental and public-health risks.²³

In Niger, household solid-waste management remains largely informal and insufficiently regulated. Collection and disposal activities are often carried out through decentralized or household-level arrangements, while source separation remains very limited and the recovery of valuable materials is frequently undertaken informally. Weak coordination among stakeholders and inadequate infrastructure constrain the establishment of an efficient and sustainable municipal waste-management chain.^{21–23} These constraints are particularly relevant in secondary cities, where municipal resources and specialized environmental services are often limited compared with those available in the capital and larger urban centres.

The situation is particularly challenging in many African cities, where rapid urban growth has frequently outpaced municipal waste-management infrastructure and financing. Open dumping, irregular collection, inadequate household storage and limited source separation remain common in several urban settings. These conditions are compounded by weak institutional coordination and by the limited availability of reliable information for planning waste services. The diversity of local socio-economic and environmental conditions also means that solutions cannot simply be transferred from one city to another; they need to be adapted to household practices, municipal capacity, settlement structure and the local waste economy.^{5–10}

Household behaviour is a central component of this service chain because households determine, to a large extent, how waste is stored, separated, transferred and presented for collection. Evidence from developing-country cities indicates that waste-management practices are influenced by socio-economic characteristics, knowledge, attitudes, perceived health and environmental risks, service accessibility, trust in local institutions and the direct or indirect costs of waste disposal.^{11–15} Source separation is particularly important because mixing recyclable, organic and residual materials at the point of generation reduces the technical and economic feasibility of subsequent recovery. At the same time, the integration of informal waste workers and small-scale recovery activities can contribute to collection and recycling when these activities are appropriately recognized, organized and supported.^{16–17}

Beyond the quantity of waste generated, inadequate management creates environmental, social and public-health concerns throughout the waste chain. When storage, collection and final disposal are poorly organized, waste can accumulate in residential areas, drains and open spaces, while uncontrolled dumping and burning may contribute to soil, surface-water and groundwater contamination, nuisance conditions and air pollution. The risks are especially important where communities lack regular collection services, appropriate storage containers, controlled disposal facilities and effective environmental regulation.^{4–7} Consequently, sustainable household solid-waste management should not be considered solely as a disposal problem; it requires an integrated service chain covering waste generation, temporary storage, source separation, collection, transport, recovery, treatment and final disposal, supported by adequate institutional arrangements and community participation.^{8–10}

Rapid population growth, urbanization, economic development and changing consumption patterns are driving a sustained increase in municipal and household solid-waste generation worldwide. The global waste stream is becoming larger and more heterogeneous, while the capacity of many cities to collect, transport, recover and safely dispose of waste has not expanded at the same pace. Global municipal solid-waste generation was estimated at approximately 2.0 billion tonnes in 2016 and is projected to reach about 3.4 billion tonnes by 2050 under business-as-usual conditions. Waste generation is also closely associated with income, consumption patterns, urbanization and household characteristics, making rapidly growing cities in developing countries particularly vulnerable to increasing waste-management pressures.^{1–3}

2 MATERIALS AND METHODS

2.1 Study area

The urban commune of Diffa is located in southeastern Niger along National Road N°1, approximately 1,355 km from Niamey. It is part of Diffa Department and Diffa Region and borders Gueskerou to the east and north, Chetimari to the west, and Nigeria and the Komadougou Yobe River to the south. The commune is characterized by a predominantly flat relief, with localized depressions near the Komadougou Yobe. The climate is dry tropical and Sahelian, with mean annual rainfall reported at approximately 300–450 mm. The main economic activities are agriculture, fishing, livestock keeping, trade, and craftwork (¹⁸; ¹⁹). The population context and waste-sector pressures are also documented in national and municipal assessments (²⁰; ²¹). The study area and municipal boundaries are shown in Figure 1.

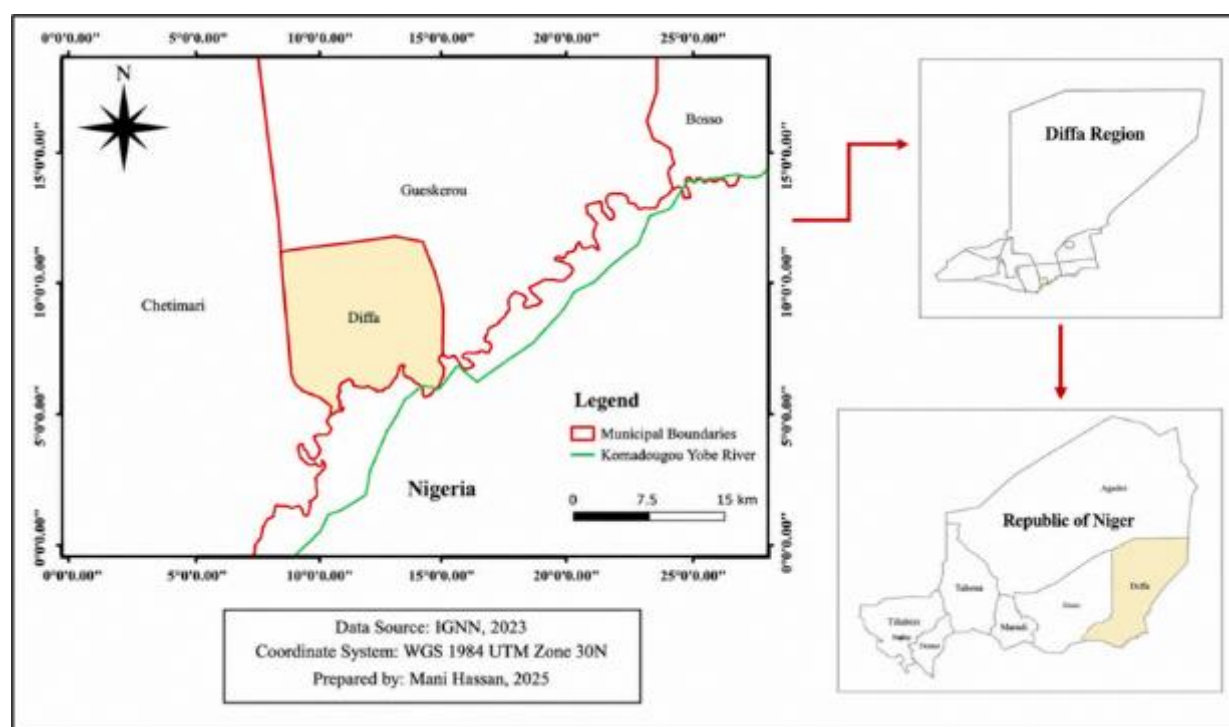


Figure 1: Location of the study area

2.2 Materials

KoboCollect/KoboToolbox was used to design and administer the household questionnaire, and smartphones were used for digital data collection. The questionnaire covered household characteristics, waste generation sources, storage

and transport practices, source separation, disposal, knowledge, perceptions, awareness of regulations, and willingness to pay for improved waste services.

2.3 Methods

A community-based cross-sectional household survey was conducted in August–September 2026. A structured questionnaire was administered directly to household respondents using KoboCollect. The digital workflow reduced transcription errors and enabled rapid synchronization and quality checking of collected records.

2.4 Sampling

Simple random sampling was used. The sample size was calculated for a finite population using the proportion-estimation approach of ²²:

$$n = \frac{t^2 \times p(1-p) \times N}{t^2 \times p(1-p) + (N-1) \times y^2}$$

The parameters used in the sample-size calculation are presented in Table 1.

2.5 Data processing and analysis

Data were synchronized and exported from KoboToolbox in Microsoft Excel format. Descriptive statistics, including frequencies and percentages, were computed using Minitab 18, while tables and graphs were prepared in Microsoft Excel. The acceptance rate for the sanitation fee was calculated as the proportion of households answering 'yes'. The conditional WTP was calculated for households willing to pay, and the overall mean WTP was obtained by weighting the conditional WTP by the acceptance rate. No inferential statistical test was reported because the study objective was descriptive and no hypothesis-testing design was specified.

Table 1: Parameters used for the sample size calculation

Parameter	Description
n	Required sample size (households)
N	Sampling population (12,934 households)
y	Margin of error (7.9%)
p	Estimated proportion (0.50)
t	z-score (1.96; 95% confidence level)

3 RESULTS AND DISCUSSION

3.1 Respondent and household characteristics

3.1.1 Identification of respondents

Table 2 summarizes respondent characteristics. The sample was predominantly male (91.45%), while women represented 8.55%. Respondents aged 41–60 years accounted for 57.89%, followed by those older than 60 years (26.97%). Most respondents were married (90.79%). Quranic education was reported by 40.13% of respondents, while 26.32% had higher education. Trading was the main reported occupation (53.95%), followed by civil service (24.34%). Households were generally large: 53.29% comprised 1–10 persons and 45.39% comprised 11–20 persons.

Table 2: Socio-demographic characteristics of respondents

Category	Modality	n	Percentage
Sex	Female	13	8.55%
	Male	139	91.45%
Age	18 to 40 years	23	15.13%
	41 to 60 years	88	57.89%

	More than 60 years	41	26.97%
Marital status	Married	138	90.79%
	Single	8	5.26%
	Widowed	4	2.63%
	Divorced	2	1.32%
Level of education	Quranic studies	61	40.13%
	Primary	15	9.87%
	No education	17	11.18%
	Secondary	19	12.50%
	Higher	40	26.32%
Main activity	Farmer	2	1.32%
	Butcher	4	2.63%
	Driver	9	5.92%
	Trader	82	53.95%
	Civil servant	37	24.34%
	Mason	4	2.63%
	Other	14	9.21%
Household size	1 to 10	81	53.29%
	11 to 20	69	45.39%
	More than 20	2	1.32%

3.2 Household waste-management practices

3.2.1 Sources of household waste

The main reported sources of household waste were the kitchen (89.47%), packaging (60.53%), and vegetable/plant waste (34.21%). Waste associated with domestic animals accounted for 30.26%, while other sources represented 15.13% (Figure 2). The dominance of kitchen waste indicates the importance of household organic waste in the local stream and suggests opportunities for composting or other forms of organic-resource recovery.

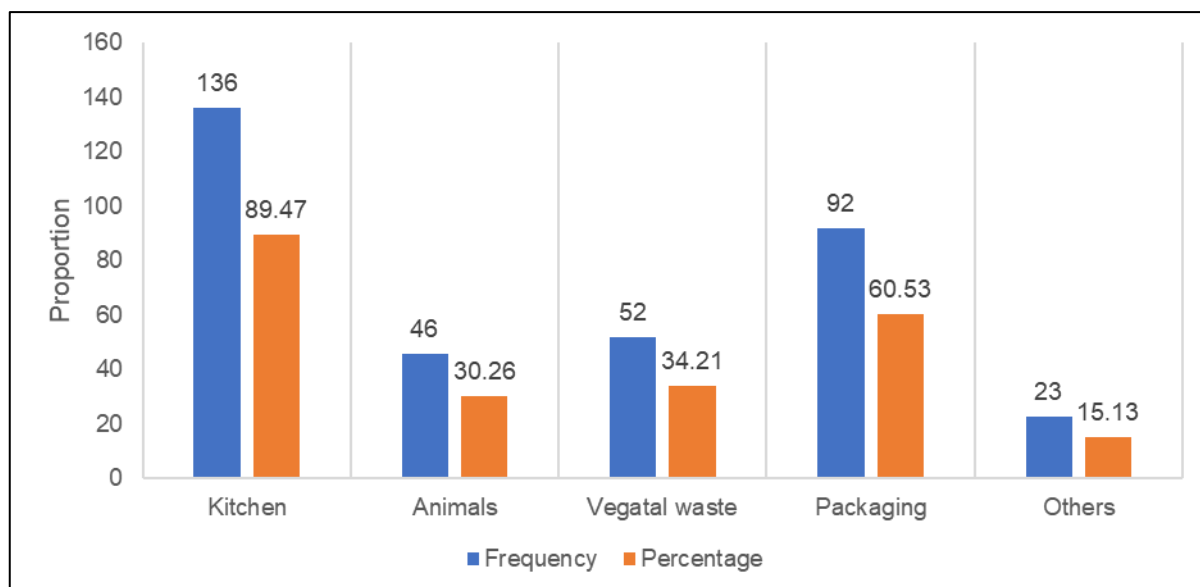


Figure 2: Sources of household waste

3.2.2 Waste-storage containers

More than half of households (58.55%) reported having no dedicated waste container. Other containers were used by 11.84% of households, followed by plastic buckets (10.53%), bags (9.21%), drums (7.24%), and plastic sachets (2.63%) (Figure 3). The high proportion of households without dedicated storage containers creates conditions for littering, uncontrolled dumping, and direct contact with waste.

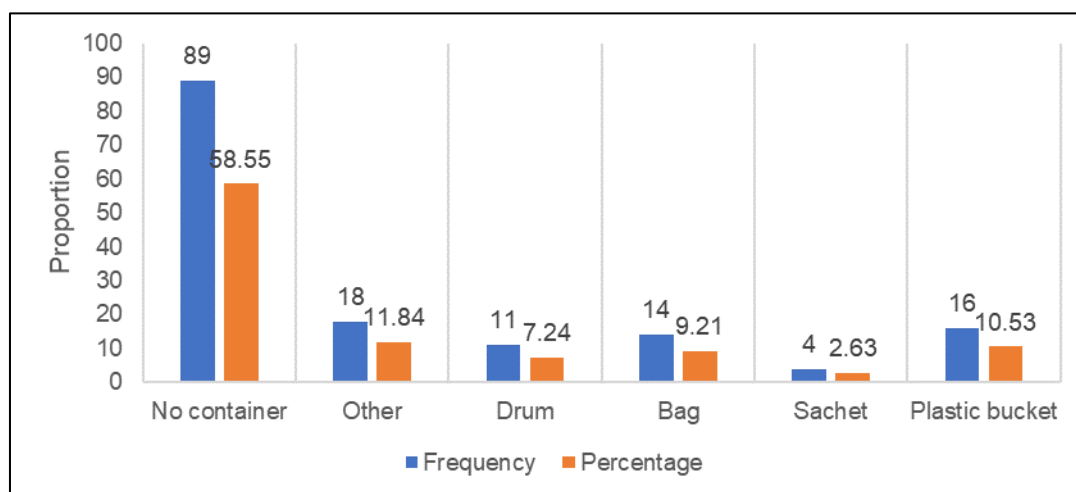


Figure 3: Types of household waste containers

3.2.3 Storage practices among households without containers

Among households without dedicated containers, waste was commonly placed in front of the house (32.58%), taken directly to dumpsites (26.97%), or accumulated in the courtyard (20.22%). Smaller proportions buried waste (4.49%) or used other practices (15.73%) (Figure 4). These practices indicate that household storage and disposal are closely linked to the proximity and accessibility of informal disposal sites.

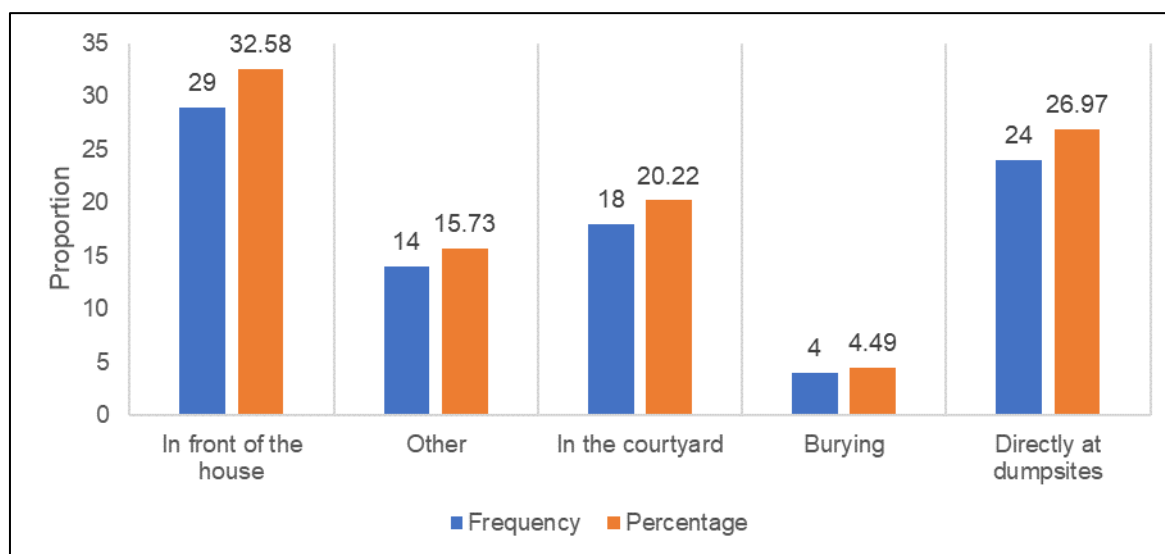


Figure 4: Waste-storage practices among households without containers

3.2.4 Source separation

All surveyed households reported that they did not practice source separation (Figure 5). Consequently, recyclable, organic, and residual fractions were mixed before disposal. The absence of source separation limits recovery options and increases the quantity of mixed waste requiring final disposal.

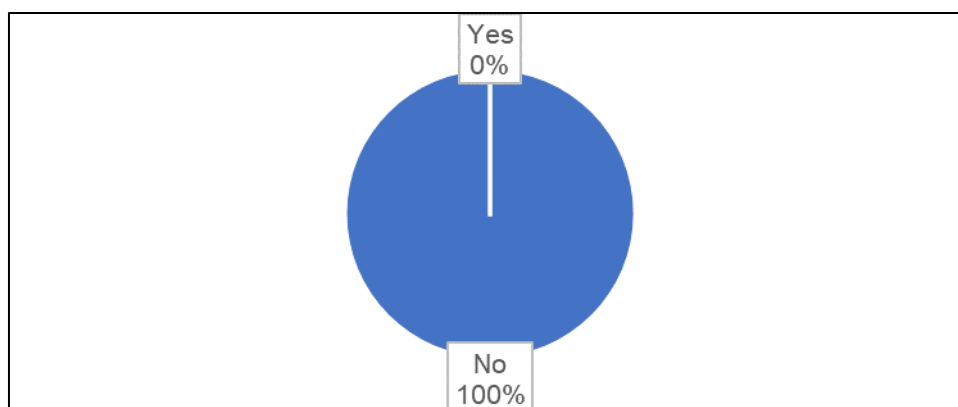


Figure 5: Household source-separation practice

The complete absence of source separation is one of the most important findings. Comparable evidence from Ghana shows that source-separation behaviour depends on socio-economic characteristics, attitudes, incentives and the type of waste service available ⁽¹²⁾. Owusu et al. (2013) also found that perceptions of health and sorting benefits and economic incentives can influence household willingness to participate in separation. Thus, awareness campaigns in Diffa should be combined with practical enabling measures such as separate containers, scheduled collection of separated fractions, and visible recovery channels rather than relying on information alone.

3.2.5 Actors involved in emptying household containers

Children were the main actors responsible for emptying household containers (78.0%), followed by collectors (13.0%), wives (4.0%), husbands (3.0%) and other actors (2.0%) (Figure 6). The prominent role of children is important from a risk-management perspective because direct handling of mixed waste can increase exposure to sharp objects, pathogens and other hazardous materials. Similar concerns about health and working conditions are reported for informal waste activities in developing-country settings ^(16; 7).

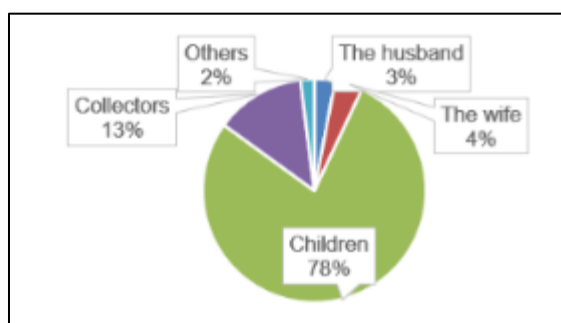


Figure 6: Actors involved in emptying household waste containers

3.2.6 Waste conveyance

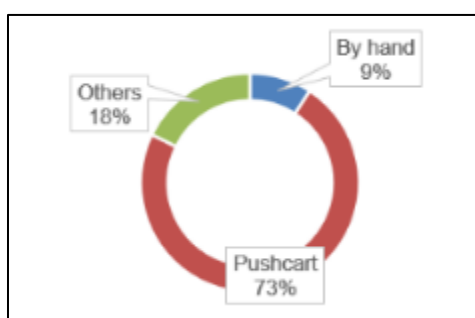


Figure 7: Means of household waste conveyance

Pushcarts were the most frequently reported means of transporting household waste to disposal sites (73.03%), followed by other means (17.76%) and manual carrying (9.21%) (Figure 7). This distribution indicates that household-

level transport is largely informal and depends on low-cost conveyance rather than an organized municipal collection service.

3.2.7 Distance from household to dumpsite

Most households (73.03%) reported using a dumpsite located within 100 m of their home, while 26.97% used a site more than 100 m away (Figure 8). The short distance may partly explain the reliance on household-level transport and the persistence of informal disposal points. However, proximity alone does not guarantee safe disposal if disposal sites are uncontrolled or lack environmental protection measures.

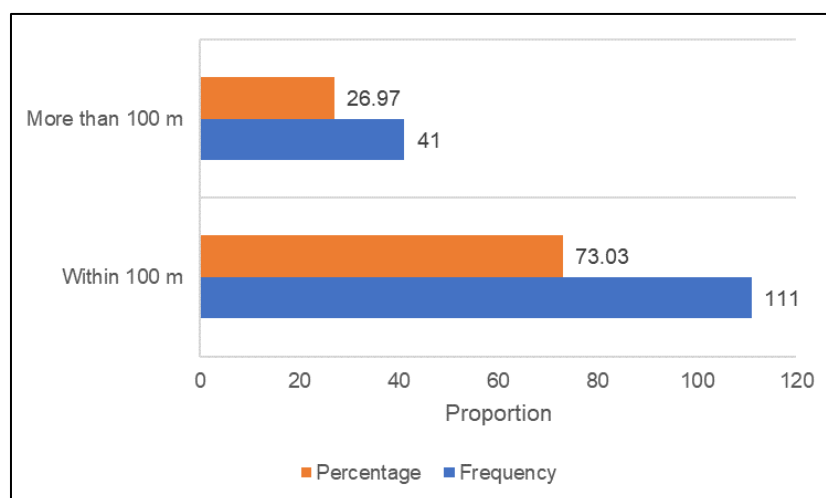


Figure 8: Distance from household to dumpsite

The results indicate that household solid waste management in Diffa is characterized by limited source separation, widespread use of informal disposal sites, inadequate storage infrastructure and a strong reliance on household-level transport. This pattern is consistent with broader evidence from developing cities, where rapid urbanization and limited municipal capacity constrain collection and safe disposal (⁶; ²⁷). Open dumping is particularly problematic because it can generate leachate, litter, smoke and other pathways of environmental contamination (⁷; ⁵). In Diffa, the municipal diagnostic also identifies weaknesses in the organization of waste services, reinforcing the interpretation that the observed household practices are embedded in wider institutional constraints (²³).

Comparable patterns have also been reported in Kinshasa, where households used a combination of containers, burying, burning and uncontrolled disposal, with hand transport remaining common (³²). Studies from Oum El Bouaghi, Algeria, have documented a strong reliance on plastic and household bags for waste storage (³³), while recent work in Arlit, Niger, reports widespread open burning and associated environmental and health concerns (³⁴). In Mateba, Kinshasa, the absence of transit sites, public bins, affordable services and waste collectors was identified among the factors contributing to poor household waste management (³⁵). Taken together, these comparisons indicate that the Diffa problem is not only behavioural; it reflects an interaction between household practices, service availability, municipal capacity and the economic organization of waste management.

Comparative evidence from other African cities further contextualizes the Diffa findings. In Maroua, Cameroon, households reported the use of rudimentary containers and a minority practiced source separation, while formal collection was provided by a specialized operator (²⁸). In Zinder, Niger, inappropriate disposal was also associated with inadequate infrastructure, limited resources and household practices (²⁹). Evidence from Abomey-Calavi, Benin, highlights the environmental risks associated with poorly sited disposal areas and inadequate protection of groundwater (³⁰). In Moundou, Chad, kitchen waste was a major component of household waste, awareness was moderate and source separation remained uncommon (³¹).

3.2.8 Payment for waste disposal

A large majority of households (86.18%) reported paying for waste disposal, whereas 13.82% did not (Figure 9). The existence of payment at the household level indicates that residents already contribute financially to waste disposal, although these payments do not necessarily translate into a regulated or environmentally safe municipal service.

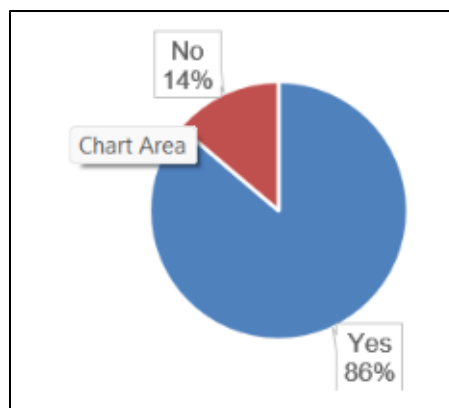


Figure 9: Payment for household waste disposal

3.3 Knowledge and perceptions of waste management

3.3.1 Knowledge of waste management

Overall, 70.39% of respondents reported knowing about waste management, while 29.61% did not (Figure 10). Although a majority had some knowledge, the remaining knowledge gap may constrain adoption of improved practices, particularly where services and infrastructure are also limited. Behavioural research shows that knowledge alone does not necessarily translate into appropriate household waste practices; attitudes, perceived control, social norms and practical opportunities also matter (¹³; ²⁴).

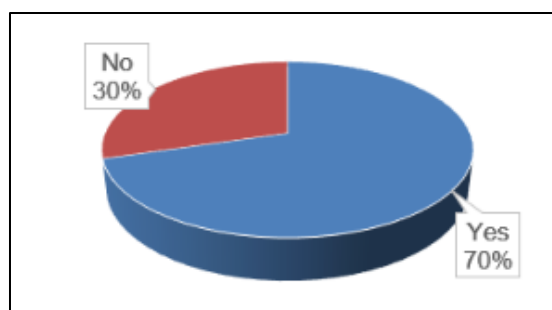


Figure 10: Self-reported knowledge of waste management

3.3.2 Perceived consequences of poor waste management

The most frequently perceived consequence of poor waste management was disease (67.76%), followed by lack of awareness of consequences (19.08%), injuries (15.13%), pollution/environmental degradation (12.50%) and other consequences (9.21%) (Figure 11). These perceptions are consistent with the broader evidence that inadequate waste management can contribute to environmental contamination and public-health risks, although the magnitude of specific health effects depends on exposure pathways and local conditions (⁸; ⁷).

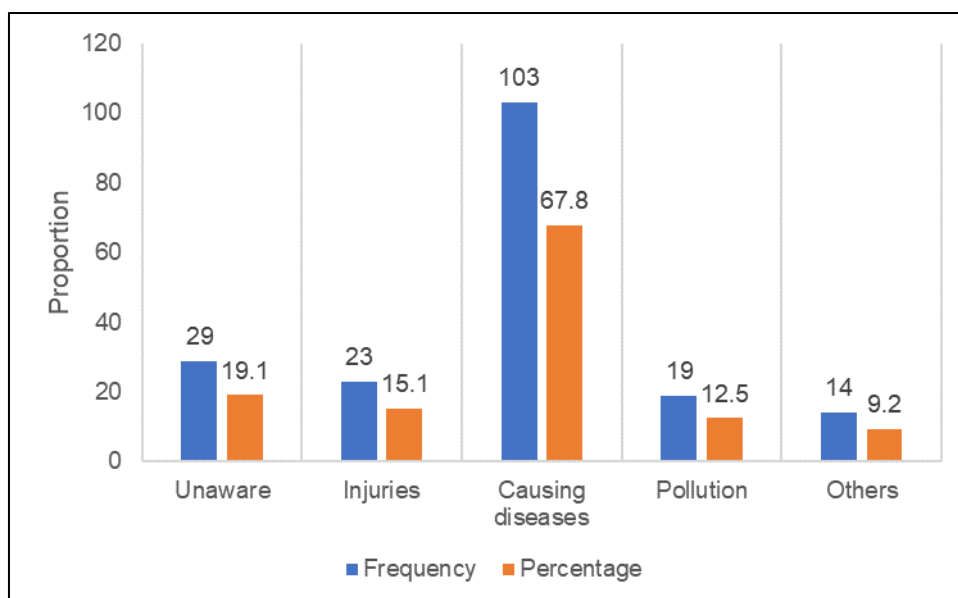


Figure 11: Perceived consequences of poor waste management

3.3.3 Perceived opportunities for solid-waste recovery

Most respondents (80.92%) identified recycling as a potential use of solid waste, while 16.90% identified composting, 3.29% animal feed and 1.97% other opportunities; 6.58% were unaware of possible opportunities (Figure 12). These responses suggest that the population recognizes resource-recovery potential even though source separation is not currently practiced. Such awareness could support gradual development of circular-economy activities if collection, sorting and markets for recovered materials are established ^(25; 26).

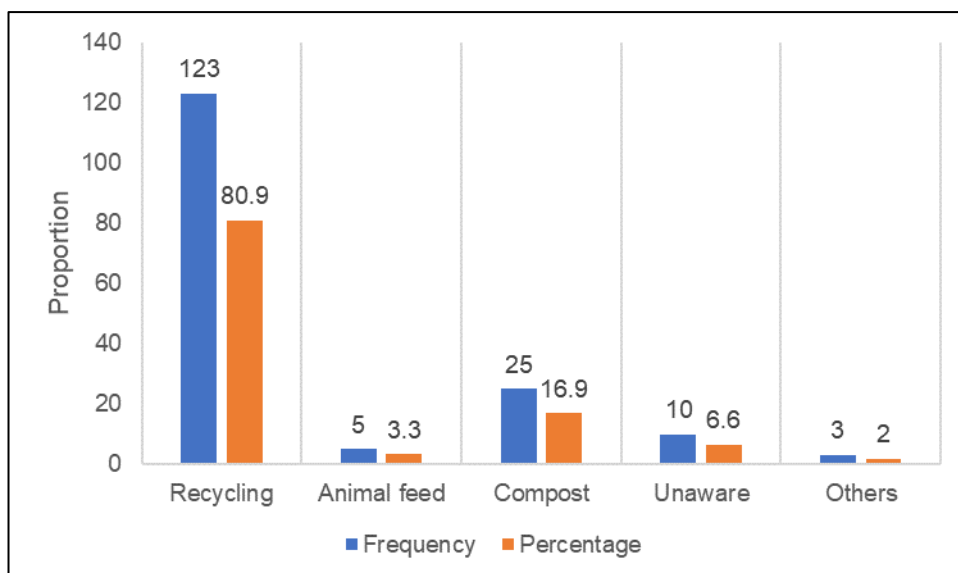


Figure 12: Perceived opportunities for solid-waste recovery

3.3.4 Knowledge of waste-management rules and regulations

Only 11% of respondents reported knowledge of waste-management rules and regulations, whereas 89% did not (Figure 13). This is a major governance gap because effective municipal waste management depends not only on infrastructure but also on clear responsibilities, communication, enforcement, and citizen participation ^(9; 10).

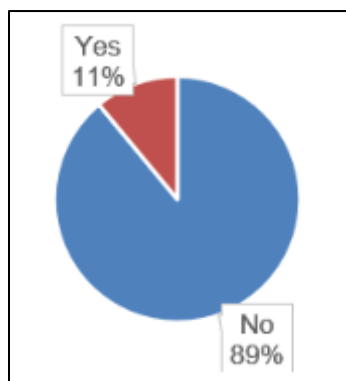


Figure 13: Knowledge of waste-management rules and regulations

3.3.5 Willingness to pay a sanitation fee

A total of 54.61% of respondents were willing to pay a monthly sanitation fee to improve waste-management services, while 45.39% were not (Figure 14). This result suggests that a municipal fee may be socially feasible for a substantial proportion of households, provided that the service delivered is visible, reliable, and accountable. Evidence from Kampala and Blantyre similarly shows that household willingness to pay for improved waste collection is influenced by socio-economic characteristics and perceptions of service quality ^(14; 15).

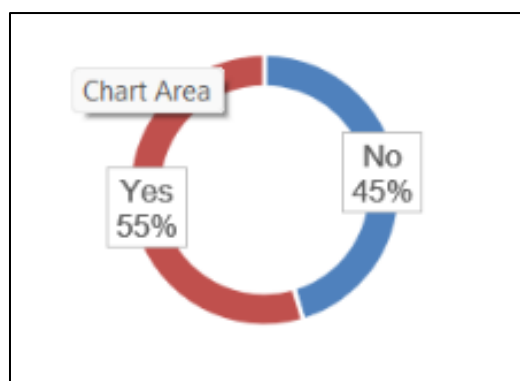


Figure 14: Willingness to pay a monthly sanitation fee

3.3.6 Willingness-to-pay amount

Table 3 presents the WTP estimates. The acceptance rate was 54.61%. The conditional mean WTP among households willing to pay was 283.13 FCFA per household per month. Weighting this conditional amount by the acceptance rate gives an overall mean WTP of 154.60 FCFA per household per month. The result should be interpreted as an indicative stated preference rather than a guaranteed revenue level because willingness to pay can differ from actual payment behaviour.

Table 3: Willingness to pay for improved waste-management services

Variable	Overall mean WTP (FCFA/household/month)	Acceptance rate (%)	Conditional mean WTP (FCFA/household/month)	Weighted mean WTP (FCFA/household/month)
Value	154.60	54.61	283.13	154.60

The WTP findings provide an initial basis for considering local financing mechanisms. More than half of the surveyed households expressed willingness to contribute, and the overall mean stated WTP was 154.60 FCFA per month. This is lower than the conditional mean of 283.13 FCFA because the overall estimate includes households unwilling to pay. Comparable studies in Kampala and Blantyre demonstrate that WTP can be useful for service design, but that affordability, household characteristics, and the credibility of the service provider influence responses ^(14; 15). Any sanitation fee in Diffa should therefore be accompanied by transparent service standards, accountability, and consideration of vulnerable households.

Abbreviations

- HSW: household solid waste;
- MSW: municipal solid waste;
- WTP: willingness to pay.

4 CONCLUSION

Household solid waste management in the urban commune of Diffa remains predominantly informal and disposal-oriented. The survey of 152 households found no source separation, a high proportion of households without dedicated waste containers, widespread use of nearby disposal sites, and substantial reliance on pushcarts for waste conveyance. At the same time, most respondents recognized health consequences and potential recovery opportunities, while 54.61% expressed willingness to pay a monthly sanitation fee. The principal priorities are therefore to establish reliable municipal collection, promote source separation, improve household storage, strengthen public communication about regulations, support inclusive recovery and recycling activities, and develop transparent financing mechanisms. These measures could help transform waste from a public-health and environmental burden into a resource for local circular-economy activities.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS*Acknowledgments*

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Disclosure of conflict of interest

The authors declare that they have no financial or non-financial competing interests that could have influenced the study design, data collection, analysis or preparation of the manuscript.

Statement of ethical approval

No formal institutional ethical approval was obtained for this household survey. The authors declare that the questionnaire did not collect identifiable personal information and that participation was voluntary. The authors acknowledge that the journal may request evidence of ethical review or an institutional exemption before publication.

Statement of informed consent

Participation was voluntary. No identifiable personal information or images requiring publication consent are included in the manuscript.

Authors' contributions

The authors jointly contributed to study design, field data collection, data analysis, interpretation of results, and manuscript preparation. All authors read and approved the final manuscript.

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