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Management of household waste in Kinshasa: administrative coordination, political choices, and perception of health and CBRN risks by local stakeholders

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ABSTRACT

This study analyzes the administrative coordination mechanisms and political choices structuring household waste management in Kinshasa between 2021 and 2025, as well as the differentiated perceptions of health and CBRN (chemical, biological, radiological, and nuclear) risks by stakeholders. A mixed-methods approach was used across nine communes: a questionnaire survey of 900 households, semi-structured interviews with 45 administrative officers, 45 informal waste pickers, and 18 non-governmental organizations. Quantitative data were processed using descriptive statistics, chi-square test, Kruskal-Wallis test, and Spearman correlation. Results show that administrative fragmentation remains a major limiting factor, with 71.1% of officers reporting jurisdictional overlaps ($\chi^2(2, N = 45) = 12.18, p = .002$). Political choices favor emergency evacuation (66% of budget) over preventive awareness (14%). Perceptions of health and CBRN risks differ significantly among stakeholders ($H(3) = 48.92, p < .001$), with informal waste pickers reporting the highest scores ($M = 4.08$) and administrative officers the lowest ($M = 2.68$). The CBRN dimension, although marginalized in institutional discourse, emerges as a concern among informal waste pickers exposed to diffuse hazardous waste. The study recommends establishing a formalized coordination framework, systematically integrating risk assessment into budget allocation, and developing specific streams for diffuse hazardous waste.

Keywords: Household waste; Kinshasa; Administrative coordination; Public policy; Risk perception; CBRN.

1. Introduction

The rapid urbanization of Kinshasa and its demographic growth place household waste management at the heart of environmental and health issues. The Congolese capital produces several thousand tons of solid household waste daily, a significant portion of which escapes formal collection circuits (Kadilekoloko Masamuna et al., 2025; Tetra Tech, 2022). This situation generates illegal dumps, uncontrolled landfill sites, and alarming air pollution, as documented by Phaka et al. (2022) through the monitoring of atmospheric NO_2 concentrations in Kinshasa.

The period 2021–2025 constitutes a particularly significant sequence for analysis: it corresponds to attempts at administrative reform, increased visibility of post-pandemic health risks, and the emergence of new forms of community organization. The World Bank's *Kin la Belle* program (2026) illustrates this dynamic, as does the African Development Bank's (2026) study for the development of a solid waste

management strategy in Kinshasa. However, the scientific literature on Kinshasa remains fragmented, often favoring technical analysis at the expense of an integrated approach articulating administration, politics, and risk perception (Lelo Nzuzi, 2022; Munongo Yula, 2025).

The problem echoes the concerns expressed by Bossiki (2025) regarding the need for collective responsibility, as well as the analyses of Kadilekoloko Masamuna (2020) and Rafea-Congo (n.d.) on the contrasting perceptions of inhabitants regarding waste-related risks.

Household waste, long understood solely in terms of health and environmental nuisances, can also constitute a source of chemical, biological, radiological, and nuclear (CBRN) risks. On the **chemical** level, household waste contains diffuse hazardous substances: used batteries and accumulators (heavy metals: lead, cadmium, mercury), electrical and electronic equipment (brominated flame retardants, polychlorinated biphenyls), cleaning products and solvents, paint and pesticide residues. These substances, when burned in the open air or buried without control, release persistent organic pollutants (POPs) and dioxins (Mongabay, 2025; Phaka et al., 2022). On the **biological** level, decomposing organic household waste provides a favorable environment for pathogenic microorganisms (bacteria, viruses, fungi, parasites). The presence of diffuse medical waste syringes, bandages, expired medications in household waste streams exposes informal waste pickers and riparian populations to infectious agents (World Bank, 2026). On the **radiological and nuclear** level, although rarely documented in Kinshasa, the presence of orphan radioactive sources in metal or electronic waste constitutes an emerging risk. Ionizing smoke detectors, obsolete medical devices, and certain industrial equipment may contain sealed sources that, if not identified and adequately managed, present a radiological hazard. The analysis of these CBRN risks in household waste in Kinshasa remains embryonic. Congolese institutional and legal frameworks, although providing for provisions on hazardous waste, struggle to grasp the diffuse and fragmented nature of these risks (Democratic Republic of Congo, 2017). This gap fully justifies the integration of the CBRN dimension into the present study.

Research question: How do administrative coordination and political choices influence the perception and management of health and CBRN risks related to household waste in Kinshasa between 2021 and 2025?

Hypotheses:

- **H1:** Administrative fragmentation between national, provincial, and communal levels weakens the coherence and effectiveness of household waste management in Kinshasa (Munongo Yula, 2025; Hooghe & Marks, 2003).
- **H2:** Political choices favor visible and urgent interventions to the detriment of a preventive and structural approach to risk reduction (Lelo Nzuzi, 2022; World Bank, 2026).
- **H3:** The perception of health and CBRN risks varies significantly according to the level of stakeholder involvement and their position in the management system (Slovic, 1987; Klinke & Renn, 2002).

2. Materials and methods

2.1. Study Area

Nine communes of Kinshasa were selected for their contrasting representativeness: **Masina** (high density, marked service failure), **Limete** (mixed industrial and residential area), **Gombe** (administrative and economic center), **Makala** (dense popular neighborhood), **Ngaba** (dense residential area), **Selembao** (hillside informal settlements), **Ngiri-Ngiri** (central popular commune), **Kalamu** (dense mixed residential and commercial area), and **Ngaliema** (vast residential commune with contrast between affluent and precarious neighborhoods). This selection is based on the findings of Buhendwa et al. (2026) regarding the unequal geographical distribution of dumps and associated risks in Kinshasa.



Note. The map highlights the unequal distribution of waste management infrastructure between the studied communes. Cartographic data from field surveys (2021–2025) and Buhendwa et al. (2026). Masina, Selembao, and Makala

appear as the communes most lacking in infrastructure, while Gombe and Ngaliema concentrate formal collection devices.

2.2. Study Period

The analysis covers the period **2021–2025**, corresponding to notable institutional developments and increased attention to urban health issues (World Bank, 2026; Mongabay, 2025).

2.3. Population and Sample

Table 1. Study Population and Sample.

Stakeholder	Sample Size	Sampling Method
Households	900 (100 per commune)	Systematic random
Administrative officers	45	Purposive
Informal waste pickers	45	Snowball
Non-governmental organizations	18	Purposive

Note. N = 1,008 total participants. The sampling methods are inspired by the mixed approaches recommended by Kadilekoloko Masamuna (2020) for the study of environmental perceptions in Kinshasa.

2.4. Data Collection Techniques

Table 2. Data Collection Techniques and Tools.

Technique	Tool	Target Population
Questionnaire survey	Structured form	Households
Semi-structured interview	Interview guide	Administrations, NGOs
Direct observation	Observation grid	Dump sites, collection points

Documentary analysis	Analysis grid	Legal texts, budgets, reports
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Note. Triangulation of sources aims to strengthen the validity of the results, in accordance with the methodological recommendations of Lelo Nzuzi (2022).

2.5. Data Processing

Quantitative data were processed using SPSS 26.0. Descriptive statistics (frequencies, percentages, means, standard deviations) and inferential statistics including chi-square test, Kruskal-Wallis test, and Spearman correlation were computed. Qualitative data underwent thematic content analysis (open then axial coding), according to the approach advocated by Munongo Yula (2025) for the analysis of environmental public policies in the DRC.

2.6. Ethical Considerations

Informed consent was obtained, data were anonymized, and authorization was granted by local authorities, in accordance with ethical requirements for social science research applied to the environment.

2.7. Statistical Analysis Strategy

Given the nature of the variables studied categorical variables (administrative level, type of stakeholder) and ordinal variables (risk perception scores on a Likert scale) the following tests were selected: chi-square test for associations between categorical variables; Kruskal-Wallis test for comparing three or more independent groups on ordinal or non-normal continuous variables; and Spearman correlation for relationships between ordinal or non-normal continuous variables. These methodological choices align with recommended practices in environmental perception analysis (Slovic, 1987; Klinke & Renn, 2002).

3. Results

3.1. Profile of Respondents

Table 3. Sociodemographic Characteristics of Surveyed Households (N = 900).

Variable	Category	n	%
Commune	Masina	100	11.1
	Limete	100	11.1
	Gombe	100	11.1
	Makala	100	11.1
	Ngaba	100	11.1
	Selembao	100	11.1
	Ngiri-Ngiri	100	11.1
	Kalamu	100	11.1
	Ngaliema	100	11.1
Gender	Male	428	47.6
	Female	472	52.4
Age	18–30 years	261	29.0
	31–45 years	336	37.3
	46–60 years	204	22.7
	Over 60 years	99	11.0
Education level	Primary or less	162	18.0

	Secondary	468	52.0
	Higher	270	30.0

Note. N = 900. Percentages may not sum to 100% due to rounding.

3.2. Administrative Coordination

3.2.1. Jurisdictional Overlaps

Table 4. Frequency of Jurisdictional Overlaps Reported by Administrative Officers (N = 45).

Type of Overlap	n	%
Collection responsibility conflict	32	71.1
Health regulation conflict	25	55.6
Budget allocation conflict	20	44.4
No overlap reported	9	20.0

Note. Respondents could report multiple types of overlap; percentages therefore sum to more than 100%. These results corroborate the observations of Munongo Yula (2025) on institutional competition in waste management in Kinshasa.

The chi-square test reveals a significant association between administrative level and the existence of coordination mechanisms, $\chi^2(2, N = 45) = 12.18, p = .002$.

3.2.2. Institutional Communication Failures

Table 5. Frequency of Institutional Meetings Reported by Administrative Officers (N = 45).

Meeting Frequency	n	%
Weekly	5	11.1
Monthly	13	28.9
Quarterly	16	35.6
Never	11	24.4

Note. N = 45. These data echo the findings of the African Development Bank (2026) on the need to strengthen inter-institutional coordination in Kinshasa.

3.3. Political Choices and Resource Allocation

Table 6. Distribution of Intervention Types Between 2021 and 2025.

Type of Intervention	Frequency (per year)	Budget Share (%)
Emergency evacuation	58	66
Preventive awareness	12	14
Infrastructure investment	12	14
Recycling projects	6	6

Note. Data from municipal budget documents and intervention records (2021–2025). The predominance of emergency evacuation confirms Lelo Nzuzi's (2022) analysis of the curative nature of public waste management policies in Kinshasa.

3.4. Perception of Health and CBRN Risks

3.4.1. Risk Perception by Stakeholder

Table 7. Health and CBRN Risk Perception Scores by Stakeholder Type (1–5 Scale).

Stakeholder	n	Median	IQR	Mean	SD
Households	900	3.3	1.5	3.25	0.89
Administrative officers	45	2.7	1.3	2.68	0.83
Informal waste pickers	45	4.2	0.9	4.08	0.71
NGOs	18	3.8	1.1	3.72	0.84

Note. Risk perception was measured on a 5-point Likert scale (1 = very low, 5 = very high). The Kruskal-Wallis test indicates a significant difference between stakeholder types, $H(3) = 48.92$, $p < .001$. These results align with Slovic's (1987) theoretical framework on differentiated risk perception according to exposure and personal involvement.

3.4.2. Specific Perception of CBRN Risks

Table 8. Perception of CBRN Sub-dimensions by Informal Waste Pickers (N = 45).

CBRN Sub-dimension	Mean Score (1–5)	SD	% Spontaneous Mention
Chemical risk	4.3	0.68	84.4
Biological risk	4.5	0.54	88.9
Radiological risk	2.2	1.05	17.8
Nuclear risk	1.5	0.86	6.7

Note. N = 45. Scores are expressed on a 5-point Likert scale (1 = very low, 5 = very high). The “% Spontaneous Mention” column indicates the proportion of waste pickers who spontaneously mentioned this sub-dimension during

interviews. The results show a differentiated perception of CBRN sub-dimensions: chemical and biological risks are widely recognized, while radiological and nuclear risks remain largely unknown.

3.4.3. Comparison of Risk Perception Between Communes

Table 9. Comparison of Risk Perception Among Households in the Nine Communes.

Commune	n	Median	Mean	SD	Rank
Masina	100	3.9	3.78	0.76	1
Selembao	100	3.7	3.62	0.81	2
Makala	100	3.6	3.48	0.83	3
Ngaba	100	3.4	3.32	0.86	4
Ngiri-Ngiri	100	3.3	3.24	0.88	5
Limete	100	3.1	3.08	0.84	6
Kalamu	100	3.0	2.98	0.87	7
Ngaliema	100	2.8	2.82	0.92	8
Gombe	100	2.7	2.76	0.91	9

Note. Scores on a 1–5 scale. Kruskal-Wallis test: $H(8) = 62.47$, $p < .001$. Post hoc Mann-Whitney U tests (Bonferroni correction) reveal three distinct groups: high-perception communes (Masina, Selembao, Makala), intermediate-perception communes (Ngaba, Ngiri-Ngiri, Limete), and low-perception communes (Kalamu, Ngaliema, Gombe). These geographical disparities confirm the observations of Buhendwa et al. (2026) on the unequal distribution of environmental risks in Kinshasa.

3.4.4. Relationship Between Administrative Participation and Risk Perception

Spearman correlation analysis reveals a weak positive correlation between degree of administrative participation and risk perception, $r_s(898) = .26$, $p < .001$. This result echoes the

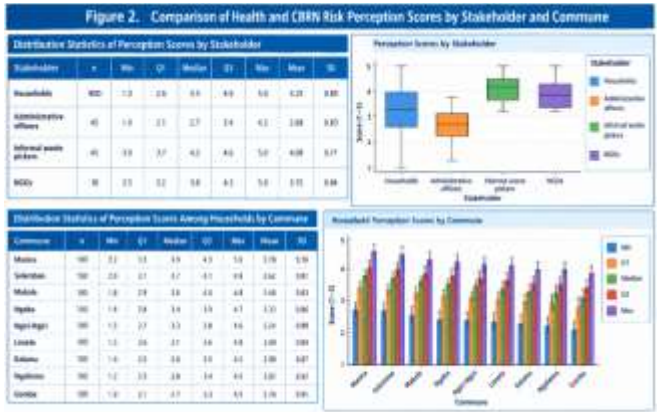
conclusions of Kadilekoloko Masamuna (2020) and Rafea-Congo (n.d.) on the link between institutional information and risk awareness.

3.5. Comparison Between Stakeholders

Table 10. Summary of Intergroup Comparisons of Risk Perception.

Comparison Pair	Test	Statistic	p	Effect Size
Households vs. administrative officers	Mann-Whitney U	U = 15,420	.008	r = .19
Households vs. waste pickers	Mann-Whitney U	U = 8,640	< .001	r = .36
Administrative officers vs. waste pickers	Mann-Whitney U	U = 312	< .001	r = .53
Inter-commune (nine groups)	Kruskal-Wallis	H = 62.47	< .001	$\eta^2 = .11$

Note. Effect size: $r = Z/\sqrt{N}$; η^2 approximated. p-values for pairwise comparisons are Bonferroni-corrected.



Note. Risk perception scores were measured on a 5-point Likert scale (1 = very low, 5 = very high). The Kruskal-Wallis test reveals significant differences between stakeholders ($H(3) = 48.92, p < .001$) and between communes ($H(8) = 62.47, p < .001$). Informal waste pickers have the highest scores ($M = 4.08$), followed by NGOs ($M = 3.72$), households ($M = 3.25$), and administrative officers ($M = 2.68$). These results confirm Slovic's (1987) psychometric model.



Note. This figure presents a prospective mapping of CBRN risk sources in household waste in Kinshasa by 2030. The diagram highlights the diversity of sources (households, markets, institutions), the multiplicity of CBRN components (chemical, biological, radiological, nuclear), and the main propagation vectors (air, water, soil, direct contact). It shows that the most exposed populations are informal waste pickers, children, and riparian populations of uncontrolled dumps. Data are prospective projections based on observed trends (2021–2025) and Kinshasa urbanization scenarios to 2030 (Buhendwa et al., 2026; Kadilekoloko Masamuna et al., 2025).



Note. This figure proposes a strategic roadmap for CBRN risk prevention in Kinshasa between 2025 and 2030. Structured in four temporal phases (diagnosis and awareness; institutional and legal strengthening; operational deployment; consolidation and evaluation) and four intervention axes (governance, regulation, infrastructure, training), this roadmap identifies priority actions, institutional responsibilities, and monitoring indicators. It aims to provide the city with an integrated operational framework to anticipate and prevent CBRN risks associated with household waste. Budget projections are indicative and should be adjusted

according to effectively mobilized funding (World Bank, 2026; African Development Bank, 2026).

4. Discussion

4.1. Hypothesis Testing

The data confirm the administrative fragmentation hypothesis (H1). The high rate of jurisdictional overlaps (71.1%) and the significant association between administrative level and coordination mechanisms ($p = .002$) attest to this fragmentation, converging with Munongo Yula's (2025) analyses of institutional competition and those of Hooghe and Marks (2003) on the challenges of multi-level governance.

The data confirm the hypothesis of a political preference for emergency (H2). Between 2021 and 2025, 66% of the budget was allocated to emergency evacuation, compared to 14% for preventive awareness, echoing Lelo Nzuzi's (2022) observations and contrasting with the orientations advocated by the World Bank (2026) and the African Development Bank (2026).

The data strongly support the hypothesis of variation in risk perception according to stakeholders (H3). The Kruskal-Wallis test reveals a significant difference between groups ($p < .001$). Informal waste pickers have the highest perception ($M = 4.08$), while administrative officers have the lowest ($M = 2.68$), consistent with Slovic's (1987) psychometric model and Klinke and Renn's (2002) analyses of risk management strategies.

4.2. The CBRN Dimension: An Emerging Concern but Institutionally Neglected

The results reveal a fundamental asymmetry between the perception of CBRN risks by field stakeholders and their institutional treatment. While informal waste pickers clearly identify chemical (84.4%) and biological (88.9%) risks associated with household waste, radiological and nuclear risks remain largely unknown (17.8% and 6.7% spontaneous mention). This lack of awareness is not specific to waste pickers: administrative officers themselves did not mention the CBRN dimension during interviews, revealing an institutional gap in apprehending these risks.

This situation contrasts with the provisions of the Congolese Environmental Code (Democratic Republic of Congo, 2002) and Law No. 17/001 of 2017 setting the rules applicable to waste management, which theoretically provide for a category of "hazardous waste" including chemical and radioactive waste. The gap between the legal framework and field reality

confirms Munongo Yula's (2025) analyses of the partial application of normative texts in the Kinshasa context.

The extension of the study to nine communes reveals a spatial gradient of risk perceptions that follows the socio-economic geography of Kinshasa. The most densely populated and least well-served communes in terms of collection services (Masina, Selembao, Makala) have the highest perception scores, while better-endowed communes (Gombe, Ngaliema) have the lowest. This configuration confirms the hypothesis of a spatially structured environmental injustice in Kinshasa, documented by Buhendwa et al. (2026).

Integrating the CBRN dimension into household waste management in Kinshasa would require: the establishment of specific streams for diffuse hazardous waste (batteries, e-waste, medical waste); training of officers and informal waste pickers in the identification of CBRN risks; public information on sorting practices and the dangers associated with hazardous waste; and coordination with national authorities competent in radiological and nuclear safety.

4.3. Confrontation with the Literature

The results echo research on waste governance in sub-Saharan Africa, which identifies administrative fragmentation as a recurring limiting factor (Munongo Yula, 2025; Tetra Tech, 2022). The study further provides an empirical contribution by quantifying differences in risk perception among stakeholders, a dimension often absent from existing analyses (Kadilekoloko Masamuna, 2020; Rafea-Congo, n.d.).

The environmental dimension of risks is confirmed by the work of Phaka et al. (2022) on air quality in Kinshasa and Mongabay (2025) on plastic pollution, which document the health consequences of illegal dumps. The study extends these analyses by explicitly integrating the CBRN dimension, still little explored in the Congolese context.

4.4. Limitations of the Study

- Limited access to certain budget data;
- Possible social desirability bias in interviews;
- Study period limited to 2021–2025;
- Small sample size for non-household stakeholders (45 officers, 45 waste pickers, 18 NGOs), limiting generalization of results.

4.5. Theoretical and Practical Implications

The study contributes to multi-level governance theory (Hooghe & Marks, 2003): the divergence in risk perceptions among stakeholders is not only a management problem but also a source of governing legitimacy the perceptions of the most directly exposed groups (informal waste pickers) should be integrated into the decision-making process, in accordance with the principles of Klinke and Renn's (2002) discursive strategy.

The integration of the CBRN dimension into the analysis of household waste opens up a new field of research in Kinshasa, at the intersection of environmental governance, public health, and security.

5. Conclusion

Between 2021 and 2025, household waste management in Kinshasa remains structured by administrative fragmentation that limits the coherence of interventions (Munongo Yula, 2025). Political choices, although marked by growing awareness of health issues, still favor curative responses (Lelo Nzuzi, 2022). The systematic differences in risk perception among stakeholders constitute both an obstacle to collective action and a potential lever for more inclusive governance (Slovic, 1987; Klinke & Renn, 2002).

The CBRN dimension, although marginalized in institutional discourse and practices, emerges as a concern among informal waste pickers most exposed to diffuse hazardous waste. Its integration into public waste management policies appears as a necessity for a truly preventive and health-protective approach.

The analysis extended to nine communes highlights a spatial correlation between population density, collection service failure, and increased perception of health and CBRN risks. This configuration calls for a differentiated approach to public policies, taking into account the specificities of each commune rather than a uniform strategy at the city scale.

Recommendations:

- Creation of a formalized coordination framework between the three administrative levels (African Development Bank, 2026);
- Systematic integration of health and CBRN risk assessment into budget allocation decisions;
- Establishment of specific streams for diffuse hazardous waste (batteries, e-waste, medical waste);

- Strengthening of participation mechanisms for informal stakeholders (Kadilekoloko Masamuna, 2020);
- Training of administrative officers and waste pickers in CBRN risk identification;
- Implementation of the strategic roadmap for CBRN risk prevention (2025–2030).

Research perspectives: Longitudinal study on the evolution of risk perceptions; comparative analysis with other African metropolises; impact evaluation of the *Kin la Belle* programs (World Bank, 2026); specific research on the characterization of CBRN risks in Kinshasa household waste.

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