

Environmental health risks associated with open dumping practices in Central Kalimantan, Indonesia: an observational study

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ABSTRACT

Introduction: Rural and semi-urban communities in Central Kalimantan face severe environmental health risks due to inadequate municipal solid waste management. With waste generation exceeding 1,200 tons daily, local infrastructure is overwhelmed. This study investigates the complex interplay among environmental degradation, occupational hazards, and community health in this region resulting from open dumping practices.

Method: We used a cross-sectional observational study design with a mixed-methods approach across 14 regencies in Central Kalimantan. Data were collected through field observations of final disposal sites, qualitative focus group discussions with local stakeholders, and a review of the 2024 national waste registry. Thematic analysis was applied to identify sanitation deficits and health vulnerabilities.

Results: The region's waste stream is heavily organic (30%–57%). The study revealed that most disposal sites operate as unregulated open dumps lacking daily soil cover and functional leachate treatment plants, posing severe risks of groundwater contamination and vector-borne diseases. Furthermore, informal waste pickers were observed foraging for recyclables and livestock feed (e.g., for swine) without adequate personal protective equipment. This practice exposes them to acute physical and biological hazards, while the use of untreated refuse for animal feed introduces severe epidemiological risks, including zoonotic and parasitic pathogens (such as *Taenia solium*), into the human food chain.

Conclusion: This research highlights the critical environmental and public health crises driven by open dumping. Urgent multisectoral interventions are required to upgrade sanitation infrastructure, enforce occupational safety standards for informal workers, and develop culturally sensitive policies to mitigate the epidemiological risks posed by unmanaged waste.

Keywords: open dumping, environmental health, occupational hazard, informal waste pickers, sanitation, Indonesia.

Introduction

Inadequate municipal solid waste management (SWM) remains a critical public health and environmental challenge in developing countries. Despite the global push towards sustainable waste management, open dumping remains the predominant method of waste disposal in many low- and middle-income nations. This practice exposes surrounding communities to severe environmental health hazards, including groundwater contamination from toxic leachate, air pollution from spontaneous combustion and methane emissions, and the proliferation of disease vectors such as mosquitoes, flies, and rodents.^[1,2] Consequently, populations living near or working within these unregulated disposal sites experience a higher burden of waterborne, vector-borne, and respiratory diseases.^[3]

In Central Kalimantan, Indonesia, rural and semi-urban communities are already facing severe environmental health challenges. Previous studies have highlighted that local populations are highly vulnerable to water contamination from extractive industries, leading to significant outbreaks of gastroenteritis and chronic dermatitis.^[4] This fragile public health baseline is now further threatened by rapid population growth and urbanization, which have significantly increased daily waste generation to over 1,200 tons per day across the province.

Despite national regulations mandating environmentally sound waste management, local infrastructure is profoundly overwhelmed. Most final disposal sites still operate as unregulated open dumps rather than controlled sanitary landfills.^[5] The high organic waste content—often exceeding 50% of the total volume—combined with high rainfall in this tropical region accelerates the decomposition process. This leads to overwhelming leachate production and severe odour, which directly compromise the sanitation and health of nearby settlements.

Furthermore, these operational deficits pose direct occupational and epidemiological risks. Informal waste pickers frequently operate in these hazardous environments without adequate personal protective equipment (PPE), leaving them highly vulnerable to dermatological infections, biological pathogens, and physical injuries.^[6,7] Crucially, these individuals not only scavenge for recyclable plastics to sell for economic survival, but they also collect organic refuse to be used as livestock feed, particularly for swine. This specific practice creates a dangerous pathway for zoonotic pathogens and toxic bioaccumulation to enter the human food chain. Given the scarcity of literature focusing on

the intersection of waste infrastructure deficits, informal scavenging practices, and health outcomes in this specific region, this study aims to evaluate the environmental and occupational health risks associated with current open dumping practices in Central Kalimantan to inform evidence-based public health policies.

Method

This cross-sectional observational study, employing a mixed-methods approach, was conducted between August and November 2025 across 13 regencies and one municipality in Central Kalimantan Province, Indonesia. To evaluate the systemic environmental and occupational health risks associated with municipal solid waste management deficits, data triangulation was achieved through field observations, qualitative discussions, and secondary data analysis. Direct site inspections were conducted at 14 major final disposal sites and various intermediate community waste-processing facilities to assess sanitary conditions, leachate management, the application of daily soil cover, and occupational safety practices—particularly the use of personal protective equipment among informal waste pickers. Furthermore, qualitative data were gathered through focus group discussions involving local environmental agency officials, facility operators, and community representatives to explore operational challenges and perceived health risks. This primary data was complemented by quantitative baseline data regarding waste generation and composition extracted from the 2024–2025 national waste registry.

For data analysis, quantitative data regarding waste volume and infrastructure capacity were evaluated using descriptive statistics to identify systemic deficits. Qualitative transcripts from the discussions and field notes were subjected to thematic analysis to identify recurring patterns in environmental hazards, occupational vulnerabilities, and governance gaps. The study maintained strict ethical standards by anonymizing all participant identities and obtaining verbal consent before the discussions, ensuring that the research focused solely on documenting observable environmental health risks rather than making speculative clinical diagnoses.

Results

Waste generation and environmental hazards

Based on the national waste registry data for 2024, Central Kalimantan generates approximately 1,213 tons

Table 1. Summary of municipal solid waste characteristics and sanitation deficits in Central Kalimantan

Parameter	Observational findings	Public health implications
Daily Waste Generation	~1,213 tons/day across the province.	High volume of unmanaged waste increases the burden of environmental sanitation.
Waste Composition	Highly organic (30%–57% food/agricultural residue); Plastic (10%–50%).	Rapid decomposition in tropical climates creates severe odour and breeding grounds for disease vectors such as mosquitoes and flies.
Disposal Site Operation	Predominantly unregulated open dumping; lack of daily soil cover.	Spontaneous combustion causes respiratory hazards; exposed waste increases vector-borne disease transmission.
Leachate Management	Effluent treatment plants are either absent, unmaintained, or malfunctioning.	High risk of toxic leachate seeping into groundwater, potentially contaminating local drinking water sources.
Occupational Safety	Workers and informal waste pickers operate without adequate Personal Protective Equipment (PPE).	Extreme vulnerability to dermatological conditions, infections, biological pathogens, and sharp-object injuries.

of municipal solid waste daily. The composition analysis (Table 1) indicates a heavy dominance of organic waste, primarily food and agricultural residue, which constitutes between 30% and 57% of the total waste stream across various regencies, followed closely by plastics (10% to 50%). In a tropical climate characterized by high humidity and rainfall, this high organic load accelerates decomposition. Consequently, this generates substantial volumes of toxic leachate and noxious gases (such as methane and hydrogen sulphide), creating an optimal breeding environment for disease vectors, including flies, mosquitoes, and rodents.

Sanitation deficits at final disposal sites

Field observations across the province revealed severe systemic deficits in sanitation infrastructure. Despite initial designs intended for sanitary or controlled landfill operations, the vast majority of final disposal sites effectively function as unregulated open dumps. Primary operational failures include the absence of daily soil cover due to severe shortages of heavy equipment and operational budgets. Furthermore, qualitative assessments indicated that several sites suffer from chronic overloading. Most notably, essential environmental safeguards, such as

functional leachate treatment plants, are either completely absent or malfunctioning, allowing untreated effluent to potentially contaminate surrounding groundwater and soil.

Occupational health and safety vulnerabilities

The most critical public health concern identified was the severe occupational vulnerability of informal waste pickers and sanitation workers. Observational data confirmed that individuals routinely operate within these highly hazardous environments without basic personal protective equipment (PPE), such as thick gloves, safety boots, or respiratory masks (Figure 1).

During qualitative discussions, stakeholders acknowledged that these workers face daily, direct exposure to a triad of hazards: physical risks (puncture wounds from sharp objects and medical waste), biological risks (pathogen exposure leading to skin infections, tetanus, and diarrhoeal diseases), and chemical risks (inhalation of toxic gases and dust during waste transportation and dumping). Furthermore, the lack of routine medical check-ups and health insurance coverage for these frontline workers exacerbates their vulnerability to chronic and acute occupational diseases.



Figure 1. Environmental and occupational hazards at a final disposal site in Central Kalimantan.

(A) Aerial view demonstrating unregulated open dumping practices without daily soil cover, situated alarmingly close to green belts and potential water runoffs. (B) Informal waste pickers operating without adequate personal protective equipment (PPE). These individuals forage for economically valuable plastics and retrieve organic waste for livestock (swine) feed, exposing themselves to direct physical hazards and creating a pathway for zoonotic disease transmission (Source: Author's own photographs).

Discussion

The findings of this observational study highlight a critical intersection between municipal infrastructure deficits and public health vulnerabilities in Central Kalimantan. The persistent reliance on open dumping, despite initial plans for sanitary landfills, mirrors the systemic challenges frequently observed in rapidly urbanizing regions of developing nations.^[8] The high proportion of organic waste documented in this region is particularly concerning from an epidemiological perspective. In a tropical climate, exposed organic matter decomposes rapidly, producing highly concentrated leachate and noxious gases.

Without functional effluent treatment systems, as observed in multiple disposal sites across the province, the continuous discharge of raw leachate poses a severe threat to local groundwater quality. Leachate from mixed municipal waste often contains dangerous levels of organic pollutants and heavy metals. This is particularly critical in Central Kalimantan, where rural communities rely heavily on river water for daily sanitation and waterborne illnesses are already a primary public health concern.^[4,9] Furthermore, the lack of daily soil cover transforms these disposal sites into massive breeding habitats for disease vectors, including rodents and insects, thereby increasing the potential for vector-borne disease outbreaks.^[10]

The occupational health hazards identified in this study are equally alarming. Sanitation workers and informal waste pickers operate in environments saturated with

biological, chemical, and physical hazards. Continuous exposure to such environments without basic PPE and routine medical surveillance directly correlates with the high incidence of dermatological infections, respiratory issues, and puncture injuries reported globally among informal waste workers.^[11,12]

More importantly, the economic realities driving these informal workers to scavenge not only for sellable plastics but also for organic refuse to feed livestock introduce a severe epidemiological risk that extends far beyond the dump site. The practice of feeding untreated, contaminated municipal waste to swine creates a direct pathway for zoonotic disease transmission, including parasitic infections such as *Taenia solium* (pork tapeworm).^[13] Additionally, it facilitates the bioaccumulation of heavy metals and microplastics within the livestock, which eventually re-enter the human food chain, posing long-term chronic health risks to the broader population.^[14]

The root cause of these environmental health crises lies in governance and financial prioritization. The regional budget allocation for waste management remains critically low, severely restricting the procurement of heavy equipment, PPE, and the maintenance of sanitary infrastructure. Addressing these health hazards requires a paradigm shift, recognizing solid waste management not merely as a public works issue, but as a fundamental public health necessity. Cross-sectoral collaboration involving public health authorities, environmental agencies, and local governments is imperative to enforce occupational

safety standards, regulate informal scavenging practices, and transition towards sustainable waste processing.

Conclusion

Municipal solid waste management in Central Kalimantan currently functions below minimum sanitary standards, relying predominantly on unregulated open dumping. This infrastructural deficit creates severe environmental health risks, including potential groundwater contamination from untreated leachate and the proliferation of disease vectors. Furthermore, the presence of informal waste pickers scavenging for recyclables and organic livestock feed without adequate personal protective equipment exposes them to extreme occupational hazards. Crucially, the practice of feeding contaminated refuse to swine introduces severe zoonotic and toxicological risks into the human food chain. Urgent multi-sectoral public health interventions are required. Policymakers must prioritize financial investments to upgrade disposal sites, enforce occupational safety standards for informal workers, and develop culturally sensitive waste management policies to mitigate these cascading health impacts.

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