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Integrating Waste Communication into Climate-Resilient Disaster Risk Reduction Strategies

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ABSTRACT

Post-disaster waste management is a critical but under-communicated dimension of climate-resilient disaster risk reduction (DRR). This study aims to explain how waste communication practices support climate resilience, clarify how adaptive communication bridges coordination among disaster-management agencies, environmental offices, volunteers, and communities, and develop an Adaptive Waste Communication Framework (AWCF). Using constructivist grounded theory, data were gathered through in-depth interviews, policy document analysis, and participatory observation with BPBD, DLH, volunteer, community, and policy-support actors in disaster-prone localities in Indonesia, including North Sumatra, Southwest Maluku, Indramayu, Sidoarjo, Batang, and Yogyakarta. The analysis followed open, focused, axial, and theoretical coding with constant comparison. The findings show that communication functions not only as information transmission but also as policy sensemaking, cross-institutional coordination, and civic environmental literacy. These dimensions explain why post-disaster waste policies often fail when technical instructions are not translated into shared meanings, role clarity, and locally legitimate risk messages. The AWCF contributes to grounded theory, environmental communication, and disaster communication by positioning adaptive communication as socio-ecological infrastructure for safer, more participatory, and climate-sensitive waste governance.

Keywords: Adaptive governance, climate resilience, disaster communication, environmental communication, grounded theory, waste management

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INTRODUCTION

Climate-related disasters have intensified the urgency of disaster risk reduction (DRR) in Indonesia, a country that faces high exposure to floods, landslides, and other hazards (Aziz & Azzamullah, 2025; Aziz & Putri, 2024). Disaster impacts do not end with evacuation and emergency response. They also generate debris, household waste, chemical residues, construction waste, and hazardous materials that can threaten health and environmental recovery when they are not managed properly (Artayasa et al., 2022; Dahana et al., 2024; Darza, 2020; Despa et al., 2024; Kurniawati et al., 2024; Wulandari et al., 2022). In this context, post-disaster waste management is linked to SDG 11, SDG 12, and SDG 13 because it affects sustainable settlements, responsible consumption, and climate action.

Indonesia has strengthened environmental governance through the Regulation of the Minister of Environment and Forestry No. 1 of 2024 concerning Post-Disaster Waste Management. Yet, regulatory direction alone does not automatically produce coordination in the field. Previous studies show that disaster mitigation, legal education, environmental governance, and flood response depend on the clarity of authority, community participation, and local capacity (Anggraeni et al., 2024; Alam, 2023; Anugrah, 2021; Maidi & Bagastyo, 2024; Maulana et al., 2024; Nurlukman & Basit, 2023; Nurmaliza & Yusnita, 2024; Putra et al., 2025;). National Waste Management Information System data in 2024 also indicate that a large share of waste remains unmanaged, while waste reduction is still limited. The flood case in Bali, where waste blocked river flows during extreme rainfall, further shows that waste is not merely a technical problem but also a risk-communication problem. If risk messages are weak, agencies and communities may not share the same priorities for sorting, transporting, isolating, or processing waste.

This paper therefore treats waste communication as an adaptive process that translates environmental risks into collective action. The research questions are: (1) how do waste communication practices contribute to climate resilience in disaster-prone areas; (2) how does adaptive communication bridge coordination among BPBD, DLH, volunteers, local communities, and policy-support actors; and (3) what conceptual dimensions form the Adaptive Waste Communication Framework (AWCF). The study contributes to disaster communication and environmental communication by explaining how policy meaning, institutional coordination, and civic literacy are constructed through field interaction rather than delivered as one-way information (Arachman et al., 2024; Imperiale & Vanclay, 2024; Islam et al., 2025; Khusna et al., 2023; Luebbe, 2024; Upadhyay & Sa-ngiamwibool, 2021; Xie et al., 2025).

THEORETICAL FRAMING

Environmental communication provides the first analytical lens for this study. It explains how environmental problems are not understood only through physical indicators, but also through messages, institutional narratives, public legitimacy, and everyday practices. Waste becomes a risk issue when actors interpret it as a threat to public health, drainage systems, emission control, and ecological recovery. Studies on waste governance, legal education, and environmental management show that regulations must be supported by public understanding and locally accepted practices (Anggraeni et al., 2024; Kurniawati et al., 2024; Nurlukman & Basit, 2023; Putra et al., 2025). In this study, environmental communication is used to examine how waste sorting, open-burning prohibition, and landfill reduction are communicated as practical norms rather than abstract environmental ideals.

Disaster communication provides the second lens. Disaster response requires rapid information flow, credible sources, clear roles, and action-oriented messages. Previous studies on flood communication, early warning, and disaster resilience show that communication is effective when it enables preparedness, coordination, and community response instead of simply distributing information (Alam, 2023; Arachman et al., 2024; Aziz & Putri, 2024; Islam et al., 2025; Maidi & Bagastyo, 2024;). In post-disaster waste management, this means that messages must explain what waste is hazardous, where it should be collected, who is responsible for transportation, and how residents can reduce secondary health and environmental risks.

The third lens is CGT, which connects empirical data with theory construction. Instead of assuming that waste communication already has a fixed model, this study allows categories to emerge from participants' experiences. This approach is aligned with social-constructivist research because it treats meaning as negotiated, contextual, and shaped through institutional interaction (Charmaz, 2020; Keane, 2025; Levitt, 2021; Mohajan & Mohajan, 2022). The AWCF was therefore developed by comparing interview data, policy documents, and observation notes until the three explanatory categories became theoretically saturated: policy sensemaking, cross-institutional coordination, and civic environmental literacy.

RESEARCH METHOD AND ANALYTICAL LENS

This study uses a qualitative approach within a constructivist paradigm. Constructivist Grounded Theory (CGT) was selected because post-disaster waste communication is shaped through negotiated meanings, institutional practices, and local experiences rather than through a fixed technical sequence. In CGT, theory is constructed interpretively through interaction between researchers, participants, and data (Charmaz, 2020; Keane,

2025; Levitt, 2021; Mohajan & Mohajan, 2022). This logic is suitable for analysing how waste becomes a public-risk issue, how environmental messages are legitimised, and how disaster actors convert information into operational action.

The research was conducted in Indonesia and focused on disaster-prone localities represented by North Sumatra, Southwest Maluku, Indramayu Regency, Sidoarjo Regency, Batang Regency, and Yogyakarta. These locations and institutional settings were purposively selected because they illustrate coastal/island vulnerability, dense settlement and floodplain problems, regional disaster-response practice, and policy-support perspectives. Participants included BPBD and DLH officials, local volunteers, community actors, health and environmental practitioners, academics, journalists, and civil society actors. Data were collected for six months through semi-structured interviews, policy and operational-document analysis, and participatory observation in disaster-response simulations and cross-sector coordination forums.

Data analysis was conducted simultaneously with data collection using open coding, focused coding, axial coding, and theoretical coding (Jailani & Husnullail, 2024; Ruslan et al., 2023). Initial codes such as role ambiguity, waste sorting, health risk, temporary storage, burning prohibition, volunteer legitimacy, and climate mitigation were compared continuously with new data. Focused coding grouped these codes into three categories: policy sensemaking, cross-institutional communicative coordination, and civic environmental literacy. Axial coding connected the categories to environmental communication and disaster communication by asking how meaning, message credibility, and response coordination affected climate-resilient DRR. Credibility was maintained through source and method triangulation, member checking, audit trails, and reflexive memos (Curmi & Farrugia, 2025; Yu, 2021).

RESULTS AND DISCUSSION

Analytical coding showed that waste communication operates at three connected levels (Table 1). At the policy level, communication helps actors interpret regulations and convert them into operational priorities. At the institutional level, communication aligns roles, data flows, and response routines. At the citizen level, communication develops environmental literacy so that communities understand sorting, public-health risks, river protection, and climate implications. These findings respond to the theoretical gap in the earlier draft by analysing the empirical data through CGT, environmental communication, and disaster communication rather than reporting interview excerpts as isolated field data.

Table 1
Condensed grounded-theory coding matrix for the AWCF

CGT Stage	Empirical Codes	Analytical Category	Theoretical Contribution
Open/focused coding	role ambiguity; sorting; temporary storage; burning prohibition	Policy sensemaking	Waste policy becomes shared meaning, not only formal regulation.
Axial coding	fleet limits; command channels; volunteer legitimacy; health messages	Cross-institutional coordination	Disaster communication connects data, roles, and field decisions.
Theoretical coding	public education; river behaviour; GHG emissions; compost/biogas	Civic environmental literacy	Environmental communication links waste practice with climate resilience.

First, policy sensemaking emerged as the core process through which actors interpret post-disaster waste regulations. Statements from DLHK North Sumatra about the need for a sustainable collaborative organisation, including youth and scouts, show that local implementers understand policy not only as a technical rule but also as a social mechanism for building an environmentally conscious culture. This finding extends environmental communication theory because policy messages become effective only when they create shared meaning and local ownership. In CGT terms, the empirical codes collaboration, youth involvement, and environmental awareness were integrated into the focused category of policy sensemaking.

However, policy meaning was also shaped by implementation gaps. Fabianus Hidayat noted difficulties caused by limited fleets and the absence of special disposal locations, while government guidance emphasised waste sorting and different bag colours. Marthen Temmar from BPBD Southwest Maluku described limited temporary shelters, hazardous-waste separation, equipment, and personnel in 3T areas. These differences reveal an interpretive gap between regulatory ideals and field capacity. Disaster communication theory explains this gap as a failure to translate centralised instructions into actionable, location-sensitive messages. For climate-resilient DRR, contingency planning must therefore be treated as an adaptive communication document, not merely an administrative requirement.

Second, cross-institutional coordination depended on the ability to connect technical information with decisions. Field data showed that the absence of a shared matrix of tasks can separate volume estimation, hazardous-waste classification, transport routes, health messages, and disposal decisions. The proposed Contingency-Based Waste Communication Protocol (P-KLB) addresses this problem by organising communication as operational infrastructure. It contains a pre-disaster phase for mapping capacity and

communication routes, an emergency phase for message coding and channel orchestration, and a post-disaster phase for feedback on waste volume, hotspots, and health-risk indicators. This protocol links disaster communication to environmental governance by making information flow accountable, repeatable, and locally understandable.

The P-KLB also clarifies why communication should include formal and social authorities. Rebayat Jelita emphasised the importance of a task force and the involvement of scouts, while Riza Zakiyah stated that actors are often involved only after a disaster, although their role can be strategic before a disaster. These statements show that communication credibility is not produced by government instruction alone. It is strengthened through volunteers, religious or customary leaders, youth groups, and community networks. Adaptive coordination should therefore combine BPBD, DLH, health offices, landfill facilities, volunteers, and community leaders through shared data formats, pre-scripted risk messages, rapid reporting channels, and inter-agency tabletop drills.

Third, civic environmental literacy became the bridge between technical waste governance and climate adaptation. Field findings show that residents and volunteers need simple knowledge about sorting, temporary storage, sanitary handling, burning prohibition, and river protection. Irvan Ardhilas Istiartono warned that burning waste, especially plastic, is dangerous to health, while Mardiono emphasised public education and sanctions to prevent waste disposal in rivers. These findings show that environmental literacy is not only knowledge of waste types. It is also a social norm that links household behaviour, flood risk, public health, and climate resilience.

The climate dimension of civic literacy was also visible in the discussion of landfills as greenhouse-gas emission sources. Rita Mulyandari emphasised that waste transported to landfills may contribute to climate change and therefore needs processing facilities such as composting or biogas. This finding connects the circular economy to DRR in a situational way. In emergency response, health and safety remain the first priority. In recovery and preparedness phases, however, organic waste processing, debris reuse, and local recycling can support emission reduction and community recovery. This distinction prevents the circular economy from being applied normatively without considering emergency constraints.

The three categories also show a sequential logic. Policy sensemaking defines the risk problem and interprets regulation. Cross-institutional coordination converts that interpretation into a division of roles, operational messages, and resource mobilisation. Civic environmental literacy embeds the message in community practice so that residents, volunteers, and local leaders can act before, during, and after disaster. This sequence is not linear in a rigid sense; it is iterative because every disaster event produces new information about waste volume, actor capacity, health risk, and community compliance. The AWCF therefore requires continuous feedback from the field to the policy level.

The empirical findings also indicate that communication must differentiate between emergency, recovery, and preparedness phases. In the emergency phase, messages must prioritise public safety, hazardous-waste isolation, evacuation access, and the prevention of dangerous practices such as plastic burning. In the recovery phase, messages can shift to debris sorting, temporary storage, sanitation, and the mobilisation of volunteers. In the preparedness phase, communication should focus on contingency planning, school and community literacy, river-cleanliness norms, and routine simulations. This phase-based communication is important because a single message cannot address all risks across the disaster cycle.

The AWCF can be operationalised through five instruments. First, a role-capability matrix should map BPBD, DLH, health offices, village governments, landfill managers, volunteers, and community leaders. Second, a rapid waste information system should report waste hotspots, available fleets, temporary-storage points, and hazardous materials. Third, pre-scripted risk messages should be prepared for residents, evacuees, volunteers, and local officials. Fourth, inter-agency tabletop drills should test whether messages, command channels, and logistics decisions are understood by all actors. Fifth, feedback from residents should be used to update contingency plans. These instruments translate CGT categories into practical tools for climate-resilient DRR.

These three categories form the Adaptive Waste Communication Framework (AWCF). The framework positions communication as socio-ecological infrastructure that links policy sensemaking, inter-agency coordination, and citizen literacy. The AWCF differs from one-way public information because it requires continuous translation between regulation, local capacity, risk messages, and community practice. Its practical components include a contingency-role matrix, rapid waste information system, standard messages for survivors and responders, training modules for volunteers, and feedback mechanisms to revise local contingency plans. In this sense, adaptive waste communication supports climate resilience by turning technical waste management into shared, legitimate, and coordinated collective action.

CONCLUSION

This study concludes that post-disaster waste management cannot be understood only as a logistical or technical problem. It is also a communication problem involving policy meaning, institutional coordination, and citizen literacy. Through CGT analysis, the study identified three core dimensions: policy sensemaking, cross-institutional communicative coordination, and civic environmental literacy. These dimensions explain how actors translate waste regulations, health risks, environmental norms, and climate concerns into collective action.

The proposed AWCF offers a practical and theoretical contribution. Theoretically, it strengthens disaster communication and environmental communication by showing how adaptive communication enables socio-ecological resilience. Practically, it recommends that local governments include waste communication in contingency plans, build shared data and reporting routines, prepare risk messages for different audiences, strengthen volunteer and community legitimacy networks, and connect waste handling with climate mitigation when the emergency phase allows. The study is limited to selected disaster-prone localities and qualitative data, so the findings are contextual. Nevertheless, the framework is transferable to regions facing similar waste, disaster, and climate-resilience challenges.

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