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GUEST EDITORIAL

Turning waste into opportunity: Advancing circular and equitable waste management in Indonesia

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BACKGROUND: GLOBAL CHALLENGES, LOCAL CRISIS

The issue of waste management has emerged as a critical environmental and social challenge globally (Hassan, 2024). Every day, billions of tons of waste are generated through human activities, much of which is inadequately managed. A 2018 report from the World Bank highlighted that over 2 billion tons of solid waste are produced annually, a figure projected to rise to 3.4 billion tons by 2050 without substantial changes in management practices (World Bank, 2018). Waste accumulation is more than a matter of disposal; it triggers complex issues, including soil, water, and air pollution (Rachmawati et al., 2024), as well as climate change, driven by greenhouse gas emissions like methane from landfills (Hoornweg & Bhada-Tata, 2012; Ahmad et al., 2023; Fauziah et al., 2023).

In Indonesia, a populous nation with high consumption rates, waste management poses significant challenges. According to the Ministry of Environment and Forestry (KLHK), national waste generation in 2023 reached approximately 19 million tons annually, with only 60–70% collected and less than 10% recycled (KLHK, 2023). Consequently, the majority of waste ends up in landfills—many of which still operate under open dumping systems that not only pollute the environment but also threaten the health of nearby communities (Ahmad et al., 2023; Astuti et al., 2024).

The escalating problem of plastic waste is particularly alarming. Research by Jambeck et al. (2015) indicates that Indonesia is the second-largest contributor to marine plastic waste globally, following China. The plastic waste entering the ocean endangers marine ecosystems and can infiltrate the human food chain as microplastics (Lebreton et al., 2012). This situation underscores the need to view waste management not only as a technical challenge but as an interconnected social, economic, and governance issue.

A SYSTEMIC APPROACH AND CIRCULAR ECONOMY AS STRATEGIC SOLUTIONS

To effectively address this crisis, a comprehensive and cross-sectoral approach is essential. It is crucial to apply a systems-based perspective throughout the waste management continuum —from product design and consumption patterns to collection, sorting, and final processing (Vallero, 2019). Waste should not be seen solely as the "end result" of consumption; rather, it is part of a larger system encompassing production, distribution, consumer behaviour, and regulatory frameworks. By understanding these interconnections, solutions can be more effective and sustainable.

A practical manifestation of this systemic approach is the adoption of a circular economy. This paradigm shifts away from the linear economic model of "take-use-dispose" to a circular system where materials and products are reused, repaired, or recycled to preserve their value (Geissdoerfer et al., 2017). In Indonesia, the beginnings of a circular economy are evident through initiatives such as converting organic waste into compost (Suyudi & Kartiwa, 2020), recycling plastics into building materials (Zainuddin , 2023), and establishing bottle return systems in the beverage industry (Lakhan, 2024).

Recent developments in 2024–2025 also demonstrate Indonesia's growing commitment to circularity. Several waste-to-energy (PLTSa) pilot facilities have begun operating in Surabaya, Tangerang, and Bekasi, signalling renewed efforts to reduce landfill dependency through controlled thermal processing and energy recovery. At the regional level, the ASEAN Circular Economy Framework (ASEAN 2021) now provides a cooperative platform for harmonising standards, improving material traceability, and supporting circular innovation across member states.

Nevertheless, the scale of implementation remains limited, requiring stronger incentive policies to encourage industries to transition to circular production models (World Bank, 2022). Embracing a circular economy not only alleviates

environmental burdens but also generates new economic opportunities. The World Bank estimates that a circular system could create millions of green jobs and enhance community economic resilience through recycling, waste management, and local resource-based innovation (BAPPENAS, 2021).

PENTAHELIX COLLABORATION: A KEY DRIVER OF CHANGE

Sustainable waste management cannot rest on the shoulders of a single entity; it requires cross-sector collaboration, known as the Pentahelix approach, which encompasses five key elements: government, academia, the business sector, communities/civil society, and the media (Putra & Raharjo, 2023). The government's role includes formulating and enforcing regulations, providing management infrastructure, and incentivizing businesses and communities that actively engage in sustainable practices (Suprapto, 2022). Academia serves as a source of innovation and research, delivering data-driven solutions and appropriate technologies (Mashudi et al., 2023).

The business sector carries significant responsibility through the implementation of the Extended Producer Responsibility (EPR) principle, requiring producers to manage post-consumer product waste (Baldé et al., 2015). Communities can function as catalysts for change at the grassroots level through initiatives such as waste banks, 3R waste disposal sites (TPS), and zero-waste community activities (Harsanto et al., 2024; Hidayati et al., 2025). The media plays a vital role in educating the public, raising awareness, and serving as a social monitor of implemented policies (Hayati et al., 2024).

The Pentahelix approach has shown effectiveness in various regions (levels of province, regency, or city) across Indonesia. For instance, a collaboration among local government, universities, and communities in Surabaya successfully reduced landfill waste by 20% through a waste bank programme and household composting (Jamaludin et al., 2023). This demonstrates that synergy among stakeholders can yield tangible impacts when consistently implemented based on data. Experience also shows that collaboration succeeds not only through participation but through sustained trust, transparent communication, and clear roles among the five Pentahelix pillars.

EDUCATION, BEHAVIOR CHANGE, AND LOCAL INNOVATION

The waste dilemma ultimately stems from consumer behaviour. Therefore, encouraging behavioural change is crucial for establishing a sustainable waste management system. Environmental education must be reinforced from elementary levels through university, instilling early awareness of the importance of managing waste at its source (Priatna & Khan, 2024; Zhan et al., 2024). Public campaigns advocating for initiatives like "sorting waste at home" and promoting a zero-waste lifestyle must expand through creative, community-based strategies (World Bank, 2022).

Local innovation is also pivotal in fostering efficient and self-sufficient waste management. The adoption of appropriate technologies—such as household composters, bioconversion using Black Soldier Fly (BSF) larvae, and app-based waste collection systems—has emerged in various regions (Mashudi et al., 2023). These innovations not only diminish waste volume but also generate new economic value for communities.

Digital waste management startups like Octopus and Waste4Change exemplify how technology can integrate recyclers, waste pickers, and consumers into a cohesive and efficient ecosystem (Qamari et al., 2023). This localized, technology-driven approach holds significant potential for replication across regions, especially in mid-sized cities grappling with inadequate formal waste management infrastructure.

GOVERNMENT POLICIES AND COMMITMENTS: FROM REGULATION TO IMPLEMENTATION

Indonesia has demonstrated its commitment to sustainable waste management through several policies, including the National Waste Management Policy and Strategy (Jakstranas), which aims for a 30% waste reduction and 70% waste management by 2025 (Badan Pusat Statistik, 2023). Additionally, various regions (levels of province, regency, or city) have enacted Regional Regulations (Perda) banning single-use plastics and promoting Extended Producer Responsibility systems within the industrial sector (Maisyarani et al., 2025; Ahmad et al., 2025).

However, the primary challenge lies not only in regulatory frameworks but also in effective on-the-ground implementation. Limited human resources, budget constraints, and inadequate infrastructure often hinder optimal policy execution (Suprapto, 2022; Harsanto et al., 2024). Strengthening institutional capacities, enhancing oversight, and developing economic incentive mechanisms are essential for the successful implementation of waste management policies.

Connecting national policies with on-the-ground practices remains a critical challenge. Municipalities often lack the capacity, funding, or technical support required to translate national targets into local action. Strengthening links between central policy, local innovation, and community participation is essential to ensure that regulatory commitments become measurable results.

Integrating waste management with broader national agendas, such as climate change mitigation (Priatna & Monk, 2023; Priatna & Khan, 2024), is crucial as well. Strategies like landfill gas recovery, composting, and waste-to-energy technologies can significantly contribute to Indonesia's Nationally Determined Contribution (NDC) targets for reducing greenhouse gas emissions (KLHK, 2022). If scaled effectively, these interventions could collectively reduce approximately 5–8 million tonnes of CO_2-equivalent annually, representing a meaningful contribution to Indonesia's overall mitigation pathway.

TOWARDS A CIRCULAR AND EQUITABLE SOCIETY

Ultimately, sustainable waste management transcends mere environmental cleanliness; it is about transitioning towards a circular and equitable society. This transformation necessitates a paradigm shift: from perceiving waste as a burden to

recognizing it as a resource (Kotyal, 2023). Such an approach can unlock economic opportunities for small communities through recycling, composting, and the recovery of economically valuable waste materials.

Achieving true circularity, however, also requires strengthening equity. Much of Indonesia's recycling performance currently depends on informal waste pickers, who recover a substantial share of recyclable materials yet remain excluded from formal policy mechanisms. A just transition demands that circular economy growth does not recentralise value within large industries but instead integrates informal recyclers through fair pricing systems, health and safety protections, and access to producer take-back and EPR schemes.

The success of this transformation hinges on equitable collaboration among the government, business sector, academia, the public, and the media. It is essential for government policies to not only favor large industries but also create avenues for innovation within communities and small enterprises (World Bank, 2022). This alignment can ensure that environmental sustainability is pursued alongside social welfare improvements.

Indonesia's experience reflects wider challenges across ASEAN: rapid urbanisation, informal waste economies, and the shared ambition to embed circularity with equity. Strengthening regional learning and cooperation will be essential for accelerating progress across Southeast Asia.

CONCLUSION: FROM CRISIS TO OPPORTUNITY

Progress in waste system reform is shaped not only by technology or policy design but by the consistency of accountability and trust among government, industry, and communities. Indonesia's circular transition will be achieved through leadership and collaboration, requiring the courage to rethink consumption, empower communities, and redesign waste as a source of value rather than a burden.

The waste crisis confronting Indonesia today reflects unsustainable patterns in consumption, production, and governance. However, this crisis also presents a pivotal opportunity for a greener and more equitable future. By employing a systemic approach, adopting a circular economy, encouraging cross-sector collaboration, and strengthening adaptive regulations, Indonesia can turn this challenge into an opportunity for inclusive and resilient development.

Sustainable waste management will not only aid Indonesia in reducing emissions and safeguarding biodiversity but will also generate green jobs and enhance community well-being. With robust political commitment, shifts in individual behaviour, cross-sector partnerships, and technological innovations rooted in local potential, waste can indeed transform from a pressing problem into a valuable resource.

Table 1 summarises several actionable priorities that could help Indonesia translate circular economy policy into measurable environmental and social outcomes by 2026.

Table 1. Policy Implications 2026: Pathways to a Circular and Equitable Waste System in Indonesia.

Priority Area	Suggested 2026 Target	Rationale / Expected Outcome
1. Household waste segregation	≥ 50% of households practicing waste separation at source (organic, recyclable, residual)	Builds efficiency in downstream recycling and composting; reduces landfill loads; encourages public participation.
2. Composting capacity	At least 1,000 tonnes of composting capacity per 100,000 residents (municipal or community-based facilities)	Diverts organic waste typically 40–50% of total municipal solid waste—from landfills; cuts methane emissions; supports urban agriculture.
3. Informal sector inclusion	Waste picker representation in ≥ 70% of Extended Producer Responsibility (EPR) audits and take-back schemes	Ensures equitable transition to circular systems; formalizes and protects livelihoods of informal recyclers.
4. Digital traceability	By 2026, at least five cities piloting digital tracking of recyclable materials (AI-based or app-integrated)	Enhances data accuracy and transparency in waste flows; supports accountability for EPR and circular metrics.
5. Local circular economy incentives	Municipalities implementing fiscal or recognition incentives for waste reduction innovation	Stimulates local entrepreneurship and aligns local budgets with national circular economy goals.

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