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Integrated waste accounting for circular economy in local government: a case study of Sleman Regency's sustainability transition (2022–2024)

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Abstract

This study investigates the integration of public sector accounting with circular economy principles in local waste governance, using Sleman Regency, Indonesia, as a case study between the 2022 until 2024 period. Despite a significant increase in funding for circular economy-related budget allocations (from IDR 2 billion to IDR 6 billion, 2022-2024), these initiatives still account for less than 25% of total waste management expenditure and remain obscured within general service categories. Analysis of financial reports and stakeholder interviews reveals that Sleman's accounting systems lack CE-specific budget tagging, standardized performance indicators, and mechanisms to trace environmental outcomes. These limitations hinder transparency, strategic evaluation, and long-term sustainability planning. Rather than incremental budget adjustments, the findings underscore the urgent need for public accounting system reformone that embeds ecological value creation, enables performance-based budgeting, and supports cross-sectoral coordination. By positioning accounting as a strategic enabler of sustainability transitions, this study offers a replicable framework for subnational governance innovation in emerging economies.

Keywords: Waste accounting, circular economy, local government.

INTRODUCTION

Waste management has emerged as a critical governance challenge for local governments across Indonesia, including Sleman Regency. The urgency of this issue was underscored by the temporary closure of the Piyungan landfill in July 2023 due to overcapacity, which triggered a regional waste crisis and exposed the limitations of linear, disposal-oriented waste systems (Kementerian Lingkungan Hidup dan Kehutanan, 2022). The incident disrupted municipal services, overwhelmed temporary waste sites, and highlighted the absence of resilient, sustainable alternatives.

In response to such systemic vulnerabilities, the circular economy (CE) has emerged as a transformative model for waste governance. By emphasizing reduction, reuse, and recycling, CE aims to decouple economic growth from resource depletion and environmental degradation (Geissdoerfer et al., 2017); (Ellen MacArthur Foundation, 2019). However, while CE principles have gained traction in policy discourse, their operationalization within local government systems particularly in financial planning and accountability remains limited.

This study argues that the integration of circular economy principles into public sector waste management remains both a conceptual and operational challenge, particularly in Indonesia's decentralized governance context. As highlighted in Sleman Regency's case, existing waste policies often rely on conventional approaches that lack systemic alignment with sustainability goals. This disconnects between sustainability ambitions and financial governance underscores the need for a deeper understanding of how public sector accounting can evolve to accommodate circular economy

principles. Public sector accounting plays a pivotal role in enabling sustainability transitions it ensures transparency, allocates resources efficiently, and supports performance evaluation.

Despite growing interest in CE and environmental accounting, empirical studies on their convergence in Indonesia's public sector—especially at the local government level—are scarce. Existing research tends to focus on private sector applications or short-term program evaluations (Murray et al., 2017)(Bocken et al., 2016). This study addresses that gap by offering a longitudinal, policy-integrated analysis of Sleman Regency's waste governance from 2022 to 2024. It investigates how accounting systems support or constrain CE implementation, what institutional barriers persist, and how financial structures can evolve to promote transparency, accountability, and sustainability.

Accordingly, this research seeks to answer the following questions:

- How is public sector accounting integrated into circular economy-based waste management in Sleman Regency?
- What policies and accounting practices are applied in managing waste from 2022 to 2024?
- To what extent do accounting systems support CE implementation, and what barriers exist?
- How effective are current financial structures in promoting transparency, accountability, and sustainability in waste governance?

By exploring these questions and situating accounting as a strategic enabler of circular transitions, the study aims to contribute to the evolving discourse on sustainable local governance. It provides actionable insights for policymakers, practitioners, and scholars seeking to align fiscal governance with environmental imperatives in decentralized settings.

LITERATURE REVIEW

The confluence of circular economy principles and public sector accounting offers a promising yet under-explored avenue for sustainable waste governance. While each domain has been the focus of independent study, their integration, particularly in local government contexts, remains limited. This review synthesizes key contributions from waste accounting, circular economy frameworks, and waste policy literature to establish a conceptual foundation for analyzing circular economy in Sleman Regency.

Waste accounting in the Public Sector

Public sector accounting theory emphasizes transparency, accountability, and stewardship in managing public resources. It traditionally focuses on financial compliance and budget control, but recent scholarship advocates for its evolution toward sustainability-oriented governance (Bastian, 2019). In public sector governance, waste accounting refers to the systematic process of identifying, recording, and reporting financial and material flows related to waste management activities. It encompasses both monetary expenditures and physical metrics—such as waste volumes, treatment methods, and diversion rates—allowing governments to assess the environmental costs of waste generation and disposal, as well as the effectiveness of environmental programs in achieving sustainability outcomes (Bastian, 2019). This dual function positions waste accounting as a strategic tool for sustainability-oriented governance. First, it enables the quantification of ecological impacts by linking financial inputs to environmental outputs—such as landfill reduction, recycling efficiency, and carbon mitigation. Second, it supports performance evaluation by providing data-driven insights into the operational success of waste programs, including composting, waste banks.

However, implementation remains uneven due to limited technical capacity, lack of standardized frameworks, and weak integration with existing financial systems. As emphasized by (Adams & Larrinaga, 2021), advancing public sector accounting requires a shift toward frameworks that capture ecological value and support enduring sustainability outcomes. Klein et al., (2020) also emphasize that circular economy integration in public sector accounting requires systemic reform, yet many local governments lack the tools to embed sustainability metrics into financial systems. This aligns with findings in Indonesia, where waste accounting remains fragmented and poorly institutionalized.

To fulfill its potential, waste accounting must evolve beyond compliance-based reporting toward systems that reflect ecological value creation and support long-term sustainability planning. This requires not only technical reform but also a shift in accounting logic—one that recognizes environmental outcomes as core components of public sector performance.

Circular Economy and Waste Management

The circular economy (CE) offers a regenerative model that prioritizes resource efficiency through reduction, reuse, and recycling. Geissdoerfer et al. (2017) define CE as a system that decouples economic growth from environmental degradation, while the Ellen MacArthur Foundation (2019) outlines its application in waste management through closed-loop systems and sustainable design. Kalmykova, et al., (2018) emphasizes CE's interdisciplinary nature, linking design, policy, and economic instruments to sustainability transitions. In Indonesia, CE adoption in local governance is gaining momentum, but remains largely policy-driven and lacks operational integration. Bocken et al. (2016) and Murray et al. (2017) argue that CE can reduce landfill dependency and generate socio-economic benefits, yet its success depends on institutional readiness and cross-sector collaboration. Agamuthu et al., (2020) underscores the importance of localized CEWM models that align with socio-cultural and regulatory contexts. The Piyungan landfill closure in 2023 exemplifies the risks of relying on linear waste systems and the urgency of transitioning to circular models (Kementerian Lingkungan Hidup dan Kehutanan, 2022)

Integrating Circular Economy into Public Accounting

Embedding CE principles into public sector accounting requires comprehensive overhaul of how accounting systems that can track environmental performance, allocate budgets to sustainability programs, and report non-financial outcomes. CE initiatives often involve non-linear investments, long-term ecological benefits, and cross-sectoral impacts that traditional accounting frameworks are ill-equipped to capture. As such, the integration of CE demands a shift from compliance-based financial reporting toward strategic, sustainability-oriented governance.

In practice, however, local governments often lack the tools to distinguish CE-related expenditures or evaluate their impact. Adams & Larrinaga (2021) argue that accounting must evolve from a backward-looking, financial-centric tool into a forward-looking instrument that supports environmental stewardship and intergenerational equity. This also aligned with Bebbington et al. (2021) that emphasize the need for accounting innovations that capture non-financial performance, such as waste diversion rates, carbon reduction, and circular resource flows.

Dagilienė et al. (2021) propose a framework for local governments to operationalize circular economy through transparent budgeting, performance indicators, and stakeholder engagement mechanisms. These tools are essential for embedding CE into fiscal systems and for aligning institutional behavior with sustainability goals. Without such mechanisms, CE initiatives risk being underfunded, poorly evaluated, or misrepresented in official reports.

In Indonesia's decentralized governance context, the urgency of reform is particularly acute. Mujiburohman et al. (2024) further highlight how spatial and regulatory fragmentation impedes CE adoption, while Ardini & Fahlevi (2024) demonstrate that the absence of CE-specific budget classifications and environmental indicators undermines strategic planning. The Sleman Regency has experienced similar systemic challenges, as evidenced by the expansion of CE-related programs within the general service categories. Despite this expansion, these programs face limitations in terms of traceability and performance evaluation.

Therefore, integrating CE into public accounting is not simply about adding new budget lines—it is about redefining the purpose and logic of public accounting itself. It requires systems that can track environmental value, support long-term planning, and foster institutional learning. This study contributes to that reform agenda by examining how local governments can reconfigure their accounting practices to enable circular transitions, using Sleman Regency as a case of subnational innovation in sustainability governance.

METHODS

This study employs a qualitative research design rooted in interpretive inquiry to explore how public sector accounting systems intersect with circular economy principles in local waste governance. The research is situated within the context of Sleman Regency, Indonesia, where the urgency of sustainable waste management has intensified following the closure of the Piyungan landfill in 2023.

The qualitative approach is chosen to capture the institutional, procedural, and contextual nuances that quantitative methods may overlook. It enables a deep understanding of how accounting practices, policy frameworks, and stakeholder perceptions shape the implementation of circular economy-based waste management. The study does not aim to generalize findings statistically, but rather to generate rich, contextual insights that inform theory-building and policy innovation.

Data Collection

Primary data were collected through semi-structured interviews with three main stakeholder groups:

- Local government officials, including representatives from the Environmental Agency (DLH), Regional Development Planning Agency (Bappeda), and Finance and Asset Management Agency (BPKAD), who are directly involved in budgeting, planning, and policy implementation.
- Community leaders and waste bank coordinators, who manage grassroots CE initiatives such as TPS3R units, composting programs, and informal recycling networks.
- Private sector and service providers, including contractors and RDF facility operators engaged in waste transport, processing, and off-taker coordination.

These interviews were designed to elicit perspectives on institutional readiness, budget practices, and operational challenges in CE implementation. In addition to interviews, the study conducted document analysis of Regional Government Financial Report (LKPD), performance accountability reports (LAKIP), and Regional Government Administration report (LPPD) from 2022 to 2024. This research also include data from policy review of regional regulations, strategic plans, and technical guidelines related to waste governance and circular economy. Secondary data were sourced from academic literature, government publications, and Scimago-indexed journals to support theoretical framing and triangulation.

Analytical Framework

Thematic analysis was applied to identify patterns across institutional practices, accounting structures, and CE implementation strategies. Coding was conducted inductively, allowing themes to emerge from the data while remaining anchored in the theoretical domains of public sector accounting and circular economy. The analysis was guided by the following dimensions:

- Budget tagging and financial traceability of CE programs
- Integration of environmental indicators in accounting narratives
- Institutional readiness and stakeholder alignment

To ensure the credibility and robustness of findings, the study employed data triangulation—cross-verifying insights from interviews, financial documents, and policy texts. This approach was particularly critical in confirming evidence of fragmented governance, inconsistent budget tagging, and the absence of standardized performance indicators across reporting systems. Discrepancies between stakeholder narratives and official documents were analyzed to surface institutional blind spots and reporting gaps.

This study contributes a novel perspective by positioning accounting not merely as a technical tool, but as a strategic enabler of sustainability transitions. Unlike prior research that treats CE and accounting as separate domains, this study examines their convergence within a real-world governance setting. The focus on Sleman Regency offers a unique lens into subnational dynamics, where decentralization, community participation, and regulatory fragmentation intersect with environmental imperatives. By combining multiple data sources and stakeholder perspectives, the study offers a comprehensive account of how accounting systems shape—and are shaped by—the transition toward circular waste governance in a decentralized public sector context.

RESULT AND DISCUSSION

This section synthesizes empirical data, stakeholder perspectives, and institutional analysis to examine the integration of circular economy (CE) principles into Sleman Regency's waste governance. The discussion is organized into four interrelated themes: budget allocation and accounting traceability, CE implementation outcomes, governance modes and stakeholder dynamics, and systemic challenges and opportunities.

Budget Allocation and Waste Accounting

Analysis of Sleman's annual financial reports and LAKIP disclosures reveals a gradual increase in budget allocation for circular economy (CE)-related programs. Between 2022 and 2024, CE funding rose from approximately IDR 2 billion to IDR 6 billion, reflecting growing institutional awareness. However, CE programs still represent less than 25% of total waste management spending, and budget tagging remains inconsistent across reporting documents. Waste accounting defined as the systematic tracking of waste-related financial flows, material volumes, and treatment outcomes plays a critical role in ensuring transparency and strategic evaluation. Yet, Sleman's LKPD disclosures lack standardized indicators to distinguish CE initiatives, making it difficult to evaluate program effectiveness or track environmental outcomes.

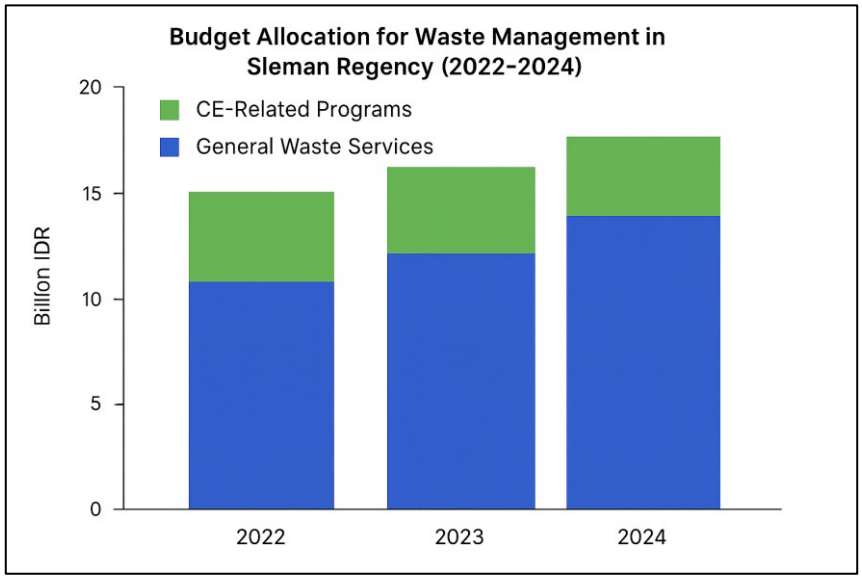

Figure 1. Sleman Regency's budget allocation for waste management

This is supported by the tabulated data showing total waste management budgets of IDR 10 billion (2022), IDR 12 billion (2023), and IDR 15 billion (2024), with realization rates above 95%. While this upward trend signals fiscal commitment to waste governance, the absence of standard CE budget tagging obscures how these funds are distributed across linear and circular programs. Without clear financial delineation, it becomes challenging for policymakers to assess the impact of CE investments, prioritize resource allocation, or make evidence-based strategic decisions.

This reflects a broader issue in Indonesia's public sector accounting, where environmental programs are often embedded within general service categories. Ardini & Fahlevi (2024) argue that without clear budget separation and performance indicators, waste accounting fails to support strategic decision-making. In Sleman's case, the lack of CE-specific financial reporting hinders the ability to assess ecological value creation and long-term impact.

Circular Economy Implementation Outcomes

Imawati et al. (2024) propose a multi-actor circular economy model tailored to Indonesia's socio-regulatory context, emphasizing the role of local innovation and stakeholder synergy. Sleman's RDF initiative and TPS3R expansion reflect early-stage adoption of such models, though scaling remains constrained by infrastructure and coordination gaps. The percentage of recycled waste in Sleman

increased from 20% in 2022 to 30% in 2024, supported by expanded recycling facilities, community education, and the development of Refuse-Derived Fuel (RDF)-based waste processing.

However, Figure 2 reveals critical trade-offs in CE implementation. Despite gains in recycling, landfills still handle 60% of total waste, and the overall volume of waste processed continues to rise—from 4,000 tons/month in 2022 to 4,500 tons/month in 2024. This upward trend reflects urbanization pressures and signals that CE interventions, while impactful, are not yet sufficient to reverse dependency on final disposal. The increase in recycled waste is offset by the growing waste stream and persistent landfill reliance, limiting the ecological benefits of CE programs.

These dynamics underscore the need for stronger institutional support, infrastructure investment, and performance-based evaluation. Waste accounting plays a key role in assessing the financial and operational effectiveness of CE initiatives, yet in Sleman, such systems remain underdeveloped. This partial success aligns with findings by Wikurendra (2024), who highlights that urbanization can drive CE adoption when paired with infrastructure investment and behavioral change. Sleman's progress demonstrates that CE principles can be operationalized at the local level, but scaling requires stronger institutional support and community incentives.

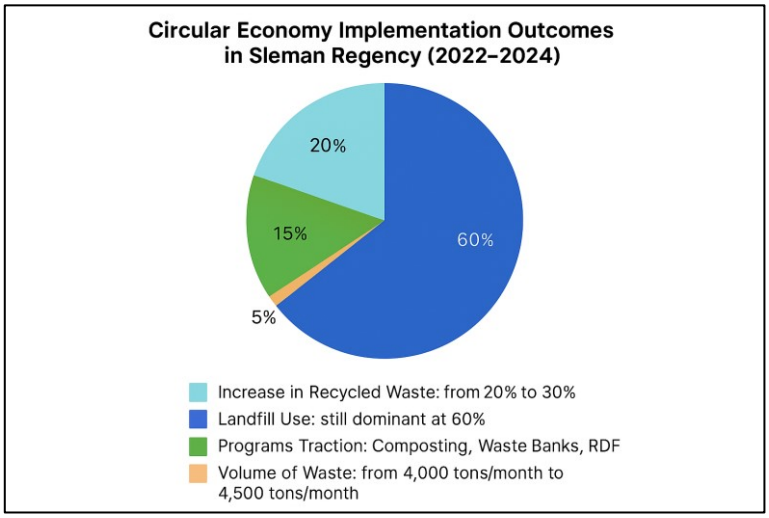

Figure 2. Waste treatment methods in Sleman Regency 2022-2024

Pambudi (2025) further notes that green transitions in waste management depend on adaptive business models and localized innovation. Sleman's RDF initiative, while promising, faces coordination and off taker alignment issues that limit its full potential.

Governance Modes and Stakeholder Dynamics

Drawing on Kooiman's governance typology, Sleman's waste system reflects a hybrid of hierarchical, market-based, and self-governance models. The local government retains regulatory authority but relies heavily on community-run TPS3R units and private service providers. Coordination remains fragmented, with limited horizontal integration.

Stakeholder interviews highlight mixed levels of institutional readiness. Local government officials acknowledge the strategic importance of CE but cite limited technical capacity and fragmented policy implementation. Community leaders demonstrate strong informal networks and grassroots engagement, while waste bank managers report high operational readiness but insufficient financial support. These dynamics reveal a governance landscape where enthusiasm for CE exists, but operational coherence and resource alignment remain uneven.

Tabel 1. Thematic matrix of stakeholder perspectives

Theme	Local Government	Community Leaders	Waste Bank Managers
Budget Clarity	Limited CE budget tagging	Unclear funding source	Need for direct subsidies

Institutional Readiness	Moderate readiness, needs training	Low awareness of CE roles	High operational readiness
Community Participation	Active in campaigns	Strong informal networks	Dependent on volunteers

The study by Cruz-Paz et al. (2023) demonstrate that decentralized waste governance often results in fragmented coordination and uneven policy execution. Sleman's post-landfill transition reflects similar dynamics, where community-led initiatives thrive but lack systemic integration. While community entities show initiative, their practices vary widely, and many lack standardized sorting or RDF alignment. Waste banks operate independently, focusing on non-organic resale, but their coverage is limited.

Ratnasari & Aschemann (2024) propose an indicator system to monitor CE progress in Indonesia, emphasizing the need for harmonized metrics and stakeholder accountability. Sleman's experience illustrates the gap between policy ambition and operational coherence.

Systemic Challenges and Opportunities

While Sleman Regency has made incremental progress in adopting circular economy (CE) programs, the transition remains constrained by deep-rooted institutional barriers. These challenges are not isolated—they reflect broader structural and institutional barriers observed across Indonesia's decentralized waste governance landscape.

- Fragmented policy implementation
  Sleman's waste governance suffers from overlapping mandates and inconsistent policy execution across agencies and administrative levels. While the Regent's Circular Letter encourages waste separation, its operationalization varies widely among TPS3R units, village governments, and private actors. This fragmentation leads to duplication, inefficiencies, and gaps in service delivery. According to Cruz-Paz et al. (2023), fragmented governance structures in decentralized systems often result in weak policy coherence and limited stakeholder compliance. In Indonesia, this is exacerbated by the absence of integrated CE frameworks that align local regulations with national sustainability goals.
- Limited waste accounting integration
  Although Sleman's waste management budget has grown from IDR 10B in 2022 to IDR 15B in 2024, CE-related expenditures remain embedded within general service categories. The LKPD disclosures lack standardized indicators to track CE program performance, making it difficult to evaluate ecological outcomes or justify future funding. Waste accounting integration remains limited, with no clear mechanism to link financial inputs to environmental outputs such as diversion rates, RDF production, or recycling efficiency. The limited integration of waste accounting systems emerges not merely as a technical shortfall, but as a foundational obstacle that significantly shapes—and often undermines—other dimensions of governance. Supported by Ardini & Fahlevi (2024) who argue that waste accounting in Indonesia remains underdeveloped, with limited integration of CE metrics into public financial systems. As Bastian (2019) notes, public accounting must evolve to reflect non-financial performance indicators, especially in environmental domains. The absence of the non-financial performance indicators could impairs strategic planning, obscures program effectiveness, and prevents evidence-based resource allocation. More critically, it contributes to fragmented policy implementation and inconsistent stakeholder coordination, as agencies and actors operate without shared metrics, fiscal clarity, or accountability frameworks. Ratnasari & Aschemann (2024) propose an indicator system for CE monitoring, emphasizing the need for harmonized accounting tools that reflect circular value creation. Sleman's experience illustrates the urgency of adopting such systems to ensure fiscal transparency and strategic alignment. Waste accounting offers a pathway to align fiscal governance with sustainability outcomes, but its adoption requires institutional reform and capacity building. Without such integration, CE programs risk being underfunded or misrepresented in official reports.
- Inconsistent stakeholder coordination

The transition to CE-based waste governance requires synchronized efforts across government, community, and private sectors. In Sleman, coordination remains ad hoc and project-based, with limited mechanisms for long-term collaboration. Waste banks, TPS3R units, and private haulers often operate independently, pursuing their own economic or social goals. Pansera et al. (2023) argue that successful circular transitions depend on institutional logics that foster citizen participation and cross-sectoral collaboration. Sleman's experience reveals that while grassroots enthusiasm exists, formal mechanisms for coordination remain underdeveloped. Effective CE transitions demand shared accountability frameworks, role clarity, and incentive structures that promote cooperation.

- Infrastructure gaps in rural areas
  While urban centers in Sleman benefit from upgraded TPSTs and RDF facilities, rural areas face persistent infrastructure deficits. Many village TPS3R units lack adequate sorting equipment, transport access, or trained personnel. This leads to informal practices such as open burning or illegal dumping, undermining CE goals. Agamuthu & Fauziah (2020) emphasize that infrastructure disparities are a critical challenge in CE implementation across Southeast Asia. Without equitable access to CE-enabling facilities, rural communities remain excluded from sustainability transitions. Wikurendra (2024) adds that urbanization must be matched with rural investment to avoid deepening environmental inequalities. Sleman's case underscores the need for targeted infrastructure development and capacity building in underserved areas.

However, opportunities exist in leveraging accounting systems for performance-based budgeting, expanding CE education, and incentivizing community participation. The integration of CE principles into waste governance is not merely technical—it requires institutional innovation, cross-sectoral collaboration, and adaptive policy frameworks. It includes, integrating CE indicators into LKPD, LPPD, and LAKIP reporting, establishing multi-stakeholder coordination platforms, expanding RDF-compatible infrastructure in rural zones, and leveraging accounting systems for performance-based budgeting. As Pambudi (2025) argue, the success of CE transitions depends on aligning financial governance with sustainability goals. Sleman's case offers a valuable lens into how accounting can evolve to support circular outcomes in decentralized settings.

CONCLUSION

This study has examined the integration of circular economy (CE) principles into public sector accounting and waste accounting in Sleman Regency, Indonesia—a region undergoing a critical transition following the closure of the Piyungan landfill. By employing a qualitative approach grounded in interpretive inquiry, the research reveals that while institutional awareness and budgetary commitment to CE have increased, implementation remains constrained by fragmented policies, limited accounting integration, uneven stakeholder coordination, and infrastructure gaps in rural areas.

Empirical data from LKPD disclosures and stakeholder interviews demonstrate that CE-related programs have grown in prominence yet still represent less than 25% of total waste management spending. Budget tagging and performance indicators remain underdeveloped, hindering transparency and strategic evaluation. Governance structures reflect a hybrid of hierarchical, market-based, and self-governance modes, but lack orchestration and alignment with CE objectives particularly in the production and delivery of Refuse-Derived Fuel (RDF).

Despite these challenges, Sleman Regency presents a compelling case for subnational innovation in circular waste governance. Opportunities exist to strengthen accounting systems, harmonize stakeholder roles, and expand CE infrastructure especially in underserved areas. The study contributes to the evolving discourse on waste accounting and decentralized sustainability transitions, offering a replicable framework for other regions navigating post-landfill governance.

Ultimately, the integration of CE into public sector accounting is not merely a technical reform—it is a strategic imperative for building resilient, inclusive, and ecologically responsible waste systems. Sleman's experience underscores the need for adaptive governance, institutional innovation,

and collaborative accountability to realize the full potential of circular economy principles in Indonesia's local government landscape.

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