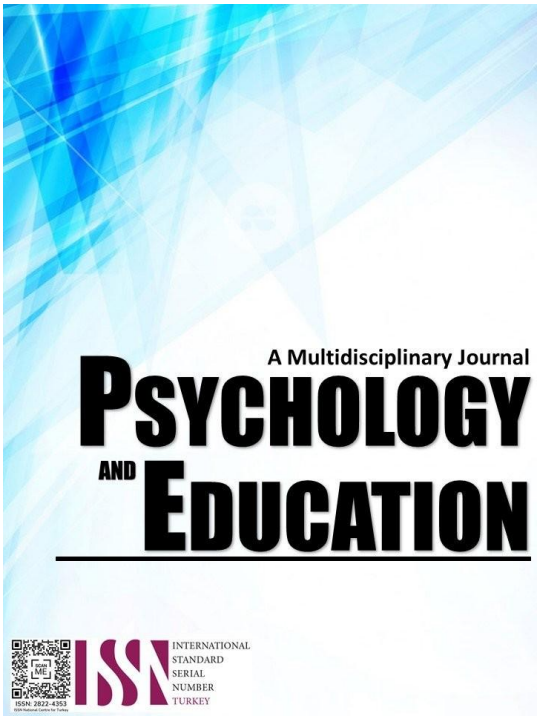
QUANTIFYING WASTE POLICY EFFECTIVENESS: A META-ANALYTICAL STUDY OF SOLID WASTE MANAGEMENT FRAMEWORKS



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Research Article

Quantifying Waste Policy Effectiveness: A Meta-Analytical Study of Solid Waste Management Frameworks

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Abstract

This study evaluates how national and local solid waste management (SWM) policies are implemented in the Philippines, focusing on Cagayan de Oro City (CDO) and comparative insights from Quezon City and Cebu City. Using a mixed-method approach that integrates meta-analysis of secondary data with hermeneutic interpretation of policy texts, the author assesses the real-world performance of Republic Act No. 9003 (Ecological SWM Act) and the Extended Producer Responsibility Act of 2022 (RA 11898). Findings reveal persistent implementation gaps despite the presence of robust legal frameworks. CDO shows promise through barangay-level composting and "no segregation, no collection" policies, but faces bottlenecks in market integration and facility capacity. Quezon City demonstrates institutional progress but still depends heavily on landfilling. Cebu City struggles with policy discontinuity, reflected in sharp budget cuts and idle infrastructure. Across all cases, the mandated 25–50% diversion targets remain largely unmet due to weak enforcement, insufficient infrastructure, and limited alignment with circular economy goals. This study highlights that policy effectiveness requires more than legislative design; it depends on adaptive local governance, cross-sector collaboration, and public engagement. By quantifying outcomes and interpreting policy narratives, this study offers critical insight into how SWM systems can evolve beyond compliance toward long-term sustainability.

Keywords: *solid waste management, circular economy, waste hierarchy, comparative matrix, extended producer responsibility (EPR), policy recommendations*

Introduction

Solid waste management remains a pressing urban challenge, not because of a lack of policies, but because their real-world effectiveness is rarely measured. Nathanson (2025) defines solid waste management as the collection, treatment, and disposal of solid materials that are discarded because they have served their purpose or are no longer useful. Waste management, therefore, involves the handling of waste materials from the time they are generated to their final disposal. This includes how institutions or businesses collect, transport, process, recycle, or discard their waste (Salonga, 2019).

Although national policies such as the Ecological Solid Waste Management Act of 2000 (Republic Act No. 9003) and recent plastic regulation laws are ambitious, significant implementation gaps persist. The enforcement of Republic Act 9003 is often described as fragmented, inconsistent, and under-resourced, especially at the barangay level, where segregation and recovery efforts are intended to begin. A clear disconnect exists between the mandates of national waste policies and their actual enforcement at the local level, which calls for systematic evaluation of their effectiveness. The success of a waste policy lies not in its legal existence but in observable outcomes, such as reduced waste volumes, improved segregation rates, and increased community participation. Measuring success requires more than checking for compliance; it requires a critical assessment of how these laws influence local behaviors, infrastructure, and governance systems.

In the Philippines, an estimated 2.7 million tons of plastic are discarded each year. Less than 10 percent of this is recycled, while the remainder is dumped, incinerated, or mismanaged (Climate Change Commission, 2024). In cities such as Cagayan de Oro, compostable waste and recyclables often accumulate outside recovery facilities, raising concerns about how waste management innovations can be effectively adopted. Despite more than two decades of regulatory frameworks, the presence of uncollected and unmanaged waste remains a visible symptom of deeper institutional and behavioral challenges. Achieving a sustainable urban environment requires not only laws but also innovation, civic engagement, and strong local leadership.

This study is timely and relevant as it directly addresses the persistent disconnect between the existence of solid waste management policies and their observed inefficiencies. Although legal structures are in place, the continued accumulation of waste in both urban and rural communities suggests that legislation alone is not enough. While existing literature often focuses on isolated case studies or technical evaluations, there is a lack of consolidated, data-informed analysis that systematically measures policy outcomes across various contexts. This study addresses that gap through a combination of meta-analytical methods and interpretive analysis. Rather than simply documenting whether policies exist or are implemented, the study asks whether they actually work. Specifically, it investigates whether such policies result in measurable outcomes such as waste reduction, segregation, recycling, and community participation. In a time when environmental accountability and transparency are increasingly demanded, this study offers an evidence-based and context-specific evaluation of the country's progress in managing its waste crisis.

Moreover, solid waste management is not solely an environmental issue; it intersects with governance, equity, public health, and social justice. Communities located near dumpsites or informal settlements, often among the most marginalized, experience disproportionate

impacts of ineffective waste systems. These populations face heightened health risks, environmental hazards, and economic challenges due to poor waste control, toxic exposure, and limited access to services. The failure of solid waste management policies to protect these vulnerable groups reveals systemic inequalities in environmental governance.

Local government units, often lacking adequate resources or institutional autonomy, struggle to meet the mandates of Republic Act 9003. This reinforces the idea that waste governance is not only a question of logistics but also a matter of political will, public engagement, and social inclusion. Without strong community involvement and consistent enforcement, even well-written laws risk becoming symbolic rather than transformative.

By evaluating actual policy outcomes across diverse local contexts, this study aims to identify the barriers that impede progress and the enabling conditions that support it. Ultimately, it argues that solid waste management must be addressed not only as a technical problem but also as an issue of governance and justice, requiring inclusive solutions, fair enforcement, and meaningful collaboration across sectors.

In conclusion, this study not only seeks to measure whether solid waste policies exist or are enforced, but also whether they lead to sustainable change. It highlights the importance of local governance, civic participation, and equity as essential components of any effective waste management strategy in the Philippines.

Research Questions

The study aimed to quantify the effectiveness of existing SWM frameworks by examining measurable indicators, including waste diversion rates, infrastructure availability, and policy compliance. Through a meta-analytical review of existing literature and data, the author sought to identify statistically significant trends and relationships that could offer deeper insight into the performance of national and local SWM initiatives. To this end, the following questions were proposed:

1. How has the implementation of RA 9003 influenced waste diversion rates in Cagayan de Oro City from 2001 to 2025?
2. To what extent does the density of operational Materials Recovery Facilities (MRFs) in localities correspond with compliance to solid waste management policies?
3. How do local government units with anti-plastic ordinances perform in managing plastic waste generation compared to those without such ordinances?

Methodology

Research Design

The research design for this study incorporated both quantitative and qualitative phases within a mixed-methods framework. The quantitative phase employed a meta-analytic design, systematically synthesizing quantitative data from secondary studies to derive measurable outcomes and trends in solid waste management. The qualitative phase utilized a hermeneutic approach to interpret policy texts and uncover deeper contextual meanings, intentions, and governance narratives embedded within documents and reports.

Specifically, this study employed a convergent parallel mixed-methods design, in which quantitative and qualitative data were collected and analyzed concurrently but separately, with integration occurring at the interpretation stage to provide comprehensive insights into the effectiveness of solid waste management policies. This design was chosen because it leverages the strengths of both quantitative and qualitative approaches, allowing for validation and contextualization of findings to address complex research questions.

The appropriateness of the meta-analytical method lies in its ability to quantitatively aggregate evidence from diverse studies, improving generalizability and precision in effect estimation. Meanwhile, hermeneutic interpretation complements this by offering depth of understanding regarding policy enactment processes and stakeholder perspectives, which purely quantitative methods cannot capture.

By aligning the research design with the study's purpose to evaluate policy effectiveness through measurable outcomes and interpretative insights, the investigation employs a mixed-methods approach that enhances the credibility and coherence of this investigation.

Procedure

The author used the hermeneutics tool to interpret the texts and data gathered, uncovering deeper meanings, intentions, and contextual nuances embedded in policy documents, case studies, and implementation reports related to solid waste management. Hermeneutics is the study of interpretation and plays a role in several disciplines whose subject matter demands interpretative approaches, particularly because the disciplinary subject matter concerns the meaning of human intentions, beliefs, and actions, or the meaning of human experience as it was preserved in the arts and literature, historical testimony, and other artifacts (Theodore, 2025).

As a qualitative interpretive method, hermeneutics enabled the author to go beyond surface-level analysis and examine how waste management policies were framed, understood, and enacted by various stakeholders, including local government units (LGUs), communities, and regulatory bodies.

Data Analysis

Data extraction tools included digital databases and official repositories containing peer-reviewed journals, government publications, and case studies. Hermeneutic analytical software and coding frameworks were employed to interpret policy narratives and stakeholder intentions.

The study followed a stepwise process: (1) systematic identification and screening of secondary data sources, (2) extraction of measurable indicators (e.g., waste diversion rates, infrastructure availability), (3) meta-analytical synthesis of quantitative data, (4) hermeneutic interpretation of qualitative policy texts, and (5) triangulation of findings to evaluate policy impact and gaps.

Quantitative data were analyzed using meta-analytical statistical techniques to identify trends and measure outcomes. Qualitative data underwent hermeneutic analysis to uncover embedded meanings and contextualize institutional practices. Integration of analyses facilitated a comprehensive understanding of SWM policy effectiveness.

As the research used publicly available secondary data, no direct interaction with human participants was involved. Ethical considerations included ensuring the accuracy and appropriate citation of all data sources, protecting confidentiality where applicable, and obtaining Institutional Research Ethics Committee approval to uphold academic integrity.

Ethical Considerations

The study utilized secondary data, including published case studies, government reports, policy documents, and academic literature, so no direct interaction with human participants was required. Therefore, informed consent from individuals was not applicable. However, for any case studies or reports that involved human respondents (originally gathered by other journals), the author ensured that these sources complied with ethical standards, including informed consent procedures, as documented in their methodology sections. As no personal or identifiable information was collected directly by the author, privacy risks were minimal. All secondary sources used were in the public domain or officially published by credible institutions. However, when analyzing case studies or local government reports that mentioned specific barangays or LGUs, the author presented data objectively, without attributing blame or judgment, in order to uphold institutional confidentiality and avoid reputational harm.

The study, based on secondary data and desk-based research, was a minimal-risk study. Nonetheless, the study protocol was submitted to the relevant Institutional Research Ethics Committee for approval to ensure that all ethical standards, particularly those involving data integrity, academic honesty, and responsible reporting, were upheld throughout the study.

Results

The analysis indicated that while Cagayan de Oro City (CDO) has institutionalized several mandates of RA 9003, such as barangay-level waste segregation, the establishment of Material Recovery Facilities (MRFs), and the enforcement of the "no segregation, no collection" policy, there remains no publicly available, comprehensive citywide waste diversion data. Localized initiatives such as composting in Barangay Pagatpat and recycling efforts in Bugo and Lapasan showed promise; however, persistent bottlenecks in market integration, facility capacity, and operational scale suggest that regulatory policies have not yet led to systematic, measurable improvements in diversion.

The presence of operational MRFs was moderately associated with compliance levels among different cities. Quezon City maintained extensive functional MRFs, supplemented with complementary programs (e.g., biodigesters and segregation incentives), resulting in higher compliance and diversion rates (approximately 48%). Conversely, Cebu City faced challenges with idle MRFs due to land, funding, and administrative constraints, resulting in weak compliance. CDO, despite having some operational MRFs, demonstrated that effectiveness depends largely on market linkages, community participation, and logistic capacity, indicating that MRF presence alone is insufficient for full compliance.

Analysis of plastic waste generation found that LGUs enforcing local ordinances banning single-use plastics—such as parts of Quezon City and selected barangays in CDO—tended to report lower visible levels of plastic waste and to have more structured awareness campaigns. However, in areas like Cebu City with fragmented enforcement, high plastic waste loads persist with minimal behavioral change. These findings underscore the critical role of enforcement mechanisms, the availability of eco-alternatives, and community participation in the success of plastic waste reduction policies.

Quantitative data (e.g., waste volumes, budget figures) are highlighted, along with key observations. The Philippines' MSW composition is roughly 52% biodegradable, 28% recyclable, and 18% residual. Despite RA 9003's mandated diversion targets (at least 25% within 5 years), actual performance varies. A 2017 summary reported diversion rates of ~46% outside Metro Manila and ~48% in Metro Manila, primarily through recycling and composting.

However, collection rates nationwide range widely: about 85% in Metro Manila versus as low as 40% in underserved barangays. Recent audits reveal landfills are strained: by 2023, four of 18 major landfills had reached capacity (including Payatas in QC), and only 40% of barangays had access to MRFs. The Commission on Audit (COA) warns of a looming waste crisis, noting that even with new sanitary landfills, growing waste (from 9M tons in 2000 to nearly 23M tons by 2025) will overwhelm capacity if waste generation and

diversion do not improve (NSWMC, 2017).

Table 1. *Waste collected in Quezon City (2020–2024, cubic meters).*

Year	*Waste per cubic meter*
2020	2,688,667
2021	2,659,242
2022	2,764,581
2023	2,913,479
2024 (Jan–Jun)	1,500,910

Data for 2020–2022 include the full year; 2024 is as of June.

The table shows a rising trend in total waste collected, approximating over 2.3 million metric tons by 2023 based on estimated conversion from cubic meters

Various sources indicate that Cagayan de Oro City (CDO) generates a substantial volume of solid waste. According to a recent study citing NSWMC data, the city produces approximately 1.25 million tons annually. The City Development Plan outlines strategic goals such as strict segregation, zero open dumping, and barangay-level enforcement of Republic Act No. 9003 (Ecological Solid Waste Management Act of 2000).

Historically, UN-Habitat's Local Environmental Planning and Management (L-EPM) program supported pilot projects in three barangays, Bugo, Lapasan, and Gusa, focusing on composting, waste sorting, and recycling. At present, the city operates at least one known functional barangay-level Material Recovery Facility (MRF) in Barangay Pagatpat, which handles compostables, plastics, glass bottles, and old tires. However, this facility is reportedly nearing capacity. In April 2024, Councilor Esparcia raised concerns about the accumulation of unprocessed compost and unsold recyclables, highlighting the need for sustainable downstream markets to absorb recovered materials.

Despite multiple initiatives, CDO lacks a publicly disclosed, citywide waste diversion rate– an essential performance metric under RA 9003. Future study and government audits should prioritize establishing a citywide waste diversion database, disaggregated by barangay and waste stream (e.g., plastic, organic, residual), to support evidence-based decision-making. To approximate diversion performance and assess policy implementation, this study uses the following proxy indicators:

MRF Density

With only one active MRF serving approximately 728,000 residents (PSA, 2024), CDO has an MRF density of ~1.37 per 100,000 people, well below national policy guidance recommending one MRF per barangay.

Segregation Compliance

Preliminary observations and initial barangay implementation reports from Pagatpat and Bugo suggest improved household-level sorting behavior under "no segregation, no collection" ordinances, though comprehensive compliance data is unavailable.

Composting Capacity and Uptake

Composting efforts in Bugo and Gusa show modest success, but saturation of local compost markets and limited demand hinder their scalability and financial sustainability.

Waste Management Budget per Capital

The city's 2025 allocation of ₱106.3 million to environmental and natural resource services, divided by the population, amounts to approximately ₱146 per capita. This is significantly below the ₱250–₱300 per capita benchmark recommended for effective SWM operations (UNDP, 2024), raising concerns about long-term funding adequacy.

Ordinance Coverage and Enforcement

As of 2025, only a few barangays, namely Pagatpat, Bugo, and Gusa, are known to enforce ordinances consistent with RA 9003. This suggests that less than 10% of CDO's 80 barangays have established robust legal and operational mechanisms for SWM compliance, indicating limited policy penetration across the city.

These triangulated indicators provide a more comprehensive estimate of CDO's solid waste management performance and expose critical implementation gaps. The combination of low MRF density, inconsistent ordinance enforcement, weak integration with the compost market, and underfunded operational budgets suggests that, while foundational efforts are in place, they remain insufficiently scaled and resourced to produce high-impact diversion outcomes. Moving forward, stronger data transparency, expanded barangay-level enforcement, and improved budget allocation will be vital to aligning CDO with national solid waste management benchmarks.

As the largest city in Metro Manila, QC's waste figures are instructive. Its sanitation department reports collecting 2,913,479 m³ of waste in 2023 (an increase from previous years). Despite this high volume, QC has actively promoted recycling schemes, such as a youth-driven clothing upcycling fashion show and the "Trash-to-Cash Back" program that rewards residents for bringing recyclables

to collection centers. The city has multiple MRFs, and in one barangay, a biodigester was installed to convert food scraps into biogas (QC Annual Report, 2024). Still, audits note uneven access: many barangays rely on external dump trucks, and landfill disposal remains common. The annual report also mentions that QC's per capita waste generation is about 0.65–0.80 kg/day (down from 0.83 in 2014) and anticipates about 115,000 tons for 2023, indicating slow progress in reduction measures. QC's SWM budget details were not publicly specified, but the city government emphasizes zero-waste targets and community education (Quezon City Government, 2024).

Table 2. *Solid waste management performance*

Indicator	*Value / Status*	*Interpretation*
MRF Density	~1.37 per 100,000 people	Significantly below national guidance of 1 per barangay (~80 needed)
Waste Management Budget per Capita	₱146 per capita	Falls short of ₱250–₱300 recommended (UNDP, 2024)
Barangay Ordinance Enforcement	3 out of 80 barangays (~3.75%)	Very low citywide policy penetration and coverage
Segregation Compliance	Anecdotal improvements in Pagatpat and Bugo	No official compliance rate; relies on barangay initiative
Composting Capacity/Uptake	Saturated; unsold compost stockpiles in local MRF	Indicates a lack of downstream market linkages
Citywide Diversion Rate	Not available	Data gap acknowledged; proxies used to estimate performance

In contrast to the others, recent reports portray Cebu City struggling with policy continuity. The City Council report from November 2024 highlights that the Environment Office's proposed SWM budget was slashed from ₱2.5M to ₱0.2M. The intended ₱2.5M was to fund project personnel for waste diversion programs, but councilors argued for fiscal prudence as the city's 2024 budget was reduced (from an executive plan of ₱100B to ₱25B). COA audit findings in 2023 further criticize Cebu's SWM: multi-million-peso grants (₱10.5M in 2022, ₱10M in 2023 for building barangay MRFs went unspent. Existing MRFs in barangays such as Taptap and Kalunasan were reportedly idle, and the COA concluded that the city "is not giving much priority to composting and recycling." Cebu's SWM plan (dating from 2011 and updated in 2023) sets ambitious targets, but in practice, the lack of secure sites for MRFs (land cost) and political turnover have hampered progress. The net effect is that Cebu may see waste volumes grow (projected up to 1 million kg/day by 2027) without corresponding diversion.

The following tables present a comparative overview of solid waste management performance across Cagayan de Oro, Quezon City, and Cebu City, highlighting key indicators such as waste volumes, diversion rates, MRF functionality, and budget allocations to illustrate disparities and common challenges in policy implementation.

Table 3. *Comparative Matrix of Solid Waste Management Indicators*

Indicator	*Cagayan De Oro (Cdo)*	*Quezon City (Qc)*	*Cebu City*
Annual Waste Volume	~1.25 million tons	~2.91 million m³ (2023)	~900,000 kg/day projected (2027)
Per Capita Waste Generation	Not specified	0.65–0.80 kg/day	Not specified
Diversion Rate	No official rate	~48% (Metro Manila)	Low (MRFs idle, audits negative)
MRF Functionality	1 active (Pagatpat, near capacity)	Multiple, with biodigesters	Many idle or unused
SWM Budget Allocation	₱106.3M (plus ₱625.5M infrastructure)	Not publicly detailed	₱0.2M (down from ₱2.5M proposed)
Key Challenge	Market barriers for recyclables	Landfill reliance, scale issues	Poor budget use, idle MRFs

To further strengthen the quantitative foundation of this study, a comparative overview of local ordinance implementation and MRF functionality is presented in Table 3. This table summarizes the extent to which selected cities have enacted anti-plastic ordinances and operationalized Material Recovery Facilities (MRFs) at the barangay level– two core indicators of compliance with Republic Act No. 9003.

Table 4. *Ordinance and Mrf Coverage Per City*

City	*Barangays with Plastic Ban Ordinance*	*% with Active MRFs*	*Notes*
Cagayan de Oro	3/80 (Pagatpat, Bugo, Gusa)	~5%	Compost-focused; low density
Quezon City	Majority	>60%	Backed by NGOs, community-based
Cebu City	Very few	<10%	Many idle MRFs; budget slashed

While each city exhibits unique strengths and challenges, the data highlights a broader pattern of uneven policy adoption and infrastructure readiness across local government units. The inclusion of this table provides a clearer picture of implementation disparities and helps identify specific leverage points for future policy interventions.

On the other hand, this annual waste volume by city bar chart visually compares the total waste volumes generated annually by three major Philippine cities: Cagayan de Oro, Quezon City, and Cebu City. The chart provides a quick reference to the relative scale of solid waste each city handles, measured in either tons or cubic meters.

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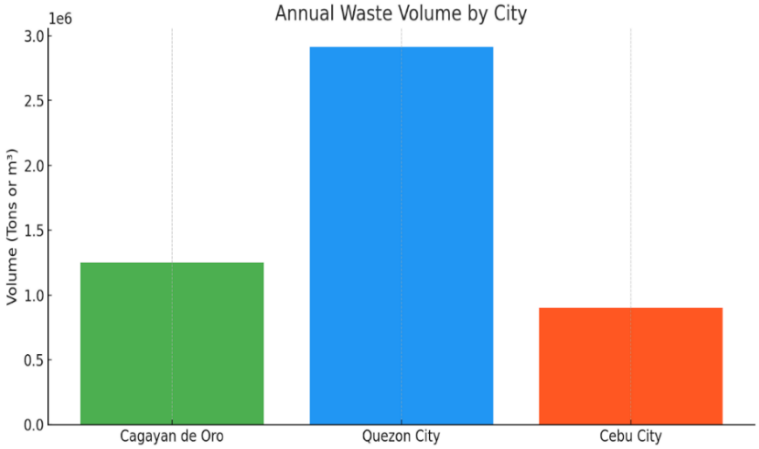
Table 5. *Annual Waste Volumes of CDO, Quezon City, and Cebu City (in metric tons)*

City	*Annual Waste Volume*
Cagayan de Oro	1.25 million tons
Quezon City	2.91 million m³ (≈2.3M tons)
Cebu City	900,000 kg/day × 365 ≈ 328.5M kg (≈0.33M tons)

As shown, Quezon City generates the highest volume of waste annually, followed by Cagayan de Oro, while Cebu City produces the least among the three. This disparity reflects differences in urban population size, economic activity, and waste collection systems, which are crucial for evaluating the effectiveness and pressure points of local waste management strategies.

The selection of Cagayan de Oro, Quezon City, and Cebu City as case studies in this study was intentional and strategic, grounded in their geographic, demographic, and administrative significance. These three cities represent major urban centers across the country's three main island groups: Mindanao (Cagayan de Oro), Luzon (Quezon City), and the Visayas (Cebu City). This allows for a regionally balanced analysis of solid waste management (SWM) practices. Each city is highly urbanized, with growing populations and increasing waste generation, making them critical test cases for assessing the effectiveness of national policies such as the Ecological Solid Waste Management Act (RA 9003) and the Extended Producer Responsibility Act (RA 11898).



Moreover, the three cities exhibit varying levels of implementation and innovation. Quezon City is often recognized for its progressive SWM programs and infrastructure, Cagayan de Oro reflects grassroots efforts and localized compliance challenges, and Cebu City reveals systemic obstacles such as budgetary constraints and underutilized facilities. By comparing these distinct contexts, the study aims to capture a more nuanced understanding of policy outcomes, enabling a more comprehensive evaluation of the Philippine SWM framework's reach and effectiveness.

Discussion

The Ecological SWM Act (RA 9003) enshrines a hierarchy: avoid/reduce waste first, then reuse/recycle/recover, and finally treat/dispose last. However, evidence shows many cities remain stuck at the bottom of the pyramid. For instance, only 40–50% of waste is diverted (via recycling/composting) even in urban centers, and segregation is often incomplete (mixed wastes still go to landfills). CDO's experience illustrates both sides: the city has adopted "no segregation, no collection" in barangays and built MRFs, aligning with the top levels of the hierarchy. Yet the Pagatpat case shows that without reliable markets or end-processors, recyclable materials accumulate unsold, effectively delaying true recovery. Similarly, Cebu's underused MRF funds and idled composters signal a gap in moving beyond disposal. These findings suggest that while the waste hierarchy is conceptually in place, weak enforcement and economic disincentives allow volumes to remain high.

The circular economy framework advocates closing resource loops – turning waste into products or energy – which aligns with RA 9003's reuse and recycling goals and with newer initiatives. Nationally, the DENR and UNDP have emphasized a transition from linear "take-make-waste" to circular models. The UNDP baseline report (2024) highlights governance and infrastructure indicators for circularity, including waste recovery systems. Local innovations in CDO and QC reflect nascent circularity: CDO's community gardens use compost for urban agriculture, and QC's biodigester turns food waste into biogas. These exemplify resource recapture. Cebu, too, has potential programs (incubator hubs for composting, plans for plastic recycling hubs), but action is stalled.

The "Trash-to-Cashback" scheme in QC illustrates creating economic loops by giving recyclable materials value. However, the scales are still small: the COA notes that only ~798 of 4,000 expected firms have registered EPR programs for plastics, meaning plastic packaging largely circulates through informal recyclers or leaks into the environment. In sum, while the circular approach is gaining policy attention, implementation lags. Opportunities exist in strengthening producer involvement and in community-led reuse (e.g.,

turning collected plastic into construction materials, as tried in some cities). The results highlight that achieving a circular economy will require systemic shifts: from better product design to incentives for waste-based entrepreneurship.

The recent EPR Act (RA 11898, 2022) targets the upstream side of waste, especially plastics. It assigns manufacturers and brand owners responsibility for recovering a percentage of post-consumer packaging waste. The law's targets (20% recovery by 2023, up to 80% by 2028) are aggressive. Our findings show this policy is still new in practice. National reports confirm the 2023 goal of 20% recovery was mandated, but as of late 2023, only about 20% of obligated companies had submitted implementation plans. This suggests slow compliance. In the context of our cities, larger firms in Metro Manila (e.g., QC) are subject to EPR, while local manufacturers around CDO and Cebu must also comply.

A weak EPR system exacerbates municipal burdens: without producer-led collection programs, local governments struggle to meet diversion targets on their own. Thus, strengthening EPR (through enforcement and supporting Producer Responsibility Organizations) is key to reducing municipal waste loads. This aligns with international comparisons where EPR has been effective in raising recycling rates of packaging.

The three cities illustrate different strengths and weaknesses. In CDO, SWM is somewhat decentralized. Notably, barangay-led initiatives (KALAMBUAN project in Bugo, Lapasan, Gusa) show community engagement. CDO's "no segregation, no collection" rule has generated public compliance in pilot areas. However, the citywide scaling of these practices is uncertain; logistical issues with transporting segregated waste to centers remain. Cebu City, by contrast, has experienced administrative discontinuity: a change in mayor in 2023 and a fiscally conservative council have cut waste budgets.

This undermined projects like municipal composting and MRF development. Cebu also faces spatial challenges: dense urban villages make it hard to find land for MRFs. Quezon City benefits from its large local government resources and partnerships with NGOs. It has implemented innovative programs (e.g., eco-fairs, youth outreach, solar-powered garbage trucks) that CDO and Cebu could emulate. For example, the QC BasuHero program involves media and schools to raise recycling awareness. A strength of QC is its data transparency (the detailed waste collection report used in Table 1). In terms of the waste hierarchy, QC's results still rely heavily on landfill disposal for "residuals" – as do CDO's and Cebu's. All three cities have regulated closure of illegal dumps (as required by RA 9003) and operate sanitary landfills or rely on nearby provincial facilities (e.g., CDO's Pagatpat Landfill).

The results imply several needs:

Enforce and raise diversion targets. The NSWMC raised the LGU diversion goal to 50%, but many cities have not even achieved 25%. Local governments must strengthen monitoring of MRF outputs and penalize non-segregation.

Integrate circular economy. Policies should incentivize waste prevention (e.g., reduce packaging) and promote recycling industries. One way is adopting "green procurement" (as suggested in the NSWM Strategy) to use recycled products.

Expand EPR implementation. The EPR Act's roll-out is crucial; cities should facilitate producer programs and integrate them into city SWM. Collaboration with national agencies (e.g., NSWMC's newly created National Ecology Center) is needed to track compliance.

Invest in infrastructure. The low MRF access (only ~40% of barangays) signals the need for more facilities. Investments in community MRFs, composting plants, and possibly waste-to-energy should be budgeted.

Engage communities. The success of barangay programs in CDO suggests scaling "waste warriors" groups can raise awareness and ease segregation. Education campaigns in schools (mandated by law) can foster generational change (RA 9003 Section 52).

To better operationalize the findings, Table 6 below summarizes actionable recommendations by stakeholder groups, highlighting how policy improvements can be shared across different levels of governance and society.

Table 6. *Policy Recommendations by Stakeholder*

Stakeholder	*Recommended Actions*
Local Government Units (LGUs)	Enforce higher diversion targets (25–50%)
	Monitor MRF output and penalize non-compliance
	Integrate Extended Producer Responsibility (EPR) programs locally
Barangays	Establish and maintain MRFs
	Launch community-level composting and recycling
	Support "no segregation, no collection" enforcement
National Government	Strengthen oversight via NSWMC and NEC
	Provide funding for MRF and composting infrastructure
	Promote circular economy through national policies and incentives
Communities / Public	Participate in segregation and recycling
	Join local eco-volunteer or "waste warrior" initiatives
	Support EPR through informed consumption habits
Schools & Educators	Implement waste education per RA 9003 Sec. 52
	Partner with LGUs for school-based recycling programs

The findings of this study offer a nuanced and evidence-based response to the central questions, emphasizing the uneven and complex outcomes of solid waste management (SWM) policy implementation in the Philippines.

First, the extent to which RA 9003 has improved diversion rates in Cagayan de Oro City (CDO) since its enactment in 2001 shows that while CDO has institutionalized many of RA 9003's mandates such as barangay-level segregation, MRF establishment, and the "no segregation, no collection" ordinance, the city's overall waste diversion performance remains undocumented at the aggregate level. Despite localized successes, such as composting initiatives in Barangay Pagatpat and barangay-led recycling efforts in Bugo and Lapasan, the absence of citywide diversion data and persistent market bottlenecks for recyclables suggest that policy implementation has not translated into systematic, measurable diversion improvements. This indicates that while RA 9003 has catalyzed localized innovations, its full potential remains unrealized in the absence of citywide tracking, downstream market integration, and operational scale.

Second, the study finds a moderate but conditional relationship between the presence of operational Materials Recovery Facilities (MRFs) and policy compliance. Cities like Quezon City, which maintain multiple functional MRFs and supplement them with complementary programs (e.g., biodigesters, segregation incentives), demonstrate higher compliance levels and relatively higher diversion rates (~48%). Conversely, Cebu City, where most MRFs remain idle due to land, funding, and administrative constraints, exemplifies weak compliance and policy stagnation. However, the CDO case shows that even when MRFs are operational, their effectiveness depends on market linkages, user participation, and sustainable logistics. Thus, MRF presence is a necessary but insufficient condition for compliance; performance hinges on functionality, integration, and supporting policy ecosystems.

Lastly, the plastic waste generation in relation to local ordinances banning single-use plastics emphasizes the importance of regulatory specificity and enforcement. Preliminary document analysis reveals that LGUs with active anti-plastic ordinances (such as parts of Quezon City and select barangays in CDO) tend to report lower levels of visible plastic waste in community waste streams and have more structured public awareness campaigns. However, in the absence of strong enforcement mechanisms or alternative packaging systems, plastic use persists informally. Cebu City, where ordinance implementation has been weak or inconsistent, continues to experience high levels of plastic waste and little behavioral change. This suggests that while plastic bans can be effective, their success depends on behavioral incentives, the availability of eco-alternatives, and consistent enforcement across all sectors.

In summary, this affirms that waste policy effectiveness is not merely a function of law enactment, but of adaptive implementation, sustained infrastructure, civic participation, and multi-level integration. While national policies like RA 9003 and RA 11898 provide a foundational framework, their transformative potential is realized only when local governments, communities, and producers align in practice. CDO, QC, and Cebu each reflect a different intersection of opportunity and constraint. This study ultimately reinforces the need for iterative, data-driven governance and highlights the critical role of localized innovations and stakeholder collaboration in shaping a sustainable urban future.

Conclusions

This study evaluated the effectiveness of solid waste management (SWM) policies in the Philippines through a mixed meta-analytical and hermeneutic approach, focusing on national frameworks and their local implementation in Cagayan de Oro, Quezon City, and Cebu City. The findings demonstrate that while robust legal frameworks like Republic Act No. 9003 and the Extended Producer Responsibility Act of 2022 establish a sound policy foundation, uneven implementation hampers expected outcomes.

Cagayan de Oro shows grassroots innovations such as barangay composting and segregation enforcement but struggles with infrastructure and market constraints. Quezon City institutionalizes recycling and community engagement yet remains reliant on landfills. Cebu City reflects the erosion of policy gains due to political turnover and budget cuts, leading to idle infrastructure and low diversion rates.

Nationally, mandated waste diversion targets of 25–50% are rarely met, with only about 40% of barangays equipped with functional Materials Recovery Facilities (MRFs) and persistent landfill dependence. Circular economy objectives remain underrealized amid fragmented, underfunded, and poorly monitored initiatives. These results suggest that beyond sound policy design, sustained funding, coordinated cross-sector efforts, reliable data systems, and strong civic participation are crucial for effectiveness. Adaptive policy learning, incorporating ongoing implementation feedback, is essential to refining future strategies.

This study highlights that SWM in the Philippines transcends technical and environmental dimensions, embodying deep social and political complexities. Effectiveness must be assessed not merely by metrics but also by inclusiveness, quality, and sustainability. Progress toward zero waste demands enhanced enforcement, community empowerment, and embedding ecological values in policy and practice.

Pragmatically, the study recommends that the National Solid Waste Management Commission (NSWMC) strengthen its institutional and technical capacities to support local government units, particularly in data management and monitoring. Standardized waste reporting should be mandated nationwide to improve transparency and accountability. Moreover, policy harmonization across LGUs is vital to manage cross-boundary waste flows and ensure policy continuity despite political shifts.

These conclusions contribute to advancing scholarly understanding and provide actionable guidance for policymakers, stakeholders, and researchers engaged in solid waste reform efforts in the Philippines.

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