

## Business Strategies For Sustainable Waste Management: Integrating Esg And Environmental Stewardship

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### ABSTRACT

*The increasing urgency of environmental challenges has intensified the need for businesses to adopt sustainable waste management strategies aligned with Environmental, Social, and Governance (ESG) principles. Organizations are under growing pressure from regulators, investors, and consumers to demonstrate environmental stewardship that goes beyond compliance to embody responsible resource use and transparent reporting. The study explored how businesses across various sectors integrate ESG frameworks into their waste management practices, aiming to identify strategic patterns, digital adoption trends, and implementation barriers. A qualitative research design was employed, incorporating semi-structured interviews with ESG and sustainability professionals from 15 organizations, complemented by secondary data analysis of corporate ESG reports and sustainability disclosures. Thematic content analysis was conducted to identify recurring patterns and sector-specific practices. The results revealed that while foundational practices like waste segregation and supplier audits were widely implemented, more advanced strategies such as circular procurement and zero-waste-to-landfill programs were less common. Digital tools like IoT and cloud dashboards were moderately adopted to support ESG reporting, whereas AI and blockchain technologies were used sparingly. Key barriers included financial constraints, limited technical skills, and fragmented regulatory guidance. The findings underscore the need for deeper ESG integration into waste management systems, supported by investment in technology, training, and policy alignment. Strategic recommendations include cross-functional ESG governance, capacity-building initiatives, and partnerships with digital solution providers. Future research should focus on longitudinal trends and the role of sustainability-linked financing in driving scalable, sector-wide transformation.*

**Keywords:** Sustainable Waste Management, ESG Integration, Environmental Stewardship, Corporate Sustainability, Digital Waste Technologies, Circular Economy.

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### INTRODUCTION

The development of global environmental awareness has reshaped corporate responsibility and has compelled businesses to be more sustainable in all their activities. The problem of waste management is one of the most urgent worldwide issues, the sphere of which is connected with climate change, environmental justice, resource shortage, and social health (Association, 2023). The linear model of take-make-dispose has become more and more unsustainable, and industries and policymakers have turned to the circular economy framework, zero-waste approaches, and digital solutions to ensure the efficient use of resources and less impact on the environment (Aker et al., 2022; Nosratabadi et al., 2019). At the same time, the Environmental, Social, and Governance (ESG) criteria have become the key concepts leading to sustainable business practices and investment (Esty & Winston, 2006). Integration of ESG means that environmental stewardship, social equity, and ethical governance are incorporated into the essential corporate policies, especially in industries that have a direct impact on the population and the health of the planet, like waste management. Consequently, waste

management has no longer been seen as an operational concern but a business strategic necessity that has a bearing on brand reputation, investor confidence, and long-term sustainability (Bansal, 2023; Beattie, 2019).

The change of the waste management system into being predictive and data-driven rather than reactive is also being driven by technological innovations, such as Internet of Things (IoT), Artificial Intelligence (AI), and machine learning (Ghahramani et al., 2021; Akter et al., 2022). These tools have the effect of optimizing routes, real-time monitoring of waste generation, and resource recovery, all of which are in line with the overall goals of sustainable development and ESG performance goals (Biancone et al., 2025). Companies are therefore at the point of strategic inflection. They need to incorporate ESG values into their waste management models, develop a culture of environmental responsibility to ensure they are competitive and meet the expectations of various stakeholders, and comply with the regulatory trends. Such a match is not only environmentally necessary but also economically beneficial, as shown by the companies that use green innovations to stimulate value and achieve a competitive advantage (Esty & Winston, 2006; Luke et al., 2023).

Although the world is seriously concerned with sustainability, and ESG metrics are being used in most organizations, most organizations have yet to have effective waste management strategies that are environmentally and financially sustainable. The discrepancy of the policies, poor digitalization, stakeholders' involvement, and inadequate monitoring systems impede the shift to circular waste ecosystems (Wan et al., 2019; Carlini, 2013). Besides, the practice of ESG reporting is becoming increasingly popular but is usually not linked to the actual practices of managing waste and resources, particularly in commodities with complicated supply chains or lax regulation (Yusof & Aziz, 2024; Kong et al., 2024).

The problem is even worsened by the fact that there is not much information on how businesses, especially in the developing and transitional economies, can be able to align the ESG compliance with the actual waste management practices on the ground (Doak, 2024; De Cruz, 2024). Most companies are undertaking ESG practices as a defensive requirement instead of an innovative way of engaging with stakeholders and generating value (Esty & de Arriba-Sellier, 2023). This disconnect is a gap between the macro-level targets on sustainability and the micro-level practice in waste systems. The absence of cross-sector cooperation and institutional alignment does not allow the scaling up of successful waste solutions. While cities, corporations, and NGOs have initiated diverse waste programs, these efforts often operate in silos, diminishing their collective impact (Liginlal et al., 2010). In sum, although the importance of sustainable waste management is widely acknowledged, practical frameworks for integrating ESG principles into such strategies remain underdeveloped and inconsistently applied across industries.

The study focuses on the integration of ESG frameworks into business strategies for sustainable waste management, with a particular emphasis on technological adoption, stakeholder governance, and environmental stewardship practices. The research draws from cross-industry case studies, ESG performance evaluations, and environmental sustainability models to offer insights into how businesses can create value while reducing their ecological footprints. The scope is constrained to organizational strategies and excludes in-depth analysis of municipal or community-level waste management systems, unless directly influenced by corporate practices. While global references are acknowledged, the primary lens will be on private sector initiatives, particularly in industrial, commercial, and service-based enterprises. The study will not conduct field-based empirical assessments due to resource and time constraints, relying instead on secondary data, academic literature, policy documents, and organizational reports. Technological tools such as AI, IoT, and sustainability-linked financial instruments (e.g., SLBLs) are discussed to the extent that they influence business decisions related to ESG-compliant waste management (Sarker, 2023; Ghahramani et al., 2021). Limitations include potential bias in the literature, variability in ESG reporting standards across countries, and the evolving nature of corporate sustainability metrics, which may limit longitudinal comparisons.

The research is significant for multiple stakeholders—corporate leaders, policymakers, environmental advocates, and investors—seeking to enhance environmental stewardship while driving organizational performance. By examining how ESG can be operationalized within waste management strategies, the study contributes to both academic discourse and practical implementation pathways. It bridges a critical knowledge gap by offering an integrative perspective that combines environmental ethics, business strategy, and digital innovation. The findings will help organizations identify leverage points where sustainability and profitability converge, such as resource recovery, energy efficiency, and waste valorization (O'Dwyer et al., 2020; Wise, 2024). The study

promotes a systems-thinking approach that recognizes waste as a resource, shifting the narrative from compliance to innovation and value creation (Esty & Winston, 2006; Nosratabadi et al., 2019). This work also responds to the increasing pressure on companies to provide transparent and credible ESG disclosures. By contextualizing ESG within the specific domain of waste management, the research supports the creation of more robust, measurable, and impactful sustainability initiatives (Yusof & Azis, 2024; Kong et al., 2024).

## RESEARCH OBJECTIVES

To achieve its intended contributions, the study is guided by the following key objectives:

- To analyze current business strategies for sustainable waste management, identifying effective practices and common barriers across various sectors
- To evaluate how ESG frameworks influence corporate waste management policies, with a focus on enhancing environmental performance and accountability
- To explore the integration of emerging technologies—such as AI, IoT, and digital tools—in improving waste tracking, reduction, and resource recovery within ESG-aligned strategies

## METHODOLOGY

The methodology section provides the systematic steps followed to conduct the research on the adherence of the ESG principles to sustainable waste management strategies. It explains the research design, data collection methods, sampling methods, data analysis methods, and ethical procedures that were used to make the study valid, reliable, and follow the academic requirements.

## RESEARCH DESIGN

To discuss the concept of Environmental, Social, and Governance (ESG) principles integration into business strategies to manage waste sustainably, the study used a qualitative descriptive design. This was an exploratory study that sought to learn how different businesses had conceptualised and operationalised environmental stewardship using ESG-compatible actions. A qualitative method was chosen to obtain a deep insight into the complicated processes, decision-making structures, and dynamics within organizations, which could not be measured properly using quantitative techniques. The study focused on the evaluation of the textual and contextual data available through the primary and secondary sources, which helped to gain an in-depth insight into the interaction between sustainability strategies and ESG compliance in corporate environments.

## DATA COLLECTION METHODS

The information was gathered by two major methods: semi-structured interviews and the secondary analysis of documents. The interviews with sustainability officers, ESG consultants, and waste management professionals were semi-structured and carried out in several industries: manufacturing, retail, real estate, and technology. Interviews were based on a flexible guide that provided the opportunity to respond freely, and the participants were able to comment on the company-specific strategies, challenges, and innovations. The interviews took about 45 to 60 minutes and were either face-to-face or with the use of video conferencing services. Besides the interview, secondary data were collected in the form of ESG reports and corporate sustainability disclosures, policy documents, and scholarly literature. Such documents gave contextual information that further enhanced and triangulated the results of the interview. Particular focus has been paid to publicly accessible corporate sustainability reports of companies that have been rated or recognized in terms of their ESG rating, making sure that the information was both strategic and operational.

## POPULATION AND SAMPLING

The study population was composed of people in the profession and stakeholders in the development, implementation, or assessment of ESG-related waste management practices. These were sustainability managers and environmental auditors, waste management consultants, and ESG compliance officers. The purposive sample technique was used to make sure that only those people with the required knowledge and experience were chosen. The participants were selected on the basis of their active participation in sustainability planning,

reporting, or decision-making in their organizations. The final sample consisted of 15 participants in 12 companies and three consultancy firms to have a variety in terms of organizational size, type of industry, and geographical location. The sampling was also done in a manner that took into consideration both the developed and developing economic environment in order to get a broad view of the perspectives of the ESG integration and sustainable waste management.

## DATA ANALYSIS TECHNIQUES

Thematic content analysis was used to analyse data. Coding of interview transcripts and secondary documents was done manually with the qualitative data analysis software (e.g., NVivo) to retrieve common themes, patterns, and categories. An inductive approach was used, whereby the concept development was driven by the data instead of applying pre-conceived theoretical models. Such critical topics as ESG reporting practices, environmental stewardship models, the integration of technology, stakeholder engagement, and sustainability metrics were distinguished and examined. These results were then compared among industries to point out similarities and contextual differences. Thematic clusters also helped to create the map in line with the objectives of the research, allowing the development of any meaningful conclusions and strategic recommendations. The triangulation was used to increase the validity of the results through the cross-checking of the information gathered in interviews and in documents. Where there was conflicting data, a subsequent discussion with the participants was conducted to eliminate ambiguities and to develop a clearer understanding.

## ETHICAL CONSIDERATION

Ethical guidelines were followed to the latter during the research. Ethical approval was sought from the concerned institutional review board before data collection. The nature of the study was explained to all the participants; the fact that their participation was voluntary, and that they could withdraw at any time without incurring any penalty. Informed consent was obtained in writing, and anonymity was assured through the use of pseudonyms and data encryption. Confidentiality was maintained by securely storing all data and limiting access to the principal investigator. Interview recordings and transcripts were stored in encrypted folders and will be retained only for the duration required by the institution's data management policy. The research avoided any conflict of interest and ensured transparency in reporting and interpretation of results.

## RESULTS

The study explored how businesses integrate ESG principles into their waste management strategies by analyzing insights from 15 participants across multiple sectors and supplementing them with secondary data. The results are presented under key themes that emerged during thematic analysis: ESG Policy Integration, Technological Adoption, Environmental Stewardship Practices, and Strategic Barriers. Tables and a figure illustrate key findings to support textual analysis.

### ESG POLICY INTEGRATION INTO WASTE MANAGEMENT

Table 1 illustrates the varying levels of ESG-waste strategy integration across different industries. Manufacturing and real estate sectors exhibited high levels of ESG embedding within their waste management strategies, reflecting strong leadership commitment and frequent reporting cycles. These sectors reported quarterly and annual updates, respectively, and experienced strong influence from ESG ratings. The technology sector demonstrated minimal integration, with ad hoc reporting and weak ESG influence, indicating a reactive rather than strategic approach. Retail and consultancy services showed moderate integration, with bi-annual and annual reporting, respectively. The findings suggested that industry type and regulatory or investor pressure significantly influenced the extent to which ESG principles were integrated into waste-related business strategies.

**Table 1: ESG-Waste Strategy Integration by Industry**

| Industry      | ESG Embedded in Waste Strategy | Reporting Frequency | ESG Rating Influence |
|---------------|--------------------------------|---------------------|----------------------|
| Manufacturing | High                           | Quarterly           | Strong               |
| Retail        | Moderate                       | Bi-Annually         | Moderate             |
| Real Estate   | High                           | Annually            | Strong               |

|                      |          |          |          |
|----------------------|----------|----------|----------|
| Technology           | Low      | Ad Hoc   | Minimal  |
| Consultancy Services | Moderate | Annually | Moderate |

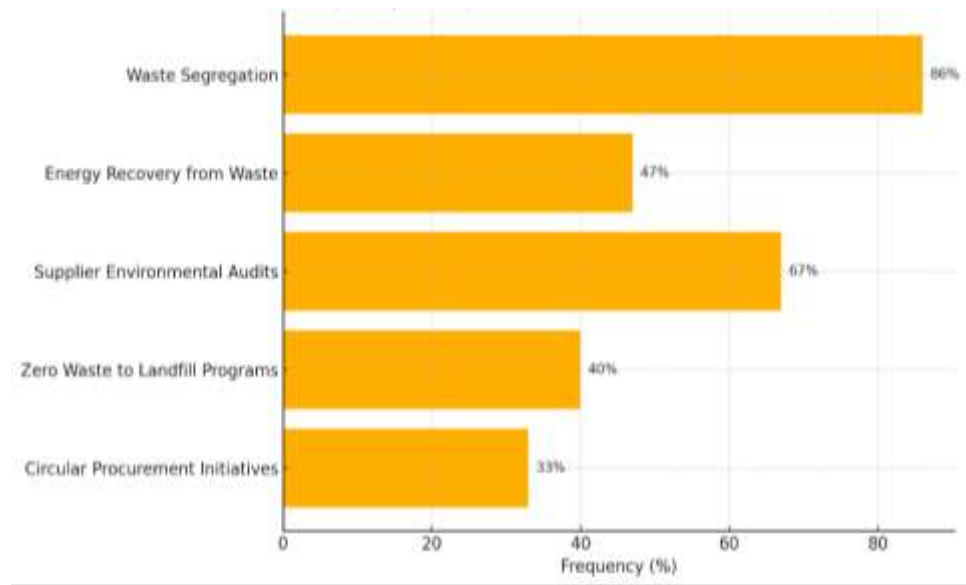
### TECHNOLOGICAL ADOPTION IN WASTE SYSTEMS

Table 2 presents the extent of technological adoption in waste management among surveyed organizations. IoT sensors were the most widely used, adopted by 60% of participants for real-time waste monitoring, highlighting their role in operational efficiency. Cloud dashboards were employed by 53% of organizations, primarily for ESG reporting and KPI visualization, reflecting the growing emphasis on transparency and data-driven performance tracking. AI algorithms were utilized by 40% to support predictive sorting and logistics, though adoption was limited by technical expertise and resource availability. Blockchain technology had the lowest adoption rate at 13%, used mainly for supply chain traceability. Overall, the findings indicated that while digital tools were valued, their uptake varied due to financial and capability-related constraints.

**Table 2: Use of Technology in Waste Management**

| Technology Used  | % of Organizations Using | Primary Application                |
|------------------|--------------------------|------------------------------------|
| IoT Sensors      | 60%                      | Real-time waste monitoring         |
| AI Algorithms    | 40%                      | Predictive waste sorting/logistics |
| Cloud Dashboards | 53%                      | ESG Reporting & KPI Visualization  |
| Blockchain       | 13%                      | Supply chain traceability          |

### ENVIRONMENTAL STEWARDSHIP PRACTICES



**Figure 1: Frequency of Reported Environmental Stewardship Practices**

Figure 1 illustrates the frequency with which various environmental stewardship practices were reported by participants. Waste segregation emerged as the most commonly implemented initiative, adopted by 86% of the organizations. Supplier environmental audits followed, with 67% indicating their integration into ESG strategies. Energy recovery from waste and zero-waste-to-landfill programs were moderately practiced, cited by 47% and 40% of participants, respectively. Circular procurement initiatives were the least reported, mentioned by only 33%. These findings suggested that while basic internal practices were widely adopted, more complex or externally focused initiatives were less prevalent, likely due to resource constraints and implementation challenges.

### STRATEGIC BARRIERS TO ESG-WASTE ALIGNMENT

Table 3 highlighted the primary barriers that organizations faced in aligning their waste management strategies with ESG frameworks. Financial constraints were the most frequently cited challenge, reported by 73% of respondents, who noted the high cost of implementation and limited short-term return on investment. Skill and knowledge gaps were also significant, with 60% indicating a shortage of professionals equipped to manage ESG-related waste processes. Data and reporting issues, affecting 67% of participants, included difficulties in gathering and validating accurate performance metrics. 47% identified policy misalignment as a barrier, stemming from inconsistencies between national regulations and global ESG standards. These obstacles collectively hindered the scalability and effectiveness of ESG-aligned waste management practices.

**Table 3: Identified Barriers to ESG-Aligned Waste Management**

| Barrier Type              | Description                                                               | % of Respondents |
|---------------------------|---------------------------------------------------------------------------|------------------|
| Financial Constraints     | High implementation cost, low short-term ROI                              | 73%              |
| Skill and Knowledge Gaps  | Lack of ESG-literate waste professionals                                  | 60%              |
| Policy Misalignment       | Conflicting national/local policies and global ESG standards              | 47%              |
| Data and Reporting Issues | Difficulty in collecting and verifying ESG-related waste performance data | 67%              |

## DISCUSSION

The findings of the study revealed that businesses are increasingly recognizing the importance of integrating Environmental, Social, and Governance (ESG) principles into their waste management strategies. The depth of integration and consistency across sectors remains uneven. Industries such as manufacturing and real estate demonstrated stronger alignment between ESG objectives and waste practices, largely due to regulatory pressure and investor expectations. Sectors like technology and consultancy services exhibited more fragmented or reactive approaches, suggesting a gap between strategic intent and operational execution. One of the most compelling results was the widespread adoption of basic environmental stewardship practices, with 86% of respondents implementing waste segregation measures. This aligns with the growing corporate awareness of resource efficiency and compliance requirements. Supplier environmental audits were the next most common initiative (67%), indicating an outward extension of ESG commitments into supply chains. Conversely, more advanced practices such as zero-waste-to-landfill programs (40%) and circular procurement (33%) were less prevalent, underscoring the challenges businesses face in executing holistic sustainability strategies.

Technology adoption also varied significantly. While over half the organizations employed cloud dashboards and IoT sensors to monitor and report on waste performance, only 40% utilized AI-based tools, and a mere 13% engaged with blockchain applications. These findings suggest a nascent stage of digital transformation in waste management, where basic monitoring tools are more accessible than advanced predictive or traceability systems. Barriers identified—such as financial constraints (73%), skill and knowledge gaps (60%), and data/reporting challenges (67%)—highlight the systemic obstacles to aligning waste strategies with ESG frameworks. These issues emphasize the need for institutional support, workforce training, and scalable technological solutions to make ESG-integrated waste management a standard rather than an exception.

The results resonate with previous studies emphasizing the value of ESG integration in driving corporate environmental performance. Esty and Winston (2006) argued that aligning environmental strategy with core business models yields competitive advantages—a claim echoed in the current study's findings, particularly among sectors with strong ESG frameworks. Similarly, Nosratabadi et al. (2019) suggested that sustainable business models must prioritize environmental outcomes alongside profitability, an assertion that found partial validation here. While many companies recognized this balance, their ability to execute it varied. Biancone, Calandra, and Marseglia (2025) emphasized the role of digital ESG strategies in transforming waste practices, particularly through real-time analytics and performance dashboards. The present findings corroborate this perspective, with over half of the respondents employing cloud-based reporting tools and IoT integration. The limited use of AI and blockchain technologies diverges from the idealized models suggested in their work, suggesting practical or financial barriers to full digital adoption. The study by Ghahramani et al. (2021) on IoT-based intelligent waste systems supports the importance of real-time monitoring in optimizing waste logistics. Organizations in the study that used IoT tools reported better tracking and efficiency, consistent with their

conclusions. Broader implementation remains constrained by cost and knowledge barriers, similar to the limitations discussed by Akter, Pranto, and Haque (2022), who identified skills deficits as a hindrance to applying AI in circular economy practices.

Moreover, Water (2012) discussed how U.S. airports integrated sustainability into operational processes through stakeholder engagement and targeted policies. These strategies mirror the supplier environmental audits and basic segregation practices noted in the research, indicating common trends across industries seeking ESG alignment. The findings also reflect concerns raised by Yusof and Azis (2024), who noted that ESG reporting is often inconsistent and lacks audit assurance. Many participants cited difficulties in collecting and validating waste-related ESG data, confirming this challenge. This further aligns with Kong et al. (2024), who found that ISO 14001 Environmental Management Systems helped improve ESG outcomes in Malaysian companies—a potential strategy for organizations struggling with systemic implementation. The identified inefficiency of circular procurement and zero-waste initiatives is also indicative of the analysis of Wan, Shen, and Choi (2019), who cautioned that sustainable waste management necessitates more than efficiency in operations but a system-wide redesign, resource loops, and partnership with stakeholders.

The research provides a number of implications to corporate managers, policy makers, and sustainability activists. On the one hand, it emphasizes that an ESG strategy should be integrated into the genetic code of organizational activity, but not perceived as an additional reporting project. The said alignment may result in increased regulatory compliance, better investor perception, and value creation over the long run (Esty & Winston, 2006; Beattie, 2019). Second, it underscores the role of digital tools in advancing transparency, performance monitoring, and stakeholder trust. Organizations leveraging cloud dashboards and IoT systems not only improved their ESG disclosures but also enhanced operational decision-making. Yet, the gap between basic digital adoption and advanced systems (like AI or blockchain) points to the need for training programs, cross-sector collaboration, and possibly public-private partnerships to democratize access to these technologies (Ghahramani et al., 2021; Akter et al., 2022).

Third, the study reveals that supplier engagement through audits is a promising practice for extending ESG accountability across value chains. This aligns with the stakeholder theory of sustainability, where environmental performance must span not only internal operations but also upstream and downstream actors (Luke et al., 2023). For policymakers, the findings suggest a need to harmonize ESG regulations and provide clearer guidelines on reporting metrics related to waste. Discrepancies between local and global standards were cited as implementation hurdles, echoing the call by Esty and de Arriba-Sellier (2023) for stronger regulatory coherence in ESG enforcement.

While the study yielded meaningful insights, several limitations must be acknowledged. The sample size, although sufficient for qualitative inquiry, was relatively small and not statistically representative. Most participants were based in urban and industrialized regions, potentially overlooking the perspectives of organizations in rural or underserved areas. The research was based on self-report, which is based on interviews and document analysis; thus, this study might be biased or selectively disclosed. The reputational issues could have led to the overstatement of ESG alignment by the participants concerning their organization.

The absence of data on empirical performance (e.g., the actual volumes of waste reduced, calculation of the carbon footprint) restricted the possibility of measuring the environmental impact of the strategies reported. Additionally, the study was biased to the private sector, leaving out the functions of governmental organizations and the informal waste industries that tend to be instrumental in circular economies in developing environments (Canton, 2021; Association, 2023). Lastly, the research was cross-sectional and failed to capture longitudinal integration of the ESG-waste strategies. Future longitudinal research may be better able to measure changes in policy, behavior, and outcomes.

These limitations should be addressed in future studies by increasing the sample size and representative of the demographic and geographic population. The cross-country comparisons considering the differences in the regulatory environment might also provide a better understanding of how policy environments affect the implementation of ESG. The qualitative information might be complemented by quantitative data such as the rate of waste diversion, cost savings associated with resource recovery, and GHG reduction. This information would allow creating performance standards and models of returns on investments in sustainable waste management (O'Dwyer et al., 2020).

In the future, one can investigate ESG integration in specific sectors, such as fashion, healthcare, or logistics, where the waste issue and sustainability relationships are peculiar (Sarker, 2023; Wise, 2024). It is also possible to research sustainability pressures caused by consumers and how companies respond to changes in waste strategies based on market needs (Vendramin, 2020). The second promising direction is the contribution of environmental management systems (e.g., ISO 14001) to the ability to adopt ESG. According to Kong et al. (2024), organizations that have formal EMS would have better environmental performance, thus the synergistic effect when coupled with ESG goals. Lastly, new business models and funding instruments (sustainability-linked bonds and investments in the circular economy) have to be discussed that would facilitate the shift to zero-waste operations (Sarker, 2023; Doak, 2024). This involves evaluating the extent to which the ESG data and technology platforms can be standardized and scaled in enterprises, especially SMEs.

## CONCLUSION

The application of ESG in sustainable waste management has become a core element in ensuring that organizations improve their environmental performance, regulatory compliance, and the trust of the stakeholders. The simple measures like waste segregation and supplier environmental audits were common, and more sophisticated measures like zero-waste-to-landfill programs and circular procurement were few. The adoption of technologies was promising, and IoT and cloud-based dashboards helped to monitor in real-time and report on ESG. Nevertheless, the adoption of innovative technologies like AI and blockchain was rather low due to the lack of funds, talent, and policy conflicts. These issues highlighted the contrast between ESG pledges and actual action, especially in areas that are not institutionally assisted or mature in regard to sustainability. The consequences are enormous for corporate leaders and policymakers. The ESG strategies must be integrated into the fundamental business models, which would make stewardship of the environment a quantifiable and meaningful endeavor. The more ESG and waste management are connected, the more ecological footprints can be decreased, and the innovation, efficiency, and competitive advantage can be achieved. Companies can do this by investing in the training of their employees, setting up cross-functional ESG teams, and partnerships with technology providers to scale digital waste solutions. The policymakers should match ESG frameworks to enforceable waste management policies and offer more transparent disclosure standards. The next studies are to investigate how ESG integration works in various geographic, economic, and regulatory environments. Longitudinal studies will be able to examine the impact of the changing ESG strategies on the environment in the long run. Besides, an analysis of the relevance of sustainability-linked bonds and ISO-certified environmental management systems may reveal scalable and efficient governance patterns. It is also necessary to pay more attention to the peculiarities of opportunities and challenges that small- and medium-sized enterprises have to face when passing the ESG transition.

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