

# Extended Producer Responsibility (EPR) Regulations: A Comprehensive Literature Review for Regulatory Impact Assessment (RIA) in Kenya

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## Abstract

Environmental accountability and protection has gained traction in the recent past. Sustainable waste management has become the point of interest for many stakeholders. Different jurisdictions have developed regulations on waste management to safeguard the planet and future generations. Extended Producer Responsibility (EPR) has emerged as the center of policy debate around the world, as it is considered a policy tool for promoting circular economy (CE) practices that transfer post-consumer waste management obligations from governments to producers. EPR ensures producers and manufacturers take responsibility for the physical end-of-life products they place on the market. The gazettement of the Sustainable Waste Management EPR Regulations, 2024, in Kenya, marked a significant regulatory milestone, mandating producer registration, take-back schemes, eco-design, and financial contributions for waste recovery and management. This review focused on the EPR framework and its implementation by synthesizing empirical studies, policy reports, and global best practices, and evaluating their implications on environmental performance, economic outcomes, and institutional capacity. It analyzed the alignment of Kenya's EPR framework with international benchmarks, compliance levels, product design innovation, recycling rates, job creation, and financial

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sustainability, focusing on a number of key waste actors at policy and implementation levels. The literature consisted of 551 articles and reports extracted from key academic databases: Web of Science, Scopus, Springer, and grey sources. Boolean logic and keyword combinations, systematic screening, and content analysis was used. The PRISMA model was applied. The findings hint at limited downstream waste management effectiveness, pointing to opportunities such as enhanced waste collection and diversion, recycling, and value recovery. The results also showed existence of the primary challenge of conflict between the EPR policy intent and implementation. While the policy is intended to shift the burden of waste management from public sector to private producers, the effort is undermined by resistance to change, lack of awareness, enforcement gaps, and legal disputes. Additionally, there is limited policy and enforcement framework, misalignment of responsibility between producers, manufacturers and importers on the management of end-of-life products upstream. Consequently, strong stakeholder involvement, clear sharing of responsibilities by producers, setting waste management targets for collection, recovery, and recycling, a progressive legal framework, public education and awareness, formalization of the informal sector, adoption of differentiated EPR fees, waste segregation at source, and targeted waste stream implementation is recommended.

### Keywords

Extended Producer Responsibility (EPR), Regulatory Impact Assessment, Sustainable Waste Management, Circular Economy, Producer Responsibility Organizations (PROs), Recycling, Waste Diversion, Environmental Sustainability, Financial Sustainability

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## 1. Introduction

Financial sustainability and environmental protection have increasingly become intertwined in policy priorities of the 21<sup>st</sup> century, particularly in the current state of escalating waste generation, resource depletion, and climate change (Aiguobaruoghian, Adanma, Ogunbiyi, & Solomon, 2024). Globally, Extended Producer Responsibility (EPR) has emerged as a transformative regulatory approach that reassigns the end-of-life management costs of products from governments and taxpayers to producers, importers, and brand owners (Tumu, Vorst, & Curtzwiler, 2023). Originating in the early 1990s, in the Organization for Economic Co-operation and Development (OECD) countries, EPR seeks to incentivize producers to design environmentally friendly products, improve material recovery, and minimize waste disposal through the principle of “polluter pays” (OECD, 2024). Over the past three decades, EPR has evolved into a core pillar of circular economy strategies, integrating environmental stewardship with economic competitiveness by encouraging closed-loop systems where waste is viewed as a resource rather than a liability (UNEP, 2023).

Germany's Packaging Act (Bundesministerium der Justiz, 2019), building on the earlier Green Dot system, introduced mandatory registration requiring licensing through approved compliance schemes, all governed by strict reporting and auditing rules. The law includes eco-modulation possibilities and strict penalties for non-compliance where PROs and collective schemes operate under transparent contractual frameworks with recyclers and logistic operators (Allen-Taylor, 2022). The outcome has been high collection and recycling rates for many waste streams, advanced sorting and recycling infrastructure with clear traceability of flows. Germany's EPR framework demonstrates a strong performance across major product streams. Packaging waste achieves an overall recycling rate of about 70%, with paper, cardboard and glass at 84% respectively. Steel is recycled at 90%, aluminum at 60% while plastic is lower at 60%. For other regulated items, waste electrical and electronic equipment (WEEE) records a collection rate of approximately 44%. Around 53% of batteries are recycled, while end-of-life vehicles achieve recovery and reuse rates of over 95% (European Environment Agency, 2022).

Germany has continued to lead in packaging waste recycling, showing substantial improvements over the past few years. According to the German Environment Agency (UBA) and the Central Agency for Packaging Register (ZSVR), from 2018 to 2023, the rate of mechanical recycling for plastic packaging surged from 42.1% to 68.9% (Castrillon-Ocampo, Jaén, & Maya-Duque, 2025). In 2023, Germany's waste management systems managed to collect, sort, and recycle over 5.5 million tons of household packaging waste, emphasizing the scale and efficiency of its dual system approach. Through eco-design incentives, the packaging and recycling made significant strides, including Green Dot initiatives that helped elevate the recycling from 3% in 1991 to 63% by 2022 (Allen-Taylor, 2022; Schmidt & Laner, 2023). The recent policy reforms, such as the 2021 ban on selected single-use plastics and the mandate for 25% recycled PET content in beverage bottles by 2025, demonstrate Germany's progressive integration of eco-design principles into its regulatory framework (Ramasubramanian, Tan, Chellappan, & Ramakrishna, 2023). Moreover, a recent review of 88 studies proposed frameworks for building effective EPR systems, showing how performance, stakeholder engagement, and circular outcomes can be improved (Mallick, Salling, Pigosso, & McAloone, 2024). Germany's experience indicates that strong institutions, a central registry, and audited PROs are critical for achieving measurable EPR outcomes.

Japan's specific approach to EPR tradition demonstrates the value of sectoral tailoring, where regulations are customized to the unique material flows, market characteristics for each product category. The EPR schemes are often product-specific and combine collection targets with mandatory recycling rates and advanced recycling fees or visible consumer charges. The regulatory approach is integrated with local government collection under industry obligations for recycling logistics (Akenji, Hotta, Bengtsson, & Hayashi, 2022). Japan's experience on the outcome emphasizes the importance of aligning local collection infrastructure

with producer obligations and of transparent recycling targets. It shows how combining mandatory rates with public-private coordination can stimulate technological investments and achieve high recovery rates in specific product streams (“Sustainability report 2023”).

Under the Plastic Resource Circulation Strategy of 2019, Japan set ambitious targets such as to reduce single use plastic waste by 25% by 2030, ensure products are designed for reuse and recycling by 2025, achieve a 60% reuse and recycling rate for plastic containers and packaging by 2030 and reach 100% utilization of all waste plastics including energy recovery by 2035. Regarding PET bottle recycling, Japan aims for 100% recycling of all collected PET bottles by 2030. This is attributed to 2017 incident where 84.8% PET bottles were recycled from a 92.2% collection rate, positioning Japan as a global leader (Hibiki, 2024; Matsuoka, 2024).

In the Nordic countries, EPR is combined with strong household segregation systems and market demand for recycled inputs. For instance, Sweden’s approach highlights the role of consumer behavior incentives such as deposit refund systems (DRS) and market pull for recyclables. The country uses producer responsibility for packaging, Waste Electrical and Electronic Equipment (WEEE) and batteries supported by well-developed municipal services and established PROs (Steenmans, 2025). The results indicate that high diversion rates occur when household participation is paired with deposit refund schemes, creating steady demand for recycled materials.

Approximately 6000 unmanned recycling stations were established for collecting packaging and paper waste through EPR systems. 90% of methane produced is used as fuel for vehicles, while 10% is used for electricity and heat production. For metals, a reject rate of 5% - 10% was adopted, while for plastics, only around 40% of Swedish plastic packaging waste are recycled with other plastics undergoing energy recovery (Miliute-Plepiene & Sundqvist, 2024). Plastic waste comprises approximately 40% of the total plastic demand with 59% representing the weight of the plastic waste. To advance circularity, the European Union set a recycling target of 55% for plastic packaging by the year 2030. Achieving this target requires a recyclable product design, greater sorting and recycling capacity and creation of a stronger demand for recycled plastics (Lu, Hasselström, Finnveden, & Johansson, 2022)

In addition to these targets, Sweden demonstrates a remarkable efficiency in waste management with very high diversion rates. For instance, in waste incineration and recycling, only about 1% of the total household waste ends up in landfills, 52% is used for energy recovery and 47% is recycled slightly below the EU target of 55% municipal waste. In 2022, the overall recycling rate for packaging was 67% which was close to the then estimated EU-27 average of 65% (Eurostat, 2025). As highlighted in the report, Sweden’s circular economy retains only about 24% of material value at end of use, meaning that 76% of value is lost through incineration or downcycling.

Despite Sweden's strong collection and recycling infrastructure, securing sufficient demand for high quality recycled materials remain a major barrier in achieving a fully circular economy. This challenge is evident in plastic recycling where only 16% of plastics are recovered and of these just 8% of the original material value is retained due to downcycling and contamination during collection and processing (OECD, 2024). The Swedish experience indicates that advanced infrastructure must be matched with consumer uptake and strong secondary material markets to achieve full circularity (Darpö, 2023; Malmaeus & Lindblom, 2022).

Drawing on the case of, South Africa, the country has actively developed EPR frameworks for packaging and paper, supported by a formal waste management institutional structure. South Africa's EPR instruments emphasize mandatory responsibility, industry-led PROs and a combination of national and provincial enforcement. Several sectors use eco-modulated fees and reporting obligations to the Department of Environment. Mixed results have been achieved with some streams, such as metals, having functional recovery markets (Adeleke, Akinlabi, Jen, & Dunmade, 2021). However, packaging and plastics face weak enforcement mechanisms and limited integration of actors from the informal sector, constraining the overall effectiveness of the system. South Africa demonstrates the importance of legal clarity, enforcement capability and strategies for incorporating informal collectors into informal PRO payment systems (Mazhandu, Muzenda, Belaid, & Nhubu, 2023; TO, 2022).

Rwanda's strong regulatory stance on plastics and rapid policy uptake makes it an interactive African case for ambitious, centralized reforms. The policy mix includes bans for some plastics, extended responsibilities in policy deliberations and pilots for producer engagement. The country pairs strict enforcement with incentives for formal business recycling businesses. Rwanda's experience demonstrates that strong governance and political will can drive rapid behavioral change, however, progress is constrained when industrial recycling capacity and market demand for recovered materials remain underdeveloped. Integrating informal actors remains a central policy issue especially in establishing fair roles and compensation within formal recycling systems (Kabera & Mutavu, 2023; Twagirayezu et al., 2024).

In the western Part of Africa, Nigeria is actively developing an EPR framework with state-level guidelines and pilot projects across multiple sectors, offering useful lessons on federal-state coordination. The country's approach combines regulatory guidelines issued by national ministries with state-level pilot initiatives, creating a multi-tiered model of implementation. However, ensuring effective enforcement and consistent policy alignment across states remains a key challenge. The result in Nigeria indicates the need for coordinated frameworks, clear roles for producers and local governments and better monitoring capacity (Abdullahi & Auwal, 2021; Umukoro & Omozue, 2024). The African experience tends to show that EPR's effectiveness depends less on legal design alone and more on institutional capacity, market development for recyclers, transparent PRO govern-

ance and inclusive mechanisms for informal sector workers.

Kenya has equally advanced its efforts by enacting the [Chitake \(2022\)](#), that require producers to take responsibility for waste streams such as plastics, packaging, e-waste and other designated categories through PROs. EPR places the obligation on the producers, including manufacturers, importers, distributors and brand owners to take financial, organizational or physical responsibility for the post-consumer stage of products they place on the market. Kenya's EPR is operationalized within the Sustainable Waste Management Legal Framework, anchored in the Sustainable Waste Management Act, 2022, and the EPR regulations gazetted in 2024. Under these regulations, producers are required to register with the competent authority, submit compliance plans, and either finance or directly operate take-back and collection schemes ([Oguge et al., 2024](#)). Producers may take responsibility either independently or through PROs who are tasked to organize and oversee coordinated industry wide recovery and recycling efforts. The framework also mandates that producers support recovery and recycling activities to minimize landfill use, prevent environmental leakage and promote circular product design with increased recycled content ([Getanda, 2023](#)).

## 2. Regulatory Impact Assessment (RIA)

Regulatory impact assessment (RIA) refers to the means by which to improve regulatory decision-making and practice when developing new policies ([Kirkpatrick & Parker, 2004](#)). The RIA often involves a systematic appraisal of the costs and benefits associated with a proposed new regulation and the critical evaluation and review of the performance of existing regulations to inform decision making by the relevant entities ([Kirkpatrick & Parker, 2004](#)). The need for Regulatory Impact Assessments (RIA) has become fundamental to the formulation of policies across jurisdictions. RIAs help in developing high-quality policies and regulations. While the concept of RIA is imperative for regulatory development and review, it has largely been confined to the OECD countries ([Kirkpatrick & Parker, 2004](#)). RIAs contribute significantly to increasing the efficiency of regulatory compliance and supporting sustainable development ([Göksu & Demirtaş, 2024](#)). RIA help in ensuring the development and maintenance of high-quality regulations ([Ullah et al., 2024](#)).

Thus, regulation as articulated by the OECD is an important tool for achieving governments' social, economic and environmental policy objectives ([OECD, 2024](#)). While Governments have a broad range of regulatory instruments reflecting the complex and diverse needs of their citizens, communities and economy ([OECD, 2024](#)), there is need to ensure that these regulatory instruments do not become burdensome to the citizens by imposing cost burdens.

Therefore, in the current Kenyan scenario, a RIA becomes an integral part to Kenya's EPR Regulations 2024 implementation as it evaluates the legal, economic and social implications of proposed regulations by providing a structured framework for assessing cost, benefits, compliance feasibility and stakeholder impacts

while ensuring the EPR regulations are of high quality. The RIA defines regulatory gaps, predicts the potential benefits, cost burdens on producers, and evaluates socio-economic outcomes, including employment opportunities in recycling sectors and inclusion of informal waste collectors. RIA also guides monitoring strategies, mechanisms for enforcement and resource allocation, ensuring that EPR interventions are cost-effective and socially equitable. Therefore, by applying RIA, Kenya aligns its EPR framework with international best practices, ensuring a balance between environmental safety, financial viability and social inclusivity. This literature review therefore formed the basis for the development of the RIA for the implementation of the Kenya's EPR regulations, 2024. The RIA facilitates the determination of costs and benefits of newly developed regulations while proposing the most feasible regulatory option against the business-as-usual scenario.

## 2.1. Justification for Environmental Protection

### 2.1.1. The Rationale for EPR

As reported by the [National Sustainable Waste Management Policy \(2019\)](#), Kenya generates approximately 22,000 tons of solid waste daily, totaling nearly 8.8 million tons annually. Of this, 65% amounting to around 5.7 tons, is organic waste comprising food scraps, yard waste, animal and agricultural residues, and biodegradable sludge. The collection system manages about 70% of this waste, while the remaining 30% is uncollected and often illegally dumped or burned. Focusing on recyclable streams, organic waste, although highly recyclable, only 10% is actually recycled while 90% remains unrecycled. About 880,000 tons of plastic waste is generated annually, with only 50% being recycled. On the other hand, paper and cardboard generate 968,000 tons yet only 20% gets recycled out of the 72% recyclable waste. Other streams like textiles, metals, bio-hazardous, and glass material similarly show high recyclable proportions but relatively low recycling rates. The informal e-waste sector, particularly in places like Nairobi's Dandora dumpsite, frequently relies on unsound recycling practices such as open burning and manual dismantling ([Omari, 2022](#)). According to [Baldé et al. \(2024\)](#), 62 billion kg of E-waste or 7.8 kg per capita per year is generated globally. Of this, only 22.3% was documented as collected and recycled in an environmentally friendly manner. Since 2010, the amount of e-waste generated has increased by an average of 2.3 billion kg annually. Kenya generated approximately 88 million kg of E-waste in 2022 or 1.6 kg per capita ([Baldé et al., 2024](#)). Additionally, Kenya's e-waste output surged to 53,559 metric tons in 2024, with nearly 37% driven largely by small household electronics, an increase from the 46,211 tons reported in 2020, yet only a fraction is properly managed, raising serious environmental and health concerns ([The Kenyan Wall Street, 2025](#)).

Notably, Municipal Solid Waste (MSW) in Kenya contains materials directly linked to the EPR frameworks, which include plastics, paper and board, glass, and metals. [JICA \(2019\)](#) reported that the amount of recycled waste includes approximately, plastics 8%, paper and board 6%, glass 2% and metals, including alumi-

num cans, 2% for urban waste. [UN-Habitat \(2023\)](#) factsheet reports that out of the 3660 tons of waste generated daily in Nairobi, households contribute 184 tons of potential recyclables, including 87 tons of dense plastics and 97 tons of plastic films. Paper and cardboard comprise 115 tons per day, while glass and metals consist of 74 and 10 tons per day, respectively.

Therefore, collectively, these EPR items represent about 10.5% of household MSW yet the citywide recovery rate remains low at 6% of the total MSW recovered, equating to 80 tons per day or 2.2% of total waste generation. The recycling rates for EPR materials are still moderate, with only 8% of plastics being collected for recycling, while PET packaging performs better, with estimates indicating a 25% recovery rate ([IUCN & UNEP, 2020](#); [WHO, 2019](#)). Whereas evidence points to a consistent trend of plastics, paper, glass, and metals constituting 10% - 15% of Kenya's MSW stream, the proportion of effectively recycled items remains marginal. Comparatively, Africa generates an estimated 9.5 million tons of e-waste annually, yet only about 1% is formally collected and recycled ([Baldé et al., 2024](#)).

The municipal solid waste across African cities also shows similar patterns in EPR-relevant material, where plastics, paper, metals, and glass collectively account for 10% - 20% of MSW. However, consumption patterns differ across countries, reflecting variations in both consumption habits and collection systems ([JICA, 2019](#)). This low recovery rate has been attributed to weak formal recycling infrastructure, heavy reliance on informal waste pickers, and limited enforcement of producer responsibility policies. This mishap largely contributes to much of the recyclable fraction being landfilled or openly dumped in fields. Without proper regulation, these methods release a combination of harmful substances, including lead, cadmium, dioxins, and other toxic chemicals into the soil, air, and water, posing serious long-term risks to both ecosystems and human health ([Office of the Auditor-General, Republic of Kenya, 2024](#)).

The EHPMP under the 2024 budget was allocated KES 188 million to tackle hazardous waste and pollution, with emphasis on e-waste and mercury exposure in hotspot areas. This allocation reflected the growing fiscal strain pollution places on the health sector, as treatment of pollution-related diseases such as respiratory infections, cancers, and heavy metal poisoning consumes a significant share of health spending.

A report by the [World Health Organization of 2019](#) indicated that environmentally mediated diseases account for 5% of Kenya's health expenditure, underscoring the need for preventive interventions such as EPR frameworks and safer waste management to ease long-term health care costs ([WHO, 2019](#)). EPR can change this trajectory by establishing a structured and financed collection and recovery system that can further reduce environmental leakage, prevent hazardous informal processing, and significantly lower pressure on public lands and marine ecosystems. By requiring producers to internalize end-of-life responsibilities, EPR creates incentives for product and packaging redesign, leading to more durable, repairable, and recyclable products ([Getanda, 2023](#)). The EPR regulations 2024

clearly encourage eco-design through lifecycle assessment and the use of recycled materials. These measures support Kenya's transition toward a circular product system, strengthening pathways for sustainable production, responsible consumption, and improved waste recovery.

### **2.1.2. Economic and Fiscal Rationale**

According to [OECD \(2024\)](#), the implementation of EPR regulations helps to generate revenues through EPR fees from Producers, Manufacturers, and Importers, which is then used to support waste collection, sorting, and materials recovery, which facilitates employment creation in the country. The [World Bank \(2024\)](#) has provided the Implementation Support Mission (ISM) for the Global Environment Facility (GEF) that supported the Environmental Health and Pollution Management Program (EHPMP) in Kenya through NEMA in the execution of national project activities in line with the GoK priorities on circular economy and youth employment. While currently Kenya relies more on donor support, most of this funding is not fully available, thus curtailing the realization of Kenya's priorities. For instance, under the donor support program, Kenya was allocated a total of USD 8.07 million, yet only USD 2.00 million (24.8%) of the amount had been disbursed. This signals a significant financing gap that risks constraining the timely and effective implementation of EPR-related initiatives like plastic packaging, e-waste management, recycling of paper, glass, and metal containers, as well as producer-led take-back schemes ([World Bank, 2024](#); [NEMA, 2022](#)). Additionally, since counties in Kenya often struggle to fund adequate waste collection and disposal, EPR reallocates these fiscal responsibilities to producers, easing municipal budgets either through direct action or PROs. Kenya's plastic pact sectors and industry stakeholders have signaled strong support for EPR as a means to spur circular economy (CE) opportunities, creating new recycling businesses, stabilizing the supply of secondary raw materials, and fostering formal jobs in sorting, collection, and recycling ([Opondo, 2024](#)).

Additionally, the United Nations (UN) projections show that Kenya's urban population will reach 50 million (62.7% of the total population) by 2030, creating immense pressure on cities to manage rising waste volumes. Currently, about 34.8%, thus 10 million people live in urban centers with the five largest cities, Nairobi, Mombasa, Kisumu, Nakuru, and Eldoret generating an estimated 2400, 2000, 1000, and 500 tons of solid waste per day, respectively. The EPR framework provides real economic opportunities for converting waste into a resource through recycling.

### **2.1.3. Governance, Compliance, and Social Inclusion**

The EPR Regulations 2024 requirements include producer registration, multi-year compliance plans, annual reporting, and licensing, alongside creating traceability for NEMA and county-level regulators to effectively monitor compliance. Kenya's embrace of mandatory EPR has brought it in line with the emerging global standards for producer accountability and circular economy (CE) credentials that are

important for export markets and trade partnerships. Effective EPR implementation must therefore deliberately include informal waste workers through PROs, contracts, quotas, and payment mechanisms to avoid marginalizing their lives and livelihoods (Lagat, Njuguna, Kivaa, & Mutungi, 2025). While counties have introduced measures such as street sweeping, skips, bylaws, and private sector engagement, waste management remains hindered by weak policy linkages, inadequate budgets, poor departmental coordination, and the absence of integrated waste management systems (Republic of Kenya, Ministry of Environment and Forestry, 2019). The implementation of the EPR regulations is therefore envisaged to strengthen Governance, Compliance, and social inclusion within the waste management value chain, as part of this responsibility is redistributed to the producers, either in terms of physical or financial responsibility. The implications are described in the sections that follow.

### **1) Producers, Importers, and Brand Owners**

Producers, including manufacturers, importers, distributors, and brand owners, are required to register with NEMA and submit a detailed four-year EPR plan explaining how post-consumer waste will be managed. They are responsible for financing take-back schemes and waste collection, either through PROs or individually (Nogueira et al., 2024). Compliance also includes tonnage reporting and implementing eco-design measures, such as prioritizing recyclable materials that facilitate product disassembly to reduce environmental impact. By shifting disposal responsibilities to producers, EPR policies alleviate environmental degradation and the municipal burden of disposing of waste. The EPR framework, therefore, provides an enabling environment for producers to plan for post-consumer waste management. Additionally, there are cost savings through eco-design where durable, recyclable products reduce reliance on virgin materials at the same time offering long-term operational savings. However, there is a danger that producers may pass on compliance costs to end users, elevating consumer prices (Brown, Laubinger, & Börkey, 2023).

### **2) PROs, Material Recovery Facilities (MRFs) & Informal Sector**

The PROs act as collective compliance entities since they aggregate resources from producers, manage logistics, contract recyclers and local waste service providers, report progress to regulators, and compensate last-mile waste collectors (Chikarmane & Narayan, 2024). MRFs receive, sort, and upgrade recovered materials into marketable recyclers, reinforcing formal CE value chains. The waste pickers in the informal settlements collect and sort materials at source. Their effort significantly diverts waste from landfills and supports the upstream input for PROs and Recyclers. The benefits are realized as PROs reduce duplication in collection and logistics spanning the entire product categories, while recyclers also benefit from predictable material inflows, thereby improving their investment viability. Further, the integration into PRO schemes leads to formal contracts, fair compensation, and improved working conditions for the informal sector. However, there is a lack of transparency, fee capture by powerful producers, and ex-

clusion of small actors attributed to governance failures in PROs (De Oliveira, Ribeiro, & Sobral, 2022).

Additionally, the cost of establishing MRFs may be prohibitive. Where they exist, the MRFs may also struggle with inconsistent quality or sudden drops in recycling prices. Further, contracts may favor established firms, hence sidelining grassroots waste pickers, since informal recyclers often lack legal recognition, thereby undermining their access to PRO benefits. To mitigate these challenges, governance reforms for PROs should include mandatory independent audits, establish fixed-term terms, and implement training programs to improve input quality and reward higher quality recyclers. Thus, formal inclusion and empowerment of waste pickers should include legal recognition, formal contracts, and public awareness/education with multi-sectoral collaboration engaging government, PROs, recyclers, and informal sector representatives in policy reforms (KEPSA, 2024).

### **3) County Governments, Municipalities, and Regulators**

The county governments play a vital role in EPR implementation by providing local collection infrastructure, including coordinating with PROs for last-mile logistics and enforcing local environmental health standards. This reduces the financial burden of routine waste handling, improves urban solid waste management outcomes, and secures technical and financial support from PROs (Sudarsan et al., 2023). However, challenges arise from the ambiguity of responsibility between national and county levels, which might lead to potential loss of municipal fees and capacity constraints for monitoring PROs. Thus, clear intergovernmental memoranda of understanding that define responsibilities and revenue-sharing frameworks, other capacity-building funds secured from PRO levies can address these gaps (Laubinger, Brown, Dubois, & Börkey, 2021). The National Environment Authority (NEMA), as the primary regulator, is responsible for registering producers and PROs, auditing their compliance, determining the applicable fee structures, and enforcing the established environmental laws and standards. While a centralized oversight by NEMA improves data availability together with policy coherence and tracking of national waste targets, this may lead to high administrative workloads such as the need for technical expertise, and litigation risks from industry stakeholders (Otundo Richard, 2024). To mitigate these challenges, digital compliance registries, transparent audit systems, and robust stakeholder consultations are essential in enhancing regulatory efficiency and credibility.

### **4) Consumers and Households**

Consumers and households contribute to EPR success by separating waste at source, returning products to designated take-back points, and in some cases paying small advance recycling fees embedded in product prices. These yield benefits such as cleaner neighborhoods, greater accountability from producers, and reduced long-term waste service costs. However, these benefits may be offset by small increases, confusion, over return systems, and inequitable cost burdens if fees are regressive. In this regard, public awareness campaigns, equitable fee mod-

ulation, and accessible return points can be used to mitigate these issues. Other actors, including retailers, distributors, and informal aggregators, function as critical logistical partners in take-back schemes, creating opportunities for reverse logistics and service diversification (Njoroge et al., 2022). Whereas financial institutions and investors can fund recycling infrastructure while benefiting from predictable revenue streams and green finance markets, the regulatory uncertainty and collateral challenges may hinder lending by these institutions. Moreover, risk-sharing instruments, blended finance market mechanisms, and credit enhancements can unlock private capital. Further, by civil society, NGOs, and research institutions providing oversight, mechanisms such as advocacy, capacity building, and data-driven evaluation can ensure accountability and help amplify the quest of the informal sector (Ishuga, Mugisho, & Thenya, 2024). This in turn ensures that multi-stakeholder platforms and dedicated funding windows strengthen their engagement and long-term participation in EPR.

### 3. Statement of the Problem

Waste management has become one of the biggest global challenges of the present time. Waste generation has continued to increase due to the population explosion. These have led to several challenges such as pollution, health challenges, and depletion of virgin material. Forests have been the biggest culprit. The livelihoods of future generations are therefore at risk. In order to conserve the planet, there is an urgent need to ensure proper waste management measures are put in place. Countries across the globe have attempted to come up with measures to mitigate this phenomenon. EPR has emerged as a key policy tool for promoting sustainable production and consumption not only in Kenya but the world. The approach aims at extending the responsibility to producers, importers, and brand owners to go beyond the point of sale to include post-consumer waste management (Maitre-Ekern, 2021). EPR encourages producers not only to design and market goods haphazardly but also to take responsibility for their collection, recycling, and safe disposal of end-of-life products. The regulations are an important step toward strengthening governance and reducing the environmental impacts of production and consumption. The regulations require producers to register, submit EPR plans, and manage post-consumer products either individually or through PROs (Ong'are & Vyalu, 2023).

Kenya generates more than 53,500 metric tons of electronic waste annually, yet only 5% is properly dismantled and recycled. 95% of this waste ends up on the environment, contributing to pollution and resource losses (Nwanege, 2024). In urban centers such as Nairobi city, approximately 2400 tons of solid municipal waste is produced daily, with a considerable share falling within the EPR category items. Recent assessments estimate that plastic contributes 10% - 15%, paper and board 8% - 12%, Glass 2% - 3%, metals 1% - 2% and e-waste 0.5% - 1% to this tonnage (JICA, 2019; UN-Habitat, 2023). Collectively, these items make up 25% - 30% of Nairobi's total daily waste stream. Despite this dominance, formal recov-

ery and recycling rates still remain low, with plastics recycled at less than 10%, paper and board at below 20%, glass at under 15%, metals between 5% - 8% and e-waste at less than 1% (JICA, 2019; NEMA, 2022). Viewed differently, waste is a resource that can contribute to economic development by creating employment opportunities within the circular economy (CE) value chain. Thus, the country could therefore benefit from recovering and recycling between 25% - 30% of the mentioned EPR category items. The key gap in the business-as-usual scenario is the lost opportunities from CE, job creation, and economic development. This is exacerbated by the absence of a comprehensive data-driven waste management framework, weak enforcement of producer compliance, inadequate infrastructure for separate collection, limited consumer awareness, and underdeveloped markets for secondary raw materials (UNEP, 2021). Additionally, most recovery is driven by the informal sector that remains poorly integrated into the waste management value chain. Consequently, there is a disconnect between policy, whose intention is to internalize waste management, and the actual capacity of Kenya's waste management systems to deliver measurable circular economy outcomes. This review, therefore, sought to address the gap by conducting a comprehensive literature review of the Extended Producer Responsibility Regulations for Regulatory Impact Assessment in Kenya to ensure the development and implementation of high-quality EPR Regulations that enhance positive environmental and socio-economic impacts.

### 3.1. General Objective

To conduct a Comprehensive Literature Review on the Extended Producer Responsibility (EPR) Regulations Implementation for EPR Regulatory Impact Assessment (RIA) in Kenya.

### 3.2. Philosophical Stance

A philosophical stance refers to the foundational beliefs, assumptions, and worldviews that guide the design, execution, and interpretation of research, shaping how knowledge is conceptualized and validated (Coates, 2021). Most contemporary frameworks identify six main stances, including Positivism, Interpretivism, Critical Theory, Pragmatism, Post-Positivism and Transformative or Critical Dialectical Pluralism. Each stance reflects different assumptions about reality, knowledge, and inquiry, with applications varying across disciplines (Omodan, 2022). With reference to EPR regulations and RIA, the Critical Dialectical Pluralism (CDP) stance is relevant as it promotes the integration of multiple perspectives, iterative reflection, and collaborative dialogue, enabling a broad understanding of complex environmental and socio-economic systems (Onwuegbuzie & Abrams, 2025). In environmental policy and EPR, these paradigms are often adapted to integrate environmental ethics such as the Polluter Pays Principle (PPP), Product Life Cycle Thinking, Stewardship and principles of intergenerational and intragenerational Equity, enabling an integrated approach that combines methodological precision with social and ecological justice (Aragão, 2022).

### 3.2.1. Polluter Pays Principle (PPP)

Polluter Pays Principle (PPP) is an environmental policy approach that mandates those responsible for pollution to bear its cleanup and prevent borne costs through ethical norms and economic mechanisms to correct market externalities (Barthakur, 2021; Tan, 2023). In 2024, the European Commission (EC) initiated a broad consultation to strengthen PPP implementation as part of its Zero Pollution Action Plan. This was in response to concerns that environmental burdens continue to fall on citizens and public budgets rather than polluters. To echo the EC initiative, the Supreme Court of Kenya reaffirmed the PPP in 2024 by reinstating a compensation award and mandating remediation costs to be borne by a polluting battery factory, hence reinforcing the PPP's legal authority in environmental rights enforcement (Muigua, 2023).

### 3.2.2. Product Life Cycle Thinking and Stewardship

Product life cycle thinking involves a comprehensive evaluation of environmental impacts across the entire product life cycle, from material extraction, production, use, and end-of-life management. It is increasingly used to inform waste and circular economy policymaking, guiding both regulatory frameworks and corporate sustainability strategies, including cross-border collaboration on resource efficiency (Lewis, 2022). Stewardship on the other hand, complements this by emphasizing the ethical responsibility of producers and other stakeholders to actively minimize negative impacts, advancing sustainable practices throughout production and distribution systems (Edirisinghe, de Alwis, & Wijayasundara, 2024).

### 3.2.3. Societal Welfare

According to Castellacci (2023), societal welfare refers to the overall well-being of a population, covering not only economic prosperity but also their health, safety, environmental quality, as well as social equity. Societal welfare is enhanced when policies like EPR contribute to cleaner environments, reduce pollution-related health risks, and increase job creation in recycling industries. EPR schemes in Quebec, Spain, and Portugal have been linked not only to higher recycling rates but also to broader societal gains such as public health improvement, increased consumer awareness, and a reinforced recycling sector creating employment opportunities, hence demonstrating how environmental governance can generate many social benefits when well designed (Rosanvallon, 2021). South Africa's bottle-to-bottle processing facility elevated collection rates to 64% and, in turn, generated local employment to its citizens. Therefore, Kenya's EPR implementation is expected to yield immense societal benefits, particularly the inclusion of informal waste pickers and producers in order to foster job creation, enhance equitable stakeholder collaboration, and improve waste recovery outcomes that contribute to social welfare (KEPSA, 2025).

### 3.2.4. Corrective Justice

According to Bronsther (2021), corrective justice refers to the ethical principle that states that those who cause harm through pollution or unsustainable waste

practices should bear the responsibility of repairing the damage and restoring the environment. Corrective justice underpins core mechanisms such as take-back obligations and levies that allocate cleanup and recovery costs to producers rather than the larger society through the Government. This aligns closely with the PPP, reinforcing the moral imperative that producers must be accountable for the consequences of their products throughout the product's lifecycle. Therefore, corrective justice frames EPR not just as a regulatory tool but also as a mechanism of ethical reparation and restitution in environmental policy (Zimm et al., 2024).

### 3.2.5. Intergenerational and Intragenerational Equity

Intergenerational and intragenerational equity are critical ethical dimensions in environmental governance that ensure fairness across time and populations. Intergenerational equity mandates that current generations preserve environmental quality and resource diversity so that future generations inherit it in its favorable condition (Cross, 2023). This mandate is anchored in the principles such as conservation of options, conservation of quality and conservation of access. In contrast, intragenerational equity emphasizes equitable distribution of environmental benefits and burdens among different groups within the present generation, addressing disparities caused by socioeconomic status, geography, or access to clean environments. Thus, both forms of equity are central to EPR frameworks, guiding how obligations on producers are designed. This is to ensure they internalize lifecycle costs and do not disproportionately burden marginalized communities in the present era or compromise the ecological inheritance of future generations (Cilento, 2024).

## 4. Significance

This study holds significance for policy makers, regulatory agencies, and industry actors by providing consolidated evidence based on the design and implementation of EPR for application in Kenya. The review highlights what has worked in other jurisdictions, what gaps persist locally, and how current regulations can be adapted to Kenya's economic and infrastructural realities. The analysis equips decision makers with data-driven insights for refining compliance mechanisms, setting realistic performance targets, and balancing environmental ambitions with economic feasibility. The policy-practice bridge will ensure that EPR evolves as a practical tool for sustainable waste governance. This review strengthens Kenya's progress toward environmental sustainability. If well implemented, EPR will reduce landfill waste, curtail pollution, and promote circular economy models that keep resources in use for a longer time. The local and global EPR experiences identify regulatory and operational mechanisms that can improve waste diversion rates, enhance recycling capacity, and minimize the environmental footprint of production and consumption. These insights contribute to broader sustainability targets, including Kenya's commitments under the Sustainable Development Goals (SDGs) and international environmental agreements. The review also pro-

vides how high-quality regulations can be designed to equitably distribute costs and benefits among stakeholders, including small-scale producers, consumers, and informal sector players. By analyzing both direct and indirect economic impacts, the review ensures that EPR delivers environmental gains and also supports livelihoods, encourages inclusive economic growth, and minimizes unintended negative effects such as job displacement or excessive compliance burdens, providing a dual focus on equity and efficiency, hence strengthening the societal relevance. Finally, from an academic standpoint, the review addresses key knowledge gaps by integrating theoretical policy perspectives with real-world waste management experiences in Kenya. The review contributes to scholarly discourse in environmental policy, sustainable development, and waste governance and provides a conceptual and empirical foundation for future studies, particularly in emerging economies, and may serve as a comparative reference for similar research.

## **5. Scope of the Review**

The review focuses on scholarly publications, government reports, policy documents, and industry studies related to EPR regulations with emphasis on their application, performance, and implications. The review focuses on international best practices and comparative case studies from other jurisdictions to contextualize Kenya's EPR regulatory approach. The scope covers the environmental, economic, and social dimensions of EPR with particular attention to waste streams such as plastics, packaging, and electronic waste. Relevant literature globally and from Sub-Saharan Africa and other regions is used to provide a broader analytical perspective. The review is limited to published materials from the past 10 years to ensure the analysis reflects contemporary regulatory trends and emerging challenges.

## **6. Theoretical Review**

### **6.1. Producer Responsibility Theory (PRT)**

This theory was introduced by Thomas Lindqvist in 1990, who defined it as a policy approach where the producer's responsibility for a product is extended to the post-consumer stage of the product's life cycle. The theory emerged from the growing environmental concerns in the late 1980s and early 1990s about the rising volume of post-consumer waste, mainly through packaging and electronics, citing the limited capacity of the then municipal authorities to manage the waste (Liu, Lai, & Cai, 2021). PRT has since become the intellectual and policy foundation for EPR, which is a regulatory framework that shifts both the economic and physical responsibility of waste management from governments and taxpayers to producers. PRT provides a logical framework for evaluating both environmental and socio-economic effects of waste management interventions by embedding life cycle accountability into producer systems. The theory promotes upstream changes such as eco-design, material substitution, and innovation for product durability.

The impact of these changes can be measured through indicators such as waste diversion rates, greenhouse gas reductions, cost savings in municipal waste management, and improvements in producer compliance behavior (Joltreau, 2022).

Further, the theory supports economic evaluations such as cost-benefit analysis by providing a normative basis for internalizing environmental externalities for financial and social outcomes. The contribution of PRT lies in its ability to align regulatory instruments with sustainable development objectives (Willar, Waney, Pangemanan, & Mait, 2021). It creates direct incentives to producers to invest in resource efficiency, reverse logistics, and secondary material markets. By making producers responsible for end-of-life product management, the theory operationalizes the polluter pays principle, encourages innovation, and enhances corporate accountability. Critics, however, argue that its implementation can be challenging due to high administrative costs, weak enforcement capacity, and potential pass-through to consumers. Also, producers may comply at a minimal legal threshold, undermining the transformative potential of the theory. Further, the inadequate infrastructure and market development for secondary markets, and the limited economic viability of EPR schemes, may prioritize profit motives over environmental outcomes (Ahlers, Hemkhaus, Hibler, & Hannak, 2021). However, PRT directly links the core variables of EPR and Regulatory Impact assessment through its emphasis on lifecycle responsibility, consisting of measurable environmental and economic outcomes. Finally, it offers a clear normative rationale for why products should bear end-of-life costs and provides a conceptual viewpoint for evaluating whether EPR schemes deliver the intended impact.

## 6.2. Stakeholder Theory

Stakeholder theory was popularized by Edward Freeman in 1984, defining stakeholders as any group or individuals who can affect or are affected by the achievement of an organization's objectives (Mahajan, Lim, Sareen, Kumar, & Panwar, 2023). The theory provides the theoretical grounding and practical framework that allowed it to evolve into a widely applied concept in business ethics, corporate governance, and sustainability. Building on Freeman's work, Donaldson and Preston in 1995, identified three dimensions of the theory: descriptive dimension that explains how organizations function as networks of relationships; instrumental dimension that connects stakeholder management to performance outcomes, and normative dimension that offers moral justification for addressing stakeholder interests. Later in 1997, Mitchel, Agle, and Wood introduced the stakeholder salience model that prioritizes stakeholders based on power, legitimacy, and urgency by providing a practical tool for decision making in complex environments (Mahajan et al., 2023). The theory is relevant to the current review on EPR as producers are expected to take responsibility for the environmental impacts of their products, including the social and economic consequences of their operations. Bai et al. (2024) posit that organizations implementing EPR policies often use stakeholder engagement to design takeback schemes, improve recycling rates, and en-

hance transparency in environmental performance. Thus, the theory provides both a normative and practical basis for ensuring that all affected parties are considered in the decision-making process. Granted, regulatory impact assessments and policy development that are grounded in stakeholder engagements tend to have greater legitimacy, stronger trust, and lead to more sustainable and socially acceptable outcomes (Bridoux & Stoelhorst, 2022). However, critics of the theory argue that its definition is too broad, allowing almost any entity to be classified as a stakeholder, hence weakening the managerial focus and making its prioritization difficult. McGahan (2021) questioned whether the theory qualifies as a rigorous scientific framework, stating that it lacks predictive precision and remains largely descriptive or normative. These contemporary debates emphasize that Stakeholder Theory, although it offers valuable, ethical, and strategic foundations for EPR and Regulatory impact assessment, its effective application requires careful operationalization, selective prioritization, and integration with complementary theoretical perspectives. Noteworthy, the theory reinforces the ethical obligation of producers to address the needs of diverse stakeholders while providing strategic insights that can strengthen legitimacy, nurture trust, and improve environmental and social outcomes. By incorporating stakeholder considerations into policy, EPR systems can move beyond compliance-driven models toward participatory, sustainable, and socially responsive governance.

### 6.3. Empirical Review

Recently, a growing body of global literature critically examined EPR and its implications to waste management, presenting interesting perspectives. Compagnoni, Grazi, Pieri, and Tomasi (2025) evaluated the impact of EPR on waste battery trade flows in Japan through a quasi-experimental econometric design. The population consisted of country-level trade flows in used batteries over multiple years with data drawn from global customs and trade statistics, and analyzed using the difference in differences (DiD) approach anchored in a gravity model. The findings demonstrated that EPR implementation significantly increased lawful cross-border shipments of waste batteries to treatment facilities, indicating that producer obligations improved upstream collection systems and reduced illegal disposal. These findings highlighted the effectiveness of strong regulatory frameworks in steering waste flows toward formal recycling channels. The study concluded that EPR not only strengthens domestic waste management but also aligns with international environmental norms.

Pongajow et al. (2025) explored stakeholder perspectives on EPR and e-waste management in China using a qualitative case study approach to investigate stakeholder perspectives on China's EPR policy and WEEE management. Both primary and secondary data were used, with data collection focused on three key stakeholder groups, using interviews, onsite observations, document analysis, and institutional reviews. The sample included 2 executives from recycling enterprises, 5 experts in the EPR research area, 1 government official, and 2 industry associa-

tion representatives. Secondary data comprised government databases, company reports, industry publications, and public information via web platforms. The findings revealed that industries prioritized financial sustainability and often lacked a comprehensive understanding of EPR, while associations served as policy intermediaries and research institutions. The study also identified role confusion between producers and recyclers, particularly following the suspension of the WEEE subsidy scheme in 2023. The conclusion was that successful EPR systems depended not only on clear regulations but also on shared responsibility mechanisms, targeted education, and adaptive financial support.

Chitaka, de Kock, and von Blottnitz (2022) focused on how South Africa's 2021 EPR regulations for plastics studied responses among industry actors. The study was anchored on Life Cycle Management (LCM) theory, framing how environmental impacts should be managed, stakeholder theory explaining how diverse actors negotiate responsibly, and the Polluter Pays Principle (PPP) justifying why producers must internalize the costs of waste management under EPR. The mixed method design, combining content analysis of corporate sustainability reports with semi-structured interviews involving 16 stakeholders from producers, retailers, recyclers, and industry associates, was used. Data was analyzed thematically using NVivo-assisted coding, with findings revealing that, whereas regulatory pressure had increased awareness of plastic leakage, actual eco-design changes remained minimal, largely due to contamination challenges and unstable recycling markets. The study concluded that although EPR mobilized firms towards recyclability, its transformative impact was constrained by weak governance and volatile end markets. They recommended the need for binding eco-design standards, transparent fee structures within PROs, and proactive government support in building stable recycling markets.

Yalwaji, John-Nwagwu, & Sogbanmu (2022), investigated the scale and dynamics of plastic pollution in Nigeria, positioning it within the broader debate of ERP. Using a quantitative systematic review design, the study analyzed 34 peer-reviewed studies published between 2000 and 2021 that focused on plastic pollution in Nigeria's environment. This aligns with PPP's argument that producers and importers of plastics must internalize environmental costs to make EPR viable. Likewise, the stakeholder theory that calls for a multi-stakeholder action, government agencies, industry actors, and civil society, was employed alongside LCA theory that addresses plastics by targeting production, consumption, and end-of-life phases. The population comprised 15 Nigerian states and the Federal Capital Authority, while data was collected through structured screening of published research using inclusion and exclusion criteria. The analysis was done using evidence synthesis to identify patterns of pollution sources, gaps in monitoring, and policy shortfalls. The findings revealed that Nigeria produces approximately 2.5 million tons of plastic waste annually, with less than 12% recycled, indicating a major gap in waste management infrastructure. The reviewed evidence highlighted urban litter, sachet water plastics, and e-waste residues as dominant sources of

pollution. They concluded that there was an urgent need to expand research into understudied areas such as microplastic contamination in soil and air, and recommended scaling up of public awareness, thereby providing incentives for recycling and strengthening the enforcement of Nigeria's 2020 plastic waste guidelines.

Kabera, Nishimwe, and Mukurarinda (2023) conducted a situational assessment of e-waste management within Rwanda's emerging EPR frameworks in East Africa. The research sought to map the existing e-waste streams in Rwanda, evaluate the institutional policy frameworks supporting EPR, identify the role of stakeholders, and highlight the gaps, challenges, and opportunities in scaling EPR as a sustainable solution. The study was guided by Stakeholder Theory, Polluter Pays Principle and Life Cycle Assessment Theory. Using a quantitative cross-sectional survey design, the research engaged 519 respondents across Kigali and Secondary cities. Data was analyzed with the aid of SPSS using Pearson's chi-square tests to assess the relationship between awareness, behavior, and socio-demographic factors. The findings revealed that 87.8% of respondents were unaware of e-waste regulations, and very few knew of designated collection or recycling centers. Further, the lack of awareness, coupled with limited disposal infrastructure, hampered effective EPR implementation. They recommended imposing eco-levies on new electronic products, increasing drop-off facilities, integrating e-waste management into education curricula, and formalizing informal collectors to align with formal recycling systems.

Kenya's shift to the legally codified EPR Regulations 2024 through the Sustainable Waste Management Act comes at a time when there is rapidly growing evidence base showing both urgent need and feasible policy pathways. Studies from 2022 converge on three interlocking problems: rapid growth of waste streams, fragmented collection and recycling value chains dominated by informal actors, and regulatory gaps in financing, producer obligations, and lack of operational targets.

Nygaard et al. (2023) assessed the emerging problems of end-of-life off-grid solar (OGS) products in Kenya and provided actionable recommendations for policymakers, investors, and sector actors. The study was anchored on stakeholder Theory, PPP, LCA, and repair After Life Sociology that recognizes informal repair and reuse practices as important socio-technical afterlives for OGS products and argues for their formal integration rather than criminalization. The population involved stakeholders from workshops and consultations, including industry players (importers and distributors), NGOs, regulators, and investors, with data being obtained from academic papers, sector reports, and policy documents. The analysis was qualitative and comparative, with the use of thematic synthesis of stakeholder inputs and document evidence to identify systemic risks and further map the risks to policy instruments, including eco-levies, registration, accreditation, and product standards. Policy gap analysis was employed for comparing existing Kenyan legal provisions and market realities against best practice EPR requirements. The findings revealed that off-grid solar adoption has accelerated. There is

also no standardized producer registration or reporting mechanism tied to clear financing to support collection and certified treatment. Additionally, the repairers, refinishers, and informal collectors perform bulk end-of-life handling, but workers lack adequate training, PPE, and pathways to formal channels. Similarly, regulatory and operational gaps were noted due to the absence of accredited PROs for OGS, limited collection points, unclear reporting standards, and insufficient capacity.

However, opportunities for OGS products lie in promoting repairable and modular product design, fostering local green jobs, and integrating informal sector actors through training and micro-enterprise models. The study recommended the creation of an OGS-specific EPR instrument, accrediting and regulating PROs, ring-fencing of eco-levy revenues, and formalizing and integrating informal actors. Additionally, the study recommended promotion of repairability and eco-design, establishing data monitoring systems, and starting pilot collection networks and PROs pilots to test levy mechanics, collection logistics, inclusion strategies, and integrating policy through evidence.

The Nairobi Circular Economy (CE) Baseline [Climate-KIC & Wasafiri \(2024\)](#) provides a comprehensive update on CE practices in the city. The study employed a mixed methods approach focusing specifically on characterizing informal workers across three high-impact neighborhoods: Dandora, Mathare and Kamukunji. The stakeholder Theory and Circular economy thinking theories were used. The survey was conducted on focus group discussions with 44 informal workers (4 Women and 40 men) exploring their livelihoods, income streams, and their perceptions of safety and reforms in the neighborhood. The design was analytical and combined narrative profiles with thematic coding to reveal how informal workers, though unrecognized, are indispensable to Nairobi's waste management infrastructure. The findings indicated critical disparities with Dandora remaining a heavily polluted site largely sustained by unmanaged informal collection. Mathare reflected residential vulnerability with minimal infrastructure support, while Kamukunji demonstrated a nascent micro-enterprise hub where salvage-based recycling thrived. The study underscored the need to formally integrate these actors into the EPR framework through interventions like eco-levies, PRO accreditation, health and safety programs, and enterprise support interventions that are grounded in polluter pays and Institutional Theories. In positioning Nairobi at a policy inflection point, the study offers both diagnostic clarity and a roadmap to inclusive circular governance.

[Njoroge, Nikam, and Ddiba \(2022\)](#) undertook a scoping study that critically assessed Mombasa city's plastic waste management and recycling value chain within the context of Kenya's emerging EPR framework. A qualitative design was adopted, anchored on Stakeholder and Circular Economy theories. The population consisted of formal waste managers, county officials, private recyclers, and informal waste collectors. Data collection was done using semi-structured interviews with key stakeholders, questionnaire surveys among waste pickers, recy-

clers, and a thorough review of institutional and policy documents. The findings revealed that informal actors play the most significant role in the recovery of PET and HDPE plastics, yet they remain excluded from formal regulatory frameworks. Additionally, there was a lack of segregation of waste at source, weak occupational safety standards, and insufficient financing that emerged as systemic weaknesses. The study recommended strengthening the EPR framework in Kenya by integrating informal actors into formal systems, improving waste segregation at household levels, creating financial incentives for recycling enterprises, and aligning county-level policies with national waste management strategies. These recommendations align with the GoK's strategy to position EPR as a dual instrument for achieving environmental sustainability and socio-economic development.

Davan Wetton et al. (2025) approached the problem of waste management in Kisumu from a behavioral science perspective, emphasizing how household and institutional practices shape environmental outcomes. A behavioral system mapping design was used, drawing on the COM-B (Capability, Opportunity, Motivation-Behavior) and the Behavior Change Wheel (BCW) as theoretical anchors. The population involved community households, local leaders, municipal officials, and civil society representatives with both qualitative data and quantitative observations. The analysis relied on systems mapping and behavioral coding that allowed the researchers to identify interconnections between infrastructure, norms, and practices. The findings showed that open burning, illegal dumping, and weak segregation practices persisted, largely due to infrastructural deficiencies, lack of affordable alternatives, and entrenched social norms. Unlike Mombasa, where the bottlenecks lay in value chain governance, Kisumu's challenge was behavioral lock-in and systemic barriers to adopting sustainable waste practices. The study recommended interventions such as community-driven waste literacy campaigns, behavioral informed nudges like color-coded bins, and the use of local champions to shift waste-related norms. Critically, it suggested embedding behavioral science into EPR policies to enhance compliance and participation, particularly among households and community groups who are often excluded from regulatory considerations.

Kariuki et al. (2025) examined household plastic waste dynamics through a structured desktop synthesis aligning their analysis with the circular Economy, Stakeholder Theory, and behavior-informed frameworks in Eldoret City, Kenya. A quantitative cross-sectional design involving interviews and questionnaires administered to managerial staff across municipal and private entities was used. The findings signaled the absence of efficient waste segregation and minimal public awareness as the main drivers of escalating plastic pollution. With insights drawn from policy documents and municipal reports, there are viable responses from community-based collection schemes, informal sector integration and private-public partnerships for recycling progressing the idea that sustainable waste governance in Eldoret city must be multipronged and inclusive. Additionally, resource capacity and regulatory frameworks significantly influenced waste service

sustainability. The study advocated for stronger collaboration between county authorities and private partners, including active engagement in drafting by laws and workforce development. Eldoret City has therefore established a partnership with Kenya Extended Producer Responsibility Organization (KEPRO) exemplifying a city at the forefront of Kenya's circular economy transition, embedding EPR into both institutional and grassroots levels of waste management. The deliberate linking of regulatory frameworks with socio-economic goals demonstrates an approach that enhances recycling outcomes as well as expands local livelihoods. In so doing, Eldoret city illustrates how medium-sized cities can lead in the operationalization of sustainability reforms and offer lessons for scaling EPR across other devolved units in Kenya.

**Table 1** presents a summary of the selected empirical review by author, topic of study, variables investigated, objectives of the study, methodology used, theories applied and the findings.

**Table 1.** Summary of reviewed literature and research gaps.

AUTHOR	TOPIC	VARIABLES	OBJECTIVES	METHODOLOGY	THEORIES	FINDINGS
Pongajow. V.D. (2025)	Stakeholder perspectives on EPR and E Waste management: A case study of China	EPR regulations & E-waste compliance Moderated by Stakeholder role	To examine how stakeholders, perceive and implement EPR in e-waste management	Qualitative Case study	Stakeholder Theory	Limited producer compliance, Weak enforcement mechanisms
Chitake, De Kock, & Von Blottnitz (2022)	Assessing the effectiveness of EPR regulations in South Africa's Plastic Sector	Plastic recycling outcomes & EPR policies	To assess the effectiveness of EPR regulations in the plastics industry	Mixed methods Policy analysis	PPP, LCM Stakeholder Theory	Fragmented approaches Industry resistance Delayed uptake
Waema & Wanyama (2023)	EPR and plastic waste recycling in Kenya	Plastic recycling & EPR Regulations Moderated by Informal sector	To analyze the link between EPR adoption and recycling practices in Kenya	Quantitative survey Interviews	PPP Stakeholder Theory	Informal sector central, Weak producer compliance
Climate-KIC& Wasafiri (2024)	The Nairobi Circular Economy Baseline study	Waste recovery, job creation & Circular Economy Moderated by Policy enforcement	To establish Nairobi's baseline status on Circular economy readiness	Mixed methods	Circular Economy Theory PPP	Nairobi is a policy inflection point with systemic leakages
Onwegbuizie & Frels (2021)	Critical Dialectical Pluralism: A philosophical stance for social and environmental governance research	Inclusivity in decision-making & Governance frameworks	To propose CDP as a stance for pluralistic environmental governance	Theoretical review	Critical Dialectical Pluralism (CDP)	Advocates Pluralistic approaches to governance

**Continued**

Owino & Akinyi (2022)	Pragmatism as a philosophical stance in environmental governance and waste management in Kenya	EPR adoption & Pragmatism	To argue pragmatism as a guiding stance for Kenya's waste management	Qualitative Conceptual	Pragmatism Theory	Pragmatism enhances flexibility in adopting EPR
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Source: Author Analysis.

## 7. Methodology

### 7.1. Protocol and Search Engine

In order to ensure transparency, accountability and consistency, it was essential to create a protocol on how research would be conducted and reported. According to [Bandara and Syed \(2024\)](#), a protocol is a document that lays out a detailed structure of a research study or blue print of end to end journey in literature review. The elements of a literature review are divided into several parts including, goal definition, topic of interest, the search strategy, screening of the paper, tools used, coding and the respective reporting plans ([Bandara & Syed, 2024](#)). On the other hand, search engines are platforms that are used by researchers to retrieve information from large datasets or the web by employing user submitted queries ([Néron et al., 2023](#)). Whereas a protocol sets out well in advance how and what search terms the researcher would seek evidence from, search engines are the actual tools used to execute the searches that are to be retrieved from literature. In this regard, the protocol provided the plan while the research engine provided the means of implementation. The review adopted the key words guided by the thematic scope with an emphasis on institutional capacity, regulatory frameworks, implementation challenges and the sectoral applications of EPR. The synonyms and keywords were chosen carefully to maximize visibility across databases ensuring that literature was retrieved both for international prominence and those specific to Kenya. The preliminary key words included were: Extended Producer Responsibility Regulations AND Kenya, EPR Implementation OR EPR Adoption AND Sub-Saharan Africa, EPR AND Plastic Packaging Waste OR Electronic Waste, EPR AND Circular Economy AND Sustainable Waste Management and EPR Policy Enforcement OR Compliance Mechanism AND Informal Waste Sector.

### 7.2. Databases and Sources

A comprehensive search was conducted across international and local repositories to include the entire scope of available literature. This comprised academic databases such as Web of Science, Scopus, Google Scholar, JSTOR, and African Journals Online (AJOL). Grey literature was drawn from institutional repositories, including World Bank, OECD, NEMA, Government of Kenya, UNEP and UNESCO. [Chugh, Macht, and Hossain \(2022\)](#) define grey literature as all the information

produced on all levels of governmental, academic, business, and industry. Others include in-print and electronic formats that are not controlled by commercial publishers. This focus ensured both academic precision and policy relevance.

### 7.3. Search Strategy

To ensure the retrieved literature remained focused, precise, and well aligned to the study objectives, Boolean logic was systematically applied. According to [Hemedan, Niarakis, Schneider, and Ostaszewski \(2022\)](#), Boolean logic is a system of reasoning that uses operators such as AND, OR, and NOT with a view to combining or excluding keywords in database searches, making it easier to retrieve precise and relevant results. Boolean logic was used to integrate the keywords, refine the search queries, filter out irrelevant records, and ensure the records were limited to those published in the English language between 2020 and 2025. This timeframe ensured that the results were specific to the period of interest.

### 7.4. Inclusion and Exclusion Criteria

The inclusion and exclusion criteria used pre-specified parameters to determine the subjects or studies considered for inclusion in the review. The criteria served as a foundational filtering mechanism to ensure that the findings are valid, reliable, and can be applied to a research enquiry ([Dekkers, Carey, & Langhorne, 2022](#)). The criteria defined the essential characteristics that the review must possess. The exclusion criteria identified characteristics that, despite meeting inclusion parameters, disqualify a participating article due to ethical, methodological, or practical concerns. Therefore, to ensure coherence and in-depth searches, the inclusion criteria adopted included empirical studies, case studies, and systematic reviews on EPR. Research published within the last 5 years, except for foundational documents and literature addressing EPR regulations, adoption, capacity, development, policy frameworks, ethics, infrastructure, and pedagogy, was used. The exclusion criteria included opinions that were not supported by empirical evidence and studies that were not relevant and unrelated to EPR and waste management systems. Publications outside the five-year defined timeframe were also excluded. [Figure 1](#) presents the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) model that shows the inclusion and exclusion criteria.

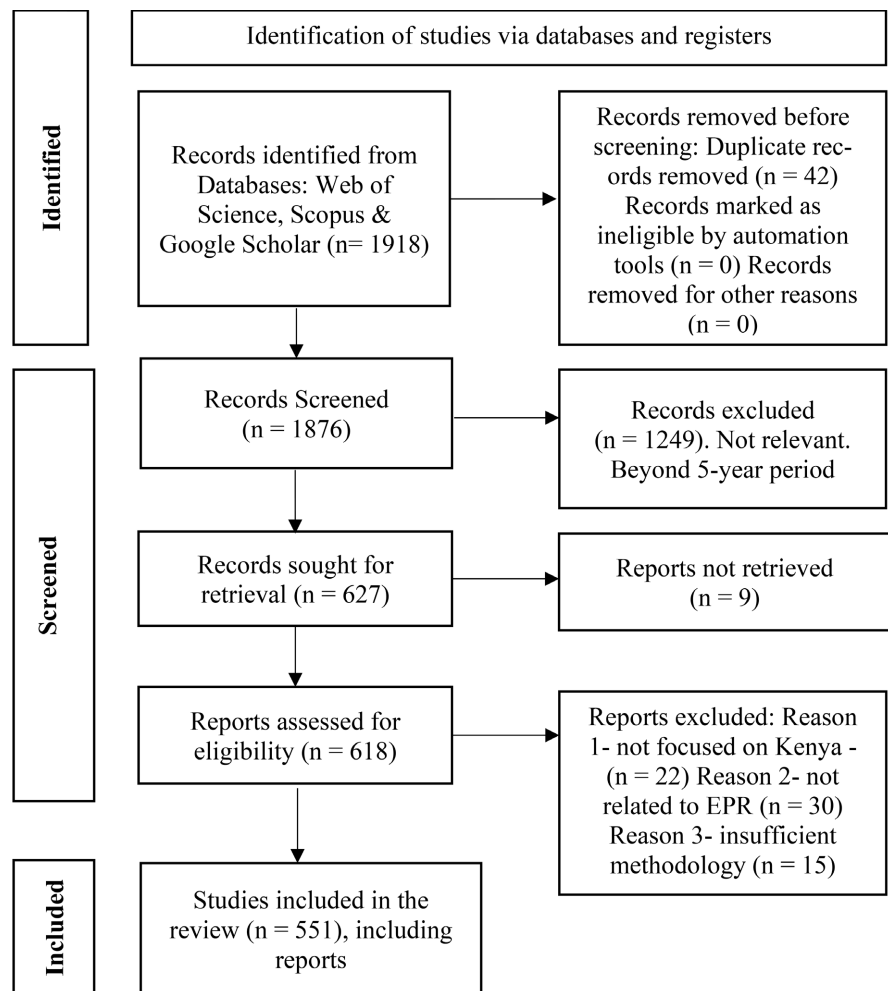
### 7.5. Research Design

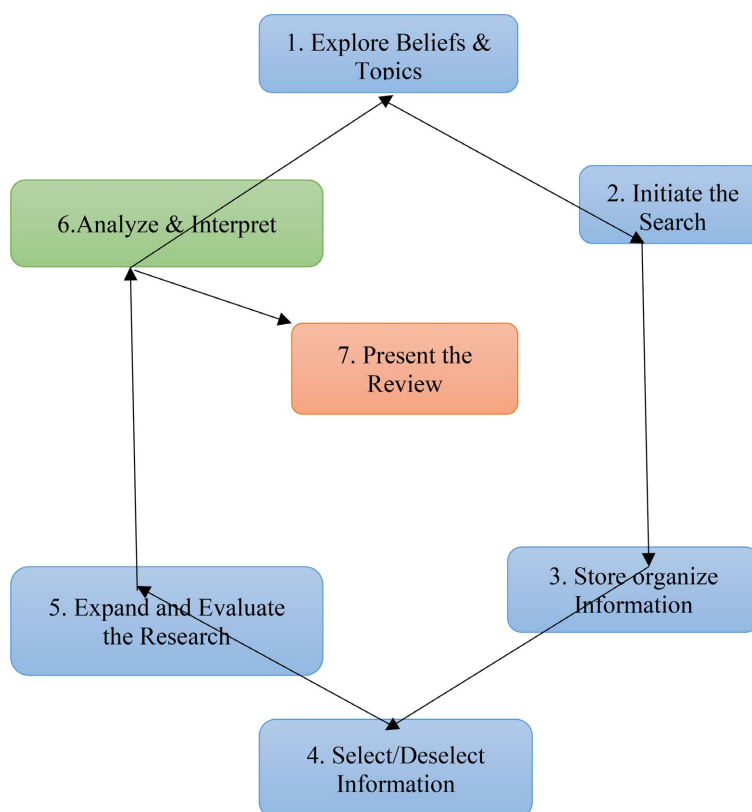
The study adopted a Comprehensive Literature Review (CLR) methodology as the overarching research design. The CLR is considered not only a data collection tool but also a structured methodological approach that allows for systematic mapping, organizing, and synthesizing of evidence across diverse designs. A study by [Snyder \(2024\)](#) indicated that the CLR design is a suitable tool for EPR discussions since both quantitative data (recycling rates, compliance costs) and qualitative insights (stakeholder perceptions and enforcement challenges) would be integrated

in providing an evidence-informed RIA. Unlike traditional narrative reviews, the CLR involves transparent procedural stages that enhance consistency and policy relevance (Pollock et al., 2022). According to Gomez-Diaz and Recio (2022), data recorded are factual materials commonly accepted in the scientific community as necessary to validate research findings, and serve as the evidential basis underpinning research conclusions. Such evidence comprised measurements, observations, survey responses, experimental outputs, model outputs, metadata and codes that necessities interpretation and replication.

### 7.6. The CLR Framework

The CLR framework adopted a seven-step process grouped in three main phases: Exploration, Literature Search, and Communication. Exploring beliefs and topics were the first steps that identified core debates around EPR, such as producer responsibility, compliance costs, and policy frameworks. The second step involved a literature search by conducting systematic databases and grey literature using keywords and eligibility criteria. The third step, communication, involved storing and organizing information using extraction matrices, selecting and deselecting information using inclusion/exclusion criteria, expanding and evaluating





**Figure 1.** Meta-framework of the seven-step CLR Model.

the search by broadening and refining the search to address gaps for comprehensive coverage, interpretation and analyzing literature by conducting thematic and quantitative synthesis of economic, environmental, and social impacts and presenting the review report by highlighting the findings and policy implications. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) standards were used to improve transparency, consistency, and quality of systematic reviews and meta-analyses (Sohrabi et al., 2021).

#### 7.6.1. Mixed Research Techniques

Given the multidimensional nature of EPR, the CLR accommodated mixed research techniques by synthesizing diverse evidence bases. Quantitative findings on recycling efficiency, cost-benefit outcomes, and compliance rates were complemented with qualitative analyses of governance frameworks, producer organizations, and stakeholder narratives (Kordi & Salo, 2023). This mixed-method integration strengthened the robustness of the findings by cross-checking numeric outcomes with contextual insights, aligning it with methodological calls for convergence in sustainability policy reviews (Kutcher & LeBaron, 2022).

#### 7.6.2. Data Sources and Search Strategy

The review drew data from multidisciplinary databases, including Scopus, Web of Science, ScienceDirect, and Google Scholar, covering the years 2016-2024 with a focus on the most recent decade of EPR implementation. Grey literature reports

from UNEP, OECD, and Kenya's NEMA were included to ensure policy comprehensiveness. In constructing the search strings, a combination of controlled terms and keywords was applied, including Extended Producer Responsibility, Regulatory Impact Assessment, Waste Management Policy, and Circular Economy Regulation. PRISMA style reporting was used to document inclusion and exclusion decisions to ensure there was transparency in the study selection (Stevens et al., 2024).

### 7.6.3. Data Extraction and Instruments

A standardized extraction matrix was used as the main instrument capturing study characteristics such as the author, year, and country, methodological design, EPR instruments assessed (fees, takeback schemes, eco-modulation), and outcomes (economic, social, and environmental). The extraction was also supplemented by the QDA Miner Lite software. To ensure validity, extraction categories were piloted on a subset of studies and refined through benchmarking consistent with COSMIN and PRISMA-COSMIN guidelines on reviewing outcome assessment measurements (Elsman et al., 2024).

### 7.6.4. Analysis and Interpretation

The analysis adopted a two-tier strategy, firstly, thematic synthesis that is conducted to identify recurrent patterns in EPR implementation, such as enforcement challenges, producer compliance behavior, and system-level outcomes. Secondly, data comparability that permitted quantitative synthesis, such as descriptive mapping and limited meta-analysis to consolidate findings on recycling rates and economic impacts, was applied (Christou, Parmaxi, & Zaphiris, 2025). The Interpretation was contextualized within the regulatory and socio-economic contexts, recognizing how variations in governance structures shape compliance outcomes (Snyder, 2024).

### 7.6.5. Quality Appraisal and Reflexivity

Quality appraisal involved systematically evaluating the credibility, reliability, and methodological soundness of included studies before the synthesis. According to Mak and Thomas (2022), studies are appraised using tailored checklists adapted from PRISMA and interactive review frameworks to evaluate methodological soundness, ensuring clarity of outcome measures and relevance to the EPR domain. Further, reflexivity requires researchers to critically examine their positionality, assumptions, and potential biases throughout the review and the research process. Reflexivity was built into the process by considering the reviewers' viewpoints and repeatedly revisiting search and synthesis decisions, thereby treating CLR's seven steps as cyclical rather than linear processes (Jilcha, Bekele, & Tesfaye, 2025). In the context of EPR, reflexivity acknowledges that choices of sources, inclusion criteria, and interpretations may be shaped by disciplinary perspectives or institutional pressures (Alejandro & Stoffel, 2024). By applying appraisal standards, the review ensured that only studies with robust sampling, measurement,

and analytic rigor contributed to the conclusions that strengthened the evidence base.

#### **7.6.6. Ethical Considerations**

Lal and Sharma (2023) indicated that ethical scholarship is maintained by ensuring accurate representation of sources, proper attribution, and avoidance of misinterpretation of secondary data. Similarly, grey literature was critically appraised for reliability to avoid policy bias, while ethical rigor in CLR and EPR included respecting intellectual property, transparency, and integrity in evidence reporting. Additionally, all sources were accurately cited to prevent selective reporting, ensuring sensitive data were anonymized. Recent scholars emphasized the ethical responsibility of open science, the FAIR data principle (Findable, Accessible, Interoperable, Reusable) and research integrity in systematic and critical reviews (Haven, Gopalakrishna, Tjldink, van der Schot, & Bouter, 2022). Further, empirical extensions and ethical clearance ensured that participants' autonomy was upheld. Confidentiality and informed consent on the materials used was upheld in accordance with established research ethics standards.

### **8. Discussion of Results**

The reviewed studies indicate that although most European, Asian and some African countries have introduced EPR policies in their waste management framework, there exists significant structural gaps between policy, design, and implementation. The studies showed inadequacy of infrastructure, such as collection points, materials recovery facilities, and reliable transport systems. Ineffective Governance mechanisms also stood out significantly. Additionally, poor waste segregation at source, particularly by households, and inadequate informal sector integration into the waste management value chain, has exacerbated waste management challenges. There is also no clear allocation of responsibilities within the waste management framework between producers and governments. Consequently, while there exists a robust policy framework for waste management, there is a gap in implementation. For instance, although regulations exist in countries like Sweden, Germany, Canada, France, China, South Africa, Rwanda, and recently, Kenya, most still struggle with low enforcement, limited monitoring, low public awareness, inadequate informal sector integration, and poor producer compliance. This shows that policy alone does not guarantee success, and so, countries require strong enforcement and monitoring systems to ensure producers' compliance upstream. Further, although the informal waste sector plays a major role in recycling, especially in many countries, there are inadequate policies that fully integrate informal waste pickers into the waste management value chain, particularly for plastic and electronic waste. The studies reveal that EPR may work better when communities and stakeholders are actively involved rather than when it is left only to government agencies.

Contrary to the producer responsibility theory (PRT) and stakeholder theories,

compliance with EPR regulations has been curtailed by concerns about the capability and cost implications. Due to the absence of predictable enforcement mechanisms, producers have consistently resisted or delayed compliance due to cost concerns and uncertainty of the EPR framework. Therefore, there is need for commitment by the Government and producers, a predictable enforcement mechanism, transparent performance metrics such as eco-modulation fees, collective and individual schemes that reduce the individual burden of compliance.

From the findings, it is also noted that strong institutions drive compliance more than incentives. Compliance increases when rules are embedded as part of day-to-day operating procedures (SOPs), such as record keeping and reporting and not just when incentives are offered. Thus, strong institutions will ensure long-term sustainability and implementation of the EPR framework. Additionally, the findings show that the success of the EPR framework hinges on operational designs such as routine optimization for improvement, standard packaging and labeling, effective deposit return logistics, efficient MRFs, sorting and segregation of waste at source, backed by robust performance monitoring mechanisms. This will ensure effective implementation of the EPR system.

Notably, there is widespread and fragmented EPR implementation across different jurisdictions, occasioned by overlapping roles and responsibilities, creating duplications and gaps. This dilutes accountability and complicates EPR system integration due to compromised data, standards, pricing, and enforcement. This raises the need for polycentric Governance for effective coordination of shared data registries, harmonization of standards, joint enforcement and inspection protocols, and pooled financing, which reduces friction and disagreements in EPR implementation. To this effect, PROs can play a key role in coordinating EPR implementation by ensuring goal congruence and waste collection targets are achieved by leveraging private capabilities and maintaining public oversight. Further, effective EPR implementation leads to increased employment of opportunities through the circular economy for the informal sector, thus improving their livelihoods. The EPR also enhances materials recovery through MRFs and facilitates reduced Government spending on waste management budgets. The materials recovered are also valued-added for the export markets, hence reducing the demand for virgin materials, leading to environmental conservation.

It is also evident that the informal sector plays a significant role in the waste management ecosystem, which is consistent with the stakeholder paradigm. A large proportion of waste is managed by this sector. The review noted that there is need to adopt a hybrid framework that involves contracting, digital traceability, fair pricing, and safety standards that formalize the waste management value chain without displacing livelihoods. Producers need to fund social safeguards such as the provision of Personal Protective Equipment (PPEs), training and capacity building, and establish adequate and stable buy-back centers to align well with the EPR goals.

Finally, in terms of the research approaches, many of the reviewed studies used

qualitative reviews and policy analysis, with very few studies providing real data on economic and social outcomes, particularly in Africa, leaving a huge gap on the impact of EPR on financial sustainability, job creation, and innovation. Similarly, regulations alone are not sufficient for effective EPR implementation. Achieving meaningful results will require strong enforcement mechanisms, clearly defined financial or other initiatives, active inclusion of informal waste actors, and broader participation from both producers and the public.

## 8.2. Summary of Findings

The reviewed body of literature demonstrates that scholarly engagement with EPR in European, African, and Asian contexts mainly focuses on regulatory evolution, institutional arrangements, and implementation challenges. While multiple jurisdictions have adopted EPR frameworks, the available studies suggest that operationalization is frequently characterized by fragmented governance structures and limited documentation of compliance behaviors among producers. A notable proportion of studies acknowledge the key role of informal waste actors in material recovery processes and recycling. However, their contribution is seldom captured within formal policy reporting mechanisms, pointing to a divergence between regulatory design and ground-level waste management practices.

Methodologically, the literature is dominated by qualitative analyses, policy reviews, and case-based assessments with relatively few empirical investigations utilizing quantitative performance indicators. As a result, evidence on the economic, social, and environmental impacts of EPR remains largely inferential instead of a data-driven evaluation. Besides, comparative analyses across countries or sectors are limited in scope, restricting the ability to generalize best practices or assess the relative impact of differing EPR models. In summary, since EPR is a new and emerging phenomenon, the literature offers rich discussion but limited evidence on actual outcomes.

## 8.3. Recommendations

Several recommendations can be derived based on the discussions from the literature and studies reviewed. Firstly, there is need for target setting. Having clarity of targets set at the national and PRO levels for waste volumes is a precursor to a sustained increase in waste collection and circularity. When EPR is paired with collection targets and litter prevention measures, improvement in local environment quality and lower costs for municipal clean-ups and collections will be realized. The NEMA should therefore, in consultation with the relevant stakeholders, set targets for waste collection, materials recovery, and recycling for meaningful and realistic impact to be achieved through a robust and supportive legal framework.

Secondly, establishing a differentiated levy structure that is predictable for financing EPR activities is imperative. A fee structure and ring-fencing of EPR funds in waste collection revenues are essential for creating an adequate pool of

resources to finance and enhance the performance of the EPR framework in the country.

Third, the establishment of an EPR council for improved and strengthened coordination of actors in the EPR value chain, i.e., producers, local government, recyclers, and informal collectors leads to reduced duplication of roles and better performance of EPR systems. The Council is expected to encourage healthy competition among the PROs to guarantee success in the implementation of the EPR framework.

Fourth, provide a mechanism for the design and use of modulated fees that provides direct economic incentives. Thus, policy should encourage fee modulation in the design of regulations to encourage recycling rates. Frameworks that embed EPR within the circular economy strategy deliver better performance outcomes, thus leveraging eco-design, re-use, and recycling are encouraged. Modulated fee structures and reporting obligations stimulate investments and lower the cost per ton of waste produced.

Fifth, EPR frameworks need to explicitly integrate informal waste pickers to increase collection rates in urban environments where equity lacks and waste collection systems are dominated by informal systems. This can also contribute towards job creation, improved livelihoods, safer working conditions for informal waste pickers, increased diversion from landfills, and improved data collection from the source.

Sixth, for EPR policy to be data, performance, and compliance driven, the framework needs to stimulate standardized reporting, third-party audits, and data access. There is a need to build stronger institutional capacity in reporting, e.g., in the National Sustainable Waste Information System (NSWIS) proposed by NEMA. Finally, communication increases public participation rates and evokes stronger public legitimacy for most EPR models.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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