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SIRKEL-JKT: A Producer-Responsibility Model for Flexible Plastic Waste Recovery in Jakarta

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Abstract

Background: Jakarta's plastic waste reduction policy primarily restricts single-use shopping bags, while low-value multilayer plastic packaging, particularly sachets, remains inadequately managed.
Objective: This study examines policy imbalances in flexible plastic waste management and proposes a Jakarta-wide producer responsibility model.
Methods: This environmental policy study combines normative legal analysis with a structured review of legal frameworks, government data, material flow studies, scientific literature, and comparative policies from the European Union, the Philippines, and India. Evidence was evaluated based on material recovery, cost efficiency, distributive justice, administrative feasibility, and legal feasibility.
Results: The findings reveal substantial gaps between producer responsibility obligations and their implementation. A technical study across Jakarta's five administrative cities estimates that 87.52% of flexible plastic reaches final disposal facilities, while only 2.99% is recycled. Although plastic bags and expanded polystyrene dominate pollution in certain locations, sachets remain particularly challenging to recover because of their low economic value and limited recycling infrastructure. These findings highlight the need for integrated collection, financing, and monitoring mechanisms.
Conclusion: The proposed SIRKEL-JKT model integrates producer financing, verified collection, traceable recycling, and social safeguards to improve flexible plastic waste management. However, its effectiveness requires empirical validation. A phased pilot program during 2027–2029 is recommended to evaluate recovery performance, financing mechanisms, operational feasibility, and social impacts before broader implementation.

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INTRODUCTION

The plastic waste problem cannot be adequately assessed solely by examining what is visible on streets or in waste bins. The relevant question is whether plastic waste can be collected, sorted, assigned economic value, and channeled into the processing chain after use. A global inventory estimates that approximately 52.1 million tons of macroplastic are released into the environment without proper management each year, with approximately 57 percent burned in the open. Indonesia is among the largest contributors, ranking third globally after India and Nigeria.

A material flow analysis at the subdistrict level estimates that Indonesia generates 9.2 million tons of plastic waste annually, of which approximately 45 percent is burned in the open, 1.16 million tons potentially leak into rivers and onto land, and the informal sector recovers

approximately 12 percent of the plastic waste—four times the recovery achieved by existing recovery facilities (Ramadan et al., 2026). These findings are consistent with global models that identify collection quality as a key determinant of plastic leakage, including an estimate that approximately 40 percent of Indonesia's urban population was not served by waste collection in 2019 (Borrelle et al., 2020; Jambeck et al., 2015; Lau et al., 2020). A policy that targets only one type of plastic may therefore not necessarily improve the waste management system as a whole. Throughout this article, the method is consistently referred to as Material Flow Analysis (MFA), following the terminology used to trace material inputs, stocks, flows, and outputs.

Jakarta has restricted single-use plastic shopping bags through Governor Regulation (*Peraturan Gubernur* or *Pergub*) Number 142 of 2019, which requires the use of environmentally friendly shopping bags at shopping centers, supermarkets, and traditional markets. This policy is easy to understand and its effects are immediately felt by consumers, but its scope is limited to bags provided at the point of transaction rather than primary packaging attached to products. Meanwhile, Jakarta generates approximately 7,700–8,000 tons of waste per day, and approximately 55 million tons have accumulated at the Bantargebang Integrated Waste Processing Site (*Tempat Pengolahan Sampah Terpadu* or TPST). The composition of incoming waste is dominated by food scraps, at 43 percent, and plastic, at 28 percent. In 2026, Governor Instruction (*Instruksi Gubernur* or Ingub) Number 5 of 2026 directed units of the Provincial Government, including village heads (*lurah*), to implement the Waste Sorting and Processing from Source Movement.

Among other measures, village heads were instructed to require residents to sort their waste, while the appendix to the Ingub classifies waste at the source into four categories: organic, inorganic, hazardous and toxic materials (*bahan berbahaya dan beracun* or B3), and residual waste. Beginning August 1, 2026, shipments to Bantargebang are to consist progressively of processed residual waste, with a target of 25 percent in 2026, increasing to 100 percent by 2029. This policy change clarifies the premise of this article. If the 2029 target is achieved and waste entering Bantargebang has been processed so that only residual waste remains, low-value flexible packaging without an established recovery pathway will become one of the most difficult waste streams to manage. The reported cumulative waste figure for Bantargebang is treated as a period-specific estimate from the cited source rather than as a current annual flow; consequently, the daily inflow and cumulative stock are not interpreted as directly comparable measures. All quantitative claims in this paragraph should be interpreted in light of the year, spatial scope, and measurement basis specified in their respective sources.

Shopping bags and sachets must be distinguished because they have different policy implications. Shopping bags are carrier bags provided at the point of transaction, whereas sachets are primary packaging used for small portions of products such as coffee, milk, shampoo, detergent, and food. Sachets are generally made from multilayer plastic packaging designed to provide durability and strength. A scoping review shows that multilayer sachets are widely used in low- and middle-income countries, with global sales exceeding one trillion units per year. Indonesia and the Philippines are among the countries most frequently discussed in the literature, although empirical evidence remains limited and the literature is dominated by non-peer-reviewed sources (Cullen et al., 2026). Sachets are difficult to sort and have minimal post-consumer economic value. Their complex composition, which may include multiple polymers, thin metal layers, inks, and adhesives, combined with their small size, makes recovery challenging. Consequently, sachets often remain in the residual post-consumer packaging waste stream (Kaiser et al., 2017; Ragaert et al., 2017).

The sachet problem is also related to affordability and market access. A systematic review identifies three corporate strategies for reaching low-income consumers, including offering products at low unit prices. However, only a few high-quality studies provide evidence that this strategy successfully reaches the intended target groups (Nordhagen & Demmler, 2023). A study in the Greater Jakarta metropolitan area (Jakarta, Bogor, Depok, Tangerang, dan Bekasi or Jabodetabek) estimates sachet and pouch waste generation at approximately 4 kilograms per person per year, equivalent to 14–16.6 percent of national plastic waste generation, with associated management costs estimated at Rp1.19–1.78 trillion per year. These figures are survey-based estimates rather than official government statistics (*Dietplastik Indonesia and Daya*

Makara Universitas Indonesia 2024). For low-income households and households with limited purchasing power, the amount payable in a single shopping transaction may matter more than the price per unit of volume. Therefore, banning sachets without providing affordable alternatives that preserve access to small purchase quantities could place a disproportionate burden on low-income households.

National regulations have established producer responsibility for waste management. Article 15 of Law Number 18 of 2008 concerning Waste Management requires producers to manage packaging and/or goods that cannot or are difficult to decompose through natural processes. Government Regulation Number 81 of 2012 further details measures concerning waste generation reduction, reuse, recycling, and the collection of packaging. Regulation of the Minister of Environment and Forestry (*Peraturan Menteri Lingkungan Hidup dan Kehutanan or Permen LHK*) Number P.75/2019 establishes a roadmap for 2020–2029 with a waste reduction target of 30 percent. For manufacturing producers, Appendix I of the regulation stipulates a prohibition, effective January 1, 2030, on using polypropylene (PP) flexible plastic sachets as product packaging in sizes below 50 milliliters or 50 grams. Thus, the principal problem is not the absence of regulations but the gap between producer obligations and the mechanisms needed to implement them at the Jakarta municipal scale, particularly with respect to collection, financing, data management, and recovery.

Previous research has examined Jakarta's plastic leakage, low-value plastic recycling, the informal sector, and Extended Producer Responsibility (EPR) separately. However, within the scope of the literature search conducted for this study, no study was identified that explicitly integrates the low economic value of sachet packaging, the authority of the Jakarta Special Capital Region Provincial Government (*Pemerintah Provinsi DKI Jakarta*), producer financing, formal and informal collection networks, and safeguards for low-income consumers into a single operational model at the Jakarta municipal scale. This research addresses that gap through the proposed SIRKEL-JKT Model. Its novelty lies in its operational design rather than in the invention of EPR itself. Existing approaches generally address national recovery obligations, producer responsibility organizations, packaging restrictions, or fee modulation separately. SIRKEL-JKT brings these elements together at the Jakarta implementation level through verified return nodes, the inclusion of formal and informal collectors, an auditable mass balance, and explicit social protection safeguards, while remaining within the limits of provincial authority.

This article addresses two research questions. First, are Jakarta's plastic policy instruments aligned with the differences in recovery characteristics between shopping bags and low-value flexible packaging, such as sachets? Second, how can producer responsibility be operationalized through an implementation model at the Jakarta municipal scale that reflects local waste generation characteristics and respects the limits of the DKI Jakarta Provincial Government's authority? This article does not argue that restrictions on shopping bags are ineffective or unnecessary. Rather, it argues that the success of shopping bag regulations does not eliminate the need for a dedicated recovery system for low-value flexible plastics. The study examines this policy imbalance using the latest available Jakarta data and formulates a testable implementation model at the Jakarta municipal scale. Its contributions are an evidence-based diagnosis, a mapping of existing regional authority, and the proposed SIRKEL-JKT Model as a conceptual framework. In this manuscript, SIRKEL-JKT stands for *Sistem Integrasi Responsibilitas Kemasan Eceran dan Logistik Jakarta* and denotes the proposed integrated framework for producer-financed recovery of low-value retail packaging at the Jakarta municipal scale.

METHOD

This research was an environmental policy study based on secondary data, normative analysis, and a structured evidence review. Sources were selected purposively based on their relevance and evidence quality; therefore, the method did not constitute a systematic literature review and did not claim to cover the entire literature. The procedure consisted of four steps. First, legal materials were identified and examined, including the text and legal status of Law Number 18 of 2008 concerning Waste Management; Law Number 12 of 2011 concerning the Formation of Legislation, as amended by Law Number 13 of 2022; Law Number 23 of 2014 concerning Regional Government and its amendments; Law Number 1 of 2022 concerning Financial Relations between

the Central Government and Regional Governments; Government Regulation (PP) Number 81 of 2012; PP Number 35 of 2023 concerning General Provisions on Regional Taxes and Levies; Presidential Regulation (Perpres) Number 97 of 2017; Regulation of the Minister of Environment and Forestry (Permen LHK) Number P.75/2019; Jakarta Regional Regulation (Perda) Numbers 3 of 2013, as amended by Number 4 of 2019, 10 of 2024, and 1 of 2024; and relevant Governor Regulations (*Peraturan Gubernur* or *Pergub*) and Governor Instructions (*Instruksi Gubernur* or *Ingub*). These materials were verified through peraturan.go.id, the Legal Documentation and Information Network (JDIH) of the Financial Audit Board (BPK), and the JDIH of DKI Jakarta Province through August 25, 2026.

The status of national EPR policy developments was rechecked through September 11, 2026. The provisions of Permen LHK Number P.75/2019 were examined using a copy published in State Gazette Number 1545 of 2019. Minister of Environment/Head of the Environmental Control Agency (BPLH) Circular Letter (SE) Number 11 of 2025 was also considered as a relevant administrative instrument. The term "structured evidence review" was used to describe a transparent but non-systematic selection procedure: sources were identified through specified legal and scholarly databases, keywords, publication periods, citation chaining, and explicit exclusion criteria, then screened for relevance, traceability, recency, and evidence quality. The approach did not claim exhaustive retrieval or PRISMA-style completeness.

Second, scientific literature and data were selected according to three criteria: direct relevance to plastic waste, flexible packaging, or producer responsibility in Jakarta, Indonesia, or comparator jurisdictions; traceability to primary sources; and data recency. Literature searches were conducted through August 25, 2026, using Google Scholar and publisher databases accessed through DOI links, including ScienceDirect, SpringerLink, Wiley Online Library, Nature.com, and Science.org, supplemented by backward and forward citation searching (snowballing) from key studies.

The search strategy combined keywords including *sachet*, *multilayer packaging*, *flexible plastic waste*, *extended producer responsibility*, *plastic waste Jakarta*, *plastic waste Indonesia*, *waste picker*, and *reusable packaging life cycle assessment*. The publication period covered 2015–2026. Exclusion criteria included media opinion pieces without primary data, sources that could not be traced to their original documents, and duplicate reporting of findings from the same source. The review ultimately used 75 cited sources: 33 journal articles, 24 regulations and other legal instruments, 7 books and institutional reports, and 11 government documents and other sources. Documents that were reviewed but did not meet the inclusion criteria were not systematically logged because the review was not designed as a systematic literature review.

Evidence quality was assessed using two approaches. For legal propositions, the hierarchy prioritized primary legal materials, followed by official implementation documents and secondary legal sources. For empirical propositions, evidence quality was assessed by prioritizing peer-reviewed journal articles and scientific syntheses, followed by official government data, traceable technical reports, and citizen science or media sources as indicative evidence. Non-scientific literature and citizen science data were used selectively and explicitly labeled as indicative. Third, key figures were summarized in a table specifying each source's data year, measurement point, and method. Figures from noncomparable sources were presented as separate indicators rather than aggregated into a single mass balance of material inputs and outputs. Fourth, policies in the European Union, the Philippines, and India were compared to evaluate policy design options rather than to transplant existing rules directly. The Philippines was selected because it implements phased EPR recovery targets in a middle-income ASEAN country, while India was selected because of its experience with specific regulations on multilayer plastics. The European Union served as a comparator for packaging design, reuse, and more advanced restrictions on packaging formats.

The analytical framework integrates three concepts: policy alignment with waste characteristics, extended producer responsibility (EPR), and waste management hierarchy with distributive justice. These concepts were operationalized into five assessment criteria: collection and material recovery, cost efficiency, distributive justice, administrative feasibility, and legal and jurisdictional feasibility. Each criterion evaluates the effectiveness of policy instruments in ensuring verifiable recovery, efficient financing, equitable distribution of costs and benefits,

institutional capacity, and regulatory compliance. The criteria were applied to assess existing policies and qualitatively evaluate the proposed SIRKEL-JKT Model without assigning empirical weights. As the study relied on secondary data without primary surveys, the proposed costs, incentives, and recovery targets were treated as preliminary design assumptions requiring validation through pilot implementation.

RESULTS AND DISCUSSION

Results

Shopping Bags as a Partial Instrument: Effectiveness and Substitution Risk

Plastic shopping bags are often targeted by government policies because they are easily identifiable, frequently used in commercial transactions, and associated with business actors whose activities can be readily monitored. However, ease of regulation does not necessarily correspond to the magnitude of environmental risk. Therefore, policy needs to distinguish between the visibility of a product and the feasibility of recovering its material.

Relevant quasi-experimental evidence on plastic bag policies comes from the United States. Taylor found that a plastic shopping bag ban in California eliminated approximately 40 million pounds of plastic bags per year but was accompanied by an increase of 12 million pounds in trash bag purchases, meaning that approximately 28.5 percent of the reduction benefit was offset by substitution with other bags (Taylor, 2019). Homonoff et al. (2022) found that a thin-bag ban in Chicago encouraged some retailers to switch to thicker bags that were not covered by the ban, whereas a tax on all single-use bags reduced their use in absolute terms. Based on an analysis of 45,067 beach cleanups, Papp & Oremus (2025) found that plastic bag policy interventions were associated with a reduction of approximately 25–47 percent in the proportion of plastic bags in beach litter. Their findings also showed that fee-based policies tended to produce greater reductions than outright bans (Papp & Oremus, 2025).

Three lessons are relevant to *Pergub* 142/2019: the shopping bag ban remains useful for its intended target; rules are needed to prevent substitution with thicker bags; and evaluations must account for the entire material flow, including substitute products. A reduction in the number of bags used does not mean that the plastic waste problem has been resolved. Sachets present a different challenge. Their small size and low weight, multilayer structures that complicate mechanical recycling, and generally lower post-consumer value distinguish them from rigid packaging, which already has an established recycling market (Soemadijo, 2022). Table 1 summarizes the differences between the policy characteristics of the two packaging types.

Table 1

Differences in policy characteristics of shopping bags and multilayer sachets

Aspect	Shopping bag	Multilayer sachet
Function	Carrier of goods after transaction	Primary packaging directly attached to product
Policy target	Cashier, shop, market	Design, factory, distribution, stall, household, collector
Post-consumer value	Reusable; reuse value varies	Generally low; size and structure hinder recovery
Main policy	Restriction, fee, reuse	EPR, eco-modulation, collection incentives, refill planning, reuse
Policy risk	Substitution to thicker bags or trash bags	Prohibition without small-quantity purchase option can add to the economic burden of low-income households
Success measure	Reduction in plastic bag use; proportion in litter	Collection rate; material recycling rate; return coverage; reuse cycles; leakage rate

Source: processed by the author.

Jakarta's Plastic Waste Flow and the Position of Flexible Packaging

Jakarta's data illustrate the magnitude of the plastic waste problem while also revealing

limitations in data availability. The DKI Jakarta Environmental Agency (DLH DKI Jakarta) records that plastic accounts for approximately 28 percent of the waste composition at Bantargebang. Meanwhile, a 2019 technical study by the DKI Jakarta Provincial Government, used in a material flow analysis, recorded a plastic proportion of 14.85 percent at the point of waste generation. These figures cannot be compared directly because they refer to different measurement points, years, waste coverage, and methods. Nevertheless, both indicate that plastic constitutes a significant part of Jakarta's waste flow.

Material flow analysis estimates that Jakarta generates 399,691 tons of plastic waste annually. Approximately 11 percent is estimated to remain uncollected, while approximately 7 percent is recovered through the informal sector. Meanwhile, approximately 211,309 tons of plastic waste per year are estimated to be transported to Bantargebang. Plastic leakage into water bodies is estimated at 28,472 tons per year, increasing to 40,880 tons when diapers are included. Of the approximately 37,995 tons of plastic waste that are not recycled and enter water bodies, plastic bags constitute the largest category, at approximately 20,777 tons, followed by diapers at 12,408 tons and plastic packaging at 3,944 tons. The study also estimates that more than 225 waste facilities, particularly depots and 3R-based waste processing sites (*Tempat Pengolahan Sampah Reduce, Reuse, Recycle*; TPS 3R) located near rivers, contribute approximately 24.3 percent of waste leakage into the aquatic environment (Rinasti et al., 2022). Another material flow study estimates that approximately 24 percent of Jakarta's plastic waste is recycled, while the remaining 76 percent ends up in final disposal facilities or the environment (Putri et al., 2018).

For flexible packaging, data from Jakarta's five administrative cities indicate that, of approximately 280 tons of flexible plastic waste generated daily, 87.52 percent ends up in landfills, 2.99 percent is recycled, 0.78 percent is processed in waste-to-energy facilities (*Pembangkit Listrik Tenaga Sampah*; PLTSa), and 8.72 percent remains unmanaged. The material composition consists of approximately 48 percent monolayer plastic, 33 percent plastic–metal multilayer material, and 19 percent plastic–plastic multilayer material; plastic–paper multilayer material is rarely found (Waste4Change, 2022). These figures come from a technical report produced by a private operator and have not been published as a peer-reviewed journal article. Nevertheless, their general direction is consistent with an analysis of Indonesia's plastics value chain: post-consumer polyethylene terephthalate (PET) is valued at approximately USD 0.34 per kilogram in Jakarta; low-value flexible plastic is available in Java but is often not accepted outside Java; and a chemical recycling trial involving sachets in 2018 was halted because of logistical, financial, and technical constraints (Iacovidou et al., 2025). A field survey in five cities recorded an average collection volume of 43.87 kilograms per waste picker per day and a monthly income of approximately USD 91.70 (Kristanto et al., 2022).

River data indicate that sachets are not the only priority for waste management. Monitoring of nine river mouths flowing into Jakarta Bay between 2015 and 2016 recorded plastic at 59 percent of total waste by number and 37 percent by weight, equivalent to approximately 8.32 tons of plastic per day, with expanded polystyrene (EPS), often called Styrofoam, as the dominant material (Cordova & Nurhati, 2019). An assessment of the Ciliwung River's banks, from upstream to downstream, likewise found that plastic accounted for more than 50 percent of waste by number, or 55 percent by weight, with the waste consisting mostly of single-use products and dominated by EPS (Cordova et al., 2024). A brand audit, which records brands found on collected waste, documented 9,698 sachets from 34 locations in Indonesia and linked them to 1,212 brands. The findings were concentrated among the five largest contributors, and 57 percent of the samples examined regionally had multilayer structures (Break Free From Plastic, 2024). These findings can help identify producers whose packaging frequently appears in collected waste and determine which parties should participate in a pilot. However, because the sample was neither random nor designed as a market survey, the data cannot be used to estimate market shares or the number of packaging units placed on the market.

Three implications follow. First, the argument for an imbalance in policy instruments does not imply that sachets are the largest source of pollution. Different studies identify plastic bags as the largest category in certain models of nonrecycled plastic entering water bodies, whereas monitoring of several river mouths and the Ciliwung River found EPS to be dominant at particular locations and during specific observation periods. The imbalance concerns the policy instruments

themselves. Plastic bags are already subject to specific regulations, whereas flexible plastic packaging, according to the available technical report, is estimated to have an 87.52 percent landfill disposal rate before any dedicated recovery pathway is established.

This waste stream risks becoming a significant residual burden if the 2029 target is achieved through processing waste delivered to Bantargebang while leaving only residual waste for final disposal. Second, the 2.99 percent recycling rate for flexible plastic reported in the available technical study can serve as an indicative baseline for pilot design, but not as an official Jakarta-wide baseline. Sachet-specific data must be collected through direct measurement in the pilot areas. Third, because the measurement points, years, and methods differ, Table 2 presents these figures as separate indicators rather than as components of a single mass balance. For interpretation, the 87.52 percent landfill disposal rate and 2.99 percent recycling rate are treated as indicative technical evidence specific to the cited flexible-plastic study, not as official Jakarta-wide rates. The primary evidence supporting the policy diagnosis is the documented mismatch between existing policy instruments and the recovery characteristics of low-value flexible packaging; the technical percentages, leakage studies, and comparator data provide supporting context.

Table 2

Summary of Jakarta plastic waste flow indicators and characteristics of data sources

Indicator	Value	Source and nature of data
Waste composition at TPST Bantargebang	Food scraps 43%; plastic 28%	DLH DKI Jakarta (2024)
Jakarta plastic waste generation	399,691 tons/year; 11% not collected; 7% informal value chain; 211,309 tons/year to Bantargebang	Rinasti et al. (2022), data 2019 to 2021
Plastic leakage to water bodies	28,472 tons/year (40,880 tons including diapers); non-recycled 37,995 tons: bags 20,777; diapers 12,408; packaging 3,944	Rinasti et al. (2022), model results
Plastic recycling rate	24% recycled; 76% to landfill or environment	Putri et al. (2018)
Flexible plastic waste (five administrative cities)	Around 280 tons/day; 87.52% to landfill; 2.99% recycled; 0.78% processed via PLTSa; 8.72% unmanaged	Waste4Change (2022), grey literature
Waste from river mouths to Jakarta Bay	Plastic 59% by number, 37% by weight; 8.32 tons of plastic/day; EPS dominant	Cordova & Nurhati (2019), data 2015 to 2016
Sachet brand audit in Indonesia	9,698 sachets; 34 locations; 1,212 brands; 57% multilayer (regional)	Break Free From Plastic (2024), citizen science
Waste picker capacity and income	43.87 kg/person/day; around USD91.7/month (five cities)	Kristanto et al. (2022)

Note: figures come from different years, measurement points, and methods so they cannot be summed into a single mass balance. Full references for each source are listed in the footnotes and References.

Why Sachets Are Difficult to Recover: Material, Economics, and Social Justice

Sachets remain widely used in daily life because they offer practical benefits, particularly a more affordable purchase price per transaction and effective product protection. However, their environmental burden becomes more apparent after disposal (Rangel-Buitrago et al., 2024). The different layers in a sachet help protect its contents but also complicate sorting and layer separation for recycling (Horodytska et al., 2018). Consequently, managing multilayer plastic in Indonesia requires a dedicated strategy linking government, infrastructure, technology, and institutions (Anwar et al., 2025).

From an economic perspective, waste pickers and collectors tend to prioritize materials with resale value. A study in urban Java found that only 11.83 percent of plastic waste enters the recycling stream and that waste pickers account for more than 80 percent of the material collected for recycling. The collected materials were dominated by rigid polypropylene (PP), high-density polyethylene (HDPE) film, and rigid PET (Darus et al., 2020). In the Greater Jakarta metropolitan area (Jakarta, Bogor, Depok, Tangerang, and Bekasi; Jabodetabek), PET accounts for 78 percent of collected plastic beverage packaging, and waste pickers collect 65 percent of that PET (Trisyanti, 2022). The Darus et al. (2020) study involved researchers affiliated with the Unilever Indonesia Foundation and Sustainable Waste Indonesia, so these affiliations should be considered when interpreting the findings. The Trisyanti (2022) study was authored by researchers from Sustainable Waste Indonesia. Nevertheless, the direction of both findings is consistent with national analyses and independent reviews of the informal sector (Ramadan et al., 2026). The implication is that sachets are more likely to be collected when the value or incentive received is sufficient to cover collection costs.

This principle aligns with eco-modulation, which differentiates producer financial contributions according to packaging design attributes and environmental performance, thereby providing a stronger economic signal for design improvement than uniform weight-based charges (Laubinger, 2021). One ton of clear PET bottles and one ton of multilayer sachets have the same mass, but their net collection and recovery costs differ substantially. A contribution based solely on weight provides an insufficient incentive to improve packaging design.

Solutions for sachets must not introduce new problems, such as replacing sachets with metal or glass containers without assessing reuse requirements. A review of 107 articles identified 22 sustainability factors for reusable packaging, with return rates, short supply chains, and standar factors (Bradley & Corsini, 2023). Life cycle assessment (LCA) indicates that reusable food containers can have lower emissions after approximately six uses, although the outcome depends heavily on consumer behavior, washing, and transportation (Yadav et al., 2024). The number of cycles required to reach the environmental break-even point is not universal; it depends on the material, container weight, washing practices, transportation, return rate, energy source, and comparison system. Therefore, Jakarta's policy should not prioritize a particular material. Instead, the government should establish performance and safety standards without mandating a single material.

Social justice and affordability must be central to policy design. Appendix I of *Permen* LHK P.75/2019 also addresses minimum packaging sizes, including one-liter PET beverage bottles and 500-milliliter liquid soap and shampoo bottles. Without an affordable alternative for small-quantity purchases, this approach could increase the amount households must spend per transaction, particularly among low-income households. A fair refill system must preserve the ability to purchase products in small monetary amounts comparable to current purchasing patterns, whether through household-owned reusable containers, standardized containers with refundable deposits, or other safe container systems. The effects on prices must also be tested because producers may pass some EPR costs on to consumers.

Discussion

From EPR Norms to Implementation at the Jakarta Scale: Lessons from the European Union, the Philippines, and India

Permen LHK P.75/2019 regulates several operational elements of producer-led waste reduction, including take-back, reporting, verification, supervision, and producer incentive schemes. Article 7 requires recycling and reuse accompanied by packaging take-back and protected containment facilities with labeled containers. Article 16 requires implementation reports to be submitted to the minister, governor, and regent or mayor. Article 17 makes those reports the basis for verification by the governor through regional government agencies, while Article 18(2) assigns the governor responsibility for supervision, evaluation, and the development of producer incentive schemes. Article 26 places waste reduction costs on producers but does not, by itself, establish a regional EPR levy. Two national developments reinforce this direction.

Circular Letter (SE) 11/2025 directs that producer waste reduction obligations be included in Environmental Approval documents, together with packaging inventories and

reporting requirements. It is an administrative instrument, not a regulation within the hierarchy established by Article 7 of Law No. 12/2011. On July 12, 2026, the government announced the development of rules for producer financing of packaging waste management through a packaging recovery organization (PRO). The latest development examined as of September 11, 2026, indicates that the Ministry of Environment/Environmental Management Agency (KLH/BPLH) is preparing a revision or update of *Permen* LHK P.75/2019 that would include the establishment of a PRO and a producer fee mechanism based on packaging volume and type. Because the revision has not yet been issued, this article treats it as a policy direction rather than an operative regulation.

Comparisons with the European Union, the Philippines, and India help inform policy design. Through Regulation (EU) 2025/40, the European Union does not impose a general ban on retail sachets. Instead, beginning January 1, 2030, it prohibits certain single-use packaging formats in contexts where alternatives are available. These include single-use plastic packaging for condiments, sauces, creamers, and sugar in the hotel, restaurant, and catering (HORECA) sector, as well as certain single-use cosmetic packaging provided to accommodation guests. The regulation also introduces packaging recyclability requirements, including design-for-recycling criteria, according to its implementation schedule and applicable exceptions. The European Union's approach is therefore a restriction on specific packaging formats, subject to considerations of function, feasibility, safety, and alternative availability, rather than a blanket sachet ban. In the Philippines, Republic Act No. 11898 does not ban sachets but requires companies with assets exceeding 100 million pesos to recover 20 percent of their plastic packaging footprint—the amount of plastic packaging they place on the market—in 2023, with the target increasing gradually to 80 percent by 2028.

Companies may comply individually, collectively, or through a PRO, with reports subject to third-party audits. Initial compliance data indicate widespread participation, but reported recovery achievements require careful interpretation because they include co-processing and depend on self-reporting. India illustrates a different regulatory risk. Rule 9(3) of the Plastic Waste Management Rules, 2016, initially required the elimination of nonrecyclable multilayer plastic within two years. However, the 2018 amendment narrowed the requirement to multilayer plastic that is nonrecyclable, cannot be recovered for energy, or has no other use. This formulation potentially excludes multilayer packaging that can still enter energy recovery or other use pathways. India is therefore more appropriately understood as a cautionary example of regulatory design than as evidence of a successful multilayer packaging ban or a successful phaseout of PP sachets smaller than 50 mL or 50 g beginning in 2030. The comparison yields three lessons: prohibitions are easier to implement when preceded by a measurable recovery system; audited recovery targets can be applied in middle-income countries; and restrictions are more reasonable when alternatives are clearly available.

In Jakarta, the regulatory framework extends beyond shopping bag policy. *Perda* 3/2013, as amended by *Perda* 4/2019, provides the overarching regional policy framework. *Perda* 10/2024 concerning Domestic Wastewater Management, through Article 68, revokes certain specific provisions of *Perda* 3/2013 and *Perda* 4/2019 without repealing the entire waste management framework. *Pergub* 108/2019, 127/2020, 77/2020, 33/2021, 55/2021, and 102/2021 complement this framework. *Ingub* 5/2026 directs further processing of inorganic waste through waste banks or off-takers (parties that receive and process materials) and provides for facility incentives for *Rukun Warga* (RW) that achieve full waste sorting.

Jakarta has also facilitated EPR implementation: in 2025, the Environmental Agency (DLH) facilitated the take-back of 1,431.23 kilograms of hazardous and toxic material (B3) aerosol can packaging by producers across the five administrative cities and the Thousand Islands. The principal problem is the lack of integration among existing programs. Producer waste reduction programs, regional waste management, waste banks, RW-level sorting, area manager obligations, and waste picker networks continue to operate in separate systems. To date, no dedicated mechanism for sachet waste integrates producer financing, return points, data on packaging placed on the market, verification, and recovery targets within a single system.

Jurisdictional limits must also be considered. Articles 7 and 8 of Law No. 12/2011 establish the hierarchy of laws and regulations, while ministerial regulations are binding when

mandated by higher-level regulations or issued under an appropriate grant of authority. Regional regulations (*Perda*) rank below government regulations (PP) and presidential regulations (*Perpres*). Therefore, the most appropriate course for Jakarta is to exercise its existing authority, including facilitation and verification under Article 17, the development of producer incentive schemes under Article 18(2), and partnerships with producers and waste management actors. New mandatory producer contribution obligations, however, can be established only if an adequate national EPR legal basis exists. The ministerial regulation on extended producer responsibility currently being prepared must be assessed after issuance to determine whether, and to what extent, it provides a legal basis for such a financing mechanism.

The SIRKEL-JKT Model: Operational Architecture and Indicators

SIRKEL-JKT (*Sistem Integrasi Responsibilitas Kemasan Eceran dan Logistik Jakarta*; Integrated Responsibility System for Retail Packaging and Logistics in Jakarta) does not assign the regional government responsibility for managing all sachet waste. The DKI Jakarta Provincial Government performs regulatory functions within the limits of its authority, while DLH acts as facilitator, verifier, supervisor, data integrator, and liaison among stakeholders. Producers, individually or through a PRO or joint producer organization, finance the collection, sorting, transportation, and post-consumer processing (4P) activities for which they are responsible. Retailers, markets, waste banks, RW, and qualifying collection points serve as return nodes. Waste pickers and collectors remain part of the collection chain, while buyers or final processors (off-takers) receive materials that meet predetermined specifications.

Operationally, eligible retailers and community return points accept consumer returns; waste banks and waste picker and collector networks consolidate materials; aggregators conduct weighing, basic sorting, and lot registration; and qualified downstream processors document final material recycling, energy recovery, or residue. Eligibility requires traceable weighing, lot identification, transaction records, and acceptance of verification so that material origins and destinations can be reconciled.

The novelty of SIRKEL-JKT does not lie in the concepts of Extended Producer Responsibility (EPR) or Producer Responsibility Organization (PRO), but in their integration at the Jakarta city scale. The Philippine scheme establishes national recovery targets, Regulation (EU) 2025/40 restricts certain packaging types where feasible alternatives are available, and eco-modulation guidelines primarily address producer financing mechanisms. Within the literature and comparator schemes reviewed in this research, no model was identified that specifically explains how a provincial or city government can link its verification authority and producer incentive development functions with retail networks, RW, waste banks, waste pickers, and collectors within a single measurable system.

In SIRKEL-JKT, data on packaging placed on the market, producer financing, return nodes, aggregation and sorting, and verified downstream management are linked through an auditable mass balance at the sixth stage. The results of this verification inform performance evaluation and the calibration of contribution simulations during the pilot. Pilot verification should be conducted by an independent verifier or audit function appointed under the pilot protocol. Each batch record should reconcile producer-reported packaging placed on the market, the weight received at eligible collection nodes, aggregation losses, processor receipts, recycling or energy recovery outputs, and final residues. Unique lot identifiers and reconciliation rules are necessary to prevent double counting across collection points and downstream processors.

The six stages explain the system's material flow architecture in Figure 1, while the following eight principles establish the design, financing, and protection rules governing that architecture. The model is based on eight principles intended to meet the five assessment criteria.

First, producer-financed recovery. The pilot proposes a conceptual formula:

$$\text{Contribution} = Q_i \times T_i \times C_i \times M_i$$

where Q_i is the mass of packaging category i placed on the market in Jakarta, measured in kilograms; T_i is the proportion of the mass of packaging category i targeted for 4P financing in the pilot, ranging from 0 to 1, established ex ante in the pilot protocol according to packaging category

and applied consistently to participants within the same category; C_i is the verified net cost of collection, sorting, transportation, and post-consumer packaging processing (4P) per kilogram of target mass in category i, measured in rupiah per kilogram; and M_i is a dimensionless modulation factor reflecting only packaging design characteristics that policy can influence, namely recyclability, material complexity, and the tendency to become litter. The resulting contribution is therefore expressed in rupiah. The T_i factor ensures that the contribution is calculated on the portion of packaging mass targeted for financing rather than on the entire mass placed on the market. The formula consequently does not assume that 100 percent of the material will be managed.

C_i does not compensate operators for every cost they claim to incur. Instead, it represents a reasonable and efficient cost benchmark verified using pilot data after deducting the value of successfully recovered materials. Unjustified or inefficient costs are excluded from the benchmark. Collection difficulty is not counted again in M_i because it is already reflected in C_i, thereby avoiding double counting. The number of packaging units is recorded as a complementary indicator because the weight of an individual sachet is very small, but unit counts are not incorporated into a formula expressed in rupiah per kilogram.

Q_i must be derived from producer sales or packaging placed on the market data, or from auditable estimates. For the pilot, it should be based on net sales attributable to the Jakarta market, using distributor, retail, or producer sales channel data after accounting for returns and cross-regional redistribution. If direct data are unavailable, a documented and auditable estimation method must be used. Data on the number of packaging units placed on the market at the producer level constitute commercially sensitive information. Detailed access should be restricted to authorized verifiers, while published results should be aggregated by material category and reporting period to maintain transparency without disclosing individual commercial information.

This formula is a policy design proposal, and an adequate legal basis must be established before it is implemented as a mandatory financing mechanism. The value of M_i has not been determined in this research and must be calibrated empirically during the pilot. Initial pilot criteria for M_i should prioritize observable and auditable design attributes, such as monomaterial versus multimaterial construction, layer separability, compatibility with available recycling pathways, and packaging size and format. The tendency to become litter should also be considered if adequate empirical data for Jakarta are available. Equivalently, the formula can be expressed as a basic contribution of $Q_i \times T_i \times C_i$, with M_i serving as a bonus–malus modulation factor.

C_i represents net 4P operating costs after accounting for the recoverable value of materials; it does not include normative penalties for packaging design. M_i is a separate policy bonus–malus factor that provides economic signals for design improvement rather than recovering operating costs. During pilot calibration, M_i should be normalized to prevent double counting of the same recovery costs. Conceptually, the weighted average M_i within a category group can be normalized to approximately 1 so that eco-modulation primarily redistributes financial burdens among packaging designs rather than changing total revenue. The normalization procedure should use the $Q_i \times T_i \times C_i$ baseline for each category so that the total contribution under modulation remains conceptually close to the contribution without modulation, unless policy explicitly intends to change the overall financing requirement (Lifset et al., 2023).

Second, Minimum Recovery Incentive (IPM), defined as the minimum incentive per kilogram of sachets meeting the pilot criteria and paid to collectors. If operational payments are made per package, sack, or bale, the material must be weighed and converted into verified kilograms for recording, payment, and mass balance reconciliation. During the pilot, IPM is proposed to be financed through a voluntary scheme or producer partnership. A new mandatory producer financing obligation may be introduced only if an adequate EPR legal basis exists, and not through the regional budget (Anggaran Pendapatan dan Belanja Daerah; APBD).

IPM payments are recorded as part of collection costs in C_i. If IPM is reported separately for pilot purposes, its components must be deducted from C_i to ensure that the same kilogram of material does not receive duplicate financing. The measured capacity and income of waste pickers—approximately 44 kilograms per day and USD 91.70 per month Kristanto et al. (2022)—serve only as contextual evidence. The IPM amount must be determined through a pilot that measures how waste pickers' collection behavior responds to different incentive levels. Several

IPM levels should be established ex ante in the pilot protocol and applied to comparable units or periods. If incentive allocation is not randomized or does not satisfy the requirements of an adequate quasi-experimental design, the relationship between IPM and collection volume should be interpreted as an implementation response rather than a causal effect.

In this research, IPM is not simply a minimum government-set commodity price. It is the minimum incentive paid through the producer responsibility scheme during the pilot to cover part of the economic gap associated with sachet collection. Positioning IPM as a private incentive is consistent with mechanisms recognized in Permen LHK P.75/2019. Article 15(2), read together with Appendix III, allows producers to provide incentives to distributors, retailers, consumers, or other parties, independently or through cooperation, to support waste reduction. Article 16(3) requires producer reports to include information on cooperation contracts and, where other parties carry out such activities, the number and types of products or packaging taken back, recycled, and/or reused. These provisions support contractual arrangements during the pilot but do not, by themselves, establish an IPM obligation. Government incentives under Article 22 are directed at producers; therefore, IPM is not framed as a government incentive. Mandatory financing still requires an adequate EPR legal basis.

The contribution equation is therefore a conceptual pilot formula rather than a calibrated tariff. Q_i requires auditable producer sales or packaging mass data; T_i is established ex ante by packaging category and pilot scope; C_i is derived from verified net 4P service costs per kilogram; and M_i is normalized around a neutral value of 1.00 and adjusted only after transparent design-performance criteria have been tested. Sensitivity analysis should be conducted before any financing decision to show how alternative values of T_i, C_i, and M_i affect total contributions.

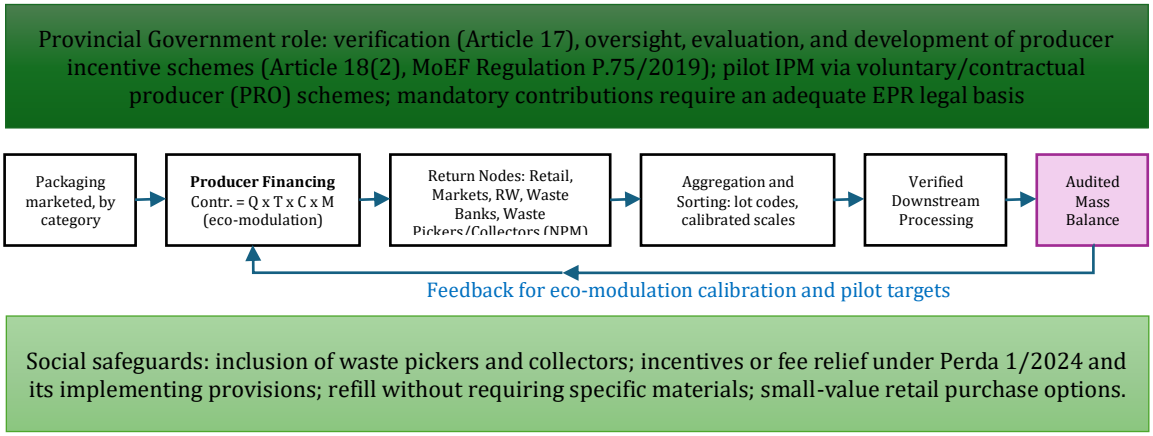


Figure 1. Conceptual model of SIRKEL-JKT: material and financing flow, authority basis, and social protection (processed by the author)

Third, return management through retail (return-to-retail). Stalls, minimarkets, markets, and shops can be tested as return nodes, but eligibility differs by category. Not every stall qualifies as a containment facility under Article 7(3) of *Permen* LHK P.75/2019. Minimarkets may serve as collection points linked to collector networks, markets may establish designated collection points, and small stalls are proposed to operate through collectors.

Fourth, return management through community networks, including RW and waste banks. Household sorting rules should be kept as simple as possible, with a single stream for low-value flexible plastic packaging that can be sorted according to off-taker specifications after aggregation. Collection costs should be allocated to producers using auditable data on packaging placed on the market or data obtained through intermediaries.

Fifth, inclusion of waste pickers and collectors. The formal system must not displace waste pickers, who play an important role in collecting recyclable materials (van Leeuwen & Surya, 2024). Waste pickers, depots, and collectors should be registered as partners under simple standards, with documentation requirements applied at the aggregator level so that formalization does not exclude small operators (Ramadan et al., 2026). The National Movement for Social Protection for the Informal Waste Sector, launched in Jakarta on August 10, 2026, can serve as an

entry point for membership.

Sixth, traceability through auditable batches (lots). For example, a single lot code records the area of origin, weight, material category, date, transporter, and final destination. This allows mass balance audits without requiring the tracking of every individual packaging unit.

Seventh, reuse systems and packaging redesign based on environmental performance, without requiring a particular material type. Material selection criteria include food-contact safety, return rates, safety, cost per transaction, and LCA results (Yadav et al., 2024). Packaging redesign should prioritize structures that are easier to collect, sort, and recycle, including monolayer packaging as recommended in Appendix I of *Permen* LHK P.75/2019. However, material selection must still account for packaging function and environmental impacts throughout the life cycle. Energy recovery should remain subordinate to prevention, reuse, and material recycling in the waste management hierarchy and must not justify retaining packaging designs that could instead be eliminated or redesigned (United Nations Environment Programme 2023).

Eighth, data transparency and social protection. SIRKEL-JKT should record the amount of packaging placed on the market, using auditable estimates where direct data are unavailable, as well as the amount successfully taken back, the processing methods used, and the residues generated. Reporting should be aligned with the obligations under Article 16 and the reporting matrix in SE 11/2025 to avoid administrative duplication. Interventions should primarily target packaging design and post-consumer management systems rather than penalizing household purchasing choices.

To avoid confusion among indicators, the model explicitly distinguishes stages that are often conflated: collection is not equivalent to recovery, recovery does not necessarily mean recycling, and energy recovery is not material recycling. SIRKEL-JKT indicators therefore follow an output hierarchy: prevention (single-use packaging avoided), reuse (number of use cycles), collection (collection rate), material recycling (material that actually becomes a secondary raw material), energy recovery or co-processing, final disposal in landfills, and leakage (waste littered or entering water bodies). Each final pathway is reported separately and treated as mutually exclusive in the mass balance. Material counted as recycled is not counted again as energy-recovered, and material sent to a landfill is not counted as recovered. Accordingly, packaging that has merely been collected is not automatically counted as recycled.

For reporting purposes, achievement levels are calculated against the same denominator: the mass of packaging placed on the market. The collection rate is the verified net mass collected divided by the mass placed on the market. The material recycling rate is the mass of recycling output that meets specifications divided by the mass placed on the market. The energy recovery rate is the mass actually entering the energy recovery pathway divided by the mass placed on the market. The final disposal rate is the mass ending up in landfills divided by the mass placed on the market. Table 3 summarizes the model's core components, scientific foundations, legal and institutional bases, and pilot indicators.

Table 3

Core components of the SIRKEL-JKT Model: scientific basis, authority basis, and pilot indicators

Component	Scientific basis	Legal/institutional basis	Pilot indicators
Contribution Q × T × C × M with eco-modulation	EPR and eco-modulation principles (Laubinger, 2021; OECD, 2016)	Requires adequate national EPR legal basis; simulation or voluntary scheme in the pilot	Total contribution (Rp) per category and effective contribution Rp per kilogram of packaging placed on the market as a supplementary indicator; changes in packaging design
Minimum Recovery Incentive (IPM)	Economics of low-value material and collectors	Voluntary scheme or contractual relationship between producer/PRO and collectors in the pilot;	Rupiah per kilogram; collection response at several incentive levels

	(Darus et al., 2020; Kristanto et al., 2022)	facilitation and verification by the Provincial Government within the limits of its authority. Article 18 paragraph (2) of Permen LHK P.75/2019 regulates incentives for producers, not a direct basis for incentives to collectors; mandatory financing requires an appropriate EPR legal basis. Private incentive mechanisms and contractual relationships are consistent with Article 15 paragraph (2) jo. Appendix III and Article 16 paragraph (3) of Permen LHK P.75/2019; these provisions do not by themselves create an IPM obligation.	
Return-to-retail and community nodes	Literature on return and reuse (Bradley & Corsini, 2023)	Article 7 paragraph (3) of Permen LHK P.75/2019; Ingub 5/2026	Kilograms per return point; access coverage
Verification and mass balance	Audit practice of EPR schemes (OECD, 2016)	Article 16 and Article 17 of Permen LHK P.75/2019	Mass balance difference; fraud detection rate
Inclusion of waste pickers and depots	Informal sector literature (Rahman & Wibisono, 2026; Ramadan et al., 2026)	Institutional support/program: National Movement for Social Protection of the informal waste sector	Number and income of registered collectors
Refill without requiring particular materials	Life cycle assessment of reusable packaging (Bradley & Corsini, 2023; Yadav et al., 2024)	Requires identification of authority and technical standards for food/cosmetic container safety before implementation	Use cycles; price per transaction

Source: processed by the author. Complete references listed in the footnotes and References.

Institutions, Financing, and Pilot Design

A PRO can be established as a joint organization representing several producers in fulfilling part of their EPR obligations. This mechanism allows administrative, collection, transportation, verification, and processing costs to be shared, creating opportunities for efficiency and economies of scale (OECD 2016). This institutional form is also being considered in the development of national EPR policy. Under SIRKEL-JKT, producers finance the PRO or joint producer organization, which allocates funds to 4P activities and verification through waste banks, aggregators, collectors, and eligible retailers. DLH is responsible for policy integration, standard-setting, verification, and supervision. DLH does not receive or manage producer contribution funds; producers or the PRO pay qualifying operators and service providers directly.

The financing context underscores the urgency of involving producers. DLH estimates ideal waste management costs at approximately Rp 2.72 trillion per year, while a simulation of potential cleanliness levy revenue estimates approximately Rp 887.7 billion. *Perda* 1/2024,

particularly Article 99, provides general authority for the governor or designated officials to grant relief, reductions, or exemptions from levies. In practice, DLH Jakarta has linked cleanliness levy exemptions to active participation in waste banks or verified household waste-sorting status. This existing incentive architecture may provide an entry point for the sachet return pilot, subject to the applicable implementing provisions.

Under SIRKEL-JKT, producer contributions are proposed to cover 4P costs attributable to post-consumer packaging, insofar as this arrangement is consistent with the applicable EPR legal basis. The regional budget (APBD) continues to finance public service functions within the regional government's authority. The payment scheme must prevent double counting, fictitious collection claims (ghost collection), and cross-regional material movements through lot codes, calibrated scales, handover documentation, sample audits, and weight reconciliation. Records must distinguish gross weight from net material weight after accounting for contamination, moisture, and rejected materials. Mass balance reconciliation must record inputs, material recycling outputs, energy recovery outputs, rejected materials, process losses, and final disposal so that total outputs can be reconciled with inputs within established audit tolerances. A centralized database with an audit trail is sufficient for the pilot; blockchain is not required.

Success should be measured using the output hierarchy described in Section D.2, from prevention to leakage, so that collection achievements are not equated with material recycling achievements. Claims concerning chemical recycling require caution because LCA results are highly sensitive to the method, system boundaries, energy source, and quality of incoming feedstock (Davidson et al., 2021; Jeswani et al., 2021). Contribution obligations for micro, small, and medium-sized enterprises (MSMEs) must also be proportionate without encouraging businesses to split into multiple legal entities to avoid obligations.

These jurisdictional limits must be interpreted within the division of concurrent government affairs established by Law No. 23/2014 concerning Regional Government, as amended. Producer contributions under SIRKEL-JKT are not structured as regional taxes or levies and, during the pilot, are not deposited as regional revenue. Financing is provided through voluntary schemes or contractual relationships between producers or the PRO and the entities implementing collection, aggregation, verification, and processing. The Provincial Government performs facilitation, verification, supervision, and producer incentive development within its authority.

If the formula is used to calculate actual pilot financing, the *ex ante* calculation must be reconciled ex post against the mass that actually satisfies the criteria for verified collection and downstream management. Any difference between initial financing and verified costs should be accounted for through an adjustment in the following period, preventing payment for unachieved results. Any transition to mandatory payments must have an adequate legal basis, and its consistency with Law No. 1/2022 concerning Financial Relations between the Central Government and Regional Governments and Government Regulation No. 35/2023 concerning General Provisions on Regional Taxes and Levies must be assessed. Accordingly, the pilot financing mechanism is not proposed as a regional tax or compulsory levy. Until a sufficient legal basis for mandatory payments exists, payments must remain within voluntary or contractual producer/PRO arrangements, while the Provincial Government performs facilitation, standard-setting, verification, and supervision within its existing authority.

Table 4 compares existing policy with the proposed SIRKEL-JKT Model against five assessment criteria. Each model component is designed to address a specific weakness in the current policy framework. However, the anticipated benefits remain design hypotheses that must be tested through a pilot. Table 4 therefore distinguishes established evidence about the current system from expected SIRKEL-JKT outcomes. Expected improvements in recovery, cost efficiency, equity, administration, and legal feasibility will be considered supported only if predefined pilot indicators improve relative to the baseline and, where feasible, comparison areas.

Table 4

Qualitative evaluation of the running policy and the SIRKEL-JKT Model against five assessment criteria

Criterion	Running policy	SIRKEL-JKT Model (proposed)

Collection and material recovery	Shopping bag policy studies show a reduction in bag use or waste Papp & Oremus (2025) and Taylor (2019), but a technical report estimates 87.52% of flexible plastic in Jakarta ends up in landfill and only 2.99% is recycled without a special recovery path (Waste4Change, 2022)	Minimum Recovery Incentive (IPM), retail returns, and verified aggregation target flexible plastic; success is tested against baseline data from pilot measurement; the 2.99% figure from the technical report is used only as an initial comparison
Cost efficiency	Estimated ideal waste handling cost of around Rp2.72 trillion per year; simulation of potential levy of around Rp887.7 billion (DLH DKI Jakarta, cleanliness levy simulation)	Formula Q × T × C × M simulates the allocation of 4P costs to producers; the amount is set through a cost study in the pilot
Distributive justice	Minimum packaging size 2030 has the potential to increase the nominal per transaction; the role of waste pickers is large, but their incentives and protection are not yet connected to the sachet system	Refill with small purchase value and not requiring a particular material; IPM for collectors; utilization of the available levy exemption scheme for sorting households or waste bank customers, without a new levy requirement; inclusion of waste pickers
Administrative feasibility	Article 16 reporting and SE 11/2025 matrix run without data integration at the Jakarta scale	Traceability per batch (lot), centralized database with audit trail, and collection points in existing networks; equipped with fraud control
Legal and jurisdictional feasibility	Producer reduction, recall, and reporting obligations are available at the national level; regional EPR contribution or levy obligations do not yet have an adequate authority basis	Can be started through facilitation, Article 17 verification, and development of incentive schemes for producers according to Article 18 paragraph (2) of Permen LHK P.75/2019; mandatory contributions require an adequate national EPR legal basis, and the ministerial regulation on producer responsibility being prepared needs to be assessed after it is issued

Source: processed by the author based on evidence in sections C.1 to C.3 and D.1 to D.2; assessment is qualitative, not a numerical score. Complete references are listed in the footnotes and References.

The proposed pilot for 2027–2029 requires explicit criteria for selecting areas. The three pilot areas should not be selected according to social class but through stratification based on population density, the relative prevalence of traditional retail versus minimarkets, waste bank coverage, estimated flexible packaging volumes, access for informal collectors, distance to aggregation facilities, household socioeconomic vulnerability, and waste service coverage. This approach enables the selection process to be justified scientifically and the results to be compared across areas.

The pilot evaluation should include three months of baseline measurement, 12 months of intervention, and three months of post-intervention observation. If a comparison area with equivalent characteristics is available, impact evaluation may use a controlled before-and-after or difference-in-differences design. If these conditions are not met, the pilot should be treated as a feasibility and implementation evaluation rather than a causal estimate of policy impact.

The three pilot areas serve as implementation strata, while the RW or *kelurahan* level

serves as the observation and evaluation unit. The number of intervention and comparison units should be determined ex ante based on estimates of baseline variation, required precision, or statistical power analysis before the intervention begins. Difference-in-differences should be used only if a sufficient number of comparison units and multiple pre-intervention observations are available and the parallel-trends assumption can be reasonably assessed. Wherever possible, comparison areas should be selected outside the service areas of the same aggregation points and collectors used in intervention areas. Cross-boundary material movements should be recorded as an intervention contamination variable and reconciled through lot-origin codes.

Indicators should include kilograms of sachets collected per 1,000 residents, collection rate, cost per kilogram collected, cost per kilogram of material actually recycled, cost per kilogram entering the energy recovery pathway if that pathway is used, contamination rate, material recycling rate and energy recovery rate reported separately, effects on collector income, consumer participation, and fraud rate. With this design, the recommendations become not merely policy proposals but a framework that can be tested and evaluated (Pruess & Garrett, 2025). Before implementation, the number of intervention and comparison units should be determined using baseline variance, the minimum policy-relevant effect, desired statistical power, and expected clustering at the RW/*kelurahan* level. If these requirements cannot be met, the study should report feasibility and implementation outcomes without making causal claims. Minimum success criteria should include the verified collection rate, material recycling rate, cost per verified kilogram, mass balance discrepancy rate, participation and retention of collection nodes, household affordability indicators, and the absence of material double counting.

Research Limitations and Implementation Risks

First, this article uses secondary data from 2015–2026, drawn from different years, measurement locations, and methods. Some plastic leakage estimates in the material flow analysis are calculated from municipal waste composition data rather than direct sampling in water bodies. Meanwhile, some flexible plastic data come from research reports that have not been published in scientific journals. Therefore, the number of sachets in circulation, collection costs per kilogram, and the most effective incentive level cannot be established with certainty and require field research.

Second, purposive source selection based on relevance and evidence quality still carries a risk of selection bias. This risk can be reduced through comparisons and triangulation among government sources, academic research, technical reports, and international literature, but it cannot be eliminated entirely.

Third, implementing a reuse system with reusable containers raises issues of quality, hygiene, and safety. Reusable containers have their own safety risks, which must be assessed according to product type, usage patterns, washing processes, and reuse frequency (Lacourt et al., 2024). For food and products that come into direct contact with the body, standardized containers managed through a controlled system may be easier to supervise than consumer-owned containers, whose hygiene conditions and usage histories are not always known.

Fourth, implementing an IPM substantially higher than incentives in areas surrounding Jakarta could attract sachets from outside the region into Jakarta's collection system. Environmental recovery targets must therefore be distinguished from regional compliance targets. The system also requires recording or sampling procedures to estimate the origin of materials entering the collection network.

Fifth, legal authority limits must be considered. Producer responsibility is grounded in Law No. 18/2008, Government Regulation No. 81/2012, and Permen LHK P.75/2019, while the DKI Jakarta Provincial Government exercises regional authority under regional regulations and governor regulations within its jurisdiction. Establishing a new levy or mandatory producer payment therefore requires a clear legal basis and separate legal analysis.

Sixth, the existence of an imbalance in policy instruments does not mean that shopping bag reduction is misguided. Reducing plastic bag use continues to provide environmental benefits. The problem arises when shopping bag reduction becomes the most prominent instrument in Jakarta's plastic waste management strategy while sachets and other low-value flexible packaging lack a comparable system for collection, financing, verification, and recovery.

Seventh, this research has not measured the extent to which producers will pass EPR costs on to consumer prices (cost pass-through) or consumers' willingness to pay. Consequently, the distributional effects of SIRKEL-JKT on low-income households must be tested during the pilot. The pilot should also examine two distributional risks that cannot be resolved using the available secondary evidence: cross-regional material movements attracted by recovery incentives and the pass-through of producer costs to consumer prices. Lot records should therefore include origin information, while household expenditure and willingness-to-pay indicators should be monitored separately from environmental recovery performance.

CONCLUSION

The findings reveal a structural mismatch between Jakarta's plastic waste policies and the recovery requirements of sachets and other flexible plastic packaging. While shopping bags are regulated under Pergub 142/2019, flexible packaging lacks adequate collection systems, recycling incentives, producer financing, and traceability mechanisms. Indicative evidence shows that 87.52% of flexible plastic is disposed of in landfills, while only 2.99% is recycled, although these figures do not represent official citywide rates. To address this gap, the proposed SIRKEL-JKT Model integrates producer financing, distributed collection points, verified recycling, transparent material tracking, and social safeguards. Its implementation requires a stronger legal basis for mandatory extended producer responsibility (EPR), with voluntary arrangements serving as an initial approach. A limited pilot across three Jakarta clusters in 2027 is recommended to assess collection performance, recycling costs, financial feasibility, social impacts, and implementation risks. The pilot findings should guide regulatory improvements and model adjustments before broader implementation. Thus, SIRKEL-JKT offers a practical framework for producer-financed flexible plastic recovery, although its effectiveness remains subject to empirical validation.

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AUTHOR CONTRIBUTION STATEMENT

Adalin Ali is the sole author of this article and is fully responsible for the entire research process, including conceptualization, evidence review and normative analysis, formulation of the SIRKEL-JKT Model, writing of the original manuscript, as well as review and editing of the final manuscript.

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