

# Investigating the Operational Efficiency for the Small Asian Retailer Stores under the Deposit Refund System: Hungary Case Study

Sipaseuth Aliyamone, Marah Almelhem\*

Kautz Gyula Faculty of Economics, Széchenyi István University, Egyetem tér 1, 9026 Győr, Hungary  
 almelhem.marah.samir.nayif@sze.hu

Waste management is crucial to achieving global sustainability goals, with the Deposit Refund System (DRS) emerging under the Extended Producer Responsibility (EPR) framework to enhance recycling rates by incentivising consumers to return beverage containers through refundable deposits. In Hungary, large retailers are required to participate in DRS, while small retailers may join voluntarily. This research aims to identify key factors influencing the voluntary participation of small Asian retail stores, focusing on economic, operational, regulatory, and social aspects. Using semi-structured interviews with ten stores in Budapest and Győr, a thematic analysis identified both motivators and barriers to participation. Findings indicate environmental awareness among participants, but low operational capacity, with space constraints, labour demands, and unclear regulations limiting engagement. Financial concerns, particularly equipment and handling costs, were major deterrents, while the potential for increased customer traffic was seen as a benefit. The study highlights the need for targeted financial incentives, infrastructure support, and clear policy communication to increase the inclusion of small retailers in DRS frameworks.

## 1. Introduction

Waste management has become a critical global issue due to the rapid growth of urbanisation, population growth, and unsustainable consumption, particularly from packaging and single-use plastics. In the European Union (EU), over 2.2 Gt of waste is produced annually (European Parliament, 2023), prompting a circular economy strategy focused on resource efficiency and waste reduction (Mertens, 2023). Beverage packaging has a value if properly collected and recycled, holds value through bottle-to-bottle reuse into new containers, reducing environmental harm, and conserving raw materials (Zhou et al., 2020). Many countries have adopted economic instruments under the EPR framework, notably the DRS, which shifts the responsibility for waste management from the municipalities to producers. The DRS incentivises consumers to return beverage containers for a refund, improving material quality and recycling rates (Gupt and Sahay, 2015). This is particularly evident in Germany and Denmark, where return rates exceed 90 % (Rossi et al., 2022; Zhou et al., 2020). Hungary introduced DRS in January 2024 for plastic, glass, and metal beverage containers. However, the operational approach and stakeholder engagement vary between countries, creating knowledge gaps, particularly concerning small retailers (Krzywda, 2022). While large retailers that have an area of >400 m<sup>2</sup> in Hungary are mandatory to participate, the small retailers that have an area of <400 m<sup>2</sup> can opt in voluntarily. The voluntary participation of small retailers, opposed to the mandatory compliance of larger businesses, is effectively analysed through Resource Constraint Theory (RCT). This theoretical framework suggests that the strategic and operational capacity of small and medium-sized enterprises (SMEs) is fundamentally constrained by significant limitations in financial capital, physical space, and human labour (Aggelopoulos et al., 2023). For small Asian retailers operating with minimal margins, the decision to adopt the DRS constitutes a complex risk assessment, where the perceived operational burden is significantly increased by their limited resources. Their participation is primarily influenced by an assessment of viability, balancing the system's requirements with their ability to accommodate them without affecting essential business functions. This study explores the perspectives of small Asian retailers in Hungary regarding voluntary participation in DRS, focusing on their willingness, ability, and influencing factors to participate. It addresses the following questions: (i) What factors influence the

willingness of Asian retailers in Hungary to participate voluntarily in the DRS? (ii) How does DRS implementation affect the operational efficiency of Asian retailers in Hungary? (iii) How does the DRS integration affect the retailers' relationship with the supplier and producer?

## 2. Waste Collection System

The waste collection systems are a critical component of sustainable waste management, facilitating the transfer of solid waste from points of generation to treatment or disposal facilities (Andales, 2025; Mwanza et al., 2018). The food and beverage sector is a major source of packaging waste, accounting for nearly 40 % of plastic in the EU (European Commission, 2025). Traditional municipal waste systems rely on centralised infrastructure and direct collection from households or designated points (Hidalgo et al., 2018). In a historic urban area with narrow streets and limited space to access for collection, relying on outdated disposal methods in landfilling has caused significant environmental harm (Conure, 2022). In the EU, only 36 % of the 2.2 Gt of waste generated annually is recycled, with an estimated 600 Mt of recyclable materials each year. Modern curbside collection has improved recovery efficiency but remains costly and complex (European Parliament, 2023; Rossi et al., 2022). Improving these inefficiencies requires integrated, technology-driven strategies supported by policy instruments such as Extended Producer Responsibility (EPR) and Deposit Refund Systems (DRS), which can enhance collection rates, improve material recovery, and support circular economy objectives.

## 3. The Extended Producer Responsibilities Framework

Extended Producer Responsibilities as an environmental policy framework, shifting the responsibility for post-consumer product management from municipalities to producers (Johannes et al., 2021). This approach encourages sustainable product design, reduced resource use, and increased recycling (Winternitz et al., 2019). EPR schemes can be mandatory or voluntary, imposing physical, financial, or information obligations on producers, using a combination of regulatory and market-based tools such as take-back mandates and a deposit return system (Watkins et al., 2017). Packaging waste, particularly plastic, constitutes over one-third of the global plastic production, which is a major focus. A recycling rate that remains low can be seen in Figure 1 (Eurostat, 2024; Watkins et al., 2020).

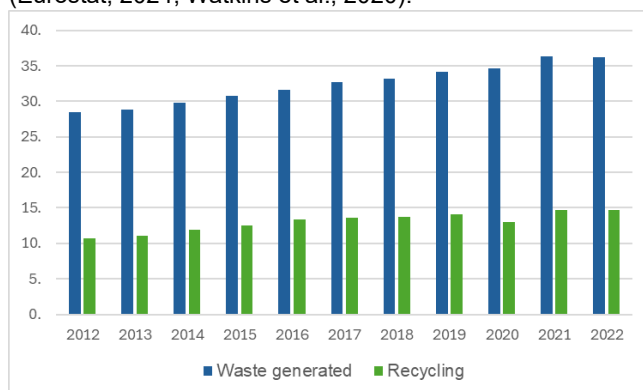


Figure 1: Plastic packaging waste generated and recycled in the EU 2012-2022

Around 80 % of a product's environmental impact is determined during the design stage (European Commission, 2025). EPR incentivises eco-design, material reduction, and reuse. Producer-led DRS exemplifies EPR by motivating consumers to return packaging, reducing waste, and advancing circular economy goals (Manomaivibool and Hong, 2014).

## 4. Deposit Refund System

The Deposit Refund System, a core EPR instrument, incentivises consumers to pay a small deposit when purchasing beverages, refunded upon returning the empty container to designated collection points (Laubinger et al., 2022; Walls, 2012). This model reduces litter, supports high-quality recyclable material for closed-loop recycling, reducing the resources required for virgin material needs and associated environmental impacts (Picuno et al., 2025). Globally, DRS models vary by social, economic, cultural, and regulatory conditions (Krzywda, 2022). Effective systems maintain low contamination rates and integrate multiple material streams, such as PET, HDPE, aluminium, and glass, collecting them through manual systems or reverse vending machine (RVM) methods (GS1, 2024; Sensoneo, 2025). By 2024, 14 European countries had implemented

national schemes, serving approximately 164 million people, with return rates in some nations exceeding 90 % (Sensoneo, 2024). The EU's 2024 Packaging and Packaging Waste Regulation (PPWR) mandates all member states to achieve 90 % collection rates for plastic bottles and cans by 2029 (EUROPA, 2024). Hungary launched its nationwide DRS in January 2024, covering PET, glass, and metal containers with capacities between 0.1 and 3 L. A fixed deposit of 50 HUF is charged at purchase and refunded at the approved collection point (Report|Mohu, 2025). Large retailers (>400 m<sup>2</sup>) are required to install RVMs, while smaller stores can participate voluntarily, with those (<400 m<sup>2</sup>) eligible for exemption. The Hungarian system is operated by MOHU, managing container registration, labelling compliance, and logistics. Producers must register products in a national database, meet labelling standards, pay for service, and pay exchange fees to support the system's operation. Retailers must handle returns manually or via RVMs, maintain hygiene standards, and report the standards (Report|Mohu, 2025).

## 5. Producer and retailer behaviour under DRS

Under the EPR framework, producers are legally responsible for products and packaging end-of-life, including post-consumer waste, to design and label (GS1, 2024; Ramasubramanian et al., 2024). In DRS, this requires product registration, compliance labelling, and payment service, connection, and exchange fees to finance system operations (Report|Mohu, 2025). Although DRS inherently incentivises producers toward eco-friendly materials and enhanced recyclability, they often delegate operational responsibilities to retailers to minimise costs, and effective producer-retailer collaboration is essential for efficiency, such as product registration, data synchronisation, and logistics support (Özdemir-Akyildirim, 2015; Laubinger, 2022). Retailers serve as collection points, responsible for refunding deposits to consumers in exchange for returned beverage containers (Picuno et al., 2025). Retailers handle empty packaging by collecting, storing, shipping, and reselling it to the operators. Following the figure 2 shown the circulation of packaging and deposits: (1) Consumers paying a standardized 50 HUF container deposit at purchase and refunded it upon return; (2) Retailers transfer collected containers to the system operator (MOHU) and are reimbursed for the refunded deposits; (3) Suppliers distribute products to retailers, who purchase them along with the pre-paid deposit liability, and (4) Suppliers register with MOHU, financing the system through participation and per-unit deposit fees (GS1, 2024). DRS participation is typically mandatory for large stores but voluntary for small retailers, as in Hungary, where those under 400 m<sup>2</sup> can apply for exemptions (Report|Mohu, 2025). The collection methods include both manual and automated RVMs, with each presenting distinct cost, labour, and space implications. Manual collection involves staff scanning barcodes; RVMs automate the process itself (Mertens, 2023).

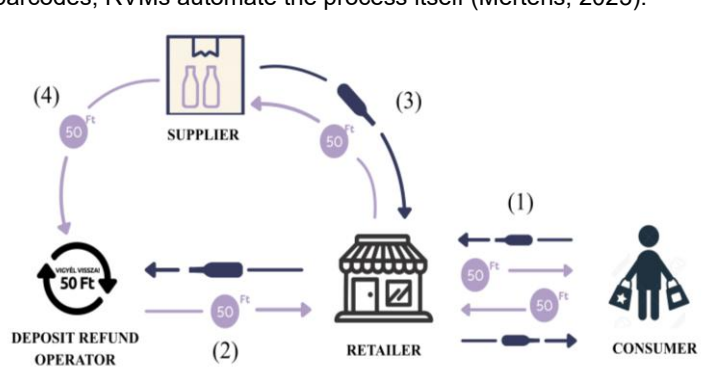


Figure 2: Circulation of packaging and deposit fee flow in Hungary

## 6. Methodology

This study adopted an exploratory qualitative design to investigate the perceptions, willingness, and operational realities of small Asian retailers in Hungary regarding participation in the newly introduced DRS. A qualitative approach was selected to capture context-specific experiences that quantitative methods might overlook (Suter, 2019). Purposive sampling identifies the selection of participants with direct relevance to the research objectives (Vasileiou et al., 2024). The final sample included ten small Asian-owned retail stores from two in Győr and eight in Budapest, each under 400 m<sup>2</sup>, qualifying for exemption from mandatory DRS participation under Hungarian regulations (Report|Mohu, 2025). Semi-structured, in-depth interviews were conducted with store owners to explore factors identified in prior literature as influencing retailer participation: economic considerations, operational constraints, supplier relationships, social influences, and regulatory understanding (Picuno et al., 2025; Zhou et al., 2020). Interviews, lasting 30 to 40 min, were audio-recorded with consent and supplemented

by field notes detailing store layout and space availability. Interviews were conducted in English or Lao (with researcher translation). Translation from Lao to English was carried out by the researcher, ensuring semantic accuracy and contextual consistency. Thematic analysis, following Hennink and Kaiser (2022), was used to organise findings into five themes: economic factors, operational efficiency, supplier relations, social influences, and regulatory understanding, with QDA software enhancing coding consistency and traceability, ensuring that findings were systematically linked to participant responses.

## 7. Results and Discussion

### 7.1 Awareness and Understanding of DRS

Table 1 shows that all retailers had some knowledge of the DRS, mainly from suppliers, informal networks, or observing the implementation in large supermarkets. However, nine out of ten retailers demonstrated a partial understanding of procedures such as container registration, exemption eligibility, or refund mechanisms. The lack of multilingual training materials and official guidance contributed to uncertainty. This reflects broader research suggesting that inadequate communication reduces small business engagement and hinders their participation in environmental policy initiatives (Zhou et al., 2020). Also, refer to an agreement with the DRS system that will help with environmental sustainability, acknowledging its potential benefits for waste reduction and recycling, it had been mentioned 11 times.

*Table 1: Retailer awareness and understanding of DRS*

Code	Freq. Count	% Code	Case
Limit Knowledge	9	3.80 %	9
System Concern	5	2.10 %	5
System Agreement	11	4.60 %	9
Method_Machine	8	3.40 %	8
Method_Manual	2	0.80 %	2

### 7.2 Economic Considerations

Financial concerns were the strongest barrier to participation. Most retailers emphasised the costs of labour, storage, and equipment, particularly RVMs, which were considered unaffordable for small stores. Handling fees were seen as necessary but insufficient to cover the full cost of participation. While some acknowledged potential indirect benefits from attracting environmentally conscious customers, these were outweighed by concerns about profit margins. These findings are consistent with previous studies showing that the cost–benefit perceptions strongly influence retailer participation in DRS systems (Laubinger, 2022; Picuno et al., 2025).

### 7.3 Operational Efficiency

Operational challenges were highlighted by almost all participants. Limited space in a small shop under 400 m<sup>2</sup> was cited as a critical issue for both manual storage and RVM installation. Hygiene risks from handling returned containers were also frequently mentioned. Manual collection was described as disruptive to normal business operations, especially during peak customer hours when staff have to collect one by one, which consumes time. These concerns mirror those identified in earlier studies, which note that small stores face disproportionate logistical burdens when implementing collection systems (Aggelopoulos et al., 2023).

### 7.4 Supplier Relations

Suppliers provided DRS-compliant labelling but offered little logistical or procedural support. Retailers were often uncertain about barcode registration and product compliance. This lack of producer–retailer coordination undermines system efficiency, echoing prior research showing that effective collaboration across the supply chain is essential for smooth DRS functioning (Özdemir-Akyildirim, 2015).

### 7.5 Social Influences

Consumer environmental awareness is increasing, and some retailers noted customer interest in local return points. However, stores located near large supermarkets experienced little customer demand for their participation, as consumers were expected to return containers to the larger, well-equipped retailers. This suggests that consumer-driven pressure is uneven and context-specific, with findings on geographic disparities in participation (Krzywda, 2022).

## 7.6 Regulatory Understanding

A lack of regulatory clarity was a recurring concern. Participants highlighted inconsistent communication, unclear exemption procedures, and limited support tailored to small businesses. Many perceived inequity between small and large retailers, with many retailers arguing that large chains are better positioned to absorb the financial and operational burdens of participation than the smaller. It noted that unclear or uneven regulations undermine stakeholder trust and reduce voluntary engagement in waste management systems (Winternitz et al., 2019).

## 7.7 Willingness to participate

As shown in Table 2, 70 % of the participants stated they would not voluntarily join the DRS under current conditions, citing cost, space, and lack of guidance. However, 30 % expressed conditional willingness if adequate incentives, infrastructure, or financial support were provided. This conditionality suggests that participation is not rejected outright but depends on policy adjustments that address specific constraints faced by small retailers.

Table 2: Willingness to participate

Code	Freq. Count	% Code	Case
Voluntary_yes	3	1.30 %	3
Voluntary_no	9	3.80 %	7
Condition for participation	18	7.60 %	10

## 8. Conclusions

This study shows that small Asian retailers in Hungary face significant barriers to participating in the DRS. While they recognise its environmental value, economic costs, operational constraints, limited supplier support, and unclear regulations reduce their willingness to engage. Only a minority expressed conditional willingness, contingent on financial and infrastructural support. The findings indicate that voluntary participation depends less on environmental attitudes and more on economic viability, logistical feasibility, and regulatory clarity. To achieve inclusive and effective outcomes, Hungary's DRS must adopt targeted measures—such as scalable handling fees, subsidies, multilingual training, and stronger producer–retailer coordination—to support small retailers and meet EU collection targets.

## References

- Aggelopoulos E., Lampropoulos I., Paraschi E.P., 2023, An empirical analysis of evaluating the operational and economic efficiency of retail stores under an adverse operating environment. *Managerial and Decision Economics*, 44(5), 2713–2741, DOI: 10.1002/mde.3844.
- Andales J., 2025, Waste Management System: a Guide. <<https://safetyculture.com/topics/waste-management-system/>>, accessed 16.03.2025.
- Conure, 2022, Waste Disposal and Recycling: Traditional vs. Smart Practices. <<https://www.conurets.com/waste-disposal-and-recycling-traditional-vs-smart-practices/>>, accessed 17.03.2025.
- EUROPA, 2024 How the EU wants to achieve a circular economy by 2050. News, European Parliament. <<https://www.europarl.europa.eu/topics/en/article/20210128STO96607/how-the-eu-wants-to-achieve-a-circular-economy-by-2050>>, accessed 17.03.2025.
- European Commission, 2025 Packaging waste. <[environment.ec.europa.eu/topics/waste-and-recycling/packaging-waste\\_en](https://environment.ec.europa.eu/topics/waste-and-recycling/packaging-waste_en)>, accessed 17.03.2025.
- European Parliament, 2023, Waste management in the EU: infographic with facts and figures. <<https://www.eumonitor.eu/9353000/1/j9vvik7m1c3gyxp/vknekgghpwm?ctx=vhsjgh0wpcp9#:~:text=Every%20year%202.2%20billion%20tonnes,is%20mainly%20generated%20by%20households>>, accessed 17.03.2025.
- Eurostat, 2024, 41 % of plastic packaging waste recycled in 2022. <<https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20241024-3#:~:text=In%202022%2C%20a%20total%20of,31.7%20kg%20compared%20with%202012>>, accessed 18.03.2025.
- GS1, 2024, Deposit Return Schemes in Europe, <<https://share.google/W59L4tAodbXQ8SQj>>, accessed 20.11.2025.
- Gupt Y., Sahay S. 2015, Review of extended producer responsibility: A case study approach. *Waste Management and Research*, 33(7), 595–611, DOI: 10.1177/0734242X15592275.
- Hennink M., Kaiser B.N., 2022, Sample sizes for saturation in qualitative research: A systematic review of empirical tests. *Social Science and Medicine*, 292, 114523. DOI: 10.1016/j.socscimed.2021.114523.

- Hidalgo D., Martín-Marroquín J.M., Corona F., Juaristi J.L., 2018, Sustainable vacuum waste collection systems in areas of difficult access. *Tunnelling and Underground Space Technology*, 81, 221–227, DOI: 10.1016/j.tust.2018.07.026.
- Johannes H.P., Kojima M., Iwasaki F., Edita E.P., 2021, Applying the extended producer responsibility towards plastic waste in Asian developing countries for reducing marine plastic debris. *Waste Management and Research*, 39(5), 690–702, DOI: 10.1177/0734242X211013412
- Krzywda D., 2022, Closing the Loop-Packaging Waste Management and the Deposit System in Poland. *Polish Journal of Management Studies*, 26(2), 233–247, DOI: 10.17512/pjms.2022.26.2.14.
- Laubinger F., Brown A., Börkey P., Dubois M., 2022, Deposit-refund systems and the interplay with additional mandatory extended producer responsibility policies OECD Environment Working Paper No. 208. OECD Environment Directorate, Paris, France, DOI: 10.1787/a80f4b26-en.
- Manomaivibool P., Hong J.H., 2014, Two decades, three WEEE systems: How far did EPR evolve in Korea's resource circulation policy? *Resources, Conservation and Recycling*, 83, 202–212, DOI: 10.1016/j.resconrec.2013.10.011.
- Mertens N., 2023, The implementation of a Deposit Return System (DRS) for refillable plastic bottles in Belgium-General guidelines. <hdl.handle.net/2078.1/thesis:41517>, accessed 02.04.2025.
- Mwanza B.G., Mbohwa C., Telukdarie A., 2018, The Influence of Waste Collection Systems on Resource Recovery: A Review. *Procedia Manufacturing*, 21, 846–853, DOI: 10.1016/j.promfg.2018.02.192.
- Özdemir-Akyildirim Ö., 2015, Deposit-refund system vs. compliance scheme membership: How to comply with producer responsibility regulations? *International Journal of Production Economics*, 162, 25–44, DOI: 10.1016/j.ijpe.2014.12.027.
- Picuno C., Gerassimidou S., You W., Martin O., Iacovidou E., 2025, The potential of Deposit Refund Systems in closing the plastic beverage bottle loop: A review. *Resources, Conservation and Recycling*, 212, 107962, DOI: 10.1016/j.resconrec.2024.107962.
- Ramasubramanian B., Reddy V.S., Paul P., Dalapati G.K., Ramakrishna S., 2024, Extended producer responsibility practices and prospects for waste management in Japan. *Sustainable Chemistry One World*, 2, 100009, DOI: 10.1016/j.scowo.2024.100009.
- Repont|Mohu, 2025, Manufacturers. Repont. (in Hungarian) <https://repont.hu/hu/gyartok>, accessed 07.04.2025.
- Rossi M., Papetti A., Germani M., 2022, A comparison of different waste collection methods: Environmental impacts and occupational risks. *Journal of Cleaner Production*, 368, 133145, DOI: 10.1016/j.jclepro.2022.133145.
- Sensoneo, 2024, Detailed overview and results of the current deposit return scheme implementation in Europe. <https://sensoneo.com/waste-library/deposit-return-schemes-overview-europe/>, accessed 07.04.2025.
- Sensoneo, 2025, Deposit Return Scheme. Accessed April 7, 2025, from <https://sensoneo.com/deposit-refund-system/>, accessed 07.04.2025.
- Suter M., 2019, Beyond PET: An extended Deposit-Return System for plastic packaging in Sweden. MSc Dissertation, KTH, Stockholm, Sweden
- Vasileiou A., Sfakianaki E., Tsekouropoulos G., 2024, Exploring Sustainability and Efficiency Improvements in Healthcare: A Qualitative Study. *Sustainability*, 16(19), DOI: 10.3390/su16198306.
- Walls M., 2012, Deposit-Refund Systems in Practice and Theory. *SSRN Electronic Journal*, DOI: 10.2139/ssrn.1980142.
- Watkins E., Gionfra S., 2020, A briefing for governments and businesses how to implement extended producer responsibility (EPR). <https://wwfint.awsassets.panda.org/downloads/how\_to\_implement\_epr\_briefing\_for\_government\_and\_business.pdf>, accessed 07.04.2025.
- Watkins E., Gionfra S., Schweitzer J.-P., Pantzar M., Janssens C., Ten Brink P., 2017, EPR in the EU Plastics Strategy and the Circular Economy: A focus on plastic packaging. <https://ieep.eu/wp-content/uploads/2022/12/EPR-and-plastics-report-IEEP-19-Dec-2017-final-rev.pdf>, accessed 07.04.2025.
- Winternitz K., Heggie M., Baird J., 2019, Extended producer responsibility for waste tyres in the EU: Lessons learnt from three case studies – Belgium, Italy and the Netherlands. *Waste Management*, 89, 386–396, DOI: 10.1016/j.wasman.2019.04.023.
- Zhou G., Gu Y., Wu Y., Gong Y., Mu X., Han H., Chang T., 2020, A systematic review of the deposit-refund system for beverage packaging: Operating mode, key parameter and development trend. *Journal of Cleaner Production*, 251, 119660, DOI: 10.1016/j.jclepro.2019.119660.