

Implementing reverse logistics practices in the supply chain: a case study analysis of recycling firms

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Musa Mbago and Joseph M. Ntayi

Makerere University Business School, Kampala, Uganda

Marcia Mkansi

University of South Africa, Pretoria, South Africa, and

Sheila Namagembe, Benjamin R. Tukamuhabwa and Noah Mwelu

Makerere University Business School, Kampala, Uganda

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Abstract

Purpose – The global focus on supply chain efficiency underscores the importance of frameworks like the Supply Chain Operations Reference model, which integrates reverse logistics (RL) into supply chain management. This study explores the understanding of RL among recycling firms, key drivers behind its practices, implementation effectiveness and RL success factors in developing economies.

Design/methodology/approach – Using a phenomenological philosophy and a qualitative multiple case study approach, the research examines leading recycling firms in East Africa, particularly in Uganda. Semi-structured interviews with practitioners yielded contextual insights analyzed through thematic and cross-case analysis to uncover key themes and patterns.

Findings – RL emerges as a multidimensional process and strategic initiative aimed at environmental and operational goals. Key drivers include environmental concerns, economic incentives, regulatory pressures and technological advancements. The implementation of RL necessitates a holistic approach that encompasses material collection, product recovery and discard. The findings emphasize that successful RL implementation relies on management commitment, strategic partnerships, technological investments, and collaboration with stakeholders. Moreover, community engagement and skilled personnel, continuous adaptation and cost management are crucial for sustaining RL operations.

Research limitations/implications – The study's focus on Uganda's plastics and paper recycling sectors may limit generalizability, warranting further research in diverse contexts.

Originality/value – This study enriches the limited knowledge of RL in developing economies, offering actionable insights for firms and policymakers to enhance reverse supply chains and foster a supportive regulatory environment for sustainable logistics practices such as RL.

Keywords Reverse logistics, Case studies, Recycling firms, Developing economies

Paper type Case study

1. Introduction

The global shift towards enhancing supply chain efficiency underscores the importance of frameworks like the Supply Chain Operations Reference (SCOR) model, which emphasizes key areas such as planning, sourcing, making, delivering and returning to align business objectives and supply chain performance. Within this context, planning involves processes that balance overall demand and supply, creating a course of action that aligns with established business goals. Sourcing focuses on procuring goods and services necessary to meet demand, while making refers to the transformation of raw materials into finished products to fulfill

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customer needs. Delivery encompasses processes related to the distribution of finished products or services, including order management, transportation and distribution operations. Finally, returning includes processes related to receiving returned products for various reasons, part of the post-delivery phase. Many firms rely on the SCOR model to establish fundamental strategic objectives, aiming for operational efficiency and effectiveness. Specifically, the returning process necessitates the execution of reverse supply chain processes, particularly through the adoption of reverse logistics (RL) practices. Despite its importance, RL has often been overlooked compared to other supply chain activities, leaving considerable potential for improved resource recovery, waste reduction and environmental sustainability underexplored. RL is a crucial aspect of reverse supply chain management and has become an integral component of modern supply chains (Makaleng, 2024; Khan *et al.*, 2023). RL deals with item flow in the opposite direction of conventional supply chain flow to recapture value or to ensure proper disposal (Prajapati *et al.*, 2022). It is “the process of planning, implementing and controlling the efficient and effective inbound flow and storage of secondary goods and related information, moving opposite to the traditional supply chain direction, with the purpose of recovering value or ensuring proper disposal” (Panigrahi *et al.*, 2018; Fagundes *et al.*, 2017). Hence, RL is a system as it comprises interdependent actors with connected flows, rendering Complex Adaptive Systems (CAS) theory important in this study. The theory posits that there are heterogeneous, interconnected elements or agents that act as a unified whole. These actors, including returners and these are the consumers, receivers, collectors and processors, are heterogeneous, interact with each other, and perform interdependent activities with information flows for better implementation of RL. Through RL, firms can obtain used products or materials from the consumption side of the supply chain and recover value by engaging in activities such as reuse, repair, reconditioning, recycling, refurbishing and remanufacturing. This promotes the sustainable utilization of resources and ensures environmentally responsible disposal practices.

Reverse logistics plays a significant role in fostering a circular economy and advancing sustainable development. It is recognized as a critical tool for promoting sustainability (Alkahtani *et al.*, 2021; Zhang *et al.*, 2021; Lee and Lam, 2012) and serves as a catalyst for transitioning from a linear to a circular economic model (Mishra *et al.*, 2019). Butt *et al.* (2023) argue that RL supports circular product design, enhances the return rate of used products and improves product traceability, collectively contributing to a reduction in environmental waste. The diverse disposition options within RL are integral to achieving sustainable development and enhancing competitive advantage in logistics (Banihashemi *et al.*, 2019; Mutha and Pokharel, 2009; Hervani *et al.*, 2005). RL enables waste reduction by managing the handling and disposition of returned and used products through various recovery strategies, including reuse, remanufacturing and recycling (Banihashemi *et al.*, 2019). For instance, global brands like Adidas and Nike leverage RL to recycle used footwear and apparel into new products, minimizing textile waste and reducing dependence on virgin materials. Moreover, RL has the potential to mitigate adverse environmental impacts such as climate change, ocean pollution, biodiversity loss and land degradation, making it a key mechanism in environmental conservation and sustainable resource management. In developing economies, RL initiatives are increasingly evident in the plastics and paper recycling sectors. For instance, in Uganda, informal waste collectors and recycling firms collaborate to retrieve post-consumer plastics and paper for reprocessing, contributing to waste management.

The integration of RL practices, such as recycling, into industrial operations is crucial but remains underutilized. Plastics, widely used in products and packaging, highlight the escalating waste crisis. Between 2000 and 2019, global plastic production nearly doubled, rising from 234 million to 460 million metric tons annually. By 2060, production is projected to triple to 1,231 million metric tons under a business-as-usual scenario (OECD, 2022). However, global recycling rates remain dismal; only 9% of the 353 million tons of plastic waste generated in 2019 was effectively recycled, while 15% was collected for recycling, of which 40% became residues. The remaining waste was incinerated (19%), landfilled (50%) or

unmanaged, often accumulating in dumpsites (OECD, 2022). Valavanidis (2022) similarly reports low recycling rates, noting that only 10% of global plastic waste was recycled in 2019, with the rest incinerated or discarded. Regional recycling rates vary significantly: developed economies achieve rates around 30%, while Africa, with limited industrial capacity, reports rates below 5%. For example, Europe and China recorded rates of 30 and 25% in 2014, respectively, while the US recycling rate fell from 9% in 2012 to 5–6% by 2021 (OECD, 2022; Sadan and De Kock, 2022). In Uganda, industrial recycling engagement is minimal. Of the 600 metric tons of plastic waste generated daily, only 6% is recovered for recycling (Planet Buyback, 2021). Few firms reuse packaging materials or engage in broader recycling efforts (End Plastic Pollution Movement Uganda, 2020; Parliament of Uganda Report, 2018). This is due to inadequate recycling infrastructure and high operational costs deterring firms from investing in large-scale recycling initiatives (Uganda Bureau of Statistics, 2020; Parliament of Uganda Report, 2018). Additionally, the absence of well-structured RL systems, coupled with low consumer awareness and limited waste separation, further hampers industrial recycling efforts. While firms like Coca-Cola Beverages Africa and EnviroServ Uganda have made strides in bottle and industrial waste recycling, their efforts remain isolated due to logistical and financial constraints. This limited adoption underscores the need for systemic interventions to address the growing plastic waste challenge.

Sadan and De Kock (2022) emphasize the environmental and health risks posed by unsustainable plastic production, poor design, and inadequate waste management, urging firms to implement RL practices like recycling and reuse. Despite its importance, RL remains understudied compared to forward logistics (Makaleng, 2024), with limited research on its enablers and implementation (Khan *et al.*, 2023; Larsen *et al.*, 2018). Current studies lack clarity on the core elements necessary for RL implementation in sectors such as recycling (Prajapati *et al.*, 2022). Globally, some firms have successfully implemented RL practices across various sectors, offering valuable lessons for other industries to leverage. This research examines four case studies of recycling firms to explore: (1) firms' understanding of RL in developing economies, (2) key drivers of RL implementation, (3) effective RL implementation strategies and (4) factors for successful RL implementation. The study aims to offer insights into RL concepts, drivers, strategies and success factors, particularly for developing economies.

2. Literature review

2.1 Theoretical framework

2.1.1 Complex adaptive systems theory. RL systems specifically exhibit characteristics of CAS. The theory postulates that dynamic systems are able to adapt to and evolve with a changing environment, and there is no separation between a system and its environment because a system always adapts to a changing environment. CAS comprise diverse individuals with multiple interconnections, engaging in ongoing interactions that reciprocally impact one another, leading to the emergence of novel behaviors (Lauser, 2010). According to Xing and Gao (2014), RL involves multiple stakeholders, activities and flows, making it a complex system. RL is a system that involves the interaction of processes, policies, customers, individuals, teams, departments, systems and field suppliers among others (Cardoso *et al.*, 2013). Interconnectedness: RL is connected to other supply chain activities, and changes in one area can affect the entire system (Massari and Giannoccaro, 2023). Dynamic nature: RL is subject to various uncertainties and changing conditions, requiring adaptability. Autonomous actors: Various stakeholders in RL, such as customers and logistics providers, make decisions independently. Feedback loops: there are information flows between stakeholders, enabling learning and adaptation in the system (Xing and Gao, 2014). The theory provides the foundation for creating more responsive and agile organizations. The theory explains how innovation/new things emerge in operations management. The theory provides a picture of the forces that affect change in operations. Hence, there tend to exist drivers triggering the

adaption of RL practices, actors in supply chains are yielding strategies as adaptive responses to the changes in the environment to enable long-term sustainability of RL operations, which are described in this study.

2.2 *The understanding of reverse logistics*

RL, as defined by the [Reverse Logistics Executive Council \(1998\)](#) and [Rogers and Tibben-Lembke \(1999\)](#), involves planning, implementing and controlling the efficient flow of materials and information from the point of consumption to the point of origin for value recovery or proper disposal. Essentially, it is the opposite of forward logistics. [Agrawal et al. \(2016\)](#) further describe it as moving products from use to origin for reuse, remanufacture or disposal, while [Arrieta \(2015\)](#) highlights activities such as remanufacturing, refurbishing, recycling, handling recalls and asset recovery. These processes emphasize collecting items from end users for repair, recycling or environmentally responsible disposal. Initially seen as a customer service function for managing product returns ([Fernando et al., 2023](#); [Meade et al., 2007](#)), RL has evolved into a strategic tool for competitive advantage ([Schwartz, 2000](#)). Its importance has grown in recent years, with significant business and research potential ([IBIS World Industry Report, 2017](#)). [Srivastava \(2008\)](#) notes that RL starts at the consumer level, where products may undergo repair, be recycled into raw materials or disposed of responsibly at subsequent stages when no economic value remains. [Bezerra and Freitas \(2016\)](#) add that RL often stems from returns of defective, obsolete or expired products, with processes varying by industry, such as recycling and understanding its intentions or aims is key, and how it is treated in firms. Hence, this study seeks to answer the question: *What is the understanding of “reverse logistics” among recycling firms in developing countries?*

2.3 *Drivers for the implementation of reverse logistics practices*

The growing importance of RL has drawn significant attention, with environmental concerns as a primary driver. RL mitigates supply chain environmental impacts through reuse, recycling and remanufacturing. Research highlights its environmental benefits, including improved environmental performance ([Vogue Business and GXO Logistics, 2024](#); [Govindan and Soleimani, 2017](#)), reduced pollution via recycled materials ([Wong, 2010](#)), and increased energy and material efficiency ([Saphire, 1994](#)). RL also supports corporate social responsibility (CSR), offering long-term economic advantages by lowering future environmental management costs ([Butt et al., 2023](#)). Environmental sustainability and organizations' commitment to sustainable practices further drive RL adoption ([Butt et al., 2023](#); [Hsu et al., 2016](#)). [de Sousa Jabbour et al. \(2019\)](#) contend that RL plays a critical role in achieving environmentally sustainable supply chains.

Economic incentives are another major driver. RL enables firms to recapture value from returned products, reducing raw material and production costs ([Bouzon et al., 2015](#)). It lowers waste disposal expenses, recovers valuable materials and streamlines logistics operations ([Khor et al., 2016](#); [Srivastava, 2008](#)). Direct benefits include reduced raw material use, while indirect benefits come from managing waste effectively ([Akdogan and Coskun, 2012](#)). Economic gains have made RL a strategic priority for many companies ([Fernando et al., 2023](#); [Lambert et al., 2011](#)). Government regulations also significantly influence the implementation of RL. Regulatory frameworks compel companies to integrate RL into their operations to comply with environmental standards ([Kalubanga and Mbekeka, 2024](#)). Policies such as extended producer responsibility (EPR), recycling quotas and take-back mandates promote RL, as seen in the EU's WEEE directive and Germany's producer responsibility system ([Bouzon et al., 2018](#); [Xevgenos et al., 2015](#)). Countries like Japan demonstrate how robust policies drive high recycling rates, particularly for PET bottles, through EPR systems introduced in 1993. Regulatory compliance and avoiding legal penalties are key motivators for firms operating under strict governmental oversight ([Bernon et al., 2018](#)).

Consumer awareness and demand for sustainable products further encourage the application of RL. Environmentally conscious consumers prefer brands demonstrating responsibility, giving RL adopters a competitive advantage (Khor and Udin, 2013). Rising demand for sustainable products accelerates RL practices (Mallick *et al.*, 2023; Cline *et al.*, 2015). Firms also use RL to differentiate themselves in the market by offering post-consumer services like returns, recycling and remanufacturing, enhancing customer satisfaction and market position (Morgan *et al.*, 2016). Technological advancements in supply chain management significantly facilitate RL adoption. Modern technologies optimize RL networks, inventory management and product collection (Waqas *et al.*, 2018). Innovations like Internet of things (IoT), data analytics and digital platforms streamline RL operations (Al-obaidy *et al.*, 2021). Japan's EPR system showcases how technology improves RL effectiveness, ensuring quality and quantity in recycled materials (Zhang and Wena, 2014). While firms around the world are increasingly adopting RL for supply chain efficiency and cost reduction, they also tend to face unique challenges, including weak regulatory enforcement, limited technological infrastructure and lower levels of consumer awareness especially in developing economies which this study explores moreover this study finds results in the recycling sector which is not so much focused on by many RL studies. Hence, we intend to find out: *What are the key factors driving the adoption of RL practices in developing countries?*

2.4 The implementation of reverse logistics

Even though RL clearly defined, studies providing a course of action for its implementation are sparse. Based on its definition and extant literature, RL implementation can comprise three major components. First, Returns Rates: Ensuring an adequate supply of used products or materials from the consumption side of the supply chain is critical (Panigrahi *et al.*, 2018; Morgan *et al.*, 2016; Dixit and Badgaiyan, 2015; Baenas *et al.*, 2011). Second, studies reveal Product Recovery: this includes reuse, resale, redistribution, recycling, repairing, refurbishing, repurposing and remanufacturing. Reuse is where products meeting quality standards are used again (Mallick *et al.*, 2023). Repair involves fixing faults to restore product functionality (Krikke, 1998). Refurbishing involves returning products to a specified quality level, often lower than new (Srivastava and Srivastava, 2006). Repurposing involves using discarded products for new applications with different purposes (Bauer *et al.*, 2017). Recycling includes collecting, processing, and using discarded materials to produce new products (Winslow *et al.*, 2018). Cannibalization involves recovering parts from returned products for repair, refurbishing or remanufacturing (Thierry *et al.*, 1995). Remanufacturing: restoring products to original equipment manufacturer specifications through disassembly, testing and component replacement (Chileshe *et al.*, 2016). The final component is discard capacity; for this, studies term it as disposal and destruction (Al-Obaidy *et al.*, 2021; Khor *et al.*, 2016). It involves the process of landfilling or incinerating parts or products on the condition that other disposition options are complex, not worthy of recovery and sales at aftermarket is almost nonexistence (Wang *et al.*, 2020). Effective RL implementation requires an integrated approach addressing material collection, product recovery and discard management. Insights into the operations of firms in developing economies are essential to understanding their RL strategies. This study seeks to explore: *How can firms implement RL effectively?*

2.5 Success factors for reverse logistics implementation

Reverse logistics allows firms to implement sustainable practices, recover value from returned products and ensure proper disposal. This discussion synthesizes extant literature on the critical factors that drive RL success. One of the most significant factors is the commitment of top management. Commitment from top management is a key factor in facilitating RL adoption (Makaleng, 2024). Strong leadership ensures resource allocation, drives organizational transformation and establishes RL as a strategic priority (Govindan and Bouzon, 2018; Ravi

and Shankar, 2015). Embedding RL into a firm's strategic objectives fosters a supportive environment for its execution. Can Saglam (2023) highlights internal culture, particularly sustainability and innovation, as critical to RL success. Factors such as vision, leadership, management strategy and aligning RL with organizational goals have also been emphasized (Bernon et al., 2018; Panigrahi et al., 2018). Effective collaboration with suppliers, distributors, logistics providers and customers is critical for RL success. Sarkis et al. (2011) underscore the importance of coordination across the supply chain to streamline product returns, manage RL flows efficiently, and share data on returns and recycling opportunities. Collaborative relationships with supply chain stakeholders enhance RL operations (Mallick et al., 2023; Olatayo et al., 2023). Supplier partnerships, as highlighted by Hammes (2019), play a pivotal role in facilitating RL processes.

Government regulations and policy incentives play a pivotal role in influencing and shaping the successful implementation of RL. Environmental regulations, such as EPR, mandate product recovery, recycling and responsible disposal (Khor and Udin, 2013). These regulations drive RL adoption, especially in industries like electronics, automotive and packaging. Firms complying with regulatory requirements gain a competitive edge, while those leveraging tax credits and public-private partnerships for RL investments excel in their efforts (Makaleng, 2024). Consumer awareness and engagement are essential in the success of RL systems. Educating customers about the environmental benefits of returning products can boost return rates and increase recovery volumes (Nguyen and Khoa, 2024). Incentives, loyalty programs and clear return policies enhance RL efficiency (Mafakheri and Nasiri, 2013). Transparent communication with consumers fosters trust and supports RL adoption.

Financial investments in collection, transportation and processing are critical for RL success. Firms that optimize operational costs through efficient RL networks and favorable agreements with third-party logistics providers are more likely to succeed (de Brito and Dekker, 2004). Cost-effective RL practices enable firms to recover more value from returned products and reduce waste management expenses. Technological advancements significantly enhance RL operations. Real-time tracking systems, ERP solutions and IoT devices streamline returns, recalls and recovery processes (Waqas et al., 2018). Advanced RL software and information management systems further improve operational efficiency (Zhang et al., 2022). Technology-driven approaches allow firms to manage RL processes effectively and reduce inefficiencies. A skilled workforce is indispensable for RL implementation. Training employees in product return management, remanufacturing and recycling ensures tasks are executed effectively (de Koster et al., 2002). Makaleng (2024) highlights that top management's commitment to staff development, including training programs, is essential for RL success. Educating employees on RL benefits and procedures promotes organizational alignment and enhances efficiency (Agrawal et al., 2016). However, developing economies tend to have limited infrastructure for material collection, technological constraints in product recovery, and inadequate waste management systems, as well as weaker institutional support. Yet RL implementation requires coordination across multiple stakeholders, including suppliers, customers, regulatory bodies and waste management companies. Therefore, this study utilizes the CAS theory to explain the success factors for the implementation of RL, which is less applied in RL studies. Based on the above discussion, therefore the study addresses: *What factors contribute to the successful implementation of RL practices in developing economies?*

3. Methodology

3.1 Research design and study sample

This research employs phenomenological philosophy to explore the experiences of practitioners in the adoption of RL practices in supply chains. Phenomenology was selected to uncover diverse perspectives on RL implementation (Erickson, 1985). The study focuses on plastics and paper recycling firms actively engaged in reverse logistics, chosen for their roles in

managing material flows from consumption back to production stages, capturing value and managing waste. The selection of three plastics recycling firms and one paper recycling firm was based on Uganda's waste composition, where plastics and paper constitute major waste streams (NEMA, 2023; Bowersox *et al.*, 2020). Given their prevalence, these categories adequately represent the country's business landscape in RL implementation. The research aims to explore the understanding of RL, identify RL drivers, effective implementation strategies and success factors. Firms were selected through judgmental sampling to ensure inclusion of those with substantial RL experience and large-scale operations. The firms included a leading paper recycling company in East Africa and a top plastics exporter in the region. Their experience ranged from 10 to over 15 years in RL operations. Additionally, RL managers with a minimum of three years of expertise were intentionally sampled to provide rich, relevant insights. A multiple case study design (Creswell, 2007) was adopted to analyze the practices of four recycling firms in Uganda. This approach allowed for an in-depth examination of RL strategies across different contexts, offering valuable lessons for RL implementation in developing economies while capturing nuances specific to the plastics and paper recycling sectors.

3.2 Data collection procedures

This study focused on leading recycling firms in Uganda, particularly in the Kampala Metropolitan Area, an industrial hub. Firms with over 10 years of operational experience were chosen to provide insights into RL drivers, approaches and strategies for successful RL adoption. Firms with over 10 years of operational experience were chosen to ensure a robust analysis of RL implementation. This criterion was based on their accumulated institutional knowledge, sustained RL practices, adaptability to market changes and ability to offer best-practice insights. Four prominent firms were selected: GL Ltd, a leading paper recycler in Mukono town; PRI Ltd, a plastics recycler in Nakawa Division; KA Plastics, located in Kawempe Division; and PF Industries, also in Kawempe Division. Each firm granted permission for interviews with personnel directly involved in RL processes. Purposive sampling was used to identify participants with expertise in RL and recycling, including roles such as Head of Reverse Logistics, Operations Manager and Collection Officer. Two tailored interview guides were developed to capture detailed insights specific to paper and plastics recycling. Formal interview requests were sent to company management, and all firms approved the study. Interviews were conducted over three months, from January to March 2024, through a combination of face-to-face and telephone sessions. This approach ensured comprehensive data collection across the selected firms, providing a nuanced understanding of RL practices within the plastics and paper recycling sectors. Face-to-face interviews were conducted to gather detailed information physically from the respondents, while telephone interviews were used to clarify any study-related issues with respondents. Broad, open-ended questions were employed to reduce bias and capture nuanced responses to issues relating to the understanding of RL, RL drivers, recycling process efficiency practices to be able to understand the implementation of RL in a developing economy.

Data collection involved semi-structured interviews with 8 RL practitioners from the 4 recycling firms (3 plastics and 1 paper). Each interview began with an assurance of each interviewee's confidentiality and academic use only, with no direct quotations to be published. Data were collected through note-taking and recording, with each interview lasting for 60–90 min. The interviews all followed a pre-determined structure based on the proforma semi-structured interview guide, which was made available a week in every scenario. Broad questions were used to minimize leading queries and detect subtle differences in responses. Interview contents were transcribed, summarized and prepared for analysis. To ensure reliability, a codebook development and calibration phase established clear definitions for each theme (Campbell *et al.*, 2013). A pilot coding session with two researchers independently applying codes on sample data helped identify discrepancies, followed by discussions to align code

interpretations. Throughout coding, ongoing calibration meetings were held, adjusting the codebook as necessary to maintain consistency. For accuracy in interpretation, member checking involved several steps. A participant review of final themes allowed respondents to verify findings, confirming that the analysis resonated with their experiences. Where responses were ambiguous or themes emerged unexpectedly, follow-up interviews clarified interpretations. Participant feedback was integrated iteratively, with any adjustments transparently documented. The main characteristics of the selected companies are summarized in [Table 1](#):

3.3 Quality of the research and data analysis

To ensure the rigor of this qualitative case study, the research adhered to key criteria: construct validity, internal validity, external validity and reliability ([Tukamuhabwa, 2015](#); [Yin, 2003](#)). Construct validity was achieved by developing an interview protocol informed by existing literature, piloting it with RL experts, and collecting data from multiple recycling firms. Internal validity was ensured through pattern matching and cross-case analysis to identify genuine causal relationships. External validity was addressed by incorporating multiple case studies for broader generalizability. Reliability was maintained through detailed documentation of procedures and adherence to a validated case study protocol. Data were analyzed using thematic analysis to extract significant themes and patterns from interview data ([Braun and Clarke, 2006, 2019](#)). Text analysis identified initial codes, which were refined into themes through iterative analysis, and conclusions were drawn in context. Cross-case analysis compared practices across firms, providing insights into successful RL adoption. This approach enabled a comprehensive understanding of RL practices and strategies in the recycling sector. MAXQDA software was employed for the visualizations of the study results.

3.3.1 Case studies.

Case 1. GL Limited (Paper Recycling)

GL Limited is a large-scale paper-making enterprise in East Africa. It is a Ugandan company established in 1999 with a local market share of 75%. GL is involved in recycling and reusing waste paper into new products. For the company to make the products in the early 2000s while at its first location at Nakawa in Kampala, it was importing already processed materials, that is, the soft jumbo rolls, which were being cut into manageable pieces and packaged as toilet papers, then put on the market. However, during the importation of the materials, the company was experiencing sourcing difficulties and production challenges. It had to search for international providers and sometimes experienced supply disruptions from the providers,

Table 1. Characteristics of selected companies

Company	Recycling sector	Start year	Position of interviewees	Other information sources
KA plastics Limited	Plastics recycling	2001	Head reverse logistics Head of Reprocessing section	Company visits Company website Company product catalogue Newspapers
PRI company	Plastics recycling	2016	Operations manager Production officer	Company visits content from newspapers
GL Limited	Paper recycling	1999	Operations manager Head of production Stores manager	Company website Company annual reports Company visits Company Magazine
PF Industries Ltd	Plastics recycling	2009	Production manager Collection officer	Company visits Newspapers

Source(s): Authors' own creation

bringing the company to a standstill in its production. Again, during the importation, there was a long lead-time of 1–2 months for its products to be ready for sale. The company was using labor-intensive production system where the jumbo rolls were being cut manually by casual workers, associated with delays and damaged products. The production capacity was on a small scale, that is, the weekly production was for only 3 warehouses of 50,000 square feet size. Also, the production costs were high; a ton of rolls used to cost the company UGX. 1.3 million. Moreover, the company was dealing in only one type of product, that is, toilet paper in its business operations.

In a bid to manage and control the challenges, the management of the company made a decision of starting to use waste papers to do in-house processing and production of its jumbo rolls and final products. In 2007, the company adopted the practice of collecting used waste papers from the field and recycling them, making different products. Second, the company put in place a waste paper collection policy in addition to establishing a waste paper management structure, procedures and processes. There are used paper receipt procedures followed by storing procedures and screening processes. The sorting processes follow where non-paper items such as polythene and metal are separated from papers plus categorization of waste papers, as well as the recycling processes into final products.

The company acquired essential facilities and hired skilled personnel to enhance its operations. Key assets include waste paper collection centers, advanced recycling machines capable of processing large volumes within hours, a fleet of trucks for transportation and delivery, and competent staff managing material assessment, storage, reprocessing and production. Agreements were made with local suppliers across Uganda and international providers from India and the United Arab Emirates, ensuring a reliable waste paper supply. Collaborations with academic institutions, public financial entities, and regulatory bodies provided access to waste paper records, enabling uninterrupted operations for 17 years. The company expanded its facilities, relocating from Nakawa to Mukono, where it now operates on a 300-acre site with comprehensive infrastructure. Batch production is performed using high-capacity machines, producing four 100,000-square-foot warehouses of output weekly. Lead time for production is one day, with reduced costs of UGX 0.6 million per ton of waste paper. The company produces diverse products from waste paper, including Ruxury toilet papers, serviettes, napkins, envelopes, plastic bags, paper towels, kraft papers and office copy paper. These products are sold locally and exported. Additionally, jumbo rolls are manufactured and supplied to 20 local companies, contributing to the company's sustainability and market expansion.

Case 2. PRI Industries (Plastics recycling)

PRI Industries Limited (PRI), Uganda's largest soft drinks producer, was founded in 2014. It manufactures a range of soft drinks, including soda and bottled water, and operates two major production plants and an independent recycling plant. The company generates annual tax revenue worth Ug Shs. 78.88 billion. Initially, its operations exhibited poor plastic waste management, focusing solely on distributing plastic-bottled products without a recovery system. This lack of accountability led to indiscriminate dumping by customers, with significant environmental impacts. The company also imported semi-processed plastics for packaging, ignoring the downstream effects of plastic waste on the environment. Recognizing the environmental risks of unmanaged plastic waste, the company's directors in 2016 adopted a sustainability-focused approach as part of its CSR. This led to the establishment of the PRI (PRI) initiative, aimed at creating a "World Without Waste" while extracting value from waste plastics. With an investment of Ug Shs. 91 million (\$25,000), the company launched a recycling plant in Kampala capable of handling over 150 tons of plastics using a hydraulic press machine. The initiative has enabled the company to recycle and reuse large quantities of plastic bottles, significantly reducing their environmental impact.

To be able to operate, PRI established structured return and recycling processes to manage waste plastics efficiently. These include clear procedures for collection, transportation, sorting

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and reprocessing plastics into flakes for reuse. The company set up collection centers to facilitate easy delivery by suppliers, reducing transportation costs and queue lengths at the recycling plant. Committed to recovering and recycling 100% of its market-introduced bottles, PRI signed a 2022 memorandum of understanding with city authorities, granting permission to purchase plastics directly from the public and pay them cash instantly. Additionally, the company formed collection agreements with plastics collectors nationwide, governed by established rules between the company and themselves. PRI actively engages consumers and the public, encouraging them to deliver waste plastics to its collection centers and headquarters. The company collaborates with government entities, NGOs, and private firms to collect and supply waste plastics. It has partnered with an international logistics company to transport plastics to reprocessing points, aligning with its vision of “building a more sustainable future for Uganda.” Collection points have been established in various areas, managed by coordinators who oversee collection and waste plastics logistics to the recycling point. PRI employs skilled staff, including recycling machine experts and material management specialists, and hires trained contractors for sorting and processing tasks. At collection centers, workers are trained to operate pressing machines that compact bottles for easier packaging. The company also provides ongoing recycling safety and waste management training for employees and business partners, ensuring efficient and sustainable operations. Lastly, the company continuously organizes recycling safety and waste management trainings for its employees and business partners.

Since 2016, Plastics Recycling Industries Limited (PRI) has consistently engaged in recycling plastic bottles, ensuring a steady supply of waste plastics from the field. The company processes significant volumes, recycling over 10–15 tons daily, significantly contributing to environmental conservation. PRI transforms waste plastics into flakes, which are sold locally and exported to countries such as China, India and South Africa. These flakes generate revenues of approximately UGX 2.38 billion (US\$660,631) annually. Additionally, the company recycles plastics into products like plastic pavers and roofing tiles. This initiative has addressed both environmental and business challenges. By recycling waste plastics, PRI has eliminated the need to import plastic flakes, previously plagued by long lead times and supply disruptions. The company’s efforts have earned it a reputation as an environmentally responsible entity, garnering trust from both private and government sectors. Its significant contributions to waste management and environmental conservation have also secured numerous contracts, boosting annual revenues.

Case 3. KA Plastics (Plastics recycling)

KA Plastics is one of East Africa’s largest packaging and recycling companies, headquartered in Kawempe division, Uganda. Established in 2001, the company initially operated a single plant in Kawempe but has since expanded to three plants in the Kampala Metropolitan Area. KA Plastics recycles plastics such as Polystyrene (PS), Polyethylene Terephthalate (PET), High-Density Polyethylene (HDPE) and Low-Density Polyethylene (LDPE). Its recycled products include chairs, jerry cans, chemical tanks, toys, garbage bags, grocery bags, DPC and woven sacks. Initially, KA Plastics relied on imported raw materials, facing high costs and long supply times. To address these challenges, the company shifted to using waste plastics as raw materials. In its early years, the company processed only 20 tons of plastics monthly due to limited capacity and a single extruder. Sales were confined to local customers. To improve operations, KA Plastics established a return policy and return procedures to guide employees and partners, ensuring formal operations and a consistent supply of waste plastics.

The company relies on trusted agents to collect, sort, and deliver waste plastics to its branches, where final selection for reprocessing occurs. Employees are trained on proper handling and reprocessing procedures. KA Plastics has invested in modern facilities, including warehouses, high-quality co-extruders, and advanced printing machines such as gravure and CI flexographic printers. This adoption of innovative technologies has significantly increased production capacity. To enhance waste plastic supply, KA Plastics actively engages with

regulatory bodies and the public, emphasizing the value of waste plastics as a raw material. These efforts have improved supply levels, though the managing director notes the growing demand for waste plastics exceeds current availability: “We don’t even get enough plastics to recycle now.” The company remains committed to reducing plastic waste and protecting the environment, aligning with its vision of becoming East Africa’s leading manufacturer of high-quality packaging materials and plastic products.

The company has since expanded its business operating three big branches. The company expanded on the reprocessing capacity, that is, from an estimated monthly quantity of 20 tons to now an estimated 300 to 400 metric tons, moreover with an always available market for its recycled products. Additionally, the company has been able to consistently to produce a number of new products from the recycled materials (plastics). The finished recycled products are sold both to the local market and also to international markets in other countries, including Kenya, Tanzania, Rwanda, Burundi, Congo and South Sudan. The recycling is always continuous with almost no input shortages. The company greatly contributes to the preservation of the environment by collecting a large quantity of waste plastics at an estimated 20–80 ton, especially the used HDPE plastics. This has contributed greatly to building good company reputation where it is perceived as an environmental rescuer by the citizens.

Case 4. PF Industries Ltd (Plastics Recycling)

PF Industries Ltd is one of the leading Plastic recycling companies located at Luzira Industrial Park, Kampala in Uganda. The company started a recycling business in 2009 after seeing an opportunity in the too much waste plastics dumped by people in communities in their day-to-day lives. Here, the company started waste cleaning campaign. The company intended to create value from the waste plastics and generate revenue, to create employment opportunities in the country and to keep non-biodegradable waste plastics out of landfills as recycling is cost-effective and environmentally recommendable and to comply with government environmental protection laws. The company recycles Polypropylene (PP), High Density Polyethylene (HDPE), Low density polyethylene (LDPE) and Linear low-density polyethylene (LLDPE) waste plastics to make Polythene shopping bags, woven bags, garbage bags, Refuse bags, fertilizer sacks, chairs, benches, plastic cups, plates, Pipes, tables and pallets and a wide range of packaging film products.

Initially, the company struggled with unreliable sources of plastic waste, relying on youth groups, women and elderly collectors, which disrupted production. Operations were limited, processing only 10 tons monthly due to low-capacity machines and inadequate infrastructure. To improve efficiency, the company formalized operations, introducing a return policy that detailed acceptable plastics, supplier engagement processes, and reprocessing guidelines. A chain awareness program educated collectors about preferred plastics like HDPE and PP. The supplier network expanded through partnerships with collectors across Uganda and the establishment of collection centers, such as in Gayaza, where plastics are sorted before being transported to production plants. There, internal staff further inspect materials for reprocessing. Agreements with bodies like Kampala Capital City Authority (KCCA) ensured a steady supply of waste plastics. Investments in warehouses, modern recycling equipment and skilled personnel enhanced operational capacity. The company employs technical staff and casual laborers for sorting and reprocessing tasks, complemented by regular on-the-job training programs to improve efficiency. These strategic initiatives have significantly scaled operations, optimized recycling processes and improved production reliability. As a result, the company now manages a robust recycling supply chain and contributes to sustainable waste management practices.

The company has been in recycling operations for over 14 years, earning revenue from new products created from recycled plastics. It has expanded operations with two additional bases and modern machinery capable of recycling large quantities of plastic waste. Initially recycling 10 tons weekly, the company now processes over 200 tons weekly, exceeding 4,000 tons annually, with plans to increase production. Renowned for promoting environmental

protection in Uganda, the company significantly reduces waste by collecting and recycling HDPE plastics, which are non-biodegradable. Its efforts have enhanced its reputation as a key contributor to environmental sustainability and waste management in the country.

4. Analysis of results

Under this section, the results on which research question are provided relating to the understanding of RL among recycling firms in developing countries, the factors driving the adoption of RL by recycling firms, how can firms implement RL effectively, the factors contributing to successful RL practices in developing countries. Here, the emerging themes corresponding to research questions are disclosed and analyzed across various case studies of recycling firms.

RQ1. What is the understanding of “RL” among recycling firms in developing countries?

The findings reveal that recycling firms in developing countries understand RL as a comprehensive strategy aimed at sustainability, resource utilization and operational efficiency. By analyzing data across four case studies, the results highlight the following key themes: RL as a sustainability strategy: Recycling firms perceive RL as integral to their sustainability efforts. Practices such as waste collection, sorting and reprocessing are designed to align with environmental conservation goals. For instance, PRI Industries emphasized their commitment to recycling 100% of their waste under the initiative “World Without Wastes,” showcasing how RL supports environmental responsibility. Waste as an economic resource: A significant understanding of RL among these firms is its role in transforming waste into economic resources. Firms such as KA Plastics identified waste materials as a vital source of raw materials for production, reducing their dependence on imported inputs. Cost and operational efficiency: The adoption of RL is also associated with improving operational efficiencies and reducing costs. For example, GL Limited reported a reduction in production costs to UGX 0.6 million due to streamlined processes in their RL framework. Efficient waste collection and sorting systems have enabled firms to optimize their logistics chains, thereby enhancing their competitiveness. Hence, the overarching understanding of RL among recycling firms is that it is more than just a logistical process; it is a strategic framework that integrates sustainability, economic resource utilization and efficiency improvements. The emerging themes suggest that RL is not only a tool for waste management but also drives corporate responsibility and operational success in developing economies. [Table 2](#) presents the summary of insights on how recycling firms understand and apply RL.

RQ2. What are the key factors driving the adoption of RL practices in developing countries?

Table 2. Summary of insights on how recycling firms understand and apply reverse logistics

Theme	Description	Supporting evidence/Quotes
Reverse Logistics as Sustainability Strategy	Waste elimination: Firms view reverse logistics as essential for environmental sustainability and corporate responsibility.	Our main goal is to reduce waste.” (KA Plastics)
Waste as an Economic Resource	Value recovery: Reverse logistics enables firms to transform waste into valuable products, reducing import dependencies.	The recycling of waste plastics has helped to generate revenues.” (PRI Industries)
Cost and Operational Efficiency	Implementing reverse logistics has led to significant cost savings and efficiency improvements.	Production costs reduced to UGX 0.6 million.” (GL Limited)

Source(s): Authors’ own creation

The causal network in [Figure 1](#) below visually represents the key drivers and outcomes of RL implementation in recycling sector.

5. Descriptions

5.1 Adoption of reverse logistics for supply chain efficiency

Supply chain efficiency drives RL implementation, mitigating challenges for the case studies. Firms transitioned from external suppliers to in-house recycling of waste materials, enhancing supply consistency and reducing costs. Reducing Supply Chain Disruptions: GL Limited and PRI shifted from relying on unreliable external suppliers to internal recycling, significantly improving supply consistency and reducing lead times. Lowering Production Costs: By reusing waste materials, all firms reduced raw material expenses. For instance, GL Limited halved production costs, while KA Plastics expanded capacity with minimal supply issues.

5.2 Environmental concerns and regulations

Environmental concerns emerged as a significant driver of RL implementation. All firms place significant emphasis on environmental sustainability, which aligns with regulatory requirements, including Commitment to reducing environmental impact: PRI initiated its “World Without Wastes” campaign, and PF Industries Ltd started a waste cleaning campaign to remove nonbiodegradable plastics from landfills. These efforts demonstrate a proactive approach to mitigating environmental damage caused by waste. Reputation as environmentally responsible firms: Firms such as PF Industries Ltd and KA Plastics have cultivated reputations as leaders in environmental protection through their recycling activities. This not only boosts their public image but also contributes to long-term business sustainability.

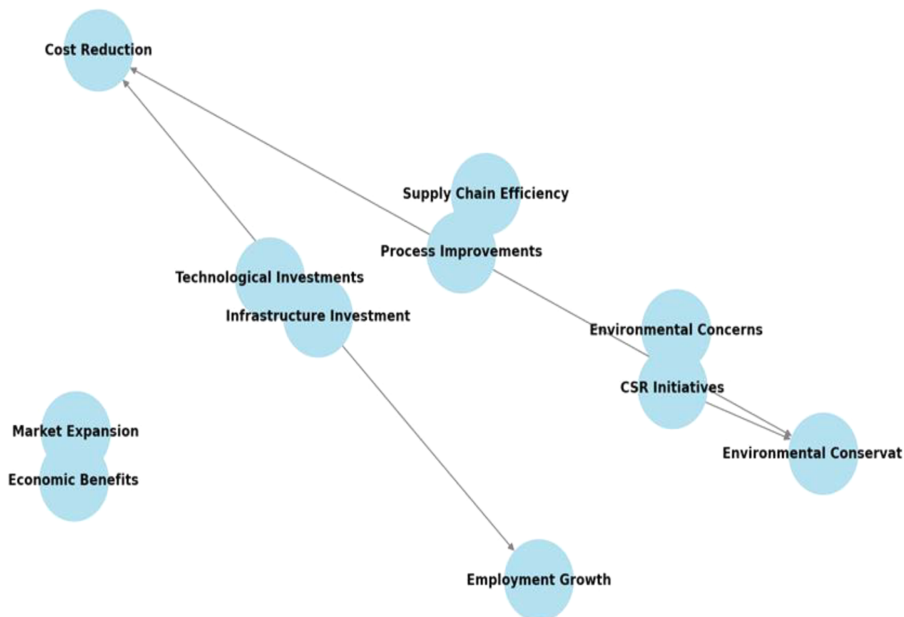


Figure 1. Causal network of reverse logistics implementation drivers and outcomes. Source: Authors’ own creation

5.3 *Competitive advantage and differentiation*

Competitiveness and differentiation drive firms to implement RL. Product Diversification: GL Limited, KA Plastics, and PRI have expanded their product lines to include a wide range of items derived from recycled materials (e.g. toilet papers, plastic pavers, roofing tiles, etc.). This diversification allows them to cater to different market needs and increase their competitive edge.

5.4 *Economic benefits in terms of revenue generation*

Economic benefits drive firms to implement RL. Revenue from Exports: Several firms, such as PRI and KA Plastics, generate significant revenue from exporting recycled materials and products, particularly to countries like China, India and Kenya. These exports help to stabilize their income streams and reduce dependence on local markets.

5.5 *Technological and infrastructure investments for scaling production*

Investing in modern recycling technologies and expanding infrastructure has been pivotal for scaling operations in the case studies. Technological Upgrades: Firms like KA Plastics and PRI acquired high-capacity equipment, such as hydraulic press machines and modern extrusion systems, to handle large waste volumes and enhance efficiency. Capacity Expansion: Companies like GL Limited, PRI, and PF Industries significantly expanded their facilities. GL Limited, for instance, relocated to a 300-acre site, while PF scaled up operations from processing 10 tons per week to over 200 tons.

5.6 *Corporate social responsibility and public perception*

CSR plays a vital role in firms' adoption of RL, enhancing public perception through sustainability initiatives. Many firms engage in CSR activities such as waste collection campaigns, recycling education, and community waste reduction efforts, building reputations as environmentally responsible entities. GL Limited integrates recycling into operational efficiency rather than focusing solely on environmental goals. PRI centers its RL within CSR initiatives, such as the "World Without Wastes" campaign, highlighting sustainability as core to its identity. KA Plastics prioritizes reducing plastic waste to protect the environment. PF Industries Ltd emphasizes grassroots engagement, involving communities in waste cleaning campaigns to promote public participation. All the identified drivers of RL implementation are shown in [Table 3](#) below.

RQ3. How can firms implement RL effectively?

The flow in [Figure 2](#) below visualizes the step-by-step movement of materials through collection, recovery, and disposal by recycling firms in their RL operations.

Table 3. Factors driving the implementation of reverse logistics practices

Cases	Themes	Supply chain efficiency	Environmental concerns	Competitive advantage	Economic benefits	Technological investments	CSR
GL Limited	✓			✓	✓	✓	✓
PRI	✓		✓	✓	✓	✓	✓
KA plastics			✓	✓	✓	✓	✓
PF Limited			✓	✓	✓	✓	✓

Source(s): Authors' own creation

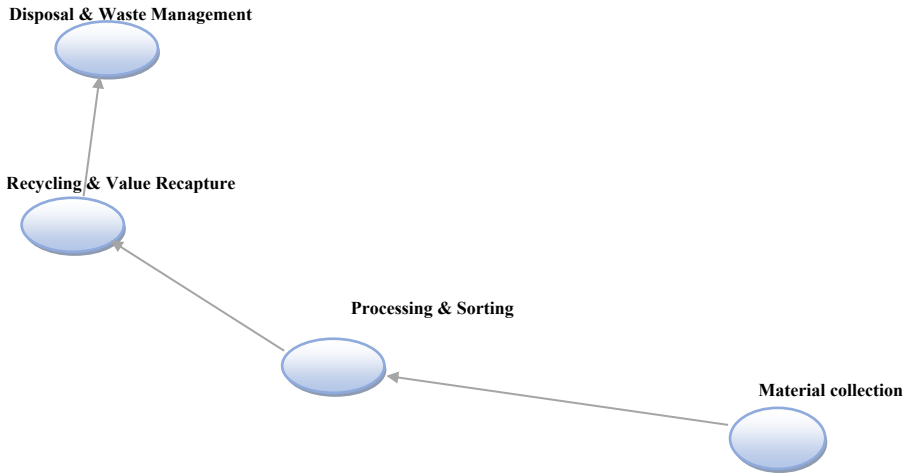


Figure 2. Reverse logistics implementation flow in recycling firms. Source: Authors' own creation

Materials collection: All the companies obtain waste materials from the field. GL collects used papers and the other three companies (PRI, KA plastics and PF limited) collect used plastics. Generally, these companies collect used materials from various sources, including: Local suppliers, and international suppliers, consumers and the general public, regulatory bodies, NGOs, Private companies, trusted agents, women and old men collection associations, Youth groups and community associations. This indicates the reverse flow of materials from the consumption side of the supply chains back to production stages. The companies employ various material collection methods, such as: use of collection centers, through agreements and partnerships, public awareness campaigns, agent networks and waste cleaning campaigns. The pie chart shown in [Figure 3](#) below illustrates the various sources of waste materials used in RL by the case study companies.

Value recapture or recovery option: It is evidenced from the cases that all companies do recapture value from the used materials that is from both used papers and used plastics. For example; GL recycles used papers into toilet papers, serviettes, napkins, plastic bags, envelopes

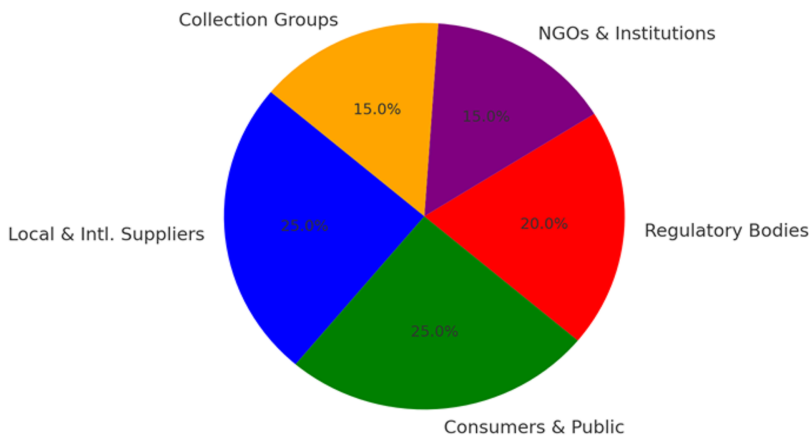


Figure 3. Sources of waste materials in reverse logistics. Source: Authors' own creation

MSCRA

and office paper. PRI recycles used plastics into plastic pavers, roofing tiles, and plastic flakes. KA recycles used plastic into goods such as chairs, bins, and packaging materials. PF limited recycles used plastics into bags, cups, furniture, plates and packaging films.

Proper disposal or discard option: It is evidenced that companies still have wastes in their operations or unused materials. Companies as away of proper disposal they resell the wastes for example GL and KA plastics do sell the wastes and unused papers and plastics respectively to other processors and users. PRI donates the unused materials to other users such as the craft business people. PF has arrangements with garbage collectors who take away the unused plastics wastes. [Table 4](#) presents the details relating to the implementation of RL practices of all case studies.

RQ4. What are the factors contributing to successful RL implementation?

5.7 Establishment of return structure and recycling processes

The implemented structured return and recycling processes as a foundation for their operations, ensuring systematic management of waste materials from collection to final product production. GL Limited established waste paper collection policies and detailed procedures for recycling waste papers into new products. PRI developed clear return and recycling processes for plastics, including collection, sorting, and reprocessing procedures. KA Plastics put in place a return policy and recycling program, guiding employees and trusted agents in the

Table 4. Implementation of reverse logistics practices

Cases	Materials collection	Collection method	Recovery option	Discard option
GL Limited	Sources: - Local suppliers - International providers - Academic institutions - Public financial institutions - Regulatory bodies	- Waste paper collection centers - Agreements with suppliers - Collaborations with institutions	Recycles used papers into toilet papers, serviettes, napkins, plastic bags, envelopes and office paper	Other processors (Unused materials)
PRI	Sources: - Consumers and the general public - Plastics collectors across the country - City authority - NGOs - Private companies	- Collection centers - MOU with city authority - Collection agreements with plastics collectors - Partnerships with logistics companies	Recycles used plastics into plastic pavers, roofing tiles and plastic flakes	- Donate
KA Plastics	Sources: - Trusted agents - Regulatory bodies - The general public	- Agent networks - Public awareness campaigns	Recycles used plastic into goods such as chairs, bins and packaging materials	Other users (Identified wastes)
PF Limited	Sources: - Youth groups - Women and old men collection associations - Collectors across Uganda - Regulatory bodies	- Collection centers - Agreements - Waste cleaning campaigns	Recycles used plastics into bags, cups, furniture, plates and packaging films	- Arrange for garbage collectors.

Source(s): Authors' own creation

collection and sorting of waste plastics. PF established a return policy to formalize operations, with clear procedures for handling waste plastics from collection to reprocessing.

5.8 Establishment of supply network

Companies have developed strong networks of waste providers to ensure a continuous supply of materials for reprocessing. GL Limited partnered with academic institutions, financial bodies, and international suppliers to enhance waste paper collection. PRI collaborated with local governments, NGOs, and international logistics companies to establish a broad waste plastic recovery network. KA Plastics formed agreements with waste plastic providers and regulatory bodies, while PF Industries worked with local authorities and waste collection groups across Uganda. These partnerships ensure a steady flow of materials for their operations.

5.9 Possession of skilled and experienced personnel

Possession of skilled personnel has been crucial for the efficient and effective operations of the recycling companies. This is mostly with the internal staffs for example GL initially utilized foreigner experts who taught the locals. The PF, KA, PRI possess knowledgeable staffs with technical expertise relating to recycling activities, equipment operation relating to proper operation and maintenance of complex machinery, minimizing downtime and optimizing production as well as trained staff monitor and maintain quality standards, ensuring recycled materials meet customer requirements.

5.10 Investment in equipment, facilities, and technology

GL Limited: Acquired necessary facilities and machines for recycling waste papers, along with transportation fleet and skilled personnel. PRI: Established a recycling plant equipped with hydraulic press machines capable of handling large quantities of waste plastics. KA Plastics Limited: Invested in high-quality production facilities, including advanced co-extruders, cleaning machines and flexible packaging machines, to scale up recycling operations. PF: Expanded operations by acquiring modern recycling machines and establishing additional operational bases.

5.11 Adaptation and continuous improvement

Each company demonstrated a strong capacity for adaptation and continuous improvement, which was key to overcoming initial challenges and achieving long-term sustainability in their recycling efforts. For example, GL Limited: Shifted from importing materials to in-house processing and recycling of waste papers to overcome production challenges. PRI: Evolved from focusing on product distribution to implementing recycling initiatives that reduced environmental impact and created new revenue streams. KA Plastics Limited: Transitioned from small-scale operations to large-scale recycling with continuous innovation and research. PF: Expanded and improved operations over time, from small-scale recycling to handling large quantities of waste plastics.

5.12 Community and stakeholder engagement

It is evidenced that firms have engaged various stakeholders such as community and local authorities for the execution of recycling activities. Firms like PRI and PF emphasize community engagement as critical component of their RL for material collection, while GL and KA plastics focus more on formalized partnerships with NGOs, suppliers, regulatory bodies and the public at large through waste management initiatives, waste cleaning campaigns and public education.

5.13 Continuous training and skill development

Training and skill development emerged as a crucial theme, with firms regularly organizing training programs for their employees and partners to improve recycling processes and ensure the efficient handling of waste materials and efficient recycling operations.

5.14 Regulatory compliance

While only two companies (PRI and PF) explicitly mention regulatory compliance, it remains a critical aspect of their operations, ensuring they meet environmental standards. Firms work closely with regulatory bodies to ensure alignment with industry standards and engaging in advocacy for better waste management for continuous operations. The interaction of the described success factors is shown in this causal network as seen in [Figure 4](#) below.

6. Discussion of findings

Regarding the first research question, the study highlights that RL is recognized as a multidimensional logistical process and strategic initiative aimed at achieving both environmental and operational objectives across the recycling case studies. This through Waste elimination: firms view RL as essential for environmental sustainability and corporate responsibility. Value recovery: RL enables firms to transform waste into valuable products, reducing import dependencies. Operational Efficiency: Implementing RL led to significant cost savings and efficiency improvements. Firms disclosed operational efficiency which is rarely described among the purposes of RL. On the other hand value recovery and waste elimination are widely described as purposes of RL as disclosed by the Reverse Logistics Executive Council (RLEC) (1998) and [Rogers and Tibben-Lembke \(1999\)](#) that RL is “the process of planning, implementing, and controlling the efficient and cost-effective flow of raw materials, work-in-process, finished products, and associated information from the point of consumption to the point of origin, to recapture value or ensure proper disposal”. [Agrawal](#)

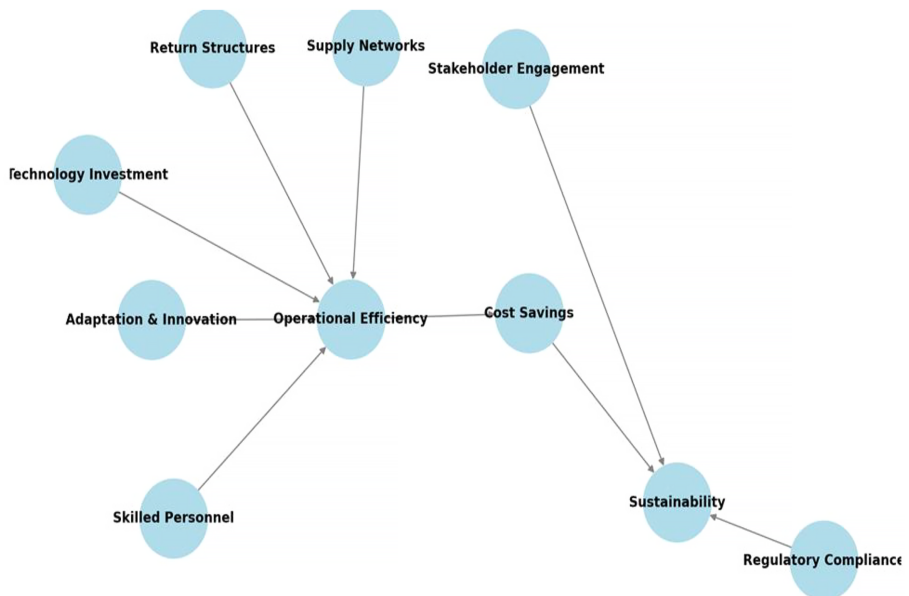


Figure 4. Causal network of success factors in reverse logistics implementation. Source: Authors' own creation

et al. (2016) add that RL as the movement of products from the point of use to the point of origin for value recovery or appropriate disposal.

Regarding the second research question, the implementation of RL in developing countries is driven by environmental concerns, economic incentives, regulatory pressures, technological advancements, and evolving consumer demands. This research highlights additional drivers, such as supply chain efficiency and CSR, which are not extensively covered in the literature. Firms, like GL Limited, adopted RL to mitigate supply disruptions from international sourcing issues. CSR and public perception also influence RL adoption, with companies engaging in environmental sustainability and community initiatives to enhance their reputation. In agreement, the findings from both the literature and case studies consistently highlight environmental sustainability as a significant driver for RL adoption. *De Sousa Jabbour et al.* (2019) and *Govindan and Soleimani* (2017) emphasize that RL facilitates the reuse, recycling and remanufacturing of materials, thereby reducing the environmental impact of supply chains. This aligns with the empirical evidence where firms, such as PRI and PF Industries, implemented campaigns like “World Without Wastes” to mitigate the harmful effects of nonbiodegradable materials. The emphasis on environmental sustainability in these firms reflects the global trend toward reducing carbon emissions and waste through high recycling rates, as discussed by *Wong* (2010). Hence, firms in developing economies are increasingly aligning their RL practices with global environmental standards, showcasing their commitment to sustainability.

The economic rationale for adopting RL is evident in both the literature and empirical findings. RL offers financial benefits, such as cost savings from reduced raw material expenses and waste disposal costs (*Zhu et al.*, 2007; *Khor et al.*, 2016). For example, GL Limited reduced production costs by over 50% by recycling waste internally, while KA Plastics increased production capacity by minimizing reliance on external suppliers. As *Butt et al.* (2023) suggest, these benefits strongly incentivize RL adoption, particularly in resource-constrained settings. However, significant investments in technology, training and infrastructure are often required to realize these benefits.

Government regulations significantly influence the adoption of RL, particularly in industries with strict environmental rules. Regulations like the WEEE directive in the EU and EPR systems in Japan compel firms to adopt RL to comply with environmental standards (*Zhu and Geng*, 2013; *Xevgenos et al.*, 2015). In developing countries, companies like PRI adopt RL to meet emerging regulatory pressures, though enforcement remains weak compared to regions like the EU or Japan. Despite this, the trend towards stricter environmental laws in relation to waste management and recycling in developing nations is likely to increase RL implementation. The role of technology in facilitating RL adoption is well-established in the literature. Modern technologies, including data analytics, IoT and digital platforms, enable firms to optimize their RL networks, efficiently manage inventory and improve the processing of returned products (*Waqas et al.*, 2018). These advancements make RL more feasible and cost-effective, especially in complex supply chains. Firms in developing countries, like PRI and PF Industries, are leveraging technology to enhance waste management and recycling, though their technological scale may lag behind developed economies. Additionally, increasing consumer demand for sustainable products has become a significant driver for RL adoption. Eco-conscious consumers are pressuring companies to adopt environmentally responsible practices, using RL as a competitive edge to differentiate themselves and improve customer satisfaction (*Guide and Van Wassenhove*, 2009; *Morgan et al.*, 2016). Firms like GL Limited are using RL as part of their sustainability initiatives to appeal to environmentally aware customers.

Regarding the third research question, based on the literature and empirical findings, RL implementation can be categorized into three key components: material collection, product recovery and discard capacity. These components offer a comprehensive approach to RL implementation, shedding light on how firms can effectively integrate RL into their operations. A key starting point for RL implementation is material collection, which ensures

that firms have a steady supply of used products or materials to process. The empirical study shows that companies such as GL, PRI, KA Plastics and PF Limited obtain waste materials from various sources, including local and international suppliers, consumers, NGOs, private companies and community associations. This is consistent with the literature, where [Panigrahi et al. \(2018\)](#) and [Morgan et al. \(2016\)](#), stress the importance of efficient returns management in RL. Without a reliable system for collecting used materials, the rest of the RL process cannot function effectively. Firms use various strategies to collect materials, such as establishing collection centers, forming partnerships with stakeholders, and running public awareness campaigns. These initiatives are crucial because they create channels for materials to flow back from consumers to producers, thus closing the loop in the supply chain. This “reverse flow” from consumption back to production, observed in the cases of GL and other firms, highlights the importance of a well-organized material collection network. It aligns with the findings of [Baenas et al. \(2011\)](#), who emphasize that firms must ensure an adequate return rate of used materials to support a robust RL system. One challenge identified in the study is the reliance on diverse sources, which can complicate the logistics of collection. For example, sourcing from local suppliers, NGOs and consumer groups requires significant coordination, particularly in developing economies where infrastructure for material collection may be less developed.

The next major component of RL implementation is product recovery, which focuses on extracting value from returned or discarded materials. Firms have several options for recovery, including reuse, resale, repair, reconditioning, remanufacturing and recycling. The empirical evidence shows that all firms studied engage in some form of product recovery. For example, GL recycles used paper into a range of products like toilet paper and office supplies, while PRI and PF Limited convert used plastics into products such as plastic pavers, roofing tiles and furniture. This aligns with the literature, where product recovery is seen as central to RL implementation ([Al-obaidy et al., 2021](#); [Khor et al., 2016](#); [Winslow et al., 2018](#)). For developing economies, where resource constraints are prevalent, recycling and remanufacturing are particularly important. The case studies illustrate how firms are maximizing value by transforming waste into marketable products. KA Plastics, for instance, produces a wide range of goods from recycled plastic, such as packaging materials and household items. This approach reduces dependency on virgin raw materials and contributes to cost savings.

The final component of RL implementation is discard capacity, which refers to the disposal or destruction of materials that cannot be recovered or repurposed. Proper disposal methods, such as landfilling or incineration, are often necessary when recovery options are not viable due to the complexity or cost of processing certain materials. The empirical study indicates that companies such as GL and KA Plastics resell their waste materials to other processors, while PRI donates unused materials to other businesses. PF Limited collaborates with garbage collectors to manage its unused plastic waste. The need for proper disposal aligns with the revelations of [Al-obaidy et al. \(2021\)](#) and [Khor et al. \(2016\)](#), who stress that RL implementation must include effective disposal strategies for unrecoverable materials. While the primary goal of RL is to minimize waste through recovery, some level of waste is inevitable. In such cases, firms must ensure that disposal is conducted in an environmentally responsible manner, such as through partnerships with specialized waste management companies or by donating materials to organizations that can reuse them. However, one challenge for firms in developing economies is the lack of advanced waste management infrastructure.

Regarding the final research question; the findings of this study reveal several key factors contributing to the successful implementation of RL in organizations. These insights integrate study results with existing literature, offering a comprehensive analysis of success elements. Top management commitment emerges as critical, aligning with research by [Makaleng \(2024\)](#). In the analyzed firms, top-level support was pivotal in establishing return and recycling processes, reinforcing the importance of integrating RL into strategic objectives for

seamless implementation (Ravi and Shankar, 2015). Structured return policies identified in the case studies underscore this commitment, echoing findings from Makaleng (2024), where 75% of retail managers emphasized the vital role of top management in RL success. Collaboration within the supply chain was another key success factor, highlighting the importance of integrated networks. This corroborates the work of Sarkis *et al.* (2011) and Olatayo *et al.* (2023), who emphasize that partnerships streamline RL operations. In the case studies, firms like PRI collaborated with local governments and logistics providers to maintain a steady flow of recyclable materials, demonstrating the necessity of coordinated efforts across the supply chain (Morgan *et al.*, 2016). Government regulations and policy incentives also played a vital role, as seen in PRI and PF's adherence to environmental standards. This aligns with arguments by de Sousa Jabbour *et al.* (2019) and Khor and Udin (2013), who noted that engaging policymakers and leveraging incentives, such as tax credits or subsidies, enhances RL success. The partnerships between firms and regulatory bodies further underscore the importance of public-private collaboration in fostering sustainable RL practices.

Investment in advanced technology and equipment is a critical factor for the success of RL practices. Waqas *et al.* (2018) emphasize the role of real-time tracking and ERP systems in optimizing RL processes. This is mirrored by the case study firms, which invested in modern recycling machinery, such as KA Plastics' acquisition of advanced cleaning and packaging machines. Robinson (2015a, b) and Samarasinhe and Wang (2019) further support the importance of state-of-the-art technology in managing returns and product recovery efficiently. Continuous improvement is crucial, with firms investing in technology to address evolving challenges. Additionally, skilled human resources are essential to RL success, as demonstrated by GL Limited and KA Plastics, who relied on skilled personnel for equipment operation and maintenance. The provision of ongoing training, as noted by Al-obaidey *et al.* (2021), enhances the adoption of RL processes, ensuring optimized production and minimal downtime.

A critical theme emerging from the empirical results is the capacity for adaptation and continuous improvement in RL practices. Each firm demonstrated a commitment to evolving their processes to overcome operational challenges, aligning with Genchev *et al.* (2011) on the role of internal culture in fostering innovation. This adaptability, as seen in GL Limited's transition from importing to in-house recycling, is crucial for long-term RL success in dynamic markets. Managing RL costs, such as transportation and processing, is also essential, with firms optimizing their networks and negotiating favorable contracts (de Brito and Dekker, 2004; Rogers and Tibben-Lembke, 1999). Community and stakeholder engagement plays a vital role in RL success. The involvement of local authorities and communities in material collection, as seen with PRI and PF Industries, aligns with the literature (de Sousa Jabbour *et al.*, 2019; Bernon *et al.*, 2018). Public education on waste management and RL further enhances system efficiency. However, customer awareness and participation, although not emphasized in this study, are critical for RL success (Nguyen and Khoa, 2024). Educating consumers about the benefits of returning products can improve return rates, and incentivizing them through loyalty programs could enhance operational efficiency (Mafakheri and Nasiri, 2013). For developing countries, governments should provide incentives, address infrastructure challenges and establish supportive regulations for RL. Recycling firms need to integrate RL strategies alongside their forward logistics to achieve success.

7. Conclusion

This study provides a comprehensive analysis of RL in developing countries, emphasizing the need for a multifaceted approach to its implementation. This research addresses critical questions surrounding the interplay between the understanding of RL, reverse logistic drivers, implementation effectiveness and success factors associated with RL practices. The research highlights that recycling firms view RL as a strategic framework that integrates sustainability, resource efficiency and economic benefits rather than just a logistical process. The findings

also reveal that the implementation of RL is predominantly influenced by environmental concerns, economic incentives, regulatory pressures, technological advancements and shifting consumer expectations. Firms in developing economies are increasingly recognizing the benefits of RL, including enhanced supply chain efficiency and cost reduction, particularly in raw material procurement. However, barriers to RL implementation persist, such as weak regulatory enforcement, outdated technological infrastructure and low consumer awareness. These challenges necessitate coordinated efforts among governments, businesses and consumers to develop the infrastructure and policies needed for successful RL implementation. The study also reveals that RL requires a holistic approach encompassing material collection, product recovery and effective waste management. Firms must collaborate with other supply chain actors to optimize RL processes as evidenced from the case studies firms cannot implement reverse logistic as single independent actors but rather along with other actors in supply chain. Finally, successful RL implementation relies on management commitment, technological investments, skilled personnel, and community engagement. Lastly, firms must continually adapt and manage costs effectively to sustain RL operations.

8. Theoretical, policy and managerial implications

The study's findings, grounded in CAS theory. CAS theory posits that systems, such as supply chains, evolve through dynamic interactions among interconnected agents, with emergent behavior shaping overall system outcomes. The study reinforces this perspective by demonstrating RL being a dynamic, adaptive network of firms, regulatory bodies, consumers and technological innovations. The study highlights that RL implementation emerges from the interactions of various supply chain actors, rather than being dictated by a single entity. The findings reveal that firms engaged in RL develop self-organizing capabilities by responding to environmental, regulatory and market forces.

Based on the study's findings, this paper also outlines key actionable policy and managerial insights that can enhance RL implementation in developing economies: Governments should strengthen regulatory frameworks and enforcement through establishing and enforcing clear regulations that incentivize RL adoption, including tax incentives for recycling firms and penalties for non-compliance. Policymakers should facilitate collaborations between the private sector and regulatory bodies to streamline compliance procedures. Policymakers should also support technological innovation by funding research initiatives and providing grants for digital infrastructure upgrades. From the managerial angle, firms need to invest in technological advancements to adopt modern tracking and sorting technologies (e.g. RFID, AI-driven waste classification) to improve RL efficiency. Second, firms should implement consumer education programs to increase participation in waste segregation and recycling initiatives. Firms need to improve supply chain collaboration for RL implementation because RL success requires coordinated efforts between manufacturers, suppliers, retailers and waste processors hence industry players should establish shared logistics networks to optimize material collection and product recovery. Firms also need to enhance management commitment and workforce skills where firms' executives should prioritize RL by integrating sustainability into corporate strategies and allocating resources for RL programs and also investing in workforce training to develop RL expertise, ensuring efficient implementation. With these, firms and policymakers can enhance RL implement, overcome existing barriers, and create sustainable supply chain practices in developing economies.

9. Study limitations and areas for further research

This study provides valuable insights into RL implementation but has limitations that highlight opportunities for further research. The focus on recycling and waste management firms limits generalizability to other industries, such as electronics or automotive, where RL practices may differ. Future studies could explore RL implementation factors across diverse sectors.

Geographically, the study is confined to Sub-Saharan Africa, where regulatory environments and infrastructure differ from those in developed economies. Expanding research to include various regions could reveal unique RL challenges and enablers worldwide. The emphasis on larger firms with significant resources overlooks the experiences of small and medium-sized enterprises (SMEs), which often lack the financial or technical capacity for large-scale RL operations. Research addressing SMEs' challenges, such as cost-efficiency and government incentives, would be valuable. Additionally, the study's reliance on qualitative case studies may introduce bias and limit the broader applicability of findings, incorporating quantitative methods could offer more objective insights. Exploring emerging technologies like AI, blockchain or automation in sorting and recycling presents an untapped area for optimizing RL processes. These innovations could enhance efficiency, reduce costs and improve transparency. Research in this area would contribute significantly to advancing RL practices. Acknowledging these limitations, future studies can provide a more comprehensive and nuanced understanding of RL implementation across industries and regions.

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Corresponding author

Musa Mbago can be contacted at: mmbago@mubs.ac.ug