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**Value Recapture through Bottle Reuse Policy: The Reverse
Logistics Case of Champion Breweries Plc**



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Value Recapture through Bottle Reuse Policy: The Reverse Logistics Case of Champion Breweries Plc

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ABSTRACT

Purpose: The study aimed to evaluate the reverse logistics operations of Champion Breweries Plc, Uyo, Akwa Ibom State to determine how value is recaptured through bottle reuse policy of the firm. More specifically, the study sought to assess the bottle reuse policy, and operations of the brewer in addition to the company's value recapture process and reasons for adopting bottle reuse as a reverse logistics option.

Methodology: The study applied quantitative research method, using the survey research approach for data collection via closed-ended questionnaire. The sampling technique applied was purposive as the study sought data from those knowledgeable about the research subject within the contextual organization's value chain. Data collected was analyzed descriptively using SPSS.

Findings: The study found that brewing companies recapture value by reusing returnable glass bottles obtained through reverse logistics processes.

Unique Contribution to Theory, Practice and Policy: As a matter of policy beverage bottles should be designed with end-of-life reuse to ease waste management, environmental, degradation, and negative impact on life forms. The effective reverse logistics management of RGBs impacts positively on profitability and should be adopted by manufacturers in compliance with new and existing regulations by local and central governments.

Keywords: *Glass Bottles, Reuse, Value Recapture, Reverse Logistics, Value Chain.*



INTRODUCTION

Glass offers advantages such as durability, chemical inertness, and higher recyclability compared to plastics. Despite its energy-intensive production, glass is reusable and less harmful in its natural state. Bottles can be reused multiple times, making them suitable for circular systems, although poor reuse practices limit their potential (Lee, 2023). Bottle reuse aligns with circular economy principles and is implemented through reverse logistics systems. Extended producer responsibility (EPR) aligns manufacturer's responsibility for post-consumption packaging, enabling recovery and reuse through coordinated supply chain activities. Reverse logistics facilitates the return of used products for value recovery, reducing waste and improving sustainability performance (Ezeudu, 2024).

Empirical studies in the brewing industry highlight the benefits of bottle reuse. Reuse systems significantly reduce production costs and improve profitability while enhancing operational efficiency. Similarly, effective logistics practices improve overall performance in breweries (Lumba and Mwanza, 2023). Globally, returnable glass bottles remain widely used due to their durability and ability to withstand multiple reuse cycles. Life cycle assessments show that reusable glass bottles reduce environmental impacts compared to single-use packaging, particularly when supported by efficient transportation systems (Morgan et al., 2022).

Problem Statement

Packaging choice significantly affects beverage quality, consumer safety, and environmental sustainability. While glass packaging has been linked to contamination risks, many firms have shifted to plastics and aluminum due to cost efficiency, durability, and resistance to corrosion. However, plastic use has created severe environmental challenges, with global production and waste increasing rapidly and recycling rates remaining low (Omilana, 2019; Kehinde et al., 2020). In Nigeria, rising plastic production has intensified waste management problems. Improper disposal contributes to pollution, flooding, and public health risks, including exposure to toxic emissions from plastic burning (Kehinde et al., 2020). Although plastics are widely used, concerns over sustainability have renewed interest in glass packaging.

Reverse logistics has become increasingly important due to environmental concerns, regulatory pressures, and evolving consumer expectations. It involves managing the backward flow of materials from consumption to origin for reuse, recycling, or disposal. In contrast to forward logistics, it focuses on end-of-life product management and value recovery (Somuyiwa and Adebayo, 2014). The transition from linear to circular systems emphasizes value retention rather than disposal. Circular economy approaches promote reuse, repair, recycling, and recovery, transforming waste into resources and improving both environmental and economic outcomes (Mallick et al., 2023).

About Champion Breweries Plc

Champion Breweries Plc is a leading beverage manufacturer located in Aka Offot, Uyo, Akwa Ibom State, Nigeria. The company produces alcoholic and non-alcoholic beverages using sustainable and innovative processes that enhance operational efficiency and environmental performance (Odohodi et al., 2023). Its flagship product is Champion Lager Beer, produced through standard brewing processes including malting, mashing, fermentation, conditioning, and packaging using returnable glass bottles (Umoren et al., 2021a). This study was conducted at the Uyo manufacturing plant.

Aim and Objectives

This study evaluates value recapture through bottle reuse policy of Champion Breweries Plc. Specifically, it seeks to:

1. Evaluate the firm's bottle reuse policy;
2. Examine bottle reuse operations;
3. Analyse value recapture within bottle reuse reverse logistics; and
4. Investigate the rationale for adopting bottle reuse as a reverse logistics strategy.

LITERATURE REVIEW

Reverse logistics has gained prominence as firms respond to environmental challenges and regulatory demands. It involves managing product returns for reuse, recycling, or disposal, extending supply chain activities beyond consumption stages (Lumba and Mwanza, 2023). In brewing, bottle recovery is routine due to reusable packaging systems. The shift from linear to circular models has redefined reverse logistics as a value-creation mechanism. Circular systems prioritize maintaining product utility through reuse and recycling, reducing environmental impact and improving resource efficiency (Mallick et al., 2023). Consumer awareness and regulatory pressures are driving adoption of sustainable practices. While some firms perceive reverse logistics as costly, evidence shows it enhances both environmental and economic performance. However, implementation challenges persist in developing economies due to weak infrastructure and policy enforcement.

Reverse logistics offers benefits such as cost reduction, improved customer satisfaction, and enhanced competitiveness. However, it requires strong coordination across supply chain actors and effective management of return processes, including collection, inspection, and redistribution (Somuyiwa and Adebayo, 2014). In brewing, product recall—particularly bottle return—is a continuous process that supports both environmental sustainability and cost efficiency. When effectively managed, it becomes a strategic tool for value creation and operational resilience.

Value Recapture and Bottle Reuse

Value recapture in circular systems involves extracting residual value from used products through reuse and recycling. In breweries, this is achieved through returnable bottle systems, where empty bottles are recovered, processed, and reused, reducing production costs and resource consumption (Ezeudu and Kennedy, 2024). Bottle reuse policies formalize these practices within organizational strategy. Although they require investment in cleaning and inspection infrastructure, they deliver long-term economic and environmental benefits. The reuse process involves multiple stakeholders, including consumers, retailers, distributors, and manufacturers. Bottles are returned, inspected, and either reused or recycled. Deposit-refund systems play a key role in ensuring high return rates and system efficiency (Roosen et al., 2023).

Economic and Environmental Implications

Bottle reuse significantly reduces production costs and improves profitability, making it a viable strategic approach. It also lowers environmental impact by reducing waste and resource consumption. However, challenges such as operational inefficiencies, infrastructure limitations, and additional waste streams (e.g., wastewater and emissions) can limit value recapture. Effective system design and management are therefore essential to maximize benefits (Umoren et al., 2021b).

METHODOLOGY

Research Design and Overview

This study adopts a quantitative research design to examine value recapture through the bottle reuse policy of Champion Breweries Plc. The methodology outlines the philosophical stance, research approach, strategy, sampling, data collection, analysis, and ethical considerations. It provides a structured framework for addressing the research objectives using systematic and objective methods (Wohlin and Runeson, 2021).

Research Philosophy

The study is grounded in positivism, which assumes that reality is objective, observable, and measurable. It adopts an objectivist ontological and epistemological stance, emphasizing the use of numerical data to identify patterns and relationships. This supports the use of quantitative methods to assess value recapture in bottle reuse operations (Zukauskas et al., 2018).

Research Approach

A deductive approach is employed, where existing theories on reverse logistics and value recapture are tested using empirical data. This top-down approach evaluates whether observed findings support theoretical expectations, making it suitable for analysing structured organisational practices.

Research Strategy

The study uses a survey strategy, enabling the collection of standardized data through a structured questionnaire. This approach is cost-effective, reduces bias, and supports statistical analysis, aligning with the study's objectives and resource constraints.

Sampling Method and Sample Size

Purposive sampling was used to select participants with relevant knowledge of bottle reuse operations. To improve representativeness, maximum variation sampling included diverse supply chain actors.

A total of 130 respondents participated:

- 55 company sales representatives
- 15 wholesalers
- 25 distributors
- 35 retailers

Participants were selected based on experience, knowledge, and willingness to contribute.

Data Collection Instrument and Procedure

Data were collected using a structured questionnaire with closed-ended questions and a five-point Likert scale. The instrument included:

- Section 1: Demographics
- Section 2: Bottle reuse policy
- Section 3: Reuse processes
- Section 4: Value recapture mechanisms
- Section 5: Adoption rationale

The questionnaire was designed to align directly with the research objectives and ensure ease of analysis.

Data Analysis Technique

Data were analysed using descriptive statistics. Responses were coded and processed using Excel and SPSS, with results presented as frequencies and percentages. Inferential analysis was not applied, as the study focuses on description rather than causality.

Reliability and Validity

Reliability was ensured through the use of a standardised questionnaire and consistent Likert-scale measurement. Cronbach's alpha was applied to assess internal consistency across key constructs.

Validity was achieved through:

- Content validity: Alignment with research objectives
- Face validity: Clear wording and logical structure
- Construct validity: Use of knowledgeable respondents

These measures ensured that the instrument accurately captured bottle reuse practices and value recapture processes (Rahi, 2017).

Strengths and Limitations

The study provides strong contextual insights into bottle reuse within Champion Breweries Plc. However, its focus on a single firm and use of purposive sampling limit generalisability. Additionally, reliance on descriptive statistics restricts deeper statistical inference.

Ethical Considerations

Ethical approval was obtained prior to data collection. Participation was voluntary, with informed consent, confidentiality, and anonymity strictly maintained. Data were handled securely and reported objectively, ensuring accuracy and neutrality.

RESULTS AND DISCUSSION

Value Chain Actors

Value chain actors in brewing include wholesalers, distributors, retailers, and consumers. Retailers, often operating in the informal sector (e.g., bars, restaurants, and hotels), work alongside the brewing company and small to medium-sized firms. Together, these actors collaborate to create, deliver, and recapture value within the system.

Table 1: Value Chain Actors

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Company Rep	43	46.7	46.7	46.7
	Wholesaler	9	9.8	9.8	56.5
	Distributor	14	15.2	15.2	71.7
	Retailer	26	28.3	28.3	100.0
	Total	92	100.0	100.0	

Bottle Reuse Policy

Results show strong agreement that Champion Breweries Plc operates a formal, well-established bottle reuse policy. Consistent responses across value chain actors indicate shared awareness and effective implementation, which supports efficient reverse logistics. The structured policy enables systematic value recapture and integration of environmental responsibility within operations.

Table 2: Bottle Reuse Policy

Champion Breweries practices glass bottle reuse and has a policy in place.

	Company Reps	Wholesalers	Distributors	Retailers	Total	%
Agree	11 (25.58%)	4 (44.44%)	9 (64.28%)	22 (84.61%)	46	50
Strongly Agree	32 (74.41%)	5 (55.55%)	5 (35.71%)	4 (15.38%)	46	50
Total	43	9	14	26	92	-
%	100	100	100	100	-	100
General Statistics						
N (Valid)	Mean	Median	Mode	Std. Dev	Variance	Range
92	4.45	4.00	4	.503	.253	1

Bottle Design

Respondents generally agreed that Champion Breweries' bottles are designed for multiple reuse cycles, though some variation reflects differences in handling and wear across roles. This highlights bottle design as a key factor enabling reuse and supporting long-term value recapture.

Table 3: Bottle Design

Champion Breweries' glass bottles are designed to be returned and reused many times.

	Company Reps	Wholesalers	Distributors	Retailers	Total	%
Agree	7 (16.27%)	7 (77.77%)	13 (92.85%)	24 (92.30%)	51	55.43
Strongly Agree	36 (83.72%)	2 (22.22%)	1 (7.14%)	2 (7.69%)	41	44.56
Total	43	9	14	26	92	-
%	100	100	100	100	-	100
General Statistics						
N (Valid)	Mean	Median	Mode	Std. Dev	Variance	Range
92	4.45	4.00	4	.500	.250	1

Health, Safety and Environment (HSE) Regulations

Moderate agreement was found on compliance with health, safety, and environmental regulations. While most respondents confirmed adherence, variation suggests uneven regulatory visibility across the value chain. Consistent compliance remains critical to avoid risks such as recalls, reputational damage, and operational disruptions.

Table 4: HSE Regulations

Champion Breweries adheres to health, safety, and environmental manufacturing regulations.

	Company Reps	Wholesalers	Distributors	Retailers	Total	%
Disagree	4 (9.30%)	2 (22.22%)	4 (28.57%)	8 (30.76%)	18	19.56
Neutral	2 (4.65%)	1 (11.11%)	-	-	3	3.26
Agree	31 (72.09%)	6 (66.66%)	9 (64.28%)	16 (61.53%)	62	67.39
Strongly Agree	6 (13.95%)	-	1 (7.14%)	2 (7.69%)	9	9.78
Total	43	9	14	26	92	-
%	100	100	100	100	-	100
General Statistics						
N (Valid)	Mean	Median	Mode	Std. Dev	Variance	Range
92	3.67	4.00	4	.903	.816	3

Bottle Ownership

Respondents agreed that bottle ownership remains with Champion Breweries Plc, with consumers paying only for the contents. This confirms a take-back system that enables control of bottle circulation, reduces losses, and supports efficient reuse and value recapture.

Table 5: Bottle Ownership

Consumers pay for the drink only but do not own the bottles.

	Company Reps	Wholesalers	Distributors	Retailers	Total	%
Agree	5 (11.62%)	6 (55.66%)	6 (42.85%)	113 (50%)	Q ^{*****}	32.60
Strongly Agree	38 (88.37%)	3 (33.33%)	8 (57.14%)	13 (50%)	62	67.39
Total	43	9	14	26	92	-
%	100	100	100	100	-	100
General Statistics						
N (Valid)	Mean	Median	Mode	Std. Dev	Variance	Range
92	4.67	5.00	5	.471	.222	1

Value Chain Collaboration

Findings show strong agreement that collaboration among value chain actors enables bottle returns. This reflects the interdependent nature of reverse logistics, where coordinated efforts support reuse, sustain production, and drive shared value creation.

Table 6: Value Chain Collaboration

Wholesalers, distributors, and retailers work together to return and reuse empty glass bottles.

	Company Reps	Wholesalers	Distributors	Retailers	Total	%
Agree	8 (18.60%)	4 (44.44%)	8 (57.14%)	11 (42.30%)	31	33.69
Strongly Agree	35 (81.39%)	5 (55.55%)	6 (42.85%)	15 (57.69%)	61	66.30
Total	43	9	14	26	92	-
%	100	100	100	100	-	100
General Statistics						
N (Valid)	Mean	Median	Mode	Std. Dev	Variance	Range
92	4.66	5.00	5	.475	.226	1

Empty Bottles

Respondents confirmed regular return of empty bottles to the brewery, supporting continuous production. This reflects an effective reverse logistics system that reduces reliance on new bottles and strengthens reuse practices aligned with circular economy principles. High return rates also reduce the risk of bottle shortages and related operational disruptions.

Table 7: Empty Bottles

Empty beer bottles are returned regularly to the brewery to keep production going.

	Company Reps	Wholesalers	Distributors	Retailers	Total	%
Agree	11 (25.58%)	4 (44.44%)	10 (71.42%)	16 (61.53%)	41	44.56
Strongly Agree	32 (74.41%)	5 (55.55%)	4 (28.57%)	10 (38.46%)	51	55.43
Total	43	9	14	26	92	-
%	100	100	100	100	-	100
General Statistics						
N (Valid)	Mean	Median	Mode	Std. Dev	Variance	Range
92	4.54	5.00	5	.501	.251	1

Social Inclusion

Results show strong agreement that bottle reuse supports social inclusion, job creation, and responsible alcohol consumption. Minor disagreement among wholesalers likely reflects operational challenges rather than rejection of these social benefits. Overall, the finding aligns with literature indicating that circular practices distribute value across supply chains and generate socio-economic benefits beyond environmental gains. Bottle reuse therefore serves both environmental and social sustainability purposes.

Table 8: Social Inclusion

Bottle reuse process promotes social inclusion, creates jobs and promotes responsible alcohol consumption.

	Company Reps	Wholesalers	Distributors	Retailers	Total	%
Disagree	-	1 (11.11%)	-	-	1	1.08
Neutral	-	1 (11.11%)	-	-	1	1.08
Agree	28 (65.11%)	6 (66.66%)	6 (42.85%)	5 (19.23%)	45	48.91
Strongly Agree	15 (34.88%)	1 (11.11%)	8 (57.14%)	21 (80.76%)	45	48.91
Total	43	9	14	26	92	-
%	100	100	100	100	-	100
General Statistics						
N (Valid)	Mean	Median	Mode	Std. Dev	Variance	Range
92	4.12	4.00	4	.724	..524	3

Glass Handling

Respondents agreed that bottles are durable enough for repeated handling and reuse. This confirms the technical feasibility of reuse systems, consistent with studies showing that returnable glass bottles can withstand multiple washing and refilling cycles under varying temperatures. Durability supports cost savings and environmental benefits by extending bottle lifespan and reducing replacement needs.

Table 9: Glass Handling

Champion Breweries glass bottles are designed tough to withstand repeated handling and use.

	Company Reps	Wholesalers	Distributors	Retailers	Total	%
Agree	25 (58.13%)	5 (55.55%)	11 (78.57%)	21 (80.76%)	62	67.39
Strongly Agree	18 (41.86%)	4 (44.44%)	3 (21.42%)	5 (19.23%)	30	32.60
Total	43	9	14	26	92	-
%	100	100	100	100	-	100
General Statistics						
N (Valid)	Mean	Median	Mode	Std. Dev	Variance	Range
92	4.33	4.00	4	.471	.222	1

High Quality

Most respondents perceived the brewery's products as high quality, though some external value chain actors disagreed. No internal representatives expressed dissatisfaction, indicating alignment between internal standards and organisational expectations. Differences in external perceptions reflect findings that quality experiences can vary across distribution channels despite consistent production processes. Maintaining perceived quality remains essential for consumer acceptance of reused packaging systems.

Table 10: High Quality

Champion Breweries products are of high quality, produced with consumers in mind.

	Company Reps	Wholesalers	Distributors	Retailers	Total	%
Disagree	-	1 (11.11%)	3 (21.42%)	5 (19.23%)	9	9.78
Agree	17 (39.53%)	7 (77.77%)	11 (78.57%)	21 (80.76%)	56	60.86
Strongly Agree	26 (60.46%)	1 (11.11%)	-	-	27	29.34
Total	43	9	14	26	92	-
%	100	100	100	100	-	100
General Statistics						
N (Valid)	Mean	Median	Mode	Std. Dev	Variance	Range
92	4.10	4.00	4	.826	.683	3

Waste Management

Perceptions of waste generation were mixed. While most respondents believed bottle reuse reduces waste, a minority disagreed due to experiences with discarded or damaged bottles. This reflects

findings that reuse effectiveness depends on collection systems, infrastructure, and enforcement. Waste reduction therefore requires ongoing operational improvements beyond reuse policies alone.

Table 11: Waste Management

Wastes are minimal in Champion Breweries because resources are utilized and preserved.

	Company Reps	Wholesalers	Distributors	Retailers	Total	%
Disagree	16 (37.20%)	2 (22.22%)	3 (21.42%)	4 (15.38%)	25	27.17
Neutral	5 (11.62%)	1 (11.11%)	-	-	6	6.52
Agree	22 (51.16%)	6 (66.66%)	11 (78.57%)	22 (84.61%)	61	66.30
Total	43	9	14	26	92	-
%	100	100	100	100	-	100
General Statistics						
N (Valid)	Mean	Median	Mode	Std. Dev	Variance	Range
92	3.39	4.00	4	.889	.790	2

Collaboration and Information Sharing

Strong agreement emerged that collaboration and information sharing enhance competitiveness. Effective information flow supports bottle tracking, inventory planning, and timely returns, enabling value recovery. This aligns with evidence that logistics integration and coordinated information systems improve brewery operational performance. Information sharing is therefore a key driver of circular supply chain efficiency.

Table 12: Collaboration and Information Sharing

Collaboration and information sharing among supply chain partners improves Champion Breweries' competitiveness.

	Company Reps	Wholesalers	Distributors	Retailers	Total	%
Agree	28 (65.11%)	5 (55.55%)	5 (35.71%)	12 (46.15%)	50	54.34
Strongly Agree	15 (34.88%)	4 (44.44%)	9 (64.28%)	14 (53.84%)	42	45.65
Total	43	9	14	26	92	-
%	100	100	100	100	-	100
General Statistics						
N (Valid)	Mean	Median	Mode	Std. Dev	Variance	Range
92	4.46	4.00	4	.501	.251	1

Reuse Cost

Unanimous agreement shows that bottle reuse reduces production costs, supporting the economic case for reuse systems. This aligns with studies indicating that cleaning and reusing returnable glass bottles is a cost-effective packaging approach for breweries. Cost savings reinforce reuse as a financially sustainable circular practice rather than a compliance requirement.

Table 13: Reuse Cost

The cost of producing new beer bottles is reduced when empty bottles are reused by Champion Breweries.

	Company Reps	Wholesalers	Distributors	Retailers	Total	%
Agree	19 (44.18%)	4 (44.44%)	4 (28.57%)	13 (50%)	40	43.47
Strongly Agree	24 (55.81%)	5 (55.55%)	10 (71.42%)	13 (50%)	52	56.52
Total	43	9	14	26	92	-
%	100	100	100	100	-	100
General Statistics						
N (Valid)	Mean	Median	Mode	Std. Dev	Variance	Range
92	4.57	5.00	5	.498	.248	1

Relationship Priorities

Responses varied on the extent to which Champion Breweries Plc prioritises relationships with channel partners and consumers. Overall perceptions were positive, but differences reflect the complexity of balancing stakeholder interests in circular supply chains. Prior research highlights that long-term value retention depends on trust, fairness, and sustained engagement across supply chain actors. Relationship management therefore remains an important area for continuous improvement.

Table 14: Relationship Priorities

Champion Breweries attaches priority to maintaining suppliers and consumer relationships.

	Company Reps	Wholesale rs	Distributo rs	Retailers	Total	%
Disagree	-	2 (22.22%)	5 (35.71%)	9 (34.61%)	16	17.39
Neutral	-	1 (11.11%)	-	-	1	1.08
Agree	9 (20.93%)	6 (66.66%)	9 (64.28%)	17 (65.38%)	41	44.56
Strongly Agree	34 (79.06%)	-	-	-	34	36.95
Total	43	9	14	26	92	-
%	100	100	100	100	-	100
General Statistics						
N (Valid)	Mean	Median	Mode	Std. Dev	Varian ce	Range
92	4.01	4.00	4	1.043	1.088	3

Bottle Disposal

Most respondents agreed that bottle reuse significantly reduces landfill disposal of glass bottles. This confirms the environmental effectiveness of the brewery's reverse logistics system and aligns with evidence that unmanaged glass disposal poses environmental risks. By institutionalising bottle return, the brewery supports pollution prevention and continuous circular material flow

Table 15: Bottle Disposal

Champion Breweries bottle reuse practice reduces the number of glass bottles disposed of in landfills.

	Company Reps	Wholesalers	Distributors	Retailers	Total	%
Disagree	9 (20.93%)	2 (22.22%)	1 (7.14%)	-	12	13.04
Agree	24 (55.81%)	7 (77.77%)	10 (71.42%)	18 (69.23%)	59	64.13
Strongly Agree	10 (23.25%)	-	3 (21.42%)	8 (30.76%)	21	22.82
Total	43	9	14	26	92	-
%	100	100	100	100	-	100
General Statistics						
N (Valid)	Mean	Median	Mode	Std. Dev	Variance	Range
92	3.97	4.00	4	.870	.757	3

Theoretical Contributions

This study contributes to reverse logistics and supply chain literature by demonstrating how value can be recaptured through bottle reuse in the beverage industry.

Managerial Implications

Managers should strengthen reverse logistics by incentivising bottle returns and actively involving all value chain actors. Effective reuse systems can reduce costs, improve returns, and minimise environmental impact, particularly by lowering landfill waste and carbon emissions.

Research Limitations

The study focuses only on bottle reuse within a single brewery, limiting generalisability. The use of purposive sampling and a restricted sample size further constrains broader application of the findings.

Future Research

Future studies should examine the financial impact of bottle reuse, expand sample sizes, and incorporate qualitative methods for deeper insights.

Conclusion

The study confirms that bottle reuse is an established practice at Champion Breweries Plc, supported by structured policies and operational systems. Reusable bottle design and supporting infrastructure enable repeated use while maintaining product quality and safety.

Bottle reuse is sustained through coordinated participation of supply chain actors, ensuring continuous production and efficient reverse logistics. Incentives are important to maintain stakeholder engagement and prevent disruptions in bottle returns.

Value recapture is a key outcome, as reuse reduces production costs and conserves resources by limiting the need for new bottles. The system also supports environmental sustainability by reducing waste and landfill pressure, although improvements are needed in managing by-products and operational efficiency.

Overall, bottle reuse is a viable circular economy strategy that delivers economic, environmental, and social benefits. However, its long-term success depends on improved infrastructure, stronger stakeholder incentives, and enhanced environmental management practices.

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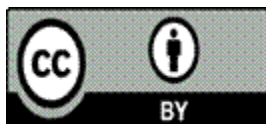
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