Influence of reverse logistics on the operational processes of the supermarket chain in the district of Santiago, province of Veraguas

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Abstract

Keywords: Reverse logistics; cold chain; operational processes; supermarkets; operations.

The objective of this study was to analyze the influence of reverse logistics on the operational processes of supermarkets in Santiago, Veraguas province. The research was conducted using a qualitative approach, through semi-structured interviews with purposively selected managers and department heads. The results show reverse logistics as a key link in the cold chain, especially with perishable products, since breaks in the cold chain generate irreversible and hidden losses and operating costs. Value recovery strategies were also described, including thorough inspections, clearance promotions, and sales to staff. Structural constraints were identified in terms of available space, the frequency of return transport, and the disparity in available technologies, all of which affect the efficiency of operational flows. The study concluded that the company's operations are sustainable to the extent that it can adequately manage returned products and minimize losses resulting from cold chain disruptions, highlighting the unique characteristics of the region. Limitations mentioned include the sample size and the contextual analysis, which limit the generalizability of the results.

INTRODUCTION

Businesses engaged in commercial activities have internationally incorporated reverse logistics as a means to enhance corporate competitiveness and sustainability. Silva Álvarez et al. (2021) discuss how globalization has prompted economic agents to reassess their processes and practices in favor of greater social responsibility. In Latin America, the Ministry of Environment and Sustainable Development of Colombia has undertaken significant efforts to integrate reverse logistics into production processes, aiming to optimize the utilization of reusable resources and prevent environmental degradation, particularly in cases involving returns, overstock, and refurbishments (González Castillo et al., 2023).

This situation presents considerable challenges in Santiago, where the adoption of reverse logistics practices remains highly limited and characterized by a lack of clarity (Hermenet Chirú, 2021). Companies in the Santiago district face obstacles related to ecological awareness, logistical infrastructure, and local regulations, although there is growing interest in incorporating these practices into corporate social and environmental responsibility frameworks (Torres y Cruz, 2024).

The retail sector, particularly supermarket chains, has transformed reverse logistics from a mere waste management function into a critical component of strategies aimed at achieving sustainability, operational effectiveness, and efficiency in commercial activities. This field of study encompasses the management of returns, packaging recycling, disposal of perishable waste, and handling of dead inventory (Mera Silva et al., 2024). When implemented effectively, reverse logistics enables companies to reduce costs and waste, contribute to sustainability, and enhance their corporate image and social projection in the eyes of increasingly demanding consumers (Achahuanco Molina et al., 2023). These issues are particularly pressing in Santiago, Veraguas Province, where community characteristics and physical-logistical constraints necessitate tailored

systems to support commercial operations.

The benefits of reverse logistics are well documented in the literature. However, research on its application in regional or secondary markets remains scarce. The majority of studies focus on large metropolitan areas or complex industrial sectors, relegating the operational dynamics of supermarkets located in peripheral regions to a secondary position (Paco Vargas, 2022). In the case of the Santiago District, a significant knowledge gap persists regarding the influence of reverse logistics practices on operational costs, material flow efficiency, and supermarket structuring. This underscores the need for context-specific studies (Campines Barría, 2023).

This research also seeks to examine how reverse logistics mitigates the negative impacts of inventory accumulation and operational process inefficiencies—factors that must be addressed to ensure business sustainability at the regional level. As noted by Cabeza (2024) and Geovanny y Martínez (2024), reducing waste generation, reusing resources, and optimizing inventories constitute key elements for competitiveness. The findings generated by this study will facilitate the identification of operational strategies adapted to local contexts, the establishment of sustainability frameworks, and the foundation for future research within the commercial chains of Veraguas Province.

Within this framework, the primary objective of this investigation is to analyze the influence of reverse logistics on the operational processes of supermarkets in Santiago, Veraguas Province, based on the perspectives of managers and department heads concerning the management of returns, recycling, disposal of perishable goods, and value recovery (Cacua-Barreto, et al 2017). Adopting a qualitative approach, the study aims to understand how these practices are adapted in daily management and the specific challenges faced by supermarkets in the country's interior, thereby contributing situated knowledge on reverse logistics in secondary markets.

MATERIALS AND METHODS

The ongoing research adopted a qualitative approach aimed at understanding the perceptions and experiences of individuals involved in the management of reverse logistics within supermarkets in the province of Veraguas, specifically in the city of Santiago. From this perspective, the phenomenon was examined as a complex text through an interpretive lens. This aspect is also emphasized by Tarrillo Saldaña et al. (2024) and Hernández-Sampieri and Mendoza Torres (2018), who highlight the importance of comprehending the meanings that participants construct in relation to the practices they undertake.

The study employed a non-experimental design with a descriptive level, as indicated by Piña-Ferrer (2023), with the objective of characterizing processes and dynamics without manipulating variables. Furthermore, it constitutes an applied investigation, as noted by Arias (2021), focusing on a specific operational management issue within real-world enterprises.

The population consisted of five supermarkets located in the Santiago district, while the units of analysis were the administrators and department heads directly involved in managing returns, handling perishable products, and associated post-process activities within the cold chain. The selection of the five participants was conducted through purposive sampling, prioritizing the relevance and specialized knowledge of the informants, in accordance with recommendations by Fuentes et al. (2020) for qualitative studies requiring direct experiential links to the phenomenon under investigation.

Subsequently, semi-structured interviews were administered using open-ended questions concerning functions, perceptions, and operations related to reverse logistics. The interview guide underwent a validation process through expert judgment. To this

end, ten specialists in logistics, operations, and methodology reviewed the questions to assess their clarity, relevance, and coherence. Their feedback enabled revisions to wording and item sequencing, thereby enhancing content validity in terms of interpretability.

Data analysis was performed via thematic coding, following the qualitative content analysis approach. The process encompassed three phases: (1) open coding to identify emerging categories, (2) axial coding to establish relationships among categories, and (3) selective coding to integrate findings around the central phenomenon. Theoretical saturation was achieved after the fifth interview, as no new significant patterns emerged. Transcripts were analyzed manually through iterative readings and comparative matrices. Finally, the findings were triangulated with the most recent literature on reverse logistics, sustainable operations, and supermarket management. This comparison allowed the results to be contextualized across diverse settings and contributed to a more integrated and contemporary qualitative synthesis

RESULTS

The analysis of interviews conducted with administrative and operational personnel from supermarkets in the Santiago District yields the following section. The information is organized into six thematic categories that elucidate the manner in which reverse logistics influences operational processes. To substantiate the findings, micro-citations from participants are included and identified as Participant 1, 2, 3, 4, and 5.

1. Critical Management of the Cold Chain and Food Safety Protocols Participants described the management of perishable products as the most demanding component of reverse logistics processes. They concurred that a primary challenge lies in ensuring food safety through precise temperature control, particularly for frozen or refrigerated items. This is reflected in Participant 1's statement: “one of the greatest challenges is maintaining temperature control for frozen or refrigerated products.” Similarly, Participant 5 reinforced this view by noting that “controlling perishable products without compromising the cold chain is a challenge.” In instances of potential spoilage or health risks, products are discarded or returned to suppliers, with food safety invariably prioritized. According to the interviewees, any disruption to the cold chain results in irreversible loss of product value, necessitating rapid classification to minimize economic impacts on supermarket operations.

2. Value Recovery and Economic Recovery Strategies To mitigate financial losses from returned products, supermarkets employ various strategies to recapture value prior to declaring total loss. A key mechanism involves internal promotions to accelerate turnover of items nearing expiration dates. As Participant 1 explained, “if the expiration date is near, it is allocated to the liquidation area (internally called the Red Zone) with discounts ranging from 20% to 50%.” Complementarily, for unsold items or those with low sales probability, negotiations with suppliers or internal markdowns are pursued. Participant 5 indicated that “for unsold products, we negotiate with the supplier or apply discounts to recover the investment.” These practices reduce waste, optimize inventory, and capitalize on value recovery opportunities before final disposal.

3. Infrastructure Limitations and Geographic Context The geographic location and physical dimensions of establishments in Santiago emerged as conditioning factors for operational flows and returns management. Participants highlighted the absence of segregated areas for storing returned products, leading to spatial conflicts, especially in stores with constrained warehouse capacity. This issue was clearly articulated by Participant 3: “the main challenge is the space to store returned products.” Furthermore, delays in supplier authorizations prolong product retention in operational areas,

saturating storage facilities. In Participant 5's words, “supplier delays occupy spaces that could be used for other merchandise.” These conditions disrupt internal organization, create visual disorder, and reduce operational efficiency, thereby adversely affecting overall reverse logistics performance.

4. Heterogeneity and Technological Gap The analysis revealed significant disparities in tools and systems employed for reverse logistics management across district supermarkets. While some establishments utilize more robust platforms for recording returns, others rely on basic resources or manual procedures. Participant 3 expressed this disparity: “here we use Excel for everything; we do not have an updated system.” In contrast, certain supermarkets integrate more advanced systems, albeit supplemented by physical records. Participant 5 noted, “we use SAP to record returns, but also physical forms for internal control.” This coexistence of digital and manual tools creates operational gaps and hinders process standardization, underscoring the need to strengthen technological infrastructure to enhance traceability and handling of returned products.

5. Friction with Supplier Front-End Interfaces The efficacy of reverse logistics hinges on suppliers' responsiveness, particularly for returns requiring external authorization or verification. Participants indicated that this process is far from instantaneous, often triggering cascading delays that affect inventory turnover. Participant 1 remarked, “authorization for a return takes between 24 and 48 hours,” during which products remain inactive, unable to be reintegrated or discarded. Similarly, Participant 5 observed, “suppliers delay acceptance of the product return or shipment of a replacement.” This external dependency generates bottlenecks, reduces storage flexibility, and necessitates advanced planning to prevent operational congestion and losses from irrecoverable inventory.

6. Hidden Costs and Impact on Labor Productivity Participants emphasized that costs associated with reverse logistics extend beyond product loss to encompass substantial investments in personnel time and effort. Processing returns involves inspection, cleaning, classification, and documentation tasks that divert employees from routine duties. Participant 2 stated, “a lot of staff is needed to handle and document returns,” capturing the operational intensity. Likewise, Participant 4 noted, “employees stop performing other tasks to manage returns; this creates overload.” These dynamics not only elevate labor costs but also demonstrate reverse logistics' influence on operational efficiency and productivity in the district's supermarkets.

DISCUSSION

The primary purpose of the present study was to analyze the influence of reverse logistics on the development of operational processes in supermarkets within the Santiago District, Veraguas Province. The findings demonstrate that reverse logistics functions not merely as an ancillary process but as one that permanently conditions the operational structure. It demands immediate responses to returns, losses, deteriorating products, and contextual constraints. This influence manifests in operational practices that appear as omissions, leading to the adoption of ineffective control mechanisms and decisions focused primarily on mitigating losses rather than building an organized system.

One of the most critical components identified was the management of deteriorating products and adherence to the cold chain. Interviewees emphasized that any breach in appropriate temperature control results in irreversible spoilage, adversely affecting commercial activity and necessitating prompt, mandatory short-term decisions. In this regard, the internal pressures described align with observations by Mera Silva et al.

(2024), who stress the importance of proper handling of deteriorating products to safeguard the operational sustainability of the retail sector.

While the literature proposes models centered on prevention and planning, the supermarkets examined adopt a reactive logic based on rapid discounts, internal sales, and ad hoc decisions to avert losses from spoilage. This approach diverges, to some extent, from the recommendations of González Castillo et al. (2023), who advocate a structured reverse logistics framework grounded in preventive planning and integrated management systems, rather than immediate liquidation.

Value recovery strategies in these establishments are closely tied to the need to accelerate inventory turnover and recapture value before declaring total loss. Actions such as aggressive promotions, controlled waste reduction, internal markdowns, or direct negotiations with suppliers reflect a focus on liquidity rather than circular economy principles. These practices respond, in part, to the nature of supermarket inventories, which feature high-perishability items and limited capacity for prolonged storage.

A significant influencing factor is the limitation of physical space and the geographic conditions of the district. The absence of segregated areas for returns leads to accumulations that interfere with sales zones, resulting in operational disorder. As one interviewee stated, “the main challenge is the space for storing returned products,” illustrating how infrastructure constrains process efficiency. This finding corroborates Paco Vargas (2022), who notes that the literature often overlooks dynamics in regional markets, where infrastructure and geographic location create distinctive “logistical friction.” Consistently, Torres y Cruz (2024) highlight that, in local contexts, proximity to distribution centers and regulatory factors decisively shape logistical processes.

Furthermore, the results reveal pronounced technological heterogeneity among establishments. While some employ enterprise resource planning (ERP) systems such as SAP, others continue to rely on manual processes or Excel records. This digital divide aligns with Hermenet Chirú (2021), who documents technological adoption challenges in Panamanian enterprises. The coexistence of advanced and manual systems generates duplication, errors, and delays, compromising traceability and inventory control. Although the literature, including Cabeza (2024), links reverse logistics to efficiency and competitiveness, in this context, hidden costs related to administrative burdens and labor hours represent a substantial challenge.

Collaboration with suppliers constitutes another key factor. Response times ranging from 24 to 48 hours delay the disposition of returned items, forcing retailers to retain products in limited facilities, thereby occupying operational space and hindering workflow (Mejia-Mójica & Pieschacon-Andrade, 2025). This discrepancy between local operational realities and centralized supplier practices exemplifies instances where general reverse logistics theory—emphasizing fluid dynamics and rapid replenishment—proves difficult to apply without contextual adaptations.

Finally, expenses arising from reverse logistics extend beyond the value of returned items. The human factor emerges as another critical dimension: the time personnel devote to classifying, documenting, cleaning, and handling returns represents a significant opportunity cost, as employees are diverted from essential customer-facing and stock-organization tasks. This scenario illustrates that reverse logistics is not an isolated process; it directly impacts daily productivity and operational management.

Considering the study's limitations, its qualitative nature, purposive sampling, and reliance on self-reported data, the findings permit reasonable conclusions regarding perishability, facilities, technological gaps, and supplier relationships that shape reverse logistics in Santiago District supermarkets. The presented evidence advances understanding of a phenomenon underexplored in provincial markets, underscoring the

necessity of adapting theoretical models to operational realities constrained by physical, temporal, and technological factors.

CONCLUSIONS

Reverse logistics exerts a disruptive influence on the operations of supermarkets in the Santiago District, permanently conditioning their operational structure. Six critical mechanisms of influence were identified: (1) cold chain management as a differentiating factor between sustainability and irreversible loss; (2) economic value recovery strategies reliant on aggressive liquidations and supplier negotiations; (3) physical infrastructure limitations that saturate operational spaces; (4) technological heterogeneity generating disparities between establishments equipped with ERP systems and those dependent on manual processes; (5) delays in supplier coordination (24–48 hours) that obstruct return flows; and (6) hidden costs stemming from intensive labor demands for classification and documentation of returns.

The study concludes that the operational sustainability of these supermarkets does not rely on universal metropolitan logistical models but on localized adaptive mechanisms. These transform reverse logistics into a defensive strategy for rapid absorption of products through controlled waste, internal promotions, and staff sales. This reactive management—shaped by spatial constraints, technological limitations, and supplier coordination challenges—reveals an operational logic centered on immediate liquidity rather than circular economy systems. Consequently, it configures a distinctive reverse logistics model tailored to replenishment markets in provincial contexts characterized by geospatial frictions and structural limitations.

The validity of these conclusions is circumscribed by the qualitative design and the purposive sample of five establishments, which restricts statistical generalizability to other regions with differing commercial densities. Additionally, reliance on self-reported data from managers may have omitted unreported informal dynamics. Future research directions should focus on the financial quantification of controlled waste impacts and exploration of suppliers' perspectives to develop a bilateral understanding of frictions within regional supply chains.

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