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Logistics Diagnosis of Nanostores in the Metropolitan Area of Barranquilla, Colombia

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Abstract

A data collection instrument was designed and applied to achieve this objective, grounded in theoretical frameworks from previous research and specialized bibliographic references. The methodology involved direct interaction with nanostore owners, field observations, and the use of descriptive statistics and multiple correspondence analysis for data processing. The findings revealed the most common ways in which nanostores operate in terms of supply, inventory, and warehousing. Several deficiencies in logistics management were also identified, including a lack of inventory control, supplier-related issues, inefficient storage practices, and low adoption of technology. As a result, common elements of logistics performance and potential indicators were established to support the measurement and evaluation of the effectiveness of each activity. The implications of this research lie in its contribution to the understanding of logistics in the traditional channel, providing a foundation for future studies and facilitating the design of strategies aimed at enhancing the sector's operational performance.

Keywords
Logistics, Nanostores, Optimization, Supply Chain, Diagnosis.

1. Introduction
To address the research objective of this study, it is important to recognize that retail trade constitutes one of the most influential distribution channels in the global economy. According to Acevedo and Ortega (2023) this sector includes over 50 million small traditional shops worldwide, with particularly high concentrations in India (12 million) and China (6 million), and a strong presence in countries such as Mexico, Indonesia, Nigeria, Brazil, Colombia, Paraguay, and Central America. These retail businesses generate value by providing immediate access to essential goods,

facilitating convenience, and ensuring market reach in areas where large retail chains have a limited presence (Mora García 2011).

According to Blanco et al. (2017), the retail trade is divided into two main channels: modern and traditional. The modern channel consists of large, organized retailers such as Walmart and 7-Eleven, which operate through corporate-owned stores or franchises, supported by advanced technologies and considerable nanostores' bargaining power. In contrast, the traditional channel comprises small family-owned businesses, among which are particularly prominent. In Colombia, these stores play a vital role, accounting for approximately 40% of retail establishments and generating around 50% of sales in consumer categories such as food and beverages (Lorduy 2024). Nanostores differ in size and product assortment depending on the cultural and economic context of each region.

Despite their relevance in the economic dynamics, nanostores face considerable challenges in logistics management. Escamilla et al. (2021) argue that their supply chains are neither agile nor adaptable and often lack strategic alignment. These businesses tend to rely on stable yet rigid replenishment processes, which limit their responsiveness to market fluctuations. Furthermore, the absence of reliable and accurate information complicates logistics-related decision-making and weakens the ability of suppliers to respond effectively to demand patterns. The expansion of hard discount retailers in low-income neighborhoods further intensifies competition by offering a wide range of products at significantly lower prices, along with more advanced logistics systems, marketing strategies, and technological tools (Londoño et al. 2020).

Given that the formal adoption of the nanostore model in supply chain management remains underexplored (Ortega Jiménez et al. 2022), and that the lack of sufficient, accurate, and reliable information can affect the overall performance of the supply chain, this project aims to address the following research question: What are the logistical elements that determine operational performance in nanostores in the metropolitan area of Barranquilla?

To address this objective, the research was conducted in three stages. The first stage involved the development of a conceptual and contextual foundation through an exhaustive review of primary and secondary sources, including academic literature and expert consultations. This process led to the construction of a theoretical framework that identifies the key logistical functions in the traditional retail channel. Sourcing, inventory management, and warehousing were identified as the primary processes influencing operational performance. The second stage focused on the design and implementation of a data collection instrument, followed by statistical analysis using descriptive techniques and multiple correspondence analysis. Finally, in the third stage, improvement opportunities were identified, and key elements of logistics performance were established. These findings facilitated the formulation of performance indicators to support the optimization of logistics processes.

The results contribute to the theoretical understanding of nanostore logistics by providing up-to-date insights into the current operational status of this segment, serving as a foundation for future studies, particularly in areas such as the out-of-stock phenomenon. On a practical level, the findings benefit store owners directly and, indirectly, employees, unions, and organizations, through the social appropriation of knowledge. This, in turn, supports the development of new methodological strategies aligned with stakeholder objectives and policy goals.Beyond its local scope, this research aims to generate knowledge applicable to broader contexts by offering valuable insights for future investigations and industry stakeholders. A deeper understanding of logistics practices within the nanostore format, which represents the final link in the supply chain closest to the end consumer, can inform the design of effective strategies to improve overall supply chain dynamics.

1.1 Objectives

This study aims to diagnose the logistics situation of the traditional trade channel in the Metropolitan Area of Barranquilla during 2024. Its goal is to identify logistics performance elements and potential areas for improvement that contribute to enhanced operational outcomes under current market conditions.

1.2. Specific Objectives

•To define the conditions that influence logistics operations within the traditional trade channel in the Metropolitan Area of Barranquilla, with the aim of identifying general performance aspects of nanostores that can be analyzed through data collection techniques.

•To characterize the logistical components of the traditional trade channel by identifying the key factors that determine the logistics performance of nanostores in the region.
•To establish performance indicators based on the logistics behavior factors identified in the second objective.

2. Literature Review

In the research conducted by Lopez et al. (2024), it is established that the supply process in nanostores consists of seven stages: ordering, order processing, preparation and dispatch, distribution, payment, returns, and after-sales service. These findings were derived from data collected from approximately 256 nanostores. Additionally, the study revealed that nanostores rely on indirect distribution channels for their supply needs, either by placing orders directly with suppliers or through sales agents.

Regarding the challenges faced by nanostores, Escamilla et al. (2021) identify three main issues that impact their supply chains, particularly in developing countries: infrastructure limitations, operational inefficiencies, and restricted access to financial services. These constraints significantly affect their ability to expand, extend market reach, and operate efficiently. Furthermore, infrastructure and operational challenges vary depending on geographic location, with significant differences between urban and rural areas. To address these barriers, various innovative business models driven by technological advancements have emerged, aiming to optimize the size, reach, and efficiency of nanostores across diverse contexts.

According to Shuxing and Bin (2022), one emerging model involves an online retailer designating a nanostore as a community leader. This store is responsible for organizing orders within its local area by promoting offers via WeChat groups and managing group purchases. The next day, products are delivered to the store, where customers pick them up. This model offers several advantages. First, it reduces costs, as online platforms save on logistics and rental expenses by using nanostores as distribution hubs, while customers avoid shipping fees. Second, it increases convenience, allowing consumers to purchase fresh products at competitive prices without leaving their communities, with the assurance of collecting them from a nearby store. Lastly, it enhances operational efficiency by integrating online sales with physical distribution, optimizing inventory levels and delivery times, and strengthening the relationship between nanostores and their customers.

It is worth noting that, according to Acevedo Amaya and Ortega Jiménez (2023), research aimed at characterizing this business model remains limited. There is a scarcity of academic studies that examine the functioning of nanostores at the micro level, from the perspective of each point of sale. Most existing research has focused on analyzing the sector in aggregate terms, without delving into the specific operational aspects of each store. Furthermore, many of these studies lack a strong empirical foundation, as they rely primarily on secondary data provided by distributors, government entities, and mass-consumption product suppliers. This limitation hinders a comprehensive understanding of nanostores' operational status, the strategies they employ, their level of business maturity, and their fundamental characteristics.

Castañeda Velásquez and Ramírez Bohórquez (2019) developed their research, Estrategias de gestión basadas en información como alternativas de desarrollo para el canal tradicional del sector retail: tiendas de barrio, characterizing the information flow processes and the degree of applicability of technology in the stores, which allowed them to define strategies concerning financial management, portfolio management, and promotion management. In the research work Diseño de una Metodología de Medición de Agotados del Canal Tienda a Tienda de la Ciudad de Barranquilla (Fuentes Amaya and Urruchurto Gonzalez 2017), a methodology was developed to know the reasons that lead to incur in out-of-stocks. Results highlight that in all product categories, those who mostly supply the store channel in Barranquilla are distributors. In addition, 92.38% of the stores have 1 to 10 suppliers, and the product category that presents the greatest amount of out-of-stock is food and beverages, with 49.85%.

The project entitled Modelo Conceptual para la Distribución de Mercancías en las Nanostores pertenecientes a la localidad Riomar de la ciudad de Barranquilla durante el COVID–19 (Álvarez Barreto 2022) describes a conceptual model for distributing merchandise in the traditional channel that helps to analyze the operations involved in the supply chain in the stores of the locality. Finally, in the degree work Modelo conceptual para la distribución de mercancías en las nanostores pertenecientes a la zona suroccidente de Barranquilla (Lopez Gomez and Marriaga Chamorro 2023) a conceptual model was developed, which describes the merchandise distribution channel in the nanostores of the south-west side of Barranquilla, using the square kilometer methodology. This approach allowed understanding the total operability of these stores and suggested alternatives to improve their distribution. The model descriptively characterized the main process factors, including demand generation, order processing, payment, physical distribution, and after-sales service.

Although no research was found that specifically proposes a methodology for establishing logistics performance measures in nanostores, existing research does offer characterizations of the traditional channel within the city and some of its localities. These previous studies serve as a valuable reference for identifying the main variables necessary for the development of the project. It is important to highlight that this research adopts a distinct methodological approach, centered on the analysis and identification of critical logistic factors, to design a logistics performance measurement instrument.

3. Methods

The study was conducted at an exploratory level, appropriate for addressing a topic that has been minimally investigated and is characterized by significant uncertainties. The chosen research strategy was fieldwork, involving direct interaction with the target population. This approach enabled the collection of primary data without manipulating or influencing the variables under study, thereby preserving the natural conditions of the environment. Table 1 presents a detailed overview of the project's stages, illustrating the relationship between each phase and the activities aligned with the previously defined specific objectives.

Table 1. Stages of Research

1. Definition of Conditions in the Logistics Operation	**2. Characterization of Logistics Aspects**	**3. Establishment of Performance Metrics**
- Identification and selection of relevant bibliographic sources - Interviews with experts and exploratory visits to nanostores - Selection of key logistics processes; development and refinement of the theoretical framework	- Definition of the study population and sampling criteria - Design and validation of the data collection instrument through a pilot test - Implementation of the instrument on the selected sample - Analysis and interpretation of the collected data	-Definition of performance metrics based on store evaluations -Conclusions and identification of improvement opportunities

3.1. Definition of the Study Population and Sampling Criteria

The study universe comprised all nanostores located within the Metropolitan area of Barranquilla. To identify and validate the relevant stores, a database provided by a company specializing in mass consumption was employed. As a result, 579 nanostores distributed across the neighborhoods of the Metropolitan area were identified as the study population.

The sampling technique employed in this research is stratified random sampling. According to Otzen and Manterola (2017) This method allows for the selection of a representative sample from a population, ensuring that subpopulations (or strata) within the population are proportionally represented in the sample based on their share of the total population. Since the general objective of the project focuses on the Metropolitan Locality, the study universe, denoted as N, includes all nanostores in the city of Barranquilla. Within this universe, homogeneous subpopulations are defined and referred to as N_h, representing the nanostores specifically located in locality h. For the sampling process, the term n_h is used to denote the sample drawn from the subpopulation N_h. In this context, n_h, refers to the group of nanostores selected within locality h to participate in the surveys.

To determine the sample size, Neyman's optimal allocation technique was applied. According to Fernández García and Mayor Gallego (1995), his method stipulates that stratified sampling should allocate the n sampling units across the L strata by determining the sample size n_h for each stratum, such: $n = \sum_{h=1}^{L} n_h$. This approach optimizes the collection of information following the statistical model described below.

$$n = \frac{N(\sum_{h=1}^{L} W_h S_h)^2}{N\, e^2 + \sum_{1}^{L} W_h\, S_h^2}$$

The representative sample, to which the instrument was applied, was selected using proportional sampling with a margin of error of 3% and a confidence level of 95%. This margin of error was chosen by the authors, as it is widely accepted in studies of this nature. Ultimately, a sample of $n_2 = 159$ tiendas was obtained for the Metropolitan Area of Barranquilla.

3.2. Multiple Correspondence Analysis (MCA)

On the other hand, to analyze the behavior and relationships among the variables, a Multiple Correspondence Analysis (MCA) was conducted using the statistical software R. This technique was selected because it is well-suited for handling categorical data, such as the one obtained from the applied surveys. MCA offers a clear and concise graphical representation that enhances the interpretation and comprehension of complex datasets. This analysis was carried out with a code provided by an expert in the field, which was adjusted according to the needs of the study. Its main objective was to explore the interrelationship of variables, identify grouping patterns among establishments, and highlight atypical trends in logistics processes.

4. Data Collection

The data collection instrument consisted of a survey designed using *Google Forms.* This tool facilitated the efficient organization of information, real-time data storage, and effective management of the responses collected. The survey was administered by each researcher to the business manager, who, in most cases, also personally manages the establishment and possesses detailed knowledge of its operations. Given the limited time available to respondents due to their customer-facing responsibilities, the questions were formulated to be clear, concise, and straightforward, enabling the collection of essential information without significantly disrupting their daily activities.

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Table 2. Instrument Design

Aspect	Variable	Objective
General	Store Context	Evaluate the environment and operational characteristics of the establishment.
	Store Size	Categorize stores according to the number of employees and the type of services offered.
	Customer Service	Assess payment policies and promotional strategies implemented by the establishment.
	Competition and Location	Analyze the competition and its impact on the establishment.
Supply	Subcategories Management	Identify the types of suppliers and product portfolios to determine the presence of a diversified offer in stores.
	Order Management and Frequency	Understand order planning and management to evaluate supply efficiency.
	Delivery Time and Supplier Compliance	Evaluate supplier effectiveness and reliability regarding delivery times and agreed-upon conditions.
	Supplier Selection Criteria	Analyze long-term supplier relationships to identify factors contributing to stability.
Inventory	Identification of Best-Selling Subcategories	Identify the most important product subcategories and sales volume to compare them with inventory management practices.
	Inventory Recording and Control	Assess the existence of accurate inventory control to ensure availability and minimize stockout risks.
	Safety Stock	Understand how reserve stock is managed to avoid both shortages and excess inventory.
	Out-of-Stock Product Management	Identify causes of stockouts and strategies to reduce their occurrence.
Storage	Product Organization and Display	Identify the criteria used to optimize product accessibility and visibility within the store.
	Product Dispatch Criteria	Distinguish the mechanisms used to promote proper product rotation.
	Return Policies	Recognize return policies managed by storekeepers and suppliers (reverse logistics).
	Inventory Losses	Identify the causes of product losses to contrast them with inventory control practices.
Technology	Point-of-Sale System and Information Storage	Evaluate the system used for data management within the stores.
	Sales Tracking	Examine the methodologies used to monitor store performance.
	Technology Adoption and Barriers	Understand perceptions regarding the importance of technology, the degree of familiarity, and the limitations to its adoption.
	Implementation Planning	Identify storekeepers' intentions to implement technology over time.

The structure of the instrument comprised five sections, each targeting different variables aligned with the specific research objectives and informed by the knowledge gained through academic consultations with subject-matter experts. The questions were logically and sequentially organized, incorporating filter questions to guide the flow from general to specific topics. The survey included a variety of question types, such as single-choice, multiple-choice, and Likert-scale items. Table 2 outlines the intended purpose of each section, upon which the survey questions were based

4.1. Instrument Functionality Validation

To ensure a proper navigation of the instrument, a flowchart was developed, which allowed visualization of the path that respondents would follow through the different sections of the questionnaire, ensuring that the process followed a logical and coherent sequence. The validation process was carried out with the support of experts, considering two fundamental approaches: mastery of the subject and statistical rigor. These specialists made an exhaustive review, suggesting rigorous adjustments to minimize the technicality in the formulation of the questions, improve the precision of the response options, and optimize the application of the Likert scale.

4.2. Test of the Degree of Consistency. Cronbach's Alpha

Finally, a pilot test of the instrument was performed in ten nanostores to evaluate its reliability and statistical consistency. Cronbach's Alpha coefficient was applied; in essence, this coefficient analyzes the pattern of responses provided to determine the internal consistency of the instrument. Its minimum acceptable value is 0.7; a value higher than 0.7 indicates a strong relationship between them (Oviedo & Campo-Arias, 2005). The calculation of this statistic was employed by using the variance of the items determined by the following equation (Cronbach, 1951):

$$\propto = \frac{K}{K-1}\left[1 - \frac{\Sigma V_i}{V_t}\right]$$

Where, $\propto$ represents Cronbach's Alpha, K is the number of items, V_i is the variance of the individual items, and V_t is the variance of the total score. A coefficient of 0.83 was obtained, indicating high reliability.

5. Results and Discussion

The analysis of the data obtained through the survey design and application revealed that both the socioeconomic location and the size of the store significantly influence its organizational structure and operational practices. Additionally, shopkeepers who own their establishments tend to invest in technological and logistical improvements aimed at optimizing their processes. To remain competitive with large retail chains, these shopkeepers have adopted strategies such as diversifying their product offerings, enhancing customer service, and incorporating home delivery services. However, the overall adoption of technology remains limited, despite the widely recognized benefits of digitalization, such as improved inventory control and reduced losses. This gap can be attributed to three interrelated factors: limited financial resources, insufficient training in the use of digital tools, and cultural resistance to change, particularly prevalent in family-run businesses with deeply rooted traditional structures.

A large proportion of shopkeepers continue to manage sales and inventory manually, increasing the risk of stockouts, overstocking, and financial losses. Supply processes largely rely on visits from sales representatives, who frequently use mobile applications to manage orders and encourage their adoption among store owners. While this reflects progress toward digitalization, the initiative typically originates from suppliers rather than from the shopkeepers themselves, revealing an imbalance in control over the supply chain. Although relationships with suppliers are generally positive, the study identified dissatisfaction with delivery times and commercial terms. Price and brand recognition are the primary factors influencing supplier selection, which limits the potential for diversification and reinforces the competitive advantage of hard discount retailers.

Inventory management shows significant deficiencies, with 70.5% of shopkeepers lacking accurate control over product inflows and outflows. This hinders the identification of high-turnover items and the ability to optimize stock levels. Furthermore, the absence of proper inventory records exposes businesses to risks such as losses, product spoilage, and theft, all of which negatively impact profitability. The relevance of certain subcategories suggests that shopkeepers should prioritize replenishment and restocking strategies for essential products, such as groceries, unprocessed meats, dairy products, beverages, and fresh fruits and vegetables, to ensure their consistent availability.

In terms of storage, shopkeepers organize products based on affinity and apply the FIFO (First-In, First-Out) method, with the support of suppliers who deliver goods ordered by expiration date. It is also worth noting that strict return policies enforced by suppliers compel shopkeepers to conduct careful inspections upon receipt to avoid losses.

5.1 Numerical Results

The following is the definition of common elements for each logistical process: inventory, supply, and storage, which arise from the findings on the operational reality of the stores studied. These elements provide a frame of reference for the usual operating model of these establishments, helping to characterize them and thus consolidate their identity.

The common elements defined in Table 3 reflect the volume of brands handled by each product subcategory, the ordering patterns adopted by the shopkeepers, and the most common delivery times offered by the supplier. It is noted that the common aspect of the nanostores in the Metropolitan area of Barranquilla is the supply through pre-sale suppliers, who mainly offer delivery times of approximately 24 hours.

Table 3. Common Supply Elements

Subcategories	**Variables**				
	Supplier Type by Category	**Number of Brands**	**Supply Frequency**	**Ordering Method**	**Supplier Delivery Time**
Fruits and Vegetables	Wholesaler	1	3 times per week	Directly	Immediate
Unprocessed Meats	Pre-sales Distributor	2–4	2 times per week	In-person visit (pre-seller)	24 hours
Processed Meats	Company's Pre-sales Staff	5–7	2 times per week	In-person visit (pre-seller)	24 hours
Ice Cream Products	Company's Pre-sales Staff	7 or more	Once per week	In-person visit (pre-seller)	24 hours
Groceries	Pre-sales Distributor	7 or more	2 times per week	In-person visit (pre-seller)	24 hours
Bakery Products	Company's Pre-sales Staff	2–4	Daily	In-person visit (pre-seller)	24 hours
Canned Goods	Pre-sales Distributor	5–7	2 times per week	In-person visit (pre-seller)	24 hours
Dairy Products	Company's Pre-sales Staff	5–7	2 times per week	In-person visit (pre-seller)	24 hours
Confectionery and Snacks	Company's Pre-sales Staff	7 or more	2 times per week	In-person visit (pre-seller)	24 hours
Beverages	Company's Pre-sales Staff	7 or more	2 times per week	In-person visit (pre-seller)	24 hours
Liquors and Cigarettes	Company's Pre-sales Staff	7 or more	2 times per week	In-person visit (pre-seller)	24 hours
Personal Care Products	Pre-sales Distributor	7 or more	2 times per week	In-person visit (pre-seller)	24 hours
Household Cleaning Products	Pre-sales Distributor	7 or more	2 times per week	In-person visit (pre-seller)	24 hours
Miscellaneous Items	Pre-sales Distributor	5–7	Once per week	In-person visit (pre-seller)	24 hours
Ironmongery products	Pre-sales Distributor	2–4	Once per week	In-person visit (pre-seller)	24 hours
Pills and Medications	Pre-sales Distributor	5–7	2 times per week	In-person visit (pre-seller)	24 hours

The behavior of inventory management by product subcategory is presented in Table 4. It can be seen that the importance of each subcategory is partially associated with sales volume. However, in the case of the most relevant products, the frequency of reserve as a safety stock measure is not directly proportional to their level of importance. Only groceries and beverages maintain a constant stock.

Table 4. Common Inventory Elements

Subcategories	Variables		
	Importance	**Sales Volume**	**Safety Stock**
Fruits and Vegetables	Neutral	High	Never
Unprocessed Meats	Important	High	Never
Processed Meats	Neutral	Medium	Never
Ice Cream Products	Low Importance	N/A	Never
Groceries	Very Important	Very High	Frequently
Bakery Products	Neutral	High	Never
Canned Goods	Neutral	Medium	Never
Dairy Products	Important	High	Never
Confectionery and Snacks	Neutral	Medium	Never
Beverages	Important	High	Frequently
Liquors and Cigarettes	Important	Medium	Never
Personal Care Products	Neutral	Medium	Never
Household Cleaning Products	Neutral	Medium	Never
Miscellaneous Items	Low Importance	Very Low	Never
Ironmongery products	Low Importance	Very Low	Never
Pills and Medications	Neutral	Medium	Never

From a logistical perspective, the results shown in Table 5 are in line with the Pareto principle or ABC analysis, where groceries would represent the subcategory A with the highest criticality and impact on inventory; this subcategory occupies 63% of the results with the highest level of importance.

Table 5. Main Subcategories

Subcategory	**Ranking**	**Frequency**	**Percentage**
Groceries	1	92	63%
Unprocessed Meats	2	50	34%
Dairy Products	3	41	28%
Beverages	4	29	20%
Fruits and Vegetables	5	27	18%

It is followed by unprocessed meats with 34%, dairy with 28%, beverages with 20%, and fruits and vegetables with 18%. This ranking directly reflects the composition of the basic family basket and its demand in nanostores.
The importance of these few subcategories suggests that grocers should focus their inventory and supply management strategy on these products, ensuring their constant availability and optimizing replenishment processes. On the other hand, Table 6 shows the frequency with which products in the different subcategories tend to experience a loss of stock.

Table 6. Common Storage Elements

Product Category	**Frequency of Product Loss**
Fruits and Vegetables	Frequent
Unprocessed Meats	Infrequent
Processed Meats	Infrequent
Ice Cream Products	Infrequent
Groceries	Infrequent
Bakery Products	Frequent
Canned Goods	Infrequent
Dairy Products	Very Frequent
Confectionery and Snacks	Frequent
Beverages	Frequent

Product Category	Frequency of Product Loss
Liquors and Cigarettes	Infrequent
Personal Care Products	Never
Household Cleaning Products	Never
Miscellaneous Items	Never
Ironmongery products	Never
Pills and Medications	Infrequent

5.2 Graphical Results

Results from Figure 1 suggest that owned nanostores that have been in operation for the longest time tend to be clustered on one side, while newer and leased stores are located on the opposite side. Also, a differentiation in store size and services offered is observed: larger stores with more services are located at the top of the graph, while smaller stores with no additional services remain at the bottom.

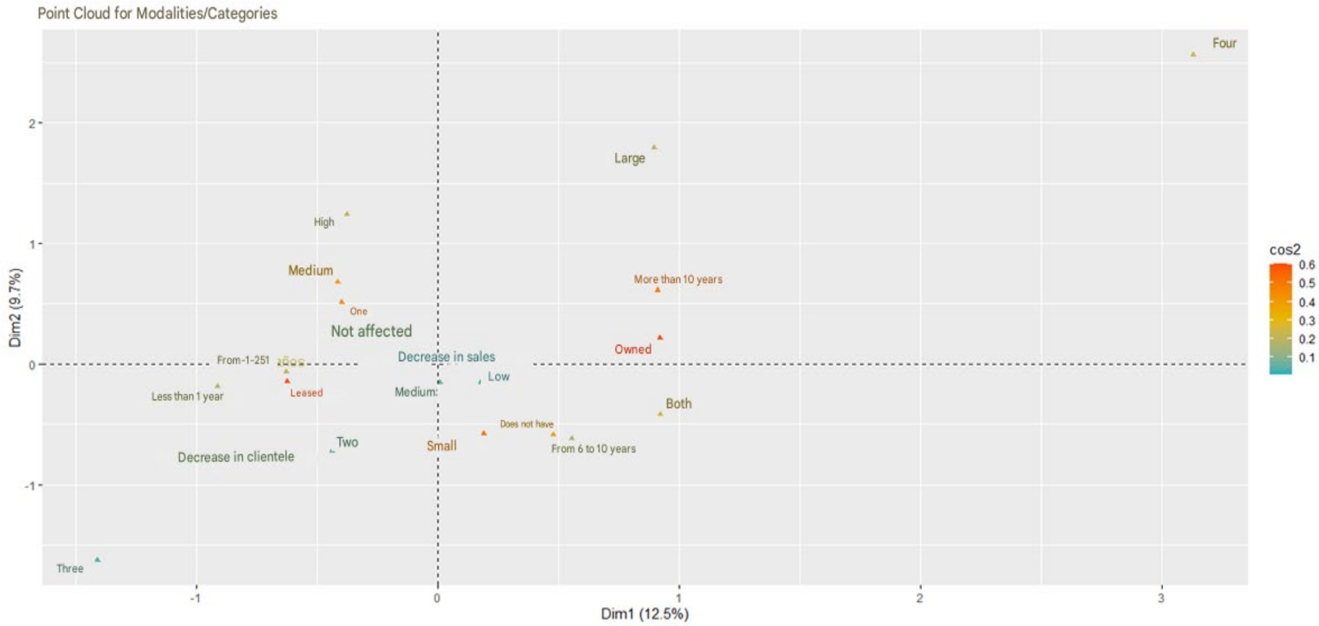

Figure 1. MCA Analysis

In addition, there is a tendency for small stores to have no additional services, to have been in operation for 6 to 10 years, and to be affected by both factors, a decrease in clientele and a decrease in sales. These findings show that variables such as business size, time in operation, and store ownership play a key role in store segmentation. Larger and more consolidated businesses tend to be clustered differently from smaller and newer ones.

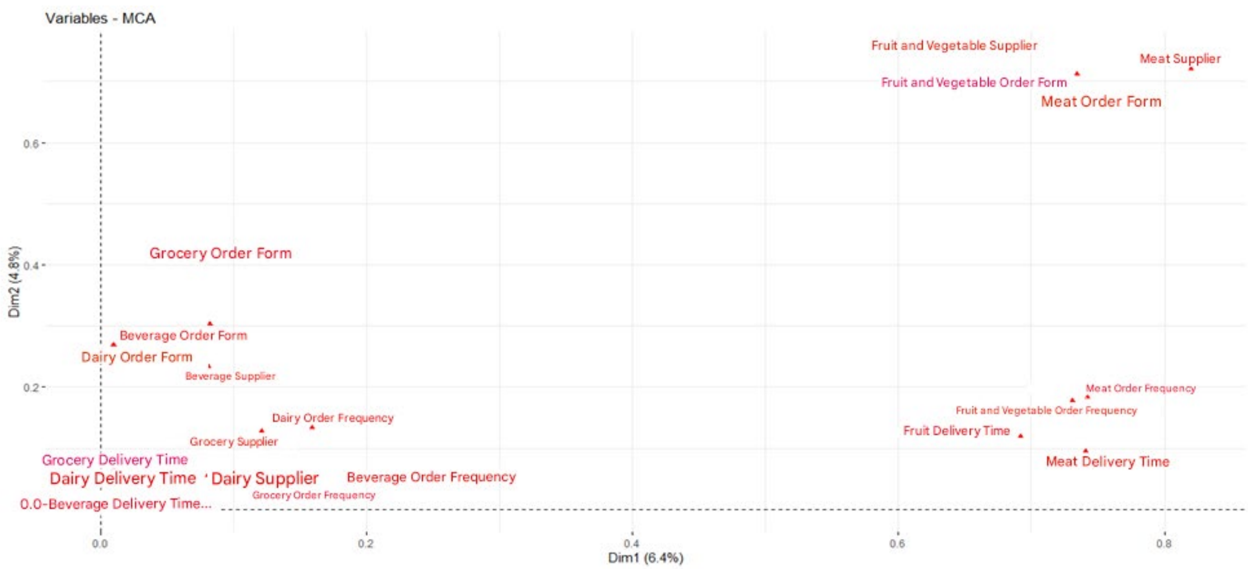

Figure 2. MCA Analysis

Based on Figure 2, generated using R programming, a clear segmentation can be observed within the supply block, where products are grouped according to their suppliers, ordering methods, ordering frequency, and delivery times. On the left side of the graph, subcategories such as groceries, dairy products, and beverages are clustered together, indicating that they share similar characteristics in the management of their supply processes. The proximity of the points representing their ordering methods suggests a common approach in how orders are placed. In contrast, on the right side of the graph, products such as fruits, vegetables, and meats appear more distantly distributed from the rest, suggesting that their logistics processes differ, likely due to their perishable nature and the need for more frequent replenishment.

The closeness between ordering frequency and delivery times for fruits and meats supports the idea that their restocking is more frequent and subject to stricter management. Additionally, the alignment of delivery times with ordering frequency for these products indicates a more consistent operational logic. Furthermore, a clear segmentation is evident among suppliers based on the product categories they serve. While suppliers of groceries, dairy products, and beverages appear closer to the center of the graph, those supplying fruits, vegetables, and meats are positioned farther away and more distinctly, suggesting that they operate under different logistical and commercial conditions.

Figure 3. Identification of best-selling products

Figure 3 shows that 62% of the shopkeepers identify the best-selling products by incurring recurring out-of-stocks, i.e., they recognize which products are the best sellers only when they notice that they are frequently out of stock. By not preventing out-of-stocks, they could face additional costs by restocking urgently or losing customers who opt for other suppliers, considering that they do not have registration systems or strategies to monitor sales behavior in real time, they are forced to rely on the perception after the out-of-stock. Meanwhile, 37% actively track the movement of products in their store, directly analyzing what sells the most, they are attentive to their sales behavior, and can make decisions based on observed patterns before out-of-stocks occur. By better understanding customer demand, they can adjust their assortment and devise strategies more quickly than grocers who rely only on out-of-stocks.

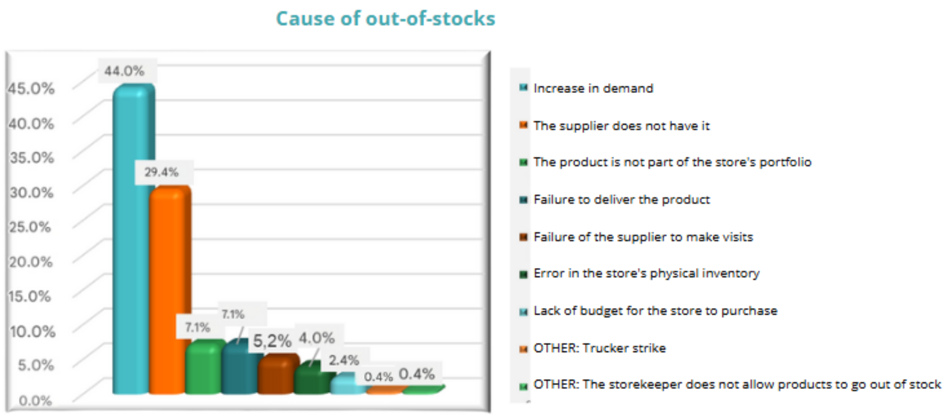

Figure 4. Causes of out-of-stock

Increased demand (44%) and lack of availability of products from the supplier (29.4%) are the main causes of out-of-stocks in nanostores, according to Figure 4. The inability to manage these scenarios can translate into economic losses and the potential deterioration of the relationship with customers, who may seek alternatives in other establishments in the event of a lack of products. Although few grocers consider it a critical problem, the absence of a specific product in the portfolio can have important consequences for the business. When a customer is looking for a particular brand or product and does not find it, there is a real risk of losing the sale and even making purchases at another store, which can affect store loyalty and revenue. In addition, non-delivery by suppliers emerges as another relevant cause of out-of-stocks. Delays or failures in supply directly impact product availability, generating inconveniences.

5.3 Proposed Improvements

The implementation of management indicators as tools for measuring logistics performance enhances decision-making by identifying areas for improvement and ensuring that efforts are aligned with the strategic objectives of nanostores, particularly in terms of maximizing profitability and minimizing losses. Table 7 presents the proposed indicators for the effectiveness of supply processes in local nanostores. It is recommended to apply the indicators outlined in Table 7 and regularly evaluate their level of compliance.

Table 7. Logistics Indicators

Indicator	Formula	Objective	Explanation
Average replenishment frequency per subcategory	$\frac{\#\ of\ weekly\ orders\ per\ subcategory}{Number\ of\ days\ in\ the\ week}$	Determine the regularity of restocking by subcategory.	Helps assess whether the replenishment frequency is sufficient to prevent stockouts
Average supplier delivery time	$\frac{\Sigma\ Delivery\ time\ per\ order}{Total\ number\ of\ orders}$	Measure the efficiency of supplier response times.	Identifies delays that may impact product availability.
Dead stock index (non-moving products)	$\frac{Products\ with\ no\ sales\ during\ the\ period\ per\ subcategory}{Total\ products\ in\ the\ subcategory} \times 100$	Identify unsold products to apply corrective actions.	Detects stagnant inventory to enable product rotation or clearance strategies.
Inventory coverage level	$\frac{7\ days}{Inventory\ turnover\ by\ subcategory} \times 100$	Determine how many days the store can operate with the available stock.	Identifies whether the store maintains a sufficient safety stock based on demand.

6. Conclusion

This study analyzed the logistical conditions and performance of nanostores in the Metropolitan district of Barranquilla, identifying key factors that influence their management. First, the literature review and academic meetings supported by experts revealed that although these stores often lack formal logistics management structures, they naturally incorporate essential processes such as procurement, storage, and inventory management, which are critical to their operational efficiency. Based on the descriptive and multiple correspondence analysis, it was possible to identify areas of improvement and to establish logistics indicators to support the measurement and evaluation of the effectiveness of each logistics activity.

The findings underscore that demand planning and the implementation of an appropriate inventory policy are decisive factors for optimizing logistics operations within the traditional retail channel. Each finding opens new avenues for inquiry that can be explored from various methodological and disciplinary perspectives, contributing to a deeper understanding of logistics management in this type of retail format. Integrating such research into academic programs in logistics and operations management could strengthen the training of professionals with skills applicable to this sector. Incorporating real case studies and logistics analysis methodologies into educational curricula would enhance comprehension of the challenges and opportunities.

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