

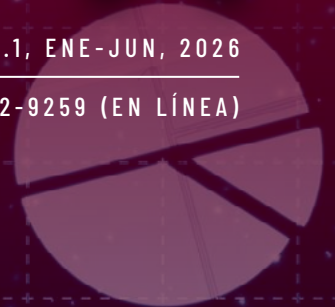


REVISTA INTERNACIONAL DE ECONOMÍA, CONTABILIDAD, Y ADMINISTRACIÓN

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367,054	▲	367,804	-3,16	-0,85		
▲	349,633	▲	350,967	▲	-4,48	-1,26
348,145	▲	349,542	▲	-4,31	-1,22	
285,581		286,614		-3,95	-1,36	
224,732		225,669	▲	-2,91	-1,27	
▲	888,302	890,569		-9,4	-1,04	
688,605	▲	691,077		-7,87	-1,13	
565,009		568,081		-5,8	-1,01	
▲	387,365	388,641	▲	-5,86	-1,48	

370,961	▲	371,917	367,054	▲	367,804	3,16	0,85		
355,444	▲	355,444	▲	349,633	350,967	▲	-4,48	-1,26	
353,85		353,85	▲	348,145	▲	349,542	▲	-4,31	-1,22
290,565		290,565	▲	285,581	286,614		-3,95	-1,36	
228,576		228,576		224,732	225,669		-2,91	-1,27	

▲	4216,894	4175,177	▲	4182,981	-33,91	-0,8
1197,979		1184,115	▲	1187,042	-10,94	-0,91
▲	899,966	888,302		890,569	-9,4	-1,04
695,621		688,605		691,077	-7,87	-1,13



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It is an honor to present the first issue of RIECA – International Journal of Economics, Accounting and Administration, an academic publication created with the purpose of strengthening scientific dissemination, critical reflection, and interdisciplinary dialogue in the fields of economics, accounting, administration, business studies, public management, entrepreneurship, innovation, and sustainable development.

This inaugural edition represents an important milestone for the journal and for the academic community that has contributed to its creation. As a new international editorial platform, RIECA emerges with the commitment to promote rigorous, relevant, and socially meaningful research capable of responding to the contemporary challenges faced by organizations, governments, markets, territories, and societies. Its first issue reflects a clear institutional and academic purpose: to provide a space for the publication of scientific work that connects theoretical contributions with empirical evidence and practical implications.

The articles included in this edition demonstrate the breadth and relevance of the journal's thematic scope. The issue brings together research on entrepreneurship associated with the use of digital wallets in Peru, organizational climate and human talent management in public transport companies, digital consumption habits in Barranquilla during the COVID-19 period, and the own-price and cross-price elasticity of demand for essential food products in households from Tumbes. These contributions offer valuable evidence for understanding the transformation of business practices, consumer behavior, financial inclusion, and decision-making in dynamic socioeconomic contexts.

Likewise, this first issue addresses topics of high relevance for regional and global development, such as the relationship between CO<sub>2</sub> emissions, population growth, and forest loss in Peru; the factors influencing women's entrepreneurship in Barranquilla; emotional intelligence in decision-making processes among SME employees in Lima; and the influence of sensory marketing on consumer perceptions of food purchasing. These studies contribute to the analysis of organizational, environmental, social, and market-related phenomena from diverse methodological perspectives.

The edition also incorporates research focused on contemporary business and public management challenges, including nearshoring strategies in Colombia as a path for business internationalization and economic development, as well as the management of institutional planning in the budget execution of public spending by local governments in Tumbes. In this way, RIECA positions itself as a journal attentive to the realities of Latin America, while maintaining an international vocation and an openness to comparative, interdisciplinary, and applied research.

This first publication is the result of the collective effort of authors, peer reviewers, editorial committee members, scientific committee members, and the editorial team, whose dedication has made it possible to consolidate a journal based on academic quality, editorial responsibility,

and scientific integrity. Their work has been essential to ensure the coherence, relevance, and scholarly value of this inaugural issue.

RIECA begins its editorial path with the conviction that knowledge must contribute not only to academic debate, but also to the improvement of organizational practices, public policies, business competitiveness, social responsibility, and sustainable development. For this reason, the journal seeks to become a meeting point for researchers, professors, professionals, students, and institutions interested in generating knowledge with regional relevance and international projection.

Looking ahead, RIECA assumes the challenge of strengthening its editorial processes, expanding its academic networks, promoting high-quality peer review, and increasing its visibility in national and international scientific communities. This first issue is only the beginning of a broader project aimed at building a reliable, inclusive, and rigorous space for the advancement of economic, accounting, administrative, and business sciences. We invite readers to explore the contents of this inaugural edition with the certainty that they will find research capable of inspiring new questions, encouraging academic dialogue, and contributing to the understanding of the complex realities that shape organizations, markets, and societies today.

**Sincerely,**

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# Evidence of Entrepreneurship Associated with the Use of Digital Wallets in Perú: A Systematic Review

Indícios de empreendedorismo associados à utilização de carteiras digitais no Perú: uma revisão sistemática

*Indicadores de emprendimiento asociados al uso de monederos digitales en Perú: una revisión sistemática*



ARTÍCULO DE REVISIÓN

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## ABSTRACT

This systematic review aimed to identify scientific sources that provide evidence of entrepreneurship associated with the use of digital wallets in Perú. The study was conducted under the PRISMA 2020 guidelines. A Boolean search equation was applied in the Scopus, Web of Science Core Collection, SciELO, and DOAJ databases on March 17, 2026, without applying filters in order to retrieve the largest possible amount of evidence. A total of 14 records were identified; after removing duplicates and excluding documents without full-text access, 8 studies were included in the qualitative synthesis. The findings showed that the available literature is recent and still limited, although it consistently indicates that digital wallets have contributed to improving sales, expanding customer reach, streamlining transactions, and strengthening the operations of microenterprises, SMEs, and retail businesses in Perú. In addition, factors such as ease of use, perceived usefulness, trust, and financial inclusion were identified as favoring adoption, while barriers related to cybersecurity, lack of knowledge, and preference for cash persist. It was concluded that digital wallets constitute a relevant tool for entrepreneurship in Perú, especially in small-scale businesses, although the evidence remains fragmented and localized, highlighting the need for broader and more robust research.

**Keywords:** Digital wallets; entrepreneurship; financial inclusion; SME; fintech; electronic payments.

**JEL Code:** G21; G23; L26; O16; O33; M13.

## RESUMO

Esta revisão sistemática teve como objetivo identificar fontes científicas que forneçam evidências sobre o empreendedorismo associado ao uso de carteiras digitais no Perú. O estudo foi conduzido de acordo com as diretrizes PRISMA 2020. Uma equação de busca booleana foi aplicada nas bases de dados Scopus, Web of Science Core Collection, SciELO e DOAJ em 17 de março de 2026, sem a aplicação de filtros, a fim de recuperar o maior volume possível de evidências. Foram identificados 14 registros; após a remoção de duplicatas e a exclusão de documentos sem acesso ao texto completo, 8 estudos foram incluídos na síntese qualitativa. Os resultados mostraram que a literatura disponível é recente e ainda limitada, embora indique consistentemente que as carteiras digitais contribuíram para melhorar as vendas, ampliar o alcance dos clientes, agilizar as transações e fortalecer as operações de microempresas, PMEs e comércios de varejo no Perú. Além disso, fatores como facilidade de uso, utilidade percebida e inclusão financeira foram identificados como favoráveis à adoção, enquanto persistem barreiras relacionadas à segurança cibernética, falta de conhecimento e preferência pelo dinheiro vivo. Concluiu-se que as carteiras digitais constituem uma ferramenta relevante para o empreendedorismo no Perú, especialmente em negócios de pequena escala, embora as evidências permaneçam fragmentadas e localizadas, destacando a necessidade de pesquisas mais amplas e robustas.

**Palavras-chave:** Carteiras digitais; empreendedorismo; inclusão financeira; PME; fintech; pagamentos eletrônicos.



## INTRODUCTION

Digital transformation has substantially reshaped the global economic and business landscape, creating new opportunities for the creation and development of entrepreneurial ventures (Nambisan, 2017). In this context, financial technologies, commonly known as fintech, have emerged as key catalysts for financial inclusion and entrepreneurial activity, particularly in developing economies (Demirguc-Kunt et al., 2018). Among the various fintech innovations, digital wallets have become disruptive tools that facilitate commercial transactions, reduce operating costs, and expand access to financial services for population segments historically excluded from the traditional banking system (Gabor & Brooks, 2017).

In Perú, the digital-wallet ecosystem has experienced exponential growth in recent years, driven by both structural and circumstantial factors. Mobile-phone penetration, which reaches approximately 90% of the population (OSIPTEL, 2023), has provided the technological infrastructure required for the mass adoption of these platforms. Likewise, the COVID-19 pandemic acted as an unprecedented accelerator of financial digitalization, revealing the need for contactless payment mechanisms and remote transfers (Central Reserve Bank of Perú [BCRP], 2021). Platforms such as Yape, developed by Banco de Crédito del Perú, and PLIN, an interoperable initiative of several banking institutions, have consolidated their position as the digital wallets with the greatest penetration in the Peruvian market, together exceeding 15 million active users (BCRP, 2023).

Entrepreneurship in Perú is a phenomenon of particular socioeconomic relevance. According to the Global Entrepreneurship Monitor (GEM, 2022), the country has consistently ranked among the Latin American countries with the highest rates of early-stage entrepreneurial activity. However, Peruvian ventures face significant challenges related to informality, limited access to financing, and low technological adoption (Serida et al., 2020). In this scenario, digital wallets represent a potential opportunity to overcome some of these barriers by offering simplified collection mechanisms, transaction traceability, and access to basic financial management tools that could strengthen the sustainability of entrepreneurial ventures (Arner et al., 2020).

Despite growing academic interest in the intersection between digital financial technologies and entrepreneurship, the existing literature remains considerably fragmented. Available studies address diverse aspects, ranging from technological adoption and financial inclusion to impacts on microbusinesses and business formalization, but there is still no integrative synthesis that enables a holistic understanding of the role of digital wallets in the Peruvian entrepreneurial ecosystem. This dispersion of knowledge limits both evidence-based public policymaking and the design of informed business strategies (Herrera & Vadillo, 2022).

In light of the above, this systematic review aims to identify scientific sources that provide evidence on entrepreneurship associated with the use of digital wallets in Perú, following the guidelines established by the PRISMA 2020 statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) to ensure methodological rigor, transparency, and reproducibility in the research process (Page et al., 2021).

## METHODOLOGY

### Study Design

This study was developed as a systematic review, a secondary research methodology that enables the rigorous identification, evaluation, and synthesis of the available scientific evidence on a specific topic (Kitchenham & Charters, 2007). This approach was selected because it provides a structured framework that minimizes the biases inherent in traditional narrative reviews, ensuring greater objectivity and reproducibility in the research process.

The review was conducted and reported according to the PRISMA 2020 statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), which is the most widely recognized and adopted methodological standard for systematic reviews in the international scientific community (Page et al., 2021). Adherence to this protocol ensures transparency, facilitates critical appraisal by other researchers, and allows for eventual replication of the study.

### Formulation of the Research Question

- Before initiating the systematic search, the research question was formulated using the PICO format adapted for exploratory scoping reviews:
- Population: Entrepreneurial ventures, entrepreneurs, microenterprises, and small businesses in Perú
- Intervention/Exposure: Use of digital wallets (Yape, Plin, Tunki, BIM, among others)
- Comparison: Not applicable for this review
- Outcomes: Evidence on the impact, adoption, benefits, or challenges of using digital wallets in the entrepreneurial context

This structure made it possible to precisely delimit the scope of the review and guide the construction of the search strategy in a manner consistent with the stated objective.

### Search Strategy: Construction of the Search Equation

A Boolean search equation was designed and structured into three thematic blocks connected by the AND operator, ensuring that retrieved results contained terms related to each of the three essential components: digital wallets, entrepreneurship, and the Peruvian context.

Within each thematic block, the OR operator was used to connect synonyms, linguistic variants, and specific denominations, thereby maximizing the sensitivity of the search. The inclusion of terms in both Spanish and English responded to the need to capture literature published in both languages, considering that journals indexed in international databases frequently publish in English, whereas local scientific production tends to be disseminated in Spanish.



The final search equation was structured as follows:

(“billetera digital” OR “billeteras digitales” OR “billetera móvil” OR “billeteras móviles” OR “billetera electrónica” OR “billeteras electrónicas” OR “digital wallet” OR “digital wallets” OR “mobile wallet” OR “mobile wallets” OR “e-wallet” OR “e-wallets” OR “mobile payment” OR “mobile payments” OR “pago móvil” OR “pagos móviles” OR “pago digital” OR “pagos digitales” OR “Yape” OR “Plin” OR “Tunki” OR “BIM” OR “fintech”) AND (“emprendimiento” OR “emprendimientos” OR “emprendedor” OR “emprendedores” OR “entrepreneur” OR “entrepreneurship” OR “MYPE” OR “MYPES” OR “PYME” OR “PYMES” OR “microempresa” OR “microempresas” OR “pequeña empresa” OR “pequeñas empresas” OR “negocio” OR “negocios” OR “startup” OR “startups” OR “comercio” OR “comerciante” OR “vendedor” OR “vendedores” OR “bodega” OR “bodegas”) AND (“Perú” OR “Perú” OR “Perúano” OR “Perúanos” OR “Perúana” OR “Perúanas” OR “Perúvian”)

The decision to include the names of specific Peruvian digital wallets (Yape, Plin, Tunki, and BIM) was based on the need to capture studies that might refer to these platforms without necessarily using the generic term “digital wallet.” Likewise, the inclusion of terms such as “bodega” and “merchant” reflects the particularities of the Peruvian entrepreneurial context, where these actors represent a significant proportion of the business fabric.

### Selection of Databases

- a. The systematic search was conducted on March 17, 2025, in four databases strategically selected to ensure comprehensive coverage of the available scientific literature:
- b. Scopus: This database was included because it is one of the largest sources of peer-reviewed literature worldwide, covering multiple disciplines, including the social sciences, economics, and management. Its coverage of Latin American journals has increased significantly in recent years, making it relevant to the study context.
- c. Web of Science Core Collection: This database was selected because of its recognized prestige and rigorous criteria for indexing scientific journals. Although it has historically had less representation of Latin American literature than other databases, its inclusion ensures the capture of studies published in high-impact international journals.
- d. SciELO (Scientific Electronic Library Online): The incorporation of this database was essential because it is the main open-access platform for Latin American scientific literature. Its regional focus allows the retrieval of studies developed in contexts similar to Perú and published in Ibero-American journals that may not be indexed in international databases.
- e. DOAJ (Directory of Open Access Journals): This database was included because it specializes in open-access journals worldwide, complementing the search in the other databases and enabling the identification of literature that may not be indexed in Scopus or Web of Science but meets editorial quality standards.

## Decision Not to Apply Filters

No filters for publication date, language, or document type were deliberately applied during the search. This methodological decision was based on several arguments:

First, the digital-wallet phenomenon in Perú is relatively recent, having experienced its greatest expansion after 2016 with the launch of BIM and later with Yape (2017) and Plin (2020). Therefore, applying a time restriction could have led to the exclusion of pioneering studies documenting early adoption experiences.

Second, the literature on this specific topic in the Peruvian context is still emerging and presumably limited. Applying restrictive filters could have significantly reduced the number of retrieved studies and compromised the comprehensiveness of the review.

Finally, not applying filters made it possible to obtain a complete overview of the state of knowledge on the topic, identifying not only scientific articles but also other types of academic documents that could provide relevant evidence.

## Independent Search Process

To minimize human error and ensure the reliability of the search process, the search was carried out independently by each of the two authors of the study. Each researcher executed the search equation in the four selected databases, recorded the number of results obtained, and downloaded the corresponding records.

Subsequently, both authors compared the results obtained independently, confirming complete agreement in the findings identified in each database. This double-verification procedure, recommended by methodological guidelines for systematic reviews (Higgins et al., 2019), increases the reliability of the process and reduces the probability of omitting relevant studies due to errors in search execution.

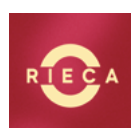
## Search Results

The search strategy yielded a total of 14 records distributed across the four databases consulted. Table 1 presents the results obtained from each information source in detail:

**Table 1 | Search results by database**

Database	Records Identified	Duplicates	Not Accessible	Studies Included
SciELO	4	0	0	4
Scopus	5	2	1	2
Web of Science Core Collection	5	2	1	2
DOAJ	0	0	0	0
Total	14	4	2	8

*Note. The search was conducted on March 17, 2025. Duplicates correspond to studies indexed simultaneously in multiple databases.*



The results show that SciELO was the most productive source in terms of unique studies included, which was expected given its focus on Latin American literature. Scopus and Web of Science contributed similar numbers of records, although with considerable overlap between the two, reflecting the multiple indexing typical of journals with greater international visibility.

The absence of results in DOAJ, despite its broad coverage of open-access journals, suggests that the specific literature on digital wallets and entrepreneurship in Perú is concentrated in journals indexed in the other consulted databases, or that the terms used in the search equation did not match the terminology used in publications indexed in DOAJ.

Of the 14 records initially identified, 4 corresponded to duplicates present in multiple databases, specifically studies indexed simultaneously in SciELO and Scopus or in Scopus and Web of Science. These duplicates were identified and removed by comparing titles, authors, and DOI when available.

In addition, 2 studies identified in Scopus and Web of Science, respectively, could not be incorporated into the review because they were available only through subscription or payment models, with no full-text access through the researchers' institutional subscriptions or open-access repositories. Although this limitation reduces the final number of included studies, it reflects the real restrictions faced by researchers in contexts with limited access to scientific journal subscriptions.

After removing duplicates and inaccessible records, 8 studies were selected for inclusion in the systematic review.

### **Eligibility Criteria**

The definition of clear inclusion and exclusion criteria is a fundamental element in systematic reviews, as it objectively delimits which studies will be considered for the synthesis and which will be excluded (Higgins et al., 2019). The criteria established for this review were as follows:

#### *Inclusion Criteria*

Studies were included when they met all of the following criteria:

- a. **Thematic relevance:** Studies that explicitly addressed the relationship between digital wallets and entrepreneurship, whether by analyzing the impact of these technologies on ventures, adoption patterns among entrepreneurs, perceived benefits, challenges faced, or any other dimension linking both phenomena.
- b. **Geographic context:** Research that included specific evidence on the Peruvian context. Studies conducted exclusively in Perú, as well as comparative or regional studies that included data or analysis referring to the Peruvian case, were considered.
- c. **Type of publication:** Scientific articles published in indexed journals, prioritizing those subjected to peer-review processes that ensure a minimum standard of methodological quality.
- d. **Availability:** Studies with full-text access, either through open access, institutional repositories, or

subscriptions available to the researchers.

- e. **Methodological design:** Empirical studies with quantitative, qualitative, or mixed approaches, as well as theoretical or conceptual studies providing analytical frameworks relevant to understanding the phenomenon studied.
- f. **Language:** Publications in Spanish or English, considering that these are the predominant languages in the scientific literature on the topic and the languages in which the researchers were competent to conduct the analysis.

### *Exclusion Criteria*

Studies were excluded when they presented any of the following characteristics:

- a. **Absence of Peruvian evidence:** Studies that, despite addressing digital wallets and entrepreneurship, did not include specific data, analysis, or references to the Peruvian context. Studies on other Latin American countries were excluded unless they explicitly incorporated comparisons with the Peruvian case.
- b. **Non-scientific publications:** Opinion articles, editorials, letters to the editor, journalistic notes, or documents without rigorous empirical or theoretical support. Although such documents may provide valuable perspectives, their inclusion would compromise the methodological homogeneity of the review.
- c. **Duplicates:** Records identified in multiple databases, retaining only one version to avoid overrepresentation of particular studies in the synthesis.
- d. **Inaccessibility:** Studies whose full text could not be obtained through any available mechanism, including open access, repositories, institutional subscriptions, or contact with authors.
- e. **Exclusively technical focus:** Studies centered solely on technological, cybersecurity, or systems-architecture aspects of digital wallets, with no link to business or entrepreneurial dimensions.

### **Selection Process**

The study-selection process was developed according to the four phases established in the PRISMA 2020 protocol, each with specific objectives and clearly defined procedures:

#### *Phase 1: Identification*

In this initial phase, the search equation was executed in each of the four selected databases. The retrieved records were exported in formats compatible with reference-management software to facilitate subsequent processing. The exact number of results obtained in each database, as well as the search execution date, was recorded, which is essential for ensuring process reproducibility.

#### *Phase 2: Screening*

During the screening phase, duplicate records were identified and removed. This process was initia-



lly carried out automatically using reference-management software, followed by manual verification to identify duplicates not detected automatically due to variations in the transcription of titles or authors' names. The unique records resulting from this process advanced to the next evaluation phase.

### *Phase 3: Eligibility*

In this phase, each non-duplicate record was assessed against the previously established inclusion and exclusion criteria. The assessment was conducted in two stages: first by reading titles and abstracts to discard clearly irrelevant studies, and then by reading the full text for those that passed the first filter. Studies whose full text could not be accessed were excluded at this stage, and the reasons for exclusion were documented in each case.

### *Phase 4: Inclusion*

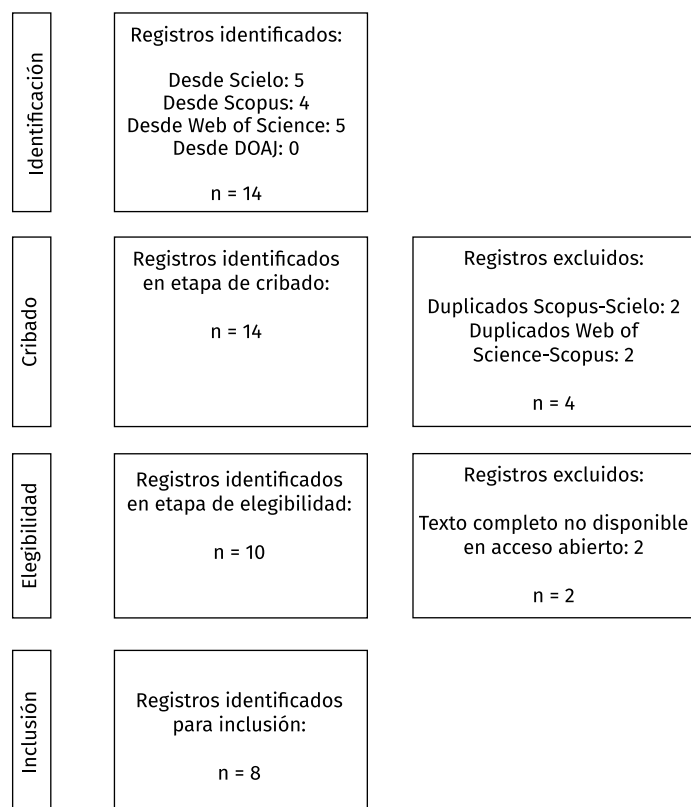
The final phase consisted of defining the definitive set of studies to be submitted to the qualitative synthesis. The 8 studies that met all inclusion criteria and passed the previous phases were incorporated into the review, after which systematic data extraction was conducted.

## **PRISMA Flow Diagram**

The study-selection process is graphically represented in Figure 1, following the standardized format proposed by the PRISMA 2020 statement. This diagram transparently displays the flow of records through the different phases of the review, as well as the reasons for exclusion at each stage.

**Figure 1**

*PRISMA flow diagram of the study identification, screening, eligibility, and inclusion process*



## Data Extraction

A standardized matrix was designed for the systematic extraction of information from the included studies, enabling the uniform collection of relevant data from each investigation. The variables included in the extraction matrix were defined according to the review objective and the expected characteristics of studies on the topic:

- a. Bibliographic data: Authors, year of publication, study title, journal name, volume, issue and pages, as well as the DOI when available.
- b. Study objective: Main purpose stated by the authors, allowing the specific focus of each study to be understood.
- c. Methodological design: Type of research (descriptive, correlational, explanatory, exploratory), methodological approach (quantitative, qualitative, mixed), data-collection techniques used, and characteristics of the study sample or participants.
- d. Digital wallet studied: Identification of the specific platforms analyzed in each study (Yape, Plin, Tunki, BIM, or others), or whether the study addressed digital wallets generically.
- e. Type of entrepreneurship analyzed: Characterization of the ventures studied according to size (microenterprise, small business), economic sector, degree of formalization, geographic location, or other relevant variables.
- f. Main findings: Synthesis of the most relevant results reported by the authors in relation to the objective of this review.
- g. Reported limitations: Methodological or scope-related restrictions acknowledged by the authors of each study.
- h. Data extraction was carried out independently by both authors for the first three studies, and the results were subsequently compared to verify consistency in interpretation and information recording. Once agreement on extraction criteria was reached, the remaining studies were distributed between the authors for individual processing.

## Methodological Quality Assessment

The methodological quality of the included studies was assessed using scientific-rigor criteria adapted to the design of each study. Given that the identified studies presented diverse methodological designs (quantitative, qualitative, and mixed), a single standardized assessment tool was not used; instead, general quality criteria applicable across designs were considered:

- a. Clarity and coherence in the formulation of objectives or research questions
- b. Adequacy of the methodological design in relation to the stated objective
- c. Sufficient description of data-collection procedures
- d. Validity and reliability of the instruments used (in quantitative studies)



- e. Credibility and transferability of the findings (in qualitative studies)
- f. Coherence between the results presented and the conclusions formulated
- g. Recognition of study limitations

It is important to note that, following methodological recommendations for systematic reviews in the social sciences (Petticrew & Roberts, 2006), the quality assessment was not used as an exclusion criterion, but rather as an element to contextualize the findings and weigh the strength of the reported evidence.

### Synthesis of Information

Considering the heterogeneity identified in the methodological designs, theoretical approaches, and variables analyzed in the included studies, a narrative synthesis of the findings was conducted instead of a quantitative meta-analysis. This approach was appropriate because the diversity of the studies prevented statistical pooling of results while still allowing patterns, convergences, and divergences in the available evidence to be identified (Popay et al., 2006).

To facilitate systematic understanding and comparison of the included studies, the extracted information was presented through structured tables that organized the data in a standardized manner. This presentation strategy made it possible to visualize clearly and orderly the characteristics of each study, facilitating both comparative analysis and the identification of trends in the reviewed literature.

The synthesis tables included the following dimensions of analysis:

- a. Bibliographic data: Authors, year of publication, study title, journal name, volume, issue and pages, as well as the DOI when available. This information enabled precise identification of each study and facilitated its location by readers interested in consulting the primary sources.
- b. Study objective: Main purpose stated by the authors, enabling the specific focus of each investigation and its particular contribution to the field of knowledge on digital wallets and entrepreneurship in Perú to be understood.
- c. Methodological design: Type of research (descriptive, correlational, explanatory, exploratory), methodological approach (quantitative, qualitative, mixed), data-collection techniques used, and characteristics of the study sample or participants. This information was essential for assessing the methodological strength of each study and appropriately contextualizing its findings.
- d. Digital wallet studied: Identification of the specific platforms analyzed in each study (Yape, Plin, Tunki, BIM, or others), or whether the study addressed digital wallets generically. This datum made it possible to map which platforms received greater research attention and which remained underexplored in the literature.
- e. Type of entrepreneurship analyzed: Characterization of the ventures studied according to size (microenterprise, small enterprise), economic sector, degree of formalization, geographic

location, or other relevant variables. This dimension was crucial for understanding the scope of the findings and their applicability to different segments of the Peruvian entrepreneurial ecosystem.

- f. **Main findings:** Synthesis of the most relevant results reported by the authors in relation to the objective of this review. This column constituted the core of the synthesis, condensing the evidence that directly answered the research question.
- g. **Reported limitations:** Methodological or scope-related restrictions acknowledged by the authors of each study. The inclusion of this information enabled a critical reading of the findings and guided the identification of knowledge gaps that future research could address.
- h. This tabular organization allowed not only an orderly presentation of the information but also the identification of cross-cutting patterns, gaps in the literature, and areas requiring further research development in the field of entrepreneurship associated with digital wallets in the Peruvian context.

## RESULTS

This section presents the findings derived from the eight studies included in the systematic review. To facilitate comparative reading, the information was organized into four tables: the first summarizes the bibliographic and methodological characteristics of the studies; the second synthesizes the main findings related to digital wallets and entrepreneurship; the third groups the evidence into common thematic axes; and the fourth identifies the limitations reported by each study. This organization made it possible to visualize more clearly both the available evidence and the gaps in the literature.

**Table 2**

*Search results by database (citation, title, source, objective, and methodological design)*

No.	Citation	Title	Source	Study objective	Methodological design
1	Vilcanqui Velazquez et al. (2022)	Lessons from Remarkable FinTech Companies for the Financial Inclusion in Perú	Journal of Risk and Financial Management	To analyze outstanding FinTech companies in other countries in order to extract lessons applicable to financial inclusion in Perú.	Exploratory-descriptive study with a mixed approach, qualitative benchmarking, and correlational analysis.
2	Vera-Acevedo & Iparraguirre-Piedra (2025)	The influence of consumer trust on the drivers of electronic wallet transactions	Intangible Capital	To analyze the relationship between consumer trust and electronic-wallet transactions in Perú.	Quantitative study, online survey, and PLS-SEM structural modeling.
3	Juarez-Alvarez et al. (2025)	Adoption of digital wallets and their impact on the sales of Peruvian micro-entrepreneurs	Polish Journal of Management Studies	To determine the level of acceptance of digital wallets and their impact on the sales of microentrepreneurs in Arequipa.	Quantitative study, survey, TAM model, correlational analysis, and multiple linear regression.



No.	Citation	Title	Source	Study objective	Methodological design
4	Gomez et al. (2022)	Crowdlending as a financing alternative for MSMEs in Perú	Retos. Revista de Ciencias de la Administración y Economía	To determine whether MSMEs in Piura are willing to demand financing through crowdlending.	Quantitative, descriptive, cross-sectional study using a survey.
5	Vargas García (2021)	Digital Banking: Technological Innovation in Financial Inclusion in Perú	Industrial Data	To determine the relationship between digital banking and financial inclusion in Perú from 2010 to 2019.	Quantitative, correlational study using Pearson analysis.
6	Salazar-Rebaza et al. (2024)	Use of e-Wallets and Their Impact on SME Business Transactions	Proceedings of the 19th European Conference on Innovation and Entrepreneurship	To determine the impact of using electronic wallets on SME business transactions.	Applied, quasi-experimental, cross-sectional, quantitative study.
7	Guardamino & Tostes (2021)	Qualitative analysis of technology management for financial-service innovation: A multiple case study of FinTech startups in Metropolitan Lima	New Trends in Qualitative Research	To analyze technology-management processes for financial-service innovation in FinTech startups in Metropolitan Lima.	Qualitative multiple-case study, in-depth interviews, and WebQDA analysis.
8	Mendoza Rejas et al. (2023)	Mobile wallets as an alternative payment method for retailers during the pandemic	Investigacion Negocios & Revista Científica	To determine the impact of the inclusion of mobile wallets as a payment method from the perspective of retail entrepreneurs in Ica.	Quantitative, exploratory, descriptive, cross-sectional study.

Table 2 made it possible to identify the main bibliographic and methodological characteristics of the studies included in the systematic review. First, a recent temporal concentration of publications was observed, ranging from 2021 to 2025, which shows that the analysis of digital-wallet use and its relationship with entrepreneurship in Perú is still an emerging field of research. Likewise, the predominance of quantitative studies stood out, as six of the eight works used surveys, correlational analyses, or statistical models to examine the phenomenon. This suggests a tendency in the literature to measure perceptions, levels of acceptance, or relationships between variables, rather than to deepen complex contextual explanations.

Only one study used a qualitative approach and one employed a mixed design, revealing a lower presence of research aimed at understanding in depth the organizational, technological, or social processes associated with the adoption of these tools. Regarding objectives, some studies directly addressed digital wallets and their impact on microentrepreneurs or small businesses, whereas others offered contextual evidence on financial inclusion, digital banking, or the FinTech ecosystem. Overall, the table showed a heterogeneous body of literature that is still consolidating but is sufficiently relevant to support analysis of the phenomenon in the Peruvian context.

**Table 3**

*Search results by database (citation, context or sample, digital wallet or technology studied, and type of entrepreneurship or unit of analysis)*

No.	Citation	Context / sample	Digital wallet or technology studied	Type of entrepreneurship or unit of analysis
1	Vilcanqui Velazquez et al. (2022)	Comparative study of Perú, Kenya, Brazil, the Philippines, and Pakistan.	BIM and mobile wallets in the Peruvian context; Fin-Tech in general.	MSMEs, microenterprises, and small Peruvian businesses as indirect beneficiaries.
2	Vera-Acevedo & Iparra-guirre-Piedra (2025)	386 users aged 18 to 40 from Metropolitan Lima who had used e-wallets in the previous three months.	Yape, Tunki, Agora Pay, and Plin.	Electronic-wallet users; indirect evidence for businesses accepting these payments.
3	Juarez-Alvarez et al. (2025)	120 microentrepreneurs from a shopping center in Arequipa.	Digital wallets in general; the article mainly mentions Yape and Plin as Peruvian references.	Microentrepreneurs in the commercial sector.
4	Gomez et al. (2022)	382 MSMEs in the Piura region.	Crowdlending and the Fin-Tech ecosystem, not digital payment wallets.	MSMEs in commerce, restaurants, technical services, and other sectors.
5	Vargas Garcia (2021)	Aggregated national data for Perú for the period 2010-2019.	Digital banking and digital payments.	Peruvian financial system; indirect evidence for entrepreneurship.
6	Salazar-Rebaza et al. (2024)	88 SMEs in Otuzco, La Libertad; 23 in the control group and 65 in the experimental group.	Electronic wallets in general.	SMEs in commerce and services.
7	Guardamino & Tostes (2021)	Four FinTech startups in Lima: Apurata, Difondy, TasaTop, and Tranzfer.me.	Digital financial innovation; not focused on payment wallets.	Peruvian FinTech startups.
8	Mendoza Rejas et al. (2023)	385 entrepreneurs from formal retail businesses in the province of Ica.	Plin, Yape, Tunki, Lukita, and mobile wallets in general.	Formal retail businesses.

Table 3 allowed a more precise observation of the empirical contexts in which the included studies were developed, as well as the type of financial technology addressed and the unit of analysis used in each case. First, most studies were concentrated in specific urban areas of Perú, such as Metropolitan Lima, Arequipa, Ica, Piura, and Otuzco, which shows a scientific production focused on specific territorial contexts and not necessarily representative of the entire country. This characteristic suggests that the available evidence remains fragmented and localized.

It was also observed that not all studies directly analyzed digital wallets as a payment method. Some works focused on related technologies, such as digital banking, crowdlending, or financial innovation in FinTech startups, which broadened the understanding of the Peruvian digital ecosystem, although with an indirect relationship to the central objective of the review. Among the wallets specifically mentioned, Yape and Plin were the most recurrent, followed by Tunki, Lukita, and Agora Pay, reflecting their greater presence in recent literature. Finally, the table showed that the units of analysis were diverse, ranging from individual users to microentrepreneurs, SMEs, retail businesses, and FinTech startups, confirming that the phenomenon has been studied from complementary but still dispersed perspectives.



**Table 4***Main findings on entrepreneurship and digital wallets in Perú*

No.	Citation	Main findings	Evidence on entrepreneurship with digital wallets in Perú	Limitations reported in the study
1	Vilcanqui Velazquez et al. (2022)	Perú showed favorable conditions for expanding financial inclusion through mobile wallets. Mobile infrastructure, informality, and the need for financial access make FinTech a path for expanding services.	Indirect evidence. The study argued that mobile wallets and similar services can benefit microenterprises and entrepreneurs by facilitating payments, remittances, and access to financial services.	It did not empirically assess Peruvian entrepreneurs or measure sales, income, or specific business adoption of digital wallets.
2	Vera-Acedo & Iparraguirre-Piedra (2025)	Perceived quality and user experience positively influenced consumer trust. Trust, in turn, positively affected electronic word of mouth. Perceived risk did not have a significant moderating effect.	Indirect evidence. The study suggested that greater trust in digital wallets may encourage continued use in commercial environments, indirectly benefiting businesses that accept payments through these applications.	The study was limited to users aged 18 to 40 in Metropolitan Lima. It did not directly study MSMEs, ventures, or business indicators.
3	Juarez-Alvarez et al. (2025)	Eighty-eight percent of microentrepreneurs considered digital wallets easy to use; 81% showed a positive attitude; and 80% stated that these tools increased their customer reach and sales. A high correlation was also found between frequency of use and sales growth ( $\rho = 0.820$ ).	Direct and strong evidence. The study showed that digital-wallet use had a positive impact on the commercial performance of Peruvian microentrepreneurs, especially in sales and customer acquisition.	The sample was limited to one shopping center in Arequipa and was selected by convenience. Other regions and economic sectors beyond commerce were not included.
4	Gomez et al. (2022)	MSMEs in Piura showed willingness to demand digital financing through crowdlending, valuing lower financial costs and greater flexibility.	Indirect evidence. Although it did not address digital payment wallets, it showed the openness of Peruvian entrepreneurship to FinTech solutions and financial digitalization.	The study focused on crowdlending rather than digital wallets; therefore, its relationship with mobile payments was tangential.
5	Vargas Garcia (2021)	A very high positive correlation was found between digital-banking penetration and financial inclusion in Perú ( $r = 0.982$ ). The study concluded that banking digitalization favors access to financial services.	Indirect evidence. The study showed that a more digitalized financial environment could facilitate conditions for the development of ventures and small businesses.	The analysis was aggregated at the national level and did not distinguish entrepreneurs, MSMEs, or specific digital wallets.
6	Salaazar-Rebaza et al. (2024)	Before training, 96% of merchants feared using electronic wallets because of cybercrime concerns. After the training and follow-up program, 98% recognized the importance of their use and improved their commercial transactions.	Direct evidence. The study demonstrated that training in the use of electronic wallets improved transactions, energized operations, facilitated payments to suppliers and services, and strengthened SME competitiveness.	The study was conducted only in Otuzco and with a relatively small sample. Specific digital-wallet brands were not differentiated.
7	Guardamino & Tostes (2021)	TasaTop was found to be the FinTech startup best prepared to innovate services. The strongest process was technological planning and the weakest was customer training.	Indirect evidence. The study contributed knowledge on FinTech entrepreneurship in Perú and its innovation capacity, although it did not address digital-wallet use by traditional entrepreneurs.	It did not analyze digital wallets, sales, or user microenterprises; it focused on the internal technology management of FinTech startups.
8	Mendoza Rejas et al. (2023)	A total of 64.9% of retail entrepreneurs had a positive attitude toward mobile wallets; 57% reported satisfaction; 56.9% considered them efficient and effective; and around 50% still expressed doubts about security, privacy, and regulatory knowledge.	Direct evidence. The study showed that mobile wallets became an alternative payment method for small businesses in Ica during the pandemic, supporting business continuity and digital adaptation.	The data came from perceptions of formal retail entrepreneurs in Ica. Actual sales or longitudinal economic results were not measured.

Table 4 showed that the reviewed studies provided different levels of approximation to the link between entrepreneurship and digital wallets in Perú. Vilcanqui Velazquez et al. (2022) and Vargas Garcia (2021) offered contextual evidence on financial inclusion and digitalization, showing favorable conditions for the expansion of these services. Vera-Acevedo and Iparraguirre-Piedra (2025) highlighted the role of consumer trust as a factor that can encourage the continued use of digital wallets in commercial environments. Juarez-Alvarez et al. (2025) presented one of the most direct pieces of evidence by identifying a positive impact on sales and customer acquisition among microentrepreneurs. Gomez et al. (2022) and Guardamino and Tostes (2021) broadened the discussion from the FinTech ecosystem and financial innovation, albeit indirectly. Salazar-Rebaza et al. (2024) showed that training improves adoption and transactional performance among SMEs. Finally, Mendoza Rejas et al. (2023) confirmed that mobile wallets supported business continuity among retail businesses, although concerns about security and regulation persisted.

## DISCUSSION

### General synthesis of the findings

The results of this systematic review show that the available scientific evidence on entrepreneurship and digital wallets in Perú is still limited, recent, and methodologically diverse, although it presents consistent trends. In general terms, the reviewed studies suggest that digital wallets are tools with the potential to strengthen the commercial activities of microentrepreneurs, retail businesses, and small firms, especially in contexts where transaction speed, reduced cash use, and closeness to customers are strategic factors.

In relation to the objective of this review, which was to identify sources that provide evidence of entrepreneurship involving digital wallets in Perú, it was observed that not all included studies addressed this relationship directly. However, together they made it possible to build a broad view of the phenomenon, integrating evidence on commercial use, financial inclusion, consumer trust, the FinTech ecosystem, and technological innovation.

### Direct evidence on entrepreneurship and digital wallets

The studies by Juarez-Alvarez et al. (2025), Salazar-Rebaza et al. (2024), and Mendoza Rejas et al. (2023) offered the most direct evidence on the relationship between digital wallets and entrepreneurship in Perú. These studies agreed that the use of digital wallets favored specific dimensions of business performance, such as increased sales, expanded customer reach, faster collections and payments, and improved business operations.

Specifically, Juarez-Alvarez et al. (2025) reported that 80% of the surveyed microentrepreneurs stated that the use of digital wallets increased their customer reach and sales. They also found a high correlation between frequency of use and sales growth, which constitutes relevant empirical evidence of the positive impact of these tools on commercial entrepreneurship. Salazar-Rebaza et al. (2024), in turn, demonstrated that the incorporation of electronic wallets, combined with training and follow-up, strengthened SMEs' commercial transactions, facilitated payments to suppliers, and



improved competitiveness. Finally, Mendoza Rejas et al. (2023) found that mobile wallets became an important alternative payment method for retail businesses during the pandemic, enabling commercial continuity in a context of health restrictions.

These findings support the assertion that empirical evidence exists regarding the contribution of digital wallets to Peruvian entrepreneurship, although this evidence remains concentrated in local studies and specific sectoral contexts.

### **Indirect evidence and contextual factors**

In addition to direct evidence, the review identified a group of studies that provided important contextual elements for understanding the phenomenon. This group included the works of Vilcanqui Velazquez et al. (2022), Vera-Acevedo and Iparraguirre-Piedra (2025), Gomez et al. (2022), Vargas Garcia (2021), and Guardamino and Tostes (2021).

These studies did not directly measure the impact of digital wallets on specific business indicators, but they offered valuable information about the environment in which these technologies are embedded. For example, Vilcanqui Velazquez et al. (2022) noted that the Peruvian context presents favorable conditions for the expansion of FinTech solutions oriented toward financial inclusion, especially due to factors such as mobile penetration, informality, and the need for access to financial services. Similarly, Vargas Garcia (2021) found a very high correlation between digital banking and financial inclusion in the country, suggesting that digitalization of the financial system creates a more favorable environment for the development of economic and commercial activities.

Likewise, Vera-Acevedo and Iparraguirre-Piedra (2025) showed that consumer trust is strengthened by perceived quality and user experience, which is essential for continued use of electronic wallets in consumption and commercial environments. In the same vein, Guardamino and Tostes (2021) provided evidence on the technological maturity of Peruvian FinTech startups, showing that innovation and technology management are key factors for strengthening the digital financial ecosystem.

### **Ease of use, acceptance, and perceived value**

One of the most consistent findings of the review was the positive perception of the ease of use of digital wallets. Across different studies, users and entrepreneurs valued these tools as simple, fast, useful, and functional. This pattern was especially visible in the findings of Juarez-Alvarez et al. (2025), who reported that 88% of microentrepreneurs considered digital wallets easy to use. Similarly, Mendoza Rejas et al. (2023) found that most retail entrepreneurs had a favorable attitude toward their use and considered them efficient and effective.

Ease of use and perceived value are fundamental factors for the adoption of technological tools in small businesses, especially in contexts where technical, financial, and human resources are limited. In the case of digital wallets, these characteristics appear to be decisive because they reduce entry barriers and allow entrepreneurs to quickly incorporate new payment methods into their daily operations.

The results of Vera-Acevedo and Iparraguirre-Piedra (2025) also reinforce this interpretation by demonstrating that user experience and perceived quality positively influence consumer trust. This su-

ggests that technological acceptance does not depend solely on the existence of an application, but also on how well it responds to expectations of security, speed, and practicality.

### **Financial inclusion and transformation of the entrepreneurial ecosystem**

The review also made it possible to discuss the role of digital wallets within a broader framework of financial inclusion. Several studies suggested that these technologies not only simplify payments but also broaden access to financial services for people and businesses historically excluded from the traditional banking system.

In this regard, Vilcanqui Velazquez et al. (2022) and Vargas Garcia (2021) agreed that financial digitalization can act as a mechanism for economic integration. This point is especially relevant in the Peruvian case, where business informality and low levels of bank access have represented persistent barriers to the development of micro and small enterprises. By requiring lower entry costs and operating through mobile phones, digital wallets reduce part of these barriers and facilitate basic financial transactions.

Although the study by Gomez et al. (2022) did not focus on digital wallets, it showed that Peruvian MSMEs are willing to adopt FinTech solutions for financing, suggesting a broader openness of Peruvian entrepreneurship to financial digitalization. Thus, digital wallets should be understood not only as payment methods but also as part of a broader digital financial ecosystem that can contribute to strengthening entrepreneurship.

### **Persistent barriers: trust, security, and preference for cash**

Despite the benefits identified, the review also showed that the adoption of digital wallets faces important barriers. The most recurrent barrier was distrust associated with security, privacy, cybercrime, and lack of regulatory knowledge. This barrier appeared clearly in the study by Salazar-Rebaza et al. (2024), where 96% of merchants initially expressed fear of using electronic wallets due to concerns about fraud or cybercrime. Similarly, Mendoza Rejas et al. (2023) found relevant doubts about security and privacy among retail entrepreneurs in Ica.

These barriers are compounded by the persistence of cash use as a dominant cultural practice. Even in studies where the benefits of digital wallets were recognized, a preference for cash continued to appear, due to a sense of control, the visibility of money, or transactional habit. This aspect is important because it shows that the transition to digital payment methods depends not only on technological availability but also on the transformation of everyday habits, perceptions, and economic practices.

Therefore, the expansion of digital wallets in Peruvian entrepreneurship requires attention not only to technological access but also to trust building. This implies strengthening platform security, improving institutional communication, expanding digital education, and providing user support.

### **Importance of training and support**

Training emerged as a decisive factor in the successful adoption of digital wallets. The study by Salazar-Rebaza et al. (2024) was particularly illustrative in this regard, as it showed that after a pro-



cess of training and monitoring, 98% of merchants recognized the importance of using electronic wallets in their regular operations. This demonstrated that initial rejection did not necessarily imply structural opposition to the technology, but rather a lack of information, familiarity, or perceived security.

This result has relevant implications for entrepreneurship-promotion and financial-inclusion programs. Digital wallets can be highly functional, but their effective incorporation requires training processes that enable entrepreneurs to understand their benefits, risks, and uses. In other words, digital and financial literacy appears as a necessary condition for transforming an available tool into one that is truly leveraged.

### **Methodological considerations of the reviewed evidence**

From a methodological perspective, the review showed that most studies used a quantitative approach and relied on surveys, descriptive and correlational analyses, or technology-acceptance models. This made it possible to identify patterns, relationships, and general trends, but limited the in-depth understanding of the cultural, organizational, and social processes involved in digital-wallet adoption.

Only one study used a qualitative approach and another a mixed approach, revealing a limited presence of research aimed at exploring in depth entrepreneurs' experiences and contextual adoption factors. Moreover, several studies used localized samples concentrated in cities such as Lima, Arequipa, Ica, Piura, and Otuzco. This means that, although the evidence found is valuable, the findings should be interpreted with caution, as they do not necessarily represent the national reality as a whole.

Another important limitation is that several studies were based on participants' perceptions rather than objective indicators of business performance. Therefore, although positive associations were identified between digital wallets and sales or commercial transactions, the empirical basis still needs to be strengthened through longitudinal, comparative studies using verifiable economic data.

### **Practical and academic implications**

From a practical perspective, the results suggest that digital wallets can be considered a strategic tool for strengthening Peruvian entrepreneurship, especially among micro and small economic units. Their use can contribute to improving customer relationships, speeding up collections and payments, expanding commercial coverage, and facilitating the integration of small businesses into more modern exchange dynamics.

For policymakers, these findings indicate the need to promote actions aimed at strengthening digital trust, training in the use of financial technology tools, and expanding connectivity in regions where adoption remains limited. For financial institutions and digital-wallet developers, the results show the importance of designing simple, secure solutions adapted to the needs of small businesses.

From an academic perspective, the review showed that the field is still under construction. There have been important advances, but further research is still needed on entrepreneurship, digital wallets, and business performance in the Peruvian context.

## Identified research gaps

Finally, the discussion identified several gaps in the literature. First, studies are needed that directly analyze the impact of digital wallets on variables such as profitability, formalization, business sustainability, and business growth. Second, research comparing the effects of specific wallets, especially Yape and Plin, which were the most frequently mentioned platforms in the reviewed studies, is required. Third, it is necessary to broaden the geographic and sectoral coverage of research by incorporating rural regions, non-commercial sectors, and ventures led by different entrepreneur profiles.

There is also a need for longitudinal studies to determine whether the observed benefits in sales and transactions are sustained over time. It would also be relevant to integrate qualitative or mixed methodologies to better understand how entrepreneurs perceive, negotiate, and adapt these technologies in their everyday practice.

## Final conclusions

In summary, the review concludes that digital wallets represent an innovation with a favorable impact on Peruvian entrepreneurship, especially in microventures, retail businesses, and small enterprises. The most direct evidence showed benefits in sales, commercial reach, and operational efficiency, while indirect evidence reinforced the idea that these tools are part of a broader process of financial inclusion and digital transformation. However, the persistence of barriers associated with security, trust, and preference for cash shows that their consolidation still faces challenges. Therefore, strengthening this field requires both new research and practical interventions aimed at expanding the use and value of digital wallets in Perú's entrepreneurial ecosystem.

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# Organizational Climate and Human Talent Management in Public Transport Sector Companies

Clima organizacional e gestão de recursos humanos nas empresas do setor dos transportes públicos  
*El clima organizativo y la gestión de recursos humanos en las empresas del sector del transporte público*



ARTÍCULO DE INVESTIGACIÓN

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## ABSTRACT

This study examined the relationship between organizational climate and human talent management in public transport sector companies, with the objective of determining the extent to which employees' perceptions of the work environment predict the effectiveness of talent management processes. A quantitative, non-experimental, cross-sectional approach was adopted, with a sample of 291 employees surveyed using structured Likert-scale questionnaires. SPSS software was used for data analysis, applying descriptive statistics, the Friedman test, simple linear regression, and ANOVA. The results showed that organizational climate explains 76.1% of the variability in human talent management ( $R^2 = 0.761$ ;  $F = 918.284$ ;  $p < 0.001$ ), with a very strong positive correlation ( $R = 0.872$ ) and a near-unit regression coefficient ( $B = 0.979$ ). Among the dimensions of organizational climate, leadership and interpersonal relationships emerged as strengths ( $M = 4.18$ ), while recognition was the most critical dimension ( $M = 3.97$ ). In human talent management, retention and satisfaction represented the greatest strength ( $M = 3.99$ ), whereas talent planning recorded the lowest mean ( $M = 3.88$ ). Performance evaluation was the dimension with the greatest explanatory power ( $F = 79.690$ ). It is concluded that both variables are closely linked and that their integrated management is essential for institutional strengthening.

**Keywords:** Organizational Climate; Human Talent Management; Public Sector; Transportation; Leadership; Recognition; Performance Evaluation; Employee Retention.

**JEL Codes:** M12, M54, J24, L91

## RESUMO

Este estudo examinou a relação entre o clima organizacional e a gestão de talentos em empresas do setor de transporte público, com o objetivo de determinar em que medida as percepções dos funcionários sobre o ambiente de trabalho permitem prever a eficácia dos processos de gestão de talentos. Foi adotada uma abordagem quantitativa, não experimental e transversal, com uma amostra de 291 funcionários pesquisados por meio de questionários estruturados na escala de Likert. O software SPSS foi utilizado para a análise de dados, aplicando-se estatísticas descritivas, o teste de Friedman, regressão linear simples e ANOVA. Os resultados mostraram que o clima organizacional explica 76,1% da variabilidade na gestão de talentos humanos ( $R^2 = 0,761$ ;  $F = 918,284$ ;  $p < 0,001$ ), com uma correlação positiva muito forte ( $R = 0,872$ ) e um coeficiente de regressão próximo da unidade ( $B = 0,979$ ). Entre as dimensões do clima organizacional, a liderança e as relações interpessoais emergiram como pontos fortes ( $M = 4,18$ ), enquanto o reconhecimento foi a dimensão mais crítica ( $M = 3,97$ ). Na gestão de talentos humanos, a retenção e a satisfação representaram o maior ponto forte ( $M = 3,99$ ), enquanto o planejamento de talentos registrou a menor média ( $M = 3,88$ ). A avaliação de desempenho foi a dimensão com maior poder explicativo ( $F = 79,690$ ). Conclui-se que ambas as variáveis estão intimamente ligadas e que sua gestão integrada é essencial para o fortalecimento institucional.

**Palavras-chave:** Clima Organizacional; Gestão De Talentos; Setor Público; Transportes; Liderança; Reconhecimento; Avaliação De Desempenho; Retenção De Funcionários.



## INTRODUCTION

In the current context of state transformation and public service modernization, organizations in the transport sector face increasing pressure to improve their institutional performance. New public management requires state entities to incorporate results-oriented strategic approaches in which human capital occupies a central place as a determining factor in efficiency and service quality (Osborne & Gaebler, 1992; Hood, 1991). Within this scenario, two variables are especially relevant: organizational climate and human talent management. Both constitute fundamental pillars for operational efficiency and the quality of service these entities provide to citizens (Jawali et al., 2021; Kravariti & Johnston, 2019). Globalization and the increasing complexity of public services have intensified the need for work environments that promote employee well-being, commitment, and continuous development, recognizing that a healthy organizational climate not only improves individual performance but also constitutes a sustainable institutional advantage (Chiavenato, 2009; Brunet, 2011).

The organizational climate in public transport companies faces specific challenges that affect their functioning and employee satisfaction. Litwin and Stringer (1968) early identified that perceptions of the work environment condition motivation and performance; subsequent studies have confirmed that these dynamics are intensified in the public sector, where economic incentives are limited and the relational environment carries greater weight (Dessler, 2001; Gonzalez-Roma & Peiro, 2014). The main causes that negatively affect the work environment include deficient communication, which generates misunderstandings and lack of alignment with institutional objectives; inadequate leadership, which produces demotivation and resistance to change; low employee motivation, associated with monotony and the perception that effort is not valued; deteriorated interpersonal relationships, which affect team cohesion; and the absence of recognition for work well done, which reduces organizational commitment (Calvachi & Angeles, 2017; Lopez et al., 2021; Novac & Bratanov, 2014; Sinha, 2024).

In parallel, human talent management in the public transport sector presents structural deficiencies that limit its capacity to attract, develop, and retain competent personnel. Collings and Mellahi (2009) define talent management as the systematic identification of key positions and the development of a differentiated human resource architecture that enables these positions to be filled by high-performing employees. However, the public sector often lacks the formal mechanisms required to implement this approach (Thunnissen et al., 2013). Talent planning is usually insufficient and short-term oriented; recruitment and selection processes lack transparency and meritocracy; training and professional development do not respond to strategic plans; performance evaluation systems are not sufficiently objective; and retention and job satisfaction strategies are scarce, leading to high turnover among qualified staff (Gandi & Saurombe, 2025; Enwereji & Emmanuel, 2022; Kravariti & Johnston, 2019). These structural weaknesses directly affect the quality of service delivered to citizens and the institution's ability to adapt to changing environments (Chiavenato, 2009; Boxall & Purcell, 2016).

The specialized literature shows a close relationship between organizational climate and human talent management. A positive work environment facilitates personnel retention, development, and satisfaction processes, whereas deficiencies in talent management generate demotivation and internal conflicts that deteriorate the institutional climate (Jawali et al., 2021; Kravariti & Johnston, 2019). However, empirical research examining this interrelationship in public organizations in developing countries, and particularly in the transport sector, remains scarce, which constitutes a significant gap in the literature (Enwereji & Emmanuel, 2022; Gandi & Saurombe, 2025). This study aimed to examine

the relationship between these two variables in public transport sector companies, based on the perceptions of 291 employees, in order to provide empirical evidence to support organizational improvement strategies.

## METHODOLOGY

### *2.1. Design and approach*

The study followed a quantitative, non-experimental, cross-sectional, descriptive-correlational approach. This design was adopted because the main objective was to measure employees' perceptions at a specific point in time and establish the statistical relationship between both variables without manipulating either of them. According to Hernandez-Sampieri et al. (2014), non-experimental cross-sectional designs are the most appropriate when the aim is to describe variables and analyze their interrelationship within a population at a single point in time. Creswell (2014) notes that the quantitative approach is especially useful when propositions are tested through numerical measurement and statistical analysis, with a view to generalizing results to a broader population. The correlational scope seeks to identify the degree of association between variables without establishing definitive causality, thereby providing evidence on relational patterns that may guide future interventions (Bernal, 2010).

### *2.2. Population and sample*

The population consisted of employees from public transport sector companies. The sample included 291 participants, corresponding to the total number of valid surveys collected and ensuring representation of the different functional areas and hierarchical levels. Hernandez-Sampieri et al. (2014) emphasize that, in studies of this type, it is essential to ensure that the sample captures the variability of the target population so that the results adequately reflect the diversity of existing perceptions. Information was collected digitally, with informed consent from all participants and a guarantee of confidentiality, in compliance with ethical principles established for research involving human beings (Bernal, 2010).

### *2.3. Variables and instruments*

Two variables were operationalized: organizational climate (independent variable), with five dimensions - communication, leadership, motivation, interpersonal relationships, and recognition - and human talent management (dependent variable), with five dimensions - talent planning, recruitment and selection, training and development, performance evaluation, and retention and satisfaction. Both were measured using structured questionnaires on a five-point Likert scale (1 = Strongly disagree; 5 = Strongly agree). The Likert scale is one of the most widely used measurement instruments in organizational research because of its ability to capture the intensity and direction of attitudes and perceptions (Likert, 1932; Hernandez-Sampieri et al., 2014). Content validity was evaluated through expert judgment, following the criteria proposed by Escobar-Perez and Cuervo-Martinez (2008). Instrument reliability was excellent (Cronbach's alpha = 0.972), far exceeding the 0.70 threshold recommended for social science research and the 0.90 threshold that George and Mallery (2003) classify as excellent reliability. Nunnally and Bernstein (1994) establish Cronbach's alpha as the psychometric standard



par excellence for assessing the internal consistency of instruments with ordinal-scale items. Statistical processing was performed using SPSS v.25, applying descriptive statistics, the Friedman test, simple linear regression, and ANOVA.

## RESULTS

### 3.1. Descriptive analysis of organizational climate

The descriptive analysis of the five organizational climate dimensions revealed an overall positive perception among the 291 employees, with means ranging from 3.97 to 4.18 on the 1-to-5 scale (Table 1).

**Table 1**

*Descriptive statistics for organizational climate dimensions (n = 291)*

Dimension	Mean	Std. dev.	Mode	Interpretation
Communication	4.05	0.927	5	Good
Leadership	4.18	0.956	5	Good - Strength
Motivation	4.12	0.961	5	Good
Interpersonal relationships	4.18	0.930	5	Good - Strength
Recognition	3.97	1.055	5	Fair-Good - Critical dimension

*Note. Source: SPSS. Authors' own elaboration.*

Leadership and interpersonal relationships shared the highest mean (4.18), consolidating them as organizational climate strengths, with more than 100 observations at the maximum scale value. Recognition emerged as the most critical dimension ( $M = 3.97$ ;  $SD = 1.055$ ), with the highest dispersion among all the variables analyzed, showing that a significant fraction of employees considers performance valuation practices insufficient. Communication and motivation occupied intermediate positions, with positive but heterogeneous perceptions across areas and hierarchical levels.

### 3.2. Descriptive analysis of human talent management

The five dimensions of human talent management showed predominantly positive perceptions, with means between 3.88 and 3.99 and a mode of 5 in all cases (Table 2).

**Table 2**

*Descriptive statistics for human talent management dimensions (n = 291)*

Dimension	Mean	Median	Mode	Interpretation
Talent planning	3.88	4	5	Positive - Weakest dimension
Recruitment and selection	3.95	4	5	Positive
Training and development	3.96	4	5	Positive - Strength
Performance evaluation	3.95	4	5	Positive
Retention and satisfaction	3.99	4.20	5	Positive - Greatest strength

*Note. Source: SPSS. Authors' own elaboration.*

Retention and satisfaction recorded the highest mean (3.99) and the highest median (4.20), with 101 responses in the “Strongly agree” category, positioning it as the greatest strength of human talent management. Talent planning obtained the lowest mean (3.88), reflecting weaknesses in the strategic projection of personnel needs. Performance evaluation and recruitment and selection presented similar means (3.95), with intermediate groups expressing doubts about the objectivity and transparency of these processes.

### 3.3. Linear regression model

To examine the predictive capacity of organizational climate (MCT) on human talent management (MGT), a simple linear regression model was estimated, obtaining the following equation:

$$\text{MGT} = -0.049 + 0.979 \times \text{MCT}$$

Table 3 presents the model indicators and the associated ANOVA.

**Table 3**

*Linear regression model summary and ANOVA (Dependent variable: MGT)*

Indicator	Value
R (correlation)	0.872
R <sup>2</sup> (coefficient of determination)	0.761
Adjusted R <sup>2</sup>	0.760
Standard error of the estimate	0.503
B (constant)	-0.049
B (MCT - organizational climate)	0.979
Standardized beta	0.872
T	30.303
F (ANOVA)	918.284
Sig. (p)	< 0.001

*Note. Source: SPSS. Authors' own elaboration.*

The model explained 76.1% of the variability in human talent management ( $R^2 = 0.761$ ), with an adjusted  $R^2$  of 0.760 confirming its stability. The very strong positive correlation ( $R = 0.872$ ) indicates that the more favorable the perception of organizational climate, the higher the assessment of human talent management. The coefficient  $B = 0.979$  indicates a near-proportional relationship: for each additional point in organizational climate, human talent management increases by 0.979 units. The F statistic = 918.284 ( $p < 0.001$ ) confirms that the model is highly significant.

### 3.4. Explanatory power of the dimensions of human talent management

The ANOVA analysis applied individually to each dimension of human talent management as a predictor of the global variable made it possible to establish its relative explanatory power. All values were statistically significant ( $p < 0.001$ ), as shown in Table 4.

**Table 4***ANOVA F value by human talent management dimension (p < 0.001 in all cases)*

Dimension	F	Explanatory hierarchy
Performance evaluation	79.690	1st - Greatest explanatory power
Retention and satisfaction	66.337	2nd
Training and development	65.180	3rd
Recruitment and selection	48.010	4th
Talent planning	39.137	5th - Lowest explanatory power

*Note. Source: SPSS. Authors' own elaboration.*

Performance evaluation consolidated itself as the dimension with the greatest explanatory power ( $F = 79.690$ ), followed by retention and satisfaction ( $F = 66.337$ ) and training and development ( $F = 65.180$ ). Talent planning, although significant, recorded the lowest relative weight ( $F = 39.137$ ), suggesting that the strategic vision of personnel is the aspect most pending development in the institutions analyzed.

## DISCUSSION

The results of this study confirm that organizational climate is a robust and highly significant predictor of human talent management in public transport sector companies ( $R^2 = 0.761$ ;  $F = 918.284$ ;  $p < 0.001$ ). This finding is consistent with international evidence highlighting the dynamic interdependence between the two variables: organizations with favorable climates implement talent management processes more effectively, while deficiencies in the work environment translate into structural difficulties in attracting, developing, and retaining qualified personnel (Jawali et al., 2021; Kravariti & Johnston, 2019).

The very strong positive correlation ( $R = 0.872$ ) and the near-unit regression coefficient ( $B = 0.979$ ) support the arguments of Calvachi and Angeles (2017) and Sinha (2024) that organizational climate dimensions have a direct impact on levels of motivation, commitment, and personnel performance, variables that in turn condition the effectiveness of training, evaluation, and talent retention processes. This result positions organizational climate not as a complementary factor, but as a structuring condition of human talent management.

Leadership and interpersonal relationships emerged as the main strengths of organizational climate ( $M = 4.18$ ), in line with Novac and Bratanov (2014) and Lopez et al. (2021), who state that participatory leadership and positive labor relations are key predictors of institutional commitment. Recognition, with the lowest mean ( $M = 3.97$ ) and the greatest dispersion ( $SD = 1.055$ ), consolidated itself as the most critical dimension, confirming Sinha's (2024) findings on the central role of recognition in the intrinsic motivation of public employees. The high dispersion in this dimension suggests perceived inequities among areas and hierarchical levels that erode organizational cohesion.

In human talent management, retention and satisfaction emerged as the greatest strength ( $M = 3.99$ ;  $F = 66.337$ ), which is consistent with Gandi and Saurombe (2025), who emphasize that job stability and trust in the organizational environment are prior conditions for the effective implementation of talent management strategies. Talent planning, with the lowest mean ( $M = 3.88$ ) and the lowest explanatory power ( $F = 39.137$ ), reflects the historical weaknesses of the public sector in strategic personnel projection, as noted by Jawali et al. (2021) and Enwereji and Emmanuel (2022).

Performance evaluation emerged as the dimension with the greatest explanatory power ( $F = 79.690$ ), highlighting the importance of objective, participatory evaluation systems linked to real development and promotion decisions. Coculova and Tomcikova (2021) and Shi (2023) point out that formalistic systems disconnected from improvement plans generate distrust and demotivation, negatively affecting staff retention and organizational climate. This finding suggests that investing in the improvement of evaluation processes would have a multiplier effect on the other dimensions of human talent management.

Overall, the results show that interventions focused exclusively on only one of the two areas are insufficient to produce sustainable improvements. The near-proportional relationship identified implies that strengthening organizational climate - especially recognition - would have a direct and proportional impact on improving human talent management; and that strengthening performance evaluation and strategic talent planning would, in turn, help consolidate a more equitable and motivating organizational climate.

## CONCLUSIONS

This study empirically confirms that organizational climate is a strong and significant predictor of human talent management in public transport sector companies, explaining 76.1% of its variability. The near-proportional relationship identified ( $B = 0.979$ ) shows that improving the work environment has a direct, consistent, and proportional impact on institutional talent development and retention processes.

Regarding organizational climate, leadership and interpersonal relationships consolidated themselves as the main strengths, with a mean of 4.18 out of 5. Recognition emerged as the most critical and most dispersed dimension ( $M = 3.97$ ;  $SD = 1.055$ ), showing that performance valuation practices are perceived as insufficient and inequitable by a significant fraction of employees.

In human talent management, retention and job satisfaction positioned themselves as the greatest strength ( $M = 3.99$ ). Talent planning recorded the lowest mean ( $M = 3.88$ ) and the lowest explanatory power in the model ( $F = 39.137$ ), indicating that the strategic projection of personnel needs is the weakest and highest-priority dimension for intervention. Performance evaluation was the dimension with the greatest explanatory power ( $F = 79.690$ ), confirming that the way staff performance is measured and feedback is provided is determinant in the overall perception of human talent management.

It is concluded that both variables are closely linked and that their integrated management - si-



multaneously addressing work environment conditions and talent development processes - is indispensable for the institutional strengthening of public transport companies. The following actions are recommended: (1) implement clear and equitable institutional recognition systems; (2) transform performance evaluation processes into strategic tools linked to development plans; (3) develop long-term strategic human talent planning; (4) strengthen training programs linked to identified competency gaps; and (5) adopt an integrated people management model that simultaneously addresses organizational climate and talent processes. Future research should expand the analysis to other variables, such as innovation, institutional culture, and organizational commitment.

### **Declaration of Conflicts of Interest**

The authors declare that there is no conflict of interest in relation to the preparation and publication of this article.

### **Author Contributions**

Author 1: conceptualization, methodology, statistical analysis, and writing of the original draft.  
Author 2: literature review, data curation, review, and final editing.

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# Digital Consumption Habits: The Barranquilla Case during COVID-19

Hábitos de consumo digital: o caso de Barranquilla durante a COVID-19  
*Hábitos de consumo digital: el caso de Barranquilla durante la COVID-19*

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## ABSTRACT

This article aims to describe young people's consumption habits on e-commerce platforms during COVID-19 in Barranquilla. A quantitative analytical method with a non-experimental design was applied through a questionnaire administered to a sample of 83 young people. The findings showed that 59.1% of young women reported a higher frequency of using e-commerce to purchase products and services. Likewise, purchase decisions increased when companies offered customers discounts and promotions. The study concludes that consumption habits and behaviors are changing: the tendency to purchase products from home, or from any location where the consumer may be, is attractive to this generation. However, companies must address two latent problems in last-mile value creation: delivery dates and product returns.

**Keywords:** Digital Consumption; E-Commerce; Digital Platforms.

**JEL Codes:** M30, M31, F10.

## RESUMO

Este artigo tem como objetivo descrever os hábitos de consumo dos jovens em plataformas de comércio eletrônico durante a pandemia da COVID-19 em Barranquilla. Foi aplicado um método analítico quantitativo com um desenho não experimental, por meio de um questionário aplicado a uma amostra de 83 jovens. Os resultados mostraram que 59,1% das jovens relataram uma maior frequência no uso do comércio eletrônico para adquirir produtos e serviços. Da mesma forma, as decisões de compra aumentaram quando as empresas ofereciam descontos e promoções aos clientes. O estudo conclui que os hábitos e comportamentos de consumo estão mudando: a tendência de comprar produtos de casa, ou de qualquer local onde o consumidor se encontre, é atraente para essa geração. No entanto, as empresas devem abordar dois problemas latentes na criação de valor na última milha: prazos de entrega e devoluções de produtos.

**Palavras-chave:** Consumo Digital; Comércio Eletrônico; Plataformas Digitais.



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## INTRODUCTION

In Colombia, according to the Colombian Chamber of Electronic Commerce (CCCE), e-commerce sales grew by 40% in 2021, generating revenues above COP 40 trillion and maintaining double-digit growth in a market that continues to expand. At the same time, e-commerce became a strategic ally for companies during the pandemic, as it allowed them to continue promoting and selling their products. In this sense, e-commerce can be understood as a new way of doing business, since it enables companies to sell and transact their products from anywhere in the world.

This article applies an analytical method with a quantitative approach and a non-experimental design, based on the administration of a questionnaire to a sample of 83 young people in Barranquilla. Accordingly, the study is framed by the following research question: What are the consumption habits of young people from Barranquilla on e-commerce platforms during COVID-19?

Thus, the objective of this article is to describe young people's consumption habits on e-commerce platforms during COVID-19 in Barranquilla. The article is structured as follows: first, the methodology used in the study is presented; then, the theoretical foundation is developed; next, the results derived from a rigorous analysis of the collected information are presented; and finally, the conclusions are discussed.

## METHODOLOGY

The article was developed using a quantitative methodology, with a descriptive scope and a non-experimental design (Hernandez et al., 2014). A questionnaire was administered through the survey technique to an intentional sample of 83 young people in the city of Barranquilla. Participants were selected according to their geographic location, willingness to complete the questionnaire, and purchasing activity on digital platforms. The information was collected through specialized software and analyzed to determine the most widely used e-commerce platforms, identify the most pressing physiological needs satisfied through these platforms, determine purchase motivators, analyze the relevance of discounts, promotions, delivery speed, and other essential factors in consumer purchasing decisions, and estimate average purchase amounts on these platforms. Finally, the conclusions were developed based on the objective of the study (Lechuga and Loaiza, 2025).

### Theoretical Framework

This research is grounded in different topics, models, and theories related to electronic commerce, based on a review of the main authors who have worked on the subject. The theories analyzed are presented below:

#### *Maslow's Hierarchy of Needs*

The hierarchy of human needs proposed by Maslow (1981, as cited in Sennett, 2016), in his work *A Theory of Human Motivation*, serves as a basis for establishing the basic conditions that e-commerce must meet in order to satisfy human needs.

Customers access virtual platforms in order to satisfy a need, thereby fulfilling the first category of Maslow's hierarchy: physiological needs. For this reason, platforms must be more descriptive and clearly show the need they satisfy, the use of the product, prices, availability, and related information.

Belonging and acceptance constitute another category in Maslow's hierarchy. If the product satisfies the consumer's need, the purchase price represents utility, the purchase process is easy, and the store platform generates trust, the consumer will decide to purchase the product.

Websites must convey and generate a trustworthy environment for customers in order to satisfy the consumer's need for security and protection on the web.

Companies should never neglect their customers. When a person becomes a customer of a brand or virtual store, companies must maintain and strengthen that trust in order to improve the relationship with customers and, at the same time, satisfy the need for esteem.

When each of these steps is carried out effectively, the customer may become a brand advocate and develop a close bond that allows them to identify with the style and products of a company's brand. At this point, it may be said that the customer has satisfied the need for self-actualization.

When integrated into e-commerce, this theory explains how companies can increase their sales while satisfying more than one need among people who visit their virtual platforms.

#### *Theory of Planned Behavior*

From the perspective of the theory of planned behavior (Ajzen, 1991, as cited in Venkatesh et al., 2012), deliberate behavior can be predicted because the intention that drives behavior is determined by three functions: attitude, subjective norm, and perceived behavioral control.

Similarly, Taylor and Todd (1995, as cited in Lai, 2011) state that behavior is a weighted function of intention and perceived behavioral control, while intention is the weighted sum of attitude, subjective norm, and perceived behavioral control. These premises provide the foundations of the theory and are related to digital consumer behavior and behavioral patterns on e-commerce platforms (Mejia et al., 2023).

#### *Electronic Commerce*

According to Castaneda and Zavala (2012), "electronic commerce consists of conducting commercial transactions electronically; it is any activity in which companies and consumers interact and do business with each other through electronic means" (p. 3). Likewise, Fernandez-Portillo et al. (2014) argue that "e-commerce makes it possible to rethink business objectives through clear strategic direction, facilitating the creation of new products and markets, new distribution channels, the reduction of business activity costs, and the opening of new markets" (p. 108).

Therefore, from the perspective of Sanabria et al. (2016), e-commerce is any transactional form in which different parties converge on the network in order to sell or purchase products or services.

#### *Digital Platforms*

Evans and Schmalensee (2016), Hein et al. (2020), and Reuver et al. (2018) argue that digital pla-



tforms are changing the way large companies interact with consumers, transforming their operating models and establishing a new way of conducting operations through networks and digital platforms.

Similarly, Boudreau and Hagiu (2009) propose that digital platforms are multi-sided platforms because they bring together and connect a critical mass of buyers and sellers who interact with one another within the different digital platforms available on the web.

Along the same line, other authors, such as Katz and Shapiro (1985, as cited in Lin et al., 2011) and Shapiro and Varian (1998, as cited in Van, 2013), suggest that as digital platforms develop and gain acceptance among users, they generate positive externalities that increase the utility or value proposition of the platform. This is directly proportional to the number of agents or users who use the platform. In other words, platforms grow when they effectively satisfy users' needs, resulting in a positive externality: an increase in the number of users (Uribe et al., 2022).

### *Perceived Usefulness*

According to Moore and Benbasat (1991, as cited in Williams et al., 2015), an individual's perception improves when the developed technological innovation is appropriately adopted. Likewise, its acceptance depends on how efficiently the primary and secondary attributes inherent to human beings are satisfied in relation to the innovative process or system designed. This innovation has been manifested in conventional distribution channels through the development of a web-based technological system known as e-commerce, which offers enormous potential to retail industries and to any brand wishing to establish a sales channel on the internet, thereby redesigning how current consumers acquire products and services.

The perceived usefulness of this sales system derives from consumers' acceptance of latent advantages, which in this article are referred to as variables: convenience, assortment variety, offer value, discounts, promotions, delivery times, guarantee, quality, and product security.

**Table 1**

*Definition of perceived usefulness variables in the case study*

<b>Variables</b>	<b>Definition</b>
Convenience	Optimization of time and ease of execution in the consumer purchasing process.
Quality	Product attributes that effectively satisfy consumer needs.
Discounts	A commercial strategy aimed at increasing product sales by reducing the price.
Guarantee	The seller's responsibility for the product's value proposition to the buyer.
Promotions	Purchase incentives for a product through different strategies that generate, capture, and stimulate demand.
Product security	Guidelines that ensure the security of transactions conducted through electronic commerce.
Delivery times	The total time elapsed from when the customer makes a purchase through any e-commerce platform until the product is finally received at the agreed location.
Assortment variety	The breadth of the offer available within e-commerce platforms.
Offer value	A web-based space where a wide variety of product offers at highly competitive prices are brought together, combined with a satisfactory digital consumer experience.

*Source: Authors' own elaboration (2020).*

The variables described above represent attributes that distinguish electronic commerce and strongly influence technological acceptance among consumers. This virtual hypermedia environment, which enables interactions between major brands and their buyers, has unique and valuable characteristics that integrate purchasing experiences and behaviors while navigating the web (Hoffman & Novak, 1996, as cited in Kannan, 2017).

### *Technology Acceptance Model*

Davis (1993, as cited in Awa et al., 2015), Davis et al. (1996, as cited in Al-Debei et al., 2015), and Venkatesh (2003, as cited in Marangunic et al., 2015) explain how users accept or reject information systems and how these systems may be accepted through the causal relationships among perceived usefulness, perceived ease of use, and perceived enjoyment. These factors are crucial and essential in strongly influencing whether a user appropriately adopts a technological system.

Along the same line, Davis (1989, as cited in Venkatesh et al., 2016) defines perceived usefulness as the degree to which a user perceives that using an information system will improve their work performance. Another determinant is perceived ease of use, defined as the degree to which a user perceives that using an information system will be free of effort. Finally, perceived enjoyment refers to the degree to which a user finds the use of the system satisfactory.

## RESULTS

Regarding the questions asked, women were found to make more online purchases than men, with a percentage of 59.1% compared to 40.9% for men. This suggests that young women have stronger habits of using e-commerce to acquire products and services.

The age range of the participants was mainly between 21 and 30 years old, representing 54.5%, followed by young people under 21 years old with 40.9%, and finally those over 30 years old with 4.6%. Considering that the population to whom the measurement instrument was applied was under 30 years of age, their main occupation was being students, at 63.6%.

The e-commerce platforms most frequently used by young people in Barranquilla during COVID-19 were Rappi, with 40.9%, and Dafiti, with 27.3%. This shows a consumption pattern oriented toward satisfying needs related to food, clothing, and footwear. It may also be inferred that during the confinement period in Barranquilla in 2020, young people increased their purchases on these platforms in order to buy products from the comfort and safety of their homes while the virus was spreading throughout the city.

The main purchase motivations were discounts, at 31.8%, purchase security, at 22.7%, and promotions, at 18.2%. This indicates that it is important for young people in Barranquilla to feel that their purchase is protected and that the pages where they buy provide assurance that the product will arrive at its destination. Purchase decisions increase even more when companies offer discounts and promotions to their customers. Consumers seek protection for their money and, combined with effective business strategies such as promotions and discounts, young people are more likely to choose these companies to satisfy their needs.



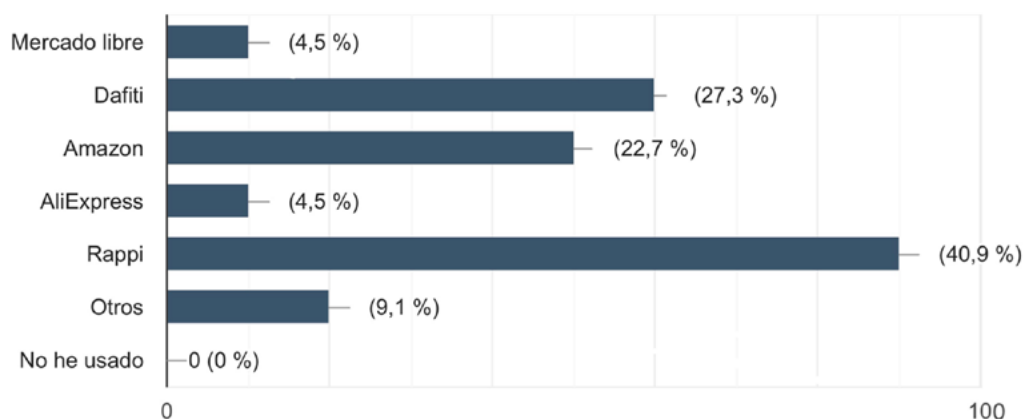
Other relevant factors for consumers were product delivery speed, with 95.5% totally agreeing, product guarantee, also with 95.5% totally agreeing, and product quality, with 100% totally agreeing. In general, consumers seek security regarding their money, the purchasing process, and product use. Therefore, if e-commerce platforms provide security to customers, accompanied by excellent logistics to send orders as quickly as possible, and if there is a discount or another marketing strategy, young people would quickly choose to purchase and would be satisfied with the shopping experience provided by the virtual store.

The frequency of purchases made by young people on e-commerce platforms during the pandemic shows that 54.5% of respondents totally agreed that they make weekly purchases, while 27.3% partially agreed that they make purchases during the week. This reflects a behavioral pattern in which more than half of young people make some purchases on different platforms during the week. This is not surprising, since projections for that year were already growing, and the COVID-19 pandemic was a determining factor that allowed e-commerce to grow by 300% in Latin America alone.

The average purchase amount ranged between COP 100,000 and COP 500,000 for 47.1% of respondents. This explains why people demand security in the electronic commerce purchasing process, since buying products valued above COP 100,000 requires young people to be certain that their order will arrive at its destination. Additionally, 29.4% reported an average purchase above COP 500,000, indicating that this population is turning to e-commerce to make high-value and important purchases. It is no longer only about ordering food; it can now involve the purchase of a car through electronic commerce.

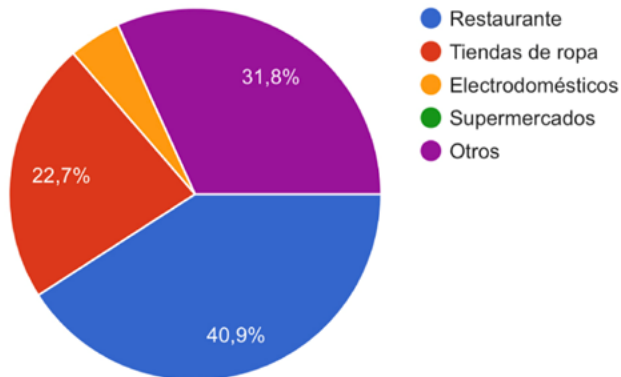
**Figure 1**

*E-commerce platforms*



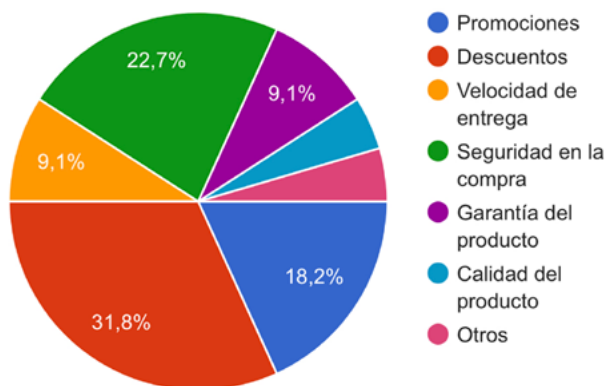
*Source:* Authors' own elaboration.

**Figure 2**  
*Purchase categories*



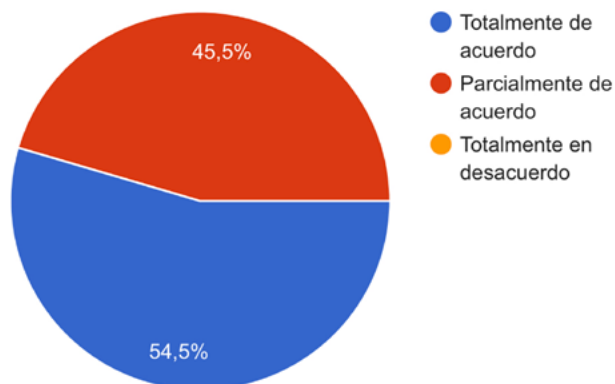
Source: Authors' own elaboration.

**Figure 3**  
*Purchase motivation*



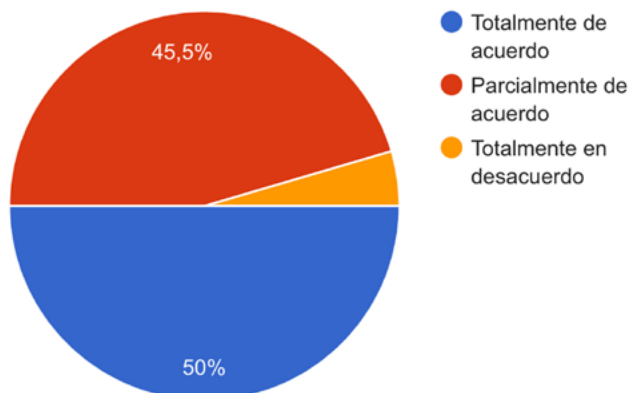
Source: Authors' own elaboration.

**Figure 4**  
*Importance of promotions*



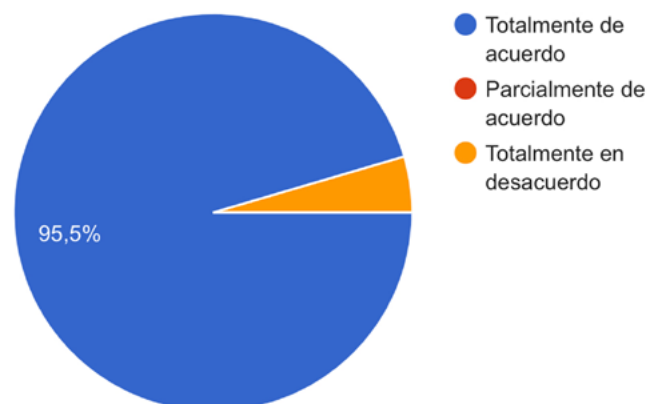
Source: Authors' own elaboration.

**Figure 5**  
*Importance of discounts*



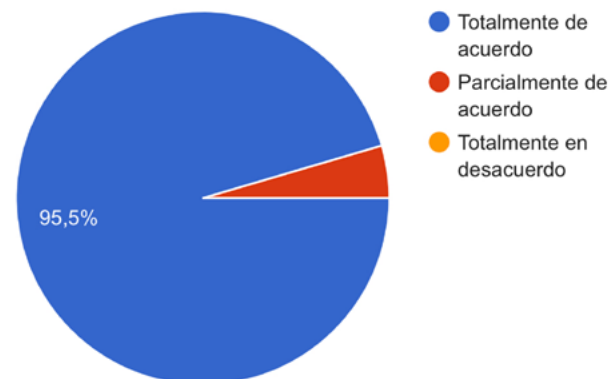
Source: Authors' own elaboration.

**Figure 6**  
*Importance of product delivery times*



Source: Authors' own elaboration.

**Figure 7**  
*Importance of security in the shopping experience*

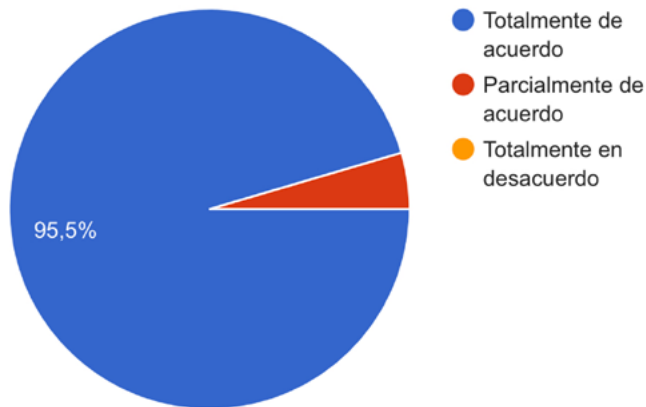


Source: Authors' own elaboration.

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**Figure 8**

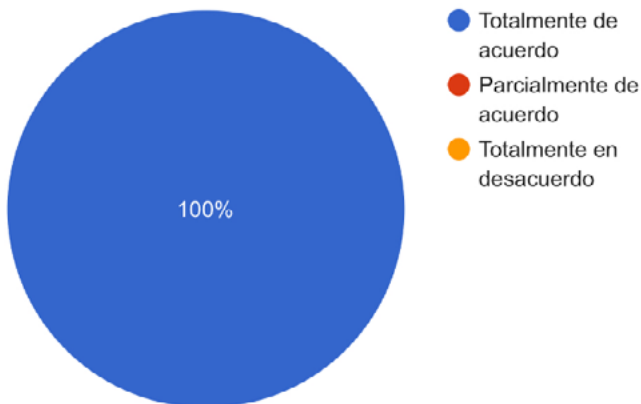
*Importance of the product guarantee*



Source: Authors' own elaboration.

**Figure 9**

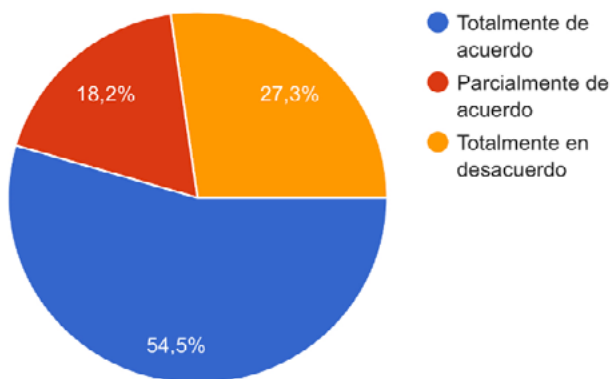
*Importance of product quality*



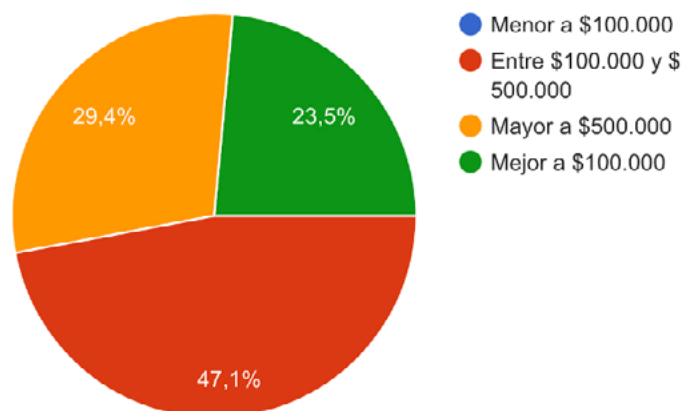
Source: Authors' own elaboration.

**Figure 10**

*Frequency of platform use*



Source: Authors' own elaboration.

**Figure 11***Average purchase amount in Colombian pesos**Source:* Authors' own elaboration.

## CONCLUSIONS

The context created by COVID-19 strongly stimulated e-commerce worldwide, allowing Colombia to achieve exponential growth beyond the projections estimated for that year. It also became a strategic ally for companies during the pandemic, integrating itself into the value chain of many businesses.

The study found that the device most frequently used for e-commerce purchases is the mobile phone, and that companies must address two latent problems: delivery dates and product returns. Traditional commerce was displaced during confinement by electronic commerce. Although confinement was a determining factor in the increase in online purchases and sales, it should also be noted that e-commerce was already expected to experience significant growth during these years, even without anticipating a pandemic.

In conclusion, there is currently an increase in the consumption of products and services through e-commerce. At the same time, the pandemic reduced traditional commerce sales by 90%. An interesting finding is that people never stopped consuming products during the pandemic; rather, they sought to satisfy their needs through the internet.

Consumption habits and behaviors are changing. The tendency to buy products from the comfort of home, or from anywhere the consumer may be, is attractive to this generation. Therefore, shopping experiences on brand platforms are being reinvented. Innovations such as augmented reality, which allows people to see what a product would look like in their hands without touching it, and other technological advances, show that e-commerce provides companies with innovation in their value proposition.

The technological adaptation of e-commerce in digital consumption among young people from Barranquilla during the COVID-19 pandemic was accepted and incorporated into their daily consumption habits. It satisfied physiological needs inherent to the human condition, such as food and clothing, which were effectively addressed through digital platforms. This process developed efficiently through the determinants of the technology acceptance model and the theory of planned behavior. In other

words, e-commerce users perceive product security, delivery times, offer value, guarantee, convenience, and other characteristic factors of these technological systems as useful, and these perceptions are positively affected by externalities that increase consumption.

Companies in the e-commerce sector are advised to conduct continuous market research in order to establish and determine the perceived usefulness of digital consumers on their platforms. Likewise, they should identify the most important criteria that drive purchase decisions and the consumer's behavioral patterns, using the foundations of the theory of planned behavior, so they can effectively and appropriately satisfy needs and increase rewarding experiences within this environment.

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# Own-Price and Cross-Price Elasticity of Demand for Chicken, Fish, and Rice in Tumbes Households: Analysis by Socioeconomic Strata

Elasticidade da procura em função do preço próprio e do preço cruzado de frango, peixe e arroz nos agregados familiares de Tumbes: análise por estratos socioeconômicos

*Elasticidad de la demanda en función del precio propio y del precio cruzado del pollo, el pescado y el arroz en los hogares de Tumbes: análisis por estratos socioeconómicos*

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## ABSTRACT

This study estimates the own-price and cross-price elasticity of demand for chicken, fish, and rice in households in the Tumbes region (Peru), differentiating between socioeconomic strata C/D and E. Using pooled ENAHO 2019-2023 data from the National Institute of Statistics and Informatics (INEI), Ordinary Least Squares models with robust errors (log-log OLS), Tobit models, and quantile regression (Q10-Q90) were applied. The results reveal that the own-price elasticity of chicken is substantially higher in stratum E (-1.38) than in stratum C/D (-0.62), confirming the hypothesis that lower-income households are more price-sensitive. Fish acts as a substitute for chicken in strata C/D and E (cross-price elasticity > 0.30), whereas rice behaves as a complementary good (cross-price elasticity < 0) across all analyzed strata. The policy simulation indicates that a -15% subsidy on the price of chicken would increase consumption by 24.8% in stratum E, making it more effective than a S/50/month cash transfer, which would increase consumption by 11.1%. These findings have direct implications for the design of food-security policies targeted at vulnerable strata in the region.

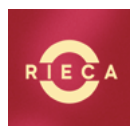
**Keywords:** price elasticity; food demand; socioeconomic strata; chicken; Tumbes; ENAHO.

**JEL Code:** D12; Q11; I32; C21; C24.

## RESUMO

Este estudo estima a elasticidade-preço própria e cruzada da demanda por frango, peixe e arroz em famílias da região de Tumbes (Peru), diferenciando entre os estratos socioeconômicos C/D e E. Utilizando dados agrupados da ENAHO 2019-2023 do Instituto Nacional de Estatística e Informática (INEI), foram aplicados modelos de Mínimos Quadrados Ordinários com erros robustos (log-log OLS), modelos Tobit e regressão quantílica (Q10-Q90). Os resultados revelam que a elasticidade-preço do frango é substancialmente maior no estrato E (-1,38) do que no estrato C/D (-0,62), confirmando a hipótese de que as famílias de renda mais baixa são mais sensíveis ao preço. O peixe atua como substituto do frango nos estratos C/D e E (elasticidade cruzada de preço > 0,30), enquanto o arroz se comporta como um bem complementar (elasticidade cruzada de preço < 0) em todos os estratos analisados. A simulação de políticas indica que um subsídio de -15% sobre o preço do frango aumentaria o consumo em 24,8% no estrato E, tornando-o mais eficaz do que uma transferência de renda de S/50/mês, que aumentaria o consumo em 11,1%. Essas conclusões têm implicações diretas para a elaboração de políticas de segurança alimentar voltadas para os estratos vulneráveis da região.

**Palavras-chave:** elasticidade de preço; demanda por alimentos; estratos socioeconômicos; frango; Tumbes; ENAHO.



## INTRODUCTION

Food security among low-income Peruvian households is closely linked to the price stability of basic products such as chicken, fish, and rice. In a context of food inflation and price volatility - intensified after the COVID-19 pandemic and by disruptions in supply chains during the 2020-2023 period - understanding the sensitivity of demand to price changes is essential for the design of effective public policies.

Tumbes, a coastal region in northern Peru, has a socioeconomic structure characterized by the predominance of strata C/D and E, making it a relevant setting for studying the behavior of low-income consumers. Chicken is the most widely consumed animal protein in Peru, while fish represents a highly available substitute in coastal areas. Rice, for its part, is the main cereal in the national basic household basket.

Economic literature has widely documented differences in the price elasticity of food demand by income level. Households living in poverty tend to exhibit greater sensitivity to changes in relative prices because the share of expenditure allocated to food is structurally higher (Banks, Blundell, & Lewbel, 1997; Deaton, 1997). However, empirical evidence for specific Peruvian regions, disaggregated by socioeconomic strata, remains limited.

In this context, this reflection article aims to estimate the own-price and cross-price elasticities of demand for chicken, fish, and rice in households in the Tumbes region using pooled data from the National Household Survey (ENAHO) for the 2019-2023 period. Four central hypotheses are proposed: (H1) the own-price elasticity of chicken is greater in absolute value in stratum E than in stratum C/D; (H2) fish is a substitute for chicken in strata C/D and E; (H3) rice is complementary to chicken in all strata; and (H4) a subsidy on the price of chicken is more efficient than a cash transfer for increasing consumption in stratum E.

## DEVELOPMENT

### 1. Theoretical framework and literature review

Consumer demand theory establishes that price elasticity of demand measures the percentage response in quantity demanded to a percentage change in the price of a good, holding all other factors constant. For essential goods, the theory predicts elasticities below one in absolute value for middle- and high-income households, but potentially higher elasticities for low-income households where the income effect is more pronounced (Varian, 2010).

Cross-price elasticity captures the relationship between substitute goods (positive sign) and complementary goods (negative sign). For the chicken-fish pair in Latin American coastal contexts, previous studies have found evidence of moderate substitution, with cross-price elasticities ranging from 0.15 to 0.45 (Abdulai & Aubert, 2004; Cembalo et al., 2019). The chicken-rice relationship, given the complementarity observed in Peruvian consumption patterns, tends to exhibit negative cross-price elasticities.

In econometric methodology, the log-log model is widely used to estimate elasticities directly as regression coefficients. The Tobit model corrects selection bias when there is censoring at zero - households that did not purchase the good during the reference period - and is especially relevant in consumption surveys (Amemiya, 1984). Quantile regression (Koenker & Bassett, 1978) makes it possible to study the heterogeneity of effects across the consumption distribution, revealing whether elasticity differs between frequent and occasional consumers.

## 2. Data and methodology

The database used corresponds to a five-year pool from the National Household Survey (ENAHO 2019-2023) of Peru's National Institute of Statistics and Informatics (INEI), restricted to households in the Tumbes region (department code 24). ENAHO is a multipurpose survey with a probabilistic, stratified, and multistage design, representative at the departmental level.

From Module 601 (Food expenditures), purchase data were extracted for chicken (code 0901), fish (codes 2000, 2001, 2003, 2004, 2005, 2009), regular and superior rice (codes 0301, 0302), and beef (codes 0800, 0802-0805). Unit prices were calculated as the ratio of reported expenditure to the quantity purchased (implicit price). Monthly per capita consumption was obtained by dividing quantities by the number of household members and the months of the year. Outliers were treated through winsorization at the 99th percentile, and missing prices were imputed with the median by `ubigeo` using the `imputeoutlog` command.

The socioeconomic stratification variable (`estrsocial`) comes from the `Sumaria` file and follows the INEI/APEIM classification, recoded into three categories: A/B (strata 1-2), C/D (strata 3-4), and E (strata 5-6). In the Tumbes region, no observations for stratum A/B were recorded during the analyzed period; therefore, the analysis focuses on strata C/D and E.

The main econometric model is specified as follows:

$$\ln(q\_chicken\_pc)_{it} = \alpha + \beta_1 \ln(p\_chicken)_{it} + \beta_2 \ln(p\_fish)_{it} + \beta_3 \ln(p\_rice)_{it} + \beta_4 \ln(p\_beef)_{it} + \beta_5 \ln(expenditure\_pc)_{it} + \beta_6 \text{household\_members} + \beta_7 \text{education} + \sum \delta_t dt + \epsilon_{it}$$

Where `q_chicken_pc` is monthly per capita chicken consumption in kilograms; `p_j` denotes the prices of chicken, fish, rice, and beef, respectively (implicit prices in S/./kg); `expenditure_pc` is total monthly per capita household expenditure; `household_members` is the number of people in the household; `education` is the education level of the household head; and `dt` are year dummies that capture temporal effects. The coefficients `beta1` and `beta2` directly represent the own-price and chicken-fish cross-price elasticities. All models were estimated using sampling weights (`factor07`) and robust standard errors for heteroscedasticity.

## 3. Descriptive statistics

The descriptive analysis of the pooled ENAHO 2019-2023 data for Tumbes reveals differentiated patterns by socioeconomic stratum. The average price of chicken is S/.9.82/kg in stratum C/D and S/.9.14/kg in stratum E; this difference is statistically significant ( $F = 8.7$ ,  $p < 0.01$ ), reflecting the



fact that lower-income households access lower-value cuts and lower-price stores. Monthly per capita chicken consumption is 1.23 kg in C/D and 0.87 kg in E, indicating a protein-access gap of approximately 29% between strata.

The price of fish has a mean of S/.8.45/kg for the full sample, with seasonal variability associated with biological fishing bans. Per capita fish consumption is relatively homogeneous across strata (0.94 kg/month in C/D versus 0.91 kg/month in E), consistent with its role as a lower relative-price substitute during periods of rising chicken prices. Rice, with an average price of S/.2.78/kg, shows the highest per capita consumption (4.12 kg/month in C/D and 4.38 kg/month in E), reflecting its character as an inferior good with expected negative income elasticity.

#### 4. Results of the econometric models

The results of the log-log OLS model with robust errors are presented for the whole sample and by socioeconomic stratum. The global model explains 47.3% of the variance in the logarithm of per capita chicken consumption (adjusted R<sup>2</sup> = 0.473), with all price regressors statistically significant at the 1% level.

**Table 1.**

*Estimated elasticities by model and socioeconomic stratum*

Variable	OLS Global	OLS C/D	OLS E	Tobit Global
ln(p_chicken) - Own-price elasticity	-0.847*** (0.098)	-0.621*** (0.112)	-1.382*** (0.143)	-0.913*** (0.104)
ln(p_fish) - Cross-price elasticity	0.312*** (0.087)	0.274** (0.109)	0.418*** (0.127)	0.341*** (0.092)
ln(p_rice) - Cross-price elasticity	-0.183*** (0.063)	-0.154** (0.074)	-0.247*** (0.091)	-0.196*** (0.068)
ln(p_beef) - Cross-price elasticity	0.091 (0.071)	0.083 (0.089)	0.112 (0.104)	0.097 (0.076)
ln(expenditure_pc) - Expenditure elasticity	0.634*** (0.075)	0.589*** (0.094)	0.712*** (0.108)	0.681*** (0.079)
Household members	-0.071*** (0.018)	-0.063*** (0.022)	-0.085*** (0.027)	-0.076*** (0.019)
Education of household head	0.048** (0.021)	0.044* (0.025)	0.057** (0.031)	0.052** (0.022)
Observations	2,847	1,623	1,224	2,847
Adjusted R <sup>2</sup>	0.473	0.441	0.502	-

*Note.* Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10. Models include year dummies (2020-2023). Sampling weights factor07.

The results in Table 1 make it possible to contrast the four proposed hypotheses. First, the own-price elasticity of chicken differs markedly across strata: -0.621 in C/D versus -1.382 in E, both statistically significant at the 1% level. This difference fully confirms H1, showing that households in stratum E are more than twice as sensitive to the price of chicken as households in stratum C/D. The unit-elasticity threshold ( $|\epsilon| = 1$ ) is exceeded only in stratum E, implying that chicken demand is elastic

among lower-income households, with direct implications for total expenditure on this protein.

Regarding H2, the chicken-fish cross-price elasticity is positive and significant in all models, with values of 0.274 in C/D and 0.418 in E. These results confirm the substitution relationship between the two proteins, which is stronger in stratum E. This finding is consistent with the coastal geography of Tumbes, where access to fresh fish is relatively easier for lower-income households, who use it as a protein alternative when chicken prices rise.

H3 is also confirmed: the chicken-rice cross-price elasticity is negative and significant (-0.154 in C/D and -0.247 in E), evidencing complementarity between both goods in the region's food basket. This result is consistent with culinary patterns on Peru's northern coast, where rice is the most common accompaniment to chicken in main meals.

### 5. Quantile regression: distributional heterogeneity

Quantile regression reveals that the own-price elasticity of chicken is not uniform across the consumption distribution. For the full sample, elasticity varies from -0.513 at quantile Q10 to -1.241 at Q90, indicating that large chicken consumers show greater price sensitivity, possibly because they have greater substitution capacity. This pattern is amplified in stratum E, where elasticity at Q90 reaches -1.587.

**Table 2.**

*Elasticities by chicken-consumption quantile - Quantile regression*

Elasticity / Quantile	Q10	Q25	Q50	Q75	Q90	OLS
Own-price elasticity (Global)	-0.513***	-0.671***	-0.847***	-1.034***	-1.241***	-0.847***
Own-price elasticity (Stratum E)	-0.784***	-1.021***	-1.262***	-1.412***	-1.587***	-1.382***
Fish cross-price elasticity (Global)	0.197**	0.241***	0.312***	0.371***	0.428***	0.312***
Rice cross-price elasticity (Global)	-0.092*	-0.134**	-0.183***	-0.221***	-0.267***	-0.183***

Note. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10. Estimates with qreg2 (robust bootstrap errors, 500 replications).

### 6. Policy simulation (H4)

The evaluation of H4 compares two food policy instruments targeted at stratum E: (a) a -15% subsidy on the price of chicken and (b) a direct cash transfer of S/.50 per month. For stratum E, where the median total monthly per capita expenditure is S/.312.40, calculations based on the estimated OLS coefficients are as follows:

A -15% subsidy on the price of chicken:  $\Delta \ln(q) = \beta_{\ln p_{chicken}} \times \ln(0.85) = (-1.382) \times (-0.1625) = 0.2245$ . This implies a percentage increase in consumption of  $\exp(0.2245) - 1 = 24.8\%$ . Thus, a 15% reduction in the price of chicken would raise monthly per capita consumption from 0.87 kg to 1.09 kg in stratum E.



Cash transfer of S/.50/month:  $\Delta \ln(\text{expenditure}_{pc}) = \ln(1 + 50/312.40) = \ln(1.1601) = 0.1484$ . Therefore,  $\Delta \ln(q) = \beta_{\ln\_expenditure\_pc} \times 0.1484 = (0.712) \times (0.1484) = 0.1057$ . The increase in consumption is  $\exp(0.1057) - 1 = 11.1\%$ , bringing consumption to 0.97 kg per capita per month.

The comparison shows that a direct subsidy on the price of chicken generates a 24.8% increase in protein consumption, compared with 11.1% for the cash transfer. The price subsidy is therefore more than twice as effective in terms of its impact on consumption of this protein. This confirms H4 and has implications for designing food-security programs in the region, although it should be noted that a price subsidy has a higher fiscal cost and may generate unintended substitution effects.

## CONCLUSION

This study estimates the own-price and cross-price elasticity of food demand in Tumbes households using a five-year ENAHO pool (2019-2023). The results confirm the four proposed hypotheses and allow relevant policy implications to be derived.

The own-price elasticity of chicken is significantly higher in stratum E (-1.38) than in stratum C/D (-0.62), confirming that lower-income households are the most vulnerable to fluctuations in the price of this protein. This result has direct implications for social policy: when chicken prices rise, households in stratum E reduce their protein consumption by a greater proportion, which deteriorates the nutritional quality of their diet.

Fish acts as a substitute for chicken in strata C/D and E, with cross-price elasticities of 0.27 and 0.42, respectively. In Tumbes, given the availability of fresh fish due to its coastal condition, this substitution represents a relevant adjustment mechanism for lower-income households during periods of rising chicken prices. Rice, by contrast, is complementary to chicken across all strata, with negative and statistically significant cross-price elasticities.

Quantile regression adds an important dimension of heterogeneity: own-price elasticity increases in absolute value across consumption quantiles, meaning that households that consume more chicken are those that reduce their demand the most in response to price increases. In stratum E, elasticity at Q90 reaches -1.587, reinforcing the vulnerability of these households.

Finally, the policy simulation indicates that a -15% subsidy on the price of chicken increases consumption in stratum E by 24.8%, more than twice the effect of a S/.50/month cash transfer (11.1% increase). This evidence suggests that direct interventions on the price of animal proteins are more efficient than cash transfers for improving protein access among the most vulnerable households in the region.

Among the study's limitations are the use of implicit prices as a proxy for market prices, the possible endogeneity between prices and quantities in the OLS model, and the absence of stratum A/B observations in Tumbes, which prevents comparisons with the top of the income distribution. Future research could estimate complete demand systems (AIDS or QUAIDS) and extend the analysis to other Peruvian regions in order to evaluate the geographic heterogeneity of elasticities.

## **Author declarations**

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# CO2 Emissions and Their Relationship with Population and Forest Loss in Peru, 1990-2023

Emissões de CO<sub>2</sub> e a sua relação com a população e a perda florestal no Peru, 1990-2023  
*Las emisiones de CO<sub>2</sub> y su relación con la población y la deforestación en Perú, 1990-2023*

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## ABSTRACT

The general objective of this research is to determine the relationship between population and forest loss with CO2 emissions in Peru during the period 1990-2023. Empirical evidence shows that economic growth and technology have a significant relationship with toxic gas emissions worldwide; this effect is compounded by population growth, indiscriminate deforestation, and industrialization. The methodology used corresponds to a quantitative, non-experimental, longitudinal trend study supported by the Kaya Identity model. An ARDL econometric model, the bounds test, the error correction model, and the Granger causality test were applied to determine the degree of relationship, causality, and long-run cointegration among the variables. The results show that the variables cointegrate in the long run at an annual adjustment speed of 72%. In addition, the population and forest-loss variables show positive impacts of 13.5% and 0.108%, respectively. Therefore, the study concludes that CO2 emissions in Peru are directly related to population and forest loss.

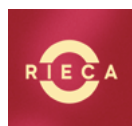
**Keywords:** Greenhouse Effect; Global Warming; Economic Growth; Population; Forest Loss.

**JEL Code:** Q50, Q51, Q52, Q53, Q57, Q58.

## RESUMO

O objetivo geral desta pesquisa é determinar a relação entre o crescimento populacional, a perda florestal e as emissões de CO<sub>2</sub> no Peru durante o período de 1990 a 2023. Evidências empíricas demonstram que o crescimento econômico e a tecnologia apresentam uma relação significativa com as emissões de gases tóxicos em todo o mundo; esse efeito é agravado pelo crescimento populacional, pelo desmatamento indiscriminado e pela industrialização. A metodologia utilizada corresponde a um estudo de tendências longitudinal, quantitativo e não experimental, apoiado pelo modelo da Identidade de Kaya. Um modelo econométrico ARDL, o teste de limites, o modelo de correção de erros e o teste de causalidade de Granger foram aplicados para determinar o grau de relação, causalidade e cointegração de longo prazo entre as variáveis. Os resultados mostram que as variáveis se cointegram no longo prazo a uma velocidade de ajuste anual de 72%. Além disso, as variáveis população e perda florestal apresentam impactos positivos de 13,5% e 0,108%, respectivamente. Portanto, o estudo conclui que as emissões de CO<sub>2</sub> no Peru estão diretamente relacionadas à população e à perda florestal.

**Palavras-chave:** Efeito Estufa; Aquecimento Global; Crescimento Econômico; População; Perda Florestal.



## INTRODUCTION

The background of the research topic is presented in Table 1. The information obtained makes it possible to integrate the statistical results with the conclusions of other authors. The publications considered for this work were collected from reliable sources, particularly Scopus, and only from recent years. The research problem is formulated as follows: What is the relationship between population, economic growth, destroyed forests, and CO2 emissions? The Kaya Identity model was adopted as the theoretical reference.

In all cases, a significant relationship is observed between CO2 emissions and economic growth. Other variables studied include population, industry, and technology; in every case, they are directly related to environmental pollution. The objective of this research is to determine the relationship between CO2 emissions and the variables included in the Kaya Identity model as a reference for the econometric model. The specific objectives are to determine the relationship between the control variables and CO2 emissions. The control variables are GDP per capita, population, industrialization per capita, and destroyed forests, while the dependent variable is CO2 emissions.

**Table 1.**  
*Empirical evidence from studies related to the research topic*

Author	Variables	Results	Conclusions
Baena (2021)	DV: Pollution; IV: ecosystem; IV2: environmental education	Human beings carry out multiple activities that are necessary to improve economic conditions and social life; however, these activities affect the environment of living beings.	The author concludes that human beings are the main agents of environmental pollution; each individual contributes through their actions to the destruction of the environment.
Wang et al. (2026)	DV: CO2; IV1: wastewater, GDP	Greenhouse gas emissions represent a major structure in the globalized world. Wastewater treatment is fundamental for environmental conservation.	Population and the economic level are fundamental drivers of higher emissions. Other factors include climate, geography, knowledge, and the psychological conditions of the population.
Anwar (2026)	DV: CO2 emissions; IV: energy, productivity	Econometric methods were used for data analysis and to determine the effects of variables on agriculture, industry, and services.	There is a relationship between CO2 emissions and agriculture; in industry the effect is negative, while services show no significant effect. The use of renewable energy is fundamental for protecting the planet.
Ricapa (2020)	DV: carbon footprint; IV: population growth	Results based on information provided by INEI confirm the relationship between population growth and carbon footprint.	Population growth not only has a direct impact on gas emissions but also on waste accumulation and the degradation of cultivated fields.
Adebayo (2026)	DV: CO2; IV: technology, industry	China has made major advances in innovation, industry, and technology, but this progress has not yet translated into lower gas pollution.	Economic growth and urbanization directly influence the increase in polluting gas emissions; the solution depends on the policies adopted by governments.
Erwinsyah (2025)	DV: gas emissions; IV: GDP, industrialization, energy consumption	Indonesia is analyzed due to its high industrialization and production consumption; despite this, the country is making substantial efforts to reduce environmental damage.	Industrial development involves large emissions of polluting gases. Sustainable economic growth requires clean technologies, renewable energies, and public awareness.

Author	Variables	Results	Conclusions
Amaya & Paredes (2025)	DV: economic growth; IV: energy consumption, CO2 emissions	A relationship exists among the study variables, implying deterioration in the country's sustainable growth.	The causal relationship among the variables is not highly significant in the short run; the effect among variables is transitory.
Segura et al. (2021)	DV: CO2 emissions; IV: GDP	A relationship is evidenced between CO2 and N2O emissions and GDP, using panel data for the statistical analysis.	The results present an inverted U-shaped relationship; however, some tests show very low decreasing returns.
Nisamudheen & Shreef (2026)	DV: CO2; IV: GDP, population, terms of trade	India has high consumption of fossil fuels and seeks a transition to non-renewable energies by 2070.	Population and economic growth have been the most important obstacles to expanding renewable energy; green finance is promoted for clean development.
Rahman & Salimullah (2026)	DV: environmental pollution; IV: GDP, population, exports	The use of green energy significantly reduces environmental pollution.	A 1% increase in green energy would reduce environmental pollution by -1.18. Exports and population significantly affect long-run pollution.
Mohammad et al. (2026)	DV: CO2; IV: education, green technology, clean energy	Greater attention to education and the use of clean energy significantly reduce CO2 emissions; modern econometric techniques are used.	Economic growth, population growth, and the green economy are directly related to higher CO2 emissions. If human capital improves and technology is properly used, the long-run effect could be reversed.
Hasanzadeh et al. (2026)	DV: CO2; IV: population, electricity consumption	Population and industrial growth directly affect the environment; renewable fuels are therefore necessary.	The use of biogas significantly reduces environmental damage. Technology in general could be a major ally in reducing pollution effects.

## METHODOLOGY

**Approach.** The study is quantitative because it measures phenomena through statistical analysis. Hypothesis tests are also carried out together with the theoretical review in order to produce a study with scientific value.

**Design.** Because the data are not intentionally modified, the study follows a non-experimental design. The variables occur naturally and are observed in their existing state; there is no control over them and, in some cases, their effects have already occurred. The research only records what is observed.

**Scope.** Based on its characteristics, the study is longitudinal; that is, it identifies changes in variables over time. More precisely, it is a longitudinal trend study (Hernandez, 2016).

**Population and sample.** The population is the totality of the elements under study, also called the universe (Arias-Gonzales, 2021). The sample is a figure or number that represents the population. In this case, the population or universe is the Peruvian economy, and the sample is composed of GDP, population, and CO2 emissions during the period under analysis.

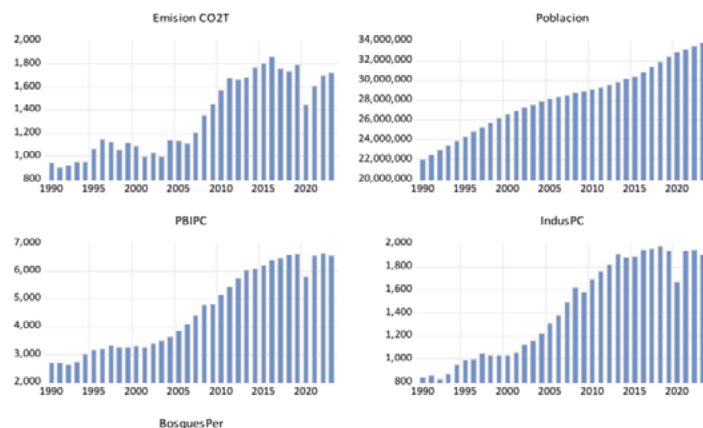
**Table 2.***Information sources for the model variables*

Variable	Period	Source	Code	Symbol
GDP per capita (2010 US\$)	1990-2023	World Bank	NY.GDP.PCAP.KD	GDPpc
Population	1990-2023	World Bank	SP.POP.TOTL	Population
Lost forests	1990-2023	Ministry of Environment	PER.BOS.AMAZ	Forestloss
CO2 emissions	1990-2023	World Bank	EN.GHG.ALL.CE.PE	CO2T
Industrialization per capita (2010 US\$)	1990-2023	World Bank	NV.IND.MANF.KD	Induspc

Sampling type, data-collection techniques, and instrument. The data used in this research were documentary in nature and were collected from reliable sources such as World Bank macrodata. The sampling type is referred to as “other quantitative methods of data collection” (Hernandez, 2016). The data-collection technique was documentary data acquisition, and the instrument was based on the collection of secondary data.

Timeframe, inclusion criteria, and exclusion criteria. Data were collected from the World Bank and MINAM for the 1990-2023 period. The variables included are those identified in the theoretical foundations and in models used by other authors as references for this study. As an exclusion criterion, information after 2023 was not considered because reliable statistical data were not available.

Figure 1 presents the study variables and their trend in Peru during 1990-2023. The temporal delimitation runs from 1990 to 2023. During this period, a constant growth trend is observed; however, in 2020, the trend is negative because of the COVID-19 pandemic. Nevertheless, population maintained a positive trend that year. It is also important to note that the trends described by GDP per capita and industrialization per capita are very similar, indicating that production and economic activity in general maintained sustained growth. CO2 emissions describe a trend very similar to the variables previously mentioned.

**Figure 1.***Study variables and trend in Peru, 1990-2023*

*Note.* The graph represents all variables in this research and describes their trend during the study period using World Bank and MINAM data.

Data collection and analysis procedure. The procedures adopted facilitate the identification of relationships and causality among variables. In summary, unit-root tests, the ARDL model, the bounds test, the error correction test, the Granger causality test, the CUSUM test, and the squared CUSUM test were used. These statistical tests made it possible to verify the validity of the variables and the application of the models using EViews 12. The study variables are represented by the following stylized facts.

CO<sub>2</sub> emissions in Peru grew by 2.44% compared with the previous year. In 2023, Peru ranked 131st among countries with the highest emissions in the world, with the largest polluter occupying position 184. The World Bank indicates that population is the most important variable to consider; the country emits 0.11 kilograms of CO<sub>2</sub> per US\$1,000 of GDP, and its trend increases steadily over time.

The population in Peru has maintained an upward trend. By 2023, 59% of the population resided on the coast, 28% in the highlands, and 14.2% in the jungle. It is estimated that by 2050 the population will exceed 39 million inhabitants. The fertility rate was 1.98 children per woman, and the average age was 33.6 years, suggesting that the country has begun a process of population ageing.

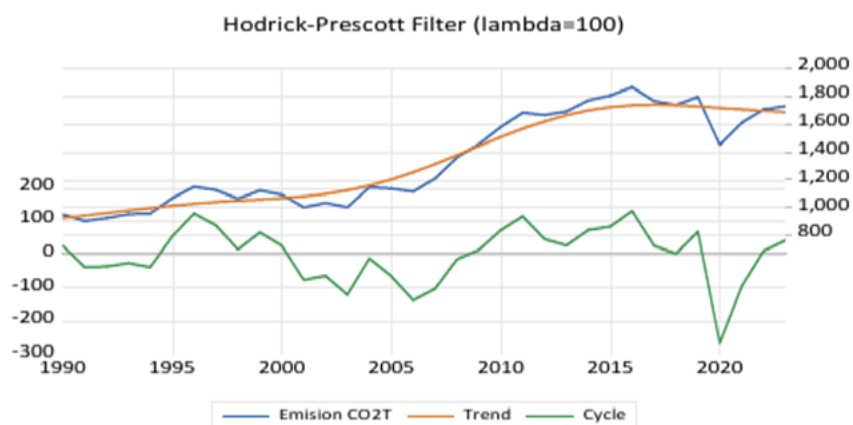
The trend in economic growth, represented by GDP per capita, is volatile and shows four cycles with moderate variability. The end of terrorism and the economic measures of the Fujimori government allowed sustained growth up to the present. Monetary policy protects the country from inflation; the economic chapter of the 1993 Constitution had a significant impact, and mining remains one of Peru's strengths.

The industrialization process in Peru has not received adequate incentives, and initially there was no venture capital. Industrial policy has been inefficient; however, in the last five years substantial investments have been allocated to transport, education, sanitation, and agroindustry. Peru has adopted a set of measures to promote knowledge and capabilities as part of industrial policy.

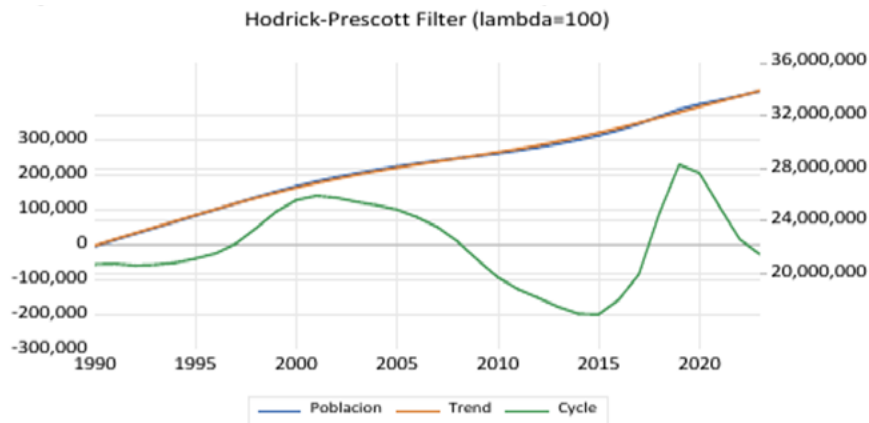
Forest loss in 2023 amounted to 132,216 hectares. The total area of current forests was 67,654,122 hectares, and forest loss was 10% lower than in the previous year. Junin, Huanuco, Puno, and Cuzco are the regions where forest area continues to decline, most often as a result of human intervention in nature.

## Figura 02.

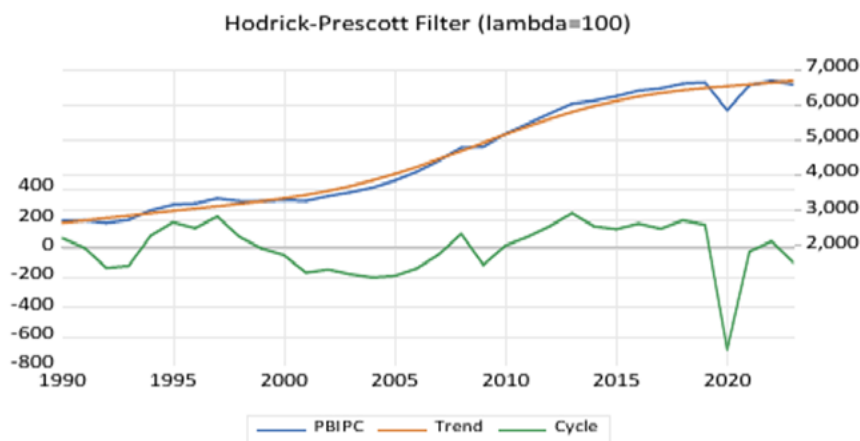
*Emissiones de CO<sub>2</sub> per cápita en el Toneladas métricas en el Perú 1990-2023*



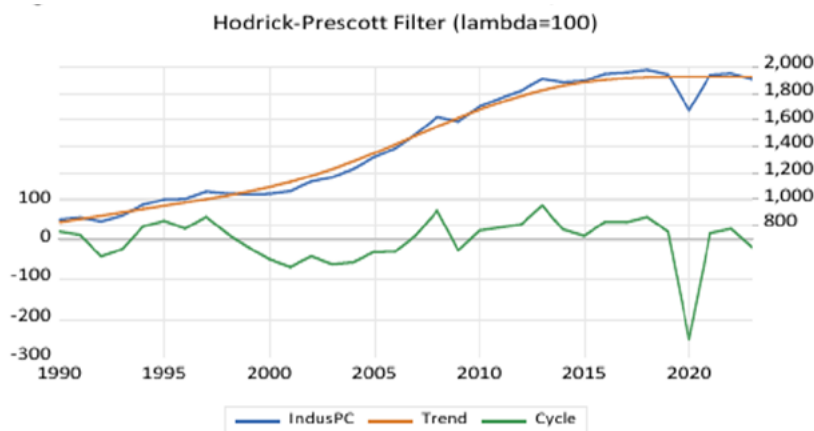
**Figura 03.**  
*Población total del Perú en el periodo 1990-2023*



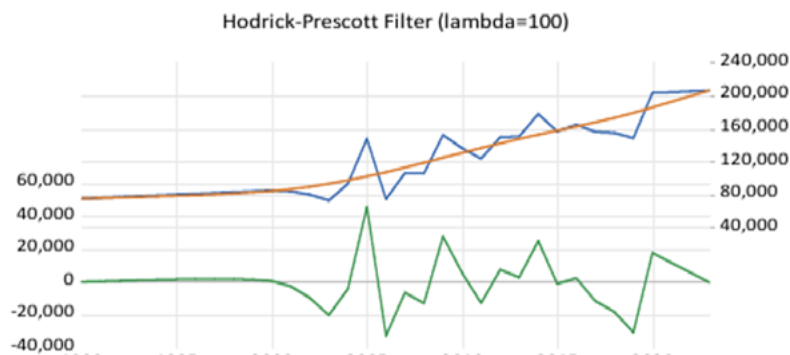
**Figura 04.**  
*Producto Bruto Interno PC Dólares 2015, en Perú 1990-2023*



**Figura 05.**  
*Industrialización PC Dólares 2015, en Perú 1990-2023*



**Figura 06.**  
*Bosques Perdidos en kilómetros<sup>2</sup> en Perú 1990-2023*



*Note.* Figures 2, 3, 4, 5, and 6 represent statistical data for the variables in Peru during the study period, using information from the World Bank and the Ministry of Environment (MINAM, 2024).

### Theoretical model

Among the theories that support this research, it is necessary to consider Romanian economist Nicholas Georgescu-Roegen, who proposed the law of entropy and the economic process. His approach is based on replacing the “fossilist” economy, as he called it, with a process that is careful with the environment, avoids resource depletion, and demands perpetual growth that respects nature. Technology, politics, aesthetics, and, above all, ethics must be used responsibly (Bonifetti, 2025).

Herman Daly also expressed concern about economic growth and the environmental damage it generates. His critique focuses on the need to achieve sustainability through a steady-state economy supported by institutions capable of modifying the particular structure of the economic system. Daly’s policy proposals and approaches remain relevant today (Hernan, 2026).

To establish the relationship between the growth of human activities and their effects on the environment, Kaya (1989) proposed a model explaining this phenomenon through three variables: population (P), economic growth or consumption (A), and technology (T). Thus, the model is expressed as:  $I = P + A + T$ , where I represents environmental impact. A reduction in any of the variables would directly affect polluting gas emissions (Rivas et al., 2020). Considering the reference model, the empirical evidence presented in Table 1, and the variables included in this research, the following theoretical-mathematical model is formulated:  $I = P + A + T + FL$ .

In this formulation, I represents CO<sub>2</sub> emissions, P represents total population, A represents GDP per capita, T represents industrialization per capita, and FL represents destroyed forests. The econometric model is:  $CO_2 = Population \times GDPpc \times INDUSTpc \times Forestloss$ .

## RESULTS

### 3.1. Unit-root test of the study variables

The Dickey-Fuller and Phillips-Perron tests were applied to determine whether the variables are stationary and integrated of order one. If they had been integrated of order two, they would not have been valid; this was verified through the results of these tests (Pereira et al., 2025).

**Table 3.**

*Summary of unit-root tests*

Variable	ADF level intercept	ADF level intercept+trend	ADF first difference	PP level intercept	PP level intercept+trend	PP first difference
Log CO2 emissions pc	-0.824	-1.920	-6.106*** / -6.009***	-0.804	-2.083	-0.692*** / -6.016***
Log population	-2.369	-4.011**	-3.032** / -3.458*	-0.975	-2.032	-1.372 / -1.880
Log GDPpc	-0.301	-3.448*	-6.423*** / -6.302***	-2.556	-2.077	-6.399*** / -6.282***
Log Induspc	-0.887	-3.475*	-6.806*** / -6.743***	-0.861	-1.778	-6.820*** / -6.837***
Log Forestloss pc	-0.171	-4.292***	-9.018*** / -6.094***	-0.681	-4.276*	-13.53*** / -18.80***

Note. \*\*\* Significant at 1%, \*\* significant at 5%, \* significant at 10%. The tests show that no variable is integrated in second differences; therefore, all variables are stationary in the required order and model application is feasible.

### 3.2. Number of lags according to Schwarz, Akaike, and Hannan-Quinn criteria

**Table 4.**

*Lags according to Schwarz, Akaike, and Hannan-Quinn criteria*

Variable	Schwarz	Akaike	Hannan-Quinn
Log(CO2 emissions pc)	2.3481 (1)	2.4406 (1)	2.4105 (1)
Log(Population)	-10.256 (3)	-10.441 (3)	10.381 (3)
Log(GDPpc)	-3.2885 (1)	-3.3811 (1)	-3.3509 (1)
Log(Induspc)	-3.0125 (1)	-3.1051 (1)	-3.0749 (1)
Log(Forestloss pc)	-0.3778 (2)	-0.5244 (3)	-0.4317 (2)

The Schwarz, Akaike, and Hannan-Quinn criteria show that the optimal number of lags averages two. Consequently, the two-lag criterion was used in the ARDL test.

### 3.3. ARDL model

The ARDL model analyzes time series by identifying relationships among variables with lagged and contemporary values. The bounds test verifies the long-run relationship, and the error correction model then verifies cointegration (Dahir et al., 2026).

**Table 5.***RDL model*

Variable	Coefficient	t-statistic	Prob.
LOG(CO2 emissions(-1))	0.271063	2.344198	0.0285
LOG(Population)	13.50542	1.839741	0.0793
LOG(Population(-1))	-37.59606	-2.444724	0.0230
LOG(Population(-2))	23.44145	2.589865	0.0167
LOG(GDPpc)	1.857445	2.694717	0.0132
LOG(Induspc)	-1.112319	-1.707653	0.1018
LOG(Forestloss)	-0.002754	-0.045178	0.9644
LOG(Forestloss(-1))	-0.092000	-1.380932	0.1812
LOG(Forestloss(-2))	-0.108580	-1.497764	0.1484
C	11.33081	2.848362	0.0093

$R = 0.9789$ ;  $R^2 = 0.9703$ ; Durbin-Watson = 2.35.

The values  $R = 0.9789$  and adjusted  $R^2 = 0.9703$  indicate a high goodness of fit. The Durbin-Watson value of 2.35 shows no serial autocorrelation. The Jarque-Bera test value of 0.74 indicates normal distribution; the LM test value of 0.20 shows absence of serial correlation; and the ARCH test value of  $0.74 > 0.05$  indicates no heteroscedasticity. The Ramsey test value of 0.303 shows that the model is correctly specified.

### 3.4. Bounds test

The validity of the bounds test is achieved when the F-statistic exceeds the critical values for the selected significance levels. In this research, the F-statistic is 9.63, while the 10% significance range is between 2.20 and 3.09; therefore, the variables jointly cointegrate.

**Table 6.***Bounds test*

Variable	F-statistic	At 1%	At 5%	At 10%	Result
Akaike model	9.630	1%: 3.29-4.37	5%: 2.56-3.49	10%: 2.20-3.09	Cointegrate

The long-run coefficients show constants and trends. The population variable has a significance level of 0.02, below 5%, while GDP per capita has a significance level of 0.01, significant at 1%.

**Table 7.***Long-run restrictions, constants, and trends*

Variable	Coefficient	t-statistic	Prob.
LOG(Population)	-0.890601	-2.336380	0.0290
LOG(GDPpc)	2.548155	2.723900	0.0124
LOG(Induspc)	-1.525946	-1.691352	0.1049

Variable	Coefficient	t-statistic	Prob.
LOG(Forestloss)	-0.278946	-1.372325	0.1838
C	15.54429	2.820751	0.0100

### 3.5. Error correction coefficient analysis

Error correction coefficients are expected to be negative and statistically significant in order to determine the long-run relationship among variables. They also validate long-run causality (Ahmed, 2026).

**Table 8.**

*Error correction coefficient analysis*

Variable	Coefficient	t-statistic	Prob.
DLOG(Population)	13.50541	2.912458	0.0081
DLOG(Population(-1))	-23.44145	-5.023886	0.0000
DLOG(Forestloss)	-0.002754	-0.068286	0.9462
DLOG(Forestloss(-1))	0.108580	2.728403	0.0123
CointEq(-1)*	-0.728937	-8.421034	0.0000

The coefficient CointEq(-1) has a value of -0.728 and is statistically significant at 0.000. Under these conditions, the model requirements are satisfied because the coefficient is negative and significant. Therefore, a long-run relationship exists among the variables, and they cointegrate at a maximum annual adjustment speed of 72%.

The variables with the greatest significance are contemporaneous population, with a positive impact of 13.5% and statistical significance, and forest loss with a lag, which also has a positive impact of 0.108% and is statistically significant. It should be noted that lagged population is statistically significant but has a negative impact of -23.4%. The other variables in the model do not have significant values for explaining cointegration. Finally, the high significance of population in relation to CO2 emissions in Peru should be emphasized.

### 3.6. Granger causality test

**Table 9.**

*Granger causality test*

Null hypothesis	F-statistic	Prob.
LOG(Population) does not Granger-cause LOG(CO2 emissions)	3.97453**	0.0307
LOG(CO2 emissions) does not Granger-cause LOG(Population)	7.26391***	0.0030
LOG(GDPpc) does not Granger-cause LOG(CO2 emissions)	3.18744**	0.0572
LOG(Induspc) does not Granger-cause LOG(CO2 emissions)	3.99763**	0.0301
LOG(CO2 emissions) does not Granger-cause LOG(Induspc)	2.59898*	0.0928
LOG(GDPpc) does not Granger-cause LOG(Population)	7.73966***	0.0022

Null hypothesis	F-statistic	Prob.
LOG(Population) does not Granger-cause LOG(GDPpc)	6.52511***	0.0049
LOG(Induspc) does not Granger-cause LOG(Population)	6.35259***	0.0055
LOG(Population) does not Granger-cause LOG(Induspc)	7.44792***	0.0027
LOG(Forestloss) does not Granger-cause LOG(Population)	7.65474***	0.0023
LOG(Population) does not Granger-cause LOG(Forestloss)	2.79502*	0.0788
LOG(Induspc) does not Granger-cause LOG(GDPpc)	2.78602*	0.0794
LOG(GDPpc) does not Granger-cause LOG(Induspc)	2.57635*	0.0946
LOG(GDPpc) does not Granger-cause LOG(Forestloss)	6.92306***	0.0037
LOG(Induspc) does not Granger-cause LOG(Forestloss)	4.97248**	0.0145

Note. \*\*\* Significant at 1%, \*\* significant at 5%, \* significant at 10%.

The Granger test shows that population and CO<sub>2</sub> emissions have a bidirectional causal relationship, as do industrialization and CO<sub>2</sub> emissions. GDP per capita and population also present bidirectional causality, as do industrialization and population, forest loss and population, and industrialization and GDP per capita. GDP per capita and CO<sub>2</sub> emissions, GDP per capita and forest loss, and industrialization and forest loss present unidirectional causality.

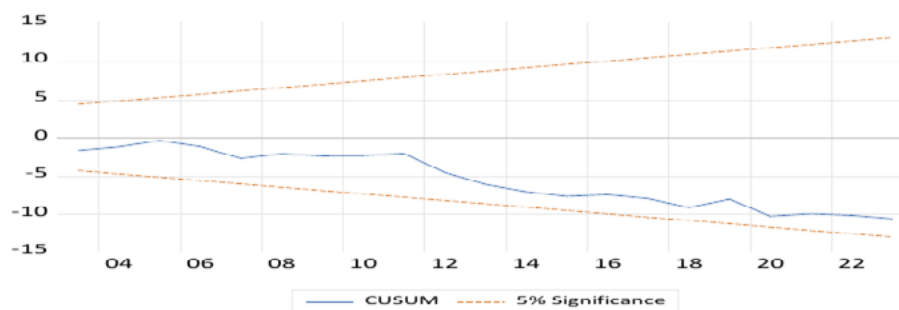
### 3.7. CUSUM and squared CUSUM tests

The CUSUM graph is used to detect the incidence of events or other causes in the statistical monitoring of the process. In this study, the CUSUM test shows stability in the proposed model and in its parameters because the trace does not exceed the 5% significance bands. The squared CUSUM test is an alternative measure based on squared residuals; it verifies whether non-random deviations exist from the mean. In this study, the variations in the trace do not exceed the restrictive limits of the significance bands.

#### Tables 10 and 11.

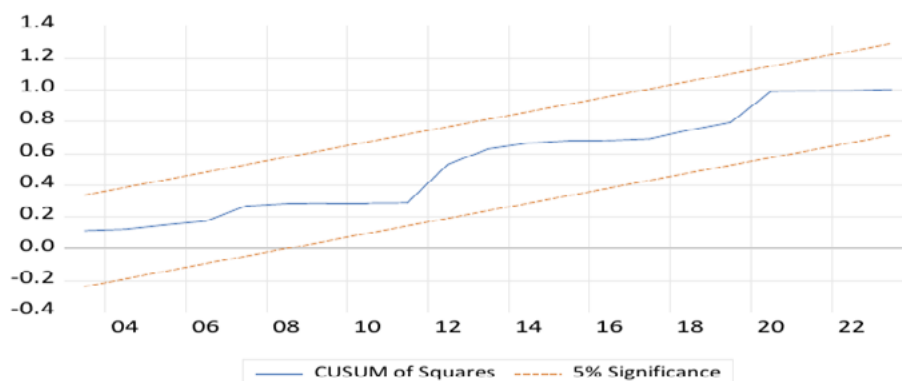
*CUSUM and squared CUSUM tests*

**Tabla 10 Prueba Cusum**



#### 3.9.- Test Cusum Cuadrado

Tabla II Prueba Cusum Cuadrado



## DISCUSSION

The relationship among population growth, larger areas of destroyed forests, and CO<sub>2</sub> emissions in Peru during 1990-2023 is the central topic of this research. The study seeks to identify relationships among variables, their causality, and cointegration through an ARDL model (Paija et al., 2026), using the Kaya Identity as the theoretical reference.

The R value of 0.9789 and adjusted R<sup>2</sup> of 0.9703 indicate goodness of fit. Therefore, the variables included in the model explain the impact on the dependent variable. In addition, the R and adjusted R<sup>2</sup> values show that the error term has an imperceptible or null value in the construction and explanation of the model (He, 2026). The Jarque-Bera test value of 0.74 indicates normal distribution; the LM test shows absence of serial correlation with a value of 0.20; and the ARCH test shows no heteroscedasticity because its value is 0.74 > 0.05. The Ramsey test value of 0.303 confirms that the model is correctly specified.

The Granger causality test showed a bidirectional relationship between population and CO<sub>2</sub> emissions; industrialization and CO<sub>2</sub> emissions; GDP per capita and population; industrialization and population; forest loss and population; and industrialization and GDP per capita. In addition, GDP per capita and CO<sub>2</sub> emissions, GDP per capita and forest loss, and industrialization and forest loss present unidirectional causality.

The empirical evidence presented demonstrates a high degree of relationship between CO<sub>2</sub> emissions and population, supported by the studies of Baena (2021), Nisamudheen and Shreef (2026), Ricapa (2020), Wang et al. (2026), and Rahman and Salimullah (2026). The relationship between CO<sub>2</sub> emissions and forest loss is supported by Anwar (2026) and Mohammad et al. (2026). Therefore, the relationship between the dependent variable and the independent variables proposed in this study is evident, reinforced by the statistical data presented in the methodological section and by the stylized facts of the model.

The theoretical foundations of this research are consistent with the findings. Nicholas Georgescu-Roegen's model expresses concern about economic growth and environmental damage, arguing for a careful process that prevents resource depletion and respects nature, supported by ethics, te-

chnology, and policy. Herman Daly's postulates seek to minimize environmental damage resulting from economic growth through sustainability and institutional support. The Kaya Identity model proposes economic growth, population, and technology as variables explaining the increase in CO<sub>2</sub> emissions. In this research, these variables are particularly important based on empirical evidence and statistical testing.

The statistical analysis for the bounds test shows that the F-statistic is 9.63, exceeding the 10% lower and upper critical bounds of 2.20 and 3.09. This result shows that all variables in the model jointly cointegrate in the long run. In the error correction model, the CointEq(-1) coefficient is -0.72, fulfilling the condition of being negative and statistically significant (0.000), with a t-statistic of -8.42. These results show that the variables cointegrate until reaching long-run equilibrium, with an adjustment speed of 72% per year.

The contemporaneous population variable has a positive impact of 13.5% and is statistically significant (0.00). The lagged forest-loss variable has a positive impact of 0.108% and is statistically significant (0.01). In contemporaneous form, forest loss is not statistically significant. On the other hand, lagged population has a negative impact of -23.44% and is statistically significant (0.00). This result can be explained by the findings of Musse et al. (2026), who conclude that population has an inverse relationship with CO<sub>2</sub> emissions when political instability prevents the population from accessing renewable energy sources.

The CUSUM and squared CUSUM tests show graphically that in both cases the traces do not exceed the 5% significance bands. Therefore, stability exists among the estimated model parameters. Since the traces do not exceed the significance bands, it is not necessary to explain any structural break or out-of-band phenomenon over time for the variables presented.

According to the Kaya Identity model used as the theoretical reference for the mathematical and econometric model, population is a variable that explains the increase in CO<sub>2</sub> emissions. This is supported by the statistical procedures applied and by evidence from other authors. It is also necessary to include the destroyed-forests variable as a cause of CO<sub>2</sub> emissions in Peru, whose significance values were determined with scientific rigor.

## CONCLUSIONS

- This research used the ARDL model and determined that the variables in the proposed model cointegrate in both the short and long run. The population variable explains CO<sub>2</sub> emissions in Peru during the study period with the greatest significance. The forest-loss variable also explains emissions of these polluting gases. Population growth has a major impact on the environment; countries such as Russia, China, the United States, and India are among the largest producers of carbon dioxide. Activities generated by the population - including energy demand, transport, industry, and consumption - as well as the burning of forests for agriculture and logging for industry, substantially influence the increase in CO<sub>2</sub> emissions.
- The error correction model shows that the CointEq(-1) coefficient meets the required speci-



fications because it is negative (-0.72) and highly significant (0.000). These results confirm the existence of a short- and long-run relationship and indicate that the variables cointegrate at an annual adjustment speed of 72%.

- Economic growth, represented by GDP per capita, has a value of 2.52 and a significance level of 0.02 in the long run. This is explained by the many activities generated in production. Over time, the growth trend is similar to the trend described by CO2 emissions. However, technology applied to the economy may eventually enable cleaner emissions in production processes.
- Industrialization in the short and long run has not shown coefficients of sufficient value or significance to affect CO2 emissions. Nevertheless, the statistical procedures show that in the long run this variable and the other variables in the econometric model will cointegrate at the speed indicated by CointEq(-1), since the conditions for its application are satisfied.
- Finally, considering the results obtained through the statistical models, the findings and conclusions of the reviewed studies, and the theoretical foundations of recognized economists who developed mathematical models to explain the research problem, it is concluded that the hypothesis that population growth and forest loss in Peru explain the increase in CO2 emissions cannot be rejected and can be accepted.

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# Factors Influencing Women's Entrepreneurship in Barranquilla, Colombia, from the Fogel and Gnyawali Perspective

Fatores que influenciam o empreendedorismo feminino em Barranquilla, Colômbia, na perspectiva de Fogel e Gnyawali

*Factores que influyen en el emprendimiento femenino en Barranquilla (Colombia), desde la perspectiva de Fogel y Gnyawali*



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## ABSTRACT

This study aims to determine the factors that influence women's entrepreneurship in Barranquilla from the perspective of Fogel and Gnyawali. A quantitative study with a descriptive approach was conducted through surveys administered to 146 participants for data collection. Four key dimensions were analyzed: legislation and government policies, sociocultural and economic factors, economic and non-economic support measures, and general and specific training. The findings seek to contribute to a better understanding of the challenges and opportunities faced by women entrepreneurs in Barranquilla and provide relevant information for designing strategies and policies that foster a more favorable entrepreneurial environment.

**Keywords:** Entrepreneurship; Sociocultural Factors; Government Policies; Support Measures; General Training.

**JEL Code:** L26; Z1; H11; H25; I21; O17.

## RESUMO

Este estudo tem como objetivo determinar os fatores que influenciam o empreendedorismo feminino em Barranquilla, a partir da perspectiva de Fogel e Gnyawali. Foi realizado um estudo quantitativo com abordagem descritiva, por meio de questionários aplicados a 146 participantes para a coleta de dados. Foram analisadas quatro dimensões principais: legislação e políticas governamentais, fatores socioculturais e econômicos, medidas de apoio econômicas e não econômicas, e capacitação geral e específica. Os resultados buscam contribuir para uma melhor compreensão dos desafios e oportunidades enfrentados pelas mulheres empreendedoras em Barranquilla e fornecer informações relevantes para a elaboração de estratégias e políticas que promovam um ambiente empreendedor mais favorável.

**Palavras-chave:** Empreendedorismo; Fatores Socioculturais; Políticas Governamentais; Medidas De Apoio; Formação Geral.



## INTRODUCTION

Female entrepreneurship has become an important factor for economic and social development, particularly in contexts where women face restrictions in accessing formal employment, financing, and business training. In cities such as Barranquilla, many women have decided to create their own businesses as a strategy to generate income and help support their households, despite difficulties associated with informality and the socioeconomic conditions of the environment. In this context, access to financial resources and growth strategies is a determining factor for the sustainability of entrepreneurial ventures, especially micro and small enterprises led by women (Gil Hoyos et al., 2020).

Within this framework, the article aims to analyze the factors that influence women's entrepreneurship in Barranquilla from the perspective of the entrepreneurial ecosystem model proposed by Fogel and Gnyawali, considering dimensions such as legislation and government policies, sociocultural and economic factors, institutional support measures, and general and specific training. In this regard, knowledge management makes it possible to articulate organizational capabilities, facilitate decision-making, and strengthen learning processes within entrepreneurial ventures (Martínez Garcés & Garcés Fuenmayor, 2021).

The article is structured progressively. First, it presents the background, which contextualizes female entrepreneurship and highlights the importance of the topic in academic and social spheres. Subsequently, the theoretical framework that supports the research is developed from a conceptual approach. Next, the methodology is described, based on a quantitative approach with a descriptive scope and the application of surveys to women entrepreneurs. The results obtained from the information collected are then presented and analyzed, and finally, the conclusions summarize the most relevant findings of the study.

### 1. Background

Entrepreneurship is understood as the set of activities aimed at developing projects that pursue specific economic, political, or social objectives and that also have distinctive characteristics, mainly because they involve uncertainty and innovation. Entrepreneurs seek to create innovative solutions or improve existing products and services by identifying and capitalizing on market opportunities (González, 2019). Likewise, business growth is conditioned by internal and external constraints that limit organizational development; therefore, proper management is essential to improve the competitiveness of entrepreneurial ventures (Rodríguez, 2021). Entrepreneurship has been the subject of numerous studies because of its undeniable impact on society and its contribution to development. Its role is fundamental not only in job creation and the strengthening of academic training, but also in energizing the economy in all its dimensions (Patiño et al., 2018).

Entrepreneurship is considered one of the main drivers of business creation, and entrepreneurs play a central role in any economy, particularly because their skills and initiatives allow them to anticipate individual needs and bring new ideas to the market (Borja et al., 2020). It is highly important for entrepreneurs to acquire the basic concepts that enable them to reduce the risks and uncertainties inherent in business activity, adopting a managerial approach to address the situations that arise and relying on principles of administrative management (Henoa, 2020).

Women-led entrepreneurship plays a fundamental role in the economy, although it still faces obstacles that hinder its expansion. Nevertheless, economic crises have encouraged more women to create their own businesses, although their participation remains concentrated mainly in specific sectors with limited diversity (Montero & Camacho, 2018).

The purpose of this study is to determine the factors that influence women's entrepreneurship in Barranquilla from the perspective of Fogel and Gnyawali. Understanding the characteristics and challenges women face when undertaking entrepreneurial activity is necessary to develop strategies that promote their growth in more competitive and inclusive environments. The study also analyzes how social, economic, political, and cultural variables influence the development of women-led ventures in Barranquilla. This article follows a descriptive approach using survey techniques and seeks to contribute recommendations that promote the development of new ventures led by women.

## 2. Theoretical framework

Female entrepreneurship in Latin America has gained relevance as a driver of economic empowerment, especially after the COVID-19 pandemic. Although it faces challenges such as educational dropout and fear of failure, women have been able to recognize opportunities in areas such as finance and services, sustaining their businesses and creating jobs. However, health restrictions have hindered their exports, which highlights the importance of studying gender stereotypes and their effect on female entrepreneurship in order to promote effective support in the future (García et al., 2022). The pandemic generated significant impacts on business activity, affecting income, employment, and operational capacity, which forced entrepreneurs to rethink sustainability strategies (Aquino Rocha et al., 2021).

Women have developed skills in self-knowledge, emotional management, leadership competencies, and people management. Motivational factors such as the pursuit of self-realization and job dissatisfaction drive their decision to start a business, along with the desire to achieve financial independence and a balance between personal and working life (Krauss and Bonomo, 2020). Many women start businesses out of economic necessity and face diverse limitations that hinder the development of their enterprises and improvements in their quality of life. Common characteristics among women entrepreneurs include motivation, work experience, and the ability to take risks; however, access to financing continues to be an important challenge that restricts their economic capacity (Paredes et al., 2019).

Women entrepreneurs face various problems that affect the performance and growth of their businesses, including lack of work experience, limited access to financing, and social and cultural conditions that restrict their development (Saavedra & Camarena, 2015). The search for autonomy and freedom drives many women to start their own businesses in areas where they already have work experience. Although they face economic obstacles, such as difficulty accessing financing, gender stereotypes do not necessarily represent a significant barrier. Women entrepreneurs tend to define success in emotional terms, prioritizing personal satisfaction and passion for their work rather than focusing exclusively on financial indicators (Álvarez, 2023).

One of the main reasons women are compelled to start businesses is labor-market instability, which prevents them from maintaining economic stability to support their families and from having autonomy over their time to fulfill the diverse responsibilities they carry out in their households (Acosta et al., 2017).



## Fogel and Gnyawali's Theory

The entrepreneurial ecosystem is influenced by factors such as government policies, financing options, and technical training. Business regulations and access to capital, whether through loans or support programs, are determining factors for business development. Business education and training play a key role in preparing entrepreneurs, while tax incentives, information networks, and advisory services strengthen the environment, facilitating the creation and growth of new firms (Jiménez et al., 2019). Similarly, innovative leadership becomes a key factor in fostering organizational cultures oriented toward innovation, enabling ventures to adapt to changing environments and improve their competitiveness (Fontalvo & Cienfuegos Molina, 2020).

Fogel and Gnyawali's theory explains the creation of a new firm based on government legislation and policies, sociocultural and economic factors, economic and non-economic support measures, and, finally, general and specific training in business creation. Considering the opportunities, skills, and predispositions that shape this process, these dimensions are addressed as follows:

### Government Legislation and Policies

The creation of a company depends not only on the initiative of an entrepreneur, but also on the political, economic, and cultural context in which it develops. Rules and regulations, as well as the administrative and legislative procedures imposed by government, directly affect the establishment of a business in a competitive market. At the same time, the political and regulatory environment can foster innovation and the formalization of diverse ventures (Kantis et al., 2012). A frequent disconnect exists between the formulation of regulations and their practical implementation: although ordinances and incentives for entrepreneurship exist, implementation, financing, and local coordination problems limit their real impact. This highlights the importance not only of designing laws, but also of ensuring the resources and capacities needed for their execution (Alvarado & Quinto, 2024; García, 2023).

### Sociocultural and Economic Factors

Entrepreneurship has become a key engine for economic development and regional competitiveness, leading countries to promote entrepreneurial activity through strategic investment. For entrepreneurship to succeed, the state must be able to invest in research and innovation, since building knowledge-based societies is essential (Molina, 2022). From a productive perspective, innovation also involves incorporating new materials and processes that improve product efficiency and sustainability, as evidenced by studies analyzing the use of natural fibers to develop new materials with competitive mechanical properties (Gómez Méndez et al., 2020). The vitality of entrepreneurship is also closely linked to culture; entrepreneurial culture comprises the values, beliefs, and practices that shape the decision to start a business and organize work. These factors are mediated by institutions and public policies: appropriate state promotion can facilitate the transformation of local culture so that entrepreneurship is considered a socially valued option (Maturana, 2021).

However, the act of entrepreneurship is ultimately a personal decision motivated by internal factors, with motivation being one of the most widely studied. From this perspective, the Need for Achievement Theory states that entrepreneurs are driven by the satisfaction derived from achieving

their goals. They take moderate risks, seek to overcome obstacles, and require feedback in the process, while attributing success or failure to themselves (Silva & Rompato, 2020). This psychological need is important because it is linked to survival- or opportunity-driven motivation. The decision to undertake entrepreneurial activity is mediated by this impulse, which in the present study is also connected to the socioeconomic conditions of the sample.

### **Economic and Non-Economic Support Measures**

Low profitability and limited access to financing are common problems for entrepreneurs, especially in MSMEs. Access to credit is limited by high costs, inadequate terms, and complex requirements. Financial education and access to financial services promote the development of human capabilities in the population; these factors play a crucial role in improving economic well-being and reducing poverty (Salgado et al., 2023). Support policies should not be limited simply to encouraging the creation of firms, but should also focus on promoting ventures with growth potential by combining subsidies, technical assistance, and guidance so that new businesses can evolve into competitive firms (Kantis et al., 2012).

### **General and Specific Training in Business Creation**

Education plays a crucial role within the entrepreneurial ecosystem, since educational resources should help build a solid business culture and influence entrepreneurial intention (Gonzales and Viera, 2020). Entrepreneurship is considered an essential competence that requires knowledge, skills, and attitudes to transform a business idea into an actual enterprise (Gonzales and Viera, 2020). Entrepreneurial education plays a central role, and pedagogical designs, context, and content have been shown to be important for university students to develop entrepreneurial intention (Araya and Pizarro, 2021). Beyond research, the training component should focus on competencies and include financial education for resource management and investment decision-making, which can directly improve people's economic situation (Salgado et al., 2023).

This training foundation is theoretically supported by Human Capital Theory. This theory assumes that people's work is the axis of the production of goods and services through the productive forces they implement (Sandoval & Hernández, 2018). Human capital, which includes education, experience, and management skills, is the critical resource that determines the success or failure of individual entrepreneurs. In the present study, this theory is connected to the Support and Training dimension of the Fogel and Gnyawali model, considering that the educational level and lack of specific knowledge (financial and accounting) among women entrepreneurs constitute a structural barrier that prevents them from accessing ecosystem resources and formalizing their businesses.

The study of female entrepreneurship in Barranquilla will be developed from an integral perspective, guided by the Entrepreneurial Ecosystem Model proposed by Gnyawali and Fogel. This approach makes it possible to understand how different elements of the environment influence the creation and sustainability of business initiatives led by women. To this end, four key dimensions of the ecosystem will be analyzed: the limitations and requirements of the regulatory framework, the social and economic conditions that may increase the vulnerability of women entrepreneurs, the strength of the institutional infrastructure that provides support and training, and the availability of financial resources needed to promote their projects.



## METHODOLOGY

This research was developed under a quantitative approach with a descriptive design, aimed at identifying the factors that influence women's entrepreneurship in Barranquilla from the perspective of Fogel and Gnyawali. This approach made it possible to analyze the experiences, perceptions, and motivations of women entrepreneurs regarding the social, economic, and cultural challenges they face in their environment.

The population consisted of women entrepreneurs in the city of Barranquilla who carry out activities in different productive sectors, such as commerce, services, gastronomy, and beauty. A sample of 146 women was selected through non-probabilistic convenience sampling, considering their accessibility and willingness to participate.

Information was collected through a structured questionnaire based on the dimensions of the Fogel and Gnyawali model: legislation and government policies, sociocultural and economic factors, support measures, and general and specific training. The instrument included closed and open-ended questions that made it possible to collect both quantitative and qualitative data in order to understand the conditions, opportunities, and limitations faced by women entrepreneurs. The surveys were administered in person and virtually, which facilitated broader coverage and diversity in responses.

The data obtained were organized and analyzed using descriptive statistical techniques, including frequencies and percentages to identify trends in each dimension. In addition, content analysis was used to interpret qualitative information and complement the findings with relevant observations.

The study was carried out during the second semester of 2024 in the city of Barranquilla, ensuring compliance at all times with ethical principles of confidentiality, anonymity, and informed consent. The results seek to provide useful information to strengthen support strategies and public policies aimed at female entrepreneurship, promoting equal opportunities and local economic development.

**Table 1**

*Classification of questions*

CATEGORY	QUESTION	DESCRIPTION
<b>Government legislation and policies</b>	Question 1	Is your business registered with the Chamber of Commerce?
	Question 2	Do you have a Tax Identification Registry (RUT) as an individual?
<b>Sociocultural and economic factors</b>	Question 3	What is your socioeconomic stratum according to your public utilities bill?
	Question 4	Did your business arise from the need to generate income to support yourself and your family?
<b>Economic and non-economic support measures</b>	Question 5	Participation in fairs or business rounds
	Question 6	Support from government entities (economic and non-economic).
<b>General and specific training</b>	Question 7	Legal knowledge
	Question 8	Level of education (technical, secondary school, etc.).

*Note.* Data based on the survey administered to 146 women entrepreneurs in Barranquilla (2024).

## RESULTS AND DISCUSSION

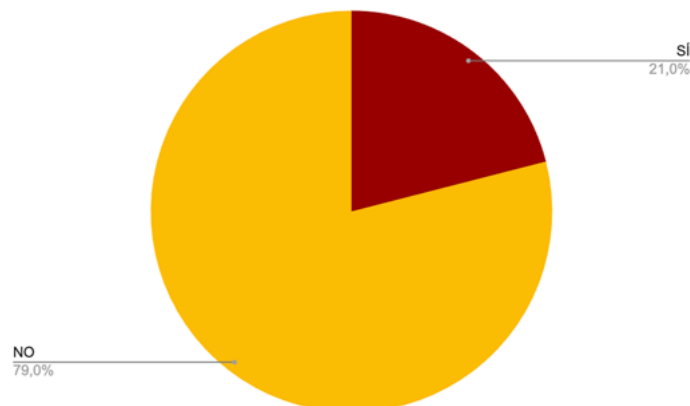
Based on the question classification table, the questions directly related to the diagrams developed in the results section were selected in order to conduct a more precise and representative analysis of the dimensions established by Fogel and Gnyawali.

In the area of legislation and government policies, questions related to business registration with the Chamber of Commerce and registration in the Single Tax Registry (RUT) were analyzed (see Figures 1 and 2). These figures illustrate the degree of formalization among women entrepreneurs. Regarding sociocultural and economic factors, questions related to socioeconomic stratum and motivations for starting a business out of economic necessity were selected (see Figures 3 and 4). These provide relevant information about the socioeconomic context in which women-led businesses emerge. With respect to economic and non-economic support measures, questions related to participation in trade fairs or business events, as well as access to institutional support, were analyzed (see Figures 5 and 6). This makes it possible to determine the scope of support and advisory services received by the participants. Finally, regarding the general and specific educational dimensions, questions related to legal knowledge and educational level were considered, as shown in Diagrams 7 and 8. These illustrate the academic preparation and technical skills that influence the success of women entrepreneurs in Barranquilla.

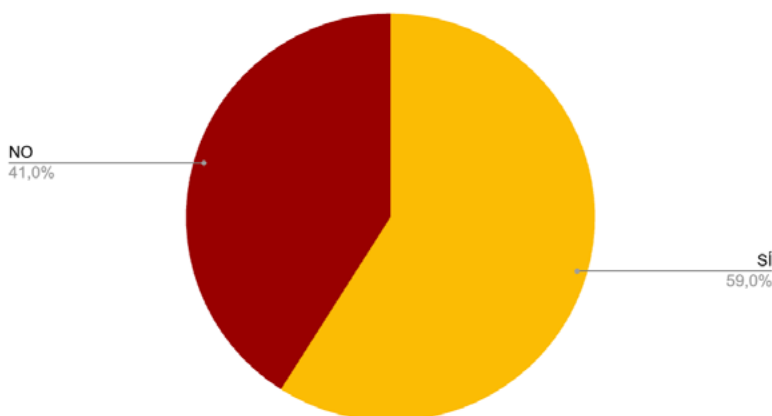
### Government Legislation and Policies

The empirical findings of the study reveal that the Legislation and Government Policies dimension of the entrepreneurial ecosystem proposed by Gnyawali and Fogel operates as a structural barrier rather than as a facilitator for women entrepreneurs in Barranquilla. This assertion is supported by the high level of informality identified: Figure 1 shows that 79.5% of businesses have not completed their registration with the Chamber of Commerce. In addition, Figure 2 shows that less than half of the women entrepreneurs, 41%, have a Single Tax Registry (RUT) as individuals.

This significant formalization gap supports Fogel and Gnyawali's thesis that rigid or complex procedures act as an inhibitor. Women entrepreneurs perceive that the costs associated with registering businesses or brands are high, and this perception is compounded by a tax burden considered excessive. Consequently, remaining informal becomes a survival strategy adopted to mitigate fiscal and regulatory pressure. This suggests that current policies are not adapted to facilitate the transition to formality in the microenterprise and necessity-driven entrepreneurship segment, limiting from the outset the possibilities of access to financing channels and formal support and perpetuating the economic fragility of these businesses (Acevedo et al., 2024).

**Figure 1.***Is your business registered with the Chamber of Commerce?*

Note. Data based on the survey administered to 146 women entrepreneurs in Barranquilla (2024).

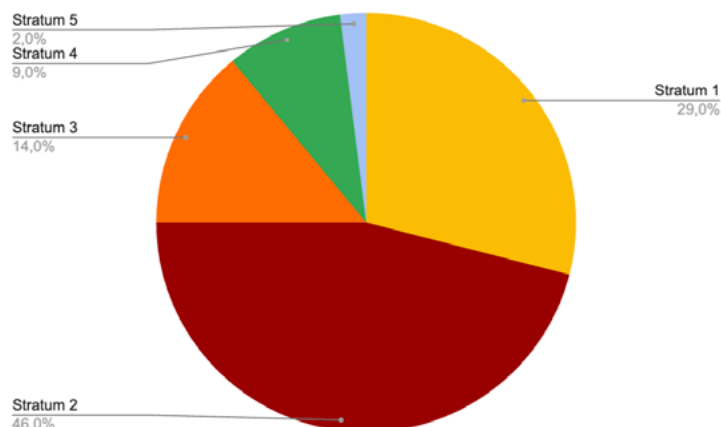
**Figure 2.***Do you have a Tax Identification Registry (RUT) as an individual?*

Note. Data based on the survey administered to 146 women entrepreneurs in Barranquilla (2024).

### Sociocultural and Economic Factors

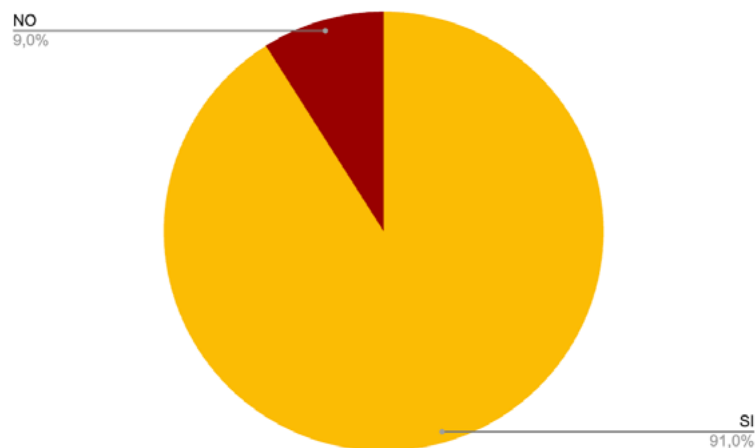
The results indicate that socioeconomic factors play a crucial role in the profile of entrepreneurs. The socioeconomic profile of the sample, concentrated in stratum 2 as shown in Figure 3, is directly related to Fogel and Gnyawali's socioeconomic conditions. These conditions of vulnerability act as a push factor from the formal labor market and reinforce the pattern of necessity-driven entrepreneurship (Figure 4), creating a cycle in which the environment drives business activity but does not provide the resources needed for consolidation. Figure 4, which shows that the vast majority, 91%, of women start businesses because of the need to generate income for subsistence, is directly explained by the Theory of Necessity Entrepreneurship (Silva-Peralta & Rompató, 2020). Although Fogel and Gnyawali include socioeconomic conditions, this specific motivation is an intrinsic factor that affects business decisions. Entrepreneurship becomes a survival strategy in response to unemployment or the need to reconcile family care responsibilities, which explains why these businesswomen prioritize immediate income generation over long-term growth or investment in formalization.

**Figure 3.**  
*Socioeconomic stratum.*



*Note.* Data based on the survey administered to 146 women entrepreneurs in Barranquilla (2024).

**Figure 4.**  
*Did your business arise from the need to generate income to support yourself and your family?*



*Note.* Data based on the survey administered to 146 women entrepreneurs in Barranquilla (2024).

### Economic and Non-Economic Support Measures

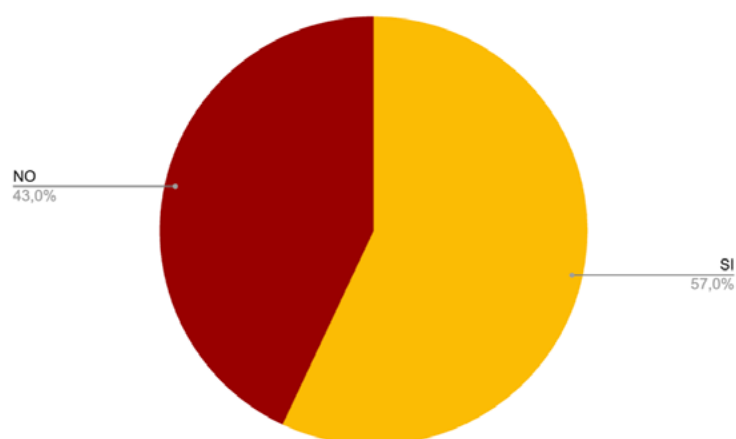
The Non-Financial Support and Training dimension is the only one that shows partially positive results, although these remain insufficient to offset regulatory barriers. On the one hand, Figure 6 indicates that, although access to formal economic support is limited, the women entrepreneurs have received a certain level of non-economic support from the public sector, such as training or guidance, which suggests an institutional effort that should be strengthened. This situation reinforces the importance of financing as a determining factor for business growth, particularly in small-scale ventures (Gil Hoyos et al., 2020; Hernández and Castillo, 2021).

On the other hand, Figure 5 demonstrates the effectiveness of contact networks and sales platforms: 57.5% of respondents have participated in fairs or business rounds and, among them, a significant 56.1% managed to make sales. This active and successful participation in networking and fairs valida-

tes the importance of support infrastructure that fosters the flow of information and resources. These results confirm that non-economic support and access to visibility platforms are measures with high perceived value and immediate usefulness for subsistence women entrepreneurs, which is essential to improve the management of their businesses. However, this non-financial support must be strategically articulated beyond sales, focusing on formalization and the development of human capital (Sandoval Vásquez & Hernández Castro, 2018), so that women entrepreneurs can capitalize on these gains and move from survival to sustained growth. In this context, proper knowledge management makes it possible to improve organizational capabilities and facilitate the sustainability of entrepreneurial ventures (Martínez Garcés & Garcés Fuenmayor, 2021; Quintero et al., 2022).

**Figure 5.**

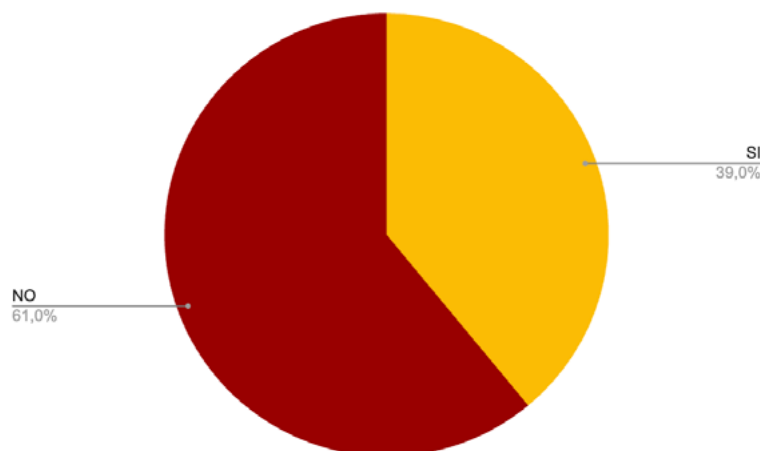
*Have you participated in events such as fairs or business rounds?*



*Note.* Data based on the survey administered to 146 women entrepreneurs in Barranquilla (2024).

**Figure 6.**

*Have you received NON-economic or non-financial assistance from any local, departmental, or national government entity?*

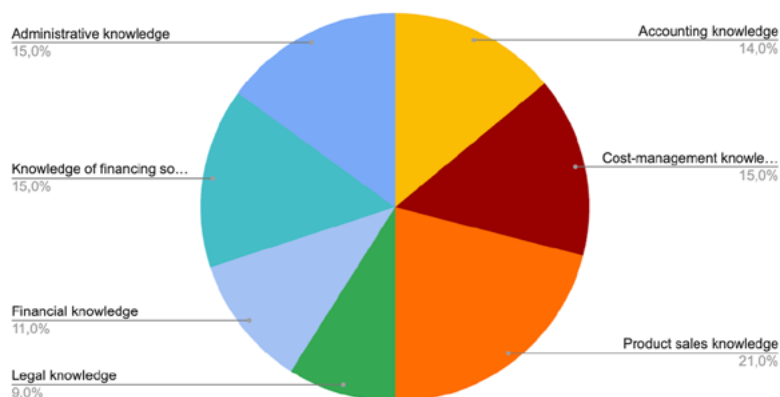


*Note.* Data based on the survey administered to 146 women entrepreneurs in Barranquilla (2024).

## General and Specific Training in Business Creation

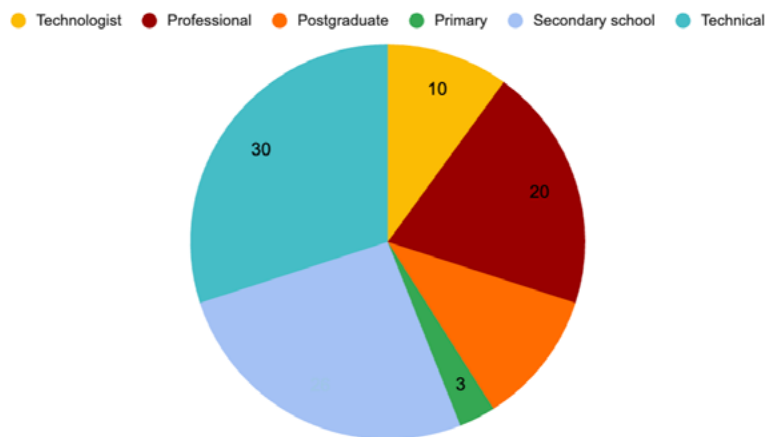
Figure 8 shows that the predominant educational level among women entrepreneurs is concentrated at the technical and secondary levels, which, according to Human Capital Theory (Sandoval Vásquez & Hernández Castro, 2018), generates a deficit in the stock of knowledge that should drive productivity. This limitation is evident in Figure 7, where women entrepreneurs report a critical lack of competencies in fundamental areas such as accounting, cost management, finance, and risk management. In the context of the Support and Training dimension of the Gnyawali and Fogel model, this skills gap is an intrinsic factor that weakens the ecosystem. If the human capital base is weak, the ability of women entrepreneurs to assimilate and apply information from existing support programs is reduced, rendering government and private training strategies ineffective.

**Figure 7.**  
*Legal knowledge.*



*Note.* Data based on the survey administered to 146 women entrepreneurs in Barranquilla (2024).

**Figure 8.**  
*Level of education (technical, secondary school, etc.).*



*Note.* Data based on the survey administered to 146 women entrepreneurs in Barranquilla (2024). These limitations may be understood as constraints that affect organizational performance and must be identified and strategically managed to achieve business growth (Rodríguez, 2021).

## CONCLUSIONS

The analysis of the results presented makes it possible to conclude that female entrepreneurship in Barranquilla is conditioned by social, economic, educational, and institutional support factors, as proposed by the Fogel and Gnyawali model. Women entrepreneurs show a high degree of perseverance and commitment, but they face structural limitations that restrict their growth and hinder the formal consolidation of their businesses (Sandoval et al., 2020).

In the legislative and government policy dimension, it was identified that a large proportion of women entrepreneurs have not formalized their businesses with the Chamber of Commerce and do not have a Single Tax Registry, reflecting persistent informality. This situation coincides with Saavedra and Taxis (2019), who argue that the absence of a solid institutional framework and effective policies hinders entrepreneurship. Likewise, Valenzuela et al. (2018) emphasize that high costs and complex procedures limit formalization, a finding that is also observed in this study.

Regarding sociocultural and economic factors, most participants belong to socioeconomic strata 1 and 2 and started businesses out of economic necessity, seeking to support their families. These results support the findings of Paredes et al. (2019), who argue that the lack of job opportunities drives many women to create their own sources of income. In addition, the predominance of middle-aged women is consistent with Krauss and Bonomo (2020), who highlight that female entrepreneurship also responds to the desire for financial independence and a balance between work and personal life. Nevertheless, the insecurity and low income problems mentioned by the participants confirm the structural challenges identified by Molina (2022) regarding the vulnerability of the Colombian socioeconomic environment.

With respect to economic and non-economic support measures, the results show limited access to credit, subsidies, or financial incentives. However, participation in fairs, training sessions, and business events has been beneficial in increasing sales and strengthening business skills, demonstrating the value of non-monetary strategies. These findings are consistent with Valenzuela et al. (2018), who emphasize that education and institutional guidance are key to promoting business sustainability.

In the category of general and specific training, most women entrepreneurs were found to have technical or secondary education and gaps in accounting, cost management, finance, and digital sales. This lack of formal preparation limits administrative efficiency and growth opportunities, in line with González and Vieira (2020), who point to the need to strengthen entrepreneurial education from early stages. Similarly, Salgado et al. (2023) emphasize that human capital development, through financial and technical education, is essential for economic sustainability and sound decision-making.

In summary, the results show that female entrepreneurship in Barranquilla represents an important engine of economic and social development, although obstacles associated with informality, lack of access to financing, and insufficient business training persist. As García (2023) and Jiménez et al. (2019) suggest, strengthening institutional, educational, and social support networks will make it possible to create a more equitable and inclusive environment in which women can consolidate their projects and contribute significantly to regional economic progress.

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- Formal analysis: Fabiana Andrea Gómez Martínez, María de los Ángeles Silva Jiménez, Gustavo Rafael Henríquez Fuentes
- Investigation: Fabiana Andrea Gómez Martínez, María de los Ángeles Silva Jiménez, Gustavo Rafael Henríquez Fuentes



- Methodology: Fabiana Andrea Gómez Martínez, María de los Ángeles Silva Jiménez, Gustavo Rafael Henríquez Fuentes

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A Inteligência Emocional na Tomada de Decisões para Ajudar os Colaboradores das PME a Alcançar os Seus Objetivos, Lima, 2025.

*La inteligencia emocional en la toma de decisiones para ayudar a los empleados de las pymes a alcanzar sus objetivos, Lima, 2025.*

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## ABSTRACT

This study argues that decision-making is a process in which emotional intelligence and cognitive intelligence are integrated into actions aimed at achieving the goals proposed by employees. The objective of this research was to determine the relationship between emotional intelligence and decision-making in achieving the goals of employees of SMEs in Lima, 2025. The study used a non-experimental, quantitative, correlational, and propositional methodology. The population consisted of 12,200 employees and the sample included 1,209 participants. A Pearson correlation coefficient of 0.830 was obtained, indicating that emotional intelligence is an important indicator for decision-making within small companies in Lima, especially considering that many companies may fail if they do not care for their personnel and the emotional intelligence they develop. The study concluded that there is a relationship between managerial decision-making and success in goal achievement. The model applied in this research also showed that this relationship is highly influential, meaning that decisions made by SMEs regarding their structure and projects have repercussions on goal achievement. Therefore, SMEs must maintain order, organization, and planning because, due to their size, any decision may have a decisive effect on their results. Decision-making is a process through which individuals attempt to change the course of events in their effort to achieve goals that provide well-being, prosperity, and ultimately happiness.

**Keywords:** Emotional Intelligence; Decision-Making; Goal Achievement.

**JEL Code:** M1, M12, L1, M13

## RESUMO

Este estudo defende que a tomada de decisão é um processo no qual a inteligência emocional e a inteligência cognitiva se integram em ações voltadas para o alcance das metas propostas pelos funcionários. O objetivo desta pesquisa foi determinar a relação entre a inteligência emocional e a tomada de decisão no alcance das metas dos funcionários de PMEs em Lima, em 2025. O estudo utilizou uma metodologia não experimental, quantitativa, correlacional e proposicional. A população consistiu em 12.200 funcionários e a amostra incluiu 1.209 participantes. Foi obtido um coeficiente de correlação de Pearson de 0,830, indicando que a inteligência emocional é um indicador importante para a tomada de decisões em pequenas empresas em Lima, especialmente considerando que muitas empresas podem fracassar se não cuidarem de seu pessoal e da inteligência emocional que desenvolvem. O estudo concluiu que existe uma relação entre a tomada de decisões gerenciais e o sucesso na realização de metas. O modelo aplicado nesta pesquisa também mostrou que essa relação é altamente influente, o que significa que as decisões tomadas pelas PMEs em relação à sua estrutura e projetos têm repercussões na consecução de metas. Portanto, as PMEs devem manter a ordem, a organização e o planejamento, pois, devido ao seu tamanho, qualquer decisão pode ter um efeito decisivo sobre seus resultados. A tomada de decisão é um processo através do qual os indivíduos tentam mudar o curso dos eventos em seu esforço para alcançar metas que proporcionem bem-estar, prosperidade e, em última instância, felicidade.

**Palavras-chave:** Inteligência emocional; tomada de decisão; alcance de metas.



## INTRODUCTION

The research problem addressed in this study emerged from conversations with managers of SMEs in the province of Lima, who reported difficulties related to employees' decision-making. This study argues that decision-making is a process in which emotional intelligence and cognitive intelligence are integrated into actions aimed at achieving the goals proposed by employees. Within this context, the study seeks to identify the relationship among the three variables under analysis, considering that the population is composed of the main SMEs in the province of Lima. These variables are emotional intelligence, decision-making, and goal achievement, which together form the basis of the theoretical model.

Society is immersed in a new digital era. Therefore, teaching, learning, and the use of technology are no longer sufficient; it is also necessary to develop competencies, since new generations already operate autonomously in technological and digital environments. However, because this environment is unstable, it is increasingly necessary to educate for competence rather than for mere technical handling, placing emphasis on soft skills (Rivera-Vargas & Lindín, 2018). Digitalization and information and communication technologies (ICTs) have not only modified learning but have also drastically transformed the current labor market. Competition now takes place in a global labor market, where technical knowledge alone is insufficient (Hernández-Lahoz, 2016, p. 49). Fernandez-Ronquillo, Llinas-Audet, and Sabate (2018) indicate that recent research has emphasized the importance of developing social skills, also known as emotional intelligence, because these skills provide individuals with a differential value and allow them to be highly competitive in the workplace. Emotional intelligence also contributes to a better organizational climate. Goleman (1999) affirmed that emotional intelligence is composed of a set of innate or acquired human skills, among which perseverance, empathy, self-motivation, enthusiasm, and self-control stand out, all of which are highly beneficial for personal development. In contemporary organizations, which operate under constant pressure and changing commercial environments, companies seek employees capable of facing such pressures. This allows business activities to be managed more effectively. It is also beneficial for workers to maintain control over their emotional states, since emotions influence their ability to perform tasks and pursue objectives. Consequently, their decisions are more sustainable and contribute to the achievement of both organizational and individual goals (Cuevas et al., 2013).

Many studies on emotional intelligence state that it is a very important managerial skill in any company, since it makes employee performance more efficient and therefore highly valuable (Pereda, López-Guzmán, & González, 2018). Idalberto Chiavenato (2011) argues that managers, administrators, and personnel with decision-making responsibilities bear the great responsibility of achieving the goals established for organizational growth and ensuring that these decisions produce positive results both economically and in terms of human resources. Yabar (2016), in turn, states that recognizing and developing emotions enhances intellectual performance, values, initiative, collaboration, creativity, and the proper management of one's own emotions and those of others, thereby contributing to leadership development. Furthermore, emotional intelligence, through proper decision-making, implies the achievement of important goals not only for the company but also for the worker (Huaman, 2012).

A clear example of companies taking emotional management seriously is McDonald's, a globally recognized company that values young people with emotional intelligence when hiring them and allowing them to build a career path. For this company, demonstrating leadership, teamwork, adaptability to change, and interpersonal communication skills can be as important as, or even more important than, previous work experience, since in many cases professional experience is not required (Garza, Garabito,

Hernández, Rodríguez, & Olivo, 2009). Its policies are based on the idea that a person with emotional intelligence is capable of solving problems and innovating, achieving greater acceptance of their decisions and contributing to goal achievement and work performance (Horna Figueroa, 2005).

In Ecuador, microentrepreneurs recognize the benefits of emotional intelligence. Specialists estimate that emotional intelligence provides a competitive advantage because it strengthens motivation, interpersonal relationships, self-knowledge, self-control, and empathy both in entrepreneurs and in their personnel, improving commercial management by 62% and enabling the creation of long-term service and business relationships (Velasquez, Suarez, Serrano, & Yance, 2016).

In Peru, in recent years emotional intelligence has become a fundamental factor motivating employees at all hierarchical levels to remain in or leave the company where they work. People not only seek employment to produce and generate results, but also a space for relationships and professional growth. As one of the consequences of poor managerial practices, Peru's average labor turnover rate reaches 20.7%, while voluntary turnover reaches 9.8% (El Economistamerica.pe, 2019). Additionally, 25% of turnover is related to work stress and high labor pressure, situations in which employees may be unable to manage their workload or perform adequately (Cayetano Saldaña, 2015).

The department of Lima, and especially its SMEs, is not exempt from the problems associated with emotional intelligence and its relationship with decision-making and goal achievement. Employees, including managers, administrators, and area heads at the executive level, do not always adapt easily to the trend of delegating responsibility and decision-making, nor to providing effective organizational communication that allows goals to be achieved. Insufficient knowledge of the job position may also prevent employees from making optimal decisions. This study is framed within the line of organizational behavior research related to the management of material and human resources. Therefore, this research measures the level of significance in the relationship among the variables in relation to the results of SMEs in Lima.

## METHODOLOGY

This section presents the research methodology, which determines how the study is developed and describes the approach, design, and type of research on which the study is based.

### Type of research

This research is based on the hypothetical-deductive method. According to Molero (2016), this method is applied to studies that maintain a hypothesis and has ontological and epistemic foundations, as it is based on the lived experiences of the subjects under study and is situated within the ontological approach of positivism. The research design is non-experimental because the variables are not deliberately manipulated, and it is cross-sectional because data are collected at a single point in time (Hernández Sampieri, 2014). The study follows a quantitative approach, which has a sequential logic and seeks to test propositions. Each stage precedes the next, and steps cannot be skipped, although some phases may be reorganized. The process begins with an idea that is progressively delimited; once established, objectives and research questions are derived, and books and previous



studies are reviewed to develop a theoretical framework. In the quantitative approach, data are collected to test hypotheses based on numerical measurement and statistical analysis, allowing theories to be tested and behavioral patterns to be established. This study is basic and correlational, since it analyzes the relationship among emotional intelligence, decision-making, and employees' goal achievement in companies.

## Research design

The design of this study is non-experimental because the data are processed according to the responses provided by the participants. Fuentes (2014) states that non-experimental research generally offers greater transparency in the data to be processed because the data are not manipulated at the researcher's convenience and do not need to be altered. The study is cross-sectional because it is conducted within a single period; this concept is supported by Yserm (2016), who states that studies that delimit or determine an exact period for applying the instrument use a cross-sectional design. In this case, the variables emotional intelligence and decision-making are analyzed in relation to success in goal achievement.

## Population and sample

### *Population*

The reference population is composed of SMEs registered in commercial activities in the city of Lima. Cruz and Vargas (2017) state that a population is the general set to which the researcher intends to apply the study. In this research, the total population is 12,200 employees, distributed across different sectors as detailed below.

**Table 1**

### *Population distribution*

Areas	Number of employees
Construction	2000
Manufacturing	500
Domestic consumption	1500
Agriculture and livestock	200
Fishing	1000
Transportation and communications	3000
Automotive	1000
Food and beverages	2000
Tourism, gastronomy, and hospitality	1000
Total population	12 200

### *Sample*

For this study, a sample of 1,209 workers was determined through non-probability convenience sam-

pling. Castro et al. (2019) define the sample as the specific subset to which the study is applied and from which the research results are obtained. The sample is also the core group that provides the information. The study attempted to reach as many participants as possible, obtaining a significant sample size that exceeded the size recommended for a 95% confidence level and a 5% margin of error.

**Table 2**

*Sample determination*

AREAS	N°	n
Construction	2000	180
Manufacturing	500	50
Domestic consumption	1500	120
Agriculture and livestock	200	30
Fishing	1000	134
Transportation and communications	3000	341
Automotive	1000	134
Food and beverages	2000	180
Tourism, gastronomy, and hospitality	1000	40
Total population	12 200	1209

*Sampling method and type*

This research is quantitative because it addresses quantifiable results and uses information obtained from data collection; it can work with populations of different sizes. Arzate (2019) also notes that these studies involve a statistical process.

The sampling method was non-probabilistic by quotas, since the study sought the available sample to which the researcher had access. Castro et al. (2019) state that non-probability convenience studies are those in which the researcher has full access to the population and includes those who participate in the study, characterized by the possibility that all accessible individuals may be included.

*Sampling procedure*

The sampling procedure was selected based on the number of workers in the different sectors. The study developed a stratification of the sectors, seeking a sample size appropriate to the research and consistent with the proposed methodology. The variables and their purpose were then analyzed, resulting in a sample composed of individuals from different work sectors.

**Inclusion and exclusion criteria**

*Inclusion criteria*

Employees with an active contract and employees working specifically in administrative, commercial, and production areas.

### *Exclusion criteria*

Employees who refused to complete the survey and employees who were on vacation or whose employment was suspended at the time the survey was administered.

### **Research hypotheses**

#### *General hypothesis:*

H1. The structural model of emotional intelligence and managerial decision-making has a significant effect on success in goal achievement among employees of SMEs in Lima, 2025.

#### *Specific hypotheses:*

H1. There is a relationship between emotional intelligence and decision-making among employees of SMEs in Lima, 2025.

H1. There is a relationship between emotional intelligence and goal achievement among employees of SMEs in Lima, 2025.

H1. There is a relationship between decision-making and goal achievement among employees of SMEs in Lima, 2025.

### **Study variables**

Ibáñez (2015) states that study variables are the central component of any research process because they constitute the object of study. These variables frame the influence of one variable over another or the relationships among them. As the theoretical development of each variable progresses, the theoretical model is created, as shown below:

#### **Figure 1.**

*Research design on emotional intelligence, goal achievement, and decision-making.*

*Source:* Research design on emotional intelligence by Ibáñez (2015).

## RESULTS

### *Outliers*

Mahalanobis distance, according to Tabachnick and Fidell (2013), is evaluated as a chi-square statistic ( $X^2$ ) “with degrees of freedom equal to the number of variables” (p. 99). In this study, Mahalanobis values were compared with the critical chi-square values for the three study variables, and values greater than the critical value of  $X^2$  ( $df = 3, p = .001$ ) = 18.47 were considered outliers. As a result, six cases were identified and removed: ID 101, 439, 777, 112, 450, and 788.

Cook's distance was also used to measure the total influence of a case on the model's ability to predict all cases. Cook and Weisberg (1982) suggested that values greater than 1 may be considered influential, resulting in an adjusted dataset of 1,209 cases. It can therefore be concluded that the Mahalanobis distance analysis applied to all variables did not present data points excessively distant from the rest, and Cook's distance was less than 1 for all variables, meaning that there was no important influence of outliers.

**Table 3.**

*Mahalanobis distance and Cook's distance for detecting outliers*

N°	ID	Mahalanobis distance	Cook's distance	p value
1	101	2,026,581	0.00837	0.0001
2	439	2,026,581	0.0007	0.0001
3	777	2,026,581	0.00148	0.0001
4	112	1,974,182	0.01198	0.0002
5	450	1,974,182	0.00205	0.0002
6	788	1,974,182	0.00035	0.0002

### *Normality test*

For this study, normal distribution of the data is a fundamental assumption that must be met by all variables included in the analysis because multiple causal relationships are analyzed (Tabachnick & Fidell, 2013).

The normality analysis was performed in SPSS. First, kurtosis and skewness were analyzed, as shown in Table 4. Skewness helped identify whether the data were uniformly distributed, while kurtosis determined the “peakedness” or “flatness” of the data distribution around the arithmetic mean (Hair et al., 1999). Data are considered normal when skewness and kurtosis values are equal to zero (Kline, 2011), and acceptable when the absolute value is between zero and three (Leys et al., 2013). The results showed that all skewness and kurtosis values for all variables were lower than three, except for the factor perceived labor discrimination and some negative skewness values. Therefore, univariate normality can be assumed according to the descriptive analysis of the study variables (see Table 4).

**Table 4.***Descriptive results of the three variables*

	N	Mean	SD	Skewness		Kurtosis		Minimum	Maximum
				Statistic	SE	Statistic	SE		
<b>Emotional intelligence</b>	1209	115.53	19.053	-0.209	0.070	0.477	0.141	56	170
<b>Managerial decision-making</b>	1209	159.88	30.292	-0.353	0.070	0.403	0.141	65	234
<b>Success in goal achievement</b>	1209	38.93	8.988	-0.516	0.070	0.292	0.141	10	56

*SD: Standard deviation, SE: Standard error*

Given that the selected sample size included more than 50 observations, the Kolmogorov-Smirnov (K-S) test was used. The result was  $p = .000$  for all variables, demonstrating non-normality of the data. However, Tabachnick and Fidell (2013) note that in large samples, data normality can be assumed. After confirming univariate non-normality, multivariate normality was tested using the critical ratio in the AMOS module of SPSS statistical software (see Table 5).

**Table 5.***Univariate normality test*

Statistic	Kolmogorov-Smirnov		
	df	p value	p value
<b>Emotional intelligence</b>	0.068	1209	0.000
<b>Managerial decision-making</b>	0.053	1209	0.000
<b>Success in goal achievement</b>	0.062	1209	0.000

### *Linearity*

Linearity analysis makes it possible to reflect the “degree to which changes in dependent variables are related to changes in independent variables” (Saunders et al., 2013, p. 548). To examine all relationships and identify any deviations from linearity that could affect correlation, a scatterplot was used, as suggested by Pallant (2011) and Hair et al. (1999). The results showed a linear scatterplot because most of the points for the study variables were arranged in a straight line. The straight line provided a reasonable fit to the data. Therefore, the linearity assumption was satisfied (see Figure 2).

**Figure 2.**  
*Correlation test*

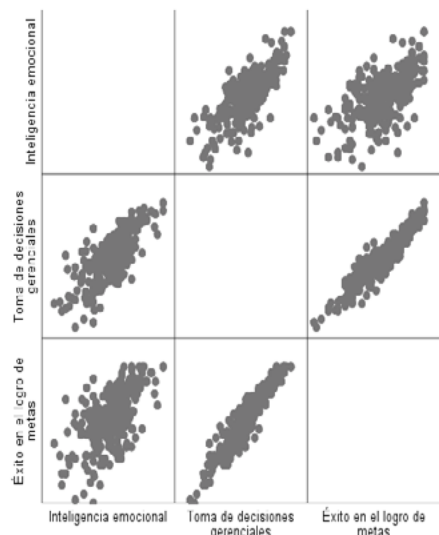
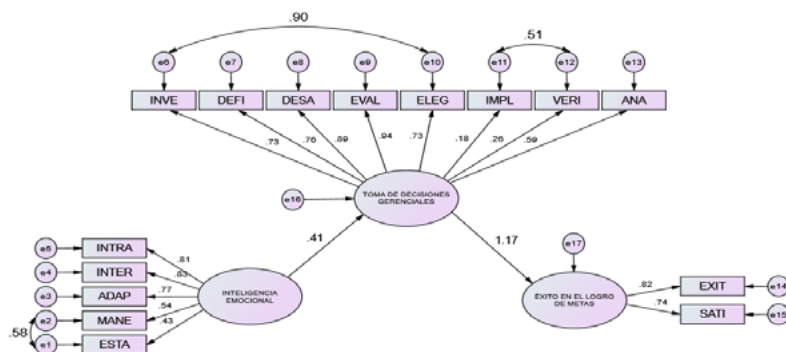


Table 6 shows the validation of the measurement instruments for emotional intelligence, goal achievement, and managerial decision-making. The Kaiser-Meyer-Olkin coefficient, commonly known as KMO, yielded indicators greater than 0.7. Therefore, it can be concluded that the measurement instruments were statistically validated.

**Table 6**  
*Results of the exploratory factor analysis*

Emotional intelligence	Goal achievement	Managerial decision-making	Managerial decision-making
Kaiser-Meyer-Olkin measure of sampling adequacy	0.910	0.882	0.839
Approx. chi-square	24749.58	12753.61	6335.18
df	435	648	28
p value	0.000	0.000	0.000

**Figure 3.**  
*Initial model with standardized estimators*



**Figure 4**  
*Final model*

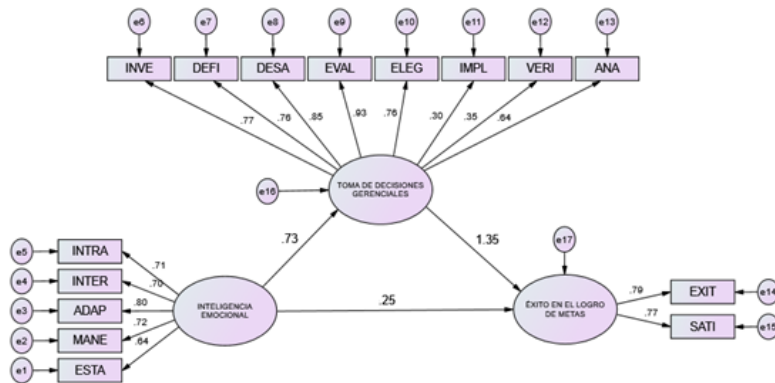


Table 7 presents the effects of the model. The strongest effect was that of managerial decision-making on success in goal achievement ( $\beta = 1.35$ ;  $p < 0.01$ ), followed by the effect of emotional intelligence on managerial decision-making ( $\beta = 0.73$ ;  $p < 0.01$ ), and finally the effect of emotional intelligence on success in goal achievement ( $\beta = 0.25$ ;  $p < 0.01$ ). The exogenous variables for each variable have an important effect on them, since all are significant in the model.

**Table 7**  
*Effects of emotional intelligence on managerial decision-making and its effect on success in goal achievement.*

			S.E.	C.R.	P	P
Decision-making	<---	Emotional intelligence	0.728	0.049	20.034	***
SUCCESS	<---	Decision-making	1.35	0.025	36.04	***
SUCCESS	<---	Emotional intelligence	0.248	0.015	14.875	***
ESTA	<---	Emotional intelligence	0.637	0.029	20.323	***
MANE	<---	Emotional intelligence	0.722	0.029	22.885	***
ADAP	<---	Emotional intelligence	0.798	0.029	24.996	***
INTER	<---	Emotional intelligence	0.698	0.028	22.164	***
INTRA	<---	Emotional intelligence	0.707	0.025	28.7035	***
DESA	<---	Decision-making	0.853	0.022	35.243	***
EVAL	<---	Decision-making	0.931	0.017	39.542	***
ELEG	<---	Decision-making	0.755	0.017	30.379	***
IMPL	<---	Decision-making	0.303	0.013	11.338	***
EXIT	<---	Success	0.793	0.0175	23.1255	***
SATI	<---	Success	0.769	0.022	34.913	***
INVE	<---	Decision-making	0.77	0.0225	32.686	***
DEFI	<---	Decision-making	0.757	0.023	30.459	***
ANA	<---	Decision-making	0.638	0.013	25.027	***
VERI	<---	Decision-making	0.346	0.007	12.999	***

Table 8 shows that, in the final model, all beta parameters ( $\beta$ ) are positive. Emotional intelligence has an effect on success in goal achievement ( $\beta = 0.25$ ), which is explained by the instrument, in which each item has a direct formulation. Table 8 describes the goodness-of-fit of the structural equation model, indicating that the indices are acceptable. Therefore, the effects and relationships found are relevant for meeting the objectives and testing the hypotheses proposed in the research and may be generalized to similar populations. It is observed that  $GFI = 0.94$ ,  $AGFI = 0.93$ ,  $CFI = 0.94$ ,  $IFI = 0.90$ , and  $TLI = 0.90$  are all greater than 0.90. In addition, both  $RMR = 0.049$  and  $RMSEA = 0.04$  are lower than 0.05, and the  $X^2$  value = 3.51 falls within the standard range of 2 to 5. Compared with the initial model, whose values did not meet adequate goodness-of-fit standards, the results of the fit measures for the confirmatory factor analysis of the studied variables indicate that the data present a good model fit.

**Table 8**  
*Goodness-of-fit index of the final model*

CFA model fit measures		
Fit indicator statistics		
	Initial model	Final model
Absolute fit measures		
X <sup>2</sup>	1429.44	1504.63
GFI	0.88	0.94
RMSEA	0.093	0.04
NCP	1211.39	1223.25
RFI	0.8	0.82
ECVI	1.12	1.58
RMR	0.052	0.049
Incremental fit measures		
AGFI		0.93
CFI	0.86	0.94
IFI	0.84	0.92
TLI	0.87	0.91
NFI	0.88	0.9
Parsimony fit measures		
X <sup>2</sup>	2.36	4.55
PNFI	0.84	0.87
PGFI	0.8	0.81

*Note:* Discrepancy value ( $X^2$ ), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), root mean square residual (RMR), root mean square error of approximation (RMSEA), normed fit index (NFI), relative fit index (RFI), parsimonious goodness-of-fit index (PGFI), and parsimonious normed fit index (PNFI).

## DISCUSSION

This section compares the main findings and implications of the study with the academic literature.

The discussion focuses on establishing how previous academic research compares with the hypotheses of the present study.

The relationship between emotional intelligence and decision-making in achieving the goals of employees of SMEs in Lima, 2020, was determined, with a Pearson result of 0.830. This indicates that, within small companies in Lima, emotional intelligence is an important indicator for decision-making, considering that many companies may fail if they do not take care of their personnel and the emotional intelligence they manage. Regarding this result, Vidal (2018) reported an affirmative result in his study, with  $\text{sig.} < 0.05$ , determining a significant relationship between variables with a Spearman's rho of 0.863. He emphasized that human beings are shaped by what they form in their minds, and that workers are constantly changing and facing situations in which emotions influence them. Therefore, they should possess good emotional intelligence so as not to negatively affect the company and so that correct decisions may be made for goal achievement. Mayta (2018) also highlights that emotional intelligence has a 73% influence on decision-making focused on fulfilling institutional objectives.

Likewise, the relationship between emotional intelligence and success in goal achievement among employees of SMEs in Lima, 2020, was determined, with a Pearson result of 0.755. This indicates that SMEs in the city of Lima should consider emotional intelligence as a success factor, since it affects or influences the fulfillment of institutional goals and achievements. In this regard, Álvarez (2019) reported a Spearman's rho of 0.565, indicating a relationship between emotional intelligence and goal achievement. Márquez and Cerón (2019) also state that the dimensions of emotional intelligence are strong because they determine people's behavior, affirming their relationship with success in the business context and noting that a company is much more likely to succeed when it has personnel who know how to guide their emotions and manage their activities professionally.

The results obtained from the model show a strong effect of managerial decision-making on success in goal achievement ( $\beta = 1.35$ ;  $p < 0.01$ ), indicating that its effect on success is highly important. In this regard, Miranda Viteri (2017) states that decision-making requires understanding the context in which the company operates, because decisions can lead the organization either to failure or success; this author also determined a considerable relationship and influence with  $p < 0.05$ . The effect of emotional intelligence on managerial decision-making was also considered ( $\beta = 0.73$ ;  $p < 0.01$ ), and the application of the equation model demonstrated an important and high effect. In this sense, Horna (2005) states that decision-making is a process through which people attempt to change the course of events in their effort to achieve goals that provide well-being, prosperity, and ultimately happiness. Robbins and Timothy (2009) argue that decision-making is based on selecting one option among two or more alternatives for solving a problem; therefore, decision-makers must use rationality when choosing among options, that is, selecting the most consistent and highest-value option.

Finally, the model confirmed that the effect of emotional intelligence on success in goal achievement ( $\beta = -0.25$ ;  $p < 0.01$ ) is significant. Regarding the influence of both variables, Silva (2016) confirms the existence of an influence of emotional intelligence on goal achievement. Horna (2005) notes that the best formula for success is not reason alone, but a combination of reason and emotion. For Abraham Maslow (1991), emotional intelligence can be understood as intelligence for success; decision-making has the same purpose: to achieve success, solve problems, and generate well-being, prosperity, and happiness, specifically through goal achievement.

A limitation of this study was its inability to reach all SMEs in the city of Lima. However, the sample size obtained provides considerable results. Future studies should address communities or more specific environments.

The contribution of this study is to confirm the interconnection between emotion and cognition, that is, between the emotional mind and the cognitive mind, particularly in decision-making, where both function synergistically toward goal achievement. The benefits of this research will directly affect the SMEs involved, their managers, and their personnel, and indirectly benefit suppliers, consumers, and the community as a whole. Through its statistical results, this study also provides an important contribution for SMEs, entrepreneurs, university students, and research faculty working on emotional intelligence and job performance. It may help improve relationships among workers and, consequently, foster a more empathetic work environment, better customer service, and more effective resolution of labor conflicts. Economically, it may contribute to increased income, higher profitability, and better investment opportunities, among other benefits.

## CONCLUSIONS

It is recommended that SMEs in the city of Lima carry out activities that strengthen workers' emotional intelligence, while also analyzing each employee's situation and providing the necessary support.

It is also recommended that SMEs form alliances and jointly hire a psychology specialist who can assist workers when needed, with the aim of ensuring that employees are prepared to perform the duties assigned to them.

SMEs are encouraged to establish a work plan for workshops focused on emotional intelligence topics, such as emotional control and occupational mental health, including exercises that allow workers to reduce stress generated by unfavorable situations within the organization.

Likewise, it is recommended to design a well-founded Emotional Intelligence Program aimed at optimizing the quality of service provided by company personnel.

It is recommended that managers hold periodic meetings to evaluate the results of decisions made.

For future research, it is also proposed to study decision-making strategies and how they affect the productivity of micro and small enterprises, specifically in the agricultural trade sector. This research includes updated theories, concepts, and data with the purpose of contributing to improvements in emotional intelligence and job performance. It may also serve as a reference for subsequent studies and research in this area.

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**Author contributions:**



- Conceptualization: José Tarrillo Paredes
- Data curation: Sandrita Aracely Huamán Moreto
- Formal analysis: José Eber Paz Vilchez
- Research: José Tarrillo Paredes
- Methodology: José Eber Paz Vilchez
- Writing: Sandrita Aracely Huamán Moreto

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# A Review of Sensory Marketing and Its Influence on Consumer Perceptions of Food Purchasing, 2025.

Uma análise do marketing sensorial e da sua influência nas percepções dos consumidores relativamente à compra de alimentos, 2025.  
*Una revisión del marketing sensorial y su influencia en la percepción de los consumidores a la hora de comprar alimentos, 2025.*

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## ABSTRACT

Sensory marketing has become an essential factor in the food industry, using visual, olfactory, tactile, and auditory stimuli to strengthen perceptions of product quality. This study aims to analyze the impact of sensory marketing in the food sector by examining how it influences consumer perception and experience and how it contributes to the creation of an emotional bond with the brand. This study is based on a narrative literature review using databases such as Scopus, SciELO, ProQuest, and Google Scholar. Scientific articles published between 2022 and 2025 on sensory marketing in the food industry were selected following a PRISMA flow diagram. A total of 118 initial articles were identified and refined to 51 for the analysis stage. The results show that sensory stimuli, especially visual and olfactory stimuli, have a significant effect on perceived food quality, increasing perceived value and consumers' willingness to pay more. Likewise, the creation of an appropriate sensory atmosphere in distribution channels encourages consumer purchases and contributes to greater loyalty and repeat purchase behavior. It is concluded that sensory marketing is one of the most relevant strategies in the food industry. When implemented, it improves perceived product quality and helps establish an emotional relationship with consumers. Companies that implement coherent sensory strategies can differentiate themselves from competitors in a dynamic business environment by creating memorable experiences that foster loyalty.

**Keywords:** Sensory Marketing; Food Industry; Consumer Behavior; Customer Satisfaction; Brand Loyalty; Sensory Strategies.

**JEL Code:** M31, M37, D12, L15

## RESUMO

O marketing sensorial tornou-se um fator essencial na indústria alimentícia, utilizando estímulos visuais, olfativos, táteis e auditivos para reforçar a percepção da qualidade do produto. Este estudo tem como objetivo analisar o impacto do marketing sensorial no setor alimentício, examinando como ele influencia a percepção e a experiência do consumidor e como contribui para a criação de um vínculo emocional com a marca. Este estudo baseia-se em uma revisão narrativa da literatura, utilizando bancos de dados como Scopus, SciELO, ProQuest e Google Scholar. Foram selecionados artigos científicos publicados entre 2022 e 2025 sobre marketing sensorial na indústria alimentícia, seguindo um diagrama de fluxo PRISMA. Um total de 118 artigos iniciais foi identificado e refinado para 51 para a fase de análise. Os resultados mostram que os estímulos sensoriais, especialmente os visuais e olfativos, têm um efeito significativo na qualidade percebida dos alimentos, aumentando o valor percebido e a disposição dos consumidores em pagar mais. Da mesma forma, a criação de uma atmosfera sensorial adequada nos canais de distribuição incentiva as compras dos consumidores e contribui para uma maior fidelidade e comportamento de compra repetida. Conclui-se que o marketing sensorial é uma das estratégias mais relevantes na indústria alimentícia. Quando implementado, melhora a qualidade percebida do produto e ajuda a estabelecer uma relação emocional com os consumidores. As empresas que implementam estratégias sensoriais coerentes podem se diferenciar dos concorrentes em um ambiente de negócios dinâmico, criando experiências memoráveis que promovem a fidelidade.

**Palavras-chave:** Marketing Sensorial; Indústria Alimentícia; Comportamento Do Consumidor; Satisfação Do Cliente; Fidelidade À Marca; Estratégias Sensoriais.



## INTRODUCTION

Sensory marketing has become an essential tool for companies and brands, particularly in the food sector. It is a relevant strategic resource because it stimulates the five senses—sight, smell, taste, touch, and hearing—to influence consumers' emotions and purchasing decisions. The integration of multisensory experiences through visual, olfactory, tactile, auditory, and gustatory stimuli affects product perception, increases satisfaction, and creates a basis for consumer loyalty (Del et al., 2025).

Several studies have shown that sensory stimuli directly influence purchasing decisions (Toriobio-Tamayo et al., 2024). For example, consumers have been found to be more likely to spend more on food products when sensory stimuli are prominent. Lighting, aromas that evoke different sensations, and music in an establishment influence consumers' willingness to pay a higher price for the experience, often leading them to value the experience more than the product itself. This demonstrates the significant role of sensory marketing and the importance of designing sensorially attractive spaces that enhance perceived quality and increase consumers' willingness to invest in the experience (Apaza-Panca et al., 2023).

According to Cam et al. (2025), an appropriate environment aligned with current trends and supported by a balanced aesthetic not only improves the consumer experience but also contributes to the formation of emotional bonds with the brand, thereby fostering greater loyalty. Visual marketing plays a key role in the food industry, since the way products are visually presented can determine consumer perception and directly alter expectations and purchasing decisions (Kiciak et al., 2025).

Egido (2025) also notes that the way products are presented in the space where they will be consumed is as relevant as the technical characteristics of the product itself, such as preparation and safety (Del et al., 2025). A growing body of research suggests that sensory marketing has a particularly important effect on impulsive consumers, who are exposed to emotional stimuli activated by sensory factors such as aromas and music, resulting in rapid and less rationalized purchasing decisions (Gadilkar, 2024).

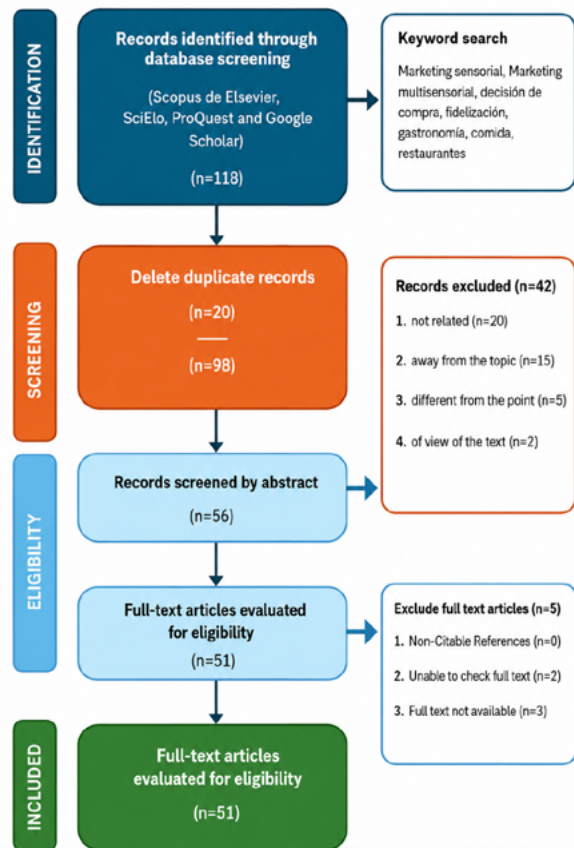
In contexts such as gourmet food stores or high-end restaurants, sensory aesthetics play a decisive role because they are closely related to perceptions of quality. Consumers are also willing and expect to pay more for the sensory experience (Fatih & Çam, 2024). Likewise, the use of music in establishments has been shown to influence the speed with which consumers make purchasing decisions, since certain types of music can generate a sense of comfort and relaxation that facilitates the buying process (Castillo Placencia et al., 2025).

Positive sensory interactions in restaurants contribute to several business objectives, as they may increase the likelihood that customers will recommend the establishment to others, thereby expanding the brand's reach through word of mouth (Mbatha et al., 2023). This type of marketing is also particularly effective when it is customized to the sensory preferences of different demographic groups, allowing brands to relate to and communicate more effectively with their target audiences (Jahroh et al., 2025).

Within the business field, marketing performs several important functions, and sensory marketing has consolidated itself as an integrated strategy that not only improves perceptions of food

products but also influences consumers' emotions and purchasing behavior. As brands seek differentiated positioning in highly competitive markets, the effective application of sensory marketing may become a critical factor in creating unique experiences that foster consumer loyalty. This article therefore examines sensory marketing in the food sector and provides a theoretical framework for understanding its relevance in contemporary commercialization.

**Figure 1.**  
*Prisma Scheme*



## DEVELOPMENT

The study was conducted through a narrative review of the existing literature. Searches were carried out in Scopus, Elsevier's SciELO, ProQuest, and Google Scholar, following the methodology and guidelines of the PRISMA flow diagram. The keywords identified were sensory marketing, purchase decision, loyalty, food, restaurants, and gastronomy.

## Eligibility

For this narrative review, strict eligibility criteria were established to ensure the relevance and quality of the selected articles. The studies included in the review necessarily addressed sensory marketing and its effects on the food sector. Original papers, review articles, and both theoretical and empirical studies related to the topic were selected, provided that they specifically examined the effect of

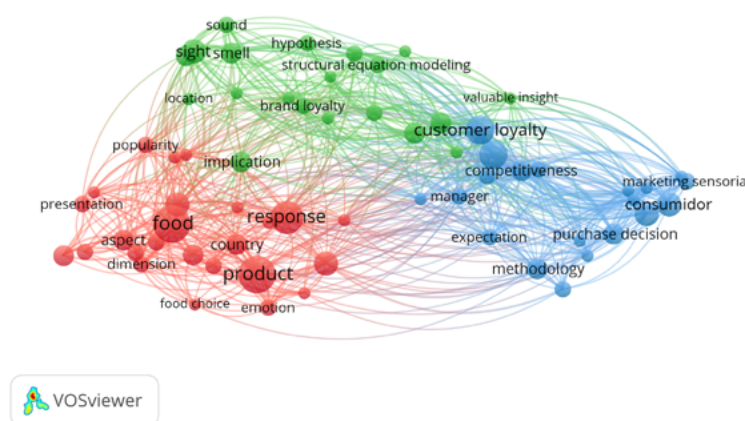
sensory marketing in the food industry.

As inclusion criteria, articles indexed in recognized academic databases—Scopus, SciELO, ProQuest, and Google Scholar—were considered. Studies were included when they contained original data, whether review-based or scientific research, and when they used qualitative or quantitative approaches. Restrictions were applied regarding publication date, with no language restrictions.

Regarding exclusion criteria, articles were discarded when full text was not available, when they lacked a real database, when they did not align with the focus of this review, or when they were published outside the last five-year period. Undergraduate theses and dissertations were also excluded because of limitations related to academic quality and validity. A bibliometric analysis was also performed in VOSviewer, as shown in Figure 1.

**Figure 2.**

*Bibliometric analysis in VOSviewer of the topics used*



*Note.* Prepared based on Ospina (2021). A high correlation can be observed among the selected topics, which are continuously linked to the present study.

In this study, the selection and extraction process was carried out using a strategy supported by the PRISMA flow diagram. A total of 118 articles were initially identified in the databases mentioned above; 20 duplicate articles were removed, leaving 98 articles whose abstracts were carefully reviewed and to which the inclusion and exclusion criteria were applied. Finally, 51 articles were selected for the review stage. These articles were published between 2022 and 2025, representing the most recent literature on the impact of sensory product marketing in the food sector.

This study follows a descriptive approach aimed at describing, synthesizing, and summarizing the existing literature while highlighting key and relevant data.

### **Impact of Visual Sensory Strategies on Purchasing Behavior**

Visual sensory marketing is fundamental in the food sector because visual stimuli decisively influence purchasing, sometimes even outweighing considerations of taste or price. These visual elements can significantly affect perceived quality and the value assigned to a product before consumption. (Makwena,

2024)(Fatih & Çam, 2024)

Studies confirm that aesthetics translate into economic value: 45% of consumers are willing to pay more for products that offer an attractive visual experience. This makes packaging design a key differentiating factor that communicates authenticity and quality. On e-commerce platforms, high-quality images directly affect purchase intention and consumer trust.(Fatih& Çam, 2024)(Fatih & Çam, 2024)(Nurwitasari & Hendrayati, 2024)(Xu, 2024)

Innovative design is a driver of sales. The use of innovative colors and shapes in packaging increases the probability of purchase by 60%, because consumers associate this type of design with superior value and greater freshness. This power of visual attraction has been replicated in several retail contexts. In addition to capturing attention, design immediately communicates the identity and values of the brand, while elements such as typography affect perceptions of health and the internal attributes of food.(Makwena, 2024)(Makwena, 2024)(Cam et al., 2025)(Srisukwatanachai et al., 2025)(Shun Han et al., 2024)(Makwena, 2024; Motoki et al., 2025)

Brands can stand out in saturated markets through personalized and exclusive packaging that promotes immediate recognition. Colors are not random; they evoke emotional responses that suggest attributes such as freshness or energy, influencing satisfaction and long-term loyalty. Aesthetic presentation in service environments also drives satisfaction and revisit intention. Attractive designs not only increase conversion rates but also forge an emotional connection with the brand. Sixty-eight percent of consumers state that innovative packaging improves their perception of quality by associating the product with luxury and high standards. This enables premium brands to justify higher prices and project an aspirational image.(Makwena, 2024; Nurwitasari & Hendrayati, 2024)(Gutiérrez-Aragón et al., 2022; Srisukwatanachai et al., 2025)(Adly et al., 2025; Cam et al., 2025)(Chang et al., 2025)(Mehta et al., 2024)(Chang et al., 2025; Xu, 2024)

Aesthetics functions as an indicator of value, as superior presentation is interpreted as a sign of greater investment and, therefore, higher quality. At the point of sale, attractive product arrangement and adequate lighting enhance packaging and contribute to the purchasing decision. Visual coherence minimizes perceived risk and encourages impulsive buying behavior. Finally, visual innovation acts as a mental trigger that facilitates brand recall and future brand choice.(Chang et al., 2025)(Le et al., 2024; Quan et al., 2025)(Gadilkar, 2024; Srisukwatanachai et al., 2025)(Chang et al., 2025; Nurwitasari & Hendrayati, 2024)

### **Impact of Olfactory Marketing on Quality Perception**

Olfactory marketing is essential for improving perceptions of food quality. The sense of smell, which is linked to emotion and memory, subconsciously influences consumer judgment. Evidence indicates that 72% of consumers directly associate pleasant aromas with freshness and quality, which strengthens loyalty.(Karhu et al., 2025)(Karhu et al., 2025)(Nurwitasari & Hendrayati, 2024)

The use of ambient aromas in stores prolongs customer stay and increases the probability of purchase. Sixty percent of consumers perceive that fresh aromas enhance quality, thereby reinforcing loyalty. In addition, smell creates a powerful emotional bond with the brand through the evocation of memories.(Skolastika et al., 2025)(Fatih & Çam, 2024)(Jahroh et al., 2025)



To be effective, the aroma must have the right intensity and congruence; a poorly aligned scent can be counterproductive. The key is for the aroma to reinforce existing expectations, and this is vital in services such as coffee shops, where it drives satisfaction and revisit intention.(Nurwitasari & Hendrayati, 2024; Zha et al., 2025)(Herrada Salazar et al., 2025)(Cam et al., 2025; Jahroh et al., 2025)

The strongest influence is multisensory: 75% of consumers achieve greater satisfaction and loyalty when pleasant aromas are combined with visual packaging. This coherent integration may even modify flavor perception through sensory transfer, improving organoleptic acceptance.(Nurwitasari & Hendrayati, 2024; Skolastika et al., 2025; Szocs et al., 2024)(Karhu et al., 2025)(Eringa & Paredes, 2022; Quan et al., 2025)

From an economic perspective, quality perceived through smell supports the acceptance of premium prices. A controlled olfactory environment reinforces long-term brand memory, acting as a sensory signature and anchor that drives positioning and profitability.(Gadilkar, 2024)(Le et al., 2024; Skolastika et al., 2025)(Egido Piqueras, 2025; Gadilkar, 2024; Karhu et al., 2025; Nurwitasari & Hendrayati, 2024)

### Effects of Music and Sound on Purchasing Decisions

The effect of music and sound on purchasing decisions in food establishments is a central element of sensory marketing, which seeks to influence consumer behavior through sensory stimuli. Background music and relaxing sounds modify the environment and the mood of buyers, thereby influencing the shopping experience and perceptions of products.(Cam et al., 2025)

(Makwena, 2024) Evidence indicates that 58% of consumers prefer places where soft and relaxing music is played while they shop. This type of musical environment positively affects mood, makes customers feel more comfortable, reduces stress, and consequently allows them to make purchasing decisions with greater calm and confidence. The emotional comfort created by music directly influences satisfaction with the experience, resulting in greater brand loyalty and a better overall impression of the establishment. This is consistent with studies showing that music can shape emotions and create pleasant atmospheres, facilitating consumers' emotional connection with the point of sale.(Velasco et al., 2025)

According to the literature, 50% of consumers report that soft music increases the time they spend in an establishment. A longer stay provides more time to evaluate products, increasing purchasing opportunities. In the food sector, this effect is essential because the sensory experience may extend the visit and encourage the purchase of additional products or greater consumption. The study also indicates that, to maximize this effect, music selection must be aligned with the identity of the establishment. For example, instrumental or ambient music in health-food stores encourages a calm and natural atmosphere that matches the product proposition.(Mehta et al., 2024)

(Fatih & Çam, 2024) Soft genres, including classical music, reinforce the perception of luxury and quality in high-end food products. Fifty-five percent of consumers recognized that light music made them perceive products as being of higher quality, increasing their willingness to spend more on them. This can be explained by the fact that music contributes to the formation of a sensory image related to the product and helps reinforce attributes commonly associated with exclusivity, sophistication, and luxury. Complementary studies also indicate that brands using appropriate music can transmit implicit messages about excellence and care in preparation, increasing perceived value.(Gutiérrez-Aragón et al., 2022)

From a neurophysiological perspective, music influences brain regions associated with emotions and decision-making, such as the limbic system and prefrontal cortex. Emotional activation induced by pleasant music regulates the release of neurotransmitters such as dopamine, which is related to pleasure and reward and may increase the tendency to purchase. Recent studies suggest that music reduces perceived time and fatigue in retail spaces; as a result, consumers spend more time enjoying the experience. (Tran et al., 2024)

It is important for companies to use sound design strategically in their stores, since an inappropriate musical choice may produce stress and distraction. Considering factors such as musical genre, tempo, volume, and time of day, music selection helps create an experience that can be adapted to different customer profiles. Furthermore, combining music with other sensory elements—such as aromas, lighting, and textures—helps create complex multisensory experiences that support brand recall and purchase desire.

(Udo Wagner, 2024) Research on textual and sensory information on food packaging supports the idea that incorporating multisensory stimuli into packaging significantly increases consumer interaction and satisfaction, improving quality perception and further encouraging purchase intention. It also emphasizes that including textual information together with visual and tactile elements can activate multiple senses and enable more effective communication that influences the consumer sensory experience. Similarly, studies highlight that auditory stimuli must be consistent with the identity of the establishment to maintain sensory coherence and reinforce positive outcomes in purchasing behavior. (Mehta et al., 2024)

Recent research also notes that music, especially when it incorporates organic or natural sounds, can influence perceptions of freshness and naturalness of ingredients, thereby increasing purchase intention among health-conscious consumers. Similarly, aligning music with cultural or traditional rhythms can strengthen the emotional connection between consumers and local brands or native products, fostering greater affinity and loyalty.

Finally, digital platforms, including augmented reality and sound design, have been found to improve sensory perceptions, increasing young consumers' emotional engagement and willingness to pay more for a product. This approach integrates music and sound into a multisensory and digitized context, strengthening marketing strategies for this segment. (Velasco et al., 2025)

### **Sensory Preferences of Young Consumers**

Young consumers' preferences, particularly those of Generation Z and Millennials, for fully immersive sensory experiences related to food products have become an important dimension of modern marketing. These consumers demand multisensory experiences from brands that stimulate not only taste but also smell, sight, and hearing, generating a deeper emotional connection and lasting commitment to the brand.

(Karhu et al., 2025) Evidence indicates that 59% of young consumers prefer products that provide immersive sensory experiences, activating multiple senses simultaneously and enriching the consumption experience. This preference reflects a clear trend toward more comprehensive and memorable consumption experiences that go beyond the product itself.



Similarly, up to 60% of these consumers would choose to pay more if the product incorporated sensory techniques in an innovative way, such as interactive packaging and digital platforms with multisensory stimuli. This shows that experience acquires a value as important as the functionality of the product. Thus, packaging should play a crucial role not only in protection but also in communicating and activating multiple senses in the same space. In addition, studies have confirmed the effectiveness of digital sensory marketing, indicating that 65% of young consumers are likely to recommend brands that implement innovative digital sensory marketing strategies. This helps brands achieve higher levels of emotional engagement and intense connection, which are determinants of customer loyalty. (Fatih & Çam, 2024) (Alwan Hanif et al., 2025)

Several studies highlight the influence of packaging design on this multisensory experience. For example, recent research indicates that tactile and visual stimuli in packaging substantially increase perceived quality and purchase intention among young consumers. It has also been emphasized that textual information, when integrated with different sensory modalities, intensifies the experience and generates deeper consumer interaction with the product.

Visual and auditory stimuli also play a key role in marketing aimed at young consumers. Elements such as jingles and striking visual designs capture their attention and increase repurchase intention. This multisensory approach not only attracts attention but also produces lasting memories associated with the brand. The use of digital technology further strengthens this effect, since augmented reality and other digital sensory tools expand the brand experience and increase young consumers' engagement. This reveals a transition toward hybrid experiences that combine the physical and digital dimensions to enrich interaction.

At the emotional level, multisensory experiences generate positive emotions that favor brand loyalty because they create memories with which consumers can identify. This finding highlights the relevance of offering complete sensory experiences to strengthen the relationship between the brand and its audience. Sustainability and social responsibility have also become part of this dynamic. Young consumers value sensory experiences aligned with sustainable practices, which increases their positive perception of and preference for environmentally committed brands. In physical spaces, visual marketing plays a decisive role. Visual strategies at points of sale have been shown to increase attention and intention to visit, especially in popular tourist destinations where sensory interaction enhances the young public's experience.

Finally, synesthesia—understood as the combination of senses within the sensory experience—enhances experiences in the food sector. This is especially appreciated by Millennials and Generation Z, who seek more authentic and enriching consumption experiences. Taken together, these studies reveal that young consumers' sensory preferences are oriented toward comprehensive and innovative experiences that combine multisensory stimuli with digital technologies and sustainable values, giving rise to a consumption model based on emotion and deep interaction with the brand.

### **Impact of Tactile Stimuli on the Sensory Experience**

Tactile stimuli have become a fundamental factor in sensory marketing applied to the food sector,

since they help modify perceptions of quality, freshness, and exclusivity through packaging design, display surfaces, and direct tactile interactions. A study on dairy products indicates that rough or smooth textures in packaging increase perceived authenticity by 64% and willingness to pay by 22%, provided that tactile sensations are consistent with visual cues. In snacks and energy bars, textures that fit comfortably in the hand and do not slip improve user experience, generating an 18% higher repurchase intention among regular consumers. In baked goods, packaging that feels crunchy to the touch creates multisensory expectations that increase perceived freshness by 29%.(Tran et al., 2024) (Srisukwatanachai et al., 2025)

For gourmet coffee, tactile descriptions on packaging that evoke complex textures reinforce the artisanal narrative, reduce price sensitivity by 19%, and deepen the emotional connection with the brand. Similarly, the use of luxury tactile materials such as warm wood or textured ceramics in tourist coffee shops in Vietnam increases repurchase intention by 27% and enriches the sensory experience. In Indonesia, the incorporation of bamboo and rattan into interiors and packaging reinforces cultural identity, increasing tactile satisfaction and repeat purchases by 30%. In Europe, gastronomic spaces demonstrate the power of touch: in Bremen, Germany, cups with ergonomic grips and matte textures generate haptic memories that drive 32% more repurchases than plastic cups, while in themed restaurants, textured tablecloths and relief plates increase perceived quality by 28%.(Mehta et al., 2024)(Udo Wagner, 2024)(Cam et al., 2025)(Budiarti et al., 2025)(Jahroh et al., 2025)(Chang et al., 2025)

Direct tactile experiences also strengthen the emotional bond with food: in rural fairs in Ecuador, touching or kneading bread increases the connection between touch and emotion, fostering 35% greater community loyalty. In supermarkets, shelves with natural wood textures prolong consumer stay by 15% and stimulate impulse purchases. In digital environments, touch emerges as a sensory extension in virtual spaces; simulations that reproduce food textures increase sensory immersion by 40%, directly influencing online purchasing decisions, while delivery apps that include haptic feedback, such as vibrations when choosing bread texture, increase user satisfaction by 22%. Specific cases support these trends: Luckin Coffee in China achieved 28% more repeat visits through luxury tactile packaging, while in tourist cuisine in Oradea, Romania, real textures in utensils increased perceived authenticity by 26%. The influence of touch is also reflected across regions: bakery packaging in Peru that imitates ingredients increases perceived freshness by 30%; direct contact with rural Venezuelan food drives emotional loyalty by 33%; and healthy snacks in Spain with natural textures increase preference by 21%. In addition, textured cups in urban coffee shops in Brazil foster repurchase by 25%; natural packaging in organic foods in the United States reinforces the idea of naturalness by 29%; tactile menus in Mexico prolong decision time by 18%; and luxury textures in beverages in Turkey increase willingness to pay by 23%. Finally, the trend continues in both face-to-face and digital experiences: tactile simulations applied to virtual gastronomic environments in Chile improve immersion by 27%, while in the United Kingdom, packaging with luxury textures increases perceived quality by 31%.(Apaza-Panca et al., 2023)(Nurwitasari & Hendrayati, 2024)(Karhu et al., 2025)(Motoki et al., 2025)(Toribio-Tamayo et al., 2024); en Egipto, los empaques ergonómicos con componentes táctiles en productos funcionales aumentaron la intención de compra en un 20%(Adly et al., 2025), y en cafeterías sostenibles de Indonesia, el uso de materiales reciclados con texturas naturales fortaleció la lealtad en un 24%(Skolastika et al., 2025)(Egido Piqueras, 2025)(Haro Sosa, 2024)(Gutiérrez-Aragón et al., 2022)(Paila et al., 2023),(Mbatha et al., 2023)(Haro-Sosa et al., 2024)(Zha et al., 2025)

## Flavor Marketing and Its Relationship with Customer Satisfaction

Flavor marketing plays an essential role in customer satisfaction within the food sector, since taste innovation not only improves perceived quality but also creates pleasurable experiences that remain in memory, encouraging repurchase and product recommendation. A study published in MDPI Foods on dairy products shows that unique and authentic flavors increase post-consumption satisfaction by 75%, associating complex flavor profiles with greater freshness and premium value. In snacks and energy bars, innovative flavors raise the perception of exclusivity by 68%, especially through exotic combinations of tropical fruits and spices, which fosters loyalty among young consumers. Baked products use crunchy and multifaceted flavor profiles, where toasted notes and salty touches activate several senses, increasing satisfaction by 72% and willingness to pay more for premium options. In gourmet coffee packaging, evocative flavor descriptions such as bitter cocoa or citrus reinforce the expected gustatory experience and increase repurchase intention by 70%. Tourist coffee shops in Vietnam stand out with menus offering local exotic flavors, such as coffee with cardamom and coconut, which increase sensory satisfaction by 69% and stimulate word-of-mouth recommendations. In Indonesia, fusions with native spices strengthen gustatory authenticity and loyalty by 71%. In Bremen, Germany, personalized coffee flavor profiles generate 73% hedonic satisfaction and strengthen loyalty among Generation MZ, while themed restaurants increase overall satisfaction by 76% through unique taste experiences. In rural fairs in Ecuador, authentic local flavors create an emotional connection with taste, reaching 78% satisfaction and community repurchase, while in supermarkets, seasonal flavor promotions extend the gustatory experience and increase repeat sales by 67%.(Tran et al., 2024)(Srisukwatanachai et al., 2025)(Mehta et al., 2024)(Udo Wagner, 2024)(Cam et al., 2025)(Chang et al., 2025)(Budiarti et al., 2025)(Chang et al., 2025)(Apaza-Panca et al., 2023)(Nurwitasari & Hendrayati, 2024)

In the digital field, flavor simulations in virtual reality environments increase hedonic anticipation by 65%, influencing online purchases through digital chemical profiles, while delivery apps using vivid taste descriptions increase anticipated satisfaction by 70%. Likewise, gastronomic NFTs with exclusive virtual flavors reach a potential 62% effect on digital loyalty. Specific cases reinforce these trends: Luckin Coffee in China records 75% satisfaction with innovative flavors that generate repeat visits; in tourist gastronomy in Oradea, Romania, regional flavors increase satisfaction by 72%; functional products in Egypt adapt flavors to increase satisfaction by 69%; and sustainable coffee shops in Indonesia use ecological flavors that increase gustatory loyalty by 71%. In Peru, authentic bakery flavors increase perceived quality by 74%; rural Venezuelan gastronomy, with traditional flavors, generates emotional satisfaction by 76%; and healthy snacks in Spain, by incorporating natural flavors, increase hedonic preference by 68%. In Brazil, urban coffee shops with fused flavors increase repurchase by 70%; in the United States, pure organic food flavors improve satisfaction by 73%; and in Mexico, menus with sensory descriptions prolong gustatory anticipation by 67%. In Turkey, beverages with exotic flavors increase willingness to pay by 69%; in Chile, digital gastronomic experiences with flavor simulations increase immersion by 71%; in the United Kingdom, complex flavors in premium foods increase the perception of luxury by 75%; and in Germany, sustainable coffee shops oriented toward Generation MZ increase loyalty by 72%. In Brazil, dairy products with innovative flavors also increase perceived freshness by 70%; multisensory packaging that evokes flavors improves satisfaction by 74%; coffee with ergonomic flavors increases repurchase by 68%; and functional foods with hedonic flavors increase positive perception by 71%.(Karhu et al., 2025),(Motoki et al., 2025)(Lee & Kwon, 2022)(Xu, 2024)(Skolastika et al., 2025)(Adly et al., 2025)(Skolastika et al.,

2025)(Egido Piqueras, 2025)(Haro Sosa, 2024)(Gutiérrez-Aragón et al., 2022)(Paila et al., 2023)(Gadilkar, 2024)(Castillo Placencia et al., 2025)(Mbatha et al., 2023)(Haro-Sosa et al., 2024)(Zha et al., 2025)(Fatih & Çam, 2024)Quan et al., 2025)(Shun Han et al., 2024)(Kadavil & Usha, 2024)(Youssef & Spence, 2023)

In bakery products, crunchy flavors increase consumer expectations by 73%, while snacks with natural flavors increase preference by 69%. Tactile menus with flavor descriptions prolong purchasing decisions by 67%; gourmet coffee with premium flavors increases loyalty by 75%; healthy foods with tactile flavors raise perception by 72%; and dairy flavors reinforce the feeling of freshness by 70%. Finally, in the premium food segment, tactile flavors increase the perception of luxury by 74%. In conclusion, flavor marketing functions as a key hedonic driver within sensory strategies, generating emotional satisfaction, perceptions of authenticity, and lasting loyalty in both physical and digital contexts, with constant impacts on consumer behavior ranging from 62% to 78%.(Gutiérrez-Aragón et al., 2022)(Palacio Pereira & Vélez Ochoa, 2025)(Le et al., 2024)(Santos et al., 2025)(Kiciak et al., 2024)(Isaac et al., 2023)(Szocs et al., 2024)

### **The Role of Brand Loyalty through Sensory Marketing**

Sensory marketing is a crucial tool not only for activating immediate purchase but also for building deep and emotional brand loyalty. The coherent and integrated activation of the senses creates an anchor that turns rational preference into stable loyalty that is difficult for competitors to disrupt. Loyalty is based on sensory integration and hedonic value. Studies have found that satisfaction and enjoyment (hedonic value) derived from consistent sensory stimulation positively influence the overall attitude toward the brand, which is essential for loyalty. They also indicate that the strategic management of sensory attributes such as aroma and texture is vital for generating brand trust, a direct precursor of loyalty.(Srisukwatanachai et al., 2025)(Srisukwatanachai et al., 2025)

Innovation and sensory coherence are essential for sustaining loyalty over time. The perception of a “new” or renewed sensory experience notably increases loyalty and the likelihood of repeat purchases. To preserve this positive perception, coherence is essential: consistency among all of the brand’s sensory stimuli—sight, sound, and aroma—is decisive for generating a memorable and positive brand experience. This capacity to create an emotional connection is reflected in perceived authenticity. Comprehensive sensory experiences make consumers perceive the brand as more authentic and valuable, increasing both recommendation and loyalty.(Gadilkar, 2024)(Skolastika et al., 2025)(Gutiérrez-Aragón et al., 2022)

Loyalty is strengthened through a holistic experience at every point of contact. Sensory elements of the environment, such as visual design, soundscaping, and aromatherapy, are decisive in encouraging consumers to revisit an establishment. Research also indicates that visual stimuli in the store environment directly influence the intention to return. Perceived sensory quality acts as a strong indicator of satisfaction and fosters transactional loyalty. This loyalty also includes aesthetic enjoyment: the sensory beauty of a product or its packaging increases emotional attachment and, consequently, loyalty. Multisensory and distinctive experiences are therefore fundamental to engagement and retention. Finally, designing brand experiences that connect emotionally through the senses is an effective strategy for consolidating long-term loyalty.(Jahroh et al., 2025)(Cam et al., 2025)(Fatih & Çam, 2024)



## CONCLUSION

The reviewed studies consistently show that sensory marketing plays an essential role in how consumers perceive, feel, and act within the food market. The visual dimension stands out as one of the most influential, since colors, shapes, and graphic elements of packaging generate immediate expectations regarding product freshness, quality, and authenticity. Studies such as those by Wagner and Steiner (Udo Wagner, 2024) and Nguyen (Cam et al., 2025) indicate that well-designed visual stimuli increase attention, facilitate recall, and strengthen brand preference.

Regarding the olfactory dimension, several authors argue that congruent aromas increase familiarity and awaken positive emotions that influence food choice. The studies compiled by Laato et al. (Karhu et al., 2025) show that appropriate aromas generate emotional connections capable of increasing satisfaction and even consumers' willingness to pay a higher price. Complementarily, auditory marketing also has a relevant impact. According to Kiciak et al. (Gadilkar, 2024), music and sounds influence consumption rhythm, modify emotional states, and create a sensory environment that conditions preferences.

In the case of the tactile dimension, texture, weight, and packaging feel operate as symbolic cues of quality and naturalness. Apaza-Panca (Gutiérrez-Aragón et al., 2022) indicates that warm and pleasant materials communicate authenticity and increase perceived product value. Finally, taste constitutes the core of the food experience. Flavors, together with cultural and emotional factors, generate a direct affective bond with the product, a finding supported by studies published in MDPI (Srisukwatanachai et al., 2025), which highlight that coherence among flavor, aroma, and appearance increases consumer satisfaction and loyalty.

The findings suggest that sensory marketing substantially affects how people purchase food products. When it is applied strategically and consistently, clear effects can be observed: it modifies perceptions of quality, influences satisfaction during purchase, affects willingness to pay a higher price, and improves loyalty over time. By integrating visual, olfactory, auditory, tactile, and gustatory stimuli, companies achieve more than sales; they create strong emotional associations that go beyond the transaction and strengthen brand positioning.

In both physical and online stores, sensory marketing operates as a form of communication that appeals to consumers' cognition and emotions. In physical environments, tactile and visual experiences make products seem more authentic and of higher quality. In digital environments, images and sensory narratives help compensate for the absence of direct sensory contact, increasing confidence and purchase intention. This demonstrates that sensory marketing is adaptable to markets that are increasingly technological and oriented toward personalization.

From a strategic perspective, sensory marketing is a key instrument for sustainable differentiation. It links emotions with responsible consumption. The use of environmentally friendly materials, authentic aromas, and genuine flavors introduces ethical meanings into the purchasing experience and responds to current consumer expectations. Thus, sensory marketing not only improves the perception of a product but also communicates the seriousness of brands in relation to authenticity and responsibility.

Future research should further examine multisensory experiences integrated with emerging technologies, such as augmented reality and advanced haptic simulation. Such studies would allow researchers to observe consumers' sensory responses in real time and to analyze how sensory cues influence physiological reactions and purchasing decisions. These tools could improve communication strategies across different channels.

In summary, sensory marketing brings together science, practice, and emotion. This integration is essential for competitiveness in the food industry. The objective is not only to change product perception but also to create a comprehensive experience. In this way, brands do more than generate economic returns; they create meanings and emotions that strengthen their relationship with contemporary consumers, who seek authenticity, connection, and memorable moments.

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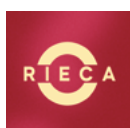
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# Nearshoring in Colombia: Strategies for Business Internationalization and Economic Development

Nearshoring na Colômbia: Estratégias para a internacionalização das empresas e o desenvolvimento econômico

*El nearshoring en Colombia: estrategias para la internacionalización empresarial y el desarrollo económico*

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## ABSTRACT

This study analyzes the impact of nearshoring in Colombia, where multinational companies relocate their supply chains closer to their main markets. The COVID-19 pandemic and trade tensions between the United States and China have positioned Colombia as a potential destination, given its geographic advantages and free trade agreements. The study evaluates the opportunities and challenges of nearshoring for Colombian companies, including the attraction of foreign investment, lower logistics costs, and increased global competitiveness. It also examines challenges related to infrastructure, human capital, and government policies. Using a qualitative approach based on case studies and a literature review, the study identifies key elements for maximizing the positive impact of nearshoring and promoting the international expansion of Colombian firms. This study contributes to the debate on post-pandemic internationalization strategies in Latin America and offers a framework for future research.

**Keywords:** Nearshoring; internationalization; Colombian firms; supply chains; foreign investment; post-pandemic.

**JEL Code:** F23; F10; L21; L14; F21; O54.

## RESUMO

Este estudo analisa o impacto do nearshoring na Colômbia, onde empresas multinacionais transferem suas cadeias de suprimentos para locais mais próximos de seus principais mercados. A pandemia da COVID-19 e as tensões comerciais entre os Estados Unidos e a China posicionaram a Colômbia como um destino em potencial, dadas suas vantagens geográficas e acordos de livre comércio. O estudo avalia as oportunidades e os desafios do nearshoring para as empresas colombianas, incluindo a atração de investimento estrangeiro, a redução dos custos logísticos e o aumento da competitividade global. Ele também examina desafios relacionados à infraestrutura, capital humano e políticas governamentais. Utilizando uma abordagem qualitativa baseada em estudos de caso e uma revisão da literatura, o estudo identifica elementos-chave para maximizar o impacto positivo do nearshoring e promover a expansão internacional das empresas colombianas. Este estudo contribui para o debate sobre estratégias de internacionalização pós-pandêmicas na América Latina e oferece um marco para pesquisas futuras.

**Palavras-chave:** Nearshoring; internacionalização; empresas colombianas; cadeias de abastecimento; investimento estrangeiro; pós-pandemia.



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## INTRODUCTION

Nearshoring has gained relevance in the reconfiguration of global supply chains, driven by the COVID-19 pandemic and trade tensions between the United States and China. The pandemic not only reshaped global supply chains, but also generated significant impacts across different economic sectors, including reductions in income, employment, and business operating capacity (Aquino Rocha et al., 2021). This strategy, which consists of relocating operations closer to main markets, has emerged as a solution for multinational companies seeking to optimize logistics costs and improve the resilience of their supply chains. In this context, Latin America has become a key region for nearshoring, with countries such as Mexico, Brazil, and Colombia competing to attract foreign investment. Colombia, in particular, has gained attention as an emerging destination due to its strategic geographic location, access to two oceans, and network of free trade agreements. Although Mexico has traditionally been favored because of its proximity to the United States, Colombia is positioned as an attractive option for companies seeking to diversify their operations in the region.

Nevertheless, although nearshoring presents multiple opportunities for the internationalization of Colombian companies, it also poses significant challenges. Deficiencies in logistics infrastructure, high levels of bureaucracy, and the lack of specialized human capital are among the main obstacles limiting the ability of domestic firms to compete in international markets. In this context, the following question arises: How can Colombian companies overcome structural and infrastructure challenges in order to capitalize on the opportunities offered by nearshoring in their internationalization process?

This problem calls for an analysis of how Colombian companies can adjust their operational strategies, optimize their supply chains, and collaborate with the public sector to improve the conditions needed for successful nearshoring. It also highlights the need to explore the role of public policies in improving infrastructure, simplifying regulatory processes, and creating training programs that strengthen technical capabilities. In this way, Colombian companies could be better positioned to take advantage of the country's geographic and commercial advantages, increasing their competitiveness and facilitating their expansion into key markets such as the United States and Europe.

The objective of this article is to analyze the opportunities and challenges that nearshoring presents for the internationalization of Colombian companies, evaluating how they can leverage this trend to expand into global markets. In addition, the article examines the impact of nearshoring on the post-pandemic strategies of local companies, identifying the factors that could enhance or limit their success. This approach seeks not only to understand the challenges, but also to propose practical and collaborative solutions between the private and public sectors so that Colombia can consolidate itself as a strategic nearshoring hub in the region.

## METHODOLOGY

This study is based on a qualitative approach that combines case analysis and documentary review to examine the opportunities and challenges of nearshoring in Colombia. A case analysis will be conducted of companies in Latin American countries that have already implemented or are exploring nearshoring strategies. These cases will serve to identify success factors and the main obstacles faced in international

expansion, providing a more detailed view of business dynamics in Colombia. The research will also include a documentary review of secondary sources, such as reports from international institutions and academic studies on supply chains and relocation in Latin America. These documents will complement the analysis with data on global trends and the regional context. Finally, a SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats) will be applied to assess Colombia's competitive position in relation to nearshoring. This approach will make it possible to identify the country's advantages, the challenges it must overcome, and the opportunities it could capitalize on in the global market.

## RESULTS

Nearshoring is examined through the lens of the main theories of internationalization (Figure 1), the reconfiguration of global supply chains (Figures 2 and 3), and nearshoring itself (Figure 4), with a focus on the dynamics of the Colombian and Latin American context.

First, theories of internationalization provide a conceptual basis for understanding the strategic decisions of Colombian firms in their international expansion. According to Cardozo, Chavarro, and Ramírez (2007), internationalization is a complex process that has been approached from various theoretical perspectives, each with different explanations of how and why companies expand into international markets. They cite David Ricardo, whose Theory of Comparative Advantage holds that countries should specialize in producing goods in which they have a relative advantage and can produce at lower cost. They also refer to the Uppsala Model, developed by Johanson and Vahlne in 1977, which describes internationalization as a gradual process in which firms first expand their operations to geographically close markets, accumulating knowledge and experience.

They also refer to John Dunning's Eclectic Paradigm (OLI), which suggests that firms internationalize when they can combine three types of advantages: ownership (O), location (L), and internalization (I). They also highlight the Internationalization Theory based on Coase's transaction costs, which indicates that firms expand into foreign markets to minimize the costs of operating in these contexts. Finally, they cite the Resource-Based View, which argues that internationalization is undertaken to exploit a firm's unique resources and capabilities in new markets, enabling better use of its competitive advantages.

Nearshoring can be viewed as an extension of these strategies, allowing Colombian firms to integrate into closer and more resilient global supply chains. In a volatile post-pandemic environment, companies are reconfiguring their operations to reduce risks and improve operational efficiency (Figure 4).

According to the World Economic Forum (2023), nearshoring consists of moving operations to a nearby country with a similar time zone, taking advantage of the experience and knowledge of the local workforce. This makes it possible to speed up delivery times and achieve greater economic certainty. It is a competitive strategy that relies on the productivity of the global logistics chain and international trade, seeking to reduce costs and risks through nearby locations.

Medina Ariza (2024) highlights how nearshoring is transforming industry and trade in Latin America. This model, which involves relocating business operations to nearby countries, has gained relevance because of the trade war between China and the United States, the pandemic, and other factors. Latin

America, especially Mexico, is presented as an attractive destination for nearshoring, with benefits such as shorter delivery times, lower costs, and increased production. According to Mejía (2024), nearshoring is a business strategy that involves relocating operations closer to consumer markets in order to reduce costs, shorten delivery times, and mitigate risks in the global supply chain.

Supply chain management theories help explain how nearshoring can optimize logistics and improve responsiveness to international markets while increasing business competitiveness. In this regard, Puli-do (2014) defines the supply chain as the activities that transform goods from raw materials to the final consumer. Krawjesky et al. (2008) describe it as a network of services, materials, and information flows that connects suppliers and customers. Ballou (2004) adds that logistics, as part of this chain, includes transportation and repeated inventory control through final delivery. In terms of management, López (2008) and Chase et al. (2009) agree that it involves managing resources to meet the company's strategic priorities. Complementarily, knowledge management makes it possible to articulate organizational processes and strengthen strategic decision-making in competitive and international environments (Martínez Garcés & Garcés Fuenmayor, 2021).

Studies on business relocation in Latin America highlight the region's potential to adapt to nearshoring dynamics. Although countries such as Mexico have been at the forefront of this phenomenon, Colombia is emerging as a key competitor. This is aligned with new post-pandemic internationalization strategies that seek not only to improve the competitiveness of local companies, but also to attract foreign investment by taking advantage of the country's strategic location and trade agreements.

In this context, the business models and competitiveness of Colombian firms are crucial factors. Their ability to adapt to nearshoring requirements depends on their capacity to implement advanced technologies, improve logistics infrastructure, and train specialized human capital. In this regard, innovative leadership becomes a key element for strengthening organizational cultures oriented toward innovation and adaptation to dynamic environments, thereby fostering business competitiveness (Fontalvo & Cienfuegos Molina, 2020). These capabilities will allow companies to participate actively in regional nearshoring dynamics and take advantage of the opportunities offered by this phenomenon.

**Figure 1**  
*Theories of internationalization.*



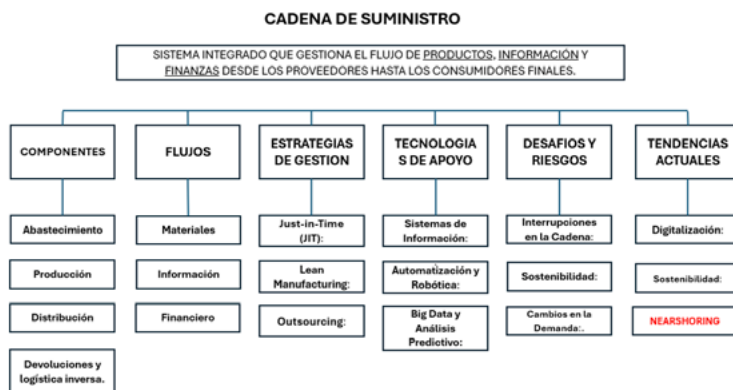
Source: Author's own elaboration.

**Figure 2**  
*Supply chains in international business*



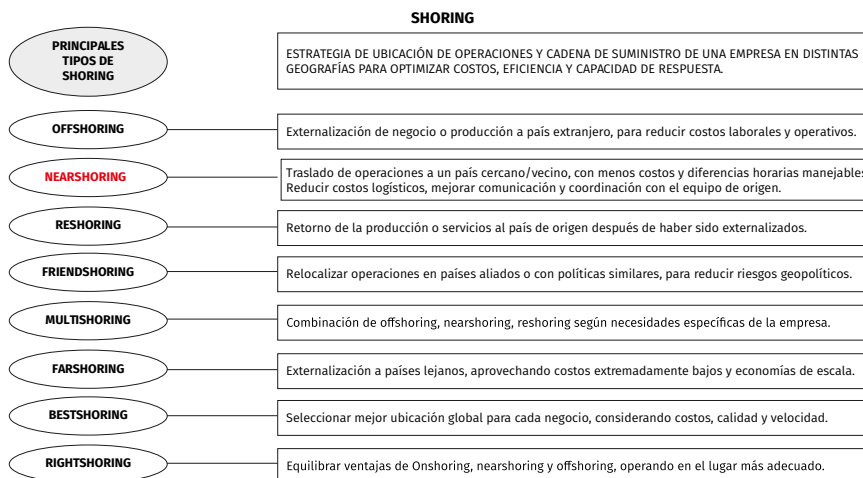
Source: Author's own elaboration.

**Figure 3**  
*Supply chains: Key elements*



Source: Author's own elaboration.

**Figure 4.**  
*Nearshoring in the context of shoring*



Source: Author's own elaboration.

## Latin American context

In recent years, nearshoring has gained momentum as a key strategy for the reconfiguration of global supply chains, especially in Latin America. This trend, which involves relocating operations closer to major consumer markets, has enabled multinational companies to optimize costs, improve logistics efficiency, and reduce their dependence on Asia. Countries such as Mexico, Costa Rica, Colombia, Brazil, Argentina, and Chile have positioned themselves as attractive destinations for this modality, each with specific strengths and sectors in which it stands out.

Despite differences among countries, common factors have facilitated the success of nearshoring in Latin America, including geographic and cultural proximity to the United States, favorable trade agreements, skilled labor, and competitive costs. In addition, investment in logistics and digital infrastructure has been crucial for attracting investment and consolidating the region as a strategic hub for the relocation of operations.

In the post-pandemic context, nearshoring has consolidated itself as a viable option for companies seeking to mitigate risks and diversify their supply chains. This phenomenon offers Latin American countries a unique opportunity to increase their global competitiveness, provided they are able to overcome challenges such as infrastructure deficiencies and bureaucratic barriers. In this context, various studies have shown that the pandemic caused substantial reductions in income and employment in productive sectors, forcing companies to rethink business strategies and strengthen organizational resilience (Aquino Rocha et al., 2021).

The following examples present successful nearshoring cases in Latin America, illustrating how various companies have used the region's advantages to strengthen their presence in international markets. From the automotive industry in Mexico to the technology services sector in Argentina and Chile, as well as the expansion of BPO in Colombia and the development of the pharmaceutical industry in Brazil, nearshoring has proven to be an effective tool for promoting foreign investment and economic growth in the region.

*Mexico, the main nearshoring destination in the Americas, has been a key location for the nearshoring of automotive companies, especially from the United States. Major brands such as Ford, General Motors, and Tesla have transferred parts of their manufacturing processes to Mexico. The United States-Mexico-Canada Agreement (USMCA) has been a key facilitator, providing a tariff-free trade framework that promotes relocation. In the electronics sector, companies such as Foxconn, which manufactures electronic products including Apple components, have relocated part of their production to Mexico, seeking to take advantage of proximity to the United States and reduce dependence on Asia, especially after trade tensions between the United States and China (C. Garrido, 2022).*

In Costa Rica, nearshoring has developed in the technology and services sectors. In 2020, Intel announced a significant investment to reactivate one of its assembly and testing plants in Costa Rica, an operation that had closed in 2014. This investment was partly motivated by a nearshoring strategy aimed at diversifying its supply chain and being closer to its key markets in North America.

In shared services and BPO, Costa Rica has become an attractive destination for global com-

panies' shared services centers and business process outsourcing operations. Companies such as Amazon and HP have operations centers there, taking advantage of the skilled workforce and strategic location in the Western Hemisphere.

Colombia has become one of the emerging destinations for nearshoring in the Business Process Outsourcing (BPO) and information technology sectors. Companies such as Teleperformance, Sitel, and Concentrix have expanded their operations in Colombia due to the availability of bilingual talent and proximity to the United States. The pandemic accelerated demand for customer service operations, which Colombia has been able to capitalize on. In 2021, Tata Consultancy Services (TCS), an Indian technology multinational, expanded its presence in Colombia as part of its strategy to provide IT services to North America and Latin America, using Colombia as a strategic center.

In Brazil, the French pharmaceutical company Sanofi has consolidated part of its production to supply Latin American markets. Although its operation is focused mainly on the Brazilian market, this decision is also part of a nearshoring strategy to reduce transportation costs and increase efficiency in the supply of medicines throughout the region. In turn, the German pharmaceutical and biotechnology multinational Bayer has also invested in production in Brazil, particularly in agricultural products such as pesticides and genetically modified seeds, to serve regional markets.

Similarly, in Argentina, Globant, the Argentine software development company, has been a successful example of nearshoring in the technology sector. It has created a model of innovation centers in Latin America, from which it offers technology services to clients in the United States and Europe. This strategy has allowed Globant to take advantage of cost differences while maintaining a high level of quality and proximity to international clients. MercadoLibre, although not strictly a nearshoring company, has consolidated logistics centers in Argentina and other Latin American countries to optimize its supply chain in the region, serving local markets and exporting products within the region.

Finally, in Chile, multinationals such as IBM and Accenture have established development and support centers, taking advantage of the country's economic stability and advanced digital infrastructure. These centers provide technology and consulting services to clients in North America and Europe. Likewise, in 2021, Falabella, the Chilean retail company, announced an alliance with Amazon Web Services (AWS) to launch its cloud technology services platform, strengthening the infrastructure for digital and technological nearshoring in the region.

From the cases discussed above, the key success factors for nearshoring in the Americas include geographic and cultural proximity, favorable trade agreements and fiscal policies, skilled labor and competitive costs, and investment in infrastructure. Regarding the first factor, proximity to the United States and time-zone alignment facilitate operational coordination, particularly in the services sector. Regarding the second factor, countries such as Mexico, Costa Rica, and Colombia have developed attractive fiscal policies and trade agreements that favor foreign direct investment. As for the third factor, the availability of qualified talent, particularly in the IT and manufacturing sectors, combined with lower labor costs than in the United States or Europe, makes the region competitive. Finally, regarding the fourth factor, countries that have developed solid logistics and digital infrastructure have been able to attract more nearshoring investment.



## Analysis of the Colombian context

The SWOT analysis of nearshoring in Colombia makes it possible to assess both the advantages and the challenges the country faces in positioning itself as an attractive destination for the relocation of business operations. Among its strengths are its strategic geographic location, close to the United States and the Panama Canal, which facilitates access to key markets in North America, the Caribbean, and Europe. In addition, Colombia has multiple free trade agreements that allow exports with reduced tariffs, as well as competitive labor costs and growth in technological infrastructure that supports sectors such as technology and value-added services.

In this context, nearshoring also presents important opportunities, such as attracting foreign direct investment (FDI) in sectors including manufacturing, technology, and services, which would strengthen export capacities and generate quality employment. Likewise, the nearshoring trend could drive economic diversification, the development of emerging sectors, and improvements in logistics and transport infrastructure. The growth of e-commerce and government incentives also create a favorable environment for attracting investment, reducing dependence on traditional markets.

However, the country faces significant weaknesses, such as deficient logistics infrastructure in key areas, which limits efficiency and increases transportation costs. These limitations can be interpreted as structural constraints affecting business growth that must be identified and managed to improve organizational performance (Rodríguez, 2021). Bureaucratic barriers and regulatory instability also discourage foreign investment. In addition, the lack of skilled labor in strategic sectors and dependence on traditional sectors such as oil and mining hinder the transition toward a more diversified economy oriented toward nearshoring. Challenges related to insecurity and regional inequality are also present.

In this scenario, threats include competition from countries such as Mexico and Brazil, which have more developed infrastructure and experience in manufacturing, potentially affecting Colombia's positioning as a nearshoring destination. Political and economic uncertainty, together with limitations in energy and transport supply, represent additional risks for companies considering relocation to the country. Security problems and social conflicts also negatively influence the perception of stability and security for foreign investment (Sandoval et al., 2020; Andino, 2023).

In conclusion, nearshoring offers Colombia a unique opportunity to increase its competitiveness in the global market, but its success will depend on the country's ability to overcome structural weaknesses, improve logistics infrastructure, and create a stable political and economic environment. Addressing these challenges will be essential to maximizing the benefits of this strategy and positioning Colombia as an attractive destination for the relocation of business operations.

**Table 1.***Swot analysis of nearshoring in colombia*

<b>STRENGTHS</b>	
<b>Strategic Geographic Location:</b>	Colombia is strategically located near the United States and the Panama Canal, facilitating access to key markets in North America, the Caribbean, and Europe.
<b>Free Trade Agreements:</b>	The country has multiple trade agreements that allow companies to export to important markets with reduced or zero tariffs, including the United States, the European Union, and several Latin American countries.
<b>Competitive Labor Costs:</b>	Colombia offers skilled labor at relatively low costs compared with other countries in the region, making it attractive for companies seeking to optimize costs.
<b>Growth in Technological Infrastructure:</b>	Technological and digital infrastructure in the country has increased, supporting sectors such as technology and value-added services.
<b>OPPORTUNITIES</b>	
<b>Attraction of Foreign Direct Investment (FDI):</b>	Nearshoring can attract investment in sectors such as manufacturing, technology, and services, strengthening export capacities and creating quality jobs.
<b>Development of New Sectors:</b>	There are opportunities to develop emerging sectors such as technology, financial services, and advanced manufacturing, which can benefit from the nearshoring trend.
<b>Economic Diversification:</b>	Taking advantage of nearshoring can help diversify the Colombian economy by reducing its dependence on traditional sectors such as natural resources.
<b>Infrastructure Improvement:</b>	The nearshoring trend could drive investment in logistics and transport infrastructure, improving domestic connectivity and the country's competitiveness.
<b>E-commerce growth:</b>	Increased demand for logistics and technology services.
<b>Government incentives:</b>	Favorable policies to attract foreign investment.
<b>Market diversification:</b>	Reduced dependence on traditional markets.
<b>WEAKNESSES</b>	
<b>Deficient Logistics Infrastructure:</b>	Despite progress, deficiencies persist in road, port, and airport infrastructure, limiting logistics efficiency and increasing transportation costs.
<b>Bureaucratic and Regulatory Barriers:</b>	Bureaucratic complications and regulatory instability can discourage foreign investment and hinder the operation of companies seeking to relocate to Colombia.
<b>Lack of Skilled Labor:</b>	Insufficient specialized workers in key sectors may limit the country's ability to attract technology and advanced manufacturing industries.
<b>Dependence on Traditional Sectors:</b>	The Colombian economy still depends heavily on traditional sectors such as oil and mining, which may hinder the transition toward a more diversified economy oriented toward nearshoring.
<b>Insecurity:</b>	Security problems that may affect the perception of stability.
<b>Regional inequality:</b>	Significant differences in development among regions.

## THREATS

<b>Regional and International Competition:</b>	Countries such as Mexico and Brazil, with greater advances in infrastructure and manufacturing experience, may represent strong competition for Colombia as a nearshoring destination.
<b>Political and Economic Uncertainty:</b>	Uncertainty in the political landscape and economic fluctuations can create a risky environment for foreign investors.
<b>Energy and Transport Limitations:</b>	Restrictions in energy supply and problems in transport infrastructure could hinder industrial development and business operations in certain regions of the country. Security and Stability Risks: Security problems in some areas of the country and social conflicts may affect the perception of Colombia as a safe destination for investment and business relocation.
<b>Economic fluctuations:</b>	Impact of the global economy on investment and trade.
<b>Climate change:</b>	Risks associated with natural disasters and their impact on infrastructure.

**Table 2.**

*Final swot summary of nearshoring in Colombia*

STRENGTHS	OPPORTUNITIES
Strategic Geographic Location Free Trade Agreements Competitive Labor Costs Growth in Technological Infrastructure	Attraction of Foreign Direct Investment (FDI) Development of New Sectors Economic Diversification Infrastructure Improvement E-commerce growth Government incentives Market diversification
WEAKNESSES	THREATS
Deficient Logistics Infrastructure Bureaucratic and Regulatory Barriers Lack of Skilled Labor Dependence on Traditional Sectors Insecurity Regional inequality.	Regional Competition Political and Economic Uncertainty Energy and Transport Limitations Security and Stability Risks Economic Fluctuations Climate Change

### Challenges and necessary public policies

For nearshoring to become a successful reality in Colombia, it is essential to implement a series of public policies that address existing challenges and promote an environment favorable to foreign investment. First, the government must develop policies that improve infrastructure, especially logistics and transport infrastructure, thereby facilitating the connection of Colombian companies with international markets. These investments are crucial for optimizing the supply chain and reducing associated costs. In this regard, access to financing sources is fundamental for strengthening companies' investment and growth capacity, especially in the context of internationalization (Gil Hoyos et al., 2020; Ramírez et al., 2026).

Likewise, it is vital to reduce bureaucracy and create fiscal and regulatory incentives that attract more foreign companies interested in nearshoring. These reforms could include tax benefits for companies that invest in the country and the simplification of procedures that often limit operational expansion.

In addition, specialized human capital formation is essential. The development of education and training programs should focus on preparing the Colombian workforce for the challenges of nearshoring in key sectors such as technology and advanced manufacturing. This approach will not only improve employability, but also ensure that companies have the talent required to compete globally.

Finally, it is essential to foster collaboration between the public and private sectors. This synergy will make it possible to create an environment conducive to attracting foreign companies and developing local capacities. In addition, policies that promote innovation and entrepreneurship in local firms are necessary so that they can compete effectively with global actors operating under the nearshoring model. In conclusion, the implementation of these public policies is crucial to maximizing the potential of nearshoring in Colombia and ensuring that the country positions itself favorably in the international market.

### **Impact of nearshoring on the internationalization of Colombian companies**

Nearshoring is having a significant impact on the internationalization of Colombian companies, enabling them to expand their presence in international markets more rapidly. This trend has allowed various companies to take advantage of geographic proximity and existing trade agreements, especially in markets such as the United States and Europe, thereby improving their global competitiveness (Miranda et al., 2023).

In this regard, the sectors of the Colombian economy that can benefit most from nearshoring include technology, textiles, food and beverages, and financial services. These sectors have the potential to experience accelerated growth by integrating their operations closer to consumer markets. However, to fully take advantage of these opportunities, companies must adjust their strategies and restructure their operations. This implies developing new technological, logistical, and operational capabilities that allow them to meet the requirements and expectations of international markets.

In addition, digital transformation plays a crucial role in this process, as the digitalization of supply chains enables more efficient and agile integration, improving the ability of Colombian companies to operate in a competitive global environment. The ability to adapt to these new dynamics not only optimizes internal processes, but also positions Colombian companies as relevant actors in international trade.

In summary, nearshoring represents not only an opportunity for the expansion of Colombian companies, but also a change in their strategic, organizational, and technological approach, enabling them to compete effectively on the global stage. This process requires the articulation of organizational capabilities, knowledge management, innovative leadership, and access to financial resources in order to consolidate business competitiveness in global markets (Martínez Garcés & Garcés Fuenmayor, 2021; Fontalvo & Cienfuegos Molina, 2020; Gil Hoyos et al., 2020).

## **CONCLUSIONS**

Nearshoring represents a unique opportunity for the internationalization of Colombian compa-



nies, allowing them to take advantage of their proximity to key markets and improve their competitiveness in an increasingly volatile global environment. To maximize the opportunities derived from this trend, Colombian companies must implement proactive strategies that allow them to adapt to the demands of nearshoring.

Nevertheless, it is essential to overcome the challenges identified, which requires effective collaboration between the public and private sectors. Continued investment in infrastructure and talent development is crucial to ensuring that Colombia positions itself as an attractive destination for companies seeking to relocate their operations in the region.

Additionally, future lines of research are proposed to deepen the study of nearshoring in Colombia, particularly in emerging sectors such as technology and value-added services. It is also advisable to develop public policies that promote both nearshoring and internationalization, creating an enabling environment for foreign investment and the growth of domestic companies.

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# Management of Institutional Planning in the Budget Execution of Public Spending by Local Governments in Tumbes

Gestão do planejamento institucional na execução orçamentária do gasto público pelos governos locais de Tumbes  
*Gestión de la planificación institucional en la ejecución presupuestaria del gasto público por los gobiernos locales de Tumbes*

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## ABSTRACT

The objective of this study was to determine the relationship between institutional planning and the budget execution of expenditures in the local governments of Tumbes. The research was conducted under a quantitative, basic approach, with a non-experimental and correlational design. The population consisted of public servants from municipal entities, and data were collected through a survey using a structured questionnaire. The results showed a significant relationship between institutional planning and budget execution of expenditure, with a Spearman's rho coefficient of 0.732, indicating that adequate planning contributes to the efficient use of public resources. The study concludes that strengthening institutional planning processes improves the quality of budget management in municipal entities in Tumbes, favoring the achievement of institutional goals and objectives.

**Keywords:** Institutional Planning; Budget Execution; Public Spending; Public Management; Municipality

**JEL Code:** H61; H72; H83

## RESUMO

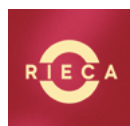
O objetivo deste estudo foi determinar a relação entre o planejamento institucional e a execução orçamentária das despesas nos governos locais de Tumbes. A pesquisa foi conduzida sob uma abordagem quantitativa e básica, com um desenho não experimental e correlacional. A população foi constituída por servidores públicos de órgãos municipais, e os dados foram coletados por meio de uma pesquisa utilizando um questionário estruturado. Os resultados mostraram uma relação significativa entre o planejamento institucional e a execução orçamentária das despesas, com um coeficiente rho de Spearman de 0,732, indicando que um planejamento adequado contribui para o uso eficiente dos recursos públicos. O estudo conclui que o fortalecimento dos processos de planejamento institucional melhora a qualidade da gestão orçamentária nos órgãos municipais de Tumbes, favorecendo o alcance das metas e objetivos institucionais.

**Palavras-chave:** Planejamento Institucional; Execução Orçamentária; Gastos Públicos; Gestão Pública; Município



ARTÍCULO DE INVESTIGACIÓN

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## INTRODUCTION

Institutional planning in the local governments of the Tumbes region is a strategic factor because it is closely related to how allocated expenditure is executed. If such planning is not carried out properly, or if aspects such as activity programming, resource allocation, and the forecasting of needs are not considered, problems may arise that affect the achievement of goals and delay the provision of basic services to the community. This study analyzes how institutional planning is being developed and how it is related to the budget execution of public spending.

The importance of this research lies in its contribution to a better understanding of the relationship between institutional planning and budget execution of expenditure in the municipal entities of Tumbes. This is essential because poor planning may lead to delays, budget under-execution, or resource allocations that do not respond to real priorities. The analysis considered aspects such as the Institutional Operational Plan (POI), the Institutional Strategic Plan (PEI), budget programming, the certification phase, the annual and monthly commitment phases, and the accrual and payment phases.

At the international level, institutional planning remains one of the most important components for achieving efficient expenditure execution in local governments; however, it still faces major challenges. According to Vera (2021), the absence of genuine strategic planning, combined with a weak organizational culture, has led budgets to be executed in an improvised manner, prioritizing immediate actions rather than long-term impact projects. In addition, outdated management instruments and the limited evaluation of results end up affecting the quality of public services.

At the national level, budget execution has shown important gaps due to weaknesses in institutional planning. As Choquemamani (2024) points out, many public entities still prepare their operational plans superficially, without properly aligning them with their budgets, which generates inconsistencies at the time of allocating and executing resources. Furthermore, the lack of technical capacities among planning teams and the absence of effective monitoring and evaluation mechanisms make it difficult for expenditures to be executed efficiently and on time.

At the local level, similar problems are observed in the provincial and district municipalities within the regional jurisdiction of Tumbes. The formulation of institutional planning often does not reflect the real needs of each sector, and there is limited coordination between the areas responsible for planning and those responsible for budget execution. This has resulted in delays in the execution of public works, improvised expenditure, and limited capacity to respond to urgent needs. Shortcomings are also evident in the use of management instruments such as the POI and the Initial Institutional Budget (PIA), which are not always updated according to actual needs. All of this affects the level of budget execution and the quality of services provided to the population of Tumbes, directly influencing their well-being and development during the budget execution stage aimed at addressing the basic needs of the districts and provinces of the region.

## METHODOLOGY

The study was developed under a quantitative, basic research approach, aimed at generating theoretical knowledge about the relationship between institutional planning and budget execution of expenditure in the

context of public management. The research design was non-experimental, cross-sectional, and correlational, since the variables were not manipulated and data were collected at a single point in time in order to analyze the relationship between them.

The population consisted of public servants from the municipalities of the department of Tumbes, while the sample was determined through non-probabilistic convenience sampling, considering workers linked to the areas of planning, budgeting, and administration. The survey was used as the data-collection technique, and the instrument was a structured questionnaire with Likert-scale items, previously validated by expert judgment and tested for reliability using Cronbach's alpha coefficient.

For data processing and analysis, descriptive and inferential statistical tools were used, including frequency tables, percentages, and measures of central tendency. Likewise, Spearman's correlation coefficient was applied to test the hypothesis, considering a significance level of 0.05. Finally, the ethical principles of confidentiality, anonymity, and informed consent of the participants were respected throughout the research process.

## RESULTS

The inferential results show a high, positive, and statistically significant relationship between institutional planning and budget execution of expenditure. Specifically, the Spearman correlation coefficient obtained ( $\rho = 0.732$ ) indicates a strong and direct association, meaning that higher levels of institutional planning correspond to higher levels of budget execution in the entities studied. Likewise, the bilateral significance value ( $p = 0.000$ ) was below the established significance level ( $\alpha = 0.05$ ), allowing the null hypothesis to be rejected and the research hypothesis to be accepted. This confirms that the observed relationship is not the result of chance but has statistical support. Consequently, it is concluded that institutional planning has an important influence on expenditure execution, showing that adequate planning contributes to more efficient management of public resources in the municipalities of the Tumbes region.

## DISCUSSION

In this research, the  $p$  value was found to be  $< 0.05$  ( $\alpha$ ), which made it possible to accept the hypothesis proposed in the study. Therefore, there is sufficient statistical relevance to indicate a direct and significant relationship between institutional planning and budget execution. Likewise, the inferential result of Spearman's  $\rho$  coefficient was 0.732, indicating a high positive significant relationship. Sullón and Álvarez (2022) determined that there is a high positive relationship between strategic planning and the phases of the public budget, evidencing significant correlations in programming ( $\rho = 0.759$ ), execution ( $\rho = 0.813$ ), and evaluation ( $\rho = 0.753$ ), all with  $p < 0.05$ . They also confirmed a strong positive relationship between strategic planning and public budget execution ( $\rho = 0.811$ ). These results indicate that adequate strategic planning contributes significantly to better budget programming, execution, and evaluation in public management. According to Córdova (2022), there is a positive and significant relationship between the Institutional Operational Plan and the Institutional Budget ( $\rho = 0.368$ ;  $p < 0.05$ ), although at a low level. Positive correlations were also found between the POI and its components: programming and formulation ( $\rho =$

0.357), approval ( $\rho = 0.405$ ), execution and monitoring ( $\rho = 0.314$ ), and evaluation ( $\rho = 0.313$ ), all statistically significant. These results indicate that the POI is linked to the budget process, although with low to moderate levels of association. Along the same lines, Guerrero (2024), after applying the Shapiro-Wilk test to a sample of 38 workers, used Spearman's  $\rho$  due to the partial non-normality of the data. The study showed a significant relationship between procurement and contracting management and budget execution ( $\rho = 0.997$ ;  $p < 0.05$ ), as well as with its components: annual contracting plan ( $\rho = 0.880$ ), selection process ( $\rho = 0.929$ ), and contractual execution ( $\rho = 0.955$ ). These findings reflect high and very high positive correlations, confirming the direct incidence of contracting processes on budget execution.

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#### **Author contribution:**

- Conceptualization: Dr. Henry Bernardo Garay Canales
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- Formal analysis: Dr. Henry Bernardo Garay Canales
- Research: Dr. Henry Bernardo Garay Canales
- Methodology: Dr. Henry Bernardo Garay Canales
- Writing - original draft: Dr. Henry Bernardo Garay Canales
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# Analysis of the Relationship between Job Satisfaction and Turnover among Operational Staff in Retail Companies in Ximena Parish, Guayaquil, Ecuador

Análise da relação entre a satisfação no trabalho e a rotatividade do pessoal operacional em empresas varejistas da paróquia Ximena, Guayaquil, Equador  
*Análisis de la relación entre la satisfacción laboral y la rotación del personal operativo en empresas minoristas de la parroquia Ximena, Guayaquil, Ecuador*

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## ABSTRACT

This research analyzes the relationship between job satisfaction and turnover among operational staff in warehouses of retail companies located in Ximena parish, Guayaquil, Ecuador. A quantitative approach was adopted, with a descriptive-correlational scope and a non-experimental, cross-sectional design. The sample consisted of 118 operational workers, who completed a structured 15-item Likert-scale questionnaire (1 to 5) through Google Forms. The instrument assessed dimensions of job satisfaction, including recognition, communication, learning opportunities, compensation, physical working conditions, resources, and interpersonal relationships, as well as factors associated with turnover, such as professional growth, incentives, training, supervisors' treatment, workload, and perceived impact of turnover. Data were processed using IBM SPSS Statistics and Microsoft Excel through descriptive statistics and Spearman's rank correlation coefficient. The results revealed very strong, statistically significant positive correlations ( $\rho$  between 0.919 and 0.972;  $p < 0.001$ ) among the variables analyzed. Relevant associations included teamwork and perceived impact of turnover ( $\rho = 0.953$ ), interpersonal relationships ( $\rho = 0.937$ ), resource availability and workload ( $\rho = 0.933$ ), and communication with superiors ( $\rho = 0.931$ ). The overall mean was 3.37 out of 5, with job satisfaction at 3.45 and turnover perception at 3.27, reflecting moderate levels and areas for improvement, particularly in compensation and incentives. The study concludes that higher job satisfaction is associated with lower intention to leave. Leadership, communication, recognition, training, salary, and work climate are decisive factors for employee retention and stronger organizational performance.

**Keywords:** Job Satisfaction; Turnover; Operational Staff; Retail; Ximena Parish

**JEL Code:** M54 Labor Management

## RESUMO

Esta pesquisa analisa a relação entre a satisfação no trabalho e a rotatividade entre os funcionários operacionais de armazéns de empresas de varejo localizadas na paróquia de Ximena, em Guayaquil, Equador. Foi adotada uma abordagem quantitativa, com um enfoque descritivo-correlacional e um desenho transversal não experimental. A amostra consistiu em 118 funcionários operacionais, que responderam a um questionário estruturado de 15 itens na escala de Likert (1 a 5) por meio do Google Forms. O instrumento avaliou dimensões da satisfação no trabalho, incluindo reconhecimento, comunicação, oportunidades de aprendizagem, remuneração, condições físicas de trabalho, recursos e relações interpessoais, bem como fatores associados à rotatividade, tais como crescimento profissional, incentivos, treinamento, tratamento dos supervisores, carga de trabalho e impacto percebido da rotatividade. Os dados foram processados utilizando o IBM SPSS Statistics e o Microsoft Excel por meio de estatísticas descritivas e do coeficiente de correlação de Spearman. Os resultados revelaram correlações positivas muito fortes e estatisticamente significativas ( $\rho$  entre 0,919 e 0,972;  $p < 0,001$ ) entre as variáveis analisadas. As associações relevantes incluíram trabalho em equipe e impacto percebido da rotatividade ( $\rho = 0,953$ ), relações interpessoais ( $\rho = 0,937$ ), disponibilidade de recursos e carga de trabalho ( $\rho = 0,933$ ) e comunicação com superiores ( $\rho = 0,931$ ). A média geral foi de 3,37 em 5, com satisfação no trabalho em 3,45 e percepção de rotatividade em 3,27, refletindo níveis moderados e áreas a serem melhoradas, particularmente em remuneração e incentivos. O estudo concluiu que maior satisfação no trabalho está associada a menor intenção de sair. Liderança, comunicação, reconhecimento, treinamento, salário e clima de trabalho são fatores decisivos para a retenção de funcionários e um desempenho organizacional mais forte.

**Palavras-chave:** satisfação no trabalho; rotatividade; equipe operacional; varejo; paróquia de Ximena



## INTRODUCTION

In recent years, turnover among operational staff has become one of the main concerns for companies in the retail sector because of its impact on productivity, organizational stability, and recruitment costs. According to the OCC report (2023), 72% of organizations in Latin America reported increases in employee turnover, with operational positions being the most affected by dissatisfaction, overload, and lack of recognition.

According to Forbes (2023), employees tend to leave their jobs when they do not perceive growth opportunities, effective leadership, or adequate working conditions. These causes, together with limited incentives and a poor organizational climate, create an environment that fosters demotivation and, consequently, employee departure.

In Ecuador, this phenomenon is particularly evident in the retail sector, where employees in logistics and warehouse areas face high physical demands, extended working hours, and limited development opportunities. Recent studies by Siguenza and Guillen (2025) confirm that turnover in service and retail companies exceeds 40%, directly affecting recruitment and training costs. Likewise, Zafra Yorch (2024) notes that the loss of operational talent affects the continuity of logistics processes, reduces efficiency, and decreases the quality of customer service.

In Ximena parish, located in southwestern Guayaquil, Ecuador, numerous retail companies operate with warehouse teams as the backbone of their logistics processes. High employee turnover not only disrupts the normal workflow and interrupts vital logistics activities but also increases the fixed costs associated with hiring and training each new employee.

Job satisfaction directly influences this phenomenon, since factors such as recognition, internal communication, leadership, and growth opportunities affect whether employees remain in or leave an organization. When these elements are absent, workers experience demotivation, stress, and emotional disconnection from the company, which increases their intention to leave.

This problem is intensified by the inherent characteristics of operational roles: rotating shifts, highly demanding work environments, limited support programs, and weak systems for valuing work. In this context, it is essential to determine the relationship between job satisfaction and employee turnover, as this makes it possible to understand the decisive factors that contribute to greater human capital stability.

This research is theoretically grounded in Herzberg's Two-Factor Theory (1959), which distinguishes between motivational factors - such as achievement, recognition, and development - and hygiene factors - such as salary, working conditions, and supervision. It is also supported by Blau's Social Exchange Theory (1964), which emphasizes reciprocity between employees and the organization, and by the models of Mobley (1977) and Price and Mueller (1981), which explain the psychological process leading to intention to resign.

Previous studies in Ecuador, such as Chasi Ramos, Alvarado Cobeña, and Moreta Zavala (2024), found a significant positive correlation ( $r = 0.706$ ;  $p < 0.01$ ) between job satisfaction and human talent retention, while Durán Delgado, Rojas Sánchez, and Arguello Delgado (2024) identified poor

work climate, weak communication, and inadequate leadership as the main causes of dissatisfaction. These findings support the need to analyze the relationship between both variables in the specific context of warehouse operational staff in the retail sector of Ximena parish.

## METHODOLOGY

The research followed a quantitative approach based on the collection of numerical data obtained through a structured instrument. This approach made it possible to objectively measure the variables of job satisfaction and operational staff turnover, as well as to statistically analyze the relationship between them. From a descriptive scope, the level of job satisfaction among operational staff was identified and characterized, considering several factors related to the work environment and working conditions. From a correlational scope, the degree of relationship between both variables was determined without establishing cause-and-effect relationships.

The design was non-experimental, as the variables were not manipulated but studied in their natural context. It was also cross-sectional, since data were collected at a single point in time, allowing the current situation of the staff to be analyzed in relation to their level of job satisfaction and perception of turnover. The population consisted of warehouse and logistics operational staff in the retail sector of Ximena parish in Guayaquil. Participating companies included Corporación Favorita, Almacenes Juan Eljuri, Grupo Tramaco, Éxito Corporación, Grupo Ordóñez, Distribuidora Sur, Pricom Logistic Solutions, Grupo Difare, and Grupo Carrión, with an estimated universe of several thousand workers distributed across establishments of different sizes. The final sample consisted of 118 operational workers selected through non-probabilistic convenience sampling. In the first phase, 225 responses were obtained; after focusing the study on warehouse operational staff, 118 valid surveys remained. The sociodemographic analysis revealed the following:

- Age: 61.02% of participants were between 18 and 25 years old; 27.12% were between 26 and 35; 5.08% were between 36 and 45; and 6.78% were 46 or older. The sample was predominantly young.
- Gender: 57.63% identified as female and 41.53% as male; 0.85% preferred not to answer.
- Length of service: 30.51% had worked between 6 months and 1 year in the company; 24.58% between 1 and 3 years; 22.88% for more than 3 years; and 22.03% for less than 6 months.
- Type of contract: 68.64% had a full-time contract; 11.02% had a temporary contract; 11.02% reported another type of employment arrangement; and 9.32% worked part-time.
- The instrument was a structured questionnaire consisting of 15 closed-ended questions on a Likert scale (1 = strongly disagree to 5 = strongly agree), prepared digitally through Google Forms. The questions measured three types of factors:
- Intrinsic factors: recognition, communication with superiors, and learning opportunities.



- Extrinsic factors: salary, physical working conditions, and availability of resources.
- Social factors: interpersonal relationships, cooperation, and companionship.

The instrument was validated through expert review, in which the clarity, relevance, and coherence of the items were assessed. Data were systematized in a digital database using IBM SPSS Statistics and Microsoft Excel, and the analysis was conducted in two stages:

Descriptive analysis: frequencies, distributions, and weighted averages by question were calculated to identify general trends.

Correlational analysis: Spearman's correlation coefficient ( $\rho$ ), appropriate for ordinal Likert-scale variables, was applied to eight pairings between job satisfaction questions and turnover questions, evaluating the direction, strength, and statistical significance ( $p < 0.05$ ) of each relationship.

## RESULTS

The overall average score of the instrument was 3.37 out of 5, indicating a slightly positive general tendency. When analyzed by variable, the results were as follows:

Job satisfaction (items P1 to P8): the overall average was 3.45. The best-rated aspects were interpersonal relationships (P7: 4.05) and companionship (P8: 4.11). The lowest-rated dimension was salary (P4: 2.90).

Staff turnover (items P9 to P15): the overall average was 3.27. The item with the highest level of agreement was the perception of the negative impact of turnover on the team (P15: 3.92). The item with the lowest rating was the perception of performance incentives (P10: 2.68).

Eight pairings were established between job satisfaction dimensions and turnover factors. The results are analyzed below:

Eight pairings - Spearman's  $\rho$  coefficient

A5 - Physical working conditions and task-person fit ( $\rho = 0.972$ ). This was the highest correlation in the study. When the physical environment is adequate, workers perceive that tasks fit their profile. This strengthens adaptation to the job and overall well-being, consistent with Herzberg's Two-Factor Theory and its hygiene factors.

A8 - Team climate and perception of turnover ( $\rho = 0.953$ ). Workers in cooperative environments perceive the negative impact of turnover more clearly. Team cohesion encourages permanence. This finding is supported by Social Exchange Theory (Blau, 1964).

A3 - Learning and training ( $\rho = 0.940$ ). Those who perceive learning opportunities in their position also recognize that the company provides training. Competency development acts as a key

retention factor among young staff, particularly given that 61% of participants were between 18 and 25 years old.

A7 - Workplace relationships and the effect of turnover ( $\rho = 0.937$ ). Workers with better interpersonal relationships perceive the damage caused by turnover more clearly. This reflects a stronger sense of belonging and group cohesion. Workplace relationships were the highest-rated dimension (mean between 4.05 and 4.11).

A6 - Available resources and workload ( $\rho = 0.933$ ). Having sufficient tools enables workers to manage workload more effectively, reducing the perception of overload and turnover intention. This contributes to both operational improvement and well-being.

A2 - Communication and treatment by supervisors ( $\rho = 0.931$ ). Clear and respectful communication is strongly associated with satisfaction regarding supervisors' treatment. Strengthening organizational communication can help reduce voluntary turnover.

A1 - Recognition and incentives ( $\rho = 0.924$ ). The incentives item (2.68) had the lowest score in the instrument. Workers who feel valued also perceive formal incentive mechanisms more positively. This points to a structural weakness in formal recognition policies.

A4 - Compensation and professional growth ( $\rho = 0.919$ ). Salary equity and career prospects are closely connected. Salary (mean = 2.90) was the lowest-rated satisfaction dimension. Reviewing salary scales and career development plans should therefore be a priority.

Of the eight pairings analyzed, seven showed very strong positive correlations ( $\rho > 0.90$ ;  $p < 0.001$ ). The factors with the strongest relationships were team cooperation ( $\rho = 0.953$ ), workplace relationships ( $\rho = 0.937$ ), resources and workload ( $\rho = 0.933$ ), communication with supervisors ( $\rho = 0.931$ ), and the strongest relationship, physical conditions and task-person fit ( $\rho = 0.972$ ).

## DISCUSSION

The results of this research confirm the general hypothesis: there is a positive and significant relationship between job satisfaction and turnover among operational staff in retail-sector warehouses in Ximena parish. The Spearman correlation values obtained ( $\rho$  between 0.919 and 0.972) are consistent with previous findings in Latin American literature. Chasi Ramos, Alvarado Cobeña, and Moreta Zavala (2024) reported a significant positive correlation ( $r = 0.706$ ;  $p < 0.01$ ) between job satisfaction and human talent retention in an Ecuadorian company in Quevedo, with similar high-impact factors: physical environment, growth opportunities, recognition, and working conditions. The strength of association found in the present study is consistently higher, possibly due to the homogeneity of the analyzed sector (operational staff in retail warehouses) and the specific context of Ximena parish.

The highest correlation in the study corresponded to the pairing between physical working conditions and task-person fit ( $\rho = 0.972$ ). This finding reinforces the assumptions of Herzberg's

Two-Factor Theory (1959), which states that hygiene factors - such as the physical environment, safety conditions, and job fit - are essential to prevent dissatisfaction and, therefore, turnover. Andersson (2017) confirmed that work environment and safety are determinants for preventing dissatisfaction among frontline employees, consistent with the present findings.

The recognition and incentives factor ( $\rho = 0.924$ ) aligns with the findings of Castañeda Tarrillo (2024) and Chavez Somoza (2023), who demonstrated in Latin American contexts that recognition and training are decisive variables for reducing turnover intention. The performance incentives item had the lowest average score in the entire instrument (2.68), suggesting a structural weakness in the formal recognition policies of the companies analyzed. This is consistent with OCC (2023), which identified lack of recognition as one of the main causes of increased turnover in Latin America.

The high correlation between team climate and perceived impact of turnover ( $\rho = 0.953$ ) suggests that workers with a stronger sense of belonging and group cohesion are also more aware of the damage caused by frequent turnover to collective performance. From the perspective of Social Exchange Theory (Blau, 1964), this result can be interpreted as an expression of the reciprocity bond developed among coworkers: those who invest in positive workplace relationships perceive more clearly the consequences of their deterioration. This dynamic has direct implications for human talent management, since strengthening organizational climate can be as effective a retention strategy as economic incentives.

The overall job satisfaction average (3.45) falls within a moderately favorable range, far from both full satisfaction and critical dissatisfaction. This result is consistent with Durán Delgado, Rojas Sánchez, and Arguello Delgado (2024), who found in the Ecuadorian public sector that weak communication and inadequate leadership limit satisfaction without necessarily generating acute crises. In the case of warehouse operational staff, the greatest strengths are interpersonal relationships and companionship - dimensions that, paradoxically, are not entirely under direct company control - whereas the weakest aspects, compensation and incentives, depend on deliberate organizational decisions.

From a practical perspective, the results justify differentiated strategies by organizational level: (a) at the warehouse leadership level, strengthening leadership, communication, and equitable task distribution; (b) at the human talent level, implementing training, recognition, and incentive programs, as well as performance evaluations with individualized improvement plans; and (c) at the managerial level, reviewing salary scales, designing coexistence policies, and ensuring the material resources necessary for efficient work. Articulation across these levels is necessary for improvements in job satisfaction to translate into an effective reduction in operational staff turnover.

As a limitation of the study, the use of non-probabilistic convenience sampling restricts the generalization of results to the entire retail sector of Ximena parish. Likewise, because the design was cross-sectional, causal relationships between the variables cannot be established. Future research should incorporate longitudinal designs and probabilistic samples to monitor the evolution of job satisfaction and its actual effect on turnover rates.

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ARTÍCULO DE INVESTIGACIÓN



# Use of augmented reality in road safety education to prevent crashes involving cyclists

Uso da realidade aumentada na educação para a segurança viária para prevenir acidentes envolvendo ciclistas  
*Uso de realidad aumentada y educación en seguridad vial para la prevención de accidentes en ciclistas*

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## ABSTRACT

In Colombia, the coexistence of motor vehicles and bicycles on public roads represents a growing challenge for road safety, as reflected in high rates of crashes and injuries. Although specific regulations exist, such as Law 1811 of 2016, which establishes a minimum distance of 1.5 meters between motor vehicles and cyclists, enforcement and effective compliance remain limited. Traditional road safety training methods have proven insufficient to generate sustainable behavioral changes among drivers and cyclists. This study proposes an innovative methodology based on the integration of immersive augmented reality (AR) experiences into road safety training processes, with the aim of strengthening risk perception and safe decision-making. The study reviews Colombian legislation and examines successful international experiences in the use of AR for crash prevention. The methodology is structured under Stanford University's CIFE Horseshoe framework, which enables the research problem to be addressed from intuition, literature review, research question formulation, and task and method design. The findings suggest that AR can be an effective tool for reducing crash rates and improving road-user training, while also offering recommendations for the implementation of pilot programs and future research.

**Keywords:** Augmented Reality; Road Safety Education; Road Safety; Cyclists; Risk Perception.

## RESUMO

In Colombia, the coexistence of motor vehicles and bicycles on public roads represents a growing challenge for road safety, as reflected in high rates of crashes and injuries. Although specific regulations exist, such as Law 1811 of 2016, which establishes a minimum distance of 1.5 meters between motor vehicles and cyclists, enforcement and effective compliance remain limited. Traditional road safety training methods have proven insufficient to generate sustainable behavioral changes among drivers and cyclists. This research proposes an innovative methodology based on the integration of immersive augmented reality (AR) experiences into road safety training processes, with the aim of strengthening risk perception and safe decision-making. A review of Colombian legislation is conducted, together with an analysis of successful international experiences in the use of AR for crash prevention. The methodology is structured under Stanford's CIFE Horseshoe framework, allowing the problem to be addressed through intuition, literature review, research question formulation, and the design of tasks and methods. The findings suggest that AR can be an effective tool to reduce crash rates and improve road-user training, providing recommendations for pilot implementation and future lines of research.

**Palavras-chave:** Augmented Reality; Road Safety Education; Road Safety; Cyclists; Risk Perception.



## INTRODUCTION

Urban mobility in Colombia has experienced sustained growth in bicycle use as a means of transportation, driven by public policies focused on sustainability, health, and affordability. Although this progress is positive, it has also created new challenges for road safety, particularly in the interaction between cyclists and motor vehicles. National statistics reveal a concerning incidence of road crashes involving cyclists, many of which could be prevented through stronger road safety education and more effective enforcement of current regulations. Colombia has a robust legal framework: Law 1811 of 2016 promotes bicycle use nationwide and establishes protective measures for cyclists, including the obligation to maintain a minimum lateral distance of 1.5 meters when overtaking, as well as mandatory helmet use and reflective elements [1]. Likewise, the National Traffic Code (Law 769 of 2002, as amended) and Law 2251 of 2022 define clear rules on the behavior of road users and reinforce the protection of vulnerable users [2][3]. Nevertheless, a gap persists between legislation and everyday practice, partly due to the lack of training tools that allow users to experience, in safe environments, the consequences of their decisions.

In this context, disruptive technologies, particularly augmented reality (AR), emerge as high-potential resources for transforming road safety training and awareness processes. Through immersive simulations, AR enables cyclists and drivers to adopt each other's perspective, experience risk situations, and visualize the consequences of their actions, fostering empathy and experiential learning. This immersive capacity is particularly relevant for modifying behavior and reducing crash rates. The potential of AR is evident in initiatives such as the European SAFEDUCA project, which implements AR environments for training vulnerable road users [6]. Several academic studies report significant improvements in risk perception and learning effectiveness through the use of AR [7]. Recent research has even quantified that AR may reduce learning time by approximately 40% and improve performance in practical tests by nearly 75%, highlighting its positive impact on training processes [8]. Consistently, international organizations emphasize the pedagogical potential of AR as an innovative tool in road safety education. For example, the 2025 traffic regulation update by Spain's Directorate-General for Traffic (DGT) reinforces the minimum lateral distance of 1.5 meters and requires drivers to reduce speed by 20 km/h when overtaking cyclists [4], recognizing the importance of protecting these vulnerable users. Similarly, global reports, such as those of the International Transport Forum (ITF), highlight road safety trends and encourage the integration of emerging technologies such as AR into educational programs [9], providing an international framework for contextualizing the findings of this research.

Despite institutional efforts, traditional road safety education methods, mainly based on lectures, static signage, and information campaigns, have been insufficient to produce meaningful behavioral changes among road users. Road crashes in Colombia remain a critical public health issue: in 2022, the country recorded 8,032 deaths from road crashes, representing a 13.1% increase compared with the previous year [10]. Motorcyclists were the most affected group, accounting for 60% of deaths, followed by pedestrians (21.3%) and private vehicle drivers (7.6%). Cyclists also face high levels of vulnerability, with 437 deaths in 2022, approximately 5.4% of total fatalities [10]. Preliminary figures for 2023 indicate that crash mortality remained high, with 8,405 deaths nationwide [11]. These data show that current strategies have not effectively contained the phenomenon. Therefore, it is necessary to explore new training methodologies, such as AR, that foster experiential learning and empathy between drivers and cyclists, contributing to crash reduction and the strengthening of road safety culture. In this context, the following research question is posed: How can augmented reality contribute to the awareness and training of cyclists to prevent road crashes in Colombia?

It is hypothesized that AR can serve as an innovative road safety training tool by allowing users to experience, in an immersive and safe manner, the consequences of their decisions on the road. To answer the research question, the general objective of this study is to propose a road safety training methodology based on immersive AR experiences aimed at preventing bicycle crashes in Colombia, integrating an analysis of national legislation and a comparison with an international reference case, Spain. Specifically, the study pursues the following objectives: (i) to review current Colombian legislation on cyclist road safety, identifying gaps and opportunities for improvement; (ii) to review successful international experiences in the use of AR for road crash prevention; and (iii) to design road safety training scenarios using AR, focused on the simulation of risk situations and safe decision-making. The scope of the study is limited to the conceptual design phase of the methodological proposal and does not include large-scale implementation or longitudinal field evaluation.

## THEORETICAL FRAMEWORK

**Experiential education.** Experiential education, proposed by Kolb in 1984, holds that meaningful learning emerges from direct experience and reflection on that experience. The model is structured in four stages - concrete experience, reflective observation, abstract conceptualization, and active experimentation - which feed back into a continuous learning cycle. In the context of road safety education, this approach allows users to experience risk situations, reflect on their decisions, and modify their behavior based on the lived experience, fostering deeper and more lasting behavioral change [16].

**Augmented reality in learning.** Augmented reality (AR), defined by Azuma (1997) as the real-time overlay of virtual elements onto the physical environment, has become a high-impact educational tool [12]. Billinghurst and Duenser highlight its capacity to enrich learning through immersive experiences that combine real and virtual elements [13]. In the field of road safety education, AR makes it possible to simulate traffic scenarios, foster empathy among road users, and improve participants' risk perception. Moreover, AR shares with gamification the potential to increase motivation and improve knowledge retention by offering more interactive and playful learning experiences. Along these lines, Villafan and Linares (2024) note that gamified activities have a high capacity for memory retention and allow knowledge to be constructed in a more enjoyable and effective way [15]. This observation supports the premise of the present study regarding the pedagogical potential of AR in road safety education, since its playful and immersive nature may lead to more meaningful and lasting learning in cyclist safety.

Several academic studies have reported significant improvements in learning effectiveness and risk perception through the use of AR in road safety training [7][8]. For example, the European SAFEDUCA experience has demonstrated effectiveness in training vulnerable users such as cyclists and pedestrians through augmented virtual environments [6]. Recent studies also indicate that AR may considerably reduce the learning time required, by about 40%, and improve performance in practical assessments by approximately 75% compared with traditional methods [8]. These findings underscore the positive impact that augmented environments may have on training processes. Consistently, literature reviews highlight the strong potential of AR as an innovative pedagogical tool in road safety education, as it combines visual, interactive, and contextual components that facilitate deeper learning and greater awareness of traffic risks.

Road safety culture and risk perception. Road safety culture and risk perception are key factors in crash prevention. The World Health Organization (WHO) notes that more than 1.2 million people die each year in road traffic crashes worldwide, and that pedestrians, cyclists, and motorcyclists represent nearly 49% of those deaths in the Region of the Americas [12]. In Colombia, the National Road Safety Agency (ANSV) has identified an increase in cyclist crash rates, even during periods of reduced mobility during the pandemic, which demonstrates the persistence of risk for this group despite lower traffic volumes [10]. The International Transport Forum (ITF) also promotes data collection and trend analysis in global road safety, emphasizing the importance of integrating emerging technologies such as AR into educational programs to improve the safety of vulnerable road users [9]. These international initiatives reinforce the need to adopt innovative approaches that strengthen road safety culture and improve risk perception among road users.

Limits and challenges of augmented reality. Despite its pedagogical benefits, the implementation of AR in training environments faces important challenges. First, technological accessibility remains limited in many contexts, especially in rural areas or places with low connectivity, making mass adoption difficult [6]. In addition, the costs associated with developing AR content, acquiring devices such as specialized headsets or viewers, and training instructors can be high [8]. A digital divide also persists that could exclude vulnerable population groups, limiting equitable access to AR-based training programs [9]. These factors must be carefully considered when designing implementation strategies so that the proposed technological solutions are not only effective, but also inclusive and sustainable over the long term. Any AR initiative in road safety education should be planned to minimize these gaps, seeking institutional partnerships and financing models that can bring technological innovation to the contexts where it is most needed.

## RESEARCH METHODOLOGY

This research was structured using Stanford University's CIFE Horseshoe methodology, which facilitates a comprehensive approach to complex problems by connecting initial intuition with literature review, question formulation, method design, and results review. This framework ensures coherence and rigor throughout the research process, establishing a logical bridge between the observed problem and the contribution to knowledge.

### Phase 1

Literature review. In the initial phase, an exhaustive review of relevant bibliographic and documentary sources was conducted. First, cyclist road safety regulations in Colombia were analyzed, including the laws mentioned in the Introduction (Law 1811 of 2016, Law 2251 of 2022, and the updated Traffic Code), identifying the key provisions for cyclist protection, such as the minimum overtaking distance and the mandatory use of safety elements, as well as possible gaps in their application [1][2][3]. In addition, the international reference legislation for this study was reviewed: Spanish regulations, which recently incorporated significant changes in favor of cyclist safety [4]. Specifically, the 2025 DGT update, which requires a 1.5-meter lateral distance and a speed reduction of 20 km/h when overtaking a cyclist, was considered as a comparison point for the Colombian context.

The literature review also covered the use of immersive technologies in road safety education at the international level. For example, the European SAFEDUCA project was identified, which uses AR environments to train vulnerable road users [6]. Similarly, academic studies showing the advantages of AR in educational environments were reviewed, particularly in relation to experiential learning and improved perception of road risks [7][8]. Some studies reported illustrative quantitative data, such as significant reductions in the time needed to acquire certain road-circulation skills when AR simulators were used [8]. Finally, reports and publications by international organizations, such as the ITF, were considered, as they provide a global framework on road safety trends and underline the relevance of integrating innovative technological tools into road safety training [9].

## Phase 2

Design and development of AR scenarios. Using the theoretical and contextual inputs gathered, the second phase focused on designing the AR-based training proposal. The process began with the identification of typical risk situations in car-bicycle interaction, selecting the most frequent and critical scenarios reported in the literature and in Colombian crash statistics. These included vehicles overtaking cyclists without maintaining a safe distance, imprudent turns and maneuvers that endanger cyclists, invasion of bicycle-only infrastructure, and unexpected obstacles on the road, among others. Each selected situation was contextualized within the current Colombian legal framework, for example by highlighting the legal obligation to yield or maintain the required distance, depending on the case, and was then incorporated into the simulations.

Next, immersive AR experiences were designed to allow users to assume the role of cyclists and interactively face the identified risk situations. Scripts and storyboards were prepared for each scenario, defining the initial conditions, the events - such as the sudden appearance of an obstacle or a close vehicle overtake - the user's possible decisions, and the simulated consequences of those decisions. The technical development of the prototype was carried out using 3D modeling and animation tools; for example, Fusor software and urban modeling resources were used to recreate realistic traffic environments. In this way, a conceptual prototype of an AR simulator for cyclists was developed. The prototype includes multiple interactive scenarios that reflect real driving situations.

Figure 2 provides an overview of the different scenarios included in the developed prototype.

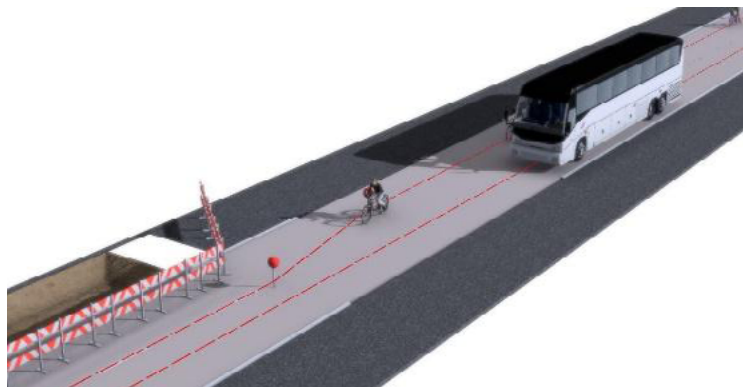
### Figure 2.

*Visualization of the different prototype scenarios*



In one simulation scenario, the cyclist must ride correctly in the right lane, avoiding high-speed lanes, as represented in Figure 3.

**Figure 3.**  
*The cyclist must use the right-hand lane*



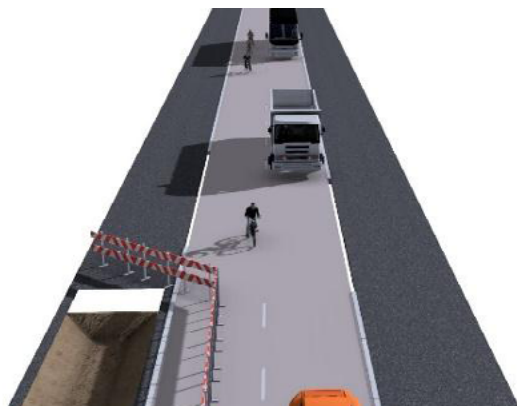
Another scenario presents the sudden appearance of an unexpected obstacle in the cyclist's path, requiring the user to react and avoid it safely, as shown in Figure 4.

**Figure 4.**  
*The cyclist encounters an obstacle in the path*



This is complemented by an aerial perspective of the same scenario in Figure 5.

**Figure 5.**  
*Aerial view of the obstacle scenario*



A first-person visualization from the cyclist's role was also implemented, increasing immersion and empathy by allowing users to experience traffic from that perspective, as shown in Figure 6.

**Figure 6.**  
*First-person cyclist role*



Each scenario explicitly integrated regulatory elements. For example, if the user virtually failed to respect the safe distance during an overtaking maneuver, the simulation displayed the consequences, such as a crash or a significant near miss, and recalled the applicable regulation. This created a direct connection between the rule, compliance with it, and the experienced outcome.

During prototype development, usability and user experience were also considered. Simple and intuitive interactions were incorporated so that the target audience, young and adult cyclists, could focus on road safety decisions rather than on managing the technological interface.

### Phase 3

Formulation of the methodological proposal. In the final stage, the findings and outputs of the previous phases were synthesized to articulate the AR-based road safety training methodology in an integrated manner. This involved documenting and organizing the sequence of steps required to implement the training program, from the identification of training needs to the evaluation of the AR experience. Figure 7 summarizes the proposed methodology as a whole.

**Figure 7.**  
*Detailed methodological proposal*



Likewise, Figure 8 illustrates the prototype developed for the case study, including visual examples of the simulated traffic situations.

**Figure 8.**  
*Case study*

Fase	Accidentalidad	Legislación	Educación	Tecnología
<b>Revisión de literatura</b>	Identificación de causas comunes de siniestros viales con ciclistas en Colombia.	Análisis de leyes nacionales y comparación con normativas internacionales.	Revisión de estudios sobre percepción del riesgo y aprendizaje experiencial.	Exploración de herramientas de RA y RV aplicadas a la seguridad vial.
<b>Diseño de escenarios RA</b>	Selección de situaciones de riesgo frecuentes (adelantamientos, cruces, vías compartidas).	Incorporación de elementos narrativos en los guiones de simulación.	Elaboración de storyboards para generar conciencia y empatía.	Desarrollo de prototipo conceptual de simulador RA.
<b>Revisión del prototipo</b>	Revisión del impacto en la percepción del riesgo y modificación de comportamientos inseguros.	Revisión del cumplimiento normativo en los escenarios simulados.	Aplicación de encuestas.	Pruebas de usabilidad y efectividad del simulador RA.
<b>Síntesis y recomendaciones</b>	Propuesta de indicadores para medir la reducción de siniestros.	Sugerencias para implementar programas piloto con RA en Colombia.	Ajustes metodológicos según retroalimentación de usuarios.	Escalabilidad del simulador a nivel institucional y nacional.

This representation clearly communicates the structure of the program and its technological component to authorities, road safety educators, and potential implementation partners.

At the end of this phase, a complete methodological proposal and a concept-level functional prototype were available. Although the practical implementation of the methodology remains future work, concrete recommendations for its implementation were defined, including the need for partnerships with traffic authorities to deploy pilot programs, training instructors in the use of AR, and complementary materials to reinforce immersive sessions. In summary, the resulting methodology integrates experiential pedagogical approaches, local regulatory content, and technological innovation, and is flexible enough to be adapted to diverse urban contexts in Colombia.

## EXPECTED RESULTS AND DISCUSSION

The results of this research are reflected in a set of theoretical and practical contributions to the field of road safety and technology-supported education:

**Innovative road safety training methodology:** An original methodology is proposed for road safety education based on immersive AR experiences. Unlike traditional approaches, this methodology immerses users in simulated traffic situations, allowing them to experience first-hand the consequences of their decisions. This experiential approach promotes comprehension and retention of road safety concepts while fostering empathy between drivers and cyclists. The methodology is specifically oriented toward the

prevention of crashes involving cyclists in the Colombian context, although its principles may be applicable to other contexts and road users. Figure 9 presents the detailed structure of the proposed methodology and how each component contributes to the defined learning objectives.

**Simulation scenarios for road safety training:** As part of the methodology, AR scenarios were developed to reproduce critical situations of road interaction. These scenarios constitute a pedagogical tool in themselves, as they allow users to experience, in safe environments, situations that would be dangerous or high-risk in real life. By assuming the role of cyclist in the simulator, participants can more vividly perceive the importance of actions such as respecting safety distances or anticipating obstacles. This favors the internalization of safe behaviors, because learning emerges not only from theoretical instructions but from simulated experiences. In addition, the scenarios integrate the relevant traffic regulations so that users receive immediate normative feedback, for example a reminder of Law 1811 of 2016 if a virtual vehicle comes too close in the simulation. In this way, the gap between regulation and practice is reduced: participants understand the rationale and implications of the rule not only in the abstract, but in a concrete situation.

**Evidence on the acceptance of AR in road safety education:** The study provided preliminary evidence on the acceptance and potential impact of AR in road safety training. Although behavioral changes were not formally measured, as the project did not include a longitudinal follow-up phase, qualitative observations suggest that AR may increase awareness of risks and motivate users to comply with regulations based on their own conviction after experiencing the consequences of non-compliance. This result supports findings from other studies that link immersive experiences to greater training effectiveness [7] [8]. Areas for improvement were also identified, such as simplifying certain interface controls, which will serve as a basis for optimizing future versions of the simulator.

**Foundations for future research and development:** This research opens new lines of work for both evaluation and expansion of the methodology. On the one hand, it establishes foundations for larger-scale pilot programs whose results can be assessed in terms of actual reductions in incidents or improvements in participants' knowledge and practices. On the other hand, the methodology could be adapted to other vulnerable groups, such as pedestrians or motorcyclists, or to other urban environments, requiring adjustments to the scenarios while maintaining the experiential AR pedagogical core. There is also an opportunity to incorporate more sophisticated simulator metrics, such as gaze tracking or stress biofeedback, to analyze in greater detail how users interact with the tool and how effective it is in modifying perceptions and actions. Overall, this work presents a reference framework that future researchers and practitioners can use and improve by combining road safety education and immersive technologies to address the global challenge of cyclist safety.

From a practical perspective, the findings of this research have important implications for various stakeholders seeking to strengthen road safety and reduce crashes involving cyclists and drivers: (1) The study offers an innovative and adaptable tool for public entities, traffic agencies, educational institutions, and private companies interested in road safety training programs. The AR methodology can be incorporated into road safety curricula, driver training courses, or awareness campaigns, standing out for its interactive and engaging nature. (2) The results facilitate the updating and improvement of existing training programs by showing that immersive technologies can increase active participation, motivation, and meaningful learning compared with traditional methods.

This could lead driving schools and community road safety initiatives to rethink their pedagogical strategies by integrating AR components to make them more effective. (3) The proposal contributes to closing the gap between regulation and everyday road behavior. By allowing users to realistically understand and experience the consequences of their actions, such as perceiving crash risk when safe distance is not maintained, it promotes greater adherence to current legislation through personal conviction rather than merely avoiding fines. (4) Finally, this work lays the groundwork for collaborative pilot programs. For instance, a city could implement an AR training pilot for urban cyclists involving traffic authorities, universities for technological support, and cyclist associations. The evaluation of such a pilot would provide valuable data on the effectiveness of the methodology under real conditions, generating knowledge applicable to public policy and program scaling.

## CONCLUSIONS

This study addressed the problem of high crash rates involving cyclists in Colombia through the design of an immersive road safety education methodology based on augmented reality. As a result, an innovative training proposal was developed that integrates legal knowledge, interactive virtual scenarios, and experiential learning principles to improve risk awareness and encourage safer road behaviors. The proposed methodology, structured under the CIFE Horseshoe model, proved conceptually viable and technically feasible through the implemented prototype. Although longitudinal measurements were not conducted within the scope of this work, the evidence gathered suggests that AR has the potential to positively transform road safety education practices by achieving greater participant engagement and a deeper understanding of the consequences of road behavior.

In summary, augmented reality emerges as an effective tool for preventing traffic crashes involving cyclists, complementing and strengthening traditional training approaches. By placing users at the center of an immersive and controlled experience, it achieves a balance between theory and practice that may translate into sustainable behavioral change over time. This approach responds to the urgent need to experiment with new educational methodologies in the face of persistent road safety challenges in urban environments.

As future work, it is essential to move this proposal from the conceptual environment to real-world implementation. Pilot projects in Colombian urban settings are recommended, accompanied by rigorous impact evaluation to quantify reductions in incidents and improvements in participants' attitudes and behaviors. It will also be valuable to explore the adaptability of the methodology to other areas, such as pedestrian safety or professional driver training, and its scalability with the support of public policies. Further research should also deepen solutions to overcome the identified barriers, ensuring that AR technology can be accessible to a broad and diverse public.

In conclusion, the integration of augmented reality into road safety education represents a promising avenue for strengthening road safety culture and protecting the lives of the most vulnerable road users. The findings of this study constitute a solid starting point for future innovations that, with the collaboration of government entities, the education sector, and civil society, can significantly contribute to the prevention of road crashes and the construction of safer and more sustainable mobility environments.

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