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Scientia et PRAXIS

Carta Editorial

Volumen 05, Número 09 | Enero–Junio de 2025

La **Academia Mexicana de Investigación y Docencia en Innovación (AMIDI)**, a través del Consejo Editorial de la revista ***Scientia et PRAXIS***, presenta el **Volumen 05, Número 09**, correspondiente al período **enero-junio de 2025**, como edición regular. Esta entrega reúne trabajos científicos originales e inéditos que exploran cómo la actividad multidisciplinaria se constituye como motor de la innovación con impacto en el desarrollo sostenible y la transformación social. Las contribuciones incluidas en este número destacan por su articulación entre el conocimiento teórico (***Scientia***) y su aplicación práctica (***Praxis***), en consonancia con los Objetivos de Desarrollo Sostenible (**ODS**).

Los artículos que conforman esta edición son los siguientes:

1 **Hacia una economía saludable y sostenible: el impacto de los impuestos al tabaco en la equidad social y la salud pública en México**

Autores:

Frida Guadalupe Atondo-García y **Luis Huesca-Reynoso.** Centro de Investigación en Alimentación y Desarrollo (**CIAD**), *Hermosillo, Sonora, México*; **Linda Llamas-Rembao**, Universidad Estatal de Sonora (**UES**), *Hermosillo, Sonora, México*.

Reseña:

Este estudio propone una visión innovadora de la política fiscal como herramienta de equidad y salud pública. A través de un enfoque multidisciplinario que combina economía de la salud, comportamiento y política pública, ofrece evidencia para rediseñar impuestos al tabaco en favor de los **ODS** 3 y 10. Ubicado en: https://doi.org/10.55965/setp.5.09.a1

2 **Innovación para una alimentación saludable: el etiquetado frontal como herramienta de cambio conductual en Jalisco, México**

Autores:

Juan Carlos Guimond-Ramos. . Centro de Investigación en Alimentación y Desarrollo (**CIAD**), *Hermosillo, Sonora, México*.;
León Alejandro Cañez-Cota, Universidad de Sonora (**UNISON**), *Caborca, Sonora, México;*
Rodrigo Mejía-Mancilla, Academia Mexicana de Investigación y Docencia en Innovación (AMIDI), *Guadalajara, Jalisco, México*.

Reseña:

El artículo evalúa empíricamente el impacto del etiquetado frontal en el gasto alimentario de hogares urbanos en Jalisco. Su enfoque combina economía conductual y salud pública para repensar políticas alimentarias eficaces y accesibles, alineadas con el **ODS 3**.

Ubicado en: https://doi.org/10.55965/setp.5.09.a2

3 **Innovando en la sucesión de empresas familiares: estrategias sustentables a través del modelo integrativo en México** *(artículo redactado en inglés)*

Autores:

Juan Pablo Patiño-Karam, **Carlos López-Hernández** y **Guillermo Sosa-Gómez**, Universidad Panamericana, Campus Guadalajara, *Guadalajara, Jalisco, México*.

Reseña:

Basado en 337 empresas familiares mexicanas, este estudio identifica factores críticos para planificar con éxito la sucesión intergeneracional. Aplica modelos predictivos e institucionales que fortalecen la continuidad empresarial y promueven el **ODS** 8.

Ubicado en: https://doi.org/10.55965/setp.5.09.a3

4 **Distinguiendo la economía ecológica de la economía ambiental, verde, circular y bioeconomía en el siglo XXI** *(artículo redactado en inglés)*

Autores:

Claudio Passalía, Universidad Nacional del Litoral (UNL), *Santa Fe de la Vera Cruz, Santa Fe, Argentina*;

Guillermo Peinado, Universidad Nacional de Rosario (UNR), *Rosario, Santa Fe, Argentina*.

Reseña:

Este metaanálisis de literatura científica examina cinco paradigmas económico-ambientales y posiciona la economía ecológica como un enfoque crítico, con fuerte contenido teórico y ético para una transición sostenible justa, en línea con los **ODS 8 y 13**.

Ubicado en: https://doi.org/10.55965/setp.5.09.a4

Estos artículos reflejan una **contribución significativa al desarrollo sostenible** desde perspectivas innovadoras y multidisciplinarias. En especial, destaca la inclusión de una colaboración internacional proveniente de **Argentina**, que enriquece el diálogo académico de la revista y **fortalece su proyección internacional**, en concordancia con el compromiso de ***Scientia et PRAXIS*** por fomentar el intercambio de ideas entre contextos diversos.

Los **autores**, las **autoridades de AMIDI** y el **Consejo Editorial** de la revista científica ***Scientia et PRAXIS*** que participaron en esta obra desean que los lectores encuentren información **accesible, rigurosa y útil para sus propósitos formativos, investigativos o profesionales**. Asimismo, los invitan cordialmente a postular sus propios trabajos para futuras ediciones como esta, en las que se analizan críticamente los problemas de nuestro país y del mundo, y se proponen soluciones fundamentadas desde una perspectiva académica comprometida con la transformación social.

Dr. Juan Mejía-Trejo
Director
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Junio 2025, Zapopan, Jalisco, México

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Scientia et PRAXIS
Academia Mexicana de Investigación y Docencia en Innovación (**AMIDI**)
Junio 2025, Zapopan, Jalisco, México

Scientia et PRAXIS

Editorial Letter

Volume 05, Number 09 | January–June 2025

The **Academia Mexicana de Investigación y Docencia en Innovación (AMIDI),**, through the Editorial Board of the journal ***Scientia et PRAXIS***, presents **Volume 05, Number 09**, corresponding to the **January–June 2025** period, as a regular issue. This edition features original and unpublished scientific works that explore how multidisciplinary activity serves as a driving force for innovation with impact on sustainable development and social transformation. The contributions included in this volume stand out for their articulation between theoretical knowledge (***Scientia***) and practical application ***(Praxis***), in alignment with the **Sustainable Development Goals (SDGs)**.

The articles presented in this issue are as follows:

1 **Towards a Healthy and Sustainable Economy: The Impact of Tobacco Taxes on Social Equity and Public Health in Mexico** (*article written in spanish*)

Authors:

Frida Guadalupe Atondo-García y **Luis Huesca-Reynoso.** Centro de Investigación en Alimentación y Desarrollo **(CIAD)**, *Hermosillo, Sonora, México*; **Linda Llamas-Rembao**, Universidad Estatal de Sonora **(UES)**, *Hermosillo, Sonora, México*.

Summary:

This study proposes an innovative vision of fiscal policy as a tool for equity and public health. Through a multidisciplinary approach that combines health economics, behavioral insights, and public policy, it provides evidence to redesign tobacco taxation in support of **SDGs** 3 and 10.

Linked in: https://doi.org/10.55965/setp.5.09.a1

Guillermo Peinado, Universidad Nacional de Rosario (UNR), *Rosario, Santa Fe, Argentina*.

Summary:
This meta-analysis of scientific literature examines five economic-environmental paradigms and positions ecological economics as a critical approach, with strong theoretical and ethical foundations for a just sustainable transition, aligned with **SDGs 8 and 13**.
Linked in: https://doi.org/10.55965/setp.5.09.a4

These articles reflect a **significant contribution to sustainable development** from **innovative and multidisciplinary perspectives**. Notably, this issue features an **international collaboration from Argentina**, which enriches the journal's academic dialogue and strengthens its global scope—aligned with *Scientia et PRAXIS*'s mission to promote the exchange of ideas across diverse contexts.

The **authors**, the **AMIDI authorities**, and the **Editorial Board** of *Scientia et PRAXIS* who contributed to this volume sincerely hope that readers will find the information **accessible, rigorous, and useful** for their educational, research, or professional objectives. They also warmly **invite scholars and professionals** to submit their own work to future issues like this one—dedicated to critically examining national and global challenges and proposing evidence-based, socially committed solutions from an academic perspective.

Dr. Juan Mejía-Trejo
Director
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June 2025, Zapopan, Jalisco, México

Dr. Carlos G. Borbón-Morales
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June 2025, Zapopan, Jalisco, México

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Towards a Healthy and Sustainable Economy: The Impact of Tobacco Taxes on Social Equity and Public Health in Mexico

Hacia una economía saludable y sostenible: el impacto de los impuestos al tabaco en la equidad social y la salud pública en México

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Keywords: health inequality indicators, low socioeconomic status, public health, tobacco use cessation, tobacco taxes.
Palabras clave: indicadores de desigualdad en salud, nivel socioeconómico bajo, salud pública, abandono del consumo de tabaco, impuestos al tabaco

Received: January-06-2025; **Accepted:** March-30-2025

ABSTRACT

Context. This review analyzes recent studies (2019–2024) on the persistent public health crisis caused by smoking, especially in low- and middle-income countries such as Mexico, where poverty exacerbates its impact. Current health effects are examined according to the use of tax revenues, the impact of updating taxes with inflation, cessation rates, and variation in consumption with new socioeconomic evidence.

Problem. Tobacco use in Mexico remains inelastic, perpetuating health and economic burdens for low-income families and increased consumption among the wealthiest. This generates secondary poverty, where incomes fall below the poverty line after spending on tobacco.

Purpose. This study seeks to promote greater equity and sustainability in the country's public health system, providing evidence based on a multidisciplinary and innovative approach to strengthen fiscal policies on tobacco.

Methodology. Our primary objective was to analyze the effectiveness and implications of tobacco taxation policies between 2019 and 2024 due to fiscal policy changes in the current government. We conducted the literature search through PubMed, utilizing **VosViewer** software.

Theoretical and Practical Findings. In the theoretical field, it combines health economics, behavioral economics, and fiscal policy to analyze tax equity and impact on health. In practice, it provides evidence to design taxes that reduce consumption, increase incomes and improve public health, aligning with Sustainable Development Goals (**SDGs) 3** (Good health and well-being) and **10** (Reduced inequalities).

Originality based on a multidisciplinary approach that promotes innovation for sustainable development. This work integrates health economics, behavioral economics, and fiscal policy, aligning with the guidelines of the Oslo Handbook on innovation in public policy. The combination of these approaches allows for a more comprehensive assessment of the economic and social impact of tobacco taxes, offering new tools for the formulation of effective and sustainable public policies.

Conclusions and limitations. This literature review provides a timely update for decision-making studies and offers relevant insights for academia and policymakers. The COVID-19 health crisis deprioritized the treatment of tobacco-related illnesses like lung cancer and acute myocardial infarction, among fifty other diseases, potentially affecting data from 2020–2021.

RESUMEN

Contexto. Esta revisión analiza estudios recientes (2019-2024) sobre la persistente crisis de salud pública causada por el tabaquismo, especialmente en países de ingresos bajos y medianos como México, donde la pobreza exacerba su impacto. Se examinan los efectos actuales sobre la salud según el uso de los ingresos fiscales, el impacto de la actualización de los impuestos con la inflación, las tasas de abandono y la variación del consumo con nueva evidencia socioeconómica.

Problema. El consumo de tabaco en México sigue siendo inelástico, perpetuando cargas sanitarias y económicas para familias de bajos ingresos y un mayor consumo entre los más ricos. Esto genera pobreza secundaria, donde los ingresos caen por debajo del umbral de pobreza tras el gasto en tabaco.

Objetivo. Este estudio busca promover una mayor equidad y sostenibilidad en el sistema de salud pública del país, proporcionando evidencia basada en un enfoque multidisciplinario e innovador para fortalecer las políticas fiscales sobre el tabaco.

Metodología. Nuestro objetivo principal fue analizar la efectividad y las implicaciones de las políticas fiscales al tabaco en México entre 2019 y 2024, a través de PubMed, utilizando el software **VosViewer.**

Hallazgos Teóricos y Prácticos. En el ámbito teórico, combina economía de la salud, economía del comportamiento y política fiscal para analizar la equidad tributaria e impacto en la salud. En lo práctico, proporciona evidencia para diseñar impuestos que reduzcan el consumo y mejoren la salud pública, alineándose con los **ODS** 3 (Salud y bienestar) y **10** (Reducción de desigualdades).

Originalidad basada en un enfoque multidisciplinario que promueve la innovación para el desarrollo sostenible. Este trabajo integra economía de la salud, economía del comportamiento y política fiscal, alineándose con las directrices del Manual de Oslo sobre innovación en políticas públicas. La combinación de estos enfoques permite una evaluación más completa del impacto económico y social de los impuestos al tabaco, ofreciendo nuevas herramientas para la formulación de políticas públicas efectivas y sostenibles.

Conclusiones y limitaciones. Esta revisión ofrece información clave para académicos y tomadores de decisiones en el desarrollo de políticas eficaces en el contexto del control del tabaco. La crisis por **COVID-19** afectó la atención de enfermedades relacionadas con el tabaco, influyendo en los datos de 2020-2021.

1. INTRODUCTION

Due to the excess demand for services caused by smoking-related sicknesses and mortality, smoking is a major global driver of economic inequality in the public health sector. This inequality results in significantly differing lifespans based on social class.

For the Ministry of Health in Mexico, medical expenses related to tobacco consumption generated a direct cost of $5.66 billion USD, a large increase compared to the expenditure of 3.9 billion USD in 2020. In addition, about 51,000 Mexicans die each year from diseases related to smoking (Gómez et al., 2020).

A significant portion of Mexico's population lives in poverty, with wealth concentrated in the hands of a few. Most Mexican families struggle to make ends meet, lacking sufficient income to cover essential needs such as education, healthcare, and housing. According to the National Occupation and Employment Survey (**ENOE**), in Mexico in 2022, 46.5% of the working population only earned one minimum wage, which monthly was the equivalent of only $371 USD, in contrast, with the 1% of the population in Mexico with five or more minimum wages (ENOE, 2023).

The Evaluation of Social Development Policy (**CONEVAL**) reported in 2022 that 36% of people in Mexico had at least one social deprivation and had an insufficient monthly income to purchase necessary services (CONEVAL, 2023). From 2018 to 2022, the population without access to medical services increased from 16.2% to 28.2% (CONEVAL, 2023). It is also important to consider that being affiliated with healthcare services does not ensure effective access to care. In 2022, the National Institute of Public Health (**INSP**) reported that 24.6% of the population had health requirements, and only 44% received health care in public services due to deficiencies (Bautista-Arredondo et al., 2023). According to **CONEVAL**, the highest percentage of the population requiring medical services are the ones with the lowest incomes (CONEVAL, 2023).

Low-income populations spend an average of $528.45 USD quarterly on cigarettes and 13.45% of their income is spent on treatments related to smoking, in contrast to only 5.26% for higher-income households (Macías Sánchez & García Gómez, 2023). In these cases, it is crucial to study consumer behavior, a concept that primarily examines how consumers, including families and households, make decisions regarding the allocation of their available resources, such as time, money, and effort, on items related to consumption (Hernández-Islas et al., 2024).

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With the increase in tobacco taxes in Mexico in 2011, studies have emerged showing that the consumption of tobacco cigarettes decreased, but the fall ceased. However, it was not until 2020 that the Special Taxes on Production and Services (**IEPS**) was changed by adjusting its specific component, and it will increase according to inflation every year; this change implies that the proportion of total taxes raised to 70% as a percentage of the sale price currently, including Value Added Taxes (**VAT**) (DOF, 2022).

Therefore, this review attempts to compile information from the most recent publications about tobacco consumption and how it is affected by the increase in the price of this harmful product. It also provides information on whether this benefits Mexico's poorest population.

2. CONTEXT DESCRIPTION

The purpose of this review is to analyze published studies on the impact of tobacco taxation on economically vulnerable populations in Mexico and to examine tax policy proposals related to health that could contribute to achieving **SDG3 (**Good health and well-being) and **SDG10** (Reduced inequalities), ultimately fostering greater equity and sustainability in Mexico's public health system.

One of the most important characteristics of this review is that a new amendment in the tax law did not propose an **IEPS** tax update on tobacco products until 2020. This year, the Economic Package modified the specific component of the tax by cumulative inflation from the 2011–2019 period but kept the ad valorem component unaltered (García, 2020). In Mexico, tobacco products are taxed by 3 different types of taxes: **VAT**, the import tax, and the excise-specific tax on **IEPS**.

The **VAT** rate on tobacco is 16% of the consumer sales price (DOF, 2021). According to the general import and export law, smoking in Mexico is subject to an import tax of 67%; in 2011, the **IEPS** established a rate of 160% on the production value and a specific tax of 0.35 Mexican pesos for each cigarette (equivalent to 7 Mexican pesos or .35 USD per pack with 20 cigarettes). In 2020, the particular component was modified from 0.35 to 0.4944 Mexican pesos per cigarette due to an update by inflation of its value over time. This change implies that the proportion of total taxes will increase to 70% as a percentage of the sale price of a pack (Huesca et al., 2020) currently, this tax has a value of 0.6166 Mexican pesos (DOF, 2023); however, as shown in **Graph 1**, when the specific IEPS was implemented in 2011, it was $0.35 Mexican pesos, and it was maintained at the

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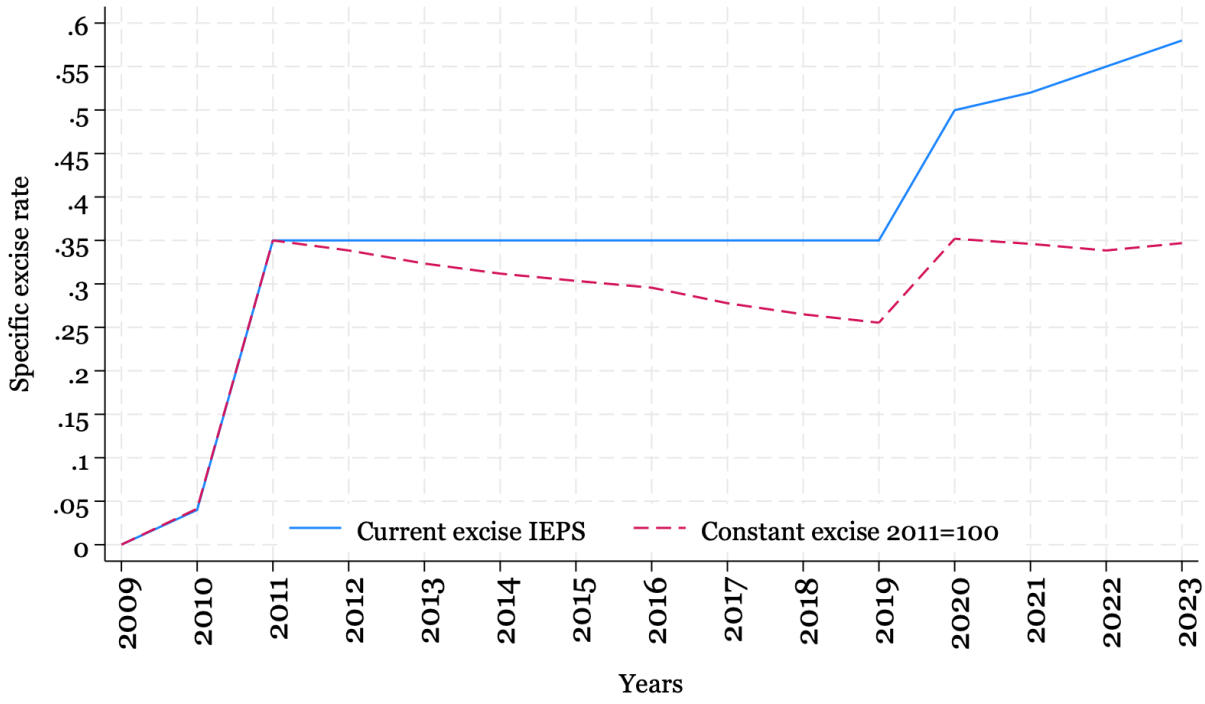
same level from 2011 to 2019; therefore, fiscal policy was not updated in real terms. It can also be seen that between 2020 and 2023, the adjustment for inflation applied on this tax component barely compensated for the level it had for 9 years without having changed in real terms, which calls for a real fiscal policy adjustment that adequately would increase its rate.

Graph 1. Specific excise cigarette tax: Current vs. constant 2011-2023 (2011=100)



Source: own elaboration

In 2021, a study of particular relevance was published, *"Impact of Tobacco Taxes on the Poverty Rate in Mexico."* The analysis reveals that the implementation of an increase in tobacco taxes near the limit established by the **World Health Organization (WHO)** could raise the poverty rate in these tobacco consumers 'households by approximately 2.6 percentage points. This finding is important as it highlights the deleterious effect of tax policy on tobacco on certain sectors of the population, where spending on tobacco products competes directly with other essential goods (Huesca et al., 2021). The authors offer a solution to compensate for the tax share paid by low-income tobacco consumers by receiving a subsidy to counteract their crowding out in necessary goods. Specifically, this adverse effect on the poverty rate could be completely neutralized if

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subsidies were implemented on the prices of basic foodstuffs, thus allowing lower-income households to offset their expenditures without compromising their general well-being. This recommendation points to a comprehensive fiscal public policy strategy that, in addition to reducing tobacco consumption through higher taxes, would increase revenues and offer support measures that protect the food security of vulnerable households (Huesca et al., 2021).

This information leads us to the research question that guides this study: What is the impact of tobacco taxes on Mexican families? The research hypothesis posits that a substantial increase in tobacco taxes—leading to at least a 34% rise in tobacco product prices—would reduce smoking prevalence, generate public revenue, and improve health outcomes without disproportionately impacting low-income consumers. This aligns directly with **SDG 3 (Good Health and Well-being)** by promoting disease prevention and reducing the burden of tobacco-related illnesses, ultimately strengthening public health systems. Simultaneously, it supports **SDG 10 (Reduced Inequalities)** by ensuring that tax policies do not exacerbate economic disparities, but rather contribute to social equity through targeted fiscal and health interventions.

3. LITERATURE REVIEW

This chapter explores the **SDGs** to which this study contributes **SDG3** (Good health and well-being) and **SDG10** (Reduced inequalities), highlighting how effective tobacco tax management can foster greater social equity in Mexico, particularly in the realm of public health. One of Mexico's most pressing challenges is economic inequality, a significant portion of the population has experienced poverty, while wealth remains concentrated among a small elite. Many families struggle to afford essential services such as education, healthcare, and housing. Therefore, it is crucial to implement equitable public policies that bridge social disparities and promote a sustainable and inclusive economy.

3.1.ODS 3: Good health and well-being

Sustainable Development Goal **(SDG)3**, entitled "*Good health and well-being*", has among its goals to "*Strengthen the implementation of the World Health Organization Framework Convention on Tobacco Control in all countries*"(UNDP, n.d.-a). This convention is a fundamental instrument in the fight against smoking, as it establishes measures to reduce both tobacco consumption and

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exposure to second-hand smoke, thus contributing to the improvement of public health at a global level.

One of the most effective strategies to reduce tobacco consumption is to increase taxes on these products. Studies have shown that increases in tobacco prices discourage tobacco purchase, especially among young people and lower-income groups, who tend to be more sensitive to price changes. Reducing tobacco consumption has a positive impact on reducing noncommunicable diseases such as cancer, cardiovascular disease, and chronic respiratory diseases, which in turn eases the burden on health systems and reduces the costs associated with treating these conditions.

3.2.ODS 10: Reduced inequalities

Sustainable Development Goal (**SDG)10**, entitled *"Reduced inequalities",* seeks to promote equity within and between countries, ensuring that all people, regardless of their socioeconomic status, have access to fair opportunities. Among its main goals is to *"Adopt policies, especially fiscal, wage and social protection, and progressively achieve greater equality"* (UNDP, n.d.-b) . Tobacco use is closely linked to socioeconomic inequalities, as its financial impact can be disproportionate for lower-income households. The costs of purchasing tobacco products reduce the ability of families to meet basic needs such as food, education, and medical care, thus perpetuating cycles of poverty and social vulnerability.

Although increasing taxes on tobacco is an effective measure to reduce tobacco consumption, it can also generate adverse effects on the most vulnerable sectors, since these households allocate a greater proportion of their income to this product. To mitigate these impacts, studies indicate that the implementation of compensatory policies, such as economic support programs, access to free treatment for smoking cessation, and educational campaigns aimed at the most affected groups, is crucial.

3.3.The design of the final instrument

We undertook a literature review encompassing studies that explored various aspects of tobacco control measures implemented in Mexico. Our primary focus was to examine the effectiveness and implications of tobacco product taxation from 2019 to 2024. This review involved a meticulous analysis of multiple studies encompassing diverse methodologies and

outcomes related to tobacco control efforts within the Mexican context. The statistical program **STATA 18** was used to make graphical representations of the data obtained.

4. METHODOLOGY

This section outlines the methodology used to select the publications analyzed in this document, as well as the connections between different authors. Following the collection and synthesis of data, we critically evaluated the findings to assess these measures 'overall impact and effectiveness. This included a comparative analysis of results from different studies, aiming to provide a consolidated perspective on the outcomes of tobacco taxation policies in Mexico.

4.1.Inclusion-exclusion criteria phase, databases, and keywords

For the included publications, the following research criteria were considered:

- Source: database PubMed.
- Area: Social and economic.
- Publication year: 2019-2024.
- Context: The article should refer to the impact of tobacco taxes on different percentiles of the Mexican population.

The reviewers implemented a systematic approach by defining key concepts pertinent to tobacco taxation in Mexico, as shown in **Table 1**, these concepts were the foundation for initiating comprehensive searches across scientific databases such as PubMed.

Table 1. Key Concepts

English Key Concepts for Research	Spanish Key Concepts for Research
"Tobacco taxes" and *"low-income"*	*"Impuestos al tabaco en México"*
"Tobacco fiscal policy" and *"Low income"*	*"Impuestos saludables en México"*
"Tobacco taxation" and "*low-income"*	
"Tobacco taxes" and *"well-being"*	
"Tobacco fiscal policy" and *"well-being"*	
"Tobacco taxation" and "well-being"	

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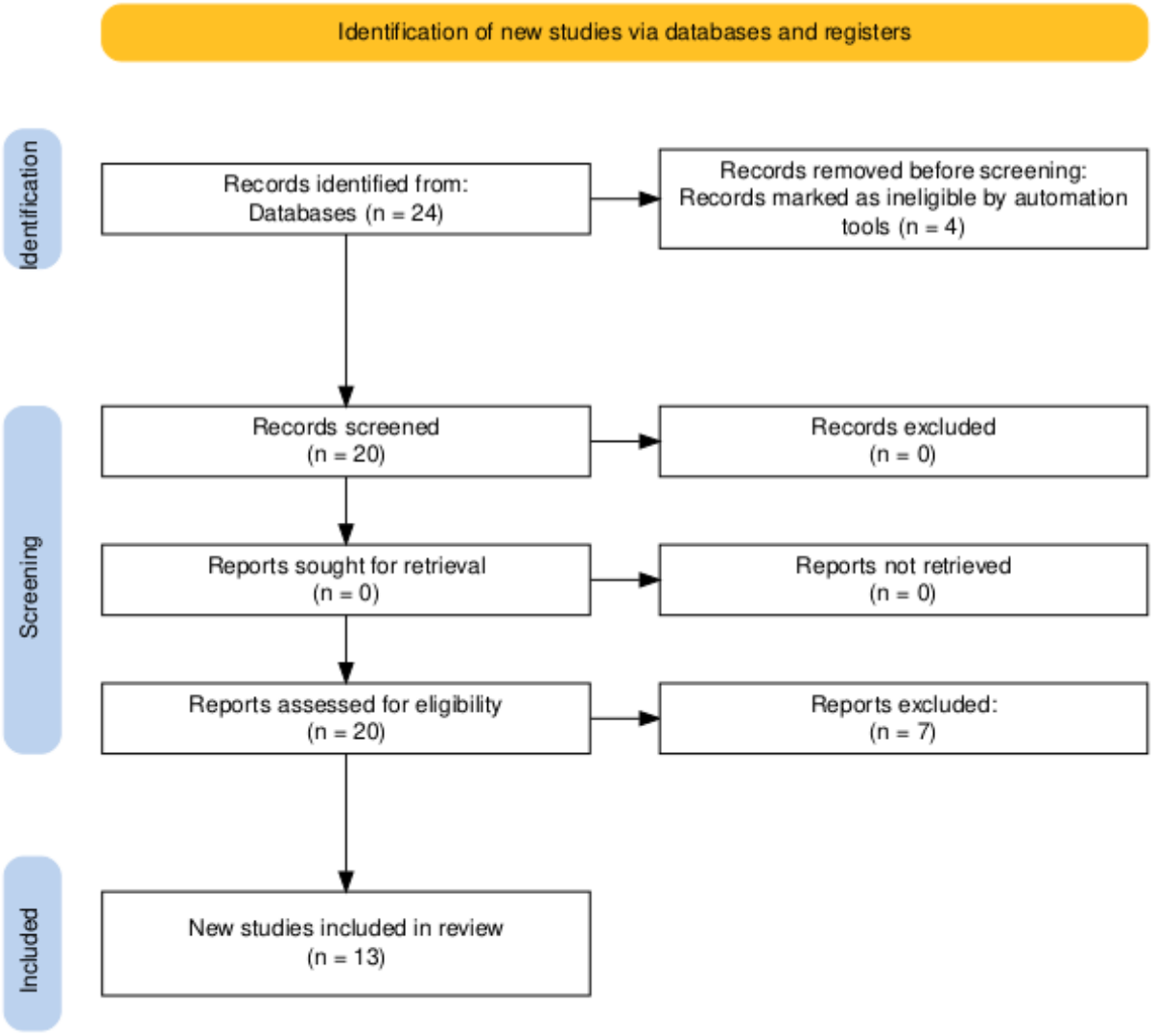
As shown in **Figure 1**, the publication selection process began with twenty-four documents identified during the initial search phase. These documents were gathered using predefined inclusion criteria aimed at capturing relevant literature on the economic and social impact of tobacco taxation in Mexico.

Figure 1. PRISMA Flow Diagram



Own elaboration utilizing **PRISMA** Flow Diagram tool (Haddaway et al., 2022).

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However, upon preliminary evaluation, four publications were immediately discarded, as their titles indicated that they focused on the issue of smoking in countries other than Mexico. Since the scope of this research is limited to the national context, these studies were deemed irrelevant, reducing the sample to twenty publications.

Subsequently, these **twenty** remaining documents underwent a more rigorous and detailed review to assess their alignment with the research objectives. During this phase, seven additional publications were excluded after a thorough examination of their content, as they did not specifically address the effects of tobacco taxation in Mexico. These studies either focused on broader public health policies, explored tobacco consumption trends without a direct link to fiscal measures, or analyzed taxation in a comparative international context without providing country-specific insights.

Ultimately, the final selection consisted of **thirteen publications** that met all predefined criteria, including the requirement of temporal relevance, as they were published between 2019 and 2024. These studies specifically analyze the impact of tax policies on tobacco within Mexico from both economic and social perspectives, providing valuable and up to date insights into the effectiveness of fiscal interventions in controlling tobacco consumption.

The **VOSviewer 1.6.20** software was employed to ensure a systematic and structured interpretation of these thirteen studies. This specialized tool facilitates the construction and visualization of bibliometric maps, enabling an in-depth analysis of relationships between selected publications, the identification of key research clusters, and the detection of emerging trends in the field. By leveraging this bibliometric approach, the study enhances the reliability of its findings, ensuring that the analysis is grounded in a comprehensive and methodologically robust literature review.

Table 2 summarizes the main characteristics of **thirteen key publications** included in this review on tobacco taxes and their impact in Mexico between 2019 and 2024. Each study is categorized according to the title, authors, source of publication, year of publication, number of citations, and the main methodology used.

The studies are grouped into different methodological approaches: quantitative (7 studies), qualitative (1 study), case studies (3 studies), and simulations (2 studies). Topics addressed include fiscal progressivity, tobacco industry pricing strategies, cost-benefit analysis of fiscal policies, as

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well as redistributive effects on vulnerable populations. Among the featured articles, the most cited include *"The Health and Economic Burden of Smoking in 12 Latin American Countries and the Potential Effect of Increased Tobacco Taxes"* and *"Smoking Trends in Mexico, 2002-2016: Before and After the Ratification of the WHO Framework Convention on Tobacco Control."*

Table 2. Bibliometric Review 2019-2024

No.	Title	Authors	Journal/Book	Publication Year	Cited by	Study
1	Progress and challenges in tobacco control policies in Mexico, 2003-2017: an approach using the Tobacco Control Scale **DOI:** 10.1057/s41271-022-00359-5	Ponce-Hernandez DJ, Sordo L, Reynales-Shigematsu LM, Regidor-Poyatos E, Henares-Montiel J, Calderón-Villarreal A.	J Public Health Policy	2022	3	**CS**
2	Tobacco industry in Mexico: a general equilibrium analysis **DOI:** 10.1136/tobaccocontrol-2021-056864	Huesca L, Llamas L, Sobarzo H.	Tob Control	2022	3	**QT**
3	The impact of tobacco tax reforms on poverty in Mexico **DOI:** 10.1007/s43546-021-00141-x	Huesca L, Araar A, Llamas L, Lacroix G.	SN Bus Econ	2021	5	**QT**
4	Crowding out and impoverishing effect of tobacco in Mexico **DOI:** 10.1136/tc-2022-057791	Macías Sánchez A, García Gómez A.	Tob Control	2024	5	**QT**
5	The Challenges of Tobacco Fiscal Policy Implementation in Mexico From the Perspective of Key Actors. **DOI:** 10.1093/ntr/ntad188	Théodore FL, González-Ángeles LR, Reynales-Shigematsu LM, Saenz-de-Miera B, Antonio-Ochoa E, Llorente B.	Nicotine Tob Res	2024	2	**QL**
6	The distributional effects of tobacco tax increases across regions in Mexico: an extended cost-effectiveness analysis.	Saenz-de-Miera B, Wu DC, Essue BM, Maldonado N, Jha P, Reynales-Shigematsu LM.	Int J Equity Health	2022	9	**QT**

	DOI: 10.1186/s12939-021-01603-2					
7	Tobacco industry pricing strategies during recent tax adjustments in Mexico: evidence from sales data. **DOI:** 10.1136/tc-2024-058711	Saenz-de-Miera B, Welding K, Tseng TY, Grilo G, Cohen JE.	Tob Control	2024	1	**QT**
8	Unlocking the power of tobacco taxation to mitigate the social costs of smoking in Mexico: a microsimulation model. **DOI:** 10.1093/heapol/czae068	Saenz-de-Miera B, Reynales-Shigematsu LM, Palacios A, Bardach A, Casarini A, Espinola N, Cairoli FR, Alcaraz A, Augustovski F, Pichon-Riviere A.	Health Policy Plan	2024	0	**QT**
9	Smoking trends in Mexico, 2002-2016: before and after the ratification of the WHO's Framework Convention on Tobacco Control. DOI: 10.1136/tobaccocontrol-2019-055153	Zavala-Arciniega L, Reynales-Shigematsu LM, Levy DT, Lau YK, Meza R, Gutiérrez-Torres DS, Arillo-Santillán E, Fleischer NL, Thrasher J.	Tob Control	2020	40	**QT**
10	Recent evidence on the illicit cigarette trade in Latin America. **DOI:** 10.26633/RPSP.2022.111	Drope J, Rodriguez-Iglesias G, Stoklosa M, Szklo A.	Rev Panam Salud Publica	2022	1	**CS**
11	Measuring the illicit cigarette market in Mexico: a cross validation of two methodologies. **DOI:** 10.1136/tobaccocontrol-2019-055449	Saenz de Miera Juarez B, Reynales-Shigematsu LM, Stoklosa M, Welding K, Drope J.	Tob Control	2021	22	**CS**
12	Health, economic and social burden of tobacco in Latin America and the expected gains of fully implementing taxes, plain packaging, advertising bans and smoke-free environments control measures: a modelling study. **DOI:** 10.1136/tc-2022-057618	Pichon-Riviere A, Bardach A, Rodríguez Cairoli F, Casarini A, Espinola N, Perelli L, Reynales-Shigematsu LM, Llorente B, Pinto M, Saenz De Miera Juárez B, Villacres T, Peña Torres E, Amador N, Loza C, Castillo-Riquelme M, Roberti J, Augustovski F, Alcaraz A, Palacios A.	Tob Control	2024	12	**SM**

13	The health and economic burden of smoking in 12 Latin American countries and the potential effect of increasing tobacco taxes: an economic modelling study. **DOI:** 10.1016/S2214-109X(20)30311-9	Pichon-Riviere A, Alcaraz A, Palacios A, Rodríguez B, Reynales-Shigematsu LM, Pinto M, Castillo-Riquelme M, Peña Torres E, Osorio DI, Huayanay L, Loza Munarriz C, de Miera-Juárez BS, Gallegos-Rivero V, De La Puente C, Del Pilar Navia-Bueno M, Caporale J, Roberti J, Virgilio SA, Augustovski F, Bardach A.	Lancet Glob Health	2020	54	**SM**

Source: own elaboration
Note: **CS.** Case Study; **QT.** Quantitative; **QL**. Qualitative; **SM.** Simulations

This table provides a comprehensive view of the state of research in the field, evidencing an increase in recent academic production and its emphasis on interdisciplinary methodologies to evaluate the impacts of fiscal policy on tobacco.

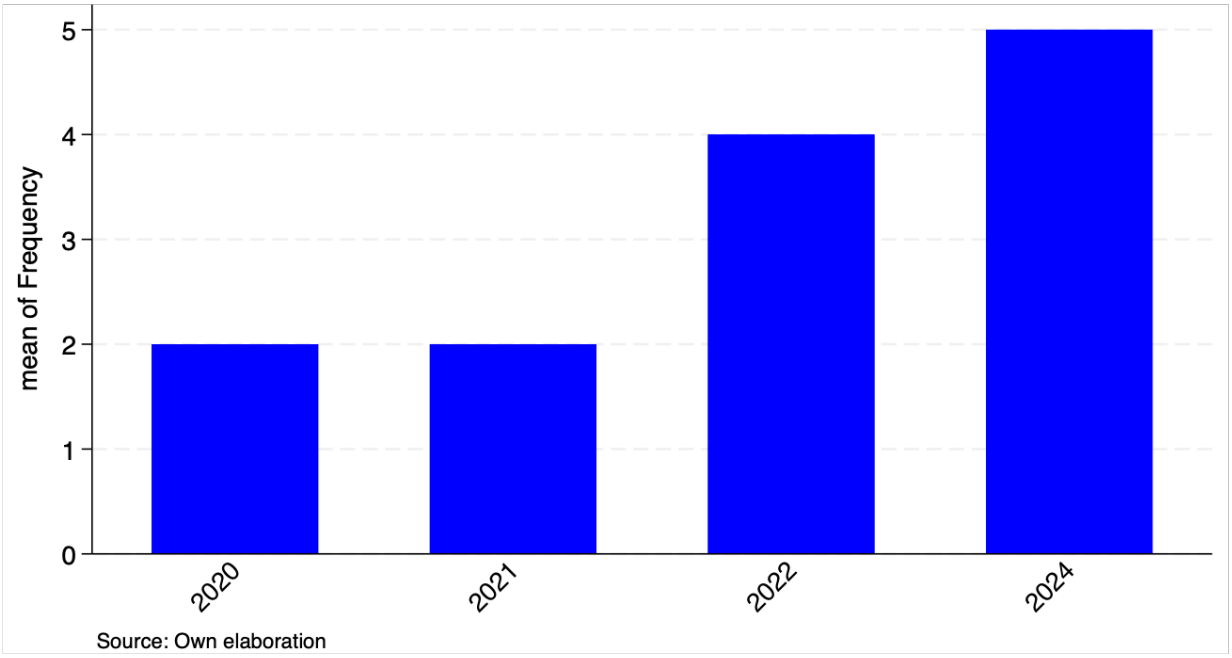
4.2. Risk of bias in studies.

Due to the **COVID-19** health crisis, treatment of tobacco-related illnesses such as lung cancer and acute myocardial infarction (**AMI**) was given a lower priority, which could have an impact on data from 2020–2021. Furthermore, there were differences in priorities, inadequate resources, and unclear duties for each state regarding healthcare spending.

5. RESULTS

Once the **thirteen** publications were selected, the data underwent analysis using two different software tools to ensure a comprehensive and multidimensional interpretation. The first analysis stage was conducted using **STATA 18**, a statistical software widely used for econometric and data analysis. This program facilitated the processing and organization of quantitative information, allowing for a more precise interpretation of the data, as illustrated in **Graph 4.**

Graph 4. Number of publications from 2019 to 2024

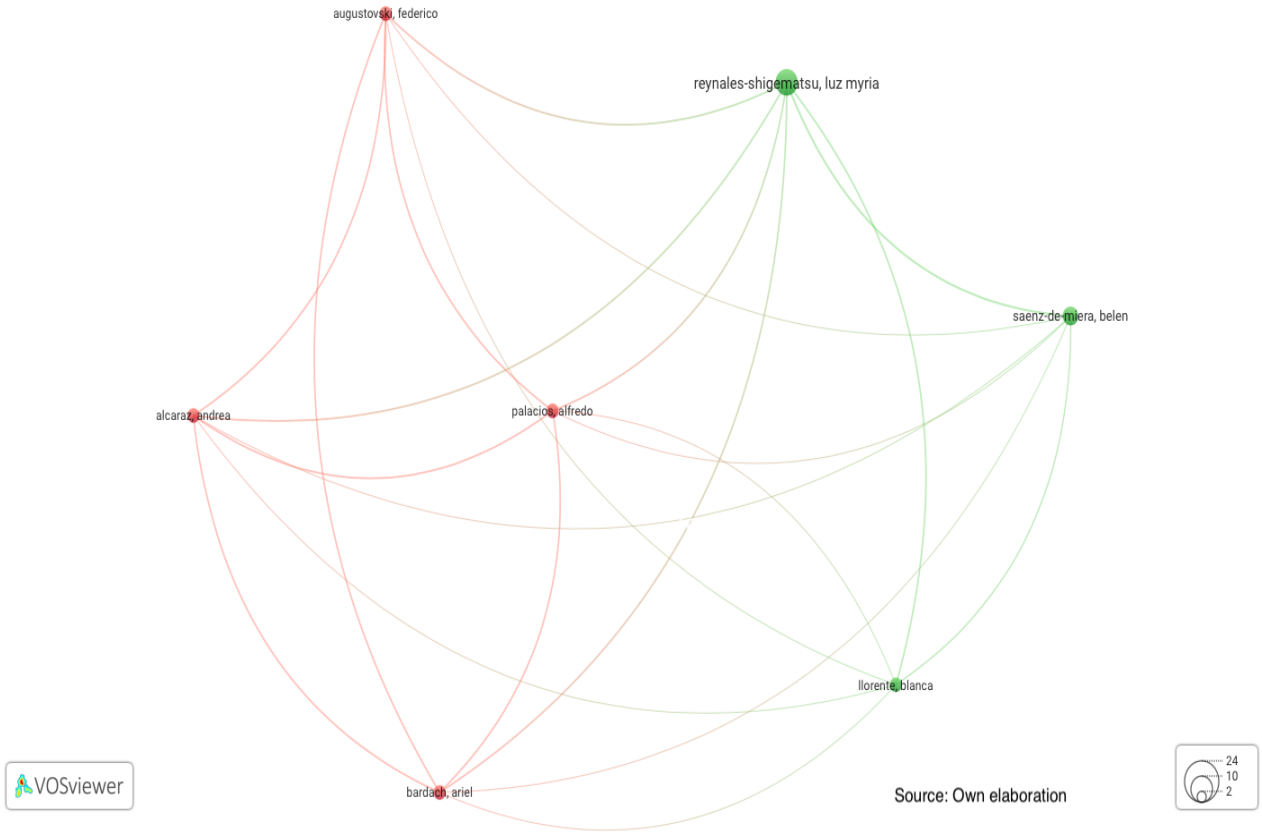


Following this initial analysis, the selected publications were further examined using **VOSviewer 1.6.20**, as illustrated on **Figure 2,** a specialized tool designed for the construction and visualization of bibliometric networks. This second stage of analysis aimed to explore the interconnections between the thirteen publications, identifying patterns, research clusters, and thematic linkages within the field.

Among the thirteen documents identified through the PubMed search, **Graph 4** shows the number of publications by year from 2019 to 2024; it was noted that no publications addressing tobacco taxes in Mexico were available for 2019. This lack of scholarly output during that year contrasts with subsequent trends. In 2020 and 2021, the research volume grew modestly, with two articles published annually. A more substantial increase was observed in 2022 and 2024, when the number of publications reached four and five articles per year, marking a significant rise in scholarly attention to the subject. This upward trend suggests an increasing recognition of the importance of tobacco taxation as a research focus, particularly in the context of its implications for public health and fiscal policy in Mexico.

As shown in **Figure 2** the bibliometric analysis conducted using **VOSviewer 1.6.20** identified two primary clusters of academic collaboration within the field.

Figure 2. VOSviewer Citation Network Visualization 2019-2024



Source: own using **VosViewer 1.6.20**

The first cluster, prominently led by Luz Myria Reynales-Shigematsu, is characterized by a strong focus on tobacco control policies in Mexico. Researchers within this network have extensively collaborated on studies examining the economic and public health implications of tobacco taxation, smoking cessation strategies, and regulatory frameworks aimed at reducing tobacco consumption in vulnerable populations.

The second cluster, centered around Federico Augustovski, appears to reflect an international or complementary perspective. This group is likely engaged in broader, cross-national research on

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health economics and tobacco control, with an emphasis on comparative policy evaluations, cost-effectiveness analyses, and the socioeconomic impact of taxation measures beyond Mexico. The interconnections between these clusters suggest an exchange of knowledge between domestic and international experts, highlighting the relevance of collaborative efforts in shaping evidence-based policies.

6. DISCUSSION

After analyzing the thirteen selected publications, various perspectives and proposals emerged, all underscoring the critical role of tobacco taxation in fostering a more sustainable economy in Mexico, marked by greater social equity. To enable a structured examination of the findings, the gathered information was organized into seven key sections: tobacco taxation, the effects of secondary poverty, consumption elasticity, inequities within the healthcare system, the tobacco industry, and the theoretical and practical implications derived from this analysis. This organization facilitated a comprehensive and systematic approach to understanding the multifaceted impact of tobacco taxation on the economic and social dynamics country.

6.1 Impact of Tobacco Taxes

Between 2019 and 2024, research on tobacco control policies in Mexico and Latin America has demonstrated significant progress, though critical challenges persist. In Mexico, measures such as tax increases, smoke-free laws, and health warnings on cigarette packages have contributed to reducing smoking prevalence, reflected in the improvement of the Tobacco Control Scale score from 24/100 in 2003 to 55/100 in 2017 (Ponce-Hernandez et al., 2022). General equilibrium studies suggest that increasing tobacco taxes could decrease consumption by 26%, boost tax revenues by 49%, and create a net positive effect on national employment (Huesca et al., 2022).

6.2 Effects on Secondary Poverty

Tobacco expenditure has been linked to secondary poverty, particularly affecting low-income households, which often fall below the poverty line after accounting for tobacco-related spending, one of the key studies estimated that around 909,132 people in Mexico would be in extreme poverty due to this phenomenon (Macías Sánchez & García Gómez, 2023). Well-designed fiscal policies

could mitigate these negative effects, as higher tobacco prices through taxation yield distributional benefits favoring lower-income regions and population quintiles (Saenz-de-Miera et al., 2022).

6.3 Elasticity of Consumption

Elasticity refers to the percentage change observed in the dependent variable in response to percentage changes in the independent variable (Rebollar et al., 2022). The studies analyzed indicate that a 34% increase in the price of tobacco products could lead to a consumption reduction of as much as 36%, economic simulations show that this effect is most pronounced among the lowest income quintiles, according to economic simulations, this effect is most pronounced in the lowest income quintiles (Saenz-de-Miera et al., 2024). Studies on cigarette consumption elasticity suggest that low-income consumers who quit or reduce smoking due to price increases experience substantial savings, improving their financial stability and mitigating secondary poverty (Théodore et al., 2024).

6.4 Health Inequalities

Graph 5 illustrates the proportion of the population lacking access to medical services in Mexico, disaggregated by income deciles for 2018 and 2022 (CONEVAL, 2023). The findings show an overall decline in the percentage of individuals without medical coverage across most income deciles, reflecting improvements in healthcare accessibility. The lowest-income deciles (I, II, and III) showed the highest levels of deprivation, with decile I exceeding 25% in 2018, decreasing significantly by 2022, yet remaining the most affected. In contrast, the highest-income deciles (IX and X) consistently exhibited the lowest levels of deprivation, close to 5%, with minimal variation between years. Despite the observed progress, these results highlight persistent inequalities in healthcare access, particularly among low-income households.

In 2020, Mexico's health expenditure on treating tobacco-related diseases for populations not covered by social security institutions reached approximately 48.223 billion Mexican pesos (around 2.76 billion USD). This amount was 19 times greater than the budget allocated for the prevention and treatment of smoking-related illnesses.

It even exceeded the total revenue generated by the tobacco excise tax (IEPS), which was estimated at 46 billion Mexican pesos (approximately 2.63 billion USD) (Gómez et al., 2020). The

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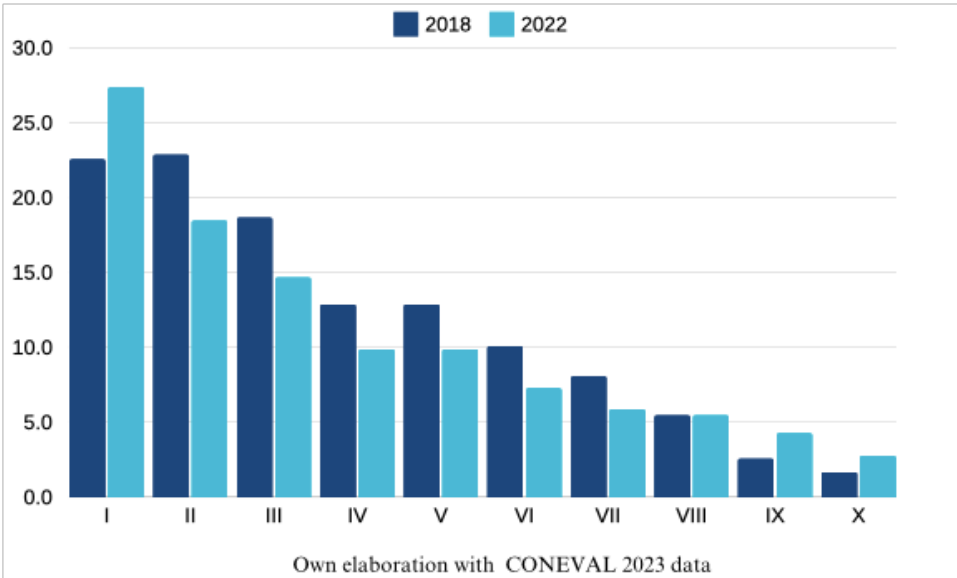
COVID-19 pandemic intensified the spread of non-communicable diseases, so it is essential to prevent harmful consumption habits (Guimond-Ramos et al., 2023).

Graph 5. The percentage of the population with a lack of medical service



6.5 Tobacco industry

The tobacco industry employs strategies such as gradual price adjustments and market segmentation to reduce the impact of tax increases, emphasizing the need for stronger regulatory measures (Saenz-de-Miera et al., 2024). Other barriers, including a lack of political will and industry interference, hinder the full implementation of the WHO Framework Convention on Tobacco Control (Saenz-de-Miera et al., 2022).

Tobacco consumption exacerbates poverty among the most vulnerable, diverting household spending from essential goods like food and healthcare to cigarettes, thereby reducing families ' ability to address medical expenses and increasing the risk of premature death for breadwinners (Ponce-Hernandez et al., 2022). The tobacco industry has perpetuated the false claim that higher tobacco taxes disproportionately harm low-income families by forcing them to spend a larger share of their income on cigarettes or resort to the black market. For instance, after the 2011 tobacco tax

hike in Mexico, industry representatives frequently cited unsubstantiated claims that the illicit cigarette trade accounted for 17% of the total market; However, independent surveys from that period showed that the actual share of illicit trade was less than 5% (Drope et al., 2024).

These findings highlight tobacco taxation's crucial role in promoting a more sustainable and equitable economy in Mexico. This aligns directly with **SDG 3 (Good Health and Well-being)** by emphasizing the public health benefits of reducing tobacco consumption and alleviating the strain on healthcare systems. Higher tobacco taxes have been shown to lower smoking prevalence, decrease tobacco-related diseases, and ultimately improve overall health outcomes, reinforcing the broader goal of disease prevention and health equity. Additionally, the discussion ties into **SDG 10 (Reduced Inequalities)** by addressing the socioeconomic dimensions of tobacco taxation. The analysis of secondary poverty, consumption elasticity, and healthcare inequities underscores how taxation policies can be designed to avoid disproportionately burdening low-income populations while generating public revenue for social programs.

6.6 Theoretical implications (*Scientia*)

The study innovates in the design of fiscal policies for tobacco control, offering a scientific basis for equitable and sustainable tax reforms. Its multidisciplinary and evidence-based approach supports the formulation of public policies aligned with the principles of sustainable development, ensuring a positive impact on both public health and economic equity.

The theoretical analysis of the 13 publications highlights the relevance of addressing the problem of tobacco addiction from an economic perspective. This is not only a matter of public health but also represents a significant impact on the economic situation, not only of tobacco users but also of their families, especially in those households living in conditions of multidimensional poverty (Macías Sánchez & García Gómez, 2023).

In Mexico, both the prevalence of smoking and the tax burden have remained stable for more than a decade, limiting progress in controlling this problem. Therefore, it is imperative to carry out economic studies that not only reflect the current panorama but also, through simulation models, evaluate how the increase in the prices of tobacco products can reduce consumption and significantly benefit public health in the country (Saenz-de-Miera, Welding, et al., 2024).

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Evidence derived from simulation models underscores the effectiveness of tax increases in reducing premature deaths attributable to smoking, increasing tax revenue, and reducing direct health costs and indirect productivity losses associated with tobacco use. In addition, the essential role that these tax increases play in mitigating the economic and health burdens derived from smoking is highlighted (Saenz-de-Miera, Reynales-Shigematsu, et al., 2024).

From the perspective of **SDG 3**, the research emphasizes how fiscal policies can serve as powerful tools for public health by reducing smoking prevalence and its associated disease burden. The analysis of tobacco taxation highlights its potential to decrease premature deaths, alleviate healthcare costs, and improve overall population health, particularly through evidence-based simulation models. By demonstrating that tax increases can lead to significant reductions in tobacco-related illnesses and healthcare expenditures, the study reinforces the importance of integrating economic strategies into public health policy.

At the same time, the study aligns with **SDG 10** by addressing the economic inequalities linked to tobacco consumption. It underscores that smoking is not just a public health issue but also a socioeconomic challenge, particularly for households living in multidimensional poverty. The research highlights how tobacco use disproportionately affects vulnerable populations by diverting financial resources away from essential needs such as food, education, and healthcare.

Furthermore, it points to the stagnation of tobacco taxation in Mexico over the past decade, emphasizing the need for fiscal reforms that do not disproportionately burden low-income consumers but instead promote equity through well-designed tax policies and compensatory measures.

By incorporating an interdisciplinary approach and leveraging economic simulations, the study provides a robust framework for developing fiscal policies that advance both public health and economic justice, thereby contributing to the broader goals of sustainable development in Mexico.

6.7 Practical implications (*Praxis*)

Although Mexico has improvements in tobacco control, they have been piecemeal, but those that perform better in cessation are related to increasing tobacco taxes. Unfortunately, Mexico has not accomplished the **WHO** mandated recommendations on tobacco control to reach a total tax share above 75% of the final price to achieve benefits to a greater extent, the special tax would

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need to increase to $1.15 Mexican pesos per cigarette, or at least three times as high as recommended by the international community, to accomplish the *Sustainable Development Goals*.

This would increase costs to over $110 Mexican pesos a pack in 2022, resulting in a 36% decrease in overall consumption. As this fiscal reform states, increasing tobacco prices will benefit low-income households. When the price of cigarettes exceeds $80 Mexican pesos (around 4.57 USD), more people with lower incomes will decide to quit (Huesca et al., 2022).

This study contributes to innovation for sustainable development by proposing innovative fiscal strategies that promote equity and improve public health. These strategies align with the Sustainable Development Goals (**SDGs**), particularly **SDG 3** (Good health and well-being) and **SDG 10** (Reduced inequalities).

7. CONCLUSION

This study provides crucial information to advance in the fulfillment of **SDG 3** and **SDG 10**, to improve the health of Mexicans, and to reduce inequalities through tobacco taxes, contributing to the fields of economics and public health by integrating health economics, behavioral economics, and fiscal policy. It develops a multidimensional framework that allows us to understand how tax structures affect health inequalities. Given the growing urgency to address tobacco use's economic and health burdens, this study is particularly relevant for academic researchers and policymakers seeking to develop and implement effective interventions.

Ultimately, these efforts promote greater equity and sustainability in Mexico's public health system. By systematically analyzing the recent literature, the review identifies key trends, knowledge gaps, and emerging areas of interest, thereby contributing to the advancement of academic discourse and the refinement of fiscal and regulatory strategies.

Furthermore, the analysis underscores the importance of data-driven policy development by highlighting sensitive and critical information that can serve as a foundation for more effective and equitable public health measures. In the context of tobacco control, where taxation, consumption patterns, and socioeconomic disparities intersect, such insights are crucial for formulating strategies that maximize health benefits while minimizing unintended economic consequences. By synthesizing the most relevant and up-to-date research, this study provides an essential framework

for stakeholders aiming to enhance tobacco control initiatives and promote sustainable public health outcomes.

7.1. How to answer the question and explain the research hypothesis

The research hypothesis aligns directly with **SDG 3** and **SDG 10** by highlighting the role of fiscal policies in promoting public health and economic equity, showing that a significant increase in tobacco taxes leading to at least a 34% rise in tobacco product prices would reduce smoking prevalence, generate public revenue, and improve health outcomes without disproportionately burdening low-income consumers (Saenz-de-Miera et al., 2024).The study also challenges the common misconception that illicit trade is a major barrier to taxation policies by presenting evidence that it accounts for less than 5% of total tobacco consumption (Drope et al., 2024).

7.2. Research findings.

Increased taxation would generate substantial government revenue, which could be allocated to improve healthcare access and fund treatment for tobacco-related diseases contributing to the goals of **SDG3**. The study also highlights that Mexico's current socioeconomic and political context is favorable for implementing these fiscal adjustments. Importantly, evidence indicates that wealthier tobacco consumers would bear a greater share of the tax burden, ensuring a more equitable outcome contributing to the goals of **SDG10** and reducing the inequalities in the country.

7.3. Research final scope.

This study provides a timely and policy-relevant literature review, offering valuable insights for both academics and policymakers to contribute to achieving **SDGs 3 and 10**. It highlights the limited scientific evidence available, with only thirteen publications between 2019 and 2024, underscoring the need for more interdisciplinary research. The implications of the study extend beyond short-term fiscal and health benefits, advocating for long-term sustainable strategies to combat tobacco use in Mexico. Future research should investigate the intersection of taxation, socioeconomic factors, and health outcomes, aiming to develop more effective and equitable tobacco control policies, as well as a stronger focus on meeting the **SDGs** to ensure a better future.

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Innovación para una Alimentación Saludable: El Etiquetado Frontal Herramienta de Cambio Conductual en Jalisco, México

Innovation for Healthy Eating: Front-of-Package Labeling as a Behavioral Change Tool in Jalisco, Mexico

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Palabras clave: alimentos densamente energéticos, *nudge*, diferencias en diferencias, política de etiquetado en alimentos

Keywords: energy-dense foods, *nudge*, differences in differences, food labeling policy

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RESUMEN

Contexto. El aumento en la prevalencia de enfermedades no transmisibles en México, atribuible en parte al consumo de alimentos densamente energéticos, ha motivado la implementación de políticas públicas orientadas a modificar los hábitos alimenticios. Entre ellas, destaca el sello de advertencia de etiquetado frontal (**SAF**) como estrategia de bajo costo cognitivo, alineada con los principios del *nudge* y el **ODS3** de la Agenda 2030.

Problema. Existe incertidumbre sobre la efectividad del sello de advertencia frontal (**SAF**) como mecanismo para reducir el consumo de alimentos poco saludables, en particular en regiones como Jalisco. A ello se suma la escasez de evaluaciones empíricas que contrasten su impacto económico en el comportamiento del consumidor.

Objetivo. Estimar el impacto del etiquetado frontal en el gasto trimestral de hogares urbanos de Jalisco en alimentos densamente energéticos, entre 2016 y 2022.

Metodología. Se utilizó un diseño cuasiexperimental de *"diferencias en diferencias"* a través del software **STATA19** , empleando datos de la Encuesta Nacional de Ingresos y Gastos de los Hogares (**ENIGH**) 2016, 2020 y 2022. Se compararon hogares urbanos (tratados) y rurales (control) en términos de gasto en doce productos considerados densamente energéticos, según la **NOM-051.**

Hallazgos teóricos y prácticos. El etiquetado frontal resultó ser eficaz para disminuir el gasto en 10 de los 12 productos evaluados. No obstante, su efecto fue nulo o incluso adverso en bebidas azucaradas y galletas saladas. En términos teóricos, se validó la eficacia del *nudge* visual como política pública, aunque limitada ante productos de consumo culturalmente arraigado.

Originalidad. El estudio integra enfoques de economía conductual, nutrición pública y políticas públicas, proponiendo una lectura multidisciplinaria sobre la innovación en salud alimentaria. Contribuye al **ODS3** al identificar condiciones donde el etiquetado es o no eficaz, sugiriendo ajustes informados a la política vigente.

Conclusiones y limitaciones. El etiquetado es una herramienta valiosa; sin embargo, resulta insuficiente por sí sola. Debe complementarse con medidas fiscales (como impuestos a bebidas azucaradas) y rediseños más accesibles visualmente. El estudio se restringe a Jalisco y al primer periodo del etiquetado **SAF**, lo cual limita su generalización. Se sugiere extender el análisis a otras entidades federativas y evaluar fases posteriores del etiquetado.

ABSTRACT

Context. The rise in non-communicable diseases in Mexico, partly due to the consumption of energy-dense foods, has led to public policies modifying eating habits. Among them, front-of-package warning labeling (**FOP**) stands out as a low cognitive-cost strategy aligned with *nudge* theory and Sustainable Development Goal (**SDG3**) of the 2030 Agenda.

Problem. There is uncertainty about the effectiveness of the front-of-package warning label (**FOP**) in reducing unhealthy food consumption, especially in regions like Jalisco. Moreover, few empirical evaluations assess its economic impact on consumer behavior.

Purpose. To estimate the effect of front-of-package labeling on quarterly spending by urban households in Jalisco on energy-dense foods from 2016 to 2022.

Methodology. A quasi-experimental design with the "*difference-in-differences"* method was used through **STATA19** software, based on National Household Income and Expenditure Survey (**NHICS**) data for 2016, 2020, and 2022. Urban (treatment) and rural (control) households were compared regarding their spending on twelve energy-dense products, according to **NOM-051**.

Theoretical and practical findings. FOP warning labeling effectively reduced spending on 10 of 12 evaluated products. However, the effect was null or adverse for sugary drinks and salty crackers. Theoretically, the visual *nudge* approach was validated as a public policy tool, though limited for culturally embedded foods.

Originality. This study adopts a multidisciplinary perspective integrating behavioral economics, public nutrition, and policy, promoting innovation for sustainable development. It supports **SDG3** by identifying where labeling works or fails and suggests evidence-based policy refinements.

Conclusions and limitations. Labeling is useful but insufficient alone. It should be reinforced by fiscal measures (e.g., taxes on sugary drinks) and more accessible visual designs. This study is limited to Jalisco and the early **FOP warning labeling** phase, which constrains its generalizability. Broader studies in other states and later policy phases are advised.

1. INTRODUCCIÓN

Los nuevos cambios económicos y sociales han propiciado la adopción de prácticas alimentarias perniciosas, entre las que se destaca el consumo de alimentos con alto contenido de azúcares y grasas. Esto, a su vez, ha fomentado el desarrollo de enfermedades no transmisibles, dentro de las cuales destacan las enfermedades coronarias y la diabetes mellitus (Dávila-Torres et al., 2015). Estas condiciones de salud representan una amenaza directa al bienestar de la población y constituyen un reto central para el cumplimiento del Objetivo de Desarrollo Sostenible 3 (ODS3), el cual busca garantizar una vida sana y promover el bienestar para todos en todas las edades (ONU, 2015).

Con la intención de reducir las comorbilidades anteriormente mencionadas, el Gobierno de México ha desarrollado políticas públicas destinadas a informar y persuadir la intención de compra del consumidor (Torres y Rojas, 2018). El etiquetado frontal ha ocupado un papel central como referente de política pública debido a sus bajos niveles de intrusividad y a su capacidad para redirigir decisiones de consumo (Liu et al., 2014). Diseños deficientes de planeación han demostrado que, para que el etiquetado sea efectivo, este debe estar estructurado de forma que el lector pueda comprender la información y, con base en ella, tomar decisiones de consumo más informadas.

La implementación de este tipo de políticas, centradas en la modificación del entorno alimentario y el acceso a información clara, se alinea con la meta 3.4 del **ODS3**, que busca reducir en un tercio la mortalidad prematura por enfermedades no transmisibles mediante la prevención y tratamiento, así como promover la salud mental y el bienestar (ONU, 2015). Además, se vincula con el enfoque del *nudge* o empujón conductual, una estrategia de política pública basada en las ciencias del comportamiento que busca influir en las decisiones sin restringir la libertad de elección (Thaler y Sunstein, 2009).

No obstante, debido a su reciente implementación, las investigaciones de índole económica que comprueben su efectividad son escasas. Por ello, esta investigación busca una aproximación para determinar el impacto de la política dentro de un sector específico, como las zonas urbanas.

El objetivo es estimar el impacto del sello de advertencia frontal (**SAF**) en el gasto de los hogares urbanos de Jalisco en alimentos densamente energéticos. Se parte del supuesto de que el

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etiquetado frontal en alimentos no ha tenido efectos positivos significativos en el gasto en alimentos densamente energéticos en el estado de Jalisco durante el periodo 2016–2022.

2. CONTEXTUALIZACIÓN

En este apartado se exponen las condiciones sociales y económicas con respecto al gasto en alimentos en el estado de Jalisco, con el fin de dar a conocer las posibles influencias ambientales que pudiesen incidir en el consumo de alimentos densamente energéticos. Esto, con el fin de determinar el panorama socioeconómico de Jalisco durante la aplicación de las políticas públicas, y de identificar factores que pudiesen incidir en el acceso a información nutricional preventiva o directamente al acceso a alimentos de calidad.

2.1 Consumo de alimentos en Jalisco

Para 2022, el ingreso corriente promedio trimestral por hogar en Jalisco es de 71,744 pesos, un 12.9% mayor al de 2020 (63,570 pesos) (Instituto Nacional de Estadística y Geografía, 2023b). En el **Tabla 1** se describen el ingreso promedio trimestral de los hogares en Jalisco desagregado por decil de ingreso, así como la variación porcentual entre el año 2020 y el 2022:

El decil de ingreso nos permite comparar el ingreso monetario que perciben los hogares en determinados ambientes socioeconómicos. A continuación, en la **Gráfica 1** se muestra la distribución porcentual del ingreso corriente en 2022 de acuerdo al decil de ingreso.

En dicha gráfica se puede observar que entre los cuatro primeros deciles de ingresos representan el 18% de ingreso total percibido en Jalisco, 10% por debajo al decil socioeconómico X, el cual representa la clase social con los niveles de ingreso más altos. Esto es evidencia de que en Jalisco existen cierta desigualdad con respecto a la cantidad percibida de ingreso entre niveles socioeconómicos.

Tabla 1. Ingreso promedio trimestral de los hogares en Jalisco

Jalisco	Promedio (PESOS)		Variación Porcentual
	ENIGH 2020	ENIGH 2022	2020-2022
I	11,117	18,712	9.3
II	25,806	29,316	13.6
III	32,577	37,609	15.4
IV	39,073	45,065	15.3
V	45,976	52,736	14.7

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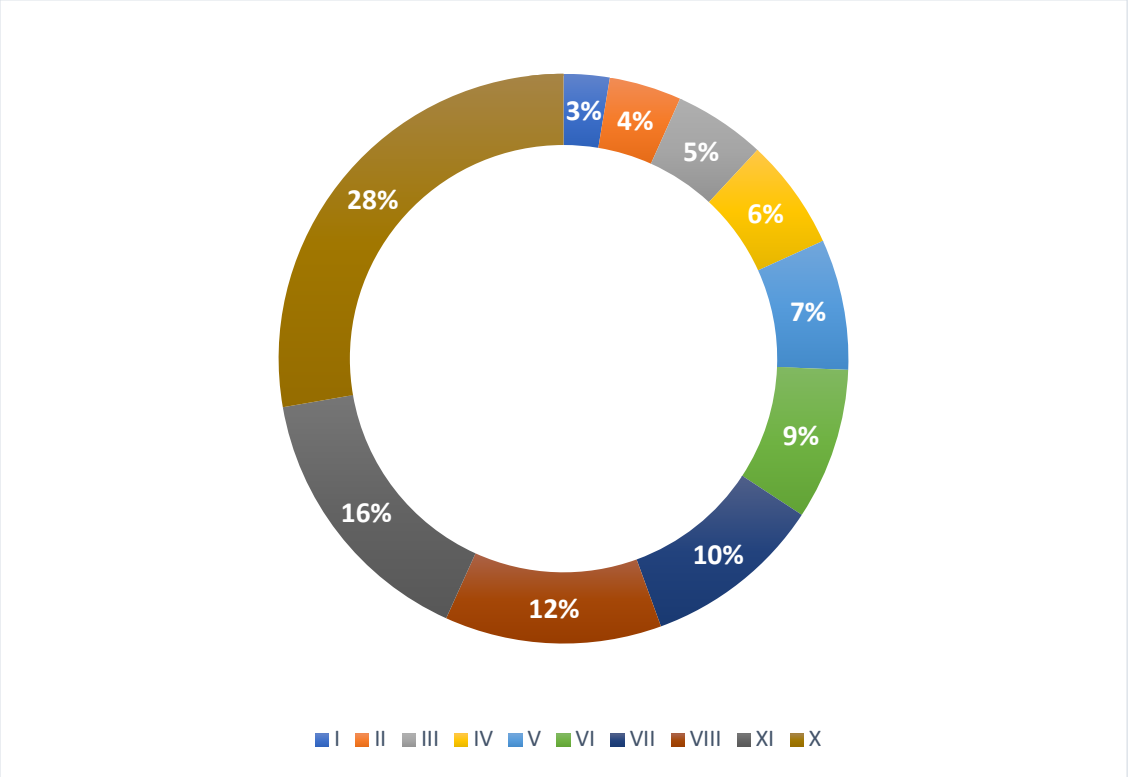
VI	53,765	61,911	15.2
VII	63,734	73,406	15.2
VIII	77,427	88,566	14.4
IX	99,307	111,434	12.2
X	180,907	198,684	9.8
TOTAL	63,570	71,744	12.9

Fuente: Instituto Nacional de Estadística y Geografía (2022).

Gráfica 1. Distribución del ingreso corriente entre deciles socioeconómicos en 2022



Fuente: Instituto Nacional de Estadística y Geografía (2022)

Asimismo, se calcula que el gasto promedio trimestral en el rubro de alimentos, bebidas y tabaco fue de 17,424 pesos por hogar (Instituto Nacional de Estadística y Geografía, 2023b). También se describe el porcentaje del ingreso destinado a cada rubro de alimentos (ver **Gráfica 2**).

Se observa que los rubros a los que se destina el mayor gasto son las carnes y los cereales. En el caso de los cereales, se toman en consideración los productos derivados de cereales como el trigo, por lo que se incluyen alimentos como botanas hechas con harinas y cereales comerciales con azúcar.

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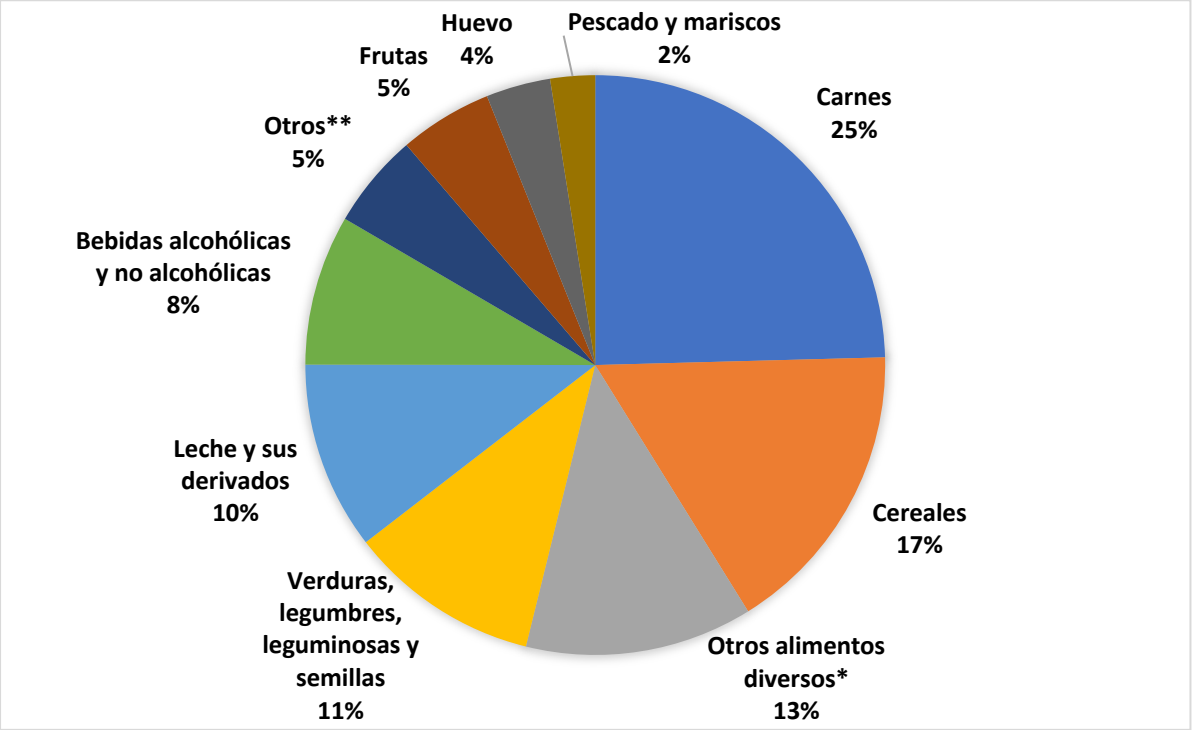
Gráfica 2. Distribución del gasto en alimentos en el estado de Jalisco



*Se incluyen alimentos como cereal de arroz, avena, mixto para bebés; papillas para bebés; hongos frescos; flanes, gelatinas, pudines en polvo, etcétera.
**Se incluyen alimentos como tubérculos, aceites y grasas: azúcares y mieles; café, té y chocolate; especia sy aderezos.
Fuente: Instituto Nacional de Estadística y Geografía (2022)

3. REVISIÓN DE LA LITERATURA

En este apartado se detallan investigaciones sobre los mecanismos teóricos y prácticos implicados en el desarrollo de la política de etiquetado frontal en alimentos. Las políticas han sido diseñadas con el fin de proporcionar información que oriente las decisiones de compra hacia opciones más saludables para el consumidor.

3.1 Objetivos de desarrollo sostenible

Los Objetivos de Desarrollo Sostenible (**ODS**) buscan responder a las necesidades sociales, económicas y alimentarias mediante 17 objetivos interrelacionados con ejes prioritarios centrados en el desarrollo global, destacando entre sus metas la seguridad alimentaria y el combate contra la malnutrición (Hernández-Islas et al., 2024). Entre ellos, el Objetivo de Desarrollo Sostenible 3 (**ODS3**) tiene como propósito garantizar una vida sana y promover el bienestar para todos en todas

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las edades, prestando especial atención a la prevención y reducción de enfermedades no transmisibles asociadas con la alimentación y el estilo de vida (ONU, 2015).

Las comunidades pequeñas y rurales suelen tener menor nivel tecnológico y acceso a la información, lo cual las hace susceptibles a bajos niveles educativos y a un acceso limitado a necesidades básicas (Chiatchoua y Ávila-Romero, 2022). La falta de información clara representa un obstáculo para que las personas tomen decisiones conscientes sobre su nutrición. Como consecuencia de lo anterior, existe un desconocimiento generalizado sobre las cantidades recomendables para el consumo de ciertos nutrientes (Valencia-Valero y Ortiz-Hernández, 2014).

En este contexto, el etiquetado frontal en alimentos se convierte en una herramienta clave para alcanzar las metas del **ODS3**, ya que, al brindar información accesible, visible y comprensible al consumidor, permite una toma de decisiones más informada y fomenta la adopción de hábitos alimenticios saludables. Esta política contribuye directamente a la meta 3.4, que busca reducir la mortalidad prematura por enfermedades no transmisibles mediante la prevención y se alinea con las estrategias de promoción de la salud propuestas por la Organización Mundial de la Salud.

Los primeros intentos de aplicación de políticas de etiquetado en México resultaron en una serie de fracasos, por su limitada capacidad para informar sobre las propiedades nutricionales de los alimentos, como consecuencia de fallas en su diseño e implementación (White y Barquera, 2020). Por lo tanto, se hace evidente la necesidad de idear una política de etiquetado con una base conceptual, metodológica y de diseño capaz de captar la atención del consumidor y orientar sus decisiones con el objetivo de prevenir padecimientos no transmisibles, lo cual es consistente con los principios del **ODS3**.

3.2 El *nudge* como política pública

En los últimos años, gobiernos de distintos países han impulsado estrategias basadas en mecanismos tipo *nudge* para orientar y condicionar comportamientos con el objetivo de mejorar la calidad de vida de la población o reducir comportamientos de riesgo (Arellano Gault y Barreto, 2016).

El *nudge* es una herramienta utilizada para influir en la toma de decisiones de forma indirecta, con mínima intervención de fuerzas coercitivas externas (Thaler y Sunstein, 2009). Diversos autores consideran que es un mecanismo efectivo para reducir los índices de sobrepeso y obesidad,

ya que genera emociones positivas o negativas al momento de adquirir un producto (Mendoza-Velázquez y Aguirre Sedeño, 2019).

Estas estrategias pueden diseñarse de manera que involucren un bajo esfuerzo cognitivo por parte del consumidor (Gorski y Roberto, 2015). Las políticas deben estar orientadas a facilitar que el individuo realice el menor esfuerzo posible en la consecución de una conducta deseada (Kahneman, 2011).

Se considera que el etiquetado con sello de advertencia frontal (**SAF**) es una herramienta eficaz para orientar las decisiones de consumo, al advertir sobre los posibles peligros del consumo excesivo de ciertos productos (Guimond-Ramos et al., 2023).

Las emociones provocadas por las imágenes juegan un papel importante en la elección de productos (Cao et al., 2020). Los empaques de advertencia pueden generar sensaciones de alerta en el consumidor, lo que contribuye a orientar su decisión de compra (Ares et al., 2021).

No obstante, existe discusión sobre si la política de etiquetado frontal es suficiente para reducir el gasto en determinados productos, como las bebidas azucaradas, o si es necesario complementarla con medidas fiscales, como impuestos especiales (Hyseni et al., 2017). En este sentido, Thaler (1980) sugiere que un *nudge* acompañado de medidas impositivas podría funcionar en este caso específico, ya que, aunque implica una restricción, sigue representando un bajo esfuerzo cognitivo para el consumidor final.

3.3 Etiquetado frontal como política

Dentro de las políticas implementadas en México, destacan el etiquetado frontal y el impuesto especial en alimentos. La segunda medida se considera una política fiscal que busca reducir el consumo mediante un coste monetario que impacte directamente el bolsillo del consumidor y restrinja la compra de productos (Thunström, 2019). No obstante, esta política podría generar rechazo por parte del consumidor, al ser una medida restrictiva e impuesta (Hagmann et al., 2018). Para lograr un mayor alcance en la reducción de enfermedades no transmisibles y en el gasto destinado a alimentos densamente energéticos, se estableció una medida conjunta de política de etiquetado.

El etiquetado Guías Diarias de Alimentación (**GDA**) se considera un precursor de las políticas de etiquetado, ya que fue el primer diseño implementado en varios países, entre los cuales

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se incluye México (Stern et al., 2011). Este etiquetado resultó inefectivo debido a fallas estructurales en su diseño, planeación e implementación, lo que conllevó a que fuese percibido como un fracaso y, posteriormente, sustituido (White y Barquera, 2020).

La principal problemática en su diseño radicó en que el consumidor debía interpretar correctamente las cantidades nutricionales, lo cual requería conocimientos especializados. Esto resultó especialmente restrictivo para la población en general, en particular para personas en situación de rezago social (Tolentino-Mayo et al., 2020).

En respuesta, el gobierno mexicano implementó la política de etiquetado de advertencia frontal, tomando como referencia experiencias previas en otros países, especialmente en Chile (Contreras et al., 2018).

Kaufer-Horwitz et al. (2018) realizaron un experimento con estudiantes universitarios mexicanos. A pesar de que el 72 % de la muestra había visto el etiquetado **GDA,** solo el 6 % podía utilizarlo de forma satisfactoria. En cambio, el 83 % logró tomar mejores decisiones de compra con base en el etiquetado **SAF**.

Además de las políticas **GDA** y **SAF** implementadas en México, existen otras medidas como el etiquetado *Health Star Rating* y el *Traffic Light Labeling*, que han demostrado niveles de eficacia similares o incluso superiores al etiquetado **SAF**, debido a su diseño basado en iconografía y cromática llamativa (Vanderlee et al., 2021).¿

3.4 Diseño del instrumento de medición y/o materiales

Como base de datos se utilizaron los registros derivados de la Encuesta Nacional de Ingresos y Gastos de los Hogares (**ENIGH**) de los años 2016, 2020 y 2022. La encuesta presenta una representatividad a nivel nacional del 95 %. En el caso de Jalisco, el tamaño de la muestra fue de 3,197 viviendas, representando un total estimado de 8,501,241 habitantes (INEGI, 2023b).

La **Tabla 2** muestra el tamaño de la muestra a nivel nacional, así como el número de hogares y habitantes representados.

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Tabla 2. Muestreo poblacional ENIGH 2016, 2018 y 2020

ENIGH	Tamaño de la muestra (hogares)	Hogares representados	Habitantes representados
2016	81,515	32,974,661	120,801,511
2020	105,483	35,749,659	126,760,856
2022	105,525	No disponible	128,889,708

Fuente: Elaboración propia con base en el descriptor de datos del Instituto Nacional de Estadística y Geografía 2016, 2020 y 2022

Dentro de la metodología de la **ENIGH** se clasifican los gastos de acuerdo al rubro de producto alimenticio. Para propósito de esta investigación se seleccionaron 12 alimentos, los cuales de acuerdo a sus características nutricionales y a los parámetros establecidos dentro de los criterios para el etiquetado frontal de advertencia se consideran densamente energéticos. Ver **Tabla 3.**

Tabla 3. Alimentos densamente energéticos seleccionados

Producto	***Nomenclatura***	***Código ENIGH***	***Producto***	***Nomenclatura***	***Código ENIGH***
Galletas dulces	Gd	A010	*Papas fritas*	Pf	A106
Galletas saladas	Gs	A011	*Chocolate en tableta*	Ct	A180
Pan empaquetado	Pe	A014	*Ates, jaleas y mermeladas*	Ajm	A207
Pastelillos empaquetados	Pae	A017	*Helados y paletas*	Hp	A208
Botanas y frituras	Bf	A022	*Bebidas azucaradas*	Ba	A220
Sopas instantáneas	Si	A023	*Bebidas alcohólicas*	Bal	A221

Fuente: Elaboración propia con base en Instituto Nacional de Estadística y Geografía, 2016, 2020 y 2022.

De acuerdo con la Norma Oficial Mexicana NOM-051-SCFI/SSA1-2010, se consideran densamente energéticos aquellos alimentos que aportan 275 kcal o más por cada 100 gramos en productos sólidos, o 70 kcal o más por cada 100 ml en productos líquidos (Secretaría de Economía, 2020) (véase **Figura 1**).

Figura 1. Ejemplo de etiquetado frontal de advertencia

Fuente: Alianza por la salud alimentaria (2020)

El etiquetado de advertencia frontal está diseñado en forma octagonal sobre fondo blanco, con letras que advierten al consumidor sobre el exceso de ciertos nutrimentos o sustancias perjudiciales (Comisión Federal para la Protección contra Riesgos Sanitarios, 2021). Este diseño suele ser considerado una mejora en diseño y planeación al compararse con el etiquetado frontal predecesor Guías de Alimentación Diarias **GDA** (White y Barquera, 2020). Ver **Figura 2**

El etiquetado **GDA** fue diseñado con el fin de informar al consumidor sobre las cantidades y porcentajes nutrimentales de los aditamentos que pudiesen ser perjudiciales en consumo excesivo (Secretaría de Salud, 2010).

Estos son los dos diseños principales utilizados en México con respecto a políticas públicas de etiquetado. Aunque se percibe que el etiquetado **GDA** fue diseñado sin seguir pautas de expertos nutricionales, es necesario determinar el grado de efectividad del mismo como mecanismo *nudge.*

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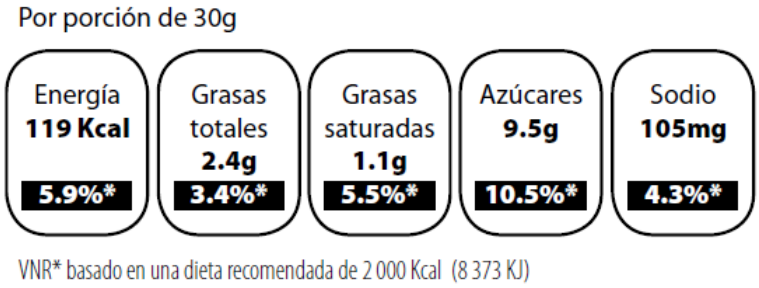
Figura 2. Ejemplo de etiquetado Guías de Alimentación Diarias



Fuente: retomado de Stern et al. (2011)

4. METODOLOGÍA

Con el fin de determinar los cambios en el gasto de los hogares respecto al consumo de alimentos densamente energéticos, se utilizó una metodología cuasiexperimental denominada *"diferencias en diferencias"*, aplicada mediante el software **STATA 19**. Este método permite evaluar la efectividad de políticas públicas de forma indirecta, mediante una comparación temporal entre un grupo experimental y un grupo control (Angrist & Pischke, 2008). El método se representa mediante la siguiente regresión lineal:

$$y_i = \beta_1 + \beta_2 Trat_i + \beta_3 Desp_i + \delta(Trat_i * Desp_i) + \varepsilon_i \ldots \textbf{(ecuación 1)}$$

En esta ecuación se toman en consideración todos los escenarios considerados de aplicación de etiquetado frontal. El estimador δ representa el escenario de las diferencias entre el grupo experimental y control antes y después de la aplicación de la política de etiquetado:

$$\delta = (\bar{y}_{tratado,\, despues} - \bar{y}_{control,\, despues}) - (\bar{y}_{tratado,\, antes} - \bar{y}_{control,\, antes}) \ldots \textbf{(ecuación 2)}$$

Donde:

$\bar{y}_{tratado,\, despues}$: es el promedio de **GT** del grupo urbano (**tratado**) después de realizar la política

$\bar{y}_{control,\, despues}$: es el promedio de **GT** del grupo rural (**control**) después de realizar la política

$\bar{y}_{tratado,\, antes}$: es el promedio de **GT** del grupo urbano (**tratado**) antes de realizar la política

$\bar{y}_{control,\, antes}$: Es el promedio de **GT** del grupo rural (**control**) antes de realizar la política

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Las zonas rurales adquieren el papel de grupo control debido a la carencia de información y baja capacidad adquisitiva al compararse con las zonas urbanas. Se percibe que estas zonas tienen mayores dificultades para acceder a la información general, y en este caso a una baja exposición a la política de etiquetado (Lartigue-Mendoza y González-Martínez, 2022).

Con el propósito de estimar el efecto del etiquetado frontal como política pública sobre el consumo de alimentos densamente energéticos, se utilizó un modelo cuasiexperimental de "*diferencias en diferencias"*. El grupo tratado fue conformado por hogares urbanos, con mayor exposición a las campañas de etiquetado, mientras que los hogares rurales fungieron como grupo control, dada su menor exposición mediática e institucional. El análisis comparó cambios en el gasto trimestral promedio entre ambos grupos antes y después de la implementación del etiquetado **SAF,** considerando los levantamientos de la **ENIGH** 2016, 2020 y 2022, y ajustando los montos a precios constantes. La identificación del efecto de política se realizó mediante una variable de interacción que capta la variación atribuible al etiquetado frontal, bajo el supuesto de que ambos grupos habrían seguido trayectorias paralelas en ausencia de la intervención. Este supuesto se considera razonable, dadas las condiciones de estabilidad observadas entre los periodos previos a la política.

5. RESULTADOS

En la **Tabla 4** se exponen los resultados derivados de la aplicación del método cuasiexperimental de *"diferencias en diferencias"*. Se analizaron dos periodos, correspondientes a las fases de aplicación del etiquetado frontal: de 2016 a 2022 para el etiquetado **GDA** y de 2020 a 2022 para el etiquetado **SAF**.

Tabla 4. Impacto de las políticas de etiquetado frontal en alimentos densamente energéticos en el estado de Jalisco

Jalisco									
	SAF		**GDA**		***Producto***	**SAF**		**GDA**	
Producto	**GTP**	***p***	**GTP**	***p***		**GTP**	***p***	**GTP**	***p***
Gd	-126.09	0.000	-127.77	0.000	*Pf*	-26.78	0.000	-31.85	0.000
Gs	6.36	0.051	1.26	0.705	*Ct*	-30.51	0.000	-43.60	0.000
Pe	-5.83	0.275	-16.78	0.003	*Ajm*	-45.12	0.000	-61.83	0.000

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Pae	-62.38	0.000	-87.90	0.000	*Hp*	-59.01	0.000	-73.33	0.000
Bf	-17.20	0.000	-26.99	0.000	*Ba*	70.28	0.000	63.16	0.000
Si	-26.77	0.000	-47.39	0.000	*Bal*	-28.32	0.000	-52.25	0.000

Nota: El coeficiente se refiere al **GTP (Gasto Trimestral Promedio)** de los hogares, con precios del 2019 **VA** (variación anual de **GDA** a **SAF**). (***) Significativo al 95% de confianza y 5% de error.
Fuente: Elaboración propia con base en Instituto Nacional de Estadística y Geografía 2016, 2020 y 2022.

De los alimentos analizados, solo las galletas saladas (en ambas políticas) y el pan empaquetado (en el caso del etiquetado **SAF**) presentaron resultados no estadísticamente significativos. Por ello, no se puede asumir que los aumentos o disminuciones en el gasto sean atribuibles a la política de etiquetado.

Es importante destacar que las políticas de etiquetado no tienen efecto significativo en la reducción del gasto en bebidas azucaradas. Por el contrario, se observó un incremento de 7.15 pesos entre ambas políticas, lo cual sugiere una tendencia creciente en su consumo.

En general, se observa que en el estado de Jalisco el etiquetado frontal ha sido una medida efectiva para reducir el gasto de los hogares en 10 de los productos analizados. Ambas fases del etiquetado demostraron ser eficaces; sin embargo, parecería que el etiquetado **GDA** tuvo un impacto ligeramente superior al del etiquetado **SAF**. En la **Tabla 5** se presentan las diferencias observadas entre ambos esquemas:

Tabla 5. Diferencias del gasto trimestral de los hogares entre políticas de etiquetado

Diferencias del gasto entre políticas de etiquetado			
Producto	**Diferencia del gasto**	**Producto**	**Diferencia del gasto**
Gd	1.68	*Pf*	5.07
Gs	5.10	*Ct*	13.09
Pe	10.95	*Ajm*	16.71
Pae	25.52	*Hp*	14.32
Bf	9.79	*Ba*	7.12
Si	20.62	*Bal*	23.93

Fuente: Elaboración propia con base en Instituto Nacional de Estadística y Geografía 2016, 2020 y 2022.

Cabe señalar, que la política de etiquetado **SAF** solo abarca la primera fase de implementación y se centra únicamente en el periodo inicial de aplicación, mientras que la política **GDA** se implementó desde 2014, por lo que los resultados mostrados solo son evidencia de la

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efectividad de la política en un periodo determinado, y se debe tener en cuenta que el etiquetado **GDA** fue una política establecida a plenitud durante el periodo de análisis.

6. DISCUSIÓN

Los resultados son evidencia de que la política de etiquetado frontal, en sus dos versiones, es efectiva para reducir el gasto en alimentos densamente energético en el estado de Jalisco, salvo en las bebidas azucaradas y las galletas saladas. Por lo tanto, un primer punto a analizar son los determinantes que han permitido que la política sea efectiva.

Kahneman (2011) afirma que las herramientas modificadoras de conductas deben de ser diseñadas de la forma más simple posible para reducir el esfuerzo cognitivo del consumidor. El etiquetado **SAF** ha sido diseñado con el fin de advertir al consumidor mediante un diseño digerible pero capaz de captar la atención del consumidor debido a su forma octagonal, alto contraste de color y ubicación destacada en el empaque.

En cuanto al etiquetado **GDA**, este diseño no cumple con los supuestos planteados por Kahneman y Tversky (1979) o por Thaler (1980), ya que no empuja la conducta del consumidor hacia ninguna dirección específica por sí mismo; el diseño es ambiguo en cuanto a su interpretación; y no advierte al consumidor sobre consecuencias en conductas indeseadas. Aun así, se parte de un diseño inicial que, de acuerdo con los datos mostrados, ha podido reducir el gasto de los hogares en alimentos densamente energéticos.

En consecuencia, puede afirmarse que el etiquetado frontal es una estrategia efectiva, la cual se alinea con el **ODS3**, ya que facilita la toma de decisión hacia alimentos saludables, y de esta forma ayuda en la prevención de enfermedades no transmisibles. Los resultados muestran que, con excepción de las bebidas azucaradas, el etiquetado es una herramienta efectiva para la disminución del gasto en alimentos densamente energéticos.

6.1. Implicaciones Teóricas

De forma indirecta se evidencia que el diseño de ambas políticas ha podido incidir en las decisiones de gasto, lo que muestra su eficacia como un mecanismo novedoso el cual es capaz de redirigir las elecciones de compra. El nuevo etiquetado **SAF** es un mecanismo novedoso cuyo

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diseño puede atraer la atención del consumidor, pero que por sí solo no es capaz de reducir el gasto en determinados productos (bebidas azucaradas).

Thaler (1980) discute que las políticas pudiesen adquirir un carácter paternalista, ya que guían las acciones hacia conductas deseadas. Aunque las medidas restrictivas son impopulares, se debe discutir la posibilidad de idear estrategias que condicionen la libertad de compra del consumidor, por lo menos en las bebidas azucaradas. Por ende, se plantea la posibilidad de que, para redirigir conductas destinadas hacia la reducción de consumo, una medida restrictiva pudiese tener mayor efectividad que una política informativa.

Sin embargo, hay escasos estudios centrados en analizar la eficacia de estos mecanismos en alimentos densamente energéticos dentro de la sociedad mexicana. Si bien se pueden tomar análisis de temas similares aplicados en Estados Unidos o en Chile, se debe de tener en consideración en contexto sociocultural mexicano con el fin de determinar el grado de efectividad de los *nudge*.

6.2. Implicaciones prácticas (*Praxis*)

El etiquetado ha demostrado eficacia como heramienta para influir en las decisiones de compra. Sin embargo, es necesario mencionar que únicamente se han implementado dos políticas de etiquetado en México. Es posible que un etiquetado con un diseño más vistoso como el *Health Star Ranking* aplicado en Estados Unidos pueda tener una efectividad mayor por su diseño atractivo y fácilmente comprensible.

Por lo tanto, se debe analizar la posibilidad de rediseñar la política de etiquetado SAF en favor de otras políticas similares, pero con un diseño más llamativo, con el fin de que abarcar una mayor cantidad de público consumidor, sobre todo, a aquellos en rezago social o bajo nivel educativo.

Por otro lado, las bebidas azucaradas es un producto en el que el efecto de las políticas de etiquetado es mínimo o nulo. Por lo tanto, es posible que una política restrictiva como lo es el impuesto en alimentos y bebidas deba ser implementada a un grado mayor al inicial propuesto. Se menciona que para que la efectividad sea mayor, el gravamen debe ser de un 20% o superior (Briggs et al., 2013).

A pesar de sus limitaciones, el etiquetado es una herramienta efectiva que incide en las decisiones de consumo, y dependiendo de su versión, puedo proporcionar información útil al

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consumidor, quien puede no conocer las características de los alimentos que consume. En este último punto, la información debe ser clara y se deben de establecer cuáles son las recomendaciones de nutrimentos de acuerdo con la edad y peso de la persona, ya que información sin contexto pudiese desviar o confundir al consumidor,

7. CONCLUSIÓN

Se concluye que la política de etiquetado es efectiva para reducir la compra de productos densamente energéticos. No obstante, los resultados correspondientes a la primera fase del etiquetado **SAF** fueron inferiores a los obtenidos bajo el esquema del **GDA**. Por lo tanto, se deben realizar estudios posteriores para verificar si esta tendencia persiste una vez que entren en vigor las fases subsecuentes del etiquetado **SAF.**

La mayoría de los productos densamente energéticos han respondido favorablemente a la implementación del etiquetado frontal. Sin embargo, las bebidas azucaradas constituyen una excepción relevante, lo cual sugiere la necesidad de explorar la aplicación de medidas adicionales o más restrictivas específicamente diseñadas para este tipo de producto.

Se recomienda ampliar el estudio a otros contextos o entidades federativas con el objetivo de evaluar la efectividad de estas políticas a nivel nacional. Asimismo, resulta pertinente analizar alternativas de política pública que incorporen mecanismos tipo *nudge* en su diseño, con el propósito de fortalecer las medidas existentes o, en su caso, sustituirlas por estrategias más eficaces.

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Innovating Family Business Succession: Sustainable Strategies through the Integrative Model in Mexico

Innovando en la sucesión de empresas familiares: estrategias sustentables a través del Modelo Integrativo: Caso México

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ABSTRACT

Context. Most Mexican businesses are family-owned, and their continuity depends on effective generational succession. However, many of these businesses lack formal transition structures, which could jeopardize their continuity and sustainability.

Problem. Family-owned businesses (**FOBs**) face the challenge of structuring their succession processes clearly and effectively to ensure continuity and sustainability. This study aims to examine the structuring of succession processes in Mexican family businesses and to identify the factors that influence the clarity and effectiveness of these mechanisms.

Purpose. To assess the suitability of Mexican Stock Exchange Funds for generational transition and identify key organizational components for structured succession. The study supports **SDG8** by promoting professionalized succession and sustainable business continuity.

Methodology. Empirical research was conducted in Jalisco between 2020 and 2022, collecting data from 337 family businesses. The correlation between the clarity of succession criteria and factors such as governance and company size was evaluated. Classification models were compared using indicators such as precision, recall, accuracy, and **F1** score.

Theoretical and practical findings. The results indicate that firms with formal governance structures, such as family protocols, boards of directors, and share transfer plans, have strict succession rules. The K-Nearest Neighbors (**KNN**) model showed the best performance in terms of accuracy (0.8038), **F1** score (0.7044), and precision (0.8038). Logistic regression had the highest **AUC** value (0.8654), indicating a high discrimination ability. The Naive Bayes model had the highest recall value (0.6944), which is relevant for the identification of more positive cases.

Originality. This study is original in applying predictive models to succession in family-owned businesses, providing empirical evidence and contributing to **SDG 8.**

Conclusions and limitations. Family-owned businesses in Jalisco, Mexico often lack succession planning, which risks their continuity. Strengthening formal mechanisms can improve transitions. The study is limited to Jalisco; further research in other contexts and the institutionalization of succession are recommended**.**

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RESUMEN

Contexto. La mayoría de las empresas mexicanas son de propiedad familiar. Su continuidad depende de una sucesión generacional efectiva. Sin embargo, muchas de estas empresas carecen de estructuras formales de transición, lo que puede amenazar su continuidad y sostenibilidad.

Problema. Las empresas familiares (**FOB**) enfrentan el reto de estructurar sus procesos de sucesión de manera clara y efectiva para asegurar su continuidad y sostenibilidad. El propósito de este estudio es examinar la estructuración de los procesos de sucesión en las empresas familiares mexicanas e identificar los factores que influyen en la claridad y efectividad de estos mecanismos.

Objetivo. Evaluar la idoneidad de los Fondos de la Bolsa Mexicana de Valores para la transición generacional e identificar los componentes organizacionales clave para una sucesión estructurada. El estudio contribuye al **ODS8** al promover una sucesión profesionalizada y la continuidad empresarial sostenible.

Metodología. Investigación empírica en Jalisco (2020 y 2022) recopilando datos de 337 **FOB**. Se evaluó la correlación entre la claridad de los criterios de sucesión y factores como la gobernanza y el tamaño de la empresa. Los modelos de clasificación se compararon utilizando indicadores como la precisión, el recuerdo, la exactitud y la puntuación **F1**.

Hallazgos teóricos y prácticos. Las empresas con estructuras formales de gobernanza, como protocolos familiares, juntas directivas y planes de transferencia de acciones, tienen leyes de sucesión estrictas. El modelo **K-Nearest Neighbors** (**KNN**) mostró el mejor rendimiento en la precisión (0,8038) con puntuación **F1** (0,7044). La regresión logística tuvo el valor más alto de **AUC** (0,8654), lo que indica una alta capacidad discriminativa. El modelo Bayes naïve tuvo el valor de recuerdo más alto (0,6944), lo cual es relevante para la identificación de más casos positivos.

Originalidad. El estudio es original por aplicar modelos predictivos a la sucesión en empresas familiares, con evidencia empírica y aporte al **ODS 8.**

Conclusiones y limitaciones. Las **FOB** en Jalisco,México carecen de planificación sucesoria, lo que pone en riesgo su continuidad. Fortalecer mecanismos formales puede mejorar la transición. El estudio se limita a Jalisco; se recomienda explorar otros contextos e institucionalizar la sucesión.

1.INTRODUCTION

Most companies in Mexico are family-owned. As in other countries (Bennedsen et al., 2006), they have low effectiveness in the intergenerational succession process; that is, most do not survive to a second generation, and a very low percentage manage to pass to a third generation successfully.

Succession has been a priority topic in existing research on family businesses, as shown in recent studies such as those developed by Ribeiro et al. (2023), Ge & Campopiano (2022), Nave et al. (2022) and Ramón (2021), among others.

For their study, several conceptual models have been developed, such as the Organizational implications of three patterns of successions by Le Breton-Miller et al. (2004), as well as the model based on the transfer of knowledge and development of the successor in the family business by Cabrera-Suárez et al. (2001), or the model of transitions in family businesses by Morris et al. (1997). Among them is the Integrative Model for Successful Succession (Le et al., 2004), which breaks down the variables and steps to be followed to achieve successful succession and the aspects that impact the process.

With this research, we intend to determine how prepared Mexican family businesses are to undergo successful succession development. For this purpose, we focus on the first phase of the Integrative Model for Successful Succession by Le Breton-Miller et al. (2004), with the understanding that companies that have already completed the first phase are in a position to advance to the following blocks of the process; similarly, those that have not even covered the first steps will find it challenging to achieve the subsequent stages in the intergenerational succession process successfully.

This study can be linked to the **UN** Sustainable Development Goal (United Nations, n.d.) named *"Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all",* because **FOB** with successful succession can guarantee the economic sustainability of a region and thereby contribute to social development as well as the preservation and growth of decent employment.

In line with this premise, we pose the following question: How influential are Mexican companies in implementing the first phase of Le Breton-Miller et al. (2004), Integrative Model for Successful Succession? In addition, and in order to identify the strongest and weakest common points of Mexican firms, we formulated a second research question: What are the variables of the

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first phase of the model that are fulfilled in most Mexican family firms? A questionnaire was designed and applied to 337 Mexican family businesses to address both questions was applied between 2020 and 2022.

The research is presented in this document in the following order: first, it developed the theoretical framework for the succession process in the family business, as well as the Integrative Model for Successful Succession (Le et al., 2004); second, it is broken down each of the points that comprise its first phase; then It is presented the methodology and the descriptive information; we move on to the description of the conclusions drawn from the research, as well as its limitations; finally, we present the section of bibliographical references used.

2.CONTEXT DESCRIPTION

From a national standpoint, the Mexican Instituto Nacional de Estadística y Geografía (INEGI, 2025) reports there are 7,056,499 established businesses in Mexico. In the state of Jalisco, two years after the COVID-19 pandemic ended, businesses and establishments in Jalisco have improved in sales compared to 2021 (IIEG, 2022). According to this survey, the percentage of companies that expect a sales increase in the second half of 2022 went from 40.7% to 43.5%, while those that expect a decrease fell from 18.6% to 12.5%. However, 81.9% of companies reported increased cost, and 37.9% indicated that the conflict between Russia and Ukraine affected their business, mainly due to higher costs and shortages of inputs.

The study also highlighted that 33.1% of economic units are family businesses, although 56% define themselves as such. Of these companies, 66.4% are run by the first generation, 25.3% by the second, and 4.5% by the third.

From a family business standpoint, *Radiografía de la empresa familiar en México* (San Martín & Durán, 2017,32), points out that the total businesses in the country 95% are small and micro. Of the total business, 83% can be considered family business, and in the state of Jalisco, around 82% are family business (San Martín & Durán, 2017, 29). Given their economic weight and employment capacity, especially in post-pandemic recovery, the role of family and small businesses is directly connected to **SDG 8: Decent Work and Economic Growth**, which emphasizes inclusive and sustainable economic growth, productive employment, and decent work for all.

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3.LITERATURE REVIEW

Before answering the questions posed in the previous section, it is necessary to examine relevant literature on family business succession and its effectiveness in family businesses. The theoretical framework is organized into two sections: the first deals with family business succession, and the second describes the Le Breton-Miller et al. (2004) Integration and Effectiveness Model.

3.1.Succession in Family Businesses

CEO succession is an issue that affects all firms and has been studied by various authors (Berns & Klarner, 2017; Duckworth-Chambless et al., 2023). Succession, understood as the transmission of ownership and leadership of a company from one generation to another, is not an issue that exclusively affects the coexistence of the family that owns it but also influences the financial performance of the company, as studied by Freidman and Singh (1989), among other authors.

Diverse elements impact the succession process. One of them is the personal factor, since in the appointment of the successor, there is often *"an attachment to the past, its total rejection or an incongruent mixture of past and present"* (Le Breton-Miller et al., 2004). A second circumstance is a dilemma of where to choose a better candidate, whether it will be a family member or an outsider (Ramírez et al., 2021). Thirdly, the leaders of family businesses (**FOBs**) strongly influence the succession process, which sometimes makes the reactions more extreme.

These obstacles sometimes come from a lack of understanding of this dimension. Succession is not a simple occurrence. It should be a strategic process (Gimenez & Novo, 2020; Porfirio et al., 2020). These reactions are mainly those of an immature successor plan due to different factors deeply studied (Picone et al., 2021; Gagne et al., 2019), such as confusion, rebellion, dependence, and excessive changes. These behaviors affect the structure and strategy of the firm (Le Breton-Miller et al. (2004).

The effectiveness of the succession process is fundamental for the company's endurance over time. Fortunately, there are different models of the succession process, such as the one proposed by Le Breton-Miller et al. (2004), where the different phases of the succession process are

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presented comprehensively, each one with its multiple factors to be considered, in addition to the external influences that surround the process. This model is related to the need for the development of Human Capital for innovation, as described by Castillo-Esparza et al. (2022).

Given its influence on long-term business continuity, employment generation, and organizational resilience, a well-structured succession process in family firms directly contributes to **SDG8**: *Decent Work and Economic Growth, by supporting sustainable business practices and intergenerational productivity* (United Nations, n.d.)

3.2.Integrative model for successful succession

This model is not widely implemented in Mexico, but it has been used for analysis and development in various countries, as indicated by the literature review. Therefore, its implementation for the evaluation and development of family businesses would be innovative in terms of Innovation management activities according Oslo Manual (OECD, 2018, 91). Developing the capabilities to innovate and keep the fundamentals for business sustainability is essential to maintain the family business throughout generations (Mejía-Trejo, 2021; OECD, 2018, Chapter 5; Pinzón-Castro & Maldonado-Guzmán, 2023).

The integrative model for successful succession encompasses different levels of information and variables such as the industry, the family business, and, at the other end, the social and family context. These two blocks are interconnected and directly affect the succession process. It starts with a series of rules of the game and the first steps that make up the initial stage; the second is the nurturing or development of successors; the third, the successor selection; and the last is the transition process that includes the transfer of capital. All these interrelated variables are monitored and evaluated in the process.

3.3.The design of the final instrument

Due to the breadth of the model and in line with the research questions posed, we focus this research on the first phase of the succession process, which comprises the rules of the game and the first steps. In subsequent work, measuring the rest of the phases will be helpful. In this first part of the process, the succession plan is founded, which serves as a basis for sharing the vision of the future; relevant variables are included, such as:

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a. Selection criteria and potential successors,

b. Range of candidates (e.g., family or external),

c. Governance guide and

d. The transition and share splitting plan, as well as the period in which it is planned and how all parties will be synchronized (Le et al., 2004).

The following is a synthesized description of the variables mentioned above.

3.4.The Conceptual Model

According to Le Breton-Miller et al. (2004), and in line with the UN **SDG8** *"Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all"*, the conceptual model is built with the following stages:

3.4.1.Selection criteria for successors

The successor selection begins with the identification of potential candidates. This choice requires generating criteria that are clear to both selectors and applicants. A common criterion is that the successor be a descendant of the **CEO**. Stewart (2003) points out that candidates descended from the **CEO** share a network of family associations and social links with the founder. This would not have impediments to succession effectiveness if proper criteria were in place to help select the best candidate among the descendants; however, the practice of transferring power in family firms to the firstborn is common in many **FOBs** (Ahrens et al., 2015)

The relevance of primogeniture and birth order has been linked to effective leadership in family firms (Schenkel et al., 2016). Nonetheless, this factor carries strong cultural significance and has experienced notable transformations in recent years.

3.4.2.Range of Candidates

The criteria for the selection rank of **CEO** candidates must be clear. The decision on this issue concerns whether the candidate is external or internal to the family. In addition to the observations made by Stewart (2003) in the previous section, internal candidates can align the interests of managers and owners and avoid or ameliorate the principal-agent problem.

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Even if the successor rank is determined only internally, there are other points to be defined, such as the issue of primogeniture. In recent years, there has been much criticism of this form of succession (based on primogeniture) and also of those ranges that consider gender and, therefore, leave female members of the family out of the selection range. Once the range of candidates is clear, it should be analyzed to see if there is a solid governance guide.

3.4.3.Governance Guide

Corporate governance is indispensable in a **FOB** to advance its performance (Gedajlovic et al., 2004; Nordqvist et al., 2014); but in addition to having a solid board of directors and management, it is also suggested to have a family council and a family protocol, as shown by several examples where the company's results were beneficial (Arteaga & Méndez-Requejo, 2017). In the succession process, and specifically in the early stages, having solid governance of the company simplifies the task. In addition to having all the governing bodies that control ownership, management, and the family, a transition and stock split plan should be established.

3.4.4.Transition and stock split plan

Several factors are involved in succession, such as cultural norms (Sharma & Rao, 2000), birth order (Stewart, 2003; Schenkel et al., 2016), as well as those of a financial nature, specifically of the shareholding partition. In some countries, such as Spain, **FOBs** have family constitutions that establish norms and rules for all their members; among them is the transfer of shares (Arteaga & Mendez-Requejo, 2017). Due to its importance and ability to empower the new leader of the company, it is suggested that this distribution of shares be made immediately after the completion of the succession (Pott et al., 2001b; Farah et al., 2020). Morris et al. (1997) assert that when family members get involved in the transfer of wealth, they have a better relationship.

Control of successor shares provides certainty to non-family shareholders who also do not have controlling shareholding, as sometimes majority shareholders can benefit from the gains made over those who hold fewer shares (Hoffmann et al., 2014; Johnson et al., 2000; Morck et al., 2005).

Gersick et al.(1999) identify three types of ownership transitions: the first type of transition is when there is a change of leaders, but the same ownership structure is maintained; the second is called Devolutionary Transitions, where there is a change to a less complex structure; finally, there

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is the Evolutionary Transitions which, contrary to the previous one, changes to a more complex structure.

In this first part of the integrative model for successful succession, the succession plan that serves as a basis for sharing the vision of the future is founded. It includes relevant variables such as:

a. **Selection criteria and potential successors,**
b. **Range of candidates** (e.g., family or external),
c. **Governance guidelines**, and finally,
d. **Transition and sharing plan**, as well as the period in which it is planned and how all parties will be synchronized, period and timing.

Le Breton-Miller et al. (2004) mention that to be established early, it should not only be adjusted based on experiences and feedback but also on communication.

4.METHODOLOGY

The methodology is mainly based on an empirical study (Bruhn-Jensen, 2014), based on the first phase of the integrative model for successful succession (Le et al., 2004), within the section of succession processes referring to management and ownership and, specifically, on the rules of the game and first steps. Based on the study of 337 surveys, we made a description, in line with Rojas (2008), that helps us to detail our findings.

The questionnaire was applied electronically through the **Questionpro tool** based on the Model described. Thirty-nine questions were summited to professionals working in family business in the state of Jalisco between 2020 and 2022 and ware answered by 337 family members and employees working in the family business. The survey was shared through digital platforms, such as LinkedIn and sent to students, graduates, and parents with family businesses at private universities and business schools. It was controlled by the number of generations currently running the company, assuming that the more advanced the generation in charge of the company, the more likely it is to be aware of the rules of the game and the first steps of the succession process.

We also analyzed several scientific articles and selected the model we considered most complete, such as the Integrative Model for Successful Succession by Le Breton-Miller et al. (2004), to serve as the basis for the development of our study. Finally, we used a criterion based

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on hierarchies (Saaty & Vargas, 2012) to order and select the stage that we considered the priority to focus our empirical study: the rules of the game and the first steps. This section presents the analytical approach applied to the data collected from 337 surveyed family businesses. It is structured as follows: first, the generational variable related to current management is addressed (5.1); then, exploratory data analysis is conducted (5.2); followed by the data cleaning process (5.3); and finally, the evaluation of the classification model's performance (5.4).

4.1.Data Analysis

To control, according to the generation currently managing the company, the information corresponding to each of the 337 surveys was obtained, as shown in **Table 1**. As can be seen, more than half of the responses were given by companies in their first generation, followed by 34% for those in the second, decreasing to 9% for the third and only 3% for the fourth or successive generation. These percentages seem to confirm the normality of the sample because, indeed, most family businesses are first-generation, which decreases as the generation advances.

Table 1: Number of generations of family members currently managing the company.

The generation is currently managing the business.	Frequency	Percentage
1st	182	54%
2nd	114	34%
3rd	30	9%
4th or higher	11	3%
Total	**337**	**100%**

Note: The table shows a simple distribution of the generation to which the general management of the companies studied corresponds (in number and percentage) according to the survey applied.
Source: own

Table 2 shows the computation of the percentages obtained from the affirmative answers in the survey regarding the existence and functioning of governance bodies in Mexican family businesses, as well as the establishment of the rules of the game and the first steps for a successful succession.

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Table 2. Percentage of affirmative responses to the survey items according to the generation currently managing the company

Generation	A	B	C	D	E	F	G	H	I	J
1st	42%	31%	49%	63%	18%	44%	48%	43%	34%	16%
2nd	34%	34%	45%	63%	14%	54%	57%	52%	41%	26%
3rd	43%	47%	70%	60%	37%	67%	70%	57%	50%	37%

A: Successor is already chosen ; **B:** Clear rules for succession; **C:** Group of candidates for succession; **D:** Clarity in decision-making; **E:** Defined timeframe for succession; **F:** Board of Directors; **G:** Shareholders meeting; **H:** Stock split plan; **I:** Family Council **J:** Written Family Protocol

Note: Table 2 shows, according to the survey applied, the percentages of companies of the total studied that have the existence and functioning of governance bodies in family businesses, establishing the rules and first steps for a successful succession.

Source: own

4.2.Data processing. Exploratory data analysis

To ensure the transparency and reproducibility of the research, the underlying data used to build the classification model has been thoroughly analyzed and performance has been assessed alongside exploratory data analysis.

Panel 1 of Graphs 1 to 15, developed based on our analysis, shows the generational distribution of family businesses, where most companies are in their first or second generation, indicating younger family businesses dominating the sample. The analysis reveals several critical perspectives regarding current succession planning practices in the context of Mexican family businesses. Most companies do not have a clearly planned succession, which highlights the potential risks to business continuity during generational transitions. In terms of corporate governance structures, there is a balanced distribution of companies that have established a formal board of directors, slightly outnumbering those that have not implemented this governing body. In addition, many companies regularly hold shareholder meetings, demonstrating consolidated practices in the governance of ownership. However, there is evidence of a significant lack of ownership succession planning, as about half of the companies do not have a clearly defined plan for the transfer of shares. This situation points to the need to implement policies that promote more efficient ownership management practices, thus ensuring more fluid and effective transitions.

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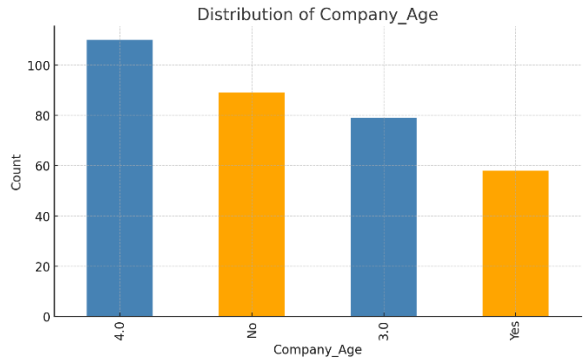
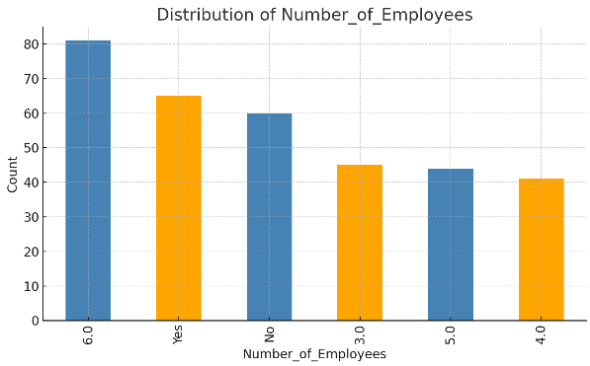
Panel 1. Graphs 1 to 15: Distribution of organizational and succession-related variables.

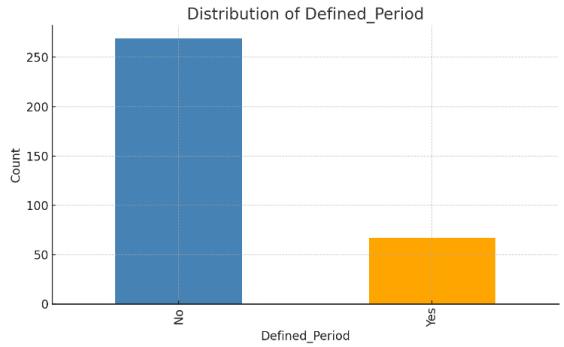
Graph 1



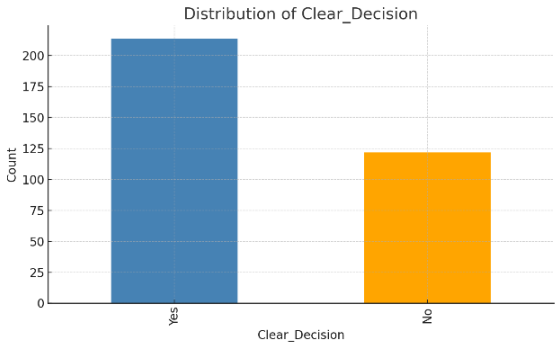
Graph 2



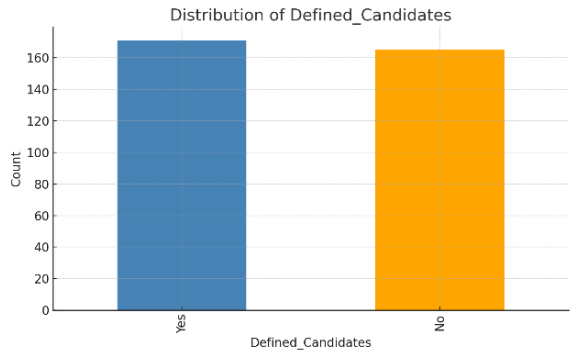
Graph 3



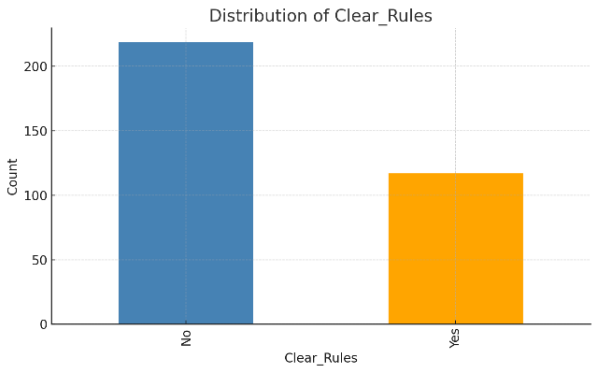
Graph 4



Graph 5



Graph 6



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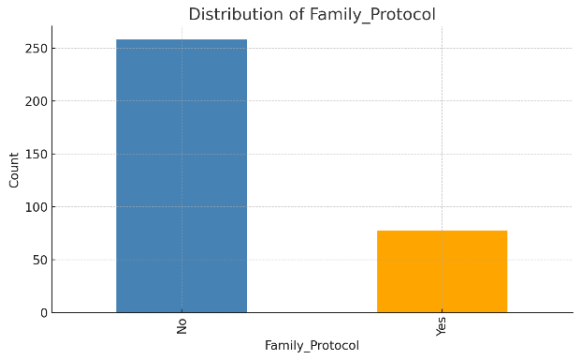
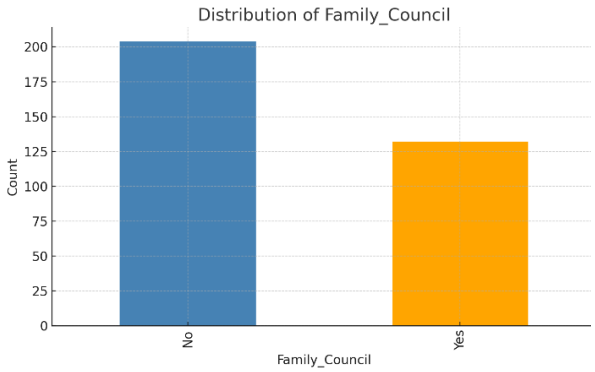
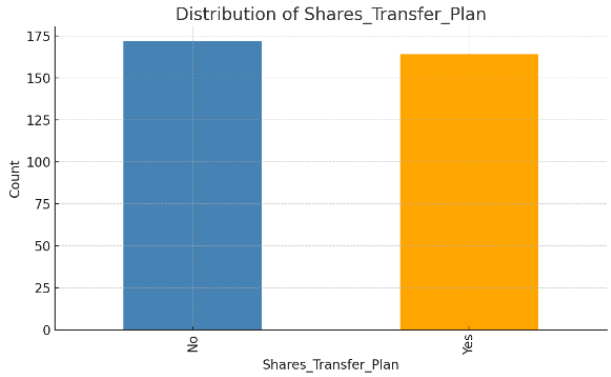
Graph 7



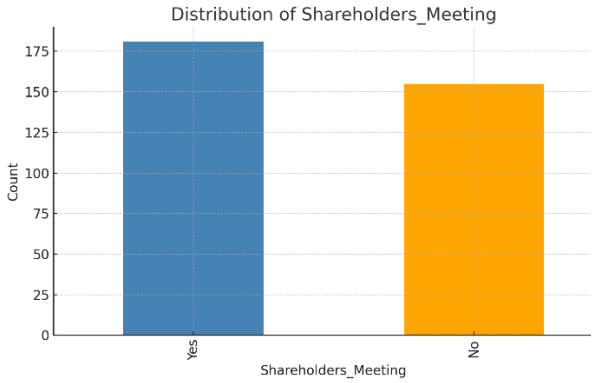
Graph 8



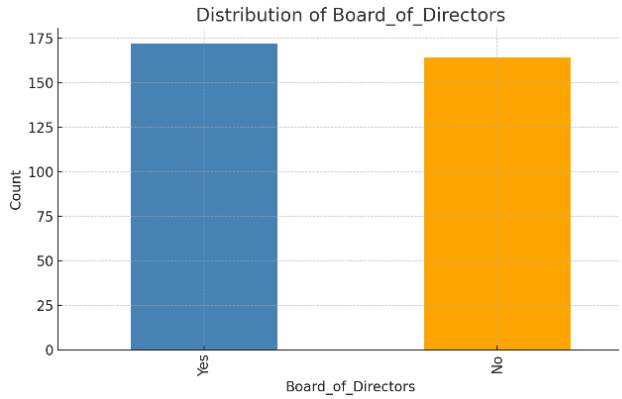
Graph 9



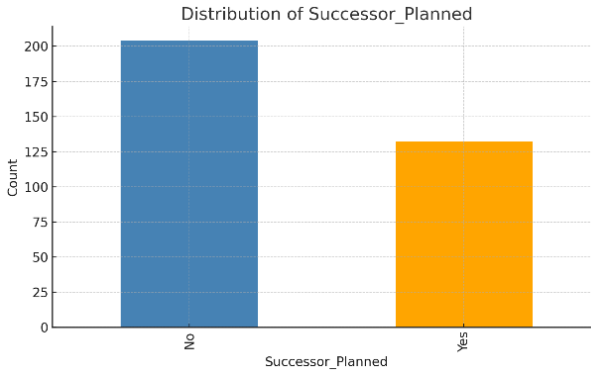
Graph 10



Graph 11



Graph 12



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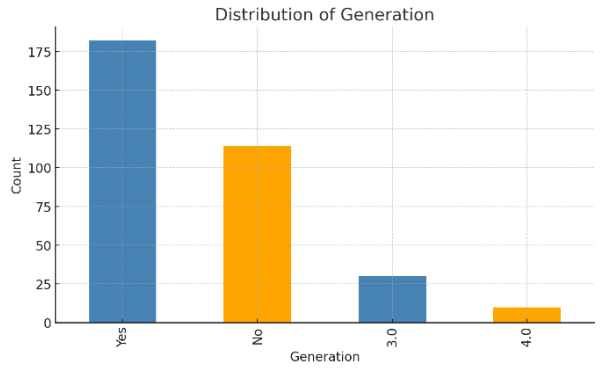
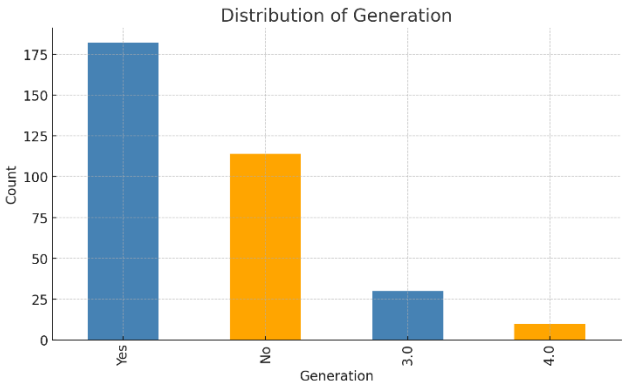
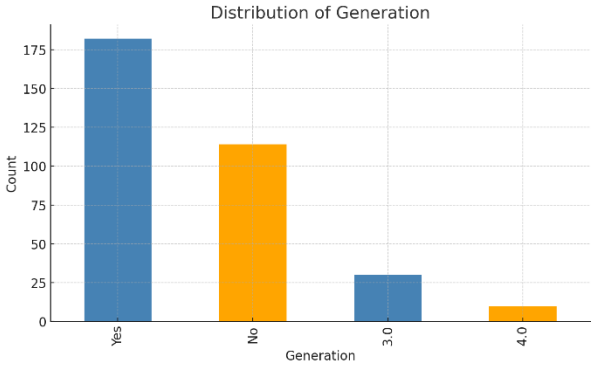
Graph 13



Graph 14



Graph 15



Source: own elaboration based on survey data (n = 337), visualized using PyCaret and Python libraries (Seaborn and Matplotlib).

There are notable deficiencies in family governance structures, with many companies lacking a formal family council and a written family protocol, which could hinder transparent decision-making and effective communication during succession processes. In fact, many companies report that they do not have clearly established succession rules, highlighting an important area for improvement.

Although a slight majority have identified potential succession candidates, many companies have not adequately addressed this issue. Paradoxically, despite the lack of formal succession rules, most companies reported clarity in their succession decision-making processes. However, the exact timing of succession remains uncertain, as the vast majority have not defined a specific time frame for this transition.

Regarding the size and life cycle of the companies, the analysis shows that many companies are small or medium-sized, with a limited number of employees and, in general, a relatively short

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life cycle. This demographic characteristic may explain why structured succession planning is not prioritized in the early stages, although it remains crucial for future continuity and stability.

Analysis of the correlation matrix provided additional information, showing moderate positive relationships between variables associated with governance structures, such as the existence of a family protocol, clear rules and regular shareholder meetings. These relationships suggest that companies implementing one aspect of governance tend to adopt several governance practices simultaneously. In addition, a moderate correlation has been observed between the size and age of the company, suggesting that, over time, companies tend to expand in terms of size and complexity, which could increase the need for structured succession planning. **See Graph 16.**

4.3.Data Cleaning

PyCaret was utilized to execute the data cleaning process, which entailed the identification, correction, and elimination of errors, inconsistencies, and redundant data from the dataset. This procedure was implemented to ensure the accuracy and reliability of the results.

PyCaret, a Python library designed to facilitate data preparation for model training, offers specific functions for data cleaning, outlier handling, missing value imputation, and categorical variable encoding. In certain instances, more specialized techniques were necessary for categorical variable encoding, including one-hot encoding and label encoding.

The **PyCare**t classification module was employed to address classification problems in the database columns. This model predicts the possibility of generating new categorical variables from the input values. Following the processing of the data, the dataset was randomly partitioned into two segments: **70%** was allocated for training the algorithms, while the remaining **30%** was set aside for testing. The training dataset was subdivided into ten parts to optimize the outcomes.

The training and comparison of the model were conducted using the *"qualified opportunity"* field as the target variable. Given that **PyCaret** facilitates the comparison of multiple machine learning models, the data were analyzed using various classification algorithms, including Naive Bayes, logistic regression, Ada Boost classifier, Random Forest classifier, Gradient Boosting classifier, Extreme Gradient Boosting, Light Gradient Boosting, Quadratic Discriminant

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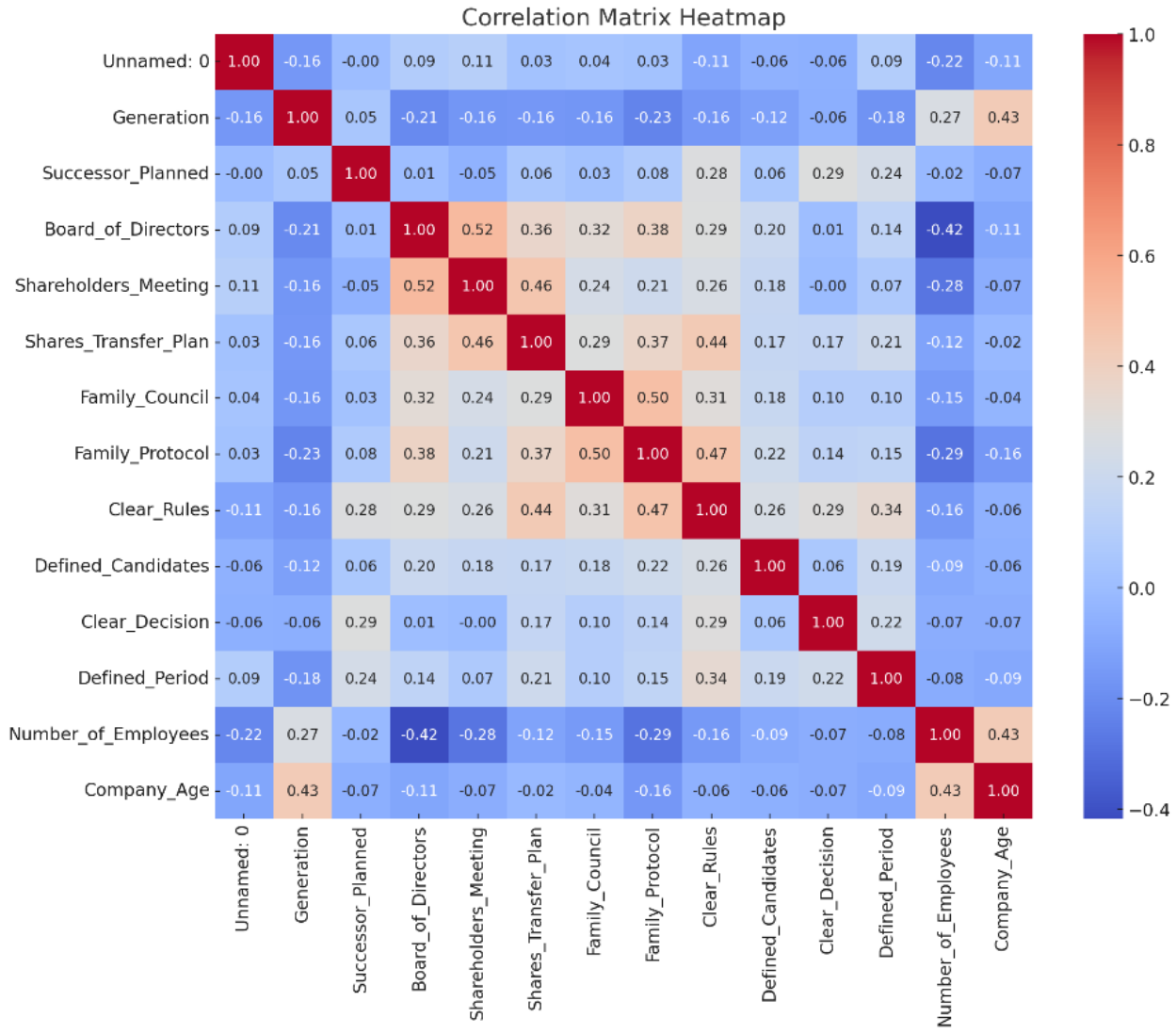
Analysis, Linear Discriminant Analysis, Decision Tree classifier, K-Neighbor classifier, Sparse Tree classifier, Dummy classifier, Ridge classifier, and SVM.

Graph 16. Correlation Heatmap of Governance and Succession-Related Variables in Family Businesses



Source: own elaboration based on survey data (n = 337), visualized using PyCaret and Python libraries (Seaborn and Matplotlib).

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4.4.Model Performance Evaluation

This section will address the evaluation of model performance by describing some of the evaluation metrics used for this purpose. First,

- **Accuracy** is defined as the proportion of correctly predicted sales out of the total number of sales predictions (correct or incorrect).
- **Precision** is defined as the proportion of true positives out of the total number of positive predictions.
- **Recall** (sensitivity or completeness) is the proportion of true positives out of the total number of true positives.
- **The F1 score** is the arithmetic mean of the precision and recall scores. This metric is defined as the percentage of correctly predicted sales out of the total number of actual sales predicted. The range of values that this metric can take is from 0 to 1, with higher values indicating higher classification performance.

To assess the efficacy of the most advanced models, the following analytical instruments were employed: Initially, the confusion matrix was employed, which encapsulates the performance of a classifier in its classification function with respect to a designated set of test data. Receiver operating characteristics (**ROC**) are employed to assess multiple systems, including machine learning systems. This two-dimensional graph enables a balanced assessment of the benefits that would result in true positives and the costs that would result in false positives.

The area under the **ROC** curve (**AUC**) quantifies the model's ability to differentiate between classes. This metric ranges from 0 to 1. A value less than 0.5 indicates an unrealistic classifier, suggesting that the prediction model is unable to differentiate between classes. Conversely, a value above 0.7 indicates that the model performs optimally in differentiating between classes.

Table 3, based on our analysis, presents a comparison of various classification models based on different performance metrics, including Accuracy, **AUC** (Area Under the Curve), **Recall, Precision, F1-score, Kappa, and MCC** (Matthews Correlation Coefficient). The highlighted values indicate the best-performing models in specific categories.

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Table 3: Model evaluation metrics

	Model	Accuracy	AUC	Recall	Prec.	F1	Kappa	MCC
knn	K Neighbors Classifier	0.8125	0.8494	0.6569	0.8038	0.7044	0.5712	0.5903
gbc	Gradient Boosting Classifier	0.7953	0.8601	0.6319	0.7770	0.6828	0.5356	0.5511
lda	Linear Discriminant Analysis	0.7953	0.8622	0.6444	0.7774	0.6830	0.5373	0.5537
lightgbm	Light Gradient Boosting Machine	0.7911	0.8418	0.6806	0.7427	0.6903	0.5358	0.5525
ridge	Ridge Classifier	0.7909	0.8607	0.6194	0.7810	0.6601	0.5191	0.5373
ada	Ada Boost Classifier	0.7908	0.8637	0.6569	0.7677	0.6933	0.5383	0.5492
nb	Naive Bayes	0.7830	0.8558	0.6944	0.7296	0.7010	0.5339	0.5408
xgboost	Extreme Gradient Boosting	0.7826	0.8346	0.6569	0.7409	0.6748	0.5158	0.5332
lr	Logistic Regression	0.7784	0.8654	0.6444	0.7506	0.6780	0.5130	0.5244
et	Extra Trees Classifier	0.7784	0.7528	0.6069	0.7522	0.6470	0.4930	0.5129
qda	Quadratic Discriminant Analysis	0.7741	0.8412	0.6444	0.7228	0.6585	0.4946	0.5088
rf	Random Forest Classifier	0.7524	0.8202	0.6069	0.6820	0.6267	0.4462	0.4570
dt	Decision Tree Classifier	0.7489	0.7234	0.5597	0.7101	0.6090	0.4299	0.4480
svm	SVM - Linear Kernel	0.7147	0.8334	0.6167	0.6695	0.5871	0.3814	0.4115
dummy	Dummy Classifier	0.6511	0.5000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: own elaboration using PyCaret's compare models function within a Python environment.

Key Observations:

1. **Best Accuracy**: **The K-Nearest Neighbors** (**KNN**) classifier has the highest accuracy (0.8125), making it the most overall accurate model in this comparison.
2. **Best AUC**: Logistic Regression (**LR**) achieves the highest **AUC** (0.8654), meaning it has the best discriminatory power between classes.
3. **Best Recall:** The Naïve Bayes (**NB**) classifier has the highest **Recall** (0.6944), meaning it correctly identifies more positive cases than the other models.

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4. **Best Precision: KNN** also has the highest Precision (0.8038), indicating that when it predicts a positive case, it is correct more often than other models.
5. **Best F1-score: KNN** (0.7044) balances precision and recall the best.
6. **Best Kappa and MCC**: **KNN** also leads in **Kappa** (0.5712) and **MCC** (0.5903), which measure agreement and correlation between predicted and actual classifications.

Interpretation:

- **KNN** emerges as the best model overall, leading in multiple categories including **Accuracy, Precision, F1-score, Kappa, and MCC.**
- **Logistic Regression** has the best **AUC**, indicating that it may perform well in ranking predictions rather than absolute classifications.
- **Naïve Bayes** has the highest Recall, meaning it is better at detecting positive cases but might have more false positives.
- **Tree-based methods (Random Forest, Decision Tree, Extra Trees)** perform worse than boosting models (Gradient Boosting, AdaBoost, XGBoost), indicating that ensemble boosting techniques improve performance.

5.RESULTS

The results section presents the key findings derived from the analysis conducted. It begins with an examination of the variables included in the predictive model, highlighting their relative importance in determining the presence of clear succession rules in family businesses. This is followed by inferential statistical analysis aimed to validating the associations between governance-related variables and succession clarity. Categorical variables were tested using chi-square analysis, while quantitative variables were examined through **ANOVA** to explore potential differences based on organizational characteristics. These results provide a comprehensive view of the structural and procedural factors that influence succession planning in the context of family enterprises.

5.1.Feature Importance Analysis

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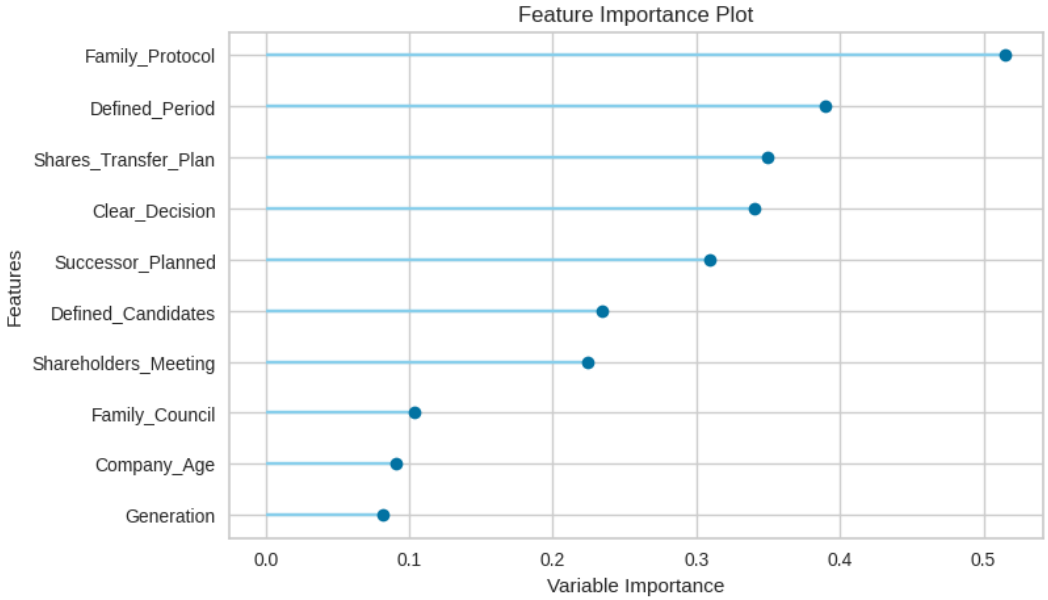
Graph 17, based on our analysis, shows the relative importance of various features used in a predictive model, ranked from most to least important.

Graph 17. Relative Importance of Variables in Predicting Succession Clarity



Source: own elaboration using PyCaret (classification module), Seaborn, and Matplotlib, based on survey data (n = 337).

Here is the interpretation in detail:

1. **Family_Protocol** is the most important feature, suggesting that having a family protocol significantly influences the predictive power of the model.
2. **Defined_Period** is the second most influential factor, highlighting the importance of having clearly defined timelines or periods.
3. **Shares_Transfer_Plan** also has a strong influence, emphasizing that having a structured shares transfer plan contributes significantly to the prediction.
4. **Clear_Decision** shows substantial importance, indicating that clarity in decision-making processes is critical.
5. **Successor_Planned** is also relevant, emphasizing the importance of succession planning in the predictive context.
6. **Defined_Candidates and Shareholders**_Meeting have moderate importance, suggesting that defined candidate pools and regular shareholder meetings positively impact the outcomes, but less strongly than the variables listed above.

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7. **Family_Council, Company_Age, and Generation** have relatively low influence, implying that while these factors are helpful, their impact is minor compared to the higher-ranking variables.

5.2.Inferential Statistical Analysis

Two types of inferential statistical analyses were conducted to validate the relationships between variables and assess their relevance to clear succession rules in family businesses. A chi-square (χ^2) test was performed for categorical variables to verify the presence of a statistically significant association between the categorical predictor variables and clear succession rules. As part of this process, contingency tables were developed to tabulate each predictor variable alongside the target variable. Chi-square statistics and corresponding *p*-values were calculated to assess the strength and relevance of these associations. The findings indicated significant correlations ($p - values < 0.05$) between key governance structures, such as a family protocol, a board of directors, a family council, clearly defined succession periods, and clearly defined candidates. This underscores that organizations with formal governance structures are more likely to have established clear succession rules.

In **Table 4,** based on our analysis, all categorical variables demonstrate statistically significant associations with the target variable (Clear Rules, clear rules for succession), with p-values less than 0.05.

Table 4. Chi-Square Test Results for Categorical Governance Variables and Succession Clarity

Variable	χ^2 Statistic	*p*-value
Successor_Planned	25.49778	4.43E-07
Board_of_Directors	26.82297	2.23E-07
Shareholders_Meeting	22.11819	2.56E-06
Shares_Transfer_Plan	62.08005	3.3E-15
Family_Council	30.45359	3.42E-08
Family_Protocol	72.25231	1.89E-17
Defined_Candidates	20.89425	4.85E-06
Clear_Decision	27.40024	1.65E-07
Defined_Period	36.81187	1.3E-09

Source: own elaboration based on survey data (n = 337), using Python

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The most notable variables are:

a. **Family Protocol** (p = 1.89e-17): This variable demonstrates a highly statistically significant association, indicating that companies that implement a family protocol tend to have clear rules.
b. **Shares Transfer Plan** (p = 3.29e-15): highly significant, underscoring the significance of a well-defined share transfer plan.
c. **Defined Period** (p = 1.30e-9) is another salient variable, as companies with a defined period demonstrate a significant degree of clarity in their succession rules.
d. **Family Council** is also closely linked to succession clarity (p = 3.42e-9). Additionally, a strong correlation was observed between the presence of a **Board of Directors** and clear decision-making processes, with p-values of 2.23e-7 and 1.65e-7, respectively.

For the quantitative variables (number of employees and organizational age), an analysis of variance (**ANOVA**) was conducted to determine whether there were statistically significant discrepancies between groups defined by the presence or absence of explicit succession rules. Essentially, the **ANOVA** tests whether the means of these continuous variables differ significantly between the two groups (companies with clear regulations versus those without). The findings indicated that only the number of employees showed significant variations, suggesting that organizational size impacts the clarity of succession planning. In contrast, corporate age was not statistically significant, indicating that corporate maturity does not significantly impact the formalization of succession rules.

Table 5, developed in our analysis, shows that the number of employees exhibited statistically significant differences depending on clear succession rules within the company (significant F, $p < 0.05$).

Table 5. ANOVA Results for Quantitative Variables and Succession Clarity

Variable	F Statistic	*p*-value
Number_of_Employees	8.359957	0.004087
Company_Age	1.104867	0.29396

Source: own elaboration based on survey data (n = 337), using Python's

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This finding suggests that company size may have a bearing on the formalization of the succession process. In contrast, the analysis revealed that company age did not exhibit statistically significant differences (p = 0.29), indicating that seniority does not appear to be a determining factor in the establishment of clear succession rules.

6.DISCUSSION

Critical Analysis of the Results: The results obtained in this research show that the **KNN** model was the most accurate, with an accuracy of 81.25%. This suggests that family businesses implementing formal governance structures, such as family protocols and share transfer plans, would have greater clarity in their succession processes. This finding is consistent with previous studies that have highlighted the importance of formalization in business succession.

Relationship with the State of the Art: The existing literature on family business succession has emphasized the need for structured succession planning. Studies such as those by Le Breton-Miller et al. (2004) have proposed integrative models that highlight the importance of factors such as governance and share transfer. The results of this research confirm these theories and provide additional empirical evidence that reinforces the relevance of these factors in the Mexican context.

6.1.Theoretical Contribution

This study provides a theoretical contribution by empirically supporting the first phase of the Integrative Model for Successful Succession developed by Le Breton-Miller et al. (2004). The results validate that elements such as the existence of a family protocol, a clearly defined period for succession, and a structured transfer plan are strongly associated with the presence of clear succession rules. These findings reinforce the model's emphasis on early formalization as a critical factor for intergenerational continuity.

The research also complements earlier work by Miller et al. (2003), who analyzed different succession patterns and their organizational implications, highlighting the need to consider both strategic and emotional dynamics in succession planning. Additionally, the inclusion of selection criteria and successor identification in the analysis is aligned with Stewart (2003), who emphasized the relevance of family ties and social capital in choosing future leaders.

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Moreover, the study provides a contrasting insight to that of Schenkel et al. (2016), who focused on birth order and identity roles in descendant CEOs. In this research, structural aspects such as company size emerged as more statistically significant than personal or cultural factors like firm age or generational leadership, suggesting new directions for succession theory.

6.2.Practical Contribution

This study offers practical implications for improving succession planning in Mexican family-owned businesses. The results show that firms that adopt **formal governance mechanisms**—such as family protocols, share transfer plans, boards of directors, and shareholder meetings—are significantly more likely to exhibit clarity in their succession rules. This highlights the urgent need to institutionalize these practices, especially in early generational stages, where such structures are often lacking.

Importantly, the study identifies **company size**, measured by the number of employees, as a statistically significant factor influencing succession clarity—more so than company age. This finding suggests that as family businesses grow, they should prioritize the implementation of structured succession processes to ensure long-term continuity.

These findings are especially relevant in the context of **Jalisco** state in Mexico where a high percentage of businesses are family-owned but lack formal succession planning. According to national data, over 66% of family businesses in Jalisco are managed by first-generation leaders (IIEG, 2022), and more broadly, 83% of businesses in Mexico can be classified as family-owned (INEGI, 2025). Strengthening their succession mechanisms is therefore critical to their survival and sustainability.

Finally, this research aligns with the United Nations **SDG8** (United Nations, n.d.), which promotes sustained economic growth and decent work for all. By contributing to business continuity, succession planning in family firms supports employment stability and local economic development.

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7.CONCLUSION

The main objective of this study is to evaluate the performance of different classification models applied to the prediction of clear succession rules in Mexican family businesses. To this end, several key factors influencing the formalization of the succession process have been identified.

The results of the study highlight that the K-Nearest Neighbors (**KNN**) model performed best in several metrics, including accuracy, **F1 score, Kappa and MCC**, which positions this model as the most robust option for classifying firms according to the clarity of their succession rules.

However, the logistic regression model had the highest **AUC**, suggesting greater effectiveness in class discrimination. In addition, the Naïve Bayes model stood out in the recall metric, indicating that it is more effective in identifying positive cases, albeit with a higher risk of false positives.

The analysis of the importance of the variables revealed that the existence of a family protocol, a share transfer plan and the definition of a succession period are the most influential factors in the formalization of clear succession rules. Other factors, such as clarity in decision-making, succession planning and the existence of a family council, were also relevant, but with less weight. On the other hand, the age of the firm and the generation of leadership were found to have less significant influence.

Statistically, chi-squared tests confirmed significant associations between different governance structures (family protocol, shareholders' meeting, board of directors, among others) and the existence of clear succession rules. Analysis of variance (ANOVA) showed that the size of the company, measured by the number of employees, has a significant impact on the clarity of succession rules, while the age of the company did not show a relevant effect.

These findings underscore the importance of implementing formalized governance mechanisms to optimize succession planning in family businesses, especially in first- and second-generation businesses, where the lack of preparation is more pronounced. Similarly, the need for a structured approach to leadership transfer is evident, highlighting the role of formal planning in the sustainability and continuity of businesses over time.

As mentioned, based on the UN Sustainable Development Goal (United Nations, n.d.), this study contributes to the **SDG8***: "Promote sustained, inclusive and sustainable economic growth,*

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full and productive employment and decent work for all", because it shows how family business successful succession helps to ensure sustainability in terms of economic growth employment development.

However, it is important to note that the inherent limitation of the study lies in its focus on the Mexican context, which may limit the generalizability of the results to other business cultures. It is recommended that future research deepen the causality of the factors identified and evaluate the implementation of succession strategies in different organizational settings.

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Distinguishing Ecological Economics from Environmental Economics, Green Economy, Circular Economy, and Bioeconomy in the 21st Century

Distinguiendo la Economía Ecológica de la Economía Ambiental, la Economía Verde, la Economía Circular y la Bioeconomía en el siglo XXI

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Palabras Clave: bases de datos bibliográficas, meta-análisis, paradigmas, medio ambiente, economía, economía ecológica.

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ABSTRACT

Context. In the 21st century, several economic-environmental approaches —such as ecological economics, environmental economics, green economy, circular economy, and bioeconomy— have emerged to address the increasing complexity of sustainability challenges. These frameworks stem from different historical, regional, and disciplinary contexts and reflect diverse interpretations of the relationship between the economy and the environment.

Problem. Although they share a common concern for sustainability, these approaches often overlap in terminology and scope, generating conceptual ambiguity and reducing their analytical clarity and policy relevance. The central question is: what distinguishes ecological economics from other paradigms in the 21st century?

Purpose. The purpose of this study is to differentiate ecological economics from other contemporary approaches that analyze the relationship between economy and environment. It reviews 21st-century scientific literature to establish conceptual similarities and differences, focusing on theoretical foundations and keywords.

Methodology. A meta-analysis was conducted on peer-reviewed articles indexed in Scopus between 2000 and 2020. Author-defined keywords were analyzed in terms of frequency, co-occurrence, and exclusivity to identify conceptual patterns among the five approaches.

Theoretical and Practical Findings. *Ecological economics* is distinguished by its emphasis on biophysical limits, social metabolism, political ecology, and distributional conflicts. Theoretically (*Scientia*), it helps delimit paradigmatic boundaries; practically (*Praxis*), it guides public policies and academic programs with a critical perspective on sustainability and justice. It contributes to **SDG 8** by encouraging structural economic transformation, and to **SDG 13** through its focus on climate action.

Originality. The study applies a multidisciplinary approach that contrasts market-based models with an ecological paradigm centered on justice. It proposes *"ecologizing the economy"* rather than *"economizing ecology."*

Conclusions and Limitations. *Ecological economics* emerges as a distinct paradigm. Its main limitation is the exclusive use of English sources. Future research should adopt multilingual and participatory approaches. It also supports **SDG 8** and **SDG 13** through inclusive and climate-focused strategies.

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RESUMEN

Contexto. En el siglo XXI han surgido diversos enfoques económico-ambientales —como la economía ecológica, la economía ambiental, la economía verde, la economía circular y la bioeconomía— para enfrentar la complejidad creciente de los desafíos de la sostenibilidad. Estos marcos provienen de distintos contextos históricos, regionales y disciplinares, y reflejan diversas interpretaciones sobre la relación entre economía y medio ambiente.

Problema. Aunque comparten una preocupación por la sostenibilidad, estos enfoques suelen solaparse en su terminología y alcance, lo que genera ambigüedad conceptual y reduce su claridad analítica y utilidad política. La pregunta central es: ¿qué distingue a la economía ecológica de los demás paradigmas en el siglo XXI?

Propósito. El propósito de este estudio es diferenciar a la economía ecológica de otros enfoques contemporáneos que analizan la relación entre economía y ambiente. Se revisa literatura científica del siglo XXI para establecer similitudes y diferencias conceptuales, enfocándose en fundamentos teóricos y palabras clave.

Metodología. Se aplicó un meta-análisis sobre artículos arbitrados indexados en Scopus entre 2000 y 2020. Se analizaron palabras clave definidas por los autores según frecuencia, coocurrencia y exclusividad, con el fin de identificar patrones conceptuales entre los cinco enfoques.

Hallazgos teóricos y prácticos. La economía ecológica se distingue por su énfasis en los límites biofísicos, el metabolismo social, la ecología política y los conflictos distributivos. Teóricamente (Scientia), delimita los marcos paradigmáticos; en la práctica (Praxis), orienta políticas públicas y programas académicos con perspectiva crítica sobre sostenibilidad y justicia. Contribuye al **ODS 8** por la transformación económica estructural, y al **ODS 13** mediante su enfoque en la acción climática.

Originalidad. El estudio aplica un enfoque multidisciplinario que contrasta modelos de mercado con un paradigma ecológico centrado en la justicia. Propone *"ecologizar la economía"* en vez de *"economizar la ecología"*.

Conclusiones y limitaciones. La economía ecológica emerge como un paradigma distinto. Su principal limitación es el uso exclusivo de fuentes en inglés. Investigaciones futuras deberían adoptar enfoques multilingües y participativos. También contribuye al **ODS 8** y al **ODS 13** mediante estrategias inclusivas y centradas en el clima.

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1. INTRODUCTION

In a given geographical area, the social and economic forms of organization establish characteristics that are specific to the transformation process of the natural environment. This depends, among other factors, on the possessions and demands for *"natural resources"* and the level and type of technology available. In any case, a systemic structure of the transformation process is shaped, which brings about socio-environmental issues related to the degradation of natural resources and the depletion of available net energy. As a result, inequities are reinforced and have uneven impacts on social classes and layers. These issues correspond to the realm of Political Ecology, in direct connection with Ecological Economics.

From a systemic perspective, the abovementioned can be explained by the simple reason that socioeconomic structures are inserted into a larger and more complex system that is given naturally, namely, the biosphere (Daly & Farley, 2004). In fact, not only can techno-structures exist, but also the whole economic dynamism depends on the flows of matter and energy coming from the natural system.

Mainstream economics consolidated throughout time with a progressive but marked disengagement from those natural bases. As it is also a social science, however, it has sought to address socio-environmental issues. Thus, it has expanded its scope but maintained its own categories of analysis (Ramos-Gorostiza, 2005). This is how Environmental Economics stands as a branch of conventional or hegemonic—mainstream— economics.

Under the same multiple assumptions of marginal analysis, Environmental Economics has developed a range of tools to address environmental challenges, including valuation methods and corrective taxation—such as environmental or health taxes (e.g., tobacco taxes) (Atondo-García, et al., 2025). Market logic, thus, has been extended to include proposals for nature monetization or privatization attempts.

As opposed to the sole —chrematistic— analysis criterion of Environmental Economics, there is a more critical, integrative, co-evolutionary, and multidisciplinary approach, Ecological Economics, which focuses on the relationships between the economic (sub)system and the environmental system.

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This is an expanding field of study that emphasizes the integrity and sustainability of ecosystem functions and structures in the long-term but also pays attention to the social differences within national boundaries and among countries.

Nevertheless, the approaches that attempt to analyze jointly the economic and environmental factors do not seem to end there. Vis-à-vis the social demands on who is to be made responsible for the environmental crisis, Environmental Economics and mainstream economics have been able to offer a series of proposals aimed at internalizing the environmental issue. Thus, concepts such as corporate social responsibility or Sustainable Development Goals (**SDGs**) (United Nations, nd.) have arisen in recent years.

This article is going to delve into a series of alternative approaches that have emerged from Environmental Economics and that tend to consider the environment in the economic aspects, namely, Green Economy, Circular Economy, and Bioeconomy.

2. CONTEXT

Current concerns about climate change, biodiversity loss, resource depletion, and social inequality have spurred frameworks that reconceptualize the economy, society, and environment. Ecological Economics, Environmental Economics, the Green Economy, the Circular Economy, and the Bioeconomy are prominent among these. A surge in international reports, institutional agendas, and academic initiatives highlights their relevance.

2.1.Ecological Economics

Ecological Economics s an interdisciplinary field that emphasizes the embeddedness of the economy within the biosphere, thereby acknowledging the biophysical limits to economic growth (Costanza et al., 2004). It prioritizes ecosystem services, natural capital preservation, and long-term sustainability over neoclassical notions of efficiency. The field critiques **GDP** growth as a sole development goal and explores alternatives such as degrowth and steady-state economics. Leading institutions include the International Society for Ecological Economics (n.d.) and its regional branches.

Notably, the contributions of authors like Georgescu-Roegen (1971), Daly (1977), Costanza et al. (2004), and Boulding (1966) are foundational references in this field. In Latin America,

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ecological economics has gained traction in critiques of extractivism, territorial conflicts, and the valuation of indigenous knowledge systems. Scholars from Brazil, Argentina, and Colombia have contributed to post-extractivist approaches and debates around ecological debt. The journal Ecological Economics (Elsevier, n.d.) remains a key international outlet, while region-specific perspectives are also disseminated through Revista de Iberoamericana Economía Ecológica (n.d.).

2.2.Environmental Economics

Environmental Economics is grounded in neoclassical economics, focuses on the internalization of environmental externalities via market-based mechanisms such as taxes, subsidies, and cap-and-trade systems. Its tools have become essential to public policy in both developed and developing countries. Global institutions such as the World Bank (n.d.), the OECD (2022), and Resources for the Future (2023) advance this approach.

Key publications include the OECD Environmental Outlook to 2050 (OECD, 2012) and the World Bank's State and Trends of Carbon Pricing annual series (n.d.). In Latin America, environmental economics has supported mechanisms like payments for ecosystem services (PES) and carbon markets. Regional institutions such as ECLAC (n.d.) and Centro Latinoamericano para el Desarrollo Sustentable (LACEEP) contribute to applied research. However, critiques persist regarding the commodification of nature and the limitations of cost-benefit analyses in complex socio-ecological contexts.

2.3. Green Economy

The **Green Economy**, popularized by the United Nations Environment Programme (UNEP) (n.d.), proposes a model that seeks improved human well-being and social equity while significantly reducing environmental risks and ecological scarcities. UNEP (2011) flagship report *"Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication"* remains a cornerstone document, highlighting priority sectors like renewable energy, sustainable agriculture, and public transport.

Globally, green economy strategies have influenced the Sustainable Development Goals (**SDGs**), particularly **SDG 8** (decent work and economic growth) and **SDG 12** (responsible consumption and production). In Latin America, UNEP (n.d.) and ECLAC (n.d.) have promoted

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national green economy plans, with countries like Uruguay and Costa Rica advancing policy roadmaps. The Green Economy Coalition (n.d.) curates case studies and tracks implementation worldwide.

2.4. Circular Economy

The **Circular Economy (CE)** proposes a systemic shift from linear *"take-make-dispose"* models to circular systems based on reuse, repair, remanufacturing, and recycling. The Ellen MacArthur Foundation (n.d.) has been central to conceptual development, particularly through reports like *"Completing the Picture: How the Circular Economy Tackles Climate Change"* and *"Cities and Circular Economy for Food"*.

The European Union has institutionalized the concept through its Circular Economy Action Plan (European Commission, 2020) and the European Circular Economy Stakeholder Platform (European Commission & European Economic and Social Committee, n.d.).

In Latin America, Circular Economy has gained momentum through public-private partnerships, urban innovation, and industrial symbiosis initiatives. Countries like Chile, Colombia, and Argentina have adopted Circular Economy strategies, often with support from the ECLAC. The ECLAC (2021) report "*Hacia una economía circular en América Latina y el Caribe"* offers a regional synthesis, while national strategies such as Colombia's Pacto por la Economía Circular and Argentina's Estrategia Nacional de Economía Circular serve as localized frameworks.

2.5. Bioeconomy

The **Bioeconomy** encompasses the sustainable production, use, and conservation of biological resources, integrating sectors such as agriculture, forestry, fisheries, bioenergy, and biotechnology. It promotes innovation in biobased products and services while aiming to reduce dependency on fossil resources. Global leaders include the European Commission (2018), the OECD (2022), and the FAO (n.d.).

The Global Bioeconomy Summit Reports (2015–2023) have emphasized the relevance of bioeconomy strategies for addressing global challenges (International Advisory Council on Global Bioeconomy [IACGB], 2023) and the Knowledge Policy Bioeconomy Platform (n.d.) are

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authoritative sources. Latin American bioeconomy development varies across subregions. Argentina, Brazil, and Uruguay have issued national bioeconomy strategies focused on biotechnology, biomass valorization, and regional development.

The FAO (2021) report *"Towards Sustainable Bioeconomy Guidelines: Shaping the Bioeconomy in Latin America and the Caribbean"* outlines policy frameworks tailored to the region's rich biodiversity and agricultural base. Key regional stakeholders include the Red Latinoamericana de Bioeconomía (REDBioLAC, n.d.), as well as national research institutions such as EMBRAPA in Brazil (EMBRAPA, 2023) and INTA in Argentina (INTA, 2022), all of which play a central role in advancing bioeconomy strategies across Latin America.

In sum, these five frameworks —ecological and environmental economics, green economy, circular economy, and bioeconomy— form a constellation of approaches that shape the discourse and practice of sustainability transitions at multiple scales. While global institutions have provided standard-setting guidance, Latin America offers unique applications grounded in biodiversity, social equity, and post-extractivist development paradigms. Understanding these interrelated frameworks is essential for crafting policies that are environmentally sound, socially inclusive, and economically viable.

To make visible how these approaches to economics and the environment have emerged in the 21st century, an online free tool is employed, **Google Ngram Viewer (2025)**.

It is an online search engine that employs *n-grams*, that is, subsequences of *n* words in a given text to carry out term searches in printed sources and in different languages. **Figure 1** shows how frequently the five approaches have appeared over time. This is a 5-year moving average.

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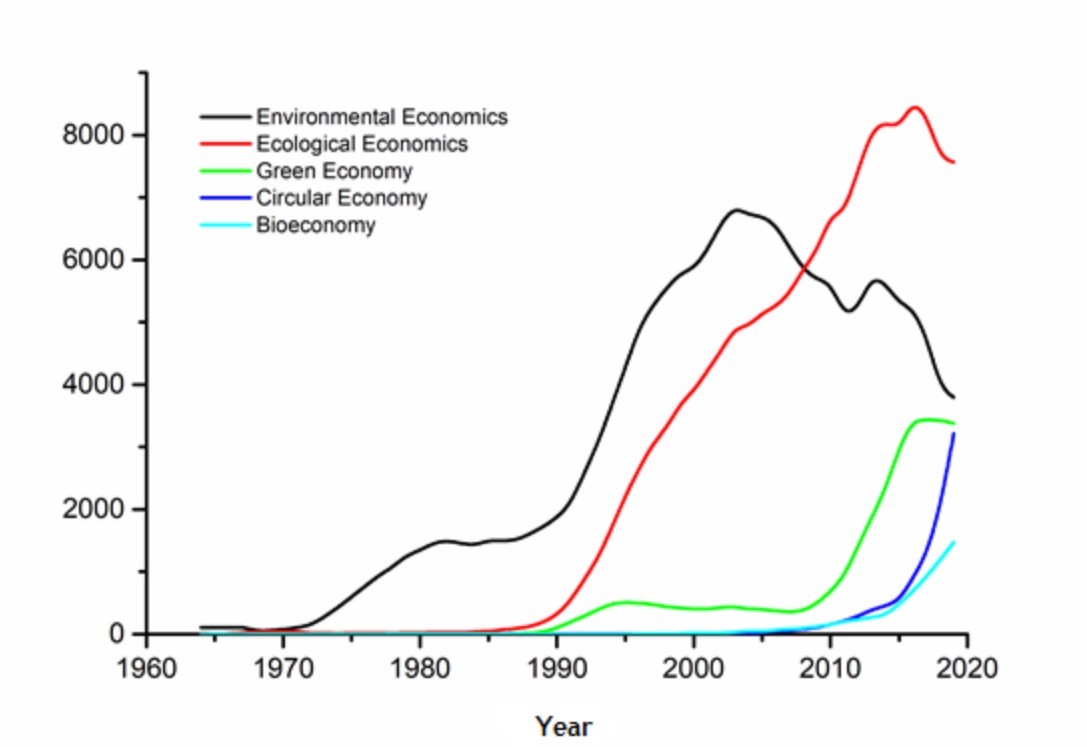
Figure 1. Time series of frequency of appearance for the five approaches



Source: Own elaboration using Google Spreadsheets based on data from Google Ngram (n.d.)

In the analysis period, the emergence of each approach is identified. Environmental Economics made its appearance in the 1970s and Ecological Economics in the 1990s. The other approaches have begun to appear much more recently, in particular Bioeconomy and Circular Economy. It is remarkable how many times more Environmental Economics appeared until the 2000s when two events took place:

a. Ecological Economics surpassed Environmental Economics, but in parallel

b. The other approaches started to develop.

Based on this preliminary analysis, there is greater dynamism and a concrete possibility of comparison among the five approaches starting in 2000. In fact, it was about ten years ago that the number of apparitions of some of these approaches began to be relevant (Green Economy) while for the others, it was only a few years ago (Bioeconomy and Circular Economy). In this way, two major reasons became sufficient to take the 21st century as the analysis period:

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1. To identify the distinctive features of these approaches today, or as close as today as possible (as opposed to a more historiographical or chronological theoretical-conceptual study), and
2. To incorporate in the analysis the newest and most dynamic approaches (Circular Economy, Bioeconomy, and Green Economy) that have appeared in recent years and that are of interest to compare.

Based on the appearance context of many *"labels"* or approaches to the relationship between economics and the environment, the main purpose of this article is to differentiate Ecological Economics from other approaches that intend to reflect such a relationship.

Thus, state-of-the-art research focused on marking the differences and similarities between Ecological Economics and other approaches—such as Environmental Economics— is assessed. To that end, the bibliography and bibliographic analyses of scientific journals are revised.

The methodology section justifies why it is important to take the 21st century as the analysis period. The following section delves into the founding and differential concepts and keywords of Ecological Economics by contrasting them with Environmental Economics, Green Economy, Circular Economy, and Bioeconomy. Then, from a selection of keywords and concepts, the differences between Ecological Economics and Environmental Economics are clearly established.

This section also aims at discussing the possibility of comparing the approaches to establish hierarchies and types of impacts economic activity has on the environment. Our initial hypothesis, however, is that Ecological Economics is the only approach that genuinely differentiates from the others. The last section resumes the main conclusions reached to in the article.

3. LITERATURE REVIEW

Here, we made a brief state of the art as a scientific production beyond slogans. In recent years, Ecological Economics has emerged as a distinct field, prompting efforts to differentiate it from Environmental Economics. Comparative studies highlight conceptual, methodological, and philosophical divergences. These distinctions reveal two separate paradigms in addressing economy-environment relations. In this sense, there have been rigorous and systemized endeavors involving theoretical-conceptual analysis, bibliography, influential authors, scope, impact ideas,

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differences, and similarities. In general, we can say that these differentiation attempts often come from authors who are pro Ecological Economics, or publish in journals devoted to Ecological Economics. There is a need to clearly distinguish Ecological Economics from Environmental Economics, which is closer to mainstream economics, and promote debate on it (Hoepner et al., 2012, Ma & Stern ,2006, and Van den Bergh, 2001). As a counterpart, there are very few attempts from Environmental Economics to differentiate itself from Ecological Economics.

One of the first comparative studies between Ecological Economics and Environmental Economics carried out in the 21st century is that of Van den Bergh (2001), which focuses on conceptual and thematic differences. Among his main conclusions, the author expresses that there is actually an overlapping between both approaches. Ecological Economics, however, is more pluralistic—it combines existing knowledge from other areas, hence its transdisciplinary character—and is also more creative and innovative than Environmental Economics at the conceptual level. In fact, almost all of the concepts used by Environmental Economics are taken directly from orthodox economics without further ado: externality; willingness to pay; opportunity cost, or are taken from it and are barely reprocessed: environmental goods, for example.

Ma and Stern (2006) analyze the citations from the articles of two specialized journals: the Journal of Environmental Economics and Management and Ecological Economics, standing for Environmental Economics and Ecological Economics, respectively. In the same line of analysis, Hoepner et al. (2012) also analyzed both approaches based on the number of influential articles, citations, authors and institutions. Díaz-Duarte et al. (2024) did it for the Circular Economy through a bibliometric review of scientific articles published in the Scopus database, analyzing the period from 2008 to 2023.

From Latin America, Cavalcanti (2010) arrives at an interesting conclusion: Ecological Economics does not constitute a branch of economics—neither of ecology—and the very name Ecological Economics can lead to confusion with Environmental Economics, since the former could well have been called eco-economics or economic ecology.

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Much more recently, Spash (2020) recognizes a series of internal fields within Ecological Economics, which explain not only the overlapping of topics with Environmental Economics but also their distinctive features. Among the authors who identify themselves with Ecological Economics, Spash (2020) distinguishes the following profiles:

1. Those who fully adhere to the dominant (neoclassical) economics, therefore, they are inseparable from Environmental Economics;

2. Authors who adopt tools and methods they consider to be useful, regardless of theoretical concerns or scientific rigor; and,

3. Authors he calls *"social ecological economists",* who seek to build a consistent theoretical approach that rejects faulty economic categories and theories.

The last position recognizes that Ecological Economics has a distinctive core and that it can be based on a critical and realistic philosophy of science. In addition, revisiting Dobson (1997), this last conceptualization within Ecological Economics is the closest to Ecologism and Political Ecology. Within this line, we could mention the so-called Radical Ecological Economics (Barkin et al. 2012).

Unlike Environmental Economics, which promotes a purely administrative approach to environmental issues, Ecological Economics is more disruptive inasmuch as it assumes that a sustainable existence means *"radical changes in our relationship with the non-human natural world, and in our mode of social and political life"* (Dobson, 1997, p. 22).

Finally, we must mention a current concern within Ecological Economics that we share. There has been a tendency to overuse tools for economic valuation, monetization, etc. Melgar-Melgar and Hall (2020) argue that the commitment of Ecological Economics to conceptual pluralism opened the doors to the same theories and methods that once served as its main criticism. Since then, Ecological Economics has become better known for its efforts to *"green"* the market economy through monetary valuation of nature (Melgar-Melgar & Hall, 2020). This has progressively taken it away from its original vision based on the biophysical understanding of the socioeconomic system and the criticism of the basic principles of mainstream economics.

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4. METHODOLOGY

The methodological criterion combines three aspects: using Scopus as a database of journals and scientific articles to be analyzed (**4.1**); selecting the keywords defined by the authors when submitting their manuscripts to journals (**4.2**); taking the 21st century as the analysis period **(4.3**).

4.1. Database used: Scopus

We employed Scopus (2025), one of the most used databases worldwide in terms of scientific publications. The database indexes scientific content from more than 25,000 peer-reviewed journals. In addition to the general searching work done with Scopus, a specific analysis of the articles published in Baumgärtner and Özkaynak (n.d.) the thematic journal in Scopus— was then carried out . Costanza et al. (2004) treat this journal as a representative sample of the papers produced within the field of Ecological Economics. It is quite an influential journal among the readers, with an impact factor of 4,482 at the moment of the web search. Furthermore, the vast majority of the results on *"ecological economics"* in Scopus correspond to that journal. Out of a total of 2,523 results including the term *"ecological economics"* whether in the title, abstract or keywords, 36% appear in the homonymous journal (the journal that follows in number of appearances is Acta Ecologica Sinica (n.d.), and represents only 3.36% of the results).

The use of a searching and indexing tool as Scopus —and in particular the analysis of that journal— allows us to establish a sort of global baseline since it is a mainstream informative forum for academia with international reach. Additionally, Ecological Economics has been employed as a thematic reference in the bibliometric articles of Ma and Stern (2006); Hoepner et al. (2012) and Zhu and Hua (2017), among others. However, they did not aim to identify distinctive features among the aforementioned economic-environmental approaches in the 21st century. The search in Scopus and in Ecological Economics is strongly limited to the English language, which is certainly a relevant fact.

4.2. Keywords as indicators

Another relevant aspect in our analysis is how data and metadata are defined, to be then contrasted in each approach. At first, we only compared keywords among scientific articles.

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Keywords help indexers and search engines to find relevant articles. All current scientific journals require authors to define a finite series —typically three to five— of keywords which can generally be compound words such as *"free will"*. There are some journals, however, that may request the use of specific encoders. This is not the case of any of the journals employed in this article.

In any case, keyword selection is up to the authors of the scientific articles and for this choice to be effective, it should be based on three simple principles:

1. Represent the content of the manuscript;

2. Be specific to the field or subfield of study and

3. Have an adequate balance between specificity and generality.

Considering such principles, it is evident that keywords are somehow a synthesis that authors employ to identify and associate themselves with a specific stance within their disciplinary field. In short, they are a self-definition or self-perception that is taken as a central element for analysis.

4.3. Analysis Period: the 21st century

The origins of what is now known as Environmental Economics can be traced back over a century, beginning with the publication of The Economics of Welfare by British economist Arthur Pigou (1920). In that seminal work—and later in A Study in Public Finance (Pigou, 1929)—Pigou elaborated on the concept of externalities, explored how taxation could enhance allocative efficiency, and addressed the empirical assessment of environmental damage. He thus laid the foundations for the modern field of Environmental Economics (Sandmo, 2015). Then, it consolidated as a discipline in the 1960s, when environmental issues intensified and, finally, in 1979, when the Association of Environmental and Resource Economists (AERE, n.d.) was formed.

As for Ecological Economics, it is more recent. It can be considered to have been instituted by the end of the 1980s, when the International Society for Ecological Economics (n.d) was founded in 1987 by Costanza and Herman Daly, who also founded the Ecological Economics journal (Elsevier, n.d.) in 1989.

Of course, the field of Ecological Economics recognizes previous contributions, both from economics and from other areas, such as ecology, physics, systems theory, to name a few (López-

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Calderón et al., 2013). Boulding (1966), Georgescu-Roegen (1971) and Daly (1977) made some of the most significant contributions to its institutionalization.

Similarly, we recognize a number of new and more recent approaches that relate economics to the environment. The early forerunners of the Green Economy are to be found, for instance, at the end of 1980, but there was a latency period during the 1990s and then it took off in the 21st century. In this sense, on the part of Bioeconomy and Circular Economy, it is necessary to mention that they have only appeared in the 21st century, although they have grown at a much faster pace.

Based on these differences and on their current relevance, as well as on the debates about the future, taking the 21st century as analysis period is quite reasonable.

5. RESULTS

This section presents the main findings derived from a comparative bibliometric analysis of the five approaches. The analysis is structured in four subsections, each contributing distinct evidence and insights about the scope, evolution, and distinguishing features of these frameworks in the scientific domain.

Section 5.1 opens with a quantitative exploration of the presence of each approach in the academic literature indexed in Scopus, revealing trends in their relative prominence and growth over the first two decades of the 21st century. It also assesses the degree of intersection between the topics by identifying shared and exclusive keywords.

Section 5.2 narrows the focus to Ecological Economics, using keyword frequency and distribution to better understand its position and central themes in comparison with the other four approaches.

Section 5.3 further investigates the semantic structure of each stream by grouping keywords into conceptual families, allowing for a visualization of their distinct academic identities.

Finally, Section 5.4 delves deeper into the specific divergences between Ecological Economics and Environmental Economics by applying a Boolean search strategy to targeted thematic terms, identifying points of convergence and differentiation in their scholarly treatment.

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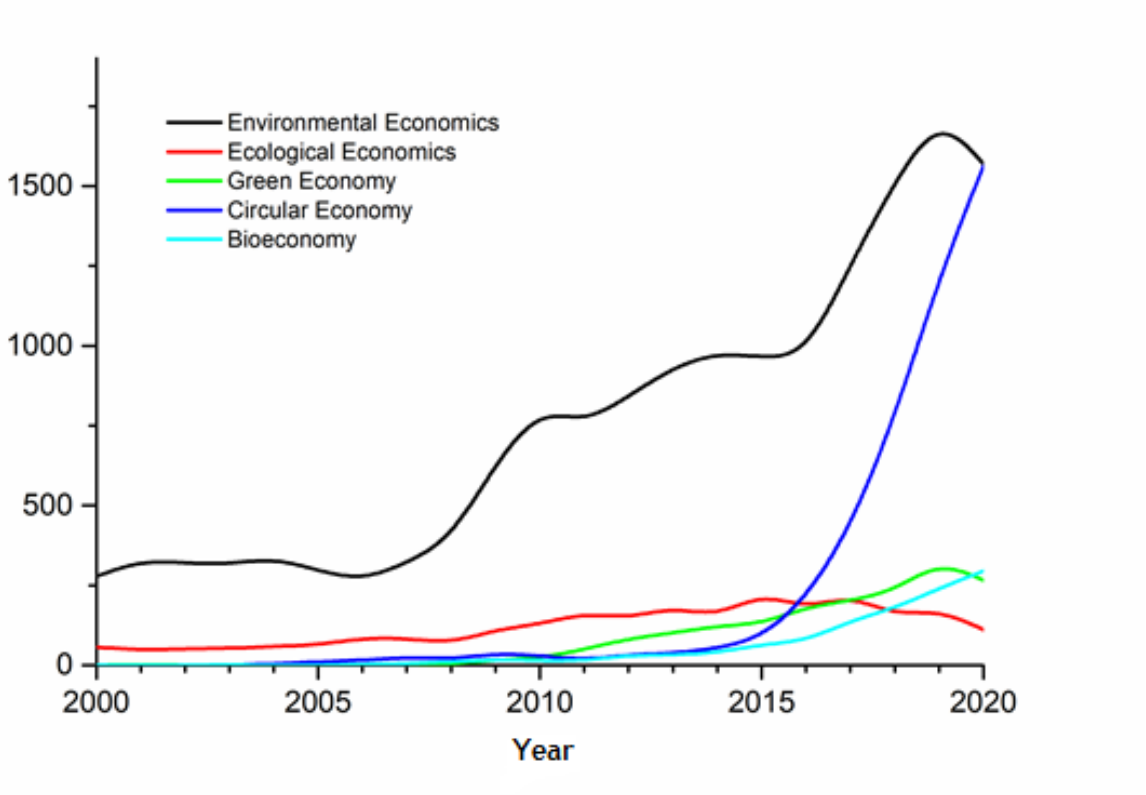
5.1.What does Scopus reveal?

Scopus was used as a complement to investigate these concepts or approaches in the scientific field, specifically in original articles published in the 21st century.

The **Figure 2** shows the absolute number of articles found in Scopus for each approach. The dynamics among them can be appreciated, especially in the last five years of the analysis period. This corresponds to the evidence also found through a bibliometric study about the expansion of the greenwashing phenomenon (Soriano-Sandoval & Alarcón-Sánchez, 2022).

Figure 2: Number of annual publications for each approach



Source: Own elaboration using Google Spreadsheets based on data from Scopus (n.d.)

On its part, **Figure 3** depicts the cumulative number of times that each approach appears.

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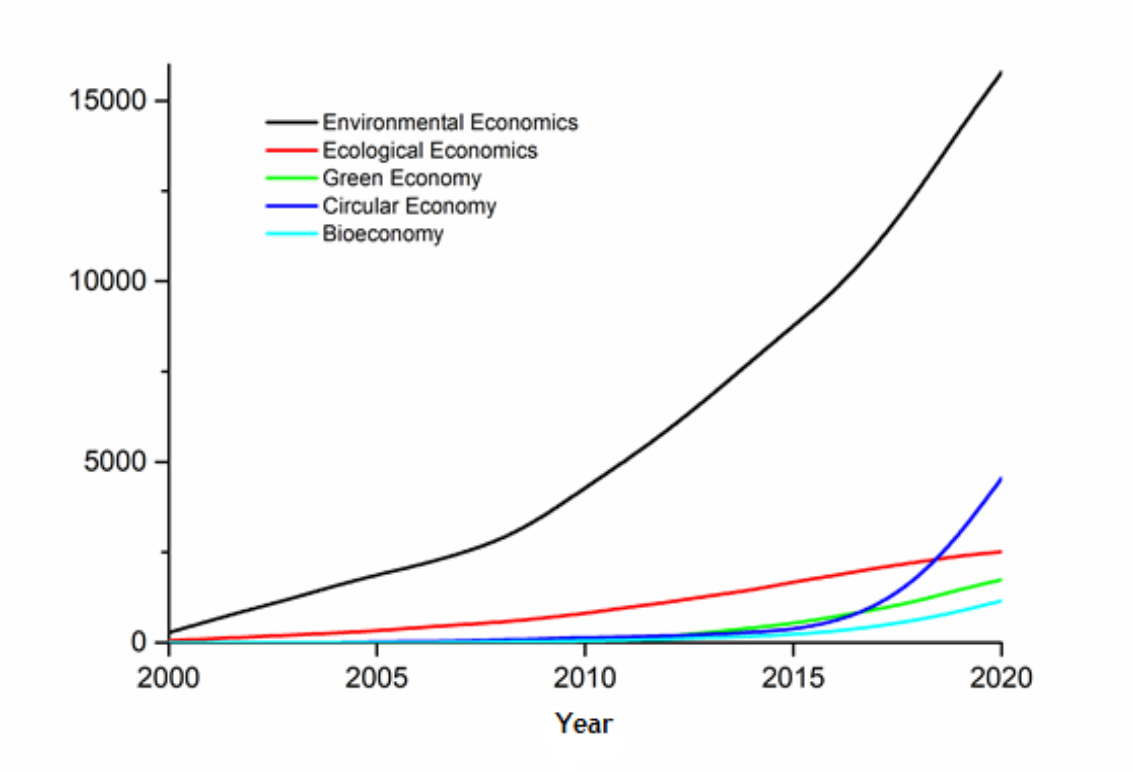
Figure 3: Cumulative number of original scientific publications for each approach



Source: Own elaboration using Google Spreadsheets based on data from Scopus (n.d.)

Notably, the number of articles on Environmental Economics significantly surpasses that of all other approaches combined. This updated analysis corroborates the findings obtained from the search of the five n-grams in books. (see **Figure 1**).

5.1.Ecological Economics as a Global Reference

Now the objective is to recognize what makes the analyzed approaches different in terms of scientific production, and to identify patterns in a broad field of study that seeks to link economic issues with the environment.

By analyzing only peer-reviewed scientific publications, we handled a sample with a degree of homogeneity, while ensuring a minimum level of quality and objectivity (in addition to non-repetition of articles). Presumably, members of the scientific community know, accept, and agree to the requirements to be able to publish their contributions in these fields. To carry out the

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comparative analysis among Environmental Economics, Ecological Economics, Circular Economy, Green Economy and Bioeconomy, the following methodological criteria was adopted:

1. Scopus.com search engine was used;
2. Papers published from 2000 onwards were analyzed and 2020 was the end of the analysis period.
3. The search terms employed were *"ecological economics"; "environmental economics"; "bioeconomy"; "green economy" and "circular economy";*
4. Results were restricted to original scientific articles, excluding reviews, book chapters, conference papers, etc.;
5. In the papers, the terms were searched among the fields Title; Keywords, and Abstract. Thus, for example, the search command was as follows: TITLE-ABS-KEY (bioeconomy) AND DOCTYPE (ar) AND PUBYEAR > 1999

Once the search criteria were applied and the results obtained, the 40 most frequent keywords were selected and ordered on a decreasing basis for each approach. The five tables are presented in **Appendix** for the sake of tidiness in the text. **Tables 1 to 5** of the **Appendix** show the absolute number and frequency of appearance of each keyword in relation to the total number of results for a given term search.

Moreover, the results presented in the **Appendix** were refined following practical criteria: keyword counts such as *"article"* and *"priority journal"* were excluded as they do not contribute to the distinction or characterization of each approach. The frequent appearance of keywords such as *"article"* or *"priority journal"* indicates that the selection authors make is not always effective, at least to represent the content of their manuscripts and the specificity of their fields of study. This may represent a bias in our own analysis methodology. Keywords whose only difference was singular or plural were combined, such as the case of "ecosystem service" and *"ecosystem services".* Ultimately, each table contains a list of the **35 most frequent keywords.**

The first analysis consisted in the processing of data to visualize overlapping areas among the five approaches. **Figure 4** includes the number of keywords that lie in each intersection of the data sets. For example, there are seven keywords that can be found in all five streams addressed here. On the other hand, 16 keywords belong only to the circular economy approach. Green Economy and Environmental Economics share 5 keywords that are not present in the other streams. It is quite

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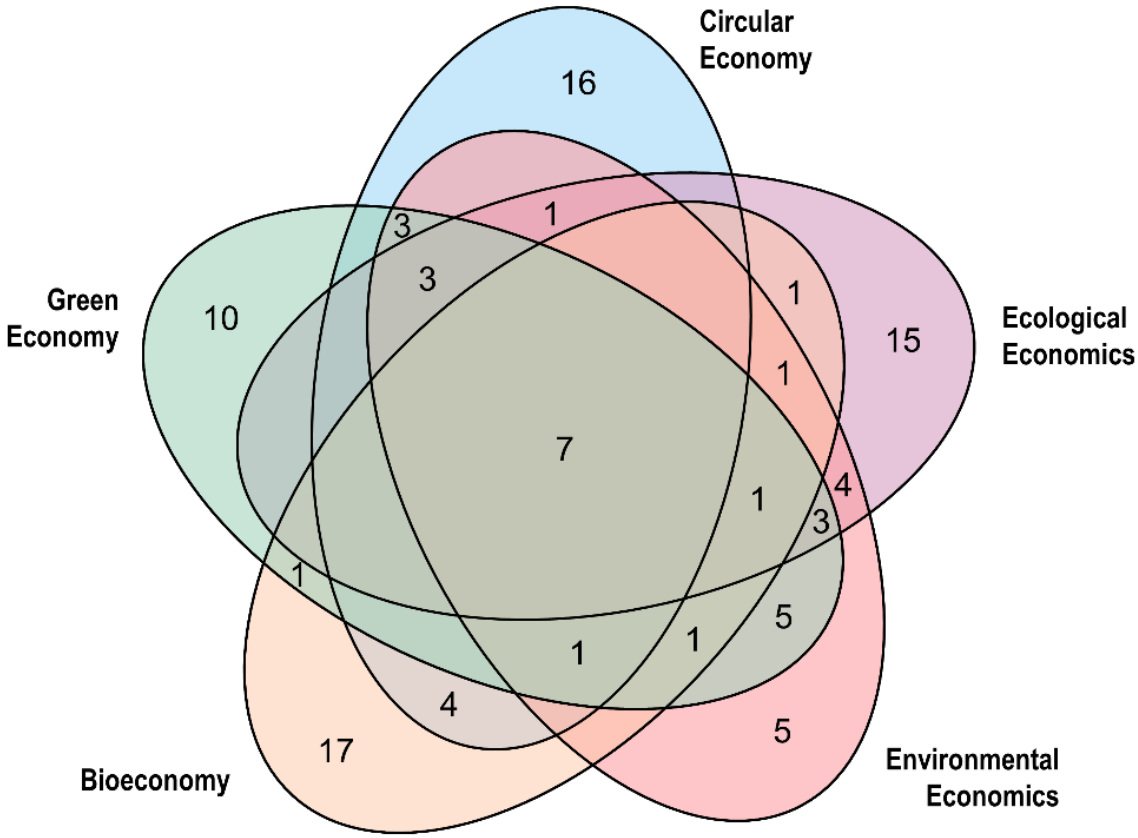
evident that among the five approaches analyzed, Environmental Economics has the least number of keywords (just five) that are exclusive to it.

Figure 4. Areas of overlap between streams



Source: Own using Python coding and Google Presentations

A fact of particular interest is to reveal which are the seven common words among all the approaches. The common keywords are Climate Change, Economic Analysis, Economics, Environmental Economics, Environmental Impact, Sustainability, and Sustainable Development. For these seven words, we calculated statistical parameters using their internal frequency of appearance. **Table 1** summarizes the obtained results, and the keywords are ordered according to their inverse-coefficient of variation $CV^{-1} = \bar{x}/_{s.d.}$. [$\bar{x}$: mean value; s.d.: standard deviation].

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Table 1: internal frequency of appearance of common keywords

Keyword	Bioeconomy	Circular	Ecological	Environmental	Green	CV^{-1}
Sustainability	0.134	0.144	0.189	0.137	0.149	7.566
Economics	0.069	0.082	0.106	0.124	0.071	4.236
Sustainable Development	0.131	0.182	0.169	0.176	0.266	4.169
Environmental Impact	0.037	0.075	0.044	0.085	0.026	2.354
Economic Analysis	0.039	0.037	0.087	0.076	0.030	2.331
Climate Change	0.064	0.033	0.058	0.132	0.085	2.239
Environmental Economics	0.042	0.053	0.096	0.979	0.175	0.751

Source: Own using Google Spreadsheets

The higher the CV^{-1}, it means that the keyword is correspondingly relevant (highly used) for the five approaches with minimum relative differences among them. Sustainability as a concept (including Sustainable Development) together with Economics constitute the main indistinguishable topics among the five approaches.

Further analysis was developed and depicted in **Figure 5.** The identification of words that appear in just one of the five approaches is also relevant. It is a simple yet seemly way of visualizing the major similarities and differences between the five lines. In the bags of words in **Figure 5**, each keyword is sized according to its internal frequency of appearance.

Among other findings from the data presented in the tables —that collect the most frequent keywords for each approach— and **Figure 5,** a series of rather general comments can be made.

The cumulative number of articles on Environmental Economics is six times bigger than that of Ecological Economics, and far exceeds any of the other approaches. It should be noted, however, that for Circular Economy, the number of publications is so high in the last two years that it reaches and even exceeds those of Environmental Economics. This reveals the wide topicality it has gained as a concept or approach.

Moreover, it is notorious —although not surprising— that the five approaches analyzed seem to be defined in common by *"sustainability"* and *"sustainable development"*. These keywords appear in all approaches, on average, in the second and third most frequent positions. Sustainability is a *"plastic"* concept, in which all approaches are placed seamlessly**.**

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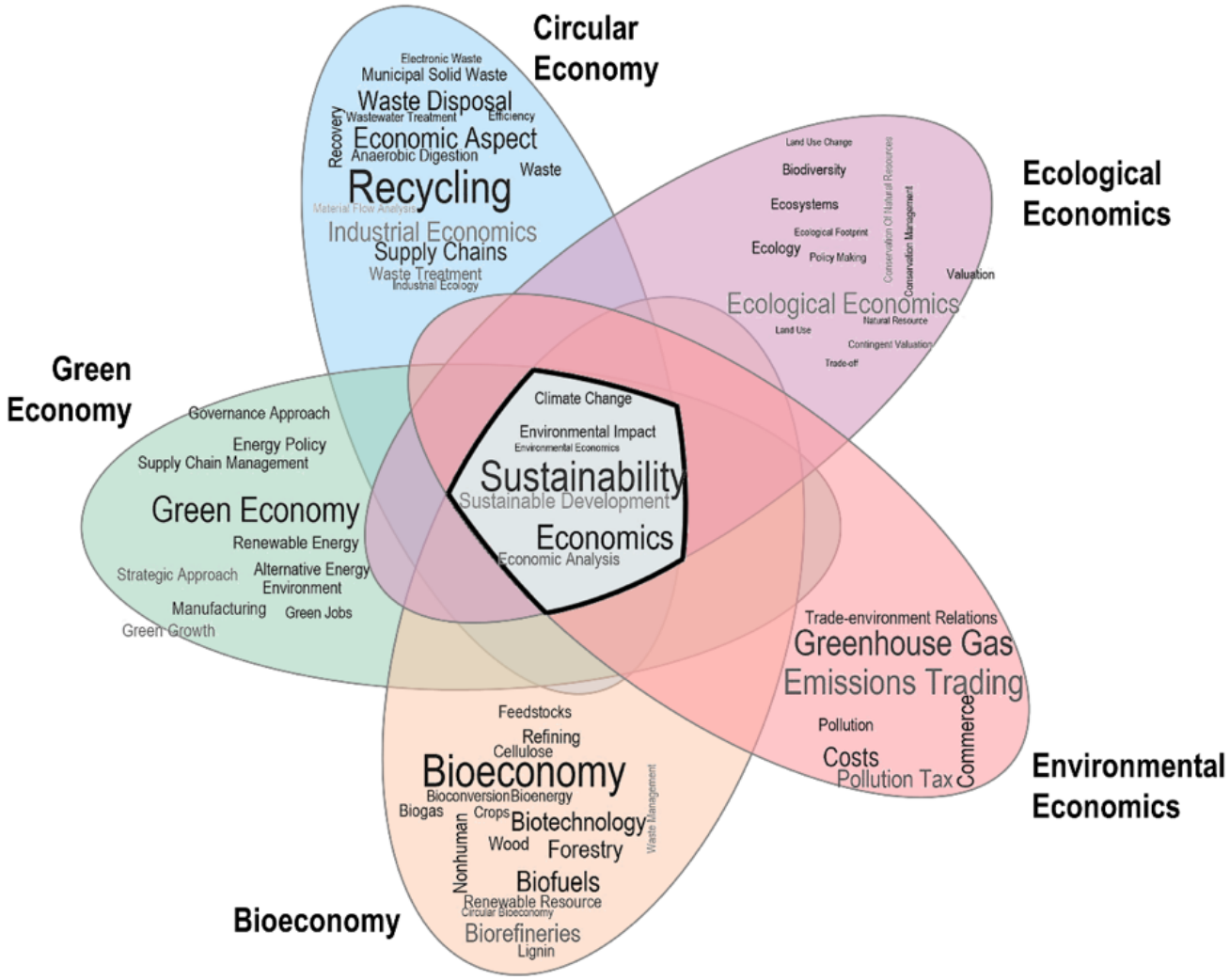
Figure 5. Schematic clustering view of the keywords



Source: Own using Python coding and Google Presentations

A third observation is that Environmental Economics, apart from being the very term of search of the approach itself, also appears as a keyword in the other four approaches. Besides, it is one of the most frequent keywords: it is the seventh most frequent for Ecological Economics, the tenth for Circular Economy, the second for Green Economy, and only in the case of Bioeconomy it is a little more relegated, in 22nd place.

Moreover, being Environmental Economics the name of one of the approaches, is the only keyword found in the five lines; then only Circular E Notably, the number of articles on

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Environmental Economics significantly surpasses that of all other approaches combined. This updated analysis corroborates the findings obtained from the search of the five n-grams in books.

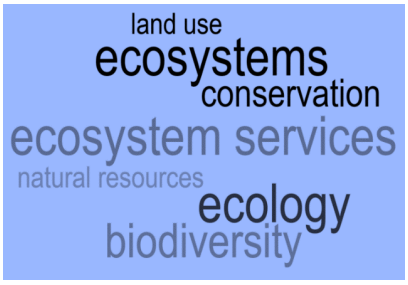
Economy appears both in its own approach and in Bioeconomy. This denotes how permeable Environmental Economics is as regards the other concepts, either by affinity or by being contested from the other approaches.

To shed light on this point, in the next section, we analyze families of words to identify degrees of homogeneity or discrepancy among the five approaches.

5.2.Keywords Groupings and Distinctive Features

To identify the degrees of homogeneity or discrepancy among the five approaches, we grouped words for each of the approaches compared. The criterion adopted was that there was certain cohesion among them, which allowed us to identify the distinctive features of the approach. The resulting groupings are by no means the only ones possible and could certainly differ in their content or other groupings might as well be defined. See **Cloud Word 1.**

Cloud Word 1. Ecological Economics, the following family of words is found.



Source: Own using Google Presentations

Broadly speaking, this approach seems to be more linked to ecologism and environmental protection, with an emphasis on the structure and functions of ecosystems and biodiversity. Many of these concepts are directly related to pure Ecology, as proposed by Cavalcanti (2010).

However, this family of words is not isolated and, within the 35 organized, refined and classified keywords, it coexists with a great deal of economics-related terms and jargon, such as valuation, cost-benefit analysis, willingness to pay, etc. See **Cloud Word 2.**

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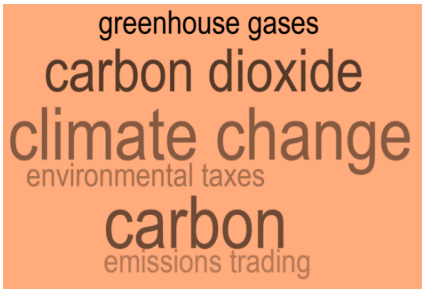
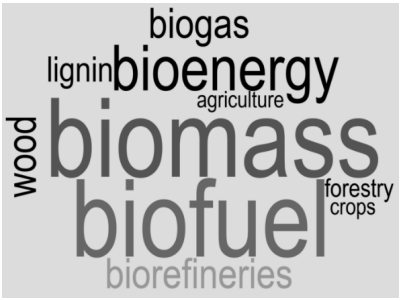
Cloud Word 2. Environmental Economics



Source: Own using Google Presentations

Based on this family of words, it can be said that, at least in recent years, Environmental Economics has been oriented to applying tools of economic policies and market instruments as a way to address climate change due to anthropogenic activities. In particular, we would say it has sought to *"internalize"* the environmental impact by expanding the market. See **Cloud Word 3.**

Cloud Word 3. Bioeconomy



Source: Own using Google Presentations

As the very name of the approach suggests, this is bio-based economics. Thus, it is recognized, on the one hand, as a specialization of mainstream economics, since it mentions areas that have to do with the primary sector (agriculture, forestry).

On the other, it is evident that there is a fully utilitarian bias towards taking advantage of biological functions as vectors for the development of economic activities, by means of energy use.

In addition, from the global analysis of the 35+ most frequent keywords, it is obvious that Bioeconomy has a more technological orientation and a clearer relationship with industry and

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engineering. Hence, out of the five approaches analyzed, it seems to be the most distant to economics as a discipline, although this does not imply closeness to ecology or the environment. See **Cloud Word 4.**

Cloud Word 4. Circular Economy

Source: Own using Google Presentations

As a distinctive approach, Circular Economy clearly points to a technological vision to reuse, treat or recycle waste from the economic activity, namely, processes that transform and treat waste, to reuse it in a new economic cycle. It is also strongly related to economic and environmental management, bearing an unmistakable technological and engineering imprint, although less than Bioeconomy. See **Cloud Word 5.**

Cloud Word 5. Green Economy

Source: Own using Google Presentations

Green Economy is the least concrete of the five approaches, although closely related to Environmental Economics, especially as regards climate change. The focus seems to be on

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redirecting investments toward certain types of technologies, particularly those related to energy and efficiency.

5.3.Differentiating Ecological Economics from Environmental Economics

Another search exercise for specific terms was carried out. A priori, they would be related to Ecological Economics, but some others would be close to Economics. A Boolean intersection criterion was employed. Each specific term was searched in Scopus within the results for each approach, either Ecological Economics or Environmental Economics alone, which ensured that the results included both search terms simultaneously.

Although it is a slightly different approach to keywords, it is still valid as it allows us to identify similarities and differences between the two approaches.

Specific search terms are ordered according to the rate of appearance over the total of articles within each approach. We have always employed scientific papers from **2000 onwards**. Thus, for example, the term *"poverty"* appears in **342** of **the 2,519** total results for *"ecological economics"*. It represents around 13%.

After obtaining the frequency of appearance for each term within each approach, the quotient between the two was obtained. This way, we obtained a ratio of relative appearances.

Th **Figure 6** summarizes the results. They have been ordered according to the ratio, that is, at a relative frequency of appearance that is higher in Ecological Economics than in Environmental Economics.

From the analysis of the more than **20** specific search terms, a series of interesting results emerges. Except for *"optimal", "efficiency" and "decoupling",* all the other concepts have a higher frequency of appearance in Ecological Economics than in Environmental Economics.

The widely differing concepts in Ecological Economics when compared to Environmental Economics are linked to *"political ecology"* and *"ecological distribution conflicts"*. Approaches to the society-nature interface, such as "social metabolism" and "biophysical indicators" of (un)sustainability, also seem to be comparatively relevant.

Surprisingly enough, the term *"valuation",* which could be presumably more associated with Environmental Economics, is a more frequent term for Ecological Economics.

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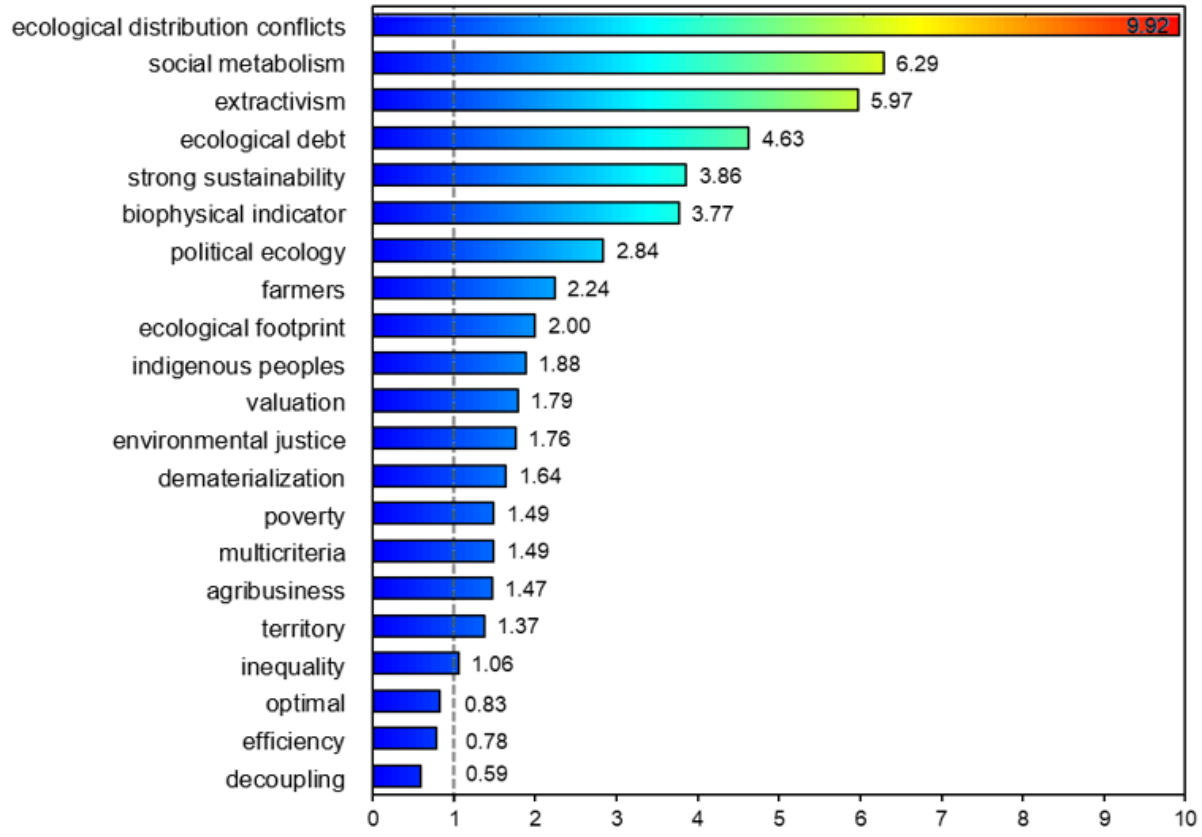
Figure 6. Ratio of relative appearances of selected concepts



Source: Own using Google Spreadsheets

6. DISCUSSION

This study, although it provides relevant elements for the analysis of the selected streams of thought, has important limitations that must be taken into account when interpreting its results.

First, the analysis was restricted to a single academic database (Scopus, n.d.), which limits the breadth and representativeness of the bibliographic corpus. Some streams, especially those with less international visibility, could be underrepresented or biased in this source. Furthermore, the inclusion of non-indexed literature or technical documents could enrich the overall picture and allow for a more inclusive analysis.

Secondly, the keywords analysis methodology, although rigorous, is not sufficient on its own to capture the practical and contextual dimensions of each current. Therefore, it is recognized that this

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study needs to be complemented with qualitative methodologies (such as expert interviews, and extended content analysis) and quantitative methodologies (such as bibliometric network analysis or thematic meta-analysis) that allow for valuable analysis.

Once our methodological biases are recognized, the discussion about the findings, which we considered consistent, may be addressed.

The research question aimed to determine the extent to which it is possible to conceptually and analytically distinguish five areas that share a common thematic field, and whether these areas constitute autonomous approaches or variants of the same logic. In this sense, the initial hypothesis proposed that, despite the similarities between them, it is possible to identify substantial differences that justify their differentiated treatment in academic and applied analysis.

6.1. Theoretical contributions

From a theoretical perspective, the analysis revealed that, while the five currents share a common focus on sustainability, not all possess the same degree of theoretical consolidation or methodological autonomy. Ecological Economics emerges as the most distinctive in terms of conceptual amplitude and critical stance towards conventional economics, justifying its treatment as a specific approach within the field. In contrast, Environmental Economics presents itself as a transitional approach to the environment strongly based on neoclassical economics. The other three currents analyzed (Circular Economy, Green Economy and Bioeconomy) only present nuances of the same conceptualization, with overlapping elements that make it difficult to clearly separate them from Environmental Economics.

6.2. Practical contributions

From a practical perspective, these findings allow for improved design and implementation of policies, strategies, or tools based on these approaches. Distinguishing Ecological Economics from Environmental Economics may enrich policymaking discussions: the former prioritizes biophysical limits and comprehensive human well-being, while the latter emphasizes the regulation of externalities and the monetary valuation of resources. This practical nuance allows for the design

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of appropriate instruments: extraction quotas and sufficiency criteria for Ecological Economics; Pigouvian taxes and permit markets for Environmental Economics.

This enhances regulatory effectiveness, avoids generic solutions, and orients sustainability strategies according to the scope and objectives of each discipline. In doing so, it contributes directly to **SDG 8** (*Decent Work and Economic Growth*) by promoting sustainable and inclusive economic strategies, and to **SDG 13** (*Climate Action*) by supporting climate-resilient policy design and the internalization of environmental costs in economic decision-making (United Nations, n.d.).

7. CONCLUSION

Current approaches that address the relationship between economic dynamics and the natural environment have diversified significantly over the past decade. Ecological Economics—as a transdisciplinary and critical alternative to mainstream economics—and Environmental Economics—as a recognized branch of orthodox economics—can be considered two distinct *"schools"*. Their historical depth and the breadth of their thematic agendas distinguish them from other approaches such as Circular Economy, Green Economy, and Bioeconomy. Among these, Environmental Economics exhibits an enveloping and evolving nature, often intersecting with other currents, including Ecological Economics. This supports the view that Environmental Economics remains the dominant paradigm.

Circular Economy, Green Economy, and Bioeconomy do not exhibit substantial theoretical or instrumental departures from the core assumptions of Environmental Economics. Their focus is sectoral and operational, lacking a structural critique of the economic system. Notably, they emphasize technological and productive components—particularly in Bioeconomy and Circular Economy—while Green Economy remains conceptually diffuse and difficult to delimit from Environmental Economics.

Within Ecological Economics itself, current research reveals internal variation. Leading academic platforms—such as the Ecological Economics journal—include numerous contributions that align more closely with the Environmental Economics framework. This includes applications of neoclassical tools such as Pigouvian externalities and market-based mechanisms for internalizing environmental costs. However, our lexical and conceptual analysis highlights terms that strongly differentiate Ecological Economics, including political ecology, ecological

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distribution conflicts, social metabolism, and biophysical indicators of (un)sustainability. Interestingly, the term *"valuation",* traditionally linked to Environmental Economics, frequently appears in Ecological Economics literature as well.

In synthesis, this analysis reinforces the idea that while Environmental Economics—along with Green Economy, Circular Economy, and Bioeconomy—seeks to economize ecology, Ecological Economics aims to ecologize economics. This tension, while productive, remains embedded in internal contradictions. These findings contribute new knowledge to the field by clarifying conceptual boundaries and overlaps that often create confusion among scholars and practitioners alike. They offer a foundation for advancing a more coherent, multidisciplinary, and innovation-oriented agenda for sustainability. In doing so, they support SDG 8 (Decent Work and Economic Growth) by encouraging structural economic transformation, and SDG 13 (Climate Action) by promoting frameworks that prioritize planetary boundaries and ecological integrity in economic decision-making (United Nations, n.d.).

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Appendix

Table 1. Keywords order for *Ecological Economics*

Order	Keyword	Count	Frequency
1	Ecological Economics	2252	89.7%
2	Ecosystem Services	535	21.3%
3	Sustainability	474	18.9%
4	Sustainable Development	423	16.9%
5	China	347	13.8%
6	Ecology	269	10.7%
7	Economics	267	10.6%
8	Environmental Economics	241	9.6%
9	Ecosystems	233	9.3%
10	Biodiversity	227	9.0%
11	Economic Analysis	218	8.7%
12	Environmental Protection	207	8.2%
13	Cost-benefit Analysis	197	7.8%
14	Valuation	181	7.2%
15	United States	173	6.9%
16	Decision Making	168	6.7%
17	Climate Change	146	5.8%
18	Environmental Policy	142	5.7%
19	Willingness To Pay	136	5.4%
20	Economic Growth	131	5.2%
21	Economic Development	129	5.1%
22	Numerical Model	125	5.0%
23	Conservation Management	113	4.5%
24	Eurasia	112	4.5%
25	Environmental Impact	110	4.4%
26	Policy Making	108	4.3%
27	Conservation Of Natural Resources	107	4.3%
28	Agriculture	105	4.2%
29	Contingent Valuation	96	3.8%
30	Land Use	94	3.7%
31	Land Use Change	89	3.5%

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32	Theoretical Study	86	3.4%
33	Europe	84	3.3%
34	Natural Resource	84	3.3%
35	Ecological Footprint	82	3.3%

Source: Own elaboration.

Table 2. Keywords order for *Environmental Economics*

Order	Keyword	Count	Frequency
1	Environmental Economics	15885	97.9%
2	Sustainable Development	2859	17.6%
3	Carbon Emission	2654	16.4%
4	China	2628	16.2%
5	Environmental Policy	2292	14.1%
6	Sustainability	2229	13.7%
7	Climate Change	2134	13.2%
8	Emission Control	2124	13.1%
9	Carbon Dioxide	2077	12.8%
10	Cost-benefit Analysis	2075	12.8%
11	Greenhouse Gases	2070	12.8%
12	Environmental Protection	2046	12.6%
13	Economics	2019	12.4%
14	United States	1402	8.6%
15	Environmental Impact	1385	8.5%
16	Investments	1384	8.5%
17	Economic Growth	1365	8.4%
18	Economic Development	1300	8.0%
19	Environmental Management	1239	7.6%
20	Economic Analysis	1238	7.6%
21	Emissions Trading	1163	7.2%
22	Decision Making	1086	6.7%
23	Costs	1030	6.3%
24	Carbon	1028	6.3%
25	Ecosystem Service	986	6.1%
26	Pollution Tax	913	5.6%
27	Willingness To Pay	847	5.2%

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28	Commerce	828	5.1%
29	Europe	826	5.1%
30	Trade-environment Relations	790	4.9%
31	Human	788	4.9%
32	Numerical Model	737	4.5%
33	Economic And Social Effects	726	4.5%
34	Energy Efficiency	698	4.3%
35	European Union	682	4.2%

Source: Own elaboration

Table 3. Keywords order for *Green Economy*

Order	Keyword	Count	Frequency
1	Green Economy	1273	68.3%
2	Sustainable Development	496	26.6%
3	Environmental Economics	327	17.5%
4	Sustainability	278	14.9%
5	China	226	12.1%
6	Climate Change	159	8.5%
7	Innovation	151	8.1%
8	Environmental Protection	147	7.9%
9	Economics	132	7.1%
10	Economic Growth	129	6.9%
11	Economic Development	126	6.8%
12	Investments	115	6.2%
13	Environmental Policy	100	5.4%
14	Environmental Management	99	5.3%
15	Human	76	4.1%
16	Energy Efficiency	75	4.0%
17	Carbon Emission	72	3.9%
18	Energy Policy	68	3.6%
19	Green Growth	66	3.5%
20	Manufacturing	65	3.5%
21	Decision Making	63	3.4%
22	Governance Approach	62	3.3%

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23	Renewable Energy	62	3.3%
24	Emission Control	60	3.2%
25	Carbon	59	3.2%
26	Alternative Energy	58	3.1%
27	Strategic Approach	58	3.1%
28	Supply Chain Management	58	3.1%
29	Economic And Social Effects	57	3.1%
30	Economic Analysis	55	3.0%
31	United States	55	3.0%
32	Environment	54	2.9%
33	Carbon Dioxide	51	2.7%
34	Commerce	49	2.6%
35	Environmental Impact	48	2.6%

Source: Own elaboration

Table 4. Keywords order for *Circular Economy*

Order	Keyword	Count	Frequency
1	Circular Economy	3224	63.9%
2	Life Cycle Analysis	1092	21.6%
3	Recycling	1055	20.9%
4	Sustainable Development	920	18.2%
5	Sustainability	727	14.4%
6	Waste Management	706	14.0%
7	Economics	414	8.2%
8	Environmental Impact	380	7.5%
9	Environmental Economics	269	5.3%
10	Economic Aspect	251	5.0%
11	Human	231	4.6%
12	Waste Disposal	225	4.5%
13	Industrial Economics	222	4.4%
14	Decision Making	213	4.2%
15	China	211	4.2%
16	Controlled Study	209	4.1%
17	Biomass	204	4.0%
18	Economic Analysis	189	3.7%

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19	Economic And Social Effects	188	3.7%
20	Municipal Solid Waste	188	3.7%
21	Waste	185	3.7%
22	Environmental Management	183	3.6%
23	Supply Chains	182	3.6%
24	Waste Treatment	180	3.6%
25	Recovery	175	3.5%
26	Carbon Dioxide	171	3.4%
27	Climate Change	165	3.3%
28	Wastewater Treatment	164	3.2%
29	Anaerobic Digestion	161	3.2%
30	Environmental Protection	156	3.1%
31	European Union	155	3.1%
32	Material Flow Analysis	147	2.9%
33	Efficiency	146	2.9%
34	Nonhuman	146	2.9%
35	Industrial Ecology	143	2.8%

Source: Own elaboration

Table 5. Keywords order for *Bioeconomy*

Order	Keyword	Count	Frequency
1	Bioeconomy	652	51.9%
2	Biomass	264	21.0%
3	Sustainability	168	13.4%
4	Sustainable Development	165	13.1%
5	Biofuels	162	12.9%
6	Bioenergy	161	12.8%
7	Biotechnology	140	11.1%
8	Biorefinery	129	10.3%
9	Forestry	115	9.2%
10	Economics	87	6.9%
11	Innovation	81	6.4%
12	Climate Change	80	6.4%
13	Agriculture	79	6.3%

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14	Nonhuman	77	6.1%
15	Circular Economy	73	5.8%
16	Refining	64	5.1%
17	European Union	64	5.1%
18	Wood	63	5.0%
19	Europe	60	4.8%
20	Human	59	4.7%
21	Cellulose	56	4.5%
22	Environmental Economics	53	4.2%
23	Feedstocks	52	4.1%
24	Renewable Resource	51	4.1%
25	Metabolism	50	4.0%
26	Biogas	50	4.0%
27	Lignin	50	4.0%
28	Economic Analysis	49	3.9%
29	Carbon	48	3.8%
30	Life Cycle	47	3.7%
31	Economic Development	47	3.7%
32	Environmental Impact	46	3.7%
33	Germany	44	3.5%
34	Crops	43	3.4%
35	Chemistry	43	3.4%

Source: Own elaboration

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