



THE CONCEPTUAL EVOLUTION OF THE AGRIBUSINESS FIELD OF STUDY: FROM THE EMERGENCE OF THE TERM TO 2020

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ABSTRACT

Objective: The objective of this study is to investigate the evolution of research trends in the field of agribusiness, identifying the most studied terms and themes from the conception of the term agribusiness up to the year 2020.

Theoretical Framework: In the integration of agriculture into industrial chains, the concepts of Agribusiness and *Filière* emerge. Gradually, an interdisciplinary field of study is structured. However, new elements begin to be faced: socio-environmental issues and technological development alter the dynamics of this field of study. Thus, it is necessary to structure a comprehensive knowledge of Agribusiness to understand this dynamic.

Method: The methodology adopted for this research comprises bibliometric analysis in time series, using particularly the co-word technique. Data collection was carried out through the Scopus database, chosen for providing a broad view of the global and interdisciplinary scientific literature.

Results and Discussion: Terms such as "agribusiness," "agriculture," and "agroindustry" form the core of studies. The terms "animal," "economy/economic impact," and "supply chains" stand out for their high occurrence in all the periods analyzed.

Research Implications: A constancy of central themes and an evolution of peripheral themes in response to new environmental and technological challenges in agribusiness were observed.

Originality/Value: This study contributes to the literature as one of the first articles exploring the dynamics and evolution of an interdisciplinary research field using bibliometric techniques.

Keywords: Agriculture, Agroindustry, Bibliometrics, Scientific Development, Interdisciplinarity.

A EVOLUÇÃO CONCEITUAL DO CAMPO DE ESTUDOS EM AGRONEGÓCIOS: DO SURGIMENTO DO TERMO ATÉ 2020

RESUMO

Objetivo: O objetivo deste estudo é investigar a evolução das tendências de pesquisa no campo dos agronegócios, identificando os termos e temas mais estudados desde a conceituação do termo agronegócios (agribusiness) até o ano de 2020.

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Referencial Teórico: Na integração da agricultura às cadeias industriais, surgem os conceitos de *Agribusiness* e *Filière*. Gradualmente, um campo de estudos interdisciplinar é estruturado. No entanto, novos elementos começam a ser enfrentados: problemas socioambientais e o desenvolvimento tecnológico alteram a dinâmica desse campo de estudos. Assim, é preciso estruturar um conhecimento abrangente do Agribusiness para compreender essa dinâmica.

Método: A metodologia adotada para esta pesquisa compreende a análise bibliométrica em séries temporais, utilizando especialmente a técnica de copalavra. A coleta de dados foi realizada por meio da base de dados Scopus, escolhida por oferecer uma visão ampla da literatura científica global e interdisciplinar.

Resultados e Discussão: Termos como “agronegócios”, “agricultura” e “agroindústria” compõem o âmago dos estudos. Os termos “animal”, “economia/impacto econômico” e “cadeias de suprimentos” se destacam por sua grande ocorrência em todos os períodos analisados.

Implicações da Pesquisa: Observou-se uma constância de temas centrais e uma evolução de temas periféricos em resposta a novos desafios ambientais e tecnológicos dos agronegócios.

Originalidade/Valor: Este estudo contribui para a literatura como um dos primeiros artigos explorando a dinâmica e evolução de um campo de pesquisas interdisciplinar usando técnicas bibliométricas.

Palavras-chave: Agricultura, Agroindústria, Bibliometria, Desenvolvimento Científico, Interdisciplinaridade

LA EVOLUCIÓN CONCEPTUAL DEL CAMPO DE ESTUDIOS EN AGRONEGOCIOS: DESDE EL SURGIMIENTO DEL TÉRMINO HASTA 2020

RESUMEN

Objetivo: El objetivo de este estudio es investigar la evolución de las tendencias de investigación en el campo del agronegocio, identificando los términos y temas más estudiados desde la concepción del término agronegocio (*agribusiness*) hasta el año 2020.

Marco Teórico: En la integración de la agricultura a las cadenas industriales, surgen los conceptos de *Agribusiness* y *Filière*. Gradualmente, se estructura un campo de estudios interdisciplinario. Sin embargo, comienzan a aparecer nuevos elementos: los problemas socioambientales y el desarrollo tecnológico alteran la dinámica de este campo de estudio. Así, es necesario estructurar un conocimiento integral del *Agribusiness* para comprender esta dinámica.

Método: La metodología adoptada para esta investigación comprende el análisis bibliométrico en series temporales, utilizando especialmente la técnica de co-palabra. La recolección de datos se realizó a través de la base de datos Scopus, elegida por ofrecer una visión amplia de la literatura científica global e interdisciplinaria.

Resultados y Discusión: Términos como "agronegocios", "agricultura" y "agroindustria" componen el núcleo de los estudios. Los términos "animal", "economía/impacto económico" y "cadenas de suministro" se destacan por su gran ocurrencia en todos los períodos analizados.

Implicaciones de la investigación: Se observó una constancia de temas centrales y una evolución de temas periféricos en respuesta a los nuevos desafíos ambientales y tecnológicos de los agronegocios.

Originalidad/Valor: Este estudio contribuye a la literatura como uno de los primeros artículos que explora la dinámica y evolución de un campo de investigación interdisciplinario utilizando técnicas bibliométricas.

Palabras clave: Agricultura, Agroindustria, Bibliometría, Desarrollo Científico, Interdisciplinariedad.

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1 INTRODUCTION

Contemporary issues such as climate change, sustainability, food security and the environmental impacts of intensive farming reflect the need for more adaptable and sustainable farming practices. The introduction of advanced technologies, such as agricultural robots and smart farms, and the focus on biotechnological innovations are responses to these challenges, transforming agribusiness as a practice and science (Kusakina et al., 2020; Mühl & Oliveira, 2022; Rocha et al., 2023).

Interdisciplinarity is a striking feature of agribusiness studies in search of a more rational use of resources and implementation of technological innovations (Kusakina et al., 2020). Various studies on agribusiness stand out for their importance and impact. Research on the negative effects of intensive agriculture, such as water degradation and its environmental impacts (Rabalais et al., 2009), and the relationship between migration, labor, class struggle and the search for better living conditions (Mitchell, 1996) are examples of this. In addition, discussions on markets, food security, food and energy, and relations between developed and emerging countries point to a global land race, presenting lasting implications for global agriculture and food security (Cotula, 2012).

However, despite the vast body of interdisciplinary research in the field of agribusiness, there is a significant gap in the literature regarding the longitudinal analysis of changes and trends in the areas of agribusiness study over time. This gap includes the need to understand how themes and concerns evolved and how new themes emerged and consolidated within the field. Understanding these transformations is crucial to anticipate future needs and drive research and public policy efforts more effectively.

From this, the objective of this article is to investigate the evolution of research trends in the field of agribusiness, identifying the terms and topics most studied since the conceptualization of the term agribusiness (*agribusiness*) until the year 2020. Using a bibliometric approach, we seek to map out how areas of focus have changed over the decades and which terms have emerged as central or innovative to the field of study.

Analyzing the evolution of focus areas and emerging terms can provide new insights into the dynamics that shape this sector and help formulate more informed and sustainable strategies for the future. Evolutionary dynamics of agribusiness can inform public policies, business strategies, and agricultural practices by identifying changes and trends in research. Additionally, this is one of the first studies exploring the dynamics and evolution of an interdisciplinary field of research using bibliometric techniques.



2 THEORETICAL FRAME

In 1957, John Davis and Ray Goldberg coined the term *agribusiness* which refers to the production, processing and distribution of products of agricultural origin. This concept represents the emergence of a cross-sectoral relationship between agriculture, industry and services (Davis & Goldberg, 1957). Agricultural activities are becoming increasingly specialized, and this process represents the industrialization and inclusion of agriculture in the capitalist system of production (Graziano da Silva & Kageyama, 1996; Silva, 1991). Although market relations, purchase, sale or exchange of goods have been present at several moments in the history of agriculture since antiquity (Mazoyer & Roudart, 2010).

This phenomenon began to be studied as agribusiness (*agribusiness*) in the United States, when Davis and Goldberg (1957) published studies on the relationships between industrial chains of inputs, agricultural production, the food industry and the food distribution system (Jackson, 1968). In France in the 60s studies applied to agro-industrial organizations also appeared. The concept coined in France was the *Filière* or chain and is more focused on the sequence of operations that leads to the production of goods, reflecting a distributive or systemic concern. The two concepts converge by emphasizing the importance of intersectoral relations, that is, both concepts address the systemic dimensions that involve the processing and consumption of agricultural raw materials (Raikes et al., 2000; Zylbersztajn, 2000). Therefore, agribusiness has emerged and consolidated itself as a field of research of an interdisciplinary nature.

Interdisciplinarity is a theoretical-methodological approach that emerged in the second half of the twentieth century as a response to fragmentation and excessive specialization of knowledge (Thiesen, 2008). This approach seeks to overcome the positivist epistemology that has dominated science since modernity, marked by empiricism, naturalism and mechanism. With the division of sciences influenced by thinkers such as Galileo, Bacon, Descartes, Newton and Darwin, a new way of integrating different areas of knowledge became necessary to promote a more holistic and comprehensive understanding (Santos et al., 2020; Thiesen, 2008).

Only complex thinking about a reality that is also complex can advance the reform of thought in the direction of contextualization, articulation and interdisciplinarity of the knowledge produced by humanity. Only one thought of context and complex is capable of capturing relationships, interrelations, mutual implications and multidimensional phenomena (Morin, 2018).

In the context of a scientific field, interdisciplinarity facilitates the integration of



different disciplines, allowing a more complete and innovative approach to complex problems. This dialectical perspective allows us to better understand the relationship between the whole and the parts, promoting greater integration between the sciences (Thiesen, 2008). In agribusiness, for example, interdisciplinarity is crucial to address challenges such as sustainability, food security and environmental impacts. Thus, interdisciplinarity not only broadens the horizon of research, but also contributes to the construction of a more integrated knowledge and applicable to the real needs of society (Costa & Loureiro, 2017).

Globalization has led to the formation of global food chains. The integration of agriculture with industry has linked food to economic interests. In particular, from the 1980s, a global food chain began to be created, characterized by a process of monopolization and the creation of a corporate diet (Delgado Cabeza, 2010). From this point onwards, studies are emerging on agro-industrial logistics, which concern the coordinated management of products between producers and consumers. Information is fundamental for logistics. The Internet makes it much easier to exchange information in all instances of logistics processes, whether from business to business, from customer to company or even from customer to customer (Iannoni & Morabito, 2006). Therefore, these new variables are integrated with the studies involving agribusiness.

Issues such as sustainable development arose and gained prominence in the scientific discussion (Meadows et al., 2013). Social issues such as those explored by Ploeg (2022) such as food security, food sovereignty, family farming, dependence or independence of large corporations and capacity to produce sustainably are other issues that have developed related to the topic of agribusiness.

In practice, this interdisciplinary integration in the context of agribusiness creates a synergistic effect between several agents, which leads to the more rational use of resources as a factor for implementing innovations and technological revolution (Kusakina et al., 2020). However, some studies of this interdisciplinary context deserve to be highlighted due to their importance and impact. Whether it is about the negative effects of current intensive agriculture such as water degradation and its impacts (Mühl et al., 2024; Rabalais et al., 2009) or the relationship between migration, class struggle work and the search for better living and working conditions (Mitchell, 1996). Similarly, discussions on markets, food security, food and energy, the relationship between developed and emerging countries lead to a global land race and have long-lasting and far-reaching implications for global agriculture, for countries' livelihoods and food security (Cotula, 2012).

A complex set of factors reflects fundamental changes in economic and geopolitical



relations involving the field of agribusiness studies. Long-term cycles, such as the industrial cycle, based on fossil energy consumption, monopolization, peaks in oil prices and agriculture as an energy producer trigger the food security alert (McMichael, 2009). So some topics that are very dear to humanity are discussed by this field of studies.

Finally, current agribusiness topics include studies on automation, smart farms, sustainable development, biotechnology, supply chains, trade and other issues of fundamental importance (Bergier et al., 2021; Deng et al., 2017; Leguizamón, 2016; Mechiche-Alami et al., 2021; Slaughter et al., 2008; Šrédl et al., 2021; Thapa Magar et al., 2021; ersink et al. 2021; Wolfert et al. 2017).

The following presents the method applied to investigate the evolution of research trends in the field of agribusiness, identifying the terms and topics most studied since the conceptualization of the term agribusiness until the present.

3 METHODOLOGY

Bibliometry, as a research approach, employs quantitative methods to analyze scientific production and its impact (Boyack & Klavans, 2019; Haddow, 2018). Some analysis variables include, but are not limited to, the number of publications, citations, authors, journals, institutions, and collaboration patterns. In this way, it is possible to quantify elements, demonstrate trends and analyze research patterns within a scientific field (Leiden University, 2024). There are two crucial types of bibliometric analysis: performance analysis and scientific mapping. The first assesses the productivity and impact of articles, authors, institutions and more. The second is a relational technique that identifies research fields, associations, main themes and research groups in a field (Donthu et al., 2021; Zupic & Čater, 2015). Overall, these approaches allow us to understand the structure and dynamics of scientific production. In the meantime, bibliometry was the research method applied in this article, that is, quantitative methods were applied to a body of literature to explore the communication patterns, trends and networks that occur in this literature (Belussi et al., 2019).

The portfolio of documents for the analysis was recovered from the Scopus database, chosen for offering a broad view of global and interdisciplinary scientific literature (Elsevier, 2024). The research term used was agribusiness (*agribusiness*), the research returned a total of 3915 scientific articles. The metadata of all retrieved documents was considered in the keyword correlation statistical analysis.

To offer an evolution perspective of the researched themes, time cuts were made in



decades to demonstrate the most studied keywords in each period, except when the volume of publications was insufficient for a quantitative analysis of correlation between keywords. However, the last decade was analyzed in two periods to present a more accurate view on the theme and due to the expressive volume of publications. Finally, in order to present the state of the art or the frontier of the field of study, a temporal clipping was presented with the keywords that most indexed studies in the year 2020.

Bibliometric analysis was performed with the help of the VosViewer software (Van Eck & Waltman, 2010), considering the precepts of Zipf's Laws on word frequency (Newman, 2005). VOSviewer assists in the construction and visualization of bibliometric networks, where individual journals, researchers or publications can be represented based on citation relationships, bibliographic coupling, co-citation, co-authoring or text mining (Leiden University, 2024).

Specifically the cword technique was used, this technique consists of graphically representing the context in which a word occurs in large masses of texts and allows identifying associations between words based on their cooccurrence (Van Eck & Waltman, 2014). The cword technique was applied to the keywords used to index documents, since keywords have the function of representing the main topics discussed in a document. For Zipf a small group of words occurs often and a large number of words are of low frequency, so it is possible to index a scientific text by the concentration of terms or keywords that represent the themes of the document (Adamic & Huberman, 2002; Guedes & Borschiver, 2005; Newman, 2005).

The graphic representation follows a sort of visualization by similarity. VosViewer groups the terms together and creates lines connecting them according to their cooccurrence, generating a map that shows the relationship between the terms. The size of a word in the map represents the frequency of occurrence of that word and the lines represent cooccurrence, i.e. if the words appear more often together in an article, then the lines connecting them are wider. In the same sense, the spatial ordering of the terms on the map reflects the similarity or proximity of the concepts. Additionally, the different colors represent groups, i.e. words of the same color are those that are related to each other more often by cooccurrence and present greater thematic similarity (Van Eck & Waltman, 2014). As an alternative to word maps, heat maps can be used, following the same principles where the colors of the map are defined according to the occurrence of the words, with the most occurring words gaining warmer colors (Leiden University, 2024).

We believe that this approach can provide a comprehensive understanding of the development of the field of agribusiness research. In addition, this presentation is particularly



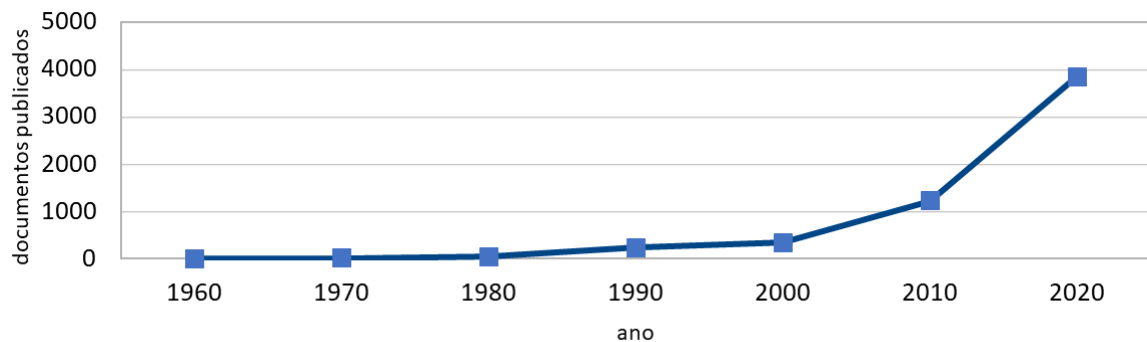
useful for individuals who are new to the field of research, such as new students, policymakers, and society at large. However, we present the state of the art of the research field at different times, which may be useful for specialists to develop new ideas.

4 RESULTS AND DISCUSSIONS

The number of publications on agribusiness increased significantly from 1960 to 2020. Until the 1980s, there were few publications on the subject. From 1980 to 2000, growth was linear. From 2000 to 2020, publications grew exponentially, as illustrated in Figure 1.

Figure 1

International agribusiness publications in the Scopus database from 1960 to 2020

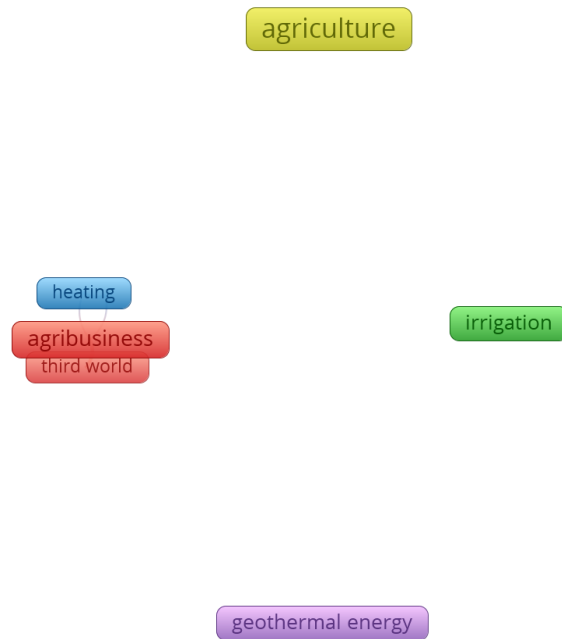


To analyze the transformations of the concept of agribusiness over the years, the documents were grouped together for decades, with an initial exception. All papers published in the Scopus database up to 1980 were grouped together in the analysis presented in Figure 2, due to the small number of papers available. Until 1980, the keywords related to the concept of agribusiness did not have a strong relationship with each other, due to the small amount of documents published and the cooccurrence of words was low to form a network with VOSView.



Figure 2

Key Keywords until 1980.



With the keyword Agribusiness, the keywords agriculture, irrigation, heating (*heating*), third world (agriculture) and thermal energy appear. However, VOSview coword analysis has not yet been able to generate a map, due to the small number of documents published at the time.

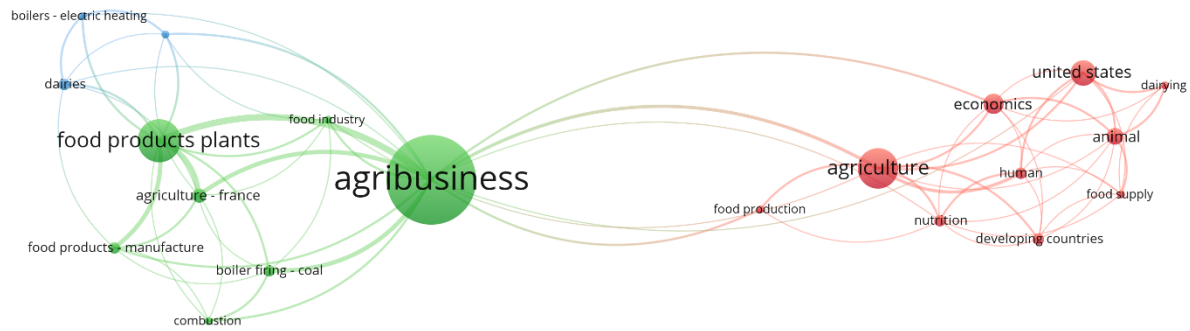
However, the pioneering studies are divided between the United States and France. In the United States, the concept of agribusiness came about addressing the relationships between industrial supply chains, agricultural production, food industry and food distribution system, with a market perspective. On the other hand, in France the concept of *Filière* or chain developed, focusing on the sequence of operations leading to the production of goods, reflecting a distributive and systemic concern (Davis & Goldberg, 2021; Zylbersztajn, 2017).

As noted in figure 1, from the 1980s the volume of publications increased and so the cooccurrence analysis became more robust, allowing the creation of a map with the keywords. Curiously enough, the bibliometric analysis represented the American and French schools in this period, that is, starting from the pioneering studies (on agribusiness in the United States and on the *filière* in France), research groups with thematic axes were developed, represented in figure 3.



Figure 3

The 20 Most Co-Occurring Keywords 1981 - 1990.



During this period, the concept of agribusiness acted as a link between two distinct groups of keywords or concepts in research. On one side, terms such as food products plants, *food products* and food industry are related to French agriculture (*such as agriculture - France*), among other terms. In the other group, the terms agriculture (*agriculture*), economics (*economics*) and the United States (United States) appear more often among other words.

Thus, the keyword count of the studies published between 1981 and 1990 reveals the reflection that the initial approaches to the concepts of agribusiness and *filère* had. Two "research fronts" related to these concepts are formed (Jackson, 1968).

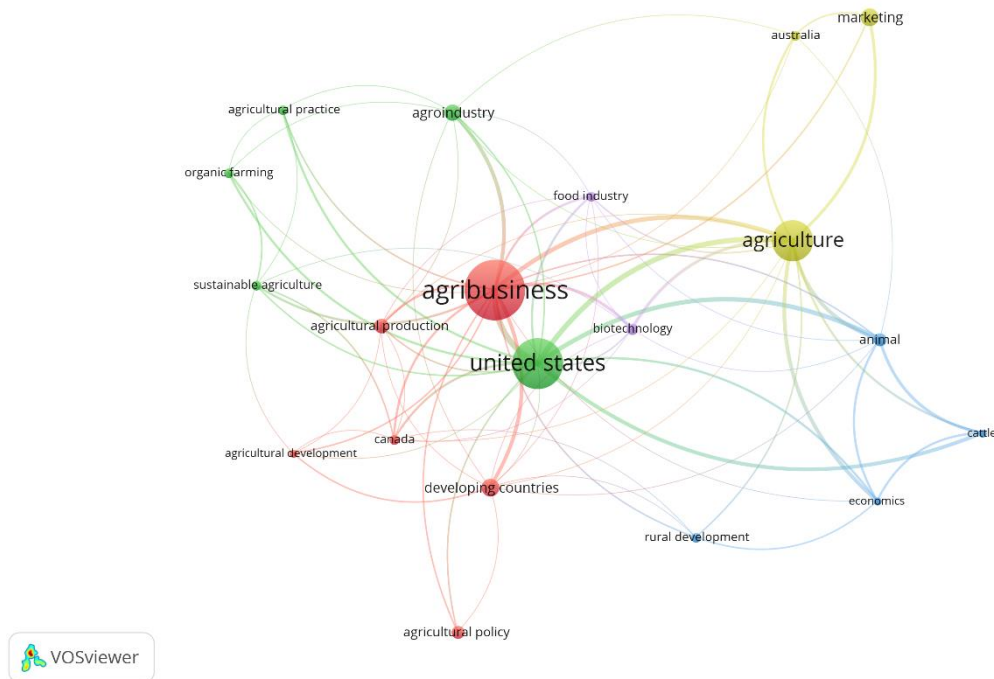
The comparison between Figure 3 and Figure 2 demonstrates a dynamic in the development of the themes of the field of agribusiness research. For example, the term agriculture remained among the main concepts. However, terms such as irrigation, geothermal energy, and heating did not appear in Figure 3. However, this does not mean that these subjects are no longer being studied in the field of agribusiness. It also means that other themes have gained greater importance over the years, demonstrating a dynamic in the development of the themes.

Following on from the analysis of the decade from 1991 until 2000, it can be seen that the subjects addressed by agribusiness continue to be in transformation. As well as the volume of publications increasing, new themes are starting to integrate the studies related to agribusiness, or that is to say, new concepts are articulated and addressed by the researchers. Figure 4 presents the 20 keywords with the highest cooccurrence from 1991 to 2000.



Figure 4

The 20 Most Cooccurring Keywords from 1991 to 2000.



Recalling that word groups are calculated by cooccurrence, reflecting the words that often appear together in studies. Thus, words with the same color represent these groups. Therefore, it can be observed that the United States, sustainable agriculture, organic farms, agricultural practices and agroindustries form a group represented in green color, indicating that many studies addressed these themes simultaneously. Another group, less evident but with emerging themes, includes the keywords food industry (food industry) and biotechnology (biotechnology).

The time series in Figure 4 reveals new elements such as sustainable agriculture, agricultural policies and biotechnology, highlighting the synergistic effect among agribusiness agents that drives technological innovations and revolutions. This effect, as described by Kusakina (et al., 2020), begins to be clearly represented in this period. The discussion on sustainability, previously initiated by researchers such as Costanza (et al., 1997) and Meadows (et al., 1972), seems to gain significant strength in the field of agribusiness during this decade. The dissolution of the previous groups represented by France and the United States suggests a greater integration of global practices and knowledge. Thus, in this decade the United States remains a central keyword, while developing countries and Canada also emerge as important



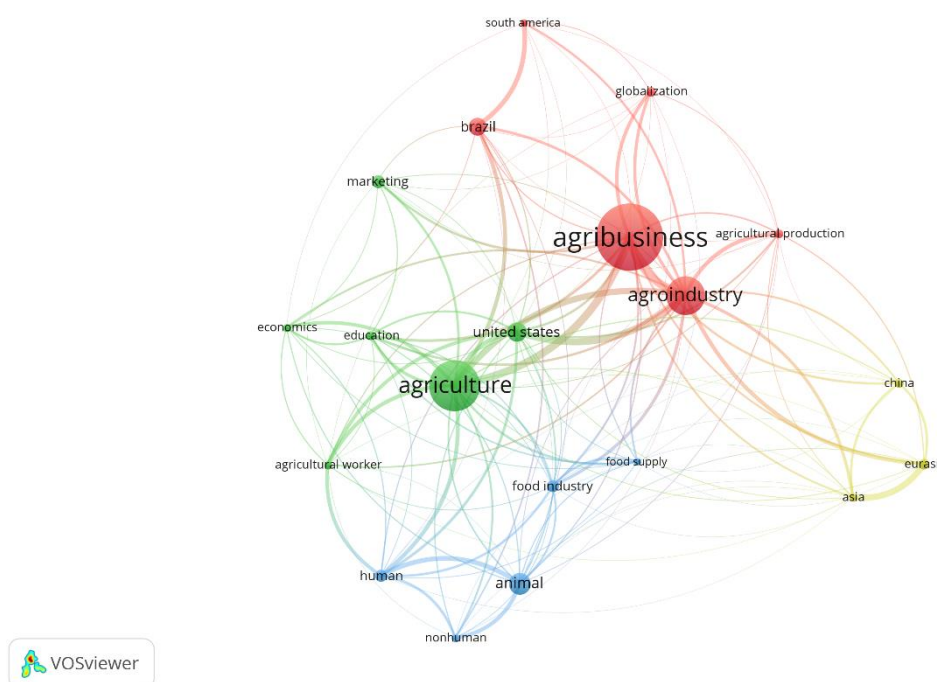
foci. Finally, the presence of new keywords indicates a growing interest in issues related to sustainability and innovative farming practices.

Approximately until 1990, the studies are more related to food, energy and economic issues. But in the cut-off from 1991 until 2000, as if the field of studies had expanded, concepts relating to social issues, sustainability and biotechnology gained prominence. In fact, in this period emerging countries such as Brazil experienced some positive effects on agricultural production and others negative in social terms as a result of the attempts to modernize agriculture and include it in global agro-industrial complexes as reported in several studies (Bianchini et al., 2023; Buainain et al., 2019; Gasques & Villa Verde, 1990; Silva, 1996).

From the year 2000 onwards, the number of publications in the field of agribusiness increases significantly, indicating an expansion of the field of studies into new concepts and territories. As depicted in Figure 1, this period marks significant growth from previous years. Figure 5 shows that, from 2001 to 2010, the studies on agribusiness spread globally, with the inclusion of new countries and regions. Brazil, China and Eurasia emerge among the top ten keywords with the highest cooccurrence, evidencing the diversification and internationalization of the field. This growth not only reflects a quantitative increase, but also a thematic and geographical expansion of research, addressing issues specific to different regions.

Figure 5

The 20 Key Words with the highest cooccurrence from 2001 to 2010.





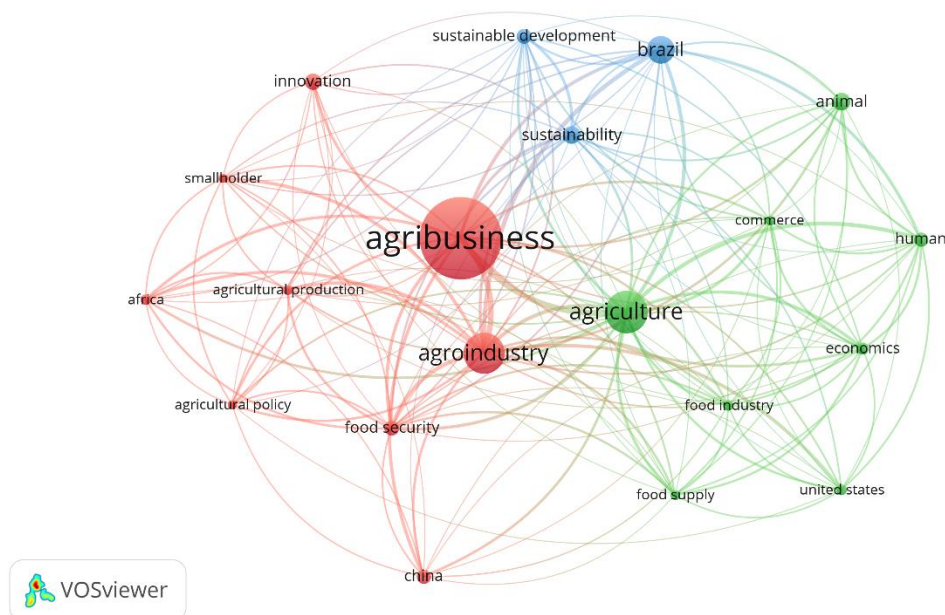
From 1991 to 2010, there was a continuity in the core concepts of agribusiness, agriculture and agribusiness. These keywords remain the most frequent and have a strong relationship with each other and with other keywords throughout that period. Going back to Figure 3 and analyzing from 1981 onwards, it is noted that the word "agroindustry" is not present, but the expression "food products plants" is used as a synonym for this concept. This linguistic adaptation suggests a continuity in the approach of the food industries over time, even if the specific terms may vary.

In this sense, the first studies in the Scopus database indexing the term agro-industry are from 1977, an article dealing with the Cooperation between agro-industries and the United Nations Organization (Albright et al., 1977) and another dealing with the agricultural revolution and its consequences (Röbbelen, 1977). Most probably the expression agribusiness was still not usual before this period and became popular in the field of agribusiness, approximately, in the 90s.

In moving towards more contemporary discussions and in view of the significant increase in the number of publications from 2010 onwards, a more specific time-cutting approach was adopted. The decade from 2011 to 2020 has been divided into two periods for more detailed analysis. Figure 6 represents the period 2011 to 2015, while Figure 7 covers the period 2016 to 2019. This subdivision allows a more granular analysis of trends and developments in the field of agribusiness over these years.

Figure 6

The 20 Most Co-Occurring Keywords from 2011 to 2015.



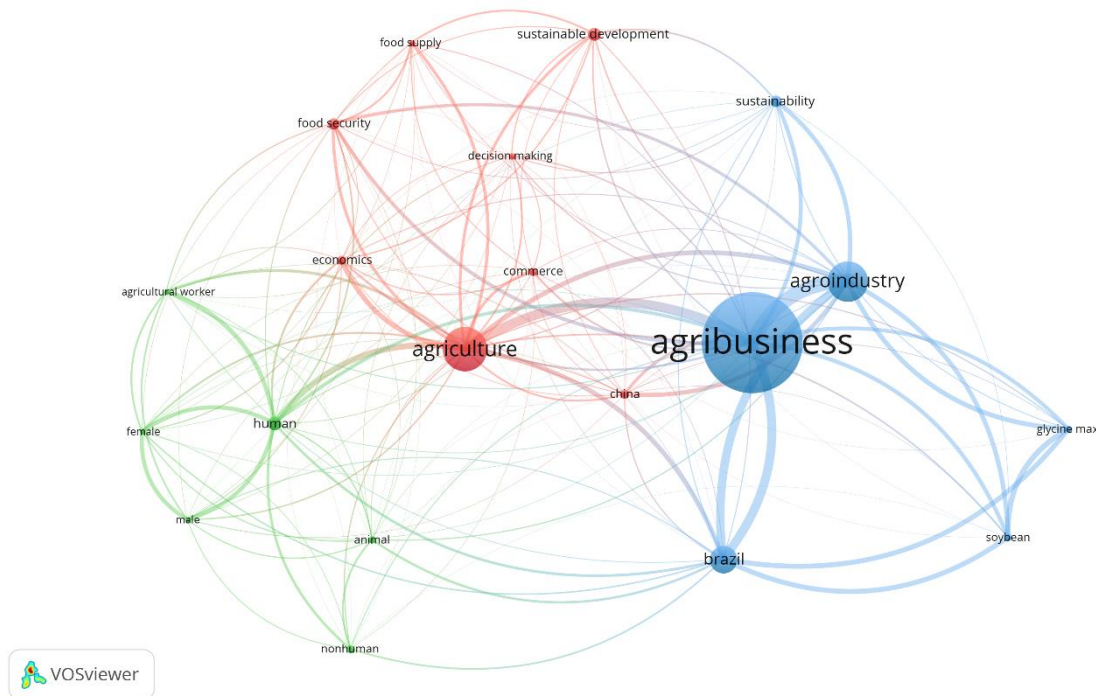


During the period analyzed, agribusiness, agriculture and agribusiness continue to be the central terms with greater cooccurrence and correlation among themselves. At the same time, innovation, sustainability and food security emerge as concepts of increasing importance. For the first time, studies on Brazil and China outnumber studies on the United States, while Africa also becomes a significant subject of study.

It is possible to notice that the resulting map of the connection between all keywords resembles an ellipse, indicating a strong interrelation between the concepts. In the previous periods, the concepts grouped themselves into more distinct groups. In figures 6 and 7, the pattern of the map remains close to an ellipse because there are more studies and many relationships between keywords are established. At this moment, the field of research is more consolidated, with interrelated concepts forming a nucleus that represents the essence of studies in agribusiness. This strong interconnection between terms reflects the maturity and complexity achieved by the field of study.

Figure 7

The 20 Most Co-occurring Keywords from 2016 to 2019.



Throughout the period analyzed, agribusiness, accompanied by agriculture and agribusiness, remain as dominant concepts. Notably, Brazil and China emerge as the most



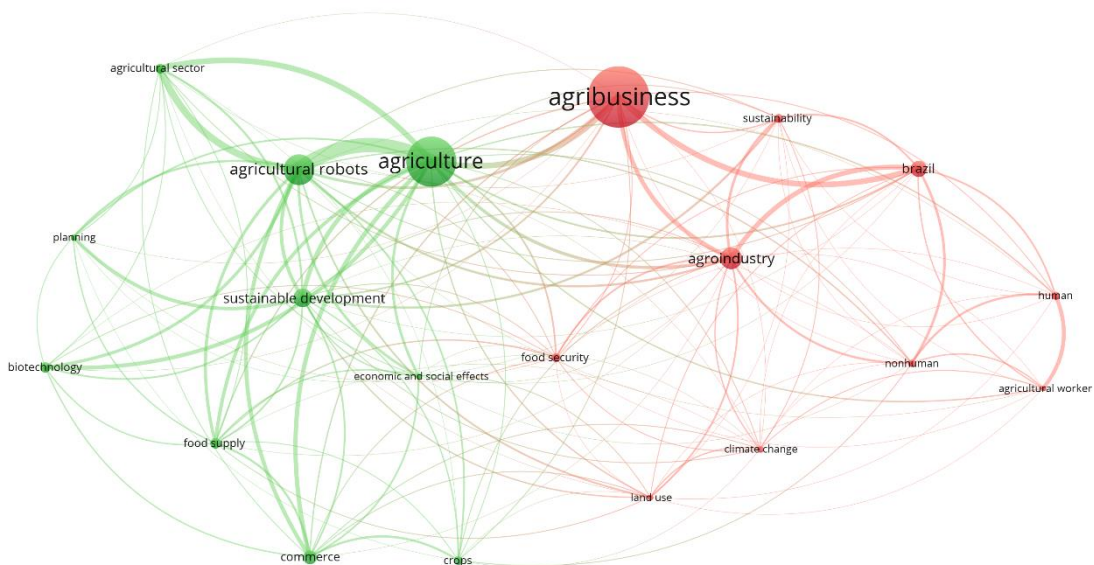
central and most studied countries in this context. Sustainability maintains its relevance, while discussions on gender issues arise, as evidenced by the group in green in Figure 7.

The evolution of the studies reflects an expansion of the scope of the field of studies over time. Until 1990, studies were more focused on food, energy and economic issues. In the period 1991 to 2000, a significant expansion was observed, with the emergence of concepts related to social issues, sustainability and biotechnology (Zylbersztajn, 2017). In the last decade, from 2011 to 2020, this expansion is directed to other territories, especially emerging countries (Mechiche-Alami et al., 2021), reflecting a growing internationalization and diversification of the field of studies (Raikes et al., 2000).

During the analysis, it was observed that some keywords remain at the core of discussions in the field of agribusiness, while others emerge and gain prominence in certain periods, replacing previous themes. This dynamic reflects the constant evolution and diversification of the issues addressed in this field of studies. In order to represent the state of the art of this field, Figure 8 presents the 20 keywords with the highest cooccurrence for the year 2020. These keywords reflect the most relevant trends and topics within agribusiness in this specific period, revealing the intentions and themes that will be popularized in the near future.

Figure 8

The 20 Most Co-Occurring Keywords in 2020.





In addition to the three core concepts - agribusiness, agriculture and agribusiness - agricultural robots and sustainable development were prominent themes in the year 2020. While sustainability and sustainable development have been frequent themes over the past decade in the field of agribusiness, agricultural robots have emerged forcefully over the past year, reflecting the growing adoption of advanced technologies in agriculture. This trend shows a change in the paradigm of modern agriculture, with a renewed focus on automation and sustainability as fundamental pillars for the future of agribusiness.

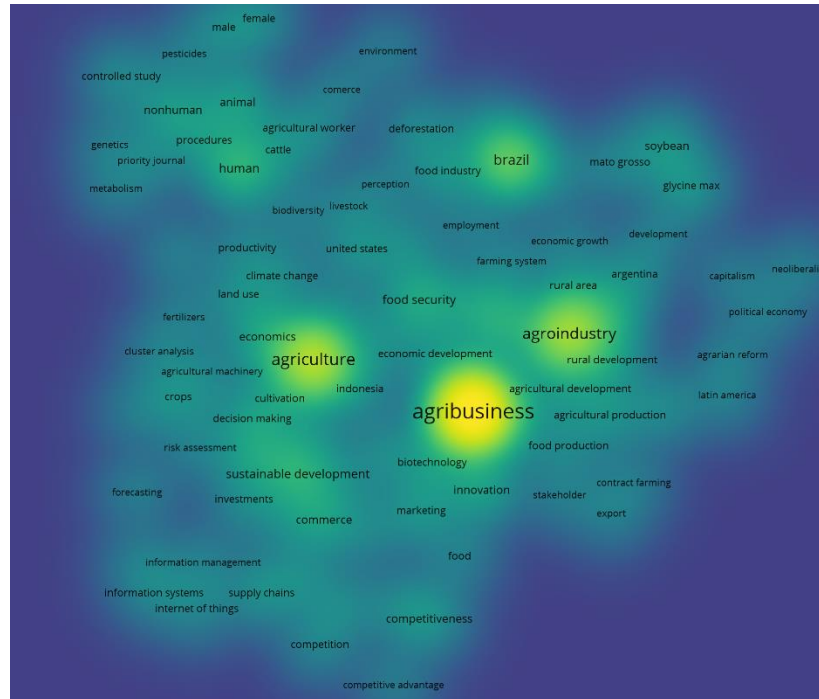
The emergence of agricultural robots as a major theme in 2020, along with the continued emphasis on sustainability and sustainable development over the past decade, indicates a major evolution in the field of agribusiness. The growing adoption of advanced technologies in agriculture reflects not only a boost towards efficiency and productivity, but also a response to the environmental and social challenges faced by the sector (Awan et al., 2021; Mühl & Oliveira, 2022a; Yang et al., 2023). The integration of agricultural robots represents a significant change in the paradigm of modern agriculture, with a renewed emphasis on automation and sustainability as fundamental pillars for the future of agribusiness (Afrianto et al., 2020; Mühl & Oliveira, 2022c, 2022b; Ribeiro Rocha et al., 2023). This change not only promises to increase efficiency and reduce the environmental impacts of agricultural production, but also provides opportunities for more resilient agriculture that is adaptable to future demands (Cesco et al., 2023). However, it is essential to ensure that such technological adoption is accompanied by policies and practices that promote inclusion, equity and sustainable development, to ensure that benefits are shared broadly and fairly across the agricultural chain (Rose & Chilvers, 2018).

To conclude the analysis, Figure 9 provides a comprehensive overview of all agribusiness-related concepts, covering the period from 1960 to December 2020. Throughout this period, the three core concepts related to agribusiness - agribusiness, agriculture and agribusiness - remained relevant. The significant increase in the number of studies carried out in the last two decades, especially after 2010, is evident. Therefore, keywords from the last decade have more occurrences, more weight in the calculation and are more represented in Figure 9. This visual representation reinforces the importance and scope of the studies carried out in this field over time, providing a holistic view of trends and developments in the field of agribusiness.



Figure 9

The 100 concepts most explored in agribusiness studies since 1960.



The terms "agribusiness", "agriculture" and "agroindustry" make up the central core of the field of studies of agribusiness, being highlighted by the high cooccurrence and relevance. These concepts serve as pillars of the research carried out in this domain and are closely correlated with other terms represented in Figure 9. Less frequent terms may not be visible in this figure due to its lower occurrence and the quantitative nature of the analysis. However, these concepts also play a crucial role in characterizing the field, interconnecting with the central terms.

The main topics addressed in the agribusiness studies include human (human), sustainable development, sustainability, food security (*food security*), economy (economy) and innovation (*innovation*). These themes reflect the central concerns and interests of researchers in this field, highlighting the scope and importance of the issues addressed.

Brazil stands out as the only country among the 10 main concepts represented in Figure 9, evidencing its significant contribution to the field of agribusiness. As one of the largest producers of agricultural commodities in the world, Brazil plays a key role in the global market. The close trade relationship between Brazil and China is also noteworthy, with China being the largest trading partner of Brazil. As a major purchaser of soybeans and meat from Brazil, China stands as the main destination for commodities exported by the South American country (Escher et al., 2019; Werner, 2020).



The transformation in the field of agribusiness can be illustrated by a detailed analysis of the terms most studied over the decades. This approach offers valuable insight into how focus areas and research trends have evolved from the 1960s to the more recent period. Table 1 summarizes, in order of occurrence, the 20 terms most studied in the different periods covered in the previous analyzes: from 1960 to 1980, from 1981 to 1990, from 1991 to 2000, from 2001 to 2010, from 2011 to 2020, and from 2020.

Table 1

Top 20 terms ranked by number of occurrences.

	1960-1980	1981-1990	1991-2000	2001-2010	2011-2020	2020
1st	<i>Agribusiness</i>	<i>Agribusiness</i>	<i>Agribusiness</i>	<i>Agribusiness</i>	<i>Agro-industry</i>	<i>Agriculture</i>
2nd	<i>Agriculture</i>	<i>Agriculture</i>	<i>Agricultural policy</i>	<i>Agricultural production</i>	<i>Agribusiness</i>	<i>Agricultural robots</i>
3rd	<i>Developed World</i>	<i>Agriculture-France</i>	<i>agricultural production</i>	<i>Agricultural worker</i>	<i>Agriculture</i>	<i>Agribusiness</i>
4T H	<i>Developing World</i>	<i>Animal</i>	<i>Agriculture</i>	<i>Agriculture</i>	<i>Brazil</i>	<i>Agro-industry</i>
5th	<i>Economic blocs</i>	<i>Boiler firing</i>	<i>Agro-industry</i>	<i>Agro-industry</i>	<i>Human</i>	<i>Sustainable development</i>
6th	<i>Energy</i>	<i>Boilers — electric heating</i>	<i>Animal</i>	<i>Animal</i>	<i>Food security</i>	<i>Commerce</i>
7th	<i>FAO</i>	<i>Catering service</i>	<i>Australia</i>	<i>Asia</i>	<i>Economics</i>	<i>Brazil</i>
8	<i>Food policies</i>	<i>Cattle</i>	<i>Biotechnology</i>	<i>Biodiversity</i>	<i>Sustainable development</i>	<i>Food supply</i>
9T H	<i>Heating</i>	<i>Combustion</i>	<i>Canada</i>	<i>Biotechnology</i>	<i>Sustainability</i>	<i>Agricultural sector</i>
10th	<i>Import and export patterns</i>	<i>Dairying</i>	<i>Cattle</i>	<i>Brazil</i>	<i>Animal</i>	<i>Biotechnology</i>
11T H	<i>Investments</i>	<i>Developing countries</i>	<i>Conference paper</i>	<i>China</i>	<i>Food supply</i>	<i>Economic and social effects</i>
12	<i>Irrigation</i>	<i>Economics</i>	<i>Crops</i>	<i>Crops</i>	<i>China</i>	<i>Nonhuman</i>
13th	<i>landlessness</i>	<i>Electric power utilization</i>	<i>Cultivation</i>	<i>Decision making</i>	<i>Commerce</i>	<i>Sustainability</i>
14	<i>Leveling valves</i>	<i>Food handling</i>	<i>Decision making</i>	<i>Economics</i>	<i>Glycine max</i>	<i>Crops</i>
15th	<i>Market shortages</i>	<i>Food industry</i>	<i>Developing countries</i>	<i>Education</i>	<i>Soybean</i>	<i>Human</i>
16T H	<i>Materials handling</i>	<i>Food products - manufacture</i>	<i>Economic impact</i>	<i>Eurasia</i>	<i>Agricultural production</i>	<i>Land use</i>
17T H	<i>Minerals</i>	<i>Food products plants</i>	<i>Economics</i>	<i>Food</i>	<i>Agricultural worker</i>	<i>Planning</i>
18	<i>Oil hydraulic</i>	<i>Food supply</i>	<i>environment</i>	<i>Food industry</i>	<i>Nonhuman</i>	<i>Food security</i>
19	<i>Production trends</i>	<i>Human</i>	<i>Food industry</i>	<i>Food supply</i>	<i>Decision making</i>	<i>Climate change</i>



20th	<i>Sewage effluents</i>	<i>Nutrition</i>	<i>Globalization</i>	<i>Globalization</i>	<i>Smallholder</i>	<i>Agricultural worker</i>
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There has been an evolution in focus areas over the decades. In the periods 1960-1980 and 1981-1990, the most studied terms reflect a traditional emphasis on agricultural production, agricultural policies, and economic development of countries. Since the 1990s and 2000s, there has been an increase in the relevance of topics such as biotechnology, agro-industry and environmental issues. In recent years, from 2011 to 2021, terms such as agricultural robots, climate change, sustainability and food security stand out, indicating a growing concern for advanced technology and environmental issues.

These results show a significant evolution in the field of agribusiness, with a shift in focus from maximizing production and efficiency to a more sustainable and technological approach. The growing inclusion of technology-related terms such as agricultural robots and biotechnology demonstrates how innovation is reshaping agricultural practices (Brennan et al., 2022; Mühl & Oliveira, 2022). In addition, the emphasis on sustainability and food security reflects increased awareness of the environmental and social impacts of agriculture (Cesco et al., 2023; Rose & Chilvers, 2018). This change in the areas of study highlights the need for continuous adaptation to new technologies and global challenges, pointing to a future where sustainability and technological efficiency will be essential for agribusiness development.

In addition to the terms agribusiness, agriculture and agribusiness that stood out in Figure 9, we noticed that other subjects persist in most periods analyzed with a high occurrence, as shown in Table 1. These themes that persist for several decades are fundamental and constitute the core of the field of agribusiness studies, as presented below:

- *Agribusiness (Agribusiness)*: This term appears in all periods analyzed (1960-1980, 1981-1990, 1991-2000, 2001-2010, 2011-2020, 2020-2021), and covers all aspects of the agricultural production chain, from production to marketing.
- *Agriculture (Agriculture)*: Another constant term in all periods, essential for the countryside, as it covers a wide range of activities related to the cultivation of plants and the rearing of animals for the production of food, fiber and other products.
- *Animal (Animal)*: This term appears in four periods (1960-1980, 1991-2000, 2001-2010, 2011-2020), reflecting the importance of livestock farming and other forms of animal husbandry within agribusiness.



- *Agroindustry (Agroindustry)*: Present in four periods (1960-1980, 1991-2000, 2001-2010, 2011-2020), highlights the integration of industry with agriculture, emphasizing importance of the processing and marketing of products value.
- *Economics/Economic Impact*: Terms related to the economy appear in four periods (1960-1980, 1981-1990, 2011-2020, 2020-2021), underlining the importance of economic growth in the euro area. economic and financial aspects in agribusiness, from the economic viability of agricultural practices to the overall economic impact.
- *Supply Chains (Food Supply)*: This term appears in four periods (2001-2010, 2011-2020, 2020-2021), indicating a constant concern with ensuring a adequate food supply to meet the growing demand for food.

The constant presence of these terms throughout the different periods indicates that they form the core of the field of agribusiness studies. These key themes reflect the complexity and interconnection of the different components of agribusiness. The evolution in focus areas over time shows how the field adapts to new technologies and challenges, but these core terms remain the ongoing basis of study and development. They represent the foundations on which new trends and innovations build, ensuring that the basic needs of production, processing, and economics continue to be met as the field progresses.

5 FINAL CONSIDERATIONS

The main result found in this bibliometric analysis is the identification of central terms that remain constant in the field of agribusiness studies over the decades. The terms "agribusiness", "agriculture" and "agribusiness" make up the core of the field of studies of agribusiness, being highlighted by the high cooccurrence and relevance. In addition, the terms "animal", "economy/economic impact" and "supply chains" also stand out as fundamental pillars, reflecting the evolution of focus areas and research trends from the 1960s to the most recent period. This constancy indicates the continuous relevance of these themes, showing that, in spite of the changes and innovations in the field, the fundamental concepts of the field of studies were structured in the first decades and maintained throughout the years.

In addition to the core terms, the analysis reveals the emergence of new topics in recent periods, such as "*agricultural robots*", "climate change", "sustainability" and "food security". These new terms reflect an adaptation to growing environmental, technological and social



concerns. The inclusion of the term agricultural robots demonstrates the advance of automation and digitalization in agriculture, promoting greater efficiency and accuracy in agricultural practices. The terms climate change and sustainability indicate a growing awareness of the environmental impacts of agricultural practices and the urgent need to develop more sustainable methods. While food security underlines the importance of ensuring agricultural production can meet global demand amid challenges such as climate change and population growth.

Despite the valuable insights provided, the bibliometric analysis used presents some limitations. The reliance on available bibliographic data may omit new emerging areas of research that do not yet have a significant amount of publications. In addition, the cooccurrence of terms does not necessarily capture the depth and complexity of the topics discussed in the research. These limitations suggest that the results should be interpreted with caution, considering the possibility of biases and gaps in the interpretations.

The possibilities for future research are wide and promising. More detailed studies can explore how the constant terms interact with each other and how their relevance has evolved in specific contexts, such as climate change, technological advances, and agricultural policies. In addition, research can deepen in the analysis of emerging terms that were not captured in this initial analysis, providing a more complete and dynamic view of current and future trends in the field of agribusiness.

In short, the bibliometric analysis carried out offers a comprehensive view of the evolution of the field of agribusiness, highlighting both the constancy of central themes and the need to adapt to new challenges and technologies. Based on the results, it is clear that agribusiness research must continue to evolve, incorporating new areas of study and interdisciplinary approaches to promote a more sustainable and efficient agricultural sector. These findings provide a solid foundation for future research and strategic decisions, benefiting both academia and agricultural practice globally.

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