Evolution of entrepreneurship research in the food sector: a bibliometric review

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1. Introduction

Entrepreneurship becomes more critical than ever in times of global crisis, as opportunities arising from uncertainty give way to different business models, new products or services, and innovative practices (Llanos-Contreras et al., 2020). Entrepreneurship pursues the need to respond to the challenges and requirements emerging from the changes (Jafari-Sadeghi et al., 2020). Similarly, entrepreneurship is considered a strategy for economic development and the creation of new jobs (Mwatsika, 2021). In a first stage, entrepreneurial behaviour starts with the intentions to create a business and is usually encouraged by an education in entrepreneurship (Cera et al., 2020). In a second stage, perceptual factors of entrepreneurship and identify salient perceptual enablers of entrepreneurial activities for nascent entrepreneurs is indeed important (Qin, 2021). However, for established entrepreneurs, at least temporarily due to COVID 19, business activity is rapidly shifting from focusing on non-core to core activities (Steffen et al., 2020), especially in the food and healthcare sector. Food sector is defined as the actors involved in the production, processing and distribution of food and agricultural products (Jones & White, 2021). In turn, during the coronavirus pandemic, there has been a shift in consumption patterns in the food sector, with an increase in demand for takeaway food versus the expense of eating out (Tajvidi and Tajvidi, 2020).

This highlights the need for governments and researchers to prioritize the strategic study of these sectors to ensure that supply chains become more local and do not endanger citizens in a similar future crisis. Undoubtedly, knowledge transfer from the research environment to small and medium-sized enterprises (SMEs) in the food sector is crucial for competitiveness and even survival (Fonseca et al., 2015). This is due to a combination of factors, such as high-quality products valued in domestic and international markets, climate, territorial prosperity, and entrepreneurship (Vrontis et al., 2019). The food sector is important to economies around the worl. It is one of the most important industries among Latin American countries, contributing between 5% and 18% of the region's GDP. (Muller et al., 2022). At the same time, the industry faces enormous challenges, such as

supply, security, or food waste, which could offer exciting opportunities for future entrepreneurs to develop innovative solutions to these challenging problems. In this context, Kuckertz et al. (2019) and Ferraris et al., (2021) find that food sector is an area of great opportunity for innovation, creativity and entrepreneurship. On the other hand, Mondrego and Foster (2021) studied different rural areas of Chile where entrepreneurship rates were found to be very high. Likewise, the personal characteristics of the Ecuadorian entrepreneur in the food sector in the city of Guayaquil were also studied (Arbitro and Andrea, 2015)

Taking into account the great challenges that the food sector is currently facing and the great opportunities for new projects and companies, it is interesting to know and analyse the scientific production on both structures. Although numerous articles relate the food sector to entrepreneurship (Tajvidi and Tajvidi, 2020; Lindbergh and Schwartz, 2021), no bibliometric articles have been found in the literature that analyses the scientific production that relates both terms. In the field of entrepreneurship, this type of study has been carried out for several years; recently, we found one on International Entrepreneurship (IE) (Baier-Fuentes et al., 2019), another on social entrepreneurship (Dionisio, 2019); or even on Entrepreneurship Education (EE) (Aparicio et al., 2019). In food sector, some studies attempt to review and evaluate the scientific literature of the discipline. Still, all of them are related to a specific area. For example, Maléchaux et al. (2020) make a scientific study on the origin of olive oil, and Zhang et al. (2020) analyze emerging trends in vinegar research. Other authors have conducted studies to identify main authors, countries, and academic social network on food packaging research (Rodríguez-Rojas et al., 2019). Also, Kamdem et al. (2019) recently presented a bibliometric overview of the main scientific advances that have been published in Food Chemistry. Similarly, Apostolopoulos et al. (2021) recently published a paper relating the agro-food sector and entrepreneurship using a systematic literature review.

Due to this increased academic interest and the lack of focused reviews, we believe it is time to examine the overall picture of entrepreneurship in the food sector in order to suggest suitable lines of future research. Thus, we detect a gap in the literature as there are no papers that, in a general way, relate all academic research in the food sector to entrepreneurship. We propose that this can be done by analysing, through a bibliometric analysis, the scientific production published in WoS on both topics.

Based on the above, our work aims to study the main patterns and trends within the academic literature on entrepreneurship and the food sector through the use of bibliometric tools. Essentially, we seek to answer six research questions (RQs) as follows:

RQ1. Which is the historical evolution of the literature about entrerpreneurship and food industry?

RQ2. Which are the main journals around which the research topic is organized?

RQ3. Which are the main documents that have influenced the intellectual structure of the topic?

RQ4. Which are the more productive authors and the top publishing countries and universities?

RQ5. Which is the social structure of this area of research?

RQ6. Which is the conceptual structure of this area or research?

The rest of the article is structured as follows. The next section presents the methodology implemented to conduct the present research. Subsequently, the results of the bibliometric analysis are introduced and discussed. Finally, the last section provides conclusions, implications and future research arising from the paper.

2. Methodology

Empirical studies have fragmented streams of research (Fink, 2019) and difficult for researchers to keep abreast of developments in the literature (Aria and Cuccurullo, 2017).

The study of the scientific production of a given topic can be carried out through two methodologies: systematic literature review and bibliometric analysis (see differences in table 1). However, while SLR is more focused on content analysis, ~~is why~~ bibliometric analyses are increasingly necessary as a tool to measure the impact of research trends in a specific field (Prabhat and Suresh, 2020, Ranjbari et al., 2022). As Pandey et al., (2022) suggests, bibliometric analysis is a statistical evaluation of published scientific articles, books, surveys and book chapters, in which qualitative conclusions are drawn from figures and values available in published works. This type of study focuses on analyzing the structural characteristics of scientific fields and/or domains (Zupic and Čater, 2015). This method has been widely used in other papers on entrepreneurship (Le and Tran, 2021; Benziane and Houcine, 2021; Zhai et al., 2022, among others) and in sectoral studies (Nurdiono et al., 2021; Kamdem et al., 2019; Batmunkh et al., 2022).

[TABLE I AROUND HERE]

Given that the aim of this research is to understand the patterns and trends of research results in entrepreneurship and the food sector and not a specific analysis of the content researched and the large number of papers to be analysed (1300 documents), the use of bibliometric analysis is more appropriate. Furthermore, bibliometric and thematic analysis are usefull to limit the results' subjectivity (Secinaro et al., 2022). To answer our research questions, the main indexes to be studied in our bibliometric analysis revolve around the following items: (i) trend in scientific production (number of publications per year), (ii) title of the journals in which the papers have been published (core journals, source dynamics), (iii) documents (most cited papers, most frequent words and trend topics), (iv) most productive and cited authors (Lotka´s Law, author´s affiliation, and country analysis), (v) social structure (author, institution and country networks) and, (vi) conceptual structure (thematic map).

The data for analyzing research productivity related to entrepreneurship and the food sector was extracted from the Web of Science (WoS) Core Collection database. WoS

collects scientific production of all disciplines and includes the journals most highly valued by the scientific community (Ramos-Rodríguez et al., 2021). We filtered the search by papers published only in English. Because bilbiometrics provides tools that compare keywords, using a single language allows for a more efficient bibliometric analysis. The search query used was food AND entrepreneur* and the results obtained were published between 1992 and January 2021.

Following Lima-Santos et al., (2020) and Lechuga et al., (2020), we used the bibliometrix R package for the bibliometric analysis. The bibliometrix R package is an open-source tool that includes bibliometric methods for analyzing quantitative research in scientometrics and bibliometrics (Prabhat and Suresh, 2020).

3. Results

The search showed a total of 1300 papers published in 761 different sources. The vast majority are articles (1144), although we have also collected 72 book chapters, 47 early access, and 37 proceedings papers. In total, 3237 authors have contributed to the publication of all the papers. Only 335 authors have published alone, while 2902 have co-authored.

3.1. Evolution of documents per year

To determine the evolution of the literature, the early accesses are not taken into account. Our analysis is carried out on the remaining 1253 works. The study period covers 28 years. The evolution of scientific production relating entrepreneurship to the food sector is upward (see Figure 1). During the first eleven years up to 2002, there is a small number of papers, an average of 3.18 articles per year. During this period, there were even years in which no papers such as in 1993 and 1997. Between 2003 and 2007 (both included), the number of publications was fairly stable, between 14 and 18 papers per year. And it is from 2008 onwards, a considerable increase in the number of papers published year by year begins to take place from 30 papers published in 2008 to 161 published in 2020. During this last stretch, an important advance can be observed in 2017, when 145 papers were published, while in the previous year (2016), only were 97. This is the year in which production grew the most in absolute terms in the entire historical serie. After this remarkable rise, in 2018, production fell slightly to 134 articles, which was a decrease of 11 fewer than in 2017. But in 2019, the output rose again to 165 papers, the highest peak in the graph that represents 12.69% of all the production analyzed in this paper. In 2020, publications remained almost stable, only declining by four papers. To illustrate the progression in the number of articles from 1992 to 2020, a trend line was used through a linear regression model (Okumus et al., 2018). The dependent variable refers to articles published, while the independent variable represents the years in which articles have been published. The linear model shows a proportion of variable explained of $R^2 = 0.6229$. The regression parameters indicate that the trend in the number of articles per year on entrepreneurship and the food sector is upward, increasing on average by 5 articles per year.

[FIGURE 1 AROUND HERE]

3.2. Sources

3.2.1. Most relevant sources (impact)

Currently, public and academic institutions are very interested in promoting entrepreneurship (Miller and Acs, 2017). To do this, research sources are essential. The main sources of papers are *Sustainability* in the first place, followed by *British Food Journal*. The first one published 35 articles, which represents 2.69% of the scientific production studied. The latter published 34 papers (2.61%). *Sustainability* is an international, interdisciplinary, academic, peer-reviewed, open-access journal on human-environmental, cultural, economic, and social sustainability. And *British Food Journal* is a peer-reviewed journal that provides an interdisciplinary platform for scientists and academics to discuss and share their latest food-related research.

Journal Citation Report (JCR) measures a journal's impact in terms of the citations received for the articles it publishes (Al-Hoorie and Vitta, 2019). This index is calculated by dividing the total number of citations of a journal in a given year by the number of publications of the journal during the last two years (Garfield, 2006). Concerning JCR impact, *Journal of Rural Studies* is the highest quality source among the nine that publish more than ten articles. Its impact is 4,849. The second journal with the highest impact is *Food Policy*, with 4,552. In third, fourth, and fifth place are *Agriculture and Human Values, Sustainability* and *British Food Journal* with an impact of more than three for the first and two for the last two.

Emerging Source Citation Index (ESCI) is a WOS database created in 2015 and collects new journals under evaluation that will have a citation index but no JCR impact index (Ruiz-Pérez and Jiménez-Contreras, 2019). Of the nine sources that publish the most articles on the subject we studied, three are part of ESCI (*Journal of Agriculture, Food Systems and Community Development*, *International Journal of Entrepreneurship* y *Innovation* y *Scientific Papers-Series Management Economic Engineering in Agriculture and Rural Development*).

3.2.2. Source Dynamics

In figure 2**¡Error! No se encuentra el origen de la referencia.**, we observe the growth of the five publications with the highest number of articles. Looking at the graph, we can see that none of the five journals published any papers during the first years. The first to start publishing papers was *British Food Journal*, and it has been doing so since 2002 increasingly and stably. *Sustainability* is the journal with the most publications. However, its 35 articles have been published in the last eight years, showing the highest growth compared to the other four journals. *International Food and Agribusiness Management Review* shows a very uneven growth, being the only journal to decrease its production in the last two years. *Journal of Rural Studies* shows a small growth graph, showing that its articles have been published in the previous decade. And finally, *Journal of Agriculture Food Systems and Community Development* shows an upward trend since 2006, flatter than the rest of the journals. However, it has decreased slightly in the last two years. We

can also see that all the journals, except for *Sustainability*, stabilize their growth trend in 2020, matching the general trend of publications in the field studied.

[FIGURE 2 AROUND HERE]

3.3. Documents

3.3.1. Most influential documents

The number of citations reflects the popularity and influence of each paper among researchers (Baier-Fuentes et al., 2019). The 1300 papers resulting from the search have obtained 11935 citations in WOS. We have highlighted 13 papers that have obtained more than one hundred citations since the year of publication in the database studied (see table I). Among these thirteen most cited papers, a total of 2473 citations have been obtained, representing a total of 20.72% of all citations. However, of the 1300 papers obtained, 385 have never been cited (29.61%). The next column shows the percentage of citations obtained by each paper. The last column shows the average number of citations per year.

The paper written by Fairhead et al. in 2012 is the most cited, representing a total of 5.87% of the 11935 citations obtained by all the papers in the sample (see Table II). In addition to having the most citations (700), it also has the highest annual average number of citations (87,5) in the eight years it has been published. This article examines the use of natural resources for food or fuel that operates through new legal and market mechanisms, in which new entrepreneurs and consumers find common interests. The second most cited paper was published in 2008 by Zunki. It has been cited on a total of 219 occasions, obtaining an average of 12.85 citations per year and representing 1.83% of the total number of citations. In this work, the author refers to how entrepreneurs can create new alternative spaces to the usual ones. Although this paper is the second most cited, it is not the second most cited paper per year, but the third. The second paper with the second-highest annual average number of citations is Diener et al. (2011), with an average of 15.44 citations per year. This research develops a field experiment in Costa Rica on waste reduction in the food sector. The rest of the most cited papers deal with a variety of other contents.

[TABLE II AROUND HERE]

3.3.2. Most frequent words and Trend topics

Keyword research and analysis provide insight into research trends and topics in a given discipline. (Okumus et al., 2018). *Cloud keyword* is very useful to get a clearer mental picture of what is going on (Tayebi et al., 2019). In this research, we have distinguished the most common words in the title of the documents and keywords in the papers below the abstract. Although it is logical because they are words in the search equation for articles, in both cases, we can see that the most common terms used by the authors are entrepreneurship and food. Although it can be seen that in the title, the word food is used more intensely, while in the keywords are both food and entrepreneurship. In the latter case, the introduction of other words such as innovation, management or performance should also be highlighted.

As discussed above, research on entrepreneurship and the food sector has boomed in recent years. As a result, we observe that the study covers different directions due to the absence of a fully established paradigm. The degree of attention to a research topic is measured by counting the number of abstracts related to that topic (Van Eck and Waltman, 2007). Politics, Strategies, and Governance are the trends that most frequently use the keywords identified above. Specifically, they have a frequency of 43, 31, and 29 keywords, respectively.

3.4.Authors

3.4.1. Most cited and productive authors

The impact of an author reflects the influence they have in a given field of research, measured by the number of citations received. In this way, it is possible to identify the most relevant authors in an area of knowledge (Garfield, 1972). In this study, 3237 authors have been identified who have related food sector to entrepreneurship. This represents an average of 0.402 papers published per author. Only 335 researchers have published single-authored documents, while the majority (2902) have participated in the publication of multi-authored documents. The average number of multi-authored documents was 2.49 authors per document. However, the previous indicator increases to 2.71 if we refer to the number of appearances, i.e., the rate of co-authorship per document. From the above data, it is possible to calculate the collaboration index, which is an index of co-authors per paper calculated only with the set of multi-authored researches (Koseoglu, 2016). In this paper, the collaboration index has a value of 3.06.

In this research, three authors have been identified as the most cited. Interestingly, all three have published a single article together (see table II). All of them have received a total of 700 citations each in WOS. James Fairhead is Professor of Social Anthropology at the University of Sussex and also chairs the UK and Commonwealth Association of Social Anthropologists. Melissa Leach is a Professor at the Institute of Development Studies (IDS) Sussex and Director of the ESRC's STEPS Centre. Finally, Ian Scoones is a Professor at the Institute of Development Studies (IDS) Sussex, and co-director of the STEPS Centre. These three scholars focus their research on sustainable agriculture and policy issues in various regions of Africa. Sharon Zukin is the fourth most cited researcher, with a total of 219 citations for a single paper. She is professor emerita of sociology at Brooklyn College and the Graduate Center of the City University of New York. Zukin writes on urban cultures and economies around the world. The fifth researcher in this ranking is Brian Ilbery, who has been cited 217 times for his three papers. Ilbery is a retired emeritus Professor of Rural Studies at Coventry University (England). His research has been extensive in questions as how we produce and consume food, agricultural change, and rural policy.

Table III shows the authors with four or more articles, papers per author, the year of first publication, the total number of citations received, and the average number of citations per published paper. It also includes three types of indicators that measure the impact and productivity of the authors. Firstly, the Hirsch index or h-index measures the professional quality of scientists based on the relevance of their output. An author has a given h-index

when h of their articles have received at least h citations each (Hirsch, 2005). The second metric, g-index quantifies bibliometric productivity based on the publication history of authors. Its use is recommended to differentiate between two researchers with the same *h-index*. It is calculated by sorting publications by the number of citations received in descending order, numbering the position, and generating two new columns: cumulative number of citations and squared position number. The order number of the position where the cumulative number of citations is equal to or greater than the squared position number is identified (Eggue, 2006). Finally, we highlight the m-index to facilitate comparisons between researchers with academic careers of different lengths (Guo et al., 2021). In this research, the comparison is with Alonso, A.D., who is the author with the most articles published. It is calculated by dividing the h-index by the number of years since the author first published it (Robinson et al., 2019).

Seventeen authors have published 4 or more articles. In this way, Alonso, A.D. stands out as the author who has published the most, 8 papers. His first article dates back to 2009. Despite being the most cited author (81 times) for the 8 papers, he is not the one with the highest annual average (10.13 citations per year), as several authors surpass him. Thus, Crescimanno is the researcher with the most citations per year (18.75), as is Galati. Ritvala follows with 14 citations per year, with 13.50 and 12.50 citations per year on average, García-Villaverde and Dana. Of the 17 academics analyzed, seven have an h-index of 4. This means that four of their works have obtained more than four citations. Cortese is the author with the lowest impact of all of them, with an h-index of 1. However, Alonso has the highest productivity in his publication history, as his g-index is the highest (8). So he stands out among colleagues with the same h-index. Comparing the careers of the different researchers with Alonso's, we observe that Parra-Requena, Rodrigo-Alarcón, Ruíz-Ortega, and García-Villaverde are the ones with the highest m-index (0.800).

[TABLE III AROUND HERE]

3.4.2. Lotka's Law

Lotka's Law is one of the most basic laws of bibliometrics that describes the frequency of publication of authors in a given field (Lotka, 1926) and it determines the distribution of publications in a research area (Bookstein, 2001). Lotka's Law shows that in a given area of science, many authors publish a single study, while only a small group of prolific researchers contribute a large number of publications. It is also known as the inverse square law of author productivity. According to this, the indicator takes the number of authors who have contributed to a single study and then predicts how many authors would have published x studies. In short, the number of researchers producing x studies can be expressed as $1/x^2$ (Bisaria, 2020). In this way, the distribution of contributions is not proportional, which is logical since authors with different research capabilities in a given area are publishing (Su et al., 2019). The same also happens in this paper, 93,1% of the authors (3013) have only contributed one publication. At the other extreme, we find Alonso, A.D., who has contributed the most in this field with eight works, an insignificant proportion. Next, five academics (Mars, M.M., Parra-Requena, G., Parzer, M., Rodrigo-Alarcón, J. and Ruíz-Ortega, M.J.) have published five papers each. As in other studies

on authors' productivity (Snaith, 2013), our results also show that Lotka's Law holds. Therefore, the group of authors with the highest impact and productivity is composed of few researchers. There are only 214 academics who publish two or more papers, which represents only 6.9% of all authors. Of course, with Lotka's Law, only a quantitative study can be made. The quality of the papers and authors cannot be measured by this index (Su et al., 2019).

3.4.3. Institutions and countries analysis

Research linking entrepreneurship and the food sector from various universities and institutions around the world. A total of 1376 institutions from 87 countries have participated in the research papers. The most prolific university is Wageningen University & Research from the Netherlands, which published 25 papers, followed by Michigan State University (USA) with 21 publications. Between 11 and 15 published papers, we find the University of Turin (15), University of Tasmania (14), Cornell University and University of Vermont (13 each), Massey University and the University of Castilla-La Mancha with 12 papers each and Universiti Putra Malaysia (11) (see table IV).

[TABLE IV AROUND HERE]

With respect to the countries with the highest production in our field of study, being one of the largest and most industrialized nations globally (Okumus et al., 2018) USA is in first place with 498 papers, an average of 10,54 citations, and 228 of them have US researchers as corresponding authors. It is followed by less than half the number of publications by the United Kingdom (213). However, with a higher average number of citations (22.12 per year) and 109 papers with corresponding English authors. After them, with more than 100 publications, we find Italy (167), Australia (106), and Canada (102). Although the most prolific university is the Netherlands, the USA, and the UK are the countries that produce the most publications, with 711 papers (see table V).

[TABLE V AROUND HERE]

3.5.Social Structure

Social network analysis detects the social structures that define the nature of knowledge exchange between actors in a network (Low & Siegel, 2020). In academia, the social structure constructs use three methods: (1) collaboration in scientific studies, (2) the existence and impact of related associations, and (3) scientific journals (Durand et al., 2017). This work has been analyzed using the first of these methods, collaboration between authors, institutions, and countries.

3.5.1. Author collaboration network

Bibliometric analysis helps to determine so-called co-authorships, represented through graphs with nodes and connecting lines. The nodes involve authors or institutions, and the network dynamics are represented by the links connecting these nodes (Ingale and Paluri, 2020). In figure 3, the nodes reveal the most influential authors, and the thickness and distance between the nodes indicate the degree of collaboration. In this way, a large

green cluster is formed by the four authors who collaborate the most. The first author is María José Ruiz-Ortega from University of Castilla-La Mancha (Spain) with five publications. In the same cluster are Pedro M. García-Villaverde, Job Rodrigo-Alarcon and Gloria Parra-Requena. All of them also belong to the University of Castilla-La Mancha, although they work in different cities. Another essential collaboration network is the one marked in pink. Maria Crescimanno and Antonio Galati form it. The first author is from the Department of Agricultural, Food, and Forest Sciences of the University of Palermo (Italy). As the second author, he is the one who has published more. In brown, we find another cluster formed by Ondřej Dvouletý and Ivana Blažková, from different countries. Dvouletý is from Austria. He is an Associate Professor of Entrepreneurship at Prague University of Economics and Business. Blažková is from the Department of Regional and Business Economics, Faculty of Regional Development and International Studies of Mendel University in Brno (Czech Republic). Therefore, the authors collaborating on entrepreneurship research in the food sector are usually from the same environment. The last cluster indeed analysed is made up of authors from different countries, but they are very close to each other.

[FIGURE 3 AROUND HERE]

3.5.2. Institution collaboration network

Our analysis determines the cooperative relationships between institutions. Figure 4 shows a collaboration between the 50 most relevant institutions that are part of this study. Three relevant clusters can be detected. The first, in green, shows Michigan State University (USA) as the strongest collaborating institution in this cluster. The closest collaboration is with the Public University at Berkeley in California (USA), followed by international relations with Makerere University (Uganda) and the University of Pretoria (South Africa). In yellow, the next cluster links Cornell University (New York) with The University of Vermont and The University of North Carolina at Chapel Hill. All three are located in the USA. The third cluster, in grey, shows the relationship between two Australian universities, The University of Queensland and the University of Tasmania. Only the first cluster shows the international collaboration of US institutions with African, while the other two clusters detect national collaborations.

[FIGURE 4 AROUND HERE]

3.5.3. Country collaboration network

Food sector and entrepreneurship arouse interest throughout the world. This promotes global social networks, which generate collaborations between authors from different countries. The network of collaboration between countries is determined by the co-authorship of papers. In this way, collaborative networks are analyzed according to the origin of the publication's first author. In this way, USA is the country that collaborates most often internationally. It has worked with Canada on 14 occasions, followed by the UK (13), China (11), the Netherlands (7), and six times with Australia and Italy. Next comes UK collaborating with Italy (11), Australia (7), and Austria (6).

3.6. Conceptual Structure

As Martinez et al. (2015) did, we analysed the thematic map to delineate the conceptual structure of the topic. The latter consists of a network analysis of co-occurrence of words to define what science in a given field is discussing, the main themes and trends. More specifically, the thematic map allows to visualise four different typologies of themes, as shown in figure 5. The size of the clusters is proportional to the number of associated documents.

Themes in the upper right quadrant are known as motor themes, because they have a strong centrality and high density. These themes are well developed and important for the structure of a research field. They play a motor role within the scientific field under consideration. In this discipline there are 2 motor themes. The most developed and most important theme for the structure of the research field is "food security". In fact, a significant number of documents (70) correspond to this term. In this sense, most of the core documents in which the term appears are studies that explore and analyse the genesis of food security and associated factors so that organisations, businesses, policy makers and stakeholders can explore and understand this important societal issue. The challenges posed by food security are eclectic in nature and cross country, societal, organisational and individual boundaries. In this context, the definition of business guidelines and behaviours to initiate and mitigate food safety risk, especially in underdeveloped countries, seems to be of utmost importance. Another driving theme is "food processing", and this is not surprising as it is an issue closely related to food safety. Indeed, one of the problems facing the world, especially developing countries, is how to avoid waste and maintain the quality attributes of food during and after processing. Therefore, there is a great need for effective and commonly used methods together with novel processes for food processing and preservation, which in turn ensure food safety and quality.

The themes in the upper left quadrant (quadrant 3) are highly specialised and peripheral in nature. These themes are considered to be of marginal importance for the field, as they have well-developed internal linkages, but poor external linkages and are therefore not of great importance for the development of the field as a whole. As can be seen in Figure 5, the theme of "rural development" is placed in this quadrant. Most papers focus on defining methods and processes to transform food systems for rural prosperity.

Themes in the lower left quadrant (quadrant 4) may represent emerging or disappearing themes, because they are underdeveloped and marginal. These themes have low density and low centrality. Consequently, there is no significant research interest. Centrality and density are low, so that the themes placed here have a weak and distinctly marginal character. In this quadrant the themes often appear for the first time and in many cases they also end up disappearing here for good. These themes are mainly "local food" and "sustainable development". Many of the articles related to "local food" focus on the analysis of the factors that contribute to the experiences of travellers and tourists with the typical food of the destinations, and are therefore mostly related to the tourism sector.

On the other hand, the concept of "sustainable development" could be seen as an emerging theme. Increasing inequalities and climate emergencies are adding new pressures to the

world's food and agricultural systems. The deterioration of environmental resources urgently calls for a rethink of current forms of production and consumption by business and society. Indeed, their sustainable exploitation, together with their protection and conservation, undoubtedly ensure the maintenance of key resources for the environmental and cultural development of mankind. In this sense, the need for sustainability certification in these systems is a growing and increasingly necessary phenomenon, especially in the agri-food sector.

Finally, "food safety" is a theme that is placed in the lower right quadrant (quadrant 2), and represents a cross-cutting, general and basic theme, in fact, we can observe that it is related to the other themes that emerged in this map, and thus can be considered a bridging theme. According to Callon et al, (1995) the themes in this quadrant are important for the research field, but are not well developed as they have low density with high centrality. More specifically, within this theme, there are papers that analyse the factors affecting the adoption of food safety management systems. Thus, food safety encompasses the whole circuit from food production, i.e. everything that is produced until it is consumed has to be included in the same chain.

[FIGURE 5 AROUND HERE]

In general, as can be seen in the strategy diagram, most of our themes are distributed around the first bisector (quadrant 1 - quadrant 4). This indicates that the field is organised around a core of well-structured and well-developed themes, to which a number of peripheral and underdeveloped themes are related.

4. Dicussion and Conclusions

In this paper, we have analyzed the literature on entrepreneurship and the food sector to study the main patterns and trends within the academic literature relating to both topics and identify future lines of research. To this end, we have carried out a descriptive bibliometric analysis and studied the social structure of the thematic. The work carried out provides exciting conclusions.

We were guided by six research questions during this process, the conclusions for which we provide below. RQ1 sought to analyse the historical evolution of literature.. Although the first paper was published in WOS in 1992, the results indicate that since 2002 there has been an increase in academic publications. Still, it has been in the last four years that this growth has taken an exponential form, indicatings the importance and the interest of academics of this subject in recent years. QR2 sought to know the main journals that have published on the topics under analysis. In response to this question the journals that have published the highest number of articles are *Sustainability* and *British Food Journal*, this is more focused on food issues. The journal with the highest impact factor is *the Journal of Rural Studies*, followed by *Food Policy*. Of the five journals with the highest number of articles published, Sustainability is the journal with the most publications and the one that has seen the greatest increase in scientific production on these topics. We call on the other journals to call for special issues to increase the number of publications on this topic

and, consequently, to broaden the sources where papers relating entrepreneurship and the food sector are published.

QR3 focused on studying the most influential papers in the intellectual structure. Of all the papers analysed, only 13 obtained more than 100 citations. The paper written by Fairhead et al. (2012) is the most cited, representing a total of 5.87% of citations obtained by all the papers in the sample, so they are considered the most relevant authors, which appears first in the ranking. The keyword analysis shows that the word food appears most intensely in the title of the papers. On the other hand, we highlight politics, strategies, and governance as trend topics. This suggests that the results of this research have important practical implications for policy makers, as will be discussed below.

QR4 aimed to analyse the profile of the main authors on entrepreneurship and the food sector as well as the countries and institutions where research on these topics has been mainly carried out. In this regard, the majority of the papers were co-authored, with a collaboration index of 3.06. Three authors stand out as the most cited, namely James Fairhead, Melissa Leach and Ian Scoones. The author who has published the most articles is Alonso, A.D., with a total of 8 articles. Alonso has the highest productivity in his publication history, as his g-index is the highest (8). It has also been found that Lotka's Law is followed, as only 6 authors have published more than four articles, which represents 0.19% of the authors. With regard to countries and institutions, the most prolific university is Wageningen University & Research from Netherlands, followed by Michigan State University (USA). And the countries that have published the most articles are USA and United Kingdom.

QR5 attempted to analyse the social structure of the research. The social structure show that the research in these subjects is done in collaboration between authors, institutions and their countries. USA is also the country that collaborates most internationally, with Canada, UK, China, and the Netherlands. The institution that collaborates most with others is Michigan State University (USA), with the strongest relations being with Public University at Berkeley in California (USA), followed by international relations with Makerere University (Uganda) and the University of Pretoria (South Africa). Collaboration between authors tends to be with colleagues in the same environment.

Finally, RQ6 refers to the conceptual structure of the research topics, entrepreneurship and the food sector. In response to this question, and deduced from the conceptual map presented in the previous section, the most developed topics (motor) are food security (Maleki et al., 2021; Prügl and Joshi, 2021) and food processing (Sudheer et al., 2021; Krishnamoorthy et al., 2021). This indicates that there is already a well-developed field of research in the food sector on process-related elements and food safety, the latter being a transversal issue in food entrepreneurship research. In addition, the conceptual map provides us with an emerging theme in this field of research: “sustainable development” (Režek Jambrak et al, 2021; Dhahri et al., 2021). It is undoubtedly a highly topical issue, given that companies are making decisions and adjusting their procedures in order to meet the sustainable development objectives for 2030 (Crecente et al., 2021; Hummels and Argyrou, 2021).

4.1. Theoretical and practical implications

This paper contributes to the academic literature with a bibliometric review of research on entrepreneurship and the food sector at a crucial moment for the world economy, the Covid'19 health crisis, and has several theoretical implications. Firstly, although there are already papers that have studied entrepreneurship in the food sector (Tajvidi and Tajvidi, 2020; Lindbergh and Schwartz, 2021), a bibliometric analysis of publications on both topics had not been carried out. We then contribute by providing knowledge on the research developed by providing information on the evolution of the research, most influential papers and authors, countries and institutions involved, as well as emerging themes that should be taken into account in future research.

Second, there has been a growing trend in recent years of publications on these topics. This indicates that there is a strong interest both in the academic community and among professionals in the sector who are starting new businesses to learn more about specific aspects of the food sector (Hajiagha et al, 2021; Umarov, 2021). In this respect, sustainable development has emerged as an emerging research topic and food safety as a cross-cutting issue of major interest. Therefore, more research is needed to understand how current companies and future entrepreneurs in the food sector must meet the requirements to maintain food safety standards and achieve the sustainable development goals set by the 2030 agenda.

Third, for researchers looking to explore this topic further, our analysis helps to identify the best journals for their work and the universities and institutions with which they can form collaborative networks to study entrepreneurship in the food sector. ~~Our study provides information for all academics to continue research on these topics and to have a framework to focus their new study.~~ This work also contributes to libraries and documentation organizations because it allows them to know the main topics and journals to be acquired for their users. Fourth, the intellectual and social structure of the research field shows that there is a concentration of research in authors and institutions in developed countries such as the United States, the UK and the Netherlands. However, in the world there are great inequalities with respect to food issues according to the level of development of the countries (González-Zapata et al., 2021; Enriquez and Archila-Godinez, 2022). The results obtained suggest the need for greater knowledge of the needs of food entrepreneurs in developing countries and even in specific geographical areas such as Latin America.

It is evident that after the Covid'19 health crisis, the food sector has been one of the most affected and has been forced to reinvent itself (Power et al., 2020; Nakat and Bou-Mitri, 2021; Vargas-Ramella et al., 2021). In parallel, governments are increasingly demanding procedural requirements to safeguard citizens' security, while climate change is driving policymakers to implement earth-friendly measures by formulating sustainable development goals. The results of our research provide a number of practical implications. First, on a practical level, the results of this work are interesting both for professionals specializing in entrepreneurship, which opens up new possibilities for them to delve into the opportunities presented by the food sector. And for professionals in the

food sector, who, through our work, can discover interesting articles for implementing new business models in the sector or new management practices. Entrepreneurs and managers in the food sector must be aware that consumers are increasingly demanding in terms of the quality of products consumed and health care. For this reason, new business models must be proposed that guarantee processes for obtaining natural resources and handling food throughout the industrial process that meet minimum requirements that satisfy consumers.

Second, researchers have concentrated their research on very few countries. There is a need for more global knowledge on entrepreneurship in the food sector that can be used to make comparisons and identify new needs for food entrepreneurs in different geographical areas.

Third, managers and entrepreneurs will help governments to understand the specific needs of the food sector in their country. This will help formulate food entrepreneurship policies to provide entrepreneurs with the necessary support to achieve the required safety and sustainability goals.

Also, our investigation has implications for governments and other stakeholders to promote entrepreneurship in the food sector. It is necessary for governments to formulate policies and strategies to handle unfavorable economic conditions (Xu et al., 2021). As a result of the COVID-19 economic downturn, the types of businesses needed could include critical areas such as health care, food, and maintenance. At least temporarily, entrepreneurial activity is rapidly moving from a focus on non-essential to essential activities, especially in the area of food and health (Steffen et al., 2020).

At the turn of the century, due to social changes and however, during the coronavirus pandemic, there has been a shift in consumption patterns in the food sector with an increase in demand for takeaway food versus the expense of eating out. In addition, the emergence of cyber entrepreneurship has generated new business opportunities in the food sector during the health crisis (Tajvidi and Tajvidi, 2020). These changes have led to changes in business models in the food sector. The food sector is a setting in which many such opportunities exist (Kuckertz et al., 2019). This situation offers researchers new topics for study, opens up new lines of research, and there is a need to learn more about entrepreneurship in the food sector.

4.3. Limitations and future lines of research

The work has some limitations that give rise to future lines of research. Our sample have been selected from a single database, WoS. Although it is the most relevant for academia, researchers publish their work in other journals not indexed in this database. The use of different databases could complement the results of this study. Another limitation is that the papers were selected by searching in the title and keyword fields but not in the full text, excluding some papers on the subject. Also, as politics, innovation, and governance have been identified as the main topics, a bibliometric analysis of research that has studied these issues in the food sector could be carried out and an in-depth analysis of the barriers encountered by entrepreneurs in this sector. Furthermore, after analysing social and

conceptual structure, to better understand research in entrepreneurship and the food sector, it is proposed to analyze intellectual structure of the discipline.

The results obtained suggest the need to obtain greater knowledge of the shortcomings of food sector entrepreneurs in developing countries and even in specific geographical areas such as Latin America. On the other hand, more research is needed to find out how current companies and future entrepreneurs in the food sector must meet the requirements demanded to maintain food safety levels and achieve the sustainable development goals set by the 2030 agenda. New business models need to be developed to ensure that natural resource sourcing and food handling processes throughout the industrial process meet minimum requirements to satisfy consumers.

Ultimately, our research offers researchers new topics for study, opens up new lines of research, and there is a need to learn more about entrepreneurship in the food sector.

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