SUSTAINABLE ENTREPRENEURSHIP: AN APPROACH FROM BIBLIOMETRIC ANALYSIS

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Abstract. Researches on issues of Sustainable Entrepreneurship are gaining traction in recent years, with this trend being aligned to the achievement of sustainable development goals set by the UN in 2030. The purpose of this paper is to carry out a bibliometric analysis on research on the subject of sustainable entrepreneurship. The information gathered is extracted from the main collection of the Web of Science (WoS) database since 1999 up to December 2019. Nvivo and VOSviewer software are used to perform initial analysis and citation analysis, co-citations, bibliographic coupling, co-authoring, among others. This study presents advances associated with the main authors, journals and countries, the general and annual citation structure and the development of this field. The results show that the publication trend increases from 2015 onwards, however 2018 and 2019 have seen the greatest production of articles. In relation to the most influential countries, the Netherlands, the United States, Germany, England and Spain are the most representative. It was also found that the most influential journals are the Journal of Cleaner Production and Sustainability. The main contribution is to show the evolution of this topic, so that researchers can use it in their theoretical frameworks and research.

Keywords: bibliometric analysis, sustainable entrepreneurship, sustainable start-up, sustainable innovation, co-citation, bibliographic coupling.

JEL Classification: M00, M13, L26.

Introduction

Literature research on sustainable entrepreneurship has had different approaches (Fichter & Tiemann, 2020; Halberstadt et al., 2019; Terán-Yépez et al., 2020). It has focused on issues related to environment or ecology (Boons & Lüdeke-Freund, 2013; Dean & McMullen, 2007), leading to the use of terms such as eco-entrepreneurship (Rodgers, 2010), understood as entrepreneurs who have an environmental perspective (Schaltegger, 2014, p. 47), that is,
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a green perspective (Demirel et al., 2019; Gast et al., 2017). It has also been related to social areas, known as social entrepreneurship (Betáková et al., 2020; Schaltegger & Wagner, 2011), among other it is defined as an individual with innovative solutions to respond to society’s problems (Neck et al., 2009). Research has also been related to sustainable development and the triple bottom line (Terán-Yépez et al., 2020).

Schaltegger and Wagner state that sustainable entrepreneurship “is in essence the realization of sustainability innovations aimed at the mass market and providing benefit to the larger part of society” (Schaltegger & Wagner, 2011, p. 225). The above definition leads us to address the term “sustainable innovations”. According to Boons there is no single definition for sustainable innovation, while it is also associated with the term eco-innovation, Boons suggests sustainable innovation as “Innovation that improves the performance of sustainability” (Boons & Lüdeke-Freund, 2013, p. 2), taking into account ecological, economic and social issues. However, Varadarajan mentions that there are three types of sustainable innovations; one associated with the decrease in the use of resources; another related to the innovation of elimination of the use of resources and, finally; the innovation of replacement of the use of resources (Varadarajan, 2017, p. 8). Another definition is “the integration of conservation and development to ensure that modifications to the planet do indeed secure the survival and well-being of all people” (Albort-Morant et al., 2017, p. 2).

Another vision of sustainable entrepreneurship is that “is focused on the preservation of nature, life support, and community in the pursuit of perceived opportunities to bring into existence future products, processes, and services for gain, where gain is broadly construed to include economic and non-economic gains to individuals, the economy, and society” (Muñoz & Cohen, 2018, p. 304). In the same way, Cohen and Winn (Cohen & Winn, 2007) define it as the review of how opportunities to create goods and services are discovered and with what economic, psychological, social and environmental consequences. In this same sense, Belz and Binder (Belz & Binder, 2017, p. 2) believe that sustainable entrepreneurship is to recognise, develop and take advantage of opportunities by individuals to create future goods and services with social, economic and ecological benefits. Likewise, the main idea of sustainable entrepreneurship is that the activities carried out by entrepreneurs must not undermine the ecological and social environments in which they operate (Muñoz & Cohen, 2018). Thus, sustainable entrepreneurship begins with the identification of ecological or social problems, and then identifies possible solutions through innovation (Eller et al., 2020). Similarly, sustainability start-ups differ from conventional start-up companies in their pronounced value-based approach and intention to initiate social and environmental change in society (Bocken, 2015, p. 3).

The purpose of this research is to present a bibliometric analysis of the sustainable entrepreneurship, in order to have an approach to this topic and identify the main authors, countries and journals that investigate this topic. Similarly, by means of maps, visualize elements such as co-citation, bibliographic coupling and co-authoring. Likewise, the presentation of the citation structure by years, which allows us to understand the historical evolution of both the number of publications and citations.

This document is organised as follows. Section 1 reviews the bibliometric methods used herein. Section 2 presents the results including the citation structures of the most representa-
tive publications, authors, institutions and countries for the topic of sustainable entrepreneurship. Also includes a graphic analysis of the bibliographic data using the VOSviewer software. Finally, the main discussions and conclusions.

1. Bibliometric method

In order to carry out the bibliometric analysis, the main collection of the Web of Science (WoS) database was consulted and the following search equation was used: Topic: (“sustainable entrepreneurship”) or Topic: (“sustainability entrepreneurship”) or Topic: (“sustainable venturing”) or Topic: (“sustainable start-up”) or Topic: (“sustainable innovation”) or Topic: (“sustainab* entrepreneur*”). The search was refined excluding 2020 and only Article or Review document types were taken into account. The time frame was from 1968 to 2019. The indices used were: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC. In this sense, by refining the search with the above equation, 761 documents were found, of which 710 are Articles and 51 are Reviews. A bibliometric analysis is done based on these articles.

Broadus’ research presents different definitions of the term bibliometric, a definition presented by the author is that of Porter who suggests that “bibliometrics is a set of methods used to study or measure texts and information of all forms of written communication, their authors and publication patterns” (Broadus, 1987, p. 374). In this sense, the bibliometric analysis allows quantitative analysis of the academic literature (Cancino et al., 2017; Merigó & Yang, 2017; Pineda Ospina, 2015). The most representative publications, citations, authors, countries and journals are analysed, which allows us to get an idea of a certain field of research (Merigó et al., 2015).

There are several indicators to measure the academic production of authors, the most popular include the total number of papers published and total number of papers published in a given period of time. There are also indicators to measure the impact of publications, including the total number of citations, the average citations per paper and the impact of the journals where the papers are published, which should be taken into account in the bibliometric analysis (Alonso et al., 2009).

However, Hirsh in 2005 designed an indicator called index h, which takes into account the quantity and impact of the researcher’s publications (Alonso et al., 2009). This revolves around the idea that “a scientist has index h if h of his or her Np papers have at least h citations each and the other (Np-h) papers have ≤h citations each” (Hirsch, 2005, p. 16569). That is, if the index h of an author is X, thus that X of his or her publications have been cited more than X times.

The main analyses include, among other: bibliographic coupling, co-citation, co-occurrence of key words. Next, each one is detailed (Boyack & Klavans, 2010; Merigó et al., 2018; Zupic & Čater, 2015): Bibliographic Coupling (Figure 2): When two papers have a common reference, that is, if paper A is cited in papers B and C, it means that they are coupled bibliographically speaking. The greater the number of common references, the greater the intensity of the relationship (Kessler, 1963), see Figure 1. Co-citation: When two papers are cited in a single paper it means that they are co-cited, in other words, when papers A and C are cited in
paper B, this indicator allows the degree of relationship of the papers according to the citing authors, that is, that the more citations the two papers have in the same paper, the greater their relationship (Small, 1973), see Figure 2. Co-authorship: It refers to documents that have more than one author, which allows to identify scientific collaboration (Merigó et al., 2018). Co-occurrence of keywords: It identify keywords more frequently and those that appear more frequently in the same documents (Merigó et al., 2018).

Finally, it is worth noting that the research that uses bibliometric analysis has focused on performing them when a journal is celebrating its anniversary (Biemans et al., 2007; Cancino et al., 2017; Merigó et al., 2018). They have also been performed focusing on a topic (Cancino et al., 2018; Fahimnia et al., 2015; Liao et al., 2018; Merigó et al., 2015; Merigó & Yang, 2017; Zupic & Čater, 2015) and in other cases they have focused on the publications of a country or region (Bonilla et al., 2015; Glänzel et al., 1999), among others.

2. Results

Since 2015, the amount of documents that have been published around the research topic of "Sustainable Entrepreneurship" has been increasing in a very representative way, having an upswing since 2011 as shown in the Figure 3. By the way (Wagner et al., 2019) mentions that as of 2009 is this increase. This originates since different disciplines have increased their interest to research the subject (Muñoz & Cohen, 2018), together with the fact that the concept of sustainability is increasingly significant. In this sense, 78.6% of the documents published correspond to the time frame from 2015 to 2019. Figure 3 displays the evolution over time of the publications per year. It is worth noting that only papers and reviews are taken into account in the bibliometric analysis presented. In total, 93.3% correspond to papers and 6.7% to reviews.

To identify the main terms that were found in the systematic information search, the NVIVO (QSR International, 2020) software was used (version 12), the author, year, title, and summary were chosen as key data. Out of the 761 papers, the title and the summary were taken and the frequency of words analysis was carried out, which consists of identifying the most frequently used words, followed by a word cloud chart, which allows to identify the most frequently used words by the size of the text, the larger the text the greater the frequency. The main words are sustainable, innovation, environmental, business, entrepreneurship, among others, see Figure 4.
Regarding the terms of sustainability, entrepreneurship and innovation, the NVIVO Software was used to track the use of these throughout the years, using the abstract of the 761 papers as data. The following table shows the historical development of these three terms. It is found that there is a greater use of these terms in research since 2010. However, it is found that there is an increase in the use of terms in 2010 compared to previous years. It is also clear that the use of the term of sustainability is growing very programmatically, especially in the last four years. Figure 5 displays the increase in the use of words.

Figure 3. Annual Number of Documents published in research on Sustainable Entrepreneurship

Figure 4. Word cloud source: own development using NVIVO
The general citation structure allows analysing the amount of documents in relation to a citation threshold (Cancino et al., 2017), in this sense, 28.52% of the documents have received at least 10 citations and 15.37% have received at least 20 citations. Only nine documents have received at least 300 citations and five documents have received at least 400 citations, see Table 1. Regarding index h, it stands at 50 for this group of documents, which means that 50 documents have received at least 50 citations.

In regards to the annual citation structure of the published documents, it is found that 74% have received at least one citation in documents indexed in the WoS database. 28.5% have received at least 10 citations, 3.2% at least 100 and 1.2% at least 300 citations, see Table 2. The year with the most citations is 2010 with a total of 1,798, with the main authors being (Bos-Brouwers, 2010; Hockerts & Wüstenhagen, 2010; Short et al., 2010; Smith et al., 2010), followed by the year 2007 with 1,469, the main authors being (Cohen & Winn, 2007; Dean & McMullen, 2007; Hellström, 2007; Stirling, 2007).

Table 1. General citation structure (source: own elaboration based on WoS)

| Number of citations | TP | %     |
|---------------------|----|-------|
| ≥400 citation       | 5  | 0.66% |
| ≥300 citation       | 9  | 1.18% |
| ≥200 citation       | 12 | 1.58% |
| ≥100 citation       | 24 | 3.15% |
| ≥50 citation        | 53 | 6.96% |
| ≥20 citation        | 117| 15.37%|
| ≥10 citation        | 217| 28.52%|
| Total Papers        | 761|       |

Note: TP – Total Papers.
Table 2. Annual citation structure on Sustainable Entrepreneurship research (source: own elaboration)

| Year | TP | TC | ≥1 | ≥10 | ≥50 | ≥100 | ≥200 | ≥300 |
|------|----|----|----|-----|-----|------|------|------|
| 1999 | 1  | 5  | 1  | 0   | 0   | 0    | 0    | 0    |
| 2000 | 1  | 1  | 1  | 0   | 0   | 0    | 0    | 0    |
| 2001 | 1  | 0  | 0  | 0   | 0   | 0    | 0    | 0    |
| 2002 | 2  | 133| 2  | 2   | 2   | 0    | 0    | 0    |
| 2003 | 2  | 141| 2  | 2   | 2   | 0    | 0    | 0    |
| 2004 | 1  | 10 | 1  | 0   | 0   | 0    | 0    | 0    |
| 2005 | 6  | 210| 6  | 4   | 2   | 0    | 0    | 0    |
| 2006 | 2  | 17 | 2  | 0   | 0   | 0    | 0    | 0    |
| 2007 | 9  | 1469| 9  | 9   | 5   | 4    | 3    | 3    |
| 2008 | 11 | 968| 10 | 7   | 4   | 2    | 1    | 1    |
| 2009 | 7  | 243| 7  | 3   | 1   | 1    | 0    | 0    |
| 2010 | 16 | 1798| 15 | 12  | 7   | 6    | 3    | 2    |
| 2011 | 30 | 1085| 18 | 12  | 6   | 3    | 2    | 1    |
| 2012 | 22 | 659 | 19 | 10  | 4   | 2    | 0    | 0    |
| 2013 | 25 | 1271| 23 | 14  | 4   | 2    | 2    | 2    |
| 2014 | 27 | 983 | 20 | 15  | 5   | 3    | 1    | 0    |
| 2015 | 50 | 749 | 45 | 23  | 4   | 0    | 0    | 0    |
| 2016 | 86 | 974 | 79 | 31  | 2   | 1    | 0    | 0    |
| 2017 | 108| 1182| 92 | 39  | 5   | 0    | 0    | 0    |
| 2018 | 183| 851 | 139| 28  | 0   | 0    | 0    | 0    |
| 2019 | 171| 222 | 72 | 5   | 0   | 0    | 0    | 0    |
| Total | 761 | 12 971| 563| 217 | 53  | 24   | 12   | 9    |
| %   | 100% | 74.0% | 28.5% | 7.0% | 3.2% | 1.6% | 1.2% |

Note: TP and TC – Total Papers and citations; ≥300, ≥250, ≥200, ≥150, ≥100, ≥50, ≥10, ≥5, ≥1 – Number of Papers with equal or more than 300, 250, 200, 100, 50, 10, 5 and 1 citation.

As mentioned above, the research published in the WoS database related to Sustainable Entrepreneurship is increasing. In the search carried out, it was found that the first paper (taking into account the search equation mentioned in section 1) is from 1999; Table 3 displays the 20 most cited papers. Authors such as Schot, J; Geels, FW; Smith, A; Voss, JP; Grin, J; Boons, F; Ludeke-Freund, F; Dean, TJ; McMullen, JS; Cohen, B; Winn, MI; Schaltegger, S; Wagner, M. Similarly, 2010 is stands out with six papers in the top 20, for its part 2007 have four papers, the years 2011 and 2014, have three papers each in the top 20. It was also found that the paper with the most citations per year is that of Boons and Ludeke-Freund.

In relation to the authors, Table 4 contains the 15 authors with their respective institutions and country, who publish the most on Sustainable Entrepreneurship matters. Authors such as Bossink, Blok and Horisch stand out with 13, 10 and 7 publications respectively. Of the 20 authors that publish the most, there are ten that have more than 100 citations, and two of whom have more than 500 citations. In relation to the index h, one author have an index of six, eight authors have an index of four, six authors have an index of three and four authors have an index of two.
Table 3. The 20 most cited documents between 1999 and 2019 (source: own elaboration)

| No. | TC  | Title                                                                 | Author/s                           | Year | TC/Y |
|-----|-----|----------------------------------------------------------------------|------------------------------------|------|------|
| 1   | 617 | Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy | Schot & Geels                      | 2008 | 56.1 |
| 2   | 577 | Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges | Smith et al.                       | 2010 | 64.1 |
| 3   | 550 | Business models for sustainable innovation: state-of-the-art and steps towards a research agenda | Boons & Lüdeke-Freund              | 2013 | 91.7 |
| 4   | 420 | Sustainable Entrepreneurship and Sustainability Innovation: Categories and Interactions | Schaltegger & Wagner               | 2011 | 52.5 |
| 5   | 406 | Toward a theory of sustainable entrepreneurship: Reducing environmental degradation through entrepreneurial action | Dean & McMullen                   | 2007 | 33.8 |
| 6   | 386 | Market imperfections, opportunity and sustainable entrepreneurship | Cohen & Winn                       | 2007 | 32.2 |
| 7   | 359 | A general framework for analysing diversity in science, technology and society | Stirling                            | 2007 | 29.9 |
| 8   | 314 | Greening Goliaths versus emerging Davids – Theorizing about the role of incumbents and new entrants in sustainable entrepreneurship | Hockerts & Wüstenhagen             | 2010 | 34.9 |
| 9   | 300 | Sustainable innovation, business models and economic performance: an overview | Frank Boons, Carlos Montalvo, Jaco Quist, & Marcus Wagner | 2013 | 50.0 |
| 10  | 286 | Sustainability-oriented innovation of SMEs: a systematic review | Klewitz & Hansen                   | 2014 | 57.2 |
| 11  | 224 | Corporate Sustainability and Innovation in SMEs: Evidence of Themes and Activities in Practice | Bos-Brouwers, HEJ                  | 2010 | 24.9 |
| 12  | 207 | The New Field of Sustainable Entrepreneurship: Studying Entrepreneurial Action Linking “What Is to Be Sustained” with “What Is to Be Developed” | Shepherd & Patzelt                 | 2011 | 25.9 |
| 13  | 183 | Green innovation in technology and innovation management – an exploratory literature review | Schiederig, Tietze, & Herstatt     | 2012 | 26.1 |
| 14  | 180 | The influence of sustainability orientation on entrepreneurial intentions – Investigating the role of business experience | Kuckertz & Wagner                  | 2010 | 20.0 |
| 15  | 179 | The entrepreneur-environment nexus: Uncertainty, innovation, and allocation | York & Venkataraman                | 2010 | 19.9 |
| 16  | 173 | Evolutionary approaches for sustainable innovation policies: From niche to paradigm? | Nill & Kemp                        | 2009 | 17.3 |
| 17  | 163 | Transforming Innovation for Sustainability | Leach et al.                      | 2012 | 23.3 |
| 18  | 162 | Overcoming barriers to innovation and diffusion of cleaner technologies: some features of a sustainable innovation policy regime | Foxon & Pearson                   | 2008 | 14.7 |
On the other hand, regarding the documents most cited in the research on Sustainable Entrepreneurship, we find that the most representative authors are: Dean Tj, Schaltegger S, Cohen B, Hockerts K, and Hall Jk., the main journals are also identified, namely: Journal of Business Venturing, Journal of Cleaner Production, Academic of Management Review and Entrepreneurship Theory and Practice, see Table 5.

Table 4. The 15 authors that publish the most on the topic of Sustainable Entrepreneurship (source: own elaboration)

| No. | Author            | TP | University                           | Country        | TC   | H   | TC/TP   | ≥100 | ≥50 | ≥10 | ≥1 |
|-----|-------------------|----|--------------------------------------|----------------|------|-----|---------|------|-----|-----|----|
| 1   | Bossink Bart      | 13 | Vrije Univ Amsterdam Univ Twente     | Netherlands    | 8    | 2   | 0.62    | 0    | 0   | 0   | 4  |
| 2   | Blok Vicent       | 10 | Wageningen University & Research    | Netherlands    | 235  | 6   | 23.50   | 0    | 2   | 4   | 10 |
| 3   | Horisch Jacob     | 7  | Alanus Univ                          | Germany        | 109  | 4   | 15.57   | 0    | 0   | 4   | 7  |
| 4   | Tsai Snag-Bing    | 6  | Dalian Univ Technol Univ Elect Sci & Technol | China          | 36   | 2   | 6.00    | 0    | 0   | 1   | 5  |
| 5   | Quist Jaco        | 5  | Delft Univ Technol                   | Netherlands    | 382  | 4   | 76.4    | 1    | 1   | 4   | 5  |
| 6   | Ratten Vanessa    | 5  | La Trobe Univ                        | Australia      | 0    | 0   | 0       | 0    | 0   | 0   | 0  |
| 7   | Schaltegger Stefan| 5  | Leuphana Univ Lueneburg              | Germany        | 522  | 4   | 104.4   | 1    | 2   | 2   | 4  |
| 8   | Tvaronaviciene Manuela | 5 | Vilnius Gediminas Tech Univ          | Lithuania      | 53   | 4   | 10.6    | 0    | 0   | 4   | 5  |
| 9   | Wagner Marcus     | 5  | Univ Wurzburg                        | Germany        | 900  | 3   | 180     | 3    | 3   | 3   | 3  |
| 10  | York Jeffrey G    | 5  | Univ Virginia                        | USA            | 274  | 3   | 54.8    | 1    | 1   | 3   | 4  |
| No. | Author                  | University                                      | Country                        | TC  | H  | TC/TP | ≥100 | ≥50 | ≥10  | ≥1   |
|-----|-------------------------|-------------------------------------------------|--------------------------------|-----|----|-------|------|-----|------|------|
| 11  | Chareonpanich Metta     | Kasetsart Univ                                  | Thailand                       | 36  | 3  | 9     | 0    | 0   | 2    | 4    |
| 12  | Cohen Boyd              | Univ Victoria EADA Business Univ Vic Univ Desarrollo | Canada Spain Australia Chile     | 412 | 4  | 103   | 1    | 1   | 2    | 4    |
| 13  | Dickel Petra            | Univ Kiel                                       | Germany                        | 14  | 2  | 3.5   | 0    | 0   | 1    | 3    |
| 14  | Donphai Waleeporn       | Kasetsart Univ                                  | Thailand                       | 36  | 3  | 9     | 0    | 0   | 2    | 4    |
| 15  | Fichter Klaus           | Carl von Ossietzky Univ Oldenburg Borderstep Inst Innovat & Sustainabil | Germany | 29  | 3  | 7.25  | 0    | 0   | 2    | 3    |

Note: Abbreviations are shown in Table 2.

Table 5. Most cited papers in research on sustainable entrepreneurship (source: own elaboration)

| No. | Reference (first author only) | TC  | TLS  |
|-----|-----------------------------|-----|------|
| 1   | Dean Tj, 2007, J Business Venturing, V22, P50 | 152 | 1757 |
| 2   | Schaltegger S, 2011, Bus Strateg Environ, V20, P222 | 143 | 1622 |
| 3   | Cohen B, 2007, J Business Venturing, V22, P29 | 131 | 1534 |
| 4   | Hockerts K, 2010, J Business Venturing, V25, P481 | 99  | 1357 |
| 5   | Hall Jk, 2010, J Business Venturing, V25, P439 | 104 | 1285 |
| 6   | Shepherd Da, 2011, Entrep Theory Pract, V35, P137 | 100 | 1103 |
| 7   | Pacheco Df, 2010, J Business Venturing, V25, P464 | 67  | 973  |
| 8   | Kuckertz A, 2010, J Business Venturing, v25, p524 | 65  | 906  |
| 9   | York Jg, 2010, J Business Venturing, V25, P449 | 64  | 906  |
| 10  | Parrish Bd, 2010, J Business Venturing, V25, P510 | 62  | 828  |

Note: TC – Total Citations. TLS – Total Link Strength.

However, analysing the countries with the most publications, it has been found that the Netherlands is the country with the most papers published on the topic of Sustainable Entrepreneurship, followed by the USA, Germany and England. These countries reached at least 300 citations in one or more papers, as did Canada, Denmark and Switzerland, see Table 6. During the first ten years (1999 to 2008) the USA published more papers than Netherlands, followed by England. In the eleven years that followed (2009 to 2019), the Netherlands leads
the field in terms of publications. Likewise, the USA stands out for having more publications in the 2008, 2009 and 2012, while the Netherlands stood out from 2013 to 2015 and Germany in 2017 and in 2018, see Table 7.

Table 6. The 11 Countries that publish the most on the topic of Sustainable Entrepreneurship (source: own elaboration)

| No. | Country             | TP | TC  | H   | TC / TP | %/761 | ≥300 | ≥200 | ≥100 | ≥50 | ≥10 | ≥1 |
|-----|---------------------|----|-----|-----|---------|-------|------|------|------|-----|-----|----|
| 1   | Netherlands         | 102| 3789| 25  | 37.15   | 13%   | 4    | 5    | 6    | 14  | 46  | 80 |
| 2   | USA                 | 97 | 2366| 24  | 24.39   | 13%   | 1    | 2    | 5    | 13  | 42  | 74 |
| 3   | Germany             | 84 | 3462| 18  | 41.21   | 11%   | 4    | 6    | 8    | 12  | 29  | 67 |
| 4   | England             | 80 | 2676| 24  | 33.45   | 11%   | 2    | 2    | 5    | 12  | 39  | 72 |
| 5   | Spain               | 58 | 624 | 12  | 10.76   | 8%    | 0    | 0    | 1    | 2   | 16  | 45 |
| 6   | Italy               | 55 | 361 | 11  | 6.56    | 7%    | 0    | 0    | 0    | 0   | 14  | 42 |
| 7   | Peoples R China     | 49 | 313 | 9   | 6.39    | 6%    | 0    | 0    | 1    | 1   | 9   | 27 |
| 8   | Brazil              | 42 | 367 | 8   | 8.74    | 6%    | 0    | 0    | 1    | 3   | 8   | 23 |
| 9   | Denmark             | 34 | 666 | 11  | 19.59   | 4%    | 1    | 1    | 1    | 3   | 11  | 30 |
| 10  | Canada              | 31 | 640 | 10  | 20.65   | 4%    | 1    | 1    | 1    | 2   | 10  | 29 |
| 11  | Sweden              | 31 | 446 | 10  | 14.39   | 4%    | 0    | 0    | 1    | 2   | 11  | 24 |

Note: Abbreviations are shown in Table 2.

Table 7. Evolution over time of publications by country (source: own elaboration)

| Country              | 99 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Netherlands          | 0  | 0  | 0  | 1  | 0  | 1  | 1  | 1  | 3  | 1  | 6  | 11 | 3  | 9  | 7  | 9  | 10 | 9  | 17 | 13 |
| USA                  | 0  | 1  | 0  | 0  | 2  | 1  | 0  | 0  | 1  | 4  | 3  | 4  | 10 | 4  | 6  | 4  | 7  | 9  | 9  | 13 | 19 |
| Germany              | 1  | 0  | 0  | 0  | 0  | 0  | 2  | 0  | 1  | 0  | 2  | 3  | 2  | 3  | 3  | 5  | 7  | 16 | 24 | 15 |
| England              | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 4  | 1  | 1  | 2  | 4  | 3  | 2  | 5  | 7  | 11 | 6  | 12 | 8  |
| Spain                | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 2  | 0  | 1  | 1  | 2  | 1  | 0  | 0  | 0  | 2  | 5  | 9  | 20 | 15 |
| Italy                | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 2  | 0  | 0  | 0  | 7  | 10 | 16 | 19 |
| Peoples R China      | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 1  | 1  | 2  | 2  | 5  | 14 | 23 |
| Brazil               | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 3  | 5  | 12 | 13 | 9  |
| Denmark              | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 3  | 5  | 12 | 13 | 3  |
| Canada               | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 2  | 0  | 1  | 1  | 4  | 6  | 5  | 8  |
| Sweden               | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 1  | 0  | 0  | 2  | 0  | 0  | 0  | 5  | 3  | 10 | 8  |

Note: TP – Total Papers; 99, 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 1, 14, 15, 16, 17, 18, 19 – year of publication.
On the other hand, the leading journals to publish papers related to the topic of sustainable entrepreneurship according to the search carried out in WoS are the following: Journal of Cleaner Production and Sustainability, the first has an impact factor of 6.395 as of 2018 and the second of 2.592, see Table 8. In relation to the citation structure, only three journals have had at least 300 citations or more in a document, the citation structure is found in Table 8. When analysing the evolution over time of journal publications, it is clear, as mentioned before, that as of 2015 there is a representative growth in publications on the subject of sustainable entrepreneurship. However, there is a significant amount of publications in 2011, see Table 9.

Table 8. Citation structure of the journals that publish the most (source: Own elaboration)

| Journal                                      | TP  | TC  | H   | TC / TP | IF 2018 | IF 5 years | %   | ≥300 | ≥200 | ≥100 | ≥50 | ≥10 | ≥1  |
|----------------------------------------------|-----|-----|-----|---------|---------|------------|-----|------|------|------|-----|-----|-----|
| Journal of Cleaner Production                | 101 | 3028| 25  | 29.98   | 6.395   | 7.051      | 13% | 2    | 3    | 5    | 12  | 58  | 94  |
| Sustainability                              | 99  | 431 | 11  | 4.35    | 2.592   | 2.801      | 13% | 0    | 0    | 0    | 0   | 15  | 67  |
| Entrepreneurship and Sustainability Issues   | 18  | 115 | 7   | 6.39    | NA      | NA         | 2%  | 0    | 0    | 0    | 0   | 5   | 17  |
| Business Strategy and the Environment        | 16  | 1069| 12  | 66.81   | 6.381   | 7.557      | 2%  | 1    | 2    | 3    | 5   | 12  | 14  |
| Corporate Social Responsibility and Environmental Management | 14  | 87  | 3   | 6.21    | 5.513   | 7.131      | 2%  | 0    | 0    | 0    | 1   | 1   | 8   |
| International Journal of Entrepreneurial Venturing | 11  | 46  | 4   | 4.18    | NA      | NA         | 1%  | 0    | 0    | 0    | 0   | 1   | 10  |
| CSR Sustainability Ethics and Governance     | 10  | 6   | 1   | 0.60    | NA      | NA         | 1%  | 0    | 0    | 0    | 0   | 0   | 3   |
| Managing Environmentally Sustainable Innovation Insights from the Construction Industry | 10  | 1   | 1   | 0.10    | NA      | NA         | 1%  | 0    | 0    | 0    | 0   | 0   | 1   |
Table 9. Evolution over time of publications by journal (source: Own elaboration)

| Journal                                                        | Journal of Cleaner Production | Sustainability | Entrepreneurship and Sustainability Issues | Business Strategy and the Environment | Corporate Social Responsibility and Environmental Management | International Journal of Entrepreneurial Venturing |
|-----------------------------------------------------------------|-------------------------------|----------------|---------------------------------------------|--------------------------------------|-------------------------------------------------------------|-----------------------------------------------|
| 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 | 0 0 1 0 0 0 2 0 2 1 0 2 0 0 6 4 6 14 19 28 16 | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 6 4 2 4 2 | 0 0 0 0 0 0 0 0 0 0 1 2 1 0 1 2 1 3 2 3 | 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 12 | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 7 1 |

Note: Abbreviations are shown in Table 2. NA: Not Available.
The subject of sustainable entrepreneurship is addressed, according to the categories defined by the WoS database, from the standpoint of the Green Sustainable Science Technology, environmental sciences, management, business, and environmental studies, among others, see Table 10. Management and business are the main categories that have had at least 300 citations or more in a document. Similarly, in relation to the research areas, it has been found that this is the case for business economics, environmental and ecological sciences, technology sciences and engineering, among others, see Table 11.

Table 10. Main categories in WoS and citation structure (source: own elaboration)

| WoS Categories                                | TP | %   | TC  | H  | C/P | ≥300 | ≥250 | ≥200 | ≥100 | ≥10 | ≥1 |
|------------------------------------------------|----|-----|-----|----|-----|------|------|------|------|-----|-----|
| Green Sustainable Science Technology          | 245| 32% | 3912| 28 | 16  | 2    | 3    | 6    | 15   | 84  | 190 |
Table 11. Main research and citation structure areas (source: own elaboration)

| Research areas                      | TP   | % % | TC  | H   | C/P | ≥300 | ≥250 | ≥200 | ≥100 | ≥10  | ≥1   |
|-------------------------------------|------|-----|-----|-----|-----|------|------|------|------|------|------|
| Business Economics                  | 353  | 46% | 7128| 36  | 20.19| 6    | 8    | 14   | 30   | 94   | 257  |
| Environmental Sciences Ecology      | 298  | 39% | 5658| 33  | 18.99| 3    | 5    | 10   | 24   | 109  | 232  |
| Science Technology Other Topics     | 257  | 34% | 5007| 29  | 19.48| 4    | 5    | 8    | 17   | 91   | 201  |
| Engineering                         | 147  | 19% | 3700| 28  | 25.17| 2    | 3    | 5    | 16   | 76   | 129  |
| Social Sciences Other Topics        | 37   | 5%  | 327 | 9   | 8.84 | 0    | 0    | 0    | 3    | 8    | 26   |

Note: Abbreviations are shown in Table 2.

3. Graphic Analysis with VOSviewer

This section aims to present a more detailed analysis to the citation structure. The software used for this analysis was VOSviewer, (van Eck & Waltman, 2020) (version 1.6.14), this software allows to create and visualise, taking into account the map co-citation of author or journal (Liao et al., 2018; van Eck & Waltman, 2010), bibliometric networks based on citation, co-citation, co-authorship, bibliographic coupling, among others (Merigó et al., 2018). With regard to the co-citation of journals, between 1999 and 2019, it is found that the most representative journals are: Journal of Cleaner Production, Journal of Business Venturing, Entrepreneurship Theory and Practice, Academy of Management Review, Research Policy and Strategic Management Journal. The more papers published the larger the size of the node, in the same way the distance between two nodes means that the frequency of citations between these, the greater the distance, the lower the frequency of citations and vice versa (Liao et al., 2018). Figure 6 shows that the Journal of Cleaner Production is the most cited and has the broadest network just like the Journal of Business Venturing. It is worth noting that the colours of Figure 6 represent the group to which each journal belongs. The threshold used was 20 documents and the 100 most representative connections. In this figure, six clusters are identified, the red and green clusters are the ones that have the most connections with the greatest number of co-citations.

The bibliographic coupling shows the papers that refer to the same set of cited papers (Boyack & Klavans, 2010). Figure 7 shows how the authors are bibliographically coupled. The
A minimum threshold of 4 documents was used and the 100 most representative connections. Figure 7 is consistent with the results shown in Table 5, with Bossink, Blok, York, Cohen, Muñoz and Tsai being the most representative. This figure also shows the networks that are created between the authors, five clusters are identified, the main one is the red one, which contains a higher concentration of connections. In this cluster we find that York, Schaltegger have a stronger connection and therefore appear closer, which implies that it is common for researchers to quote these two authors in the same document.

Figure 8 contains the bibliographic coupling between countries, the main countries that create documents related to the topic of sustainable entrepreneurship are the Netherlands, the USA, England and Germany, in accordance with what is presented in Table 6. This map also shows the relationships that exist between countries, with Spain, the USA and the Netherlands close to each other, which means they have greater connections. This figure was made with a threshold of at least five documents and 100 connections.

Figure 9 contains the co-authorship by country, showing the most influential countries and the degree of communication between them. While it is similar to Figure 8 on biblio-
Figure 8. Bibliographic coupling by countries

Figure 9. Co-authorship by countries
graphic coupling, the difference can be found in the connections. It is worth noting that the largest nodes mean that they are the most influential countries, in this case the Netherlands, Germany, England, the USA and Spain. The relationship lines represent the cooperation between the countries. This figure was made with a threshold of at least five documents and 100 connections.

Finally, by reviewing the main keywords, Figure 10 displays the main keywords, taking into account a threshold of five occurrences and the 100 most representative connections. The words that stand out the most are: sustainability, sustainable innovation, sustainable entrepreneurship, innovation, entrepreneurship, sustainable development, social entrepreneurship, environmental entrepreneurship, eco-innovation and corporate social responsibility. On the other hand, Table 12 shows all the most common author keywords with their respective co-occurrences and the total strength of the connection. It is evident that the main word is Sustainability, Sustainability Innovation and Sustainability Entrepreneurship.

![Figure 10. Co-occurrence of author keywords](image_url)

Table 12. Most common author keywords (source: own elaboration)

| No. | Keywords                        | Occurrences | TLS   |
|-----|---------------------------------|-------------|-------|
| 1   | Sustainable Innovation          | 138         | 87.00 |
| 2   | Sustainability                  | 124         | 104.00|
| 3   | Sustainable Entrepreneurship    | 113         | 72.00 |
| 4   | Innovation                      | 64          | 49.00 |
| 5   | Sustainable Development         | 60          | 53.00 |

*Note: TLS – Total Link Strength.*
4. Discussion

The number of researches related to sustainable entrepreneurship has increased since 2015 on the back, firstly, that the issue of sustainability is flourishing and, secondly, since there is greater access to databases and the internet more publications can be found on the subject. While the increase can be seen in 2015, it is worth noting that, starting in 2010, the terms (with their derivatives) Entrepreneur, Innovation and Sustainability, had a greater growth. This approach indicates that the issue of sustainable entrepreneurship is becoming emerging fields of interest for researchers in different areas of knowledge, entrepreneurs, State and professionals.

Development trends on sustainable entrepreneurship have focused on reviewing how sustainable entrepreneurship relates to sustainable development, in this sense researches have focused on innovation issues, sustainable innovation and sustainable business models, among others. Likewise, there is a tendency to define what sustainable entrepreneurship is, but there is no unification of concepts, researches have been focused towards ecological, environmental and social areas. Nevertheless, there are other definitions of sustainable entrepreneurship. It is important to mention that these trends have solved problems related to environmental and social issues and how sustainable entrepreneurship contributes to the solution of these problems. They have also solved how market imperfections create opportunities for sustainable entrepreneurship.

Conclusions

This research contributes to the field of investigation since it presents the main authors and documents on the subject, as well as the main countries and journals through 2019. In conclusion the most relevant countries in publishing topics on sustainable entrepreneurship are the Netherlands, the USA, Germany, England and Spain. The authors more related to leading journals establish that the Journal of Cleaner Production and Sustainability are the most relevant. The authors with the most publications are York (USA), Blok (Netherlands), Bossink (Netherlands) and Cohen (Canada, Spain, Australia and Chile). However, it is necessary to strengthen the academic production of Latin American countries, since, as shown in Figure 9, academic production and co-authorship are very low. Equally, the documents found in their majority do not have more than 10 citations, this reflects that it is still necessary to disclose more knowledge and generate impact that it serves for future researches.

Among the future lines of research there is the possibility of a comparative sustainable entrepreneurship by countries taking into account that the main publications are in Europe. Another line is to analyze how sustainable entrepreneurship is being approached in Latin American countries and compare the results with other countries, however, this type of analysis could be carried out using other databases such as Scopus or Google Scholar, in order to have more information, because it is evidenced that Latin American countries have very few publications in the WoS on the subject, but this does not mean that they are not writing and publishing. Another line of research is to analyze how the different areas of knowledge are interwoven. In this sense, it would be of great value for researchers to understand what is
being researched and where research is going in each field of knowledge, taking into account that in our analysis we presented areas associated with business/management, environment, engineering, among others. Finally, a research problem was identified that has not been solved and that is that there is no index that measures sustainable entrepreneurship, this could be a very interesting line of research.

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