

Bibliometric analysis of scientific research: bioeconomy and climate change

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ABSTRACT

Objective: To offer a comprehensive bibliometric study of how bioeconomy research has been developed concerning climate change, finding the most researched issues, as well as the least researched issues and trends in scientific publications during the last ten years.

Design/methodology/approach: To conduct this study, the academic database Scopus was used. The selection criteria were the keywords “bioeconomy” and “climate change”. The selected study period was ten years (2014-2024), considering all types of documents such as articles from scientific journals, reviews, book chapters, conferences, among others. The obtained data was processed in VOSviewer software tool to construct bibliometric network map.

Results: The bibliometric data analyzed was a total of 791 scientific publications related to bioeconomy and climate change in the last ten years. Production has shown a significant increase, with notable trends since 2016-2023, being the year with major publications (165), reflecting a growing interest in the interaction of both fields. Subjects with major scientific production are environmental sciences, agriculture, biological sciences and energy, while the subjects with lesser scientific production are veterinary, psychology and nursing.

Limitations on study/implications: The scope’s study exclude another scientific database.

Findings/conclusions: Some of the identified emerging trends are: interdisciplinarity, reflecting an increase in research combining environmental, economic and social sciences to address complex problems related to bioeconomy and climate change. And the focus on public policies, which presents a recent interest in how policies can integrate the bioeconomy to face climate challenges.

Keywords: co-occurrences, VOSviewer, circular economy.

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INTRODUCTION

According to Lewandowski (2017), the bioeconomy concept evolution began in the 1960s decade on the proposal of Zeman, who utilized the concept to name an economic order that recognizes the biological bases of almost all economic activities, and then, It was defined for the first time by Juan Enriquez Cabot (1998) stating that, the application of discoveries in genomics will conduce to a restructuration in the roll of enterprises and industries, and it will change the world economy. Described the creation of a new economic sector: Biological Science. He didn’t use the bioeconomy concept, but this may be the first debate that would lead later to recent concepts. In the document, aspirational principles and criteria for a sustainable bioeconomy are stated. According to FAO (2021), bioeconomy is defined as the production, use, conservation and regeneration of biological resources, including related knowledge, science, technology and innovation, to provide sustainable solutions within and across all economic sectors and enable a transformation towards a sustainable economy.

MATERIALS AND METHODS

Scopus was used as the main source for bibliographic data collection. The search was made using the combination of terms such as “bioeconomy and climate change”, selecting publications from the period 2014 to 2024. The analysis was conducted using basic statistical tools in Microsoft Excel, together with the advanced capabilities of VOSviewer for graphical visualization. VOSviewer is a tool developed by the Center for Science and Technology Studies (CWTS). It was used to generate bibliometric maps and visualize the relationships between the analyzed documents. A bibliometric network map was generated from conceptual bibliographic data showing the relationships between different documents and the co-occurrence of keywords within the field of study. This map allows us to identify thematic groups and emerging trends in research on bioeconomy and climate change. This methodological approach not only helps to understand the current state of knowledge in this field but also guides future research by identifying gaps in the existing literature.

RESULTS AND DISCUSSION

Figure 1 shows the increase in scientific publications related to the keywords: bioeconomy and climate change. In 2015 only seven documents were identified where the relationship exists in the concepts. From 2020 onwards, more considerable production was achieved with 74 articles, finding 165 in 2023. In the second half of the year 2024, 137 documents were found. According to Pyka *et al.* (2021) bioeconomy modeling must consider variables such as climate change, biodiversity, circular biomass use, consumer behavior related to biomass and bioproduct use, and innovation and technological change. Wohlfahrt *et al.* (2019) propose an integrated assessment to tackle specific bioeconomy sustainability issues, among them, climate change.

Figure 2 shows the top ten authors in the topic. Blumberga, D., is the one with the most scientific publications, nine during the analysis period.

Figure 3 represents the group of the ten most publications by affiliation has 213 publications in the analyzed period (2014-2024). The main three affiliations show their

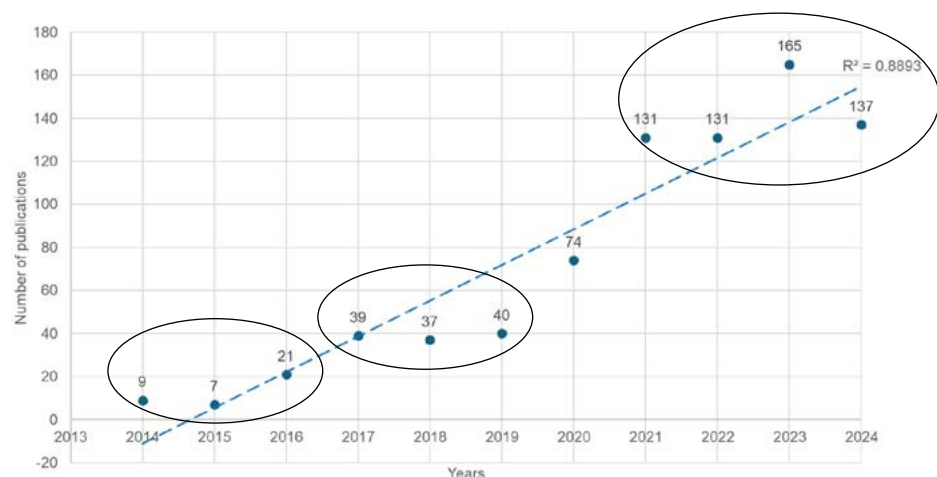


Figure 1. Temporal evolution of scientific production of bioeconomy and climate change.

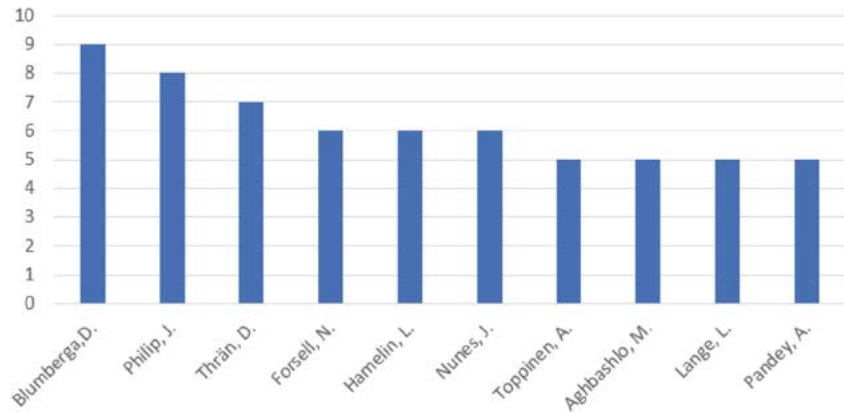


Figure 2. Publications by author on bioeconomy and climate change.

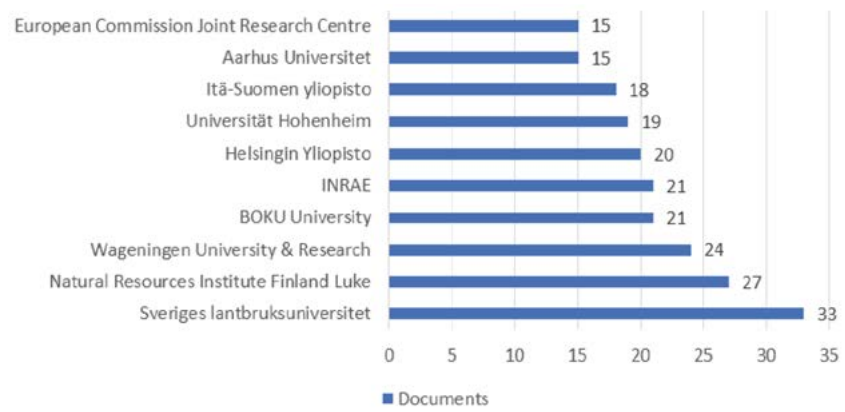


Figure 3. Publications by affiliation of bioeconomy and climate change.

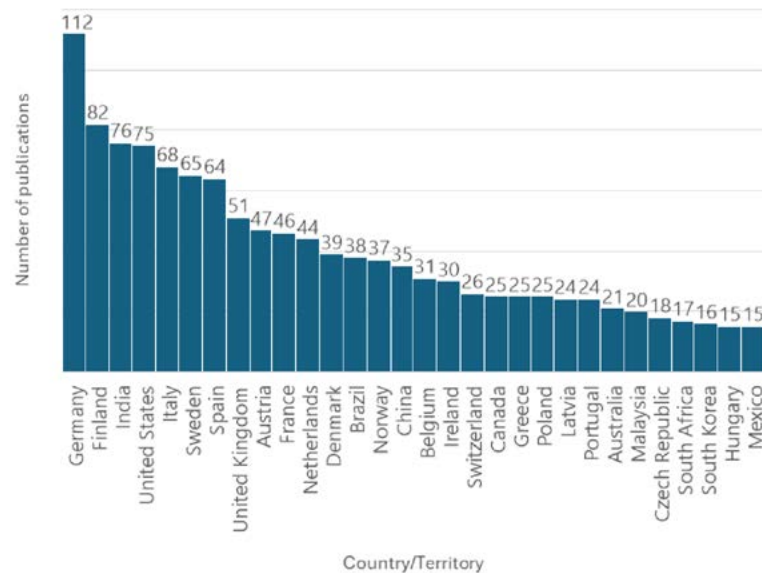


Figure 4. Publications by country on bioeconomy and climate change.

leadership in the scientific production of the studied knowledge field, with 39% of the publications in the mentioned group. Resulting: Sveriges Iantbruksuniversitet (33), Natural Resources Institute Finland Luck (27) and Wageningen University & Research (24).

Analysis criteria taken of sample universe selected was a minimum of five documents with a minimum of five countries. The countries where belong authors most cited are Germany 109 documents and 2356 cites, Finland 79 documents and 1989 cites, India 74 documents and 2353 cites, United States 72 documents and 1459 cites, Italy 65 documents and 1759 cites (Figure 5).

It is appreciated that most of the documental production on the field corresponds to articles (416, 52.6%), reviews (175, 21.1%) and book chapters (113, 14.3%). The percentage of each type of document is presented in Figure 6.

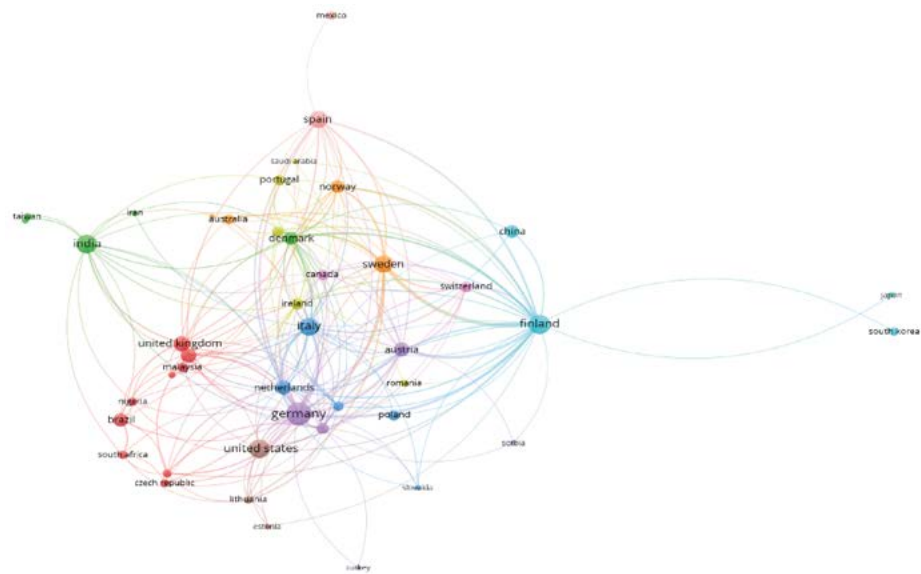


Figure 5. Citation level network map of the countries that produce scientific documents on bioeconomy and climate change.

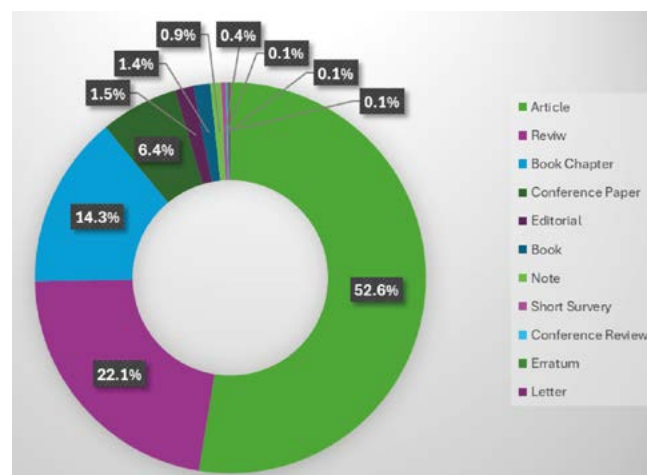


Figure 6. Percentage of publications by type of document.

In Figure 7. The citation level-network map of the documents on bioeconomy and climate change, the group of documents that cite each other, and the leader per group can be clearly observed. The most cited documents are written by Parisi 2015, Stegmann 2020, Antar 2021, Koul 2022, and Venkatamohan 2016.

Table 1 shows the title, author, source, year, and number of cited, of the two most cited documents in the research.

Analysis criteria taken of sample universe selected was minimum one document per author and three cites per author. Only 34 authors are connected.

The five most cited authors are: Parisi Claudia, with 4 documents and 568 cites; Amulya 4 documents and 552 cites; Junginger and Martin 4 documents and 526 cites; Viagani and Mauro 2 documents and 505 cites; Lendo and Marc 3 documents and 494 cites (Figure 8).

Figure 9 indicates the number of scientific publications by subject area, where it can be seen a dominant number of documents related to bioeconomy and climate change on environmental science (415), agriculture and biological science (242), energy (230), engineering (158), and social sciences (142). The percentage of publications by subject area is showed too.

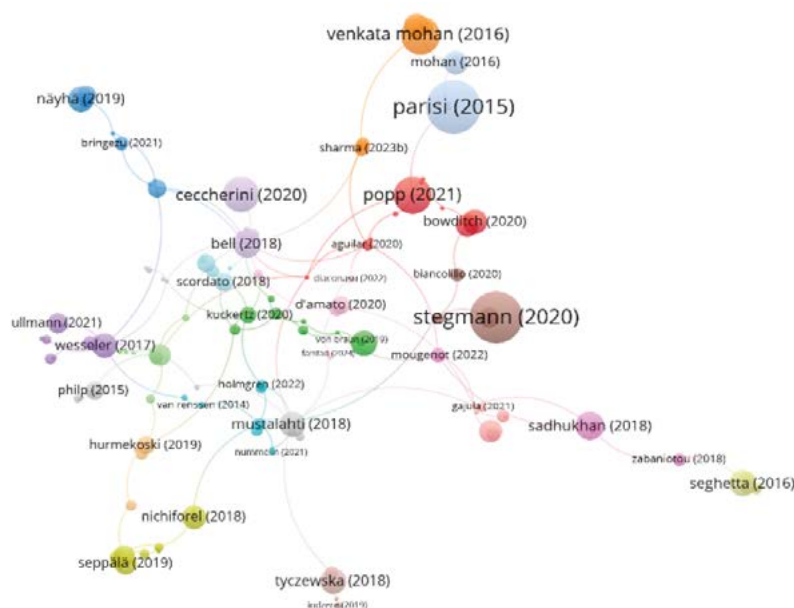


Figure 7. Citation level network map of the documents on bioeconomy and climate change.

Table 1. The most cited documents.

Author	Title	Source	Year	Citations
Claudia Parisi, Mauro Vigani, Emilio Rodríguez-Cerezo	Agricultural Nanotechnologies: What are the current possibilities?	Nanotoday	2015	490
Paul Stegmann, Marc Londo, Martin Junginger	The circular bioeconomy: Its elements and role in European bioeconomy clusters	Resources, Conservation & Recycling	2020	428

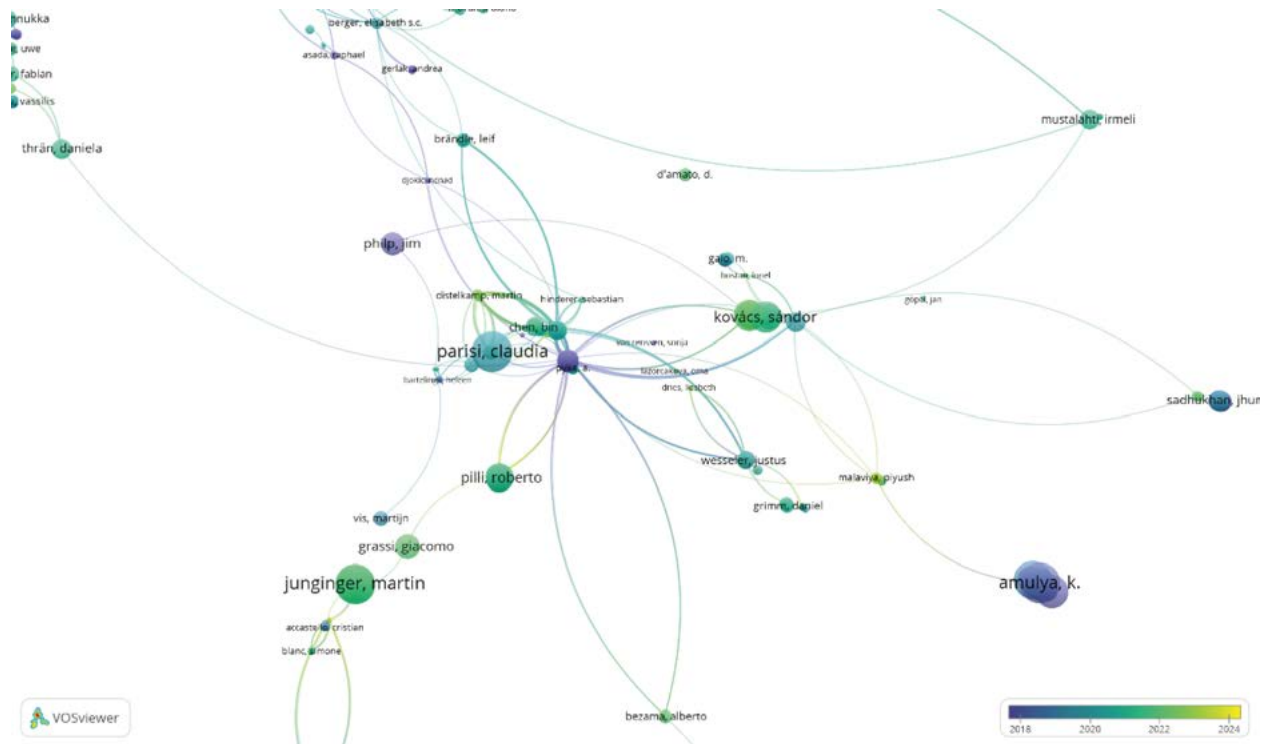


Figure 8. Citation level per authors network map of the documents on bioeconomy and climate change.

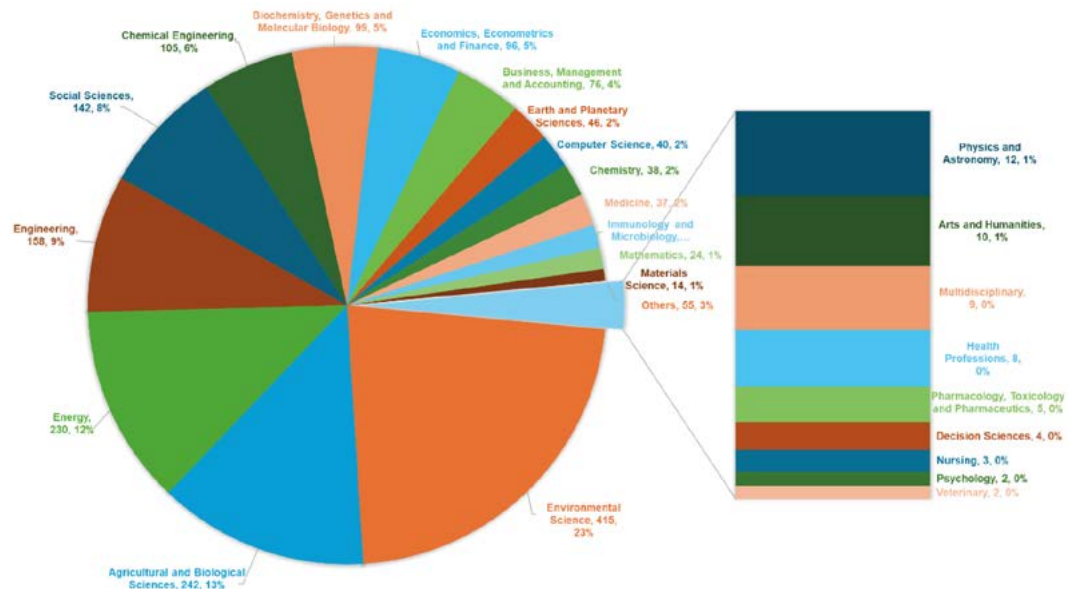


Figure 9. Percentage of publications by subject area.

The map in Figure 10 shows the density of the co-occurrence, in all keywords from 415 documents classified by Scopus in environment category to know, which are the most and lesser researched issues. According to the Vosviewer statistics, the most repeated keywords are: biomass with 111 co-occurrences, sustainable development 100, sustainability 77,

know, which are the most and lesser researched topics. According to Vosviewer statistics, the most repeated keywords are: Forestry 58, biomass 44, sustainable development 39, sustainability 36 and biodiversity 44. The keywords with less co-occurrences, having only one are adaptative management, biofuel production, crop production, crop productivity, crop residues, and environmental sustainability.

The most researched areas, include: Environmental science. Sharma and Malaviya (2023), indicates that circular economy has been used as efficient approach in order to propose environmental ecosystem services for socio-ecological development and transformation oriented sustainability. In agriculture sector is found data about sustainable linked on circular economy, mainly in the strategies that integrate the bioeconomy to minimize waste and maximize the use of biological resources. According to Bhabesh Gogoi *et al.* (2020) Two important element of bioeconomy are efficiency and effectiveness use of all kinds of biological resources from land and water, that are renewable in a sustainable management. Ahmed *et al.* (2023) indicates how mass generated from food waste can be used to produce valuable bioproducts through bioconversion techniques such as: anaerobic fermentation, oleaginous metabolism and solventogenesis. Sanz-Hernández *et al.* (2019) present a systematic academic review of social contributions to the bioeconomy field.

In Figure 12, it can be seen that the largest node, which specifies the greatest use in the data set, matches climate change. Also, it can be shown that the bioeconomy co-occurrence with other clusters, represented by other colors such as environmental sciences (blue), energy (purple), economy (yellow), and agricultural and biological sciences (green).

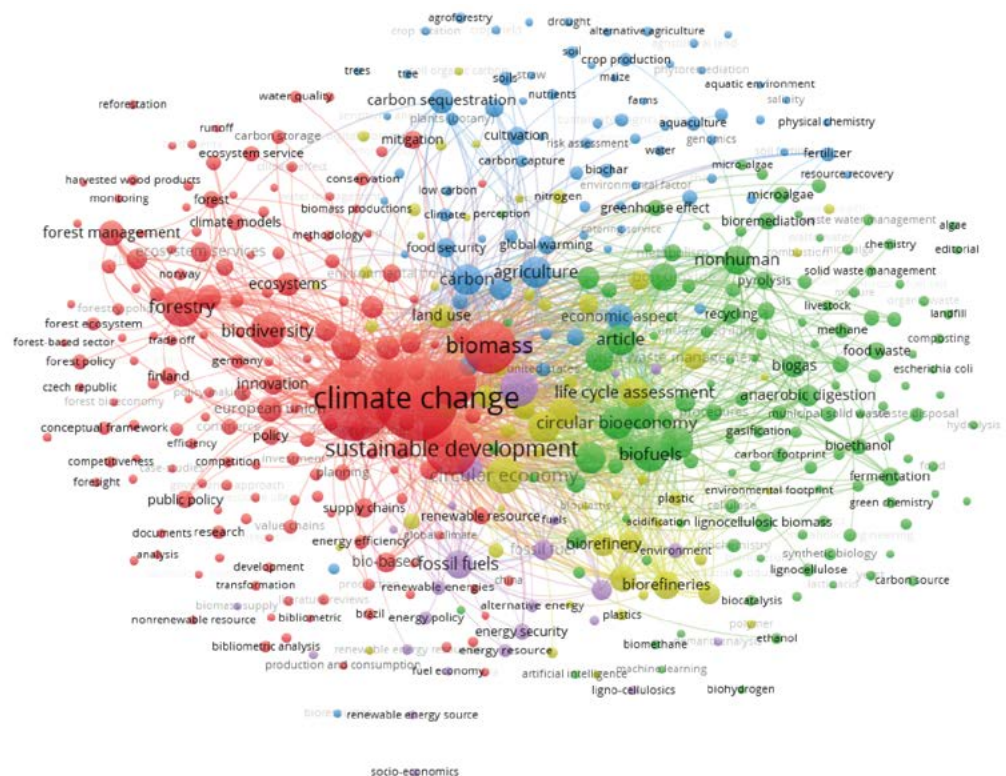


Figure 12. Bibliometric map created based on author keywords co-occurrence bioeconomy and climate change.

Bioeconomical agroecosystems are those that have gone through a process of knowledge transformation in their controllers over time, into nonlinear innovation guidelines between innovation agents and producers. Research on knowledge value networks is proposed to understand the causes of functionality, as well as the motivations for adopting innovations in agroecosystems, adopting diversification strategies, and creating new products and services to address the effects of climate change on rural families.

CONCLUSION

The issues bioeconomy and climate change needed depth analysis and to identify the challenges and opportunities that both fields of knowledge faces in social and economic terms, such as in environmental policies (analysis of policies that promote the bioeconomy as a tool to combat climate change). In contrast, the topics that have received less attention are socioeconomic impacts of the bioeconomy (studies on how bioeconomy practices impact local communities), biodiversity and bioeconomy (relationship between biodiversity conservation and bioeconomic practices), emerging technologies (technological innovations in bioeconomy that could influence climate change mitigation). Some of the emerging trends found are: interdisciplinarity reflected in an increase in research that combines environmental, economic, and social sciences to address complex problems related to bioeconomy and climate change. And the focus on public policy, which presents a recent interest in how policies can integrate the bioeconomy to address climate challenges.

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