

INNOVATION AND BIOECONOMY: WHAT IS THE NEWS?

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Introduction

Having emerged from the need to identify how the themes Bioeconomy and Innovation are treated in Applied Social Sciences, the research aims to identify theoretical gaps in studies on the subject. This need lies in the fact that most published articles and books adhere to other knowledge areas, such as Agronomy, Biology, Ecology, Engineering, Microbiology, and Chemistry. Furthermore, studies in this area lack contextualization for other countries due to the concentration in certain areas, such as Europe (some examples are Cristea et al., 2020; Fischer et al., 2020; Lovric et al., 2020). In this sense, there is still a gap in terms of empirical studies based on primary data for this type of research, which could shed light on this process and be a way to understand the concept of sustainability in this area of activity.

The research was designed to collect scientific articles published in the last ten years in international journals. Data were collected on the Web of Science (Ellegaard & Wallin, 2015) platform encompassing articles published from 2010 to 2020 and included only those in open access format. The research was restricted to articles published in Administration (business and management), Economics, and Regional Urban Planning because it includes articles on strategy and economic development. The use of only open articles occurred for everyone to have access and thus generate knowledge dissemination. The research resulted in 33 articles that were analyzed in the following questions: country where the research was conducted, year of publication, number of citations received on the platform, article impact index, web of science categories, the journal where the article was published, journal impact factor, word count, keywords, strategy/research methods employed and suggested theoretical gaps. These last two items required a full reading of the content of the articles.

Data analysis presents future research suggestions regarding the theoretical framework and epistemological terms (research locus and collection and investigation methods). Another aspect of being considered is the studies' actuality because the first ones were published in 2013, and the research is when observing the trend chart, on the rise in recent years. The theoretical gaps suggested by the authors focus on three points: changing the theoretical framework, expanding the database, and researching different contexts.

The last suggestion concerns aspects of generalization of research findings because the articles predominantly focus on Countries of the European Union, except for an article whose study was conducted in Madagascar (Neimark, 2016). Regarding the theoretical gap related to the database, it is suggested to use other independent variables and increasing the number of observations both in terms of questionnaires and in terms of interviews. The authors also suggest the use of other theories to explain the phenomenon. The suggestion is in line with what this article proposes because the combination of Bioeconomy and Innovation is a phenomenon that also involves the theory of organizations and public policy theories (see for instance John, 2013). Bioeconomy can be explained both in the aspect of the organizations that are using this new form of production and the need for government involvement in aspects of regulation and promotion. In this sense, this phenomenon still lacks other theoretical and methodological lenses for its understanding to gain in terms of context.

The article is structured in five sections: 1) this introduction, where the limits of the research are established; 2) review of the scientific literature, where the concepts of Bioeconomy and Innovation employed in the research are pacified; 3) research methodology, where the details of all stages of bibliometric research and literature review are explained; 4) results, where the results of all stages are presented; 5) discussion, where the theories studied are compared, the data collected and the suggestion of possible research agendas; and 6) conclusion.

1. Review of the Scientific Literature

1.1 Bioeconomy

Bioeconomy is a science that relies on contributions to the development of new techniques and technologies capable of sustaining the growth of the industry while reducing its negative impact (Anghel et al., 2018). The same authors point out that no commonly accepted definition pacifies the concept of bioeconomy. However, at *the Communiqué Global Bioeconomy Summit 2015*, it was considered to understand bioeconomy as a production based on knowledge and use of biological resources, innovative biological processes, and principles to provide sustainability in all goods and services economic sectors (Vuță et al., 2019) In this way, bioeconomy represents a developing sector, supported by the conjunction of intellectual capital and technology in the relationship between man and planet Earth.

When it comes to the use of the term, as explained by Bugge et al. (2016), bioeconomy is present in a fragmented and evidenced way in the studies of natural sciences and engineering. In the literature review, three views of bioeconomy were identified:

- a. one related to Biotechnology, emphasizing the importance of research and applications and marketing in different sectors of the economy;
- b. evidencing Bioresources, which focuses on the processing and modernization of biological raw materials, as well as the establishment of new value chains; and
- c. a vision related to Bioecology highlights sustainability and ecological processes that optimize the use of energy and nutrients, promote biodiversity, and prevent monocultures and soil degradation.

Already to Pasnicu et al. (2019), bioeconomy is a complex and multidisciplinary concept. A science that aims to investigate economic development and innovation for a society in which renewable resources replace fossil resources and where it seeks to understand "climate change, energy and resource efficiency, health and demographic change" (Pasnicu et al., 2019, p. 10). On the same tuning, Georgescu-Roegen (1978) teaches that bioeconomy was originally conceived as an alternative economic system but with low risk to the environment.

Over time, the theme gains popularity as an alternative way to organize production and consumption practices for society in a more sustainable way using renewable and biological resources instead of fossil fuels (Bugge et al., 2016). Ayrapetyan and Hermans (2020, p. 1) corroborate this argument by claiming that bioeconomy would have the power to "combine the fight against climate change and reduce the use of fossil fuels with the promotion of innovation, the knowledge economy and rural and regional areas for sustainable development."

However, Gawel et al. (2019) draw attention to the fact that a transformation of the bioeconomy does not automatically imply sustainability. Bioeconomy strategies designed mistakenly can lead to economic, social, and environmental problems, this being a dilemma of the transformation process. Production increases need to be matched with social and environmental demands, with the complexity inherent in increasing the scale of production and at the same time balancing sustainability aspects (Gawel et al., 2019)

The OECD - Organization for Economic Cooperation and Development (Osborne, 2006) conceptualizes that bioeconomy refers to economic activities related to the invention, development, production, and use of products, services, and biological processes in four macro sectors: 1. Agri-food; 2. Forestry; 3. Bio-based industry; and 4. Marine bioeconomy. In the document presented, the OECD proposes a transition to a circular Bioeconomy, integrating it into circular economy models in a vision where the production and use of renewable biological resources and their conversion into value-added products is part of a circular system. This process would result in an economically viable and sustainable business esplanade in the long term.

When talking about Bioeconomy and circular economy, it is necessary to consider that, as exposed by Ayrapetyan and Hermans (2020, p. 1) when they argue about the complexity of seeking balance when dealing with ecosystems, which "in complex systems, cause and effects are often linked at different scales and levels". In this sense, the Bioeconomy model needs to be adequate to the various means and modes of production that exist so that there are no imbalances that shake the functioning of the economy.

With the definition of research terms related to Bioeconomy, the next section is intended to define the aspects relevant to the innovation.

1.2 Innovation

Innovation is conceptualized as something new that can be a product, an idea, or a mechanism (Kahn, 2018). The concept of innovation can be seen in terms of results or process depending on the alternatives that this mode of use of production factors can provide to the production of goods. In the same sense, the Bioeconomy can also be considered concerning its potential as an element of coping with climate change, globalization, and economic crises (Grundel & Dahlstrom, 2016; Wassenhoven et al., 2020).

According to Kahn (2018), innovation, as a result of a process, includes innovation in products, processes, marketing, business models, supply chain and organizational innovation. As innovation requires some kind of break with the current paradigm, in the case of bioeconomy, this aspect is more evident due to dependence on fossil resources (Bröring et al., 2020). Thus, bioeconomic has in its scope, on the one hand, issues inherent to new products and services and the need to induce research that leads to the creation of the conditions for these products and services to be produced.

Due to the vastness that the concept of Bioeconomy can assume, Bröring et al. (2020) suggest types of innovation in Bioeconomy. They are substitute products, new processes, new products, and new behaviors. This classification is relevant because it establishes a taxonomy of aspects in which the Bioeconomy can collaborate with the economic, social, and sustainable development of a country. For example,

- substitute products can bring a new class of products not based on fossil fuels. According to the authors (Bröring et al., 2020) the most discussed type of bioeconomy applications. This situation would be the case for the substitution of petroleum-derived raw materials by plant-derived materials such as sugarcane, for example;
- new processes may involve new supply chains, as would be the case with ethanol production through the processing of grain waste used in industrial processes;
- entirely new products would be developed to meet current or emerging demands using artificial organisms for the production of pharmaceutical products, for example;
- new behaviors that are generated by the need to change forms of production. The authors mention the contribution of stakeholders in the different phases of the production process as an innovation in the way companies manage their activities.

From the ideas presented, it is perceived that there are still several gaps in the discussion of how the Bioeconomy can evolve and become a viable alternative of clean and sustainable production creating innovations to improve the productivity of industry, solve health and food problems, as well as generate alternatives for this and future generations.

Given this scenario, the following research question is proposed: how has literature been dealing with bioeconomy and innovation in Applied Social Sciences? It is understood that the answer to this question could suggest an investigation agenda indicating theoretical and

epistemological gaps to guide research that generates knowledge for production, business management, and economic development in the areas of Applied Social Sciences.

2. Research Methodology

2.1 Bibliometric Analysis

The research was carried out through bibliometric research, which consists of analyzing publications using quantitative and statistical methods (Ellegaard & Wallin, 2015). The basis consulted was the Web of Science* portal. The terms entered in the advanced search were '*Bioeconomy*' and '*Innovation*,' and the results were restricted by language. The chosen language was English due to the scope that the language allows. The analysis focused on articles over a period stipulated in 2010 until 2020.

The first phase of the data collection, which resulted from the Web of Science platform's search for the terms '*Bioeconomy*' and '*Innovation*', resulted in 240 articles. Among these articles, a second filter was given preference to those who had open access, and this process resulted in 117. In view of the objective of the research, whose focus is on the areas of Applied Social Sciences, a third filter was applied prioritizing articles published in the categories related to '*economics*', '*business*', '*management*' and '*regional urban planning*', when the following results were obtained: 20, 13, 12 and 8 respectively in 33 articles. This result was the basis of analysis for bibliometric research, whose procedures will be described below (equation no. 1). According to this research's objective, the impact index of the article (II) is calculated by the following formula: the number of citations received subtracting from the age of the article.

$$II = 2021 - AP \quad (1)$$

Where:

II - Article Impact Index;

AP - year the article was published.

The higher the II, the greater the impact of the ideas of the article on others published from its publication. Such analysis may allow the evaluation of the measure of the degree of acceptance of the article as a vehicle for the propagation of knowledge and measure the potential of the theme in generating citations.

2.2 Literature Review

The literature review was implemented to understand how the terms Bioeconomy and Innovation appear in articles published in the fields of Economics, Administration (business and management), and Regional Urban Planning. The latter's inclusion is due to its proximity to the area of public administration, a field not contemplated in the literature review. With the help of the Software NVivo 12 for Mac, the articles were analyzed in terms of countries where the researches were carried out, year of publication, the number of citations received on the platform, article impact index, Web of Science category, the journal where it was published, journal impact factor, keywords, strategy/research methods employed and theoretical gaps suggested.

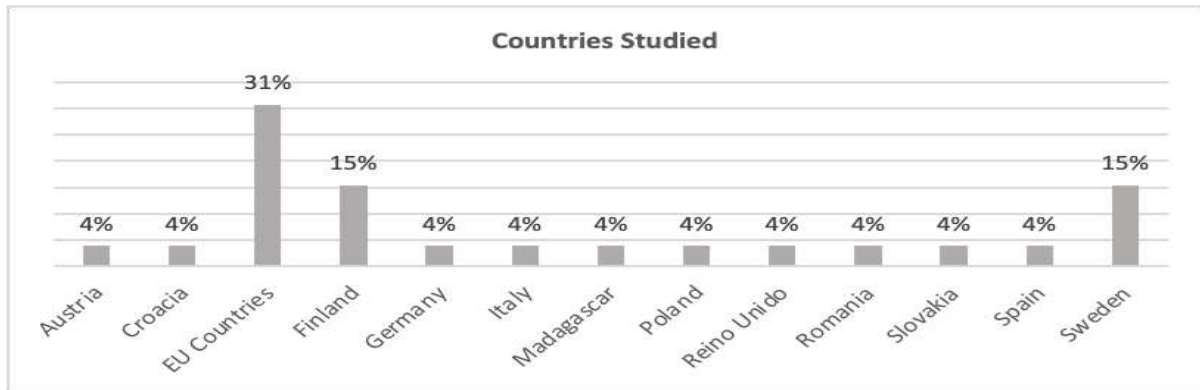
In this section, the data collection and data analysis that comprised the bibliometric research were presented. In the next section, the results of this process will be presented.

3. Results

3.1 Descriptive Analysis of Data

Data analysis indicates that only one study involved countries outside the European Union, Madagascar. Research involving the European Union comprises 31% of the articles, in Finland 15%, and in Sweden 15%. The other countries of the European Union and Madagascar each account for 4% of the total. Graph no. 1 illustrates this data.

Graph no. 1: Countries Studied in Articles



Graph no. 2 shows the chronological order of publication of the articles, which may indicate the research's opportunity. It is important to highlight that the investigation found no articles published before 2013. It is inferred that this fact may have been influenced by actions of international organizations, such as those implemented by the OECD (Grundel & Dahlstrom, 2016). The vast majority of the articles were published in 2019 and 2020, which denotes the novelty of the subject in academic circles. This research identified in the bibliographic survey made an (Näyhä, 2021) mode 'online first' in 2020. From the year 2017, it is possible to notice a jump in publications.

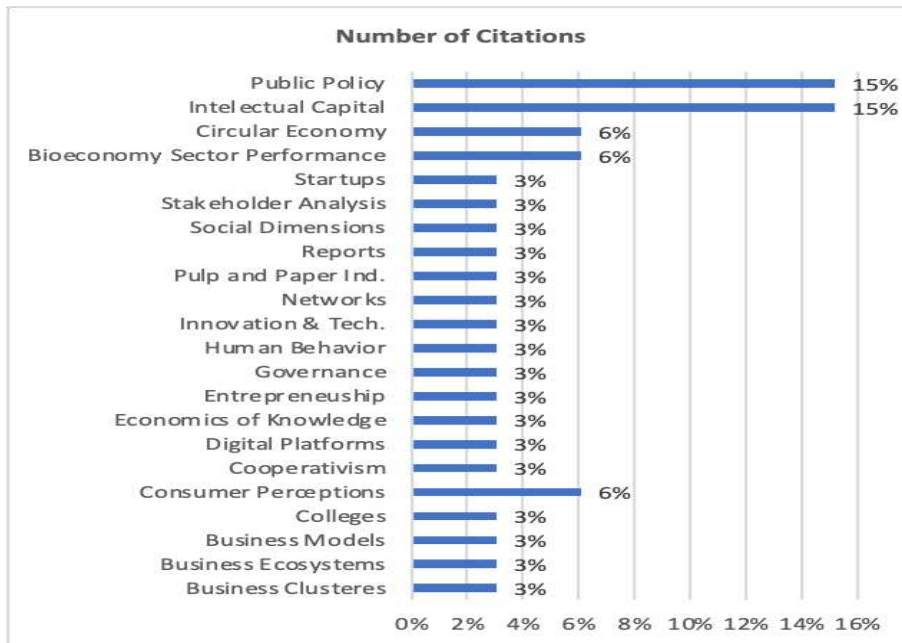
Graph no. 2: Year of Publication



Regarding the Article Impact Index, one may question whether an older article reaches a higher number of citations than a more recent one. However, this is not always the case, as the article "Towards Sustainability? Forest-based Circular Bioeconomy Business Models in Finnish SMEs" (D'Amato et al., 2020), published in 2020, obtained 22 citations, which indicates an impact of 22.

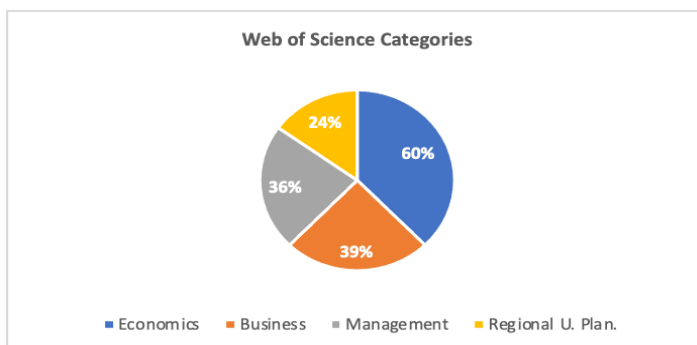
An important aspect of the bibliometric analysis is the number of citations that an article generates over time. This finding is also a factor considered by the main scientific rankings to measure an article's impact and the journal where it was published. Graph no. 3 indicates a way forward in terms of choices of central research themes and their respective occurrences. Based on the results, public policy and intellectual capital would be a good context for research along other topics such as, circular economy, bioeconomy sector performance, startups, stakeholder analysis, and so on. Therefore, there is a fertile ground for research in Social Science and this investigation points out.

Graph no. 3: Number of Citations per Central Article



Graph no. 4 presents the journal category in the Web of Science. It is necessary to be in mind that a journal may belong to more than one category, but the idea was to analyze each journal's central theme. For this analysis, the journal's website was used for such verification. Most of the articles are in Economics (60%), followed by the Business area (39%), Management (36%), and Regional Urban Planning (24%). The importance of the Economics area and the other are presented in graph no. 4.

Graph no. 1: Web of Science Categories



Another important aspect is the journals where the articles were published. The journal *Amfiteatru Economic* was the one with the highest recurrence in the sample, accounting for

24% of the articles' impact factor. *Amfiteatru Economic* is a journal published quarterly by the University of Bucharest in Romania that is dedicated to production in economics and business areas. The journal has been published since 1999 and is in its issue number 23. His qualification in the impact rankings is 1.625 in JCR and 1.8 in Scopus.

Figure no. 1, referring to word counting, was designed with the NVivo 12 for Mac software. The software has a search engine for all words present (word frequency) in the 33 articles (bibliographic references included). Excluding the terms, Bioeconomy and Innovation, the search words on the Web of Science, one perceives a predominance of the terms 'development', 'research', 'forest', 'economy', 'industry', 'policy', and so on. These terms may provide clues to the theoretical framework of future articles on the subject.

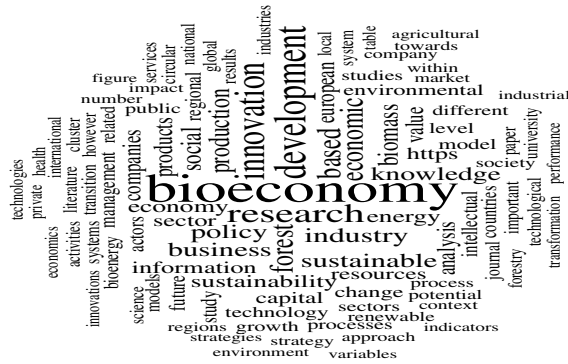
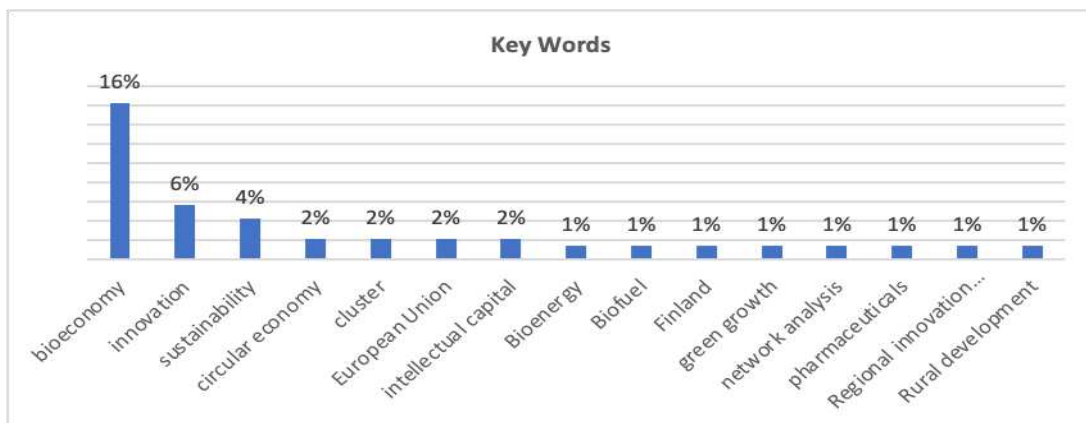


Figure no. 1: Article Word Cloud

Then, the analysis focused on the authors' keywords to facilitate the process of finding the articles in search engines. Graph no. 5 shows the results of this analysis. Of course, bioeconomy and innovation are the terms most used by authors. Other widely used terms are sustainability, circular economy, clusters, intellectual capital, and the country where the research was conducted. These results may also guide future research on the subject in terms of theoretical framework.

Graph no. 5: Key Words Indicated in Articles

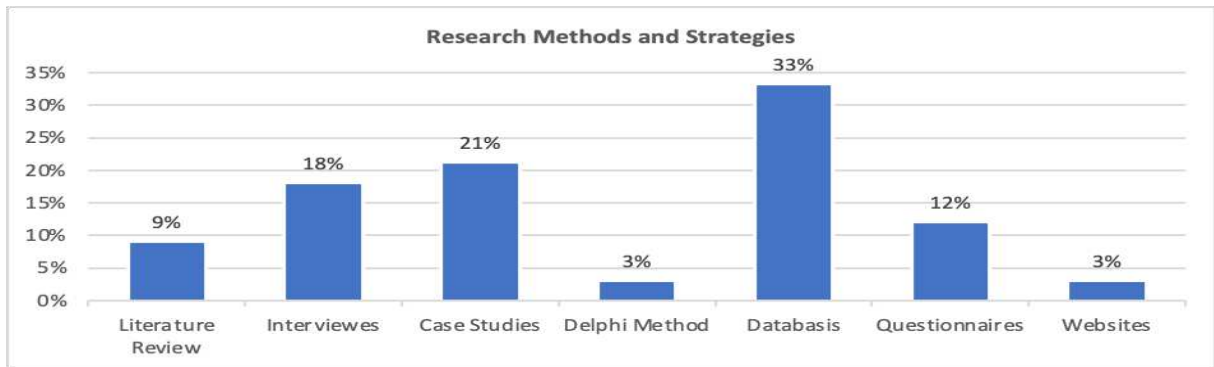


Finally, the data regarding the type of strategy/research methods used are presented. Among 33 articles analyzed, only three were considered theoretical because they did not include a section of data collection and analysis methods.

Regarding the methods, there is a predominance of qualitative methods using interviews, literature reviews, Delphi, and websites. We also found studies that used quantitative methods such as questionnaires (primary data) and databases (secondary data).

Many articles stated that they had collected the data in databases, such as *Eurostat Databases*. Graph no. 6 details the occurrence of articles with an approach considered empirical.

Graph no. 6: Research Methods and Strategies



3.2 Theoretical Gap Analysis

With the help of the Software NVivo 12 for Mac, content analysis (Neuendorf, 2016) analyze articles seeking suggestions for future research. Not all articles have suggested future research. In these cases, there was the understanding that, if the article is empirical, researchers could adopt their methods to replicate other countries' research. This is justified by the data presented in graph no. 1 at the beginning of the previous section, where the predominance of studies conducted in EU countries is clear. The analysis of the theoretical gap suggested by the authors is presented using the themes as a parameter and greater recurrence.

3.2.1 Public Policies

The analysis made in this research demonstrates the existence of five articles whose central theme is public policy. All articles deal with the formulation, implementation, or evaluation of various types of policies but are connected to the theme Bioeconomy. The articles that comprise this topic:

- The first article on this topic was written by Zilberman et al. (2013) and published in *Agricultural Economics* (impact factor 2.263). The article aims to understand the forces that will (important to remember that the article is already eight years old) shape the emergence of the Bioeconomy and the challenges it will bring to macroeconomics. Eminently theoretical, the article concludes by indicating the importance of having a public policy of investments in research and innovation and establishing a regulatory framework and financial arrangements that would encourage the private sector to develop and commercialize new products. The authors recommend that additional research can focus on what changes in strategic investments, for example, are needed in the industry to achieve and maintain global competitiveness in the future.
- The second article was written by Sotarauta and Suvinen (2019) and published in *European Planning Studies* (impact factor 2,226). The article aims to understand how '*local leadership*' can promote changes in the context of a green growth policy. In other words, how local leaders manage to convince those involved in increasing green production. The study adopts the strategy of case studies in the city of Tampere and the region of Finland. As a result, the authors conclude the importance of local leaders as promoters and collectively disseminate knowledge. Leaders seek to involve the entire community in the search for the knowledge needed to grow green production. Although the authors do not indicate future studies' possibility, findings corroborate that the research could be replicated in other countries and involving other aspects of the Bioeconomy.

- The third article was written by Avram et al. (2019) and published in the journal *Amfiteatru Economic* (impact factor 1.625). It is worth mentioning that this journal published the most articles in the sample (eight articles). The article aims to assess the clarity of reports published by organizations regarding how financial and non-financial information is presented. The research collected 17 companies from environmentally sensitive sectors of basic materials (chemical, mining, and metals), industries (steel and transportation services), oil & gas. The companies are located in 11 countries. The methodology of data collection was the gathering of reports produced by the companies. The article's main conclusion is that the companies studied do not obey the principle of clarity in their reports of information about the Bioeconomy. The factor that affects clarity is related to the country's culture in which the company is located. As a continuity, the authors intend to deepen their understanding of how companies meet the GRI - Global Reporting Initiative guidelines in terms of publishing information on bioeconomy.
- The fourth article was written by Hellsmark and Hansen (2020) and published in the journal *Energy Policy* (impact factor 5,042). The article aims to understand the role of elected politicians[†] in the formulation of energy public policy decisions. As a research strategy, the authors adopt longitudinal case studies to study forest biorefineries in Sweden. Data were collected through 44 interviews over ten years based on their observations in this period. The research results indicate that elected politicians only engage when they have the motivation and ability to debate the effects of politics with stakeholders. Without the effective participation of these actors, energy renewal policies do not materialize. The article does not present a continuity solution for the research, but it is understood that this research could be replicated in other countries using the theoretical framework and the research methods presented.
- The fifth article on the theme 'public policies' was written by Martin (2020) published in *European Planning Studies*. The article aims to clarify the changes in RIS - Regional Innovation Systems and the limits of innovation policy to face social challenges, as would be climate change. The research was carried out through case studies on the chemical industry in the Gothenburg-Stenungsund region (Sweden). Data were collected using semi-structured and in-depth interviews with 13 stakeholders between 2013 and 2019. The research concludes the need to expand the number of actors participating in the formulation and implementation of this type of policy, necessarily involving society sectors. The authors suggest specifically studying the role of multinational companies as collaborators or impediments to transformation. They also suggest studying the phenomenon in other contexts to understand the role of regional differences in innovation processes.

3.2.2 Intellectual Capital

The five articles with a central theme of intellectual capital pointed out the following gaps for future research:

- The first article with this central theme (Anghel et al., 2018) was published in the journal *Amfiteatru Economic* (impact factor 1.625) and had as main objective to analyze the interdependence between intellectual capital and financial performance of biotechnology companies. Financial performance was measured by return on investment, return on equity, and debt concerning equity. Intellectual capital was calculated by measuring the efficiency of research and development expenditures. As a suggestion for future research, the authors indicate the inclusion of other variables to measure financial performance (variables based on the company's operating results, such as gross sales revenue and market expansion - *our*
-

suggestion) and to measure intellectual capital (using the number of patents can be a good suggestion to expand the use of this analysis model for other bioeconomy companies).

- The second article on this topic was written by Anghel et al. (2019). The article was published in the journal *Ekonomiska Istrazivanja*, which has an impact factor of 2,229. The study aimed to identify the effects of intellectual capital on the dimensions of the Bioeconomy. Intellectual capital is measured in terms of the percentage of the population (30 to 34 years old) with a higher education level, the percentage of the population with complete education (first, second and third-degree), and expenditures on research development. The dimensions of the Bioeconomy are related to several indicators of solid waste reuse. The data was extracted from a platform called *Eurostat Databases* for the years 1995-2016. The authors suggest expanding the analysis to other sectors of the bioeconomy to measure the impact of intellectual capital and bioeconomy credentials on economic and sustainable development.
- The third article was written by Wield (2013), published in the journal *Technology Analysis & Strategic Management* (impact factor 5,846) and goes in the same direction as the previous one in the extent that suggests expanding the analysis to different sectors of bioeconomy and measuring the impact on economic and sustainable development. It is worth remembering that this article was published six years before the previous one and obtained only four citations in the entire period. The article focuses on the health, pharmaceutical industry as a dimension of bioeconomy. As main contributions, the article asserts that new forms of governance and regulation are key aspects for developing an industrial policy in emerging developing countries to contemplate the complexity that is formed between technology, markets, regulation, and civil society. The authors recommend expanding the analysis to different sectors of the bioeconomy and measuring the impact on economic and sustainable development.
- The fourth article under this topic was published by Sandulescu et al. (2018) in *Amfiteatru Economic* (impact factor 1.625). The article investigates the existence of organizational evolution in bioeconomy companies in the oil and gas sector and explores the extent to which intellectual capital participates in this process. The investigation is carried out with a longitudinal case study strategy of the OMV Group (Austria). As the study's main contribution, the authors propose that organizations adopt bioeconomy practices oriented with economic growth and job creation first and then turn their attention to issues related to biodiversity and sustainability. As suggestions for future research, the authors indicate the need to expand to other dimensions of the bioeconomy in a longer time. They also suggest the comparison between different industries and countries.
- Another article on this topic of intellectual capital was written by Cristea et al. (2020) and published in the journal *Technological and Economic Development of Economy* (impact factor 2,194). The article aims to research the implications of bioeconomy and intellectual capital (specifically for education, research, development, and innovation) on European Union countries' economic development. Data were also collected at *Eurostat Databases*, and the authors use a set of variables to measure economic development, bioeconomy, and intellectual capital. The contributions offered are relevant and suggest the great importance of higher education in GDP growth. However, the effect is not the same for countries with less developed due to the migration of skilled labor from the poorest countries to the richest. As suggestions for future research, the authors recommend increasing the number of variables related to the economic issue and sustainability. Due to the discrepancy of effects between countries, the authors suggest the inclusion of variables that measure immigrants and different ethnic groups' roles.

3.2.3 Circular Economy

The research found the presence of three articles whose central theme is the circular economy. Below are the articles and their respective theoretical gaps.

- The first article was written by Biber-Freudenberger et al. (2020) and published in the journal Sustainable Development (impact factor 4.082). The aim of this article is to provide an analysis of the risks and chances of bioeconomy growth. The study is conducted using a questionnaire to identify experts' perceptions about the impacts of the bioeconomy sectors on SDG - Sustainable Development Goals. The research results indicate that transformations of the bioeconomy sector are perceived as contradictory with positive and negative impacts. The biomass sector has attracted a lot of attention from the academy, while biological fuels and innovations in the food and seed sector are not attracting much attention from the academy. As suggestions for future research, the authors indicate using the theoretical framework in other contexts and cases.
- The second article was written by Sudaric et al. (2019) and published in Ekonomski Vjesnik (no impact factor). The aim of this article was to identify the links between a cooperative business and bioeconomy in the function of sustainable rural development. The study focused on cooperatives in the municipality of Osijek-Baranja (Croatia). Data were collected from a database of the Croatian Center for Cooperative Entrepreneurship. The main contributions of the research would be to ensure institutional support for the development of cooperatives, improve the image of cooperatives as a business model and emphasize the importance of cooperatives in the secondary and tertiary sectors as solutions for future research; the authors suggest expanding the literature review to before 2010 and including other sources of bibliographic references.
- The third article was written by D'Amato et al. (2020) and published in the journal Forest Policy and Economics (impact factor 3,139). Based on the scarcity of empirical research on circular business models or bioeconomy, the article aims to analyze the business models of bioeconomy of small and medium-sized enterprises. The study was carried out with a qualitative approach interviewing representatives of 13 small and medium-sized companies in Finland. The study's conclusions are as follows: the profitability of the bioeconomy sector is still low, which causes dependence on public resources for research and development; the study finds benefits for different stakeholders. However, this is still a topic in which very little is known; the diversification of business models in bioeconomy is important to support sustainability goals. As suggestions for future research, the authors recommend expanding the analyze of social impacts to different countries and products.

After content analysis of the 13 articles on public policy (05), intellectual capital (05), and circular economy (03), table no. 1 summarizes the theoretical gaps recommended in all articles. The information was aggregated into three major groups: changing the theoretical framework, increasing the database, and replicating research in other contexts.

Table no. 1: Analysis of Suggestions for Future Research

Suggestions for Future Research	General Theme	Articles
<i>Change theoretical framework</i>	intellectual capital; business clusters in Bioeconomy; circular economy; business ecosystems; entrepreneurship, governance; pulp and paper industry; new	(Anghel et al., 2019; Biber-Freudenberger et al., 2020; Busu & Busu, 2019; Fischer et al., 2020; Kargyte et al., 2018; Näyhä, 2021; Rantala et al., 2020; Sudaric et al., 2019; Toppinen et al., 2017;

<i>Grow database</i>	business models; public policy; transparency (reports)	Wassenhoven et al., 2020; Wield, 2013; Zilberman et al., 2013)
<i>Search for different contexts</i>	startups and MEP; human behavior; innovation and technology; intellectual capital stakeholder analysis; intellectual capital; cooperativism; performance of the bioeconomy sector; circular economy; knowledge economy; higher education institutions; <i>marketing</i> (consumer perception); digital platforms; public policy; networks	(Anghel et al., 2018; Cirstea et al., 2019; Neimark, 2016; Pasnicu et al., 2019) (Avram et al., 2019; Bueno et al., 2018; Cristea et al., 2020; D'Amato et al., 2020; Erika et al., 2020; Falcone et al., 2019; Golowko et al., 2019; Grundel & Dahlstrom, 2016; Hellsmark & Hansen, 2020; Martin, 2020; Nedelea et al., 2018; Ryymin et al., 2020; Sandulescu et al., 2018; Soltysik et al., 2019; Sotarauta & Suvinen, 2019; Viaggi, 2018; Wield et al., 2017)

4. Discussion

The research points out that academic production involving bioeconomy and Innovation in journals in Economics and Administration was driven by OECD actions in its documents and conferences. The first articles in the sample were published in 2013, such as Zilberman et al. (2013) and Wield (2013). While the first (Zilberman et al., 2013) had 35 citations on the Web of Science database, the second (Wield, 2013) had only 4 citations. Based on Google Scholar, which was not used in this study because it included more varied citations than only in scientific journals, the first obtained 74 citations and the second 28. Analyzing the keywords of the two articles, 'bioeconomy'; 'Renewable resources'; 'Nonrenewable resources'; 'Biotechnology'; 'Biofuel'; 'Discounting'; 'Sustainability' in the first and 'Bioeconomy'; 'Global Economy'; 'Pharmaceuticals'; 'Innovation'; 'Global Health' in the second, it can be seen that both employ bioeconomy as the first search term. The difference in citations may be related to the first one's focus on sustainability.

Regarding research methods, most of the articles are empirical studies combining quantitative and qualitative methods. Most of the articles collected secondary sources, but others used primary data collected through interviews and questionnaires. There was a single case of collection through the Delphi method and another where researchers collected the company websites' data. There seems to be no correlation between the number of citations and the type of research adopted. In contrast, the article with the highest number of citations is empirical, and the second largest is theoretical.

Regarding the research gaps, the content analysis represented in table no. 1 suggests three paths to be used: changing the theoretical framework, increasing the database, and replicating the research in other contexts. If the option is to change the theoretical framework, the researcher can review the concepts that underlie bioeconomy combined with innovation to draw a theoretical framework that includes new concepts. In the case of innovation, one suggestion would be to adopt the classification proposed by Bröring et al. (2020), suggesting four types of innovations: substitute products, new processes, entirely new products, and new behaviors. It was not the case for the study to examine the industry sector in which the articles were addressed, but perhaps new studies in the pharmaceutical industry, agriculture, and new drugs to help cope with the problems. A question, also of great interest, would be to examine how to combine innovations and products related to bioeconomy in its ethical aspects. This recommendation would be in line with what Bugge et al. (2016) proposes, which classify

bioeconomy in Biotechnology, Bioresources and Bioecology. It is suggested to identify whether science can combine the three concepts and develop products that are, at the same time, an alternative to fossil fuels that meet the different needs of society and are sustainable.

Another perceived gap in the content analysis of the articles was the use of the Stakeholder Theory. The search for the term in the analysis of content related to the articles indicates that the term appears in 25/33. In other words, high importance is inferring in the research carried out. However, only one article has as its central theme 'stakeholder analysis'. In the other articles, the term appears along with relevant categories in theory, such as attitude and influences, participation, involvement, engagement, values, perspectives, among others. This finding is evidence that the use of Stakeholder Theory could add much value to understanding how bioeconomy can propose technologically innovative innovations that allow the replacement of products harmful to the environment and that are sustainable.

Conclusions

This research aimed to identify theoretical gaps that guided research on Bioeconomy and Innovation in areas known as Applied Social Sciences and understand the possibilities of research in this field. This research is justified by the ontological importance of the term Bioeconomy, which means a profound change in the modes of production of goods and services, having as a paradigm the preservation of the planet Earth by reducing effluents and replacement of the use of fossil fuels.

A literature review is carried out on the Web of Science platform using the search terms '*Bioeconomy*' and '*Innovation*' to achieve the research objectives. The first results were filtered by articles to which access is opened to download pdfs and articles published from 2010. Another filter used was the concentration of articles related to economics, management, business, and planning (Economics and Administration). Although no articles published in journals without impact factor on the JCR base were not removed, this information was considered a factor in identifying the articles. At the end of the process, we concluded the inclusion of 33 articles published in 2013 related to the theme.

The research results indicate that all the articles present research conducted in Europe, except one article that studied Madagascar's phenomenon (Neimark, 2016). The analysis indicates that one of the principal's theoretical gaps is the lack of reference for comparing the results in terms of context. Economic, legislation, and management differences between European countries and other continents are notorious. In this sense, the replication of these researches in developing countries would offer a greater richness to understanding the innovation issues that occur related to the Bioeconomy. An important contribution of this research is the analysis of contexts in which bioeconomy processes are inserted so that theories gain in cultural terms. In the same vein, Stakeholders' Theory could also contribute to a better understanding of the causes of success and failure of initiatives to implement the Bioeconomy in countries.

Only one article specifically mentions having performed stakeholder analysis (Falcone et al., 2019) and the terms mentioned in contexts revert to the principles of the theory. Given the importance of Stakeholder Theory in public and private environments, there is an important gap in the analysis of stakeholders involved in Bioeconomy actions and how they could impact the process. Another contribution to future research is that the articles began to be published in 2013, having their culmination in the years 2019 and 2020. That is, the theme is justified as of great current interest.

It is known that the current research has limitations. A limitation may be related to the delimitation of the categories worshipped in the survey. The first research resulted in 251 articles, and most of them were in the categories 'Environmental Science', 'Green Technology'

and 'Environment Studies'. That is, research aimed at including these themes could add knowledge to this study.

Another suggestion regarding epistemological aspects would be the inclusion of other key countries related to bioeconomy, such as Biotechnology, Circular Economy, and the impact analysis of these studies, if such factors are antecedents or consequent contexts focused on bioeconomy. It is understood that the inclusion of these terms, which had a considerable frequency in the research, could expand the scope and scope of the research results.

At the end of the article, the evidence collected indicates a very fertile field for research in Applied Social Sciences. Bioeconomy has focused on the attention of Environmental Sciences, Agriculture, Technology, Biology, and Chemicals. Still, it must be considered that the events related to the theme are, eminently, organizational and business. Knowledge needs to be enriched about how companies work and what economic and labor relations impact this new phenomenon can entail.

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