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Review

Renewable energy and leather industry - bibliometric analysis

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Abstract

The impact on the environment, disregarding the industry is constant. The implications are various out of which the energy sector stands out due to its ability to help reduce the climate change effect. Renewable energies can constitute a necessary change in some domains due to their high environmental impact. Thus, in this paper, the link between renewable energy and the leather industry is highlighted through a bibliometric analysis of the scientific community research.

Keywords

bibliometric analysis, renewable energy, leather industry

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Introduction

Environmental pollution has a serious impact on ecosystems, biological diversity, and human health on a global scale. One of the largest contributors to this pollution, which is brought on by a variety of economic activities, is the textile industry with its high emissions [1]. European leather production has always held the top spot in the industry, continually aiming to raise the bar and provide cutting-edge products. Enhancing openness within tanneries is a collective endeavor involving various stakeholders within the leather industry [2]. Over the past decade, the industry's social partners have consistently shown that the process of leather production brings advantages to individuals, the environment, and economic well-being. They have effectively conveyed the message that responsible leather processing fulfills crucial social requirements [3]. According to [4] the chemical substances consumed by the leather industry are 2.15 kg/m². Regarding energy consumption, industry is constantly trying to reduce the level of consumption. Replacing the old equipment's with other new had a positive impact. Natural gas is still the main source of energy used. Also, implementing effective systems to reduce electricity usage, such as employing electric motors with built-in inverters, energy-efficient compressors, and voltage optimization, has led to a substantial decrease in electricity consumption [5]. Anaerobic digestion has become a practical and desirable approach for treating solid wastes in tanneries as a result of the expanding need for energy and the advent of strict environmental rules and policies [6, 7].

The primary goal of this study was to conduct a bibliometric analysis on the articles related to renewable energy and the leather industry published in the Web of Science (WoS) database. To reach the goal the following questions were addressed:

- Q1. How did the publications on renewable energy and the leather industry evolve?
- Q2. What type of documents are most frequently published?
- Q3. Which is the network map of the co-occurrence of keywords?

Material and Methods

The method of analysis selected by the authors to link renewable energy and the leather industry was bibliometric analysis. The literature research took place in May 2023 using the Web of Science database. Its selection came from the fact that the database Web of Science is considered to be the one with the highest degree of stringency. Also, its international prestige was considered. To obtain the sample for

the analysis we began by selecting the keywords that were later applied for data gathering. The keywords selected were “renewable energy” and “leather industry”, which gave a result of 49 articles. The database result was downloaded in plain text with all the information given: publication type, authors, author keywords, abstract, researcher IDs, times cited, publication date, etc. Thus, further analysis and results presented show the evolution in publications regarding the leather industry and renewable energy, the type of documents frequently published, and the co-occurrence of the keywords that have the most influence on the subject.

Results

As mentioned, the number of articles that were given by Web of Knowledge when applying the keywords was 49, written by 193 authors. Figure 1 presents the distribution of the literature from the first articles that linked the keywords till 2023. As can be seen in the past years the accent of the connection was accentuated.

As it can be observed from Figure 1, the highest scientific production happens in 2022 with more than 22.45% of the articles produced. We still must take into consideration that 2023 has not ended and there are still 6 months left. Spikes on the subject were in 2017 with 12.24% and 2019 with 14.29% of the scientific articles elaborated.

Regarding the type of document, as can be seen in Figure 2 the articles are the ones mostly presented among the scientific community. As it can be seen, with a percentage of 67.35% the type of document “article” is the one mostly selected by the others to present their findings.

The second type of scientific publication with a percentage of 20.41% is review articles followed by proceeding papers. Regarding the network map, we analyzed at first the network of co-occurrence considering all keywords as the unit of analysis. The results provided are presented in Figure 3, the visualization being possible using VOSViewer. The results provided 370 keywords, on which we applied a minimum of 2 occurrences of a keyword which narrowed the results to 51 elements used for the network.

The most powerful cluster contains 22 keywords among which leather industry and energy can be found. When applying the co-occurrence type of analysis where the unit of analysis is authors' keywords, the number of keywords resulted was 171. Applying also a minimum number of occurrences of keywords of 2, then just 19 meet the threshold. Since just 16 items were connected then the network map shows just this network created. The results revealed two clusters, one that contains 9 items and the other with 7 items.

Also, the connections between authors are important to see how the research and the interdisciplinarity of the sub-

ject is approached. In this respect using the data the following network map presented in Figure 5 is presented.

Also, the most influential countries that published in the subject are presented in Figure 6. The results presented are just for the top 10 results and it can be seen that India and Spain are the most influential countries on the subject.

In recent years, there has been a growing understanding of the need to address certain sustainability challenges within the leather industry and as such renewable energy

challenges. Thus, the development and application of more sustainable techniques is being promoted by initiatives like:

- Sustainable sourcing: some companies make an effort to ensure that the leather they use comes from morally and environmentally responsible sources that don't harm animals or the environment and maintain moral principles.
- Chemical use reduction: efforts are being made to reduce the use of potentially hazardous chemicals in the production of leather and to adopt environmentally suitable alternatives.

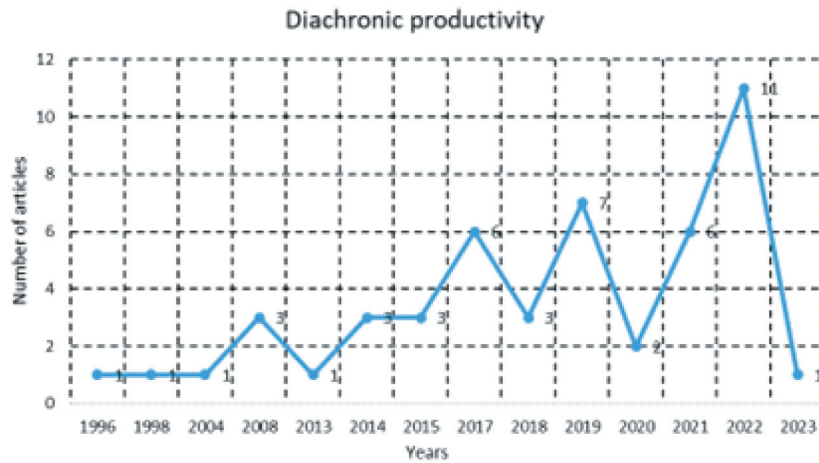


Fig. 1. Diachronic productivity of renewable energy and leather industry materials published in Web of Science since 1996, Source: own creation

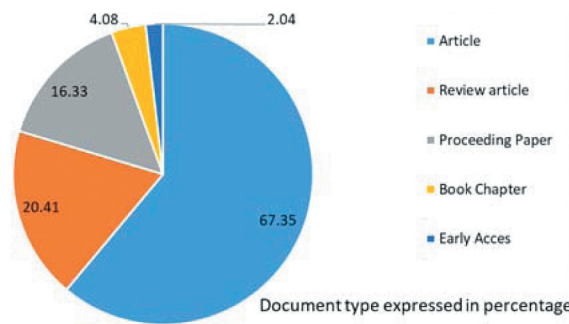


Fig. 2. Type of documents, Source: own creation

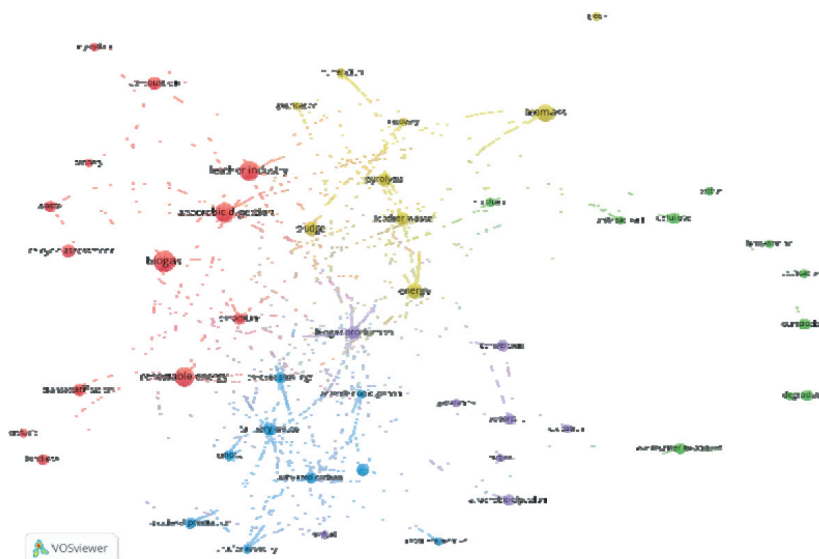


Fig. 3. Network of all keywords occurrences, Source: own creation

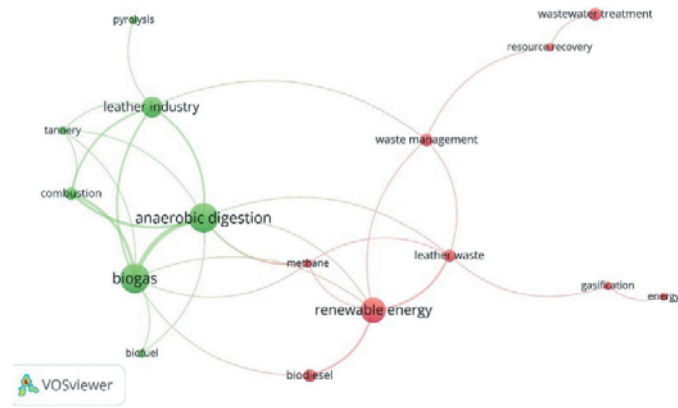


Fig. 4. Network of authors' keywords occurrence, Source: own creation

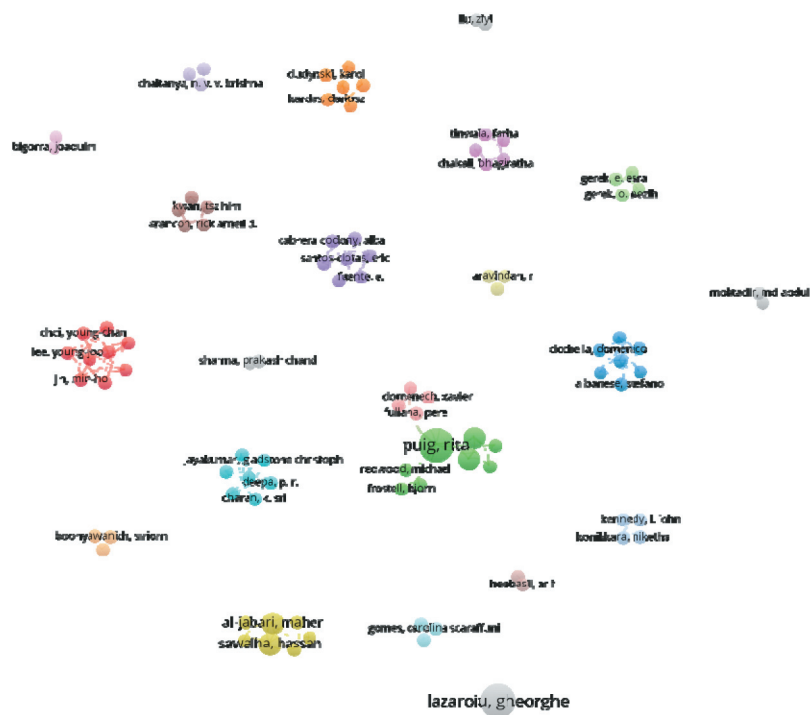


Fig. 5. Authors connections, Source: own creation

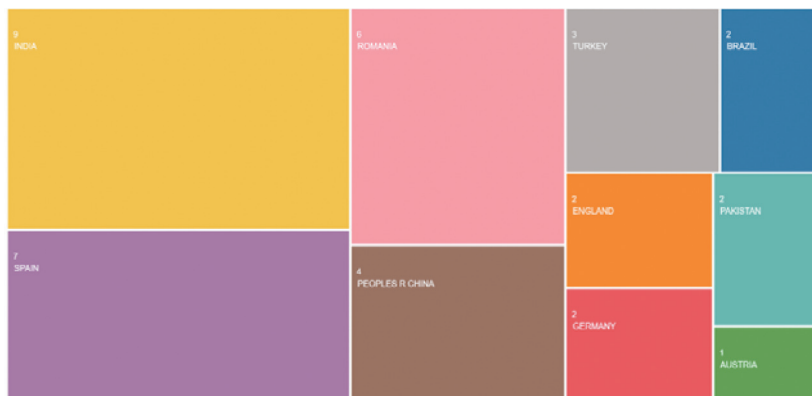


Fig. 6. Most influential countries with publications on the subject. Source: ISI Web of Knowledge Tree Map for 10 most important countries



Fig. 7. Most encountered SDGs on the subject, Source: ISI Web of Knowledge Tree Map for 5 most important countries SDGs

- Recycling and reuse of leather scraps are two waste management strategies that leather companies are looking to use.
- Innovation: the leather sector is researching and funding innovative technology that can reduce the negative effects of leather production on the environment.

Despite some progress, there are still barriers standing in the way of fully integrating the leather industry with the SDGs. Consumer awareness, regulatory support, and industry-wide cooperation are necessary to bring about a major change in this sector. Considering the analysis in this paper the results related to the SDGs in connection to the words analyzed in the paper revealed that the most discussed SDG within the scientific community was “Responsible Consumption and Production” followed by “SDG 6 – Clean Water and Sanitation”. In Figure 7 the Tree Map Chart supplied by ISI Web of Knowledge is presented.

Discussions

Regarding Q1 “How did the publications on renewable energy and the leather industry evolve?” it must be said the subject emerged in 1996 there are still some years when scientists did not publish any material that linked the two keywords. Also, the results revealed a continuously increasing interest in the subject, maybe also due to the fact that the European Union regulation regarding environmental protection is much harsher than before. The publications evolved from treating the leather industry on its own to adjusting the research to better provide for the future of the environment [8, 9]. Also, the increasing number of publications also expresses the fact that there is still a sizable difference between the stated targets for sustainable leather technology and the levels that have been reached, despite ongoing research efforts [10].

Regarding Q2 “What type of documents are most frequently published?” the results revealed that a great source of information for the scientific community and not only

comes from scientific articles that mainly present scientific results, which can be considered as an evolution due to possible innovations and technology evolution.

Regarding the innovations within the leather industry, it must be said that there are processes that still require exploration to answer the industry’s needs [11]. Also, most of the documents are scientific articles due to the extended research that started on the subject. Some present the fact that leather industries are embracing a range of modern technologies both in production and effluent management to regulate the release of pollutants into the environment and minimize waste generation [12]. Others mention the need for a safe environment, mainly safe water and present various technologies for water purification [13].

Regarding Q3 “Which is the network map of the co-occurrence of keywords?” the analysis revealed that scientific results that link the leather industry to renewable energy are still needed. Also, a higher interaction between the authors may increase the degree of importance of the subject and the scientific relevance of the results.

If we analyze the connection, we can see that several clusters work closely together and bring results in the scientific community. Also, usually, the authors tend to write and maintain connections in their closed cluster.

Conclusions

The research conducted presented the evolution in the scientific community on the subject of renewable energy and the leather industry. In conclusion, the bibliometric analysis in this paper provides a tool for researchers to invest more in the topic. Also, the evolution of technology implies that all industries will have to adapt at some point, and in the leather industry it is necessary to innovate and improve the working process, considering renewable energy in order to apply sustainability concepts.

Conflict of interest

The authors declare that they have no conflicts of interest.

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