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Advances in science and technology for the production of biofuels and value-added products from the use of biomass and agricultural residues

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Abstract

With significant challenges ahead, advances in science and technology are providing various alternatives for the production of biofuels and value-added products. Among these options are the use of biomass and agricultural waste, which through proper management can lead to the generation of management schemes under the principles of sustainable development. The objective of this research was focused on showing a general overview of the scientific and technological trajectory of this field of knowledge through information obtained from the Scopus and Lens databases, which allowed the elaboration of a bibliometric, patent, and network analysis. In the first case, from the following search: (TITLE-ABS-KEY ("agricultural biomass" OR "agricultural residues") AND TITLE-ABS-KEY (biofuels OR "value-added products")), 1,085 documents were obtained and, with this, it was possible to analyse the main bibliometric indicators and to elaborate the network map. In the part of bibliometric indicators, the main results show, for example, that most of the scientific research is in areas such as energy, environmental sciences, chemical engineering, biological and agricultural sciences, and engineering, and that the leading countries in this area are the United States, India, China, Canada and Germany. With respect to the network analysis, a map was obtained consisting of 16 clusters, 244 nodes, 2,059 links and a total link strength of 3,325 where the most recurrent themes mention associated aspects such as enzymatic hydrolysis, lignocellulosic biomass, anaerobic digestion, pre-treatment, among others. In the second case, the patent analysis indicates that through the following search: (Title: ("agricultural biomass" OR "agricultural residues") OR (Abstract: ("agricultural biomass" OR "agricultural residues") OR Claims: ("agricultural biomass" OR "agricultural residues")))) AND (Title: (products OR materials) OR (Abstract: (products OR materials) OR Claims: (products OR materials)))), a total of 272 granted patents were obtained and grouped into 202 simple families. This section shows, for instance, that the relevant jurisdictions in this type of technology are the United States and European patents. Applicants include companies such as Xyleco Inc, Du Pont, Novozymes Inc, US Agriculture, and Virent Inc. Regarding the technological sectors according to the IPC (International Patent Classification), the categories C12P19/02, C12P7/10, and C12P19/14, subclassifications of the subclass C12P focused on fermentation and

enzymatic processes for different purposes, predominate. Finally, the co-occurrence analysis generated a network with 8 clusters, 161 nodes, 1,726 links and, a total link strength of 13,645, where relevant nodes related to topics such as enzymes, lignocellulosic material, hydrogen, among others, are observed. In conclusion, the results provide a general overview of the scientific and technological trajectory that could represent a starting point for the generation of policies and management schemes that promote research and development (R&D) activities to generate different inputs through sustainable schemes.

Keywords: Biofuels, value-added products, biomass, agricultural residues, innovation.

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