Fruit Growing Research, Vol. XXXIX, 2023 DOI 10.33045/fgr.v39.2023.14
https://publications.icdp.ro/index.php

EVALUAREA FEZABILITĂȚII POTENȚIALULUI BIOECONOMIEI ÎN SECTORUL HORTICOL: PROGRESE, PROVOCĂRI ȘI OPORTUNITĂȚI

ASSESSING THE FEASIBILITY OF BIOECONOMY POTENTIAL IN THE HORTICULTURAL SECTOR: TRENDS, CHALLENGES AND OPPORTUNITIES

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Abstract

One of the major challenges of the sustainable agri-food system around the world is the prevention of losses and waste along the value chains. As global demand for food, feed and fuel is rising there is a need for innovative strategies to improve resource efficiency in food production. Bioeconomic approaches focus on developing processes that exploit underutilized by-products from agricultural and horticultural food production. The horticultural sector is all the more affected because fresh produce in this sector is highly perishable and also contains inedible parts. In this sense, in order to evaluate the feasibility of the bioeconomy's potential to meet these problems, the present study will present a bibliometric analysis of research for the superior processing of waste and horticultural by-products with practical applications such as the bioremediation of pollutants, the production of renewable energy, bioactive compounds, biofertilizers.

Cuvinte cheie: bioeconomie, horticultura**,** compusi bioactivi, biofertilizanti.
Key words: bioeconomy, horticulture, value chain, bioactive compounds, biofertilizers.

1. Introduction

In recent decades, the focus on sustainable development has led to a significant increase in interest in the bioeconomy. Bioeconomy represents an economic concept that promotes the sustainable use of biological resources and application of biotechnological developments in industrial processes. The bioeconomy is an innovative paradigm that explores the ways in which biological resources are managed, processed and harnessed to meet society's needs in a sustainable way (Balan et al., 2022, Rodino et al., 2019).

Recent advances in research and technology have opened new horizons for the sustainable development of horticulture, and this article explores recent developments, significant challenges and emerging opportunities in this field. The integration of bioeconomic principles in horticulture not only contributes to increasing productivity and resource efficiency, but also to reducing the impact on the environment and creating an agricultural system more resilient to climate change (Brandão, et al. 2021).

The horticulture sector's transition to a bioeconomy-based agriculture signifies a commitment to sustainable, regenerative practices that align with broader global goals. Bioeconomic strategies target the development of various processes for exploiting underutilized by-products from agricultural and horticultural production, such as the significant biomass generated from vegetables cultivation. Currently, these residues are either used for biofuel or compost production or incur disposal costs (Junker-Frohn et al., 2019). An essential aspect of feasibility assessment in the horticultural sector for bioeconomy is the multidisciplinary analysis of environmental, economic and societal impacts. In this context, both the economic and ecological advantages as well as the practical and social challenges will be explored, providing a comprehensive review of bioeconomic transformations in horticulture.

2. Material and methods

To illustrate the feasibility of the bioeconomy potential in the horticultural sector, this research relies on the use of bibliometrics to analyze and quantify the progress, challenges and opportunities identified in the scientific literature. The bibliometrics provide a truly comprehensive perspective on the field, allowing the assessment of the growth of interest and paradigm shifts in horticultural bioeconomic research. Through bibliometric analysis, a systematic approach is proposed to identify emerging trends and connections between various aspects of the bioeconomy and the horticultural sector, thus providing a comprehensive perspective on the current state of knowledge.

The research questions of this study were as follows:

- How has the dissemination of knowledge about horticulture and the bioeconomy evolved worldwide, including countries, affiliations and authors?
- What are the main research topics of horticulture and bioeconomy?
- What is the culture trend, bioeconomy strategies, health implications
- What are the challenges and directions for future research on horticulture and the transition to the circular bioeconomy?

The methodology used in this research involved a systemic approach, with an emphasis on the analysis of networks of terms used in scientific literature, to evaluate the feasibility of the bioeconomy potential in the horticultural sector. First, we used the academic database Scopus to identify and collect relevant articles related to bioeconomy and horticulture. We selected key information such as titles, authors and keywords of the articles to obtain a solid database (Figure 1). We then exported this data into VOSviewer, a software tool specialized in analyzing and visualizing networks of terms in the scientific literature. Through VOSviewer, we performed a detailed analysis of the connections between the different concepts, identifying groups of significant terms. This approach provided a comprehensive picture of the evolution and interconnections in the literature, thus facilitating the assessment of the progress, challenges and opportunities related to the bioeconomy in the context of horticulture.

3. Results and discussions

The bibliometric analysis using Scopus and VOSviewer brought to the fore significant insights into the feasibility of the bioeconomy potential in the horticultural sector. The results highlight a constant growth of scientific interest in this topic, illustrated by the growing number of publications in recent years (Fig. 2). By identifying key terms and the connections between them, we were able to map the conceptual networks, identifying the central nodes that support the evolution of the bioeconomy in horticulture (Fig. 3).

The results of the keyword co-occurrence analysis, performed using VOSviewer, reveal significant patterns in the scientific literature on the bioeconomy in the horticultural sector. The central term "horticulture" is closely related to a number of relevant keywords, highlighting key areas of interest. For example, "agricultural robots" and "agricultural waste" were identified as particularly relevant research topics with a significant number of connections, suggestive for exploring technological innovations and efficient waste management in horticulture.

Another notable aspect is the close association between "circular economy", "circular horticulture" and "waste management", indicating the scientific concern for circular and sustainable approaches in the management of resources and waste in the context of horticulture. Also, the significant connections between "sustainable agriculture", "sustainable development" and "sustainability" underline the importance of sustainable development in the planning and implementation of bioeconomic strategies.

On the other hand, terms such as "greenhouse gases", "climate change" and "environmental impact" reflect the interest in the ecological aspects of the bioeconomy in horticulture, emphasizing the need to address climate change and minimize environmental impact within horticultural systems.

In the context of advances, we have seen a particular focus on innovative technologies such as sustainable processing technologies and smart farming methods. They offer practical solutions for increasing efficiency and sustainability in horticultural production. On the other hand, the studied articles highlighted the challenges associated with the transition to a bioeconomy in the horticultural sector, such as the necessary structural changes and adaptation to new environmental standards.

The opportunities identified, reflected in the scientific literature, aim at interdisciplinary collaborations and partnerships between industry, research and the public sector. Thus, the development of the bioeconomy in horticulture is not only a theoretical aspect, but also a practical reality with tangible implications regarding the sustainability and future of the sector.

Bioeconomy represents an innovative and sustainable approach to the use of biological resources for the production of goods, energy and services. In the context of intensive horticulture, where the vegetable supply chain has gained considerable importance, it faces major challenges related to environmental pollution, residual toxicity to microorganisms and humans, plant resistance to pathogens, loss of biodiversity and risks to human health.

The papers reviewed highlight a number of key processes related to the bioeconomy and horticulture, focusing on sustainable practices, recycling agricultural waste and implementing a circular economy, as follows:

Recycling agricultural waste through composting and compost tea

A crucial aspect in addressing these issues is recycling agricultural waste through on-farm composting and applying compost tea, improving soil quality and plant health. This practice fits into the concept of a circular economy, where waste is considered a valuable resource. The resulting compost contains valuable substances such as minerals and microorganisms that contribute to improving the soil

and fighting plant diseases. However, there are obstacles such as complex regulations, variability in compost quality and greenhouse gas emissions that require solutions to promote this practice within a circular economy.

Development of biostimulants from agro-food by-products

Other aspects discussed in specialized literature include the efficient use of agro-food by-products for the production of biostimulants. These bioproducts help promote plant growth and increase crop productivity, reducing reliance on chemical fertilizers. The careful selection of designated by-products for valorization as biostimulants includes criteria such as the absence of pesticide residues, low collection and storage costs, sufficient supply, and synergy with other valorization pathways (Zulfiquar et al., 2020; Xu et al., 2018; Titirica et al., 2023).

The biochar industry in the circular economy

It also highlights the potential of the biochar industry within the circular economy. Biochar, produced as a by-product of biomass pyrolysis/gasification, can significantly contribute to reducing environmental impact, managing climate change and implementing a circular economy model. It is essential, however, to establish an international standard for biochar production and to define guidelines for its use in different fields, such as agriculture and horticulture, construction, activated carbon production, and anaerobic digestion (Hu et al., 2021).

Agricultural waste management within the circular economy and bioeconomy

With regard to agricultural waste management in the context of a circular economy and bioeconomy, the importance of policy and approaches to encourage sustainable production and consumption, as well as the need for government support for awareness, training and research and development are highlighted (Duque-Acevedo et al, 2020).

The importance of a transdisciplinary and collaborative approach

Addressing the challenges of the social, economic and environmental impacts of intensive horticulture requires collaborative and transdisciplinary efforts, including government. This involves strengthening a culture of shared responsibility for sustainability, efficient water management, biodiversity conservation, implementing a circular economy plan, technology and knowledge transfer, and strengthening the image and identity of the agricultural sector(Balan et al., 2022; Stegman et al., 2020; Grade et al., 2019) .

4. Conclusions

In conclusion, the application of bioeconomy principles in the horticultural sector offers significant opportunities for the sustainable transformation of agricultural practices. Recycling agricultural waste through techniques such as on-farm composting and the use of biostimulants from agri-food by-products demonstrates the potential to improve soil quality, enhance plant health and reduce reliance on chemical inputs. Integrating these practices into a circular economy framework can contribute to efficient resource management and reduced environmental impact. In addition, the development of the biochar industry and the exploration of innovative ways to manage agricultural waste offer promising prospects for value-added and sustainable resource generation. To fully exploit these opportunities, collaboration between government policymakers, the private sector and the scientific community is essential. Investments in research and development, facilitating access to advanced technologies and promoting a favorable legislative framework can catalyze the transition to a bioeconomic horticultural system, with positive impact on the environment, economy and society as a whole.

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Tables and Figures

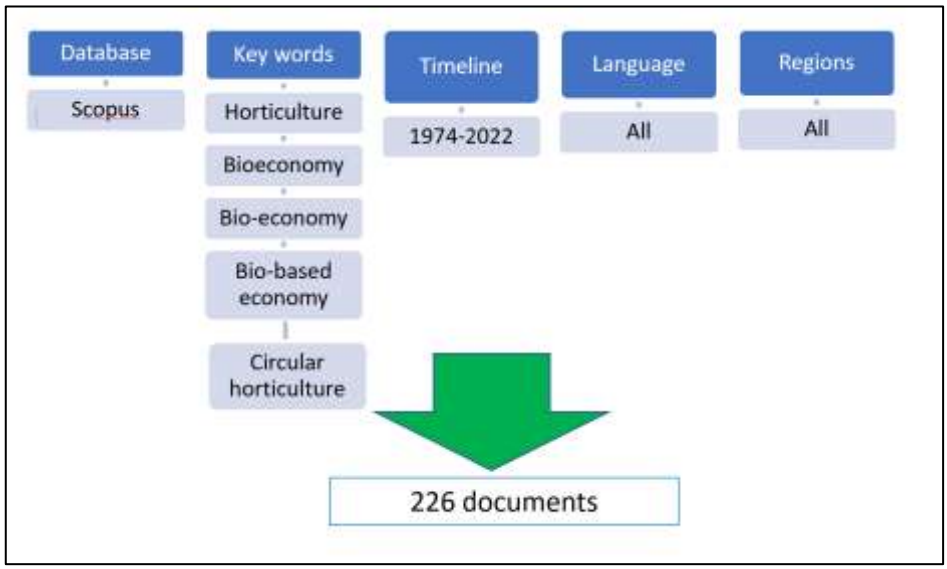

Fig. 1. Methodological steps

Area	Value
Spain	37
Italy	27
China	23
Netherlands	22
Germany	21
Belgium	16
Australia	14
India	13
United States	10
United Kingdom	10
Canada	9
Portugal	7
Brazil	7
Poland	6
France	6
South Korea	5

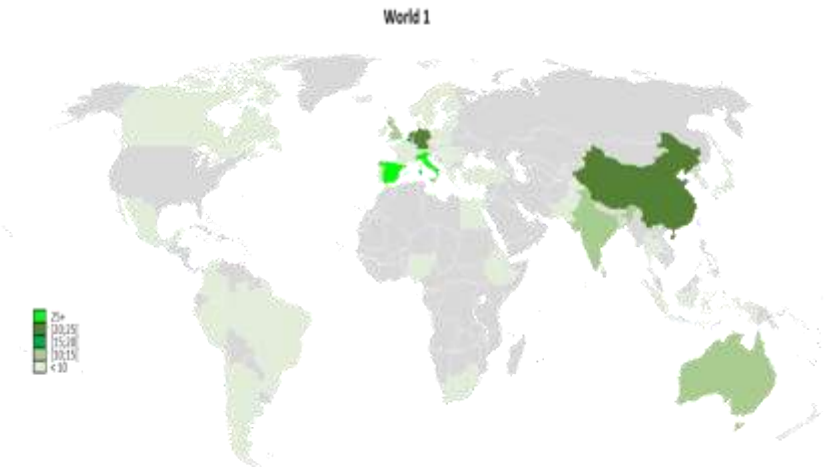

Fig. 2. Scientific production related to selected domain, by country

 DOI 10.33045/fgr.v39.2023.14

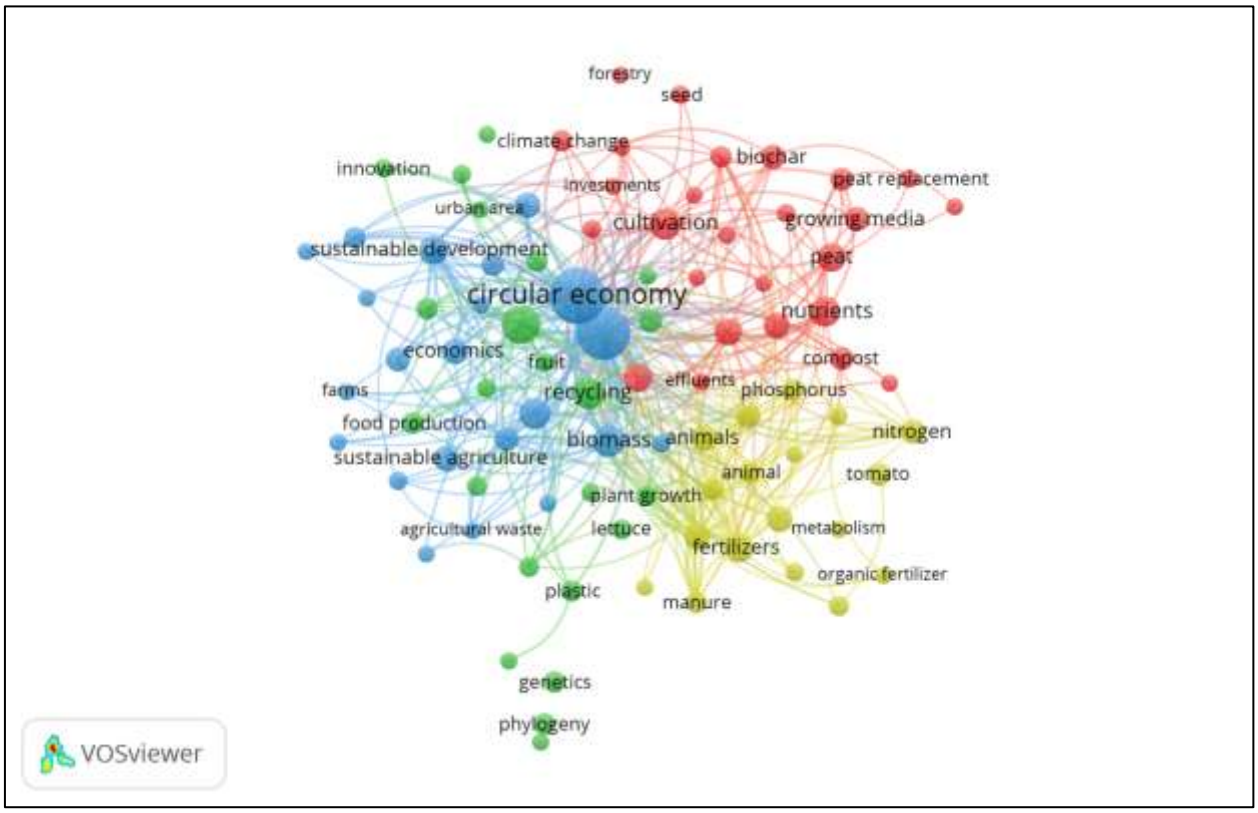

Fig. 3. Co-occurrence network of articles keywords