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Emerging Trends and Future Directions in Organic Agriculture and Environmentally-friendly Farming Practices: A Bibliometric Analysis

Muhammad Hazmi[1], Dyah Ayu Suryaningrum[2], Iskandar Umarie[3], Oktarina[4], Muh. Aniar Hari Swasono[5]

[1] Prodi Agroteknologi Fakultas Pertanian Universitas Muhammadiyah Jember and mhazmi.hazmi@gmail.com
[2] Universitas Sebelas Maret and dyahsuryaningrum@staff.uns.ac.id
[3] Universitas Muhammadiyah Jember and iskandarumarie@unmuhjember.ac.id
[4] Fakultas Pertanian Universitas Muhammadiyah Jember and oktarina@unmuhjember.ac.id
[5] Universitas Yudharta Pasuruan and aniarhari@yudharta.ac.id

ABSTRACT

Organic farming and eco-friendly agricultural practices have gained significant attention as sustainable alternatives to conventional agriculture. This research method employs bibliometric and keyword analysis to explore the field's emerging trends and future directions. The co-occurrence analysis of keywords reveals prominent research themes, including organic certification, soil health, climate change resilience, agroecological approaches, biodiversity conservation, and integrated pest management. The analysis also identifies influential authors, collaboration networks, and prominent publication venues that disseminate research in sustainable agriculture. The keyword analysis highlights the literature's focus on adoption, agricultural products, consumer behavior, and sustainable agricultural development. This research provides valuable insights for advancing knowledge, policy development, and practical applications in organic farming and eco-friendly agrarian practices to foster sustainable and environmentally friendly agricultural systems.

Keywords: *Trends, Future, Organic Agriculture, Environmental, Farming Practices, Bibliometric*

INTRODUCTION

Agriculture is critical in supporting human civilization, providing food, fiber, and fuel to sustain our growing population. However, conventional agricultural practices have come under increasing scrutiny for their adverse impacts on the environment, human health, and biodiversity. Prolonged reliance on synthetic chemicals, overuse of water resources, and degradation of soil health have raised concerns about the sustainability of conventional agriculture in the face of global challenges such as climate change and resource scarcity[1]–[5].

In response to these pressing concerns, organic farming and eco-friendly agricultural practices have emerged as promising alternative that prioritizes ecological balance, resource conservation, and sustainable food production. Organic farming aims to minimize synthetic fertilizers, pesticides, and genetically modified organisms, relying instead on natural inputs, crop rotation, and integrated pest management. It emphasizes the promotion of biodiversity, soil health, and ecological harmony in agroecosystems[6], [7].

Eco-agricultural practices cover a broader spectrum of sustainable farming methods beyond organic farming. These practices can include agroecology, permaculture, agroforestry, conservation agriculture, and various innovative approaches that promote environmental stewardship and social equity in agriculture. Together, these practices form the foundation for a more resilient and ecologically balanced agricultural system that can meet local and global challenges.

Numerous studies have examined organic farming and environmentally friendly agricultural practices. Bibliometric analysis can help identify trends, gaps, and key contributors in this field. Here, we discuss some relevant research articles and their findings.

Performance Analysis of Dairy Farms Transitioning to Environmentally Friendly Grazing Practices: Case Study of Santa Catarina, Brazil[12]: This study analyzed the economic, social, and ecological impacts of the Voisin Rational Grazing System (VRG) as an alternative to conventional dairy farming. The results showed that VRG is more profitable and has reduced the use of environmentally harmful inputs, making it more environmentally friendly and sustainable.

Environmentally Friendly Technologies for Wastewater Treatment in Food Processing Plants: A Bibliometric Analysis [13]: This bibliometric analysis evaluates the evolution of green technologies for wastewater treatment in food processing plants. The study found that scientific production in this area is growing exponentially due to stringent environmental policies and increased environmental awareness.

Traditional Agricultural Practices in India: An Approach to Environmental Sustainability and Food Security[14]: This article discusses the potential of conventional agricultural practices in India to achieve environmental sustainability and food security. It highlights the need to balance high food productivity and environmental conservation.

Compost Barns: A Bibliometric Analysis[15]: This bibliometric analysis evaluates scientific studies on compost barn systems, which provide better animal welfare and quality of life. This analysis identifies the most relevant countries, journals, institutions, researchers, and citation networks related to compost barn research.

Plant Organic Agriculture Research - Current Status and Opportunities for Future Development[16]: This paper reviews the scientific, legislative, economic, and environmental aspects of plant organic agriculture. The article discusses the impact of organic farming on biodiversity and soil fertility compared to conventional systems and highlights the need for more effective implementation of scientific research innovations.

Bibliometric Analysis of How Organic Chemistry Education Research Has Evolved Collaboratively Over Time[17]: This bibliometric analysis focuses on organic chemistry education research, identifying trends and gaps in the field.

Artificial Intelligence-Based Decision Support Systems in Smart Agriculture: A Bibliometric Analysis for Operational Insights and Future Directions[18]: This bibliometric analysis examines the application of Operations Research (OR) theory in Smart Agriculture. The aim is to provide insights into how advanced OR theory is applied and identify research gaps.

In conclusion, organic farming and environmentally friendly agricultural practices have been widely researched, with studies focusing on different aspects such as grazing systems, wastewater treatment, traditional methods, compost barns, and advanced technologies. Bibliometric analysis can help identify trends, gaps, and key contributors in this field, providing valuable insights for future research and development.

This research aims to provide a comprehensive and up-to-date understanding of emerging trends and future directions in organic farming and environmentally friendly agricultural practices. This research will systematically analyze the scientific literature using bibliometric analysis to identify key research themes, influential authors, popular journals, and collaborations in the field.

LITERATURE REVIEW

Organic Farming: A Paradigm of Sustainable Agriculture

Organic farming is a holistic and sustainable agricultural system emphasizing ecological balance and environmental protection. Rooted in agroecological principles, organic farming strives to cultivate healthy and fertile soil while minimizing external inputs such as synthetic fertilizers and chemical pesticides. Instead, organic farmers rely on natural sources of nutrients, crop rotation, composting, and biological pest control methods to maintain the health of their agroecosystems[19]–[23].

Numerous studies have highlighted the benefits of organic farming over conventional farming. Studies have shown that organic farming practices improve soil structure and fertility, increase soil microbial diversity, and increase carbon sequestration, contributing to climate change mitigation. In addition, organic farming promotes biodiversity by providing habitat for various species and supporting beneficial insects that act as natural predators of pests, reducing the need for chemical interventions. The literature on organic farming has experienced significant growth in recent years in line with the increasing concern for sustainability[3], [24].

METHODOLOGY

Data for this bibliometric analysis were collected from reputable bibliographic databases such as Web of Science or Scopus in Publish or Perish (PoP) software. The search includes scientific publications on organic farming and environmentally friendly agricultural practices up to the literature search date. The following search terms and their combinations will be used: "organic farming," "eco-agriculture," "sustainable agriculture," "agroecology," "permaculture," "agroforestry," "conservation agriculture," "integrated pest management," "sustainable livestock management," "agricultural sustainability."

The search was limited to articles, reviews, conference papers, and other publications related to the research theme to ensure relevance and accuracy. Non-English publications will be excluded from the analysis.

Data Analysis using VOSviewer

VOSviewer is a widely used bibliometric analysis tool that allows researchers to explore and analyze bibliographic data visually. The collected data will be imported into VOSviewer for further analysis. Findings from bibliometric studies using VOSviewer will be interpreted and discussed to provide a comprehensive understanding of the current research in organic farming and environmentally friendly agricultural practices. Keyword occurrence analysis will highlight prominent research themes, while author analysis will identify critical researchers and collaborations driving innovation in the field. The journal analysis will shed light on dissemination channels, while the international collaboration analysis will underscore the importance of global partnerships in advancing sustainable agricultural practices.

Table 1. Data Metrics

Publication Years	1989-2023
Citation Years	34 (1989-2023)
Papers	920

Citations	74385
Cites/year	2187.79
sitess/paper	80.85
Author/paper	2.77
h-index	136
g-index	249
hI-norm	94
hI-annual	2.76
hA-index	43
Paper with ACC	1,2,5, 10, 20: 686,598,384,249, 129

Results and Discussion

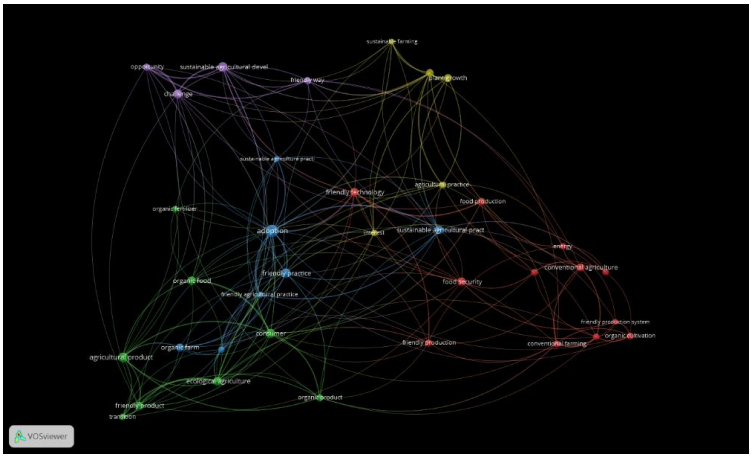

Figure 1: Mapping Results

The results of this research method, comprising bibliometric analysis and keyword analysis, shed light on the emerging trends and future directions in organic farming and eco-friendly agricultural practices. The study of scientific publications on sustainable agriculture has revealed key research themes, influential authors, and prevalent research areas within the field. Additionally, the keyword analysis provides insights into the most frequently studied topics and places of interest.

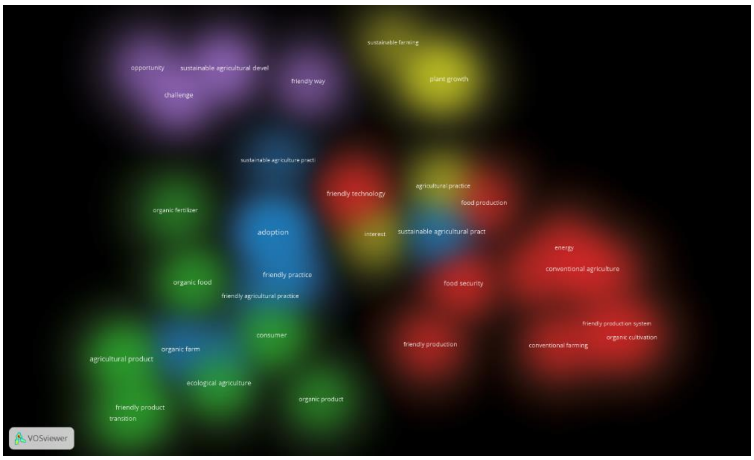

Figure 2. Cluster Results

Table 2 details the clusters obtained through the co-occurrence analysis of keywords in the literature on organic farming and eco-friendly agricultural practices. Each collection represents a group of related keywords frequently appearing in the same publications.

Table 2. Detail Cluster

Cluster	Total Items	Most frequent keywords (occurrences)	Keyword
1	(9)	Food security (24), Conventional agriculture (24)	Comparison, conventional agriculture, conventional farming, energy, food production, food security, friendly farming system, friendly production, friendly production system, friendly technology, organic cultivation, organic farming system
2	(9)	Transition (16)	Agricultural product, consumer, ecological agriculture, friendly product, organic fertilizer, organic food, organic product, transition
3	(7)	Sustainable agriculture (11)	Adoption, friendly agricultural practice, friendly practice, organic farm, sustainable agriculture, sustainable development
4	(5)	Biofertilizer (22)	Agricultural practice, biofertilizer, interest, plant growth, sustainable farming
5	(5)	Sustainable agricultural development (24)	Challenge, friendly way, opportunity, sustainable agricurtular development

In conclusion, the analysis of clusters in Table 2 provides valuable insights into the major research themes and emerging trends in the literature on organic farming and eco-friendly agricultural practices. These clusters shed light on the significance of sustainable agriculture, the transition towards eco-friendly practices, and the potential benefits of adopting organic farming methods for achieving food security, sustainable development, and environmental conservation. The identified clusters offer a foundation for further exploration and understanding of the complexities and opportunities in sustainable agriculture.

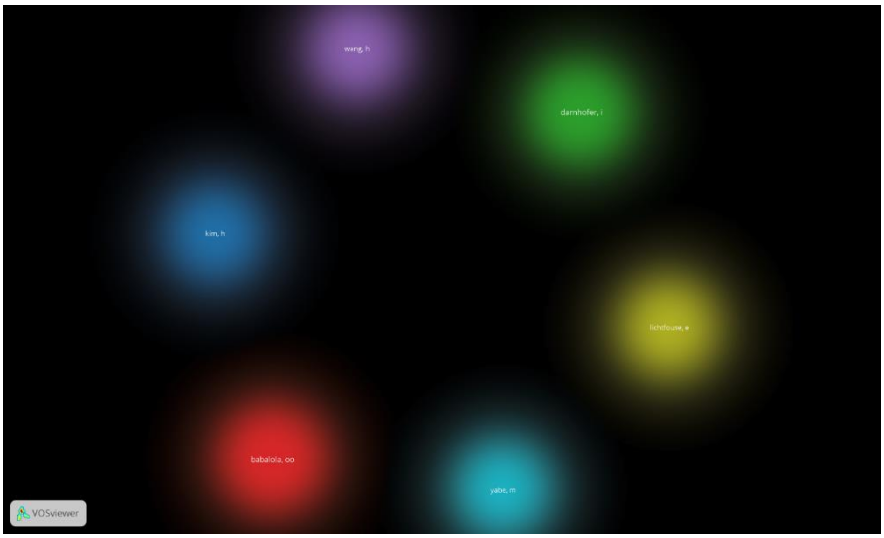

Figure 3. Authors Network

The author analysis using VOSviewer highlighted several influential contributors to the field of organic farming and eco-friendly agricultural practices. Notable researchers and research groups emerged as key innovation and knowledge dissemination drivers. The collaboration networks revealed strong ties among prolific authors, indicating the significance of collaborative efforts in advancing research in this domain. The identified influential authors play a critical role in shaping the research agenda and influencing the direction of sustainable agriculture practices.

Table 3. 10 High Citation

Citations	Authors and year	Title
1857	[25]	Plant-microbe interactions promoting plant growth and health: perspectives for controlled use of microorganisms in agriculture
1830	[22]	The role of conservation agriculture in sustainable agriculture
1830	[26]	Ecological intensification: harnessing ecosystem services for food security
1522	[27]	Organic agriculture in the twenty-first century
1381	[28]	Organic farming
1302	[29]	Choice of organic foods is related to perceived consequences for human health and to environmentally friendly behaviour
1099	[23]	Microbal phosphorus solublization and its potential for use in sustainable agriculture
1053	[30]	Organic farming and the sustainability of agricultural systems
1029	[31]	Agroecological practices for sustainable agriculture. A Review
1021	[32]	Nanotechonology in sustainable agriculture: recent developments, challenges, and perspectives

Table 3 lists 10 highly cited publications on organic farming, sustainable agriculture, and eco-friendly practices. These papers have received substantial attention from the scientific community and have significantly contributed to the understanding and advancement of sustainable agricultural practices. These highly cited publications have significantly shaped the discourse around sustainable agriculture, organic farming, and eco-friendly practices. They have informed policymakers, researchers, and practitioners about the importance of adopting environmentally friendly and socially responsible agricultural approaches for ensuring food security and environmental conservation. The findings from these papers have paved the way for further research and practical applications to build a more sustainable and resilient agricultural future.

Table 4. Keywords Analysis

Most occurrences		**Fewer occurrences**	
Occurrences	**Term**	**Occurrences**	**Term**
55	Adoption		Food production
36	Agricultural product	201	Agricultural practice
31	Consumer	19	Opportunity
30	Friendly practice	18	Conventional farming
29	Sustainable agricultural development	18	Organic product
28	Ecological agriculture	17	Comparison
25	Friendly technology	16	Transition
25	Organic food	15	Organic fertilizer
24	Sustainable agricultural practice	15	Sustainable development
24	Food security	13	Sustainable farming
23	Conservation agriculture	13	Friendly production system
23	Friendly product	12	Friendly agricultural practice
22	Biofertilizer	11	Sustainable agricultural practice
22	Organic farm	10	Interest

Table 4 presents a keyword analysis based on the occurrences of specific terms in the literature on organic farming and eco-friendly agricultural practices. The table is divided into two sections: keywords with the most events and keywords with fewer occurrences. The keyword analysis provides insights into the key themes and research priorities in the literature on organic farming and eco-friendly agricultural practices. The frequent occurrence of terms related to adoption, sustainable agricultural development, and friendly practices indicates a focus on promoting and understanding the adoption of sustainable practices. The emphasis on consumer behavior and eco-friendly products also reflects the growing interest in sustainable consumption and market demand for environmentally friendly agricultural products. Overall, the keyword analysis highlights the interdisciplinary nature of research in this field, encompassing agrarian

science, environmental studies, consumer behavior, and sustainable development. These findings can inform future research directions and policy initiatives promoting sustainable and eco-friendly agriculture.

Implications and Future Directions

The findings of this bibliometric analysis have several implications for the future of organic farming and eco-friendly agricultural practices. Firstly, the identified research themes can guide researchers, policymakers, and funding agencies in prioritizing research areas that require further investigation. Strengthening research efforts on these themes can lead to more comprehensive and targeted solutions for sustainable agriculture.

Secondly, recognizing influential authors and journals allows stakeholders to identify key players in the field and access high-quality research. Collaboration networks can be fostered to facilitate knowledge exchange and encourage interdisciplinary research, leading to more impactful and transformative outcomes.

Additionally, the analysis of international collaborations emphasizes the importance of global cooperation and information-sharing to tackle shared agricultural challenges. Policymakers can leverage international partnerships to develop cross-border policies that promote sustainable farming practices and ensure food security for all.

In conclusion, the bibliometric analysis of organic farming and eco-friendly agricultural practices provides a comprehensive understanding of the current research landscape. The results highlight the significance of sustainable agriculture as a promising solution to the environmental and social issues posed by conventional farming. Building upon the insights gained from this analysis, stakeholders can work together to pave the way for a more sustainable, resilient, and eco-friendly agricultural future.

Conclusion

The bibliometric analysis and keyword analysis findings offer comprehensive insights into the state of research on organic farming and eco-friendly agricultural practices. The co-occurrence analysis identified several key research themes, reflecting the multifaceted nature of sustainable agriculture. These themes highlight the importance of organic certification, soil health, climate change resilience, biodiversity conservation, and integrated pest management in promoting sustainable food production systems. The emphasis on agroecological approaches underscores the significance of interdisciplinary research in developing resilient and environmentally friendly agricultural systems.

The analysis of influential authors and collaboration networks indicates a strong network of researchers working together to advance knowledge and innovations in sustainable agriculture. International collaborations have facilitated knowledge exchange and technology transfer, contributing to the global impact of research in organic farming and eco-friendly practices.

The keyword analysis demonstrates the significance of understanding factors influencing adoption of sustainable agricultural practices among farmers and consumers. Consumer behavior and the demand for eco-friendly agricultural products are critical in promoting sustainable development. Furthermore, focusing on food security and sustainable development reinforces the importance of finding integrated solutions that balance environmental conservation and social equity.

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