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A Bibliometric Analysis of the Development of Organic Agriculture Research in the World

Loso Judijanto, Haryono
IPOSS Jakarta
Universitas Bhayangkara Surabaya

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ABSTRACT

This study presents a comprehensive bibliometric analysis of global research on organic agriculture, examining publication trends, thematic focuses, author collaborations, and international research networks. By analyzing data from major academic databases, this study identifies the core themes that define organic agriculture research, including sustainable agriculture, soil fertility, and crop rotation, and highlights emerging topics such as innovation, agroecology, and economic viability. The analysis also reveals strong international collaboration, with significant contributions from North America, Europe, and Asia, and identifies opportunities for expanding partnerships in underrepresented regions. These findings provide valuable insights into the development and future directions of organic agriculture research, underscoring its relevance in addressing global sustainability challenges. The study serves as a useful resource for policymakers, researchers, and practitioners aiming to promote and expand organic agriculture as a sustainable alternative to conventional farming.

Corresponding Author:

Name: Loso Judijanto
Institution: IPOSS Jakarta
Email: losojudijantobumn@gmail.com

1. INTRODUCTION

Organic agriculture has expanded significantly in recent decades as a sustainable alternative to conventional farming and as a reaction to escalating worldwide concerns regarding environmental degradation, biodiversity loss, and health dangers linked to synthetic chemicals in agriculture. Since its emergence in the early 20th century, organic farming has transitioned from specialized methods to a globally acknowledged and controlled system, principally driven by the demand for organic products from health-conscious customers and environmentally aware legislators [1]. Multiple studies indicate that organic farming promotes soil health, mitigates greenhouse gas emissions, and improves ecological diversity, rendering it an essential strategy in the global pursuit of sustainability [2]. This expanding corpus of research supports organic agriculture's capacity to tackle global concerns while also illustrating the field's swift growth in both breadth and technique.

Due to escalating worries regarding food safety and sustainability, organic farming is progressively garnering support from researchers, legislators, and farmers in

diverse places. Studies indicate that organic farming methods, including crop rotation, composting, and biological pest management, enhance sustainable soil management and benefit local ecosystems [3]. The demand for organically certified products has prompted governments in several nations to establish rules and incentives that promote organic farming practices. These activities are evident in Europe, the United States, and certain regions of Asia, where comprehensive studies have been undertaken to evaluate the effects of organic agriculture on economic, social, and environmental domains [4]. Consequently, comprehending the trajectory and subject emphases in organic agriculture research is essential for informing policy and promoting sustainable agricultural development.

Despite global interest, research on organic farming covers many subjects and regional contexts, resulting in a fragmented knowledge base that hinders full understanding of the field's evolution. Organic agriculture includes diverse practices and philosophies, from small-scale, subsistence-oriented systems to large-scale, market-driven organic farms. Research in developed regions typically concentrates on consumer attitudes, market mechanisms, and certification processes, while studies in developing countries frequently highlight organic farming as a strategy for poverty alleviation and ecological conservation [5]. This thematic diversity signifies the necessity to examine the evolution and transformation of organic agriculture research across many areas and disciplines.

The bibliometric study of organic agriculture research provides a systematic method for comprehending the field's expansion, recognizing key trends, and discovering gaps that could inform future investigations. Bibliometric tools evaluate publication data and offer an objective analysis of the evolution of organic agriculture research across time. Bibliometric studies have been utilized in diverse sectors in recent years to guide policy and strategic research initiatives [6]. This study utilizes bibliometric approaches to provide a comprehensive analysis of organic agriculture research, highlighting the impact of several disciplines and the progression of research focal points within this growing field.

Despite the rapid expansion of organic agriculture research, comprehensive understanding and strategic guidance for future research development are still limited due to fragmented themes, regional variations, and methodological differences. A significant challenge lies in identifying influential themes, top contributing countries, key authors, and major publication sources that shape the discourse in organic agriculture research. Previous studies on organic farming have focused on localized impacts, specific practices, or regional case studies, but few studies have attempted a global, bibliometric perspective that connects these individual pieces into a holistic understanding of the field. Without this broader perspective, it is difficult to understand the overall influence and trajectory of organic agriculture research or to determine how effectively it addresses global agricultural and environmental challenges. The objective of this study is to conduct a bibliometric analysis of global organic agriculture research to map its development and identify key themes, influential countries, authors, and sources that contribute to the field.

2. LITERATURE REVIEW

2.1 Systems Theory in Organic Agriculture

Systems theory is a basic concept pertinent to organic agriculture, perceiving agricultural operations as components of a larger ecological and socio-economic framework. Organic agriculture is fundamentally holistic, acknowledging the interdependence of soil, plants, animals, and human activities within an agricultural ecosystem [7]. This systems-based approach significantly differs from conventional agriculture, which typically emphasizes productivity maximization through isolated interventions, including chemical inputs or monoculture methods. Organic agriculture underscores the significance of natural

processes—such as nutrient cycling, pest-predator interactions, and biodiversity—as vital elements of a robust agricultural system [8].

Within organic farming, systems theory elucidates the significance of biodiversity and ecosystem services in sustaining soil fertility, averting pest infestations, and promoting general ecological equilibrium [9]. By conceptualizing organic agriculture as an ecosystem-oriented approach, researchers may assess the effects of organic methods on the wider environment and comprehend how various farming practices affect the sustainability and health of ecosystems. This methodology has significantly influenced research on the ecological advantages of organic farming, encompassing investigations into soil health, water retention, carbon sequestration, and biodiversity preservation.

2.2 Sustainable Development Theory

Organic agriculture is also deeply connected to the broader concept of sustainable development, as defined by the Brundtland Commission in 1987. Sustainable development emphasizes the need to meet current human needs without compromising the ability of future generations to meet their own [10]. Organic agriculture aligns with this goal by prioritizing environmental stewardship, reducing reliance on non-renewable resources, and promoting farming methods that support long-term ecological health. Sustainable development theory, therefore, provides a foundation for understanding organic agriculture's role in addressing food security, resource conservation, and climate change adaptation [11].

In recent years, sustainable development goals (SDGs) set by the United Nations have further defined the priorities for global organic agriculture research, particularly in relation to SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), and SDG 15 (Life on Land). Organic agriculture contributes to these goals by promoting farming practices that reduce environmental impact, support biodiversity, and create resilient agricultural systems. Studies have shown that organic agriculture can be more resource-efficient than conventional methods, especially regarding water use, energy consumption, and chemical inputs [12]. By embedding sustainable development theory within the framework of organic agriculture research, scholars can better assess how these practices support global sustainability targets and address pressing environmental challenges.

2.3 Socio-Ecological Perspective

The socio-ecological viewpoint offers a vital theoretical framework for comprehending organic agriculture by emphasizing the interplay between agricultural methods, human communities, and natural ecosystems. This viewpoint highlights the interdependence of social and ecological systems, acknowledging that human behaviors are shaped by and affect the environment [13]. Organic farming constitutes not merely a technical or economic decision but also a cultural and ethical choice that embodies social values concerning food, health, and environmental stewardship. This viewpoint elucidates the divergent evolution of organic agriculture across regions, shaped by local social, economic, and ecological determinants.

From a socio-ecological perspective, organic agriculture is perceived as a countermeasure to the adverse effects of industrial farming, such as soil degradation, biodiversity depletion, and pollution. Organic agricultural approaches aim to alleviate these effects by promoting natural processes, improving soil health, and preserving ecological equilibrium. The socio-ecological perspective enables researchers to examine how organic farming bolsters rural communities by generating sustainable livelihood options, fostering local food systems, and enhancing community resilience. Research on organic agriculture has underscored its capacity to enhance social justice by offering more equitable market options for smallholder farmers and alleviating rural poverty. Consequently, the socio-ecological viewpoint is essential for

examining the social aspects of organic farming and its contributions to human well-being.

2.4 Theory of Innovation Diffusion

The innovation diffusion theory, proposed by [14], elucidates the mechanisms, motivations, and velocity of the dissemination of novel ideas and practices within civilizations. Organic agriculture constitutes a notable advancement in farming, characterized by approaches that markedly diverge from traditional methods. This idea posits that the adoption of organic agricultural practices occurs in a sequence, beginning with innovators and early adopters, subsequently followed by the majority as awareness and acceptance increase. Organic agriculture has proliferated worldwide due to heightened awareness of its environmental, health, and economic advantages, driven by knowledge dissemination, market demand, and favorable legislation [14].

The notion of innovation diffusion elucidates the differential adoption rates of organic agricultural practices across different countries and regions, shaped by factors including governmental assistance, customer demand, and cultural acceptance. Research indicates that areas with substantial regulatory backing and consumer awareness exhibit markedly greater rates of organic agricultural adoption compared to those with diminished support for organic methods [1]. This theory emphasizes the significance of communication channels, social networks, and institutional support in advancing organic agriculture, providing insights into the potential future expansion of organic farming techniques.

2.5 Theory of Environmental Justice

Ultimately, the notion of environmental justice offers a vital framework for analyzing the role of organic agriculture in promoting equitable access to safe, nutritious, and sustainable food. Environmental justice confronts the unequal vulnerability of vulnerable people to environmental detriments and underscores the entitlement to a healthy environment [15]. Within the realm of organic agriculture, environmental justice underscores the advantages of organic techniques for marginalized communities by diminishing exposure to toxic chemicals, bolstering local economies, and enhancing food security.

In many developing regions, smallholder farmers often adopt organic farming as a means of survival and resistance against industrial agriculture's ecological and economic pressures [16]. The theory of environmental justice underscores the importance of supporting organic farming not only for its environmental benefits but also for its potential to empower marginalized communities. For instance, organic certification programs and fair-trade initiatives provide opportunities for small-scale farmers to access lucrative markets and improve their livelihoods [17]. The environmental justice framework, therefore, adds a socio-political dimension to the understanding of organic agriculture, emphasizing the need for policies that promote fair access to resources and opportunities within the organic farming sector.

3. METHODS

This study employs a bibliometric analysis to systematically examine the global development of organic agriculture research, utilizing data from the Scopus databse. First, relevant research articles are identified through targeted search queries using keywords such as "organic agriculture," "sustainable farming," and "organic farming practices," covering publications from the inception of organic agriculture research to the present. The collected data are then analyzed using bibliometric techniques to evaluate publication trends, author collaborations, geographical distribution, and citation patterns. VOSviewer bibliometric tool are employed to visualize networks and thematic clusters, allowing for the identification of influential authors, countries, and emerging topics.

4. RESULTS AND DISCUSSION

4.1 Yearly Publication

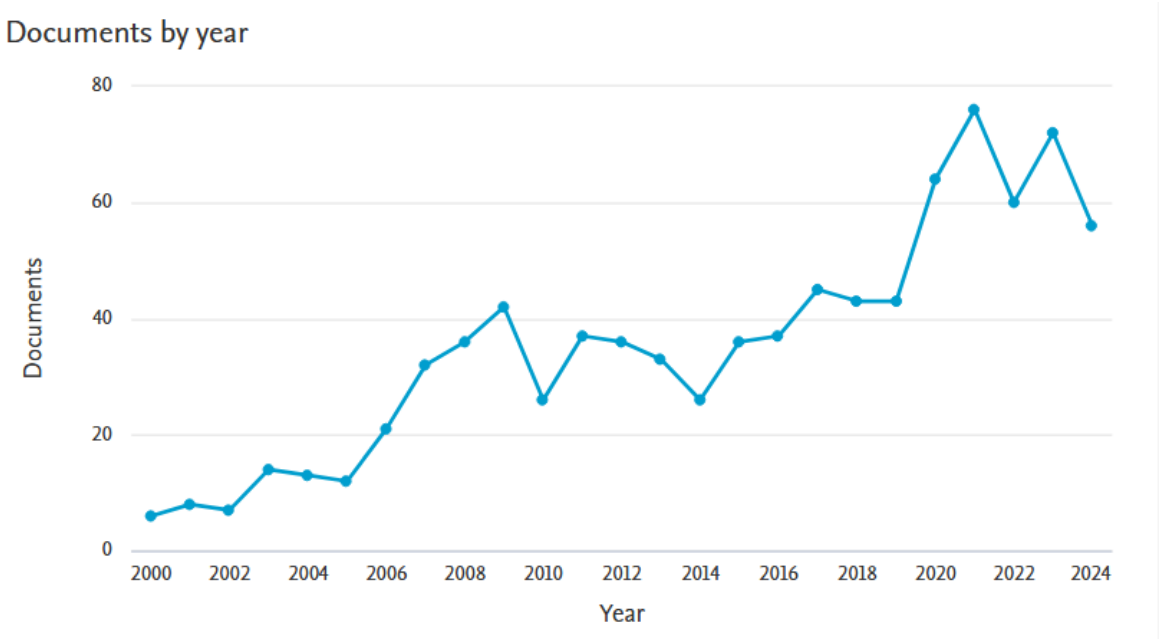

Figure 1. Yearly Publication
Source: Scopus Database, 2024

The annual publication graph demonstrates a consistent rising trajectory in the quantity of documents pertaining to the research topic over time, signifying an increasing interest and engagement in the field. From 2000, the publication count remains consistently modest and stable until approximately 2005, when it begins to rise significantly. The rising tendency persists with certain oscillations, especially around 2010, when a significant decline is observed before the count increases once more. Following 2018, there was a significant rise in publications, reaching a zenith in 2021 with over 70 documents released, indicating intensified academic focus and potentially augmented financial or policy interest in recent years. Nevertheless, post-2021, there is a marginal dip, suggesting a possible plateau or transient reduction in research production. This tendency indicates the maturing of the field and potential shifts in emphasis or saturation in specific study domains.

4.2 Citation Analysis

Table 1. Top Cited Literature

Citation	Author	Title
1234	[18]	The effects of organic agriculture on biodiversity and abundance: A meta-analysis
1012	[2]	Organic agriculture in the twenty-first century
655	[19]	Organic agriculture and the global food supply
588	[20]	Environmental impact of different agricultural management practices: Conventional vs. Organic agriculture
497	[21]	Strategies for feeding the world more sustainably with organic agriculture
448	[22]	Organic agriculture promotes evenness and natural pest control
355	[23]	Organic agriculture: Does it enhance or reduce the nutritional value of plant foods?
344	[5]	Many shades of gray—the context-dependent performance of organic agriculture
336	[24]	Financial competitiveness of organic agriculture on a global scale

320	[25]	Weed management in organic agriculture: Are we addressing the right issues?

4.3 Keyword Co-Occurrence Analysis

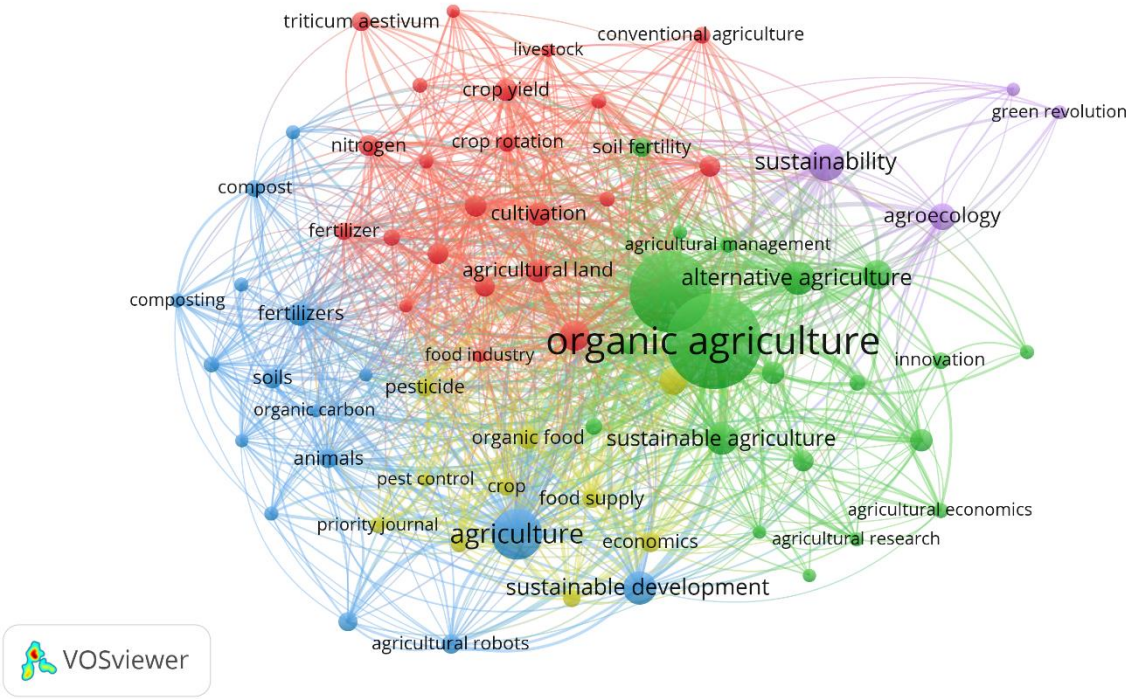

Figure 2. Network Visualization
Source: Data Analysis, 2024

This visualisation illustrates the study framework in organic agriculture through a network of often co-occurring terms. Each node represents a keyword or concept relevant to organic agriculture, with the size of the node indicating its frequency or importance in the literature. The lines or edges linking nodes represent co-occurrence links, with more robust connections denoting increased frequency of co-mentions. The color-coding classifies these phrases into distinct clusters, each representing a thematic subject or research focus within organic agriculture.

The primary cluster, centred on the term "organic agriculture," is encircled by associated ideas including "sustainable agriculture," "sustainability," and "alternative agriculture." This core suggests that the literature predominantly focuses on the fundamental ideas of organic farming as a sustainable alternative to traditional agriculture. Central themes in this cluster encompass soil management, crop rotation, and food supply, highlighting an emphasis on sustainable approaches that improve soil health and support ecological farming. This cluster highlights the significance of organic agriculture in fostering environmental sustainability and outlines fundamental practices and goals that distinguish it from traditional agricultural methods.

A notable cluster, characterised by phrases such as "soil fertility," "crop yield," "nitrogen," and "fertiliser," indicates research focused on the agronomic dimensions of organic farming. This cluster examines the biological and chemical mechanisms that support plant development in organic systems devoid of synthetic fertilisers or pesticides. Terms like "crop rotation" and "compost" underscore the importance of soil health and fertility control, which are essential in organic agriculture. The inclusion of phrases such as "livestock" and "agricultural land" indicates that the study within this

cluster also investigates the amalgamation of animal husbandry and land utilisation techniques, underscoring the comprehensive methodology of organic agriculture in the stewardship of agricultural ecosystems.A third cluster, with terms such as "sustainable development," "economics," "agricultural economics," and "food industry," demonstrates a socio-economic emphasis within organic agriculture research. This cluster indicates that a substantial segment of the literature investigates the economic feasibility of organic farming, its market dynamics, and its contribution to sustainable development. Terms such as "agricultural management" and "innovation" suggest that academics are focused on management methods and technical breakthroughs that may improve the efficiency and profitability of organic farming. This emphasis on economics underscores the two objectives of organic agriculture: attaining environmental sustainability and preserving economic competitiveness.

A smaller but separate cluster is represented by phrases such as "agroecology," "green revolution," and "innovation," indicating an interdisciplinary approach that integrates ecological concepts with agricultural advancements. The word "Agroecology" refers to a research emphasis on the integration of ecological knowledge with organic agricultural practices, highlighting biodiversity, ecosystem services, and resilience. The reference to the "green revolution" alongside agroecology indicates a comparative analysis in the literature, juxtaposing the industrial agricultural methods of the green revolution with the environmentally based tenets of organic farming.

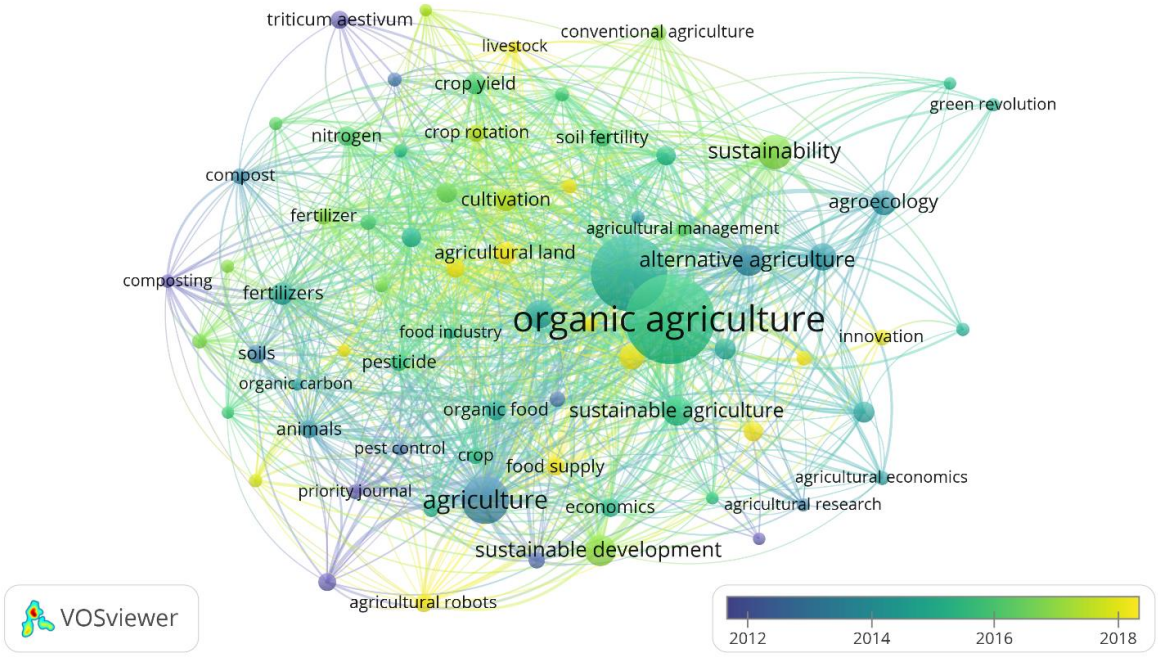

Figure 3. Overlay Visualization
Source: Data Analysis, 2024

This second visualization builds on the previous analysis by incorporating a temporal dimension, using color gradients to show the average publication year of each term. The color scale at the bottom right of the figure ranges from dark blue (representing earlier years around 2012) to yellow (representing more recent years closer to 2018). This temporal aspect provides insight into how research themes in organic agriculture have evolved over time, with terms in darker shades indicating foundational or earlier areas of study and terms in lighter shades highlighting emerging topics within the field.

The central node, "organic agriculture," appears in green, signifying its consistent importance over the years. Surrounding terms like "alternative agriculture," "sustainable agriculture," and "sustainability" are also shaded in green, suggesting that these core concepts have been consistently relevant in organic agriculture research over the past decade. This steady focus underscores a continuous interest in examining organic farming as a sustainable alternative to conventional practices. Key agronomic terms, such as "soil fertility," "crop rotation," and "cultivation," are similarly shaded, highlighting their foundational role in organic agriculture studies.

Notably, the visualization reveals emerging areas of research through the lighter yellow nodes, such as "innovation," "livestock," and "food supply." These terms, appearing towards the periphery, indicate a growing interest in interdisciplinary approaches that integrate ecological principles and innovative practices into organic agriculture. The appearance of terms like "agricultural land" and "agricultural robots" in lighter shades reflects the recent expansion of research into economic viability and technological innovation within organic farming. This trend suggests a shift in the field towards incorporating economic analyses and technological advancements to enhance the scalability and efficiency of organic agriculture, positioning it as a competitive and sustainable option for future food systems.

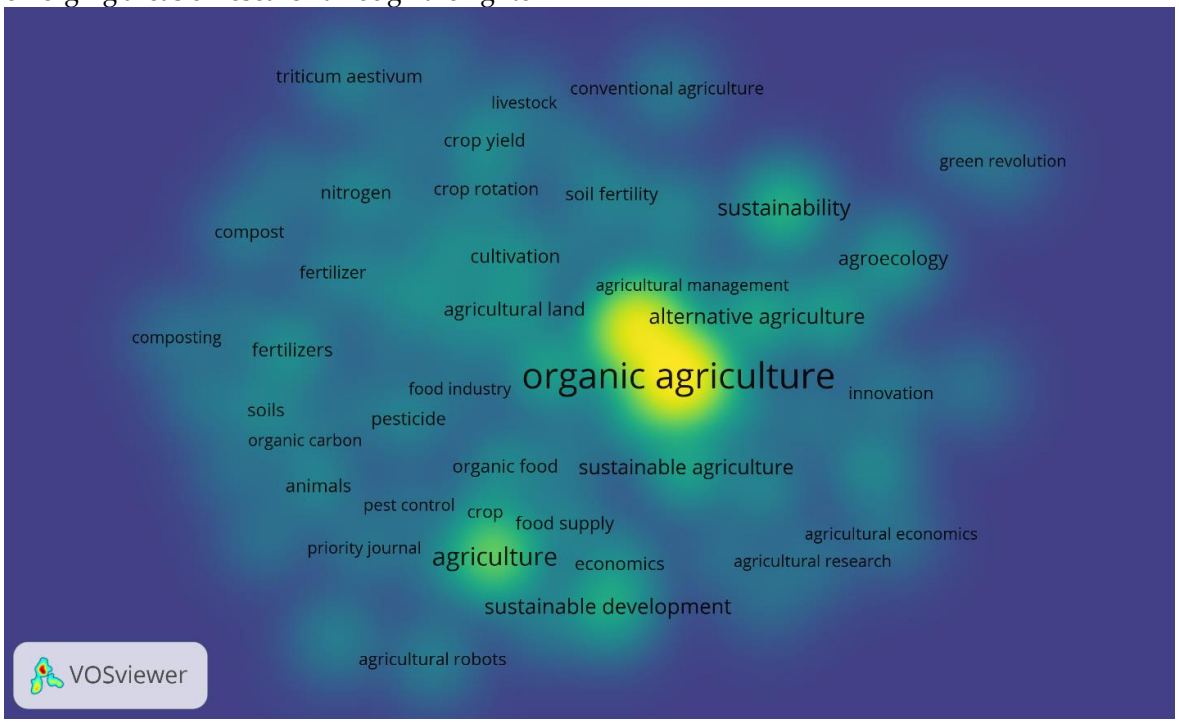

Figure 4. Overlay Visualization
Source: Data Analysis, 2024

This heatmap visualization of organic agriculture research highlights areas of high and low concentration within the thematic network. The brighter yellow regions indicate terms that are most frequently co-occurring and central to the field, with "organic agriculture" as the most prominent term, suggesting its fundamental role in the literature. Other bright areas include "sustainable agriculture," "alternative agriculture," "sustainability," and "agriculture," indicating that these themes are closely linked to the core concept of organic farming and represent frequently discussed topics. This concentration reflects the ongoing interest in examining organic agriculture as part of a broader sustainable and alternative agricultural framework.

In contrast, the darker, blue areas represent terms that are less central or less

frequently occurring in the network. Terms such as "agricultural robots," "priority journal," "animals," and "pest control" appear in the outer regions with lower intensity, suggesting they are either emerging topics or niche areas within organic agriculture research. The distribution of these less concentrated terms around the periphery indicates an expanding diversity in research topics, with growing attention to technology, ecological practices, and economic aspects. This heatmap reveals a layered structure within organic agriculture literature, where certain foundational themes are well-established, while newer or more specific areas are gaining attention as the field evolves.

4.4 Co-Authorship Analysis

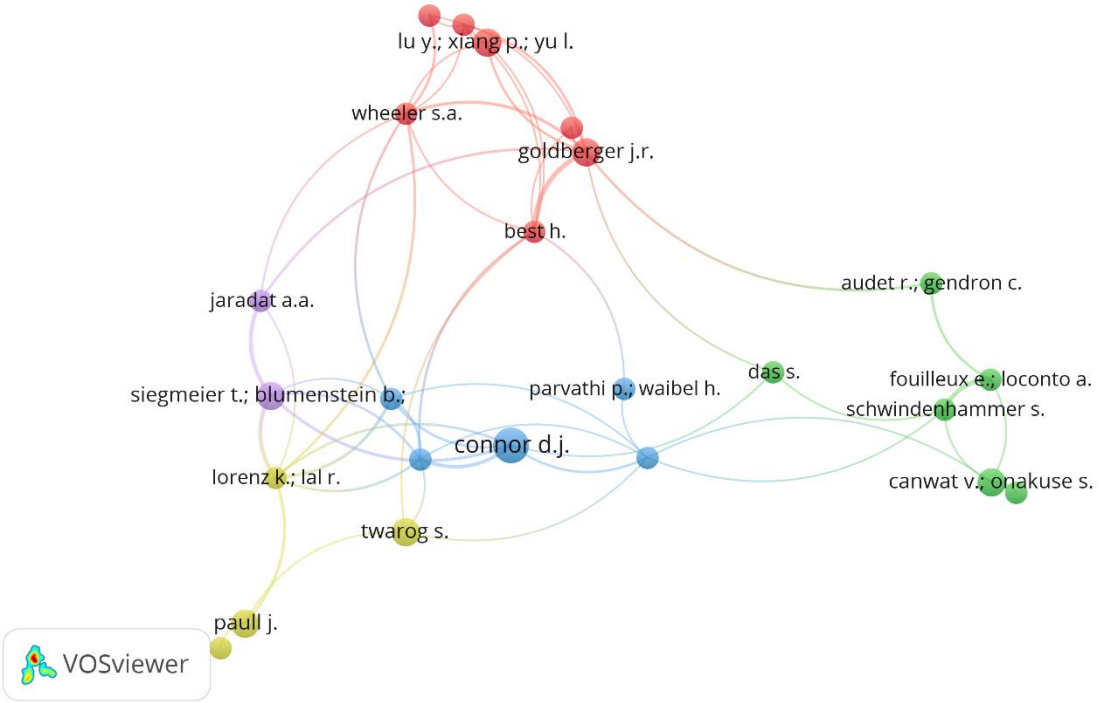

Figure 5. Author Collaboration Visualization
Source: Data Analysis, 2024

This author collaboration network visualization illustrates the connections and co-authorships among researchers in the field of organic agriculture. Each node represents an author, with the size of the node indicating their prominence or productivity, while the lines represent collaborative relationships between authors. The color-coded clusters reveal distinct research groups, suggesting that researchers within each cluster frequently collaborate with one another but have fewer connections with authors in other clusters. For instance, a prominent red cluster includes authors like Goldberger J.R., Wheeler S.A., and Lu Y., indicating a closely connected group working together on related topics. Similarly, other clusters such as the blue one, with authors like Connor D.J. and Waibel H., and the green one, featuring Fouilleux E. and Onakuse S., reflect collaborative networks that likely focus on specific themes or regions within organic agriculture research.

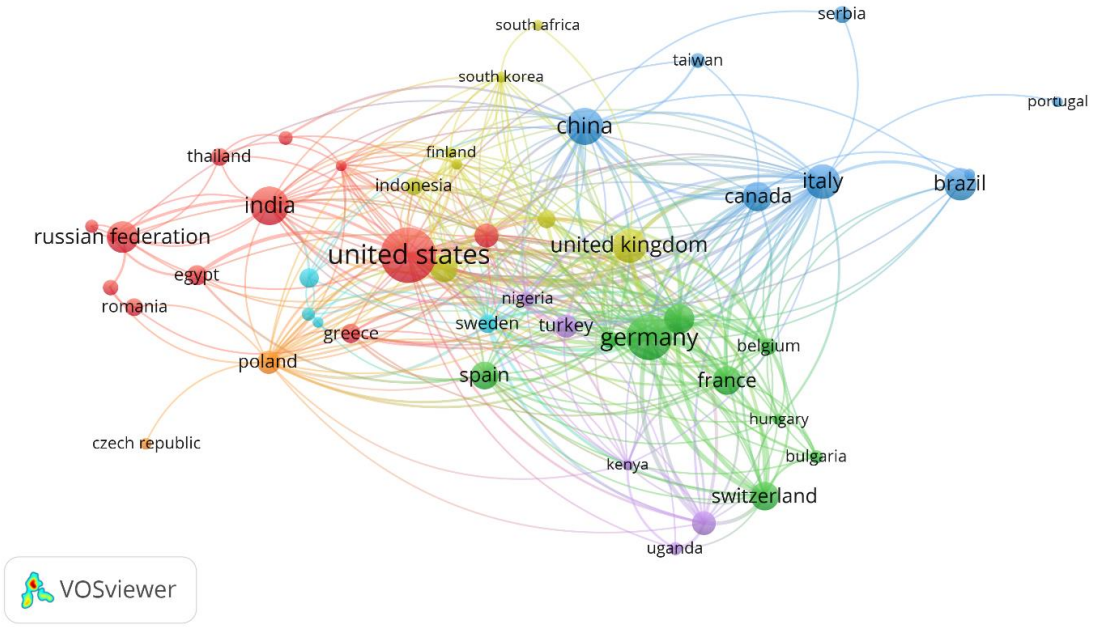

Figure 6. Country Collaboration Visualization
Source: Data Analysis, 2024

This country collaboration network visualization shows the global research collaborations in the field of organic agriculture. Each node represents a country, with larger nodes indicating higher research output or prominence in collaboration within the field. The lines connecting the nodes represent co-authorships or collaborative links between researchers in different countries, with thicker lines indicating stronger or more frequent partnerships. The colors signify clusters of countries that tend to collaborate more closely with each other. For example, the United States, positioned centrally with a large node, has extensive connections with countries across different clusters, including strong links with countries like China, Germany, and the United Kingdom. This suggests that the U.S. plays a major role in fostering international research collaborations in organic agriculture. Other key players, such as China, Germany, Italy, and India, also have significant collaborative networks, indicating a high level of research activity and international partnership.

DISCUSSION

Growth of Research in Organic Agriculture

The growth trend illustrated in the annual publication chart confirms an increasing interest in organic agriculture research worldwide, especially over the past two decades. This surge in publications aligns with heightened awareness of environmental sustainability, food security, and public health, which has driven both scholarly interest and policy support for organic farming practices. Since 2000, the number of publications has steadily increased, with notable peaks in recent years, possibly due to international commitments to sustainable development goals (SDGs), which include sustainable agriculture as a key target. The sustained growth reflects organic agriculture's recognition as a critical component of sustainable food systems and its potential to address global challenges like climate change, biodiversity loss, and soil degradation.

Despite this growth, the recent slight decline in publications after 2021 suggests that the field may be experiencing a plateau, or it may indicate a shift in research focus towards more specific or interdisciplinary studies within sustainable agriculture. This could be an indication of maturity in the field, where foundational aspects of organic agriculture are well-established, and researchers are now exploring more nuanced

or advanced topics, such as technological integration and economic implications. Alternatively, this slight decline may be temporary, influenced by factors like shifting funding priorities or global events (e.g., the COVID-19 pandemic) that have affected research productivity.

Core Themes and Emerging Areas

The keyword co-occurrence network provides a detailed view of the core themes and emerging topics within organic agriculture research. At the center of this network is "organic agriculture," closely connected to "sustainable agriculture," "sustainability," and "alternative agriculture." These keywords represent the foundation of the field, underscoring the primary focus on sustainable farming methods as alternatives to conventional practices. Core agronomic themes, including "soil fertility," "crop rotation," and "fertilizer," highlight the emphasis on sustainable soil and crop management practices that are essential to organic farming.

Beyond these core themes, the network also reveals emerging areas that reflect evolving research interests. For instance, terms like "innovation," "agroecology," "sustainable development," and "agricultural economics" suggest an increasing focus on interdisciplinary approaches that integrate technological, ecological, and economic perspectives. This shift reflects a growing recognition of organic agriculture's potential to contribute not only to environmental sustainability but also to social and economic development. The inclusion of terms like "agricultural robots" and "agricultural economics" indicates an interest in exploring how technological advancements and economic analyses can enhance the scalability, efficiency, and profitability of organic farming. Such topics are likely to become more prominent as researchers seek to address the practical challenges of expanding organic agriculture globally.

Author and Country Collaboration Networks

The author collaboration network highlights several distinct research clusters, each representing influential groups of authors who collaborate within specific thematic areas. For instance, clusters led by authors such as Goldberger J.R. and Connor D.J. indicate groups of researchers who have made significant contributions to organic agriculture and likely work on related themes. These clusters suggest that while organic agriculture is a global field, it is also characterized by regional or thematic specialization, where groups of authors tend to focus on particular aspects, such as agronomic practices, socio-economic impacts, or technological innovation in organic farming.

The country collaboration network further illustrates the global nature of organic agriculture research, with major hubs of activity in North America, Europe, and Asia. The United States stands out as a central player with extensive international collaborations, linking with key countries like China, Germany, the United Kingdom, and India. This strong collaborative network may reflect the role of the United States in funding and leading large-scale research projects that involve international partnerships. Other countries, such as China, Germany, and Italy, also play prominent roles, highlighting Europe and Asia as significant regions for organic agriculture research. The diversity in country collaborations indicates that organic agriculture is a global concern, with research reflecting both local and international priorities, including environmental sustainability, food security, and economic viability.

Interestingly, there is a notable presence of collaborations involving developing countries, such as India, Brazil, and South Africa, suggesting that organic agriculture is seen as a viable option for sustainable development in these regions. These collaborations often focus on adapting organic practices to local conditions, addressing food security, and creating sustainable livelihood opportunities. However, the relatively weaker connections among African and South American countries suggest that there may be opportunities for

strengthening regional collaboration and capacity building, which could enhance knowledge sharing and support the global expansion of organic agriculture.

Implications for Policy and Practice

The findings of this bibliometric analysis have several implications for policy and practice in the organic agriculture sector. First, the strong focus on themes such as "sustainability," "soil fertility," and "crop rotation" reflects the field's commitment to environmental stewardship. Policymakers can leverage these insights to promote organic farming practices as part of national and international sustainability agendas. In addition, the growing interest in economic and technological aspects, as indicated by keywords like "innovation," "agricultural economics," and "agricultural robots," suggests that organic agriculture is not only about environmental benefits but also about economic viability and technological advancement. Policymakers should consider providing incentives for innovation and supporting research that explores the economic impacts of organic farming, which could encourage more farmers to adopt these practices.

The strong collaborative networks among countries also suggest a need for policies that facilitate international research partnerships and knowledge exchange. Collaborative research programs that involve multiple countries, especially those that include both developed and developing nations, can help address common challenges in organic agriculture and promote the adaptation of organic practices to diverse ecological and socio-economic contexts. Furthermore, given the concentration of research hubs in North America, Europe, and parts of Asia, there is an opportunity to expand capacity-building efforts in underrepresented regions like Africa and South America. Enhanced funding for research in these areas, along with support for local adaptation of organic practices, could help bridge the gap in organic agriculture knowledge and practice across regions.

Future Research Directions

Based on the observed trends and gaps, future research in organic agriculture could benefit from exploring several areas. First, there is a need for studies that focus on technological integration in organic farming, including precision agriculture, automation, and digital tools. As indicated by the emerging interest in "agricultural robots" and "innovation," these technologies have the potential to improve efficiency and scalability, which could make organic farming more accessible to large-scale operations. Additionally, future research should continue to examine the economic dimensions of organic agriculture, including market dynamics, profitability, and consumer demand, to ensure that organic farming is not only sustainable but also economically viable.

Another promising area for future research is the socio-economic impact of organic agriculture in developing countries. The presence of countries like India and Brazil in the collaboration network highlights the relevance of organic farming in the context of sustainable development. Studies that assess the impact of organic farming on rural livelihoods, poverty alleviation, and food security in these regions could provide valuable insights for policymakers and practitioners. Moreover, as organic agriculture is increasingly recognized for its role in mitigating climate change, research on its potential for carbon sequestration, biodiversity conservation, and resilience to extreme weather events would be beneficial.

Lastly, to further enhance global collaboration, it would be valuable to establish international databases or platforms that facilitate knowledge sharing among researchers, especially those from underrepresented regions. This could foster greater inclusivity in organic agriculture research and help build a truly global understanding of best practices, innovations, and challenges. By addressing these research gaps and fostering international cooperation, the field of organic agriculture can continue to evolve and contribute to sustainable food systems worldwide.

5. CONCLUSION

This bibliometric analysis of global organic agriculture research reveals a field that has grown significantly in recent decades, driven by a commitment to sustainability, environmental stewardship, and food security. Core themes such as sustainable agriculture, soil health, and agronomic practices underscore organic farming's foundational principles, while emerging topics like innovation, agroecology, and economic viability highlight the field's dynamic evolution and interdisciplinary expansion. The author and country collaboration networks emphasize the importance of global partnerships, particularly among countries in North America, Europe, and Asia, although there is room for stronger collaborations in underrepresented regions. These findings indicate that while organic agriculture has established itself as a key area within sustainable development, future research must continue to explore technological advancements, economic impacts, and region-specific adaptations to further enhance its effectiveness and accessibility worldwide. This study provides a valuable roadmap for policymakers, researchers, and practitioners looking to advance organic agriculture as a viable and sustainable alternative to conventional farming practices.

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