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Trends in Digital Transformation Research in Agribusiness Based on International Publications from 2012 to 2025

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ABSTRACT

This study aims to map global research trends on digital transformation in agribusiness based on international publications indexed in Scopus during the period 2012–2025. Using a bibliometric approach and visual analysis through VOSviewer, this research examines publication growth, author and country collaboration networks, institutional linkages, and thematic evolution within the field. The results indicate a significant increase in scholarly output, reflecting growing academic and practical interest in the digitalization of agribusiness systems. Co-authorship and country collaboration analyses reveal strong regional hubs in Europe, Asia, and North America, with emerging participation from developing economies. Keyword co-occurrence and density visualizations identify digital transformation and agribusiness as the central intellectual pillars, closely linked with themes such as artificial intelligence, Internet of Things, precision agriculture, sustainability, food security, and digital economy. Overlay analysis demonstrates a temporal shift from foundational digital infrastructure and economic restructuring toward intelligent, AI-driven applications and smart agriculture systems. The study highlights the interdisciplinary consolidation of digital transformation research in agribusiness while identifying future research opportunities related to governance, digital capability development, inclusivity, and socio-economic impacts.

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1. INTRODUCTION

Digital transformation has become a defining pathway for agribusiness systems as they respond to climate risks, market volatility, food safety requirements, and rising expectations for transparency and sustainability [1], [2]. Across the agri-food chain, digital tools are increasingly used to improve decision-making, reduce waste, strengthen traceability, and connect producers to markets through faster information flows. This shift is not limited to on-farm technologies; it also encompasses processing, logistics, quality control, financing, and retail platforms, making "digital transformation" a value-chain phenomenon rather than a single technology adoption decision. Recent development-oriented agendas emphasize that data, digital innovation, and inclusive technology design can increase productivity while also supporting equity and resilience—especially

when digital systems are aligned with smallholder realities and institutional capacity [3], [4].

Within international research, the concept has expanded from "ICT in agriculture" and "e-agriculture" toward broader framings such as Agriculture 4.0, smart farming, and digitally enabled value chains. This evolution reflects the integration of IoT sensors, remote sensing, robotics, artificial intelligence, big data analytics, and blockchain-enabled traceability into agribusiness operations. In the literature, these technologies are often positioned as enablers of real-time monitoring, predictive analytics, precision input use, and logistics optimization [4], [5]. The cumulative effect is a shift from experience-based management toward data-driven agribusiness models where decisions, coordination, and verification become increasingly automated and measurable [6].

At the same time, researchers note that digital transformation is shaped by more than technological availability. The quality of digital infrastructure, interoperability of data systems, human capital, and governance arrangements influence whether digital solutions scale beyond pilots. For example, global development reports highlight how improving data collection and use can support yield gains, reduce transaction costs, and lower emissions—but also stress that benefits are uneven if farmers and small enterprises lack capabilities, connectivity, or bargaining power in data value chains. These concerns have made inclusion, data rights, and capacity building central to the debate on digital agribusiness transformation [7], [8].

The 2012–2025 period is particularly important because it captures multiple waves of research and policy attention: early mobile advisory and ICT4D initiatives; the acceleration of precision agriculture, drones, and satellite analytics; the mainstreaming of AI and platform-based agribusiness services; and the more recent emphasis on resilience, sustainability reporting, and supply-chain transparency. In practical terms, agri-food systems increasingly rely on digital market information, digital payments, e-procurement, platform logistics, and traceability systems—while research has also broadened to examine organizational change, adoption barriers, business model innovation, and the governance of digital ecosystems [6].

Given the rapid expansion and fragmentation of this scholarship, bibliometric analysis offers a systematic way to map the intellectual structure, collaboration patterns, and thematic trajectories of digital transformation in agribusiness. Bibliometric methods can reveal which countries, institutions, and authors shape the field; which keywords and clusters dominate across time; and where emerging topics (for example, AI-enabled supply chains, data governance, or digital inclusion) are forming new research fronts. By synthesizing patterns at scale, bibliometric mapping complements narrative reviews and helps scholars and practitioners identify gaps, underexplored regions, and promising future directions for globally relevant agribusiness research.

Despite growing international publications on digital transformation in agribusiness, the knowledge base remains dispersed across disciplines (agriculture, information systems, operations, development studies, and sustainability), making it difficult to identify the dominant themes, the evolution of research hotspots, and the structure of global collaboration over time. Moreover, the field often advances faster than shared conceptual clarity: studies may emphasize technologies (IoT, AI, blockchain) without consistently connecting them to agribusiness performance mechanisms, adoption conditions, and governance implications—especially for inclusive value chains and smallholder participation. As a result, a comprehensive bibliometric mapping of international publications from 2012–2025 is needed to clarify how the field has developed, where the evidence concentrates, and which research directions are most strategic for the next phase of agribusiness transformation. This study aims to analyze international research trends on digital transformation in agribusiness during 2012–2025 using a bibliometric approach.

2. METHOD

This study applies a quantitative bibliometric approach to map and analyze global research trends on digital transformation in agribusiness during the period 2012–2025. The bibliometric data were retrieved from the Scopus database, which was selected due to its broad international coverage, high indexing standards, and comprehensive metadata structure, including authors, affiliations, abstracts, keywords, citations, and references. The search strategy was developed using a combination of relevant keywords such as "digital transformation," "digitalization," "agribusiness," "agriculture 4.0," "smart farming," "precision agriculture," and related terms. Boolean operators (AND, OR) were applied to ensure comprehensive coverage while maintaining relevance. The search was limited to journal articles, conference papers, and reviews published in English between 2012 and 2025. After the initial extraction, the dataset was screened to remove duplicates and documents that were not directly related to agribusiness contexts.

The cleaned bibliographic data were exported from Scopus in CSV format and processed using VOSviewer as the primary analytical tool. VOSviewer was selected because of its capacity to construct and visualize bibliometric networks, including co-authorship, co-occurrence of keywords, citation analysis, co-citation analysis, and bibliographic coupling. The analysis was conducted in several stages. First, publication trends were examined to identify annual growth patterns. Second, co-authorship analysis was performed to map collaboration networks among authors, institutions, and countries. Third, keyword co-occurrence analysis was applied to detect dominant research themes and cluster structures. Minimum thresholds for the number of occurrences or citations were determined to ensure clarity and reduce noise in the network visualization.

To analyze thematic evolution and research dynamics, overlay visualization and density visualization features in VOSviewer were utilized. Overlay visualization enabled the identification of emerging and recent topics by assigning temporal colors to keywords based on their average publication year. Density visualization was used to highlight highly concentrated research areas within the field. The results were interpreted descriptively by examining cluster compositions, link strengths, and centrality patterns within the generated networks

3. RESULT AND DISCUSSION

Co-Authorship Analysis

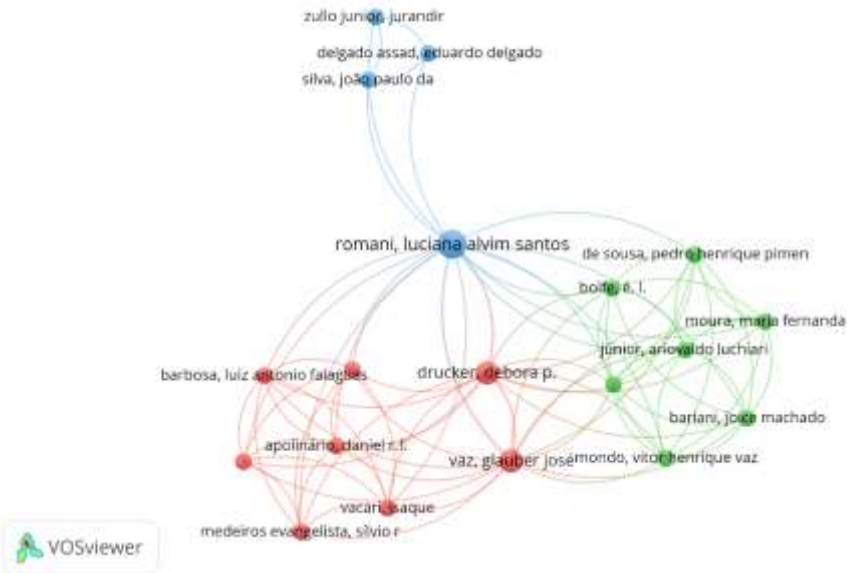

Figure 1. Author Visualization
Source: Data Analysis

Figure 1 reveals three main collaborative clusters in research on digital transformation in agribusiness during 2012–2025. The red cluster appears to be strongly interconnected internally, with authors such as Drucker, Debora P., Vaz, Glauber José, and Apolinário, Daniel R.F. forming a dense collaboration group, suggesting a stable research team or recurring co-authorship pattern. The green cluster represents another active collaboration network, linking authors like Junior, Ariovaldo Luchiari, Moura, Maria Fernanda, and Bariani, Joice Machado, indicating a cohesive research stream that likely focuses on complementary or related subthemes within digital agribusiness. Meanwhile, the blue cluster is smaller and more centralized around Romani, Luciana Alvim Santos, who acts as a bridging node connecting to authors in both other clusters. This positioning suggests that Romani plays a key integrative role in cross-group collaboration, potentially linking different thematic or institutional research lines.

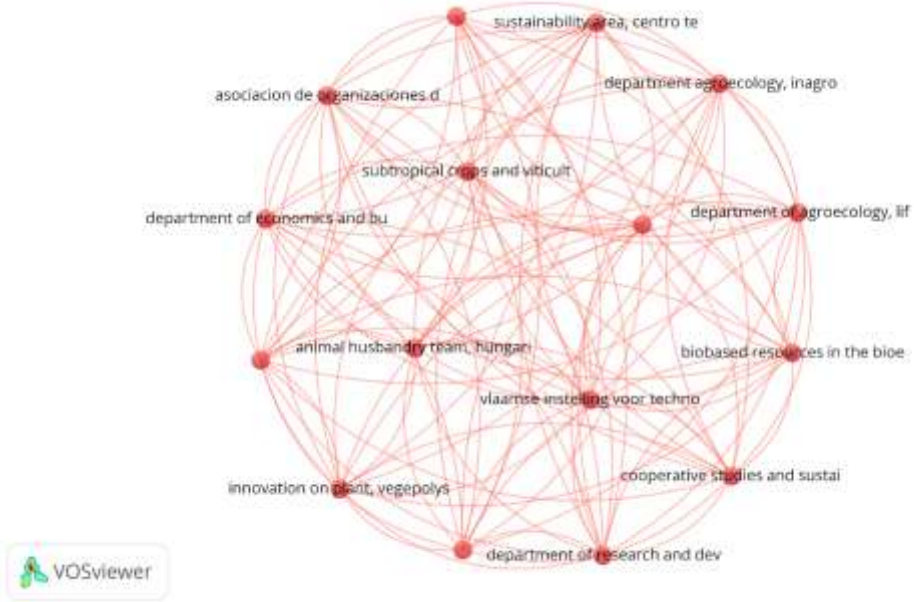

Figure 2. Institution Visualization
Source: data Analysis

Figure 2 shows a highly dense and interconnected structure, indicating strong cross-institutional partnerships in research on digital transformation in agribusiness. Most institutions—such as the Department of Agroecology (INAGRO and LIF), Sustainability Area Centro, Subtropical Crops and Viticulture, Animal Husbandry Team (Hungary), Biobased Resources in the Bioeconomy, and Department of Research and Development—are closely linked with multiple others, forming a tightly integrated collaboration core rather than fragmented subclusters. The absence of clearly separated color clusters suggests that collaboration is not confined to isolated regional or thematic groups but instead reflects multidirectional cooperation across disciplines such as agroecology, bioeconomy, plant innovation, economics, and sustainability studies. Institutions like the Department of Agroecology and Sustainability Area Centro appear centrally positioned, potentially acting as key hubs in the network. Overall, the map indicates a mature and well-connected research ecosystem where digital transformation in agribusiness is addressed through interdisciplinary and international collaboration.

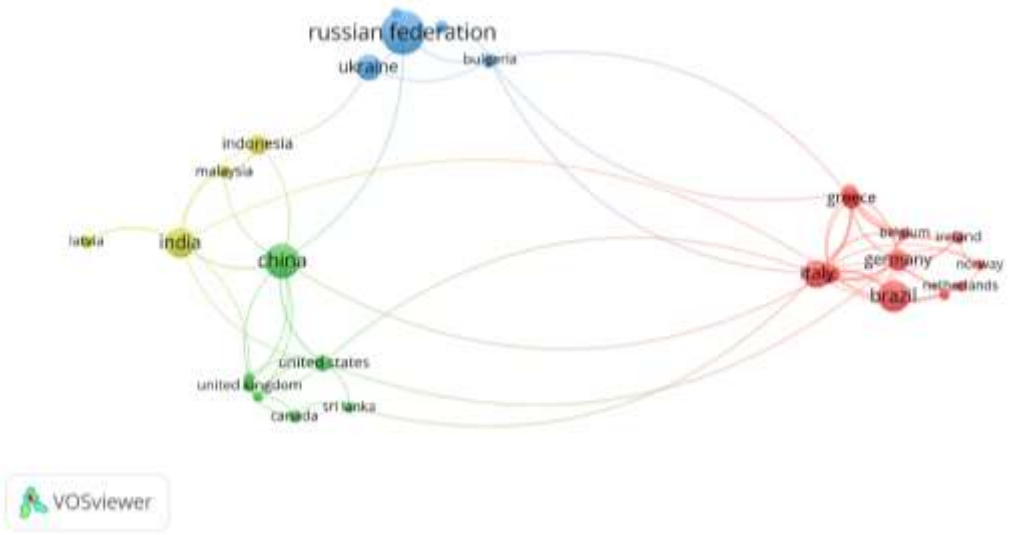

Figure 3. Country Visualization
Source: Data Analysis

Figure 3 illustrates four major regional clusters in digital transformation research within agribusiness during 2012–2025. The red cluster, centered around Italy, Germany, and Brazil, forms a tightly connected European–Latin research hub, with additional links to Greece, Belgium, Ireland, Norway, and the Netherlands, indicating strong intra-European collaboration and transatlantic partnerships. The green cluster highlights China and the United States as key actors, connected with the United Kingdom, Canada, and Sri Lanka, suggesting a significant Asia–North America collaboration axis. The yellow cluster, led by India and linked with Malaysia, Indonesia, and Latvia, reflects an emerging South and Southeast Asian research network. Meanwhile, the blue cluster centers on the Russian Federation, connected to Ukraine and Bulgaria, representing a distinct Eurasian collaboration group. Cross-cluster linkages—particularly between China, Italy, and the Russian Federation—indicate increasing global integration, although collaboration patterns still show regional concentration.

Citation Analysis

Table 1. Top Cited Literature

Citations	Authors and Year	Title
213	[9]	Who drives the digital revolution in agriculture? A review of supply-side trends, players and challenges
73	[10]	Digitalization and agricultural transformation in developing countries: Empirical evidence from Tanzania agriculture sector
67	[11]	Agritourism resilience against Covid-19: Impacts and management strategies
65	[12]	Dimensions of digital transformation in the context of modern agriculture
50	[13]	Competitiveness of Food Industry in the Era of Digital Transformation towards Agriculture 4.0
45	[14]	Analyzing agrifood-tech e-business models
39	[15]	How does digital transformation affect agricultural enterprises' pro-land behavior: The role of environmental protection cognition and cross-border search
31	[16]	Digital integration to enhance market efficiency and inclusion of smallholder farmers: A proposed model for fresh fruit and vegetable supply chain
29	[17]	Agro 4.0: Enabling agriculture digital transformation through IoT
28	[18]	The Brazilian beef cattle supply chain in the next decades

Source: Scopus Database

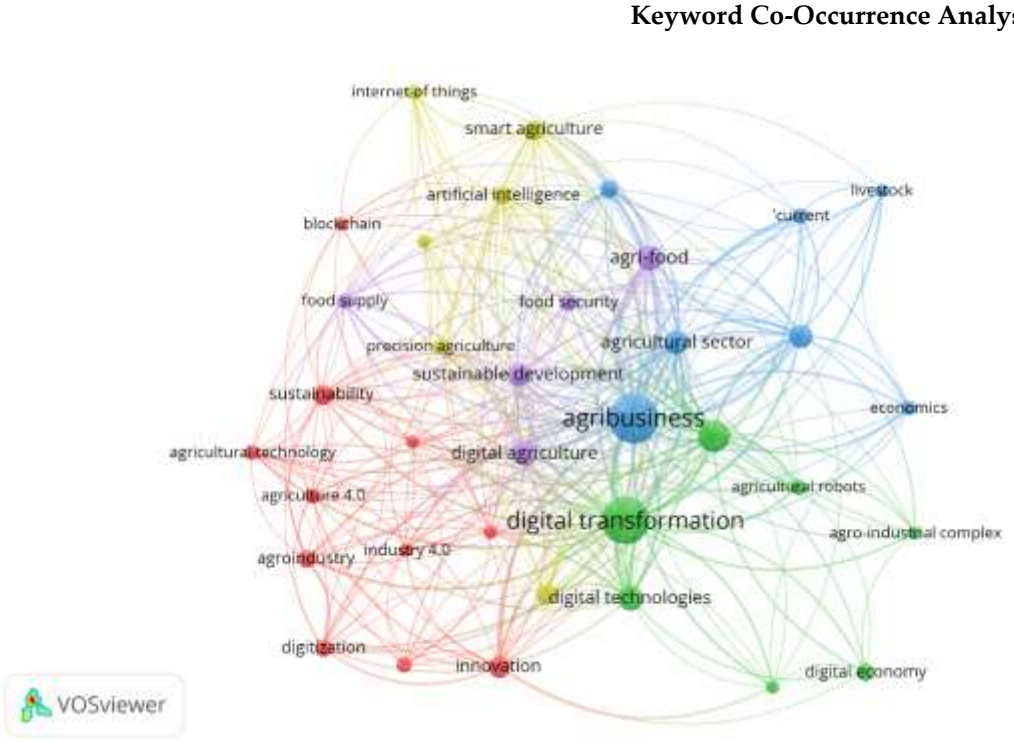

Figure 4. Network Visualization
Source: Data Analysis

Figure 4 reveals that agribusiness and digital transformation function as the central pillars of research on digital transformation in agribusiness during 2012–2025. These two terms appear as the largest and most connected nodes, indicating their dominant role in structuring the intellectual landscape. Their strong links with related keywords such as digital technologies, agricultural sector, and digital agriculture suggest that the field is primarily framed around systemic technological integration within agribusiness ecosystems rather than isolated technological applications. The green cluster highlights the economic and structural dimension of digital transformation. Keywords such as digital economy, agro-industrial complex, agricultural robots, and economics indicate that research increasingly situates agribusiness digitalization within broader economic transformation and industrial modernization frameworks. This cluster suggests that scholars are examining how automation, robotics, and digital platforms reshape productivity, competitiveness, and value chains at both firm and sectoral levels.

The red cluster reflects a strong technological–innovation orientation. Terms such as agriculture 4.0, agricultural technology, industry 4.0, innovation, digitization, and sustainability emphasize the transition toward smart, technology-driven agricultural systems. The presence of agroindustry and agricultural technology indicates integration between primary production and processing industries. This cluster underscores the narrative that digital transformation in agribusiness is closely aligned with the broader Industry 4.0 paradigm and sustainable modernization efforts. The yellow cluster focuses on emerging enabling technologies, particularly Internet of Things, artificial intelligence, and smart agriculture. These keywords are strongly connected with precision agriculture and food security, signaling that research is increasingly concerned with data-driven decision-making to improve productivity and resilience. The inclusion of blockchain and food supply also suggests growing interest in traceability, transparency, and trust within agri-food supply chains, especially in the context of global food systems. The blue

cluster emphasizes sector-specific and thematic applications, including livestock, agri-food, agricultural sector, and current research streams. This indicates that digital transformation is not limited to crop production but extends to animal husbandry and broader agri-food systems.

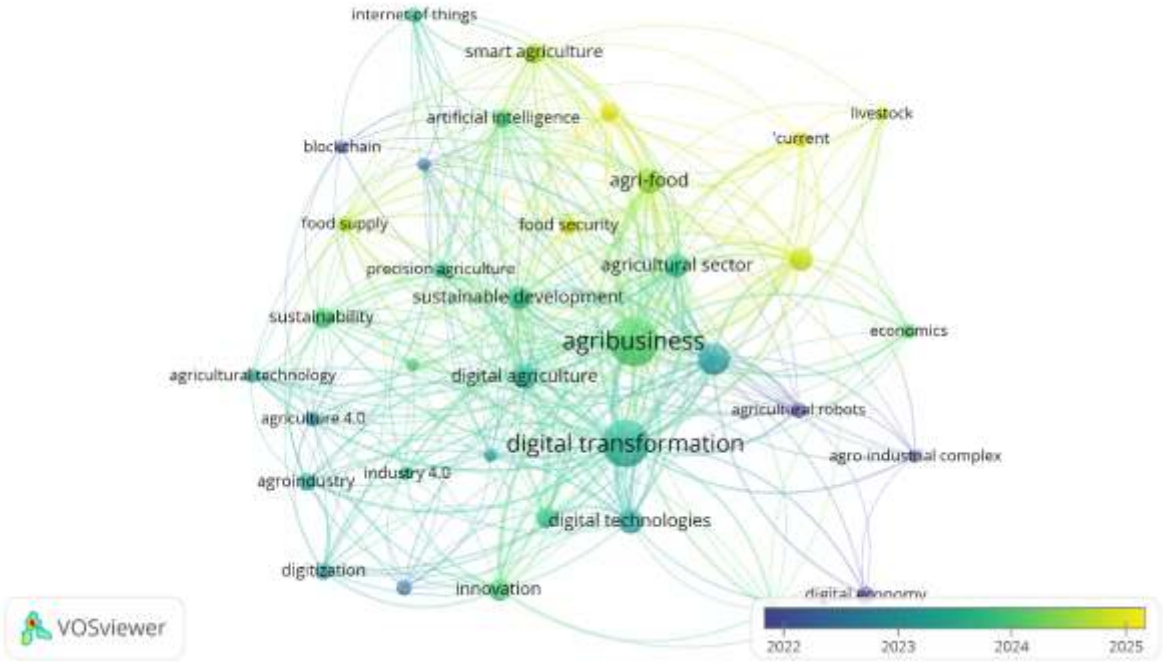

Figure 5. Overlay Visualization
Source: Data Analysis

Figure 5 highlights the temporal evolution of research themes in digital transformation within agribusiness from 2012 to 2025. Earlier research phases, represented by darker blue tones (around 2022), are associated with keywords such as digital economy, blockchain, and parts of the agro-industrial complex, indicating that initial studies focused more on macro-level digital infrastructure, traceability systems, and economic restructuring. These early themes emphasize foundational digitalization processes and systemic integration within agribusiness supply chains. As the field progressed toward 2023–2024 (green tones), research became more centered on digital transformation, agribusiness, digital technologies, and sustainable development. This suggests a conceptual consolidation phase in which scholars began framing digitalization not merely as technological adoption but as a broader transformation of agribusiness models, sustainability practices, and value creation mechanisms. The increasing density around these central terms indicates growing theoretical maturity and interdisciplinary integration across economic, technological, and environmental dimensions. More recent themes (yellow tones, 2024–2025) show an emerging focus on smart agriculture, artificial intelligence, agricultural sector, livestock, and current research directions. This shift reflects a move toward application-oriented and data-driven innovations, particularly AI-enabled decision systems, IoT-based monitoring, and precision livestock management.

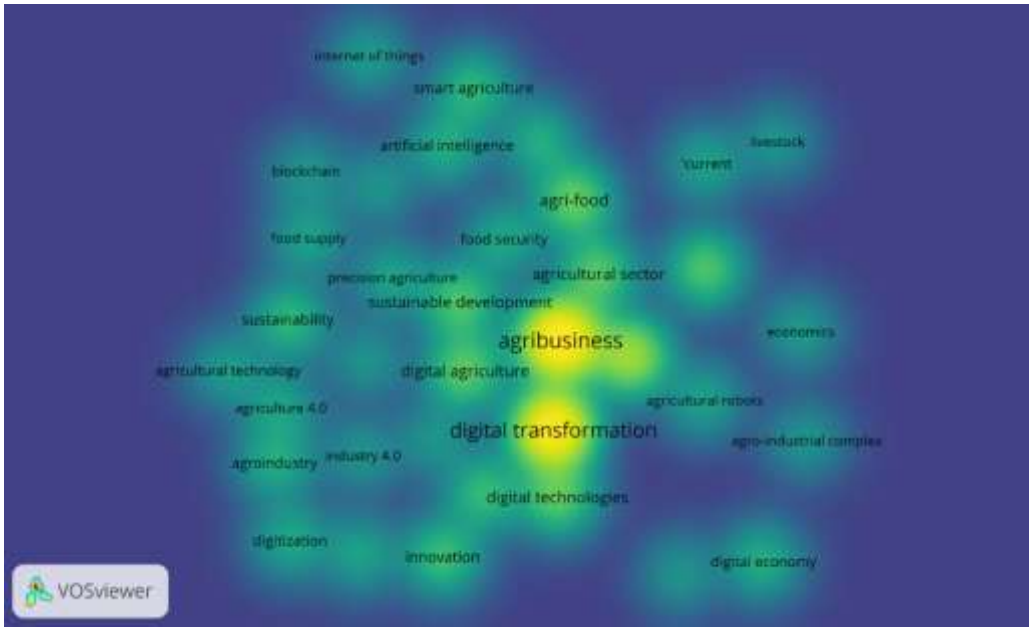

Figure 6. Density Visualization
Source: Data Analysis

Figure 6 highlights digital transformation and agribusiness as the most prominent and frequently occurring themes in the research landscape, shown by the bright yellow concentration at the center of the map. These two keywords form the intellectual core of the field, strongly connected with related concepts such as digital technologies, digital agriculture, agricultural sector, and sustainable development. The high-density area indicates that much of the literature converges on understanding how digital technologies are reshaping agribusiness systems, integrating innovation, sustainability, and sectoral modernization into a unified research focus. Surrounding this central hotspot are moderately dense themes such as agri-food, food security, smart agriculture, artificial intelligence, precision agriculture, and agricultural robots, reflecting expanding interest in application-oriented and technology-driven solutions. Lower-density areas, including blockchain, digital economy, and agro-industrial complex, suggest more specialized or emerging subtopics that support the broader transformation narrative.

Discussion

The findings of this bibliometric analysis reveal that research on digital transformation in agribusiness has experienced significant conceptual consolidation and thematic expansion between 2012 and 2025. The steady growth in publications and the increasing density of keyword networks indicate that digital transformation is no longer treated as a peripheral technological issue but as a central paradigm shaping agribusiness systems. The dominance of keywords such as digital transformation, agribusiness, and digital technologies confirms that the literature has moved beyond isolated studies on automation or ICT adoption toward a broader systemic understanding of structural change in agricultural value chains.

The co-authorship and country collaboration networks further demonstrate that research in this field is globally distributed but regionally clustered. European countries, particularly Italy and Germany, appear as strong collaborative hubs, while China and the United States form another major axis of cooperation. Emerging participation from India, Southeast Asia, and parts of Eastern Europe suggests a gradual globalization of the research agenda. However, the regional clustering pattern also indicates that collaboration remains partially concentrated within geographic or institutional blocs. This implies that while digital transformation in agribusiness is a global concern, knowledge production is still

shaped by regional research ecosystems and funding structures.

The keyword co-occurrence and density analyses highlight the multidimensional character of the field. Technological themes such as artificial intelligence, Internet of Things, precision agriculture, and agricultural robots are strongly interconnected with sustainability-related concepts including food security and sustainable development. This convergence suggests that digital transformation is increasingly framed as a solution to productivity challenges and environmental pressures simultaneously. Rather than focusing solely on efficiency gains, contemporary research integrates digital tools with broader sustainability objectives, reflecting the alignment between Agriculture 4.0 and global development agendas.

The overlay visualization provides insight into the temporal evolution of the field. Earlier studies emphasized foundational digital infrastructure and economic restructuring, including blockchain applications and digital economy frameworks. Over time, the focus shifted toward systemic transformation, and more recently toward intelligent, AI-driven applications in smart agriculture and livestock management. This evolution indicates a transition from exploratory adoption to advanced implementation and optimization. The research frontier now appears to prioritize real-time analytics, integrated platforms, and decision-support systems, signaling a move toward highly data-centric agribusiness ecosystems.

Despite these advances, the network structure suggests several research gaps. First, although technological themes are well developed, fewer studies appear to focus on governance, digital capability development, organizational readiness, and inclusivity for small and medium agribusiness actors. Second, cross-country collaboration, while growing, could be strengthened to ensure knowledge transfer between technologically advanced and emerging agrarian economies. Third, socio-economic impacts such as employment transformation, digital inequality, and rural institutional adaptation remain underexplored relative to technological innovation themes.

4. CONCLUSION

This bibliometric study concludes that research on digital transformation in agribusiness during 2012–2025 has evolved into a well-structured and increasingly interdisciplinary field, with digital transformation and agribusiness serving as its intellectual core. The findings reveal strong growth in global collaboration, particularly across Europe, Asia, and North America, alongside expanding thematic integration between advanced technologies—such as artificial intelligence, IoT, precision agriculture, and robotics—and sustainability-oriented goals including food security and sustainable development. The temporal analysis shows a clear shift from foundational digitalization concepts toward intelligent, data-driven, and application-focused innovations. The field demonstrates conceptual maturity and technological depth; however, future research should place greater emphasis on governance, digital capability development, inclusive adoption, and socio-economic impacts to ensure that digital transformation in agribusiness supports resilient and sustainable agricultural systems globally.

REFERENCES

[1] B. Setiawan and F. Faizal, "Sistem Pemasaran Berkelanjutan Pada Bumdes di Kota Batu," *J. Ekon. Pertan. dan Agribisnis*, vol. 8, no. 2, pp. 438–450, 2024.

[2] D. Chalil and R. Barus, "The sustainability of Indonesia Pakistan palm oil supply chain," *J. Manaj. Agribisnis*, vol. 15, no. 2, p. 136, 2018.

[3] P. M. Kusnaedi, C. A. Hartono, S. Kamilah, and E. Ernah, "Etika Permaculture Sebagai Solusi Ilmiah Untuk Keberlanjutan Lingkungan dan Ekonomi yang Meredakan Kecemasan Petani Organik," *Mimb. Agribisnis J. Pemikir. Masy. Ilm. Berwawasan Agribisnis*, vol. 10, no. 1, pp. 789–796, 2024.

[4] S. Sartono, M. Zalviwan, D. Octaviani, A. Hendharsa, A. Afif, and S. Sugiardi, "DEVELOPMENT

POLICIES OF THE MICRO, SMALL, AND MEDIUM ENTERPRISES (SMEs) FOR IMPROVING REGIONAL COMPETITIVENESS," *J. AGRISEP Kaji. Masal. Sos. Ekon. Pertan. dan Agribisnis*, pp. 111–128, 2024.

[5] J. Jaya, Z. Zulkifli, and N. Nurhapsa, "Prospek dan Strategi Pengembangan Jagung (Zea Mays L) Berbasis Agribisnis di Kota Parepare," *J. Galung Trop.*, vol. 9, no. 1, pp. 87–94, 2020.

[6] S. U. BASIROH, "Analisis Sistem Agribisnis Kencur di Kecamatan Seputih Agung Kabupaten Lampung Tengah," 2017.

[7] S. H. Nina Nurani, *Daya Saing Agribisnis: Aspek Hukum dan Strategi Pengembangan*. Nuansa Cendekia, 2023.

[8] S. Sinniati, Y. Yusriadi, and A. Arman, "STRATEGI PENGEMBANGAN AGRIBISNIS JAGUNG DI DESA RAJANG KECAMATAN LEMBANG KABUPATEN PINRANG," in *Prosiding Seminar Nasional Politeknik Pertanian Negeri Pangkajene Kepulauan*, 2021, pp. 418–438.

[9] R. Birner, T. Daum, and C. Pray, "Who drives the digital revolution in agriculture? A review of supply-side trends, players and challenges," *Appl. Econ. Perspect. policy*, vol. 43, no. 4, pp. 1260–1285, 2021.

[10] F. A. Kitole, E. Mkuna, and J. K. Sesabo, "Digitalization and agricultural transformation in developing countries: Empirical evidence from Tanzania agriculture sector," *Smart Agric. Technol.*, vol. 7, p. 100379, 2024.

[11] W. L. Chin and S. F. Pehin Dato Musa, "Agritourism resilience against Covid-19: Impacts and management strategies," *Cogent Soc. Sci.*, vol. 7, no. 1, p. 1950290, 2021.

[12] J. A. J. Mendes, N. G. P. Carvalho, M. N. Mourarias, C. B. Careta, V. G. Zuin, and M. C. Gerolamo, "Dimensions of digital transformation in the context of modern agriculture," *Sustain. Prod. Consum.*, vol. 34, pp. 613–637, 2022.

[13] I. C. Baierle *et al.*, "Competitiveness of food industry in the era of digital transformation towards agriculture 4.0," *Sustainability*, vol. 14, no. 18, p. 11779, 2022.

[14] M. Vlachopoulou, C. Ziakis, K. Vergidis, and M. Madas, "Analyzing agrifood-tech e-business models," *Sustainability*, vol. 13, no. 10, p. 5516, 2021.

[15] Y. Xie, Z. Chen, F. Boadu, and H. Tang, "How does digital transformation affect agricultural enterprises' pro-land behavior: The role of environmental protection cognition and cross-border search," *Technol. Soc.*, vol. 70, p. 101991, 2022.

[16] S. Nedumaran, A. Selvaraj, R. Nandi, B. Suchiradipta, P. Jyosthnaa, and D. Bose, "Digital integration to enhance market efficiency and inclusion of smallholder farmers: a proposed model for fresh fruit and vegetable supply chain," *Int. Food Agribus. Manag. Rev.*, vol. 23, no. 3, pp. 319–338, 2020.

[17] G. C. Lima, F. L. Figueiredo, A. E. Barbieri, and J. Seki, "Agro 4.0: Enabling agriculture digital transformation through IoT," *Rev. Ciência Agronômica*, vol. 51, p. e20207771, 2020.

[18] G. C. Malafaia, G. de Vargas Mores, Y. G. Casagranda, J. O. J. Barcellos, and F. P. Costa, "The Brazilian beef cattle supply chain in the next decades," *Livest. Sci.*, vol. 253, p. 104704, 2021.