

BIBLIOMETRIC ANALYSIS OF RESEARCH HOTSPOTS AND TRENDS IN THE TRANSFORMATION AND DEVELOPMENT OF AGRICULTURAL ENTERPRISES

Zhu Lin¹, Alina Brychko²

¹ PhD student, Sumy National Agrarian University, 160, Herasyima Kondratiieva str., Sumy, Ukraine, E-mail address: 1379580020@qq.com

² Assoc. Prof., Sumy National Agrarian University, 160, Herasyima Kondratiieva str., Sumy, Ukraine, E-mail address: alinkabrychko@gmail.com

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Abstract

As a pivotal subject within the realm of agriculture, the transformation of agricultural enterprises has been progressively capturing extensive attention from scholars and decision-makers alike. In order to understand the research hotspots and trends in the field of agricultural enterprise transformation, a comprehensive analysis was conducted employing Citespace software, utilizing the Web of Science Core Collection as the primary data source. This multidimensional investigation encompassed diverse aspects such as publishing countries, research institutions, publishing journals, subject categories, most cited journals, most cited papers, keyword co-occurrence, keyword clustering, and keyword burst. The synthesis of these analyses yielded a comprehensive overview of research hotspots and developmental trends in the field of agricultural enterprise transformation and development. The findings indicate an ascending trend in the annual paper publications within the agricultural enterprise transformation and development field. The countries contributing most significantly to publications include the People's Republic of China, the United States, Italy, Spain, and Australia. Notably, the journal "Sustainability" featured the highest publications. Keywords with substantial frequency of occurrence encompass "Innovation", "Performance", "Impact", "Management" and "Sustainability". The identified research hotspots could be synthesized into two main thematic categories: "Sustainable Development and Innovation" and "Agricultural Innovation Development and Policy". Foreseeably, the forthcoming trajectory of research within agricultural enterprise transformation and development is likely to focus on sustainable development and innovation management of agricultural enterprises.

Keywords: agricultural enterprise, transformation, sustainable development, CitesPace, research hotspots, research trends, innovative management.

JEL Codes: O30.

Introduction

Agriculture serves as the cornerstone of human sustenance and advancement. Agricultural enterprises assume a crucial role across various facets of agricultural activities, representing organized entities engaged in agricultural production, processing, sales, and related services. These enterprises hold significant implications for ensuring food security, driving rural revitalization, and promoting sustainable development. In the backdrop of rapid global socioeconomic progress and escalating environmental concerns, agricultural enterprises are confronted with an array of challenges and imperatives for change.

Conventional agricultural production models confront scarcities in resources, environmental contamination, and structural industrial adjustments, compelling agricultural enterprises to continually seek innovation and transformation to align with the novel demands of the socioeconomic landscape. Simultaneously, heightened expectations have arisen pertaining to food safety, ecological preservation, and the advancement of rural communities. Within this context, research on hot hotspots and trends in the transformation and development of agricultural enterprises is of great significance for guiding policy formulation and promoting sustainable agricultural development.

The main purpose of this work is to conduct a comprehensive exploration of the hotspot issues, predominant research fields, and developmental trajectories within the purview of agricultural enterprise transformation and development research. This endeavor seeks to furnish novel insights and reference points for the sustainable advancement of agricultural enterprises. To accomplish this objective, a bibliometric analysis employing the widely-utilized Citespace software was employed to investigate a corpus of 429 papers from the Web of Science (Wos) database (Biancone et al. (2022); Pasko et al. (2021)). A comprehensive analysis was conducted on the research hotspots and trends within the field of agricultural enterprise transformation and development from the perspectives of publishing countries, research institutions, publishing journals, subject categories, most cited journals, most cited papers, keyword co-occurrence, keyword clustering, and keyword burst. The findings of this research can offer valuable reference for the transformational development and decision-making processes within agricultural enterprises.

Literature review

At present, a multitude of scholars have engaged in research pertaining to the transformation of agricultural enterprises. Ludwig et al. (2022) conducted an investigation into the transformation and innovative development of German food start-ups, offering practicable recommendations therein. Su and Wang (2021) harnessed big data within the purview of agricultural transformation research, analyzing the principal determinants and fluctuations in egg prices, thereby furnishing a foundation for innovative economic management within enterprises. He et al. (2021) adopting a technological transformation perspective, probed the evaluative indicator system and influencing factors underlying the green efficiency of agricultural innovation within the People's Republic of China. Their study further encompassed an analysis of the evolutionary patterns of green benefits derived

from agricultural innovation. Zhang et al. (2020), employing genetic algorithms, undertook a study on innovative development and capability evolution within agricultural machinery manufacturing enterprises, scrutinizing energy consumption during production processes and delving into measures promoting the sustainable development of such enterprises. From the vantage point of agricultural division of labor and cooperation, Liu et al. (2019) delved into the repercussions of transitioning agricultural production modes on production efficiency. Their research revealed that optimizing production methods holds affirmative potential for enhancing production efficiency. While extensive research has been conducted on the transformation and development of agricultural enterprises, the majority of these endeavors have predominantly fixated upon specific regions or particular typologies of agricultural enterprises, thereby manifesting a dearth in comprehensive and holistic analyses. Especially under the background that digitalization and technological innovation are increasingly integrated into the production of agricultural enterprises, the application of emerging technologies, changes in market demand, and the influence of social and economic factors will all undergo rapid changes. Therefore, the research trends on the transformation and development of agricultural enterprises still needs to summarize further.

Data Sources and Research Methods

The data for this study were sourced from the WoS Core Collection. The search criteria were based on subject terms, with the search strategy formulated as follows: (agricultural enterprise OR agro-industrial enterprise OR agribusiness enterprise) AND (innovation transformation OR innovation development OR transformation and development). The scope of the literature search was from January 2010 to December 2022. A total of 429 papers were obtained according to the retrieval criteria.

The retrieved dataset was subjected to quantitative and visual analysis using the

Citespace software developed by Chaomei Chen (Chen (2004); Chen (2006)). The Citespace software was developed using the Java language based on co-citation analysis theory and path-finding network algorithm. It is capable of effectively analyzing the cutting-edge research focal points and the evolution trends of subjects, finding widespread application in bibliometric analyses across various fields (Chen et al. (2015); Shi & Tong (2018)).

Results and Discussion

The annual paper publications can represent the development process of a research field. The annual paper publication status of 429 articles in the field of agricultural enterprise transformation and development was sorted out, as shown in Figure 1.

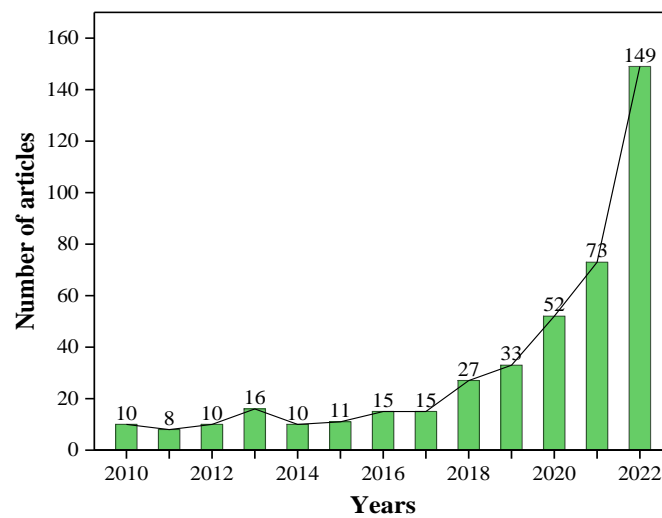


Figure 1. Annual paper publications in the field of transformation and development of agricultural enterprise

As depicted in Figure 1, the earliest research endeavors related to agricultural enterprise transformation and development within the WoS database originated in the year 2010, followed by a continuous expansion of the scope of investigation. Overall, the annual paper publication within the field of agricultural enterprise transformation and development can be divided into two stages. The period from 2010 to 2017 signifies a stage of stable development, during which the fluctuation in annual paper publication remains relatively modest. The minimum annual paper publication occurred in 2011, comprising 8 papers, whereas the maximum was observed in 2013, totaling 16 papers. The interval from 2018 to 2022 represents a stage of rapid development. Within this period, the annual paper publication exhibits a steep ascendant trajectory. By the year 2022, the

annual paper publication culminates at 149 papers. Research during the stage of stable development predominantly centered on agricultural industrial and enterprise transformation. With the widespread integration of technologies such as the Internet of Things, big data, and artificial intelligence into agricultural enterprises, a surge of interest from researchers materialized in the fields of technological innovation and digital transformation, yielding a surge in research output. Moreover, in 2015, the United Nations, comprising 193 member states, officially ratified 17 Sustainable Development Goals during the Sustainable Development Summit. The transformation and development of agricultural enterprises share a profound nexus with these sustainability objectives, thereby diversifying researchers' investigative directions

and consequently further augmenting the number of publications.

The field of agricultural enterprise transformation and development encompasses contributions from 85 countries, with information concerning the top 10 countries in terms of published paper quantity being collated, as presented in Table 1. From Table 1, it is evident that the People's Republic of China has made the highest number of paper publications, amounting to 119 papers, constituting 27.74 % of the total publication count. The United States has contributed 49 papers, securing the second position in terms of paper publications, while Italy has

contributed 45 papers, securing the third position. The cumulative paper count from the top 10 countries amounts to 387, accounting for 90.21% of the overall publication count. Upon examining the year of first publication, it becomes apparent that the United States, Australia, and the Netherlands demonstrated an earlier onset of research contributions, indicating their early engagement within the agricultural enterprise transformation and development field. Additionally, Ukraine contributed 5 papers, ranking 28 th among the 85 countries, with the inaugural paper publication recorded in 2019.

Table 1. Top 10 countries with the highest number of publications

Ranking	Country	Number of papers	Year of first publication	Proportion
1	The People's Republic of China	119	2013	27.74%
2	The United States	49	2010	11.42%
3	Italy	45	2011	10.49%
4	Spain	36	2011	8.39%
5	Australia	28	2010	6.53%
6	England	27	2013	6.29%
7	Germany	26	2011	6.06%
8	Netherlands	24	2010	5.59%
9	Brazil	18	2012	4.20%
10	India	15	2012	3.50%

The collaborative network map of papers in the field of agricultural enterprise transformation and development across different countries is depicted in Figure 2. From Figure 2, it is evident that substantial international collaboration exists among various countries in the field of agricultural enterprise transformation and development. Notably, countries such as the United States, the Netherlands, and Spain exhibit considerable levels of collaborative paper

production. The United States collaborates with 34 countries, including Germany, Australia, and Canada, while Ukraine engages in collaborations with 10 countries, including the People's Republic of China, Poland, and Switzerland, within the agricultural enterprise transformation and development field. The close cooperation among nations significantly augments the research endeavors and scholarly exchange within the field of agricultural enterprise transformation and development.



Figure 2. Collaborative network map of papers across different countries

The data of the top 10 research institutions with the highest number of published papers was compiled, as presented in Table 2. It is evident that Wageningen University in the Netherlands and Michigan State University in the United States have published more papers in the field of agricultural enterprise transformation and development. Wageningen University holds the distinction of being the earliest contributor of research papers in this field. While the

People's Republic of China has the highest overall paper publication count, it has comparatively entered the agricultural enterprise transformation and development field at a later stage. Zhejiang University, for instance, initiated its paper contributions in this field in 2017. Notably, both the Netherlands and the People's Republic of China have two research institutions each among the top 10 in terms of paper publications.

Table 2. Top 10 research institutions with the highest number of publications

Ranking	Research institution	Number of papers	Year of first publication	Proportion
1	Wageningen University	9	2010	2.10%
2	Michigan State University	9	2012	2.10%
3	Sichuan Agricultural University	7	2022	1.63%
4	Universidad Politécnica de Madrid	6	2013	1.40%
5	University of Tehran	6	2015	1.40%
6	Wageningen University & Research	6	2020	1.40%
7	University of Ghent	5	2015	1.17%
8	University of Zaragoza	4	2011	0.93%
9	International Food Policy Research Institute	4	2012	0.93%
10	Zhejiang University	4	2017	0.93%

The collaborative network map of major research institutions was created and is depicted in Figure 3. In Figure 3, larger nodes correspond to higher paper publications, while a greater number of connecting lines between nodes indicates a higher degree of collaborative interactions among research

institutions. From Figure 3, it is observable that Michigan State University has been extensively engaged in collaborations within the field of agricultural enterprise transformation and development, and other research institutions have also undertaken significant collaborative endeavors.

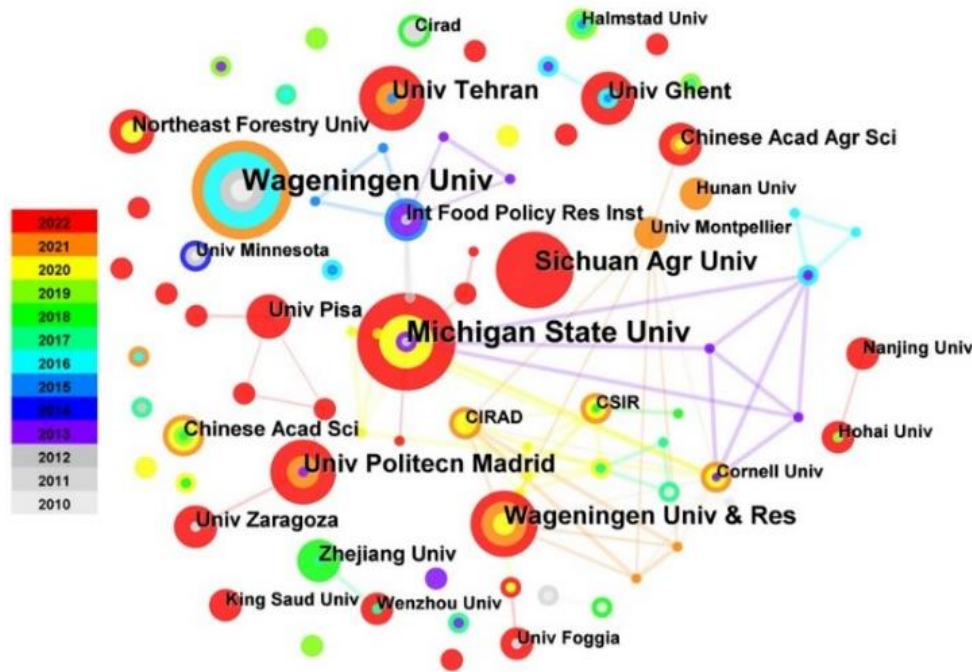


Figure 3. Collaborative network map of major research institutions

The publication of papers within the field of agricultural enterprise transformation and development is distributed across 136 journals. The top 10 journals in terms of paper publication quantity are presented in Table 3. Sustainability leads with a publication of 85 papers, securing the first position. British Food Journal and Agriculture Basel respectively hold the second and third positions, with publication quantities of 34 and 15 papers. By employing Bradford's Law, the publication quantity of core journals can be calculated using the formula: $C_n = 2\ln(e^E \times M)$, where C_n denotes the number of papers in core

journals, E represents the Euler's constant with a value of 0.5772, and M signifies the paper quantity of the most prolific journal (Li & Su (2022); Bradford (1934)). Calculation yields a value of $C_n \approx 10$, signifying that journals publishing more than 10 papers fall under the category of core journals within the agricultural enterprise transformation and development field. Consequently, the top 6 ranked journals are identified as core journals, playing a pivotal role in advancing research pertaining to agricultural enterprise transformation and development.

Table 3. Top 10 journals with the highest number of publications

Ranking	Journal name	Number of articles
1	Sustainability	85
2	British Food Journal	34
3	Agriculture Basel	15
4	Agricultural Systems	10
5	International Food and Agribusiness Management Review	10
6	Journal of Cleaner Production	10
7	Agricultural Economics Zemedelska Ekonomika	9
8	China Agricultural Economic Review	8
9	International Journal of Environmental Research and Public Health	8
10	Agribusiness	7

To understand the focal subject orientations within the field of agricultural enterprise transformation and development, the top 10 subject categories were tabulated, as illustrated in Table 4. A total of 151 papers were associated with Environmental Sciences, constituting the highest proportion at 35.20%. 117 papers were linked to Green & Sustainable Science & Technology, accounting for 27.27% and securing the second position. Papers related to Agricultural

Economics & Policy numbered 103, comprising 24.01% and ranking third. Consequently, it becomes evident that the current research emphasis on agricultural enterprise transformation and development primarily centers on environmental science, sustainable development, and agricultural economics and policy fields. Simultaneously, heightened research interest is observed within the fields of agriculture, economics, and food science and technology.

Table 4. Top 10 journals with the highest number of publications

Ranking	Category	Count	Proportion
1	Environmental Sciences	151	35.20%
2	Green & Sustainable Science & Technology	117	27.27%
3	Agricultural Economics & Policy	103	24.01%
4	Environmental Studies	99	23.08%
5	Agriculture, Multidisciplinary	58	13.52%
6	Economics	58	13.52%
7	Food Science & Technology	56	13.05%
8	Agronomy	39	9.09%
9	Multidisciplinary Sciences	15	3.50%
10	Engineering, Environmental	13	3.03%

The data from the top 10 most cited journals (citation data among the 429 papers) were counted and presented in Table 5. From Table 5, it is apparent that Sustainability ranks first with 168 citations, followed by Journal of Cleaner Production with 131 citations in the

second position, and Research Policy with 102 citations in the third. This attests to the substantial influence and recognition these journals hold within the research field of agricultural enterprise transformation and development.

Table 5. Top 10 most cited journals

Ranking	Journal	Citation counts	Year of first publication
1	Sustainability	168	2015
2	Journal of Cleaner Production	131	2017
3	Research Policy	102	2011
4	Journal of Rural Studies	101	2010
5	Food Policy	96	2010
6	World Development	89	2010
7	Agricultural Systems	81	2011
8	Land Use Policy	77	2016
9	Technological Forecasting and Social Change	76	2010
10	Journal of Business Research	75	2012

Based on the statistical results from the WoS database, the fundamental details of the top 10 most cited papers were extracted, as presented in Table 6. The paper titled “Adaptive management in agricultural

innovation systems: The interactions between innovation networks and their environment,” authored by Klerkx Laurens, boasts the highest citation count, totaling 449 citations (as of August 10, 2023).

Table 6. Top 10 most cited papers

Ranking	Title	First author (Year)	Journal	Doi	Cited in Wos
1	Adaptive management in agricultural innovation systems: The interactions between innovation networks and their environment	Klerkx Laurens (2010)	Agricultural Systems	10.1016/j.agsy.2010.03.012	449
2	Supermarket revolution in Asia and emerging development strategies to include small farmers	Reardon Thomas (2012)	Proceedings of The National Academy of Sciences of the United States of America	10.1073/pnas.1003160108	195
3	Does command-and-control regulation promote green innovation performance? Evidence from China's industrial enterprises	Tang Kai (2020)	Science of the Total Environment	10.1016/j.scitoten.v.2019.136362	178
4	Cooperative membership and dairy performance among smallholders in Ethiopia	Chagwiza Clarietta (2016)	Food Policy	10.1016/j.foodpol.2016.01.008	135
5	Revolution 4.0: Industry vs. Agriculture in a Future Development for SMEs	Zambon Ilaria (2019)	Processes	10.3390/pr7010036	134
6	Unlocking challenges and opportunities presented by COVID-19 pandemic for cross-cutting disruption in agri-food and green deal innovations: Quo Vadis?	Rowan Neil J. (2020)	Science of the Total Environment	10.1016/j.scitoten.v.2020.141362	130
7	Enhancing the Multifunctionality of US Agriculture	Jordan Nicholas (2010)	Bioscience	10.1525/bio.2010.60.1.10	97
8	Green process innovation, green product innovation and its economic performance improvement paths: A survey and structural model	Wang, Mingyue (2021)	Journal of Environmental Management	10.1016/j.jenvma.n.2021.113282	96
9	Transforming agriculture in China: From solely high yield to both high yield and high resource use efficiency	Shen Jianbo (2013)	Global Food Security- Agriculture Policy Economics and Environment	10.1016/j.gfs.2012.12.004	84
10	Exploring future changes in smallholder farming systems by linking socio-economic scenarios with regional and household models	Herrero Mario (2014)	Global Environmental Change-Human and Policy Dimensions	10.1016/j.gloenvc.ha.2013.12.008	82

Keywords are terms used to describe and encapsulate the content and themes of a paper. The frequency of keyword occurrence can help identify research focal points. A keyword co-occurrence network map for the field of agricultural enterprise transformation and development was generated using Citespace software, as depicted in Figure 4. The size of nodes represents the frequency of occurrence for specific keywords. From Figure 4, it is evident that keywords such as “Innovation” (68 occurrences), “Performance” (53 occurrences), “Impact” (48 occurrences), “Management” (43 occurrences), and “Sustainability” (38 occurrences) exhibit higher frequencies. This indicates that research hotspots in agricultural enterprise transformation and development

encompass areas such as innovation and technological applications, performance and impact assessment, management, and sustainable development. Additionally, keywords such as “System” (33 occurrences), “Determinant” (27 occurrences), “Knowledge” (25 occurrences), “Adoption” (23 occurrences), and “Framework” (23 occurrences) also exhibit substantial frequency. This suggests researchers' heightened interest in aspects related to institutional and policy dimensions, determinants and influences, theoretical frameworks and models within the context of agricultural enterprise transformation. Furthermore, topics such as technology research and development, climate change, supply chain, and food are also of notable interest to researchers.

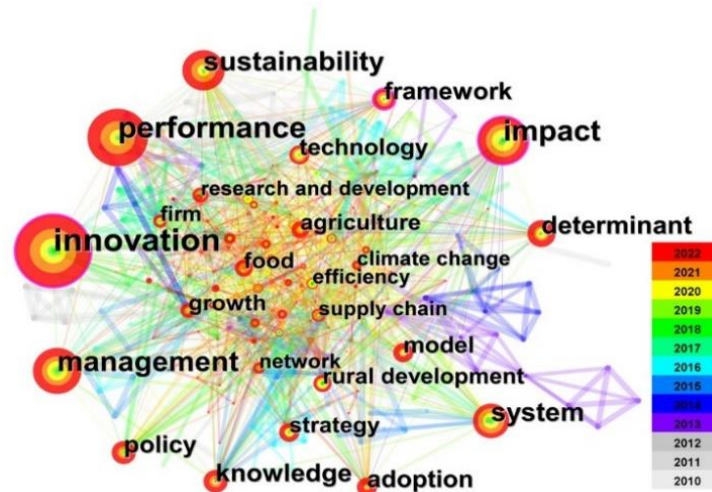


Figure 4. Keyword co-occurrence network map for the field of agricultural enterprise transformation and development

Keyword clustering analysis involves grouping keywords based on their semantic or contextual relevance, creating distinct clusters. This analytical approach aids in revealing latent thematic structures and content within a research field. Keyword clustering analysis was conducted for the field of agricultural enterprise transformation and development, resulting in the formation of 12 clusters, as depicted in Figure 5. In Figure 5, the Modularity $Q = 0.4825$, surpassing the critical

threshold of 0.3, indicating a significant network structure. The Weighted Mean Silhouette $S = 0.7566$, exceeding the critical value of 0.5, suggests the reasonableness of the clustering outcomes (Tao & Shi, 2022). It can be seen from Figure 5 that there are obvious crossover phenomena among various clusters, indicating that there are some common research contents in various fields of research on transformation and development of agricultural enterprises.

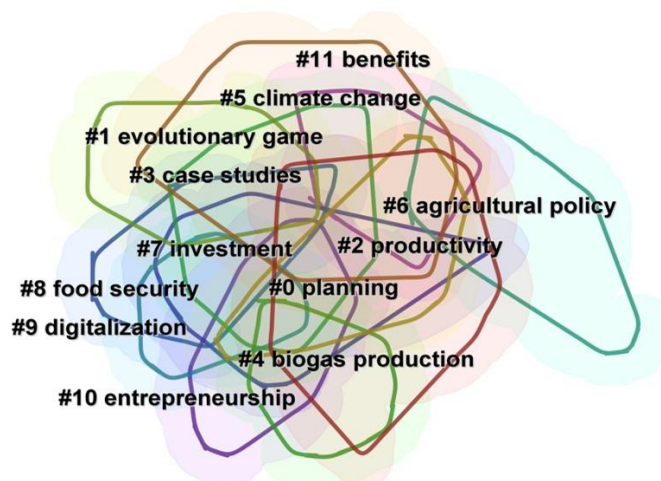


Figure 5. Keyword clustering map for the field of agricultural enterprise transformation and development

According to the main content of the clusters, the 12 clusters can be summarized into two hot research areas: “Sustainable Development and Innovation” and “Agricultural Innovation Development and Policy”, as shown in Table 7.

Table 7. Keyword clustering details

Hot research areas	Cluster number	Size	Top 5 terms
Sustainable development and innovation	#0 planning	53	circular economy; case-based learning; business model canvas; problem-based learning; circular business model
	#1 evolutionary game	35	evolutionary game; agricultural eco-innovation; technology diffusion; green agriculture; ambidexterity theory
	#2 productivity	28	propensity score; technology adoption; sustainable development; green production technology; agricultural enterprises
	#4 biogas production	27	model; knowledge; tool; sustainable development; system
	#5 climate change	26	climate change; resource use efficiency; crop diversification; sustainability innovation; organic cotton production
	#9 digitalization	24	sustainable development; eco-innovation capability; participative decision-making; motivational factors; model
	#11 benefits	19	spain; bioma; renewable energy; barrier; bioenergy
Agricultural innovation development and policy	#3 case studies	27	business model; mountain region; business model innovation; farming system; pasture-based livestock
	#6 agricultural policy	26	agricultural policy; agriculture industry; agriculture sustainability; interpretive structural modeling; urban-rural integration
	#7 investment	25	wine sector; innovation ecosystem; factorial analysis; critical success factor; innovation ecosystem dimension
	#8 food security	25	food security; rural development; food product innovation; community-based enterprise; multi-stakeholder approach
	#10 entrepreneurship	24	agriculture; matter; research and development; business; impact

In the field of sustainable development and innovation, researchers have conducted substantial studies on the green sustainable development and innovative transformation of agricultural enterprises. Hamam et al. (2022) investigated the ecological innovation transition of agricultural food enterprises towards a circular economy. Their research revealed that product and process innovations significantly influence the circular benefits of enterprises, and collaboration between industry and academia contributes to product innovation within the food sector. Knickel et al. (2021) also emphasized the role of academic research institutions and innovation intermediaries in enhancing cross-border collaboration advantages for small and medium-sized agricultural food enterprises. Xiong (2021) analyzed the impact of environmental requirements on the development of green animal husbandry from an evolutionary game theory perspective, indicating that higher environmental requirements promote the development of green animal husbandry. Effective incentive mechanisms can facilitate the attainment of environmentally-friendly objectives for enterprises at lower regulatory costs. Wang (2022) examined the effects of green agricultural development on environmental optimization, asserting that the advancement of green agriculture contributes to environmental improvement. The introduction of ecological agriculture, the promotion of green production methods, and the enhancement of output efficiency are identified as strategies to ameliorate the ecological environment. Belarmino et al. (2022) scrutinized the economic sustainability issues of emerging agricultural industry systems. Their study highlighted that the economic sustainability of agricultural-industrial systems reflects enterprise competitiveness, and economic sustainability can be achieved through intensified innovation, enhanced productivity, and judicious price control. Furthermore, Zhou et al.'s (2022) research indicated that under environmentally compliant conditions, digital

transformation contributes to enhanced productivity in agricultural enterprises.

In the field of agricultural innovation development and policy, researchers have undertaken extensive investigations into aspects such as technological innovation within agricultural enterprises and governmental policy regulatory mechanisms. Secinaro et al. (2022) explored the interrelation between agricultural entrepreneurship and emerging technologies like artificial intelligence and machine learning. Their study revealed that the emergence of these technologies facilitates high-quality development within agricultural enterprises. Wu et al. (2022) highlighted the effective role of government subsidies in promoting technological innovation within agricultural enterprises. Liu et al. (2020) established a game-theoretic model involving agricultural enterprises, government, and farmers, analyzing their dynamic evolutionary processes. The study suggested that providing appropriate subsidies to agricultural enterprises and implementing reasonable carbon taxes can foster low-carbon development, as part of a government strategy. Moreover, Hua et al.'s (2022) research indicated that carbon emission trading systems significantly enhance the productivity of agricultural enterprises. With suitable governmental regulation, this approach contributes to the sustainable long-term development of agricultural enterprises in a green manner. Hu et al. (2022) examined the impact of government policies on research and development investment, innovation, and productivity. The study found that greater research and development investment correlates with stronger innovation capability and higher productivity. The innovative capacity and productivity of pesticide enterprises positively correlate with factors such as funding input, production subsidies, and policy orientation.

To explore the research trends in the field of agricultural enterprise transformation and development, a keyword burst analysis was conducted. Keyword burst analysis

identifies specific keywords that experience sudden increases in usage frequency over a certain period, aiding in predicting research

trends in the near future. Table 8 presents the top 25 keywords with the strongest citation bursts.

Table 8. Top 25 keywords with the strongest citation bursts

Keywords	Year	Strength	Begin	End	2010 - 2022
Framework	2010	1.27	2010	2012	
Biofuel	2011	1.03	2011	2017	
Consumption	2012	1.07	2012	2017	
Collective Action	2013	1.66	2013	2018	
Cost	2013	1.61	2013	2016	
Dynamics	2013	1.3	2013	2014	
Agricultural Research	2013	1.21	2013	2014	
Complementarity	2013	1.11	2013	2017	
Cooperative	2015	1.29	2015	2016	
Biodiversity	2016	1.67	2016	2017	
Best Practice	2016	1.25	2016	2017	
Absorptive Capacity	2016	1.05	2016	2017	
Arrangement	2016	1.02	2016	2019	
Research and Development	2017	1.51	2017	2018	
Agricultural Co-operative	2017	1.21	2017	2018	
Biogas Production	2017	1.08	2017	2019	
Case Study	2017	1.02	2017	2018	
Challenge	2017	0.99	2017	2018	
Social Innovation	2019	2.88	2019	2020	
Enterprise	2016	1.09	2019	2020	
Adaptation	2015	1	2019	2020	
Industry	2020	3.19	2020	2022	
Business Model	2017	2.51	2020	2022	
Sector	2020	1.41	2020	2022	
Driver	2020	1.09	2020	2022	

From Table 8, it can be observed that three keywords of Biofuel, Consumption and Collective Action lasted for a long time between 2011 and 2018, indicating significant interest among researchers in topics related to resource consumption and agricultural cooperatives during this period. Additionally, keywords like Biodiversity, and Research and Development exhibited substantial citation strength, implying that environmental sustainability and technological development were focal points of research in the field of agricultural enterprise transformation and development during that time frame.

Moving from 2019 to 2022, keywords such as Social Innovation, Industry, and

Business Model displayed considerable citation strength, suggesting a comprehensive and in-depth exploration by researchers into various aspects of agricultural enterprise transformation and development during this stage. This encompassed not only the study of internal factors influencing agricultural enterprise transformation and development but also the emerging focus on external conditions shaping this transformation. The research emphasis shifted from the earlier focus on aspects like corporate strategic transformation, organizational framework construction, and production process organization towards the establishment of models for technological

innovation and application, as well as innovative transformation theories.

Based on the findings from cluster analysis and keyword burst analysis, it can be inferred that in the coming years, the trajectory of agricultural enterprise transformation and development will continue to center around sustainable development and innovative management within agricultural enterprises. Concurrently, the research emphasis will pivot towards evaluating the outcomes of transformation efforts and constructing corresponding mechanisms, systems, and policies. The application of digital technologies in the transformation and development of agricultural enterprises is anticipated to witness a growing trend. Technological innovation remains a pivotal factor influencing the effectiveness of agricultural enterprise transformation and development. The rapid advancement and widespread implementation of intelligent agricultural equipment are expected to enhance production efficiency for enterprises. The collaboration between enterprises, universities, and research institutions will continue to strengthen, and cross-regional and international collaborations are projected to increase, accompanied by the enrichment and refinement of collaborative models. Simultaneously, there will be a growing synergy and interdependence between enterprises and society in terms of innovation. The overarching objective of agricultural enterprise transformation and development is to achieve sustainable agricultural production by striking a balance between economic, social, and environmental benefits, thereby fostering the enduring, stable, and healthy growth of agricultural enterprises.

Conclusions

This work employs the Citespace software to conduct a comprehensive analysis and organization of pertinent literature within the field of agricultural enterprise transformation and development from the year 2010 to 2022, based on the WoS database. The

main conclusions derived from this study are as follows:

(1) The annual paper publication in the field of agricultural enterprise transformation and development demonstrates an overall increasing trend, with prominent contributing countries including the People's Republic of China, the United States, Italy, Spain, and Australia. Wageningen University and Michigan State University are prominent contributors in terms of the number of papers published within the agricultural enterprise transformation and development field. Michigan State University exhibits a significant involvement in collaborative endeavors. Research outputs in the agricultural enterprise transformation and development field are distributed across 136 journals, with “Sustainability” topping the list with 85 published papers.

(2) The research focus within the field of agricultural enterprise transformation and development predominantly lies in subjects such as Environmental Sciences, Green & Sustainable Science & Technology, and Agricultural Economics & Policy. Journals such as “Sustainability”, “Journal of Cleaner Production”, and “Research Policy” exhibit substantial citation frequencies, thereby exerting significant influence within the agricultural enterprise transformation and development sphere.

(3) Within the field of agricultural enterprise transformation and development, keywords like “Innovation”, “Performance”, “Impact”, “Management”, and “Sustainability” demonstrate a notable frequency of occurrence. After conducting keyword clustering analysis, a total of 12 clusters have been identified, encompassing subjects that can be summarized into two prominent research fields: “Sustainable Development and Innovation” and ‘Agricultural Innovation Development and Policy’.

(4) The trajectory of agricultural enterprise transformation and development will concentrate on sustainable development and innovative management of agricultural enterprises. Research emphasis will lean

towards assessing transformation effectiveness and investigating the mechanisms, supporting systems, and policies of transformation. The digital transformation and technological innovation of agricultural enterprises stand as pivotal elements propelling their sustainable development.

(5) This study exclusively analyzed English-language papers from the WoS

database, excluding papers from other databases and languages from the scope of analysis. In future research, to comprehensively grasp the research dynamics of a specific subtopic, it is advisable to collect a more extensive range of papers from various databases and languages for integrated analysis.

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