



# Agricultural Transformation 2.0: A Bibliometric Study

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## Abstract

Agriculture remains a critical driver of economic growth and rural livelihoods in low-income countries such as Nepal, yet the sector continues to be constrained by traditional, subsistence-oriented practices that limit productivity and resilience. While global advancements in digital technologies, climate-smart practices, and inclusive value-chain development are reshaping agricultural systems, Nepal faces gaps in institutional capacity, technology adoption, and coordinated policy implementation. This study examines global research trends and thematic developments in Agricultural Transformation 2.0 to identify knowledge patterns and inform Nepal's ongoing transition toward modern, sustainable agriculture. A bibliometric analysis was conducted using Dimensions AI, from which 899 journal articles published between 2010 and 2025 were retrieved and analyzed through Biblioshiny and VOSviewer. Results reveal a rapid global expansion of scholarly interest after 2022, driven largely by China and the United States, and highlight dominant themes related to modernization, sustainability, digital innovation, smallholder development, and climate resilience. Thematic mapping further indicates that while foundational topics are well established, areas such as community participation and spatial analysis remain underexplored. The study concludes that Nepal can accelerate its agricultural transformation by strengthening digital capacity, fostering inclusive policies, and improving multi-level coordination, thereby enhancing productivity, resilience, and equitable development outcomes.

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## 1. Introduction

Traditionally, agriculture has been a core economic development (Devkota et al., 2023), food security, and rural livelihood source in all developed and developing economies (Acharya, 2006; Pingali, 2007). The agricultural sector is especially critical in low-income countries where it can offer jobs to the high percentage of the population and help build inclusive growth and reduce poverty (Deininger et al., 2022; Devkota & Paija, 2020). Nevertheless, the low productivity with low mechanization and low market integration in the traditional and subsistence-oriented farming systems still limit the agricultural performance in most areas. Global agricultural regimes are responding to this by engaging in a radical transformation that is caused by technological innovation, issues of sustainability, and climate durability.

In recent decades, agricultural transformation has become more integrated and knowledge-based and is no longer aimed at mechanization and increase in input (Razu et al., 2025). This transition has come to be conceptualized as Agricultural Transformation 2.0 that focuses on digital agriculture, precision farming, climate-smart practices, inclusive value chains, and the institutional coordination (Aggarwal & Verma, 2022). China, India, Brazil and Israel are examples of those countries that have shown that by incorporating digital tools, data-based decision-making, and innovation-focused policies, agricultural productivity and resilience can improve considerably (Jefferson et al., 2013). These changes indicate a larger international awareness that modernized agricultural systems are the key to sustainable food system in the long term and economic restructuring. Farming is still the foundation of the Nepalese economy with more than a majority of labor forces employed and up to about a quarter of the gross domestic product (Paija et al., 2026). Nepalese agriculture remains in the grip of small-scale agriculture, traditional modes of production, minimal use of technology and poor institutional coordination

despite its structural significance. These systemic problems are also exacerbated by climate change, labor mobility, escalating input prices, and exposure to market uncertainty (Joshi & Rawat, 2024). Therefore, the necessity of a wholesome change in the farming industry in Nepal has been mounting up in intensity.

Although the discourse on policy and development activities in Nepal has been shifting towards more modernization, digitalization, and climate-smart agriculture, the scholarly literature on Agricultural Transformation 2.0 is still disjointed. The existing research has been concentrated on certain issues (including information and communication technologies (ICTs), mechanization, or climate-smart practices) in isolation (Khatri et al., 2024; Mishra et al., 2023). Despite the insights that are offered by these studies, they lack a comprehensive overview of the development of the concept of Agricultural Transformation 2.0 in the world, the most dominant contributors, the most common themes in the field, and the existing research gaps.

The literature on agricultural transformation is growing swiftly throughout the world, especially during the period following the COVID-19 pandemic, which boiled down to the accrual of digital technologies and the renewed interest in resilient food systems (Hossain et al., 2022). Nevertheless, in spite of this rise, no detailed bibliometric findings have the power to trace the intellectual landscape, cooperation networks, and thematic development of the research on Agricultural Transformation 2.0. Scientific mapping methods have been shown to be a useful tool in revealing the research paths, key stakeholders, and new themes, as previous bibliometric studies in similar fields have already indicated the usefulness of science mapping methods (Cobo et al., 2011; Okolie et al., 2022). However, the specific bibliometric evaluation of Agricultural Transformation 2.0 is still a neglected area of literature. It is especially significant to fill this gap with developing countries like Nepal, in which evidence-



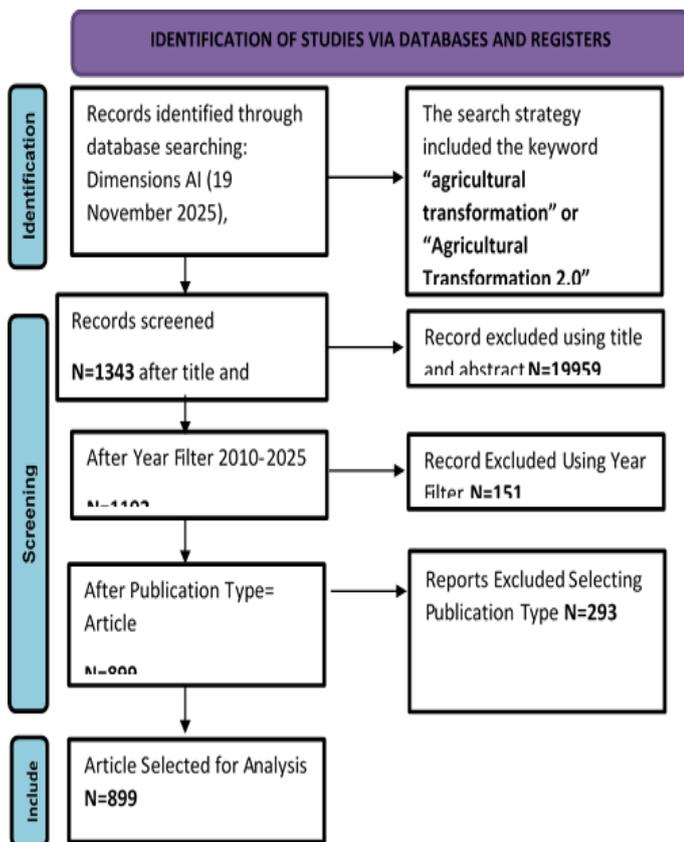
based policymaking and strategic planning require a clear picture of global knowledge trends. Bibliometric analysis offers a methodical and quantitative method of synthesizing extensive amounts of academic publications, which allows researchers to investigate the pattern of publications, citation, collaboration patterns, and thematic clustering in a research area (Ellegaard & Wallin, 2015; van Eck & Waltman, 2010). Through mapping of the global body of research, bibliometric research can be used to establish certain prevailing paradigms and under-explored areas that need further research.

Thus, the purpose of the proposed study will be to carry out an extensive bibliometric examination of the research on Agricultural Transformation 2.0 published within the period of 2010-2025. The research defines publication trends, leading authors, journals, institutions, and countries, determines the structure of collaboration, and determines the prevalent and emerging research topics using the retrieved data provided by the Dimensions AI and analyzed with the help of Biblioshiny and VOSviewer. The synthesis of the patterns of global research can be used to offer insights that are especially applicable to Nepal and other developing economies that aim to fast-track agricultural modernization with the help of digital innovation, inclusive policies, and integrated institutional frameworks. By so doing, the study has added value to the current body of literature on agriculture transformation as well as provided a strategic basis on future empirical and policy-based studies. Aggarwal and Verma (2022) emphasizes digital and smart technologies are rapidly transforming Agricultural Transformation 2.0, yet the global research continues to grow and enlarge, without the understanding of the overall patterns, the leading contributors, teams and emerging themes. An overview of this field is required to be mapped through a bibliometric study. The main objective of my research is to analyze research on Agricultural Transformation

2.0 by studying publication trends, key contributors, collaborations, major themes, and identifying gaps for future study.

## 2. Methodology

A quantitative technique called bibliometric analysis is used to look for patterns in published literature, including major research themes, influential journals, leading authors, and publication trends (Ellegaard & Wallin, 2015). The current body of work on Agricultural Transformation 2.0 is methodically evaluated in this study, which aids in identifying research advancements, highlighting significant contributors, and identifying gaps in the literature that support the need for more research. The PRISMA diagram shows how the relevant studies were filtered step by step to select the relevant studies in Dimensions AI. The first search with the keyword “agricultural transformation” or “agricultural transformation 2.0” found 21,302 records. A filter was applied to the results to limit the search to titles and abstracts to narrow down the dataset to 1,343 records. After that, I filtered the results with a publication-year filter between 2010 and 2025 and hence, the results were reduced to 1,192 records. Lastly, only 899 relevant studies were obtained because of the search being restricted to journal articles and were used in further analysis. This procedure demonstrates how the big original data set was narrowed to generate the final list of articles employed in the research. The final set of data was analyzed by using Vosviewer and R biblioshiny. For performance analysis and science mapping R biblioshiny was used. Performance analysis uses metrics such as publications, citations, and authorship patterns to assess the impact and productivity of research (Merigó & Yang, 2017). Science Mapping reveals a field’s conceptual structure by visualizing connections between research themes, topics, and trends (Cobo et al., 2011) and network Analysis uses co-authorship or citation networks to look at relationships and partnerships between authors, organizations, or nations (van Eck & Waltman, 2010).



**Figure 1:** Preferred Reporting Items for Systematic Reviews and Meta-Analysis

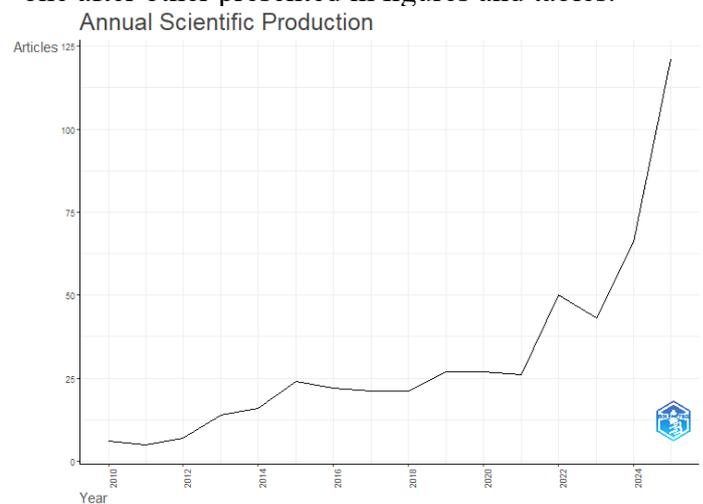
This study is based on bibliometric analysis, for which we used R-biblioshiny and Vosviewer. According to Alsharif et al. (2020) Bibliometric analysis is a kind of research methodology used to comprehend worldwide research trends in a specific field based on academic publications from the WoS or Scopus databases or Dimension Ai. A bibliometric analysis was carried out to investigate the Agricultural Transformation 2.0 research landscape. This study takes a comprehensive approach by combining science mapping and performance analysis and using VOSviewer for network analysis to look at collaborative patterns, leading authors, countries, institutions, and publication trends (van Eck & Waltman, 2010). The main conclusions from this analysis are shown in the section that follows.

According to Van Raan (2014) Bibliometrics Performance analysis is the systematic appraisal of scientific output and influence of research elements such as authors, institutions, journals, or countries

with quantitative measures such as the number of publications, the number of citations, or citation per publication, and the h-index. This type of analysis allows one to know who and what are the most prolific and active in a particular research area, and it shows tendencies in the productivity and the influence of scholarly activity in the past.

## 2. Results

The frequency of publication by year, source of publication production and many more are analysed one after other presented in figures and tables.



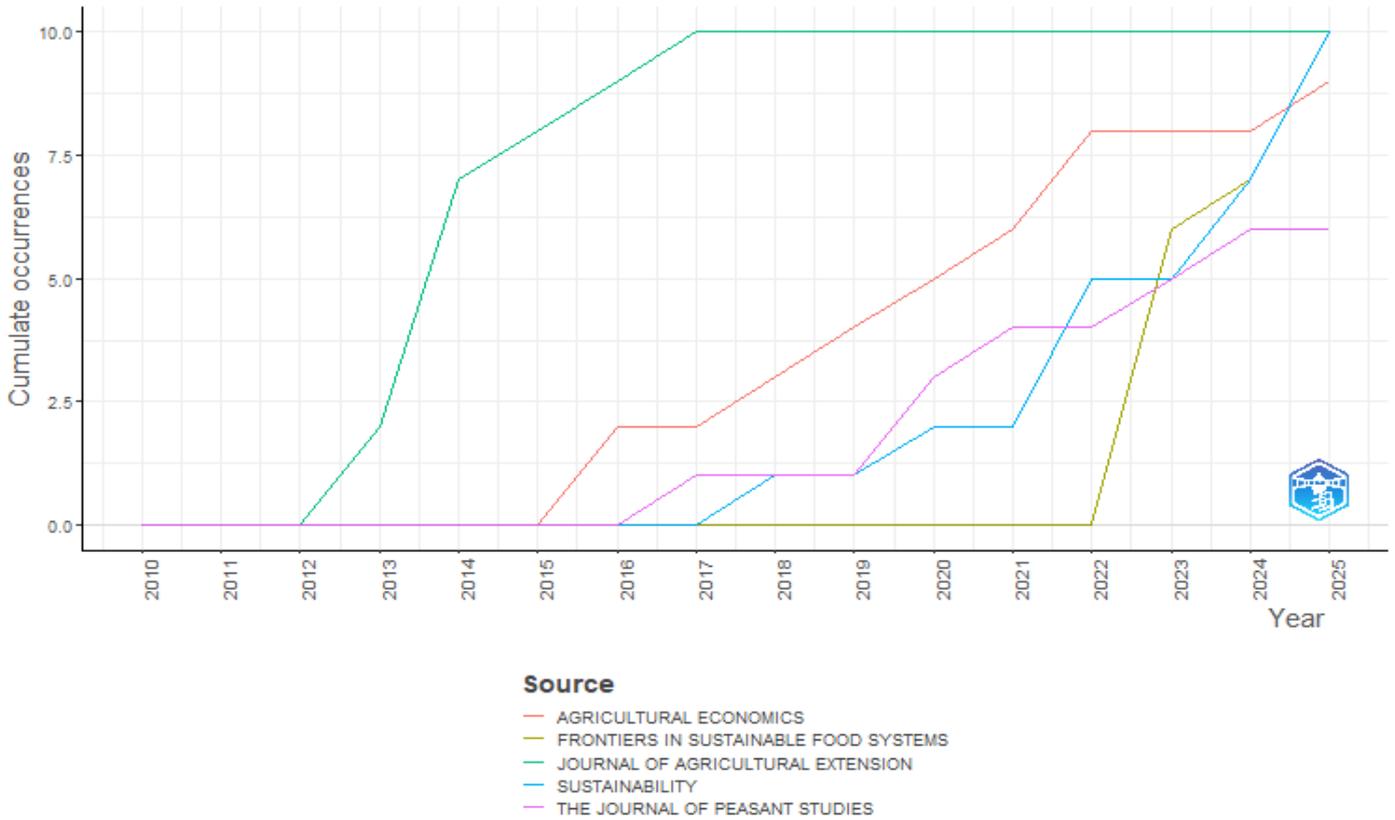
**Figure 2:** Annual Scientific Production

Annual scientific production helps show growth trends and the temporal evolution of scholarly activity by reflecting the annual output of research publications in a particular field (Malaialagu, 2019). According to the figure, scientific output on Agricultural Transformation 2.0 increased gradually and steadily between 2010 and 2021, with only slight increases in publications. However, after 2022, it started to increase significantly. This spike, which lasts until 2024 and peaks in 2025, shows a notable recent increase in research interest, probably due to developments in smart technologies, digital agriculture, and the growing emphasis on modernizing agricultural systems worldwide.

The graph shows how different journals have contributed to research on Agricultural Transformation 2.0 over time by tracking their cumulative publications.

The *Journal of Agricultural Extension* shows the

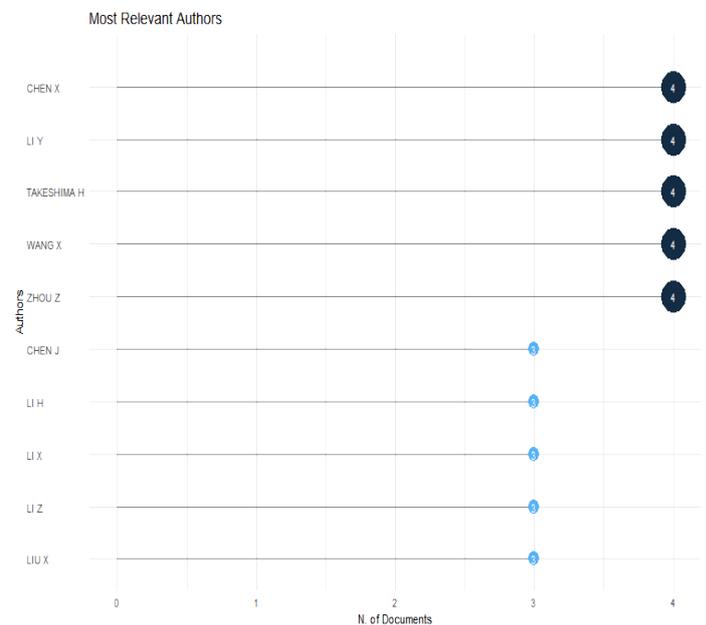
### Sources' Production over Time



**Figure 3:** Sources Production over Time

earliest and strongest growth, reaching a stable output of 10 papers by 2017, indicating its long-term engagement with agricultural modernization topics. Other journals begin contributing later: *Agricultural Economics* grows steadily after 2016, *Sustainability* starts increasing after 2018, and *The Journal of Peasant Studies* shows gradual contributions from 2017 onward. The most rapid recent growth comes from *Frontiers in Sustainable Food Systems*, which begins contributing in 2023 and quickly reaches 10 papers by 2025. Overall, the graph shows that while early research was concentrated in one main journal, recent years have seen a sharp increase and diversification of sources, reflecting rising global attention to Agricultural Transformation 2.0 across multiple research fields.

The Biblioshiny plot named Most Relevant Authors indicates the most active people in the study on Agricultural Transformation 2.0. The authors are also ranked according to the number of publications, which show the productivity of the authors in this sectors.



**Figure 4:** Most Relevant Authors

Such contributors as Chen X., Li Y., Takeshima H., Wang X., and Zhou Z. with four articles each, show excellent interest in the issues of modernization of agriculture, digital agriculture, and structural transformation. On the other hand, the other faction led by Chen J., Li H., Li Z., Li X., and Liu Y. each

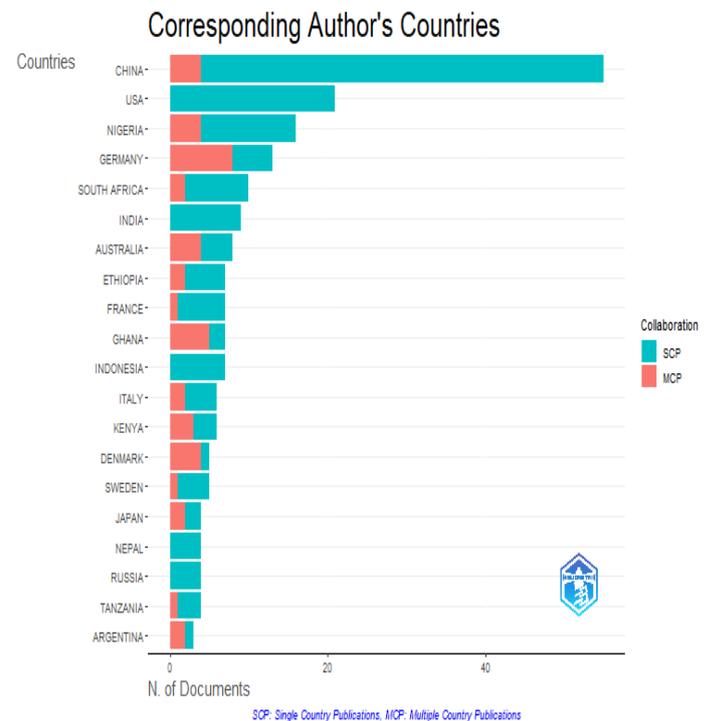
contributed three articles, which was moderate in their productivity. The graphic representation of author relevance can be used to recognize the most prominent scholars, areas of research influence, and possible directions to take when exploring the topic of Agricultural Transformation 2.0.

**Table 1:** Country wise Scientific Production in Current Study Theme

Country	Number of Publications
China	231
Usa	85
Nigeria	56
Germany	52
Indonesia	35
India	32
South Africa	31
Kenya	30
Italy	29
Ethiopia	22
Ghana	21
Australia	18
France	17
Tanzania	17
Sweden	16
Uganda	13
Nepal	12
Russia	12
Uk	12

A frequency table map is used to illustrate the geographical distribution of the global scientific output on Agricultural Transformation 2.0. Nigeria, Germany, Indonesia, India, South Africa, Kenya, and Italy have made significant contributions, but China leads with 231 publications, followed by the United States (85). Ethiopia, Ghana, Australia, France, Tanzania, Sweden, Uganda, Nepal, Russia, and the United Kingdom are among the other nations that take part. Higher outputs are shown on the map in North America, Asia, and portions of Europe and Africa. Overall, the research shows broad international interest despite being

dominated by a small number of nations.



**Figure: 5** Corresponding Author's Countries

The figure reveals the distribution of scientific publications of the countries where the authors work in BiblioShiny, with emphasis on Single Country Publications (SCP) and Multiple Country Publications (MCP). China has the highest SCPs, meaning that it has high domestic productivity and United States has a balanced combination of SCP and MCP, which means that both the country and the rest of the world collaborate actively. Others, such as Nigeria, Germany, South Africa, India and Australia, are also producing a fair share, with lesser but globally linked those in Ethiopia, France, Ghana and Nepal. In general, the studies are focused within a limited number of countries but manifest a wide range of international interaction.

The term cloud defines the prevailing ideas that surround the study of Agricultural Transformation 2.0, agricultural and transformation are the most prominent concepts, hence highlighting the major preoccupation of the field of modernizing and restructuring the

agricultural sector. The keywords surrounding the



**Figure 6:** Word Cloud for the Agricultural Transformation 2.0 in a multidimensional research field

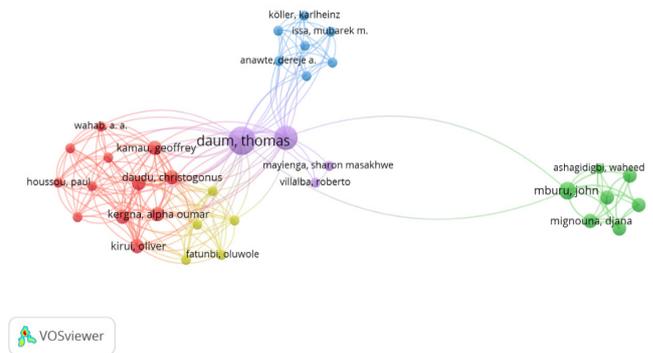
article such as development, agriculture, rural, farmers, food, sustainability, and Nigeria indicate strong connections to the rural development, food systems, smallholder livelihoods, and country-specific case studies, specifically in developing countries. There are other words like digital, policy, climate, innovation and security that show that technological development, support in policy, climate resilience and food security are critical facets of such change. Generally speaking, the word cloud illustrates that the concept of Agricultural Transformation 2.0 is a multidimensional research field that revolves around modernization, development, and change, which is farmer-oriented.



**Figure 7:** Tree Map

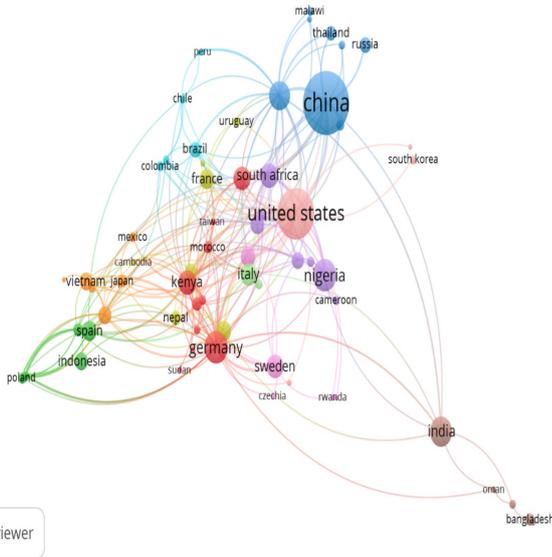
According to the treemap and dataset, the studies concerning Agricultural Transformation 2.0 focus on modernizing the agricultural systems, where

the most common words are agricultural (323) and transformation (221). Keywords that are used more often (like development, rural, food, and country-specific ones e.g., Nigeria, China, India) indicate that sustainable agriculture and rural development in the Global South are highly prioritized. The other words such as farmers, smallholder, digital, technology and climate highlight the importance of technological innovation, climate-smart practices and smallholder-oriented development. Lastly, policy, security and adoption represent an area of governance and implementation concerns.



**Figure 8:** Co-Authorship Network

The co-authorship network in agricultural transformation 2.0 research is visualized in this VOSviewer map, which displays author groups grouped according to the frequency of their joint publications. Daum, Thomas, the biggest and most central node, serves as a key link between several author clusters, demonstrating widespread cross-regional cooperation. Tightly knit African researchers are represented by the dense red and yellow clusters on the left, another cooperative group is shown by the blue cluster, and a distinct team focused on Mburu, John, is highlighted by the green cluster on the right. Overall, the figure depicts a network with multiple regionally concentrated collaboration clusters and a single dominant bridging author.



**Figure 9:** Countries Collaboration Network

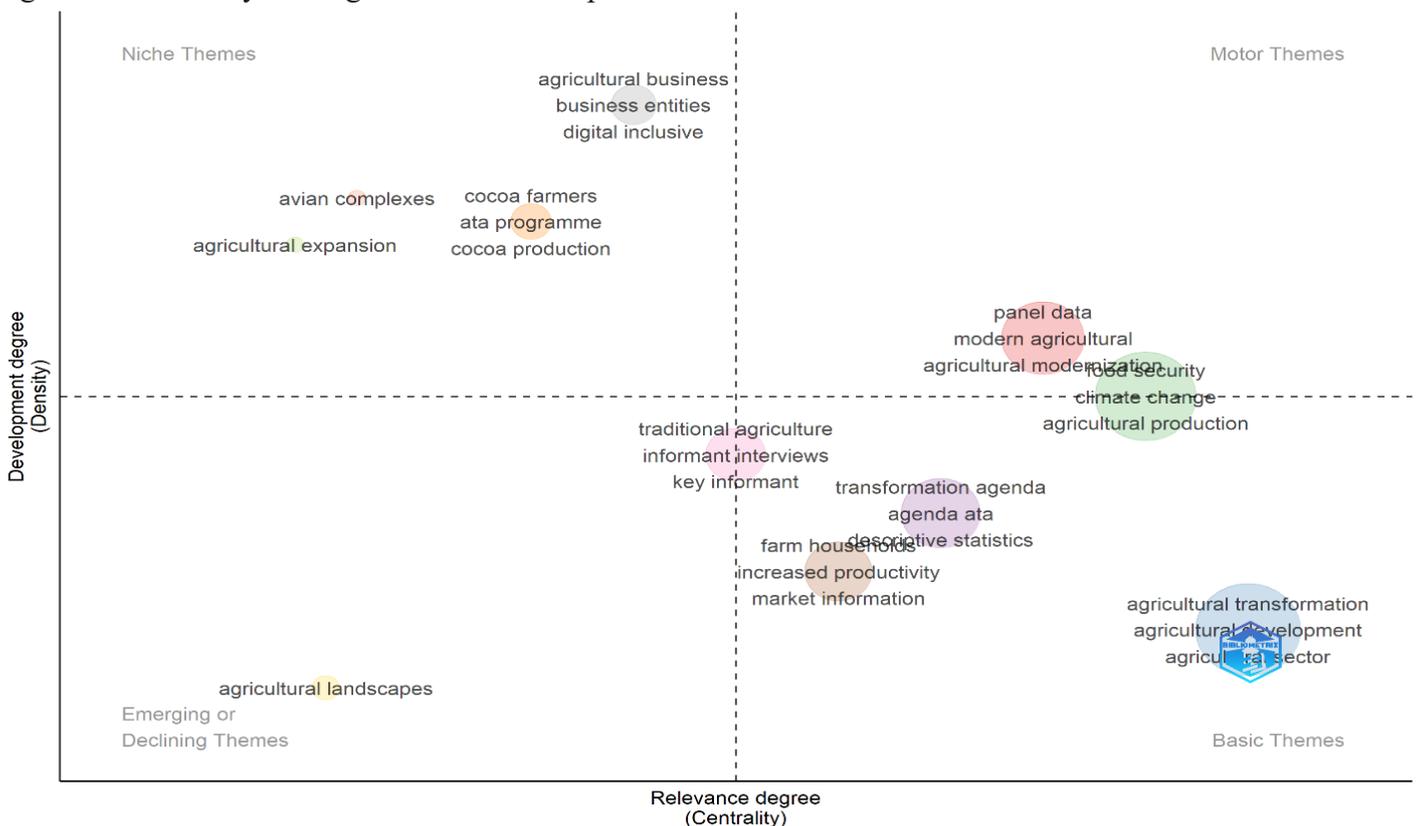
The collaboration between nations in agricultural transformation 2.0 research is depicted in this VOSviewer map. The number of publications increases with the size of the nation’s name, and the connecting lines indicate collaborative relationships. As the biggest and most interconnected countries, China and the US conduct the most research and work together extensively. Strong networks of cooperation

are also formed by nations like Germany, India, Nigeria, Kenya, South Africa, and France. These networks include smaller nations like Nepal, Vietnam, Bangladesh, and Peru through collaborations with bigger research centers. With China and the United States at the center and numerous nations connected through international cooperation, the figure depicts a globally interconnected research landscape.

According to the thematic map, important subjects like agricultural development, agricultural transformation, and the transformation agenda are located in the Basic Themes quadrant, indicating that they are extremely pertinent but still lacking in depth. On the other hand, topics like modern agriculture, food security, and agricultural production show up as Motor Themes, indicating significant advancement and influence in the field. Overall, it is evident from the Basic Themes quadrant’s placement of key ideas that Agricultural Transformation 2.0 is still understudied, indicating a substantial research gap and opportunity.

### 5. Discussion

This bibliometric analysis gives a unified evaluation of



**Figure 10:** Thematic Map



global research professions and conceptual frameworks and research partnerships in regards to Agricultural Transformation 2.0 during the 2010-2025 timeframe. Empirical data indicate a steady rise in the academic attention until 2021, then a substantial growth in 2022, which is also representative of the international patterns in the publication of works on digital and smart agriculture (Bhagat et al., 2022; Sott et al., 2021). This rapid growth is in accordance with the global trends in digital agriculture, precision technologies, and climate smart technologies, which, in turn, increases the scholarly interest over recent years, consistent with the previous bibliometric research in the emerging areas of technology (Bertoglio et al., 2021; Okolie et al., 2022).

Analytical data also indicate that China and the United States dominate major production of research with the largest number of publications being published in China (Bhagat et al., 2022; Gund et al., 2025; Sott et al., 2021). This observation can be linked to previous literature where China is considered to be a hub of agricultural modernization and digital transformation research in the world (Li et al., 2025). The comparatively equal distribution of SCP and MCP of the United States also reflects the long-standing spirit of cooperation in the research, as observed in the previous global bibliometric cartographies of digital and smart agriculture (Bhagat et al., 2022; Sott et al., 2021). Besides, salient in the contributions of Nigeria, Germany, India, South Africa and Indonesia reveal increasing participation of the Global South in the scholarship of agricultural transformation, in line with literature indicating that Africa and Asia are emerging as the centers of research on digital and climate smart agriculture (Gherțescu et al., 2025; Mamun & Várallyai, 2025).

The thematic analysis (a word cloud, tree map, etc.), implies that thematic themes like agricultural development, agricultural transition, food security, digital innovations, and climate continue to be central

and become institutionalized keys in the various areas (Bertoglio et al., 2021; Judijanto, 2025; Mamun & Várallyai, 2025; Sott et al., 2021). The use of more powerful terms to describe smallholder, farmer, rural development, and certain developing nations indicates that the discipline is also prone to solve the problems of productivity and livelihood in the developing environments resonating work done on a larger scale on climate smart agriculture and sustainable agriculture (Judijanto, 2025; Vasavi et al., 2025). These results confirm previous claims that agricultural transformation research cannot be discussed outside the context of sustainability, rural resilience, and technology adoption (Bhagat et al., 2022; Gherțescu et al., 2025; Vasavi et al., 2025). Yet, the presence of the phrase agricultural transformation in the Basic Themes quadrant shows that, regardless of its usefulness, the topic under consideration remains underdeveloped, meaning that Agricultural Transformation 2.0 and digital transformation in agriculture is conceptually underdeveloped and fetishized, in particular, in the developing world (Gherțescu et al., 2025; Hang and Vãn, 2025; Sott et al., 2021).

The country level collaboration and co authorship network also reveal that there are regionally concentrated research communities, where a small group of core authors and countries play the role of linking clusters, which also reflect other bibliometric findings that show a strong regionalization and limited cross continental collaboration in agricultural and digital agriculture research (Abdollahi et al., 2021; Bhagat et al., 2022; Gund et al., 2025; Sott et al., 2021; Yousaf et al., 2023). The presence of such dominant personalities like Thomas Daum in digital agriculture and smallholder innovation scholarship is predictable under the citation network analysis that can pinpoint a handful of highly central authors who dominate the development of a particular theme (Bhagat et al., 2022; Gherțescu et al., 2025).

Part of the findings are in conflict with the prior

literature. As an example, the hyper growth in publications since 2022 is stronger than the previous bibliometric studies that ended before 2022 and thus failed to reflect the recent growth of digital agriculture, AI, and IoT based applications (Gund et al., 2025; Hang and Văn, 2025; Mamun & Várallyai, 2025). Post COVID trends in the increased use of digital tools, investments in climate smart projects, and improved access to data can explain this deviation, as they have been recently associated with spikes in smart agriculture and IoT irrigation research output (Dewi Hendrawati et al., 2025; Montalvo et al., 2025). Simultaneously, comparably scarce representation of such themes as community engagement, institutional capacity on the local level and spatial analytics, even though they are crucial to studies of rural development, may indicate that these areas are not sufficiently represented in the international discourse. This gap indicates the preeminence of the technologically focused research in which digital and production themes are prioritized over social or governance aspects, which is also present in general digital agriculture and smart farming bibliometrics (Bhagat et al., 2022; Gherțescu et al., 2025; Hang and Văn, 2025; Poorna et al., 2025).

Altogether, it is possible to note that most of the literature written previously is proved and some new directions are disclosed. The dominance of the modernization, digital farming, and climate resilient agriculture themes confirms the long term international interests (Bertoglio et al., 2021; Judijanto, 2025; Sott et al., 2021), yet the recent rise in the intensity of the research activity preconditions the indications of the rapidly changing environment (Yousaf et al., 2023). The underrepresentation still of some of the themes reveals research gaps that need to be fulfilled in the long run, particularly in the countries, where it is essential to consider the importance of institutional preparedness, the engagement of farmers, or localized adoption strategies (Mamun & Várallyai, 2025; Poorna et al., 2025; Vasavi et al., 2025). These findings

thus indicate that more context specific and farmer centric research is required to supplement the growing technology focused body of literature (Bhagat et al., 2022; Okolie et al., 2022; Poorna et al., 2025).

Regarding implications, this article clarifies the increasing world trend of Agricultural Transformation 2.0 and demonstrates the uneven distribution of it across space and theme, similar to the results of digital and climate agriculture bibliometric studies (Judijanto, 2025; Mamun & Várallyai, 2025; Sott et al., 2021). The digital capacity development and policy coordination as well as multi stakeholder partnerships become the lessons of the world, which Nepalese scholars can utilize to develop their own setting (Judijanto, 2025; Mamun & Várallyai, 2025; Vasavi et al., 2025). Simultaneously, the proposed research gaps provide the Nepalese researchers with an opportunity to make a unique input on the behavior of farmers, institutional processes, and modernization concepts based on communities (Poorna et al., 2025; Schwoob et al., 2019; Vasavi et al., 2025).

Finally, the use of Dimensions AI is also a weakness of this study as coverage and types of documents are not comparable to Scopus and Web of Science, which is also a concern in other bibliometric studies that use single databases (Mamun & Várallyai, 2025; Sott et al., 2021). The future studies might expand the coverage of databases, incorporate qualitative evaluation, or compare thematic development across countries, as well as extend the analysis to grey literature and policy documents to receive a more comprehensive vision of Agricultural Transformation 2.0 (Judijanto, 2025; Mamun & Várallyai, 2025).

## **6. Conclusion**

This study provides a comprehensive bibliometric assessment of Agricultural Transformation 2.0 research from 2010 to 2025, highlighting global trends, thematic structures, and key contributors in the field. Empirical evidence demonstrates a steady growth in scholarly



interest until 2021, followed by a pronounced surge after 2022, reflecting the rapid adoption of digital technologies, precision agriculture, and climate-smart innovations worldwide. China and the United States emerged as the dominant contributors, while countries in the Global South, including Nigeria, India, South Africa, and Indonesia, are increasingly participating, signaling a gradual diversification of research leadership.

Thematic analyses reveal that central topics such as agricultural development, food security, digital innovation, climate resilience, and smallholder development remain the core of Agricultural Transformation 2.0 research. However, foundational themes, including community participation, local institutional capacity, and spatial analytics, are still underrepresented, indicating persistent research gaps. Co-authorship and country-level collaboration networks further show that research is highly regionalized, with limited cross-continental engagement, emphasizing the need for broader international collaboration.

For Nepal, the study underscores the importance of strengthening digital capacity, fostering inclusive policies, and promoting multi-stakeholder partnerships to accelerate agricultural modernization. The gaps identified present opportunities for Nepalese scholars to contribute original research, particularly in farmer-centric studies, institutional processes, and community-based approaches to Agricultural Transformation 2.0.

In summary, Agricultural Transformation 2.0 is an evolving research domain characterized by technological innovation, modernization, and climate-resilient practices, yet it continues to exhibit conceptual immaturity in certain areas, especially regarding social and governance aspects. The findings of this study provide critical insights for policymakers, researchers, and practitioners to guide evidence-based interventions and strategic planning. Future research should expand data sources beyond journal articles, include qualitative analyses, and explore localized,

context-specific strategies to ensure that the benefits of transformation are equitably distributed and aligned with sustainable development goals.

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#### Declaration of Competing Interest

The author states that there are no conflicts of interest.

#### Data Availability

The data that underlie the findings of this research can be provided by reaching out to the author.

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