Business Strategy and Management Insights, e-ISSN: 3107-7609
July-December 2025 | Volume: 01, Issue: 02, Page No.: 01-19
https://doi.org/10.64006/bsmi/1201

REVIEW ARTICLE |Received:10th July. 2025 | Revised: 22nd August. 2025 | Accepted: 16th October. 2025 | Published: 2nd December 2025

Fintech and Small Farmers: A Bibliometric Analysis of Current Landscape and Emerging Research Frontiers

Rahisha[1], Mohammed Jamshed[2], Waseem Khan[3]

ABSTRACT

This study aims at doing comprehensive bibliometric review of scholarly literature on the interface between financial technology (fintech) and smallholder farming. The study examines the research terrain of fintech use among smallholder farmers and determine frontiers of research, annotation the field, and document emerging trends over time. The dataset was obtained for the study from scoups due to its extensive coverage of peer-reviewed business, economics, and agriculture journals. The study is grounded on 137 articles which symbolize intellectual structure, prominent authors, thematic patterns, and up-and-coming trends in research from ScientoPy and VOSviewer. The study indicates a staggering explosion of research productivity subsequent to 2020, testifying to growing scholarly interest toward digital financial inclusion in rural economies. Co-citation and co-occurrence analyses also categorized four broad thematic clusters as digital finance and financial inclusion, mobile money adoption among smallholder farmers, sustainability and agri-fintech interface, and socio-economic dimensions like gender and rural development. China, USA, and Ghana ranked as the most productive nations, while journals like PLOS ONE, World Development, and China Agricultural Economic Review has been the primary outlets for publication. The study adds to academic literature by presenting a systematic review of the available studies and providing guidelines for future research, specifically in under-researched fields like gender, digital literacy, and policy regulation. Notably, it also provides insight into how FinTech innovations can assist smallholder farmers by enhancing financial access, productivity, and economic resilience.

Keywords: Fintech, Smallholder farmers, Bibliometric analysis, Mobile money, Agricultural finance, VOSviewer, ScientoPy.

INTRODUCTION

Smallholder farmers are centre to global food security, as they about 30 percent of global food output, mostly in developing economies (FAO, 2017). In India, 86.1 percent of the farmers can be classified as small or marginal, with strong concentrations in the Uttar Pradesh and Bihar, cultivating mostly staple food like paddy and wheat (Saini & Chowdhury, 2023). Though, smallholder farmers are constantly faced the issue of limited access to financial services, high costs of transactions, market risks, and rising exposure to climate threats (Touch et al., 2024). Financial technology (fintech), including advancements in mobile banking, blockchain, peer-to-peer(P2P) lending, and artificial intelligence (AI)-based financial products, has come as a game-changer to overcome these impediments by improving financial inclusion and business resilience (Demirguc-Kunt et al., 2018). The research examines the existing level of fintech uptake by smallholder farmers and suggests future research directions based on a bibliometric analysis, and suggest implications for researchers, policymakers, and agricultural stakeholders.

fintech has potential to bring down the financial exclusivity to smallholder farmers by reducing cost economies and geographical limitation. In Kenya, M-Pesa lowered transaction fees by as much as 30% so that farmers utilize

[1]Research Scholar, Department of Management, SMBS, Jamia Hamdard, New Delhi, India. rahishakhan987@gmail.com
[2] ✉Assistant Professor, Department of Management, SMBS, Jamia Hamdard, New Delhi. mohammedjamshed@jamiahamdard.ac.in
[3] Assistant Professor, Dr. Vishwanath Karad MIT World Peace University, Pune. waseemdbf42@gmail.com

How to cite: Rahisha, Jamshed, M., & Khan, W. (2025). Fintech and small farmers: A bibliometric analysis of current landscape and emerging research frontiers. *Business Strategy and Management Insights*, *1*(2), 1–19. https://doi.org/10.64006/bsmi/1201

mobile phones to obtain credit and savings (Jack & Suri, 2014). Blockchain systems have lowered remittance fees by 50%, making agricultural supply chains more transparent (Market Data Forecast, 2024). Fintech solutions, like crop insurance through satellites in Kenya and Ghana, reduce climate risks by increasing resilience (Forbes, 2023). Yet, adoption is skewed, with 24–37% of small one-hectare farms and below having accessed 3G or 4G services compared to 74–80% of large farms, and revealing differences in digital infrastructure (Mehrabi et al., 2021).

The uptake of fintech by smallholder farmers is a function of factors like digital literacy, infrastructure, and regulatory frameworks. Digital literacy is still an obstacle as 40% of smallholder farmers in poor nations have limited digital competencies (FAO, 2023). Variability in regulation in 60% of emerging economies also discourages the use of fintech (Kshetri, 2017). Gender disparities are also involved, with 43% of smallholders in developing nations being female farmers, and facing socio-cultural barriers in accessing digital tools (FAO, 2017). The disparities highlight the need for context-specific fintech solutions. Sub-Saharan Africa has fewer than 40% of rural households with internet access, and the cost of data limits the scalability of fintech (Mehrabi et al., 2021). China's digital inclusive finance, on the other hand, has promoted agricultural productivity using AI to reduce the cost of financing (Gao et al., 2022). In India, a study identified that hedonic motivation and price value have significant impact on the adoption of fintech among farmers, and it is mediated through behavioral intention (Sharma et al., 2025).

Academic research on fintech and smallholder farmers has increased, though in a piecemeal fashion, and without a comprehensive synthesis of trends and gaps. Past research have examined the contribution of mobile banking to financial inclusion (Jack & Suri, 2014), blockchain as a means of supply chain visibility (Kamilaris et al., 2019), and AI-based credit scoring (Omokhoa et al., 2024). The accelerated development of fintech application in agriculture requires a systematic review to chart the intellectual terrain. Bibliometric analysis, a successor of systematic literature reviews, provides a quantitative approach to measuring publication productivity, detecting influential literature, and determining thematic clusters (Donthu et al., 2021). Using Scopus bibliographic data and tools such as ScientoPyGui and VOSviewer, this paper examine co-authorship networks, keyword co-occurrence, and citation, which provide robust background to comprehend the fintech-smallholder farmer nexus (Van Eck & Waltman, 2017; Bastian et al., 2009).

This research fills the gap of consolidating the existing situation and the way forward for the adoption of fintech by smallholder farmers by responding to the following research questions:

RQ1: What are the most important documents, journals, authors, and countries associated with fintech research on smallholder farmers?

RQ2: How has the intellectual discourse on fintech and smallholder farmers changed over time?

RQ3: What are the dominant research topics at the intersection of fintech and smallholder farming?

RQ4: What might be the possible future directions for fintech innovation for smallholder farmers?

The originality of this research lies in its bibliometric examination of fintech-smallholder farmer literature, which is less studied by researchers (Sharma et al., 2024; Sanga & Aziakpono, 2023). Drawing on previous scholarship (Pandey, 2025), via main contributors identification, gaps in research, and thematic clusters, this research extends the analysis to agriculture.

The results have policy implications for agricultural economist policymakers, fintech firms, and agricultural industry players, to guide the development of inclusive digital financial systems. Because, targeted financial literacy programs and reduced regulations can help increase the adoption of fintech, enhancing resilience of smallholder farmers (Frimpong et al., 2022). To academics, the paper provides a fact-based and synthesized view of the intellectual sophistication and subject matter of fintech use in smallholder agriculture. To policymakers, it provides evidence-based priorities that can be scaled up for rural financial inclusion. For agritech companies and Fintech startups, this study identifies demand-side and contextual complexities which can design customized solutions for small farmers. Notably, the research also highlights the multidisciplinary aspect of this area, which

How to cite: Rahisha, Jamshed, M., & Khan, W. (2025). Fintech and small farmers: A bibliometric analysis of current landscape and emerging research frontiers. *Business Strategy and Management Insights*, *1*(2), 1–19. https://doi.org/10.64006/bsmi/1201

necessitates greater intersectionality among finance, technology, agriculture, and development policy stakeholders.

The rest of the paper is structure as follow: Section 2 presents an overview of research methods, data collection process, bibliometric sources used, and analysis techniques. Section 3 present the results of bibliometric analysis, publication trends, keyword co-occurrence clusters, citation and co-authorship networks, and source-level indicators. Section 4 deals with an integrated conclusion and discussion, future research directions, and limitations. Last section discusses the industry, policymaker, and researcher practical and theoretical implications of the research.

MATERIALS AND METHODS

This research attempts a bibliometric analysis to examine the research terrain of fintech use among smallholder farmers and determine frontiers of research, annotate the field, and document emerging trends over time. Bibliometric analysis, an empirical science of measurement, measures publication productivity, charts networks of collaboration, and characterizes knowledge structures through citation and co-occurrence analysis (Chen, 2006; Donthu et al., 2021). The method is in line with the study goals to identify important documents, authors, and themes, and to propose avenues for future research.

Data Gathering

The dataset was obtained from Scopus due to its extensive coverage of peer-reviewed business, economics, and agriculture journals, which provides a stable base for reducing bias (Bar-Ilan, 2010). We opted to use Scopus instead of Web of Science because the former indexes more agricultural journal (Vieira & Gomes, 2009).

Search strategy to search relevant literature employing the search query:

TITLE-ABS-KEY ("fintech" OR "financial technology" OR "digital finance" OR "mobile banking" OR "digital payment" OR "mobile money" OR "agri-fintech" AND "smallholder farmer" OR "small farmers" OR "small-scale farmers" OR agriculture OR farming OR agribusiness OR "agricultural finance")

Time Span: 2011-2025
Records Identified: 230
Records Removed Pre-Screening: Duplicates (n=0)
Records Screened: 230
Records excluded: Article type restrictions (n=88),
Language restrictions (n=3)
Full-text articles screened: 139
Records found to be ineligible: 2
Studies included: 137 (for bibliometric analysis)

Data collection was made on April 15, 2025, using the PRISMA process to enable systematic and transparent evidence collection (Page et al., 2021). The initial sweep yielded 230 records using Scopus. All 230 were screened because no duplicates were encountered. From here, 91 records were removed (88 because article type exclusion, 3 because language exclusion), reducing the pool to 137 full-text articles to be filtered on relevance. That Figure 1 illustrates the PRISMA process.

Research Instruments

VOSviewer and ScientoPyGui has been used for in-depth bibliometric analysis of fintech and smallholder farmers research articles, published in the Spain of 2013–2025. The rational for selection of this software was due to its complementary strengths in network relationship visualization and quantitative bibliometric indicator extraction, respectively, to the research purpose of mapping the research landscape, trends identification, and suggestion of areas for future research.

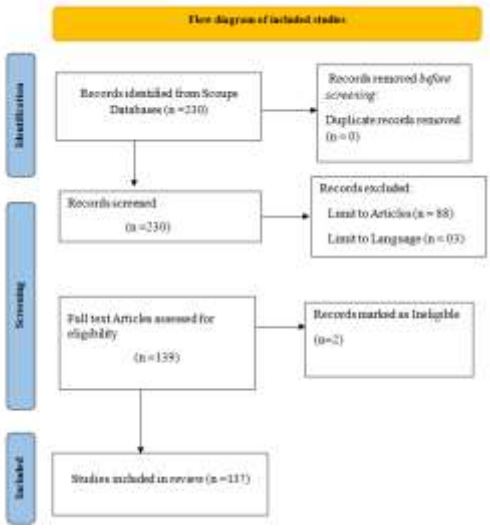


Figure 1. *PRISMA Screening and Selecting Literature Flow Diagram*

VOSviewer, developed by Van Eck and Waltman in 2009, is a dedicated software for building and visualizing bibliometric networks with robust analytical function for measuring relations among entities like authors, keywords, journals, and documents. It accommodates different kinds of analyses, including co-authorship, co-occurrence, citation, bibliographic coupling, and co-citation, which play a critical role in uncover collaboration patterns, thematic frameworks, and intellectual links within the literature (Van Eck & Waltman, 2017). Clustering and mapping by VOSviewer's algorithms result in high-quality network visualizations through node location and link strength optimization (Sood et al., 2021). For this research, VOSviewer was set to process the dataset with thresholds (e.g., at least 5 documents per country, 3 documents per author) to emphasize important relationships without cluttering the resulting networks. Its capacity to export visualizations into interactive maps facilitated interpretation of bibliometric interconnectivity considerably, for example, global collaboration networks and keyword clusters.

ScientoPyGui is a graphical user interface bibliometric tool based on Python. It use to preprocess data, perform quantitative analysis, and identify trends (Ruiz-Rosero et al., 2019). As a wrapper built on the ScientoPy library, ScientoPyGui facilitates extraction of bibliometric measures from large datasets such as publication, citation metrics, and author productivity. It provides functionalities such as filtering of data, removal of duplicates, and analysis of time trend, which is very important in pre-sorting the dataset for VOSviewer network analysis. Its provision of data exportability in a form readable by network visualization software also facilitated its integration with VOSviewer without any problems. The integration of the tools facilitated extensive probing of the fintech-smallholder farmer research environment, identifying major contributors, thematic sets, and highly impactful publication channels.

Research Methods

This study used a range of methodologies, such as quantitative bibliometric analysis, co-authorship examination, keyword co-occurrence, citation analysis, and co-citation analysis. Multi-methods were applied to provide a detailed description of publication patterns, thematic groupings, key contributors, and international collaboration trends, which yielded enriching information on the emergence of this inter-disciplinary area.

Quantitative Bibliometric Analysis

ScientoPyGui is used to retrieve pertinent bibliometric values, including cumulative publication, citations, mean citation per document, and author productivity indexes (e.g., h-index, g-index) (Díaz et al., 2016). It performs journal influence measures, i.e., cited half-life, and determined prominent countries by published work. This

method provides a statistical snapshot of the expansion, reach, and output of the field, including prolific authors, high-profile journals, and hotspots of research by region (Ruiz-Rosero et al., 2019). The data filtering of ScientoPyGui ensured that the dataset was pre-cleaned (e.g., duplicates removed) before being analyzed further.

Co-authorship Analysis

VOSviewer's co-authorship analysis mapped collaboration networks of authors, organizations, and countries. Entities one shown as nodes and co-authored publications as links, with nodes' size indicating publication numbers and link strength representing collaboration intensity (Van Eck & Waltman, 2017). The strategy aims at prominent research networks, such as institutional collaborations and cross-national collaborations, because it captured collaborative dynamics that shaped fintech-smallholder farmer studies.

Keyword Co-occurrence Analysis

VOSviewer's co-occurrence explore co-occurrence of keyword pairs in the data set where thematic clusters are formed (Van Eck & Waltman, 2017). Keywords nodes and co-occurrence indicates through links with clustering algorithms grouping similar words into areas of research focus (e.g., financial inclusion, mobile banking). The method follows research theme direction over time and highlighted the development of new themes such as application of blockchain in agriculture.

Citation Analysis

Citation analysis by VOSviewer has been done to analysis direct citations between documents and journals (Yu wt al., 2020). Analysis pinpointed influential journals and documents and give ideas towards intellectual influence and publication patterns in the area.

Co-citation Analysis

The co-citation analysis has also been done to explore how often two items (e.g., documents, journals) are cited together as a sign of intellectual similarity. Items are shown as nodes, and edges denoted co-citation intensity (Small, 1973). It produced the intellectual base map of the domain, with root works and journal-level connections.

These methods together presented a holistic framework for the study of intellectual structure, patterns of collaboration, thematic trends, and avenues for future study of fintech-smallholder farmers.

RESULT

This section provides the results of the bibliometric analysis of literature related fintech and smallholder farmers. The results were achieved through ScientoPyGui for quantitative analysis and VOSviewer for network visualization, which provide a broad outlook of the research landscape. Analyses outline the intellectual landscape, thematic development, co-authorship networks, and unfolding research boundaries in the discipline, making a data-derived basis for understanding and future research inquiry.

Quantitative Bibliometric Analysis

Annual Scientific Production

Yearly analysis of scientific production is presented in figure 2, findings show growing interest of researchers in fintech and smallholder farming over the years. Initial related publication came out in 2005, tackling the issue of mobile banking in rural areas, consistent academic publication only commenced from 2013 onward. Between the years 2013 and 2017, there was minimal publication activity as only ten documents were published during these five years. Publication activity increased steadily from 2019, with a sudden spike to 13 publications in 2020 and 17 in 2022, which is an indication of growing academic interest in digital financial solutions for agriculture.

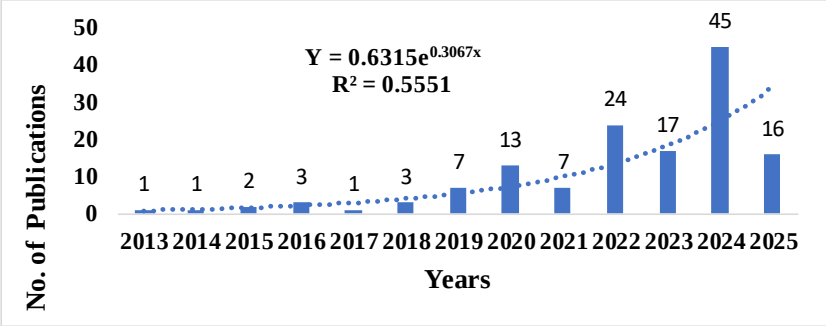


Figure 2: *Trend in Publication per Year*

The exponentially increasing (Y = 0.6315e^0.3067x, R^2 = 0.5551) shows steep growth pattern with an R^2 of 0.5551 increasing moderate fit, showing constant rises irrespective of yearly fluctuations. The publication in the area has shown a remarkable sharp increase in 2024 to publications-apparently as a result of widespread adoption of fintech instruments and increased policy concern in financial inclusion in agriculture as well as rural economy. As of April 2025, 16 publications were listed, which indicates continued scholarly vigor on the topic. Although this biannual figure may not capture the full picture of annual production, it tells much of continued interest and indicates that fintech's contribution to smallholder development is an active and growing field of research.

Table 1: Highly cited publications

Rank	Title	Journal	Years	Citations	References
1	Mobile money, smallholder farmers, and household welfare in Kenya	PLoS ONE	2014	346	Kikulwe et al., 2014
2	Digital marketplace and FinTech to support agriculture sustainability	Energy Procedia	2019	315	Anshari et al., (2019)
3	Transforming agribusiness in developing countries: SDGs and the role of FinTech	Current Opinion in Environmental Sustainability	2019	236	Hinson et al., (2022)
4	Improving access to savings through mobile money: Experimental evidence from African smallholder farmers	World Development	2020	135	Batista & Vicente, (2020)
5	Does digital inclusive finance promote agricultural production for rural households in China? Research based on the Chinese family database (CFD)	China Agricultural Economic Review	2021	125	Liu et al., 2021
6	An empirical analysis of rural farmers' financing intention of inclusive finance in China: The moderating role of digital finance and social enterprise embeddedness	Industrial management & data systems	2019	120	Aisaiti et al., (2019)

7	Configuring the digital farmer: A nudge world in the making?	Economy and Society	2021	80	Brooks (2021)
8	Mobile money adoption, input use, and farm output among smallholder rice farmers in Ghana	Agribusiness	2022	71	Abdul-Rahaman & Abdulai, (2022).
9	Financing Sustainable Agriculture in Sub-Saharan Africa: A Review of the Role of Financial Technologies	Sustainability	2023	70	Mapanje, et al., (2023).
10	The impact of digital finance use on sustainable agricultural practices adoption among smallholder farmers: evidence from rural China	Environmental Science and Pollution Research	2022	52	Zhao et al., (2022).

Highly cited Documents

Table 1 presents the most cited top ten documents in the area of fintech and smallholder farmers that reflect the intrinsic contribution made in influencing research agendas within this transdisciplinary research domain. The highest-cited paper, authored by Kikulwe et al. (2014) investigate mobile money welfare impacts for farmers in Kenya, a flagship paper with 346 citations. Anshari et al. (2019) and Hinson et al. (2022) allude to the strategic importance of digital platforms and fintech in enabling sustainable agriculture and realization of the Sustainable Development Goals (SDGs).

Empirical research like Batista & Vicente (2020) and Liu et al. (2021) examines the effect of digital finance and mobile money on agricultural productivity and savings, especially in China and Africa. Aisaiti et al. (2019) incorporate social enterprise dynamics, which provide rural financing plans in China. Recent publications like Brooks (2021) and Abdul-Rahaman & Abdulai (2022) explore behavioral reactions and farm production with fintech adoption.

Lastly, Mapanje et al. (2023) and Zhao et al. (2022) connect digital finance with sustainable agriculture, in a research shift. These lead-cited articles as a corpus represent the interdisciplinary and international possibilities of fintech to improve smallholder agriculture via financial inclusion, innovation, and sustainability.

Source

ScientoPyGui was used to explore journal-level trends of publications in the area of fintech and smallholder farmer research, using literature from 2013 up to April 2025. As shown in Figure 3, Resources Policy has remained steadily active, publishing 1–2 papers per year and a high of four papers in 2024. The trend is consistent with increasing policy-focused discussion of digital finance for agriculture. Other high-ranked journals are PLOS ONE and Sustainability (Switzerland), which exhibited significant activity in 2021–2024, especially at the peak in 2022, as would be expected from a very high correlation between sustainability, digital innovation, and rural financial inclusion.

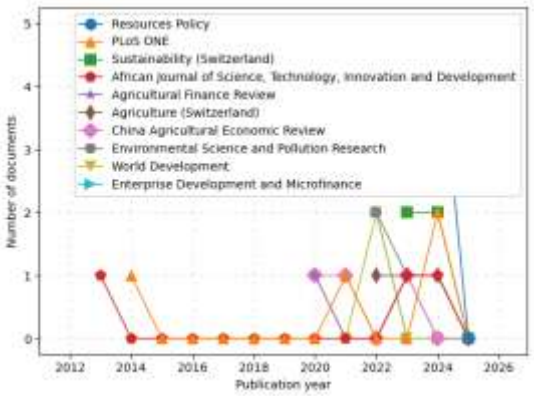


Figure 3: *Trends in Journal Publications*

From the citation data, Table 2 shows the interdisciplinary nature and scholarly impact of the leading contributor journals. The highest cited journal is PLOS ONE with 186 citations, reflecting its standing as a highly ranked outlet for publishing research spanning the boundaries of agriculture, health, and information technology. China Agricultural Economic Review with 109 citations highlights the economic and policy aspects of fintech adoption, especially in the context of developing economies.

Environmental sustainability is a central theme, as the high citation rate of journals like Environmental Science and Pollution Research (100 citations) and Journal of Cleaner Production (64 citations). The presence of Sustainability (Switzerland) and Agriculture (Switzerland) also indicates the inclusion of fintech applications in food security and sustainable agricultural practice themes.

The review ascertains that fintech-related agriculture research is not limited to a single disciplinary also but rather spreads across an extensive range of academic disciplines—encompassing development economics, environmental science, public health, to agribusiness. The diversity of journals indicates a rich and growing interdisciplinary base, provide good scope for future research.

Table 2: Top 10 Journal

S. No	Journal	Subject Area	Citations
1	PLOS ONE	Multidisciplinary Science, Agriculture, Public Health	186
2	China Agricultural Economic Review	Agricultural Economics, Rural Finance, Development Policy	109
3	Environmental Science and Pollution Research	Environmental Science, Pollution Studies, Public Health	100
4	World Development	Development Economics, Agricultural Development, Rural Studies	73
5	Journal of Cleaner Production	Environmental Management, Sustainability, Green Technology, Industrial Ecology	64
6	Agribusiness	Agricultural Business, Food Economics, Supply Chain Management	47
7	Global Food Security	Food Systems, Agricultural Economics, Sustainable Development	37
8	Agriculture (Switzerland)	Agricultural Sciences, Food Security, Crop Production	32

9	International Journal of Environmental Research and Public Health	Public Health, Environmental Health, Epidemiology, Health Policy	31
10	Sustainability (Switzerland)	Sustainable Development, Environmental Sciences, Climate Policy, Agriculture	27

Production country wise

In Figure 4 and Table 3, country-level analysis reveals engaged worldwide activity in research on fintech and smallholder farmers with varying productivity levels, academic impact, and worldwide cooperation are presented China leads in publication numbers with 50 papers, which show its strategic leadership in driving discourse on rural financial innovation. Though its research impact is moderate with a mean of 13.8 citations per article, reflecting breadth of coverage in research but variable citation performance.

In contrast, the United States with less than 20 publications, holds the highest overall citation rate (638) and a high per-article average of 106.3 citations. This suggests that authors of United States less prolific, have a large impact on intellectual material and exposure within the field. Likewise, Germany, Brazil, and Portugal, with fewer publications, have high per-article citation rates of 29.2, 67, and 64 respectively, indicating highly effective and academically notable production.

India, with 12 articles and a combined 32 citations (average 4), indicates increasing scholarly interest but is in the emerging stage with vast potential for greater global reach. African nation like Kenya and Ghana, both with seven articles, are also contributing.

The discipline is characterized by a growing web of international collaborations, as seen through the occurrence of multi-national patterns of authorship. Studies include authors from Asia, Africa, Europe, and North America, as a reflection of the common global aspiration to solve rural development issues using digital financial solutions. Notably active publication in China, India, Kenya, and Ghana places Asia and Africa on the map as new centers of fintech-agriculture scholarship, especially in the post-2005 period of rapid digitalization. On the other hand, Western countries like United States and Germany's high citation performance places them firmly in their continued status as sources of theoretical and methodological excellence.

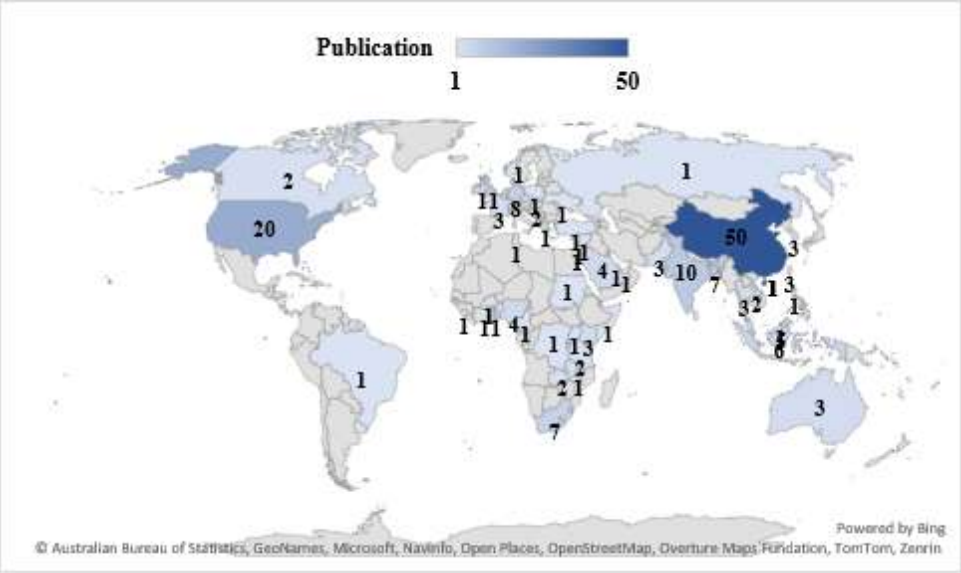


Figure 4: *Country Collaboration Network Map*

Table 3: Most Cited Countries

Country	Total Citation	Average Article Citations
USA	638	106.3
China	619	13.8
Germany	146	29.2
Ghana	115	12.8
United Kingdom	91	15.2
Indonesia	79	19.8
Brazil	67	67
Portugal	64	64
India	32	4
Malaysia	28	14

Author

Figure 4a presents the number of papers for the top 10 authors as a cumulative number and reveals insignificant output until 2015 and a sudden hike thereafter. Wang Y. is the top author with five papers up to 2025, reflecting active scholarly work on a regular basis to followed by Musshoff O with four publications. Other prominent authors such as Zhang Y., Li H., Qaim M., Zhang X., Liu X., Liu L., Ma W., and Zhou X. each contributed three to four documents, with most of their publications occurring after 2015—a time when global interest in digital innovation in agriculture was growing.

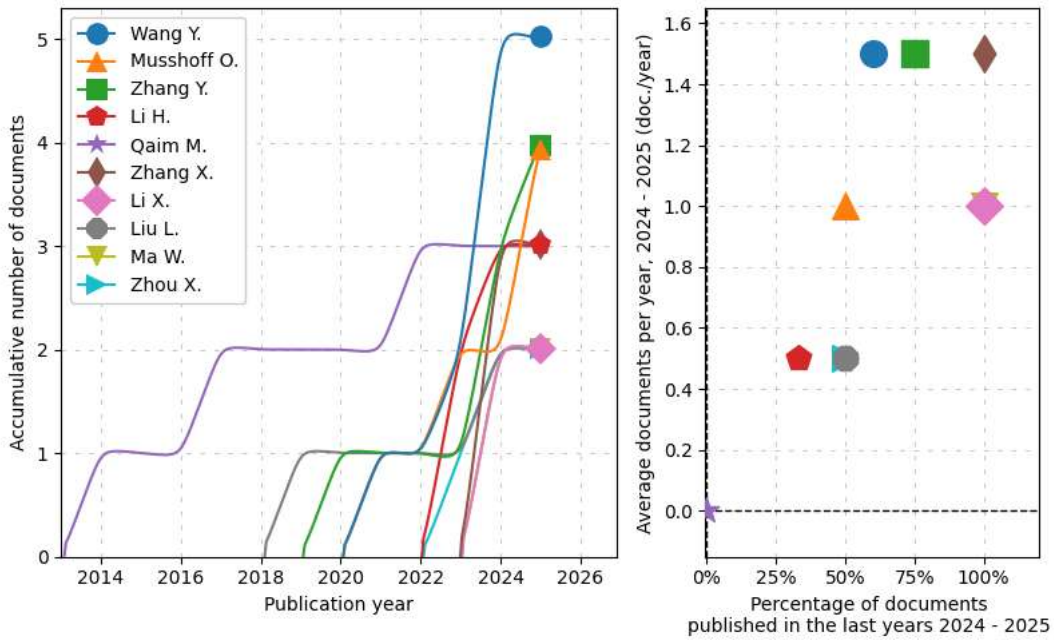


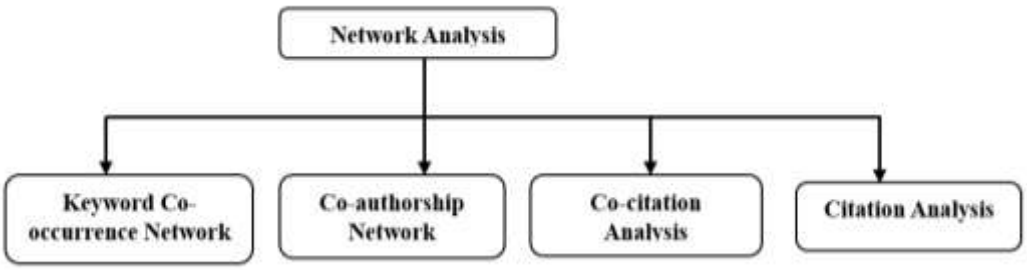
Figure 4 (a & b): *Highest Productive Writers*

Figure 4b verifies this by showing recent productivity patterns for the years 2024–2025. It plots the average per year publications against the proportion of each author's total output in these years. Wang Y. is a standout with an

average of 1.4 per year, 100 percent of their scholarly output in the last two years, which reflects a high and recent surge in publication in this area. Musshoff O. has a high-profile average of 1.2 papers per annum, 75 percent of which were published within the same time frame, indicating continuous momentum. This grouping of productivity points towards Wang Y.'s pivotal status in the setting of the modern agenda under this research area, perhaps indicative of specialization in digital finance, agriculture rural development. The more elevated grouping of output after 2015, and specifically across 2024–2025, indicates shifting momentum of intellectual interest tripped by progress in technology, increasing policy enablers in financial inclusion, as well as general appreciation for the capacity of fintech in changing smallholder agriculture.

Network Analysis

To uncover the intellectual underpinnings, research partnerships, and research topic associations in FinTech and smallholder farmers, network analysis using VOSviewer was employed. This help in mapping and interpretation of bibliometric relationships among publications, authors, keywords, and citations. By analyzing co-authorship networks, keyword co-occurrence patterns, citation relationships, and co-citation clusters, this analysis reveals the disciplinary makeup as well as collaborative forces driving this new field of study. Networks plotted hold important information regarding leading contributors, geographic research clusters, and research themes in transition.



Keyword Co-occurrence Network

In order to find out the thematic environment of the fintech and smallholder farmer scholarly literature, VOSviewer was used to conduct keyword co-occurrence analysis. The visualization produced (Figure 5) identifies four clusters, each representing a prominent area of concern, based on the frequency and co-occurrence of the most frequent words in the corpus.

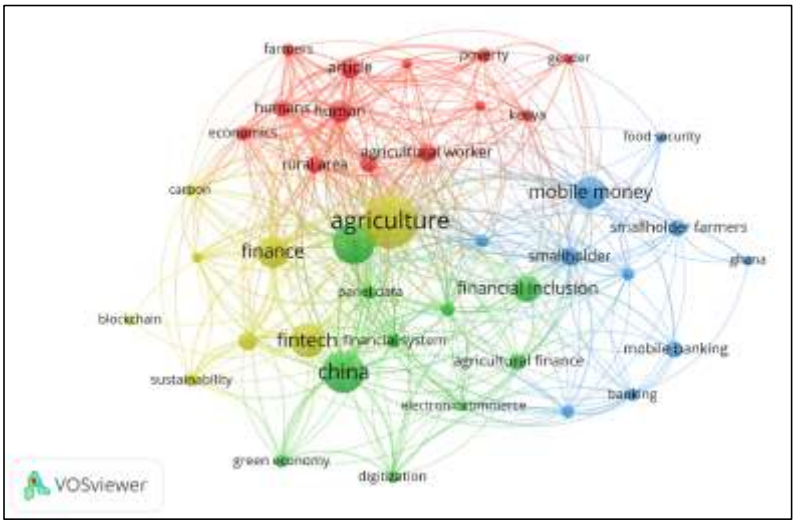


Figure 5: *Keyword Co-occurrence Network*

Cluster 1 (Green) – Fintech, Financial Inclusion, and Digital Transformation

This cluster is built around words like fintech, financial inclusion, china, digitization, electronic commerce, and financial system. The fact that these words appear indicates the presence of an emergent literature concerned with the question of how digital financial services and fintech innovations are revolutionizing access to finance, especially in agriculture. Financial inclusion as a keyword is a pivot between fintech and agricultural finance because it plays a key role in facilitating smallholder entry into the digital economy.

Cluster 2 (Blue) – Smallholder Farmers and Mobile Money

This cluster contains words such as smallholder farmers, mobile money, mobile banking, Ghana, banking, and food security. This is a study of the use of mobile financial services by smallholder farmers based in the rural areas. The use of mobile money as an instrument in the provision of financial services and its implications on productivity, income, and food security are a major area of study in this theme area.

Cluster 3 (Yellow) – Agriculture, Finance, and Sustainability

Important words in this cluster are agriculture, finance, panel data, green economy, sustainability, and blockchain. The cluster indicates the convergence of agricultural finance with sustainable agriculture and technology advances like blockchain. The connection between agriculture and wider economic and environmental objectives is indicated by the co-occurrence of words like green economy and sustainability, implying a multidisciplinary strategy.

Cluster 4 (Red) – Socioeconomic and Human-Centric Characteristics

This cluster contains words like article, humans, poverty, gender, rural area, farmers, and kenya. It captures the social science nature of the research, considering poverty reduction, gender relations, and socio-economic conditions of rural societies. The predominance of country-specific words like kenya is indicative of case-based studies based on regional development issues and policy interventions.

Collectively, the keyword co-occurrence network illustrates a prosperous, cross-disciplinary research culture. Although the conceptual pillars are fintech and agriculture, the area of research is bolstered by a range of disciplines that also contribute to the field, such as development studies, environmental economics, digital banking, and gender studies. This blend illustrates the intricate, multi-faceted nature of research at the nexus of financial innovation and smallholder agriculture.

Co-authorship Network

The country-level co-authorship network, as depicted in VOSviewer, reveals changing trends in global cooperation in fintech and smallholder agriculture. The network map (Figure 6) reveals clear clusters of scholarly cooperation, geographically concentrated and thematically related among contributing nations.

China is among the highest-ranked hubs in the network with high cooperative links to Vietnam, Malaysia, Pakistan, and France. This suggests China's leadership in the direction of research agendas and its proactiveness in cross-border scholarship. Likewise, the United States also constitutes an important cluster of collaborations, most notable with Germany, Kenya, and Thailand, representing its dominance in establishing cross-regional research collaborations and generating high-impact research. India exhibits a modest but rising degree of international cooperation, with interfaces with China, Canada, and South Africa. This is a reflection of greater international integration of Indian researchers within the fintech-agriculture space. The total network structure indicates four large clusters, mostly geographically organized and similar in thematic focus. The overlap of developed and developing countries within the same collaborative clusters reflect to rich academic diversity. The trend corroborates the universal applicability of fintech to solve agriculture finance solution issues and the need for interdisciplinary and global collaborations to evolve the field.

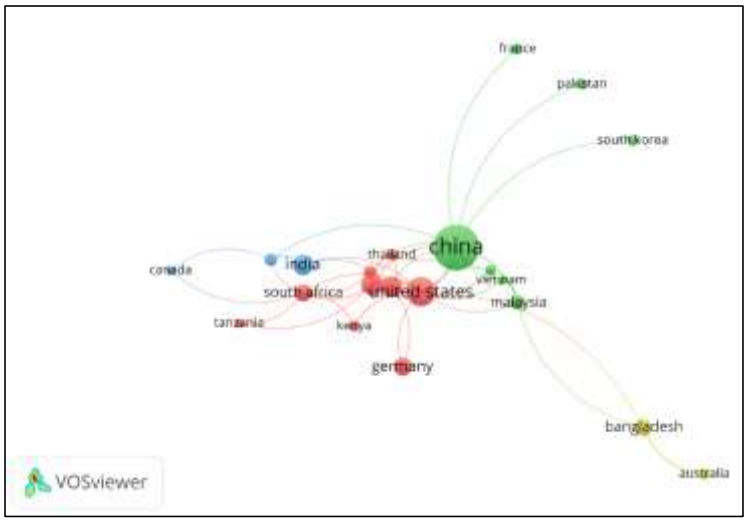


Figure 6: Network of Co-authorship by Countries

Author Co-citation Analysis

Author co-citation yields sound information regarding intellectual basis and changing themes of fintech research for smallholder farmers. Figure 7 presents four different clusters that are identified by the analysis, each representing an accumulation of scholarly influence and thematic agreement between widely co-cited authors.

The first cluster (Red) is centered on leading contributors like Suri, Jack, and Sekabira, whose research has informed the discussion of mobile money and financial inclusion in low-income and rural communities. This cluster also comprises methodologically innovative researchers like Greene and Abor, which captures high empirical and econometric foundations in initial studies of digital finance and development.

The second cluster (Blue) includes authors such as Liu, Zhou, and Aziz and represents an expanding literature with a focus on mobile technologies and wider policy and institutional concerns. This thematic thread represents an extension of fintech use from financial inclusion to digital transformation and governance in various regional contexts.

Another group (Green) includes Jack, Riley, and Ahmad, with the research interest focused on socio-economic impacts of mobile money offerings, especially Sub-Saharan Africa. The widespread nature of researchers such as Jack and Suri cuts across groups in evidence of the similarity across numerous themes in their areas of activity. The fourth cluster (Yellow) groups scholars such as Kikulwe, Fischer, Qaim, and Batista, who examine the integration of mobile finance into rural livelihoods, agricultural productivity, and risk-reduction measures. Policy-centered scholars such as Demirguc-Kunt and Klapper are also represented well in this group, and their work connects micro-level financial behavior to broader development policy agendas.

In combination, these clusters demonstrate how fintech studies are deeply connected to agricultural development. Many authors, who have been co-cited, have examined how digital financial services affect farm-level choices, usage of inputs, and coping strategies, emphasizing the contribution of fintech to financial inclusion and upgrading of smallholder farm systems and rural economies. The patterns of co-citation show a lively and diverse research environment. Early research in mobile money has set the ground for more and more interdisciplinary research linking financial technology with agricultural development, poverty alleviation, and institution building. Tightly clustered groups show an established area of research with intellectual leaders and increasing numbers of participants that add diversity to the discussion.

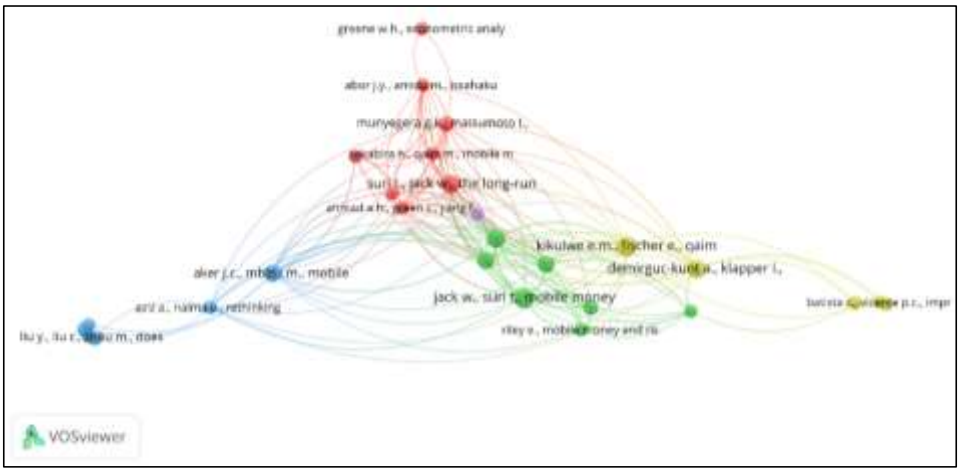


Figure 7: Author Co-citation Network

Citation Network

The citation network gives a formalized picture of the scholarly influence and thematic evolution in fintech and smallholder farmers. As seen in Figure 8, the network captures interconnected clusters of highly cited studies, with seminal contributions and more contemporary, influential papers defining the field.

The largest cluster centers on the seminal article by Suri (2016) as a central point of reference as a top citation hub. This cluster, with core studies, emphasizes the original priority of mobile banking and its continued involvement in rural financial inclusion. This cluster corresponds to subsequent research by scholars such as Brooks (2021) , signalling continuity in research on the socioeconomic effect of mobile financial services.

There exists a dense cluster for another influential paper by Sekabira (2017), which analyzes the contribution of financial inclusion to agricultural household wellbeing. This article has strong citation associations with other papers in the same theme reflecting continued interest in financial conduct and household-level impacts.

Cluster erupting trends are encompassed by recent research like Yang (2024) and Song (2022) that explores new money technologies in rural environments. Such research signifies the trends towards newer trends in research, e.g., the usage of fintech instruments beyond traditional mobile money molds.

The other group consists of Liu (2021), Aisaiti (2019), and Wang (2021), which, although fairly recent, are attracting academic attention. Their growing citation numbers reflect greater interest in a number of subjects like digital credit, rural fintech ecosystems, and regional policy analysis.

Generally, the network exhibits a neatly constructed pattern of citation, with Suri (2016) at the base of the core literature and a range of subsequent publications stretching out the intellectual space. The citation patternindicates both continuity of interest in the core questions such as mobile banking and widening into more developingthemes in rural digital finance and agricultural innovation.

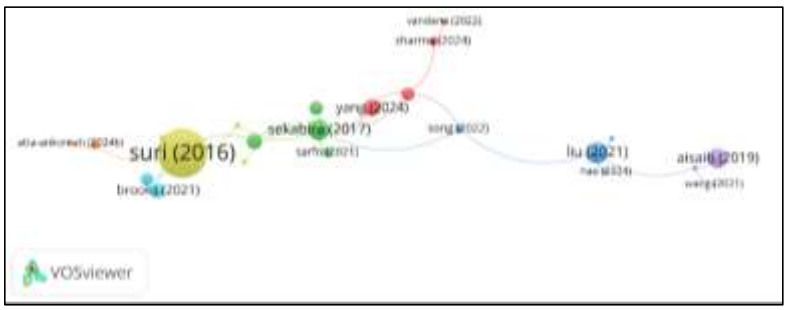


Figure 8: Citation Network

DISCUSSION

The bibliometric analysis of 137 articles on fintech among smallholder farmers shows an evolving and interdisciplinary field of research with increasing scientific attention and theme diversity. The rapid growth in the number of publications after 2020 indicates that the intersection of financial technology and small-scale farming is quickly becoming a top field of inquiry, motivated by the world's digital financial inclusion and sustainable development agenda. The extraction of four main clusters of research: (i) fintech, financial inclusion, and digital transformation; (ii) mobile money and smallholder farmers; (iii) agriculture, finance, and sustainability; and (iv) socio-economic and human-centric dimensions, represents the wide and inclusive thematic framework of the discipline. The clusters align with wider global agendas such as the United Nations Sustainable Development Goals (SDGs), namely poverty reduction, responsible innovation, and climate-resilient agriculture.

The availability of high-impact journals across fields, spanning environmental science (Environmental Science and Pollution Research) to development economics (World Development) to digital innovation (Journal of Cleaner Production), demonstrates the cross-disciplinary interest in this topic. Likewise, research leadership outputs by nations like China, the United States, and Ghana, with increasing participation from India and Sub-Saharan Africa, demonstrate a geographically dispersed research landscape. Notably, China possesses the greatest number of publications, the United States shows the greatest citation impact, indicating the qualitative aspect of academic influence.

The co-authorship and author analysis indicate growth research clusters with reasonable representation of developed and developing economies. But the comparatively low rates of international collaboration indicate a need for more cross-regional collaborations to facilitate knowledge exchange and locally enabled fintech innovations.

The co-citation and citation network easily identifies a core focus on mobile money (e.g., Suri and Jack), but also identifies an emergent literature on digital credit, platform design for inclusive finance, and behavioral intention. Emerging research on innovative technologies like AI, blockchain, and satellite-insurance systems are the emerging wave of innovations, though with very minimal existing penetration in research.

Although these are encouraging trends, this analysis findings critical gaps. Firstly, gender-sensitive research has too little representation, despite women being a major percentage of smallholder farmers. Secondly, studies of the long-run effect of fintech uptake on productivity, resilience, and livelihoods are scarce. Thirdly, there are weak institutions and regulatory systems, critical for scaling fintech, especially in low-income economies. These gaps are areas with potential for future research.

To further develop the field, future research should include mixed-methods approaches involving bibliometric mapping and qualitative case studies. It should also perform comparative evaluations based on regions and technologies and utilize the co-design of fintech instruments in cooperation with local stakeholders. There is also a need to urgently examine ethical concerns, digital divides, and data governance in fintech application for agriculture.

CONCLUSION, FUTURE RESEARCH DIRECTIONS, AND LIMITATIONS

This study establishes a detailed bibliometric overview of the academic literature through the intersection of smallholder agriculture and financial technology (fintech). Based on peer-reviewed studies published in Scopus, indexed journal using VOSviewer and ScientoPy, this research has established the intellectual landscape, leading authors, top-cited journals, geographic distribution, and changing topical themes for this literature. The research shows an escalating trend in academic activity in the last decade with a colossal explosion of papers following 2020, echoing increased recognition of the contribution being made by fintech in remolding rural financial scenes and addressing challenges confronting smallholder farmers.

The analysis found four general research topics: digital financial inclusion, smallholder farmer and mobile money usage, fintech applications for sustainability, and gendered and socio-economic dimensions of rural finance. These topics reflect the multi-disciplinary nature of the field and its interconnectedness with global development

agendas, especially those relating to the United Nations Sustainable Development Goals. In addition, the findings accentuate interdisciplinary research, with strong implications from economics, development studies, agricultural sciences, and information systems.

With regard to this study's thematic gaps and clusters, future studies could investigate the following major dimensions. Firstly, there is a critical need to address the gendered nature of the uptake of fintech by smallholder farmers since previous research hardly disaggregates by gender even as women are at the center of agriculture systems. Further, long-term socio-economic effects of fintech interventions, such as on household income, productivity, and resilience to shocks relative to climate variability and market volatility, need to be evaluated in future studies. Additionally, new-age technology innovations like blockchain to traceable supply chain, artificial intelligence to evaluate credit risk, and crop insurance based on satellite imagery provide rich opportunities for innovation-focussed studies. Cross-geographic comparative studies, especially between developed and emerging markets, can yield insightful information on contextual enablers and impediments to digital finance adoption. Moreover, additional research on national policy frameworks, regulatory innovations, and public-private partnerships is needed to determine how institutional arrangements affect fintech solutions' scalability and sustainability. Follow-up research would further be strengthened through higher levels of interaction with entrepreneurs, fintech start-ups, and agricultural extension institutions for co-creation and piloting of context-appropriate digital finance models. Stakeholder-inclusive and inter-disciplinary research will be essential to developing inclusive, effective, and scale-able fintech systems for smallholder farmers.

Although this study is a significant contribution to knowledge systematization in the nexus of agriculture and fintech, it does come with some caveats. Analysis was restricted to the Scopus database, possibly may not cover all relevant literature, especially regional or grey literature. It only considered English-language sources, possibly missing leading-edge contributions in other languages. Additionally, the bibliometric practices employed are based on metadata like title, abstract, and keywords, hence restricting the range of content-level analysis. Lastly, since fintech innovation is dynamic and keeps evolving with gigantic pace in its applications in agriculture, future revisions of this analysis will have to include new trends and research shifts emerging.

IMPLICATIONS

Theoretical Implications

The present study offers theoretical implication. This research adds to the theoretic advancement of the fintech-agriculture interface through providing a data-rich synthesis of extant research and mapping important intellectual terrains, emergent themes, and research lacuna areas. Using bibliometric methods, the research enlarges the theoretical basis of financial inclusion, rural development and the conceptualization and analysis of fintech innovation cross-disciplinarily. Specifically, the study emphasizes the way digital financial technologies are being integrated deeply into agricultural systems to address longstanding challenges of smallholder farmers like access to credit, market participation, and income security.

The co-citation and keyword co-occurrence results identify the development of theory from isolated research on mobile money and microfinance to newer paradigms like digital platforms, behavior intention theory models, and sustainable finance. This shift also reflects a growing emphasis on the application of fintech in agricultural contexts, where digital tools are increasingly leveraged to enhance farm productivity, enable access to agricultural credit, and support climate-resilient farming practices.

In addition, the study weaves concepts from development studies, economics, and information systems to add depth to the multidisciplinary focus of fintech research in agriculture. The study encourages researchers towards the use of hybrid models incorporating technology adoption theories (such as UTAUT, TAM) and rural development and socio-economic resilience theories. The characterization of thematic gaps, e.g., the insufficiency of proper theorization of gender, governance, and platform ethics, translates into a challenge to future theoretical work that remains responsive to intersectionality and institutional variety in fintech adoption.

Practical Implications

For policymakers, the research highlights the need for investment in digital infrastructure, especially in poor among farmer, where device and connectivity access are still a significant constraint. Enhancing regulatory environments to enable secure, accessible, and inclusive digital financial services will contribute signi ficantly to the adoption of digital financial services among smallholder farmers. The research also highlights the need for gender-insensitive policy and financial literacy initiatives in light of the identified access and digital capability gaps. Finally, the research outfits NGOs, cooperatives in rural areas, and agricultural extension agencies with a strategic map of the digital finance value chain for smallholder farmers with which to campaign for inclusive technology and to better engage with fintech stakeholders.

AUTHOR DECLARATIONS

CRediT author statement / Author contributions

Rahisha: Conceptualization; Writing – Original Draft; Visualization; Methodology.
Mohammed Jamshed: Conceptualization; Software; Validation; Formal Analysis; Investigation.
Waseem Khan: Writing – Review & Editing; Resources: Supervision; Project Administration.

Acknowledgment: The authors would like to state that no specific funding or support was received for this study.

Conflict of interest: The author(s) declare no conflicts of interest.

AI statement: This work has benefited from the use of Grammarly, an AI-powered language tool, which assisted in grammar checking, spelling correction, and clarity improvements. No generative content was produced by Grammarly; the responsibility for the ideas, interpretations, and conclusions remains solely with the authors.

PUBLISHER'S NOTE: All claims expressed in this article are solely those of the authors and do not necessarily represent those of the publisher, the editors and the reviewers. This journal remains neutral with regard to jurisdictional claims in published institutional affiliation.

REFERENCES

Abdul-Rahaman, A., & Abdulai, A. (2022). Mobile money adoption, input use, and farm output among smallholder rice farmers in Ghana. *Agribusiness*, *38*(1), 236-255.

Anshari, M., Almunawar, M. N., Masri, M., & Hamdan, M. (2019). Digital marketplace and FinTech to support agriculture sustainability. *Energy Procedia*, *156*, 234-238.

Aisaiti, G., Liu, L., Xie, J., & Yang, J. (2019). An empirical analysis of rural farmers' financing intention of inclusive finance in China: The moderating role of digital finance and social enterprise embeddedness. *Industrial management & data systems*, *119*(7), 1535-1563.

Bar-Ilan, J. (2010). Citations to the "Introduction to informetrics" indexed by WOS, Scopus and Google Scholar. *Scientometrics*, *82*(3), 495-506.

Bastian, M., Heymann, S., & Jacomy, M. (2009, March). Gephi: an open source software for exploring and manipulating networks. In *Proceedings of the international AAAI conference on web and social media* (Vol. 3, No. 1, pp. 361-362).

Batista, C., & Vicente, P. C. (2020). Improving access to savings through mobile money: Experimental evidence from African smallholder farmers. *World Development*, *129*, 104905.

Brooks, S. (2021). Configuring the digital farmer: A nudge world in the making?. *Economy and Society*, *50*(3), 374-396.

Chen, C. (2017). Science mapping: a systematic review of the literature. *Journal of data and information science*, *2*(2).

Demirguc-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2018). *The Global Findex Database 2017: Measuring financial inclusion and the fintech revolution*. World Bank Publications.

Díaz, I., Cortey, M., Olvera, À., & Segalés, J. (2016). Use of H-index and other bibliometric indicators to evaluate research productivity outcome on swine diseases. *PloS one*, *11*(3), e0149690.

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of business research*, *133*, 285-296.

FAO. (2023). *Digital Agriculture Report*. Food and Agriculture Organization.

Food and Agriculture Organization, F. A. A. O. (2017). The state of food and agriculture 2017: leveraging food systems for inclusive rural transformation.

Forbes. (2023). Fintech solutions for climate resilience in agriculture. Retrieved from https://www.forbes.com

Frimpong, S. E., Agyapong, G., & Agyapong, D. (2022). Financial literacy, access to digital finance and performance of SMEs: Evidence From Central region of Ghana. *Cogent Economics & Finance*, *10*(1), 2121356.

Gao, Q., Cheng, C., Sun, G., & Li, J. (2022). The impact of digital inclusive finance on agricultural green total factor productivity: Evidence from China. *Frontiers in Ecology and Evolution*, *10*, 905644.

Hinson, R., Lensink, R., & Mueller, A. (2019). Transforming agribusiness in developing countries: SDGs and the role of FinTech. *Current Opinion in Environmental Sustainability*, *41*, 1-9.

Jack, W., & Suri, T. (2014). Risk sharing and transactions costs: Evidence from Kenya's mobile money revolution. *American Economic Review*, *104*(1), 183-223.

Kamilaris, A., Fonts, A., & Prenafeta-Boldó, F. X. (2019). The rise of blockchain technology in agriculture and food supply chains. *Trends in food science & technology*, *91*, 640-652.

Kikulwe, E. M., Fischer, E., & Qaim, M. (2014). Mobile money, smallholder farmers, and household welfare in Kenya. *PloS one*, *9*(10), e109804.

Kshetri, N. (2017). Blockchain's roles in strengthening cybersecurity and protecting privacy. *Telecommunications policy*, *41*(10), 1027-1038.

Liu, Y., Liu, C., & Zhou, M. (2021). Does digital inclusive finance promote agricultural production for rural households in China? Research based on the Chinese family database (CFD). *China Agricultural Economic Review*, *13*(2), 475-494.

Market Data Forecast. (2024). Fintech Market Size, Share, Analysis & Growth Report, 2033. Retrieved from https://www.marketdataforecast.com

Mapanje, O., Karuaihe, S., Machethe, C., & Amis, M. (2023). Financing sustainable agriculture in sub-saharan africa: a review of the role of financial technologies. *Sustainability*, *15*(5), 4587.

Mehrabi, Z., McDowell, M. J., Ricciardi, V., Levers, C., Martinez, J. D., Mehrabi, N. & Jarvis, A. (2021). The global divide in data-driven farming. *Nature Sustainability*, *4*(2), 154-160.

Omokhoa, H. E., Odionu, C. S., Azubuike, C., & Sule, A. K. (2024). AI-powered fintech innovations for credit scoring, debt recovery, and financial access in microfinance and SMEs. *Gulf Journal of Advance Business Research*, *2*(6), 411-422.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *bmj*, *372*.

Pandey, D. K. (2025). FinTech and small and medium enterprises: current state and future directions. *The TQM Journal*.

Ruiz-Rosero, J., Ramírez-González, G., & Viveros-Delgado, J. (2019). Software survey: ScientoPy, a scientometric tool for topics trend analysis in scientific publications. *Scientometrics*, *121*(2), 1165-1188.

Saini, S., & Chowdhury, A. (2023). India's small and marginal farmer. Arcus Policy Research. Retrieved from https://arcusresearch.in

Sanga, B., & Aziakpono, M. (2023). FinTech and SMEs financing: A systematic literature review and bibliometric analysis. *Digital Business*, *3*(2), 100067.

Sharma, A., Mohan, A., Johri, A., & Asif, M. (2025). Determinants of financial technology (FinTech) adoption by the farmers in agrarian economy. *Social Sciences & Humanities Open*, *11*, 101370.

Sharma, S. K., Ilavarasan, P. V., & Karanasios, S. (2024). Small businesses and FinTech: A systematic review and future directions. *Electronic Commerce Research*, 24(1), 535–575. 10.1007/s10660-023-09705-5

Sekabira, H., & Qaim, M. (2017). Mobile money, agricultural marketing, and off-farm income in Uganda. *Agricultural Economics*, *48*(5), 597–611. https://doi.org/10.1111/agec.12360

Small, H. (1973). Co-citation in the scientific literature: A new measure of the relationship between two documents. *Journal of the American Society for information Science*, *24*(4), 265-269.

Song, K., Tang, Y., Zang, D., Guo, H., & Kong, W. (2022). Does digital finance increase relatively large-scale farmers' agricultural income through the allocationof production factors? Evidence from China. *Agriculture*, *12*(11), 1915. https://doi.org/10.3390/agriculture12111915

Sood, S. K., Kumar, N., & Saini, M. (2021). Scientometric analysis of literature on distributed vehicular networks: VOSViewer visualization techniques. *Artificial Intelligence Review*, 1-33.

Suri, T., & Jack, W. (2016). The Long-Run Poverty and Gender Impacts of Mobile Money. Science, 354, 1288-1292. https://doi.org/10.1126/science.aah5309

Touch, V., Tan, D. K., Cook, B. R., Li Liu, D., Cross, R., Tran, T. A. & Cowie, A. (2024). Smallholder farmers' challenges and opportunities: Implications for agricultural production, environment and food security. *Journal of Environmental Management*, *370*, 122536.

Van Eck, N. J., & Waltman, L. (2017). *VOSviewer manual version 1.6. 6. Leiden, The Netherlands: Universiteit Leiden*.

Van Eck, N., & Waltman, L. (2009). Software survey: VOSviewer, a computer program for bibliometric mapping. *scientometrics*, *84*(2), 523-538.

Vieira, E. S., & Gomes, J. A. (2009). A comparison of Scopus and Web of Science for a typical university. *Scientometrics*, *81*, 587-600.

Wang, S. (2021). Online Learning Behavior Analysis Based on Image Emotion Recognition. Traitement Du Signal, 38, 865-873. https://doi.org/10.18280/ts.380333

Yu, Y., Li, Y., Zhang, Z., Gu, Z., Zhong, H., Zha, Q., & Chen, E. (2020). A bibliometric analysis using VOSviewer of publications on COVID-19. *Annals of translational medicine*, *8*(13), 816.

Yang, Y., Qi, C., Gu, Y., & Fang, G. (2024). *Use efficiency, reduction potential, and effects of fertilizers on carbon emissions in China's major citrus regions.*

Zhao, P., Zhang, W., Cai, W., & Liu, T. (2022). The impact of digital finance use on sustainable agricultural practices adoption among smallholder farmers: An evidence from rural China. *Environmental Science and Pollution Research*, *29*(26), 39281-39294.