BRIDGING THE GAP: AN ANALYSIS OF FINTECH-DRIVEN FINANCIAL INCLUSION FOR SMALLHOLDER FARMERS IN SOUTHERN AFRICA (A BIBLIOMETRIC REVIEW)

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Abstract

This study provides a systematic bibliometric analysis of fintech-driven financial inclusion for Southern African smallholder farmers. Financial exclusion severely limits these farmers' productivity and resilience, trapping them in cycles of poverty. Fintech offers transformative solutions through mobile money, digital credit, and insurtech. The research employs a multi-theoretical framework to analyse adoption, impact, and ecosystem dynamics. A review of empirical literature documents both the costs of exclusion and the benefits of inclusion. The methodology involves sourcing relevant documents from the Scopus database for quantitative and thematic analysis. Key findings reveal a field in a state of emergence with exponential growth in publications since 2021. The intellectual structure comprises six thematic clusters, including AI-driven finance and digital ecosystems. Analysis shows a pronounced dependence on knowledge production from outside the African continent. This indicates a gap in locally anchored research perspectives. The study concludes by proposing a critical future research agenda that deepens the contextual and longitudinal studies on fintech adoption and impact. Further research should bridge the implementation gap by examining viable business models; investigating robust consumer protection frameworks for vulnerable farmers; intersectional analysis of how gender, age, and land tenure shape financial access and exploring the synergy between fintech and other Fourth Industrial Revolution technologies.

Keywords: *Bibliometrics; Digitalisation; Agriculture; Mobile; Ecosystem*

JEL Classification: *O33, Q14, G23, O55, O16*

1. Introduction

Smallholder farmers form the foundation of agricultural production and food security across Southern Africa. Despite their fundamental role, there exists a deep financial inclusion gap that repeatedly challenges their capability. Smallholder farmers are commonly excluded from formal financial systems, and this restrains their expansion and resilience. Traditional banking institutions perceive smallholder farmers as high-risk, low-profit clients, leading to their exclusion. This perception is driven by factors such as a lack of conventional collateral and irregular income streams. Smallholder farmers are normally located in remote, poorly serviced areas which further compounds this financial marginalisation [1].

The consequences of this exclusion are severe and multifaceted for Southern African smallholder farmers. Without access to credit, small-holder farmers cannot invest in quality seeds or required fertilisers. Smallholder farmers also remain vulnerable to climatic shocks as they do not have capital to set up irrigation or agricultural insurance. This often forces smallholder farmers into distress sales of their produce at low unsustainable prices. Consequently, smallholder farmers remain locked in a vicious cycle of subsistence farming and poverty [2]. This cycle perpetuates food insecurity and constrains rural economic development and sustainability across Southern Africa. To address the exclusion challenge, technologically innovative solutions that transcend traditional banking models are required.

Financial technology (fintech) presents a transformative pathway to bridge the financial inclusion gap towards smallholder farmers in Southern Africa. Leveraging digital tools, fintech can overcome barriers that financially exclude smallholder farmers. Platforms such as mobile money

and internet banking drastically reduce transaction costs of financial services. Mobile money platforms also avail credit facilities to smallholder farmers. Digital credit models utilise alternative data to assess creditworthiness beyond the traditional physical collateral. Fintech also avails index-based insurance products that are linked to satellite data which offer protection against climate risks [3]. These solutions integrate farmers into the digital economy, thereby creating an enabling and more inclusive financial ecosystem.

The inclusion of smallholder farmers enhances their productivity and income thereby enabling investments in improved agricultural inputs and agricultural insurance. This builds resilience by providing tools for managing financial and climatic shocks. Furthermore, fintech empowers smallholder farmers by improving their market linkages and bargaining power through its buying and selling platforms [4]. Therefore, this study seeks to systematically analyse the scholarly discourse on fintech-driven financial inclusion for smallholder farmers in South Africa. The study will Map the evolution and growth of research towards fintech-driven financial inclusion for smallholder farmers in Southern Africa. The study seeks to visualise the intellectual structure, main research themes, highlight the existing research gaps, and propose future research agendas for Southern Africa's smallholder farmers.

2. Theoretical Framework

This section outlines the theoretical frameworks that underpin the analysis of fintech-driven financial inclusion for smallholder farmers in Southern Africa. It presents six key theories that collectively provide a multi-dimensional scope for fintech-driven financial inclusion for smallholder farmers. This elucidates fintech adoption, impact, and ecosystem of these digital financial solutions towards smallholder farmers. The synthesis integrates these perspectives to form a comprehensive analytical foundation for the study.

2.1 Diffusion of Innovations Theory

The diffusion of innovation theory was advanced by Rogers in 1962. The theory explains how, why, and at what rate new ideas and technologies spread through cultures. It posits that adoption is not simultaneous across the board. Instead, individuals fall into categories such as innovators, early adopters, early majority, late majority, and laggards [5]. The speed of adoption is influenced by the innovation's perceived relative advantage, compatibility, complexity, trialability, and observability [6]. This theory provides a critical framework for analysing the uptake of fintech solutions among smallholder farmers in Southern Africa. It helps move beyond simply documenting fintech's existence to understanding the dynamics of its spread within the specific social system of Southern African agriculture [7]. The theory directs attention to how the characteristics of different fintech products such as mobile money, mobile credit, and agricultural insurance influence their diffusion trajectory.

2.2 Technology Acceptance Model (TAM)

The Technology Acceptance Model was propounded by Davis in 1989. The Technology Acceptance Model is an information systems theory that shows how users come to accept and use technology [8]. The model suggests that there are two primary factors that determine behavioural intention to use. These factors are Perceived Usefulness and Perceived Ease of Use. Perceived usefulness relates to the degree to which a person believes that using a system would enhance their job performance. On the other hand, perceived ease of use relates to the degree to which a person believes that using a system would reduce effort used [9]. TAM offers a micro-level user-centric complement to the broader Diffusion theory. TAM supports the article by systematically mapping research on the psychological determinants of fintech adoption among farmers. It allows for the investigation of how factors such as digital literacy (affecting ease of use) and tangible financial

benefits (affecting usefulness) shape adoption [10]. This theoretical framework helps explain the reason behind the adoption rates.

2.3 Capability Approach

The Capability approach was advanced by Amartya Sen in the 1980s. This approach posits that social welfare should be evaluated in terms of the substantive freedoms (capabilities) that people must lead the lives they value [11]. The theory focuses on the expansion of human capabilities rather than merely on utility (happiness) or resources (income) [12]. This theory elevates the study's focus from simple financial access to broader developmental outcomes. It provides a normative framework to assess whether fintech genuinely enhances farmers' capabilities. These capabilities include security from climate shocks and the ability to participate in markets through digital platforms [13]. The Capability Approach informs the article's literature which measures impact beyond economic metrics and focuses on empowerment and well-being [14]. The capability approach challenges the assumption that inclusion automatically translates to improved welfare.

2.4 Transaction Cost Economics

The Transaction Cost Economics theory was advanced by Oliver E. Williamson in 1975. The theory explains that firms and economic actors exist to minimise the costs associated with an economic exchange [15]. These transaction costs include search and information costs, bargaining costs, and policing and enforcement costs [16]. The theory is relevant to the study as it provides a powerful economic rationale for how fintech bridges the financial inclusion gap. Transaction Cost Economics can be used to identify and categorise research demonstrating how fintech reduces critical transaction costs for smallholder farmers in Southern Africa [17]. Such transaction costs that can be reduced by adopting fintech are cost of travelling to a bank, cost of enforcing a contract, and cost of finding a buyer [18]. This theory helps frame fintech not just as a technological innovation but as an institutional one that creates more efficient market structures [19]. These efficient market structures accommodate previously marginalised smallholder farmers in Southern Africa, making it economically viable for formal institutions to serve them.

2.5 Institutional Theory

Paul J. DiMaggio and Walter W. Powell advanced the Institutional theory in 1983. The theory examines how organisational structures and processes are shaped by institutional standards [20]. These standards include institutional regulations, replication of successful business models, and sector-wide professional standards. It emphasises that organisations adopt practices perceived as legitimate within their institutional environment [21]. This theory is relevant to the study as it shifts the focus from the smallholder farmer to the broad ecosystem. It helps analyse the literature on the role of governments, regulators, and financial institutions in enabling fintech for inclusion for smallholder farmers in Southern Africa. The review can use the Institutional theory to map studies on regulatory sandboxes, the replication of successful business models, and the role of organisations in shaping industry standards [22]. It explains how the broader institutional environment influences the development and legitimacy of fintech solutions.

2.6 Theory of Planned Behaviour

The theory of planned behaviour was propounded by Icek Ajzen in 1991. The theory links beliefs and behaviour, suggesting that behavioural intention is the central predictor of actual behaviour. The theory states that bahavioural intention is influenced by three factors which are Attitude, Subjective Norm, and Perceived Behavioural Control [23]. The theory is relevant to the study as it offers a meticulous social-psychological model to complement the Technological Acceptance Model. It is particularly relevant for understanding how social dynamics in close-knit

rural communities influence fintech adoption. The analysis can employ the Theory of Planned Behaviour to examine how peer influence and self-efficacy in using technology interact with individual attitudes to drive usage decisions [24].

2.7 Synthesis of the theoretical framework

Fintech-driven financial inclusion for smallholder farmers is a complex process which requires a multi-theoretical framework. The Diffusion of Innovations theory maps the trajectory of financial technology adoption among smallholder farmers in Southern Africa [7]. This macro-level view is complemented by the micro-level psychological model of fintech adoption provided by TAM. The Technology Acceptance Model (TAM) explains individual perceptions of usefulness and ease of use. The Theory of Planned Behaviour adds social context to these perceptions. It incorporates peer pressure and self-efficacy into decisions regarding fintech adoption [24]. These user-centric views are grounded in Sen's Capability Approach which evaluates impact beyond economics, focusing on freedoms and well-being [14].

The economic rationale for fintech-driven financial inclusion for smallholder farmers is supported by Transaction Cost Economics theory. It shows how fintech reduces market friction for smallholder farmers in Southern Africa by establishing efficient market structures [18]. Institutional Theory then explains the ecosystem's role by analysing how regulations and standards enable fintech legitimacy [25]. This multi-faceted approach is critical for understanding fintech's true impact on Southern African farmers.

3. Empirical Literature Review

This section reviews empirical studies that document both the detrimental impacts of financial exclusion and the transformative potential of fintech inclusion for smallholder farmers. The evidence is drawn from various African contexts and beyond to illustrate the real-world effects of these financial dynamics. The review is structured to first examine the consequences of exclusion before presenting findings on how fintech creates positive outcomes.

3.1 The Effects of Financial Exclusion

Financial exclusion severely limits smallholder farmers' adaptive capacities. In Northern Ghana it was shown that a lack of access to formal credit directly constrained the adoption of climate-resilient agricultural practices. Farmers without credit could not purchase drought-tolerant seeds or invest in irrigation equipment. This resulted in significantly lower yields and higher livelihood vulnerability to climate shocks [26]. Consequently, they remained trapped in a cycle of subsistence farming and poverty. Another study in rural Zambia highlighted how financial exclusion exacerbates post-harvest losses. Smallholders lacking access to storage finance were forced into immediate distress sales. This occurred when local market prices were at their most unfavourable point [2]. This pattern severely diminished their potential incomes and food security. In Zimbabwe, research linked financial exclusion to heightened gender inequality. Women farmers, facing greater barriers to formal loans, were less able to invest in productive assets. This limited their agricultural productivity and economic empowerment within their households and communities [27]. These cases collectively show that exclusion perpetuates vulnerability and poverty.

3.2 Fintech Inclusion through Digital Credit and Payments

Fintech is overcoming traditional barriers through innovative digital credit and payment systems. In Kenya, the platform DigiFarm provides smallholder farmers with a bundled service. It integrates access to formal credit for inputs with agronomic advice and a mobile money wallet. It was established that farmers using DigiFarm's credit facility significantly increased their fertiliser

usage and improved seed usage. This led to measurable yield enhancements compared to non-users [3]. The mobile money component also streamlined transactions, reducing costs.

In Tanzania, the use of mobile money service M-Pesa has demonstrably improved household resilience. Research showed that households using mobile money were better able to receive and manage remittances. This allowed them to maintain consumption levels during agricultural lean seasons or following weather-related shocks [28]. This digital financial cushion reduced the need for harmful survival strategies. Furthermore, a pilot in Mozambique used blockchain-based smart contracts for cashew smallholder farmers. These contracts automate payments upon delivery, ensuring transparency and speed. This system reduced payment delays from weeks to minutes, improving farmers' cash flow and financial planning [29]. These tools directly enhance productivity and economic resilience.

3.3 Fintech Inclusion through Insurtech and Market Linkages

Novel fintech applications are also de-risking agriculture and improving market access for smallholder farmers in Southern Africa. Index-based insurance (IBI) is a platform that uses satellite data to trigger automatic payouts. This program was carried out in Ethiopia using satellite indices to monitor pasture quality for pastoralists. When drought conditions are detected, the system automatically triggers payouts through mobile money to registered individuals. This provided a critical safety net that prevented the distress sale of livestock or assets to feed livestock [30]. This preserved vulnerable households' long-term livelihood capital. In India, the platform DeHaat uses a digital marketplace to connect smallholder farmers directly with buyers. It integrates mobile-based access for price information, logistics, and input linkages. Farmers using DeHaat achieved higher sales prices by reducing intermediary margins as they had direct access to the market [4]. They also gained better access to quality agricultural inputs. Similarly, in Rwanda, the platform Copia Global links rural smallholder farmers to a wider goods network. Farmers can order agricultural inputs and consumer goods through local agents using mobile money. This has increased their access to affordable products, thereby saving them time and transportation costs [1]. These fintech platforms directly enhance market efficiency and risk management for smallholder farmers.

4. Methodology

The study employs a bibliometric analysis to systematically map the intellectual landscape of fintech-driven financial inclusion for smallholder farmers in Southern Africa. Bibliometrics offers a quantitative, reproducible method for analysing large volumes of scholarly data [31]. This enables the identification of research trends, key contributors, and thematic evolution [32]. The methodology followed a structured process for data retrieval and analysis, as outlined below.

4.1. Data Source and Search Strategy

The data were sourced from the Scopus database, which is renowned for its comprehensive coverage of high-quality, peer-reviewed literature across social and scientific disciplines [33]. A Boolean search query was constructed to capture the core concepts of the research. The keywords used for the search are financial inclusion, smallholder farmers, fintech, financial technology, digital finance, mobile money, and Southern Africa. The search string was executed within the search all fields to ensure as much coverage and relevance as possible. The asterisk (*) served as a wildcard to capture plural forms and related terms [34]. This query was designed to be inclusive, reflecting the multidisciplinary nature of the field by combining terms from development economics, agricultural studies, and information systems.

4.2. Inclusion Criteria and Data Extraction

The study did not use chronological filters to enable the construction of a complete historical record of the fintech-driven financial inclusion. This allows for an analysis of the entire publication timeline and growth trajectory [35]. Similarly, no subject-area filters were used, as the topic spans disciplines such as Economics, Social Sciences, and Computer Science. The only filter applied was to exclude documents published in languages other than English to mitigate potential misinterpretation in the analysis. The search was conducted on a single day to ensure data consistency [36]. The resulting dataset was exported in CSV format and downloaded for subsequent analysis on Scival and VOSviewer. In Vosviewer, the study used fractional counting of keywords. The minimum number of keyword co-occurrences was set at 2, yielding 46 keywords from the 361 words meeting the criteria.

4.3. Data Analysis

The exported data were analysed using the bibliometric software VOSviewer and Scival. The analysis comprised two primary approaches, which are performance analysis and science mapping [37]. A performance analysis was conducted to examine the scientific productivity and impact of documents. This involved calculating descriptive statistics on publication growth, leading authors, institutions, source journals, and most cited documents. Science mapping analysis was also performed to reveal the intellectual structure of the field [38]. This included keyword co-occurrence analysis to identify major research themes and conceptual clusters, and wordcloud. Wordclouds allow for quick identification of the most frequent words in the search output, helping to reveal key themes and trends [39]. This mixed-method approach within bibliometrics provides both a quantitative overview and a qualitative understanding of the field's dynamics [37].

5. Presentation and Discussion of Findings

This section presents and interprets the key findings for this bibliometric analysis. It begins with a descriptive overview of the dataset. It then examines publication trends, prolific authors, and leading contributing countries. The analysis then proceeds to explore the field's intellectual structure through network visualisations, highlighting thematic clusters through keyword co-occurrence. Finally, a word cloud provides a visual summary of the most prevalent terminology.

5.1 Data overview

Table 1: MAIN INFORMATION ABOUT DATA

Description	Results		Description	Results
MAIN INFORMATION ABOUT DATA			**AUTHORS**	
Timespan	2019:2025		Authors	131
Sources (Journals, Books, etc)	44		Authors of single-authored docs	9
Documents	52		**AUTHORS COLLABORATION**	
Annual Growth Rate %	53.34		Single-authored docs	14
Document Average Age	1.81		Co-Authors per Doc	2.75
Average citations per doc	15.4		International co-authorships %	21.15
References	14310		**DOCUMENT TYPES**	
DOCUMENT CONTENTS			article	26
Keywords Plus (ID)	199		book	12
Author's Keywords (DE)	215		book chapter	8
			conference paper	1
			review	5

Table 1 presents a statistical overview of a collection of 52 published documents focused on the critical intersection of Fintech, financial inclusion, and smallholder farmers in Southern Africa. The rapid growth rate indicates that this area of study is still in its early stages. The data covers a timespan from 2019 to 2025. The annual production growth rate of 53.34% indicates a surge in interest and publication output in this area of study. This is further emphasised by the short average document age of 1.81 years, indicating that most of this literature has been produced since 2021. The intellectual foundation is drawn from 14,310 references indicating that researchers are building on a wide and established body of knowledge. The documents collection is diverse, comprising 26 articles, 12 books, 8 book chapters, 5 reviews and 1 conference paper. This suggests the topic is being explored from both academic and practical perspectives.

A total of 131 researchers have contributed to these 52 documents under consideration of which 9 are authors of single-authored documents. This points towards a highly collaborative area of study as shown by the high average co-authors per document of 2.75 and the significant international co-authorships of 21.15%. The intellectual landscape is mapped with 199 keywords plus and 215 authors' keywords, signalling a complex and multi-faceted subject matter. The high number of keywords both author-defined and system-generated paints a picture of a fragmented but fertile field. The explosive growth rate suggests that Fintech's potential to address the long-standing challenge of financial inclusion for smallholder farmers in Southern Africa has moved from a theoretical possibility to an urgent and active area of investigation. The convergence of mobile money, blockchain, insurtech, and digital credit with the agricultural value chain in Southern Africa is now recognised as a transformative force worthy of significant scholarly attention.

The collaborative nature of the research is particularly telling. The low number of single-authored documents (14) and the high rate of co-authorship (38) indicate that the subject demands interdisciplinary expertise. Solving this problem most probably requires agronomists, economists, computer scientists, sociologists, and financial experts working together. The 21.15% international collaboration rate is a healthy sign, suggesting that global knowledge is being shared and adapted to the context of Southern Africa. It also implies that most of the work remains domestically or regionally focused. This diversity is a strength, but the relatively low average citations per document (15.4) for such a contemporary field hints that seminal and foundational papers that everyone cites are still emerging. The literature is growing fast, but it may not yet have consolidated around key theories or findings.

5.2 Document production over time

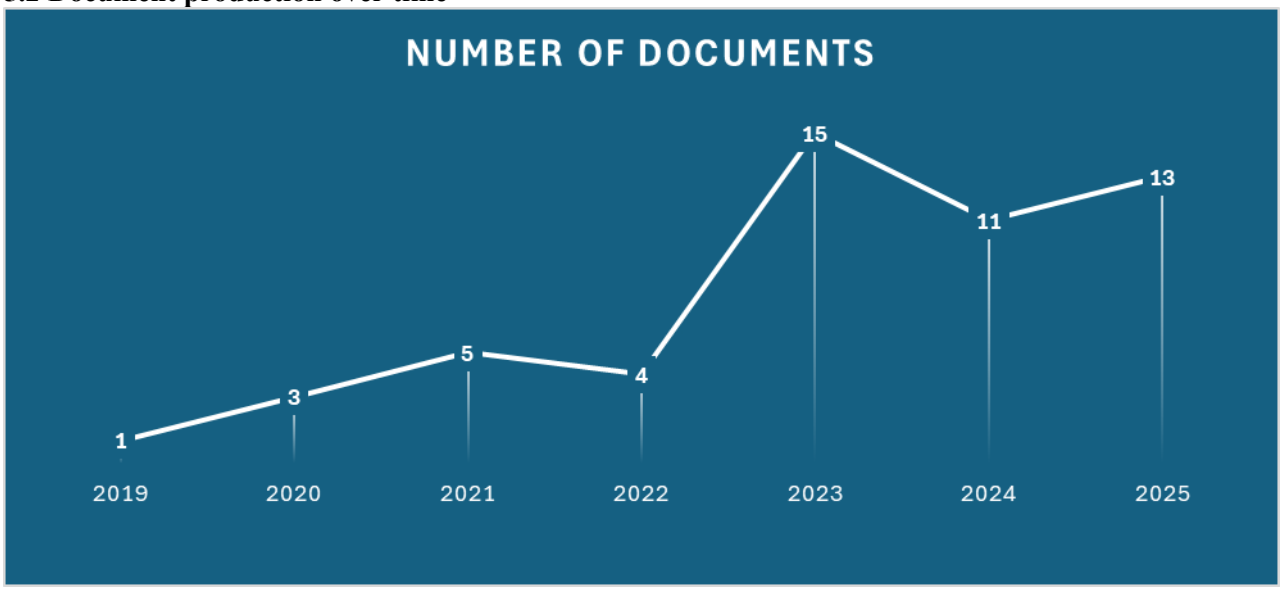

Figure 1: Document production over time

Figure 1 presents the annual output of publications on fintech-driven financial inclusion for smallholder farmers in Southern Africa. It illustrates the trajectory of a research niche from its emergence to its current status as an emerging field of major academic interest. The data reveals a clear pattern of exponential growth, demarcating distinct phases in the field's establishment. The period from 2019 to 2022 can be characterised as the formative and incubation phase of the field of study. Beginning with a single pioneering publication in 2019, production steadily increased in the single digits per year until 2022. This phase was crucial for laying the conceptual groundwork, identifying key challenges, and proposing early frameworks.

The subsequent explosion of document production in 2023, with publications leaping to 15. This jump translated to a 275% increase from the previous year's publication, marking a critical inflection point. This surge signifies the field's take-off where the topic gained significant traction within the academic community. This is likely driven by the demonstrable success of fintech solutions and a growing policy focus on financial inclusion post-COVID-19 pandemic. The production figures for 2024 and particularly 2025 show a sustained high volume of 11 and 13 documents respectively. This confirms that the 2023 boom was not an anomaly but a fundamental shift in fintech-driven financial inclusion for smallholder farmers in Southern Africa. This sustained output indicates that the niche has successfully established itself as a legitimate and urgent area of study.

5.3 Distribution of Documents Production by Authors

Figure 2 presents the distribution of document production per author over the period under study. Document production of academic research concerning fintech-driven financial inclusion for smallholder farmers in Southern Africa is characterised by a pronounced dominance of a single leading scholar. The authorship distribution reveals a research domain that is both emerging around key figures and highly fragmented, indicative of its contemporary and interdisciplinary nature. The most striking feature of the data is the dominance of Mhlanga, D. with six documents which triple that of the next most prolific authors. This significant productivity establishes Mhlanga, D. as a central and highly influential voice in fintech-driven financial inclusion for smallholder farmers in Southern Africa.

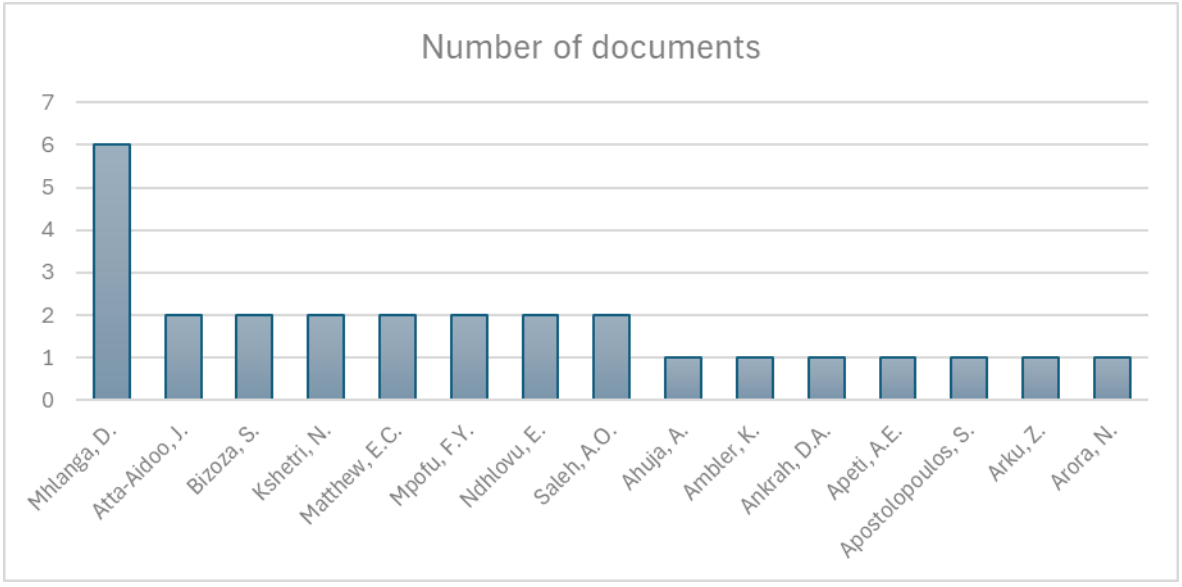

Figure 2: Distribution of document production by authors

Their body of work forms a substantial pillar of the existing literature, suggesting a dedicated research focus on this topic. A cohort of eight authors that includes Atta-Aidoo, J.; Bizoza, S.; Kshetri, N.; and Mpofu, F.Y., among others, have each produced two documents. This group represents the core collaborative base of scholars who are actively building the foundation of

knowledge beyond a single publication. Most of the intellectual community consists of single-document contributors, such as Ahuja, A., and Ambler, K., who represent a wide array of researchers dipping into the field. This structure suggests that while the topic is attracting broad academic attention from diverse perspectives, it is most likely to be from experts in finance, agriculture, development studies and technology. The research focus area has not yet consolidated around large established group of continuous contributors beyond a few key individuals. The authorship results indicate a specialised research area in its formative stages. This pattern highlights the growing relevance of fintech for financial inclusion in Southern African agriculture. It also suggests the need for more sustained, collaborative research efforts to deepen the field's scholarly foundation.

5.4 Distribution of Documents Production by Country

The geographic distribution of research on Fintech-driven financial inclusion for smallholder farmers in Southern Africa is presented in Figure 3. It reveals a narrative of both regional leadership and significant global interest. The data illustrates that while the problem is regionally specific, its solutions and academic inquiry are international in scope.

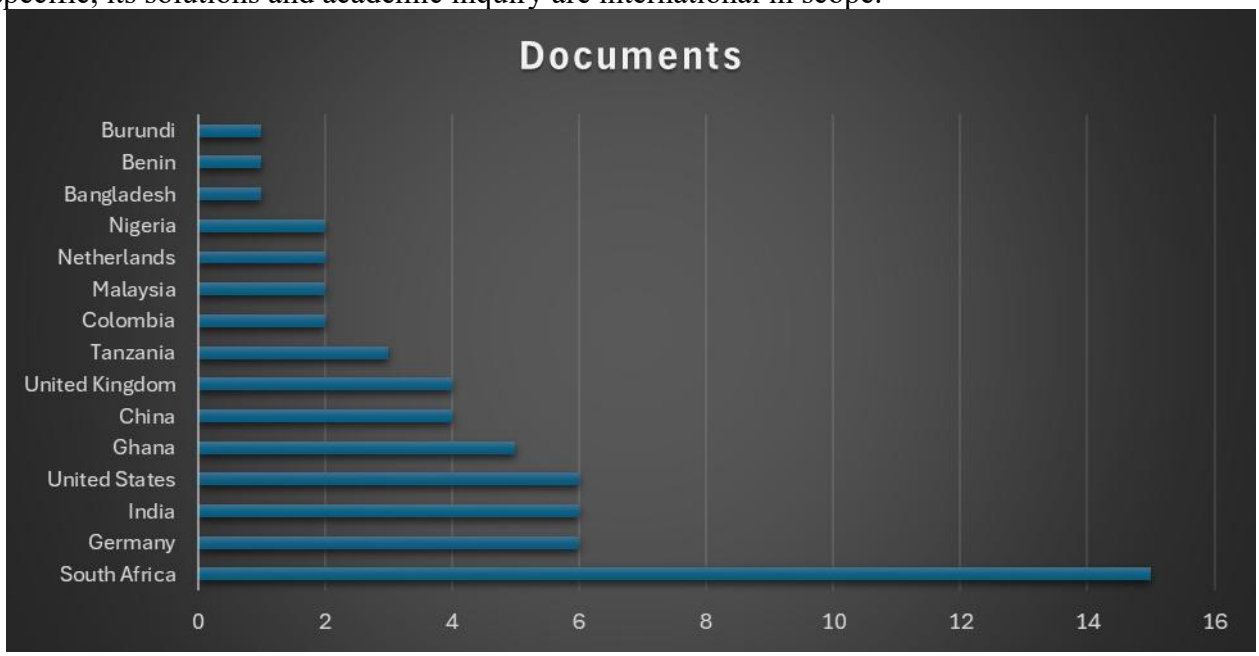

Figure 3: Distribution of document production by country

South Africa stands as the dominant contributor with 15 documents, reflecting its position as a leading advanced economy and a hub for financial technology innovation in Southern Africa. This leading output suggests a strong local academic and policy focus on leveraging fintech to address developmental challenges within Southern Africa. The subsequent ranking also reveals a fascinating interest from the global landscape. Nations from the Global North, including Germany, the United States, and the United Kingdom, contributed six documents. Other emerging economies, such as India (6) and China (4), also contributed documents. This indicates that the topic is not a regional one but has attracted attention globally as a critical frontier in development finance and agricultural technology.

The strong presence of Western and Asian nations suggests that the drive to understand and document this phenomenon is externally fuelled. This brings vital global expertise, funding, and technological perspectives. However, this might jeopardise the framing of the research potentially prioritising external theories and solutions. This in turn may result in solutions which are not wholly grounded on the realities of Southern African farmers. The modest contributions from other African nations such as Ghana (5), Tanzania (3), and Nigeria (2) show a budding intra-continental

knowledge exchange though this remains less pronounced as compared to the influence from outside the continent.

The data portrays a research field where Southern Africa is the subject of study, but not yet the dominant voice in its own narrative. While South Africa provides a crucial anchor, the intellectual engagement is disproportionately external. For research in this field to mature effectively, a crucial step will be to foster greater research leadership from within the Southern African region itself. This ensures that global interest complements and amplifies local expertise that is on the ground.

5.5 Network visualisation on Co-occurrence of keywords

The discussion of FinTech-driven financial inclusion for smallholder farmers in Southern Africa is multifaceted. Based on an analysis of 46 research items, six clusters have been identified and presented in Figure 4. Each cluster represents an important element of this discourse, collectively portraying a dynamic field moving from foundational concepts to specialised technological applications.

Cluster 1 (Blue) focuses on AI & Data-Driven Development Finance which highlights the borderline of innovation relevant to smallholder farmers. This research explores how artificial intelligence and machine learning can transcend traditional banking barriers for smallholder farmers in Southern Africa. For Southern African farmers, this could mean AI-powered credit-scoring models that analyse alternative data, such as mobile phone usage patterns or satellite imagery of their fields, to offer loans without requiring collateral. Furthermore, the cluster's emphasis on women empowerment and sustainable development is critical, suggesting a focus on using these advanced tools not just for profit. These tools can be used to deliberately address gender disparities in agricultural finance and promote environmentally sustainable farming practices endorsed by global bodies such as the United Nations.

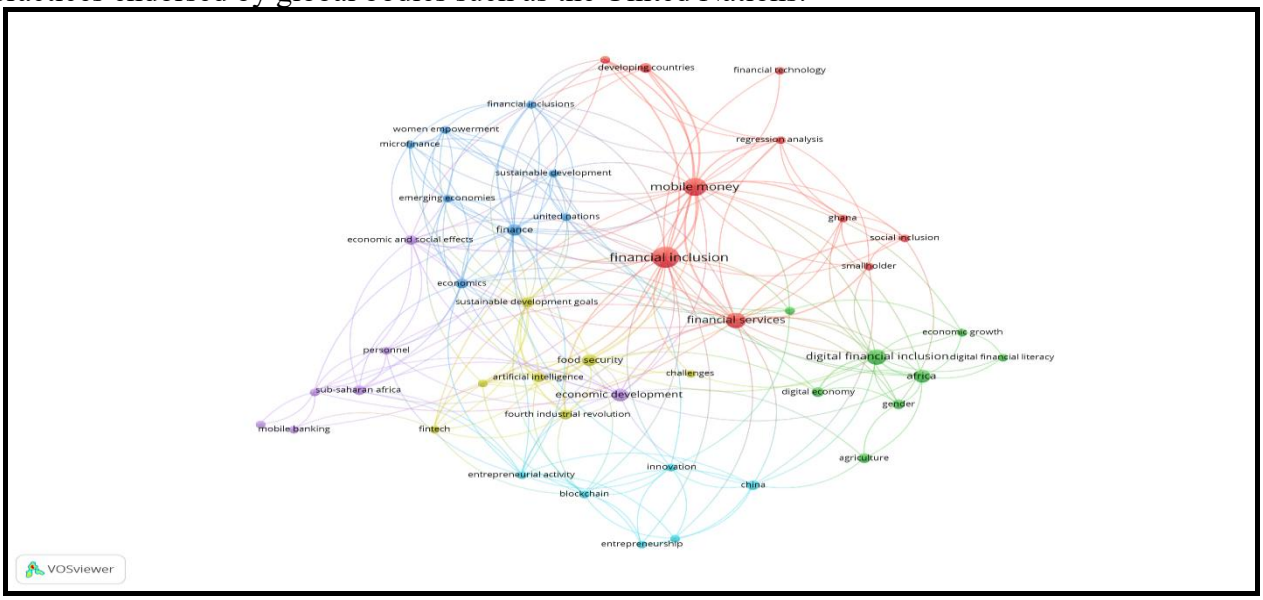

Figure 4: Network visualisation on Co-occurrence of keywords

Cluster 2 (Green) is centred on digital financial ecosystems in Africa, which broadens the view to the systemic environment in which smallholder farmers are operating. The cluster shows that technology in isolation is insufficient. The keywords such as challenges, digital financial literacy, and gender point to the very real hurdles of technology adoption in Southern Africa. For a smallholder farmer to benefit from mobile money or digital loans, they must first adopt, trust and understand the technology. This cluster's output, therefore, deals with the essential groundwork for efficient use of Fintech. Issues surrounding educating farmers, addressing infrastructural challenges

such as network coverage are vital for the usage of digital financial technology. Also ensuring that digital financial innovation actively includes women who are pivotal actors in the agricultural sector but often the most financially excluded.

Cluster 3 (Yellow) is premised on technology adoption for development as it directly links specific tools to transformative outcomes for smallholder farmers. The prominence of mobile money services and mobile banking underscores their role as the bedrock of current FinTech inclusion in Southern Africa. This technology not only facilitates savings and payments but also allows the receipt of remittances and agricultural subsidies securely and instantly. The connection to food security and economic development is paramount. Integrating smallholder farmers into the formal digital economy through FinTech enhances their resilience to shocks. It also improves their ability to invest in good quality seeds and equipment thereby strengthening the local and national food systems.

In contrast, Cluster 4 (Purple) focuses on the foundational concepts of financial inclusion. It establishes the reasons behind the technological push, examining the broader economic and social effects of moving from cash-based to electronic money economies in developing countries. The research in this cluster provides the theoretical and empirical evidence that financial inclusion through financial technology is a catalyst for development. This validates the entire endeavour of financial inclusion in Southern Africa. It shows how access to mobile money can lead to increased household savings. It also suggests greater investment in health and education, and enhanced participation and contribution in the economy for smallholder farmers.

Blockchain and entrepreneurial innovation is covered in Cluster 5 (Light Blue). The cluster introduces an emerging but potentially disruptive technological dimension. The keywords of blockchain, China, and supply chain management imply a profound ideology for Southern African farmers. Blockchain technology can create transparent and tamper-proof records for agricultural supply chains. This would allow smallholder farmers to verify the quality and origin of their produce. It also potentially grants them access to premium markets thereby receiving a fairer price for their produce. The link to entrepreneurial activity suggests that this cluster also explores how such innovations can generate new Agri-tech startups which in turn further energises the rural economy.

Finally, Cluster 6 (Red) shows the empirical studies on social inclusion. This cluster focuses on the localised, evidence-based impact of fintech-driven financial inclusion towards smallholder farmers in Southern Africa. A specific study on Ghana, using regression analysis to examine financial services for smallholder farmers provides a methodological blueprint for research in Southern Africa. The cluster goes beyond theoretical benefits to quantitatively measure the relationship between FinTech adoption and tangible outcomes such as social inclusion. This allows policymakers and innovators to identify how FinTech tools are helping to lift smallholder farmers in Southern Africa out of poverty and marginalisation.

The clusters collectively demonstrate that FinTech-driven financial inclusion for smallholder farmers in Southern Africa is not a single-threaded effort but a complex ecosystem. It ranges from the foundational push for financial inclusion (Cluster 4) and the addressing of systemic barriers (Cluster 2) for financial inclusion. The current revolution led by mobile money (Cluster 3) and the future potential of AI (Cluster 1) and blockchain (Cluster 5). All of which must be validated through the localised, empirical research (Cluster 6) that ensures they truly deliver social and economic transformation.

5.6 Wordcloud on research fields key-phrases

This bibliometric wordcloud, presented in Figure 5, reveals a multifaceted research landscape surrounding FinTech, financial inclusion and smallholder farmers. Key themes that can be derived from the Wordcloud include financial inclusion and financial access, which indicate a core research focus on bridging economic sectors. The significant presence of small and medium-sized

enterprises and the rural population directly anchors this study within the target demographic. The interaction of terms such as digital financial inclusion, electronic banking, and artificial intelligence demonstrates the technological mechanisms being explored for financial inclusion. Concurrently, foundational economic concepts such as human capital, poverty alleviation, and food security form critical socio-economic objectives.

Figure 5: Word cloud on co-occurrences of keywords

The high frequency of methodological terms such as propensity score matching and research design signifies a field prioritising empirical thoroughness and causal inference. This suggests that research is evolving from theoretical discussion towards robust impact evaluation. The co-occurrence of Industry 4.0 and the Fourth Industrial Revolution with agricultural terms highlights a modern research narrative that frames fintech as part of a broader technological transformation in agriculture. The wordcloud indicates a well-developed research agenda connecting technological tools to developmental outcomes. However, specific challenges such as cybersecurity and land market complexities are also evident. The position shown by the word cloud is one of an established interdisciplinary field which seamlessly integrates finance, technology, development economics and agricultural policy. This synthesis is important for comprehensively addressing the plight of Southern Africa's smallholder farmers through innovative financial solutions.

6. Conclusion and Future Research Agenda

This study has systematically mapped the intellectual structure and thematic evolution of research concerning fintech-driven financial inclusion for smallholder farmers in Southern Africa. The bibliometric analysis reveals a field in a robust state of emergence that is characterised by exponential growth in publication output since 2021. The intellectual landscape is structured around six themes which are AI and data-driven finance, digital financial ecosystems, technology adoption, foundational concepts of inclusion, blockchain innovation and empirical studies on social inclusion. This demonstrates a progression from conceptual validation towards specialised technological applications and context-specific impact assessment.

The synthesis of theoretical frameworks including diffusion of innovations, technology acceptance model, and institutional theory provides a complimentary multi-dimensional framework for this study. The framework elucidates how fintech's potential extends beyond transactional convenience. It shows how fintech can fundamentally reshape market structures, reduce transaction costs, and expand human capabilities. The geographic distribution of research production indicates a significant reliance on external perspectives. This is shown by the substantial portion of

knowledge generation originating outside the African continent. This suggests a critical gap in locally anchored research and the contextual framing of solutions.

Several relevant research gaps emerge from this analysis leading to proposing a clear agenda for future scholarly inquiry that includes deepening contextual and longitudinal studies. The field identifies challenges such as digital literacy and gender disparities as hurdles in fintech-driven financial inclusion for smallholder farmers. There is a pressing need for in-depth qualitative studies that explore the socio-cultural dimensions of fintech adoption within Southern African rural contexts. Furthermore, longitudinal research is required to go beyond documenting initial adoption and assess the sustained impact of fintech on smallholder farmers' resilience, productivity, and intergenerational poverty.

The study also proposes research in bridging the implementation gap. Future research should pivot from technological potential to the implementation of science. This includes a critical investigation into viable business models for last-mile service delivery such as the integration of fintech with traditional informal financial systems. Also, the development of robust consumer protection frameworks to safeguard vulnerable farmers from digital risks is important. The study also proposes research into intersectional analysis of financial Inclusion in Southern Africa. The discourse on gender, while it is currently present, requires a varied dimension. Research must adopt an intersectional lens to understand how factors such as land tenure, age, and education interact with gender to shape access and benefits. Studies specifically designed to evaluate the efficacy of fintech tools in empowering women smallholder farmers are urgently needed.

The study also proposes exploring synergistic technologies towards financial inclusion for Southern African smallholder farmers. The potential of converging technologies remains underexplored. Research should investigate the integrated application of fintech with other fourth industrial revolution technologies. Technologies such as the internet of things (IoT) facilitate precision agriculture or blockchain for transparent land registries to create comprehensive digital ecosystems for smallholder farmers. Fintech presents a transformative pathway for enhancing financial inclusion among Southern Africa's smallholder farmers. The future research agenda must prioritise contextual depth, practical implementation, nuanced inclusion, and technological synergy to ensure that the digital revolution in agriculture is both inclusive and sustainable.

7.References

[29]. Agyekum, O., Sirivardana, C. & Narayanan, S. (2021) *'Blockchain for sustainable development: Perspectives from smallholder cashew farmers in Mozambique'*, *World Development Perspectives*, 24, p. 100371.

Ajzen, I. (1991). *The theory of planned behavior*. *Organizational Behavior and Human Decision Processes*, 50(2), pp. 179-211.

[23]. Akter, S. (2024) *'Understanding FinTech Adoption: An Extension of the Theory of Planned Behavior with Trust'*, *Journal of Financial Services Marketing*, 29(1), pp. 123–138.

[26]. Alhassan, H., Kwakwa, P.A. & Adzawla, W. (2021) '*Farmer's choice of climate-resilient strategies: Evidence from Ghana'*, *Climate and Development*, 13(9), pp. 832–842

Aria, M., & Cuccurullo, C. (2017). *bibliometrix: An R-tool for comprehensive science mapping analysis. Journal of Informetrics*, 11(4), pp. 959-975.

Arner, Douglas & Buckley, Ross & Zetzsche, Dirk & Veidt, Robin. (2020). *Sustainability, FinTech and Financial Inclusion. European Business Organization Law Review*. 21. 7-35. 10.1007/s40804-020-00183-y.

Davis, F. D. (1989). *Perceived usefulness, perceived ease of use, and user acceptance of information technology*. *MIS Quarterly*, 13(3), pp. 319-340.

DiMaggio, P. J., & Powell, W. W. (1983). *The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields*. *American Sociological Review*, 48(2), pp. 147-160.

[32]. Donthu, N., et al. (2021). *How to conduct a bibliometric analysis: An overview and guidelines*. *Journal of Business Research*, 133, pp. 285-296.

[19]. Dow, S.C. (2022) *'Transaction costs and institutions: A review of the literature', Journal of Economic Issues*, 56(1), pp. 1–20.

[33]. Gerasimov, A., Mehrabian, N., Acker, O. & McGuire, J. (2024) *'Scopus vs. Web of Science: A bibliometric analysis for subject matter experts', Journal of Academic Librarianship*, 50(1), p. 102856.

[28]. Gosavi, A. (2020) *'Can mobile money help firms mitigate the impact of COVID-19? Evidence from small-scale enterprises in Tanzania'*, *The European Journal of Development Research*, 33(4), pp. 853–872.

Griffin, M., Martino, R. J., LoSchiavo, C., Comer-Carruthers, C., Krause, K. D., Stults, C. B., & Halkitis, P. N. (2022). *Ensuring survey research data integrity in the era of internet bots*. *Quality & quantity*, *56*(4), 2841-2852.

[35]. Ha, D., Le, P., & Nguyen, D. K. (2025). *Financial inclusion and fintech: a state-of-the-art systematic literature review*. *Financial Innovation*, *11*(1), 69.

[17]. Hasanah, N. (2024) *'The role of FinTech in reducing transaction costs for smallholder farmers: A systematic review'*, *Agricultural Finance Review*, 84(2), pp. 245–264.

[15]. Hennart, J.F. & Verbeke, A. (2022) *'Transaction cost economics: Past, present, and future', Journal of International Business Studies*, 53, pp. 1–19.

[13]. Hermann, A. (2025) *'Digital finance and human development: A capability approach perspective for smallholder agriculture'*, *World Development*, 176, p. 106512.

[11]. Jamil, I. (2024) *'Beyond access: Evaluating financial inclusion through the capability approach', Journal of Human Development and Capabilities*, 25(1), pp. 45–62.

[30]. Jensen, N., Ikegami, M. & Mude, A. (2020) *'Index Insurance and Pastoralist Risk Management: Evidence from Ethiopia', The Journal of Development Studies*, 56(9), pp. 1732–1747.

[22]. Johnson, W. G. (2023). *Caught in quicksand? Compliance and legitimacy challenges in using regulatory sandboxes to manage emerging technologies*. *Regulation & Governance*, *17*(3), 709-725.

[39]. Khare, A. & Jain, R. (2022) *'Mapping conceptual structure of sustainability science: A bibliometric analysis', Scientometrics, 127*(2), pp. 978–1012.

[34]. Kuhn, E., & Rücker, K. (2025). *Boolean Searches. Legal Research for Alberta Legal Professionals*.

[4]. Kumar, V., Verma, P. & Sharma, R. (2023) *'DeHaat: A digital platform for smallholder farmer empowerment in India'*, *Technological Forecasting and Social Change*, 188, p. 122312.

[37]. Kumar, S., et al. (2020). *Science mapping and bibliometric analysis: A practical guide*. *Journal of Business Research*, 115, pp. 354-365.

[18]. Kusuma, R., Darma, D. & Arifin, A. (2021) *'Financial technology and transaction cost efficiency in the agricultural sector'*, *Journal of Asian Finance, Economics and Business*, 8(3), pp. 1121–1132.

[16]. Libecap, G.D. (2024) *'Transaction Cost Economics and the Evolution of Property Rights', Journal of Institutional Economics*, 20(e2), pp. 1–20.

[8]. Marikyan, D., & Papagiannidis, S. (2023). *Technology Acceptance Model: A review*. *In* Papagiannidis, S. (Ed.), *TheoryHub Book*. [Online]. Available: https://open.ncl.ac.uk / ISBN: 9781739604400

[10]. Maseko, N., Mago, S. & Chitokwindo, S. (2022) *'Digital literacy and the adoption of mobile money services among smallholder farmers in Zimbabwe'*, *African Journal of Science, Technology, Innovation and Development*, 14(5), pp. 1345–1357.

[24]. Mbama, C.I., Eze, P. & Alboul, L. (2021) *'Social influence and mobile banking adoption: An extension of the theory of planned behavior', Journal of Retailing and Consumer Services*, 63, p. 102685.

[1]. Munyua, H. (2021) *'Digital platforms and rural market access: The case of Copia Global in Kenya', Information Technologies & International Development*, 17, pp. 1–15.

[3]. Munyua, H. & Karanja, J. (2022) *'DigiFarm: A bundled digital service for smallholder credit and advisory in Kenya', Journal of Agribusiness in Developing and Emerging Economies*, 12(3), pp. 429–447.

[27]. Nhundu, K. & Mushunje, A. (2020) *'Gender disparities in access to agricultural finance in Zimbabwe', African Journal of Agricultural Research*, 16(5), pp. 702–710.

[31]. Ninkov, A., Frank, J. R., & Maggio, L. A. (2022). *Bibliometrics: Methods for studying academic literature*. *Perspectives on Medical Education*, 11(3), pp. 173-176.

[21]. Özkan, N. (2025) *'Institutional theory and the legitimization of FinTech'*, *Research in International Business and Finance*, 73, p. 102345.

[38]. Öztürk, O., Kocaman, R. & Kanbach, D.K. (2024) *'How to design bibliometric research: an overview and a framework proposal', Review of Managerial Science*.

[20]. Powell, W. W., & DiMaggio, P. J. (Eds.). (2023). *The New Institutionalism in Organizational Analysis*. Chicago: University of Chicago Press.

Rogers, E. M. (1962). *Diffusion of Innovations*. New York: Free Press.

[5]. Sangwa, B., Ndahimana, J. & Dusengumuremyi, P. (2025) *'Diffusion of mobile financial services in rural Rwanda: A Rogers' perspective', Journal of Rural Studies*, 107, p. 103289.

Sen, A. (1985). *Well-being, agency and freedom: The Dewey Lectures 1984*. *The Journal of Philosophy*, 82(4), pp. 169-221.

[2]. Sichone, M., Mwanaumo, E. & Mubanga, M. (2020) *'Post-harvest losses and financial exclusion among smallholder farmers in Zambia'*, *Agricultural Finance Review*, 80(4), pp. 511–525.

[7]. Tiwari, S., Singh, P. & Rana, N.P. (2023*) 'Diffusion of FinTech innovations for financial inclusion: A review and research agenda', Information Systems Frontiers*.

[9]. Ursavaş, Ö.F. (2022) *'A comprehensive meta-analysis of the Technology Acceptance Model', Education and Information Technologies*, 27, pp. 10113–10143.

Williamson, O. E. (1975). *Markets and Hierarchies: Analysis and Antitrust Implications*. New York: Free Press.

[12]. Yahiaoui, R. (2025) *'Financing freedom: A Senian perspective on digital financial inclusion', Journal of Economic Methodology*, 32(1), pp. 78–95.

[6]. Yu, T.K. (2022) *'Predicting the adoption of mobile payment during the COVID-19 pandemic'*, *Journal of Innovation & Knowledge*, 7(4), p. 100260.

[14]. Zheng, L. (2023) *'Digital financial inclusion and farmer well-being: An application of the capability approach in China'*, *China Agricultural Economic Review*, 15(2), pp. 399–417.