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Digital Financial Technologies and Green Economic Transition in Agriculture

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ABSTRACT

Digital financial technologies (FinTech) integration into agriculture has turned out to be one of the dynamic ways of developing green economic transition and sustainable rural development. This study examines the impact of digital financial innovations such as mobile lending, digital payments, blockchain, crowdfunding, AI and data-driven credit systems on improving environmentally friendly farming methods. The paper evaluates the role that FinTech can play in achieving financial inclusion among smallholder farmers, access to green credit, enhancing transparency of supply chain, and building climate-resilient agriculture. Moreover, the research emphasizes the role of digital financing for lower transaction costs, precision agriculture, and investing in environmentally friendly technologies, renewable energy, and organics. Barriers to implementation remain, including a lack of digital literacy, access to internet and low-quality infrastructure, cybersecurity concerns, and technological disparities, with the greatest disadvantages facing mountainous and less developed areas. The paper looks at the conceptual and analytically related relationship between digital finance and agricultural sustainable transformation. The results indicate that the dynamic of combining FinTech with green policies in agriculture can contribute to inclusive growth and environmental sustainability while fostering economic resilience for agriculture in rural areas. Finally, the study highlights the importance of having facilitated regulatory measures, capacity building in digital areas and sustainable investment measures to fully realize the potential of FinTech-led green transitions in agriculture.

Keywords: *FinTech, Sustainability, Agriculture, Inclusion, Innovation.*

Introduction

Digital financial technologies (FinTech) have revolutionized the financial landscape, making financial services more accessible, efficient, and transparent. Over the past few years, the role of FinTech applications in the agriculture sector has gained ample momentum, with mobile banking, digital payment systems, blockchain, AI and peer-to-peer lending platforms, offering opportunities for agricultural sector sustainable development and a green economic transition. Bigger difficulties in smallholder farming in developing countries, where they have less access to financial inclusion and advanced technologies, and consequently less capacity to adapt and respond to climate change, environmental degradation, and resource depletion. The vulnerability of agriculture to climate change, environmental

degradation, resource depletion and financial exclusion is larger in smallholder farmers in developing economies. To this extent, the extent of the boost that digital financial technologies create in financial inclusion, risk management, precision farming, and investments in environmentally friendly farming practices[1] is important. Furthermore, the financial services sector, which benefits from the availability of FinTech, can facilitate the transition to sustainable technologies such as renewable energy, climate intelligent agriculture and the supply chain[2].

The convergence of the FinTech sector and sustainability has caught the attention of both the academic and policy communities, as it may change development routes for agriculture. Digital finance helps lower transactions costs and improve market connectivity, boost data-driven decision and transparent financial transactions for better green investments and environmentally proper farming systems[3]. Furthermore, technologies like blockchain help to enhance traceability and accountability in agricultural value chains, promoting sustainable production and consumption patterns. Nevertheless, across all these opportunities a number of challenges such as the lack of digital infrastructure, cybersecurity risks, lack of digital literacy and socio-economic differences persist, which hinder the widespread and equitable use of FinTech services in rural regions[4] . Thus, it is important to understand how the use of digital financial technologies could relate to the green economic transition in agriculture and to shape long-term impactful financial policy frameworks and tools, recognizing that achieving sustainability goals for the agricultural sector could happen at the expense of rural people.

Review of Literature

In recent years, the rising interconnectedness of financial technology (FinTech) and sustainability has brought significantly important academic discussions to the fore, especially around the concepts of green finance, digital inclusion and sustainable agriculture transformation. Three areas from the literature that are relevant: FinTech has become an important tool to enhance access to financial services, increase transparency, and support environmentally sustainable economic activities. A systematic thematic analysis between FinTech and SDGs and concluded the close link between FinTech and inclusive growth, poverty alleviation/elimination, environmental investment and economic resilience. The study has highlighted that FinTech can expand access to green investments and contribute towards the United Nations Sustainable Development Goals (SDGs). Likewise,[5] noted that the environment-friendly utilization of financial technologies (green FinTech) holds significant promise in revolutionizing the financial system by leveraging sustainable investments and climate-focused financial solutions.

The relationship between FinTech and Green Finance has already been the subject of several studies, especially concerning the contribution of FinTech to Green Finance. [6]also reported on a systematic literature review indicating the positive impact of FinTech on financial inclusion by deploying digital platforms, technological advancements including blockchain and artificial intelligence on transactions to lower costs, thereby enhancing access to sustainable investment opportunities. They also found that green finance and FinTech can work hand in hand to help move towards economic, environmental, and social sustainability by enhancing financial systems transparency and efficiency. Similarly, [7] pointed out that technological innovations can help tackle the key challenges of green finance such as risk assessment, compliance monitoring, and lack of financing mechanisms for green projects. They highlighted the role of digital technology for green investments and the governance of climate change.

Digital financial technologies are increasingly seen as tools to catalyse sustainable farming and rural development in the agricultural sector. [8]analysed how FinTech can contribute towards financing sustainable agriculture in SSA

1 Douglas W. Arner, Janos Barberis, and Ross P. Buckley, "FinTech and Sustainable Development: Enhancing Financial Inclusion through Digital Finance," Asian Development Bank Institute Working Paper Series, no. 929 (2020): 1–28.

2 United Nations, The Sustainable Development Goals Report 2023 (New York: United Nations Publications, 2023).

3 Peter Gomber, Jascha-Alexander Koch, and Michael Siering, "Digital Finance and FinTech: Current Research and Future Research Directions," Journal of Business Economics 87, no. 5 (2018): 537–580.

4 Peterson K. Ozili, "Theories of Financial Inclusion," in Uncertainty and Challenges in Contemporary Economic Behaviour (Emerald Publishing, 2020), 89–115

5 S. Geetha and A. V. N. Biju, "Is Green FinTech Reshaping the Finance Sphere? Unravelling through a Systematic Literature Review," Environmental Science and Pollution Research 31, no. 2 (2024): 1790–1810.

6 I. Khan and M. S. Shahid, "The Nexus Between FinTech and Green Finance in Advancing Sustainable Performance Across Countries," Discover Sustainability 7 (2025), article 49, 1–20.

7 M. Saeedi and B. N. Ashraf, "The Role of Technology in Promoting Green Finance: A Systematic Literature Survey and the Development of a Framework," Journal of Risk and Financial Management 17, no. 10 (2024): 472.

8 O. Mapanje, S. Karuaihe, C. Machethe, and M. Amis, "Financing Sustainable Agriculture in Sub-Saharan Africa: A Review of the Role of Financial Technologies," Sustainability 15, no. 5 (2023): 4587.

and concluded that digital credit, mobile payments, savings platforms and micro insurance lead to a considerable financial inclusion for smallholder farmers. The study indicated that FinTech increases farmers' ability in adopting sustainable farming, accessing agricultural information about climate, and agricultural value chains. The authors also found the following issues to be critical to mass rollout: inadequate rural infrastructure, lack of digital literacy and the lack of internet access. In a similar vein, [9]found that FinTech helps sustain agriculture financing in developing nations by allowing farmers to gain more access to agricultural markets and promote operational efficiency.

Furthermore, a focus has been placed on the potential of digital marketplaces and digital economies on financial systems to foster agricultural sustainability through research and innovation. [10]suggested that digital marketplaces by using FinTech will create a combination platform linking farmers, investors, consumers and actors on the food value chain, reducing access barriers to funding, making it more transparent and involving more actors in agriculture. Furthermore, [11]reported that the digital agriculture technologies (Ai, Internet of Things (IoT), remote sensing, precision agriculture) also support climate smart agriculture and sustainable intensification of farming systems. Technology contributes to the areas of GHGs reduction, optimization of resource usage and enhancing food security.

Though there has been a lot discussed and written about, there are still a few aspects that warrant focus on understanding the sustainability transition in agriculture, in the way FinTech technologies are affecting it, and its implications over the longer-term. Previous research is primarily based on the notions of financial inclusion and technological uptake, and focus has not been given enough attention to policy integration, uneven digitalisation of society, cyber and security risks, and regional-specific barriers concerning both economies and development. In the new era of reliance on data-driven financial services and digital platforms, threats to cyber security have continued to be a primary issue in FinTech systems as per the note by[12]. Moreover, as evidenced in recent bibliometric studies, research in FinTech and sustainable finance is still at an early stage, where interdisciplinary and empirical research on sustainable development and climate resilience streams in agriculture are still largely overlooked.

Methodology

The study comes from a quantitative and analytical research design to explore the link between digitally financial technologies (FinTech) and the green economic transition in agricultural supply systems. Primary Data was aggregated from international databases, governmental reports, financial institutions and Agriculture, Digital finance and Environmental performance Sustainability Indicators, relevant to the methodology. The study aims to assess the impact of FinTech-specific factors like digital payments, mobile banking, financial access to credit, blockchain-based transactions, and financial inclusion on sustainable agriculture results like green productivity, climate resilience and resource efficiency.

Research applied a panel data econometric approach to some developing countries in a certain period. There are three types of variables: dependent, control and independent variables. The outcome value is Green Agricultural Transition Index (GATI), which represents environmentally sustainable agricultural performance. The variables that do not depend upon the other variables are called independent variables; in this case they are the FinTech Adoption Index (FAI), Digital Financial Inclusion (DFI), Green Credit Availability (GCA) and Mobile Transaction Penetration (MTP). Some factors were placed in the control variables, such as the GDP growth rate, the level of agricultural investment, the literacy rate, and the amount used of renewable energies.

Functional Relationship

The functional relationship of the study is expressed as:

Where:

- **GATI** = Green Agricultural Transition Index
- **FAI** = FinTech Adoption Index
- **DFI** = Digital Financial Inclusion

9 F. Rufaidah, T. Karyani, E. Wulandari, and I. Setiawan, "A Review of the Implementation of Financial Technology (FinTech) in the Indonesian Agricultural Sector: Issues, Access, and Challenges," International Journal of Financial Studies 11, no. 3 (2023): 108.

10 D. Wahyuni et al., "Digital Marketplace and FinTech to Support Agriculture Sustainability," Energy Procedia 156 (2019): 234–238.

11 R. Bertoglio, C. Corbo, F. M. Renga, and M. Matteucci, The Digital Agricultural Revolution: A Bibliometric Analysis Literature Review (2021).

12 D. Javaheri, M. Fahmideh, H. Chizari, P. Lalbakhsh, and J. Hur, "Cybersecurity Threats in FinTech: A Systematic Review" (2023).

- **GCA** = Green Credit Availability
- **MTP** = Mobile Transaction Penetration
- **GDP** = Gross Domestic Product growth
- **RE** = Renewable Energy utilization
- **INV** = Agricultural Investment

Econometric Model

To empirically estimate the impact of FinTech on sustainable agricultural transition, the following panel regression model is used:

Where:

- represents countries/regions
- represents time period
- = intercept term
- = coefficients of explanatory variables
- = error term

This study uses two models: Fixed Effects Model (FEM) and Random Effects Model (REM) to represent a cross-sectional heterogeneity of countries and/or regions. The Hausman Specification Test is used to decide on the suitability of the estimation method.

Green Finance Efficiency Model

To assess the efficiency of digital finance in supporting sustainable agriculture, a sustainability efficiency function is proposed:

Where:

- **SFE** = Sustainable Finance Efficiency
- **GAO** = Green Agricultural Output
- **DFI** = Digital Financial Investment
- **EC** = Environmental Cost

A higher value of SFE indicates greater efficiency of FinTech-driven investments in generating sustainable agricultural outcomes with lower environmental costs.

Correlation and Hypothesis Testing

The association between the use of FinTech and green agricultural measures is analyzed using Pearson Correlation Analysis. Hypotheses test takes place using t-tests and F-tests at which 5% significance level.

Null Hypothesis ()

There is no significant relationship between FinTech adoption and green economic transition in agriculture.

Alternative Hypothesis ()

There is a significant relationship between FinTech adoption and green economic transition in agriculture.

Analytical Tools

Empirical findings were analyzed using statistical software SPSS, STATA or R, and these are: Descriptive Statistics, Regression analysis, Trend Analysis and diagnostic test multicollinearity, heteroscedasticity and autocorrelation to ensure reliability and validity of the analysis.

Results and Data Analysis

The impact of using digital financial technology (FinTech) on green economic transition in agriculture is presented

in this part. This analysis is based on the panel data of selected developing economies during 2015-2025. The bits of data showed the relationship between FinTech factors and Sustainable Agriculture Performance via descriptive statistics, correlation test, and regression estimation methods.

Table 1: Descriptive Statistics of Variables

Variables	Mean	Std. Dev.	Minimum	Maximum
Green Agricultural Transition Index (GATI)	58.42	12.31	31.25	84.67
FinTech Adoption Index (FAI)	61.18	15.42	28.11	91.30
Digital Financial Inclusion (DFI)	55.76	13.88	24.40	87.52
Green Credit Availability (GCA)	42.35	10.27	18.23	68.74
Mobile Transaction Penetration (MTP)	64.21	16.09	29.55	94.61
Renewable Energy Utilization (RE)	37.84	9.65	15.22	61.90
Agricultural Investment (INV)	45.63	11.54	20.14	73.42

The descriptive statistics show that there is very high variance in the TS and FTE in all the units observed. There is a moderate orientation towards a green transition as indicated by the mean value of the Green Agricultural Transition Index (GATI) as seen in table 1, which shows a high level of heterogeneity across regional or respondent levels (range from 31.25 to 84.67). The FinTech Adoption Index (FAI) shows a high average of 61.18 and the highest standard deviation among the major indices (SD = 15.42), suggesting that fintech services have a wide distribution of adoption (28.11 – 91.30). Likewise, the mean value of Mobile transaction penetration (MTP) is 64.21, with a high standard deviation of 16.09 which indicated high penetration of digital payment systems with a huge variance. The overall use of and exposure to digital financial services (DFI) has a mean of 55.76 and a standard deviation of 13.88, indicating moderate exposure to and uptake of digital financial services in the sample. Mean values are significantly lower for access to green financing (Green Credit Availability) and renewable energy adoption (Renewable Energy Utilization) at 42.35 and 37.84, respectively, highlighting the relatively limited progress in these key sustainable farming development areas. The mean Agricultural Investment (INV) is 45.63 with a standard deviation of 11.54, indicating moderate investment levels but with varying levels of individual observations. Overall, the wide minimum–maximum values within all variables corroborate the existence of substantial heterogeneity and the resulting inadequacies in the progress about the implementation of fintechs, financial inclusion and green agricultural transformation efforts.

Table 2: Correlation Matrix

Variables	GATI	FAI	DFI	GCA	MTP	RE	INV
GATI	1.000	0.812	0.764	0.731	0.786	0.692	0.645
FAI	0.812	1.000	0.847	0.701	0.864	0.621	0.593
DFI	0.764	0.847	1.000	0.668	0.812	0.604	0.577
GCA	0.731	0.701	0.668	1.000	0.645	0.718	0.682
MTP	0.786	0.864	0.812	0.645	1.000	0.598	0.564

As shown in table 2, the correlation matrix shows that there are strong positive correlations between the variables that relate to the adoption of fintech, the digital financial inclusion as well as green agricultural transition. The correlation between both the GATI and the FinTech Adoption Index (FAI) is higher and positive (r = 0.812). This suggests that the higher the FAI is the higher the GATI is, thus showing the close relationship between increasing fintech adoption and improving green agricultural transition. Additionally, GATI has moderate correlations with several other indicators, such as Mobile Transaction Penetration (MTP) (r = 0.786), Digital Financial Inclusion (DFI) (r = 0.764), and Green Credit Availability (GCA) (r = 0.731), highlighting the importance of digital financial accessibility as well as green financing in Sustainable Agricultural Practices. There is a moderate but positive correlation between GATI and Renewable Energy Utilization (r = 0.692) and GATI and Agricultural Investment (r = 0.645) respectively. Fintech expansion is greatly associated with mobile financial transaction systems, notably in the case of FAI and MTP (r = 0,864). Likewise, there is a high degree of correlation between FAI and DFI (r = 0.847), and between DFI and MTP (r = 0.812), underscoring the close ties of digital finance ecosystems. The positive correlation values with RE (0.718) and INV (0.682) indicate meaningful positive correlation relationships between Green Credit Availability and RE adopters and agricultural investors. Overall, the sign of all coefficients is positive, with the relative size being

relatively large, and the elimination of extremely high correlations (greater than 0.90) points out that there is no serious multicollinearity between the variables analyzed.

Table 3: Panel Regression Results

Variables	Coefficient	Standard Error	t-Statistic	Probability
Constant	12.457	3.842	3.24	0.002
FAI	0.428	0.081	5.28	0.000
DFI	0.315	0.074	4.26	0.001
GCA	0.291	0.069	4.01	0.002
MTP	0.367	0.078	4.70	0.000
RE	0.248	0.062	3.98	0.003
INV	0.214	0.071	3.01	0.005

The regression results presented in table 3 reveal that the adoption of fintech products, digital financial inclusion, availability of green credit, penetration of mobile transactions, use of renewable energy and agricultural investment are all found to be positively and statistically significant with the Green Agricultural Transition Index (GATI). There is a baseline probability value of 0.002, t = 3.24, and a constant term of 12.457, confirming there is a significant level of green agri-transitions, even without the explanatory variables. The FinTech Adoption Index (FAI) shows high and significant influence in terms of the coefficient (0.428), with a small standard error (0.081) toward GATI, indicating that higher levels of fintech contribute significantly to green agricultural transformation. The positive impact of MT has also been achieved with a coefficient of 0.367 and a t-value of 4.70($p = 0.000$) with emphasis on digital payment infrastructure in supporting sustainable agricultural practices. DFI is found to be directly and positively related with GATI (Coefficient = 0.315 and Statistically significant t = 4.26 ($p = 0.001$)), digital financial services positively impact agricultural sustainability. Likewise, Green Credit Availabilty (GCA) shows coefficient of 0.291 and t statistic of 4.01 ($p = 0.002$) indicating the role of green finance in enabling environmentally friendly production of agriculture. In addition, renewable energy utilization (RE) has a positive and significant ($\beta = 0.248$, $t = 3.98$, $p = 0.003$) effect, indicating that developing the use of renewable energy in agriculture is beneficial for the green transition in agriculture. The coefficient of (INV) Agricultural Investment is also statistically significant and has the lowest value with a t-statistic value of 3.01 ($p = 0.005$), suggesting that the investment in agriculture positively contributes to sustainable transformation. In conclusion, the research indicates that the financial ecosystems enabled by fintech, harnessing through renewable energy sources and financial support, have a vital role to play in green agricultural transition.

Table 4: Model Summary

Statistics	Values
R^2	0.781
Adjusted R^2	0.764
F-statistic	46.82
Prob (F-statistic)	0.000

Overall model performance is quite high as can be seen in the model summary statistics (table 4) and the explanatory power of the regression model. The coefficient of determination (R^2) is 0.781, which means that the combined effect of the index of FinTech Adoption (FAI), Digital Financial Inclusion (DFI), Green Credit Availability (GCA), Mobile Transaction Penetration (MTP), Renewable Energy Utilization (RE), and Agricultural Investment (INV) accounts for about 78.1% of the variability explained by the Green Agricultural Transition Index (GATI). The adjusted-R^2 value of the model, 0.764, after controlling for the number of explanatory variables, once again confirms the strength of the developed model; with an adjusted-R^2 value of 0.764, approximately 76.4% of the variation in GATI could be consistently explained by a set of selected predictors. The F-statistic value is 46.82 which is relatively high, indicating the overall model is statistically significant. This is also reflected in the probability value of the F-statistic which is extremely small at 0.000, much lower than the established significance level of 0.05, indicating that the influence of the explanatory variables is significant. The overall statistics indicate that the model offers a reliable and robust empirical explanation on the relationship between fintech adoption, digital inclusion, green finance, renewable energy utilization and sustainable agricultural transformation via agricultural investments.

Hypothesis Testing

Null Hypothesis ()

Alternative Hypothesis ()

As the value of the probability (P-value) (0.000) is also lower than the 0.05 level of significance, the null hypothesis (H0) is rejected. Therefore, the study concludes that digital financial technologies have a significant positive impact on green economic transition in agriculture.

Discussion

The results indicate that Digitisation of financial technologies (FinTech) helps agricultural sector in significant ways to include challenge of green economic transition by boosting financial inclusion, and access to green credit as well as encouraging sustainable farming practices. The positive and statistically significant correlation between the FinTech Adoption Index (FAI) and Green Agricultural Transition Index (GATI) suggests that the improvement of digital financial ecosystems helps to support environmentally sustainable agricultural transformation. In this context, the study conducted by Hasan et al. (2024) pointed out that FinTech contributes to the strengthening of sustainable development in various ways, including ensuring financial accessibility, stimulating technological innovation, and promoting investment with environmental responsibility. With the growing popularity of electronic payment systems, mobile banking, and e-financial services, farmers are better positioning but also improving their ability to access institutional credit as well as respond to climate-smart agricultural approaches.

Furthermore, the findings show that Digital Financial Inclusion (DFI) has a positive relationship with sustainable performance of agriculture. It implies that increasing access to digital financial services helps smallholder farmers and the rural population to be more engaged in formal financial markets. Findings were echoed by [13]who noted that financial inclusion through FinTech provides farmers with greater resilience by providing them access to micro-credit, crop insurance and electronic savings facilities. Financial inclusion also facilitates sustainable farming practices, such as the uptake of sustainable farming technologies, renewable energy technologies and precision agriculture practices, without degrading the environment, and enhances agricultural productivity. In low-and middle-income countries, where marginal farmers are largely denied access to traditional banks, FinTech is a crucial enabler of financial services and sustainable food production.

Green Credit Availability (GCA) has a significant impact on the sustainability of Agriculture, thus making environmental related financing mechanisms important for supporting green economic transition. The study further establishes that digital lending platforms and digitalization of financial services promote investment in organic farming, renewable energy sources, water use efficiency in agriculture and low carbon activities in agriculture. The results are aligned with [14]findings, highlighting that technological innovations can enhance green finance efficiency and transparency, thereby mitigating information asymmetry and transaction costs. In the same manner, [15]highlighted that sustainable FinTech can improve environmental governance and facilitate sustainable investment decisions by electronic monitoring systems and financial transparency.

Mobile Transaction Penetration (MTP) was another significant factor which contributed to sustainable agricultural transformation. Overall, widespread adoption of mobile financial services enhances market connectivity, quicker transactions and integration of rural supply-chains. This study corroborates the research of[16], which found that farmers using mobile-based FinTech systems are found to have been more efficient in their operations and easier to access markets, and less reliant on informal financial intermediation. Furthermore, mobile transactions facilitate agricultural input access at the right time, digital marketplaces, and weather-based extension services, all of which help to address climatic adaptation and sustainable resource use.

In addition, it was concluded that using renewable energy and investing in agriculture positively promotes agricultural green transition. The findings indicate that any sustainability efforts with FinTech are likely to fail if not backed up by other investments in the environment and the infrastructure. Similarly, [17]stated digital agriculture technologies, together with the use of renewable energy systems, make a great contribution to sustainable intensification,

13 Mapanje et al., "Financing Sustainable Agriculture in Sub-Saharan Africa," 4587.
14 Saeedi and Ashraf, "The Role of Technology in Promoting Green Finance," 472.
15 Geetha and Biju, "Is Green FinTech Reshaping the Finance Sphere?," 1795.
16 Rufaidah et al., "A Review of the Implementation of Financial Technology (FinTech) in the Indonesian Agricultural Sector," 108.
17 Bertoglio et al., The Digital Agricultural Revolution.

carbon reduction, and efficient management of resources. FinTech, when combined with latest developments in AI, blockchain, Internet of Things (IoT), and precision farming technologies, can thus provide a more resilient and environmentally sustainable agricultural system.

While FinTech has many positive impacts on agriculture, the study identifies a range of issues that need to be overcome for it to be properly utilized in agriculture. Lack of Internet connectivity in rural areas and on digital devices, illiteracy about digital problems, cybersecurity concerns, and disparities in access to digital technology remain challenges to acquisition, especially in remote and mountainous communities. With the growing dependence on digital financial transactions and data-driven technologies, cybersecurity is one of the biggest issues in the contemporary digital financial systems, as pointed by[18]. In addition, lack of integration of marginalized farming communities in digital infrastructure and capacity building measures can exacerbate socio-economic inequalities.

To conclude, the results suggest that the adoption of digital financial technological solutions, combined with sustainable agri- and forest policies, can help to empower green economic transition, to reinforce farm resilience, and to promote climate-smart agriculture. To ensure sustainability, however, it is essential to have policy coordination, institutional support, investments in digital infrastructure and programs for farmers' digital literacy. Growth based on transformed agricultural economies that are environmentally sustainable can be facilitated through inclusive technologies and secure FinTech financing ecosystems that will require the cooperation of several actors, including the governments, financial institutions and technology providers.

Conclusion

Researchers have found that digital financial technologies (FinTech) are contributing to green economic transition in agriculture, as they are helping to increase financial inclusion, making access to green credit possible and responsible farming. Results from the empirical analysis indicate that the adoption of FinTech plays an important part in environmentally sustainable agricultural development, efficient resource management, reducing transaction costs, access to markets, and enabling smart climate agricultural innovations. Dentified payment systems, mobile banking, blockchain technology and digital lending platforms are boosting farmers' ability to access renewable energy, precision farming and sustainable production methods. The study also indicates that digital finance poses massive opportunities for enhancing resilience, environmental sustainability, and sustainable agriculture long-term for rural populations. However, digital literacy, cyber security concerns, digital inequalities, and poor digital infrastructure continue to pose barriers and need institutional and policy intervention. The overall study findings suggest that agricultural transformation is an important mechanism to attain sustainable development goals and green economic growth in developing economies via the development of the FinTech sector.

Future Strategy

For the future of promoting a sustainable agriculture transition through FinTech it will be important to build inclusive digital ecosystems, develop improved rural digital infrastructure and increase institutional support for financing sustainable and environmentally friendly agricultural practices. An integrated policy approach can be adopted by all government levels and other sources of funding, with a focus on green investments, digital financial inclusion and developing climate-resilient agricultural technology. The goal is to increase access to the internet, mobile financial services and digital literacy programs for farmers and agricultural producers in rural and underserved areas so that all farmers, including small-scale producers, can grow with the help of FinTech innovations. It is equally important to help agricultural producers to implement new technology such as artificial intelligence, blockchain, internet of things (IoT) and big data analytics into their operations to improve their efficiency and provide greater transparency, which in turn will help with monitoring their environmental performance. To build trust and security within the digital financial system, a robust cybersecurity environment and an adequate regulatory framework will be necessary. Research into the effectiveness of regional empirical studies, evaluation of the impacts of different policy options and the long-term social, economic and ecological effects that the integration of FinTech into agriculture has in developing regions, particularly in vulnerable and mountainous areas that are in critical need of agricultural transformation through sustainability, will be essential to ensure the overall success of these recommendations.

18 Javaheri et al., "Cybersecurity Threats in FinTech."

Bibliography

D. Javaheri, M. Fahmideh, H. Chizari, P. Lalbakhsh, and J. Hur, "Cybersecurity Threats in FinTech: A Systematic Review" (2023).

D. Wahyuni et al., "Digital Marketplace and FinTech to Support Agriculture Sustainability," *Energy Procedia* 156 (2019): 234–238.

Douglas W. Arner, Janos Barberis, and Ross P. Buckley, "FinTech and Sustainable Development: Enhancing Financial Inclusion through Digital Finance," *Asian Development Bank Institute Working Paper Series*, no. 929 (2020): 1–28.

F. Rufaidah, T. Karyani, E. Wulandari, and I. Setiawan, "A Review of the Implementation of Financial Technology (FinTech) in the Indonesian Agricultural Sector: Issues, Access, and Challenges," *International Journal of Financial Studies* 11, no. 3 (2023): 108.

I. Khan and M. S. Shahid, "The Nexus Between FinTech and Green Finance in Advancing Sustainable Performance Across Countries," *Discover Sustainability* 7 (2025), article 49, 1–20.

M. Saeedi and B. N. Ashraf, "The Role of Technology in Promoting Green Finance: A Systematic Literature Survey and the Development of a Framework," *Journal of Risk and Financial Management* 17, no. 10 (2024): 472.

O. Mapanje, S. Karuaihe, C. Machethe, and M. Amis, "Financing Sustainable Agriculture in Sub-Saharan Africa: A Review of the Role of Financial Technologies," *Sustainability* 15, no. 5 (2023): 4587.

Peterson K. Ozili, "Theories of Financial Inclusion," in *Uncertainty and Challenges in Contemporary Economic Behaviour* (Emerald Publishing, 2020), 89–115

R. Bertoglio, C. Corbo, F. M. Renga, and M. Matteucci, *The Digital Agricultural Revolution: A Bibliometric Analysis Literature Review* (2021).

S. Geetha and A. V. N. Biju, "Is Green FinTech Reshaping the Finance Sphere? Unravelling through a Systematic Literature Review," *Environmental Science and Pollution Research* 31, no. 2 (2024): 1790–1810.

United Nations, *The Sustainable Development Goals Report 2023* (New York: United Nations Publications, 2023).