

**REVIEW ARTICLE****Review and analysis of FinTech approaches for smart agriculture in one place****Sreekanth Reddy Pothula**¹ *Business System Architect - Finance Technology, Stripe, Inc., United States*Corresponding email: sreekanthreddy.pothula@gmail.com**ABSTRACT**

A revolution in agribusiness must happen to meet the goal of sustainable development. Many Agri Tech companies are still researching how to incorporate Financial Technology (FinTech) into their business models and how to manage the financial risks associated with the entire Agri supply chain. FinTech's wider impact on the farmer community aids in democratising the economics of agriculture. AgriTech and the agricultural industry are both growing as a result of FinTech and its integration with digital technology and digitalized agriculture. When there is a proper integration with the Internet of Things (IoT), artificial intelligence (AI), machine learning (ML), big data, and encrypted blockchain technology, fintech embraces the power of cooperation and improves transaction security. Agriculture funding development may have stagnated for a variety of reasons, but FinTech has the ability to resurrect it and advance global food security. Arguably, agriculture financing growth has stalled for many reasons, while financial technology (FinTech) has the potential to offshoot the expansion of agriculture financing so that global food security could be stimulated. Meanwhile, agriculture in different parts of the world is hindered by an ineffective, underdeveloped downstream segment and low access to financial technology. FinTech could promote agricultural sustainability. The financial sector is critical in allowing agriculture to contribute to economic growth and poverty reduction. This paper provides an integrated review and smart approaches to follow in de-risking agriculture for farmers.

Keywords: AgTech, AgriTech, FinTech, Financial Technology**1.0 Introduction**

The rapidly evolving technical environment creates new possibilities to target and price credit, share risk, and use information technology to boost agricultural productivity. To overcome the various obstacles that are not technological in nature, it is essential to pinpoint the most important areas for investment and policy that could aid farm households in getting better outcomes. Due to the desire for innovative financing for the agricultural sector, FinTech's enhanced ability to objectively quantify variation in the shifting of risks in the agricultural system makes it feasible to promote financial inclusion and high value in agriculture (McIntosh and Mansini, 2018). The focus of this study is agriculture technology (AgriTech). The creation of new products in the credit and risk markets is influenced by financial technology (FinTech), which is discussed in more detail in the next section along with how this benefits the agricultural sector. Instead, this article examines major policy takeaways for FinTech in

agriculture technology in order to foster growth, increase financial inclusion, and promote regional economic integration (AgriTech). FinTech's increased ability to objectively measure variation in the shifting of risks in the agricultural system makes it possible to promote financial inclusion and high-value agriculture as a result of the demand for novel financing for the agricultural sector (McIntosh and Mansini, 2018). Agriculture technology is first positioned in this study's investigation (AgriTech). The next section describes how FinTech influences the development of new products in the credit and risk markets and how it enhances the agriculture industry. To boost growth, expand financial inclusion, and strengthen regional economic integration, this article instead discusses major policies and strategies that could be adopted for FinTech in AgriTech.

An innovation in technology might contribute to a modification of the risks in the agriculture system. Due to this, we now have the capacity to objectively and finely measure variation. Agriculture must achieve the quality control required to satisfy urban customers and supply global markets, as well as increase overall yields, if it is to positively contribute to overall economic growth. It is rare for individual producers to make these improvements; instead, entire value chains must become sufficiently well organized to provide "farm to fork" custody certification.

From the above inferences, it has been understood that the main players might not be farmers but rather processors, middlemen in the value chain, and certifying bodies that can enable the capture of quality premiums in final output markets and their translation back up the supply chain to the original producers.

2.0 Developing concepts for FinTech and AgTech approaches

Each strategy is carefully examined in this section, along with how they work together to benefit the Farmers.

2.1 FinTech (financial technology) approach

Over time, financial and technological advancements have become more and more intertwined and mutually supportive. FinTech offers cutting-edge, technologically enhanced financial services and the supporting business models to go with them. FinTech is the term used to describe the recent limited collaboration between financial services and information technology. These two industries have long been connected. Specifically, a project started by Citigroup in the early 1990s is when the name "FinTech" first appeared. However, it wasn't until 2014 that authorities, businesses, and consumers began to pay the sector more attention. Fin-Tech, as a sector, describes up-and-coming tech firms that compete with established banks and financial market participants by providing a range of services, including crowdfunding platforms, mobile payment systems, online portfolio management, and international money transfers. Financial services consumers and investment corporations are both showing an interest in Fintech start-ups because they consider them to be the industry's future.

FinTech integrates the fields of finance, technology management, and innovation management. In a variety of settings, the term has created awareness among audiences with varying backgrounds, including business executives and students. It has been discovered that the term helps people comprehend fintech and its possibilities. The term "FinTech" has been around for a while, and it has gained a lot of attention from industries that want to use and adopt the technology. The financial technology sector includes businesses that offer financial services through the use of technology as well as organisations that supply technology services to financial institutions directly. Technology is used by FinTech companies to facilitate financial transactions between consumers and enterprises.

2.2 The AgriTech (Agricultural Technology) Approach

Any technology that is used on the farm or that enters the farm is agritech. Increasing production and sustainability through horticulture or aquaculture in agriculture is referred to as "Agritech." In simple terms, Agritech is necessary to enable the world to be sustainable and meet its need for high-quality and safe food (FAO et al., 2020), which makes it both a One Health requirement for maintaining good human and animal health and a lucrative domestic and global business.

With 40% of the world's population now relying on agriculture for their livelihood, it is the largest employer in the world. By 2030, the United Nations has established a goal to implement resilient agricultural techniques, double agricultural productivity, increase small-scale food producers' earnings, and assure sustainable food production systems. The £14 billion UK agritech business supports approximately 500,000 jobs. The UK is a global leader in the creation of technologies that enhance outcomes and ease the strain on finite resources.

Agritech is one of the innovative funding methods used to improve the agricultural business process. To magnify production competitiveness, processing, marketing, and distribution, smallholder farmers need access to other actors throughout the supply chain, including brokerages, dealers, and financial institutions (Meyer, 2007). Different value chain frameworks for agricultural finance offer different perspectives on local and global trade. Financial instruments are necessary to have the greatest possible social and financial effect because each value chain has various risks, returns, and financing plans (Shwedel, 2007). Technology, regulation, standardisation, push and pull influences, and other external variables may present possibilities and problems.

2.3 The combined agritech and fintech approaches

As the first digitalized agriculture ecosystem, Crowde developed the financial technology platform depicted in Fig. 1 to support smallholder farmers' revenue. Through convenient financial access and individualised services, financial technology is used to promote the financial inclusion of agricultural enterprises (Anshari et al., 2019; McIntosh and Mansini, 2018). Financial enclosure might boost their market participation, which might assist them in promoting farmers' wellbeing (Casuga et al., 2008). This platform invites lenders or funders, including individuals and organisations, to choose a variety of projects to invest in over the

course of a set amount of time. By connecting all participants, it might develop a more sustainable and integrated agricultural ecosystem. Borrowers must submit project documentation for evaluation by Crowde in order to propose a fund. After being approved, the project might be posted on the platform for a set period of time, from which donors could select it. Borrowers may use the funds after the crowdfunding period or the desired amount has passed. They might pay the principal and return the funds after the project is completed.

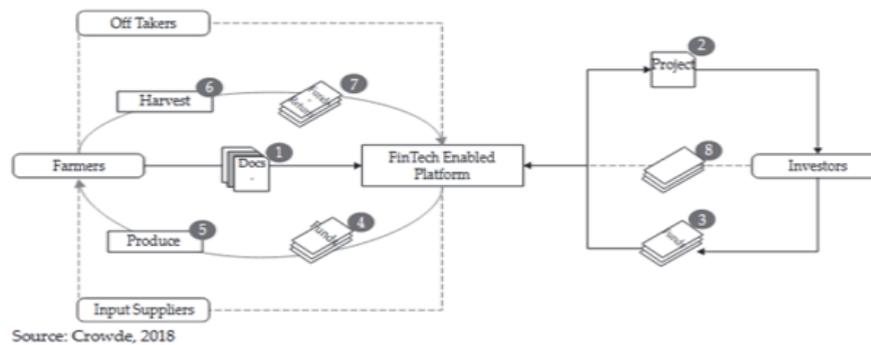


Fig. 1 Technology platform with fintech integration

According to the figure, Crowde developed a collective mechanism with a field agent to gather farmers based on their geographic region and serve as an intermediary between farmers. Additionally, Crowde makes sure that chain participants acquire profits from the system (Agyekumhene et al., 2018). Their primary responsibility is to make sure that the farming process, data input, and money collection all go smoothly. Crowde built a group of applications for each participant in the value chain.

However, suppliers, farmers, and off-takers would be integrated into a single platform for Fintech and AgriTech in the Agricultural Value Chain to be processed as collective information and create intelligent information that could be shared with all participants. This technology might close the information gap left by market development programmes that still manually collect all data from each network of value chain actors.

3.0 FinTech's technology push for smart agriculture

A certain group of policies are vivid when agriculture is treated as a sector that provides employment for the vast majority of the world's working poor. Here, FinTech is the key idea for enhancing AgriTech, since we need to figure out how to organise agricultural output so that smallholder farmers benefit as much as possible. In this regard, FinTech offers fundamental policy changes that support the development of AgriTech or the agricultural sector in the following ways:

- Using mobile money infrastructure rather than cash to operate input and output suppliers, G2P payments, bank financial services, and agricultural payment systems.

- Creating a credit bureau infrastructure that enables better uncollateralized credit market targeting and performance, granting smallholder producers without collateral access to finance
- A concerted regulatory effort to compel FIs to share information, especially with regard to smallholder loans. The "ladder of credit" needs to be prioritised, which calls for collaboration between small (microfinance) and large (private commercial) lending institutions so that the economically underprivileged can use their credit histories as a vehicle for economic mobility.
- Financial literacy initiatives make sure people are aware of new FinTech possibilities, can use systems to engage and compare prices, and can use tools to make future plans. Financial literacy is strongly influenced by gender, and programmes designed for particular groups of people are more successful.
- ICT-driven agricultural extension services that help smallholder farmers increase quality, boost earnings, and feed production into supply chains with higher value (e.g., Olam, Precision Agriculture for Development, etc.)
- Trading systems powered by ICT provide smallholders with access to price information and wider markets. Smallholders are prevented from investing in productivity improvements by shallow markets since prices drop as output rises.
- Land titling and land registries to allow farmers to use their land as collateral for loans. To prevent borrowers from engaging in "risk rationing" on the demand side, explicit credit insurance may need to be linked with land-collateralized loans. If banks do not clearly include this conditionality in their loans, providing them with agricultural insurance is insufficient.

4.0 Review of previous works

Using (Hinson.R et al., 2019) through the transformation of agriculture as a crucial component of the country's economic development, the author underlines the importance of attaining sustainable development through fintech. The emphasis is on using FinTech in rural Sub-Saharan Africa, where mobile money and mobile financial services are the most widely used applications of FinTech that are connected to digital agricultural systems. Mobile financial services are linked to solar panels and digital crop insurance, and mobile money can be a crucial source of capital for smallholder farmers. It can also promote additional investment in agribusiness. Especially in the Sahara region of sub-Africa, where approximately 600 million people lack access. Regarding power and increasing agricultural productivity in line with SDG 12, these measures are encouraging. FinTech applications stress how machine learning and artificial intelligence (AI) may dramatically boost the benefits of such integrated systems. FinTech applications employ digital platforms. Information about individual farms is provided through digital markets. An example of a digital inputs market that operates outside of Asia, in countries like Kenya, Mozambique, and Nigeria, is Hello Tractor. In the case of Uganda, where loans, market links, and drought insurance are integrated with meteorological advice and supplied to farmers via text messages, agronomic guidance is given. The analysis highlights the need for further research into the cost, advantages, and scalability of using these resources, as well as their effects on inclusive business.



Hong. M et.al., (2022) focuses on the significance of financial inclusion in the digital age for China's agricultural green total factor production. Further research demonstrates that digital financial inclusion has an impact on the improvement of agricultural total factor production, which is spatially varied. The various traits of digital financial inclusion would also have varying effects on the growth of agricultural total factor productivity. To support the environmentally friendly development of agriculture, the agricultural sector's organisational structure must be improved, the financial development environment must be further strengthened, and development strategies for digital inclusive finance must be created in accordance with local requirements. One of the many factors that increases productivity is the level of financial development, which is an important factor to take into account. The distribution of financial resources in China is characterised by low efficiency and an unbalanced mismatch. To increase the productivity of agricultural green total factors, digital inclusive finance first boosts rural financial efficiency, reduces rural financial costs, and raises anticipated production. Second, by reducing harmful items, increasing agricultural biotechnology, and easing financial constraints. The study focuses on the effects of including digital finances in the form of a hypothesis, which claims that doing so will increase China's green total factor productivity, optimise the structure of the agricultural and industrial sectors, and create some degree of heterogeneity. The study examined the macro-level impacts of digital, inclusive finance on the productivity of green total factors in agriculture. Based on this, it is anticipated that in the subsequent writing process, in order to make up for the time constraint and extend the study to microdata in order to further support the conclusions of this paper, we can try to draw on more indicators or construct more reasonable indicators to represent digital financial inclusion.

The authors (Kambali et.al., 2022) make the case that agricultural finance is necessary for agricultural development initiatives that aim to boost production. Farmers must have quick and adequate access to capital for irrigation, farm mechanisation, and land expansion. The main goals of the study are to understand the challenges farmers face, identify and investigate the factors affecting agricultural finance, compare the growth of farmers' incomes before and after using financial support, and choose the most effective strategies for expanding agricultural credit to farmers. Due to the significant sums of money involved at every level and the meticulous planning necessary to earn the required revenue, the financial sector is one of those with the highest level of risk. Agriculture investment requires long-term planning, which the Indian banking industry actively encourages. Farmers are able to complete their work successfully and without interruption thanks to this. In India, the agricultural industry accounted for 14% of the country's GDP, and agricultural financing was used both locally and internationally. Farmers' and other people's incomes in agriculture and related businesses can also increase if the growth rate of the agricultural GDP is increased. Agriculture financing assists impoverished farmers in increasing their income by providing significant loan guarantee packages. The work comprises an analysis of the growth of farmers before and after obtaining financial aid, schemes for assisting agricultural financing, and financial institutions that provide money for the farmers through various means. According to the author, regional banking institutions, financial industry participants, and loan providers, including cooperative

banks, the public sector, the private sector, and self-help organizations, all play a significant role in financial integration.

The author (Yan.S, 2020) emphasises the role of agriculture in boosting the national economy. As science and technology advanced, various policies were put in place to protect farmers. Agriculture needs the constant support of finance to thrive. Rural banking institutions should help the agricultural sector by extending finances and required alignments as well as greater resources to the vital areas and weak regions of agriculture in order to give good service to agricultural development and achieve sustainable development. Agriculture is a country's main industry and the foundation of all human life. This essay examines the potential economic benefits of China's financial support for agriculture. The financial support that is more suited to the development of agriculture should be given. Governments and financial institutions should place a high priority on the growth of agriculture, as well as raise funds for the production of high-quality agricultural products and promote organisational changes in the agricultural sector. The author proposes that for the greater growth of China's agriculture, the government and financial institutions should work together. In order to best allocate financial resources to agricultural development and to promote the development of green finance, which helps recycle agricultural resources when the government takes effective action to improve agriculture, financial support for agriculture analyses the following outcomes: Financial institutions should promote the development of agricultural tourism. Agriculture-related financial institutions should evaluate the region's financial needs in order to efficiently supply it with cash based on the expansion of the agricultural industry there. The author comes to the conclusion that financial institutions must extend their support to rural areas in order for agriculture to thrive sustainably. Financial assistance offers agriculture's development strong economic backing. Agriculture's expansion and the accomplishment of farmers' earnings are significantly reliant on financial support for the sector. From various observations, the adoption of FinTech in various use cases has been provided in Table 1.

Table 1: Review of adoption of FinTech in several use cases

Anshari et al (2019)	This study focussed on crowdfunding. The authors have discussed about the usage of AgroPay
M.Robbi Qawi & Mahawan Karuniasa (2020)	The authors have provided an overview of the technology that has been evolved to make the parties to actively participate towards the progress in the agricultural production.
Chen et al (2021)	In this study, it has been observed that the usage of fintech product services among men are found to be more when compared with women
Ningrat, R. Gratiyana (2019)	According to this analysis, all market segmentation and value chain participants from different financing sources and stakeholders might get benefits financially from Islamic finance.

5.0 Methodology

The research techniques used to evaluate the impact are listed below:

5.1 Data collection technique

As per the author (Creswell, 2014), investigation begins with the purposeful sampling of data. An extensive search of books, journals, and internet sources was conducted in order to develop agricultural value chain finance and market development strategies, as well as to use FinTech as primary data sources. To supplement the qualitative data, several institutional internal and public documents were also gathered. Additionally, certain publications and peer-reviewed journals on the FinTech and agriculture value chain processes were gathered as secondary sources of data, i.e., text and visual, as supplementary data on models. However, a thematic analysis was used as a paradigm in conjunction with recent AgriTech and FinTech research.

5.2 Analysis of data

The goal of the research method known as content analysis is to make reproducible and reliable inferences from texts (or other significant issues) to the settings in which they are used. As a measure of reliability, this method should produce findings that are reproducible over time and under different conditions. The agritech and fintech approaches were chosen for content analysis. The two most significant and successful strategies for advancing the economic development and welfare of agriculture are agricultural technology (AgriTech) and financial technology (FinTech). The strategy attempts to promote farmers' access to the market to boost their earning potential and competitiveness (Briones, 2015). Access to institutional financing for smallholder farmers in rural areas is one issue that has to be addressed.

6.0 Discussions

Elimination of information asymmetry through improved data availability for all parties, which boosts transparency and allows for more efficient and cost-effective communication among value-chain participants increasing transparency may lead to increased output and less food waste. Employing digital solutions to decrease manual and paper processing or data entry errors will lower operational and transaction expenses. Through the implementation of data analytics, artificial intelligence (AI), and machine learning, crop yields are augmented. By eliminating middlemen and improving access to markets, producers will be able to charge higher prices for their products, and this strategy ensures savings on the customer's end. Access could be enabled for the farmers to finance by assessing the creditworthiness of those who previously did not have access using different data. Fintech firms have the ability to overcome significant obstacles to funding smallholder farmers by combining big data analytics with financing, including the difficulties of determining the creditworthiness of smallholder farmers and connecting loan repayments to the cycles of agricultural production. If finance platforms are combined with AgriTech solutions intended to increase agricultural production, this influence may be very potent. Additionally, peer-to-peer lending systems are being introduced by FinTech companies, giving smallholders access to loans that are more flexible and affordable than those provided by traditional banks.

7.0 Conclusion

This study emphasises the involvement of financial technology that has been developed so that the new social issues, including agriculture, during the Fourth Industrial Revolution could be addressed. It is widely acknowledged that for the agricultural sector to thrive and expand sustainably, FinTech innovation must connect all actors in the value chain from upstream to downstream. The FinTech strategy is an effective tool for improving the adaptability of customer-focused goods and services, particularly to improve access to Agritech. This study's finding raises the possibility that financial technology (FinTech) could significantly advance all agricultural industries financially. Further, the study has provided an overview of the impact on the economy, reduction in poverty, and food security through the deployment of advancements in technology. The future work could focus on paying more attention to the integration of FinTech with green technologies, as well as the exploration of mobile money services and their economic impact.

8.0 Acknowledgements

8.1 Funding

None.

8.2 Declaration of interest

None

9.0 References

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