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Mediating Function of Sustainable Agriculture in The Impact of FinTech on AI-Based Green Marketing

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Abstract

Global sustainability agendas, especially in the agricultural sector, are being advanced by the convergence of green marketing, sustainable agriculture, and technological innovation. Green marketing orientation gauges an organization's commitment to putting strategic, tactical, and internal procedures and activities into place with the goal of developing, communicating, and delivering goods and/or services with the least amount of environmental impact. FinTech is the use of cutting-edge digital technologies, like blockchain, digital credit, mobile banking, and alternative data analytics, to provide financial services, particularly in areas where traditional systems are still insufficiently advanced or exclusive. By improving efficiency, increasing access, lowering transaction costs, and promoting financial inclusion, all of which are essential components of sustainable development, FinTech has quickly upended traditional financial infrastructures. The purpose of this study is to determine the influence of fintech on sustainable agriculture and ultimately affect artificial intelligence (AI)-based green marketing. This research uses theoretical literature review as a research method. Authors found that fintech affects sustainable agriculture, and AI-based green marketing affected by sustainable agriculture. Digital finance has emerged as a transformative force in the agricultural sector, reshaping how farmers, agribusinesses, and intermediaries access and manage financial services. The agricultural value chain, which encompasses production, processing, distribution, and retail, has historically faced challenges related to inefficiency, lack of transparency, and limited access to credit. By integrating digital technologies such as mobile banking, blockchain, and digital payment systems, financial transactions within agriculture are becoming more transparent, accessible, and efficient.

Keywords: *Fintech, Sustainability, Agriculture, Artificial Intelligence, Green Marketing, Theoretical Review*

1. Introduction

Global sustainability agendas, especially in the agricultural sector, are being advanced by the convergence of green marketing, sustainable agriculture, and technological innovation. The use of artificial intelligence (AI) and financial technology (FinTech) is becoming more widely acknowledged as interrelated forces that can change food systems in support of the Sustainable Development Goals (SDGs) of the United Nation (UN), particularly those pertaining to climate action, responsible consumption, and rural prosperity [1] [2]. However, sustainable agriculture—a vital operational, moral, and useful link between financial inclusion, technological innovation, and ecologically conscious production and marketing methods—often mediates the interface between FinTech and AI-based green marketing [3]. With a focus on the theoretical underpinnings and mechanisms of mediation, this background section summarizes current conceptual frameworks and empirical findings to shed light on how sustainable agriculture mediates the wider impact of FinTech on AI-enabled green marketing.

Green marketing orientation gauges an organization's commitment to putting strategic, tactical, and internal procedures and activities into place with the goal of developing, communicating, and delivering goods and/or services with the least amount of environmental impact [4]. Organizations can improve their green marketing initiatives by utilizing artificial intelligence technology and solutions through the integration of AI-enabled green marketing. These AI-powered tactics allow businesses to assess and improve their environmental procedures, find sustainable substitutes, tailor consumer communications, and increase sustainability project transparency.

FinTech is the use of cutting-edge digital technologies, like blockchain, digital credit, mobile banking, and alternative data analytics, to provide financial services, particularly in areas where traditional systems are still insufficiently advanced or exclusive [5]. By improving efficiency, increasing access, lowering transaction costs, and promoting financial inclusion—all of which are essential components of sustainable development—FinTech has quickly upended traditional financial infrastructures [2] [5]. By democratizing access to funding for environmental projects, promoting innovative business models like crowdfunding for agri-sustainability, and enabling transparent, low-cost international transactions for climate finance, FinTech is a catalyst for sustainable investment and green finance, according to a number of reputable reviews [6].

Financial inclusion is a fundamental tenet of FinTech in sustainable development, particularly for groups that have historically been shut out of formal banking, like women, smallholder farmers, and rural business owners. FinTech fills important financial gaps that impede the adoption of sustainable agricultural practices in both developed and developing nations by offering customized credit, insurance, and payment solutions [7]. Fintech offers many benefits, but there are a few issues that must be resolved. Farmers often meet data security hazards, financial literacy challenges, and difficulties implementing new technologies [8]. FinTech platforms, for example, facilitate risk assessment and loan disbursement for smallholders without collateral or credit history by utilizing alternative credit scoring models based on non-traditional and real-time data—such as mobile phone usage, satellite images, and transaction records [7]. This directly affects their ability to invest in sustainable production systems.

Additionally, FinTech-driven financial products—such as peer-to-peer lending, mobile microloans, payment facilitation, and blockchain-enabled traceability—are being developed and implemented more frequently to encourage the adoption of sustainable practices, such as organic certification, climate-smart agriculture, and lower input farming [9]. These financial innovations lay the groundwork for future integration with AI-driven supply chain management and marketing technologies by directly connecting investment flows to verifiable sustainability outcomes [2].

A collection of integrated plant and animal production systems known as "sustainable agriculture" are intended to meet current food and fiber demands while maintaining the ability of future generations to meet their own, guaranteeing socioeconomic justice, financial success, and the long-term health of ecosystems (<https://www.nal.usda.gov/farms-and-agricultural-production-systems/sustainable-agriculture>). Food security, environmental stewardship, economic resilience, and social inclusion are highlighted as multifunctionality as the main objectives of sustainable agriculture in this definition, which is supported by the US Department of Agriculture and echoed by international organizations [10]. Among the fundamental ideas of sustainable agriculture are:

- 1.1. Resource efficiency, means the process of maximizing yields while reducing the impact on the environment by making the best use of inputs (water, fertilizer, and chemicals) [10] [11].
- 1.2. Promoting a variety of cropping systems (polyculture, crop rotation, and agroforestry) to increase ecological resilience and lessen reliance on artificial inputs is one way to promote biodiversity and ecosystem services (<https://www.britannica.com/technology/sustainable-agriculture>).
- 1.3. Maintaining soil fertility, halting erosion, and applying conservation strategies (cover crops, no-till farming) for sustained productivity are all aspects of soil and water health (<https://farmonaut.com/case-study/sustainable-agriculture-case-study-ai-iot-innovations>).
- 1.4. Socioeconomic viability: facilitating participation in market value chains and bolstering livelihoods, particularly for marginalized and smallholder farmers (<https://pmarketresearch.com/hc/agri-fintech-platforms-market>).

Green marketing is promoting goods, services, or business operations on the basis of their positive environmental effects and it is frequently done to change consumer behavior, increase brand equity, and satisfy ethical or legal requirements for sustainability [12]. A new era of precision, personalization, and data-driven strategy development has been ushered in by the integration of AI into green marketing over the past ten years, turning traditional advertising into interactive, value-based communication [13]. AI-based green marketing uses computer vision, machine learning, natural language processing (NLP), and real-time analytics to analyze large datasets on supply chain operations, understand and predict consumer preferences for sustainable products, and create highly targeted advertising campaigns that appeal to environmentally conscious consumers [12] [13]. These systems can optimize product recommendations for eco-friendly consumers, track and validate environmental certification claims, and track social sentiment to dynamically modify campaign strategies and narratives [12] [13].

One way to conceptualize the mediation role of sustainable agriculture in the relationship between FinTech and AI-based green marketing is to use frameworks for causal mediation analysis, which look at how an independent variable (FinTech) influences a dependent variable (AI-based green marketing) through an intervening mediator (sustainable agriculture) [14] [15]. FinTech solutions enhance farmers' access to customized credit, insurance, and electronic payments, facilitating investments in low-input agriculture, drip irrigation, and organic certification, among other sustainable farming methods that serve as the operational foundation for reliable green marketing claims [7]. Adoption of FinTech and digital platforms in sustainable agriculture creates rich, verifiable datasets on resource usage, production practices, and traceability. AI-powered marketing systems use these datasets to target environmentally conscious consumers, increase transparency, and set their products apart from competitors [12]. FinTech-backed precision agriculture powered by AI lowers waste, boosts yields, and enables real-time monitoring of environmental impact (carbon, water, and chemical use) (<https://pmarketresearch.com/hc/agri-fintech-platforms-market>). It also provides valuable content for green marketing campaigns that can be algorithmically optimized for resonance and credibility (<https://farmonaut.com/case-study/sustainable-agriculture-case-study-ai-iot-innovations>). The feedback loop between farm-level action and market recognition is closed when producers communicate value to environmentally conscious consumers, investors, and regulators through sustainable agricultural practices validated by FinTech and AI (e.g., drone-monitored compliance, blockchain-enabled traceability) [12].

2. Research Methods

In order to accomplish the goals and objectives of the research, a theoretical literature survey is carried out, and a conceptual framework for further investigation is provided. We discussed the research methodology used by earlier studies [16] [17].

3. Results and Discussions

In the current research, the authors consider the sales of Indonesian MSMEs as dependent variable that affected by digital marketing contents, and AI influencer as a variable affect digital marketing contents. The conceptual model of the research is given at the Figure 1.

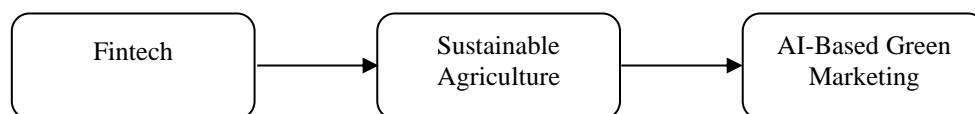


Figure 1. Conceptual model of the research

In this research, authors analyze based on existing theory that fintech affects sustainable agriculture, and AI-based green marketing affected by sustainable agriculture. The mediating function of sustainable agriculture in empowering FinTech to propel AI-based green marketing is demonstrated by a plethora of case studies and field research. Platforms such as CropIn, Apollo Agriculture, and Jai Kisan are prime examples of how FinTech, AI, and sustainable agriculture can work together. These platforms encourage the use of climate-resilient seeds, precision input application, and traceable production methods by distributing credit based on AI-driven evaluation of digital agronomic, transaction, and satellite datasets [7]. These methods directly support AI-driven green marketing initiatives that prioritize eco-innovation, carbon neutrality, and ethical sourcing. Market differentiation and price premiums can be achieved through AI-driven marketing by algorithmically highlighting sustainable practices and value chain transparency offered by blockchain-based systems like BeefLedger and Provenance [12]. Additionally, by facilitating feedback mechanisms, these platforms give eco-friendly producers greater access to markets and financing through FinTech channels. In order to strengthen sustainability as a mediating condition for access to FinTech-enabled value chains and AI-based market innovations, government, non-profit, and fintech partnerships—like the one between the Syngenta Foundation and the International Research Institute for Climate and Society—have effectively combined insurance and financial literacy training with digital tools for sustainable agriculture [9].

Digital finance has emerged as a transformative force in the agricultural sector, reshaping how farmers, agribusinesses, and intermediaries access and manage financial services. The agricultural value chain, which encompasses production, processing, distribution, and retail, has historically faced challenges related to inefficiency, lack of transparency, and limited access to credit. By integrating digital technologies such as mobile banking, blockchain, and digital payment systems, financial transactions within agriculture are becoming more transparent, accessible, and efficient. This digitalization not only enhances productivity but also promotes

sustainability and builds capacity among farmers and agribusinesses. Digital finance refers to the use of digital platforms and technologies to deliver financial services, including payments, credit, insurance, and savings. In agriculture, digital finance encompasses mobile money, online banking, blockchain-based traceability, and digital lending platforms. These innovations reduce transaction costs, improve financial inclusion, and enhance transparency across agricultural supply chains.

Transparency is a critical benefit of digital finance in agriculture. Blockchain technology, for example, enables immutable records of financial transactions, ensuring that payments to farmers are traceable and verifiable. This reduces corruption, eliminates exploitative intermediaries, and builds trust among stakeholders. Transparent financial systems also allow consumers to verify sustainability claims, linking agricultural practices to eco-friendly outcomes. Digital finance increases accessibility by providing farmers with mobile-based platforms for payments, loans, and insurance. In regions where traditional banking infrastructure is limited, mobile money services have revolutionized access to financial services. Farmers can now receive payments instantly, access microloans, and purchase insurance products directly from their phones. This accessibility empowers smallholder farmers, who constitute the majority of agricultural producers in developing countries.

Ensuring that fintech development is in line with sustainability objectives and morally sound green marketing strategies requires strong regulatory and policy frameworks [5]. These frameworks focus on enforcing transparency and uniform environmental, social, and governance (ESG) metrics across marketing, FinTech, and agricultural platforms [9], and enforcing rules for privacy, data security, and moral AI/Fintech use, particularly to avoid bias or exclusion from opportunities for marketing and sustainable finance [5]. Further, those frameworks also focus on supporting outreach and education initiatives to increase user capacity will improve adoption and results, enhancing sustainable agriculture's mediating effect [3].

Multiple studies demonstrate fintech's transformative role in sustainable agriculture. Fintech enhances capital access and promotes green farming methods [18], and fintech can become a "support system" for sustainable agricultural practices [19]. Regarding green marketing, over 50% of users choose financial services based on sustainability initiatives, indicating sustainable agricultural practices directly impact marketing strategies [20], and Fintech integration supports sustainable agriculture by influencing farmer adoption through social influence, performance expectancy, and convenience [21].

Efficiency is enhanced through digital finance by reducing transaction times and costs. Digital payment systems eliminate the need for cash-based transactions, which are often slow and insecure. Online loan processing platforms accelerate credit approval, enabling farmers to access funds when needed for planting or harvesting. Efficiency also extends to supply chain management, where digital platforms streamline payments between producers, processors, and retailers. Digital finance contributes to productivity by enabling farmers to invest in modern technologies and sustainable practices. Access to credit allows farmers to purchase improved seeds, fertilizers, and equipment. Insurance products protect farmers against climate risks, reducing vulnerability and encouraging investment in productivity-enhancing practices. Digital platforms also provide financial literacy training, building farmers' capacity to manage resources effectively.

FinTech has become a cornerstone of modern economic transformation, reshaping industries through digital innovation and financial inclusion [22]. Its influence extends beyond traditional banking, reaching sectors such as agriculture, sustainability, and marketing [23]. AI, meanwhile, has revolutionized marketing practices by enabling predictive analytics, personalization, and transparency in sustainability communication, when combined, FinTech and AI create powerful synergies that support green marketing strategies aimed at promoting environmentally friendly products and practices [24]. Sustainable agriculture mediates this relationship by providing the ecological and social foundation upon which financial and marketing innovations can thrive.

FinTech encompasses digital financial services such as mobile banking, blockchain, peer-to-peer lending, and digital payment systems. These innovations reduce transaction costs, increase financial inclusion, and enhance transparency in resource allocation. In sustainability contexts, FinTech platforms embed environmental, social, and governance (ESG) principles into their operations. For example, blockchain-based financing tools allow farmers to access microloans for sustainable practices, while ensuring traceability of funds [23]. Climate-focused FinTech investment surpassed \$50 billion globally in 2024, with more than 60% of startups integrating ESG strategies [22]. This demonstrates FinTech's capacity to mobilize capital toward sustainable projects, including agriculture and green marketing initiatives.

Green marketing refers to strategies that promote environmentally friendly products and practices. AI enhances green marketing by enabling predictive analytics, consumer segmentation, and personalized communication that highlight sustainability attributes [24]. Machine learning algorithms can analyze consumer preferences for eco-

friendly products, thereby improving targeting efficiency and reducing waste in marketing campaigns. AI-driven platforms also allow firms to measure carbon footprints and communicate sustainability metrics transparently to consumers. Thus, AI-based green marketing strengthens consumer trust and aligns corporate strategies with global sustainability goals.

Sustainability is promoted through digital finance by linking financial services to environmentally friendly practices. Blockchain-based traceability systems ensure that funds are directed toward sustainable agricultural projects. Digital lending platforms increasingly incorporate environmental, social, and governance (ESG) criteria into loan approvals. This incentivizes farmers to adopt practices such as organic farming, water conservation, and reduced pesticide use. Sustainable agriculture emphasizes practices that maintain ecological balance, conserve resources, and ensure long-term food security. It mediates the relationship between FinTech and AI-based green marketing by serving as the practical domain where financial innovation and marketing strategies converge. FinTech provides farmers with access to credit, insurance, and digital marketplaces, enabling them to adopt sustainable practices. AI-based green marketing then communicates these sustainable practices to consumers, creating value chains that reward ecological stewardship. In this way, sustainable agriculture acts as the bridge that translates FinTech's financial empowerment into marketing narratives that resonate with environmentally conscious consumers.

Capacity building is a key outcome of digital finance in agriculture. Digital platforms provide farmers with access to training, market information, and financial literacy programs. Agribusinesses benefit from improved supply chain management and access to digital marketplaces. Capacity building strengthens resilience, enabling farmers and agribusinesses to adapt to market fluctuations and climate challenges. The sense of anticipated relative benefits was the most significant antecedent influencing the development of initial confidence in agricultural FinTech, outweighing the effects of structural guarantees of data processing and individual inclination to trust. That perceived relative benefits influence trust accords with earlier studies that study the influence of perceived relative benefits of innovations on trust development in various sectors and geographical locations [25]. Trust in FinTech is positively impacted by FinTech services' practicality and ease of usage. Farmers' confidence and desire to employ autonomous field robots rise when they believe the innovation will function as advantageous when compared to the methods currently in use [25].

These results can also be applied to the situation of farmers and their FinTech trust-building process. Conventional financial services have placed a greater focus on mobile apps' efficiency and convenience, enabling consumers to access services whenever they choose (ubiquity) [25]. FinTech solutions, however, make it possible for more people to access capital and financial services, particularly those who were previously shut out. For instance, better risk assessment can make funding choices available to smaller farmers who might not have collateral. Another illustration is the possibility of cheaper loan rates or financing for innovative production techniques since FinTech solutions driven by AI and Big Data are better able to evaluate the associated risks [25]. Farmers now have access to more reasonably priced banking solutions.

As they work to obtain fair pricing for their agricultural products, smallholder farmers in developing countries encounter a variety of difficulties. This conceptual paper explores the transformative potential of FinTech solutions with a major focus on supporting sustainable agricultural value chains (SAVC). The paper summarizes findings from earlier studies on SAVC, smallholder farmers' challenges, traditional approaches, and the unrealized potential of FinTech solutions in the agriculture industry.

Digital technology being used in previously unheard-of ways in the Fintech revolution that is currently sweeping the world, which has sparked new entrepreneurship, unrestrained creativity, and a notable increase in venture capital firms' interest in getting involved [26]. Fintech is anticipated to provide several noteworthy advantages. Fintech makes financial services more accessible and less expensive for users. Fintech expands the extent and depth of financial institutions' offerings while also improving their operational efficiency. Fintech can help entrepreneurs create and take advantage of new business opportunities by improving the speed and transparency of financial data. Because the conventional recommendations for strategy fail to take into consideration at least four distinctive features of Fintech platforms, a thorough analysis of their competing tactics is necessary [26]. First, Fintech platforms need to reconcile their opposing dual identities as a risk-averse financial company and a growth-oriented technological company. Second, clients from the vulnerable societal groups that established financial institutions have historically ignored are more likely to be served by Fintech platforms. Third, Fintech platforms may be more vulnerable to sudden legislative changes and an unpredictable regulatory environment since they pose a danger to the financial services industry, which is typically seen as a crucial pillar of economic stability in the majority of nations worldwide. Fourth, the Fintech platforms usually face competition from larger, more established, and generally more powerful incumbent corporations. Fintech practitioners who want to learn

from their peers' experiences in other Fintech sectors as well as from their own companies may find value in the insights that such a study could produce. Without this understanding, the emerging Fintech platforms may find it particularly challenging to overcome the many obstacles they face, including resource limitations, competition from well-established, established financial institutions, and the risk of being a novel business model.

Although farmers can access digital technology through the platform's digital environment, the cost of implementing planting technology can be prohibitively high [27]. The majority of farmers in many developing nations lack the funds necessary to purchase agricultural machinery and other inputs. The agriculture supply chain may be significantly and adversely impacted by this lack of funding. Commercial banks, nonprofits, and government-led farmer support programs are just a few of the funding options that have been introduced to assist farmers. The banking market is the most often used source of funding [27]. Nevertheless, the majority of farmers lack the necessary collateral and trustworthiness to obtain bank credit. In addition, the agricultural sector is susceptible to erratic weather, pests, and illnesses.

Digital finance has emerged as one of the most significant innovations in the global economy, reshaping how individuals, businesses, and governments access and manage financial services. The integration of digital technologies into financial systems has created new opportunities for efficiency, transparency, and inclusion. In agriculture, digital finance plays a transformative role by enabling farmers to access credit, insurance, and digital marketplaces. At the same time, inclusive development is supported by digital finance through financial inclusion, poverty reduction, and empowerment of marginalized communities. However, financial digitalization also presents challenges, including digital divides, cybersecurity risks, and regulatory fragmentation.

Blockchain technology provides transparency and security in financial transactions. In agriculture, blockchain ensures traceability of supply chains, linking financial flows to verified sustainable practices. Distributed ledger technologies also support smart contracts, automating payments and reducing fraud. Digital lending platforms provide farmers and small businesses with instant access to credit. By using AI-driven risk assessment, these platforms reduce reliance on collateral and expand credit access to underserved populations. FinTech ecosystems integrate mobile payments, digital lending, and blockchain into comprehensive platforms. These ecosystems support financial inclusion, enhance efficiency, and promote sustainability.

Practitioners are interested in the study's findings because they assist FinTech companies in developing certain application features and strategically targeting marketing campaigns to guarantee the effective implementation of FinTech solutions in agriculture. FinTech organizations should divide their customer base and concentrate on those who are more likely to trust new technology, since this study shown a favorable influence of personal tendency to trust on the creation of first trust. Personalized communication tactics should be used to especially target these clients. This study demonstrated the beneficial impact of structural guarantees of data processing in addition to an individual's inclination to trust. FinTech businesses should focus on providing assurance programs that deal with concerns related to the processing of personal data. Guarantees can be useful in addition to contracts that indicate who is responsible for possible losses. The impression of relative benefits was found to have the biggest impact on the development of initial trust. Marketing campaigns should therefore highlight the direct benefits of FinTech solutions for farmers. Because of its illustrative power, a comparison with traditional banks and their services might be very beneficial. To make the advantages of this solution obvious and identifiable to prospective clients, interfaces should be made simple and easy to use. Practitioners should minimize communication about data processing and encourage farmers to give their data by emphasizing the advantages of FinTech solutions rather than overburdening them with information about secure data processing. Therefore, by offering insights that aid in distributing the "capital of change," this research also contributes to sustainable transitions on an even broader scale.

4. Conclusion

Based on the conceptual research, authors conclude that fintech affects sustainable agriculture, and AI-based green marketing affected by sustainable agriculture. Future research should conduct empirical studies about the concept. Future research should explore how FinTech innovations such as decentralized finance and carbon credit trading can further support sustainable agriculture. AI-based green marketing should also integrate behavioral economics to better understand consumer decision-making in sustainability contexts. Sustainable agriculture, as a mediator, can be strengthened through partnerships between governments, private firms, and civil society organizations. These collaborations will ensure that financial and marketing innovations are grounded in ecological realities.

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