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CONCEPTUAL MODEL OF LEARNING FOR FARMERS BASED ON DIGITAL MEDIA

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ABSTRACT : This study examines the crisis of farmer regeneration in Indonesia, driven by low youth participation, limited economic attractiveness, and a weak social image of agriculture. The problem is compounded by restricted access to land, capital, and technology, as well as skill gaps. This study employed an Integrative Literature Review (ILR) based on Thematic Coding Analysis to develop a conceptual model of digital media–based farmer learning and analyzed thematically. The findings show that farmers actively utilize platforms such as Facebook, YouTube, and WhatsApp to access information, share experiences, and ad opt innovations. Digital media serves as a key reference for new techniques, with visual content enhancing understanding. Communication via these platforms improves coordination and collaboration, while farmers demonstrate critical literacy by verifying information before application.The model identifies four key variables: Farmer Digital Transformation, Digital Learning Communities, Digital as a Source of Innovation, and Hybrid Agricultural Learning. It underscores the importance of digital and economic literacy to support innovation and entrepreneurial performance among young farmers. The study concludes that strengthening digital infrastructure, policy innovation, and human resource capacity is essential to enhance farmer capability, promote sustainable practices, and accelerate agricultural transformation for improved welfare and food security.

KEYWORDS: *Digital Transformation, Farmer Regeneration, Digital Learning Communities, Agricultural Innovation, Food Security*

I. INTRODUCTION

In the current era of digitalization, the use of digital media has become essential in various aspects of life, including the agricultural sector (Setiawan, 2022). This transformation opens new opportunities for farmers to independently access information, knowledge, and best practices, thereby improving efficiency and productivity (Suwanan et al., 2021). The emergence of digital technology has fundamentally reshaped communication, learning, and interaction patterns, while also posing new challenges for agricultural extension workers in responding to societal changes (Sugihono et al., 2022). This phenomenon is characterized by a shift in knowledge sources from traditional institutions to digital platforms, enabling farmers and farmer groups to share ideas and experiences within virtual communities (Sugihono et al., 2022). This development has driven a transformation in the provision of agricultural information, from a government- and public sector–dominated model toward a more open, data-driven innovation system that utilizes social media platforms such as YouTube, Facebook, and WhatsApp as hubs for knowledge dissemination (Paudi et al., 2022; Sugihono et al., 2022).

This conceptual model aims to integrate the potential of digital media into farmer learning processes, providing a systematic framework to enhance farmers' capacity through the use of information and communication technologies. The rapid advancement of digital technology and the widespread penetration of mobile devices have created new opportunities for alternative knowledge flows and farmer empowerment, particularly through social media applications that offer accessible and low-cost means to acquire, share, and generate agricultural knowledge beyond formal institutional frameworks (Gwelo, 2025; Hariadi et al., 2022).

The utilization of digital media also enables agricultural extension workers to adapt to changing times, where access to information via the internet is increasingly available to all segments of society (Irpan et al., 2023). This accessibility allows rural communities, including farmers, to obtain information on cultivation techniques, sustainable agricultural practices, and other educational resources, thereby enhancing their skills in using technology and information in daily life (Mashis et al., 2023).

Thus, this conceptual model serves as a strategic framework to optimally leverage digital media, facilitate alternative knowledge flows, and empower farmers in addressing the demands of modern, increasingly digitalized agriculture.

II. LITERATURE REVIEW

Transformation of Farmers' Learning Processes

The development of information and communication technologies (ICT) has fundamentally transformed how farmers learn and access agricultural information, shifting from linear dissemination models toward collaborative innovation and peer-to-peer learning (Khan et al., 2024). This transition requires agricultural extension agents to adapt to new roles as facilitators and connectors, rather than acting as the sole source of knowledge (Sugihono et al., 2022). For instance, the use of social media enables farmers to directly share knowledge and experiences, expand information networks, and accelerate the adoption of innovations and new technologies (Ihsaniyati et al., 2024). Digital transformation has also reshaped the role of extension agents in coordination and collaboration, digital learning, virtual group dynamics, promotion, mobilization, as well as online consultation and monitoring (Sugihono et al., 2022). Furthermore, the use of mobile phones and mobile-based applications, including calls and text messaging, holds significant potential to accelerate access to agricultural information, enabling farmers to connect with experts, extension agents, and fellow farmers in real time (Mwakatwila et al., 2025). This approach not only broadens information dissemination but also enhances farmers' cognitive and technical capacities, promoting the adoption of adaptive, productive, and sustainable precision agriculture (Adiana et al., 2025).

Digital Media as an Alternative Learning Space

The digitalization of agriculture aligns with the need for transformation in agricultural extension systems for the future, although challenges remain, particularly in the limited digital literacy among extension workers (Suswadi & Irawan, 2023). Nevertheless, the role of agricultural extension agents has evolved alongside digital adoption, allowing them to function as informants, consultants, facilitators, and even content creators or influencers within the digital ecosystem (Sugihono et al., 2022). This paradigm shift requires extension agents to move beyond being primary knowledge providers and instead act as mediators who facilitate farmers in accessing and processing abundant information available on digital platforms (Sugihono et al., 2022). Consequently, digital literacy becomes a crucial competency for extension agents to maximize their roles in supporting the agricultural sector in the digital era (S et al., 2023). Optimizing these roles also requires readiness among agricultural stakeholders to embrace the changes brought by digital transformation (Sugihono et al., 2022).

Integration of Digital and Local Knowledge

The integration of digital knowledge with local wisdom is essential for developing relevant and sustainable agricultural solutions that consider the specific social, cultural, and ecological contexts of each region. This approach enables the use of technology to strengthen proven traditional agricultural practices while introducing innovations suited to local conditions. Therefore, ICT implementation strategies must be gradually adapted and modified based on local contexts, integrating conventional media with digital technologies to accelerate knowledge dissemination (Erlinnawati & Purwanto, 2024). This approach not only enhances human resource quality but also fosters community-driven innovation through research grounded in local wisdom (Erlinnawati & Purwanto, 2024). Moreover, synchronizing modern technology with local knowledge should be prioritized to achieve sustainable socio-economic harmony in the agricultural sector (Yudari et al., 2023). Modern agricultural extension agents must also possess soft skills such as collaboration, communication, and complex problem-solving both technical and non-technical to bridge the digital divide among farmers and ensure inclusivity across generations, including millennial farmers (Sugihono et al., 2022).

Strengthening Farmers' Adaptive Capacity

In this context, strengthening farmers' adaptive capacity is key to addressing the challenges and opportunities of Agriculture 4.0, where farmers are expected to possess organizational skills, problem-solving abilities, creative thinking, and the capacity to build effective partnerships and collaborations (Widiyanti et al., 2023). Enhancing farmers' digital literacy, along with improving technological infrastructure in rural areas, is essential to optimize the potential of agricultural digitalization (Herawati et al., 2023). A holistic approach that integrates digital infrastructure development with capacity-building programs through tiered digital training is necessary to ensure the sustainability of digital transformation in rural areas (Sulistiarini et al., 2025). It is also important to recognize that farmers' local knowledge is a valuable asset that should be integrated with external innovations to develop new knowledge tailored to their specific conditions (Faronny et al., 2024). Therefore, the provision of adequate Wi-Fi and internet facilities at agricultural extension institutions is crucial to enable

extension agents to access up-to-date information and communicate effectively with farmers (Aminah & Syafri, 2023).

III. METHODOLOGY

This study employed an Integrative Literature Review (ILR) based on Thematic Coding Analysis to develop a conceptual model of digital media–based farmer learning. The Integrative Literature Review approach was used to synthesize findings from previous national and international studies related to digital agriculture, farmer learning transformation, digital literacy, agricultural communication, and innovation adoption. Relevant journal articles were systematically reviewed to identify recurring concepts, empirical patterns, and theoretical relationships associated with the use of digital media in agricultural learning systems.

The collected literature was analyzed qualitatively using thematic coding techniques consisting of open coding, axial coding, and selective coding. Open coding was used to identify key findings from previous studies, while axial coding connected similar concepts into broader analytical categories. Selective coding was then applied to generate major themes and construct the conceptual model. Through this process, several core themes emerged, including Farmer Digital Transformation, Digital Learning Communities, Digital as a Source of Innovation, Farmers' Digital Literacy, and Hybrid Agricultural Learning, which collectively explain the evolving role of digital media in strengthening farmers' learning capacity and innovation adaptation.

IV. RESULTS AND DISCUSSION

Data were collected through in-depth interviews, participatory observation, and document analysis, and subsequently analyzed using thematic analysis to identify patterns, themes, and key categories emerging from the data. This qualitative analysis focuses on gaining a deeper understanding of changes in farmers' attitudes and readiness to adopt digitalization, as well as the legal aspects of their agricultural practices (Nurhayati, 2025). The case study, involving in-depth interviews with multiple stakeholders including startup owners, staff, farmers, government officials, and financial sector actors enabled empirical validation of the conceptual model of digital-based farmer learning (Forney & Dwiartama, 2022).

Table 1. Field Findings, Codes, Categories, and Main Themes

Field Findings (Meaning Excerpts)	Open Coding	Axial Coding	Main Theme
Farmers access Facebook daily for agricultural information and peer experiences	Routine social media access	Media usage intensity	Farmer digital transformation
Farmers join Facebook groups to follow discussions	Participation in online groups	Learning networks	Digital learning communities
Facebook and YouTube are used as references before adopting new techniques	Practice referencing	Decision-making	Digital as a source of innovation
Farmers test techniques gradually from YouTube	Incremental trials	Innovation adaptation	Experimental learning
YouTube videos are easy to understand due to visual examples	Visual practice	Ease of understanding	Functional digital literacy
WhatsApp accelerates communication among farmers and extension agents	Rapid communication	Coordination efficiency	Digitalized agricultural communication
Farmers share field photos via WhatsApp for advice	Visual sharing	Practical collaboration	Collaborative learning
Digital information is verified before application	Information verification	Critical attitude	Farmers' critical literacy
Digital media supports farmers with limited access to formal training	Training substitution	Learning access	Knowledge inclusivity
Digital platforms cannot fully replace face-to-face interaction	Digital limitation	Technological boundaries	Hybrid agricultural learning

Source: Primary Data Processed 2026

This table presents key field findings on farmers' use of digital media in a structured format to facilitate analysis and interpretation (Engås et al., 2023; Sugihono et al., 2025). Each row represents specific observations or farmer statements that were systematically coded and categorized to identify major themes related to digital transformation in agricultural learning (Abdulai et al., 2023; Widiyanti et al., 2023). These findings were used to

construct a conceptual model illustrating how farmers actively integrate digital platforms into their daily activities, from information seeking to collaborative practices (Hasan et al., 2023).

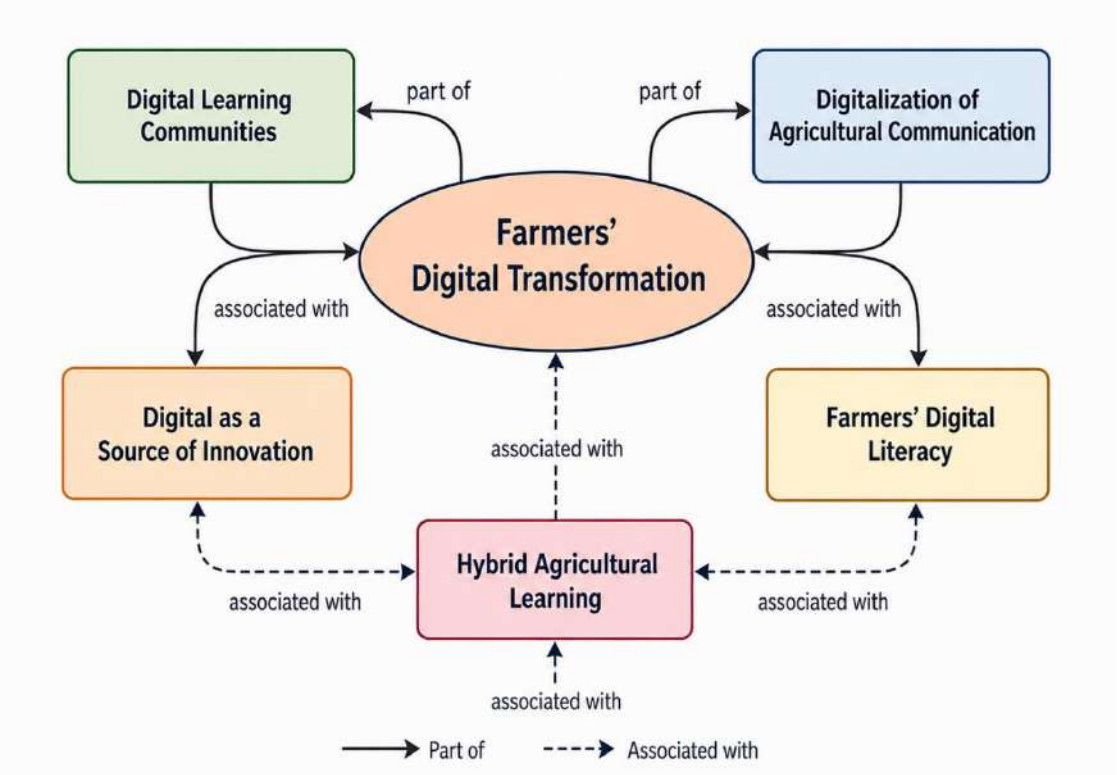
The findings indicate that farmers utilize social media such as Facebook and WhatsApp for routine information access, participation in online communities, and rapid communication, significantly accelerating innovation adoption (Adiana et al., 2025). Additionally, visual content from YouTube enhances comprehension and serves as a primary reference before experimenting with new techniques, while careful verification of information reflects farmers' critical digital literacy (Nurdin & Pettalongi, 2022; Widiyanti et al., 2023).

However, the study also highlights limitations of digital media in fully replacing face-to-face interactions, emphasizing the importance of a hybrid learning approach that integrates both physical and digital engagement (Adiana et al., 2025). This phenomenon reflects a paradigm shift in agricultural learning, where digital media functions as a catalyst for knowledge dissemination and adaptive innovation at the farmer level (Knitsch et al., 2024).

These findings are consistent with previous studies showing that social media platforms including Facebook, Twitter, and WhatsApp are highly beneficial for farmers in accessing agricultural information and applying digital knowledge (Singh & Verma, 2023). Platforms such as YouTube and Instagram further support knowledge dissemination through visual tutorials and shared success stories (Sugihono et al., 2025). The adoption of digital technologies is also facilitated by widespread internet access, enabling stakeholders to collect, analyze, and utilize agricultural data for capacity building and training (Wijaya & Salahudin, 2023).

In conclusion, farmers are increasingly adopting digital media as an essential tool for learning and innovation in agricultural practices. While digital platforms do not fully replace face-to-face interactions, they complement and enrich farmers' learning experiences. The use of platforms such as Facebook, YouTube, and WhatsApp has significantly improved access to information, enhanced communication efficiency, and fostered digital learning communities that support innovation adoption and informed decision-making in agriculture (Arvianti et al., 2022; Khotimah et al., 2022).

The figure illustrates the conceptual model of digital media based farmer learning developed from the empirical findings discussed earlier. This model reflects how farmers' interactions with various digital platforms create a continuous cycle of information access, verification, innovation adaptation, and collaboration, which collectively contribute to enhancing agricultural capacity and productivity. More specifically, the model highlights the central role of digital media as a key facilitator in the adaptive learning cycle of farmers, enabling them to continuously update their knowledge and skills in response to the dynamic demands of modern agriculture.



Figuare 1. The Relatioship Between Key Thema in Farmers Digital Transpormation

Based on the field findings, four core variables can be synthesized to construct the conceptual model: Farmer Digital Transformation, Digital Learning Communities, Digital as a Source of Innovation, and Hybrid Agricultural Learning. These variables collectively represent a fundamental shift in how farmers acquire knowledge and skills, integrating digital technologies into their workflows to improve productivity and sustainability (Ilyas, 2022). This transformation includes the adoption of digital platforms for information access such as YouTube and WhatsApp (Ernawatiningsih, 2023) participation in learning networks, and the utilization of digital tools to enhance operational efficiency (Sugihono et al., 2022).

The adoption of information and communication technologies has also reshaped agricultural extension strategies, particularly in coordination, digital learning, and consultation, although it has not entirely replaced traditional extension methods (Sugihono et al., 2025). The model further integrates social support from farmer communities and educational institutions with media and information support to strengthen farmers' identity and improve their well-being through innovation (Widiyanti et al., 2023). In this context, strengthening farmers' digital literacy is crucial to ensure they possess the necessary competencies to navigate the digital economy, thereby enhancing their entrepreneurial performance (Firmansyah & Dede, 2022).

Farmers' ability to utilize digital media extends beyond information access and collaboration; it also encompasses competencies in mobile application management, data management, and digital marketing, which are essential for modern agribusiness development (Daroini & Hardianti, 2023; Sulistiarini et al., 2025). These capacity-building efforts directly contribute to improving farmers' economic independence and expanding their access to broader market opportunities (Sulistiarini et al., 2025; Widiyanti et al., 2023). This approach aligns with conceptual frameworks emphasizing agricultural innovation ecosystems, where farmers act as active agents of change through solution networks and interactive collaboration (Reis et al., 2023).

Furthermore, this model comprehensively integrates economic literacy and digital literacy as fundamental prerequisites for young farmers to innovate and enhance their entrepreneurial performance. It underscores that digital transformation is not merely about technological adoption but also about the development of sustainable collective competencies (Firmansyah & Dede, 2022; Sulistiarini et al., 2025). Therefore, the model highlights the urgency of investing in digital infrastructure, developing innovative policies, and strengthening human resource capacity to create inclusive and sustainable rural digital ecosystems (Hutapea et al., 2025; Sulistiarini et al., 2025).

An adaptive and context-sensitive approach is essential to accommodate the diverse social, cultural, and economic characteristics of rural communities, ensuring that uniform digitalization interventions are not applied ineffectively (Sulistiarini et al., 2025). Moreover, community-based approaches and cross-sector collaboration particularly involving government and private stakeholders are critical to providing sustainable technical and financial support aligned with rural social dynamics. Village governments are expected to integrate digital training programs into development planning, expand access to technology, and strengthen multi-stakeholder collaboration to support structured and comprehensive digital transformation at the local level (Sulistiarini et al., 2025).

V. CONCLUSION

1. The conceptual model of digital media–based farmer learning provides a comprehensive framework for understanding and optimizing the role of technology in enhancing farmers' capacity. The model emphasizes that improving digital and economic literacy constitutes a fundamental foundation for farmers to adapt to agricultural innovations, which in turn contributes to improved household economic well-being through more informed and rational decision-making. Strengthening this capacity is essential for advancing digital transformation in the agricultural sector, particularly in promoting the adoption of sustainable, energy-efficient, and climate-smart agricultural practices. In this context, policies that support greater access to digital technologies, the provision of digital skills training, and the active involvement of younger generations in decision-making processes are critical to accelerating the transformation of agrifood systems. Such initiatives encompassing investments in digital infrastructure and the establishment of enabling regulatory frameworks are vital for fostering an innovation-driven environment where digital tools can be effectively utilized to address challenges related to food security and sustainability. Furthermore, effective digital agriculture initiatives require continuous monitoring and evaluation mechanisms to assess their impact and inform future policy development. This process creates a feedback loop between research, policy, and field practices, thereby enhancing the adaptability and responsiveness of the agricultural sector. From a theoretical perspective, the integration of human capital theory highlights that improvements in digital literacy directly enhance farmers' ability to absorb and apply new technologies, ultimately accelerating agricultural technological progress and supporting the development of the rural digital economy.

2. The development of digital infrastructure and comprehensive digital literacy programs, supported by integrated policies, represents a crucial step toward achieving advanced and self-reliant rural communities. These initiatives should not only focus on expanding access but also on strengthening farmers' capabilities to effectively utilize digital technologies to improve productivity, efficiency, and sustainability in agricultural practices. Governments are encouraged to increase investments in digital infrastructure, provide large-scale digital skills training, and support innovation and entrepreneurship in rural agricultural sectors. In addition, strong collaboration among government, universities, and the private sector is essential to create a supportive ecosystem that enables young farmers to become technologically proficient agricultural entrepreneurs capable of driving smart agriculture and rural development.

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