

Digital Transformation of Livestock Farming Through Financial Technology: Reducing Dependence on Middlemen for Socio-Economic and Environmental Sustainability

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ABSTRACT

Livestock farmers in Indonesia often rely on middlemen for financing, price information, and market access, creating structural dependence and weakening their bargaining position. In this context, digital transformation through financial technology has emerged as a potential mechanism for reducing dependence on intermediaries and promoting more inclusive livestock market relations. This study aims to analyze the role of financial technology in driving the digital transformation of the livestock sector in Indonesia, particularly in reducing farmers' dependence on middlemen and examining its implications for socio-economic and environmental sustainability. Employing an exploratory qualitative approach with an intrinsic case study design, this research was conducted in the livestock center region of East Java Province. Data were collected through semi-structured interviews, participatory observation, and documentary study, and subsequently analyzed using thematic analysis. The findings indicate that Financial Technology expands farmers' access to financing and markets, enhances transaction transparency, and promotes partial disintermediation within the livestock value chain. Socio-economic impacts are evident in increased income, operational efficiency, and financial inclusion among farmers. While environmental considerations are not yet a primary motivation for adoption, Financial Technology holds the potential to support sustainability through distribution efficiency and waste reduction. This study affirms that financial technology functions as an instrument of social and economic transformation within the rural livestock sector. Farmer behavior undergoes a gradual transformation due to their enhanced capacity for direct market access, improved financial transparency, and reduced structural dependence on intermediaries. This shift strengthens farmers' agency over price setting, cash flow management, and production decisions. Consequently, the role of intermediaries evolves from price-determining actors to logistical or coordinating partners. This transformation highlights digitalization as a catalyst for adaptive change.

Keywords: Digital Transformation, Disintermediation, Financial technology, Livestock Farming

INTRODUCTION

The livestock sector plays an important role in rural Indonesia because it supports food provision, employment, and household income, especially among smallholder producers whose livelihoods remain closely tied to village-based production systems (Hasanah et al., 2025; OECD, 2025). In this study, the livestock sector refers broadly to smallholder livestock activities and related sub-sectors, including cattle, goats, sheep, and poultry production, together with the distribution relations that connect farmers to traders and markets (Hilmiati et al., 2024; Kazanski et al., 2025). Beyond its economic contribution, livestock farming also supports household survival strategies, social relations, and, in some contexts, cultural practices passed down across generations (Felix et al., 2025; Taruvinga et al., 2022).

Despite its importance, the sector continues to operate within unequal market arrangements in which many farmers have limited access to capital, price information, and stable buyers. In this context, middlemen often function not only as buyers but also as informal lenders, information brokers, and gatekeepers to downstream trade, creating dependency that weakens farmers' bargaining position, narrows marketing options, and locks them into low-margin transactions (Cohen et al., 2022; Sudrajat et al., 2021).

In the Indonesian context, particularly in Java, this dependency should be understood as part of a longer structural trajectory shaped by agrarian change, uneven market integration, and state-led rural development (Batubara et al., 2023; Luthfi, 2021; Natadireja et al., 2024; Rustiadi et al., 2023). During the New Order period, rural development and commercialization expanded market incorporation but did not necessarily strengthen the position of small-scale producers within livestock distribution networks (Abdoellah et al., 2020; Edwin Kiky Aprianto et al., 2021; Ishak et al., 2020; Marisa & Sitepu, 2025). This helps explain why intermediary actors remain influential in livestock trade despite ongoing modernization efforts (Fajar et al., 2025; Madarisa et al., 2025; Sunyigono et al., 2021). This condition is also related to the persistence of a poverty trap among small-scale livestock farmers. Limited access to formal finance, dependence on informal credit, weak market information, and unequal control over distribution channels make it difficult for farmers to improve their position within the livestock value chain, while middlemen remain the most accessible source of liquidity and market linkage (Nuryitmawan, 2021; Purwanti et al., 2023; Syahfrizal et al., 2025).

In recent years, digital transformation has been promoted as one possible pathway to address these constraints. In the livestock context financial technology (*fintech*) refers to digital financial services such as online financing, digital payments, transaction recording, and platform-based market access (for instance, TaniHub, iGrow, etc) that support farmers' production and marketing activities (Joy et al., 2024; Rufaidah et al., 2023). Beyond economic benefits, complementary digital technologies such as the Internet of Things (IoT) enable livestock health monitoring, feed optimization, and real-time monitoring of greenhouse gas indicators, including the carbon footprint of livestock production, thereby supporting more accurate environmental management in livestock systems (Dadallage et al., 2025).

Previous studies suggest that Financial Technology can improve transaction transparency, expand access to working capital, and widen market opportunities for rural producers, although its adoption remains constrained by low digital literacy, limited infrastructure, and the persistence of conventional intermediary.

Although the literature on agricultural digitalization and financial inclusion has grown, much of it still focuses on general efficiency or access to finance, while studies examining how Financial Technology reshapes livestock supply chains, reduces dependence on middlemen, and affects socio-economic and environmental sustainability in rural Indonesia remain limited. From a rural sociology perspective, digital transformation shifts farmers from structurally dependent producers with weak bargaining power and limited market information into more autonomous market participants with greater negotiating capacity, broader price visibility, and more control over sales decisions.

Based on this background, this study aims to analyze the role of Financial Technology in driving the digital transformation of the livestock sector in Indonesia, particularly in reducing farmers' dependence on middlemen. More specifically, it identifies patterns of Financial Technology adoption, analyzes changes in supply-chain relations, and evaluates the socio-economic and environmental implications of this transformation in rural areas. The study contributes to the literature by showing how Financial Technology facilitates partial disintermediation that transforms farmer-middlemen relations from structural dependency to negotiated partnerships, while identifying the social and institutional conditions required for inclusive, sustainable digital transformation.

Conventional Supply Chain and the Dominant Role of Middlemen

Indonesia's livestock supply chain features layered middlemen structures where local traders (often ex-farmers or village residents) connect smallholder producers to markets via word-of-mouth networks and informal credit ties (Karyani et al., 2024; Rufaidah et al., 2023). This condition is reinforced by farmers' limited access to end-market price information and restricted logistics infrastructure. Through interlocked transactions such as providing feed or seeds with tied sales contracts, middlemen control price information, capital access, and market channels, creating structural dependency that yields farmers less than 30% of final consumer prices (Liverpool-Tasie et al., 2020; Saparova et al., 2024). Consequently, smallholder farmers lose bargaining power and become trapped in a difficult-to-break

cycle of poverty. These patron-client dynamics perpetuate information asymmetry and exit barriers: farmers rejecting middlemen risk social ostracism and credit exclusion (Putri et al., 2023; Sudrajat et al., 2021). Thus, this traditional system is not only economically inefficient but also reinforces structural inequities in rural areas.

Financial Technology alternatives have emerged through platforms like TaniHub and Crowde. TaniHub enables direct farmer-to-buyer connections, cutting middlemen and increasing farmer revenue by 25–40% through transparent pricing (Eloksari, 2021). Furthermore, TaniHub's integrated logistics features reduce spoilage rates of livestock products during shipping. The Crowde platform, via peer-to-peer lending, provides capital access without tied contracts, reducing interlocked transactions for over 12,000 farmers with a 30% increase in productivity (Firmansyah & Ayyubi, 2024; Satria et al., 2025; Taufik & Andina, 2025). Nevertheless, the adoption of these Financial Technology solutions still faces obstacles such as low digital literacy among older farmers and limited internet coverage in remote areas.

Digital Transformation in the Livestock Sector

Digital transformation in the livestock sector refers to the use of digital technologies to improve production, management, marketing, and distribution while reshaping farmers' decision-making and supply-chain interactions (Fuentes et al., 2022; Jiang et al., 2023). In practice, technologies such as IoT, mobile applications, and digital logistics systems support animal health monitoring, feed efficiency, reproductive management, and transport planning that reduces repeated livestock mobilization and unnecessary delivery trips, thereby lowering fuel use and transport-related emissions that substantially affect environmental quality (Food and Agriculture Organization of the United Nations, 2023; He et al., 2025; Morrone et al., 2022). For instance, analysis reported by Telkom Indonesia through the MyTEnS application showed that real-time monitoring and farm-management features can improve operational efficiency and support earlier disease detection (MyTEnS, 2022). Introduced in 2019, MyTEnS was developed by Telkom Indonesia to support the digital transformation of agriculture and livestock through monitoring and connectivity services (MyTEnS, 2022). This analysis demonstrates how digital tools can enhance productivity while reducing middlemen dependency.

However, digital transformation is not merely technical. In rural livestock systems, imbalanced economic relations between farmers and middlemen are manifested in interlocked transactions, in which middlemen provide feed or other inputs on credit but require future sales at below-market prices, and in information asymmetry, in which middlemen control price information, transport access, and buyer networks (Karyani et al., 2024; Mazya et al., 2022). For example, dairy farmers may receive only around 40 percent of the retail price, while beef farmers often receive less than half of the final consumer price despite bearing most production costs (Hasanah et al., 2025). Therefore, digital transformation should be understood as a socio-technical process that requires empowerment, inclusion, and institutional support.

Financial technology directly addresses these problems by widening access to digital payments and financing, reducing dependence on tied credit, improving transaction transparency, and supporting farmers' gradual adaptation through platform-based training and record-keeping features. For example, digital payment records help farmers verify transaction amounts, while platform-based financing can provide working capital without forcing exclusive sales to middlemen (Febriyani et al., 2024; Rahmah, 2021).

Financial Technology (Fintech) and Its Role in the Livestock Sector

Financial technology uses digital technology to deliver efficient, flexible financial services for rural smallholder farmers and livestock producers underserved by formal banking (Benami & Carter, 2021). P2P lending provides collateral-free working capital tailored to livestock cycles (feed, healthcare), while digital payments accelerate secure transactions and reduce manipulation risks compared to conventional delayed payments (Azis et al., 2023; Singh & Sharma, 2023). Agribusiness crowdfunding diversifies funding sources, and index-based microinsurance addresses disease/price risks with affordable premiums (Kalaskar et al., 2025).

However, adoption faces structural barriers: low digital or financial literacy, poor rural connectivity, and data security concerns erode trust (Rufaidah et al., 2023). Financial technology also introduces risks like data privacy violations, digital fraud, and platform abuse, particularly threatening low-literacy farmers more than traditional intermediaries (Jhamb, 2025). Sociologically, financial technology restructures

power dynamics by reducing middlemen dominance, but requires inclusive policies and capacity building for equitable impact (Rayhan et al., 2024).

Digital Disintermediation: Breaking Dependence on Middlemen

Digital disintermediation reduces intermediaries by enabling farmers to access price information, buyers, and financing more directly through digital platforms (Sekar & Siddiq, 2023). Previous studies and reviews suggest that fintech can reduce information asymmetry, expand direct market access, and strengthen financial inclusion, although these benefits are often accompanied by challenges related to digital literacy, infrastructure, and platform governance (Magableh et al., 2025; Rufaidah et al., 2023). In this context, Financial Technology offers three main benefits: reducing information asymmetry, expanding direct market access, and improving farmers' bargaining position through more transparent transaction (Zhang et al., 2025). For example, TaniHub functions as a digital marketplace that links producers with commercial buyers, thereby shortening marketing channels and improving transaction transparency (Firmansyah & Ayyubi, 2024; Rahmah, 2021). By contrast, iGrow is better understood as a digital financing or crowdfunding platform that broadens farmers' access to capital rather than directly replacing marketing intermediaries (Aziz et al., 2024, 2024; Hendrasto et al., 2021).

However, digital disintermediation also creates clear challenges, including unequal digital literacy, weak rural connectivity, nontransparent platform terms, and cyber risks such as fraud and data breaches, especially for farmers with limited digital experience (Rufaidah et al., 2023; Suryono et al., 2020). Digital disintermediation does not automatically eliminate dependence; in some cases, it shifts dependence from conventional middlemen to digital platforms that control market access, payment timing, fees, and user data. When platform policies are unclear, farmers may face hidden charges, digital fraud, account misuse, or data privacy breaches. For this reason, digital disintermediation must be supported by transparent platform rules, consumer protection, and accessible dispute-resolution mechanisms. More equitable relations can emerge when digital platforms provide transparent prices and service fees, traceable payment records, accessible complaint mechanisms, and cooperative-based collective bargaining that prevents new forms of dependence on platform owners or dominant buyers.

Financial Technology (Fintech) and Socio-Economic Sustainability

Financial Technology enhances socio-economic sustainability for smallholder livestock farmers by strengthening income stability, risk management, and market bargaining power (Benami & Carter, 2021). For example, P2P lending improves cash flow timing by enabling credit access aligned with livestock production cycles (Aziz et al., 2024). Socially, Financial Technology expands financial inclusion through digital payments and record-keeping, connecting rural producers to urban markets beyond local middlemen networks (Firmansyah & Ayyubi, 2024). Economically, transaction applications enable systematic financial recording and data-driven business planning, enhancing resilience against price volatility (Wolfert et al., 2025; Zhang et al., 2025). The bargaining power effect operates via price transparency: real-time wholesale data on mobile platforms reduces information asymmetry that middlemen traditionally exploited. Income stability further improves through bundled micro-insurance such as weather-indexed livestock mortality payouts, not just credit access. Empirically, platforms like iGrow in Indonesia have enabled crowdfunding for feed purchases, while Kenyan dairy credit apps show how opaque interest rates can backfire.

However, adoption exacerbates disparities: digitally capable farmers benefit while low-literacy groups face fraud, data breaches, and non-transparent platform policies requiring literacy training and regulatory oversight (Rufaidah et al., 2023; Suryono et al., 2020). Equitable outcomes demand farmer cooperatives, capacity building, and inclusive platform policies to prevent elite capture and digital exclusion (Jin, 2024; Qureshi et al., 2025; Xie et al., 2021). Specifically, cooperatives should negotiate collective digital contracts to cap fees, while regulatory sandboxes can test products for harmful practices before mass rollout. Gender-responsive literacy programs are also essential, as female farmers face higher barriers to smartphone access and formal ID.

Financial Technology (Fintech) and Environmental Sustainability

Financial Technology supports environmental sustainability in livestock systems primarily through enhanced efficiency in financing, logistics, and supply chain transparency rather than biological production processes. Integrated digital payments, transaction records, and logistics coordination enable demand-driven distribution planning that reduces unnecessary deliveries, fuel consumption, and

transport emissions (He et al., 2025). Green financing schemes incentivize low-emission practices, waste management, and renewable energy adoption, while integrated financial-production data strengthens environmental monitoring and sustainability reporting (Ashta, 2023; Shen & Zhang, 2024). However, digitalization generates environmental costs including e-waste accumulation and data center energy demands. Sustainable fintech strategies must therefore balance economic, social, and environmental objectives (Arshi et al., 2024; Ashta, 2023). In Indonesia's livestock sector, this integration remains emerging; however, it holds transformative potential with supportive regulation and institutional frameworks (Rufaidah et al., 2023).

Conceptual Framework

This study adopts an integrated conceptual framework to explain Financial Technology-based digital transformation in the livestock sector as a social, economic, and institutional process (Figure 1). Rather than treating theory as a separate normative section, this framework combines three theories: Innovation Diffusion Theory, Value Chain Theory, and Sustainable Development Theory, to interpret how Financial Technology adoption reshapes supply-chain relations, bargaining power, and sustainability outcomes (Rayhan et al., 2024; Wolfert et al., 2025).

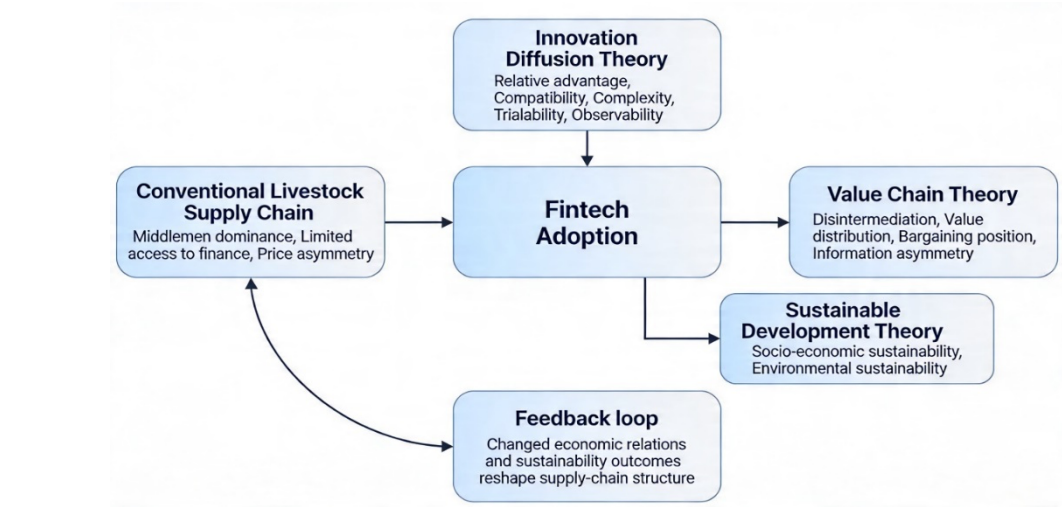


Figure 1 Integrated Conceptual Framework

Innovation Diffusion Theory, originally developed by Rogers, explains adoption as a social process influenced by perceived relative advantage, compatibility, complexity, trialability, and observability (Rogers, 1983; Savari et al., 2025). In this study, the theory helps explain why some farmers adopt Financial Technology because it offers faster financing, transparent transactions, and wider market access, while others remain hesitant due to limited digital literacy, weak infrastructure, and low trust in digital systems (Rufaidah et al., 2023; Satria et al., 2025).

Value Chain Theory was introduced by Michael Porter in 1985 through his work *Competitive Advantage: Creating and Sustaining Superior Performance*. The theory explains how value is created and captured through a set of interconnected primary activities, such as inbound logistics, operations, outbound logistics, marketing and sales, and service, supported by procurement, technology development, human resource management, and firm infrastructure (Dagys et al., 2025; Porter & Chandler, 1985). Its main emphasis is to identify where value, cost, and control are concentrated across the chain and how this affects efficiency and bargaining power among actors. In this study, the theory is useful for examining how digital financing, payment systems, and marketing platforms can redistribute information and value across farmers, middlemen, cooperatives, logistics actors, and buyers rather than leaving control concentrated in traditional intermediaries (Aziz et al., 2024; Zhang et al., 2025). Recent studies on agricultural digitalization also suggest that digital platforms may not remove intermediaries entirely, but instead reposition their roles in value creation and capture (Qureshi et al., 2025).

Sustainable Development Theory, associated with the Brundtland perspective, provides the evaluative lens for assessing whether Financial Technology-driven transformation improves present livelihoods without undermining long-term social and environmental sustainability (Obura et al., 2026; World

Commission on Environment and Development, 1987). In this study, socio-economic sustainability is reflected in income stability, financial inclusion, business resilience, and stronger bargaining power, while environmental sustainability is reflected in distribution efficiency, greener financing, and reduced emissions from inefficient logistics (Arshi et al., 2024; Gao & Gao, 2024; Uzar et al., 2026).

These three theories are integrated to guide the development of the conceptual framework and to explain the phenomenon under study. The conceptual framework is situated within a conventional livestock supply chain characterized by middlemen dominance, limited farmer access to finance and markets, and asymmetrical economic relations (Ayu Trisia et al., 2021; Makmun et al., 2024). Financial technology adoption, shaped by farmers' perceptions and capacities, influences supply-chain restructuring through digital financing, payment systems, and market access (Jahroh & Meliala, 2021). This restructuring shapes economic relations, bargaining power, socio-economic inclusion, and environmental sustainability (Rayhan et al., 2024). In turn, these outcomes feed back into the supply-chain structure: when farmers gain benefits and capacity, dependence on middlemen declines; when digital exclusion, weak institutions, or platform concentration persist, inequality may be reproduced (Jin, 2024). In addition, the framework highlights the interaction between adoption, value-chain change, and sustainability rather than presenting a simple linear flow.

METHODS

This study employed an exploratory qualitative case study design to examine how digital transformation through financial technology affects the role of middlemen and the socio-economic and environmental sustainability of the livestock sector in Kepanjen District, Malang Regency, East Java. The study was conducted over one month, from January 20, 2026 to February 19, 2026.

Areas of Study

The study was conducted in Kepanjen District, Malang Regency, East Java, which was purposively selected because it is a livestock-producing area where financial technology-related initiatives and digital financial practices have emerged (Figure 2). To protect participant confidentiality, the manuscript reports the study location at the subdistrict level rather than naming specific villages, business units, or community groups in the main text. A spatial map of the broader study area and a summary of the selected livestock farmers, including Financial Technology users, non-users, and middlemen, together with the estimated number of respondents and the types of financial technology services used, are presented at the end of this section.

Sampling

Informants were selected using purposive and snowball sampling. They included livestock farmers who had used financial technology services for at least one year and middlemen. A total of 20 informants participated in this study, with the final number determined based on data saturation, that is, the point at which no substantially new information or themes emerged from the data (Saunders et al., 2017).

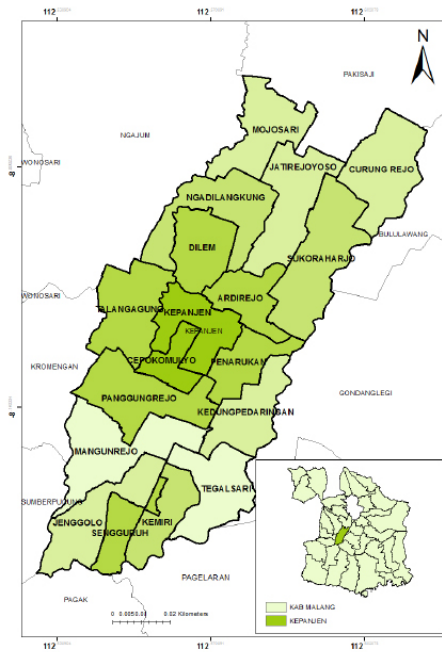


Figure 2 Spatial map of the study area

Data Collection Methods

Data were collected through semi-structured interviews, participant observation, and document analysis. Interviews explored perceptions of financial technology, changes in relations with middlemen, and the socio-economic and environmental implications of digital transformation. Observation was conducted at farms, transaction points, and cooperative settings, while documents such as transaction records, distribution reports, and cooperative records (monthly report or annual report) were also reviewed. Before each interview, all respondents received an informed consent sheet explaining the purpose of the study, the voluntary nature of participation, confidentiality safeguards, and the right to withdraw at any time. Interviews were conducted only after participants had agreed to take part.

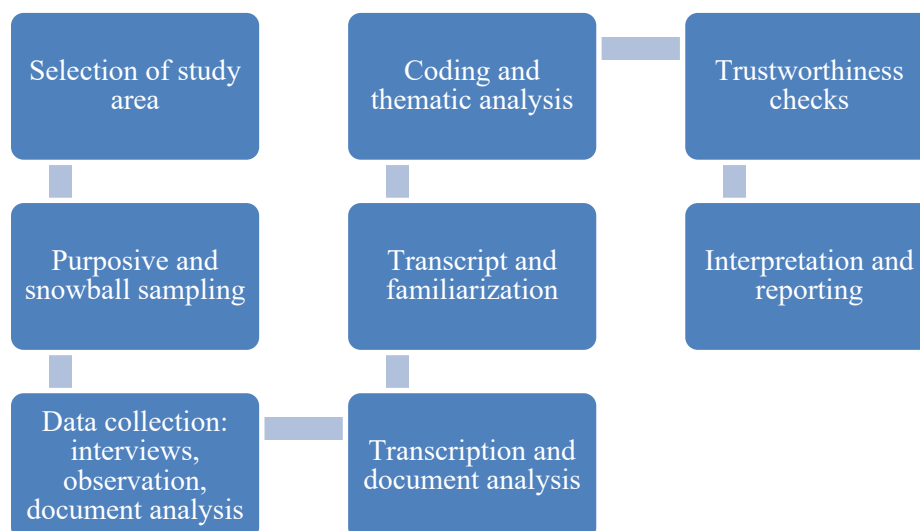


Figure 3 Research Flow Diagrams

Data Analysis Methods

The data were analyzed using thematic analysis through transcription, familiarization, coding, theme development, and interpretation (Braun & Clarke, 2006). The coding process was assisted by NVivo 15. To enhance trustworthiness, the study applied source triangulation, method triangulation, member checking, and peer debriefing (Carter et al., 2014; Stahl & King, 2020).

RESULT AND DISCUSSION

Overview of Respondents Demography

This study involved 20 respondents from East Java. To protect confidentiality, all respondents are presented using pseudonyms rather than real names. The respondents consisted of livestock farmers who used Financial Technology, livestock farmers who had not adopted Financial Technology, and middlemen involved in livestock trading and distribution. Their profiles include age, occupation, and general area of residence at the regency level rather than specific village addresses in order to maintain anonymity.

The respondents were engaged in small- to medium-scale livestock activities, particularly beef cattle, goats, and poultry farming. Most livestock farmers operated under family-based production systems, while middlemen acted as collectors, local traders, brokers, or distribution coordinators who linked farmers with buyers, arranged transport, and provided short-term transaction support. For example, some middlemen purchased livestock directly at the farm gate and then coordinated delivery to larger traders or market destinations (Depari & Lindell, 2023).

Table 1 Demographic Profile of Respondents

Pseudonym	Category	Age	Occupation	General Residence
R1	Fintech user farmer	28	Beef cattle farmer	East Jawa
R2	Non fintech farmer	31	Goat farmer	East Jawa
R3	Middleman	45	Livestock trader and collector	East Jawa
R4	Fintech user farmer	34	Poultry farmer	East Jawa
R5	Non-fintech farmer	39	Beef cattle farmer	East Jawa
R6	Fintech user farmer	42	Goat farmer	East Jawa
R7	Middleman	50	Livestock broker and distributor	East Jawa
R8	Fintech user farmer	30	Poultry farmer	East Jawa
R9	Non-fintech farmer	37	Beef cattle farmer	East Jawa
R10	Fintech user farmer	41	Goat farmer	East Jawa
R11	Middleman	47	Livestock trader	East Jawa
R12	Fintech user farmer	29	Beef cattle farmer	East Jawa
R13	Non-fintech farmer	35	Poultry farmer	East Jawa
R14	Fintech user farmer	43	Goat farmer	East Jawa
R15	Non-fintech farmer	46	Beef cattle farmer	East Jawa
R16	Fintech user farmer	32	Poultry farmer	East Jawa
R17	Middleman	49	Livestock collector and local trader	East Jawa
R18	Fintech user farmer	36	Beef cattle farmer	East Jawa
R19	Non-fintech farmer	40	Goat farmer	East Jawa
R20	Middleman	44	Livestock trader and intermediary	East Jawa

Table 2 Result Thematic analysis

Theme	Code	Respondents mentioning the code	Frequency
Distribution Independence	Easier market access	R1, R4, R7, R11	4
Distribution Independence	Reduced dependence on middlemen	R2, R5, R8, R13	4
Distribution Independence	Greater bargaining power	R1, R6, R10, R14	4
Supply Chain Efficiency	Faster financing access	R1, R3, R9, R12	4
Supply Chain Efficiency	Faster payment process	R4, R7, R11, R15	4
Supply Chain Efficiency	Better transaction records	R2, R8, R16	3
Socio-Economic Transformation	Increased confidence and autonomy	R1, R5, R10, R17	4
Socio-Economic Transformation	Financial inclusion	R3, R6, R12, R18	4
Socio-Economic Transformation	Youth interest and technology acceptance	R4, R9, R19, R20	4

Distribution Independence

One of the strongest patterns emerging from the interviews was the gradual increase in farmers' distribution independence. Before using Financial Technology, many respondents relied heavily on middlemen not only to sell livestock products but also to access capital, market information, and buyers. This created an unequal relationship in which farmers often accepted prices with limited room for negotiation. After adopting Financial Technology-supported transactions and digital marketing channels, several farmers reported having more options in choosing buyers and comparing prices before making sales decisions. For example, R1 stated, *"Before using digital transactions, I usually sold through the same collector because I did not know other buyers. Now I can compare prices first and decide where to sell."* Similarly, R2 noted, *"If the offer is too low, I do not have to accept immediately because I have more information now."*

This shift did not mean that middlemen disappeared completely from the livestock supply chain. Instead, Financial Technology reduced the degree of structural dependence by opening alternative channels for communication, transactions, and market access. From the perspective of Value Chain Theory, this finding indicates a redistribution of informational and transactional power within the supply chain. Farmers no longer occupy only the weakest downstream position; they become more active actors capable of evaluating alternatives and timing their sales more strategically. This result is consistent with studies showing that digital platforms can reduce information asymmetry and improve producers' market participation, although intermediaries may still remain relevant in aggregation and logistics functions (Mushi et al., 2024; Nwangwu et al., 2024). In this study, therefore, Financial Technology enabled partial disintermediation rather than total disintermediation.

Supply Chain Efficiency

The second major theme concerns supply chain efficiency, which encompasses three interrelated outcomes: faster financing access, more efficient payment mechanisms, and improved record-keeping. Farmers who adopted Financial Technology emphasized that its main practical value lay in accelerating these functions. Compared with conventional arrangements, digital financial services were perceived as more flexible and quicker, especially for short-term working capital and transactions that previously depended on informal personal relations.

Several respondents linked Financial Technology use to smoother business cycles. R3 explained, *"The payment process is faster now, so I can buy feed or prepare the next cycle without waiting too long."* R4 added, *"It is easier to track how much comes in and how much goes out because the records are already there."*

These accounts show that Financial Technology was experienced not as an abstract technological innovation, but as a practical tool that improved transaction speed, financial visibility, and operational planning.

From the perspective of Innovation Diffusion Theory, this finding aligns with the dimensions of relative advantage and reduced perceived complexity through use experience (Klerkx, 2023; Rogers, 1983; Ruzzante et al., 2021). At the early stage of adoption, some respondents experienced difficulties related to digital literacy, unstable internet access, and uncertainty in using applications. However, these barriers were gradually reduced through repeated use, informal assistance from younger family members, and growing familiarity with digital features. In this sense, supply chain efficiency was not only a technical outcome but also a learning process. The results support previous studies showing that adoption accelerates when users experience clear functional benefits, such as faster payments, simpler financing access, and more transparent transactions (Cui et al., 2022; Suri & Jack, 2016).

Socio-Economic Transformation

The third theme, socio-economic transformation, captures the broader changes associated with Financial Technology adoption beyond immediate market and transaction outcomes. Respondents described how Financial Technology influenced their confidence, autonomy, and capacity to manage livestock businesses more systematically. Digital records, non-cash payments, and easier access to information encouraged more deliberate decision-making and reduced uncertainty in managing daily operations.

Some farmers associated this change with improved income stability and stronger control over cash flow. R7 stated, *“Previously, I often waited for payments and that disrupted the business. Now the money comes in faster and planning becomes easier.”* R8 noted, *“Digital records help me monitor expenses, so I know where money is being spent and what should be reduced.”* These statements indicate that Financial Technology contributed not only to efficiency but also to more rational financial behavior and improved business confidence.

The social dimension was also evident. Several respondents reported increased interaction among farmers through information sharing about applications, transactions, and opportunities. Some also observed that digital tools made livestock activities appear more attractive to younger people, who had previously viewed the sector as outdated or uncertain. R19 remarked, *“We can see a lot of young people now starting to think about livestock business because everything is easier through the phone.”*

Environmental implications emerged indirectly within this theme as part of broader transformation. Respondents did not adopt Financial Technology primarily for environmental reasons, yet some described benefits such as more planned distribution, lower risk of unsold livestock products, and reduced inefficiency in transport and transaction coordination. These indirect effects suggest that Financial Technology may contribute to environmental sustainability when integrated with better planning, waste-reduction strategies, and green financing mechanisms. However, such outcomes remain dependent on institutional support and platform design. This interpretation is consistent with perspectives on Sustainable Development Theory, which emphasize that economic, social, and environmental dimensions must be considered together to achieve resilience and long-term well-being in rural production systems (Onkarrao Manjare, 2025).

Theoretical Implications

The findings offer more specific theoretical implications in relation to the livestock context of Kepanjen District, Malang Regency. First, with respect to Innovation Diffusion Theory, the study shows that Financial Technology adoption among livestock farmers is driven less by novelty itself than by immediate and concrete utility. Relative advantage was expressed through faster access to financing, more transparent payments, and broader market reach, while perceived complexity remained a barrier mainly at the initial stage. This means that, in rural livestock settings, adoption is strongly conditioned by whether technology solves day-to-day production and transaction problems rather than by general attitudes toward innovation (Baker et al., 2022).

Second, the findings refine Value Chain Theory by showing that Financial Technology does not simply remove intermediaries. Instead, it changes the function of intermediaries within the livestock chain. In Kepanjen District, middlemen remained relevant in situations requiring aggregation, rapid logistics, and established buyer networks, but their dominance over price information and financing was weakened. The theoretical contribution here lies in showing that value-chain digitalization in livestock systems may produce functional repositioning of middlemen rather than complete exclusion, which aligns with recent literature on how digital platforms reshape roles rather than eliminate them altogether (Klingenberg et al., 2022).

Third, the findings extend Sustainable Development Theory by showing that the significance of Financial Technology lies in its interconnected socio-economic and environmental effects. In this case, Financial Technology improved inclusion, confidence, and business planning, while also creating indirect efficiencies in distribution and resource use. Thus, sustainability in livestock digitalization should be understood not only as increased income but also as broader institutional and behavioral change that shapes resilience, inclusion, and operational efficiency in rural production systems (Karyani et al., 2024).

Policy and Practical Implications

The findings imply that Financial Technology adoption in the livestock sector requires stronger institutional support rather than mere technology availability. First, local and national stakeholders should strengthen digital and financial literacy programs for livestock farmers, especially in rural areas where adoption barriers are linked to practical skills, confidence, and access to assistance. Training should be continuous, locally adapted, and supported through extension services, cooperatives, or village-based mentoring rather than one-off socialization programs.

Second, digital infrastructure remains a precondition for inclusive transformation. Stable internet connectivity, access to affordable digital devices, and user-friendly platform design are essential if Financial Technology is to reach small- and medium-scale livestock farmers more broadly. Without such support, Financial Technology may reproduce inequality by benefiting only those already equipped with digital access and skills.

Third, the study suggests the need for a collaborative regulatory and institutional framework involving government, Financial Technology providers, cooperatives, and livestock market actors. In the Indonesian context, this should be aligned with the regulatory framework for financial technology supervision under the Financial Services Authority (OJK) and with national legal provisions governing livestock and animal health systems, such as Law No. 18 of 2009 on Husbandry and Animal Health and related animal welfare regulations (Lever, 2026; Otoritas Jasa Keuangan, 2025; Republik Indonesia, 2009). The use of Financial Technology in rural livestock transactions should therefore be supported by regulatory clarity on digital lending, payment services, consumer protection, and data security, while also remaining compatible with legal and policy frameworks governing livestock distribution, animal health, and agribusiness development (Bayu Suryadi Manggala, 2024; Global Legal Insights, 2025; Suryadarma & Faqih, 2024).

Fourth, environmental sustainability should be incorporated more explicitly into Financial Technology-based livestock programs. Financing products and digital platforms could be designed to support waste management, more efficient transport coordination, biosecurity improvements, and low-emission production practices. For example, credit products could include incentives for farms that adopt better manure management or biosecurity protocols, while digital marketplaces could prioritize buyers and logistics providers that minimize transport distance and product loss. Practical interventions of this kind would make Financial Technology more relevant not only for economic modernization but also for greener livestock development (Karyani et al., 2024).

CONCLUSION

This study aimed to examine how financial technology influences the livestock sector in Kepanjen District, Malang Regency, especially in relation to farmers' access to finance, market participation, and changes in supply-chain relations. The findings show that Financial Technology contributes to livestock-sector digital transformation by improving access to financing, accelerating payment processes, strengthening financial record-keeping, and expanding market information available to farmers. As a result, farmers become less structurally dependent on middlemen and gain greater bargaining power, stronger control over cash flow, and more autonomy in production and marketing decisions. At the same time, the findings indicate that Financial Technology does not completely remove middlemen from the livestock value chain, but instead reshapes their role toward functions such as aggregation, logistics, and transaction support.

The study further shows that Financial Technology should not be understood merely as a technical tool, but as a broader socio-economic mechanism that affects institutional relations and everyday business practices in rural livestock systems. Its significance lies not only in improving transaction efficiency, but also in strengthening farmers' confidence, financial inclusion, and ability to manage livestock

activities more systematically. In this regard, the study contributes to the existing literature by showing that Financial Technology adoption in rural livestock settings is driven mainly by practical utility rather than by technological novelty alone. It also adds to value-chain and rural development discussions by demonstrating that digital transformation in livestock systems is multidimensional, involving economic inclusion, social empowerment, and indirect environmental benefits through improved planning and reduced inefficiency.

These findings also have important implications for policy and practice. To broaden the benefits of Financial Technology in the livestock sector, policymakers and relevant stakeholders need to strengthen digital and financial literacy among farmers, improve rural connectivity and digital infrastructure, and encourage collaboration between Financial Technology providers, cooperatives, and livestock-market actors. Such efforts are necessary to ensure that digital transformation remains inclusive and does not only benefit farmers who already have stronger access to technology, information, and institutional support. In this sense, Financial Technology development should be integrated into wider rural development strategies that promote not only efficiency and market access, but also resilience, inclusion, and more sustainable livestock management.

This study has several limitations. Its qualitative design and relatively limited number of respondents do not allow broad statistical generalization across all livestock commodities and regions in Indonesia. Future research should therefore examine a wider range of regional and commodity contexts, compare users and non-users more systematically, and combine qualitative and quantitative approaches to assess the long-term effects of Financial Technology adoption on income, bargaining position, social inclusion, and sustainability in rural livestock development.

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Declaration of Generative AI Use. During the preparation of this work, the author(s) used Perplexity AI and Grammarly in order to develop the early framework and check grammar. After using this tool, the author(s) reviewed and edited the content as needed and take full responsibility for the content of the published article.

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