

# Research on the Current Status, Key Challenges and Optimization Pathways of Improving Farmers' Digital Literacy: Evidence from an Empirical Investigation in Suqian, Jiangsu Province

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**Abstract:** Under the critical imperative of rural revitalization, farmers' digital literacy has emerged as a foundational cornerstone for advancing digital rural construction and driving the digital transformation of agricultural industries. Grounded in the European Digital Competence Framework (DigComp), this study contextualizes its inquiry in Suqian City, Jiangsu Province, to systematically evaluate the current status, underlying dilemmas, and optimization strategies regarding farmers' digital literacy. The empirical findings reveal a distinct structural polarization, characterized by "strong foundational fluencies but deficient higher-order competencies" among local farmers. Specifically, the investigation identifies three systemic bottlenecks: an urgent need for innovation in digital technology training models, a critical shortage of specialized talents in digital agriculture, and an insufficient intrinsic drive for digital transformation among farmers. To address these dilemmas, this paper proposes three strategic pathways: innovating multi-modular digital talent training models to establish a precision-targeted, tiered cultivation system; bridge the gap between supply and demand in digital training while accelerating digital agricultural infrastructure construction; and stimulating farmers' intrinsic motivation for digital transformation by expanding accessible, digital public services that benefit rural communities.

**Keywords:** Farmers' Digital Literacy; Digital Countryside; European Digital Competence Framework; Suqian City

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## 1. Introduction

In the contemporary digital era, emerging technologies typified by big data and artificial intelligence are profoundly reshaping and reconstructing rural production modes and lifestyles. Within this macro-environment, digital rural construction has become an indispensable pathway toward achieving rural revitalization and agricultural-rural modernization. As a foundational cornerstone of this digital transition, farmers' digital literacy directly conditions the utilization efficacy of rural digital infrastructure; furthermore, it dictates whether digital services and terminals can truly permeate and take root in rural communities. To accelerate digital rural development and elevate farmers' digital capabilities, the General Office of the CPC Central Committee and the General Office of the State Council jointly promulgated the Outline of the Digital Rural Development Strategy as early as 2019, positioning the substantial enhancement of farmers' digital literacy as a primary objective. Driven by this top-level strategic design, a sequence of complementary policy instruments—such as the Action Plan for Digital Rural Development and the National Framework for Enhancing Digital Literacy and Skills—has been

progressively instituted, thereby forging a relatively comprehensive policy infrastructure dedicated to upgrading farmers' digital competencies.

Although this array of policy initiatives offers robust institutional guarantees, translating strategic texts into empirical reality remains fraught with systemic bottlenecks. Extant literature indicates that the overall digital literacy of farmers remains low, with pronounced disparities persisting across the rural-urban continuum, notably manifesting as the access divide, skills divide, and usage divide. The path toward upgrading farmers' digital literacy is further impeded by an insufficient intrinsic drive for digital transformation and a pervasive deficit in digital application capabilities. This realistic discrepancy between farmers' actual digital literacy and the practical demands of digital rural construction not only obstructs the localization of digital industries and services but also curtails the momentum of agricultural digitalization. To address these critical dilemmas, it is imperative to comprehensively diagnose the authentic status of farmers' digital literacy, dissect the underlying impediments and their root causes during the enhancement process, and formulate corresponding optimization pathways.

Consequently, focusing on the core nexus of enhancing farmers' digital literacy, this study anchors its empirical inquiry in Suqian City, Jiangsu Province—a representative agricultural municipality in northern Jiangsu. Utilising the European Digital Competence Framework as its theoretical lens, this paper systematically evaluates the holistic landscape and salient predicaments of contemporary farmers' digital literacy before proposing targeted countermeasure suggestions. This inquiry aims to provide both actionable pragmatic guidance and a rigorous academic response to the dual imperatives of elevating rural digital literacy and advancing digital countryside construction.

## **2. Literature Review and Theoretical Framework**

### **2.1 Domestic and International Literature Review**

Digital literacy, as a foundational competency for utilizing digital technologies, has consistently remained a core agenda in digitalization research. Extant scholarship both at home and abroad can be broadly categorized into three thematic strands: the conceptual connotation of digital literacy, the cultivation pathways of digital literacy, and the strategic countermeasures for its enhancement.

Regarding the conceptual connotation of digital literacy, Yoram Eshet (2004) posited that digital literacy extends far beyond the mere capability to operate software or digital hardware; rather, it encompasses a complex matrix of cognitive, motor, sociological, and emotional skills indispensable for users to function effectively in digital environments. This perspective forged a holistic conceptual framework comprising photo-visual, reproduction, branching, information, and socio-emotional literacies. Domestically, Su Lanlan and Peng Yanling (2021) defined digital literacy as an individual's capacity to acquire, comprehend, create, and disseminate digital information, as well as the ability to utilize digital tools and resources safely and efficiently. On this basis, Su Lanlan et al. dismantled farmers' digital literacy into four distinct dimensions—general digital literacy, digital social literacy, digital creative literacy, and digital safety literacy—thereby constructing a theoretical analysis framework for empirical measurement. Concurrently, Chang Lingchong (2021) proposed a "cognition-behavior" analytical framework, arguing that farmers' digital literacy should be evaluated via media cognition (the cognitive level regarding media information) and media behavior (the proficiency in utilizing digital media). Synthesizing these diverse perspectives, Li Chunchiu et al. (2023) drew upon global baseline digital literacy frameworks to formulate a domestic measurement matrix for farmers, which evaluates five key domains: general digital literacy, safety and ethical literacy, communication literacy, creation literacy, and problem-solving literacy.

Regarding the cultivation of digital literacy. From the perspective of well-rounded competency development, Jiang Minjuan and Zhai Yun (2022) introduced a "Five-Forces" analytical framework adapted from international frameworks. They argued that digital literacy cultivation must integrate five interconnected modules: perception, convergence, absorption, practice, and evolution. Specifically, perception aims to sharpen information insight; convergence enhances digital communication and interaction; absorption elevates information processing and application; practice fosters creative problem-solving capabilities; and evolution guarantees an individual's adaptive capacity to keep pace with technological advancements. They asserted that a synergistic, compounding effect on digital literacy can only be achieved when these five forces are simultaneously elevated. Diverging from this competency-building approach, Tan Xiangping et al. (2025), through empirical fieldwork in national

digital rural pilot zones, observed that the contextualized application of digital literacy among Chinese farmers remains severely constrained. Taking an application-scenario perspective, they maintained that digital literacy cultivation must anchor itself in farmers' pragmatic needs, particularly highlighting three critical scenarios: digital governance participation, digital agricultural operations, and e-commerce live-streaming. This insight re-validates the developmental stage theory proposed by Martin (2008), which posits that digital literacy cultivation must undergo a progressive transition from "general competencies" to "contextualized applications." Only when digital literacy is embedded into concrete social scenarios driven by survival or livelihood demands can its cultivation yield substantive efficacy.

Regarding the enhancement countermeasures of digital literacy. Prototyping from the dual effects of digital rural governance, Ding Bo (2022) formulated a three-dimensional theoretical model encompassing "institution-technology-everyday life." He contended that digital rural construction is neither a unidirectional institutional regulation imposed by the state onto rural areas, nor a one-way technological empowerment of rural revitalization; rather, it is a dynamic, reciprocal adjustment among institutional norms, technological applications, and rural daily life. Consequently, upgrading farmers' digital literacy cannot rely solely on top-down technical diffusion or institutional imperatives; it must be seamlessly woven into the fabric of rural everyday life. This perspective of embeddedness enjoys widespread consensus in international rural studies. Saleminck et al. (2017), in their systematic review of global rural digital development, found that the exogenous promotion of technological infrastructure, when detached from indigenous rural social networks, inevitably results in "technological suspension" (technological floating). Therefore, they emphasized the necessity of aligning digital skills training with the socio-technical networks embedded in rural daily life. Furthermore, Li Xiaojing et al. (2022) utilized empirical data to investigate the causal nexus between digital literacy and rural entrepreneurial behavior, identifying a significant spatial spillover effect of digital literacy on increasing farmers' income. Accordingly, they advocated for a targeted, demand-driven training methodology that "radiates from points to areas" based on sectoral requirements. Complementarily, Li Zuoyi et al. (2023), adopting a talent-classification paradigm, proposed three tailored strategic interventions for high-quality farmers: stabilizing infrastructure guarantees, intensifying human resource investment, and fostering multi-stakeholder synergy.

In summary, while existing studies have laid a preliminary foundation regarding the dimensional classification, curricular content, and enhancement pathways of digital literacy, there remains a conspicuous lack of a holistic macromangement perspective that aligns with digital countryside construction and industrial digitalization. Specifically, systematic and multidimensional suggestions tailored to heterogeneous industries and varied farmer cohorts remain scarce. This paper contends that elevating farmers' digital literacy is a complex systemic project that intertwines consciousness, skills, resources, and institutional designs. Consequently, building upon extant scholarship and adopting a systems-engineering paradigm, this study employs the European Digital Competence Framework (DigComp) as its analytical lens to systematically diagnose the holistic status and salient bottlenecks of contemporary farmers' digital literacy, thereby offering feasible and granular countermeasure recommendations.

## 2.2 Theoretical Framework

The European Digital Competence Framework (DigComp) stands as one of the most globally influential evaluation paradigms for assessing digital literacy. This theoretical model not only yields profound critical references for the scholastic inquiry into Chinese farmers' digital literacy but also provides a highly systematic analytical blueprint for empirical evaluation. DigComp conceptualizes digital literacy as a triadic nexus encompassing technical skills, cognitive knowledge, and value-oriented attitudes. Accordingly, the framework encapsulates digital literacy into five core competence domains: information and data literacy, communication and collaboration, digital content creation, safety, and problem solving. Specifically, information and data literacy denotes the capacity to discern the authenticity of data and filter instrumental information; communication and collaboration emphasizes the proficiency in navigating interpersonal communication and engaging in digital governance within networked environments; digital content creation involves the competence to generate, edit, and refine digital content; safety relates to the accountability and capability regarding data protection, ethical norms, and social responsibilities; and problem solving refers to the ability to diagnostically identify and solve systemic challenges within digital environments.

To date, the DigComp framework has been widely adapted and deployed by Chinese scholars in the domain of rural digital

studies, serving as a primary theoretical cornerstone and analytical framework for constructing index systems to evaluate farmers' digital literacy. Grounded in this established scholarship and drawing upon the international baseline of the DigComp framework, this study synthesizes these theoretical dimensions with the pragmatic empirical realities of contemporary agricultural production and management. Consequently, a tailored evaluation index system has been developed to systematically measure the authentic digital literacy levels of farmers in the Suqian region through an extensive questionnaire survey.

*Table 1. Evaluation Index System for Measuring Farmers' Digital Literacy*

<b>Dimensions</b>	<b>Specific Measurement Items</b>
Information and Data Literacy	Can use digital tools to search for and filter agricultural information. Able to evaluate the credibility of online agricultural information. Competent in classifying, storing, and managing informational data.
Communication and Collaboration	Can utilize instant messaging software for online interpersonal communication. Able to leverage digital tools to share agricultural experiences or seek assistance. Capable of participating in online agricultural discussions or technical training sessions.
Digital Content Creation	Competent in producing and publishing agriculture-related digital content. Able to optimize the visual effects of digital content. Understand copyright rules and regulations concerning digital content.
Safety	Aware of potential safety and security risks inherent in digital environments. Able to adopt relevant measures to protect personal information and privacy. Capable of safeguarding the legal rights of oneself and others in digital environments.
Problem Solving	Competent in resolving common technical issues with digital tools. Able to utilize digital tools to identify and address practical dilemmas. Capable of using digital technologies creatively and innovatively. Understand and recognize specific areas where one's own digital literacy needs improvement.

### **3. The Holistic Status of Farmers' Digital Literacy: Evidence from Empirical Fieldwork in Suqian City, Jiangsu Province**

#### **3.1 Descriptive Statistical Analysis of the Sample**

Based on the conceptualized evaluation index system for farmers' digital literacy, this study examined the five core dimensions of digital literacy through a methodological combination of questionnaire surveys and semi-structured field interviews. A total of 250 questionnaires were distributed, and 211 valid responses were recovered, yielding a valid response rate of 84.4%. The baseline sociodemographic characteristics of the sample are delineated below: Gender Distribution: The cohort comprised 110 males (52.13%) and 101 females (47.87%). Age Structure: 63 respondents were aged 18–30 (29.86%), 77 were aged 31–45 (36.49%), 62 were aged 46–60 (29.38%), and 9 were over 60 years old (4.27%). Educational Attainment: 46 individuals held a primary school degree or below (21.80%), 53 completed junior high school (25.12%), 40 graduated from senior high school or secondary specialized school (18.96%), and 72 possessed a junior college degree or above (34.12%). Annual Household Income: 49 households earned below 20,000 RMB (23.22%), 65 fell within the 20,000–50,000 RMB bracket (30.81%), 56 earned between 50,000 and 100,000 RMB (26.54%), 30 reported an income of 100,000–200,000 RMB (14.22%), and 11 reported over 200,000 RMB (5.21%). Collectively, the sample encompasses a heterogeneous cohort of farmers spanning diverse genders, age brackets, educational backgrounds, and income strata, thereby exhibiting robust representativeness for this empirical inquiry.

Table 2. Sociodemographic Characteristics of the Sample (N = 211)

Variables	Categories	Frequency (n)	Percentage (%)
Gender	Male	110	52.13%
	Female	101	47.87%
Age	18–30 years old	63	29.86%
	31–45 years old	77	36.49%
	46–60 years old	62	29.38%
	Above 60 years old	9	4.27%
Educational Attainment	Primary school or below	46	21.80%
	Junior high school	53	25.12%
	Senior high school / Secondary specialized school	40	18.96%
	Junior college or above	72	34.12%
Annual Household Income	Below 20,000 RMB	49	23.22%
	20,000–50,000 RMB	65	30.81%
	50,000–100,000 RMB	56	26.54%
	100,000–200,000 RMB	30	14.22%
	Above 200,000 RMB	11	5.21%

### 3.2 The Holistic Status of Farmers' Digital Literacy in Suqian City

In terms of information and data literacy, 78.68% of the surveyed farmers demonstrated the capacity to utilize digital tools to search for and filter agricultural information, 80.10% were able to evaluate the credibility of online agricultural information, and 79.14% could classify, store, and manage informational data. While the information literacy of rural residents is generally robust, certain critical facets warrant further enhancement—specifically, the nuance of operational tool utilization and the critical discernment of online information require ongoing refinement.

Regarding communication and collaboration, 80.10% of the farmers had participated in online agricultural consultations, discussions, or technical training sessions, while 80.09% frequently leveraged instant messaging software for interpersonal communication, sharing personal agricultural experiences, or seeking assistance via digital channels. Although the vast majority of farmers have mastered baseline online communication skills, their proficiency in higher-level information acquisition, interactive sharing, and collaborative training remains to be further optimized.

In the domain of digital content creation, 73.93% of the farmers were capable of producing and publishing digital content related to agricultural products. Among them, 77.73% optimized the visual effects of their digital output, and 76.30% exhibited an awareness of copyright regulations concerning digital content. These findings suggest that while basic content creation is emerging, the creative depth is structurally constrained by the generally lower educational attainment across rural populations, thereby underscoring the critical necessity of intensifying institutional support for rural cultural and digital infrastructure.

With respect to safety literacy, 80.09% of the farmers recognized that they face diverse latent security and privacy risks within contemporary digital environments, and 78.67% proactively adopted measures to safeguard both their own legal rights and those of others in networked spaces. This indicates that farmers possess a relatively sophisticated grasp of digital safety knowledge, enabling them to execute rational and effective protections over legitimate rights within the macro-context of rural digitalization.

Regarding problem solving, 74.88% of the respondents were able to troubleshoot common technical issues associated with digital tools, 77.73% utilized digital modalities to diagnose and address practical dilemmas, and 72.98% demonstrated

creative and innovative applications of digital technology. Concurrently, 80.57% recognized specific domains where their own digital literacy required improvement. Nonetheless, the empirical diagnostics reveal that farmers' autonomous problem-solving efficacy remains restricted, particularly manifesting as a pronounced deficit in digital innovation consciousness and creative capacity.

Synthesizing the empirical data, this study concludes that while farmers' proficiencies in information and data literacy, communication and collaboration, and safety have reached a relatively high baseline, their scores in digital content creation and problem solving remain conspicuously low, thereby exhibiting a structural polarization characterized by "strong foundational fluencies but deficient higher-order competencies." Farmers demonstrate a commendable mastery over basic digital utilities but fall short in advanced, value-added applications; specialized skills present a significant bottleneck compared to pervasive, generalized proficiencies, and operational capabilities possess a distinct advantage over innovative competencies. Consequently, the contemporary development of farmers' digital literacy is situated at a critical inflection point, transitioning from pervasive application to deep-seated innovation. While consolidating existing foundational advantages, strategic priority must pivot toward fostering high-order, creative digital competencies.

## **4. Systemic Bottlenecks in Elevating Farmers' Digital Literacy**

To unearth the deep-seated predicaments underlying farmers' digital literacy in Suqian City, this study complemented the aforementioned quantitative questionnaire with targeted, qualitative empirical field interviews. The diagnostic results demonstrate that the trajectory of upgrading rural digital literacy is significantly impeded by three systemic bottlenecks: an urgent imperative for innovation in digital technology training systems, structural deficits in specialized talents within the digital agricultural sector, and profound deficiencies in farmers' intrinsic driving forces for digital transformation.

### **4.1 The Urgent Imperative for Innovation in Digital Technology Training Systems**

The pedagogical architectures and operational modalities for cultivating digital agricultural talents require comprehensive structural reform. Empirical analysis reveals that 53.08% of the respondents perceived contemporary training and guidance as fundamentally inadequate. The most prominent vulnerability manifests as a severe dislocation between the training curricula and the pragmatic demands of actual agricultural production; simultaneously, the iterative updating of educational content lags significantly behind the rapid evolution of the digital economy. Furthermore, the utilization rate of online educational resources remains marginal, illustrating that traditional, homogenized training modalities can no longer satisfy the multi-dimensional learning needs of heterogeneous rural cohorts. Crucially, there is a conspicuous absence of tiered pedagogical programming and standardized evaluation matrices designed to benchmark practitioners' digital competencies. Consequently, there is an urgent necessity to establish a demand-driven, categorically guided, and dynamically adjusted ecosystem for cultivating digital agricultural talents.

### **4.2 Structural Deficits in Specialized Talents within the Digital Agricultural Sector**

The traditional agrarian workforce is characterized by a fragile foundation in holistic educational attainment and basic digital literacy; meanwhile, the institutional framework for cultivating composite talents—who possess both agricultural expertise and advanced digital skills—remains highly underdeveloped. The empirical data indicate that over 46% of the rural sample fall within the educational brackets of "primary school" or "junior high school," the majority of whom represent an aging agrarian workforce aged 45 and above. This baseline demographic reality severely constrains their capacity to absorb higher-order digital competencies. Moreover, because digital agriculture intrinsically demands highly composite talents, the training programs for specialized technical personnel remain incomplete, thereby exacerbating the supply-demand mismatch in the rural labor market. The survey demonstrates that traditional subsistence farming (encompassing grain cultivation, cash-crop farming, and livestock breeding) remains the dominant livelihood option, whereas farmers engaging in emerging digital vocations constitute a nominal minority—with only 9.95% operating independent rural e-commerce businesses. This analytical mapping underscores a critical developmental gap hindering the cultivation of next-generation agricultural specialists in the contemporary digital era.

### **4.3 Deficiencies in Farmers' Intrinsic Driving Forces for Digital Transformation**

The intrinsic motivation indispensable for farmers' digital transition has not been sufficiently nurtured or institutionalized.

The empirical findings reveal a distinct polarization in farmers' behavioral intentions: while 80.10% expressed a proactive willingness to engage in online agricultural information exchange and digital training, a notable 19.90% held a negative stance (6.16% strongly disapproved; 13.74% disagreed). This motivational friction inevitably leads to a pronounced technological dislocation. Due to the chronic absence of long-term post-training technical guidance and localized support services, a substantial cohort of farmers fails to internalize abstract digital skills into real-world applications, resulting in persistent information poverty at the household level. Ultimately, this deficit in intrinsic drive is inextricably bound up with the aforementioned structural talent shortages, lagging training paradigms, and weak rural infrastructure—collectively forming the core institutional barriers that restrain the upgrading of rural human capital.

In conclusion, the development of rural digital literacy in China is currently entangled in a multidimensional and systemic bottleneck. At the subject level, it manifests as a structural erosion of digital agricultural human resources; at the institutional level, it represents a temporal lag in technical training frameworks; and at the motivational level, it reflects an alienation from the intrinsic dynamics of industrial transformation. To break through these institutional walls and drive meaningful digital rural reconstruction, policy interventions must simultaneously target the innovation of talent-cultivation mechanisms, the optimization of tiered training ecosystems, and the institutionalization of robust incentive structures.

## **5. Strategic Countermeasures and Implementation Pathways for Upgrading Farmers' Digital Literacy**

### **5.1 Innovating Multi-Modular Training Paradigms to Establish a Precision-Targeted, Tiered Cultivation System**

To address the urgent imperative for innovation in digital training models, a flexible, multi-modular pedagogical ecosystem must be instantiated. Mechanistically, this entails a dual-track approach combining advanced online modalities and localized empirical practices. On the virtual axis, institutions should deploy interactive software for synchronous distance education regarding digital agrarian operations; more importantly, next-generation technologies—such as digital twin architectures, holographic classroom systems, and adaptive learning engines—should be harnessed to facilitate high-risk virtual simulations of agricultural machinery, dynamically modulating curricular difficulty via AI algorithms to realize individualized instruction. On the practical axis, training must be anchored in experiential learning, utilizing field demonstrations, site visits, and on-site expert consultations to reinforce cognitive retention. Furthermore, longitudinal digital talent portfolios should be established to track farmers' skill trajectories, allowing for the dynamic recalibration of cultivation objectives. Synergistically, institutionalized university-enterprise collaborations should be forged with local higher education institutions and research academies to launch specialized digital agriculture curricula, generating a stable pipeline of highly qualified human capital for agrarian enterprises.

Simultaneously, to dissolve the structural homogeneity of the current training framework, a four-tier precision-targeted cultivation matrix should be established based on demographic characteristics and baseline capacities: Tier 1 (Foundational Literacy): Tailored for vulnerable cohorts—specifically farmers aged 45 and above with restricted educational attainment. The curriculum focuses on baseline digital fluencies, smartphone operations, ubiquitous everyday applications, and cyber-fraud awareness. Tier 2 (Specialized Competencies): Designated for agricultural cooperative personnel, college-graduate village officials, and "new farmers" (xin nong ren). Training encompasses specialized technical skills including Internet of Things (IoT) hardware operations, e-government platform management, and agricultural e-commerce. Tier 3 (Advanced Continuing Education): Structured for experienced agricultural practitioners, delivering virtual modules on deep-level IoT integration and big data analysis in smart agriculture. Tier 4 (Knowledge Translation & Extension): Driven by elite student cohorts, the "Science and Technology Backyards" (STBs) initiative, and dedicated agrarian development funds, aiming to seamlessly translate abstract scientific breakthroughs into empirical manifestations directly on the farmlands.

### **5.2 Strengthening the Supply-Demand Alignment in Technical Training and Accelerating Digital Infrastructure Construction**

First, upgrading rural human capital requires aligning digital training frameworks with authentic market dynamics. To achieve this synchronization, a case-based pedagogical reform should be institutionalized, anchoring training in regional cluster

economies—such as the flower and plant industry in Shuyang or the aquaculture sector in Sihong—thereby embedding advanced competencies like IoT monitoring and live-streaming communication design into the entire lifecycle of agricultural production. Consequently, a three-stage progressive training matrix (comprising foundational, intermediate, and advanced echelons) should be deployed to group trainees based on their mastery of hardware operations, data analytics, and innovative applications, implementing targeted classroom tracking aligned with village-specific dominant industries. Furthermore, an objective skill-certification and star-rating matrix should be established in partnership with industry associations; farmers who pass rigorous field examinations will be designated as "Digital Agrarian Craftsmen," a distinction directly coupled with preferential financial and institutional credit policies.

Second, the structural constraints of rural information poverty must be dismantled by accelerating digital industrial infrastructure construction. A dedicated network-blind-spot elimination initiative should be enforced through public-private partnerships to extend fiber-optic networks into remote villages and densify telecommunication base stations, ensuring uninterrupted, high-bandwidth connectivity across specialized industrial zones. Crucially, a municipal-level agricultural data convergence center should be instituted to integrate scattered, heterogeneous data streams—encompassing real-time production guidance, meteorological disaster warnings, and market supply-demand dynamics—into a unified mobile platform featuring "one-click query" capabilities. To bridge the last mile of technology diffusion, village-level digital service hubs equipped with multi-functional intelligent terminals must be rolled out, delivering localized access to remote expert diagnostics and digital public services to satisfy villagers' high-frequency administrative demands.

### **5.3 Stimulating Intrinsic Driving Forces for Digital Transformation and Advancing Accessible Public Services**

To unlock the intrinsic motivation indispensable for a sustainable digital transition, policy interventions must leverage the transformative power of the digital economy to empower the entire agrarian value chain, enabling farmers to perceive tangible economic dividends from technological adoption. In the upstream sector, precision-oriented automated hardware should be promoted to optimize resource efficiency; in the midstream sector, an end-to-end product traceability architecture must be deployed to ensure holistic lifecycle supervision; and in the downstream sector, e-commerce live-streaming ecosystems should be institutionalized to catalyze rural economic growth. Concurrently, standardized digital competency certifications and regional skills competitions should be organized to foster an institutional culture of autonomous learning.

Regarding practical technological diffusion, the application threshold must be systematically lowered. Installing user-friendly, single-click intelligent control systems in flower greenhouses and aquaculture facilities, and establishing a cohort of pioneering demonstration households, can empower adjacent farmers to overcome the cognitive alienation and technological anxiety associated with digitalization. Moreover, a comprehensive data-linkage architecture must be forged to harmonize data chains across cultivation, processing, logistics, and e-commerce, creating a real-time "production-supply-marketing" integration platform capable of dynamically adapting production schedules. Finally, institutional support must focus on digital brand asset appreciation, establishing a traceability system within origin-based live-streaming bases to drive premium pricing through quality certification and narrative-driven marketing, ensuring farmers directly capture the surplus value of digital transformation.

Ultimately, digital public services must be strictly calibrated against the actual demands of rural communities. The government should launch integrated, one-stop mobile applications and deploy network-based digital financing services to realize ubiquitous convenience. To ensure institutional continuity, the "one service station per village" project must be executed, allocating interconnected computer terminals, interactive touchscreens, and dedicated digital facilitators tailored to the unique socioeconomic realities of each community. Lastly, the state should innovate digital financial incentive mechanisms by constructing a credit-evaluation architecture that links individual digital literacy scores with access to preferential financial services, thereby structurally mobilizing farmers' enthusiasm for autonomous digital upskilling.

## **Conclusion**

In conclusion, this study systematically evaluates the contemporary landscape of farmers' digital literacy in Suqian City, Jiangsu Province, utilizing the European Digital Competence Framework. The empirical findings reveal a distinct structural

polarization characterized by "strong foundational fluencies but deficient higher-order competencies," with critical bottlenecks residing in rigid training models, specialized talent shortages, and weak intrinsic motivation. Fostering farmers' digital literacy is a complex, systemic project that demands multi-stakeholder synergy. To achieve sustainable digital rural reconstruction, future policy interventions must transition from pervasive application to deep-seated innovation. By implementing precision-targeted, tiered cultivation models, aligning technical training with market demands, and lower the technological threshold to stimulate farmers' intrinsic drive, agricultural communities can effectively bridge the digital divide and capture the economic dividends of digital transformation, thereby providing a robust impetus for comprehensive rural revitalization.

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## Conflict of Interests

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