

DIGITAL INFRASTRUCTURE AND ITS ROLE IN SPATIAL ECONOMIC TRANSFORMATION AND RURAL DEVELOPMENT: A SYSTEMATIC LITERATURE REVIEW

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Abstract

This study provides a systematic literature review (SLR) of 17 empirical studies published between 2021 and 2026, examining the role of the digital economy in rural and agricultural development. The findings indicate that digitalization significantly improves rural income, agricultural productivity, and household resilience. However, evidence also suggests that digital transformation may exacerbate inequality in the absence of inclusive policies. Four major themes emerge: (1) digital technology adoption, (2) economic impacts on income and productivity, (3) inequality and digital divide, and (4) mechanisms and enabling factors. The study highlights the importance of digital infrastructure, human capital, and inclusive policies to ensure equitable benefits of digital transformation in rural areas.

Keywords: Digital economy, rural development, agriculture, inequality, digital divide, systematic literature review

INTRODUCTION

1. Introduction

Digital transformation has become a central driver of global economic development. In rural areas, particularly in agriculture, digital technologies offer new opportunities to enhance productivity, expand market access, and improve livelihoods. Technologies such as ecommerce platforms, digital extension services, and digital finance are reshaping traditional economic structures.

However, rural digitalization faces structural challenges, including limited infrastructure, low digital literacy, and socio-economic constraints. These challenges create uneven adoption and heterogeneous impacts across regions and populations.

This study aims to systematically review empirical evidence on the role of the digital economy in rural transformation. Specifically, it addresses the following questions:

1. How is digital technology adopted in rural areas?
2. What are the economic impacts on income and productivity?
3. Does digitalization reduce or exacerbate inequality?
4. What mechanisms drive these impacts?
5. What factors enable or hinder digital adoption?

LITERATURE REVIEW

2. Background and Theoretical Foundations

The literature reviewed in this study is grounded in several complementary theoretical frameworks. Understanding these theoretical foundations is essential for interpreting empirical findings and explaining the causal mechanisms underlying the impacts of the digital economy.

Technology Adoption Theory serves as a primary framework in several studies examining determinants of individuals' or households' decisions to adopt digital technologies. Ruslan and Sukma (2025), as well as Fan and Gan (2025), employ this framework to analyze how farmers and agricultural entrepreneurs integrate e-commerce and internet technologies into their economic activities ^[1], ^[5]. This theory emphasizes that technology adoption is not solely a rational cost–benefit decision, but is also shaped by social, psychological, and contextual factors.

The Theory of Planned Behavior (TPB) is explicitly applied by Le Thi Hoa Sen et al. (2024) to investigate the adoption of Digital Extension Services among smallholder farmers in Southeast Asia ^[2]. TPB provides a systematic framework to explain how attitudes, social norms, and perceived behavioral control influence individuals' intentions and actual adoption behavior. Their findings indicate that social norms and perceived behavioral control significantly affect adoption decisions, highlighting the importance of social dimensions in the technology adoption process.

The Household Resilience Theory is utilized by Xu et al. (2024) to examine how the digital economy influences the capacity of rural households to cope with economic shocks ^[3]. This framework conceptualizes resilience as a multidimensional construct encompassing economic stability, social capacity, and security. It is particularly relevant as it broadens the analysis beyond income effects, emphasizing the sustainability and stability of household welfare

The Digital Divide Theory provides a critical perspective in studies by Xia et al. (2024) and Wang et al. (2025), which analyze how disparities in access to and capability in using digital technologies may exacerbate economic inequality ^[4], ^[7]. This framework recognizes that the benefits of digitalization are unevenly distributed, and that marginalized groups may fall further behind in the absence of appropriate policy interventions. It therefore introduces an important counterbalance to the otherwise optimistic narrative surrounding the transformative potential of digital technologies.

In addition, Production and Growth Theories, particularly the Cobb–Douglas production function and the Solow growth model, are employed by Kharazishvili et al. (2025) and Melnychenko (2025) to quantify the contribution of innovation and technology to economic growth ^[12], ^[14]. These approaches enable a more rigorous analysis of how digital factors contribute to Total Factor Productivity (TFP).

Beyond these primary frameworks, several studies also draw on more specialized theories. These include Self-Efficacy Theory to explain rural women's entrepreneurship ^[13], Diffusion of Innovation Theory to analyze the spread of communication technologies ^[8], and Digital Financial Inclusion Theory to examine access to finance ^[9]. The diversity of theoretical approaches reflects the complexity of the digital economy phenomenon and underscores the need for a multidisciplinary perspective in understanding its impacts.

Tabel 1. SLR Summary Table

No	Author(s)	Year	Country	Focus Area	Method	Key Findings
1	Ruslan & Sukma	2025	Indonesia	E-commerce	PSM, QR	Income ↑ >30%
2	Le Thi Hoa Sen et al.	2024	ASEAN	Digital extension	TPB	Adoption driven by social norms
3	Xu et al.	2024	China	Household resilience	Regression	Improved resilience

4	Xia et al.	2024	China	Income gap	Spatial model	Mixed inequality effects
5	Fan & Gan	2025	China	Internet use	Regression	Efficiency ↑ 3.5%
6	Wang et al.	2024	China	Production structure	Panel data	Structural transformation
7	Wang et al.	2025	China	Inequality	Econometric	Inequality increases
8	Silvestri et al.	2021	Tanzania	ICT tools	Experiment	SMS & radio effective
9	Li et al.	2024	China	Digital finance	Panel	Innovation increases
10	Asrofi et al.	2023	Indonesia	Women entrepreneurship	Regression	Income & participation ↑
11	Suwanmaneepong et al.	2024	Thailand	Value chain	Case study	Inclusive growth
12	Kharazishvili et al.	2025	Multi	Growth theory	Model	Innovation drives growth
13	Ghouse & McElwee	2026	Oman	Women entrepreneurs	SEM	Self-efficacy critical
14	Melnychenko	2025	Global	AI in agriculture	Conceptual	AI potential high
15	Martínez Arroyo et al.	2022	Spain	Rural policy	Case study	Job creation
16	Zheng et al.	2025	China	E-commerce policy	DID	Productivity ↑ 1.6%
17	Sari et al.	2025	Indonesia	Disability inclusion	3SLS	Income & access ↑

RESULTS & DISCUSSION

3. Adoption of Digital Technologies in Rural and Agricultural Contexts

The adoption of digital technologies in rural areas and the agricultural sector is a fundamental prerequisite for realizing the benefits of the digital economy. The reviewed literature shows that adoption patterns vary greatly depending on the type of technology, geographic context, and characteristics of adopters.

E-commerce and digital platforms have become one of the most widely adopted forms of digital technology among rural economic actors. Ruslan and Sukma (2025) found that agricultural entrepreneurs in Indonesia who adopt e-commerce earn more than 30% higher income compared to non-adopters, with the greatest impact experienced by low-income groups during the COVID-19 pandemic [1]. This finding indicates that e-commerce not only increases income but can also function as a mechanism of economic protection during crises. Zheng et al. (2025) provide further evidence from China that rural e-commerce policies increase agricultural total factor productivity by approximately 1.6% through improvements in technological efficiency and agricultural industrialization [16].

Digital Extension Services (DES) are a form of digital technology application specific to the agricultural sector. Le Thi Hoa Sen et al. (2024) examined the adoption of DES among smallholder farmers in Cambodia, the Philippines, and Vietnam, finding that social norms, perceived behavioral control, and perceived usefulness have significant effects on adoption [2]. These

findings emphasize that the adoption of agricultural technology depends not only on the availability of technology but also on social factors and perceived benefits. Differences in adoption rates across countries indicate that local context, including digital infrastructure and institutional support, plays an important role.

The use of the internet and information technology for accessing agricultural information also shows positive impacts. Fan and Gan (2025) found that farmers in China who use the internet to obtain agricultural information have fertilizer-use efficiency approximately 3.5% higher than non-users [5]. Although this increase appears modest, its cumulative impact on environmental sustainability and agricultural profitability can be highly significant. This finding suggests that digital technology not only increases output but can also promote more sustainable agricultural practices.

Simple communication technologies such as radio and SMS have also proven effective in certain contexts. Silvestri et al. (2021) evaluated an agricultural communication program in Tanzania and found that radio and SMS increased knowledge and adoption of sustainable agricultural technologies, with radio being the most cost-effective method [8]. This finding is important as it shows that digital technology does not need to be sophisticated or expensive to have an impact; simple technologies that fit local contexts can be equally effective.

Digital inclusive finance is another important dimension of digital adoption for the agricultural sector. Li et al. (2024) found that digital inclusive finance increases the likelihood of agricultural enterprises in China engaging in innovation by improving access to financing and information [9]. This finding underscores that digital technology adoption in one domain (finance) can have positive spillover effects on other economic activities (innovation).

Adoption patterns also vary based on demographic and socio-economic characteristics. Asrofi et al. (2023) found that Indonesian women who use the internet are more likely to become entrepreneurs and earn higher incomes during the COVID-19 pandemic [10]. This finding suggests that digital technology can be an important enabler for women's economic inclusion, particularly in crisis contexts that limit physical mobility.

4. *Economic Impacts of Digital Economy on Rural Income and Productivity*

The economic impacts of rural digitalization constitute a central focus in the reviewed literature. Empirical evidence shows consistently positive effects on income and productivity, although the magnitude and distribution of these impacts vary across contexts.

The impacts on household and individual income have been widely documented. Ruslan and Sukma (2025) find that agricultural entrepreneurs in Indonesia who use e-commerce earn incomes more than 30% higher than non-adopters, with the largest effects observed among low-income groups [1]. The magnitude of this impact is highly substantial and demonstrates the transformative potential of e-commerce for rural economic welfare. The use of Propensity Score Matching (PSM) and Quantile Regression methods in this study provides stronger causal evidence regarding the impact of e-commerce adoption.

Asrofi et al. (2023) provide similar evidence for women's entrepreneurship, finding that internet use increases the likelihood of women becoming entrepreneurs and earning higher incomes [10]. This finding is important because it shows that digital technology can overcome structural barriers faced by women in economic participation, such as limited mobility and restricted access to traditional business networks.

Sari et al. (2025) extend the income impact analysis to persons with disabilities in Indonesia, finding that digital access and education significantly improve income and productivity among disabled workers [17]. This finding highlights the potential of digital technology for the economic inclusion of marginalized groups.

The impact on agricultural productivity represents another important dimension. Zheng et al. (2025) use the Difference-in-Differences method to evaluate the impact of rural ecommerce

policies in China on Agricultural Total Factor Productivity (ATFP), finding an increase of approximately 1.6% [16]. Although this increase appears modest, its impact on aggregate agricultural output is highly significant given the scale of China's agricultural sector. The study also identifies transmission mechanisms through improvements in technological efficiency and agricultural industrialization.

Fan and Gan (2025) provide micro-level evidence on productivity impacts, finding that the use of the internet for agricultural information increases fertilizer-use efficiency by about 3.5% [5]. This finding indicates that digital technology not only increases output but also improves input efficiency, which is important for both economic and environmental sustainability.

Impacts on production structure and agricultural modernization have also been documented. Wang et al. (2024) find that the rural digital economy significantly promotes the upgrading of agricultural production structures in China through technological innovation, industrial integration, and increased consumption [6]. This finding suggests that the economic impact of digitalization is not limited to improvements in output or efficiency, but also includes more fundamental structural transformations in how agricultural production is organized.

The impact on household economic resilience is a dimension that is often overlooked but critically important. Xu et al. (2024) find that the digital economy affects rural household resilience in China through three main mechanisms: employment effects, income structure, and family member security [3]. This finding is important because it shows that the benefits of the digital economy lie not only in increasing average income, but also in enhancing income stability and diversification, which improve households' ability to cope with economic shocks.

5. *Inequality and Digital Divide: The Dark Side of Digital Transformation*

Although the literature generally shows positive impacts of the digital economy, several studies provide important evidence on the potential of the digital economy to exacerbate inequality if not accompanied by adequate inclusion policies. These findings add a critical nuance to the optimistic narrative of digital transformation.

Intra-rural inequality is an issue explicitly raised by Wang et al. (2025), who find that the rural digital economy increases intra-rural income inequality in China because its benefits are more enjoyed by high-income groups [7]. This finding indicates that although the digital economy can increase average income in rural areas, the distribution of benefits is uneven. Groups that already possess better human capital, financial capital, and digital access tend to gain greater benefits, while marginalized groups may fall further behind.

The mechanisms underlying this increase in inequality are related to the digital divide in various dimensions: access to digital infrastructure, digital literacy, financial capital for technology investment, and the ability to exploit digital economic opportunities. Wang et al. (2025) find that the rural digital economy increases inequality through non-agricultural employment, entrepreneurship, and online learning pathways, all of which are more easily accessed by higher-income groups [7].

The spatial heterogeneity of the digital economy's impact also shows the potential to exacerbate inequality across regions. Xia et al. (2024) use the Spatial Durbin Model to analyze the impact of the digital economy on the rural–urban income gap in China and find that the effects are highly heterogeneous across regions [4]. In some areas, the digital economy narrows the rural–urban income gap, while in others it widens the gap due to the digital divide. This finding shows that the impact of the digital economy is highly contextual and depends on the initial conditions of digital infrastructure, human capital, and local economic structure.

This spatial heterogeneity has important policy implications: uniform digital economy policies (one-size-fits-all) are likely to be ineffective and even counterproductive in regions with less favorable initial conditions. Policy approaches tailored to local contexts and that explicitly address digital inequality are required.

Factors mediating the impact of inequality have been identified in several studies. Xu et al. (2024) find that the impact of the digital economy on household resilience differs across household groups, with those possessing higher human capital and social capital obtaining greater benefits [3]. This finding is consistent with digital divide theory, which emphasizes that the ability to utilize digital technology depends not only on access but also on the capacity to use it effectively.

However, it is important to note that not all evidence shows negative effects on inequality. Ruslan and Sukma (2025) find that the impact of e-commerce on income is actually greatest among low-income groups during the pandemic [1]. This finding indicates that in certain contexts, particularly during crises that limit access to traditional markets, digital technology can function as an equalizer. This contradiction underscores the importance of understanding the contextual conditions that determine whether the digital economy will reduce or exacerbate inequality.

6. *Mechanisms and Pathways of Digital Economy Impact*

Understanding the mechanisms and pathways of digital economy impact is very important for designing effective policy interventions. The reviewed literature identifies several main mechanisms through which the digital economy affects rural economic outcomes.

Employment effects are one of the main mechanisms. Xu et al. (2024) identify employment effects as one of the three main mechanisms through which the digital economy affects rural household resilience [3]. The digital economy creates new job opportunities, both in the digital sector itself (for example, e-commerce, digital services) and in traditional sectors transformed by digital technology. Wang et al. (2025) find that non-agricultural employment facilitated by the digital economy is one of the main pathways through which the digital economy affects intra-rural income distribution [7].

Income diversification and structure are another important mechanism. Xu et al. (2024) identify income structure as a transmission mechanism of the digital economy's impact on household resilience [3]. The digital economy enables rural households to diversify their income sources, reducing dependence on traditional agriculture that is vulnerable to weather and market shocks. This diversification increases income stability and household economic resilience.

Market access and transaction cost reduction are fundamental mechanisms through which e-commerce and digital platforms affect income. Ruslan and Sukma (2025) show that e-commerce enables agricultural entrepreneurs to access wider markets and reduce dependence on traditional intermediaries [1]. The reduction of transaction costs and the increase in producers' bargaining power against buyers are important pathways through which e-commerce increases farmers' income.

Access to information and improvement in production efficiency are mechanisms documented by Fan and Gan (2025), who find that the internet enables farmers to access better agricultural information, which in turn improves the efficiency of input use such as fertilizer [5]. Better access to information allows farmers to make more optimal production decisions, reduce input waste, and increase productivity.

Access to finance and facilitation of innovation are mechanisms identified by Li et al. (2024), who find that digital inclusive finance increases innovation activities of agricultural business entities by improving access to finance and information [9]. Limited access to finance is a major barrier to investment and innovation in the agricultural sector, and digital finance can overcome this barrier by reducing transaction costs and information asymmetry in credit markets.

Technological innovation, industrial integration, and increased consumption are multiplier effect mechanisms identified by Wang et al. (2024) [6]. The digital economy not only affects agricultural production directly but also facilitates vertical and horizontal integration in

agricultural value chains, encourages technological innovation, and increases consumer demand for agricultural products through e-commerce platforms. This multiplier effect explains why the impact of the digital economy can be greater than what is estimated from direct effects alone.

Learning and human capital improvement are important long-term mechanisms. Wang et al. (2025) identify online learning as one of the pathways through which the digital economy affects income distribution [7]. Access to online learning platforms enables individuals in rural areas to improve their skills and knowledge, which in turn increases their productivity and income.

7. *Enabling Factors and Barriers to Digital Adoption*

The success of rural digitalization depends on various enabling factors and barriers that operate at the individual, household, community, and system levels. Understanding these factors is important for designing effective interventions.

Individual and household factors that influence digital adoption have been identified in several studies. Le Thi Hoa Sen et al. (2024) find that perceived usefulness, social norms, and perceived behavioral control are the main determinants of Digital Extension Services adoption [2]. This finding shows that technology adoption does not only depend on the objective characteristics of the technology, but also on individuals' subjective perceptions of its benefits and ease of use.

Demographic and socio-economic characteristics also play an important role. Ruslan and Sukma (2025) find that education, training, and business characteristics influence ecommerce adoption [1]. Asrofi et al. (2023) find that education, work experience, and marital status influence internet use and women's entrepreneurship [10]. Sari et al. (2025) find that education and training are very important to increase digital benefits for workers with disabilities [17].

Psychological factors are also important, especially for entrepreneurship. Ghouse and McElwee (2026) find that resilience is the strongest factor influencing entrepreneurial self-efficacy of rural women entrepreneurs in Oman [13]. This finding shows that psychological factors such as self-confidence, the ability to cope with failure, and social support play an important role in the success of digital entrepreneurship.

Digital infrastructure is a fundamental prerequisite for digital technology adoption. Le Thi Hoa Sen et al. (2024) emphasize the importance of digital infrastructure for the productivity of smallholder farmers [2]. Xia et al. (2024) show that spatial heterogeneity in the impact of the digital economy is largely explained by differences in digital infrastructure across regions [4]. Limitations in digital infrastructure, including poor internet connectivity and limited access to digital devices, are major barriers to digital adoption in many rural areas.

Institutional and policy support is also very important. Zheng et al. (2025) evaluate the impact of rural e-commerce policies in China, showing that coordinated policy interventions can significantly accelerate adoption and maximize the economic impact of the digital economy [16]. Martínez Arroyo et al. (2022) provide evidence from Spain that rural development programs based on local projects (LEADER programme) are effective in encouraging job creation [15].

Stakeholder collaboration and participatory approaches are enabling factors identified by Suwanmaneepong et al. (2024), who find that participatory approaches in value chain development help rural community enterprises in Thailand increase value added, economic inclusion, and sustainability [11]. This finding shows that the success of rural digitalization does not only depend on technology, but also on social and institutional processes that facilitate collaboration and collective learning.

Cost and cost-effectiveness are important practical considerations. Silvestri et al. (2021) find that radio is the most cost-effective digital communication method for disseminating agricultural information in Tanzania [8]. This finding shows that digital technology does not have

to be advanced or expensive to be effective; simple technologies that are appropriate to the local context and financial capacity of the target population can be equally or even more effective.

Structural barriers faced by certain groups also need to be considered. Asrofi et al. (2023) show that digital technology can help overcome structural barriers faced by women in economic participation [10]. Sari et al. (2025) show the importance of digital inclusion in improving labor market inclusion for persons with disabilities [17]. These findings underline that rural digitalization policies need to explicitly consider and address the structural barriers faced by marginalized groups.

8. *Discussion and Synthesis*

The synthesis of the reviewed literature reveals several important patterns, themes, and insights regarding the role of the digital economy in transforming rural development.

Consistency of Positive Impacts with Variation in Magnitude: Almost all studies show positive impacts of the digital economy on economic outcomes such as income, productivity, and economic resilience. However, the magnitude of these impacts varies substantially across contexts, technologies, and population groups. Ruslan and Sukma (2025) found income effects exceeding 30% [1], while Zheng et al. (2025) reported productivity effects of around 1.6% [16], and Fan and Gan (2025) identified efficiency gains of approximately 3.5% [5]. This variation reflects differences in the types of technology (e-commerce vs. internet for information), the outcomes measured (income vs. productivity vs. efficiency), and implementation contexts.

Importance of Context and Heterogeneity: Findings on spatial and group heterogeneity are highly consistent across studies. Xia et al. (2024) demonstrate spatial heterogeneity in the impact of the digital economy on rural–urban income gaps [4], Xu et al. (2024) highlight heterogeneity across household groups [3], and Wang et al. (2025) show that the benefits of the rural digital economy are unevenly distributed within rural populations [7]. These findings underscore that the impact of the digital economy is highly contextual and cannot be generalized simplistically.

The Inequality Paradox: The literature reveals an important paradox: the digital economy can both reduce and exacerbate inequality, depending on the context and accompanying policies. Ruslan and Sukma (2025) found that e-commerce had the greatest impact on low-income groups [1], while Wang et al. (2025) found that the rural digital economy increased intra-rural inequality [7]. These differences are likely related to variations in technology type, implementation context (pandemic vs. normal conditions), and the presence of inclusive digital policies.

Multiplicity of Mechanisms: The digital economy affects rural economic outcomes through multiple interacting mechanisms. Xu et al. (2024) identify three main mechanisms (employment, income structure, family security) [3], while Wang et al. (2024) identify three additional mechanisms (technological innovation, industrial integration, consumption upgrading) [6]. Other studies highlight further mechanisms such as market access, information access, and financial access. This multiplicity explains why the impacts of the digital economy can be broad and why interventions focusing on a single mechanism may be suboptimal.

Importance of Complementary Factors: The success of rural digitalization depends not only on the technology itself but also on complementary factors such as human capital (education, training, digital literacy), physical and digital infrastructure, institutional support, and social capital. Le Thi Hoa Sen et al. (2024) emphasize the importance of social norms and perceived behavioral control [2], Ghouse and McElwee (2026) highlight resilience and self-efficacy [13], and Suwanmaneepong et al. (2024) stress stakeholder collaboration [11]. These findings suggest that investments in digital technology must be accompanied by investments in these complementary factors.

Simple vs. Advanced Technologies: The literature indicates that digital technologies do not need to be sophisticated or expensive to be effective. Silvestri et al. (2021) found that radio and SMS—relatively simple technologies—are effective in promoting the adoption of sustainable agricultural practices [8]. This finding is important as it suggests that rural digitalization can begin with technologies suited to local contexts and financial capacities, rather than requiring advanced digital infrastructure from the outset.

Inclusion and Equity: Several studies explicitly examine issues of inclusion and equity, showing that digital technology can be an important enabler of economic inclusion for marginalized groups such as women [10], people with disabilities [17], and smallholder farmers [2]. However, this inclusion does not occur automatically and requires policies and interventions that explicitly address the structural barriers faced by these groups.

Knowledge Gaps: Despite the rich evidence on the impacts and mechanisms of the digital economy, several knowledge gaps remain. First, most studies are cross-sectional or rely on short-term panel data, limiting understanding of the long-term impacts of the digital economy. Second, much of the literature focuses on Asia, particularly China and Southeast Asia, restricting the generalizability of findings to other geographic contexts. Third, the causal mechanisms underlying digital economy impacts require further exploration particularly the interactions among mechanisms and the contextual conditions that determine their effectiveness.

9. *Future Directions and Policy Recommendations*

Based on the synthesis of the literature, several future research directions and policy recommendations can be identified.

Future Research Directions:

First, long-term longitudinal studies are needed to understand the long-term impacts of the digital economy on the structural transformation of rural economies, including impacts on rural–urban migration, changes in employment structures, and the transformation of agricultural systems. Most of the reviewed studies use cross-sectional or short-term panel data, which limits the ability to identify long-term impacts and adaptation dynamics.

Second, cross-country and cross-context comparative studies are needed to understand the contextual conditions that determine the success of rural digitalization. Xia et al. (2024) and Xu et al. (2024) show significant spatial heterogeneity in the impacts of the digital economy [3], [4], but understanding of the factors explaining this heterogeneity remains limited. Systematic comparative research can help identify best practices and conditions that facilitate or hinder positive digital economy impacts.

Third, research on causal mechanisms and interactions among mechanisms is needed. The reviewed literature identifies various mechanisms through which the digital economy affects economic outcomes, but understanding of how these mechanisms interact and the conditions under which each mechanism is most effective remains limited. Experimental or quasi-experimental research that can identify causal effects more rigorously would be highly valuable.

Fourth, research on the impact of the digital economy on non-economic dimensions of welfare, such as health, education, social cohesion, and environmental sustainability, remains limited. Fan and Gan (2025) provide initial evidence of positive environmental impacts through improved fertilizer-use efficiency [5], but further research on environmental and social impacts is needed.

Fifth, research on the role of artificial intelligence and other advanced digital technologies in agriculture and rural development remains very limited. Melnychenko (2025) provides a theoretical analysis of the potential of AI to optimize sustainable production [14], but empirical evidence on the implementation and impacts of AI in rural contexts is still scarce.

Policy Recommendations

First, investment in rural digital infrastructure should be a policy priority. The literature consistently shows that limited digital infrastructure is a major barrier to the adoption and impact of digital technologies. Investment in internet connectivity, access to digital devices, and other supporting infrastructure is essential.

Second, policies on digital literacy and human capital development are needed to ensure that rural populations have the capacity to effectively utilize digital technologies. Le Thi Hoa Sen et al. (2024) and Sari et al. (2025) show the importance of education and training [2], [17]. Digital literacy training programs tailored to local contexts and the specific needs of target groups need to be developed.

Third, digital inclusion policies that explicitly address the digital divide and ensure that marginalized groups can access and benefit from digital technologies are crucial. Wang et al. (2025) show that without inclusion policies, the digital economy can exacerbate inequality [7]. Policies targeting low-income groups, women, people with disabilities, and other marginalized groups are needed.

Fourth, context-specific policy approaches are required. Xia et al. (2024) show significant spatial heterogeneity in digital economy impacts [4], indicating that one-size-fits-all policies are unlikely to be effective. Policies need to be tailored to initial conditions of digital infrastructure, local economic structures, and the characteristics of target populations.

Fifth, integration of digital policies with broader rural development policies is necessary. Wang et al. (2024) show that the digital economy has multiplier effects through technological innovation, industrial integration, and increased consumption [6]. To maximize these multiplier effects, digital policies need to be integrated with agricultural, industrial, education, and broader rural development policies.

Sixth, support for digital entrepreneurship and innovation in the agricultural and rural sectors is needed. Li et al. (2024) show that digital inclusive finance can promote innovation [9], and Ghouse and McElwee (2026) highlight the importance of supporting entrepreneurial self-efficacy [13]. Policies supporting access to finance, digital business incubation, and innovation ecosystems in rural areas need to be developed.

Seventh, systematic monitoring and evaluation of digital policy impacts are required. Zheng et al. (2025) provide an example of rigorous impact evaluation of rural e-commerce policy [16]. Systematic monitoring and evaluation systems can help identify effective policies, adjust implementation based on evidence, and ensure accountability.

CONCLUSION

10. Conclusion

This literature review synthesizes findings from 17 empirical studies examining various aspects of the digital economy in the context of rural and agricultural development. The reviewed evidence shows that the digital economy has transformative potential to increase income, productivity, and economic resilience of rural communities. Agricultural entrepreneurs who adopt e-commerce earn more than 30% higher income, rural e-commerce policies increase agricultural productivity by about 1.6%, and the use of the internet for agricultural information improves fertilizer-use efficiency by around 3.5% [1], [16], [5].

However, the literature also reveals that the impacts of the digital economy are highly heterogeneous and contextual. The benefits of the digital economy are not evenly distributed, and without adequate inclusion policies, it can exacerbate inequality both across regions and within rural populations [4], [7]. The digital divide in terms of infrastructure

access, digital literacy, and human capital remains a major barrier that needs to be addressed.

The digital economy affects rural economic outcomes through multiple interacting mechanisms, including employment effects, income diversification, market access, information access, financial access, technological innovation, and industrial integration [3], [6]. The success of rural digitalization depends not only on the technology itself but also on complementary factors such as human capital, infrastructure, institutional support, and social capital [2], [11], [13].

The policy implications emphasize the importance of investment in digital infrastructure, digital literacy programs, digital inclusion policies targeting marginalized groups, context-specific policy approaches, and integration of digital policies with broader rural development strategies. Digital technologies offer significant opportunities for transforming rural development, but realizing this potential requires comprehensive, inclusive, and evidence-based policies

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