

Digital leadership and green technology for sustainable smart community village transformation: An Islamic economics perspective in Indonesian villages

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ABSTRACT

Introduction

Digital transformation has become a strategic agenda for rural development, particularly in villages that seek to become adaptive, inclusive, and environmentally sustainable Smart Community Villages. However, previous studies have not fully explained how digital leadership drives village transformation through green technology, nor how competence shapes this relationship. In the context of an Islamic economics journal, this issue is also relevant to *maslahah*, *maqasid al-shariah*, stewardship, justice, and sustainable welfare.

Objectives

This study examines the effect of digital leadership on Smart Community Village transformation in Indonesia. It also analyzes the mediating role of green technology and the moderating role of competence in the relationship between digital leadership and sustainable village transformation.

Method

This study used an explanatory quantitative approach with a causal research design. Data were collected through a structured questionnaire from 167 village stakeholders, including village heads, village officials, community leaders, and local changemakers involved in digital transformation and sustainability initiatives. The research model was analyzed using Structural Equation Modeling with Partial Least Squares.

Results

The results show that digital leadership has a positive and significant effect on Smart Community Village transformation. Green technology

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also has a significant effect on Smart Community Village transformation and significantly mediates the relationship between digital leadership and village transformation. These findings indicate that digital leadership contributes to sustainable transformation not only directly, but also indirectly through environmentally responsible technological practices. However, competence does not significantly moderate the tested relationships, suggesting that its role may be more complex and context-dependent than a simple interaction effect.

Implications

The study implies that village transformation requires leadership capacity, green technology adoption, and systematic competence-building. Policy makers should integrate digital village programs with environmental innovation, digital literacy, inclusive governance, and Islamic economics principles that emphasize public welfare, justice, and ecological stewardship.

Originality/Novelty

This study contributes by integrating digital leadership, green technology, competence, and Smart Community Village transformation into a single empirical model while extending the discussion through an Islamic economics perspective on sustainable rural development.

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INTRODUCTION

The rapid expansion of digital technology has transformed the logic of rural development by reshaping public services, local governance, economic participation, and community-based innovation. Villages are no longer viewed merely as administrative units or agricultural spaces, but as socio-economic ecosystems that must respond to digital disruption, environmental pressure, and changing expectations of public accountability. In this context, the Smart Community Village has emerged as a strategic approach to sustainable rural development because it combines digital infrastructure, participatory governance, community empowerment, and environmental responsibility (Tosida et al., 2022; Zavrtnik et al., 2018). This approach is especially relevant for developing countries, including Indonesia, where digital transformation must address not only service efficiency but also rural inequality, uneven institutional capacity, and ecological vulnerability. Therefore, rural digitalization requires leadership that can integrate technological change with inclusive and sustainable development goals.



Recent literature increasingly emphasizes that Smart Community Village transformation depends on more than the availability of information and communication technology. It requires a governance capability that connects digital vision, institutional coordination, citizen participation, and sustainable resource management. Digital leadership is therefore central because it enables leaders to formulate a digital vision, mobilize stakeholders, encourage innovation, and guide organizational change in uncertain environments ([Alexandro & Basrowi, 2024](#); [Aziiza et al., 2023](#); [Aziiza & Susanto, 2020](#); [Sasmoko et al., 2019](#); [Tigre et al., 2023](#)). In rural contexts, digital leadership must operate across village, district, and community levels to ensure that technology supports public service delivery, local economic development, and social inclusion. Studies on smart villages also stress that digital transformation should be place-based and people-centered rather than technology-centered, since the legitimacy of transformation depends on its relevance to local needs and its ability to improve collective welfare ([Stojanova et al., 2021](#); [Zavratnik et al., 2018](#)).

Despite this growing attention, the main research problem lies in the limited understanding of how digital leadership produces sustainable village transformation. Existing studies often discuss digital leadership, smart governance, or green development separately, while fewer studies examine how these elements interact in one integrated empirical model. The literature also shows that rural digital governance remains uneven across regions, with no universally accepted framework for diagnosing digital leadership or comparing smart village outcomes across different institutional contexts ([T. Wang et al., 2024](#); [Y. Wang et al., 2024](#); [Wieliczko et al., 2021](#); [Xu et al., 2023](#)). This limitation is important because digital transformation in villages is affected by local leadership, infrastructure readiness, digital literacy, governance culture, and access to finance. Without a clearer model, policy recommendations risk becoming too general and may fail to explain why some villages transform successfully while others remain administratively digitalized but socially or environmentally underdeveloped.

A general solution proposed in recent scholarship is to position digital leadership as a strategic capability rather than a merely technical function. Digital leaders are expected to align technology adoption with poverty reduction, inclusive public services, climate resilience, and sustainable livelihoods. In Indonesia, evidence from smart village initiatives such as Banyuwangi, Banyumas, Karanganyar, Nagari governance contexts, and Bali suggests that village transformation is shaped by leadership, collaborative governance, stakeholder coordination, and local capacity-building ([Hamka et al., 2023](#); [Jayanthi et al., 2022](#); [Oktaviane et al., 2023](#); [Rokhman et al., 2023](#); [Wargadinata, 2021](#); [Yuniarta et al., 2023](#)). These studies indicate that digital leadership can improve governance capacity when it is embedded in multi-actor collaboration involving village governments, communities, private actors, and knowledge institutions. However, the literature also notes that much Indonesian evidence remains descriptive, leaving room for more explanatory research on the mechanisms through which digital leadership affects sustainable village outcomes.

A more specific solution is to examine green technology as the mechanism that connects digital leadership with sustainable Smart Community Village transformation.



Green technology refers to environmentally responsible technologies and practices, including renewable energy, energy efficiency, waste management, environmental information systems, and innovations that reduce ecological harm (Purwati et al., 2023; Shahbaz & Malik, 2025). From the perspective of Green IT, environmental leadership, and sustainability-oriented innovation, digital leadership creates the governance, knowledge, and coordination conditions that enable green technology adoption; green technology then converts digital governance into tangible environmental and social benefits (Koh et al., 2026; Le et al., 2024; Miranda et al., 2023; Taneja et al., 2023). This mediating role is theoretically important because it prevents digital transformation from being reduced to administrative efficiency and instead links it to ecological responsibility, sustainable productivity, and long-term rural resilience.

Another specific issue concerns competence as a potential condition that strengthens the effect of digital leadership and green technology. Competence includes digital literacy, managerial capability, social skills, problem-solving ability, and absorptive capacity, all of which influence whether village actors can understand, adopt, and sustain digital and green innovations (Chansukree et al., 2022; Guerrero, 2012; Khoeroni et al., 2023; Kristian et al., 2024; C. Sun et al., 2020). However, rural competence is often uneven because of disparities in infrastructure, education, generational experience, and access to training. Digital divide studies show that limited connectivity, affordability, and digital literacy can prevent rural communities from fully benefiting from digital public services and smart village programs (Enayati et al., 2024; Lu et al., 2024; Saputra et al., 2023). Therefore, competence must be examined not only as an individual attribute, but also as a governance-related capability shaped by local institutions and development inequalities.

The Islamic economics perspective further strengthens the relevance of this study for a journal concerned with ethical and welfare-oriented development. Islamic economics views development through the principles of *maslahah*, *maqasid al-shariah*, *khalifah*, *adl*, and sustainable welfare. These principles require public policy and economic transformation to protect life, intellect, wealth, social continuity, and moral order while preventing harm and ensuring justice (Asmar et al., 2023; Harahap et al., 2023; Jaafar & Brightman, 2022; Karimullah, 2023; Maulida et al., 2023; Mukhibad et al., 2020). From this perspective, digital leadership is not merely managerial competence, but an ethical responsibility to ensure that technology improves public welfare, expands fair access, protects the environment, and strengthens community resilience. Green technology can also be understood as a practical expression of ecological stewardship, while digital inclusion reflects distributive justice in access to knowledge, services, and economic opportunities.

Although prior studies have examined smart villages, digital leadership, green technology, and competence, important gaps remain. First, few studies integrate these variables into a single model that explains direct, mediating, and moderating relationships in village transformation. Second, limited empirical research has tested green technology as a mediating mechanism between digital leadership and sustainable Smart Community Village outcomes, especially in Indonesian rural

contexts. Third, the role of competence remains conceptually important but empirically uncertain, particularly because digital literacy and village capacity are uneven across rural communities. Fourth, the Islamic economics literature has not been sufficiently connected to rural digital transformation and green technology adoption, even though *maqasid al-shariah* and *maslahah* provide a strong normative foundation for sustainable and inclusive village development. These gaps justify a study that combines digital governance, environmental innovation, human competence, and Islamic welfare ethics.

This study aims to analyze the effect of digital leadership on Smart Community Village transformation, examine the mediating role of green technology, and assess whether competence moderates the relationships within this model. The novelty of this study lies in its integration of digital leadership, green technology, competence, and Smart Community Village transformation within an explanatory quantitative framework, while also positioning sustainable village development within an Islamic economics perspective. The study argues that digital leadership can directly enhance village transformation and indirectly strengthen it through green technology adoption. It also hypothesizes that competence may condition the effectiveness of digital leadership and green technology, although rural heterogeneity may shape this relationship. By focusing on Indonesian villages that have adopted or are adopting smart village initiatives, this study contributes to theoretical debates on rural digital governance and offers practical insights for ethical, inclusive, and environmentally sustainable village transformation.

LITERATURE REVIEW

Theoretical Foundations of Smart Community Village Transformation

Smart Community Village transformation can be understood through several complementary theoretical perspectives. The resource-based view and dynamic capabilities theory explain how villages use leadership, knowledge, routines, and institutional capacity as strategic resources to respond to technological and environmental change. Digital leadership enables rural institutions to sense digital opportunities, seize innovation pathways, and reconfigure governance arrangements for sustainable development. This view is relevant because village transformation requires more than technology adoption; it requires the capacity to integrate digital infrastructure, green innovation, and community participation into local development systems ([Abdul Rashid et al., 2023](#); [Astuti et al., 2025](#); [Cao et al., 2023](#); [Doloi, 2025](#); [Sarja et al., 2021](#)).

Multi-actor governance theory further explains why Smart Community Village transformation depends on collaboration among government, communities, private actors, universities, and civil society. Triple Helix and Quintuple Helix perspectives emphasize that innovation emerges from interaction among institutional actors rather than from isolated leadership initiatives. In rural contexts, such collaboration supports shared learning, legitimacy, financing, and co-creation of digital and environmental



solutions ([Abdillah et al., 2022](#); [Rosalia et al., 2024](#); [Stojanova et al., 2021](#); [Zavratnik et al., 2018](#)). These theories suggest that digital leadership becomes effective when it coordinates diverse stakeholders and links technology with social and ecological priorities.

Socio-technical systems theory also provides an important foundation because it views transformation as an alignment between technological systems and social arrangements. In a village setting, information technology, renewable energy, public service platforms, and environmental management tools must be embedded in local institutions, norms, skills, and governance practices. Technology alone cannot ensure transformation if it is not supported by legitimacy, learning, and inclusive participation. Therefore, Smart Community Village transformation should be treated as a socio-technical and sustainability-oriented process that connects digital governance, human competence, green technology, and public welfare ([Cambra-Fierro & Pérez, 2022](#); [Wijaya et al., 2023](#); [Xu et al., 2023](#)).

Digital Leadership in Rural Governance

Digital leadership refers to the ability of leaders to guide transformation through digital vision, innovation orientation, adaptive governance, and technology-enabled coordination. It is not limited to the technical use of digital tools, but includes the capacity to mobilize actors, redesign services, encourage experimentation, and manage organizational change in complex environments ([Antonopoulou et al., 2020](#); [Mei-jiao, 2025](#); [Rakovic et al., 2024](#); [Robertson et al., 2022](#); [Tigre et al., 2023](#)). In village governance, digital leadership is particularly important because village leaders are expected to translate national and regional digital agendas into locally meaningful programs that improve public services, citizen participation, accountability, and sustainable livelihoods.

Previous studies suggest that digital leadership strengthens innovation capability and supports the transition toward smart governance ([Cuevas-Vargas, 2025](#); [Fatimah et al., 2023](#); [Mihardjo et al., 2019](#); [Sasmoko et al., 2019](#)). In Indonesia, smart village experiences show that leadership at village and district levels can influence the effectiveness of digital service delivery, institutional readiness, and multi-stakeholder collaboration ([Jayanthi et al., 2022](#); [Kusumastuti et al., 2024](#); [Oktarina et al., 2023](#); [Rokhman et al., 2023](#); [Wargadinata, 2021](#)). This evidence indicates that digital leadership is a strategic governance capability, especially when leaders can align digital transformation with local welfare, environmental sustainability, and inclusive participation.

From a dynamic capabilities' perspective, digital leadership helps villages sense development problems, seize digital opportunities, and reconfigure resources to achieve transformation. Leaders with digital orientation can promote data-driven decision-making, integrate information systems into public services, and foster community learning. However, digital leadership must be understood as a relational capability rather than an individual trait. Its effectiveness depends on institutional coordination, citizen trust, infrastructure readiness, and the ability to involve local actors

in the transformation process (S. Liu & Wang, 2026; Y. Liu et al., 2024; Z. Liu et al., 2024; Rosalia et al., 2024; Y. Zhang & Liao, 2025).

Green Technology and Sustainability-Oriented Innovation

Green technology refers to environmentally responsible technologies and practices that reduce ecological harm and improve resource efficiency. It includes renewable energy, waste management, energy-efficient systems, green infrastructure, climate-smart production, and environmental information systems (Al-Husain et al., 2025; Lv & Shi, 2023; Purwati et al., 2023; Shahbaz & Malik, 2025; Voronkova et al., 2023). In village development, green technology is important because rural transformation should not merely digitize services, but also protect natural resources, reduce environmental risks, and improve quality of life. This makes green technology an essential component of sustainable Smart Community Village development.

Green IT, environmental leadership, and sustainability-oriented innovation provide theoretical support for placing green technology at the center of rural digital transformation. Green IT argues that information and communication technologies should be designed and used to reduce environmental costs and improve ecological performance. Environmental leadership literature shows that leaders can stimulate green innovation by shaping organizational values, resource allocation, and environmental commitment (Le et al., 2024; Nilam et al., 2024; Rasyid & Stepanus, 2024; Riaz et al., 2024; Y. Sun et al., 2023). Sustainability-oriented innovation further explains how product, process, and organizational innovation transform digital capacity into measurable environmental and social outcomes (Florek-Paszkowska & Ujwary-Gil, 2025; Santos et al., 2025; Umair et al., 2025; Van De Wetering et al., 2017).

In this study, green technology is conceptually positioned as a mediating mechanism between digital leadership and Smart Community Village transformation. Digital leaders may create the governance, knowledge, and collaborative conditions that enable green technology adoption, while green technology translates those conditions into concrete sustainability outcomes. Studies on digital rural development, green finance, and environmental performance suggest that digital governance can improve green productivity and environmental quality when supported by appropriate technology, financing, and institutional arrangements (Hu et al., 2023; Shen et al., 2023; Y. Sun et al., 2023; Tang & Chen, 2022).

Competence, Digital Literacy, and the Rural Digital Divide

Competence is generally understood as a combination of knowledge, skills, attitudes, and behavioral capabilities required to perform tasks effectively (Lamri & Lubart, 2023; Salman et al., 2020; Sass et al., 2020). In digital transformation, competence includes digital literacy, managerial ability, communication skills, problem-solving capacity, and absorptive capacity (Cyfert et al., 2025; Kahveci, 2025; Kozanoglu & Abedin, 2020; Pihlajamaa et al., 2023; Schiuma et al., 2024). At the village level, competence is necessary because digital and green technologies require users who can understand, operate, adapt, and sustain new systems. Without adequate competence, digital



platforms and green innovations may remain underused or fail to produce inclusive benefits.

However, competence in rural areas is shaped by the digital divide. The rural digital divide includes differences in infrastructure access, affordability, device ownership, digital literacy, and the capacity to benefit from technology. Studies in developing-country contexts show that limited connectivity, low digital literacy, unequal access, and socio-economic disparities can constrain digital service adoption and weaken the outcomes of smart village initiatives (Faozanudin et al., 2025; Ridzki, 2024; Sari, 2025). These constraints indicate that competence is not merely an individual attribute, but a socially and institutionally embedded condition.

The literature also suggests that competence may play different roles in transformation models. It may moderate the relationship between leadership and technology adoption when skilled actors strengthen the effect of leadership. Yet, competence may also operate as a mediator, prerequisite, or threshold condition. In heterogeneous villages, aggregate competence may not always strengthen digital leadership effects because infrastructure gaps, leadership dominance, and institutional arrangements can outweigh individual skill differences (Asmorowati et al., 2025; Priharjanto et al., 2023; Sihombing, 2021). Therefore, competence should be examined critically within village-specific socio-institutional contexts.

Smart Community Village Transformation

Smart Community Village transformation reflects the integration of digital technology, participatory governance, social inclusion, economic development, and environmental sustainability. It differs from narrow digitalization because it does not only emphasize online services or administrative efficiency. Instead, it seeks to develop a village ecosystem where information systems, public participation, local entrepreneurship, environmental management, and community welfare reinforce one another (Badri et al., 2025; Briyadi et al., 2025; Hendrawan & Perwitasari, 2025; Heripracoyo, 2026). This perspective aligns with the view that smart villages should be people-centered, place-based, and sustainable.

Smart village literature emphasizes that successful transformation depends on leadership, community participation, institutional readiness, and technology that responds to local needs (Aziiza & Susanto, 2020; Tosida et al., 2022; Zavratinik et al., 2018). Indonesian studies further show that village digitalization is shaped by collaborative governance, readiness assessment, local leadership, and multi-level coordination (Hamka et al., 2023; Jayanthi et al., 2022; Oktaviane et al., 2023; Rokhman et al., 2023; Yuniarta et al., 2023). These findings indicate that Smart Community Village transformation is best understood as an ecosystem-level process rather than a single administrative innovation.

The transformation process must also include environmental and social dimensions. Digital public services may improve efficiency, but sustainable village transformation requires green infrastructure, responsible resource use, inclusive access, and community empowerment. In this regard, green technology becomes a

bridge between digital governance and ecological sustainability. Competence and digital literacy are also essential because community members and village officials must be able to participate in and benefit from digital and green systems. Thus, Smart Community Village transformation requires the interaction of leadership, technology, competence, and institutional legitimacy.

Islamic Economics Perspective on Digital and Green Village Development

Islamic economics provides a normative framework for understanding sustainable rural development through *maslahah*, *maqasid al-shariah*, *khalifah*, *adl*, and sustainable welfare. *Maqasid al-shariah* emphasizes the protection and promotion of religion, life, intellect, lineage, and wealth, while *maslahah* requires development policies to maximize public welfare and minimize harm (Arifin et al., 2025; Izzati et al., 2025; Muharir et al., 2025; Muhlisah & YUSDANI, 2023; Wulandari et al., 2025). These principles are highly relevant to village digital transformation because technology should not be pursued only for efficiency, but for holistic welfare.

From this perspective, digital leadership can be understood as an ethical and developmental responsibility. Village leaders are expected to ensure that digital transformation promotes justice, transparency, inclusion, and public benefit. Green technology reflects the principle of *khalifah*, which frames humans as stewards responsible for protecting natural resources and preventing ecological harm. Equitable access to digital services is also connected to *adl* because digital transformation should not deepen inequality among rural communities. Therefore, Islamic economics strengthens the moral justification for integrating digital leadership, green technology, and competence in village development.

Islamic finance and governance literature also support environmentally responsible technology adoption. Instruments such as green *sukuk*, *waqf*-based funding, *zakat*-linked programs, Islamic social finance, and *Shariah*-aligned investment can provide ethical financing pathways for digital infrastructure and green technology in villages (Al Azizah & Haron, 2024; Faizi et al., 2024; Haji Wahab & Naim, 2020; Miftahorrozi et al., 2022). *Maqasid*-based measurement can also help evaluate whether digital village programs improve welfare, environmental quality, knowledge, and fair access. This framework makes Smart Community Village transformation compatible with Islamic economic objectives and sustainable development goals.

Relationships among the Main Constructs

The relationship between digital leadership and Smart Community Village transformation is supported by leadership, innovation, and digital governance literature. Digital leaders build vision, mobilize resources, coordinate stakeholders, and encourage the use of technology for public service and community development (Hendri & Setiyowati, 2025; Mulyani, 2024; Oktapiani, 2025; Susarianto, 2024). In rural contexts, this relationship becomes stronger when leadership is embedded in collaborative governance and responsive to local needs. Therefore, digital leadership is



expected to positively influence Smart Community Village transformation by improving governance capacity, innovation, and community participation.

The relationship between digital leadership and green technology is supported by Green IT and environmental leadership literature. Leaders with digital and sustainability orientation are more likely to promote environmentally responsible innovation, support resource-efficient technologies, and align digital infrastructure with ecological goals (Gan & Chu, 2025; Li & Fu, 2026; Nasrun et al., 2025). Digital leadership can create the institutional conditions for green technology adoption by encouraging learning, allocating resources, building partnerships, and legitimizing environmental initiatives. Thus, green technology can be viewed as an outcome of leadership-driven digital and ecological orientation.

The mediating role of green technology is theoretically plausible because it explains how digital leadership becomes environmentally meaningful. Digital leadership may improve governance and innovation, but green technology provides the practical mechanism through which transformation produces environmental and social benefits. Likewise, competence may strengthen transformation when village actors have sufficient digital, managerial, and social capabilities. However, competence may also be constrained by digital divide, infrastructure inequality, and village heterogeneity. These relationships justify an empirical model that tests direct, mediating, and moderating effects within Smart Community Village transformation.

Research Gap and the Significance of the Study

Although previous studies have examined digital leadership, green technology, competence, and smart village development, the literature remains fragmented. Many studies discuss digital governance or smart villages descriptively, while fewer test an integrated explanatory model that links leadership, environmental technology, human competence, and sustainable village transformation. Research on Indonesian villages also remains limited in explaining how digital leadership produces environmental outcomes through green technology. In addition, Islamic economics has rarely been used to interpret digital and green rural transformation, despite its relevance to welfare, justice, stewardship, and ethical development.

This study is significant because it integrates digital leadership, green technology, competence, and Smart Community Village transformation into a single empirical framework. It contributes theoretically by positioning green technology as a mediating mechanism and competence as a moderating condition in rural digital transformation. It also expands the discussion by incorporating Islamic economics principles, particularly *maslahah* and *maqasid al-shariah*, as a normative foundation for sustainable village development. Practically, the study offers insights for policymakers, village leaders, and development actors seeking to promote inclusive, environmentally responsible, and ethically grounded Smart Community Village transformation in Indonesia.

METHOD

Research Design

This study employed an explanatory quantitative approach with a causal research design. This design was selected because the study aimed to examine the direct, indirect, and interaction effects among the main constructs in the transformation of villages toward a sustainable Smart Community Village. The proposed model tested the effect of Digital Leadership as the independent variable on Smart Community Village Transformation as the dependent variable. Green Technology was positioned as a mediating variable, while Competence was examined as a moderating variable. This approach was considered appropriate because the research model involved multiple relationships that required simultaneous statistical testing. The explanatory design also enabled the study to assess whether digital leadership contributes to village transformation directly and whether its effect is transmitted through environmentally responsible technological practices.

Research Context and Population

The study was conducted in several Indonesian villages that had adopted or were in the process of adopting Smart Village programs. The research context was selected to reflect villages that were already exposed to digital governance practices and sustainability-oriented initiatives. The selected villages met three criteria: they had adopted digital technology in village governance, they were active in environmental sustainability programs, and they had local changemakers who encouraged digital initiatives. The research was implemented over a twelve-month period, covering instrument development, questionnaire testing, field data collection, data processing, statistical analysis, report preparation, and publication planning. The population consisted of key village-level stakeholders directly involved in digital transformation and sustainability programs, including village heads, village officials, community leaders, and community-based actors who facilitated citizen participation.

Sampling Technique and Respondent Profile

The study used purposive sampling because the research required respondents who had direct knowledge of village governance, digital transformation, and sustainability initiatives. This technique was suitable because the target respondents were not ordinary village residents, but actors involved in decision-making, policy implementation, or community mobilization. A total of 167 respondents participated in the study. This number was considered adequate for Structural Equation Modeling–Partial Least Squares because the model contained mediation and moderation effects. The respondents represented relevant stakeholder groups in village transformation, including village heads as strategic decision-makers, village officials as implementers of digital policies, and community leaders or local changemakers as facilitators of social participation. This composition strengthened the relevance of the data because the respondents were positioned close to the phenomenon being examined.



Research Variables and Measurement

The study measured four main constructs: Digital Leadership, Green Technology, Competence, and Smart Community Village Transformation. Digital Leadership was measured through indicators related to digital vision, technological innovation, digital transformation orientation, and adaptive capability. Green Technology was measured through the use of renewable energy, environmentally friendly waste management, energy-saving technology, and environmental innovation. Competence was assessed through digital, managerial, social, and problem-solving capabilities. Smart Community Village Transformation was measured through indicators covering digital public services, citizen participation, technological infrastructure, and social and environmental sustainability. These constructs were aligned with the conceptual framework of the study, which viewed village transformation as the result of leadership capacity, green innovation, and human capability.

Data Collection Procedure

Primary data were collected using a structured closed-ended questionnaire. The questionnaire used a five-point Likert scale to capture respondents' perceptions of each construct and its indicators. This format was selected because it enabled standardized measurement across respondents and allowed the data to be analyzed quantitatively. Before the main data collection, the instrument was prepared and tested to ensure that the items were understandable and appropriate for the village context. The field data collection process was directed toward respondents who met the purposive sampling criteria. Since the study examined perceptions of leadership, technology, competence, and village transformation, the questionnaire was designed to capture both institutional and behavioral aspects of digital village development.

Data Analysis Technique

The data were analyzed using Structural Equation Modeling–Partial Least Squares with the latest version of SmartPLS. SEM-PLS (Ringle et al., 2024) was selected because it is suitable for examining complex models involving direct effects, mediation, and moderation. It is also appropriate for predictive and explanatory models in social science research, especially when the objective is to assess relationships among latent constructs. In addition to SEM-PLS, descriptive analysis was conducted using SPSS to summarize respondent characteristics. The analytical procedure consisted of two main stages: measurement model evaluation and structural model evaluation. This sequence ensured that the validity and reliability of the constructs were assessed before testing the hypothesized relationships among variables.

Measurement Model Evaluation

The measurement model was evaluated to ensure that the research instrument met validity and reliability requirements. Convergent validity was assessed using factor loading and Average Variance Extracted, with AVE values expected to exceed 0.50. Reliability was evaluated through Composite Reliability and Cronbach's Alpha, with acceptable values expected to exceed 0.70. Discriminant validity was also examined to

ensure that each construct was empirically distinct from the others. These procedures were important because the constructs, especially Digital Leadership, Green Technology, Competence, and Smart Community Village Transformation, represented multidimensional concepts. Establishing measurement quality was therefore necessary before drawing conclusions from the structural relationships in the model.

Structural Model, Mediation, and Moderation Testing

After the measurement model met the required criteria, the structural model was assessed by examining R^2 , Q^2 , path coefficients, and the significance of relationships among variables. Bootstrapping was used to test the statistical significance of the hypothesized paths. The mediation analysis examined whether Green Technology transmitted the effect of Digital Leadership on Smart Community Village Transformation. This was evaluated through the indirect effect and Variance Accounted For. The moderation analysis examined whether Competence strengthened or weakened the relationship between Digital Leadership and Smart Community Village Transformation, including pathways involving Green Technology. Depending on data distribution and model requirements, the moderation test used either the two-stage approach or the product indicator approach. This analytical strategy allowed the study to test the theoretical model comprehensively.

RESULTS

Respondent Profile

The study involved 167 respondents who represented key stakeholders in village-level digital transformation and sustainability initiatives. The demographic profile shows that the respondents were relatively balanced in terms of gender, although male respondents were slightly dominant. Of the total respondents, 91 were male, representing 54.49 percent, while 76 were female, representing 45.51 percent. This composition indicates that the study captured perspectives from both male and female stakeholders involved in Smart Community Village transformation. Although the male group was larger, the difference was not substantial enough to suggest a highly unequal gender distribution. Therefore, the respondent profile provides a reasonably balanced picture of stakeholder participation in village governance, digital leadership, green technology implementation, and community-based transformation.

In terms of education, the majority of respondents held a bachelor's degree, accounting for 135 respondents or 80.83 percent of the sample. Respondents with senior high school education accounted for 17 individuals or 10.17 percent, while those with a master's degree accounted for 15 respondents or 8.98 percent. This distribution indicates that most respondents had a relatively strong educational background, which is important for a study concerning digital leadership, green technology, competence, and smart village transformation. A higher level of education may support better understanding of digital governance, environmental sustainability, and institutional change, although education alone does not necessarily guarantee technical competence or digital readiness.

Table 1*Respondent Demographics (N = 167)*

Respondent Profile	Category	Frequency	Percentage
Gender	Male	91	54.49%
	Female	76	45.51%
Education	Senior High School	17	10.17%
	Bachelor's Degree	135	80.83%
	Master's Degree	15	8.98%
Age	25–35 years old	59	35.32%
	36–45 years old	70	41.91%
	46–55 years old	38	22.75%

Source: Primary data. Authors' estimation.

The age distribution shows that most respondents were in the productive and professionally mature age groups. The largest group consisted of respondents aged 36–45 years, with 70 respondents or 41.91 percent. This was followed by respondents aged 25–35 years, with 59 respondents or 35.32 percent, and respondents aged 46–55 years, with 38 respondents or 22.75 percent. This composition suggests that the sample was dominated by actors who were likely to be actively involved in village administration, community leadership, or local development initiatives. Overall, the demographic profile reflects a relevant respondent base for examining Smart Community Village transformation because the respondents were educationally prepared, socially active, and positioned within productive age categories.

Measurement Model Evaluation

The measurement model was evaluated by examining factor loading, Composite Reliability, and Average Variance Extracted. The results show that all retained indicators had factor loading values above the recommended threshold of 0.70. This indicates that each item had adequate convergent validity and was able to represent its respective latent construct. Digital Leadership was measured by four indicators, with factor loading values ranging from 0.770 to 0.853. Green Technology was measured by seven indicators, with factor loading values ranging from 0.717 to 0.784. Competence was measured by seven indicators, with factor loading values ranging from 0.795 to 0.871. Smart Community Village Transformation was measured by twelve indicators, with factor loading values ranging from 0.744 to 0.883.

Table 2*Validity and Reliability Results*

Variable	Item	Factor Loading	Composite Reliability	AVE
Digital Leadership	D5	0.825	0.893	0.677
	D7	0.853		
	D8	0.841		
	D9	0.770		
Green Technology	D11	0.749	0.894	0.547

Variable	Item	Factor Loading	Composite Reliability	AVE
	D12	0.749	0.935	0.674
	D13	0.722		
	D14	0.717		
	D18	0.736		
	D19	0.729		
	D20	0.784		
	D22	0.795		
Competence	D24	0.848	0.935	0.674
	D25	0.848		
	D27	0.831		
	D28	0.871		
	D30	0.828		
	D31	0.804		
	D41	0.817	0.967	0.711
Smart Community Village Transformation	D42	0.842		
	D43	0.882		
	D44	0.866		
	D45	0.798		
	D46	0.844		
	D47	0.883		
	D48	0.845		
	D49	0.880		
	D50	0.744		
	D51	0.866		
	D52	0.838		

Source: Primary data. Authors' estimation.

The reliability results further confirm that all constructs met the recommended internal consistency criteria. The Composite Reliability value for Digital Leadership was 0.893, Green Technology was 0.894, Competence was 0.935, and Smart Community Village Transformation was 0.967. All these values exceeded the threshold of 0.70, indicating that the indicators consistently measured their respective constructs. The highest Composite Reliability was found in Smart Community Village Transformation, suggesting strong consistency among its indicators. Competence also showed high reliability, indicating that the items measuring digital, managerial, social, and problem-solving capabilities were internally consistent. These results provide evidence that the measurement instrument was reliable for subsequent structural model testing.

The Average Variance Extracted values also met the recommended minimum value of 0.50. Digital Leadership had an AVE of 0.677, Green Technology had an AVE of 0.547, Competence had an AVE of 0.674, and Smart Community Village Transformation had an AVE of 0.711. These values indicate that each construct explained more than half of the variance in its indicators. Although Green Technology had the lowest AVE among the four constructs, its value remained above the acceptable threshold, confirming adequate convergent validity. Thus, the measurement model demonstrated sufficient

validity and reliability, meaning that the indicators were appropriate for testing the structural relationships among Digital Leadership, Green Technology, Competence, and Smart Community Village Transformation.

Structural Model and Path Analysis

The structural model was examined to determine the direct effects among the main constructs. The first direct path tested the effect of Digital Leadership on Smart Community Village Transformation. The result showed a positive and significant effect, with an estimated correlation of 0.113, a t-value of 2.492, and a p-value of 0.013. This result indicates that stronger digital leadership contributes to higher levels of Smart Community Village Transformation. Although the coefficient is relatively modest, the relationship is statistically significant, suggesting that digital leadership plays a meaningful role in shaping the transformation process. This finding supports the argument that digital vision, innovation orientation, and adaptive leadership are important factors in village-level digital and sustainable development.

Table 3

Path Analysis Results

Construct	Estimated Correlation	t-Value	p-Value
Digital Leadership → Smart Community Village Transformation	0.113	2.492	0.013
Green Technology → Smart Community Village Transformation	0.154	2.355	0.019
Digital Leadership → Green Technology	0.546	11.913	0.000
Digital Leadership → Green Technology → Smart Community Village Transformation	0.084	2.334	0.020
Moderating Effect 1 → Smart Community Village Transformation	-0.017	0.331	0.741
Moderating Effect 2 → Smart Community Village Transformation	0.002	0.037	0.971
Moderating Effect 3 → Green Technology	0.028	1.103	0.270

Source: Primary data. Authors' estimation.

The second direct path tested the effect of Green Technology on Smart Community Village Transformation. The result was positive and significant, with an estimated correlation of 0.154, a t-value of 2.355, and a p-value of 0.019. This finding indicates that the adoption of green technology contributes significantly to village transformation. In practical terms, environmentally friendly practices such as renewable energy use, green waste management, energy-saving technologies, and environmental innovation are associated with stronger transformation outcomes. This result confirms that Smart Community Village development should not be interpreted only as administrative digitalization or public service modernization. Instead, it should include ecological sustainability as a core element of rural transformation.

The strongest direct relationship in the model was found between Digital Leadership and Green Technology. The estimated correlation was 0.546, with a t-value of 11.913 and a p-value of 0.000. This result shows that digital leadership has a strong and statistically significant effect on green technology adoption. The finding suggests that leaders with strong digital orientation are more capable of encouraging environmentally responsible technological practices in village governance and community development. This may occur because digital leaders tend to promote innovation, coordinate resources, build partnerships, and integrate environmental considerations into digital transformation agendas. Therefore, Digital Leadership is not only associated with Smart Community Village Transformation directly, but also with the enabling conditions required for Green Technology implementation.

Mediation and Moderation Results

The mediation test examined whether Green Technology mediated the relationship between Digital Leadership and Smart Community Village Transformation. The indirect effect was positive and significant, with an estimated correlation of 0.084, a t-value of 2.334, and a p-value of 0.020. This result confirms that Green Technology serves as a significant mediating variable in the model. In other words, digital leadership contributes to Smart Community Village Transformation partly by promoting the adoption of environmentally friendly technologies. This finding strengthens the conceptual argument that digital transformation becomes more sustainable when leadership is able to connect digital innovation with ecological responsibility. Green Technology therefore functions as a practical mechanism through which digital leadership generates sustainable transformation.

The moderation tests showed different results. The first moderating effect on Smart Community Village Transformation had an estimated correlation of -0.017, a t-value of 0.331, and a p-value of 0.741. The second moderating effect on Smart Community Village Transformation had an estimated correlation of 0.002, a t-value of 0.037, and a p-value of 0.971. The third moderating effect on Green Technology had an estimated correlation of 0.028, a t-value of 1.103, and a p-value of 0.270. Since all p-values were above 0.05, the moderation effects were not statistically significant. These findings indicate that Competence did not significantly strengthen or weaken the tested relationships in the structural model.

Overall, the results demonstrate three key empirical findings. First, Digital Leadership has a significant direct effect on Smart Community Village Transformation. Second, Green Technology significantly influences Smart Community Village Transformation and mediates the effect of Digital Leadership. Third, Competence does not show a statistically significant moderating role in the model. These results indicate that leadership and green technology are central drivers of sustainable village transformation, while competence may require further investigation as a direct predictor, mediator, or context-dependent capability rather than as a simple moderator. The findings provide empirical support for the view that Smart Community



Village development requires the integration of digital leadership and environmentally responsible technology.

DISCUSSION

Digital Leadership and Smart Community Village Transformation

The findings show that Digital Leadership has a positive and significant effect on Smart Community Village Transformation. This result indicates that village transformation is not driven only by the availability of digital technology, but also by the ability of leaders to formulate a digital vision, coordinate resources, promote innovation, and guide institutional adaptation. In the context of Indonesian villages, digital leadership appears to function as an enabling capability that supports digital public services, citizen participation, technological infrastructure, and social-environmental sustainability. Although the path coefficient is modest, its statistical significance suggests that leadership remains an important driver of rural digital transformation.

This finding is consistent with previous studies that position digital leadership as a central factor in digital transformation and innovation management. [Antonopoulou et al. \(2020\)](#) and [Tigre et al. \(2023\)](#) emphasize that digital leadership involves the capacity to direct organizations toward technology-based change. [Mihardjo et al. \(2019\)](#) and [Sasmoko et al. \(2019\)](#) also show that digital leadership strengthens innovation capability. In the smart village literature, leadership has been linked to improved digital governance, public service transformation, and multi-actor collaboration in Indonesian contexts, including Banyuwangi and other digital village initiatives ([Aziiza & Susanto, 2020](#); [Jayanthi et al., 2022](#); [Wargadinata, 2021](#)).

Theoretically, this finding reinforces the relevance of dynamic capabilities theory in explaining village transformation. Digital leaders help villages sense technological opportunities, seize innovation pathways, and reconfigure governance arrangements for sustainable development. Practically, the result implies that village digitalization programs should not focus only on infrastructure procurement, but must also strengthen leadership capacity, digital vision, and adaptive governance. From a policy perspective, central and regional governments should design training and mentoring programs for village leaders so they can manage digital platforms, build partnerships, and align village transformation with sustainable welfare objectives.

Green Technology as a Driver of Sustainable Village Transformation

The results also show that Green Technology has a positive and significant effect on Smart Community Village Transformation. This finding confirms that smart village development should not be reduced to digital administration or online service delivery. Instead, village transformation becomes more meaningful when it incorporates environmentally responsible technologies, such as renewable energy, waste management, energy-saving systems, and environmental innovation. Green Technology contributes to sustainability by linking digital governance with ecological responsibility. Therefore, the transformation of a Smart Community Village requires a

balance between technological modernization, environmental protection, and community welfare.

This result supports prior research on green technology and sustainability-oriented innovation. [Shahbaz & Malik \(2025\)](#) argue that environmentally responsible innovation is important for improving environmental performance and competitive advantage. [Purwati et al. \(2023\)](#) also show that green technology can support business and sustainability outcomes. The broader Green IT and sustainability-oriented innovation literature similarly views green technologies as mechanisms that translate digital capabilities into environmental benefits ([Koh et al., 2026](#); [Miranda et al., 2023](#); [Taneja et al., 2023](#)). These findings are also compatible with studies on digital rural construction and green productivity, which show that digitalization can support environmental improvement when accompanied by green innovation ([Hu et al., 2023](#); [Shen et al., 2023](#); [Tang & Chen, 2022](#)).

The implication is that Smart Community Village policies must integrate digital transformation and green development into one coherent agenda. Theoretically, the finding expands smart village literature by showing that environmental technology is not an additional element, but a core determinant of village transformation. Practically, village governments should prioritize green infrastructure, digital environmental monitoring, energy efficiency, and sustainable waste management. At the policy level, digital village programs should be connected to green finance, environmental incentives, and climate-resilient rural development strategies. Without green technology, digital transformation may improve administrative efficiency but fail to deliver long-term sustainability.

The Mediating Role of Green Technology

The mediation analysis confirms that Green Technology significantly mediates the relationship between Digital Leadership and Smart Community Village Transformation. This means that digital leadership influences village transformation not only directly, but also indirectly by encouraging the adoption of environmentally responsible technologies. Leaders with strong digital orientation are more likely to build institutional readiness, mobilize resources, and coordinate stakeholders for green innovation. Green Technology then becomes the practical mechanism through which digital leadership produces sustainable outcomes. This finding strengthens the argument that ecological innovation is a central pathway in digitally driven rural transformation.

This result is supported by Green IT, environmental leadership, and sustainability-oriented innovation literature. Green IT explains that digital systems can become instruments for environmental efficiency when they are designed to reduce ecological harm. Environmental leadership studies show that green-oriented leaders stimulate green innovation and environmental performance ([Cai et al., 2020](#); [S. Zhang et al., 2025](#); [Zhong et al., 2025](#)). Sustainability-oriented innovation literature further explains that product, process, and organizational innovations mediate the relationship between digital capabilities and sustainability outcomes ([Miranda et al., 2023](#); [Taneja et al., 2023](#)). Indonesian smart village studies also indicate that leadership and collaborative



governance create the conditions for green and digital diffusion ([Hamka et al., 2023](#); [Jayanthi et al., 2022](#); [Wargadinata, 2021](#)).

Theoretically, this finding contributes by positioning Green Technology as an explanatory bridge between digital leadership and sustainable village transformation. It clarifies the mechanism through which leadership becomes environmentally meaningful. Practically, village leaders should not treat green technology as a separate environmental project, but as an integral component of digital transformation. Policy makers should therefore design smart village programs that explicitly include renewable energy, green public services, environmental data systems, and circular economy initiatives. The mediation result also suggests that leadership development must include environmental literacy and green innovation management.

The Non-Significant Moderating Role of Competence

The study finds that Competence does not significantly moderate the relationships among Digital Leadership, Green Technology, and Smart Community Village Transformation. This result indicates that competence, as measured in this model, did not strengthen or weaken the tested relationships. The finding does not mean that competence is irrelevant. Rather, it suggests that competence may not function effectively as a simple interaction variable in the present village context. Digital, managerial, social, and problem-solving capabilities may influence transformation through other pathways, such as direct effects, mediation, readiness, or threshold mechanisms.

This finding can be explained by rural digital divide and competence literature. Studies show that competence in rural areas is often uneven because of differences in digital literacy, infrastructure access, education, affordability, and institutional support ([Enayati et al., 2024](#); [Lu et al., 2024](#); [Saputra et al., 2023](#)). In Indonesian villages, leadership dominance, heterogeneous village capacity, and infrastructure gaps may obscure the moderating effect of competence. Competence may also be too broad as a construct if it combines digital literacy, managerial capability, and social skills into one measure. [Priharjanto et al. \(2023\)](#), [Sihombing \(2021\)](#), and [Asmorowati et al. \(2025\)](#) suggest that competence-related constructs require careful contextual specification.

Theoretically, the non-significant result invites a more nuanced model of competence in rural digital transformation. Future studies may test competence as a mediator, antecedent, threshold condition, or component of absorptive capacity rather than only as a moderator. Practically, the finding suggests that competence-building remains necessary even if it does not show a significant moderating effect. Policy makers should design targeted digital literacy, managerial training, and green technology capacity-building programs for different village actors. Such programs should be differentiated by age, education, role, and infrastructure readiness to avoid assuming that all villages have the same competence base.

Islamic Economics Interpretation of the Findings

From an Islamic economics perspective, the findings can be interpreted through the principles of *maslahah*, *maqasid al-shariah*, *khalifah*, *adl*, and sustainable welfare. The significant role of Digital Leadership indicates the importance of ethical and responsible leadership in guiding technological change toward public benefit. The significant effect and mediating role of Green Technology reflect the principle of ecological stewardship, because technology is used to reduce harm and protect resources. The non-significant moderating role of Competence also highlights the need for equitable access to skills and knowledge so that digital transformation does not reproduce rural inequality.

This interpretation aligns with Islamic economics literature that views development as the pursuit of holistic welfare, not merely material growth. *Maqasid al-shariah* emphasizes the protection of religion, life, intellect, lineage, and wealth, while *maslahah* requires public policy to maximize benefit and minimize harm (Harahap et al., 2023; Jaafar & Brightman, 2022; Karimullah, 2023; Maulida & Ali, 2023; Mukhibad et al., 2020). Islamic green finance and ESG-related literature also show that environmental protection, justice, and ethical governance can be integrated into development financing and institutional practice (Adirestuty et al., 2025; Dewi & Muhyarsyah, 2025; Hadi et al., 2025; Mohd Zain et al., 2024).

Theoretically, the Islamic economics perspective broadens the interpretation of Smart Community Village Transformation by connecting digital and green development with welfare, justice, and stewardship. Practically, it encourages village leaders to design digital programs that improve public services, protect the environment, and ensure fair access for all community groups. At the policy level, the findings support the development of Shariah-aligned rural financing instruments, such as Islamic green finance, *waqf*-based funding, and *zakat*-linked initiatives for digital infrastructure and green technology. This perspective strengthens the ethical foundation of sustainable smart village development.

Integrated Implications for Smart Community Village Development

Taken together, the findings indicate that Smart Community Village Transformation is shaped primarily by Digital Leadership and Green Technology. Digital Leadership provides the strategic direction and institutional coordination necessary for change, while Green Technology translates this leadership into environmentally sustainable outcomes. Competence, although theoretically important, did not significantly moderate the model, suggesting that its role may be indirect or context-dependent. This integrated pattern shows that village transformation requires leadership, ecological innovation, and human capability, but these elements may not operate in the same statistical manner.

These findings are consistent with smart village and rural governance studies that emphasize leadership, multi-actor collaboration, and sustainability-oriented innovation as central to successful transformation (Rosalia et al., 2024; Stojanova et al., 2021; Zavrtnik et al., 2018). However, they also qualify competence-based assumptions by showing that human capability does not automatically strengthen the effects of



leadership and technology. This contrasts with studies that view competence as a strong moderator of digital transformation, but it aligns with literature suggesting that governance structures, infrastructure readiness, and digital divide conditions can shape or obscure competence effects (Enayati et al., 2024; Saputra et al., 2023).

The implication is that smart village policy should be designed as an integrated ecosystem rather than a collection of separate programs. Theoretically, this study contributes a model that connects digital leadership, green technology, competence, and sustainable rural transformation. Practically, village governments need leadership development, green technology adoption, digital literacy programs, and participatory governance mechanisms. Policy makers should also develop diagnostic tools to assess village readiness, digital divide conditions, competence gaps, and environmental priorities. Such integrated policies can support Smart Community Villages that are digitally capable, environmentally responsible, socially inclusive, and aligned with ethical welfare principles.

CONCLUSION

This study examined the role of Digital Leadership in promoting Smart Community Village Transformation, with Green Technology as a mediating variable and Competence as a moderating variable. The findings demonstrate that Digital Leadership has a positive and significant effect on Smart Community Village Transformation, indicating that village transformation requires more than the availability of digital infrastructure. It depends on leaders who can formulate a digital vision, coordinate stakeholders, encourage innovation, and guide institutional adaptation. The results also show that Green Technology significantly contributes to Smart Community Village Transformation, confirming that sustainable rural digitalization must integrate environmental responsibility, not merely administrative modernization or online public service delivery.

A key finding of this study is that Green Technology significantly mediates the relationship between Digital Leadership and Smart Community Village Transformation. This result suggests that digital leadership becomes more effective when it is translated into environmentally responsible technological practices, such as renewable energy use, energy-efficient systems, green waste management, and environmental innovation. Conversely, Competence does not significantly moderate the tested relationships. This finding does not imply that competence is unimportant, but indicates that its role may be more complex than a simple moderating effect. Competence may operate through direct, mediating, threshold, or context-dependent pathways shaped by digital divide, infrastructure readiness, and village heterogeneity.

This study contributes to the literature by integrating Digital Leadership, Green Technology, Competence, and Smart Community Village Transformation into a single explanatory model. It also enriches smart village studies by emphasizing that green technology is a crucial mechanism linking leadership and sustainable transformation. From an Islamic economics perspective, the study highlights the relevance of

masalah, maqasid al-shariah, khalifah, adl, and sustainable welfare in guiding ethical rural digital transformation. Future studies should examine alternative roles of competence, include broader village-level contextual variables, and apply longitudinal or comparative designs to better explain how digital leadership and green technology produce inclusive, environmentally responsible, and welfare-oriented village transformation.

Limitation of the Study

This study has several limitations that should be acknowledged. First, the research used a cross-sectional quantitative design, which limits the ability to infer long-term causal relationships among Digital Leadership, Green Technology, Competence, and Smart Community Village Transformation. Although SEM-PLS is appropriate for testing complex relationships involving mediation and moderation, the data capture respondents' perceptions at one point in time. Therefore, the study cannot fully explain how leadership practices, green technology adoption, and competence development evolve across different stages of village transformation. Future interpretation of the findings should consider this temporal limitation, especially because digital transformation and sustainability initiatives often require gradual institutional learning and long-term implementation.

Second, the study relied on purposive sampling with 167 respondents from villages that had adopted or were adopting Smart Village programs. This sampling strategy was suitable for targeting relevant stakeholders, but it may limit the generalizability of the findings to all Indonesian villages. Village contexts vary considerably in infrastructure, governance capacity, digital literacy, social capital, leadership style, and access to financing. In addition, competence was measured as a broad construct, which may have obscured the specific effects of digital competence, managerial capability, absorptive capacity, and social competence. These limitations suggest that the non-significant moderation result should be interpreted cautiously and contextually.

Recommendations for Future Research

Future research should develop more refined models to examine the role of Competence in Smart Community Village Transformation. Rather than treating Competence only as a moderating variable, subsequent studies may test it as a mediator, antecedent, threshold condition, or part of a moderated mediation model. Researchers should also disaggregate competence into more specific dimensions, such as digital literacy, managerial competence, green technology capability, absorptive capacity, and community facilitation skills. This approach would provide a clearer understanding of which forms of competence matter most in rural digital and green transformation. Longitudinal designs are also recommended to capture the gradual development of competence and institutional learning over time.

Future studies should also expand the contextual scope of the model by including variables such as digital divide, infrastructure readiness, village financial capacity,

community participation, social innovation, institutional trust, and policy support. Comparative research across provinces, village typologies, or levels of digital maturity would help explain whether the relationships found in this study are consistent across different rural environments. In addition, future research may incorporate Islamic economics more explicitly by developing maqasid-based indicators for evaluating digital inclusion, environmental stewardship, public welfare, and justice in village development. Such research would strengthen the ethical and theoretical foundations of Smart Community Village studies, especially in Muslim-majority rural contexts.

Author Contributions

Conceptualization	A.G., D.H.K., W., & N.S.	Resources	A.G., D.H.K., W., & N.S.
Data curation	A.G., D.H.K., W., & N.S.	Software	A.G., D.H.K., W., & N.S.
Formal analysis	A.G., D.H.K., W., & N.S.	Supervision	A.G., D.H.K., W., & N.S.
Funding acquisition	A.G., D.H.K., W., & N.S.	Validation	A.G., D.H.K., W., & N.S.
Investigation	A.G., D.H.K., W., & N.S.	Visualization	A.G., D.H.K., W., & N.S.
Methodology	A.G., D.H.K., W., & N.S.	Writing – original draft	A.G., D.H.K., W., & N.S.
Project administration	A.G., D.H.K., W., & N.S.	Writing – review & editing	A.G., D.H.K., W., & N.S.

All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

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Informed Consent Statement

Informed consent was obtained before respondents answered questions for this study.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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Conflicts of Interest

The authors declare no conflicts of interest.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work the authors used ChatGPT, Grammarly, and PaperPal in order to translate from Bahasa Indonesia into American English, and to improve clarity of the language and readability of the article. After using these tools, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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