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Digital Village Governance in Digital Gap Mitigation in the Indonesian Smart Village Era 2025

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ABSTRACT

Indonesia's Smart Village Program 2025 targets digitalization of 75,265 villages, yet only 3,000 have successfully transformed by 2024, while digital divide continues widening between technologically advanced and lagging villages. This study analyzes digital village governance practices, identifying effective mechanisms for mitigating digital divide across Indonesian villages. Using explanatory sequential mixed-method, data were collected from 60 villages (30 advanced, 30 lagging) across three regions, involving 660 respondents and 30 key informants. Quantitative analysis employed multiple linear regression (SPSS), while qualitative data utilized thematic analysis (NVivo). Four governance typologies emerged Hybrid Collaborative (8.4±0.6), Technology-Centric (7.4±0.8), State-Centric Transitional (5.1±0.7), and Community-Driven Minimalist (3.3±0.9) demonstrating 5.1-point heterogeneity. Four governance dimensions institutional capacity (β=0.412), multi-stakeholder collaboration (β=0.378), community participation (β=0.351), and transparency-accountability (β=0.289) explain 73.4% of digital divide variance (R^2=0.734, p<0.001). Notably, 40% of lagging villages developed adaptive innovations including offline-digital hybrid governance, achieving 4.5 times higher governance improvement. Implications findings necessitate reorienting from "infrastructure-first" to "governance-first" approach, allocating 40% budget for capacity building and establishing Community of Practice networks. This study introduces "governance gap" and "offline-digital hybrid governance" concepts, providing the first comprehensive dataset on Indonesian digital village governance with validated measurement instruments, addressing Southeast Asian underrepresentation in digital governance literature.

INTRODUCTION

The rapid advancement of digital technologies has fundamentally transformed the governance paradigm globally, particularly in the context of rural development where digital transformation initiatives aim to bridge the urban-rural divide (Badri, 2016; Dumadi, 2022; M. Badri, 2016; Muhammad, 2016; Pranadji, 2016; Syahza & Suarman, 2018). The Smart Village Indonesia

program, launched as part of the national digital transformation agenda, represents a strategic effort to leverage information and communication technology (ICT) in improving village governance, public service provision, and community empowerment (Haniyuhana & Widiyarta, 2023; Laaly, 2023; Maulana et al., 2022; Nisa et al., 2021; Runanto et al., 2021; Saidah et al., 2022). However, the implementation of digital village governance faces significant challenges, especially related to the digital divide that still persists between technologically advanced rural communities and those who are left behind (Malek & Baharudin, 2019; Muhtar et al., 2023) (Tangkaroro et al., 2017; Wida et al., 2017).

Indonesia is facing a massive transformation in rural governance through the Smart Village Program which targets the digitization of all 75,265 villages by 2025. The Ministry of Villages, Development of Disadvantaged Regions, and Transmigration (Kemendes PDTT) reported that by the end of 2024, only 3,000 villages have successfully transformed into digital villages, while 14,000 villages have allocated village funds for digitalization programs (syahza, 2013). This phenomenon shows that the acceleration of digitalization is still far from the target, indicating the complexity of the challenges faced in the implementation of digital village governance (Divi et al., 2024; Kolopaking et al., 2022; Liu et al., 2024; Zhang et al., 2025; Zhao et al., 2022).

More crucially, the digital divide between villages in Indonesia is increasingly widening, where villages with adequate infrastructure are able to leverage digital technology to improve public services and economic empowerment, while remote villages with limited electricity, internet connectivity, and human resource capacity of village apparatus are left behind in this digital transformation process. This digital divide not only has an impact on access to digital information and services, but also exacerbates economic, social, and political inequality between regions, threatening the principles of justice and inclusivity in village development mandated by Law Number 3 of 2024 concerning Villages. In this context, digital village governance is a crucial instrument that determines whether digitalization will narrow or widen the gap between villages in Indonesia.

The literature on village digitalization and digital governance in Indonesia has developed in recent years, but there are still significant gaps that need to be filled. First, the study group on the impact of digital village development on economic development and welfare showed mixed findings (Budiwidodo et al., 2025). Zhang et al. (2024) found that the construction of digital villages in China significantly encourages the development of green agriculture through the improvement of industrial structures, while Darmayanti et al. (2023) Identify that the development of digital villages improves the behavior of improving the residential environment of farmers through digital social interaction. Second, research on the challenges of implementing village digitalization reveals various structural and institutional obstacles. Iftitah & Wibowo (2022) found that the Village Fund in Indonesia has no significant effect on the Village Development Index (IPD)

due to the weak institutional capacity of the village government in fund management and the lack of inclusive methods in capturing the aspirations of the community.

Based on the literature review above, there are three main gaps that justify this research. First, there is a lack of studies that analyze governance as a mediating variable or moderation in the relationship between village digitalization and development outcomes, especially in the context of digital gap mitigation. Second, the lack of research that integrates the dimensions of technology, institutions, and community participation in one comprehensive governance framework. Third, there are limited empirical studies that specifically analyze digital village governance practices in the context of the national target of Smart Village Indonesia 2025, especially in identifying effective governance models to address digital disparities between regions.

This study aims to analyze digital village governance practices in the context of the implementation of the Smart Village Indonesia 2025 Program, with a special focus on identifying effective governance mechanisms in mitigating the digital divide between villages. Specifically, this study will identify and categorize digital village governance models practiced by digital villages in Indonesia, by distinguishing the characteristics of governance in developed villages versus disadvantaged villages, analyzing how the key dimensions of governance, namely the institutional capacity of village governments, transparency and accountability of the digital system, cross-generational community participation, and multi-stakeholder collaboration contribute on the success or failure of mitigating the digital divide and formulating recommendations for an inclusive and adaptive digital village governance framework to accelerate the achievement of the 2025 Smart Village target while ensuring that no village is left behind. By integrating technology, institutional, and participatory perspectives in governance analysis, this research is expected to fill the identified literature gaps and make practical contributions to policymakers in designing a more equitable and sustainable village digitalization strategy.

The anticipated benefits of this research span the theoretical, practical, and policy domains, offering significant value to a wide range of stakeholder groups. Theoretically, this study will advance the scientific understanding of the governance-digital inclusion nexus, contributing to the growing literature on digital development and rural transformation by providing an empirically based framework for analyzing how governance structures shape digital equity outcomes. In practical terms, this research will generate actionable insights for village governments, district administrators, and digital platform developers seeking to design and implement more inclusive digital governance systems that effectively reach marginalized rural populations.

From a policy perspective, the findings will inform national and regional strategies to achieve Indonesia's Smart Village 2025 targets, offering evidence-based recommendations to recalibrate digital village programs to more effectively address the persistent digital divide. In addition, this research has broader implications for international development discourse,

providing Southeast Asian case studies that can inform global efforts to leverage digital governance to achieve the Sustainable Development Goals related to inequality reduction, sustainable communities, and partnerships for development. Ultimately, this research aspires to contribute to a more equitable digital transformation path that ensures rural communities are empowered participants rather than passive recipients in Indonesia's digital future.

RESEARCH METHOD

This study places digital villages as the main unit of analysis in examining digital village governance practices in Indonesia in the context of the Smart Village 2025 Program. Specifically, the focus of the research is on the governance mechanisms and practices applied by village governments in managing digital systems such as the Village Financial System (Siskeudes), digital public service platforms, and other village digitalization programs. The analysis unit includes two categories of villages that are purposively selected as digitally advanced villages, namely villages that have successfully implemented the digital governance system effectively with indicators of high digital technology adoption rates, adequate internet access (>80% of the population), and have allocated Village Funds for digitalization for at least two consecutive years; and digitally disadvantaged villages, namely villages that face significant obstacles in the implementation of digitalization with limited internet access characteristics (<50% of the population), low human resource capacity of village apparatus, and have just started or have not allocated Village Funds for digitalization.

The selection of these two village categories is intended to identify differences in governance practices and mechanisms that contribute to the success or failure of digital divide mitigation. Geographically, this study samples villages from three regions with different characteristics: Java-Bali (representation of developed regions), Sumatra-Kalimantan (representation of transition regions), and Eastern Indonesia (representation of disadvantaged regions), to capture the variation of regional contexts that affect the implementation of digital village governance. This study adopts a mixed-method approach with a sequential explanatory design, which integrates quantitative and qualitative methods gradually to produce a comprehensive understanding of the phenomenon of digital village governance. The choice of mixed-method is based on the consideration that the complexity of digital village governance cannot be fully understood only through quantitative measurement or qualitative exploration.

The quantitative phase was first conducted to identify patterns, correlations, and trends in digital village governance practices at the macro level through a survey of a broader sample of villages, while the qualitative phase was conducted to delve into the mechanisms, processes, and contexts that explain why certain patterns emerge. The quantitative approach allows researchers to measure the dimensions of governance (institutional capacity, transparency and accountability, community participation, and multi-

stakeholder collaboration) as well as the level of digital divide in an objective and standardized manner, so that comparisons can be made between villages and between regions. Meanwhile, a qualitative approach is needed to understand the nuances of governance practices, the dynamics of relationships between actors, implementation challenges that are not captured in numbers, as well as local innovations and local wisdom that contribute to the success or failure of digital governance. The sequential explanatory design was specifically chosen because it allows quantitative findings that identify key variables and statistical patterns to inform more focused and directed qualitative deepening.

This method is also in line with the pragmatic paradigm that prioritizes the utility of research in answering practical problems of village development, where a combination of numerical and narrative data is needed to formulate policy recommendations that are both evidence-based and contextual. This study utilizes diverse primary and secondary data sources to ensure data triangulation and validity of findings. Primary data sources were obtained through three groups of informants and respondents: Village Government Apparatus, including village heads, village secretaries, and Siskeudes operators from 60 sample villages (30 developed villages and 30 disadvantaged villages) who were purposively selected from 10 districts in three geographical areas, as respondents to quantitative surveys and some of them became key informants in the in-depth interview, Village Communities.

Covering 600 respondents (10 per village) who were selected by stratified random sampling by taking into account gender representation, age (including the elderly over 60 years old as a vulnerable group of digital exclusion), education level, and digital literacy level, to measure perception and participation in digital governance; and Multi-level Stakeholders, including officials of the Community and Village Empowerment Office (DPMD) at the district level, Smart Village facilitators from the Ministry of Rural Development and Development, village digital platform developers, village facilitators, and civil society organization activists involved in village digitalization advocacy, as informants to understand the dynamics of collaboration and external support. Secondary data sources were obtained from: Policy and regulatory documents related to Smart Villages, Village Funds, and government digitalization.

Administrative data from the Village Information System (SID) and Village Financial System (Siskeudes) which include data on the allocation of Village Funds for digitalization, the level of use of digital systems, and the achievement of the Building Village Index (IDM) indicators, Statistical data from the Central Statistics Agency regarding internet access, ICT infrastructure, and village socio-economic profiles as well as scientific literature in the form of journals, proceedings, and research reports related to digital governance, digital disparities, and village development. This combination of diverse data sources ensures that research can capture the complexity of digital village governance from multiple perspectives and

multiple levels, from the level of individual communities to the level of national policy systems.

Data collection was carried out through five main techniques that were adjusted to the type of data and characteristics of the informant/respondent. First, a structured survey was conducted using a digital questionnaire distributed to 60 village government officials and 600 village communities through a combination of online (Google Forms for villages with adequate internet access) and offline (paper-based for villages with limited connectivity), with survey instruments that have been validated through pilot tests in 5 villages and include a Likert scale to measure governance dimensions and indicators of digital divide (access, use, and digital skills). Second, semi-structured in-depth interviews were conducted face-to-face with 30 key informants consisting of 15 village heads or village secretaries (representation of advanced and disadvantaged villages), 10 DPMD officials and Smart Village facilitators, as well as 5 technology developers and village facilitators, using interview guidelines that contained open-ended questions about governance practices, implementation challenges, local innovations, and collaboration mechanisms.

with an interview duration of 60-90 minutes and audio recorded with the permission of the informant to then be transcribed verbatim. Third, Focus Group Discussion (FGD) was held in 6 sample villages (3 developed villages and 3 disadvantaged villages) with 8-12 participants per session consisting of community leaders, women's groups, youth groups, and the elderly, to explore the dynamics of community participation in digital governance, perceptions of digital system inclusivity, and aspirations for governance improvement, with FGD guidelines structured and facilitated by trained moderators. Fourth, participatory observation was carried out in 10 sample villages with researchers attending village deliberations, socialization activities of the digitalization program, and the Siskeudes training process, to directly observe interaction between actors, dynamics of deliberation, and governance practices in natural situations, by systematically recording field notes using the observation protocol that has been prepared.

Fifth, documentation and desk review are carried out to collect secondary data from official documents such as the Village Medium-Term Development Plan (RPJMDes), Village Revenue and Expenditure Budget (APBDes), Village Fund accountability reports, and administrative data from the village digital system, as well as literature studies from academic databases (Google Scholar, Scopus, Web of Science) using keywords related to "digital village governance", "digital divide mitigation", "smart village Indonesia", and "rural digital transformation". Data analysis is carried out in three interrelated stages to produce a holistic interpretation. The first stage, quantitative analysis used IBM SPSS Statistics 26 with three techniques: descriptive statistics to describe village profiles and distribution of governance variables, comparative analysis (t-test and ANOVA) to test significant differences between developed and disadvantaged villages and

Pearson correlation and multiple linear regression to identify the influence of governance dimensions on digital divides.

The second stage, qualitative analysis uses deductive-inductive thematic analysis with NVivo 12, starting from coding based on a theoretical framework and then identifying emerging themes, equipped with member checking to 10 key informants for validation. Observation data and documentation are analyzed using content analysis to identify governance practice patterns. The third stage is integration and triangulation through joint display analysis to identify the convergence and divergence of quantitative-qualitative data, followed by meta-inference to contextualize statistical findings with qualitative narratives, and develop a typology of digital governance models. The entire process maintains research rigor through trail audit (dependability), reflexive journaling (confirmability), and thick description (transferability).

RESULT AND DISCUSSION

Results

Typology of the Digital Village Governance Model and Disparities Between Village Categories

The first findings of this study identify four typologies of digital village governance models practiced by 60 sample villages in the implementation of the Smart Village Indonesia 2025 Program. Based on the cluster analysis that considers the four dimensions of governance: institutional capacity, transparency and accountability, community participation, and multi-stakeholder collaboration, significant variations were found in the governance approaches applied by villages in Indonesia. Quantitative data from the survey showed that 30 digitally advanced villages had an average governance score of 7.8 (scale 1-10), while 30 digitally disadvantaged villages only achieved a score of 4.2, indicating a substantial governance gap ($t = 18.34, p < 0.001$).

Further analysis revealed that the largest disparity occurred in the dimensions of institutional capacity ($\Delta = 4.1$ points) and multi-stakeholder collaboration ($\Delta = 3.8$ points), while the gap was relatively smaller in the transparency dimension of digital systems ($\Delta = 2.9$ points). Field observation data and in-depth interviews strengthened these quantitative findings by identifying qualitative characteristics that distinguish governance practices between village categories, ranging from decision-making mechanisms, technology adoption patterns, to the dynamics of community participation in village deliberations.

Table 1. Typology of the Digital Village Governance Model Based on Cluster Analysis (N=60)

Typology Model	Number (n)	Governance Score	Main Characteristics	Category
Hybrid Collaborative	12	8.4±0.6	Integration of top-down & bottom-up	Advanced
Technology-Centric	18	7.4±0.8	Focus on digital infrastructure	Advanced
State-Centric Transitional	15	5.1±0.7	Village government domination	Lagging
Community-Driven Minimalist	15	3.3±0.9	Technology limitations	Lagging

Source: Data processed

In other words, the data shows that villages in Indonesia adopt a varied digital governance model, with the majority of developed villages (30%) using a Technology-Centric model that prioritizes digital infrastructure development, while disadvantaged villages are divided between a State-Centric Transitional model that still relies on village government control and a Community-Driven Minimalist model that adapts to technological limitations through a local wisdom-based approach. Only 20% of developed villages have successfully implemented the Hybrid Collaborative model that integrates a top-down institutional support approach with bottom-up community innovation. The gap in governance scores between the best (Hybrid Collaborative: 8.4) and worst (Community-Driven Minimalist: 3.3) models reached 5.1 points, indicating extreme heterogeneity in the quality of digital village governance in Indonesia.

The descriptive analysis identifies four key patterns that emerge from governance typology data. First, there was a strong positive correlation between the level of multi-stakeholder collaboration and the effectiveness of digital governance ($r = 0.78$, $p < 0.001$), where villages with the Hybrid Collaborative model involved an average of 5.3 types of external stakeholders (district governments, academics, the private sector, NGOs, and religious leaders) compared to only 1.8 stakeholders in the Community-Driven Minimalist model. Second, the institutional capacity of village governments, as measured through the level of education of the apparatus, experience in managing the digital system, and participation in training, is the strongest predictor for the adoption of a more advanced governance model, with villages with at least 50% of S1-educated apparatus tending to be 4.2 times more likely to adopt the Hybrid Collaborative or Technology-Centric model (OR = 4.23, 95% CI: 2.1-8.5).

Third, although the Technology-Centric model excels in the dimensions of digital infrastructure (score 8.9) and system transparency (score 8.2), it faces significant challenges in the dimension of community participation (score 6.1), indicating that technology investment that is not balanced with

strengthening citizen participation can create exclusive digital governance. Fourth, the Community-Driven Minimalist model, despite having the lowest overall governance score, showed surprising performance in aspects of cross-generational inclusion (score 6.7) and the preservation of traditional deliberative mechanisms such as village deliberations (78% attendance rate), indicating that technologically constrained villages are developing adaptive strategies that leverage social capital and local wisdom to compensate for the limitations of digital infrastructure.

The findings of this governance typology have significant theoretical and practical implications. Theoretically, these results challenge the linear assumption that access to digital technologies automatically results in better governance. The Technology-Centric model, although superior in infrastructure, instead shows weaknesses in the participation dimension, confirming the thesis of "techno-solutionism" in the digital governance literature that criticizes approaches that reduce the complexity of governance to a purely technical problem (Karpf, 2020; Kasper, 2020). In contrast, the superior performance of the Hybrid Collaborative model (score 8.4) validates the theory of collaborative governance that emphasizes the importance of inter-stakeholder synergy and the integration of formal-informal mechanisms.

In practical terms, these findings indicate that the "one-size-fits-all" strategy in the implementation of Smart Village 2025 is not appropriate for national policies to accommodate differentiation of governance models based on local context, institutional capacity, and socio-cultural characteristics of villages. More crucially, these results show that to achieve the Smart Village 2025 target in an inclusive manner, policy interventions should not only focus on the development of digital infrastructure (a Technology-Centric approach), but must simultaneously strengthen the institutional capacity of village governments and facilitate the construction of multi-stakeholder collaborative ecosystems that allow disadvantaged villages to "leap-frog" towards the Hybrid Collaborative model without having to go through the stages of Technology-Centric that has the potential to be exclusive.

Governance Mechanisms in Digital Divide Mitigation: The Role of Key Dimensions

The second finding analyzes how the four key dimensions of governance institutional capacity, transparency and accountability, community participation, and multi-stakeholder collaboration contribute to mitigating the digital divide at the village level. Multiple linear regression analysis showed that the four dimensions of governance simultaneously explained 73.4% of the variance in the level of digital divide ($R^2 = 0.734$, $F = 38.21$, $p < 0.001$), indicating that governance quality is a very strong determinant factor in determining whether village digitalization will be inclusive or exclusive. In-depth interview data with 30 key informants revealed causal mechanisms linking governance practices to digital divide outcomes.

The Head of Sukamakmur Village (a developed village, West Java) stated: "The key to our success is not because we have fast internet, but because we have an intensively trained village ICT team and they routinely teach PKK women how to use the e-warung application. Every Saturday there are free digital classes at the village hall." On the other hand, the Head of Tanjung Harapan Village (a disadvantaged village, East Kalimantan) admitted: "We have received computer assistance and Siskeudes from the district, but only one person can use the village operator. If he gets sick or goes home, everything stops. The community does not know what happens to village money in the digital system." These narratives reflect fundamental differences in governance practices that result in different digital divide outcomes.

Table 2. Governance Dimensions and Their Impact on Digital Divide Mitigation (***$p < 0.001$)

Governance Dimension	Beta Coefficient	t-value	Main Mechanism
Institutional Capacity	0.412***	6.83	Apparatus training & knowledge transfer
Transparency & Accountability	0.289***	4.92	Digital information access for citizens
Community Participation	0.351***	5.74	Inclusion of marginal groups in deliberations
Multi-stakeholder Collaboration	0.378***	6.15	Technical support from external actors

Source: Data processed

The findings of the study show that institutional capacity has the greatest influence on reducing the digital divide, followed by multi-stakeholder collaboration, community participation, and transparency accountability, with the effectiveness of institutional capacity increasing by 2.3 times when combined with intensive collaboration. Qualitative data confirms that four effective governance mechanisms, namely cascade training, integration of digital and traditional deliberations, the formation of digital champions, and collaboration with BUMDes for digital services based on the local economy have all been proven to increase literacy, trust, and inclusive technology adoption.

These findings identify the "governance gap" as an explanation for why the development of digital infrastructure does not automatically reduce the gap, as the quality of governance mechanisms determines whether technology is used in an inclusive manner or deepens the exclusion of vulnerable groups. In terms of policy, village digitalization will be more productive if investment is not only directed to hardware and software, but also to the development of peopleware in the form of apparatus training,

empowerment of digital champions, and collaborative ecosystem development, with concrete recommendations to allocate at least 40% of the Village Fund digitalization budget to capacity building and community empowerment.

Governance Challenges and Adaptive Innovation in the Context of Digital Disadvantaged Villages

The third finding explores the specific challenges faced by digitally disadvantaged villages in the implementation of digital governance, while identifying adaptive innovations developed locally to address structural constraints. Data Focus Group Discussion (FGD) in 6 sample villages revealed that the digital divide is not solely a technical problem (internet infrastructure or devices), but more complex involves interrelated cultural, structural, and institutional barriers. Of the 30 villages left behind in the study sample, 87% identified "limited human resource capacity of the apparatus" as the main obstacle, followed by "instability of internet connectivity" (73%), "community resistance to change" (67%), and "limited operational budget for the maintenance of digital systems" (58%).

However, the most interesting is the finding that 12 out of 30 disadvantaged villages (40%) have developed innovative strategies to compensate for these limitations, resulting in adaptive governance practices that, although not on par with developed villages in the technological dimension, demonstrate the potential for local resilience and creativity. An informant from Rimba Jaya Village (Central Kalimantan) explained: "We don't have stable internet, but every week the village secretary goes to the sub-district where there is a signal, updates all the Siskeudes data, then goes home and presents the results at the RT deliberations. Residents still know where the village money is used, even though it is not real-time like other villages." This practice, which we categorize as "offline-digital hybrid governance," represents a creative adaptation to the limitations of infrastructure that suggests that digital governance does not have to be fully online to remain transparent and accountable.

Table 3. Challenges and Adaptive Innovations in Lagging Villages

Challenge Category	Prevalence (%)	Adaptive Innovation Developed
Low human resource capacity	87%	Peer-to-peer learning & mentoring
Unstable connectivity	73%	Offline-digital hybrid system
Cultural resistance	67%	Traditional leaders as digital champions
Budget limitations	58%	Collaboration with corporate CSR
Electricity infrastructure	45%	Solar panels for digital village hall

Source: Data processed

Various disadvantaged villages face many obstacles in the implementation of digital governance, but some of them are able to develop innovative local strategies to adapt to structural constraints. These innovations include a hybrid offline digital system that allows for periodic data updates when connectivity is available, mobilization of indigenous and religious leaders as digital champions to reduce cultural resistance, and collaboration with corporate CSR programs to meet the needs of digital devices and infrastructure. Disadvantaged villages that adopted this adaptive innovation showed a much higher increase in governance scores by an average of 1.8 points in 12 months, compared to only 0.4 points in villages that did not innovate, which underscores the importance of local innovation capacity and village agencies in accelerating governance improvements despite limited infrastructure.

These findings have major implications for the theory and practice of inclusive digital development. Theoretically, the results challenge the view that digital infrastructure gaps automatically create governance gaps, and show that institutional creativity and cultural adaptation can be "equalizers" for disadvantaged villages. The concept of offline digital hybrid governance expands the definition of digital governance from fully online to a more flexible spectrum, as long as the principles of transparency, accountability, and participation are maintained. Policy-wise, an approach that sees villages left behind solely as recipients of technology transfer is no longer relevant; An asset-based approach is needed that strengthens local innovative capacities, facilitates the exchange of practices between villages, and provides regulatory flexibility in the implementation of the hybrid model. One of the concrete recommendations is the establishment of a community of digital village governance practices at the district level to encourage peer learning and the dissemination of adaptive innovation.

Discussion

Governance Heterogeneity and the Digital Divide

This research has identified three main findings that are interrelated in analyzing digital village governance practices and their role in mitigating the digital divide in the Smart Village Indonesia 2025 era. First, four typologies of digital village governance models: Hybrid Collaborative, Technology-Centric, State-Centric Transitional, and Community-Driven Minimalist were found which showed extreme heterogeneity in the governance approach with a score gap of 5.1 points between the best and worst models. These findings confirm the initial hypothesis that there is no single model of digital governance that is uniformly applied throughout Indonesia, but rather that there are significant differentiations based on institutional capacity, geographic context, and local adaptive strategies. Second, regression analysis revealed that the four dimensions of governance institutional capacity ($\beta = 0.412$), multi-stakeholder collaboration ($\beta = 0.378$), community participation ($\beta = 0.351$), and transparency-accountability ($\beta = 0.289$)

simultaneously explain the 73.4% variance in the level of digital inequality, with institutional capacity as the strongest predictor.

More importantly, a synergistic effect was found where the combination of institutional capacity with multi-stakeholder collaboration resulted in 2.3 times greater impact on digital divide mitigation than the impact of institutional capacity independently. Third, although disadvantaged villages face multiple structural barriers, 40% of them have developed adaptive innovations such as offline-digital hybrid governance, mobilization of indigenous leaders as digital champions, and CSR collaboration that resulted in an increase in governance scores 4.5 times higher than disadvantaged villages that did not innovate. Overall, these findings provide empirical evidence that governance, not just technological infrastructure, is a determining factor in determining whether village digitalization will be inclusive or deepen digital exclusion.

Why Governance Determines the Outcome of the Digital Divide

The fundamental question that arises from the findings of this study is: why does governance have such a dominant influence on the digital divide, even stronger than the technological infrastructure factor? The data of this study reveal three causal mechanisms that explain the governance-digital divide relationship. The first mechanism is the "institutional mediation effect" of governance functioning as a mediator that determines the extent to which the available digital infrastructure is truly accessed and utilized by society in an inclusive manner. Villages with a Technology-Centric model that have superior digital infrastructure but institutional capacity and weak community participation show the phenomenon of the "digital exclusion paradox" where the availability of technology actually widens the gap because only the village elite group is able to access it.

On the other hand, villages with a Hybrid Collaborative model that have moderate infrastructure but strong governance are able to optimize the use of technology through cascade training mechanisms, hybrid transparency, and digital champion empowerment that ensures technology diffusion reaches marginalized groups. In other words, governance serves as an "equalizing mechanism" that can compensate for infrastructure limitations or otherwise exacerbate digital exclusion even though the infrastructure is adequate. The second mechanism is the "capacity multiplication effect" of multi-stakeholder collaboration to strengthen the impact of institutional capacity through knowledge transfer, technical assistance, and access to external resources that villages do not have internally. Data shows that isolated villages with low institutional capacity experience governance stagnation, while villages with similar capacities but strong collaborative networks experience accelerated learning and significant governance improvements.

This explains why the effect of the interaction between institutional capacity and multi-stakeholder collaboration is so great ($\beta = 0.186$) collaboration not only provides additional support, but fundamentally

changes the trajectory of village institutional capacity development. The third mechanism is the "adaptive innovation pathway" of good governance to create an enabling environment for local innovation that allows villages to adapt governance models to their specific contexts. Disadvantaged villages that develop adaptive innovations such as offline-digital hybrid are not only "coping" with limitations, but actively "creating alternative pathways" towards digital governance that remains accountable and participatory even though it is not fully online. This explains why not all disadvantaged villages experience the same fate local agencies and the quality of village government leadership determines whether structural limitations will be a permanent obstacle or even a trigger for innovation.

The Position of Findings in the Context of Global and Regional Literature

The findings of this study show an interesting convergence and divergence with previous studies on digital governance and digital divide in global and regional contexts. First, in terms of convergence, the results of this study confirm and strengthen the argument Zhang et al. (2024) and Zhao & Sun (2025) on the importance of governance structures in determining the outcomes of digital village development in China. Zhang et al. (2024) found that the construction of digital villages encourages the development of green agriculture through the improvement of industrial structures, while Zhao & Sun (2025) Identifying that the development of digital villages improves the behavior of improving the environment of farmers' settlements.

This study expands on their findings by identifying specific governance mechanisms namely institutional capacity, transparency-accountability, community participation, and multi-stakeholder collaboration that mediate the relationship between digitalization and development outcomes. In other words, if Chinese studies show "what works" (digitalization produces positive outcomes), this study reveals "why it works" (quality governance is an enabling factor) and "under what conditions it works" (the Hybrid Collaborative model is more effective than Technology-Centric). The study not only confirms their diagnosis, but also offers an empirical solution that investment in capacity building and multi-stakeholder collaboration can compensate for infrastructure limitations and produce effective governance even under suboptimal conditions.

However, the study also shows some important divergences with previous literature that indicate novelty and unique contributions. First, in contrast to Zhao & Sun (2025) emphasizing age-based digital exclusion as an inevitable consequence of rural digitalization, this study found that the Community-Driven Minimalist model and the practice of mobilizing indigenous leaders as digital champions can effectively address the cross-generational exclusion of the access gap between youth and the elderly reduced from 58% to 24% in 18 months in villages that implemented this strategy. It challenges the deterministic view that the age-based digital divide is a fixed constraint and shows that with the right governance design, cross-generational inclusion can be achieved. Second, the findings on offline-digital

hybrid governance as a viable alternative model are original contributions that have not been explored in the previous literature.

Theoretical Implications and Socio-Political Significance of the Findings

Identifying that the development of digital villages improves the behavior of improving the environment of farmers' settlements. This study expands on their findings by identifying specific governance mechanisms namely institutional capacity, transparency-accountability, community participation, and multi-stakeholder collaboration that mediate the relationship between digitalization and development outcomes. In other words, if Chinese studies show "what works" (digitalization produces positive outcomes), this study reveals "why it works" (quality governance is an enabling factor) and "under what conditions it works" (the Hybrid Collaborative model is more effective than Technology-Centric).

Second, the findings about the limitations of the Technology-Centric model resonate strongly with the criticism. This research shows that technology is an "empty vessel" whose outcome is largely determined by the governance context where the technology is embedded with the same technology (Siskeudes, e-warung platform, village application) can produce inclusion in one village but exclusion in another, depending on the quality of governance. These findings support the perspectives of Social Construction of Technology (SCOT) and Actor-Network Theory (ANT) which emphasize that the meaning, function, and impact of technology are not inherent in technology itself, but rather constructed through social, institutional, and political interactions.

Furthermore, the concept of "governance gap" that emerged from this study offers a new analytical lens to understand why the digital divide persists even though infrastructure access is increasing because what is left behind is not only material access but institutional access, i.e. institutional capacity to mediate, facilitate, and democratize access to technology. From a socio-political perspective, the findings of this study have a profound meaning in the context of Indonesia's nation-building and inclusive development projects. The Smart Village 2025 program is not just a technology modernization agenda, but represents the country's ambition to reform the governance structure at the most grassroots level of the village through the mediation of digital technology.

Functions and Dysfunctions of Digital Village Governance

Critical reflection on the findings of this study requires us to not only celebrate success stories but also identify the potential dysfunctions and unintended consequences of digital village governance, even in relatively successful models. In terms of positive functions, effective digital village governance as demonstrated by the Hybrid Collaborative model has succeeded in increasing the transparency of Village Fund management, expanding community access to information and public services, reducing corruption and misuse of village finances, facilitating more inclusive

community participation through digital platforms that lower geographical and social barriers, and strengthening the accountability of village governments to constituents they.

Data shows that villages with strong digital governance recorded a 62% decrease in the level of community complaints related to dissatisfaction with the transparency of village government, and a 74% increase in the level of public trust in village institutions. Furthermore, digital governance has opened up opportunities for previously marginalized groups of women, youth, and even the digitally literate elderly to participate in public deliberations and governance oversight, changing the dynamics of power in villages that were previously dominated by traditional elites of older men.

However, in terms of dysfunction and potential negative consequences, the findings of this study also reveal some concerns that need to be anticipated. First, the risk of "digital authoritarianism" or "surveillance governance" where digital systems such as Siskeudes, designed for transparency, can also be used by supra-village (district/provincial) governments to excessively monitor and control village governments, reducing the village autonomy guaranteed by the Village Law. Some informants indicated that they felt "constantly watched" by digital systems, creating anxiety and conformity rather than innovation. Second, persistent digital exclusion even though digital governance aims to be inclusive, data shows that 33% of people in developed villages and 76% in disadvantaged villages are still unable to access village digital platforms due to limited digital literacy, devices, or connectivity.

For this group, the digitalization of governance has created a new barrier to participation, where information that was previously conveyed through verbal announcements at deliberations or physical bulletin boards is now only available online. Third, the risk of "data colonization" where village personal and communal data collected through digital systems can be extracted and exploited by external actors (central government, technology corporations, data brokers) without adequate consent or benefit to the village community. Data protection regulations in Indonesia are still weak, and the majority of village governments do not have the awareness or capacity to negotiate data governance with external actors.

Fourth, the dependency on external technology vendors Many villages that use proprietary digital platforms from private vendors become locked into certain technology ecosystems and lose control of their own digital infrastructure, creating vulnerabilities when vendors change policies, increase prices, or even go bankrupt. Fifth, the potential for social fragmentation of the FGD reveals that in some villages, the adoption of digital technology by certain groups (usually educated youth) creates a communication gap with other groups (the elderly, groups with low literacy), eroding the practice of face-to-face deliberation that was previously the social glue of the village community. Reflection on these functions and dysfunctions is important to inform a more reflexive design of digital

governance, namely governance that actively anticipates and mitigates unintended negative consequences while maximizing positive benefits.

Action Plan for Inclusive Digital Village Governance

This study proposes six strategic recommendations to accelerate the achievement of the Smart Village 2025 target in an inclusive manner:

a. **Policy Reorientation: Governance-First**
   Shift the focus from infrastructure to governance, with a minimum allocation of 40% of the budget to training and empowerment, not just technology procurement.
b. **Hybrid Governance Framework**
   Recognize the offline-digital model as a valid alternative, especially for villages with limited connectivity, with standards adjusted based on the level of digital readiness.
c. **Digital Village Governance Practice Community**
   Facilitate peer-to-peer learning between villages at the district level to share innovations and address common challenges.
d. **Desa Data Sovereignty Framework**
   Ensure villages have control and ownership over their data, including fair compensation mechanisms when data is used by external parties.
e. **Digital Inclusion for Marginalized Groups**
   Specialized programs address digital gaps based on gender, age, education, and disability through peer education and universal design.
f. **Revision of the Monitoring-Evaluation System**
   Measuring not only infrastructure output, but also the quality of governance and long-term social impact.

Digitalization must be a means for inclusive governance and sustainable development, not just a goal, so that no village is left behind in Indonesia's digital transformation.

CONCLUSION

This research demonstrates that Smart Village transformation success in Indonesia is fundamentally determined by digital governance quality rather than infrastructure availability. The digital divide manifests as a governance gap, characterized by disparities in institutional capacity, multi-stakeholder collaboration, community participation, and transparency-accountability. These four governance dimensions collectively explain 73.4% of digital inequality variance, with institutional capacity as the strongest predictor ($\beta=0.42$, $p<0.001$). The Hybrid Collaborative model demonstrates highest effectiveness (score 8.4) in mitigating digital exclusion, while 40% of disadvantaged villages developing adaptive innovations—offline-digital hybrid governance, digital champions, and BUMDes-CSR synergy—experience significant governance improvements, confirming that structural constraints do not equate powerlessness.

This study contributes two theoretical concepts: governance gap as digital inequality determinant and offline-digital hybrid governance as an adaptive paradigm responsive to local infrastructure and sociocultural contexts. Practically, findings provide evidence-based recommendations for Smart Village 2025 strategy reformulation through governance-first approaches, hybrid framework institutionalization, and Digital Governance Index-based monitoring systems. However, limitations include small sample coverage, cross-sectional design restricting long-term causality determination, and insufficient depth in political dynamics and intersectionality analysis. Ultimately, village digitalization must function as an instrument for inclusive, accountable governance—not as an end goal.

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