Volume 10, Nomor 2, Desember 2025,91-112
ISSN 2407-4292 (Print), ISSN 2721-6780 (Online)
Doi: https://doi.org/10.33701/j-3p.v10i2.5811
Available Online: http://ejournal.ipdn.ac.id/jpdpp

SUSTAINABLE VILLAGE DEVELOPMENT PLANNING: A CASE STUDY OF THE BI-SMART SOCIALIZATION PROGRAM IN NGEMPLAK SUBDISTRICT

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Received: 23-09-2025; Accepted: 19-10-2025; Published: 31-12-2025

ABSTRACT

Village development plays a crucial role in achieving sustainable development in Indonesia, particularly within the framework of the Sustainable Development Goals (SDGs). The integration of digital technology in village governance has become an important strategy to enhance public services, administrative efficiency, and community participation. Objective: This study aims to analyze the implementation of the Bi-Smart socialization program in Ngemplak Subdistrict as an initiative to promote technology-based village development aligned with the SDGs. Method: This research employs a qualitative approach using a case study method. Data were collected through interviews with village officials, participants of the Bi-Smart socialization program, and representatives from the Boyolali Regency Communication and Informatics Office as well as the Yogyakarta Multimedia College (STMM). Observations of program activities and documentation analysis were also conducted to examine the application of information and communication technology (ICT) in village governance. Results: The findings reveal that the Bi-Smart socialization program significantly improves digital literacy among village officials and communities, enhances access to information, and increases transparency and accountability in village administration. Furthermore, the program creates opportunities for local economic development through the utilization of digital technologies. However, several challenges remain, particularly related to limited technological infrastructure and varying levels of digital skills among stakeholders.Contribution: This study highlights the importance of technology-based capacity-building programs in accelerating SDG-oriented village development. The findings provide practical insights for policymakers and local governments in designing digital village initiatives to support sustainable development at the grassroots leve

Keywords: *Digital Village, Bi-Smart Program, Sustainable Development Goals (SDGs), ICT in Governance, Village Development*

A. **Introduction**

Village development is an essential element in realizing sustainable development in Indonesia. As the smallest administrative unit, villages play a strategic role in creating social, economic, and environmental welfare for the community. In the global context, Indonesia is also committed to achieving the Sustainable Development Goals (SDGs) as agreed upon in the UN 2030 Agenda. These SDGs aim to end poverty, protect the planet, and ensure prosperity for all, leaving no one behind. In achieving the SDGs, village development based on information and communication technology (ICT) holds great potential to accelerate transformation and realize more inclusive, independent, and sustainable villages (Bi-Smart Socialization in Ngemplak District: Realizing Digital Villages Through Social Media Optimization, 2025(Salemink et al., 2020; Janssen et al., 2022; Criado et al., 2021).

The rapid development of digital technologies has significantly transformed governance systems and public service delivery worldwide. In recent years, the concept of a digital village has emerged as an important strategy for promoting rural development, improving governance efficiency, and enhancing citizen participation. Digital technologies enable village governments to provide more efficient administrative services, increase transparency, and expand access to information for rural communities. Several studies have shown that the integration of digital technology into village governance can strengthen public service delivery and improve citizen participation in rural development processes. (Salemink et al., 2020; Janssen et al., 2022; Criado et al., 2021).

Digital transformation in rural areas has also become increasingly relevant in achieving sustainable development. The development of digital villages is considered an important approach for supporting rural revitalization and improving the quality of life of rural communities. Previous studies indicate that digital village initiatives can enhance rural governance effectiveness, promote economic opportunities, and improve social welfare. In addition, digital village development contributes to improving the overall quality of life of rural residents through better access to information, services, and digital infrastructure. (Philip et al., 2022; Bai et al., 2024; Ren et al., 2024).

Another important aspect of digital village development is digital literacy among village officials and rural communities. Digital literacy plays a crucial role in enabling individuals to access, understand, and effectively utilize digital technologies in daily activities. Research has shown that improving digital literacy can empower rural communities, enhance access to information, and support inclusive development processes. Moreover, digital literacy has been

identified as an important factor in accelerating the achievement of the Sustainable Development Goals (SDGs), particularly in areas such as quality education, poverty reduction, and reducing inequality. (van Deursen & van Dijk, 2020; Lythreatis et al., 2022; Helsper, 2021).

Several studies have also emphasized the importance of strengthening digital governance and community participation in rural development. Digital governance initiatives can enhance transparency, improve communication between government institutions and citizens, and facilitate more responsive public services. In addition, digital participation platforms enable rural communities to be more actively involved in village development planning and decision-making processes. (Meijer & Bolívar, 2021; Cordella & Tempini, 2020; Kassen, 2021).

Furthermore, limited research has examined the relationship between digital literacy initiatives and the implementation of SDGs at the village level, especially in terms of how digital empowerment programs influence community participation and governance effectiveness. Therefore, further investigation is needed to understand how digital literacy programs can support digital village development and contribute to sustainable rural development. (Vinuesa et al., 2020; United Nations, 2023

Based on these considerations, this study aims to analyze the implementation of the Bi-Smart socialization program in supporting digital village development in Ngemplak District, Boyolali Regency. Specifically, the study examines how the program contributes to improving digital literacy among village officials and community members, and how digital technology utilization can support the achievement of sustainable development goals at the village level.

Although previous studies have extensively examined digital villages, digital governance, and digital literacy as separate domains, limited attention has been given to how a technology-based socialization program functions as a strategic mechanism for integrating digital literacy, village governance transformation, and the achievement of Sustainable Development Goals (SDGs) at the village level. Existing research predominantly focuses on digital infrastructure development, e-government adoption, or the outcomes of digital transformation, while overlooking the process through which digital capacity-building initiatives facilitate institutional change and community participation in rural governance. Addressing this gap, this study offers a novel contribution by conceptualizing the Bi-Smart socialization program as an integrated capacity-building model that links digital literacy enhancement, technology adoption, participatory governance, and SDGs-oriented village development. Through an in-depth qualitative case study in Ngemplak Subdistrict, this research extends the digital village literature by demonstrating that technology-based socialization serves not merely as a training

activity but as a governance mechanism capable of strengthening institutional capacity, improving public engagement, and accelerating sustainable rural transformation. These findings provide both theoretical enrichment for digital governance studies and practical insights for policymakers seeking to implement sustainable digital village initiatives in developing countries.

B. Literature Review

Digital Village and Rural Governance

The concept of the digital village has gained increasing attention in recent years as governments seek to integrate digital technologies into rural development strategies. Digital villages refer to the use of information and communication technologies (ICT) to improve governance, enhance public services, and promote economic development in rural areas. The integration of digital technologies enables village governments to improve administrative efficiency, facilitate access to information, and strengthen communication between government institutions and local communities (Salemink, Strijker, & Bosworth, 2020; Bai et al., 2024).

Previous studies have highlighted the importance of digital transformation in improving rural governance systems. Digital technologies can support transparency, accountability, and efficiency in administrative processes while also providing new opportunities for citizen participation in local development planning (Criado, Sandoval-Almazan, & Gil-Garcia, 2021). Furthermore, digital governance initiatives have been shown to enhance the effectiveness of public service delivery in rural areas (Janssen, Rana, Slade, & Dwivedi, 2022). However, the successful implementation of digital villages depends on several key factors, including technological infrastructure, institutional capacity, and the digital literacy of community members (Philip et al., 2022). Without adequate capacity and knowledge, the potential benefits of digital technologies in rural governance cannot be fully realized

Digital Literacy and Community Empowerment

Digital literacy is widely recognized as a critical component of digital transformation in rural areas. Digital literacy refers to the ability of individuals to access, understand, evaluate, and effectively use digital technologies for communication, information sharing, and problem-solving (van Deursen & van Dijk, 2020; Helsper, 2021). In the context of rural development, improving digital literacy is essential for enabling communities to participate in digital governance systems and utilize digital platforms for economic and social activities.

Several studies have demonstrated that digital literacy programs can empower rural communities by improving access to information, expanding economic opportunities, and enhancing social participation (Park, 2021; Lythreatis, Singh, & El-Kassar, 2022). For example, digital platforms allow rural communities to promote local products, access online markets, and engage in digital entrepreneurship. These opportunities contribute to strengthening rural economies and reducing socio-economic disparities between urban and rural areas. (Park, 2021; Ragnedda & Ruiu, 2020; OECD, 2021). Nevertheless, many rural communities still face challenges related to limited digital skills, insufficient training opportunities, and unequal access to digital infrastructure (Ragnedda & Ruiu, 2020). These challenges highlight the importance of implementing targeted digital literacy programs that address the specific needs of rural communities.

Digital Technology and Sustainable Development Goals (SDGs)

Digital technologies have also been recognized as important tools for supporting the achievement of the Sustainable Development Goals (SDGs). The integration of digital solutions in governance and development initiatives can improve access to education, healthcare, economic opportunities, and public services (Vinuesa et al., 2020). In rural contexts, digital technologies can contribute to several SDG targets, including poverty reduction, inclusive economic growth, and improved institutional governance (Hilbert, 2020; OECD, 2021). Digital platforms enable more efficient service delivery and enhance transparency in government administration. Additionally, digital technologies support community participation and information sharing, which are essential for sustainable development.

Despite these potential benefits, the relationship between digital village initiatives and SDG implementation at the local level remains underexplored in many developing countries. In particular, limited research has examined how digital literacy programs and technology adoption initiatives contribute to strengthening village governance and promoting sustainable rural development (Ren et al., 2024). The integration of digital technology into village governance is closely related to the achievement of the Sustainable Development Goals (SDGs), particularly those related to inclusive institutions, innovation, and sustainable communities. Digital village initiatives support SDG implementation by improving access to information, strengthening governance transparency, and enhancing community participation in development planning.

According to United Nations (2020), digital technologies play a crucial role in accelerating sustainable development by enabling governments to deliver inclusive and efficient services. In rural contexts, digital village programs contribute to several SDG targets, including poverty reduction, quality education, economic development, and institutional capacity building. Previous studies have also emphasized that digital village initiatives can strengthen local governance structures and create new opportunities for community empowerment (Zhao et al., 2022). By integrating ICT into village administration, governments can support more transparent, participatory, and sustainable development processes.

Sustainable Development Goals (SDGs) Village Development refers to the implementation of the global SDGs agenda at the village level through integrated governance, community participation, and the utilization of digital technologies. The SDGs village approach aims to promote inclusive economic growth, social welfare, environmental sustainability, and institutional strengthening in rural areas. In Indonesia, the concept of SDGs Desa has been adopted as a national framework to guide village development policies and programs in alignment with the global sustainable development agenda. The integration of digital technology plays a crucial role in supporting SDGs village development. Digital platforms and information systems can improve transparency, efficiency, and accessibility of public services, enabling village governments to manage administrative data, deliver public services, and monitor development programs more effectively. According to recent studies, the implementation of digital governance in rural areas contributes to improved public service delivery, stronger institutional capacity, and increased community engagement in local development processes.

Furthermore, the smart village concept emphasizes the use of information and communication technologies (ICT) to enhance governance, economic activities, and social inclusion in rural communities. Through digital platforms such as village websites, online public service systems, and digital data management, village governments can facilitate better communication with citizens, streamline administrative services, and support data-driven decision making. These digital innovations also enable villages to monitor progress toward SDGs indicators more effectively.

In this context, the Bi-Smart platform serves as a digital infrastructure that supports the implementation of smart village governance and SDGs-based village development. By integrating online public services, social media communication, and village data management,

the Bi-Smart platform can enhance community participation, improve service efficiency, and strengthen digital governance at the village level. Ultimately, the adoption of digital platforms such as Bi-Smart contributes to achieving SDGs village development by fostering transparent governance, inclusive participation, and sustainable rural development.

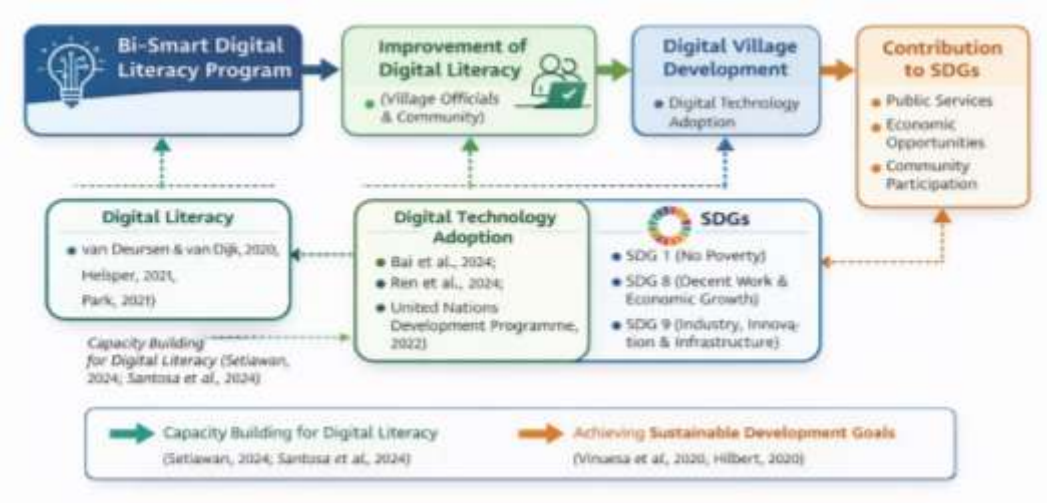

Figure 1. Conceptual Framework
Source: Authors' own work

C. Methods

This study employed a qualitative research approach using a case study design to explore the implementation of the Bi-Smart socialization program in supporting digital-based village governance in Ngemplak District, Boyolali Regency, Indonesia. A qualitative approach was selected to provide an in-depth understanding of how digital technology initiatives are introduced and utilized at the village level within the framework of the Sustainable Development Goals (SDGs).

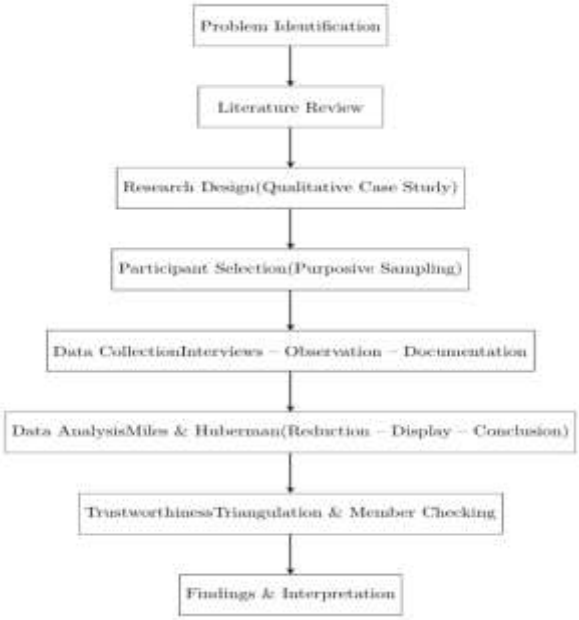

Figure 2. Flowchard Research
Source: Authors' own work

The research was conducted in Ngemplak District, Boyolali Regency, which served as the location for the implementation of the Bi-Smart socialization program. Figure 2 shows that participants were selected using purposive sampling, focusing on individuals who were directly involved in or affected by the program. These participants included village officials, community representatives, participants of the Bi-Smart socialization activities, and representatives from the Boyolali Regency Communication and Informatics Office as well as the Multi Media College (STMM) Yogyakarta.

Data were collected through several qualitative data collection techniques. First, semi-structured interviews were conducted to obtain detailed information regarding participants' experiences, perceptions, and responses toward the implementation of the Bi-Smart program and the adoption of digital technology in village governance. The interview format allowed flexibility while maintaining consistency across participants.

Second, participant observation was carried out during the socialization activities to observe the interaction between facilitators and participants, the learning process, and the level of engagement in the program. These observations provided contextual insights into how digital literacy and technology utilization were introduced.

Third, documentation analysis was conducted by reviewing relevant documents such as program reports, training materials, policy documents, and other digital village-related

materials. These documents were used to complement and triangulate the data obtained from interviews and observations

The collected data were analyzed using thematic qualitative analysis following the procedures proposed by Miles and Huberman, which include data reduction, data display, and conclusion drawing. In the data reduction stage, raw data from interviews, observations, and documents were organized and coded to identify relevant information. The data were then categorized into themes related to digital technology adoption, village governance improvement, and the role of the Bi-Smart program in supporting SDG implementation.

To ensure the credibility and reliability of the findings, this study applied data triangulation by comparing information obtained from interviews, observations, and documentation. Additionally, the researcher conducted member checking with several participants to confirm the accuracy of the interpreted data. These procedures helped strengthen the validity of the research findings.

D. Results and Analysis

Implementation of the Bi-Smart Digital Literacy Program

The findings of this study show that the implementation of the Bi-Smart socialization program plays an important role in introducing digital technology to village officials and community members in Ngemplak District, Boyolali Regency. The program was designed as a digital literacy initiative aimed at improving the capacity of rural communities in utilizing digital tools for governance and socio-economic activities. During the implementation process, participants were introduced to various digital platforms and applications that can support administrative work and communication. The training activities included the introduction of digital tools such as graphic design applications and social media platforms that can be used to disseminate village information and promote local potential.

Observations conducted during the program indicated that participants demonstrated a positive response to the training activities. Many participants expressed enthusiasm in learning how digital technology could be utilized to support village administration and community activities. These findings indicate that digital literacy programs such as Bi-Smart can serve as an important first step in facilitating digital transformation at the village level.

Improvement of Digital Literacy among Village Communities

The results further indicate that the Bi-Smart program contributed to improving the digital literacy of both village officials and community members. Participants reported increased confidence in using digital devices and online platforms after attending the training sessions. Village officials began to understand how digital technologies could be used to improve administrative processes, including document management and communication with residents. Similarly, community members gained knowledge about using digital platforms to access information and communicate more effectively with local government institutions. This improvement in digital literacy is crucial for rural communities, as the ability to utilize digital technology determines the success of digital governance initiatives. The findings support previous studies which suggest that digital literacy is a key factor in enabling communities to participate in digital transformation and governance processes.

The increase in digital literacy among village officials subsequently encouraged the adoption of digital technologies in village governance practices. Village administrators began to explore the use of digital platforms to manage administrative tasks and share information with residents. For instance, digital media platforms were used to disseminate village announcements, program information, and public service updates. This digital communication channel allowed village governments to reach community members more efficiently compared to conventional communication methods. The use of digital technologies also improved transparency and accessibility of information. Community members were able to access village information more easily, which contributed to strengthening trust between the government and the community.

The adoption of digital technologies within village governance represents an important step toward the development of a digital village. The findings suggest that digital literacy programs such as Bi-Smart can support the transformation of traditional governance systems into more modern and technology-based governance practices. Through digital platforms, village governments are able to improve the efficiency of public service delivery and enhance communication with community members. In addition, digital tools provide opportunities for promoting local economic activities, including the promotion of village products and tourism potential. These developments indicate that digital literacy initiatives not only improve individual technological skills but also contribute to broader institutional transformation within rural governance systems.

The development of digital villages also contributes to the achievement of several Sustainable Development Goals (SDGs). Improved digital literacy and technology adoption can

support economic development, enhance access to information, and strengthen institutional governance at the local level. First, digital technologies can support SDG 8 (Decent Work and Economic Growth) by enabling rural communities to access digital markets and promote local products. Second, the adoption of digital technologies contributes to SDG 9 (Industry, Innovation, and Infrastructure) through the development of digital infrastructure and innovation in public services. Third, improved transparency and governance practices support SDG 16 (Peace, Justice, and Strong Institutions). Therefore, the findings suggest that digital literacy initiatives such as the Bi-Smart program can play an important role in supporting sustainable rural development and strengthening governance at the village level.

In the next session, internship students from STMM Yogyakarta provided training on the use of the Canva graphic design application. This application is highly useful for village officials in creating attractive visual content for publication on social media or other platforms. Engaging visual content is more likely to capture public attention and enhance engagement. In the digital world, creating creative and informative content is essential for effective communication. Using Canva, village officials can produce posters, infographics, and digital banners even with limited design skills yet still achieve professional-quality results. An important aspect of this socialization is improving digital literacy among village officials. Digital literacy is not merely about mastering technology but also about understanding how to use technology for the benefit of the community. Bi-Smart training provided officials with knowledge on using applications and social media effectively and efficiently in village governance. Mastery of technology enables village officials to adapt to technological developments and respond to emerging challenges. Technology also allows villages to accelerate service delivery and ensure services remain transparent and accessible to all parties.

Through this activity, village officials in Ngemplak District are expected to utilize technology to improve service quality and accelerate development processes. With the Bi-Smart application and effective use of social media, more open communication between village governments and communities can be established, thereby increasing public participation in development programs. The Bi-Smart socialization also serves as an initial step for Ngemplak District toward establishing a digital village based on information technology. In the long term, the application of digital technology will contribute to the achievement of Boyolali Smart City, supporting the creation of an innovative, competitive, and investment-friendly city.

Thus, Bi-Smart socialization is not merely a technology training activity but part of broader efforts to build village governance that is transparent, efficient, participatory, and aligned with

a more digital and sustainable Indonesia. In the context of village development, technology serves as a strategic catalyst that accelerates development processes across governmental, economic, social, and environmental sectors. Empowering technology in villages aims to enhance the quality of public services, speed up the flow of information, and facilitate community access to services provided by the village government. One way to realize a sustainable village is by integrating technology into various aspects of village administration, which not only simplifies administrative procedures but also improves efficiency and effectiveness in service delivery.

One example of technological application in villages is through the Bi-Smart application introduced during the socialization program in Ngemplak District. This application enables village officials to manage data in a more organized and integrated manner, accelerate administrative processes, and provide an effective communication platform between village governments and residents. With an integrated system, information about village programs, budgets, and development activities can be more easily accessed by the community, thereby creating greater transparency in village governance.

Social media has become a highly effective tool for expanding information reach and accelerating communication between village governments and the community. In today's digital era, nearly all levels of society—including those in rural areas—have access to platforms such as Facebook, Instagram, and WhatsApp. Therefore, the use of social media in village development can be an effective strategy for disseminating information, educating the public, and increasing community participation in development activities.

In the Bi-Smart socialization program in Ngemplak District, participants were trained on how to utilize social media for public purposes. The use of social media as a medium for promotion, education, and public communication is essential for creating community awareness and participation in village programs. Additionally, social media can be used to promote village potentials that are not yet widely known, such as tourism, agricultural products, or local crafts, which can strengthen the village economy and create new opportunities for residents. The use of social media to share government activities also enhances transparency and accountability. By providing open information on digital platforms, the community can easily follow the progress of village programs and offer constructive input or criticism. This strengthens the relationship between village governments and residents, establishing more democratic and responsive governance.

Beyond social media, graphic design technology also plays an important role in empowering sustainable villages. Creating engaging visual content can increase the appeal of information shared on social media and other digital platforms. During the Bi-Smart socialization program, participants were also trained to use graphic design applications such as Canva to create posters, infographics, and other promotional materials. Informative and creative visual content is crucial to ensure that messages are effectively conveyed to the community. For example, information about village development activities, budget allocation, or important announcements can be presented in the form of infographics or posters that are easy to understand. By using a simple graphic design application, village officials can produce materials that are not only visually appealing but also effective in delivering key messages to the community.

Graphic design also improves the quality of village promotion at broader levels, such as in attracting tourists or investors. With compelling visual content, villages can more easily promote their local potential—be it in tourism, agriculture, or creative industries. This contributes positively to the village economy and enhances community welfare. Village data management is a critical aspect in realizing sustainable villages. In many villages, data management is still carried out manually, which often leads to delays, errors, or loss of essential information. In this context, technology can be used to manage village data more efficiently and accurately.

The Bi-Smart application offers a solution by providing a system that allows village officials to manage administrative and development data in an integrated manner. This application enables villages to manage population data, budgets, development programs, and other community needs in a structured and easily accessible format. With better data management, village governments can make more accurate, data-driven decisions, which in turn accelerates development processes and improves service quality for the community.

Technology for Sustainable and Environmentally Friendly Development

One important aspect of technological empowerment for sustainable villages is the development of environmentally friendly technological solutions. Technology can help address various environmental challenges faced by villages, such as natural resource management, waste management, and the use of renewable energy. Villages can use technology to optimize natural resource use, reduce negative environmental impacts, and raise public awareness about environmental conservation. Examples of environmentally friendly technologies that can be implemented in villages include digital-based clean water management systems, air quality

monitoring tools, or renewable energy solutions such as solar panels. By adopting such technologies, villages can create more sustainable systems and minimize environmental harm.

Empowering technology for sustainable villages is a significant step toward building more efficient, transparent, and community-responsive governance. Through the use of the Bi-Smart application, social media, graphic design tools, and technology-based data management, villages can enhance public service quality, accelerate development, and create more inclusive and transparent governance. Furthermore, technology plays a vital role in maintaining environmental sustainability and creating eco-friendly solutions for village development. With proper technological empowerment, Indonesian villages can better face development challenges, accelerate progress, and realize a sustainable future.

In the context of technology-oriented rural development, HR empowerment refers to the provision of knowledge, skills, and access to technology that suits the needs of the village. A technologically advanced village is built not only on infrastructure and hardware but also on the community's capacity to manage and utilize these technologies effectively. Thus, HR empowerment forms the foundation for achieving an efficient local government, improved public services, and increased community participation in development processes.

HR empowerment is closely linked to improving digital literacy, including the ability to understand, use, and manage technology effectively. In many villages, officials and residents may lack sufficient digital skills, which limits the village government's ability to deliver technology-based services. Therefore, systematic training and education are needed to improve digital capabilities, such as data management, the use of digital applications, and the utilization of social media for communication and public participation.

The Role of Village Officials in Technology Implementation

Village officials, as administrators of local governance, hold significant responsibility for implementing technology-based development policies and programs. Their technological skills are essential in administrative processes, communication with residents, and development planning. In the digital era, village officials must be able to operate hardware (computers, smartphones, information management systems) as well as software (e-government applications, social media platforms, and data analysis tools). For example, the Bi-Smart application used during community outreach in Ngemplak District illustrates a digital tool that accelerates administrative processes and enhances transparency. Using such applications requires competency in data management, information processing, and efficient service delivery. Furthermore, village officials must act as facilitators by introducing technology to the

community and encouraging public participation in development activities. Through social media, for instance, they can inform residents about village programs, budget management, and community events. This role requires village officials to possess both digital competence and communication skills so that knowledge transfer to the community can be effective.

Village Communities as Technology Users

Aside from village officials, the broader community is also a crucial actor in technology-based rural development. Residents are not only beneficiaries but also active users of technology who play a direct role in accelerating development. Therefore, empowering villagers through digital literacy and technology usage training is necessary. Community members need basic training on how to use digital devices such as smartphones, computers, and relevant applications. For example, e-government platforms allow residents to access public administration services—such as ID card applications or certificate requests—more efficiently than through manual procedures.

Technology also supports rural economic development. Digital platforms and social media enable villagers to market local products more widely and efficiently. Agricultural goods, handicrafts, and tourism potentials can all be promoted digitally, increasing income and reducing poverty. However, the digital divide between residents with and without adequate technological access must be addressed. This underscores the importance of continuous assistance and education led by village officials.

Education and training form a central pillar in strengthening human resources for digital rural development. Digital skills cannot be acquired instantly; they require continuous and structured learning. Hence, recurring training programs are essential for improving the technological capabilities of village officials and the community. Training topics may include basic computer skills, e-government applications, data management, social media communication, and even graphic design for village outreach purposes. For example, during Bi-Smart socialization in Ngemplak District, training on using Canva for visual content creation helped improve the quality of communication and promotional activities. Training should also align with each village's specific needs. If a village has tourism potential, training programs on digital marketing for tourism or local products should be prioritized. Tailored training ensures that the knowledge gained has a direct impact on community welfare.

Collaboration between village governments, educational institutions, and private organizations is also essential in HR empowerment. Universities and training institutions can act as partners in providing relevant training materials and expert guidance for village officials

and communities. Private sector entities—especially those in technology—can contribute by supplying technological devices, supporting system development, and providing technical assistance. Such multi-stakeholder collaboration accelerates digital transformation and enhances the overall quality of human resources in the village.

Village development that prioritizes economic empowerment offers a strategic solution for reducing poverty at the local level. Enhancing community access to economic opportunities—such as capacity-building programs, increased agricultural productivity, and the development of creative or tourism-based industries—can significantly reduce poverty. Adequate infrastructure, including roads, bridges, and internet access, also accelerates rural economic progress. Technologies such as e-commerce platforms and social media marketing enable rural communities to expand their market reach. Additionally, promoting sustainable agriculture and economic diversification helps create long-term employment opportunities and increase household income.

Food security is a central concern in village development, especially since most rural areas depend on agriculture as their primary economic sector. Sustainable village development includes efficient natural resource management, environmentally friendly agricultural technologies, and farming systems that can produce sufficient, affordable, and high-quality food. Modern agricultural technologies—such as efficient machinery, water-saving irrigation systems, and data-driven applications—enhance productivity and strengthen food security. These tools allow farmers to manage land more effectively, reduce resource waste, and improve agricultural yields.

Health is inseparable from sustainable village development. Strengthening primary healthcare services through collaboration between village governments and health institutions is essential. Providing accessible basic services—immunizations, routine check-ups, and affordable treatment — helps improve community well-being. The development of village health facilities equipped with medical technologies and digital health information systems enables faster diagnosis and treatment. Technology-based health campaigns and digital health applications also enhance health awareness and encourage healthier lifestyles.

Education is a fundamental driver of sustainable development. Improving rural access to quality education helps prepare younger generations for future global challenges. This includes better school facilities, relevant skills training, and nonformal education opportunities. Villages can leverage technology through online learning platforms and educational

applications to improve access to quality learning materials. Digital literacy programs and teacher training on technology use are also essential for strengthening rural education. Clean water and proper sanitation are basic rights that must be fulfilled. Sustainable village development requires adequate water infrastructure and environmentally sound water management. Technological innovations—such as energy-efficient water treatment systems and digital water-quality monitoring—ensure safe and sustainable access to clean water. Environmentally responsible waste and sanitation management technologies also help reduce pollution.

Adequate infrastructure is a critical pillar of sustainable village development. Quality infrastructure expands access to public services and promotes economic growth. Digital infrastructure—particularly reliable internet access—is crucial for enabling digital transformation in villages. Inclusive and sustainable village development must ensure that all groups benefit—women, children, persons with disabilities, and indigenous communities. Through equitable policy implementation, villages can reduce local socioeconomic disparities. Technology can also strengthen community participation in decision-making. Digital platforms that allow villagers to vote or engage in public consultations promote social justice and empowerment.

Village development is therefore central to SDG achievement, as it directly affects the daily lives of Indonesia's rural population. Technology-supported, inclusive development ensures that no one is left behind, aligning with the SDG principle of "Leaving No One Behind." Collaboration among governments, communities, and private actors remains key to achieving sustainable villages (Yanti & Indahsari, 2024).

Challenges and Opportunities in Implementing Digital Villages in Indonesia

Digital village development represents a strategic effort to improve rural welfare, accelerate equitable development, and strengthen local competitiveness. A digital village refers to the use of information and communication technology (ICT) to enhance village governance, streamline public services, and optimize village potential. Although the potential is substantial, practical implementation faces several challenges requiring innovative solutions and multisector collaboration. At the same time, digital villages present promising opportunities for advancing sustainable rural development (Tamrin et al., 2023).

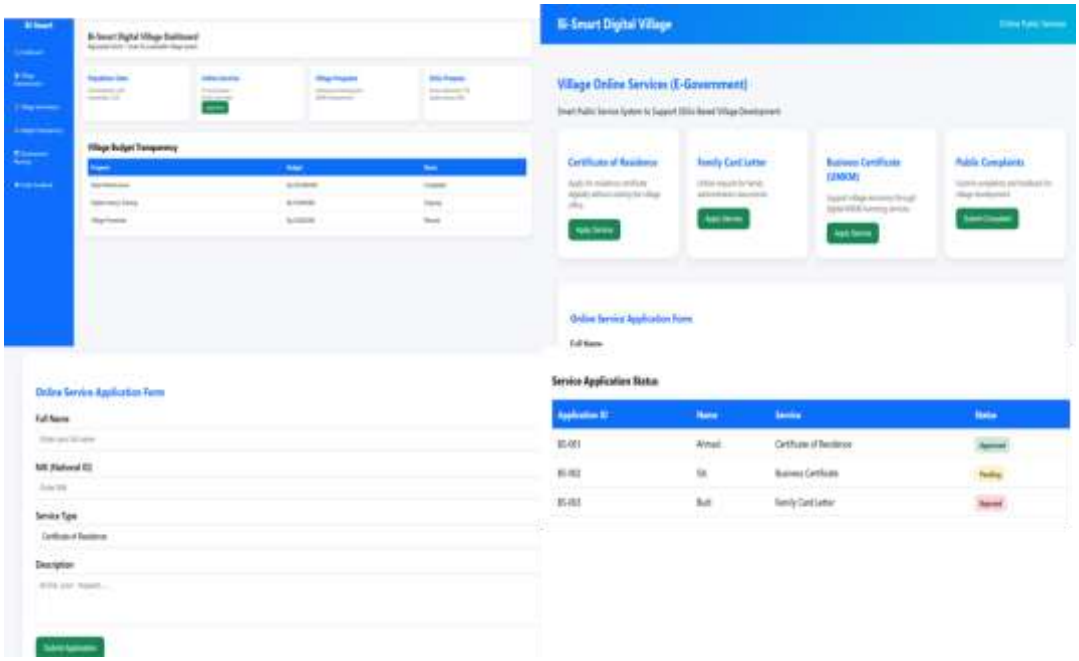

Figure 3. User Interface Application Bi-Smart Digital Village
Source: Authors' own work

In many rural and remote areas, limited access to fast and stable internet severely restricts digital participation. This limitation affects the ability of villagers to access digital information, engage in technology-driven economic activities, and enjoy digital public services. Adequate hardware—computers, smartphones—is also lacking in many villages, hindering both local governments and residents from fully utilizing digital platforms. Digital literacy among village officials and community members remains low. Many local administrations lack the skills needed to manage ICT systems or digital services. Similarly, villagers often lack the digital competencies required to benefit from digital platforms in economic, educational, or health-related activities.

As a result, digital literacy training is essential for enabling communities to fully benefit from technological innovations. A pronounced digital divide persists between urban and rural areas. While major cities enjoy high-speed internet and diverse digital services, many villages experience limited access. Remote areas with challenging geographical conditions are often the most affected. Addressing the digital divide requires equitable infrastructure distribution across Indonesia.

Despite existing government initiatives, policy constraints remain. Some villages struggle to access technical support or funding for digital initiatives. Issues related to data privacy and cybersecurity also pose risks, requiring robust regulatory frameworks. Digital village implementation in Indonesia indeed faces significant obstacles—limited infrastructure, human

resource gaps, regional inequality, and regulatory constraints. However, the opportunities are equally substantial, ranging from improved public services to economic empowerment and enhanced human development. Achieving successful digital villages requires cross-sector collaboration, technological investment, capacity-building, and equitable policy support. With these efforts, digital villages can serve as catalysts for sustainable, competitive, and autonomous rural development (Tyas et al., 2025).

The present study demonstrates that the Bi-Smart initiative has become an important catalyst for strengthening digital governance capacity at the village level by fostering both institutional adaptation and community readiness for digital transformation. Rather than serving merely as a technology training program, the initiative creates an enabling environment in which village officials gradually integrate digital tools into administrative processes, public communication, and service delivery. This finding suggests that the success of digital village development relies on the interaction between technological capability and organizational preparedness rather than on infrastructure alone. Improved digital competence among public officials facilitates greater transparency, more responsive governance, and broader public access to administrative information, thereby reinforcing participatory governance principles. At the same time, the program encourages local communities to utilize digital platforms for economic and social purposes, indicating that digital empowerment extends beyond governance and contributes to local development opportunities. Nevertheless, the empirical evidence also reveals that disparities in internet accessibility, technological facilities, and digital competencies continue to constrain the effectiveness of digital transformation initiatives. Consequently, sustainable digital village development requires integrated policy interventions that combine infrastructure investment, continuous capacity development, institutional collaboration, and long-term community engagement. These findings enrich the digital governance literature by illustrating that technology-based capacity-building programs constitute an institutional process capable of strengthening governance effectiveness while simultaneously supporting multiple dimensions of sustainable rural development.

Conclusion

The design of village development within the framework of the Sustainable Development Goals (SDGs) in Indonesia, as illustrated in the case study of the Bi-Smart Socialization Program in Ngemplak District, demonstrates the significant potential of technology in accelerating the achievement of sustainable development objectives. The implementation of

digital tools, such as the Bi-Smart application, enables village administrations to optimize their administrative processes, enhance transparency, and improve the speed of communication between village governments and the community. This contributes to more efficient, accountable, and responsive development practices that align with local needs. The Bi-Smart socialization activities not only strengthen the digital literacy of village officials but also empower community members to become more engaged in development processes through information technology. The use of social media for promotion, education, and public communication, along with training in graphic design using applications such as Canva, provides concrete examples of how technology can be leveraged to expand the reach of information and encourage active community participation.

By integrating technology into various aspects of village development—including governance, the economy, education, and health—villages can contribute directly to the achievement of SDGs, particularly in poverty reduction, food security, and the improvement of education and health services. Human resource empowerment through training and the enhancement of digital skills is essential to ensure that villages are adequately prepared to face global development challenges. Overall, the implementation of SDGs-based digital villages, as seen in Ngemplak District, shows that with strong collaboration between government, communities, and the private sector, sustainable and inclusive village development can be achieved more effectively and efficiently.

This research confirms that technology-oriented capacity-building initiatives can substantially accelerate the transition toward more adaptive and sustainable village governance. The implementation of the Bi-Smart program has enhanced the ability of village governments to utilize digital technologies in administrative management, public communication, and community engagement, while simultaneously expanding digital literacy among local stakeholders. These outcomes indicate that digital transformation in rural areas is fundamentally a process of institutional and human capacity development rather than simply the adoption of technological devices. From a theoretical perspective, the study contributes to digital governance research by demonstrating that digital literacy programs function as institutional drivers that facilitate governance modernization and strengthen progress toward Sustainable Development Goals at the local level. From a practical standpoint, the findings highlight the importance of policy frameworks that integrate infrastructure development with continuous training, cross-sector partnerships, and community empowerment to ensure the sustainability of digital village initiatives. Although the findings are limited to a single case

study, they provide a valuable empirical foundation for future comparative research examining the institutional dynamics of digital transformation across different rural contexts in developing countries.

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