

Smart Villages In Suburban Communities: Lessons Learned From Industrial Area Of Java Toll Road Frontier

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ABSTRACT

The implementation of smart village is becoming a fundamental instrument within the policy framework of the Ministry of Villages, Disadvantaged Regions, and Transmigration (Kemendes PDTT) Republic of Indonesia, but the ways this concept is implemented to promote micro-level sustainable rural development has lack of attention. This study aims to examine the ways smart village principles are applied in suburban communities, as well as the degree of success this strategy achieves on the industrial peripheries of Java toll areas. The intervention is specifically implemented in Clarak, located on the peripheral frontier of the Probolinggo District, East Java Province, Indonesia. A case study, involving in-depth interviews with 30 participants, focuses on the implementation of the smart village policy from 2020 to 2023 through smart initiatives and social empowerment. The study identifies four primary sources of the smart village policy: beneficiaries, village government, village-owned enterprises (BUMDES), and micro, small, and medium-sized enterprises (UMKM). Four primary sources of the smart village policy are identified: human, financial, material, and informational resources. Human resources are recognised as a critical factor that impacts the remaining three sources. Understanding the implementation of the smart village concept through smart initiatives at micro-level is crucial for addressing similar challenges in industrial areas. The smart village policy is projected to serve as pivotal instruments for enhancing in Indonesia's financial landscape in the upcoming years (2024-2045), as reflected in the increasing numbers of successful implementations on a national scale, including suburban communities in the frontier of Java toll road outskirts.

Keywords: smart village; suburban communities; industrial area; Java toll outskirts.

INTRODUCTION

Over the past few years, there has been an increasing interest in supporting sustainability of development (Zhang & Zhang, 2020), promoting public services (Satoła & Milewska, 2022), and encouraging local initiatives (Kusio, Rosiek, ¹& Conto, 2022) in rural areas. In this realm of research, a significant question has arisen regarding the survival strategies for the industrialization-affected rural regions by utilising digital electronic devices and Information and Communication Technology (ICT). The Indonesian government is currently working on bridging the gap between urban, suburban, and rural areas by implementing a digitalization programme (Muhtar, Abdillah, Widianingsih, & Adikancana, 2023). This programme aims to use digital policies to increase income and promote economic equality. In the past few years, great hope is given to the smart village policy as a crucial initiative with initially aiming for achieving this objective. In order to improve

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their well-being, rural or suburban communities should utilise digital technology and innovation to optimize the local resources and enhance the quality of public services (Malik, 2022).

Extensive research on smart villages, specifically on the digital economy, has been conducted across different geographical levels, including continents (Doloi, Green, & Donovan, 2018; Lakshmanan, Chockalingam, Murty, & Kalyanasundaram, 2021; van Gevelt et al., 2018), countries (Fennell et al., 2018; Ł. Komorowski & Stanny, 2020), and administrative regions (Adamowicz & Zwolinska-Ligaj, 2020; Vaishar & Št'astná, 2019). A wide range of topics have been investigated in these studies, covering projects in various regions such as Asia, America, and Africa, often focusing on energy systems, climate, and sustainable agriculture (Adesipo et al., 2020; Majumdar, 2020; Puthal, Mohanty, Wilson, & ..., 2021; Recha, Ambaw, Nigussie, Radeny, & Solomon, 2022). In contrast, studies in Europe predominantly focused on the various factors that contribute to the revitalization of local communities. This includes improving public services, utilising innovative technologies, building social connections, and promoting the exchange of knowledge (Cvar, Trilar, Kos, Volk, & Duh, 2020; Visvizi & Lytras, 2020; Visvizi, Lytras, & Mudri, 2019).

However, a few of attention is given to the ways rural community goes beyond the utilisation of digital technology, since it becomes a fact that the digital literacy has been lower in rural community in Indonesia. Recently, rural development policy frameworks in Indonesia have increasingly embraced the concept of smart villages in boarder meaning. The Ministry of Villages, Disadvantaged Regions, and Transmigration (Kemendes PDRT) has developed a thorough definition of smart villages, which includes 4 essential elements for implementing smart initiatives within local communities.

This conceptualization goes beyond the boundaries of the digital economy, covering environmental aspects, infrastructure, resident mobility, village governance, resident economies, quality of life for village residents, as well as the skills and innovation capacities of the inhabitants (Kemendes PDRT, 2021).

The novelty in the evolution of smart villages lies not in the isolation of the aforementioned elements, but rather in their interconnectedness and adaptability to specific localities, contextual conditions, economic structures, and diversities. In addition, smart villages go beyond just economic digitalization, intertwining with the ideas of prosperity and survival by using information and communication technology (Torre, Corsi, Steiner, Wallet, & Westlund, 2021).

Numerous studies highlighted the potential applicability of the smart village concept across diverse territorial, social, and economic contexts. It encompasses its effectiveness in addressing the negative effects of rural decline (Paniagua, 2020), serving as a catalyst for sustainable rural development (Guzal-Dec, 2018) and mobilising local communities (Nieto & Brosei, 2019). In line with these dimensions, Kemendes PDRT encapsulates a shared aspect, emphasizing that smart villages are not merely an approach confined to the sustainable development of rural communities. They serve as a strategic framework to improve the overall quality of life and to provide the younger generation strong incentives to stay in their local areas instead of migrating (Visvizi & Lytras, 2020).

One fundamental tenet of the smart village concept is territorial adaptation to the unique needs and characteristics of the local area. Numerous studies highlighted the various functions of rural areas and classified them into different types, each with its own social, economic, and environmental characteristics which shaped its specific development patterns (Weingarten et al., 2010).

An interesting aspect of these various types of rural is that around 80% of the rural population worldwide lives near cities, forming distinctive communities in the form of suburban villages or settlements. However, these areas are vulnerable to intense effects of urbanisation, frequently transforming into bedroom communities, where residents

primarily spend their time in urban settings (Jolley, Lane, & Brun, 2011; Salamon, 2003; Tapa & Mohd Noor, 2021).

This urbanisation has resulted in various developmental challenges (Dudek-Klimiuk & Warzecha, 2021; Wysocka, Biegańska, & Grzelak-Kostulska, 2022). The economic challenges in residential areas are evident in the rising costs of public infrastructure and services, as well as the high reliance on individual transportation. Social issues involve the reduction of social connections and tensions between newcomers and indigeneous residents. Environmental concerns encompass the significant decrease in green spaces, increased energy and water usage, and the degradation of landscapes, which is particularly noticeable in suburban and industrial regions.

In addition to these issues, the increasing economic demands of urbanisation have a range of effects on suburban and industrial areas. These effects can be seen in the uncontrolled influx of population (Crankshaw & Borel-Saladin, 2019; Li, 2021), changes in spatial and landscape features (Huang, 2017; Ramachandra, Bharath, & Sowmyashree, 2015), environmental strain (Adekola, 2016; Md. Faysal Ahmed, 2014; Shi et al., 2022), and the consequences for ecosystem services, including cultural services (Adger, Safra de Campos, Siddiqui, & Szaboova, 2020; Jia et al., 2023).

The ambitious prospect of addressing diverse issues in suburban industrial areas is encompassed in the fundamental principles of the smart village concept, as evidenced by the regulations, strategies, and plans outlined in Kemendes PDTT policy framework for 2021-2027. Specific policies are designed to address the needs of residential, suburban, and industrial areas, in line with the Village Sustainable Development Goals (SDGs) (Peraturan Pemerintah RI, 2014). These goals emphasize the equitable development of infrastructure for suburban areas located within urban functional zones, in proximity or remote from urban centers.

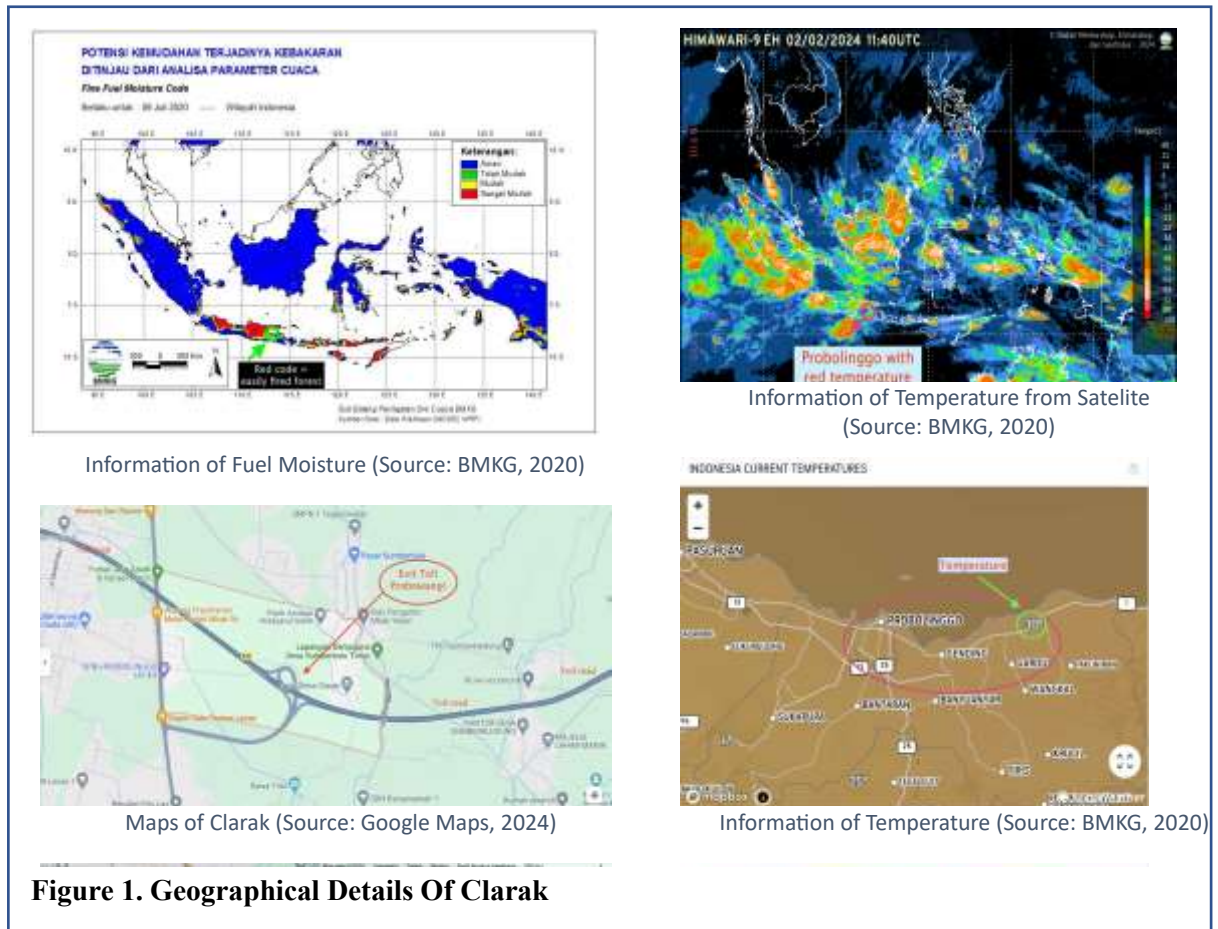
Therefore, the policy document of Kemendes PDTT emphasises the importance of implementing integrated strategies at the settlement level. These strategies involve the use of ICT and social innovation, and require a multifaceted and multi-institutional approach. This approach has been thoroughly examined within the Smart Village project, particularly through the PERTIDES (Perguruan Tinggi untuk Desa / Colleges for Village) initiative (Kemendes PDTT, 2018). The findings of the project demonstrate that the strategic revitalization of suburban industrial areas can effectively leverage available resources to bring about positive change in these regions.

This study aims to examine the ways local communities in suburban areas along the Java toll road in Indonesia are implementing the smart village concept and the effectiveness of this approach in addressing challenges related to industrialization and natural conditions.

Description of Intervention

The intervention took place in Clarak Village, Probolinggo Regency, on the outskirts of the Java Toll Road, around 112 kilometres at southeast of capital city of East Java, Surabaya. This toll road connects Probolinggo and Banyuwangi, making it the longest continuous toll road in Indonesia. Figure 1 shows that Clarak Village is located right next to KM 840 of the toll road, just about 10 metres away from the main thoroughfare.

This village is located at an elevation range of 10 to 50 MDPL and shares a direct border with Probolinggo City. It is known as a dormitory village, where many of villagers reside but seek to employment in the nearby city. By the end of 2022, the village had a population of 10,984 people, showing an increase of around 1,000 residents compared to the 2020 census, which documented 11,021 inhabitants (BPS Kab. Probolinggo, 2022). The rapid increase in population is a result of the growth of residential areas in urban Probolinggo, specifically in the southern sector which is adjacent to an industrial zone, Lumajang.



Using the Developing Village Index (Indeks Desa Membangun / IDM) typology, the Leces District, in where Clarak Village is located, consists of 44 independent villages, 192 developed villages, and 89 developing villages (Peraturan Pemerintah RI, 2016). Clarak Village can be classified as a developing or intermediary village. It has significant social, economic, and ecological resources, but there is room for improvement in terms of enhancing the well-being of the village, improving the quality of life for its residents, and reducing poverty.

Clarak was eligible as a recipient of the Digital Economy Self-Management grant project, a collaborative effort between Kemendes PDTT and PERTIDES. The project was implemented in 2021. Funded by the Directorate General of Economic Development and Village Investment under Kemendes PDTT, the project had the objective of exploring the use of social innovation by digitising local products, spreading awareness and promoting smart villages, and generating digital knowledge for Micro, Small, and Medium Enterprises (UMKM/MSMEs) participants. This project, which focuses on universities affiliated with the PERTIDES consortium, contributes to the ongoing discussion on digital interventions in rural development.

Table 1. Intervention Information

Parameter	Details of Research Field
Location	Clarak Village, Leces, Probolinggo, East Java
Coordinates	7°49'43.7"S 113°14'07.1"E
Duration	2022-2023

Initiator	Village Government, UMKM/MSMEs, BUMDES, Director General of PEID Kemendes PDTT
Beneficiaries	Village community

This article focuses on the locally driven endeavors put forth by the residents of Clarak, specifically the administrators of the Village-Owned Enterprises (BUMDES), Micro, Small, and Medium Enterprises (UMKM/MSME) actors, and the village government. Implemented in various stages, this initiative followed the Asset-Based Community Development (ABCD) approach, which was the chosen social service strategy at that time. The completed projects are in line with the principles of the smart village concept and are divided into four interconnected domains: (1) innovation, (2) improvement of quality of life, (3) optimisation of public services, and (4) utilisation of local resources. The fourth category, known as local resources, serves as the fundamental basis for all smart projects, making it a crucial horizontal category.

RESEARCH METHOD

The evaluation of the impacts of the smart initiative utilised a combination of research methods. Triangulation, in this context, involves the use of various methods to gather a wide range of data, which helps to strengthen and validate the research findings (Hussein, 2009; Yeasmin & Rahman.K.F, 2012).

Table 2. Implementation of Smart Initiatives in Clarak Village

Problem	Solution	Category	Year	Initiator	Funding
Some residents have lack of information about product certification, especially certification of the legalized local products	Implementing product certification training (PIRT, Halal Certificate, and Trademark)	Local resources	2021	Village government	Kemendes PDTT
Increasingly hot weather in urban and industrial areas, especially in residential areas directly adjacent to toll roads	Building a vertical garden with green plants and vines	Quality of life	2022	Community association	Kemendes PDTT
Lack of cultural centers and libraries; residents' access to culture is less than	Opening libraries and outdoor reading corners in coffe shop	Public service	2022	Community association	Other contributions

satisfactory, including that which is available outdoors					
Lack of lighting, common gazebo; reduced security after dark	Installing 5 automatic solar lights on the edge of the main sub-district road	Social innovation	2022	Community association	Probolinggo Transportation Department
The underutilized history of the village and its surroundings; the need to develop educational and recreational offerings that utilize local natural assets	Designing a history and tourist directory of Clarak village, accessible online and offline	Public service	2022	Community association	Kemendes PDTT
There are no skills yet in branding products and managing digital marketing through e-commerce	Setting up e-commerce Clarak Store and implementing online marketing training	Digital technology	2023	UMKM and BUMDES actors	Kemendes PDTT

Table 2 highlights the details of implementation of initiatives in Clarak. The first step involves conducting an in-depth review of existing literature to examine the current condition of the specified village, its surrounding areas, and the socio-economic changes it has experienced. This stage requires a thorough examination of various important documents, such as scholarly studies, reports, developmental analyses and strategies, statistical data compilations (such as those related to demographic changes), and relevant information from local websites (official, informational, and social platforms).

The research methodology involves a comprehensive case study (Baharein, 2008; Diop & Liu, 2020). A total of 32 in-depth interviews were conducted with selected respondents using the snowball sampling technique. The respondents were divided into three interview scenarios, each assigned a sequential number for anonymity: 7 interviews were conducted with the project initiators, 12 interviews involved individuals who directly benefited from the solutions being examined, and 13 interviews included participants from the village government, Micro, Small, and Medium Enterprises (MSMEs), and Village-Owned Enterprises (BUMDES).

In addition, the researcher conducted non-participant observations during field visits, taking on a passive role. This method of observation was utilised to enhance understanding of the processes and mechanisms at work within the particular population (Ekka, 2021).

RESULTS AND DISCUSSION

Exploring the Concept of Smart Villages

The community's understanding of the smart village concept highlights a strong emphasis on concerns such as environmental responsibility, tackling climate change, and maintaining a balance between economic and social factors. According to a local government representative, "a smart village refers to individuals who are intelligent, proactive, and capable of coming up with small-scale innovations to achieve common goals that are relevant to their specific situation" (Village Government 9).

Other participants emphasised the importance of achieving these shared goals through collaboration between different community groups, which are divided based on factors such as age, occupation, and preferences. In addition, there is a shared understanding of the mutual advantages that this collaboration offers for their future welfare. This perspective is in line with the overall concept of the Sustainable Development Goals of Village (SDGs Desa) framework. The framework seeks to create villages that are free from poverty and hunger, promote fair economic growth, prioritise health, environmental conservation, education, gender inclusivity, connectivity, and cultural responsiveness. This alignment aims to accelerate the achievement of the broader objectives outlined in SDGs.

The Rationale behind the Initiatives

The residents of the village have a common understanding of the environmental issues as a result of the toll road construction and its direct effects on their daily lives. This awareness demonstrates their commitment to the environment, mindfulness of ecological issues, or dedication to a developmental vision in line with specific goals. At times, a practical approach is taken to deal with specific challenges. For example, residents living near toll roads who receive significant compensation from government as the result for their selling of agricultural land demonstrate a practical perspective. Nevertheless, this situation gives rise to feelings of social envy among those who are not compensated, which is seen as a cause of the escalated conflict.

The effective identification of certain problem, encapsulated by the query "Why is the area affected by hot weather?", is pivotal, particularly when external funding for projects is available. The problem diagnosis is crucial for selecting the best solution, as demonstrated by the creation of a vertical garden to address hot weather issues. A parallel pattern emerges in the installation of solar panel lights on sub-district roads, driven by the presence of night markets and the nighttime agricultural practices of residents. The need to ensure safety and encourage extended nighttime activity is in line with environmental consciousness and the economic interests of local governments, which support the use of renewable energy to reduce maintenance expenses.

The similar level of awareness emerges when it comes to the certification and commercialization of local products. Requests for legal certification assistance often arise after they deal with challenges in entering the retail market become apparent, along with the realisation that certification services are located far away in urban centres. The economic rivalry in the online market and diverse consumers' preferences regarding product authenticity highlight their needs to seek assistance from universities, as demonstrated by their partnership with Nurul Jadid University which had managed some official branches of certification, such as Halal Center, Property Right Center, and Curators of Local Product.

Another factor is the unique nature of the region. "Living in proximity to suburban areas and toll roads not only influences our behaviour to be more urban-like, but also

requires us to have more living space and take initiatives to adapt to the digital economic sector” (Local Government 3). This changing dynamics is reflected in a fact that residents of villages work in cities, while urbanites are seeking homes in rural areas, demanding increased efforts to adapt interaction and trade practices (Ainoriza, Murni, & Aziz, 2016; Mekonen, 2022). As a result, it is widely recognised that “newcomers often have higher demands and innovative ideas compared to local residents” (Beneficiary 5).

Implementation of the Initiatives

All participants emphasised the crucial importance of social consensus in effectively carrying out different initiatives. This agreement was reached through a series of steps: sharing information through various social media platforms and engaging citizens at different stages of implementation. Most projects need a formal approval from the regional or village government, as they are responsible for overseeing specific land or structures. The absence of such approval could lead to the cessation of various project activities. Fortunately, this was not the case in Clarak.

Furthermore, obtaining financial support for project implementation is a crucial step for initiatives regardless of their subject matter. The preferred project model involves an idea that stimulates searching for funding, contrasting with models where the availability of funding for a specific purpose prompts proponents to apply for subsidies, often without addressing the most urgent local needs. As a result, many projects frequently stray from their intended objectives.

Interestingly, project initiators do not anticipate substantial funding for their endeavors. Instead, they place great importance on grants that are relatively small and easy to calculate. As an example, one initiator pointed out that the funding they requested was not substantial, some projects were valued at millions (specifically, no more than 10 million). However, this funding was intended for website design, certification support, and commercialization assistance. Considering the participation of over 30 MSME actors, it is evident that this funding is not excessive.

After getting funding, the next phase is a vital component in project activities: infrastructure construction. The case of automated solar lights highlights the importance of not only achieving social consensus but also promoting shared participation and responsibility for the success of this stage. A total of 12 residents enthusiastically took part in this initiative, and the project initiator organised an extended meeting with the residents and the village government to demonstrate the functionality and advantages of automated solar lights. “The main objective was to showcase the effectiveness of solar lights, aiming to change people’s views by highlighting the benefits of energy conservation and improving safety during nighttime activities” (Initiator 6).

For the beneficiaries of initiative, three key factors possibly drive their community engagement. Firstly, individuals are encouraged to use their skills in a way that makes a meaningful contribution. For example, electricians could assist in installing solar light poles. The motivation for active involvement stemmed from the perception that their needs were met through collaborative projects, such as halal certification and product legalisation. Finally, previous engagements in comparable initiatives that did not produce positive outcomes have had a lasting impact on the community’s well-being. As a result, when seeking funding for projects in which they are fully involved, their level of engagement highly increased.

Based on a community development perspective, this phenomenon reflects a grassroots initiative that embraces a bottom-up approach (Colenutt, 2022; Kamruzzaman & White, 2018). The community takes charge as the initiator and implementer, collaborating with other local actors during the project.

The Effects of Initiatives and Its Sustainability

An evaluation of the effectiveness and sustainability of an initiative involves two primary approaches. The first is a quantitative analysis, which involves assessing concrete and measurable outcomes using numerical data after the initiative has been completed. The

second approach is a qualitative analysis, which highlights the subjective changes in people's lives, such as shifts in behaviour that promote stronger community connections (Allawi & Al-Jazaeri, 2023; Wahyu, Suharjito, Darusman, & Syaufina, 2022). These effects usually have a lasting impact, often only becoming apparent to individuals once the advantages become evident after a significant period of time.

The quantitative impacts frequently include the active participation of various village residents at different stages of initiative implementation. The tangible effects are evident in the streamlined processing of product certification and legality, the enhanced experience of enjoying shaded environments, and the enthusiastic support for the mini library gazebo. This project has resulted in significant positive outcomes. It has enhanced the sense of security among residents and improved their ability to move around at night. Additionally, it has provided better working conditions for individuals who work in areas with limited lighting. The understanding of the effects of online product commercialization requires a more extended period as it necessitates the acquisition of specialised digital skills.

The establishment of vertical gardens has successfully mitigated the escalation of solar radiation in several residential areas, resulting in a more naturally warm climate. Based on the data of BMKG (Meteorological, Climatological, and Geophysical Agency) of Indonesia, the temperatures in Probolinggo Regency soared to 31 °C by the end of 2023, presenting a warm to hot weather and potentially making fuel moisture in the area (Figure 1). Addressing the decrease in sunlight intensity in specific areas is a significant obstacle that requires holistic approaches at different regional levels, including the micro-scale. This challenge is especially evident in industrial areas located along toll roads, which are at a higher risk of encountering increased temperatures (Figure 1).

The long-term effects of this study are significant. They reveal a shift in attitudes towards green environments, an increase in knowledge about mitigating climate radiation, and the adoption of solutions by residents, such as constructing vertical gradients in their backyards. One respondent described a noticeable change in the community as a "learning process" (Beneficiary 7). Within this context, the learning process goes beyond simply acquiring new skills and working together in local communities. It also includes the transfer of knowledge from community associations responsible for implementing the initiative to other residents. This knowledge involves engaging in activities such as discussions, designing plans, coordinating with local authorities, carrying out the plans, and providing reports.

A comprehensive assessment of the enduring social impacts remains challenging due to the relatively short duration since project completion. However, the residents' opinions highlight a major concern related to these projects, specifically focused on the expenses involved in maintaining the infrastructure. According to a representative from the village government, "The success of these initiatives heavily relies on the maintenance of the procured goods. The expenses associated with repairs and maintenance can significantly impact the sustainability of these initiatives, sometimes even surpassing the allocated village budget" (Village Government 4).

Main Resources

Every village usually has its own specific resources to carry out various initiative programmes. These resources encompass, but are not limited to, human, financial, material, and information resources (Aziiza, Sulistiyani, & Fitri, 2023; L. Komorowski, 2022). Within the realm of smart villages, each resource category possesses unique characteristics. The human resources include the abilities, knowledge, skills, competencies, and inclinations of all village residents and communities who may be involved in implementing the smart village concept. Financial resources refer to the funds utilised by local communities to finance a range of projects, including regional budgets, grants from the Kemendes PDPT, subsidies, and primarily, other contributions from the community. Material resources refer to physical assets such as buildings, spaces, and equipment that

are used to improve rural areas. Information resources consist of vital data that is crucial for making well-informed decisions, such as community groups on social media, external advisors, and a wide range of information channels.



Figure 2. Smart Village Resources

Figure 2 demonstrates the ever-changing nature of resources in each category. The role of local sensitivity is crucial in determining the universal applicability of these resources in all villages. However, when considering villages located in industrial areas, these resources seem well-suited for facilitating the implementation of smart villages. While resource categories can be applied to both mountainous rural and coastal areas, it's important to note that the involved parties and specific cases might vary significantly.

This study highlights the necessity for a diverse range of actions to address these resource, necessitating the activation of each resource type. As new initiatives involve citizens and stakeholders, these resources gradually come together and become more responsible. This consolidation enables efficient resource management, encompassing financial resources (acquiring specialised knowledge, enhancing research capabilities, and gaining experience), physical resources (procuring equipment, optimising infrastructure management, and establishing a strong technical foundation for future initiatives), and information resources (embracing new forms of communication, disseminating knowledge, and gaining social recognition for the region).

Discussion and Future Directions

While the smart village policy initially targeted remote and underdeveloped areas, its evolution into a universal concept suggests applicability to address diverse rural challenges at the local micro scale, including industrial and suburban villages. The key aspects highlighted by smart villages—local communities, public services, quality of life, and new technologies— provide a framework for revitalizing rural areas. Nevertheless, the implementation of smart villages, in line with the theory of territorial sensitivity, differs depending on the regional characteristics.

The incorporation of the "smart" dimension is a central element in all aspects of smart villages. This concept, similar to the smart city, involves the integration of new technologies, particularly those that are environmentally friendly, in various areas such as the economy, society, environment, and mobility. ICT implementation, in so far, is the main objective in smart city (Dameri, 2017). However, in smart village approach, ICT goes beyond utilisation of technology; it includes all facilities, infrastructure, and devices that contribute to improving quality of human life (Wolski, 2018). This distinction plays a vital role in the comparison between smart cities and smart villages, serving as a central focus in this study.

ICT implementation is a prominent feature in the smart city paradigm. In contrast, the smart village concept focuses on improving residents' quality of life based on their

needs, with ICT playing a significant but optional role. The initiatives of Clarak highlight a strong commitment to the principles of a smart village: digital technology, innovation, quality of life, public services, and local resources. ICT is primarily used in projects related to local product commercialization and certification, although its importance is relatively lower compared to other initiatives. It highlights the understanding of 'smart' mainly through societal actions rather than as a technological revolution in rural settings.

For successful implementation of smart initiatives, it is crucial to have a complementary elements: basic infrastructure, public services, well-coordinated institutions, and diverse local resources. While previous studies have identified these elements as vital for supporting smart village success (Hedlund, 2016; Torre et al., 2021; Turgel, Pobedin, & Bozhko, 2020), this research highlights their importance within the context of village characteristics and initiatives. Implementing ICT initiatives requires substantial support from local governments, often involving substantial financial commitments. In contrast, local initiatives that are based on public services, social innovation, and quality of life tend to rely more on local human resources and are less reliant on external financial support.

Clarak, initially identified with low community engagement, encountered environmental issues due to rapid industrialization, specifically dealing with extreme temperatures near the toll roads. The location on the outskirts of the city played a crucial role in determining citizen participation and the effectiveness of smart initiatives. The influx of newcomers from cities and the high mobility of local residents commuting to urban areas emerged as key drivers for the success of smart initiatives (Guimond & Simard, 2010; Herrero-Jáuregui & Concepción, 2023).

This study provides insights on the transformation of Clarak into a smart rural area by incorporating elements like vertical gardens, inspired by both urban and rural architectural concepts. The migration of city residents, facilitated by improved access via toll roads, played a central role, transcending geographical constraints imposed by government policies. These questions are crucial when considering how to adapt the smart village approach to different geographic locations and to address complex issues, including urbanisation, social migration, climate change, and human resource quality (Singh & Rahman, 2018; Suryanarayanan, Prabhakar, Venkadesh, & Kaythry, 2021).

The case presented here highlights the importance of shifting the focus of rural development from spatial to contextual considerations, which is crucial for the success of smart village initiatives. Although current national village policies address some aspects, such as Village Funds and Village Empowerment, the lack of comprehensive monitoring and evaluation at the village level undermines the effectiveness of interventions. The Developing Village Index (Indeks Desa Membangun / IDM) serves as a strategic indicator, categorizing villages based on social, economic, and environmental resilience (Peraturan Pemerintah RI, 2016). Nevertheless, this study emphasises that the effectiveness of these policies and statistics can only be fully realised through localised interventions.

Although the allocation of state budget to Village Funds is commendable, there is a risk of creating village dependency on government aid. A location-sensitive development policy is of utmost importance, highlighting the need to deal with local potentials and opportunities while avoiding projects that foster reliance and demand significant investments. The results suggest that by adopting this approach, local communities can effectively guide the implementation of smart village initiatives. The implementation of initiatives at the local level, managed by community leaders, are grassroots initiatives that demonstrate strong sustainability and require minimal reliance on significant investments. Every case requires a distinct approach at different stages, covering development planning, initiative implementation, and impact assessment.

The idea of smart villages is becoming increasingly important in the Ministry of Villages PDDT policy document on SDGs-based village development, positioning it as a crucial tool in Indonesia's future financial framework (2024-2045). This study highlights the trajectory of a remote village located on the outskirts of a toll road. It provides a valuable

model for village development that takes into account local considerations, making it relevant for inclusion in official policy documents of Kemendes PDTT. The findings of this case serve as a reference for implementing similar initiatives in various landscapes, such as mountains, foothills, city outskirts, underdeveloped and remote areas, seaside locations, and even forested regions.

CONCLUSION AND RECOMMENDATION

In advancing the smart village concept, several overarching considerations are universally applicable and valuable across different locations: mountainous regions, coastal areas, suburbs, forests, or industrial zones. It is imperative to recognize the multifaceted nature of smart villages, acknowledging their diverse needs that are contingent upon local sensitivities. Several villages meet the requirements for smart villages, even if they don't explicitly label themselves as such.

The concept of "smart" goes beyond just the use of advanced technology. Although ICT is important, it should be seen as a tool rather than the ultimate objective. Micro-scale smart initiatives can attract funding from a wide range of sources, agencies, and networks. While the Village Fund policy represents a positive step, it should be viewed as a catalyst for sustainable village development, not merely fostering its dependence on huge investments.

For smart village success, it is crucial to have proactive initiators with smart initiatives, as the determinants of success have highly varied. Usually, these initiators appear as local leaders within the community, such as village heads, BUMDES administrators, village governments, and even universities. However, it strongly needs policy support from the regional or national government. Afterwards, it is crucial to secure funding for smart village implementations through a flexible and sustainable financing mechanism.

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REFERENCES

- Adamowicz, M., & Zwolinska-Ligaj, M. (2020). The "smart village" as away to achieve sustainable development in Rural Areas of Poland. *Sustainability (Switzerland)*, 12(16). <https://doi.org/10.3390/su12166503>
- Adekola, P. O. (2016). Migration, urbanisation and environmental problems in Nigeria. *Migration and Urbanization in Contemporary Nigeria: Policy Issues and Challenges*, (March 2016).
- Adesipo, A., Fadeyi, O., Kuca, K., Krejcar, O., Maresova, P., Selamat, A., & Adenola, M. (2020). Smart and climate-smart agricultural trends as core aspects of smart village functions. *Sensors (Switzerland)*, Vol. 20. <https://doi.org/10.3390/s20215977>
- Adger, W. N., Safra de Campos, R., Siddiqui, T., & Szaboova, L. (2020). Commentary: Inequality, precarity and sustainable ecosystems as elements of urban resilience. *Urban Studies*, Vol. 57. <https://doi.org/10.1177/0042098020904594>
- Ainoriza, A. M., Murni, N., & Aziz, W. N. A. W. A. (2016). Housing aspirations of the elderly in Malaysia: A comparison of Urban and rural areas. *Journal of Design and Built Environment*, 16(2). <https://doi.org/10.22452/jdbe.vol16no2.2>
- Allawi, A. H., & Al-Jazaeri, H. M. J. (2023). A new approach towards the sustainability of urban-rural integration: The development strategy for central villages in the Abbasiya District of

- Iraq using GIS techniques. *Regional Sustainability*, 4(1).
<https://doi.org/10.1016/j.reg.sus.2023.02.004>
- Aziiza, A. A., Sulistiyani, E., & Fitri, A. S. (2023). What is the Element of the Smart Village Model?: Domains, aspects and indicators. *INTENSIF: Jurnal Ilmiah Penelitian Dan Penerapan Teknologi Sistem Informasi*, 7(1). <https://doi.org/10.29407/intensif.v7i1.18898>
- Baharein, K. N. M. (2008). Case Study: A strategic Research Methodology. *American Journal of Applied Sciences*, 5(11).
- BPS Kab. Probolinggo. (2022). *Kabupaten Probolinggo Dalam Angka 2022*. Probolinggo: BPS Kabupaten Probolinggo.
- Colenutt, R. (2022). Knowledge and power in the politics of property development. *Area*, 54(3).
<https://doi.org/10.1111/area.12612>
- Crankshaw, O., & Borel-Saladin, J. (2019). Causes of urbanisation and counter-urbanisation in Zambia: Natural population increase or migration? *Urban Studies*, 56(10).
<https://doi.org/10.1177/0042098018787964>
- Cvar, N., Trilar, J., Kos, A., Volk, M., & Duh, E. S. (2020). The use of iot technology in smart cities and smart villages: Similarities, differences, and future prospects. *Sensors (Switzerland)*, 20(14). <https://doi.org/10.3390/s20143897>
- Dameri, R. P. (2017). Smart City Implementation - Creating Economic and Public Value in Innovative Urban Systems. In *Breakthroughs in Smart City Implementation*.
- Diop, K. A. S., & Liu, E. (2020). Categorization of case in case study research method: new approach. *Knowledge and Performance Management*, 4(1).
[https://doi.org/10.21511/kpm.04\(1\).2020.01](https://doi.org/10.21511/kpm.04(1).2020.01)
- Doloi, H., Green, R., & Donovan, S. (2018). Planning, Housing and Infrastructure for Smart Villages. In *Planning, Housing and Infrastructure for Smart Villages*.
<https://doi.org/10.1201/9781351261081>
- Dudek-Klimiuk, J., & Warzecha, B. (2021). Intelligent urban planning and ecological urbanscape-solutions for sustainable urban development. Case study of wolfsburg. *Sustainability (Switzerland)*, 13(9). <https://doi.org/10.3390/su13094903>
- Ekka, P. M. (2021). A review of observation method in data collection process. *IJRTI International Journal for Research Trends and Innovation*, 6(12).
- Fennell, S., Kaur, P., Jhunjhunwala, A., Narayanan, D., Loyola, C., Bedi, J., & Singh, Y. (2018). Examining linkages between Smart Villages and Smart Cities: Learning from rural youth accessing the internet in India. *Telecommunications Policy*, 42(10).
<https://doi.org/10.1016/j.telpol.2018.06.002>
- Guimond, L., & Simard, M. (2010). Gentrification and neo-rural populations in the Québec countryside: Representations of various actors. *Journal of Rural Studies*, 26(4).
<https://doi.org/10.1016/j.jrurstud.2010.06.002>
- Guzal-Dec, D. (2018). Intelligent Development of the Countryside – The Concept of Smart Villages : Assumptions, Possibilities and Implementation Limitations . *Economic and Regional Studies / Studia Ekonomiczne i Regionalne*, 11(3). <https://doi.org/10.2478/ers-2018-0023>
- Hedlund, M. (2016). Mapping the Socioeconomic Landscape of Rural Sweden: Towards a Typology of Rural Areas. *Regional Studies*, 50(3). <https://doi.org/10.1080/00343404.2014.924618>
- Herrero-Jáuregui, C., & Concepción, E. D. (2023). Effects of counter-urbanization on Mediterranean rural landscapes. *Landscape Ecology*, Vol. 38. <https://doi.org/10.1007/s10980-023-01756-1>
- Huang, G. (2017). Modeling Urban Spatial Growth in Mountainous Regions of Western China. *Mountain Research and Development*, 37(3). <https://doi.org/10.1659/MRD-JOURNAL-D-16-00078.1>
- Hussein, A. (2009). The use of Triangulation in Social Sciences Research. *Journal of Comparative Social Work*, 4(1). <https://doi.org/10.31265/jcsw.v4i1.48>
- Jia, K., Huang, A., Yin, X., Yang, J., Deng, L., & Lin, Z. (2023). Investigating the Impact of Urbanization on Water Ecosystem Services in the Dongjiang River Basin: A Spatial Analysis. *Remote Sensing*, 15(9). <https://doi.org/10.3390/rs15092265>
- Jolley, G. J., Lane, E. B., & Brun, L. C. (2011). Journal of Rural and Community Development Economic Development Planning In Bedroom Communities: A Case Study of Chatham County, North Carolina. *Journal of Rural and Community Development*, 6(1).
- Kamruzzaman, P., & White, S. C. (2018). Empowerment and Community Participation. In *The International Encyclopedia of Anthropology*.
<https://doi.org/10.1002/9781118924396.wbiea2062>
- Kemendes PDTT. (2018). Kemendes PDTT dan Forum PERTIDES Matangkan Sinergi Nyata Pembangunan Desa. Retrieved February 2, 2024, from

- <https://www.kemendes.go.id/berita/view/detil/2412/kemendes-pdtt-dan-forum-pertides-matangkan-sinergi-aksi-nyata-pembangunan-des>
- Kemendes PDTT. (2021). Program Smart Village Harus Berkelanjutan. Retrieved February 1, 2024, from <https://www.kemendes.go.id/berita/view/detil/4113/program-smart-village-harus-berkelanjutan>
- Komorowski, L. (2022). Smart Initiatives in a Suburban Community: An Example from the Holy Cross Mountains in Poland. *Mountain Research and Development*, 42(1). <https://doi.org/10.1659/MRD-JOURNAL-D-21-00037.1>
- Komorowski, Ł., & Stanny, M. (2020). Smart villages: Where can they happen? *Land*, 9(5). <https://doi.org/10.3390/LAND9050151>
- Kusio, T., Rosiek, J., & Conto, F. (2022). Urban–Rural Partnership Perspectives in the Conceptualization of Innovative Activities in Rural Development: On Example of Three-Case Study Analysis. *Sustainability (Switzerland)*, 14(12). <https://doi.org/10.3390/su14127309>
- Lakshmanan, V. I., Chockalingam, A., Murty, V. K., & Kalyanasundaram, S. (2021). Smart Villages: Bridging the Global Urban-Rural Divide. In *Smart Villages: Bridging the Global Urban-Rural Divide*. <https://doi.org/10.1007/978-3-030-68458-7>
- Li, M. (2021). Rural-urban migration, urban-rural migration and urbanization in China. *ACM International Conference Proceeding Series*. <https://doi.org/10.1145/3481127.3481137>
- Majumdar, S. (2020). Developing Integrated SMART Villages for Rural Transformation in Response to Sustainable Development Goals. *Africa Journal of Technical and Vocational Education and Training*, 5(1).
- Malik, A. (2022). Pendidikan Islam Moderat Kelompok Islam Transnasional; Critical Pedagogy pada Pola Pendidikan Jama'ah Tabligh di Indonesia. *Journal on Education*, 4(4), 2002–2018.
- Md. Faysal Ahmed. (2014). Urbanization and Environmental Problem : An Empirical Study. *Journal International Institute for Science, Technology and Education*, 4(3).
- Mekonen, E. K. (2022). Drivers of rising residential house rent in Wolkite town, Gurage zone, Ethiopia. *Cogent Social Sciences*, 8(1). <https://doi.org/10.1080/23311886.2022.2087328>
- Muhtar, E. A., Abdillah, A., Widianingsih, I., & Adikancana, Q. M. (2023). Smart villages, rural development and community vulnerability in Indonesia: A bibliometric analysis. *Cogent Social Sciences*, 9(1). <https://doi.org/10.1080/23311886.2023.2219118>
- Nieto, E., & Brosei, P. (2019). The Role of LEADER in Smart Villages: An Opportunity to Reconnect with Rural Communities. In *Smart Villages in the Eu and Beyond*. <https://doi.org/10.1108/978-1-78769-845-120191006>
- Paniagua, A. (2020). Smart Villages in Depopulated Areas. In *Modeling and Optimization in Science and Technologies (Vol. 17)*. https://doi.org/10.1007/978-3-030-37794-6_20
- Peraturan Pemerintah RI. (2014). Undang-undang (UU) Nomor 6 Tahun 2014 tentang Desa. <https://doi.org/https://peraturan.bpk.go.id/Details/38582/uu-no-6-tahun-2014>
- Peraturan Pemerintah RI. (2016). Peraturan Menteri Desa, Pembangunan Daerah Tertinggal, dan Transmigrasi Nomor 2 Tahun 2016 tentang Indeks Desa Membangun. Jakarta: Pemerintah Indonesia. Retrieved from <https://peraturan.bpk.go.id/Details/150585/permentdes-pdtt-no-2-tahun-2016>
- Puthal, D., Mohanty, S. P., Wilson, S., & ... (2021). Collaborative edge computing for smart villages [energy and security]. *IEEE Consumer ...*
- Ramachandra, T. V., Bharath, A. H., & Sowmyashree, M. V. (2015). Monitoring urbanization and its implications in a mega city from space: Spatiotemporal patterns and its indicators. *Journal of Environmental Management*, 148. <https://doi.org/10.1016/j.jenvman.2014.02.015>
- Recha, J. W., Ambaw, G., Nigussie, A., Radeny, M., & Solomon, D. (2022). Soil Nutrient Contents in East African Climate-Smart Villages: Effects of Climate-Smart Agriculture Interventions. *Agriculture (Switzerland)*, 12(4). <https://doi.org/10.3390/agriculture12040499>
- Salamon, S. (2003). From hometown to nontown: Rural community effects of suburbanization. *Rural Sociology*, 68(1). <https://doi.org/10.1111/j.1549-0831.2003.tb00126.x>
- Satoła, Ł., & Milewska, A. (2022). The Concept of a Smart Village as an Innovative Way of Implementing Public Tasks in the Era of Instability on the Energy Market—Examples from Poland. *Energies*, Vol. 15. <https://doi.org/10.3390/en15145175>
- Shi, G., Lu, X., Zhang, H., Zheng, H., Zhang, Z., Chen, S., ... Wang, S. (2022). Air pollutant emissions induced by rural-to-urban migration during China's urbanization (2005–2015). *Environmental Science and Ecotechnology*, 10. <https://doi.org/10.1016/j.ese.2022.100166>
- Singh, C., & Rahman, A. (2018). Urbanising the Rural: Reflections on India's National Rurban Mission. *Asia and the Pacific Policy Studies*, 5(2). <https://doi.org/10.1002/app5.234>

- Suryanarayanan, B., Prabhakar, R. B., Venkadesh, T., & Kaythry, P. (2021). Letting Villages Go Smart in Indian Scenario. IEEE Region 10 Annual International Conference, Proceedings/TENCON, 2021-December. <https://doi.org/10.1109/TENCON54134.2021.9707268>
- Tapa, A., & Mohd Noor, N. W. (2021). The Impact of Transportation and Walkability on Residential Property Value. *Indian-Pacific Journal of Accounting and Finance*, 5(3). <https://doi.org/10.52962/ipjaf.2021.5.3.130>
- Torre, A., Corsi, S., Steiner, M., Wallet, F., & Westlund, H. (2021). Smart development for rural areas. In *Smart Development for Rural Areas*. <https://doi.org/10.4324/9780429354670>
- Turgel, I., Pobedin, A., & Bozhko, L. (2020). Spatial socio-economic heterogeneity of rural areas in the Russian Federation. *E3S Web of Conferences*, 222. <https://doi.org/10.1051/e3sconf/202022206022>
- Vaishar, A., & Št'astná, M. (2019). Smart Village and Sustainability. Southern Moravia Case Study. *European Countryside*, 11(4). <https://doi.org/10.2478/euco-2019-0036>
- van Gevelt, T., Canales Holzeis, C., Fennell, S., Heap, B., Holmes, J., Hurley Depret, M., ... Safdar, M. T. (2018). Achieving universal energy access and rural development through smart villages. *Energy for Sustainable Development*, 43. <https://doi.org/10.1016/j.esd.2018.01.005>
- Visvizi, A., & Lytras, M. D. (2020). Sustainable smart cities and smart villages research: Rethinking security, safety, well-being, and happiness. *Sustainability (Switzerland)*, Vol. 12. <https://doi.org/10.3390/su12010215>
- Visvizi, A., Lytras, M. D., & Mudri, G. (2019). SMART VILLAGES IN THE EU AND BEYOND. In *Smart Villages in the Eu and Beyond*. <https://doi.org/10.1108/9781787698451>
- Wahyu, A., Suharjito, D., Darusman, D., & Syaufina, L. (2022). Assessment of Village and Community Forest Sustainability: Evidence from the Local Level. *International Journal of Sustainable Development and Planning*, 17(6). <https://doi.org/10.18280/ijstdp.170609>
- Weingarten, P., Neumeier, S., Copus, A., Psaltopoulos, D., Skuras, D., & Balamou, E. (2010). Building a Typology of European Rural Areas for the Spatial Impact Assessment of Policies (TERA-SIAP). In *Jrc*.
- Wolski, O. (2018). Smart Villages in EU Policy: How to Match Innovativeness and Pragmatism? *Wiś i Rolnictwo*, (4 (181)). <https://doi.org/10.53098/wir042018/09>
- Wysocka, D., Biegańska, J., & Grzelak-Kostulska, E. (2022). IDENTIFICATION AND EVALUATION OF THE MAIN PROBLEMS OF SUBURBAN ZONE DEVELOPMENT IN PLANNING AND STRATEGIC DOCUMENTS. A CASE STUDY OF BYDGOSZCZ AND TORUN POWIATS. *Czasopismo Geograficzne*, 93(1). <https://doi.org/10.12657/czageo-93-04>
- Yeasmin, S., & Rahman, K.F. (2012). 'Triangulation' Research Method as the Tool of Social Science Research. *Bup Journal*, 1(1).
- Zhang, X., & Zhang, Z. (2020). How do smart villages become a way to achieve sustainable development in rural areas? Smart village planning and practices in China. *Sustainability (Switzerland)*, 12(24). <https://doi.org/10.3390/su122410510>