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Smart Village Development Strategy In Pakuli Village, Sigi Regency, Central Sulawesi Province

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ABSTRACT

Smart village has become an important policy instrument for rural development in Indonesia, yet empirical evaluations of its implementation, particularly outside Java, remain limited. This study aims to (1) identify the potentials and challenges of smart village implementation, (2) determine development priorities, and (3) formulate strategic recommendations for Pakuli Village, Gumbasa District, Sigi Regency, Central Sulawesi. A mixed methods explanatory sequential design was applied using scoring analysis, the Cobweb Model, Gap Analysis, and SWOT Analysis. Data were collected through questionnaires from 25 purposively selected respondents, field observations, interviews, and documentation. The instrument covered seven smart village dimensions and 17 indicators, demonstrating acceptable validity (r = 0.421–0.821) and high reliability (Cronbach's Alpha = 0.92). The findings indicate that Pakuli Village remains in the Poor category (mean = 2.23), with only Smart Living (3.84) and Smart Governance (3.51) classified as Good. Gap Analysis identifies Smart Tourism, Smart Economy, Smart People, and Smart Environment as very high priorities, while Smart Mobility is a high priority. SWOT analysis recommends a WO strategy emphasizing digital literacy, village-owned enterprise revitalization, environmental management, and tourism awareness development

INTRODUCTION

The development of information and communication technology (ICT) has driven fundamental transformations in development governance at various levels, including at the village level. One concrete manifestation of the use of technology in local governance is the development of smart villages (Hadian & Susanto, 2022). Conceptually, a smart village is an innovative effort to develop rural areas by utilizing ICT to improve the quality of life, efficiency, and competitiveness of the community in economic, social, and environmental aspects (Herdiana, 2019). The concept of a smart village is an adaptation of the smart city framework developed by Giffinger et al. (2007) thru research on medium-sized cities in Europe, which includes six main characteristics: smart governance, smart economy, smart mobility, smart environment, smart people, and smart living. Adapting to the rural context requires fundamental adjustments because the characteristics of villages differ significantly from urban areas, both in terms of population density, infrastructure availability, and human resource capacity (Gerli et al., 2022). Herdiana (2019) simplified the framework into three main elements of a smart village, namely smart government, smart community, and smart environment, which interact with each other based on the utilization of ICT.

In Indonesia, smart villages have transformed from academic discourse into concrete policy instruments. Central Sulawesi Province has enacted Governor Regulation Number 44 of 2022 concerning the Implementation of the Smart Village Program for 2022–2026, which designates twelve pilot villages,

one of which is Pakuli Village in Gumbasa District, Sigi Regency. The designation of this pilot status positions Pakuli Village as a strategic locus for evaluating the extent to which the smart village policy is implemented at the grassroots level.

Desa Pakuli has strong agrarian characteristics with 43.90% of the population working as farmers, supported by 470 hectares of agricultural land and 513 hectares of forest area. The main commodities include rice, corn, and cocoa. In addition to its agricultural potential, this village has a tourism asset in the form of a Traditional Medicinal Garden with a collection of herbal plants and local knowledge that holds high authenticity value. However, this potential is faced with several limitations, including uneven access to technology, low human resource capacity with 57.09% of the population having only elementary school education, and infrastructure that has not yet reached all villages.

Studies on smart villages in Indonesia have developed rapidly, but most are still concentrated on the island of Java, which has relatively more established infrastructure and human resource capacity (Muhtar et al., 2023). The significant digital divide between Java and outside Java causes the findings from these studies to not be fully applicable to the context of villages outside Java (Susilowati et al., 2024). Moreover, most smart village research still stops at the stage of descriptively identifying conditions and has not yet integrated the measurement of actual conditions, gap-based prioritization, and strategy formulation into a systematic analysis flow (Hadian & Susanto, 2022). This condition indicates a research gap, both in terms of the coverage of the study area and the completeness of the methodological flow.

Starting from these gaps, this research offers three novelties. First, this research presents an empirical study of smart villages in Central Sulawesi Province, which has not been extensively researched, especially after the enactment of Governor Regulation Number 44 of 2022, so that the results can provide direct feedback for the implementation of regional policies. Second, this research applies a tiered analysis flow that integrates scoring analysis, Gap Analysis, and SWOT analysis within a Mixed Methods Explanatory Sequential framework, so that the determination of priorities and development strategies has a measurable and verifiable quantitative basis. Third, this research adapts the framework of the six elements of a smart village by adding the Smart Tourism dimension in response to the local potential of Pakuli Village, which provides a conceptual contribution to the development of a more contextual and region-based smart village assessment instrument. Therefore, the research aims to achieve three objectives: (1) to identify the potential and issues in the implementation of the smart village concept in Pakuli Village based on the seven elements of a smart village, (2) to determine the elements and indicators that should be prioritized for development thru Gap Analysis, and (3) to formulate optimal and sustainable smart village development strategies thru SWOT analysis

METHODS

Research Location

The research was conducted in Pakuli Village, Gumbasa District, Sigi Regency, Central Sulawesi Province. Sigi Regency is located in the western part of Central Sulawesi Province, bordering Palu City to the north and Donggala Regency to the west. Topographically, Pakuli Village is located in a region of plains to hills, with some hamlets situated in highlands that have limited accessibility.

The selection of Pakuli Village as the research location is based on two considerations. First, this village is one of the twelve pilot villages of the Smart Village program in Central Sulawesi Province based on Governor Regulation Number 44 of 2022, thus having high policy relevance. Second, this village has a unique combination of agricultural and tourism potential but faces limitations in human resource capacity, making it a representation of conditions commonly found in villages outside Java Island.

Type and Technique of Data Collection

This research uses the Mixed Methods Explanatory Sequential Design approach, which is an approach that integrates quantitative and qualitative data sequentially within a single research framework (Creswell & Creswell, 2018). The

quantitative phase is conducted first to produce a profile of the actual conditions and priority rankings, followed by the qualitative phase to explain the causes of the gaps and formulate development strategies. The integration of the two phases is carried out thru two points, namely the results of the Gap Analysis that direct the focus of qualitative deepening, and the intersection of internal and external factors in the SWOT matrix.

Data collection is conducted thru four complementary techniques. Questionnaires were distributed to 25 purposively selected respondents from five stakeholder groups, namely village government, sub-district and district government, community leaders, business actors, and the general public. Semi-structured in-depth interviews were conducted with key informants who were considered to have the best understanding of the smart village program. Structured field observations were conducted based on indicators for each element to observe the physical and non-physical conditions of the village. Documentation was carried out to collect secondary data in the form of policy documents, village profiles, and statistical data.

The research instrument adapts the framework of six smart city elements from Giffinger et al. (2007), which is combined with the three main elements of smart village from Herdiana (2019), and then expanded with the Smart Tourism dimension based on Hanum et al. (2020). The addition of Smart Tourism is based on its relevance to the local potential of Pakuli Village in the form of a Traditional Medicine Garden. The resulting framework includes seven elements with a total of 17 indicators as presented in Table 1.

Table 1. Elements and Indicators of Research

No	Elements	Indicators
1	Smart Governance	Digital public services, information transparency, community participation
2	Smart Economy	Digital entrepreneurship, innovation, and digital training
3	Smart Mobility	Road accessibility, public transportation, ICT and GIS infrastructure
4	Smart Environment	Waste management, energy efficiency, greening, and conservation
5	Smart People	Digital literacy and education, citizen participation and creativity
6	Smart Living	Health and education, internet access, public facilities
7	Smart Tourism	Management and promotion of tourism

Source: Adaptation from Giffinger et al. (2007), Herdiana (2019), and Hanum et al. (2020)

The assessment of each indicator uses a Likert scale from 1 to 5 with criteria arranged in the form of an operational rubric. The criteria at each score level are formulated using measurable metrics such as coverage percentage, activity frequency, or unit count, so that respondents' interpretations of each score level become uniform. The instrument's validity was tested using the Pearson Product Moment correlation technique with a table value of r equal to 0.396 ($n = 25$; $\alpha = 0.05$), and the results showed that all 17 items were declared valid with calculated r values ranging from 0.421 to 0.821. The reliability test using the Cronbach Alpha method resulted in an α value of 0.92, exceeding the minimum threshold of 0.60, thus the instrument is declared reliable (Sugiyono, 2019).

Data Analysis

Data analysis is conducted thru a tiered process consisting of four stages. The first stage is scoring analysis to map the condition of each element based on the average rating value of the respondents, with categorization following the class intervals as presented in Table 2.

Table 2. Category Based on Score Range

Score Range	Categories	Descriptions
1,00 – 1,80	Very Bad	Not yet implemented or at the very early stage
1,81 – 2,60	Bad	Not going well yet
2,61 – 3,40	Moderate	Running but needs significant improvement
3,41 – 4,20	Good	Going well but still room for improvement
4,21 – 5,00	Excellent	Has been carried out optimally

Source: Sugiyono (2019)

The second stage is visualization using the Cobweb Model, which is used solely as an instrument for visualizing multi-element profiles, not as a prioritization tool. The third stage is Gap Analysis, which serves as a prioritization instrument, with the gap calculated as the difference between the ideal condition (5.00) and the actual condition. Elements with the largest gap value are designated as the highest development priority because they require the most urgent intervention (Rangkuti, 2017). The categorization of priority levels is determined using class intervals with a gap range of 0.00 to 4.00, divided into four categories as presented in Table 3.

Table 3. Categorization of Gap Priority Levels

Gap Range	Priority Level	Policy Response
3,01 – 4,00	Very High	Immediate intervention and priority investment
2,01 – 3,00	Hight	Needs immediate attention within 1–2 years.
1,01 – 2,00	Medium	Gradual improvement in the village program
0,00 – 1,00	Low	Maintained as a strength

Source: Researcher modification based on Rangkuti (2017) & Sugiyono (2019)

The fourth stage is SWOT analysis to formulate development strategies. Internal factors in the form of strengths and weaknesses are directly derived from the scoring analysis and Gap Analysis results, while external factors in the form of opportunities and threats are obtained from strategic environment analysis thru interviews and observations. SWOT analysis is conducted qualitatively without the inclusion of IFAS and EFAS weighting. The use of a qualitative approach in SWOT analysis is a common and methodologically accepted practice, especially in research aimed at formulating alternative regional development strategies based on local conditions (Gürel & Tat, 2017; Benzaghta et al., 2021). The main consideration is that the weighting function has already been performed in the previous stage thru Gap Analysis, so the application of additional weighting would result in double weighting of the same construct.

RESULTS AND DISCUSSION

Condition of Smart Village Implementation

The assessment results from 25 respondents on the seven elements of the smart village indicate that the implementation in Pakuli Village overall falls

into the Poor category with an average score of 2.23 out of a maximum score of 5.00. Recapitulation of the scoring analysis results is presented in Table 4.

Table 4. Recapitulation of Smart Village Scoring Analysis for Pakuli Village

No	Smart Village Element	Mean	Categories
1	Smart Governance	3,51	Good
2	Smart Economy	1,52	Very Bad
3	Smart Mobility	2,09	Bad
4	Smart Environment	1,65	Very Bad
5	Smart People	1,54	Very Bad
6	Smart Living	3,84	Good
7	Smart Tourism	1,48	Very Bad
	Mean Total	**2,23**	**Buruk**

Source: Analysis Results, 2026

Table 4 shows that only two elements reached the Good category. Smart Living received the highest score of 3.84, supported by the availability of educational facilities in the form of two elementary schools, one junior high school, and one senior high school, as well as health facilities in the form of a Community Health Center, a Village Health Post, and a Community Health Post. Smart Governance received a score of 3.51, reflecting a fairly good governance foundation, marked by the presence of an active village website and transparency in village fund management thru public information media.

On the other hand, the other five elements fall into the Poor to Very Poor category. Smart Tourism received the lowest score of 1.48, reflecting that the potential of the Traditional Medicine Garden has not been managed professionally and has not been promoted thru digital channels. Smart Economy received a score of 1.52, indicating that a digital economy ecosystem has not yet been formed, marked by the inactivity of Village-Owned Enterprises and the absence of online marketing platforms for flagship products. Smart People received a score of 1.54, reflecting the low digital literacy of the community. Smart Environment received a score of 1.65 due to the lack of waste management systems, renewable energy programs, and institutionalized conservation activities. Smart Mobility received a score of 2.09, indicating limited connectivity between villages and the absence of a public transportation system.

Qualitative findings provide important explanations for that pattern. Interview results revealed that the previously available digital administration services had to be discontinued due to the community's low ability to utilize them. Similarly, the public internet network that has been installed has not been optimally utilized by the majority of residents. This condition shows that the availability of digital infrastructure does not automatically correlate with its utilization rate, in line with the findings of Susilowati et al. (2024) that the digital divide outside Java is more determined by the limitations of human capacity rather than the availability of physical infrastructure.

Visualization using the Cobweb Model reinforces that interpretation. The spider web profile that forms shows a distinct two-layer pattern, where the two axes, Smart Living and Smart Governance, stretch close to the ideal point while the other five axs are drawn toward the center point. This pattern confirms that the performance gap of the smart village in Pakuli Village is not uniform, but rather polarized between two elements that are relatively mature and five elements that are still in the early stages of development.

Development Priority Scale

Gap Analysis is conducted to transform descriptive findings into a measurable hierarchy of priorities. The order of priority is entirely derived from the calculation of the difference between the ideal condition and the actual condition, not from the subjective assessment of the researcher. The results of the Gap Analysis along with the priority rankings are presented in Table 5.

Table 5. Gap Analysis Results and Development Priority Ranking

Rank	Element	Value	Gap	Priority Level
1	Smart Tourism	1,48	**3,52**	Very High
2	Smart Economy	1,52	**3,48**	Very High
3	Smart People	1,54	**3,46**	Very High
4	Smart Environment	1,65	**3,35**	Very High
5	Smart Mobility	2,09	**2,91**	High
6	Smart Governance	3,51	**1,49**	Medium
7	Smart Living	3,84	**1,16**	Medium

Source: Analysis Results, 2026

Table 5 shows that the top four elements form a Very High priority cluster with a tight gap range, namely between 3.35 and 3.52. This density indicates that the four elements are a unified set of interrelated structural issues, rather than a sequence that is far apart from each other. The implication is that interventions on these four elements should be designed simultaneously and supportively, rather than partially and sequentially.

Smart Tourism ranks first with a gap of 3.52. This figure reflects the most extreme paradox in the village profile, where the Traditional Medicine Garden has an authenticity value that cannot be replicated by other villages, yet lacks official management, digital promotion, and basic tourism infrastructure. From a policy perspective, this condition demands immediate intervention because local wisdom-based tourism is a relatively realistic path to creating economic added value without requiring large infrastructure investments. These findings are in line with Utami et al. (2023), who identified the authenticity of local products, community engagement, and the utilization of digital platforms as key factors in the success of village tourism entrepreneurship.

Smart Economy ranks second with a gap of 3.48, displaying a similar paradox on a larger scale. Although 43.90% of the population earns a living as farmers with high-value commodities such as cocoa and herbal plants, the absence of a digital marketing ecosystem and the inactivity of Village-Owned Enterprises cause farmers to be entirely dependent on middlemen with a weak bargaining position. These findings are consistent with Tosida et al. (2022), who demonstrated that technology-based village development significantly impacts the economic performance of villages thru the digitalization of the agricultural value chain.

The most important analytical finding of this research lies in the position of Smart People. Quantitatively, this element ranks third with a gap of 3.46, but substantively, it functions as a driving factor that influences the condition of all other elements. Empirical evidence shows that low digital literacy, reflected in 57.09% of the population being educated only to the elementary school level, directly hinders or sabotages initiatives in all four elements simultaneously. Smart Governance digital services were halted because residents were unable to use them, the Smart Economy marketplace did not form

because farmers were not yet accustomed to online platforms, the Smart Living public internet network was not utilized optimally, and Smart Tourism digital promotion did not proceed due to a lack of management capacity.

The position of Smart People is important to emphasize because it shows that quantitative rankings and strategic significance do not always align. In the applied mixed methods framework, field observations and interviews do not serve to change the priority order of the Gap Analysis results, but rather provide causal explanations that deepen the understanding of the generated numbers. Thus, Smart People can be positioned as the root of cross-dimensional problems, while elements with larger gaps are the most tangible manifestations of these issues as felt by the community.

Smart Environment with a gap of 3.35 completes the Very High priority cluster. The absence of a waste management system, renewable energy programs, and institutionalized environmental conservation are the main causes. Considering that the village has a forest area of 513 hectares and an agricultural land area of 470 hectares, environmental management is an ecological prerequisite for the sustainability of agricultural productivity, which is the basis of the Smart Economy. A community-based approach to environmental management has proven to be more effective and sustainable in the rural context (Ariyaningsih & Shaw, 2023). As for Smart Mobility with a gap of 2.91, it falls into the High Priority category, while Smart Governance with a gap of 1.49 and Smart Living with a gap of 1.16 are established as strengths that serve as development capital.

Development Strategy

SWOT analysis is compiled as a synthesis stage that brings together all previous findings into a single strategic framework. Internal factors are directly derived from the scoring results and Gap Analysis, so each factor has a verifiable data basis. Smart Living and Smart Governance are established as strengths, while the five elements with high gaps are identified as weaknesses. External factors are obtained from strategic environmental analysis, including the support of Governor Regulation Number 44 of 2022, the availability of partnerships with universities and non-governmental organizations, as well as the development of digital technology as opportunities. The threats include disparities in digital access between villages, the risk of natural disasters, low regeneration of young farmers, and potential environmental damage. A summary of the four groups of strategies is presented in Table 6.

Table 6. Summary of Strategy from SWOT Analysis

Strategy Group	Strategy Focus
SO (Agressive)	Digitalization of the value chain of village flagship products thru e-commerce platforms and the development of edutourism based on Traditional Medicine Gardens, utilizing existing infrastructure and provincial policy support.
WO (Conservative)	The organization of digital literacy training thru the Village Digital House, the reactivation of Village-Owned Enterprises as the engine of the digital marketplace, the development of community-based environmental management, and the formation of the Tourism Awareness Group.
ST (Diversification)	Expansion of internet coverage to all remote villages, economic diversification thru the integration of modern agriculture and herbal agrotourism, and programs for the regeneration of young farmers.

Strategy Group	Strategy Focus
WT (Defensive)	Development of village information systems based on geographic information systems and strengthening the institutional capacity of villages to ensure the sustainability of programs independently.

Source: Analysis Results, 2026

Based on the synthesis of all research findings, the WO strategy was established as the group of strategies most worthy of prioritization in the initial implementation. This determination is based on four mutually reinforcing arguments. First, from the perspective of the urgency of the problem, five out of seven elements fall into the Poor to Very Poor category, so the internal profile of the village is more characterized by structural weaknesses than strengths. In such conditions, a strategy that can systematically address weaknesses is more realistic than a strategy that only optimizes existing strengths.

Second, from the perspective of resource readiness and external opportunities, the support of Governor Regulation Number 44 of 2022, technical assistance from relevant agencies, and the availability of partnerships with universities are real opportunities that are currently open. The WO strategy is the only group that directly utilizes that opportunity to address internal weaknesses. Third, from the perspective of cross-element impact, the digital literacy training program as the core of the WO strategy not only addresses the weaknesses of Smart People but simultaneously creates prerequisites for the success of interventions in Smart Governance, Smart Economy, Smart Tourism, and Smart Mobility. Fourth, from the perspective of independence and sustainability, the establishment of Digital Village Houses, the reactivation of Village-Owned Enterprises, and the formation of Tourism Awareness Groups are aimed at building internal institutional capacity that can operate independently after external assistance ends.

The SO strategy is recommended to run in parallel as a complementary step that utilizes existing strengths, while the ST and WT strategies are positioned as medium-term agendas that are gradually reinforced after the foundation of human resource and institutional capacity is built. This implementation sequence emphasizes that the development of smart villages in villages with limited capacity cannot directly focus on technical digitization, but must be preceded by strengthening literacy and institutions as prerequisites.

The findings of this research provide three implications for the implementation of smart village policies at the regional level. First, the designation of model villages should be accompanied by a measurable initial condition assessment so that interventions are not uniform across all villages with different characteristics. Second, program allocation should be directed simultaneously to priority clusters, considering that the elements within those clusters are structurally interconnected. Third, the success indicators of the program should include the level of digital service utilization by the community, not just the availability of infrastructure, as findings show that these two are not directly proportional.

CONCLUSION

The implementation of the smart village concept in Pakuli Village is still categorized as Poor with an average score of 2.23, where only the Smart Living and Smart Governance elements have reached the Good category.

The village has potential in the form of abundant natural resources, adequate basic facilities, and relatively good governance, but still faces various obstacles, including low digital literacy among the community, the underdevelopment of the digital economy, weak environmental management, and the suboptimal development of the tourism sector.

The results of the Gap Analysis show that Smart Tourism, Smart Economy, Smart People, and Smart Environment are the main development priorities, while the SWOT analysis identifies the WO strategy

as the most appropriate implementation strategy thru strengthening digital literacy, revitalizing BUMDes, community-based environmental management, and developing tourism institutions. Based on these findings, the Sigi Regency Government and the Pakuli Village Government need to focus policies and resource allocation on the development of these priority elements, supported by collaboration with universities, the private sector, and the community. Further research is recommended to involve a broader range of respondents and to use longitudinal or comparative approaches to gain a more comprehensive understanding of the implementation of smart villages in various regions..

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