

Research Paper: A Qualitative Meta-Analysis of Smart Village Dimensions

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ABSTRACT

Purpose: This research aims to examine and conduct a qualitative meta-analysis of studies on the dimensions of smart villages worldwide.

Methods: Through qualitative analysis, 47 research articles published between 2016 and 2024 on “smart villages” were retrieved from academic databases and analyzed using documentary and library-based research methods to meet the study’s objectives. Further, various dimensions such as environmental, governance, economic, social (people), educational, agricultural, and health and well-being were examined.

Results: The results showed that stakeholder participation, empirical research, and government intervention are essential for establishing smart villages. Furthermore, the development and expansion of smart villages require collaboration among villagers, government officials, and experts to more effectively identify and address local needs.

Conclusion: For the establishment and sustainability of smart villages, modern technologies must be appropriate for the rural context, affordable, efficient, and user-friendly, while also preserving the valuable aspects of rural life and promoting sustainable development. These findings contribute to the enrichment of theoretical studies on smart villages.

1. Introduction

In the 21st century, information and communication technology (ICT) and subsequent digital transformation are among the most significant drivers of change and

development. The profound impact of these technological advancements on people’s lives is such that neglecting them could lead to major social disruptions. Therefore, to mitigate these disruptions and help improve rural quality of life, create economic opportunities, ensure environmental sustainability, and enable rural com-

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munities to benefit from modern technologies, the smart village approach appears to be a promising solution.

The complex and evolving structure of rural areas in the current century, characterized by urbanization, population aging, and technological advancement, faces numerous challenges in maintaining and adapting to sustainable development standards (Bokun & Nazarko, 2023; EC, 2023). Therefore, to address these challenges through technological development and its resulting transformations, efforts to create an information society, promote technological advancements, and encourage digitalization over the past decade (Komorowski & Stanny, 2020; Sobczyk, 2014) have been prioritized by governments. Attention has shifted to policies aimed at empowering rural populations, enhancing the sustainability of rural life, and facilitating the transition of rural communities toward self-sufficiency through smart development (Adesipo et al., 2020; Liu & Liu, 2016).

Since the development of smart villages can enhance the self-sufficiency of rural areas and contribute to rural revitalization (Adesipo et al., 2020), rural development experts have emphasized strengthening learning systems, increasing knowledge, and fostering active stakeholder participation to empower rural communities through smart solutions. They have also highlighted the importance of recognizing local capacities in information and communication technologies in rural regions, as understanding these capacities accelerates the progress toward achieving sustainable development goals and rural empowerment through smart development (Adamowicz & Zwolinska, 2020).

In implementing sustainable development programs, a smart village seeks to enhance resilience, improve quality of life, expand service accessibility, boost competitiveness, and strengthen future-oriented local communities by leveraging and optimizing existing rural resources. It aims to foster constructive interaction between smart systems and social structures to achieve rural sustainability across multiple dimensions, environmental, health, renewable energies, education, and public awareness, with the active participation of rural residents (Zhang & Zhang, 2020; European Commission EU, 2020; Holmes & Thomas, 2015; Vadivel et al., 2017).

Nevertheless, smart villages offer hope that, by harnessing the power of technology and innovation, fundamental transformations can be achieved in rural communities (Harakalova, 2018). Smart development has the potential to more effectively address the challenges and deficiencies of rural areas (Saeedi, 2009), serving

as tools to reduce poverty, bridge the digital divide, and mitigate uncontrolled rural-to-urban migration (Razavi Mashouf et al., 2018).

Accordingly, in the European Union, although the concept of smart villages was relatively new in policy documents, by 2017, smart villages had been introduced as a key mechanism to implement rural development strategies in remote and sparsely populated areas (ENRD Smart Villages, 2018, 2019; Budziewicz-Guźlecka & Drozd, 2022). According to the European Network for Rural Development (ENRD), smart villages enhance their resilience through innovative measures and are built upon local strengths and opportunities (Chowdhury et al., 2023). These villages seek practical solutions to key challenges, particularly in areas such as internet connectivity, telecommunications, and digital access to information (Komorowski & Stanny, 2020). Digital access expands participation in governance and policymaking at all levels by increasing socio-political awareness, improving digital literacy, and enhancing individual skills, while also ensuring adequate access to digital infrastructure and smart solutions. Beyond facilitating smart transformation, it plays a crucial role in revitalizing rural areas and empowering communities (Patnaik et al., 2020).

Undoubtedly, achieving the objectives of establishing smart villages requires not only sustainable financial resources and appropriate infrastructure but also improvements in individuals' educational levels. In the near future, there will be a significant demand for specialists capable of utilizing smart tools and systems to enhance residents' comfort, safety and productivity (Yang & Lam, 2021; Khmel'nitskaya & Bogdanova, 2021). Additionally, the role of local governance and community participation should not be overlooked (Sutriadi, 2018). Although regional governments have not yet sufficiently prioritized rural development, addressing key obstacles, such as inadequate infrastructure, poor connectivity, limited human resources, and restrictive regulations, is essential for establishing smart villages (Fennell et al., 2018). The rural development process should be driven by smart development through the active participation of local communities.

While the term "smart villages" lacks a universally accepted definition (Cvar et al., 2020), it is often regarded in rural planning as an ideological and strategic framework. Smartness entails strategic orientations, with governments and public institutions at various levels adopting the concept to inform programs and policies aimed at sustainable development, economic growth, improved quality of life for rural residents, and enhanced well-be-

ing (Albino et al., 2015). A smart village is essentially a region in which digital technologies are utilized to deliver essential services to residents and businesses (Bogataj et al., 2021). As fundamental human rights become increasingly linked to digital inclusion, sustainable services function as key enablers of development.

To better manage resources, sensor networks and the Internet of Things (IoT) are used as data-gathering infrastructure in buildings (Ransing & Rajput, 2015; Colnar et al., 2020; Marchenko & Temeljotov-Salaj 2020; Haider et al., 2018). These technologies facilitate progress in healthcare, economic services, social care, connectivity, accessibility, and bureaucratic efficiency (Rogelj, Salaj, & Bogataj, 2021). Ultimately, smart villages emphasize the integration of digital technologies and community engagement to improve rural quality of life. They represent a paradigm shift in rural development by addressing contemporary rural challenges across multiple dimensions (Renukappa et al., 2024; Bokun & Nazarko, 2023). Accordingly, smart villages require a practical and actionable framework encompassing various domains_ smart citizens, smart governance, a smart economy, smart marketing, and a smart environment_ to align with broader governmental goals, integrate sustainability with digitalization, and foster local community development (Emerllahu & Bogataj, 2024; Subekti & Damayanti, 2019).

However, the necessity of examining smart villages lies in the fact that many studies conflate them with concepts such as e-villages, digital villages, or ICT-based villages. These terms, however, represent only a subset of the broader smart village initiative. The development and expansion of smart villages depend on various interrelated factors, and analyzing these alongside existing challenges offers a clearer and more precise framework for planning_ whether to overcome obstacles or strengthen enabling elements.

While numerous studies have investigated the development and expansion of smart villages using various statistical methods, each producing different results, this research aims to qualitatively review and meta-analyze existing literature. By examining prior studies on smart villages, including their key themes, dimensions, and theoretical frameworks, this study seeks to identify the most critical factors and core components influencing smart village development. Accordingly, researchers' perspectives and empirical findings were systematically reviewed through qualitative meta-analysis to determine the most influential factors and essential dimensions of smart villages.

Certainly, there is no doubt that achieving the goals set for the development of smart villages requires not only sustainable financial resources and appropriate infrastructure but also a strong emphasis on improving individual education. This is particularly important because, in the near future, there will be a significant demand for specialists capable of utilizing smart tools and programs to enhance both the comfort and security of the population (Yang & Lam, 2021; Khmel'nitskaya & Bogdanova, 2021).

Moreover, the role of government representation and village participation (Sutriadi, 2018) should not be overlooked. Although regional governments have not yet adequately prioritized rural development, addressing key obstacles in the creation of smart villages, such as infrastructure, connectivity quality, human resources, and regulatory frameworks, requires urgent attention (Fennell et al., 2018). This includes ensuring that the rural development process incorporates local community participation through smart solutions. While the term "smart village" lacks a universally accepted definition (Cvar et al., 2020), in rural planning, it is often understood as an ideological construct. From this perspective, smartness entails strategic orientations through which governments and public institutions at all levels apply the concept of intelligence to guide their programs and policies. These efforts aim to achieve sustainable development, economic growth, improved quality of life for villagers, and overall well-being (Albino et al., 2015). Essentially, a smart village is a community where digital technologies are employed to deliver essential services to residents and businesses (Bogataj et al., 2021). As fundamental human rights become increasingly linked to access to smart technologies, sustainable services act as key enablers of development. To better and more efficiently manage community assets, sensor networks and the Internet of Things (IoT) are deployed within buildings as infrastructure for data collection (Ransing & Rajput, 2015; Colnar et al., 2020; Marchenko & Temeljotov-Salaj, 2020; Haider et al., 2018). These technologies support improvements in healthcare, economic services, social care, communication, accessibility, and the reduction of bureaucratic inefficiencies (Rogelj et al., 2021). Ultimately, smart villages emphasize the integration of digital technologies and community participation to enhance rural quality of life. They represent a paradigm shift in rural development, addressing contemporary needs across various dimensions (Renukappa et al., 2024; Bokun & Nazarko, 2023). To achieve broader governmental objectives, combining sustainability with digitalization and fostering local development, smart villages require an actionable and multidimensional

framework. This includes smart people, smart governance, a smart economy, smart marketing, and a smart environment (Emerllahu & Bogataj, 2024; Subekti & Damayanti, 2019).

However, the necessity of examining smart villages becomes evident when considering that many studies equate the term “smart villages” with concepts such as electronic villages, digital villages, or ICT-based villages. In reality, these terms reflect only a subset of the broader smart village initiative. The development and expansion of smart villages depend on a range of factors. Analyzing these factors, along with the associated challenges, provides a clearer and more precise understanding of the field. This understanding, in turn, supports more effective planning aimed at overcoming obstacles and strengthening key drivers within these communities. Although numerous studies have investigated the development of smart villages using various statistical approaches, often producing diverse results, this research aims to take a significant step toward identifying the most critical factors, components, and dimensions of smart village development. By conducting a meta-analysis of existing studies, it seeks to examine the literature comprehensively, highlight key themes and theoretical frameworks, and synthesize insights from available data. Accordingly, the perspectives and findings of previous researchers were systematically reviewed through qualitative meta-analysis to determine the most influential factors and defining dimensions of smart villages.

2. Literature Review

Given that “smartness” is a measure of a country’s scientific capability and its ability to produce, distribute, and utilize knowledge, the establishment of smart villages can provide a foundation for assessing this criterion. Therefore, neglecting the role of smartness in rural areas not only contributes to the digital divide but also exacerbates economic and social disparities.

In this regard, adopting innovative approaches such as smart villages can address the challenges of rural development and, while enhancing the resilience of underdeveloped areas, place rural development through smart development on the agenda of policymakers (Kelvin et al., 2022; McIntyre-Mills et al., 2019; Slee, 2019; Anastasiou et al., 2021; Zavratinik et al., 2018). However, the smart village development approach should aim to enhance the competitiveness of rural areas in line with the new rural development paradigm (Wolski, 2018), as smart development is essentially sustainable rural development that leverages research and development,

innovation, and knowledge (Naldi et al., 2015). A smart village, in this context, can support sustainable rural development and foster innovation. Like rural development more broadly, however, it requires external support, the efficient use of internal resources, and a coherent rural development strategy at the central, regional, and local levels (Adamowicz, 2021). Although smart villages pursue multiple objectives, such as improving living conditions through better access to infrastructure and services, raising living standards, strengthening local entrepreneurship, and attracting investment (Anastasiou et al., 2021; Gorain, 2022), their development is rooted in mutual trust, which facilitates knowledge and information sharing, the exchange of experiences, and full collaboration among all stakeholders.

In recent years, the concept of the smart village has gained significant attention among rural development experts and is commonly defined as the integration of information technology to generate positive outcomes for rural communities (Herdiana, 2019). However, the first step in establishing a smart village is to develop a clear understanding of its underlying concept. A brief review of the relevant literature reveals that there is no single, universally accepted definition of a smart village.

The concept of smart villages in development literature has its precedents, one of which is the smart city (Biel-ska et al., 2021; Visvizi & Lytras, 2018). The smart city framework, when adapted to the shared characteristics of urban and rural areas, has evolved into the smart village model. Countries around the world have adopted this approach to address rural challenges, positioning smart villages as integrated rural communities that leverage information technology to enhance livelihoods (Herdiana, 2019). A smart village develops while retaining the core characteristics of rural society, representing the integration of technology into rural life. Its significance lies in treating the village as a social unit where development is driven by community participation. As an innovation in rural development, the smart village model promotes knowledge-based growth through technology, contributing to improved economic conditions and the enhancement of human capital (Sutriadi, 2018). Operationally, a smart village represents a rural development paradigm that employs technology to deliver services, facilitate access to information, and educate residents on local issues (Syamsiah, Meilinda, & Saputra, 2022). Within this model, even fundamental human rights intersect with smart technologies. Sustainable services function as enablers of development within the smart village framework. The figure below illustrates the range of smart services available in a smart village (Haider et al., 2018).

In smart villages, both traditional and modern networks and services are enhanced through digital technologies, ICT innovations, and improved knowledge utilization

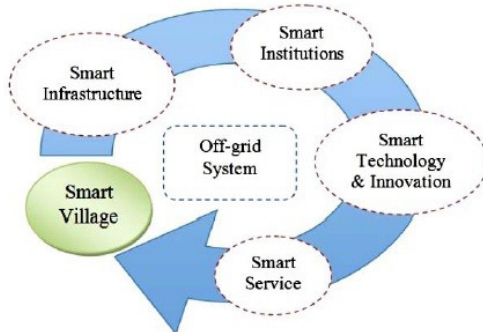


Figure 1. Village Smart Services.

Reference: Haider et al., 2018



to benefit residents and entrepreneurs (Zwolińska et al., 2018; Wójcik, 2018; Krieviņa et al., 2015). The European Commission (2017) defines smart villages as a concept derived from two theoretical frameworks: smart cities and bottom-up development. Later, in its 2019 project titled “Smart Rural Economy”, the Commission expanded on this definition: A smart village refers to rural areas and communities that build their development strategies based on existing assets and strengths while pursuing new opportunities linked to digital technologies, networks, and services. These strategies are supported by better knowledge utilization and innovative solutions (ENRD, 2019).

In smart villages, the underlying premise is that technology, when effectively integrated with other rural development initiatives, can create new opportunities for income generation, service enhancement, and community empowerment, ultimately improving the overall quality of life. According to Wójcik (2018), these services fall into the following categories:

- 1) Public Services – Addressing residents’ needs in areas such as education, healthcare, safety, and housing.
- 2) Participatory Governance – Encouraging community involvement in decision-making and resource allocation.
- 3) Local Creativity – Promoting innovative solutions to local socioeconomic challenges.
- 4) Technological Innovation – Strengthening social collaboration and entrepreneurial growth.

5) Connectivity Development – Expanding access to modern communication infrastructure, such as broadband networks.

6) Environmental Conservation – Supporting the use of renewable energy.

Thus, smart villages create an enabling environment for rural communities to develop according to their specific needs and potential, positioning the community as the actor (user) of information and communication technologies (Imron & Nababan, 2022). The factors associated with smart villages have been examined from various perspectives. Economic theorists, in particular, hold three distinct views regarding the impact of smart village development on rural economies. According to the first perspective, smart development promotes rational resource allocation between urban and rural areas, reduces urban–rural income disparities, and fosters coordinated urban–rural development (Zhao et al., 2022). It also expands employment opportunities (Rani & Furrer, 2021) by creating a significant number of skill-appropriate jobs for rural residents, thereby increasing incomes and enhancing the efficiency of market resource allocation (Cheng & Zheng, 2023).

The second perspective suggests that due to disparities in technological infrastructure and digital literacy between urban and rural residents, and the resulting concentration of high-quality infrastructure required for smart development in urban areas, coordinated urban–rural development remains limited. Furthermore, the lower average education level of rural residents compared to their urban counterparts, along with the technological gap between urban and rural areas, further restricts balanced smart development (Karar, 2019; Sujarwoto & Tampubolon, 2016). Yaping & Canning (2019) argue that although access to technological infrastructure, such as high-speed internet, reduces search costs, facilitates information acquisition, and increases income levels, income disparity between urban and rural areas may widen due to unequal internet usage among farmers.

From the third perspective, the smartening of villages, by transforming the traditional growth pattern of the labor market, contributes to optimizing income distribution. Although some simple and mechanized jobs may be lost due to the introduction of modern technologies, many low-skilled positions are created, offering greater employment opportunities for low-skilled workers and average villagers. This, in turn, helps reduce the income gap between urban and rural areas. However, over the

long term, the smartening of villages may produce the opposite effect (Jiang et al., 2022).

From the institutionalist perspective, the smart village concept emphasizes the development and expansion of ICT infrastructure to enhance learning, increase knowledge, foster innovation and creativity, improve competitiveness, strengthen human and social capital, and ultimately achieve regional development (Ghaffari, 2014; Aghayari Heer et al., 2019). In this view, the smart village is assessed through the following indicators.

1. Smart Communities

The concept of smart communities emphasizes an integrated approach to the social reconstruction of smart regions by actors and their networks, grounded in a constructivist and socially informed understanding of space (Matern et al., 2020). Furthermore, smart communities, viewed as a form of independent and self-sustaining development, should aim to provide improved services to residents, enhance living conditions for all inhabitants, promote social equity, and simultaneously ensure the protection of natural resources (Osmani, 2023).

2. Smart Growth

The term smart growth is grounded in concepts such as “acting according to local capacities and capabilities in future policies,” with an emphasis on regional advantages, knowledge, and innovation. It forms the foundation of the European Union’s 2020 growth strategy (Barca et al., 2012; Combes & Overman, 2004; European Commission, 2005).

Within the theory of empowerment, information and communication technology (ICT) serves as a tool to enhance the capabilities of unskilled human resources. It plays a critical role in promoting human and spatial rights, as well as strengthening individuals’ abilities to realize those rights (Cecchini & Scott, 2003; Harris & Achora, 2018; Navabakhsh et al., 2015).

Although a key prerequisite for ICT initiatives aimed at empowering rural communities is assessing and addressing the information needs of rural societies through the active participation of stakeholders (Harris & Achora, 2018), it is equally important to develop locally tailored software that reflects community conditions, ensuring local ownership and long-term sustainability.

According to capacity development theory, the use of technology is emphasized as a means to establish or

strengthen existing capacities within individuals and civil society institutions, foster an environment conducive to innovation and creativity, generate new capacities, enhance inter-organizational collaboration, and facilitate networking efforts (Ahmadian Diukti et al., 2018).

3. Methodology

To systematically review and synthesize the results of various studies conducted on a specific topic, the use of the qualitative meta-analysis method is appropriate.

Qualitative meta-analysis is a method through which the results of independent studies are combined and integrated, revealing new relationships between social phenomena (Glass, 1976). Since the primary goal of meta-analysis is to merge findings from multiple individual studies, it is often referred to as an “analysis of analyses” (Decoster & Claypool, 2004). In this approach, findings are purposefully combined and integrated with precision to uncover deeper insights. In other words, meta-analysis typically involves:

- A comprehensive search for all available studies;
- The application of clear criteria to determine which articles to include;
- The determination of an effect size for each study;
- The combination of effect sizes to provides an overall estimate of a given behavior’s impact.

In this study, a qualitative meta-analysis method was employed to systematically review and analyze research on smart village studies. Unlike quantitative meta-analysis, which is inferential, qualitative meta-analysis is descriptive in nature. It relies on statistical elements such as frequency, percentage frequency, cumulative frequency, cumulative percentage, and visual aids like bar and pie charts for presenting results, identifying modes, and more (Salimi & Maknun, 2018).

The selection criteria for the articles were based on the presence of keywords or topics related to “smart village,” “smart development,” and “digital village.” To support the research process, respected professors were consulted for recommendations on relevant articles and journals. Although “smart village” has been indexed in 930 academic journal articles and conference papers (Emerllahu & Bogataj, 2024), after expert consultation and further review, 122 articles were selected from databases including Google Scholar, Scopus, ResearchGate,

ScienceDirect, and Google. Of these, 75 articles were excluded due to a lack of direct relevance to the research topic. Ultimately, 47 highly relevant articles, based on survey-based and field research conducted between 2016 and 2024, were analyzed and categorized by frequency. The criteria for article selection and data extraction are summarized in Table 1.

4. Findings

A review of the existing literature indicates that 47 scientific research papers were included, employing various statistical and field-based methods. Analysis of the publication timeline shows that the selected studies were conducted between 2016 and 2024 (Figure 2). The highest number of studies was published in 2022 (13 articles), followed by 2023. The findings also reveal a limited number of studies on smart villages published in Persian; therefore, most of the selected articles are in English and were published in international journals.

Sampling Methods in the Reviewed Studies:

Based on the collected data, the reviewed articles employed various methods for data collection. As shown in Table 2, 57% of the articles used random sampling, while 13% did not specify a sampling method. Additionally, 11% of the studies utilized snowball sampling to select participants.

Data Collection Methods in the Reviewed Articles:

The analysis indicates that in 23% of the reviewed articles, data was collected through both interviews and questionnaires. In 21% of the articles, data was gathered solely through questionnaires, while 17% relied exclusively on interviews. Additionally, in 11% of the cases, a combination of observation, interviews, and questionnaires was used (Table 3).

Research Methods in the Reviewed Articles:

Table 1. Dimensions and Guiding Indicators for Article Analysis

| Dimensions | Indicators |
|-------------------------------------|--|
| Research Method | Type of study, research method, data collection technique |
| Sampling Method | Sampling method, sample size, whether sample size is clearly stated |
| Research Framework | Hypotheses or questions |
| Theoretical Approach | Main conceptual approach to the smart village, explicit articulation of the approach |
| Subjective and Objective Indicators | Type of indicators used, separation of subjective and objective indicators, distinct conclusions |
| Core Research Dimensions | Environmental, social, economic, institutional, communication, and health |
| Variables and Analytical Tools | Independent/dependent variables, correlated variables, and analytical tools employed |
| Findings | Results categorized by cities studied and spatial distribution of findings across the country |

Source: Research Findings, 2024

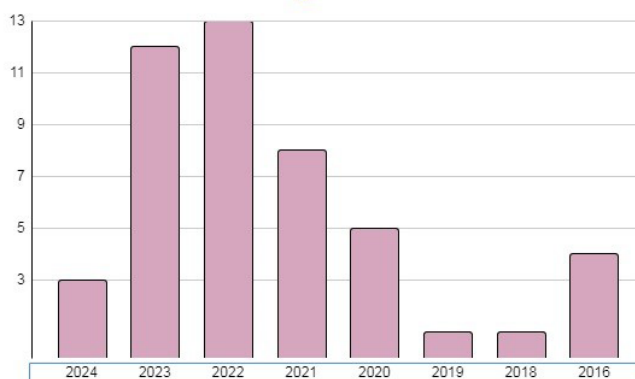


Figure 2. Frequency of Studies Conducted Based on Research Year. Source: Research Findings, 2024



Table 2. Frequency of Sampling Methods in the Reviewed Articles

| Detail | Random sampling | Stratified sampling | Systematic sampling | Cluster sampling | Snowball sampling | Purposive sampling | Convenience sampling | No sampling method |
|------------|-----------------|---------------------|---------------------|------------------|-------------------|--------------------|----------------------|--------------------|
| Number | 27 | 1 | 1 | 4 | 5 | 2 | 1 | 6 |
| Percentage | 57 | 2 | 2 | 9 | 11 | 4 | 2 | 13 |

Source: Research Findings, 2024



Table 3. Frequency of Data Collection Methods in the Reviewed Articles

| Detail | Questionnaire | Interview | Interview-questionnaire | Interview-observation | Questionnaire-observation | Observation, interview, questionnaire | Interview, documentary research |
|------------|---------------|-----------|-------------------------|-----------------------|---------------------------|---------------------------------------|---------------------------------|
| Number | 10 | 8 | 11 | 8 | 3 | 5 | 2 |
| Percentage | 21 | 17 | 23 | 17 | 6 | 11 | 4 |

Source: Research Findings, 2024



According to the analysis, the research methods used in the reviewed studies include survey, survey-documentary research, action research, and meta-analysis. Specifically, 68% of the studies employed a combined survey-documentary research method, 11% used a survey approach, 19% conducted meta-analyses, and only 2% utilized other methods (Table 4). Additionally, as shown in Table 3, in survey-based studies, the necessary data were primarily collected through questionnaires, interviews, or a combination of both.

Articles with Solutions and Recommendations:

Based on the analysis, out of the 47 reviewed articles, 66% provided clear recommendations and solutions, while 34% either did not provide suggestions or presented recommendations that were unclear, vague, or irrelevant to the topic (Table 5).

Frequency of Research Locations:

According to Table 6, many studies on smart villages have been conducted in foreign countries, with Indonesia leading at 45%. This reflects Indonesia’s prioritization of rural poverty reduction as a key government agenda and part of its efforts to achieve the Sustainable Development Goals. One of the country’s practical strategies for poverty alleviation is the digital village initiative, an integral part of the smart village ecosystem since 2010. The initiative includes infrastructure development and an expanded fiber-optic internet network across 189 villages and 28 sub-districts. Following Indonesia, Tehran and Poland each account for 9% of the studies, while other locations contribute less than 5%.

Qualitative Findings

Table 4. Frequency of Research Methods in the Reviewed Articles

| Detail | Action research | Survey | Survey-documentary research | Meta-analysis |
|------------|-----------------|--------|-----------------------------|---------------|
| Number | 1 | 5 | 32 | 9 |
| Percentage | 2 | 11 | 68 | 19 |

Source: Research Findings, 2024



Table 5. Frequency of Articles Based on Solutions and Recommendations

| Detail | Articles with Recommendations | Articles Without Recommendations |
|------------|-------------------------------|----------------------------------|
| Number | 31 | 16 |
| Percentage | 66 | 34 |

Source: Research Findings, 2024



Table 6. Frequency of Research Locations

| Detail | Nepal | Tehran | Indonesia | Albania | Jiroft | Urmia | Spain | Poland | China | EU | England | Russia | America | Chaharmahal Bakhtiari | Hungary | Mashhad | India | Macedonia |
|------------|-------|--------|-----------|---------|--------|-------|-------|--------|-------|----|---------|--------|---------|-----------------------|---------|---------|-------|-----------|
| Number | 2 | 4 | 21 | 1 | 2 | 1 | 1 | 4 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Percentage | 4 | 9 | 45 | 2 | 4 | 2 | 2 | 9 | 2 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

Source: Research Findings, 2024



One effective method for developing the theoretical foundation of research is to examine the dimensions, components, and variables related to the subject under study. Findings from the review of selected articles indicate that the factors influencing the development of smart villages can be classified into seven dimensions: environmental, governance, economic, social (community), educational, agricultural, and health and well-being.

In the environmental dimension, according to Table 7, the variable “energy consumption reduction” has the largest share at 13.6%. This is followed by “renewable and alternative energy sources” and “environmental protection,” which account for 12.3% and 9.9%, respectively. Additionally, the variables “fossil fuel reduction,” “smart homes,” “water and soil conditions,” and “waste management” each hold an equal proportion.

According to Table 8, in the governance (governmental) dimension, the variable “use of information and communication technology (ICT or e-government)” is the most significant factor, accounting for 26.2%. In smart villages, the aim of e-government is to enhance both the quantity and quality of public services provided to citizens, ensuring faster and more efficient service delivery.

In addition to improving public services, governance must also be transparent, meaning that access to information, including budget details, resource allocations, and production data, should be available to the public (Herdiyanti et al., 2019). Other key variables in this dimension include public participation (18%), financial transparency (14.8%), and government information transparency and administrative services (13.1%).

Table 7. Environmental Factors Influencing the Establishment of Smart Villages

| Variable | Frequency | Percentage |
|--------------------------------|-----------|------------|
| Energy Consumption Reduction | 11 | 13.6 |
| Livestock Farming & Fisheries | 7 | 8.6 |
| Renewable & New Energy Sources | 10 | 12.3 |
| Fossil Fuel Reduction | 7 | 8.6 |
| Access to Water & Electricity | 6 | 7.4 |
| Smart Homes | 7 | 8.6 |
| Crisis Management | 6 | 7.4 |
| Environmental Protection | 8 | 9.9 |
| Fire Suppression Systems | 5 | 6.2 |
| Water & Soil Conditions | 7 | 8.6 |
| Waste Management | 7 | 8.6 |
| Total | 81 | 100.0 |

Source: Research Findings, 2024



It is important to note that ICT forms the core of the smart village concept, encompassing both technological infrastructure and appropriate technology tailored to rural areas. Because ICT is closely tied to the concept of “smartness,” the technologies implemented in smart villages must be efficient, durable, affordable, and user-friendly, while also being adapted to the local needs and technological capabilities (Ella & Andari, 2019).

According to Table 9, within the economic dimension, the “entrepreneurship” variable accounts for 14.9%, representing the largest share. This is followed by “facilities and credits” at 13.8%, and “electronic payment” at 12.8%. “Branding” holds the lowest value, at 4.3%. Additionally, both “access to employment” and “support and assistance” share an equal proportion of 6.4%.

Studies suggest that the smart village model has been effective in addressing many of the challenges faced by rural areas. Following the implementation of smart-related programs, the rural economy has undergone a significant transformation (Saleh & Ibad, 2022).

According to the findings, within the social (community) dimension, the variables “participation and social capital” hold the largest share at 16.5%, followed by “innovation and creativity” at 13.2%, and “literacy level” at 12.1% (Table 10). In a smart village context, intelligent factors should function in a manner that fosters empowerment, enhances creativity, and improves overall well-being.

Table 8. Governance (Governmental) Factors Influencing the Establishment of Smart Villages

| Variable | Frequency | Percentage |
|---|-----------|------------|
| Administrative Services | 8 | 13.1 |
| Use of Information and Communication Technology | 16 | 26.2 |
| Complaint Handling Services | 6 | 9.8 |
| Government Information Transparency | 8 | 13.1 |
| Financial Transparency | 9 | 14.8 |
| Leadership | 3 | 4.9 |
| Public Participation | 11 | 18.0 |
| Total | 61 | 100.0 |

Source: Research Findings, 2024



Table 9. Economic Factors Influencing the Establishment of Smart Villages

| Variable | Frequency | Percentage |
|-----------------------|-----------|------------|
| Entrepreneurship | 14 | 14.9 |
| Access to Employment | 6 | 6.4 |
| Economic Institutions | 9 | 9.6 |
| Support & Assistance | 6 | 6.4 |
| Facilities & Credits | 13 | 13.8 |
| Electronic Payment | 12 | 12.8 |
| Marketing | 8 | 8.5 |
| Advertising | 7 | 7.4 |
| Branding | 4 | 4.3 |
| Electronic Banking | 7 | 7.4 |
| E-Commerce | 8 | 8.5 |
| Total | 94 | 100.0 |

Source: Research Findings, 2024



Table 10. Social (Community) Factors Influencing the Establishment of Smart Villages

| Variable | Frequency | Percentage |
|----------------------------------|-----------|------------|
| Innovation and Creativity | 12 | 13.2 |
| Participation and Social Capital | 15 | 16.5 |
| Economic Creativity | 9 | 9.9 |
| Literacy Level | 11 | 12.1 |
| Electronic Literacy | 8 | 8.8 |
| Electronic Investment | 9 | 9.9 |
| Digital Age | 8 | 8.8 |
| Empowerment | 10 | 11 |
| Electronic Transport (Welfare) | 9 | 9.9 |
| Total | 91 | 100.0 |

Source: Research Findings, 2024



According to [Table 11](#), the variable “Internet access” holds the highest share among educational factors, accounting for 23.3%. “IT infrastructure” follows at 19.2%, while “digital literacy” stands at 17.8%, and “smart boards” rank next at 15.1%.

Based on findings from the reviewed literature on smart agriculture, “crop diversity” ranks highest in this dimension, accounting for 21.9%. “Innovation in product packaging” follows with 18.8%, while “meteorological systems” hold the lowest share at 6.3%. The variables “irrigation methods” and “online agricultural consulting” both have an equal share of 15.6% ([Table 12](#)).

Smart villages implement precision agriculture by utilizing advanced techniques for livestock and crop production. This approach enhances time efficiency, reduces costs, and promotes rural sustainability ([Maheswari et al., 2019](#)). Moreover, smart farming techniques support higher agricultural productivity in an environmentally

sustainable manner, optimize farmers’ income, and help address the challenge of feeding a growing global population ([Adesipo et al., 2020: 2](#)).

According to [Table 13](#), within the health and well-being dimension, the variable “electronic health records” has the highest impact at 19.6%. This is followed by “food security” and “online medical services”, both sharing an equal value of 17.6%. Health services in smart villages, particularly in developing countries, can be significantly enhanced by supporting telemedicine initiatives and mobile health services. These mobile services offer remote health diagnostics and related healthcare solutions at reduced costs for rural communities ([Mahmoud et al., 2021](#)).

Table 11. Educational Factors Influencing the Establishment of Smart Villages

| Variable | Frequency | Percentage |
|---------------------|-----------|------------|
| Internet Access | 17 | 23.3 |
| Educational Systems | 9 | 12.3 |
| Smart Boards | 11 | 15.1 |
| Digital Literacy | 13 | 17.8 |
| Education Level | 9 | 12.3 |
| IT Infrastructure | 14 | 19.2 |
| Total | 73 | 100.0 |

Source: Research Findings, 2024



Table 12. Factors Influencing the Establishment of Smart Villages – Agricultural Dimension

| Variable | Frequency | Percentage |
|---------------------------------|-----------|------------|
| Irrigation Methods | 5 | 15.6 |
| Crop Diversity | 7 | 21.9 |
| Innovation in Production | 3 | 9.4 |
| Online Agricultural Consultants | 5 | 15.6 |
| Meteorological Systems | 2 | 6.3 |
| Modern Harvesting Methods | 4 | 12.5 |
| Innovation in Product Packaging | 6 | 18.8 |
| Total | 32 | 100.0 |

Source: Research Findings, 2024

**Table 13.** Factors Influencing the Establishment of Smart Villages – Health and Well-being Dimension

| Variable | Frequency | Percentage |
|-----------------------------------|-----------|------------|
| Food Security | 9 | 17.6 |
| Electronic Health Records | 10 | 19.6 |
| Elderly Care Services | 8 | 15.7 |
| Online Medical Services | 9 | 17.6 |
| Internet-Based Healthcare Centers | 8 | 15.7 |
| Online Pharmacies | 7 | 13.7 |
| Total | 51 | 100.0 |

Source: Research Findings, 2024



5. Discussion

A smart village is commonly defined as a rural community that develops by addressing both its strengths and weaknesses. In such villages, traditional and modern services are integrated with digital innovations stemming from ICTs to improve the quality of life for rural residents. For the expansion and creation of smart villages aligned with the Sustainable Development Goals, it is essential to examine the key dimensions and influencing factors in their establishment. While the criteria for smart villages may vary across regions, there are universal standards that must be considered and implemented.

The present study aims to examine the dimensions of the smart village concept. The research employed document analysis and qualitative meta-analysis methods. Initially, existing academic studies on smart villages published between 2016 and 2024 were identified and reviewed. These studies explored the smart village concept from various perspectives. The present study specifically focused on identifying and analyzing its key dimensions. The findings indicate that the smart village is a multidimensional concept that fosters interactions

among information technology, sustainable development, and the enhancement of quality of life in rural areas. The study highlights the crucial role of government support in the creation and expansion of smart villages across multiple dimensions, including environmental, social, economic, and institutional. The reviewed literature suggests that integrating modern technologies and efficiently utilizing natural resources significantly contributes to environmental protection. Furthermore, social theories related to smartness support the notion that digital communication and social networks enhance social capital by strengthening interpersonal relationships and fostering more connected communities. From a practical perspective, smartness also serves to strengthen rural–urban linkages by facilitating the creation of shared meanings, the exchange of ideas and resources, and the transmission of experiences between regions.

Studies on smart villages emphasize the active role of community members and government support in their formation and development. In such villages, modern technologies are applied in alignment with local culture, values, and needs. The selection of technologies can even be tailored to each village's customs, historical con-

text, specific requirements, and local narratives. Smart villages, in essence, transcend traditional boundaries and create innovative spaces that enable individuals to move beyond conventional patterns and discover creative solutions to local challenges.

Most of the reviewed literature highlights the expansion of ICT in rural areas as a key driver of increased connectivity and capacity-building. These studies note that government-provided services have improved in both quantity and quality. Moreover, maximizing ICT usage in rural settings enhances not only hardware and software infrastructure but also emphasizes the importance of educating rural populations. The literature argues that without a trained workforce, the implementation of ICT is not only ineffective but may also exacerbate the rural–urban divide. In smart villages, smart governance entails transparency in service delivery, providing public access to information on programs, budgets, and expenditures. Such villages offer significant potential across economic, social, political, and cultural domains. As digital literacy increases, the empowerment of rural communities becomes more achievable.

The findings indicate that rural smartification is generating a new wave of economic activity, particularly in the production and marketing of rural goods. Smart villages not only create new online-based employment opportunities but also introduce residents to broader markets, thereby fostering entrepreneurship, promoting local economic development, and improving income levels.

This transformation enhances the rural economy by fostering competitive environments for rural businesses, enabling international marketing of local products, increasing income, diversifying rural activities, and reducing unemployment. It may also contribute to higher government revenues, increased foreign exchange earnings, and the establishment of more sustainable rural economic foundations. Moreover, smart rural economies, by expanding employment opportunities, help reduce the income gap between urban and rural areas, promoting a more equitable distribution of wealth. These economies align rural economic activities with advancements in information technology, aiming to guide and empower them to compete effectively in global markets through modern business models and processes.

Findings in the field of smart villages reveal that their development enables rural residents to access essential information related to markets, agriculture, health, education, and other critical domains. As the use of modern ICT becomes more widespread, the social and political

awareness of community members increases, leading to greater public participation in institutional processes and policymaking.

This process not only empowers individuals but also enhances their quality of life by updating local knowledge, creating participatory opportunities, and building community-relevant skills. Empowerment facilitated by smartification fosters new spaces for innovation, creativity, entrepreneurship, and the growth of social capital. New types of networks and connections emerge, emphasizing citizen involvement in decision-making processes. In smart communities, holistic improvements in quality of life, addressing both material and non-material needs, are prioritized through empowerment-based and consultative approaches. These approaches aim to improve decision-making, raise awareness, and strengthen local capacity.

A review of studies on smart villages indicates that increased access to communication technology infrastructure, such as the internet, by educational centers has enhanced both the quantity and quality of educational services in rural areas. As a result, a greater number of individuals benefit from training courses and skill development programs. As knowledge and skill levels rise, the demand for smartification of other social dimensions, such as economic, environmental, and political spheres, also increases, advancing the community further along the path toward becoming a smart society. In this context, smart education can be viewed as both an incentive and a catalyst for broader smart development.

A review of studies indicates that improving agricultural production is essential in smart villages, as a significant portion of the world's food supply is produced in rural areas. With advancements in technology, there is not only increased diversity in agricultural products but also notable progress in areas such as waste reduction, early detection of plant and animal diseases, optimized and efficient irrigation, and improved planting and harvesting methods. The findings suggest that the adoption of advanced and smart agricultural techniques not only reduces time and costs but also enhances productivity in an environmentally sustainable manner while ensuring a stable income for farmers.

Studies on smart villages have also examined the integration of smart healthcare in rural areas. In these settings, services and health-related information are made accessible to the public through the internet and modern technologies, with the goal of enhancing preventive measures and improving overall healthcare delivery. In-

dividuals can access their medical information remotely via electronic health records. Advancements in ICT have enabled governments to explore the concept of smart healthcare and to plan strategically in response to these changes. The application of ICT in the health sector encompasses various areas, including online medication purchases, virtual consultations, appointment scheduling, and preventive care services. Its implementation contributes to cost reduction, faster access to healthcare professionals, and increased system efficiency.

In summary, a review of the articles collected indicates that the development and expansion of smart villages require collaboration among villagers, authorities, and experts to more effectively identify and address community needs. A smart village encompasses a broad range of services and facilities across multiple dimensions, each containing various interrelated variables. It is important to note that the significance and impact of each dimension and its associated variables may vary depending on the specific context. A central conclusion is that the primary objective of smart village initiatives should be to enhance the quality of life and livelihoods of rural populations. While smart villages introduce a new model of rural living, they must also preserve valuable aspects of traditional rural life and function as instruments for its enhancement. Ultimately, the technologies adopted by rural communities should not only optimize resource use but also promote sustainable rural development. These technologies should be affordable, efficient, user-friendly, and adapted to the specific structure and needs of each village.

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Conflict of Interest

The authors declared no conflicts of interest.

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