

Review article

Analysis of Smart Village Development in Supporting Smart City in Indonesia: A Systematic Review

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Abstract

Along with the enactment of the Law of Village in 2014, village development is a top priority on the national development agenda in Indonesia. Village development through the implementation of smart village is thought to be significant given the current state of technology's rapid expansion. Smart village refers, generally speaking, to the implementation of the smart city idea inside the village borders. This study analyzes the concepts developed in the relationship between smart village and smart city based on a systematic literature review, compares how smart village are implemented to support smart city in various Indonesian regencies, and offers policy alternatives in the form of smart village dimensions that are more appropriate for Indonesian village conditions. Systematic literature review is used as the method for this research, with data collected from the Scopus journal database. The analysis is enriched with empirical findings based on local government policies governing smart village. The results showed that smart village development in Indonesia tends to be top-down with the initiation coming from the central and local governments. It is important to implement smart village that are in line with smart city in order to foster relationships between the two, promote village independence, and assist the smart city implementation in a complementary manner by integrating digital services and bolstering the local economy. The recommended smart village dimensions to support smart city in Indonesia consist of community, technology, institutional, and potential village resources.

Keywords: smart village; smart city; village development; urban-rural linkages; systematic review.

1. Introduction

Village development has become a national development agenda in Indonesia through the new paradigm of village development in Law Number 6 of 2014 concerning Village. This law provides the spirit of village renewal (LAN, 2018). Through this law, villages have tremendous authority through the re-recognition of local diversity and rights of origin, as well as the management of Village Funds to promote village service facilities and fulfillment of fundamental needs (Sunggoro, 2022). Villages have the potential to become centers of local economic development and the maintenance of local wisdom. The "building village/desa membangun" model, which highlights the role of the village to be the basis, concern, and arena of development so that it can autonomously develop the village, has made development that begins in the village a national development priority (village driven development) (Andari & Ella, 2021a).

Technological developments have a significant and transformative impact on human life (Jezic *et al.*, 2021). However, rural areas and digital transformation appear to be at odds, with the assumption that rural populations and conditions have a low ability to adapt to digital transformation and rapid changes in technological development (Nababan & Imron, 2022). Along with the global Covid-19 pandemic in 2020, there have been significant changes in the internet and technology utilization, including in rural areas in Indonesia. Rural communities are experiencing many changes in various aspects, especially with the development of ICT which causes social changes to occur rapidly (Rokhman *et al.*, 2023).

Not only influential in daily life, technological advances are also used as an instrument to accelerate regional development. The smart village concept was proposed by Indian researchers, N. Viswanadham and Sowmya Vedula, in 2010 as a new rural development concept (Aziiza & Susanto, 2020). European Commission, through "EU Action for Smart Villages" in 2017, defined smart villages pragmatically for villages in the European region as villages that are built on the initiative of rural communities themselves in a bottom-up manner to find practical solutions to problems through optimizing their opportunities. Smart village is considered as an alternative model of village development that is in accordance with environmental changes and rapid technological advances (Ella & Andari, 2018). Generally, the smart village concept is derived into several dimensions that represent several themes related to aspects of village development. When



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discussing the dimensions of a smart village, some experts make reference to the smart city dimensions by Giffinger *et al.* (2007), which were initially developed and put into practice in a number of cities. These dimensions include the following: smart governance, smart economy, smart environment, smart people, smart mobility, and smart living. Herdiana (2019) considers that the smart city concept cannot be fully implemented in the village context due to the homogeneity of the population and cultural locality.

In Indonesia, the development of smart city is mandated in the National Medium-Term Development Plan for 2015–2019 as one of the policy directions and urban development strategies. Smart city implementation in Indonesia has been pursued through the “Movement Towards 100 Smart Cities” program since 2017 (Ministry of Communication, 2017), until in 2023 starting the “Movement Towards Smart Province” program as a follow-up to smart city through integrated collaboration between regions (Ministry of Communication, 2021). The development of smart city as one of the objectives of urban development is the basis of one of the strategic issues of urban infrastructure in the National Medium-Term Development Plan for 2020–2024, which is related to urban ICT infrastructure and ecosystems. During this period, the program continued as a “Movement Towards 100 Smart Cities” to expand the implementation of smart city in various regencies/cities in Indonesia. The smart city approach is also mentioned in Government Regulation Number 59 of 2022 on Cities, as the implementation of urban management through innovation, collaboration, and/or utilization of digital technology in accordance with the needs of urban residents to accelerate the realization of sustainable cities.

In contrast with standardized and massive smart city implementation in Indonesia, the smart village implementation is still diverse, and the direction and focus are less standardized in terms of programs and policies (LAN, 2018). Developing smart villages is one way to lessen the disparity between rural and urban areas (Santoso *et al.*, 2019). The Ministry of Villages’ “Smart Village” program marked the beginning of the central government of Indonesia’s implementation of smart villages in 2021. This program is part of accelerating digital transformation as a strategic priority project in the National Medium-Term Development Plan for 2020–2024. The program’s implementation of smart village complements the UN Smart Village Approach, which aims to meet the global target of 2030 Sustainable Development Goals (SDGs) (The ASEAN, 2020).

In Indonesia, the achievement targets of the SDGs at the village level are measured using the Village SDGs (SDGs Desa). In order to achieve the 18 goals of the Village SDGs, the Ministry of Village is concentrating its execution of the Smart Village program on enhancing human resources and fortifying infrastructure (Ministry of Village, 2022). The concept of Village SDGs is based on Presidential Regulation Number 59 of 2017, which addresses the implementation of achieving the National SDGs, as an integrated endeavour for the community development of legal, social, economic, environmental, and governance at the village level. The 17 goals in the Global and National SDGs and the 18 Village SDGs differ slightly. In addition to the 17 Global and National SDGs goals that adapted in the village context, there is an addition of one goal as the 18th SDGs Village goal, namely “Village Institutions”. It is believed that strengthening this element is essential to achieving the objectives of sustainable development.

To improve the performance of smart cities and smart regencies, smart village development is required (Rachmawati, 2018). From the village, and city, to the province level, smart synergy across regions is necessary, despite differences in regional scale and physical and social characteristics. Smart village is needed, especially in supporting smart cities to realize the connection between villages and cities as an effort to reduce urbanization, while guaranteeing the effective execution of smart city initiatives that affect society at all levels. Villages developed as smart villages are able to develop independently by optimizing local resources, both local potential and skilled human capacity. At the city/regency level, it is mainly to improve the quality of public services, government bureaucracy, and support the improvement of quality of life. At the provincial level, it acts as a follow-up to smart cities that have been implemented in cities/regencies through integrated collaboration between regions. This emphasizes the necessity for smart village development to start picking up speed in order to assist Indonesia’s extensively implemented smart city and smart province.

Smart villages can be realized in the form of community connectivity to public services that can be accessed online from isolated rural areas through the provision of internet and broadband networks (Lundmark, 2021). Smart villages can encourage the economic sector to be more effective and efficient, especially in the secondary and primary sectors, through the support of appropriate and modern technology to facilitate sustainable rural-urban linkages (Sutriadi, 2018). This study fills a gap in the literature by considering smart cities and smart villages as complementary ideas for regional development rather than as distinct ideas. Smart city and smart village

implementation cannot be done separately with distinct purposes; rather, they must work together to promote regional development objectives and along to strengthen urban-rural linkages. In line with the Village Law's mission, this is also connected to the "building village/desa membangun" and "developing the village/membangun desa" approaches that are incorporated into village development planning. As a result, even though villages are entitled to local decision-making and autonomy under subsidiarity, they draft development plans by referring to the city or regency's development plans.

As a result, it is critical to conduct a thorough analysis of the ideas developed in the context of smart villages and smart cities based on the literature review. To achieve the implementation of smart concepts in overall regional development, with the interaction between villages and cities from many angles, the concepts of smart city and smart village should be investigated concurrently. The analysis of prior research offers a viewpoint that informs the study in developing the concept, which is enhanced by a comparison of the implementation of smart villages to assist smart cities across multiple Indonesian regencies. Based on empirical facts and existing literature, this study will also provide smart village dimensions that are better suited to the circumstances of Indonesian communities.

2. Literature Review

2.1. Smart Village

Many experts define smart village as the application of the "smart" concept in rural areas (Tosida *et al.*, 2020a; Darmawan *et al.*, 2023; Ariyaningsih & Shaw, 2023). As a result, many experts propose concepts for smart village that are comparable to those for smart city (Santoso *et al.*, 2019; Faisal & Suharjito, 2021). Actually, as villages have unique local wisdom values derived from traditions and cultures that cannot be homogenized between villages (Aziiza & Susanto, 2020; Yuniar & Hasanah, 2021; Jayanthi *et al.*, 2022; Muhtar *et al.*, 2023) and differ physically from urban areas (Ariyaningsih & Shaw, 2023), the smart city concept cannot be fully applied in villages (Rachmawati, 2018). To ensure that the development of smart villages has a more progressive influence, a variety of experts provide ideas and concepts that are appropriate for the Indonesian village conditions.

Muhtar *et al.* (2023) found that eight areas-including village government, village economy, village environment, energy, human resources, ICT, agriculture, and tourism—are covered by Indonesia's implementation of the smart village concept. The development of smart village in Indonesia is expected to become a national development priority agenda (Agustiono, 2022), considering that Indonesia consists of 84,097 villages as of 2020 (Village Potential data, 2021), with the majority engaged in the agrarian economic sector. When agricultural areas are the primary emphasis, there is a greater likelihood of successful smart village development than in other areas (Tosida *et al.*, 2022). Agriculture 4.0 can be supported by the use of a variety of agricultural technology in smart farming (Ilham *et al.*, 2022).

A smart village is generally understood to be a concept of information and communication technology (ICT)-based village development (Adi *et al.*, 2017; Ella & Andari, 2018; Ella & Andari, 2019; Tosida *et al.*, 2020a; Andari & Ella, 2021b; Irwansyah, 2021; Mazya & Kolopaking, 2021; Tosida *et al.*, 2022; Irmayani *et al.*, 2022; Darmawan *et al.*, 2023; Ariyaningsih & Shaw, 2023). Through the support of infrastructure, literacy, and service (Ella & Andari, 2019; Irmayani *et al.*, 2022), village communities' social resilience in using ICT is required to deal with fundamental changes that occur along with technological improvements (Muhtar *et al.*, 2023). In Indonesia, public services and government bureaucracy are the areas where smart village implementation is essentially dominating (Yuniar & Hasanah, 2021; Jayanthi *et al.*, 2022). Through information disclosure and community involvement in decision making, ICT greatly contributes to bringing the community and the government together (Tosida *et al.*, 2020a; Ariyaningsih & Shaw, 2023). This allows the development process to be carried out bottom-up and to take the community's goals into consideration. To raise the standard of living and economic standing, the smart village narrative is used to support community-based local tourism, as demonstrated in Banyuwangi Regency (Yuniar & Hasanah, 2021; Jayanthi *et al.*, 2022) and the creation of an ecotourism support marketplace application (Kurniawan *et al.*, 2020).

The implementation of smart village does not require an ICT-based approach, but rather emphasizes technology that meets the needs of the local community (Muazir *et al.*, 2021). Therefore, mapping the ability of human resources as the subject of village development is important before digital technology tools are widely deployed. The community's willingness to embrace, absorb, engage in, and use ICT-based innovations, as well as uphold program sustainability, is one of the obstacles to Indonesia's smart village development (Tosida *et al.*, 2022). In order to meet this

requirement, the village's human resources—particularly its digital talents and community knowledge—must be prepared as best they can (Andari & Ella, 2021b; Tosida *et al.*, 2020b). To facilitate dynamic and multifaceted village development, smart village built on big data (Tosida *et al.*, 2020a; Yusuf *et al.*, 2022) and GIS (Adi *et al.*, 2017) are also being created.

Young people are also crucial to the implementation of smart village since they are more receptive to technological advancements (Tosida *et al.*, 2020b) and function as change agents in village development (Mazya & Kolopaking, 2021). Improvement in the quality of education and digital literacy is necessary to realize a smart village supported by the community (Muazir *et al.*, 2021). As to Jayanthi *et al.* (2022), community participation plays a crucial role in the establishment of smart villages and serves as a catalyst for their successful implementation (Tosida *et al.*, 2022). Furthermore, leaders play a crucial role as policy makers with well-defined objectives and effective plans (Muazir *et al.*, 2021; Jayanthi *et al.*, 2022). The development of smart village that have been clearly regulated in policy is needed to ensure program sustainability, budget certainty (Tosida *et al.*, 2020a), and potential cooperation with external stakeholders who are able to support smart village implementation, such as universities and the private sector (Ariyaningsih & Shaw, 2023).

Smart village have been implemented in a number of Southeast Asian countries, including Myanmar, Cambodia, and Brunei Darussalam, which are adjacent countries in a region with comparable characteristics. A participatory action research (PAR)-based climate smart village (CSV) strategy has been implemented in four villages in Myanmar from 2017. Through community facilitation using technologies and practices, CSV aims to lessen the impact of climate change on agricultural productivity (Barbon *et al.*, 2022). Consequently, food security and dietary diversity were achieved, and the Covid-19 pandemic had minimal effect on agricultural production (Barbon *et al.*, 2022).

Hossain & Tin (2022) carried out study in Cambodia to investigate the possibilities, difficulties, and prospects of digitalizing agriculture and developing rural areas into digital villages. An essential component of this endeavor is the empowerment of women and youth, along with the cooperation of all relevant parties (government, academia, national and international non-governmental organizations), in terms of both supplying digital infrastructure and raising digital literacy (Hossain & Tin, 2022).

The revitalization of Kampong Ayer (Water Village), which focuses on the civic and social sectors, is one of the prioritized efforts in Brunei Darussalam, according to the ASEAN Smart City Network (ASCN) report in 2023 in Rachmawati *et al.* (2024). The development of Kampong Ayer as a smart village can address some of the fundamental issues that arise, such as the lack of information, facilities, and lodging options for tourists in Kampong Ayer, which has been identified by Hamdi *et al.* (2023) as an area with strong historical and cultural values in Brunei Darussalam.

2.2. Smart City

Since 1990, the term “smart city” has been used in conjunction with the liberalization of telecommunications and the growth of internet-based service facilities (De Santis *et al.*, 2014). Efforts to integrate the use of ICT in various aspects of urban development have led to the introduction of the concept of smart city (Rachmawati *et al.*, 2018). One of the most frequently used operational definitions to explain the concept of a smart city was proposed by Giffinger *et al.* (2007). Smart city as a city that has good performance with the insight of prioritizing the economy, people, governance, mobility, environment, and living, which is built on a smart combination of contributions and activities of capable, independent, and knowledgeable residents.

Although the definition of a smart city varies depending on who performs or interprets it, all smart cities have one thing in common: they use information and communication technology. Djunaedi *et al.* (2018), in the context of local government, smart city is defined as urban services generated from the use of ICT resources, in accordance with geographical, sociological, and administrative characteristics, which provide urban characteristics and standards that encourage governments, the public, and businesses to do desired things. Meanwhile, the “Boyd Cohen Smart City Wheel”, which comprises the elements of smart environment, smart mobility, smart government, smart economy, smart people, and smart living, is how Cohen (2014) presents the aspects of smart city.

The six characteristics of a smart city or smart region are smart governance, smart society, smart economy, smart branding, smart living, and smart environment, according to Citiasia Inc. (2016). Later, this idea was incorporated into the “Smart City Masterplan Guideline” and the “Movement Towards 100 Smart Cities” program by the Ministry of Communication and Information Technology Republic of Indonesia. Smart city or smart region is designed to use innovation and

information and communication technology to create a safer, easier, healthier, and more prosperous community life. It also aims to improve performance, increase resource efficiency, and involve all communities in the process (Citiasia Inc., 2016).

In Indonesia, the implementation of smart city is typically the result of local government initiatives. One such initiative is the central government's or ministry through "Movement Towards 100 Smart Cities" program. Due to the top-down planning process, the implementation of smart city in Indonesia begins with issues pertaining to governance, or smart governance. Local governments in Indonesia have worked hard to provide digital infrastructure, create applications, and operate websites as online platforms. To truly effect the deployment of smart city, the government must optimize application utilization in terms of both raising community usage levels and enhancing service quality (Syalianda & Kusumastuti, 2021).

Determining the needs and priorities of the issues a city has is a crucial first step in implementing smart city (Rachmawati, 2019). A city is not considered a smart city simply because it uses ICT for government (Mutiarin *et al.*, 2018). A smart city is one that incorporates advanced technology into city management, but also one that shows how technology can be used to manage resources in an economical and efficient manner to enhance human well-being and maintain environmental sustainability (Pratama, 2021). As a result, a variety of current technologies may be used to support smart city, but they must be modified to fit the unique circumstances and traits of each region.

The government, which has political authority over development programs, typically sets the course for smart city development (Yigitcanlar, 2021). The absence of community preparation frequently results in poor smart city implementation (Anam *et al.*, 2023). Supangkat in Pratama (2021) states that two factors must be taken into account when implementing smart city in Indonesia: the process or governance associated with the efforts that must be made to achieve this readiness, as well as the readiness of individuals-local governments, legislative, and communities. This highlights the significance of community involvement through a bottom-up process by encouraging social innovation and local efforts, in addition to the provision of sufficient physical and digital infrastructure (Warsilah *et al.*, 2022). To ensure that the community can make use of the available smart services and that smart city are sustainable, a coordinated effort including all stakeholders in a complex socio-economic process is required (Visvizi & Lytras, 2018a).

Cheng & Cheah (2020) demonstrated that Indonesia and Singapore had superior smart city implementation than Malaysia. While Singapore has a defined aim with collaboration between the public and private sectors, Indonesia's efforts are measured by the development of applications connected to IoT devices and the empowering of local talents (Cheng & Cheah, 2020). Mutiarin & Lawelai (2023) compared the implementation of smart city in Jakarta and Kuala Lumpur, two major cities in Malaysia and Indonesia. They found that while public transportation, urban space management, and community participation are prioritized in Jakarta, public transportation, difficulty management, and technology use are prioritized in Kuala Lumpur.

2.3. Urban-Rural Linkages

One of the key components to achieving sustainable development is realizing a strong link between urban and rural communities (Baffoe *et al.*, 2021; UN-Habitat, 2022). Urban and rural regions establish several interactions, including labor markets, access to service centers, tourism, infrastructure development, the movement of food and agricultural goods (Rijanta, 2006; Cattaneo *et al.*, 2022), and labor markets. As an integral element of an open system, this is inextricably linked to the hierarchy of villages and cities. Gebre *et al.* (2019) contend that rural development must be taken into account in urban growth, and that both should benefit equally from urban development. The interaction between urban and rural regions is mutual. The development of infrastructure, labor markets, agricultural markets, remittances from family members living in the city, social assistance, and other social services are among the benefits that rural communities receive from urban areas. Urban communities also get tourism services and commodities (such as food, water, energy, raw materials, etc.) produced in rural areas (Dinh *et al.*, 2023).

However, along with the enormous urbanization, there are also a lot of disparities in how villages and cities develop (Wilsonyudho *et al.*, 2017). A few of the challenges are unequal economic and human resource distribution, inadequate infrastructure, young disinterest in the agriculture industry, and a lack of supportive regulation (Dinh *et al.*, 2023). Research by Jatayu *et al.* (2024) shows that infrastructure development is still biased toward urban areas. The Infrastructure Development Index (IDI) score in urban areas is higher and has a greater impact on regional growth and development, while non-urban areas experience the opposite due to disparities and access difficulties. Therefore, since the mid-20th century, social scientists have been striving to eliminate the urban-rural dichotomy, moving towards an integrated and comprehensive urban-rural continuum

(Cattaneo *et al.*, 2022; Huang *et al.*, 2024). Urban and rural areas interact through the flow of people, goods, energy, capital, and information (Baffoe *et al.*, 2021). Rural and urban communities need to be understood as cross-relational relationships that can't be separate each other (Dinh *et al.*, 2023).

2.4. The Impact of ICT in the Dynamics of Urban and Rural Area

The city's spatial structure can undergo changes with the role of ICT, followed by advancements in transportation, in the form of the decentralization of activities from the city center to the suburbs (Rachmawati, 2014). The flexibility provided by ICT allows commercial and office hubs to relocate to residential areas by eliminating the need for face-to-face interaction between people (Rachmawati, 2014). Because services may be accessed from internet-connected devices, the use of ICT in the government sector facilitates public access to services without regard to time or location constraints (Kumar, 2015).

Besides influencing changes in the spatial structure of the city, the impact of ICT is also evident in the economic sector, which now predominantly operates in the digital way (digital economy). The findings of Xia *et al.* (2024) indicate that the digital economy influences the increase or decrease of income disparity between urban and rural areas in China, with significant spatial variations forming specific patterns. Therefore, certain policies from the government are needed to ensure that the digital economy can have a positive impact and support the urban-rural linkages.

The distinctions between rural and urban areas are almost disappearing as society grows and becomes more interconnected through ICT (Cattaneo *et al.*, 2022). The physical characteristics of suburban areas are affected by the phenomenon of urban sprawl, which is also driven by the advancement of ICT. This urbanization leads to changes in land use, usually the conversion of agricultural land into non-agricultural land, to accommodate the growing demands of community activities. ICT turns becoming the primary force behind urbanization, but it can also impede growth by causing a digital divide (Wang *et al.*, 2021).

As a driver of urbanization, the role of ICT is evident through the use of mobile phones and the internet, which can open up knowledge and various campaigns regarding urban life improvement. At the same time in underdeveloped areas, ICT hinders urbanization due to the digital divide with poor basic conditions and low levels of perception towards ICT (Wang *et al.*, 2021). This shows that uneven technological development causes urban and rural populations to not enjoy the benefits of income growth that should accompany the penetration of digital technology (Sun & Kuang, 2023).

3. Research Methods

The method of this research is a systematic literature review, with data collected from the Scopus journal database. The analysis is enriched with empirical findings based on local government policies governing smart villages using the case study method. This method is based on searching for data and information through web browsing for several Indonesian regencies that have adopted smart villages and smart cities in their regions. Case studies are employed to present actual instances of applying the phenomenon being studied. In the exploratory stage, the case study technique focuses on providing answers to what research questions; in the explanatory stage, it addresses how and why (Yin, 2009).

The relationships between literature collected from Scopus are visualized in the form of bibliometric networks using VOSviewer software, which can show a variety of interesting results when applied to the social sciences (Van Eck & Waltman, 2010). Systematic literature review is the process of collecting, analyzing, and comprehending all available research information with the goal of providing an answer to a particular question (Kitchenham & Charters, 2007). The formulation of the problem set is: "How are smart villages related to the smart city in supporting the smart city in Indonesia?"

The literature search in Scopus is based on the search strategy ((TITLE-ABS-KEY (smart village) AND TITLE-ABS-KEY (smart city))). This search strategy was used to find articles that specifically had the main topic of smart villages and smart cities. Based on this search, 120 articles were found from the range of 2015–2023. Additional articles were searched to support the analysis and 1 article was found that was most relevant to this study, resulting in a total of 121 articles found.

Furthermore, the literature was selected using the PRISMA method, or Preferred Reporting Items for Systematic Reviews and Meta-analysis, as a systematic stage in accordance with the established research protocol. A screening and assessment stage was then conducted to ascertain which of the 121 articles about smart villages and smart cities were appropriate for inclusion in the

literature study. Based on reading the abstracts, 97 articles that were appropriate and accessible were chosen from the screening stage. Reading the complete article was the next step in the assessment process, which produced a list of 26 pertinent articles that were to be reviewed for the literature study. Table 1 displays the process of the literature. The 26 articles selected and used in this review are shown in Table 2.

Table 1. The process of literature study.

Step	Criteria	Number of selected articles	Number of excluded articles (due to irrelevance)	Total
1	Articles identified from Scopus search using the keywords “smart village” AND “smart city”, with Indonesian and English literature within 2010-2023 period (IC1) and smart village-smart city linkages (IC2)	120	0	120
2	Further searching in Google Scholar to find the most relevant articles	1	0	121
3	Initial screening (whether the article can be accessed or not)	121	24	97
4	Screening based on title, abstract, and keywords	97	61	36
5	Eligibility test with skimming read the full article	36	10	26
Articles included for literature review				26

Table 2. Articles selected and used in this literature review.

No.	Article's title	Author(s)	Year	Source
1	(Re)thinking smart in rural contexts: A multi-country study	Cambra-Fierro, J.J. & Pérez, L.	2022	Growth and Change, 53, 868-889
2	An Interpretive Structural Model Approach to Strategic Management Modelling for Sustainable Smart Village Development in Indonesia	Darmawan, A.K., Muhsi, M., Anekawati, A., Sakdiyah, H., Yusuf, M., Sophan, M.K., Ferdiansyah, D., Umam, B.A., Jalil, D.K.A.	2023	10th International Conference on ICT for Smart Society (ICISS), Bandung, Indonesia, 1-7
3	Connecting the Smart Village: A Switch towards Smart and Sustainable Rural-Urban Linkages in Spain	Fernández, C.G. & Peek, D.	2023	Land, 12, 822
4	Defining smart city, smart region, smart village, and technopolis as an innovative concept in Indonesia's urban and regional development themes to reach sustainability	Sutriadi, R.	2018	IOP Conf. Series: Earth and Environmental Science, 202, 012047.
5	Determinism Technology in Smart Village: Structuration and Construction Socio- Techno in Osing Culture, Banyuwangi Indonesia	Yuniar, A.D. & Hasanah, F.	2021	2nd International Conference on ICT for Rural Development (IC-IC-TRuDev), Jogjakarta, Indonesia, pp. 1-6
6	Development of Smart Rural Village Indicators in Line With Industry 4.0	Maja, P.W., Meyer, J., Solms, S.V.	2020	IEEE Access, 8, 152017-152033
7	Emerging Paradigm of IoT Enabled Smart Villages	Rohan, R., Pal, D., Watanapa, B., Funilkul, S.	2022	IEEE International Conference on Consumer Electronics (ICCE)
8	Increased Attention to Smart Development in Rural Areas: A Scientometric Analysis of Smart Village Research	Wang, Q., Luo, S., Zhang, J., Furuya, K.	2022	Land, 11, 1362
9	Is ICT smartness possible development way for Hungarian rural areas?	Nagy, H., Kaposzta, J., Varga-Nagy, A.	2018	17th International Scientific Conference Engineering for Rural Development
10	It's Not a Fad: Smart Cities and Smart Villages Research in European and Global Contexts	Visvizi, A. & Lytras, M.D.	2018	Sustainability, 10, 2727
11	<i>Pengembangan Smart Village untuk Penguatan Smart City dan Smart Regency</i>	Rachmawati, R.	2018	Jurnal Sistem Cerdas, 1(2), 12-18
12	Rural Urban Migration: Disturbing the Equilibrium between Smart Cities and Smart Villages	Srivatsa, P.	2015	FIIB Business Review, 4(3)
13	Smart City (SC) – Smart Village (SC) and the ‘Rurban’ Concept from a Malaysia-Indonesia perspective	Malek, J.A. & Baharudin, R.A.	2019	African Journal of Hospitality, Tourism and Leisure, GCBSS Special Edition
14	Smart City Projects in the Small Sized Municipalities: Contribution of the Cohesion Policy	Smékalová, L. & Kučera, F.	2020	Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration, 28(2), 1067
15	Smart Villages: IoT Technology Based Transformation	Mudholkar, P., <i>et al.</i>	2021	Journal of Physics Conference Series, 2070, 012128
16	Smart villages, rural development and community vulnerability in Indonesia: A bibliometric analysis	Muhtar, E.A., Abdillah, A., Widianingsih, I., Adikancana, Q.M.	2023	Cogent Social Sciences, 9(1), 2219118

Table 2. (Continued).

No.	Article's title	Author(s)	Year	Source
17	Smart Village: An IoT Based Digital Transformation	Degada, A., Thapliyal, H., Mohanty, S.P.	2021	IEEE 7th World Forum on Internet of Things (WF-IoT)
18	Sustainable and Community-Centred Development of Smart Cities and Villages	Zavratnik, V., Podjed, D., Trilar, J., Hlebec, N., Kos, A., Duh, E.S.	2020	Sustainability, 12, 3961
19	The Smart Village Model for Rural Area (Case Study: Banyuwangi Regency)	Aziiza, A.A. & Susanto, T.D.	2020	IOP Conference Series: Materials Science and Engineering, 722, 012011
20	The Use of IoT Technology in Smart Cities and Smart Villages: Similarities, Differences, and Future Prospects	Cvar, N., Trilar, J., Kos, A., Volk, M., Duh, E.S.	2020	Sensors, 20, 3897
21	Towards a multiscalar perspective on the prospects of 'the actually existing smart village' – a view from Hungary	Szalai, A., Varró, K., Fabula, S.	2021	Hungarian Geographical Bulletin, 70(2), 97–112
22	Toward a New Sustainable Development Model for Smart Villages, Visvizi, A., Lytras, M.D., Mudri, G. (Ed.) Smart Villages in the EU and Beyond (Emerald Studies in Politics and Technology)	Pérez-delHoyo, R. & Mora, H.	2019	Emerald Publishing Limited, Leeds, 49-62
23	Urban–Rural Partnership Perspectives in the Conceptualization of Innovative Activities in Rural Development: On Example of Three-Case Study Analysis	Kusio, T., Rosiek, J., Conto, F.	2022	Sustainability, 14, 7309
24	Village 4.0: Digitalization of village with smart internet of things technologies	Malik, P.K., Singh, R., Gehlot, A., Akram, S.V., Das, P.K.	2022	Computers & Industrial Engineering, 165, 107938
25	What makes a smart village smart? A review of the literature	Gerli, P., Marco, J.N., Whalley, J.	2022	Transforming Government: People, Process and Policy, 16(3), 292-304
26	Examining link-ages between Smart Villages and Smart Cities: Learning from rural youth accessing the internet in India	Fennell, S., Kaur, P., Jhunjunwala, A., Narayanan, D., Loyola, C., Bedi, J., Singh, Y.	2018	Telecommunication Policy, 42, 810-823

4. Results and Discussion

4.1. Concepts Developed in the Relationship between Smart Village and Smart City

The bibliometric network of articles on smart villages and smart cities is visualized using VOSviewer, shown in Figure 1. The topics of smart village, smart city, and rural areas are the most frequently occurring topics in studies on smart city and smart village linkages.

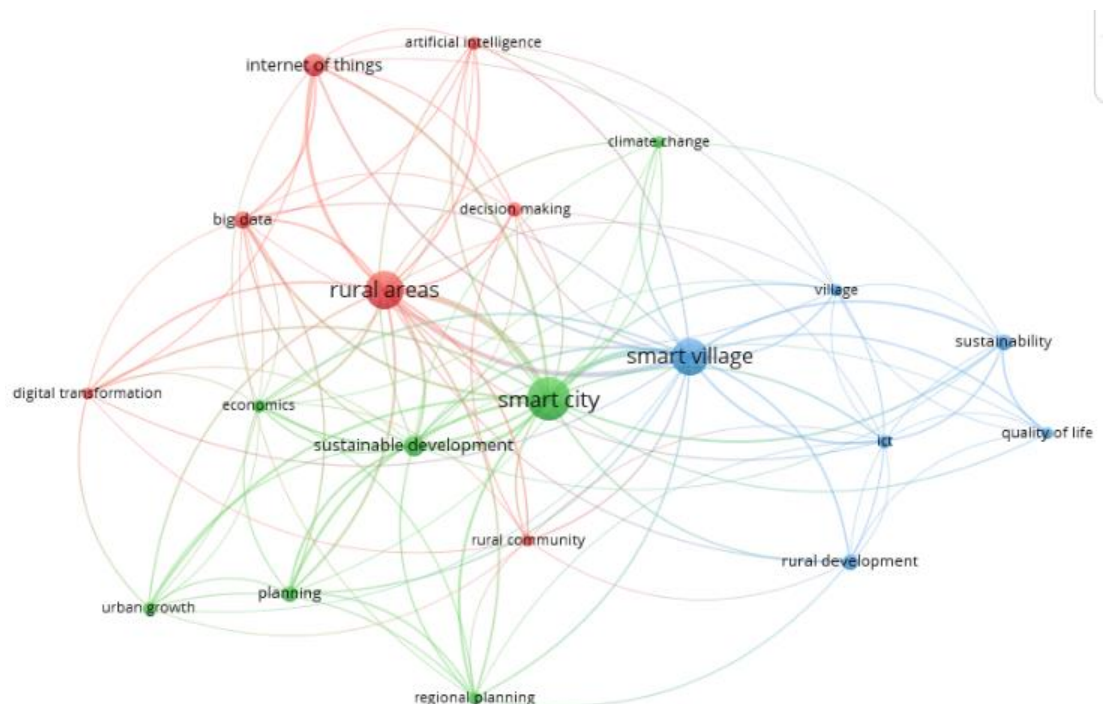


Figure 1. The bibliometric network of articles on smart village and smart city. Source: Scopus journal database processing results using VOSviewer (2024).

Studies on this topic do not have many variations of other interrelated topics with only three clusters formed, as shown in Table 3. The first cluster is related to the instruments used in the development of areas based on smart concepts, namely artificial intelligence (AI), big data, digital transformation, decision-making, Internet of Things (IoT), and communities and rural areas as objects and subjects of development. The second cluster deals with the implementation of smart cities in planning, urban growth, climate change management, economic improvement, and sustainable development. The third cluster focuses on implementing smart villages for ICT-based rural development with the goal of raising community standards of living.

Table 3. Topic clusters of articles on smart villages and smart cities.

First cluster: instruments used in the regional development of based on smart concepts	Second cluster: implementation of smart city	Third cluster: implementation of smart village
artificial intelligence (AI) big data digital transformation decision making Internet of Things (IoT) communities and rural areas as objects and subjects of development	planning urban growth climate change management economic improvement sustainable development	rural development quality of life

The bibliometric network above shows that smart village and smart city are closely related as development and planning concepts that aim to achieve sustainability and improve the community's economy through the technology utilization as digital transformation emerges. Based on the literature review conducted on the selected literature, several concepts can be formulated regarding the relationship between smart city and smart village, as follows.

4.1.1. The concept of smart city and smart village emerged as a result of ICT globalization

Smart village and smart city concepts first emerged in alongside with the fast globalization of ICT (Malek & Baharudin, 2019). Empirical findings by Skare & Soriano (2021) show that globalization positively influences the transfer and spillover of digital technologies in all countries. ICT is considered by many experts as the main instrument and focus of implementing smart concepts in regional development (Nagy *et al.*, 2018; Aziiza & Susanto, 2020; Darmawan *et al.*, 2023). ICT is not the exclusive criterion in the implementation of smart city and smart village, despite being seen as the central component of its practices (Zavratnik *et al.*, 2020; Szalai *et al.*, 2021). This is due to the fact that every location has unique qualities that vary in terms of geography, society, culture, and the duality of urban and rural areas (Rachmawati, 2018; Szalai *et al.*, 2021).

4.1.2. The influence of urbanization phenomena in the smart city and smart village concepts development

The smart city and smart village concepts development is also impacted by the phenomenon of urbanization. Smart village were initially intended to be bottom-up development concepts based on the community's own initiative in exploiting its potential and assets (ENRD, 2017). Smart village are supposed to be able to overcome a number of issues that plague villages, like uncontrolled urbanization, underdevelopment of villages, migration in an effort to raise living standards and economic standards, and so forth (Srivatsa, 2015). However, there are different conditions between villages in Europe and Asia, namely villages in Europe with people who are independently able to utilize technology and develop entrepreneurship, while villages in Asia and developing countries with ICT roles that are not yet dominant and focus more on traditional economic activities, such as agriculture (Gerli *et al.*, 2022).

Unlike the smart city concept, which has matured in implementation and has been widely researched before, smart village are just gaining momentum and are still in the conceptual stage for the past 5-6 years (Maja *et al.*, 2020; Kusio *et al.*, 2022). The main barriers to smart village development are infrastructure availability, financing capability, and sustainability (Rohan *et al.*, 2022). Villages experience a common problem of depopulation due to urbanization of the productive age population and aging population, resulting in a lack of human resources, especially young people as subjects and drivers of smart village development initiatives (Visvizi & Lytras, 2018b; Cambra-Fierro & Pérez, 2022). This phenomenon needs to be addressed, considering the increasing urban population density with an insufficient number of cities to accommodate rural-to-urban migration (Srivatsa, 2015).

4.1.3. Village and city connectivity in the implementation of smart village that support smart city

Reducing urbanization rates and preserving a balance between urban and rural growth can both be aided by the smart village concept (Srivatsa, [2015](#)). To do this, the community and the government must exercise wisdom and seriousness in the village's growth and in its interactions with the city. Developing smarter connections between rural and urban areas is crucial to creating resilient, adaptable, and efficient communities (Fernández & Peek, [2023](#)). According to research by Fennell *et al.* ([2018](#)), young people in rural India who use mobile phones can serve as a spark for the development of smart village since internet connection can elevate ambitions for higher education and expand the range of non-farm jobs available in rural areas.

On a regional scale, with links to the economy, environment, and society, rural-urban connectivity supported by regional infrastructure is essential (Sutriadi, [2018](#)). Infrastructure, especially broadband infrastructure, will help eliminate the digital divide in rural areas by promoting the utilization of digital services, enhancing digital literacy, and facilitating communication between rural and urban areas (ENRD, [2018](#)). ICT infrastructure needs to be supported by affordable, sustainable, and modern energy to achieve connectivity and smartness (Maja *et al.*, [2020](#)).

4.1.4. The notion of “Rurban” within the framework of smart city and smart village

According to Malek and Baharudin ([2019](#)), “Rurban” refers to a type of interconnected network that connects rural and urban area. It is evaluated not only on the existence of physical infrastructure, like roads and cables, but also on intangibles things, like market linkages, settlements, tourism, and security. The notion of Rurban involves infrastructure capacity, human and social resource capabilities, and appropriate policies (Malek & Baharudin, [2019](#)). Smart village developments can function as areas of economic growth in line with their individual potentials, complementing each other with smart city. They are linked to major cities via ICT to enhance knowledge and streamline services, ultimately enabling participation in local, regional, and national governance processes (Gerli *et al.*, [2022](#)).

4.1.5. Implementation of smart village cannot be homogenized with smart city

By providing dependable network infrastructure and connectivity in villages, digitalization of fields and services can aid in the realization of the smart village concept (Malik *et al.*, [2022](#)). The Internet of Things (IoT) is envisioned as a key instrument in the realization of smart village that can provide an interactive platform for information exchange and control of smart devices (Degada *et al.*, [2021](#)). Several ideas were proposed by Mudholkar *et al.* ([2021](#)) regarding various forms of smart village implementation, especially in agriculture, such as technology innovation for buildings, weather & irrigation, farming, dairy, healthcare, surveillance system, and education. However, the condition of villages, which generally have various limitations to digital infrastructure, hampers the dream of a smart village with all the latest technology utilization.

IoT is often used to refer to smart city, which can be applied to broad areas like cities, while smart village are symbolized by low population density and lack of technology so that there are barriers to the application of IoT in rural areas (Cvar *et al.*, [2020](#)). This is also supported by the findings of Gerli *et al.* ([2022](#)) which states that the conceptualization of smart village by researchers in Asia, Africa, and Latin America does not focus too much on ICT, but rather encourages the utilization of existing technological, human, and natural resources.

Rachmawati ([2018](#)) considers that the application of ICT is still required for smart village development, but the smart aspect focuses more on improving human resources, in this case village officials and communities, in order to encourage independence and innovation in village social and economic activities. A study by Smékalová & Kučera ([2020](#)) on the implementation of smart city initiatives in small cities in the Czech Republic reveals a relationship between city size and budgetary capability, which is related to the differences in regional scale in the application of smart concepts. The government invests more heavily in initiatives linked to the implementation of smart city in larger cities (Smékalová & Kučera, [2020](#)). This demonstrates the intricacy of problems that arise in urban areas, where village size and population density are essential components.

4.1.6. The need for sustainable smart village development

Smart village projects in developing and poor countries mostly target the dearth of resources, essential infrastructure, and services, or the agriculture sector as a means of reviving rural communities (Wang *et al.*, [2022](#)). The different conditions and characteristics of urban and rural areas necessitate different approaches in both of development in smart city and smart village. This

shows that smart village development needs to pay attention to the uniqueness and specialization of the village with the traditions and culture inherent in the community (Muhtar *et al.*, 2023). Smart strategies that consider the conditions and characteristics of the village towards optimal smart village development will be the focus and driver of sustainable development (Pérez-del-Hoyo & Mora, 2019). The role of local communities as the main actors of smart village development is required to be actively involved in the planning process (Nagy *et al.*, 2018; Kusio *et al.*, 2022). Smart village development is also aided by partnerships with pertinent stakeholders (Kusio *et al.*, 2022), particularly when it comes to building village communities' ability.

4.2. Case Study of Smart Village Development in Supporting Smart City in Indonesia

The current smart village development in Indonesia tends to be top-down with initiatives coming from the central and local governments. With the state of Indonesian villages, which still need knowledge transfer to fully implement the smart village idea, supralocal stakeholders' support is still required (Kusio *et al.*, 2022). The initiative to develop smart village as a rural development goal is more influenced by the increasing attention to digitalization on a national and global scale (Szalai *et al.*, 2021; Yuniar & Hasanah, 2021). The following areas act as case studies for this research are Banyuwangi Regency in East Java Province, Batang Regency in Central Java Province, Pesisir Selatan Regency in West Sumatera Province, and Kuningan Regency in West Java Province. The reason Banyuwangi Regency, Batang Regency, Pesisir Selatan Regency, and Kuningan Regency were selected as case study subjects was that they already have regional laws pertaining to the technology-based village development through smart village, or what is called by other names. Regional policies that oversee the development of smart village allow for the prioritization of development and guarantee the availability of resources to support the program's implementation and sustainability.

4.2.1. Case Study from Banyuwangi Regency

The Banyuwangi Regency Government has put the smart village concept into practice by establishing Banyuwangi Regent Regulation Number 18 of 2016 concerning Smart Kampung as Integration Village-based Work and integrating it with Banyuwangi Regent Regulation Number 60 of 2017 concerning Masterplan for Banyuwangi Smart Kampung to Achieve Smart City. Based on the regulation, smart kampung is "the concept of community development in a community to do something smart in overcoming various problems with the ability of available resources efficiently in an area inhabited by people who form their own community with a life order related to local customs and norms that apply in it". Technology's favorable motivation for development and public services was also greatly aided by the leadership of the Banyuwangi Regent at the time, Abdullah Azwar Anas (Manar *et al.*, 2021).

The smart kampung program incorporates work initiatives from the regency administration that cover public services, health, poverty, education, legal information, economic empowerment, culture and arts, education, and strengthening human resource capacity. However, the community is already benefiting from a number of online service innovations that demonstrate how smart kampung is being implemented in the sphere of public services (Aziiza & Susanto, 2020) and community-based local tourism promotion (Yuniar & Hasanah, 2021; Jayanthi *et al.*, 2022). The primary objective of smart kampung is to enhance public services for Banyuwangi residents (Anas, 2020 in Jayanthi *et al.*, 2022).

The implementation of smart kampung is achieved through a collaborative effort between the local government and the community. The government serves as a provider of appropriate infrastructure, while the village communities contribute their own ideas and expertise to construct the smart kampung (Aziiza & Susanto, 2020). This indicates that the community and village government are working together to creatively implement this program in accordance with each village's particular potential. At the beginning of the smart kampung development, the government collaborated with PT Telkom Indonesia to provide internet services, and was followed by improving facilities, infrastructure, and human resources (Manar *et al.*, 2021). These efforts are also supported by budget allocations from the Regional Budget, Regional Apparatus Organization assignments in providing assistance, and the commitment of village heads through Village Budget allocations (Manar *et al.*, 2021).

The Banyuwangi Regency is gradually implementing smart kampung in all of its villages and subdistricts. Currently, smart kampung is developed as a portal for all online-based Banyuwangi Regency Government services that can be accessed through <https://smartkampung.id/>. Village certificate services can be processed through the portal, consisting of introductory, application, incapacity, crowd, business, general, and domicile certificate services. In addition, there is a

collection of services at various regional levels (villages, sub-districts and regency) that can be accessed, including population services from the Population Office, villages in the form of certificate applications), Digital Population Identity as a form of centralized Civil Registration Information System services, licensing from the One Stop Investment Office, Compact Fishermen from the Fisheries Service, health, public information, regency courts, environment, agriculture, sports and culture, social, and Banyuwangi Festival Art Week Ticket.

As part of the “Movement Towards 100 Smart Cities”, Banyuwangi Regency has been one of 25 pilot regencies/cities in Indonesia that adopted smart city concept from 2017. Apart from being applied in the governance and public service sectors, “Smart Kampung” is also regarded as a city branding catchphrase that benefits Banyuwangi’s efforts to promote regional tourism (Oktarina *et al.*, 2023). The differences and advantages highlighted by a city through the branding process are carried out to attract to accelerate development and improve the economy, and directly shape the city’s identity (Rahayu & Hariadi, 2021). In the tourism sector, Banyuwangi Regency has a tagline in the form of “Majestic Banyuwangi” with a variety of natural tourism potential in the area.

Tourism development based on community empowerment and local wisdom in smart village in Banyuwangi Regency is done in the utilization of social media and the availability of an effective internet network in encouraging the promotion and publication of tourist objects (Oktarina *et al.*, 2023). Smart kampung is one of the programs that promotes tourism attractions through the media in order to increase community welfare while preserving the Osing tribe’s customs and culture (Yuniar & Hasanah, 2021). The utilization of digital technology to assist Banyuwangi Regency development priorities, such as improved public services and inclusive economic growth through tourism, is at the basis of the smart kampung implementation (Jayanthi *et al.*, 2022). Banyuwangi Regency, which was originally only a stopover or transit point for tourists who wanted to visit Bali or Yogyakarta as two mainstay tourist locations on the island of Java, has now made Banyuwangi Regency a major tourist destination (Purwowibowo, 2020).

4.2.2. Case Study from Batang Regency

The Batang Regency Government has stipulated Batang Regent Regulation Batang Regent Regulation Number 10 of 2018 on the Smart City Development and Construction Program, and stipulated Number 11 of 2018 on the Smart Village Development and Construction Program. Smart village is defined as “the development of villages in a community to carry out smart activities in overcoming various problems with the ability of available resources efficiently and effectively in a village by utilizing information and communication technology and innovation directed at improving performance and involving community participation”. As with Banyuwangi Regency, Batang Regency’s smart village covers public services, health, poverty alleviation, economic empowerment, education, human resource capacity building, and other areas that arise in the village community. It also provides legal information.

In 2018, Batang Regency became a part of the “Movement Towards 100 Smart Cities” program. The Batang Regency Government has developed an integrated portal for Batang Regency smart village self-service that can be accessed via <https://desa.batangkab.go.id/>. In Self Service, online services offered under self-service often take the form of correspondence for population and administrative record requirements, such as certificates of heirs, *boro* work, work permits, *mirudo*, poor, general, business; cover letters of death, general; and statement letters. On the Village Information menu, several village website announcements and information are presented according to the selected sub-district. Public can access the village information system using the same domain name for every village., namely the village name followed by “desa.id”. However, not all villages have made good use of the village information system provided by the regency government.

4.2.3. Case Study from Pesisir Selatan Regency

The Government of Pesisir Selatan Regency has stipulated Pesisir Selatan Regent Regulation Number 54 of 2018 concerning Smart Nagari. Smart nagari is “the concept of community development in a community to do something smart in overcoming various problems with the ability of available resources efficiently in an area inhabited by people who form their own groups with a life order related to local customs and norms that apply in it”. Nagari is the designation for the administrative area of the village in the West Sumatra Province. Smart nagari’s stated goal is to facilitate the realization of smart governance, smart environment, smart living, smart economy, smart mobility, and smart people—all of which are components of smart city, which are integrated to enhance public services via the creation of information systems and applications.

Pesisir Selatan Regency has not been incorporated in the “Movement Towards Smart City” program, but has had the initiative to implement an integrated smart village from the district level. Nonetheless, the regency government has developed a Nagari Information System for Pesisir Selatan Regency that can be accessed by the public with the same domain name for all nagari, namely the name of the nagari and followed by “.pesisirselatankab.go.id”. However, not all nagari utilize the information system provided by the government to provide data transparency and update information related to nagari governance.

4.2.4. Case Study from Kuningan Regency

The Kuningan Regency Government specifically stipulates the governance of the village information system towards a smart village through the Kuningan Regent Regulation Number 367 of 2022. Smart Village in this definition is “a village that is capable in utilizing its potential resources in a new way through the use of science and technology and the utilization of local wisdom for the welfare, progress of the village, and improving the standard of living of the community by involving all elements of the village”. Compared to other regions, Kuningan Regency characterized a “smart village” as one that can use technology and local knowledge to realize the potential of its assets on its own. The adoption of smart village is considered in compliance with the objectives of the Regional Medium-Term Development Plan for 2018-2023 of Kuningan Regency, namely “Kuningan Prosperous, Religious, and Excellent Based on Villages”.

According to the regulations, every village must set up an offline and online village information system that is run by the village authority. The content of the village information system at least consists of village data, village government information, communication media between the village government and the community, and village administration services. The integrated village information system is provided by the Kuningan Regency Government on the website <https://kuninganmaju.id/dashboard>.

From the dashboard, the data portal of each sub-district and the latest statistical data of Kuningan Regency in 2024 can be accessed, such as data on gender, religion, blood type, age, marital status, occupation, and education. Meanwhile, to obtain public services online, it is done through the “EasyDes” application which can only be accessed by local residents because it requires a username and password.

From the sub-district data portal, the information system for each village can be accessed. Public can access the village information system using the same domain name for every village, namely the village name followed by “.godesa.id”. Not all villages utilize the information system provided by the government to provide data transparency and update information related to village administration. The information system that is not utilized properly can be caused by the lack of attention of village officials to the management of the information system, which can be impacted by inadequate information technology tool utilization, while the inaccessible website is caused by the lack of technical website maintenance from the regency government.

Kuningan Regency is included in the “Movement Towards Smart City” program from 2022, but there is no local regulation in Kuningan Regency that regulates smart city. Therefore, it is still necessary to harmonize the implementation of smart city and smart village policies in Kuningan Regency so that there is measurable planning and development. Kuningan Regency Government, which has established a Regulation on SID governance towards a smart village, should facilitate villages in mobilizing the budget and infrastructure needed in SID management in order to achieve one of the realizations of smart village implementation, namely through e-government. One form of e-government in public services and village governance is through the use of village information systems (Faozanudin *et al.*, 2022).

Based on case studies of several regional policies that support smart village, Table 4 shows a comparison of the implementation of smart village in supporting smart city in several regions in Indonesia.

Smart village is not a universally applicable solution or one-size-fits-all (Nagy *et al.*, 2018; Zavrtnik *et al.*, 2020; Wang *et al.*, 2022). Therefore, the definition of smart village by various experts may vary by considering the unique geographical features, demographics, and social and physical resources of each region (Cambra-Fierro & Pérez, 2022). It is reemphasized that the ICT solutions implemented can be different and specific to each community with varying adaptability to its needs based on existing customs and practices (Zavrtnik *et al.*, 2020). The smart village ecosystem is open and interacts with other systems (Wang *et al.*, 2022), one of it is smart city. This proves that regional approaches to smart village development should be customized through intensive collaboration networks to enhance capacity and technical support (Fernández & Peek,

2023). Drawing from the analysis and case studies of several regions above, it can be inferred that the implementation of smart village that are supporting smart city needs to be done in order to foster relationships between the two, promote village independence, and assist the smart city implementation in a complementary manner by integrating digital services and bolstering the local economy.

Table 4. Comparison of the implementation of smart village in supporting smart city in several regions in Indonesia.

Forms of implementation	Regency			
	Banyuwangi	Batang	Pesisir Selatan	Kuningan
Local regulations governing smart city	Yes	Yes	No	No
Local regulations governing smart village or related	Yes	Yes	Yes	Yes
Prioritized aspects	Governance and tourism	Governance	Governance	Governance
Form of technology/innovation used	Website https://smart-kampung.id/ as a portal for all online-based services and “Smart Kampung” as city branding tagline	Website https://desa.batangkab.go.id/ as an integrated portal for village self-service and uniformity of the village information system domain into “desa.id” (not all villages have utilized it)	Uniformity of the village information system domain into “.pesisirselatankab.go.id” (not all villages have utilized it)	Website https://kuninganmaju.id/dashboard as an integrated village information system, “EasyDes” as application for public services online, and uniformity of the village information system domain into “.godesa.id” (not all villages have utilized it)

4.3. Policy Alternative for Smart Village Development in Supporting Smart City in Indonesia

Experts and institutions have outlined the dimensions/aspects that are suitable to be applied in the smart village development, especially in the rural areas in Indonesia. The Ministry of Villages, as the ministry in charge of the program, defines the smart village dimensions as smart community, smart governance, smart economy, smart environment, smart mobility, and smart living. These characteristics solely make reference to Giffinger’s description of a smart city, as though the government views smart village as a type of smart city application implemented in rural areas. The dimensions of smart village that have considered the different characteristics of villages and cities are elaborated by Rachmawati (2018), including smart governance, smart community, smart economy, and smart environment, with the possibility of being complemented by the smart branding dimension for villages that have certain potential. In the meantime, smart people, smart mobility, and smart transportation dimensions are less suitable to be implemented in smart village because the scope of these dimensions is too complex and more appropriately applied in smart city (Rachmawati, 2018).

Andari & Ella (2021a) formulated the smart village dimensions consisting of local resources, applied technology, service chain, and institutions within the village. These dimensions tend to reflect the smart village dimensions according to Viswanadham & Vedula (2010) and Ramachandra *et al.* (2015) which are synthesized based on rural conditions in India and assess that villages can become economic and commodity centers independently. Aziiza & Susanto (2020) also formulated smart village dimensions based on the smart kampung implementation in Banyuwangi Regency, which consist of governance, resources, technology, public facilities, village services, and tourism.

This study proposes an alternative for the next smart village development policy that supports smart city in Indonesia. The smart village dimensions included in this policy alternative are based on a synthesis of earlier research, making it confirmatory and supported by findings from empirical data. The resulting dimensions of the smart village are anticipated to be more in line with the conditions of the reality in current villages, validated by the research findings of earlier studies, and able to provide policymakers with information for the development of smart village in Indonesia.

After using Village Potential data to explore the factors determining the notion of smart village in Indonesia, five factors were found to be influential, including the utilization of information systems in government, community participation, community interest in ICT, leadership, and availability of communication access. The aforementioned variables suggest that technology, infrastructure, and human resources are important factors in deciding how far along a smart village is in its development. ICT is considered a tool or instrument that serves to help accelerate the

development process (Susilowati & Rachmawati, 2024), although the practice in Indonesia for now, the utilization of ICT is generally still limited to government administration, public services, digital markets, and tourism. There is not much empirical evidence showing that villages in Indonesia have applied technology in agricultural and environmental activities, considering that rural areas are identical to the agricultural sector.

Then, according to the analysis of the linkages contrasting smart village and smart city, there is a need for connectivity between villages and cities through equitable provision of digital infrastructure and institutional support from relevant stakeholders to assist village communities in developing smart village. Although smart village require active participation and initiative from the community, there is still a need for encouragement from the supra-village government in the form of the establishment of regulations that allow the availability of budgets and infrastructure in the implementation of smart village at the village level. Rural areas' young and working-age populations are crucial to the developing of smart village because they spur village growth and are less resistant to technological advancements. The presence of a productive age population in the village, along with strong capacity and capability, lessens the transfer of resources from the village to the city as a result of urbanization and increases the chance for independent village development.

Based on these findings, the proposed smart village dimensions consist of community, technology, institutions, and potential village resources. In the Ministry of Village's Smart Village ecosystem (2022), the smart community dimension is the primary requirement in the realization of a smart village. This dimension must be fulfilled first before reaching the next smart village dimension. The good quality of human resources in a community is expected to encourage an optimal smart village (Cahyadani & Djunaedi, 2022). The community dimension instrument consists of elements of education and community interest in ICT. The community as the subject and object of village development needs to have initiative and creativity, as well as a good ability to utilize technology. The technology dimension acts as a supporting factor in village development through smart village depending on the circumstances and features of each village. Technological instruments consist of the availability of communication access, the amount of digital infrastructure, and the use of technology in village government.

Table 5. Recommendations for smart village dimensions in supporting smart city in Indonesia.

No	Dimensions	Instrument
1	Community	- Highest level of education completed by the population - Ratio of people using cellular phones to total population - Ratio of families using electricity to the total number of households
2	Technology	- Cellular/Phone signal in most areas of the village - Cellular/Phone internet signal in most areas of the village - Existence of free internet that can be accessed by the public in the village - Number of mobile phone/HP communication service operators that cover most of the village area - Number of village information systems - Number of village financial systems
3	Institutions	- Number of types of community institutions in the village - Highest level of education completed by village leaders and officials - Number of village regulations in 2020 - Number of village head regulations in 2020 - Total budget for activities related to smart village - Number of village deliberation activities conducted during 2020 - Existence of supra-village level regulations governing smart village - Number of village partners in developing smart village (private sector, non-profit organizations, universities)
4	Potential village resources	- Soil conditions - Water availability - Renewable energy sources - Landforms - Culture and traditions that are still maintained - Level of accessibility to other regions

The institutional dimension serves as a regulator that offers a legal shield, validates the smart village implementation in each village, and involves the community in the government's oversight of smart village development. The institutional dimension instrument consists of aspects of village government capacity, community participation, regulatory and budgetary guarantees, and village partnership networks with relevant stakeholders in smart village development. The dimension of potential village resources is generally included to accommodate the potential and condition of villages that vary in wealth in natural or cultural resources, which can be developed as an

industrial or tourism sector. The instrument consists of physical, socio-cultural, and economic conditions in the village. Table 5 displays the recommendations for smart village dimensions in supporting smart city in Indonesia.

4.4. Discussion

Many ideas regarding the connection between smart village and smart city were developed as a result of the thorough literature review, including the concept of smart city and smart village emerged as a result of ICT globalization, the influence of urbanization phenomena in the smart city and smart village concepts development, village and city connectivity in the implementation of smart village that support smart city, the notion of “Rurban” within the framework of smart city and smart village, implementation of smart village cannot be homogenized with smart city, and the need for sustainable smart village development. Through these notions, it is recognized that, despite the fact that the implementation of smart village and smart city require distinct approaches, in order to build smart village and smart city together, a connection between rural and urban areas must be established. A “smart village” is a development concept that gives the village’s residents the power to shape its own future by utilizing both technology and the qualified, self-sufficient resources in the town. As a result, this action can address the village’s issues, which are typically linked to its low degree of development as a result of its poor human resource quality. Urbanization, which draws skilled labours to the city, also has an impact on the village’s issues.

Diverse regencies in Indonesia have adopted smart village as a means of bolstering smart city, exhibiting variations in terms of priority elements, technological advancements, and local policy facilitation. With the “Smart Kampung” program, which has been in place since 2016, Banyuwangi Regency leads the way in creating smart village that support smart city. The government and tourism sectors are implementing this program by creating an online, integrated website for all village-level public services and branding Banyuwangi Regency as the primary tourism destination under the slogan “Smart Kampung”. This is followed by enhancing village-level tourist attractions and upgrading all related infrastructure.

As for the implementation of smart village to support smart city, Batang and Kuningan Regency are generally on par with one another. They concentrate on the governance component by creating integrated websites and village information systems that allow residents to access public services online. But not every village has made advantage of the regency government’s information system. This suggests that the development directives of the regency government, even with the deployment of supporting infrastructure, are unlikely to have a positive effect on the implementation of smart villages if they are not complemented by initiatives to improve the capacity of village officials and active community participation.

Research by Shabrinawati & Yuliastuti (2020) examined the achievement of smart governance implementation in villages that became the Batang Regency smart village pilot project. The findings show that, out of the three areas examined—public services, village information systems, and management of village funds—the majority of the 56 smart villages pilot project’s smart governance implementation was still lacking. In addition, villages that have optimised the implementation of smart governance are generally located close to the regency center, while villages that are still less than optimal are located far from urban areas. This shows that there is a digital infrastructure disparity between urban and rural areas in Batang Regency, with villages still having poor or no internet coverage (Shabrinawati & Yuliastuti, 2020). This finding reinforces the need for connection between villages and cities through the provision of digital infrastructure so that all people have the same rights in obtaining the convenience of public services through the digitization of ICT-based services.

There is currently no regional legislation on smart cities in Pesisir Selatan Regency, but there is one governing smart nagari. Pesisir Selatan Regency has been preparing for the implementation of smart cities since 2017, with a focus on e-government and e-health, according to a search for news stories in online media (Padangkita, 2017). Several programs, including the creation of a database information system for roads and bridges, administration, land, and regional original revenue, support the implementation of e-government, according to a policy review of Pesisir Selatan Regency Number 8 of 2018 concerning Amendments to Regional Regulation Number 3 of 2016 concerning the Regional Medium-Term Development Plan of Pesisir Selatan Regency for 2016–2021. Despite the fact that there are currently a number of programs in place, the sustainability and seriousness of program implementation may be impacted by the lack of a regulatory framework for smart city initiatives, both in terms of legal products such as regional regulations and nomenclature in planning documents. The Government of Pesisir Selatan Regency translates smart nagari as only providing a website or information system that the community can

access to obtain general administrative services of the village government (Government of Pesisir Selatan Regency, 2018). The regency government should create digital network infrastructure in all nagari areas and increase the capacity of nagari authorities to use these facilities in order to facilitate the availability of village information systems. To guarantee commitment to budget availability and area coverage, this stage can be accommodated through regency-level smart city programs.

Since Pesisir Selatan Regency is an agricultural region, smart nagari implementation there can concentrate on the potential of local resources stimulated by technology. A review of the previously mentioned medium-term development plan document reveals a number of initiatives aimed at expanding the use of suitable technology in the domains of industrial technology, animal husbandry, and agriculture/plantations.

The proposed smart village dimensions have implications for the development of smart village and smart city in the four case study's regencies. With "Smart Kampung" that has been fully implemented in each of the regency's villages, Banyuwangi Regency is thought to have optimized all four aspects of a smart village. The community has been involved in the implementation of this initiative as the primary subjects and objects in the implementation of smart village, with capacity building in technology use provided by integrated public service websites and social media branding. Banyuwangi Regency is becoming well-known as a new tourism destination as a result of the community's ability to realize the potential of their respective regions, including their natural beauty and culture. This highlights that the city/regency governance must support the implementation of smart villages under the auspices of smart city policies, budgetary readiness, and partnership with private sectors. Therefore, the advancement of city/regency growth is greatly done, that impacted by the optimal development occurring at the village level.

On the other hand, Batang, Pesisir Selatan, and Kuningan Regency should give the four aspects of smart village more careful consideration. The government's role as a regulator and facilitator extends beyond the approval of laws pertaining to smart cities and smart villages, nor does it end with the establishment of websites for the villages, many of which are inaccessible due to poor maintenance. Concrete programs are required to implement the regulations that have been set. These programs could begin with recognizing the potential of the community and helping them grow their village so they can become more independent. In addition, it is necessary to seek equitable infrastructure development to guarantee that the rights of all societal strata are realized, both in urban and rural areas (no one and no space is left behind) (UN-Habitat, 2022). This is where technology may function as a link across regions, allowing access to services and facilitating interactions between them.

The study's findings support those of Rachmawati (2018), who found that in order to strengthen the application of smart concepts in both urban and rural areas, consideration must be given to the variations in regional characteristics. Additionally, a connection between villages and cities must be established through the development of social, and physical infrastructure, and synergistic policies at every level of the hierarchical region. This is necessary to guarantee that the deployment of smart villages can assist the development of smart cities and that the influence of such development may be felt locally in the village level. This research complements Malek & Baharudin (2020) findings regarding the need to address rural-urban dualism in smart villages and smart cities by using the concept of "Rurban" and empirical data comparisons between Malaysia and Indonesia. The research includes a thorough and systematic review of the literature as well as case studies of several districts in Indonesia specifically.

5. Conclusion

Not many studies have examined the linkages between smart villages and smart cities, especially in Indonesia. In these studies, the topics of smart villages, smart cities, and rural areas are the topics that appear most frequently in various studies. As a result of globalization, which appears to be eliminating time and geographic borders in alongside the quick advancement of technology, the concept of a smart city or smart village has evolved. Even while ICT is often considered the cornerstone of the smartness concept in regional development, different countries have distinct criteria when it comes to the establishment of smart cities and smart villages.

The phenomenon of urbanization also affects the smart village and smart city concept. It is expected that smart villages will hasten village development through the active role and initiative of the community, especially the youth and productive age population, to reduce the number of urbanization and depopulation that occurs in rural areas. Therefore, to create a smart village that might support the implementation of a smart city, connectivity between villages and cities is

required through the provision of equitable digital infrastructure and the quality of trained human resources.

The current smart village implementation in Indonesia is generally done to support village governance through the use of village information systems and online public services, as well as supporting the local economy through tourism. Smart village development in Indonesia is typically in the top-down mechanism, with the national and local governments in Indonesia take the lead. Nevertheless, the community's active participation in capacity building and policymaking, among other things, is crucial to the implementation of regional legislation, as is the role played by village officials. The smart village implementation that supports smart city needs to be done in order to foster relationships between the two, promote village independence, and assist the smart city implementation in a complementary manner by integrating digital services and bolstering the local economy.

Different conditions and regional characteristics between rural and urban areas require different approaches in developing smart city and smart villages. The recommended smart village dimensions to support smart city in Indonesia consist of community, technology, institutional, and potential village resources.

Author Contributions

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Conflict of interest

All authors declare that they have no conflicts of interest.

Data availability

Data is available upon request.

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