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Does the digital divide matter? Comparison between Java and the rest of Indonesia in developing smart villages

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Abstract: Indonesia faces development disparity issues, particularly between Java and the rest of the country. This uneven development has resulted in a digital divide between these regions. This study examines the digital divide in Java and the one outside Java through the perspective of smart village, which positions technology as an enabler for development, and identifies the contribution of smart village to village development outcomes in Indonesia. The Spearman Rank test is used to determine the correlation between the factors shaping the smart village concept in Indonesia and the Village Development Index. The main factors that influence smart villages in Indonesia are ICT and internal village factors. Findings showed that overall, smart village factors are significantly and positively correlated with village development, although the correlation is weak. However, there is a difference in the contribution of ICT factors to village development in Java and outside it. ICT factors significantly and positively correlate with village development outside Java, but the opposite is true in Java. This indicates that the smart village concept offers more significant benefits for outside Java regions through its role as a connector between regions with spatial inefficiencies and low population agglomeration.

***Key Words**: digital divide, development disparity, Java-outside Java, smart village, village development.*

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Introduction

Indonesia is the largest archipelago in the world, comprising approximately 17.508 islands, five of which are massive. Among these five islands, only one—the smallest in size—has a high population density and serves as the centre of development in Indonesia: Java Island. According to the Statistical Yearbook of Indonesia 2023 data from Statistics Indonesia, the population density on Java Island in 2022 reached between 500 to 1.000 people per km^2. In contrast, Papua

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Island, the largest in size, has less than 30 inhabitants per km², and other islands have population densities ranging from 30 to 499 people per km². This indicates an uneven population distribution, particularly in regions outside Java Island.

In developing countries, spatial inequality is an aspect that needs attention in development planning (Sujarwoto & Tampubolon, 2016). Indonesia's demographic and geographic conditions, especially between Java Island and other islands, create a clear disparity in development. Inequality issues always arise during the regional development process (Fauzi et al., 2019). Development disparities can occur due to differences in demographic conditions and natural resources between regions (Raharti et al., 2021). Historically, the disparity between Java and the rest of the regions has existed since the pre-colonial era because of Java Island's comparative advantages, such as its strategic location on shipping routes and wealth of natural resources (Rinardi et al., 2023). This prompted the colonial government to establish the centre of administration in Java, followed by the development of various facilities supporting governance and trade (Rinardi et al., 2023).

Development disparities result in unequal infrastructure provision to meet the population's needs. With the development of ICT since the late 1990s, the digital divide has become an issue attracting the attention of researchers and government policy agendas (van Dijk, 2006). Uneven development causes many problems, one of which is the digital divide. A region's development lag can be due to poor primary conditions and low ICT perception among residents (Wang et al., 2021). One of the problems faced by developing countries is the digital divide between rural and urban communities due to uneven infrastructure availability and differing levels of ICT needs among rural populations (Rachmawati et al., 2018).

In general, the digital divide is defined as the opportunity and ability of individuals, organizations, and regions to access or utilize digital technology (van Dijk, 2019). According to van Dijk (2012), there are four sequential types of access to technology use, splitting the digital divide into two stages. The first and second types of access are motivation and materials, which constitute the first stage of the digital divide if these accesses are not fulfilled. The third and fourth types of access are skills and usage, forming the second stage of the digital divide. Hadi's (2018) research shows that the lack of digital infrastructure deepens the digital divide between urban and rural areas in Indonesia, leading to a deficiency in media and digital skills. The uneven development of ICT among provinces in Indonesia results in a digital divide (Wilantika et al., 2018). Kartiasih et al.'s (2022) research measures the level of the digital divide between districts in Indonesia using the Regional Digital Divide Index (RDDI). Regions with high RDDI values are primarily concentrated in metropolitan areas in western Indonesia, whereas regions with low RDDI values tend to be in rural-mountainous, remote, and island areas in eastern Indonesia. This indicates the effect of extreme spatial conditions between western and eastern Indonesia on the performance of the digital divide.

DataReportal indicates that there were 185,3 million internet users in Indonesia at the beginning of 2024, with an internet penetration rate of 66,5% (Kemp, 2024). However, 93,4 million people in Indonesia are still not connected to the internet, ranking the country seventh globally in terms of the number of unconnected individuals. Meanwhile, according to data from The World Bank (2022), compared to neighbouring ASEAN countries—Malaysia, Singapore, Thailand, and Vietnam—Indonesia has the lowest percentage of individual internet users, with only 66% of the population online. The global COVID-19 pandemic in 2020 brought significant changes to internet and technology utilization, including in rural areas of Indonesia. Rural communities experienced

many changes in various aspects, primarily due to the development of ICT, which led to rapid social changes (Rokhman et al., 2023).

Village development through implementing the smart village concept is considered relevant given today's rapid technological advancements. Smart villages are seen as potential solutions to the problems faced by rural areas (Mishbah et al., 2018). This study examines Indonesia's digital divide between Java and the rest of the regions through the smart village concept perspective. The smart village concept is chosen because it places technology as a catalyst or enabler that accelerates village development. This research also seeks to identify the contribution of smart village to village development outcomes in Indonesia. This is particularly interesting to explore further, as there is still limited evidence regarding the broader contribution of ICT to development (Lwoga & Sangeda, 2018).

Methods

The study uses village as the unit of analysis, specifically, those villages in Indonesia that have been designated as smart village according to the Decree of the Head of the Development and Information Agency for Villages, Disadvantaged Regions, and Transmigration of the Ministry of Villages, Development of Disadvantaged Regions, and Transmigration of the Republic of Indonesia in Phase I in 2021 and Phase II in 2022, as well as villages developed as smart village based on findings from previous research. Based on the identification results, 1.424 villages were developed as smart villages in Indonesia up to 2023.

In this study, the digital divide in Indonesia is examined through the contribution of smart village to village development outcomes. The smart village concept refers to exploring the factors that determine the smart village concept in Indonesia based on the 2021 Village Potential (*Potensi Desa*) data. The factors shaping the smart village concept in Indonesia include using information systems in governance, community participation, public interest in ICT, leadership, and the availability of communication access. The village development outcomes in Indonesia are represented by the 2023 Village Development Index (*Indeks Desa Membangun*/ IDM) values. The 2023 IDM data is obtained from the IDM data publication on the idm.kemendesa.go.id website. IDM is a composite index that measures the status of village progress and independence in Indonesia based on three dimensions: social, economic, and ecological.

The study employs secondary data with a quantitative approach. The Spearman correlation test method is applied using SPSS 26 software to determine the relationship between the scores of the smart village concept factors and IDM values. Spearman Rank correlation is more appropriate for continuous data that is not normally distributed and ordinal scale data (Schober et al., 2018). The correlation coefficient is represented by *r*, a number that indicates the strength and direction of the relationship between two variables. The correlation range spans from -1 to +1, with -1 indicating a perfect negative linear relationship and +1 indicating a perfect positive linear relationship. The interpretation of correlation coefficient values refers to Sugiyono (2016), as shown in Table 1.

Table 1. Interpretation of correlation coefficient values

Coefficient (r)	Strength of correlation
0,00 - 0,199	Very weak
0,20 - 0,399	Weak

0,40 - 0,599	Moderate
0,60 - 0,799	Strong
0,80 - 1,000	Very strong

Source: Sugiyono (2016)

Correlation tests were carried out for the entire smart village in Indonesia to know the contribution of smart village to village development in general. Furthermore, discrimination was made between smart village in Java and outside it to accommodate the diversity of development characteristics physically and socioculturally in the two areas while examining the existence of digital gaps between Java and outside Java from the point of view of the smart village concept.

Results

Correlation between smart village to village development outcomes in Indonesia

A correlation test was conducted between the factors shaping the smart village concept in Indonesia and the IDM value. The existence of a correlation between the two variables is seen from the significance value, while the strength and direction of the correlation are seen from the correlation coefficient value, as presented in Table 2.

Table 2. Correlations between the factors shaping the smart village concept in Indonesia and the IDM value

			IDM 2023
Spearman's rho	Information systems utilization in government	Correlation Coefficient	.146**
		Sig. (2-tailed)	.000
		N	1424
	Community participation	Correlation Coefficient	.222**
		Sig. (2-tailed)	.000
		N	1424
	Community interest in ICT	Correlation Coefficient	.089**
		Sig. (2-tailed)	.001
		N	1424
	Leadership	Correlation Coefficient	.277**
		Sig. (2-tailed)	.000
		N	1424
	Communication access availability	Correlation Coefficient	.126**
		Sig. (2-tailed)	.000
		N	1424

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Data processing using SPSS (2024)

Table 2 shows that the correlation test produces a significance value of less than 0,05 for each variable, meaning that the five factors shaping the smart village concept in Indonesia significantly correlate with the IDM value. Each variable has a positive value, so the factors shaping the smart village concept in Indonesia have a correlation that is directly proportional to the IDM value. However, the strength is calculated to be very weak in the factors of using information systems in

government, community interest in ICT, and availability of communication access; and weak strength in factors such as community participation and leadership.

Correlation between smart village to social, economic, and ecological dimensions of village development in Indonesia

A correlation test was conducted between the factors shaping the smart village concept in Indonesia and the IDM indices, namely the social, economic, and ecological dimensions. This analysis was conducted to determine the contribution of smart village to the basic dimensions of village development in Indonesia. Correlations of the factors shaping the smart village concept in Indonesia with the IDM constituent indices are shown in Table 3.

Table 3. Correlations between factors shaping the smart village concept in Indonesia with the social, economic, and ecological dimensions

			Social	Economic	Ecological
Spearman's rho	Information systems utilization in government	Correlation Coefficient	.120**	.117**	.112**
		Sig. (2-tailed)	.000	.000	.000
		N	1424	1424	1424
	Community participation	Correlation Coefficient	.192**	.171**	.157**
		Sig. (2-tailed)	.000	.000	.000
		N	1424	1424	1424
	Community interest in ICT	Correlation Coefficient	.093**	.110**	.018
		Sig. (2-tailed)	.000	.000	.488
		N	1424	1424	1424
	Leadership	Correlation Coefficient	.255**	.255**	.135**
		Sig. (2-tailed)	.000	.000	.000
		N	1424	1424	1424
	Communica-tion availability	Correlation Coefficient	.131**	.156**	.028
		Sig. (2-tailed)	.000	.000	.296
		N	1424	1424	1424

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Data processing using SPSS (2024)

Table 3 shows that the five factors shaping the smart village concept in Indonesia have a significant and positive correlation with the value of the social and economic dimensions. Overall, the strength of the correlation between variables is calculated to be very weak, except for leadership, which has a weak correlation strength. However, when correlated with the ecological dimension, the factors of community interest in ICT and availability of communication access do not show a significant correlation. In contrast, the other three factors have a significant correlation, albeit with a very weak correlation strength.

Smart village vs village development outcomes in Java and outside Java

This time, the correlation test between the factors shaping the smart village concept and the IDM value was carried out by distinguishing between villages in

Java and outside it. Of the 1.424 smart villages in Indonesia, there are 489 smart villages in Java and 935 others outside Java. The correlations of factors shaping the smart village concept with IDM for villages in Java are shown in Table 4, while those for villages outside Java are shown in Table 5.

Table 4. Correlations of factors shaping the smart village concept with IDM for villages in Java

			IDM 2023
Spearman's rho	Information systems utilization in government	Correlation Coefficient	.028
		Sig. (2-tailed)	.530
		N	489
	Community participation	Correlation Coefficient	.153**
		Sig. (2-tailed)	.001
		N	489
	Community interest in ICT	Correlation Coefficient	.000
		Sig. (2-tailed)	.993
		N	489
	Leadership	Correlation Coefficient	.167**
		Sig. (2-tailed)	.000
		N	489
	Communication access availability	Correlation Coefficient	.024
		Sig. (2-tailed)	.593
		N	489

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Data processing using SPSS (2024)

The analysis shows that information systems utilization in government, community interest in ICT, and availability of access to communication are not significantly correlated with IDM scores. The other factors, namely community participation and leadership, show a significant and positive correlation with IDM scores, although the correlation's strength is very weak.

Table 5. Correlations of factors shaping the smart village concept with IDM for villages outside Java

			IDM 2023
Spearman's rho	Information systems utilization in government	Correlation Coefficient	.183**
		Sig. (2-tailed)	.000
		N	935
	Community participation	Correlation Coefficient	.235**
		Sig. (2-tailed)	.000
		N	935
	Community interest in ICT	Correlation Coefficient	.109**
		Sig. (2-tailed)	.001
		N	935
	Leadership	Correlation Coefficient	.294**
		Sig. (2-tailed)	.000
		N	935
	Communication access availability	Correlation Coefficient	.159**
		Sig. (2-tailed)	.000
		N	935

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Data processing using SPSS (2024)

In contrast with Java, the five factors shaping the smart village concept in villages outside Java have a significant and positive correlation with the IDM value.

The information systems utilization in government, community interest in ICT, and availability of communication access have a very weak correlation, while the factors of community participation and leadership have a weak correlation with the IDM value.

Discussions

Contribution of smart village to village development outcomes in Indonesia

For further analysis in this chapter, the five factors shaping the smart village concept in Indonesia are simplified into two main factors: ICT and internal village factors. ICT factors include the utilization of information systems in government, community interest in ICT, and availability of communication access. Internal village factors consist of community participation and leadership factors. Based on the correlation test with IDM values, the ICT factor has a very weak correlation strength to village development outcomes, while the internal village factor has a weak correlation strength.

ICT factors have a significant and positive correlation with IDM, but the strength of the correlation is very weak. Similar results were shown by research by Furqan et al. (2023), which examined the impact of ICT utilization on the IDM value of 1.842 villages in Central Sulawesi Province in 2021. The study shows that ICT positively impacts the overall IDM value, but the presence of internet facilities has no impact on village development. Research by Fahmi and Mendrofa (2023) also supports the results of this study, which state that the presence of ICT has not been a driver of rural structural transformation. ICT performance will also increase when rural areas experience economic diversification through economic shifts from agriculture to non-agriculture, along with improvements in infrastructure and education levels (Fahmi & Mendrofa, 2023). This phenomenon occurs in most villages in Indonesia, influenced by the condition of rural communities that tend to experience low economic diversification, a shrinking labour force, and low-skilled with lower levels of education. In addition, Indonesia's geographical barriers and population distribution patterns cause a digital divide between urban and rural areas (OECD, 2020).

These findings suggest that the impact of ICT is indirect on village development, but its influence can be felt in the improvement and acceleration of services and development. ICT is important in developing rural areas in various sectors, ranging from education, agriculture, health services, and so on (Nimodiya & Ajankar, 2021). ICT utilization significantly facilitates the dissemination of information and becomes a forum for integration between the government and the community (Ariyaningsih & Shaw, 2023). In practice in Banyuwangi Regency, through the implementation of "Smart Kampung", which emphasizes improving public services, smart village can facilitate the administrative process for citizens so that matters can be resolved at the village level (Yuniar & Hasanah, 2021). In addition, smart village also play a role in the development of tourist villages through the implementation of smart tourism (Hartatik et al., 2021; Jayanthi et al., 2022) and innovation in creating business ecosystems involving partnerships with telecommunications services, logistics and trade, and e-commerce platforms (Adiningtyas & Gunawan, 2021).

Internal village factors have a significant and positive correlation with IDM, but the strength of the correlation is weak. This means internal village factors contribute slightly more to village development outcomes than ICT factors. With the enactment of the Village Law, villages have the autonomy to regulate and

manage government affairs, local community interests based on community initiatives, origin rights, and/or traditional rights that are recognized and respected in the government system of the Unitary State of the Republic of Indonesia, as well as manage Village Funds for the implementation of village development and governance. This authority places the village head (or other name) in a major role in the success of village authority and governance (Kushandajani et al., 2020). The leadership of the village head is an important factor in developing the village's potential (Rahman et al., 2022).

Susilowati and Rachmawati's research (2024) shows that the development of Cemani Village, Sukoharjo Regency, Central Java Province, as a smart village originated from the initiative of the village head to transform the government bureaucracy and build transparency of village information and data through optimizing the use of village websites, social media, and digital studios. Leadership at the local rural community level is important in spreading influence regarding ICT solutions in smart rural development (Zavratnik et al., 2020; Szalai et al., 2021). The practice of effective leadership styles by village heads is considered capable of bringing changes in social, economic, cultural, and ways of thinking among rural communities (Rami et al., 2016). Village development efforts are carried out not only by the village government but also through the participation of the village community (Aulia, 2022). The leadership role of the village head influences community participation to be actively involved in the public interest. The aspects that play a role in the leadership of the village head in encouraging community participation are moral exemplary, leadership charm, and personal concern from the leader's figure for his citizens (Zhang et al., 2023).

However, research by Damayanti and Syarifuddin (2020) shows that the participatory planning process in Indonesian villages only involves people close to village leaders and is not implemented continuously in the development process. As a result, village development in Indonesia has not responded to the needs of the community inclusively. Therefore, it is necessary to increase community trust in the village government to encourage village community participation in the development process (Handayani et al., 2023).

Digital divide between Java and the rest of Indonesia in developing smart village

The discrimination between villages in Java and those outside Java in the correlation test between the factors shaping the smart village concept and the IDM score shows different results than the analysis for all smart villages in Indonesia. This finding indicates differences in the role of smart village in supporting village development, especially in terms of ICT. Indonesia experienced a major problem in the development inequality between Java Island and the rest of the country. Java Island, as a region that get prioritized over other regions for its development by the government, benefits from a variety of infrastructure and services. (Ananta et al., 2023). This has implications for the digital divide between Java and outside Java, mostly caused by infrastructure provision inequality. The uneven infrastructure provision between Java and the rest of the country is influenced by different population distribution and density. Uneven population distribution between regions implies low population numbers in large areas on several large islands besides Java. As a result, spatial inefficiency occurs, and it is not easy to form population agglomerations for public service delivery following the population threshold (Probosubanu et al., 2020).

These constraints occur in most areas outside Java, especially in rural, remote, and border areas. Communities in these areas find it difficult to access

telecommunications networks due to the availability of minimal infrastructure, resulting in low digital literacy skills. In fact, with spatial barriers such as long distances between settlements, the role of ICT is expected to connect people and resources by conquering geographical distance and time (Onitsuka et al., 2018). However, there is a paradox that rural communities actually need increased digital connectivity to overcome the problem of spatial remoteness, but they are not connected to communication access due to the uneven availability of infrastructure (Salemink et al., 2017). Information technology helps people in border areas interact with people in other regions without significant obstacles to the existence of information technology. However, there can be obstacles under certain conditions due to limited telecommunications infrastructure (Muazir et al., 2021).

The private sector plays a role in the uneven infrastructure provision in regions outside Java. Underdeveloped regions are unattractive to ICT workers and companies due to insufficient training opportunities and experts with appropriate specifications (Kravchenko et al., 2021). Therefore, ICT activities tend to be concentrated in regions with high levels of economic development, technology and production-based, and large universities (Kravchenko et al., 2021). Research by Salemink et al. (2017) shows that market mechanisms play a role in realizing digital connectivity between villages and cities.

With the advantage of a large population, Java Island encourages agglomeration and market mechanisms that automatically lead to development. Agglomeration increases the number and variety of intermediate inputs, opens wider market access, encourages labour specialization, and provides wider employment opportunities (Chaniago et al., 2021). According to Chaniago et al. (2021), the agglomeration effect in Java will be greater than outside it due to higher financial capacity so that the availability of public facilities and infrastructure can be guaranteed to improve connectivity, economic activity, and regional productivity. Furthermore, market mechanisms by telecommunication companies are more likely to provide networks to households and businesses with higher profits and efficiency. Therefore, people in Java Island have generally been able to connect to the internet personally without the need for intensive government intervention.

The results obtained from the correlation test between the factors shaping the smart village concept in Indonesia and IDM, which distinguishes between villages in Java and outside it, are interesting because they show different results from the villages as a whole in Indonesia. The analysis shows that the smart village concept correlates significantly and positively with villages outside Java. In contrast, for villages in Java, ICT factors do not have a significant correlation in supporting development; only internal village factors are positively correlated with village development outcomes. This indicates that the smart village concept provides greater benefits for villages outside Java through its role as a connector between regions that are separated by time and space. Meanwhile, for villages in Java, the role of ICT does not have a strong correlation with village development due to the ability and performance of the community to implement technology in their daily lives. Internal village factors have a significant and positive role in village development, meaning that village development in Java Island requires efforts to increase the capacity of human resources to encourage community participation and transform village leadership into smart village development.

The difference in the contribution of ICT factors as part of the smart village concept to the detriment of village development between Java and outside it, also indicates that there is still a real digital divide between the two regions. Outside Java, with its spatial inefficiencies and lack of population agglomeration, ICT

requires a greater role in supporting development. This finding corroborates that of Korovkin et al. (2023), who state that the digital divide is caused more by differences in demand than supply. Remote rural areas are uncertain of services due to low-profit opportunities for access over longer distances and fewer users (Fife & Pereira, 2016). Referring to the research of Lythreatis et al. (2022), the factors that influence the digital divide between Java and outside Java are sociodemographic, socioeconomic and infrastructure. However, supply factors—particularly in the gaps in telecommunications infrastructure, human resources and education—also relate to the internet divide (Sujarwoto & Tampubolon, 2016).

Rural communities need solutions tailored to their environment to universally access ICTs (Tognisse et al., 2021). The main driver of ICT usage by rural communities is the expansion of internet access (Tambotoh et al., 2015). Therefore, it is important to improve the distribution of telecommunications infrastructure and educational facilities, particularly in rural areas, hinterlands, and remote islands, to bridge the internet gap in Indonesia (Sujarwoto & Tampubolon, 2016). Government capacity is needed to address gaps in digital infrastructure and access to education in less developed regions to help reduce regional disparities (Wang et al., 2021; Liu et al., 2024). In addition to the role of the government, it can also be accompanied by private collaboration in investing in the provision of infrastructure that is evenly distributed throughout Indonesia, as well as the role of local communities as a driver of digital literacy to the community (Jayanthi & Dinaseviani, 2022). Improving ICT skills and literacy needs to be considered in policy-making to narrow the digital divide in Indonesia (Puspitasari & Ishii, 2016).

Conclusions

Overall, the main factors shaping the smart village concept in Indonesia, namely ICT and internal village factors, have a significant and positive correlation with village development outcomes in Indonesia, but the strength of this correlation is weak. This indicates that the development of a smart village does not directly impact village development; rather, it plays a role in improving the quality of services and supporting development. The factors shaping the smart village concept are significantly and positively correlated with village development's social and economic dimensions, but the ICT factor is not correlated with the ecological dimension. This means that the role of technology in managing environmental aspects is not yet optimal, particularly in village development in Indonesia.

There is a difference in the contribution of ICT factors to the development of smart villages between villages in Java and those outside it. The ICT factor is significantly and positively correlated with village development outcomes in areas outside Java but not for villages in Java. ICT with its ability as a connector between spaces, in this case through smart villages, is able to overcome the spatial inefficiency and low population agglomeration as the limitations that exist in most villages outside Java.

The digital divide between Java and areas outside it is evident due to the uneven availability of infrastructure, making it difficult for people in most regions outside Java to access technology, which impacts their digital literacy capabilities. Meanwhile, in Java, technology does not have a strong correlation in supporting village development because individuals can access technology daily. The market mechanisms of telecommunications companies contribute to this phenomenon as they tend to provide networks for households and businesses that offer higher

returns, particularly in Java, which already has established agglomerations and high population density. Therefore, more intensive government intervention is needed to provide infrastructure for rural, border, and remote areas in collaboration with the private sector to cover a wider area. It is necessary to support increasing capacity and digital literacy skills among the community to bridge the digital divide further.

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