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Rural Digital Transformation in Indonesia: A Policy Analysis

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Abstract: The purpose of this investigation is to appraise the adequacy of existing policies in supporting digital transformation efforts within Indonesia's rural agricultural sector. The study focuses on a) identifying policies influencing rural digital transformation, b) strategizing solutions to rural challenges, and c) proposing a digital transformation model for Indonesia's rural agricultural sector. A descriptive qualitative approach is employed, utilizing policy study methods such as SWOT analysis (Strengths, Weaknesses, Opportunities, Treatment) and the TOWS Matrix for evaluating digital transformation policy strategies. The study reveals several influential policies, including the obligation to achieve the SDGs and various laws and regulations like the Village Law. The strategy to address rural issues involves the digital transformation of existing resources. The proposed digital transformation model involves the application of Technology 4.0 in the agricultural sector, supported by institutional backing, funding, and digital literacy programs.

Keywords: *Digital transformation, Rural Agricultural Sector, Policy Evaluation, SWOT Analysis, Technology 4.0, Indonesia*

1. Introduction

The main problemsis currently facing rural areas are a) urbanization, which has an impact on decreasing labor in the agricultural sector; b) damage to natural resources due to excessive exploitation and use of chemicals in the agricultural sector; c) in many villages that are still underdeveloped and have not been able to achieve the village SDGs; d) lack of access to progress, lack of access to technology, poor internet network conditions, which causes a weak circular economy. This requires a change in the development model more technology-intensive, more competent institutions, innovations and creations, and natural resource management more productive and efficient(Yustika&Baks, 2016; Rahardjo,1986).

As a subsequencetothereform in 1998, rural regulations underwent significant transformations. This included the introduction of Law Number 22 in 1999, succeeded by Law No. 32 in 2004, and Law No. 23 in 2014. Additionally, Law No. 6 of 2014 pertained specifically to Villages.

The enactment of this Legislation signifies the advancement of democracy, devolution, and autonomy at both regional and village levels, representing the most suitable and logical form of governance. Beyond the power of original rights and local authority at the village level, villages are also conferred with responsibilities that include the management of Village Governance, execution of Village Development, enhancement of Village society, and upliftment of Village communities(Iskandar, 2020).

The change in the rural development paradigm in Indonesia cannot be separated from the global. Transitioning from the proclamation of the Millennium Development Goals (MDGs) to the Sustainable Development Goals (SDGs), a worldwide development agenda has been established that encompasses 17 goals and 169 targets that are interconnected, mutually influential, inclusive, and integrated, universal with no one being left behind (no one left behind), with a target achievement date of 2030. This agenda is guided by five fundamental principles

that balance economic, social, and environmental dimensions, known as the 5P (U.N., 2015), namely: People (Humanity), Planet (Terrestrial), Prosperity (Affluence), Peace (Harmony), and Partnership (Collaboration). Indonesia has actualized this commitment by ratifying Presidential Regulation No. 59 of 2017 concerning the achievement of sustainable development, which delineates 17 objectives. These goals delineate the responsibilities of each governmental institution, as well as the participation and roles of non-governmental stakeholders. These stakeholders include civil society organizations, scholars, philanthropists, and business entities, all of whom play a crucial role in the execution of the Sustainable Development Goals (TPB).

One of the SDGs can be achieved through a digital transformation strategy, The G20 country forum held in Bali this year underscored the significance of digital transformation in rural areas. It is imperative for rural development to incorporate a smart strategy to address distinct challenges innovatively and enhance the living standards of residents. The Smart Village initiative's digital transformation should inspire rural societies to keep pace with recent advancements.

Especially in this era of technological disruption(Aritenang et al., 2022). By taking a proactive 21st-century approach to the digital economy will the G20 maximize the enormous potential the digital economy has for the economy and prosperity(OECD, 2017). Digital transformation is a long-term effort to improve how an organization continues to improve and change (McKinsey.com, 2023). In the rural context, digital transformation policies play an essential role in encouraging the achievement of the SDGs (Zavratnik et al., 2020), and overcoming the digital divide between cities and villages(Li et al., 2012, Ranade et al., (2015), (Holmes & Thomas (2015; Muke et al., 2017).

A-numbersof prior research papers (Verhoef et al., 2021), identify various key external elements that necessitate digital transformation. This encompasses progressions in technology such as high-speed internet, mobile devices, Web 2.0, Search Engine Optimization (SEO), distributed computing, speech recognition, digital transaction systems, and digital currencies. These technologies have significantly propelled the expansion of e-commerce. Moreover, the emergence of digital technologies like artificial intelligence (A.I.), distributed ledger technology (blockchain), the internet of things (IoT), and automation have deep-seated effects on businesses. Several of these advancements have altered the competitive dynamics, leading to a dramatic transformation in businesses, shifting consumer behavior towards digital, and fostering the emergence of large-scale digital-centric corporations globally. Kuhlmann and Heuberger (2023) underscore the impact of digitalization on institutional policies from a public policy standpoint, particularly the digitalization of administration and public services. As per Park & Cha (2019), with the digital metamorphosis of villages, rural communities can generate new opportunities from existing potential and resources. Guzal-Des (2018) emphasized challenges in executing this concept, such as limited openness of rural communities to change, diminished innovation capacity and levels of social capital, restricted local market capacity, geographical distance, and underdeveloped transportation and communication networks.

A more in-depth study is needed to see the dynamics of government policies and strategies in efforts to carry out rural digital transformation. Several things can be questioned, including a) what policies influence rural digital transformation; b) what strategies are used to overcome village problems; c) what is the digital transformation model for the agricultural sector in villages in Indonesia?

2. Materials and Methods

2.1 Area Study

Saludewata Village, Anggeraja District, Enrekang, is one of the villages declared a Smart Village by the second phase of the PDTT Village Ministry. This research uses the following procedures: a) collect relevant data and appropriate concepts or theories; b) the collected data and concepts are sorted and selected which have relevance to the research topic. Data sources come from related agencies, the Ministry of Villages and Ministry of Information and Communication, Regional Government, Village Government, P4S, Farmer Groups, Farmers, and Private sector. Data Collection Method is primary data obtained by researchers through field data collection activities/research objects, such as interview results and observation results. Research Time: January-May 2023.

2.2 Analysis Techniques

The research approach utilized in this investigation is a case study approach utilizing qualitativemethods (Creswell, 1998, Creswell, 2014;Hollweck, 2016, Yin, 2002, Kusmarini, 2020, Sandelowski, 2000). The case highlighted is the rural digital transformation program in Indonesia. The method used is collecting categories, carrying out direct interpretation, forming patterns, and looking for similarities between two or more categories. This analysis is strengthened by the SWOT method combined with TOWS analysis (SO et al., and W.T. Strategies). By integrating opportunities and threats from the external environment with the strengths and weaknesses within the organization, management can devise four fundamental strategies tailored to the current circumstances(de Bruins, 2017).

Analysis was carried out through a combination of inductive and deductive methods. Initially, researchers tried to build patterns, categories, and themes from the bottom up (deductively) by processing data into information units abstractly until a complete set of themes was found. After that, the existing data is looked at again to determine more evidence that can support each theme and analyze the need to combine it as additional information (Creswell, 2014).

3. Results

3.1 General Overview of Rural Areas in Indonesia

The current advancement in rural areas can be assessed by examining the level of achieved development indicators and contrasting them with the progress made in urban regions. The Village Development Index (IDM), a composite index of three indices: the Social Resilience Index, Economic Resilience Index, and Ecological (Environmental) Resilience Index, serves as a tool for this assessment. An increase in the IDM value signifies an improvement in the village's social, economic, and ecological conditions. Based on these index values, the IDM can classify villages such as Autonomous, Progressive, Underprivileged, and Extremely Underprivileged Villages.

With the enactment of the rural Law, along with several auxiliary policies, there has been considerable progress in the development of villages in Indonesia. As per the data from the Ministry of Villages PDTT, the evolution of IDM from 2015 to 2022 is as follows: a) The number of villages in the Very Disadvantaged Villages category as per IDM decreased by 8,471, moving a) The number of villages decreased from 13,453 to 4,982; b) The category of Underprivileged Villages experienced a reduction by 24,008 villages, transitioning from 33,592 villages to 9,584 villages; c) The category of Evolving Villages observed an augmentation by 11,020 villages, transitioning from 22,882 villages to 33,902 villages; d) The category of Progressive Villages experienced an increase by 16,641 villages, transitioning from 3,608 villages to 20,249 villages; e) Finally, the category of Autonomous Villages observed an increase by 6,064 villages, transitioning from 174 villages to 6,238 rurals.

The progression status of 122 villages has escalated significantly from Extremely Underprivileged Villages in 2015 to Autonomous Villages in 2022. In the forthcoming times, there will be potential for cooperation between IDM accomplishments and Village SDGs realizations. The attainment of the Evolving Village Index (IDM) with independent village status in 2022 has surpassed the target set for the 2024 National Medium-Term Development Plan (RPJMN). As per the IDM data for 2022, villages with autonomous status amounted to 6,238, exceeding the target set for the 2024 RPJMN, which was 5,000 villages, with independent status(Republika.co.id, 2022).

The ideal village development target is still far from expectations, only reaching around 7 percent of the total villages. The target of village development is to make villages independent, leaving villages in the category of underdeveloped and very underdeveloped villages. For this reason, the PDTT Ministry of Villages is pioneering a path to rural development through rural digital transformation, which can create positive changes in villages through digital technology—carrying out rural digital transformation per sustainable development goals (SDGs), which includes improving people's quality of life, increasing productivity and income, empowering rural communities, encouraging innovation and technological development, reducing digital and regional gaps,

increasing environmental sustainability, and strengthening partnerships and collaboration. By achieving these goals, rural digital transformation is expected to provide significant benefits for rural communities, improve the quality of life, and accelerate sustainable development in rural areas.

The rural economy is primarily fueled by the utilization of natural resources, with a significant emphasis on the agricultural sector. However, the management of the agricultural sector in rural regions has not been maximized and remains largely traditional. As per the 2018 Inter-Census Agricultural Survey (SUTAS), an estimated 87.59% of farming households do not employ technology. Only a small fraction of households, 7.28%, have mechanized, and an even smaller percentage, 3.26%, use technology beyond mechanization. These figures indicate a relatively low agricultural productivity in Indonesia. The incorporation of innovative agricultural technology is vital for improving the resilience of farming households. Such technological innovation is necessary in the production sector to enhance agricultural productivity of high quality at economical prices (Fatchiya et al., 2016). As per the report by We Are Social, Indonesia has 204.7 million internet users, accounting for 73.7% of the nation's total population (we-are-social-Indonesian-digital-report-2022).

Internet availability is generally high at present, there is a need for improvement in infrastructure to ensure equitable distribution of internet access to villages in terms of both quantity and quality. Numerous villages still require internet access, and even when it is affordable, the quality remains low, limiting its use to communication and not data management. The presence of network infrastructure significantly influences the successful adoption of digital technology for the creation of smart villages (Nurchim, 2018). A paradox exists wherein rural communities, who require better digital connectivity the most to offset their geographical remoteness, are in fact the least connected and included in digital networks (Salemink et al., 2017).

3.2 Dynamics of Rural Development Policy

Post the reform in 1998, rural regulations underwent substantial alterations, which included the introduction of Law Number 22 in 1999, succeeded by Law No. 32 in 2004, and subsequently Law No. 23 in 2014. Law No. 6 of 2014 concerning Villages. The birth of this Law marks the rise of democracy, decentralization, and regional and village autonomy as the most ideal and rational governance. (Iskandar, 2020) Law No. 22 of 1999 provides the core message that the Government recognizes the origins, diversity, and uniqueness of villages (self-governing communities). The primary perspectives of U.U. No. 22 of 1999 and U.U. No. 32 of 2004 does not have significant differences. In preserving heterogeneity, involvement, authentic independence, democratization, and community fortification. The village regulations in this Legislation are elaborated more explicitly in government regulation (P.P.) No. 72 of 2005 pertaining to villages. Concurrently, Law Number 23 of 2014 underscores the partition of national territory. This Law places villages as part of sub-districts and state administration with regional governments above them.

The Village Legislation has conferred substantial power to villages, specifically: a) power rooted in original rights; b) local authority at the village scale; c) power delegated by the Government, Provincial, regional government, or Regency/City regional government; and d) additional powers delegated by the Government, Provincial, regional Government or Regency/City regional government. Beyond the power of original rights and local village-scale authority, villages are also endowed with additional powers by the Government, Provincial and/or Regency/City Government, as articulated in article 22 of Law Number 6 of 2014 encompassing the administration of Village Governance, execution of Village Development, enhancement of Village society and empowerment of Village communities.

The discussions, both the Government and the DPR agreed that the existing rules related to Villages in Law No. 32 of 2004 were no longer adequate, necessitating a revision. As a result, Law No. 6 of 2014, also referred to the Village Law, was formulated and announced on January 15, 2014. The General Explanation of the Village Law delineates the objectives of the rules regarding Villages as follows: 1) To recognize and honor the diversity of villages existing before and after the formation of the Republic of Indonesia; 2) To offer clarity on the status and legal assurance of villages within the constitutional structure of the Republic of Indonesia to guarantee justice for all Indonesian citizens; 3) To conserve and enhance the customs, traditions, and culture of the Village

community; 4) To encourage initiatives, movements, and participation from Village communities to utilize Village potential and resources for communal prosperity;5) To form a village government that is professional, efficient, effective, transparent, and accountable;6) To improve public services for rural residents to hasten the achievement of general welfare;7) To strengthen the social and cultural resilience of Village communities to promote social unity as an element of national resilience; 8) To promote the economy of village communities and bridge national development disparities; and to strengthen Villagers communities as active contributors in development.

In addition to the Village Law, there are multiple legislations that facilitate the execution of village digitalization in Indonesia. These include; 1) Law no. 32 of 2009 on Environmental Protection and Management. As per Article 3, paragraph; 2), it is the Government's responsibility to offer technical assistance and infrastructure to enhance the environmental quality in villages; 2) Law no. 25 of 2009 on Public Services. According to Article 1, the Government is mandated to deliver public services that are of high quality, efficient, and effective, including those in villages; 3) Law no. 11 of 2008 on Information and Electronic Transactions. Article 1 mandates that the Government is required to provide technical support and infrastructure to improve the standard of public services in villages.

Several regulations supporting digital villages, including: 1) Government Regulation no. 71 of 2010 concerning the Establishment and Organization of Regional Apparatus. Article 4 paragraph (1) states that regional governments are obliged to provide technical support and infrastructure to improve the quality of public services in villages; 2) Government Regulation no. 24 of 2018 concerning public service systems and procedures in Villages. Article 1 states that the Government is obliged to provide quality, efficient and effective public services, including in villages; 3) Directive of the Minister of Villages, Advancement of Underprivileged Regions and Transmigration Number 11 of 2018 pertaining to Guidelines for the Formulation of Village Development Plans (RPD); 4) Directive of the Minister of Home Affairs Number 32 of 2020 pertaining to Guidelines for the Formulation of Village Development Plans (RPD) with a Digital Perspective.

The Government of Indonesia has implemented a policy to accelerate the development of telecommunications infrastructure, as indicated in Press Release No. 168/H.M./Kominfo/12/2020. This policy is intended to enhance Indonesia's digital transition. The Indonesian Ministry of Information and Communication is making efforts to guarantee that all villages and sub-districts in the nation have 4G network connectivity by the conclusion of 2022.

Specifically, there are 3,435 remaining villages and sub-districts situated in non-3T areas (disadvantaged, outermost, frontier). The heads of cellular operators have collectively pledged to complete development or provide signals in these non-3T areas by 2022. Consequently, the Indonesian Ministry of Information and Communication will construct the remaining 9,113 villages and sub-districts (kominfo.go.id, 2022a).

The Indonesian Government is actively involved in building a variety of Information and Communication Technology (ICT) facilities. They have installed 348 thousand kilometers of fiber optic cables, of which 226 thousand kilometers are terrestrial and 123 thousand kilometers are submarine. Currently, Indonesia is using 9 telecommunication satellites, including 5 domestic ones and 4 rented from international sources. There are ongoing plans to launch a multifunctional satellite named SATRIA, the Republic of Indonesia Multifunction Satellite, with a data capacity of 150 GB per second at the146east longitude of Indonesia's orbital slot. It is anticipated to be in service by the last quarter of 2023.

4. Discussion

4.1 Government Strategy for Rural Digital Transformation

The Government's strategy in digital transformation policy is to overcome the digital divide and improve the welfare of rural communities. This strategy is based on the objective conditions of the village as well as the external environmental challenges faced by the village. S.W.O. T analysis (Strengths, Weaknesses,

Opportunities, Threats) and T. O. W. S Matrix, various types of strengths, weaknesses,opportunities, and threats, as well as strategic choices in a village, can be mapped(de Bruins, 2017).

IFAS (Internal Factor Analysis Strategy)	STRENGTH (Strength) Natural resources and agricultural culture	WEAKNESS (Weakness) Digital literacy
EFAS (External Factor Analysis Strategy)		
OPPORTUNITIES (Opportunity) -Industrial revolution 4.0 -Internet growth	SO Technology 4.0-based natural resource management	WO Developing digital literacy and competence for village residents
THREATS (Threat) -Climate change -Poverty -Environmental degradation	ST Wise management of natural resources to overcome climate change,environmental degradation, and poverty	W.T Increasing digital literacy to overcome the problems of climate change,environmentaldegradation, and poverty

Figure 1: SWOT Analysis and TOWS Matrix adapted from several sources (de Bruins, 2017)

Based on this analysis, the main strategy that can be used in village development is to use strengths while taking advantage of opportunities. The internal strength of rural areas lies in natural resources such as agricultural land and agricultural culture that has been carried out for generations. Apart from that, the village population's education level is improving, and rural infrastructure development, such as public facilities and the Internet, is becoming more evenly distributed. Suppose these internal strengths can be optimized and combined with various existing opportunities, such as the development of the Industrial Revolution 4.0 in the agricultural sector and the rapid development of the digital ecosystem. In that case, villages can make big leaps of future progress through digital transformation in the agricultural sector.

In Indonesia has escalated to 215.63 million during 2022-2023, marking a 2.67% rise from the preceding period's tally of 210.03 million users. Internet users now make up 78.19% of Indonesia's total populace of 275.77 million. Simultaneously, cellular connections have surged to 353.8 million at the onset of 2023. Notably, this implies that cellular connections in Indonesia represent 128.0% of the total population as of January 2023.

In line with the growth of internet users, the growth of social media users is also very fast. Based on social media statistical data for Indonesia in 2023, it is estimated that there will be around 167.0 million social media users in Indonesia in January 2023. As of the onset of 2023, the proportion of social media users in Indonesia constituted approximately 60.4% of the entire population. However, it is crucial to underscore that these users may not correspond to distinct individuals. The user base for various social media platforms is as follows: Facebook has an estimated 119.9 million users, YouTube has approximately 139.0 million users, Instagram has around 89.15 million users, and TikTok has close to 109.9 million users. Notably, the reach of these platforms has extended to include rural communities.

The digital transformation strategy is also in line with the growth of the digital eco system and has had a positive impact on the growth of the digital economy. Indonesia is one of the leading countries in the digital economy sector in ASEAN. The Coordinating Ministry for Economic Affairs projects that the value of Indonesia's digital economic transactions will continue to grow to reach 360 billion U.S. dollars (Rp. 5,364 trillion) in 2030.The growth of Indonesia's digital economy in 2022 alone was recorded at 77 billion U.S. dollars (Rp. 1,147 trillion). This number grew 22 percent from the previous year. Supported by a strong foundation, the value of Indonesia's digital economy in 2025 is predicted to double to 130 billion U.S. dollars and continue to increase to 222 to 360 billion U.S. dollars in 2030. The accelerated growth of the digital economy in Indonesia is also supported by the many startup companies that have now reached 2,400 startups(antaranews.com, 2023).

Government policy in developing telecommunications and information infrastructure is an opportunity that village communities must utilize. The Government has tried to provide quality, fast internet services to all districts/cities throughout Indonesia through national strategic projects by building the Palapa Ring fiber optic backbone network, which is currently fully operational, and the Government Multifunction Satellite Project or Republic of Indonesia Satellite (SATRIA) which is targeted for completion by the end of 2023, through the Telecommunications and Information Accessibility Agency (BAKTI) of the Ministry of Communication and Information. The development of Internet infrastructure must be an instrument for the economic development of village communities. Digital village development is carried out to stimulate the economy of village communities through empowering village communities, which can provide economic benefits. Therefore, the Government continues to accelerate access and development of digital infrastructure to serve the public quickly and efficiently.

To support the village digital transformation program, the Ministry of Communication and Information has provided National Data Center (PDN) services so village governments no longer need servers. Apart from that, it has also provided a special application related to digital villages called Sideka. Not only that, for village governments who want to create a government website, they have provided a particular domain, namely desa. id. Village government officials were taught how to create a village website and register the domain name. Therefore, breakthroughs and acceleration of digital transformation in various sectors in Indonesia must be carried out, including the acceleration of rural digital transformation. The challenge is adapting and adopting new values and carrying out work culture transformations such as adaptive, fast, responsive, efficient, and integrated behavior (kominfo.go.id, 2022b)

The Ministry of Communication and Information targets digitalization in strategic sectors, including logistics, education, health, tourism, agriculture, and maritime. This effort is aimed at increasing digital economic growth in Indonesia. In the digitalization of strategic sectors, such as Agriculture and Maritime, we are trying to implement the development of smart farming ecosystems, smart fishing, and digital auction markets. The Ministry of Communication and Information is doing two main things in digitizing the agricultural sector:precision agriculture and digitizing the recording of auction results for horticultural commodities.

Precision agriculture is an agricultural concept that uses the help of Internet of Things (IoT) technology and Geographical Information System (GIS) to identify, analyze and manage the diversity of information on land, including regarding air, water, weather, and climate conditions to ensure appropriate treatment. so that productivity and land sustainability are optimal. The Ministry of Communication and Information assists farmers in using data analysis applications based on the Internet of Things (IoT) and Geographic Information System (GIS). It is hoped that farmers' production can increase through applications connected to soil and weather sensors.

The target of this program is to increase farmer productivity amidst various challenges of limited land, lack of digital literacy, and minimal investment financing. Soil and weather sensor tools can provide recommendations regarding agricultural production processes. Starting from the right time of fertilization or irrigation, the type of fertilizer needed, and predicting the possibility of pest attacks when the temperature drops or seasons change. The Ministry of Communication and Information's support is part of the Government's efforts to implement digitalization initiatives in the agricultural sector. Farmers can take advantage of applications developed by various agricultural technology 4.0 companies.

The Ministry of Communication and Information supports the Digital Village Program in West Java Province. Hundreds of developing and underdeveloped West Java villages received free wifi from the Ministry of Communication and Information's Telecommunications and Information Accessibility Agency (BAKTI). This is aimed at eroding the digital gap between villages and cities, so that not only city people enjoy the internet, but everyone should enjoy it, including village people. Digital Village is a collaboration between BAKTI Kominfoand the West Java Provincial Government. In this program, BAKTI facilitates VSAT (Very Small Aperture Terminal) internet access connected to satellites (kominfo.go.id, 2022a)

The digital transformation process can potentially increase the capacity of villages in Indonesia. One of the village capabilities can be seen in the condition of villages in Indonesia currently experiencing a lot of progress, at least when seen from the perspective of IDM achievements. The Developing Village Index (IDM) is one of the indices used by the Indonesian Ministry of Villages, Development of DisadvantagedRegionand Transmigration (PDTT). IDM is a measurement tool for evaluating the level of development in villages in Indonesia. IDM is also an indicator to see the extent of Village SDG achievements. SDGs are guided by five basic principles that balance Economic,Social and Environmental dimensions, known as 5P (U.N., 2015): People, Planet, Prosperity, Peace, and Partnership (Partnership). (ifad.org, 2018). IDM achievements can be supported through rural digital transformation.

Indonesia has demonstrated its commitment to the Sustainable Development Goals (SDGs) by enacting Presidential Regulation No. 59 of 2017. This regulation outlines 17 SDGs, specifying the responsibilities of each ministry and institution, as well as the roles and contributions of non-governmental stakeholders such as civil society organizations, academics, philanthropists, and business entities. These SDGs have been adapted into Village SDGs as per Permendesa 13/2020, which includes at least 18 development objectives and targets: 1) Poverty-free villages; 2) Hunger-free villages; : 3) Villages that are healthful and affluent; 4) Villages with superior education; 5) Villages with gender parity; 6) Villages with access to clean water and sanitation; 7) Villages utilizing clean and renewable energy; 8) Villages with employment opportunities and economic growth; 9) Villages with innovative infrastructure; 10) Inclusive villages without disparities; 11) Sustainable village habitats; 12) Environmentally responsible village consumption and production; 13) Villages actively controlling and adapting to climate change; 14) Villages with marine ecosystems; 15) Villages with terrestrial ecosystems; 16) Peaceful and just villages; 17) Villages fostering development partnerships; 18) Villages with dynamic institutions and adaptive culture.

The Government also emphasizes participative development policies. Based on Law. No. 6 of 2014 concerning Villages Article 83 paragraph 2, Rural Area Development is development between villages carried out through a participatory approach. The emphasis on a participatory approach aims to enable local communities and institutions to independently determine development in their area and be involved in every process of implementing rural area development programs. In this case, the state, villages, and the private sector can build

partnerships to develop rural areas oriented towards local economic development, opening rural access to outbound areas, accelerating economic growth, and providing jobs, ultimately leading to reducing urbanization. The process of involving the community and village government starts from proposing a rural area, including determining the location of the village, determining superior potential, and preparing a matrix indicating program/development needs through to program implementation. (Diartika&Pramono, 2021).

Even though there are many opportunities, the obstacles are also not small. The obstacles faced are weak digital literacy and low participation of women, small farmers, and the elderly; their low income and education status are the main obstacles to digitalization (Kudama et al., 2021). The potential of the digital ecosystem is huge, but it has its challenges. Village communities, in general, need to improve in terms of digital literacy. This condition can be influenced by factors such as low education, lack of experience in contact with technology, and uneven internet network infrastructure. This condition requires the Government to develop the next strategy, namely increasing digital literacy, including how to increase digital competence.

Strategies to increase digital literacy can be carried out through various digital literacy outreach, network infrastructure development, and many others. Every farmer Requires practical abilities in utilizing technology to access, administer, modify, and generate information in an ethical and sustainable manner. (Wan Mokhtar et al., 2022). In Indonesia, themajority of farmers are elementary school graduates who are over 45 years old and do not utilize the internet. (World Bank, 2022). This circumstance poses challenges for farmers in adapting to novel technology. Nevertheless, the growing population of youth in the agricultural sector is anticipated to enhance digital literacy among farmers. The activities can be incorporated into agricultural outreach programs. (Widaningsih et al., 2021).

The following strategy is needed to find methods for managing land resources wisely to overcome climate change, environmental degradation, and poverty. Even though villages have rich resources, such as agricultural land, they face various threats, such as: climate change, extreme poverty, environmental degradation, and others. Using industry 4.0-based agricultural technology can help provide environmentally friendly technology and can increase people's income significantly. Through digital transformation, it is necessary to increase digital literacy to overcome the problems of climate change, environmentaldegradation,and poverty.

4.4 Rural Digital Transformation Development Models in Indonesia

The Government's strategy for rural digital transformation is pursued using several models. The West Java Digital Village Program is a prominent digital transformation model. This program was developed by the West Java Regional Government and supported by the Ministry of Communication and Information. This program is often paired with other programs such as millennial farmers, one village, one product, etc. This program aims to improve the welfare of people in villages through digitalization, developing community capacity, and maximizing village potential. One of the stages is to use Internet of Things (IoT) technology to the village's potential. Through this program, the West Java Provincial Government (Pemdaprov Jabar) provides IoT technology assistance to village residents for a certain period so villages can be more advanced and independent. Carrying the Penta helix concept, now 2,205 villages in West Java have become beneficiaries, and 22 partners have been connected to innovate together. Inorderto, realize village independence in West Java, the Digital Village program invites academics, business people, communities, and society, especially in rural areas, to contribute to the infrastructure development process, use of the Internet of Things (IoT), and participate in digital literacy training. (desadigital.jabarprov.go.id, 2023)

The West Java Digital Village Development Scheme is as follows: a) Digital Village 1.0 focuses on infrastructure development. It provides basic internet use infrastructure in 141 villages, together with West Java Diskominfo and Lintasarta. This includes preparing adequate infrastructure to build connectivity, either through the construction of VSAT, transmitter towers, the availability of road access, and a stable electricity supply are also needed; b) Digital Village 2.0 focuses on Digital Literacy Training, conducting outreach regarding the use of the internet as a step to minimize the negative impacts of digitalization; c) Digital Village 3.0 focuses on Digital Marketing Training. Generating village competitiveness through digital marketplace training for Micro,

Small, and Medium Enterprises (MSMEs) and Village-Owned Enterprises (BUMDes); d) Digital Village 4.0, which focuses on implementing the use of technology, increasing the productivity and independence of village communities by launching various thematic villages according to village potential. Themes that are already running include: Digital Agriculture Village, Digital Fisheries Village, Digital Health Village, Digital Education Village, Digital Waste Management Village, and Digital Multimedia Village. (desadigital.jabarprov.go.id, 2023). 70% of the economic potential in West Java is in the agricultural sector.

Technology allows opportunities to optimize this potential to be opened more widely. West Java, with a vision to become an inclusive Digital Province, seeks to realize the agricultural revolution 4.0 by launching the "Digital Agricultural Village" program. In implementing the Digital Village 4.0 program in the agricultural sector, the Government is collaborating with technology companies, startup Habibi Garden which operates in the field of precision agriculture, the West Java Provincial Government is carrying out activities to launch Digital Agricultural Villages as well as precision agriculture outreach which is attended by around 100 representatives of farmer groups in West Java. This Digital Agricultural Village Program utilizes Internet of Things (IoT) technology to help increase productivity, cut costs, and reduce the possibility of farmers' crop failure. The West Java Provincial Government hopes that through the implemented digital innovation, it can improve the welfare of farmers in West Java.

Digital village development is carried out to stimulate the economy of village communities through empowering village communities, which can provide economic benefits. The program's mission is to narrow the digital divide. The presence of technology can help increase the productivity of village communities and even expand the reach of their business products. Appropriate technology has brought benefits to the beneficiaries, including 12 farmer groups from 11 villages in West Java, experiencing an increase in crop yields and income of 42.2% and 32.7%, respectively. Fish farmers in 51 villages have also felt the benefits. (desadigital.jabarprov.go.id, 2023)

This program receives support from the Ministry of Communication and Information through the development of digital transformation in the strategic sector. The Ministry of Communication and Information is doing two main things in digitizing this sector (agriculture), namely precision agriculture and digitizing the recording of horticultural commodity auction results. Precision agriculture is an agricultural concept that uses the help of Internet of Things (IoT) technology and Geographical Information System (GIS) to identify, analyze, and manage the diversity of information on land, including regarding air, water,weather, and climate conditions to ensure appropriate treatment. so that productivity and land sustainability are optimal. (kominfo.go.id, 2018)

Apart from West Java, the Ministry of Communication and Information assists farmers in using data analysis applications based on the Internet of Things (IoT) and Geographic Information System (GIS). Through an application connected to soil and weather sensors, it is hoped that farmers' production in GunungKidul Regency, Yogyakarta. The assistance provided by the Ministry of Communication and Information is the implementation of precision agriculture. The target is to increase farmer productivity. However, in implementation, there are challenges regarding sufficient agricultural land area for precision agriculture, the ability of farmers and extension workers to input precision agricultural data, and financing investment in precision agricultural infrastructure. The soil and weather sensor equipment handed over can provide recommendations regarding agricultural production processes. Starting from the right time of fertilization or irrigation, the type of fertilizer needed, and predicting the possibility of pest attacks when the temperature drops or seasons change. In this activity, each participant was accompanied and trained to be able to read and follow up on recommendations from the tool via their respective Android-based cell phones. The Ministry of Communication and Information's support is part of the Government's efforts to implement digitalization initiatives in the agricultural sector. Farmers can take advantage of applications developed by smartphone-based technology companies. Even through the application, farmers can use the agricultural question-and-answer feature regarding pest and plant disease problems. (kominfo.go.id, 2018)

PT Telekomunikasi Indonesia Tbk has also launched a rural digitalization program under the name Smart Village Nusantara Program. This program continues the Smart City Nusantara program, which was initiated

previously. The objectives of this program are 1) To provide experience for villages in empowering and improving the sustainable village economy; 2) As it means of collaboration and benchmarking for villages, regional governments, and other stakeholders (relevant ministries/institutions); 3) As a form of Telkom Group support in developing the digital village ecosystem.

The Smart Village Nusantara digital village piloting program was carried out in two stages. The first phase will be implemented in Pangandaran Village, Pangandaran Regency and Kemuning Village, Karanganyar Regency, while the second phase will be implemented in Palasari Village, Subang Regency, Sambirejo Village, Sleman Regency and Ranupani Village, Lumajang Regency, as a form of support for the Government's program to develop Indonesia from the outskirts. Digital Village is one of the Government's strategic plans to support the national digital transformation process towards a Smart Nation. Telkom is developing aspects of digital village development, which include village governance, village commercial governance, and village social governance by utilizing information and communication technology. (smartvillagenusantara.id, 2022)

Village governance includes the use of applications that speed up administrative processes more effectively and efficiently, data-based village management, increasing citizen contribution and participation in planning, implementing,monitoring,and evaluating the Village Revenue and Expenditure Budget, as well as the existence of two-way communication and collaboration media between the government village and its residents. The village commerce system consists of marketing solutions for superior village products through BUMDesa as village wholesalers, market application solutions for products/services between residents under the characteristics of the village ecosystem, digitalization solutions for MSMEs through digital cashier applications that are connected to banking and non-cash payments and enable additional Village Original Income. Village social governance includes the educational sector, such as a digital-based village library, the security and comfort of residents through panic button facilities, CCTV, disaster sensors, and the health sector through ePuskesmas, ePosyandu integrated at the district and provincial levels. These three aspects must be supported by adequate internet connection infrastructure for access for village officials and residents.

Smart Village Nusantara Program by P.T. Telkom Indonesia; launching nine villages on the island of Java, namely East Java, Central Java, and West Java. The program pattern is as follows: tourist, agricultural, and trading villages. Managing Villages Becomes Easier. Fulfill your village's needs with various digital service solutions from Smart Village Nusantara. We help the community to organize the village more comfortably, safely, and efficiently. Smart Village offers a variety of products that can make villages superior and advanced, such as: a) Smart Government, access to all services for more efficient administrative processes and public services; b) Smart Economy, easy market access to various superior village products. c) Smart Society, easy access to social services to improve the quality of village residents.d) Infrastructure Management of village support facilities so they are maintained and appropriate. (smartvillagenusantara.id, 2022)

Six hundred villages have been digitized, 26 provinces, 28,739 combined village residents, 14.1 billion, Smart Economy. Benefits of Smart Village Nusantara Services: a) Improved Village Economy and Food Security. Assist in the marketing process of superior products and optimize village income through evaluating village activities. b) Effective and Efficient Village Governance, Increasing the efficiency of government and village community service processes and encouraging two-way collaboration to increase citizen participation. c) Increasing Village Community Empowerment: Increasing the empowerment of village community life through digital service solutions in education, health, security, and citizen comfort. Village Level Data Integration: Helps manage village data in a centralized and integrated manner.

Many villages in Indonesia have benefited from the Smart Village Nusantara (SVN) service. Telkom works together with villages to create the right solution for developing digital village transformation. One of them is through providing Village Portal services to display village information digitally which can be accessed anywhere and at any time by Village Officials, Village Residents, and the wider community. Through the village portal provided by SVN, villages can update information about the village in real time. They can be creative in it to attract visitors because it will represent each village digitally.

Another new digital transformation program is the Smart Village Program, launched by the PDTT Ministry of Villages. This program has a broader scale than the previous digital village program, in the first phase, there were 500 villages, in the second phase there were 1000 villages and in the third phase there were 1500 villages. According to him, intelligent villages are developed to increase productivity and economic activities in rural areas. Smart villages support the achievement of SDGs (Sustainable Development Goals) and help villages to develop while also reducing poverty at the same time.

The Smart Village or intelligent village is a digital-based village development concept that 2016 was introduced by the National Research and Innovation Agency (BRIN), which at that time was called LIPI, which then involved several ministries in its implementation, such as the Ministry of Villages, Development of Disadvantaged Regions and Transmigration, Ministry of Home Affairs, and Ministry of Forestry. A Smart Village is a village that develops development in a participatory manner, where the initiative comes from all stakeholders and is accountable, transparent, and innovative based on science technology and local wisdom. Utilizing and applying science, technology, and innovation (iptekin) is necessary for realizing a digital-based smart village. (brin.go.id, 2022).

In the Smart Village Program, the PDTT Village Ministry presents a new digital-based ecosystem, namely the presence of the Village Digital Community Space (RKDD). The community can use this space to carry out transformative processes such as learning, discussing, and creating innovative solutions based on digital technology, as well as improving community skills in managing village resource potential. This community brings together communities in the village to serve as a basis for carrying out the digital transformation process. All communities in the village can join this space.

RKDD management is carried out by digital talents recruited by the Ministry of Villages PDTT called Digital Ambassadors, Digital Cadres, and Village Digital Communities. Digital Ambassadors are coaches who lead, coordinate, monitor, and evaluate community space development activities in villages that coordinate 5 villages. At the same time, Digital Cadres are responsible for all assets, planning, and compiling RKDD activity schedules. The digital cadet consists of 1 person per village. Meanwhile, the Village Digital Community plays a role in coordinating the activities of the Village Digital Community Space with members of their community group. RKDD operational costs and activities to increase digital literacy in village communities come from the Ministry of Villages PDTT. Village(PusdaingKemendes PDTT, 2022).

The execution of a savvy village is steered by six fundamental pillars: intelligent populace, smart lifestyle, smart surroundings, proficient governance, smart economics, and smart transportation. These pillars depict the endeavors of the Ministry of Villages, Advancement of UnderprivilegedRegions, and Transmigration to adopt the Sustainable Development Goals (SDGs) at the grassroots level within rural societies.

The concept of a smart village serves as a potent strategy and instrument for addressing diverse challenges (kominfo.go.id, 2020). The significance of these six pillars underscores the crucial role of villages in advancing national progress and prosperity.

Presently, Indonesia is home to a minimum of 74,960 villages, with 71% of the nation’s populace residing in these rural areas. These villages can be viewed as the vanguard of governmental development initiatives. Following the enactment of Law Number 6 in 2014, which pertains to villages, concerted efforts have been undertaken to augment the role of villages in advancing societal welfare. A primary mechanism for actualizing the concept of a ‘smart village’ is through the allocation of village funds. Between 2015 and 2020, a cumulative total of IDR 329.65 trillion in village funds was disbursed. These funds have facilitated the construction of various facilities and infrastructure that bolster economic activities and enhance the living standards of rural communities (brin.go.id, 2022).

5. Conclusion

This study focuses on a single village that has been recognized as a Smart Village by the Ministry of Villages and Development of Disadvantaged Regions and Transmigration. The research primarily examines the village's

strategy and roadmap development based on its unique challenges, resources, and potential. However, to gain a holistic understanding of smart villages, further research is needed in villages with different conditions.

Global trends, such as the implementation of Sustainable Development Goals (SDGs), along with various laws and regulations like the Village Law, are key factors driving digital transformation. The approach to addressing diverse village issues involves managing resources via digital transformation, which includes promoting digital literacy. The model for digital transformation in rural areas involves the use of 4.0 technology in agriculture and the implementation of digital literacy initiatives.

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References

[1] antaranews.com. (2023, May 23). Nilanyaterustumbuh, Indonesia pemainutamaekonomi digital ASEAN. DiunduhTanggal 29-07-2023; Pukul 7;44.

[2] Aritenang, A. F., Hidayat, F., Warouw, F. F., Giroth, L. G. J., Pribadi, M. A., Nasution, M. A., Nugraha, R. A., Regif, S. Y., & Rotty, V. (n.d.). Digital Transformation for Rural Areas and Smart Villages; Policy Brief.

[3] brin.go.id. (2022, July 29). Smart Village Solusi Percepatan Pembangunan Desa. Https://Www.Brin.Go.Id/News/109681/Smart-Village-Solusi-Percepatan-Pembangunan-Desa; Diunduh 12-05-2023;14.50.

[4] Creswell, J. W. (1998). Qualitative Inquiry and Research Design: Choosing Among Five Tradition. SAGE Publications.

[5] Creswell, J. W. (2014). Research Design; Pendekatan Metode Kualitatif, Kuantitatif dan Campuran (Terjemahandari Research Design, Qualitatif, and Mixed Methodes Approach), 4th Editon (Achmad Fawaid and RianayantiKusminiPancasari (Translator), Ed.; 4th ed.).

[6] de Bruins, L. (2017, April 14). SWOT Analysis: Bringing Internal and External Factors Together. B2U Business to You.

[7] desadigital.jabarprov.go.id. (2023, July 28). Data Perkembangan Desa Digital dan Mitra. Https://Desadigital.Jabarprov.Go.Id/Data Perkembangan Desa Digital Dan Mitra; DiunduhTanggal 28-07-2023;Pukul 17.16.

[8] Diartika, F., &Pramono, R. W. D. (2021). Program Pembangunan Kawasan Perdesaan: Strategi Pengembangan Desa BerbasisKeterkaitan Desa-Kota. Jurnal Pembangunan Wilayah Dan Kota, 17(4), 372–384. https://doi.org/10.14710/pwk.v17i4.34503

[9] Fatchiya, A., Amanah, S., &Kusumastuti, Y. I. (2016). The Adoption of Agricultural Technology Innovation and its Correlationwith Food Security of Farmer Households. JurnalPenyuluhan, 12 no 2.

[10] Guzal-Dec, D. (2018). Intelligent Development of the Countryside – The Concept of Smart Villages : Assumptions, Possibilities and Implementation Limitations. Economic and Regional Studies / Studia EkonomiczneiRegionalne, 11(3), 32–49. https://doi.org/10.2478/ers-2018-0023

[11] Hollweck, T. (2016). Robert K. Yin. (2014). Case Study Research Design and Methods (5th ed.). Thousand Oaks, CA: Sage. 282 pages. The Canadian Journal of Program Evaluation. https://doi.org/10.3138/cjpe.30.1.108

[12] Holmes, J., & Thomas, M. (2015). Introducing the Smart Villages Concept. In The InTernaTIonal Journal on Green GrowTh and developmenT • (Vol. 1, Issue 2). www.e4sv.org

[13] hootsuite-we-are-social-indonesian-digital-report-2022. (2022, February). Hootsuite (We are Social): Indonesian Digital Report 2022.

[14] ifad.org. (2018, April 16). A new paradigm for rural development. By Manuel Otero, Director General, IICA; Julio Berdegué, Assistant Director-General and Regional Representative, FAO; Joaquín Lozano, Regional Director for LAC, IFAD; Miguel Barreto, Regional Director, WFP. Originally Published on Télam;Download 18-07-23 .

[15] Iskandar, A. H. (2020). SDGs Desa PercepatanPencapaian Tujuan Pembangunan Nasional Berkelanjutan. Yayasan Pustaka OborIndonesia .

[16] kominfo.go.id. (2018, September 17). Petani Go Online, KolaborasiTingkatkanKesejahteraanPetani Indonesia; SIARAN PERS NO. 225/HM/KOMINFO/09/2018. Https://Www.Kominfo.Go.Id/Content/Detail/14431/Siaran-Pers-No-225hmkominfo082018-Tentang-Petani-Go-Online-Kolaborasi-Tingkatkan-Kesejahteraan-Petani-Indonesia/0/Siaran_pers; Diunduh 12-05-2023;15;32.

[17] kominfo.go.id. (2020, February 25). Webinar ITU, Menteri Desa PDTT UngkapKonsep Smart Village di Indonesia. Www.Kominfo.Go.Id/Content/Detail/27412/Webinar-Itu-Menteri-Desa-Pdtt-Ungkap-Konsep-Smart-Village-Di-Indonesia/0/Berita; Diunduh 26-0502023:7;48am.

[18] kominfo.go.id. (2022a, April). siaran-pers-no-168-tentang-dukung-transformasi-digital-indonesia-pemerintah-bangun-infrastruktur-maju-satu-dekade/0/siaran_pers diunduhtanggal 6/4/2022 pukul 8:38.

[19] kominfo.go.id. (2022b, October 19). Tiga Hal PentingdalamTransformasi Digital Desa, Apa Saja? DirektoratJenderalAplikasiInformatika Kementerian Komunikasi Dan InformasiRepublik Indonesia.

[20] Kuhlmann, S., & Heuberger, M. (2023). Digital transformation going local: implementation, impacts and constraints from a German perspective. Public Money and Management, 43(2), 147–155. https://doi.org/10.1080/09540962.2021.1939584

[21] Kusmarini, Y. (2020). Review tentangPenelitian Studi Kasus Menurut (John W. Creswell).

[22] Li, W., Badr, Y., &Biennier, F. (2012). Digital ecosystems: Challenges and prospects. Proceedings of the International Conference on Management of Emergent Digital EcoSystems, MEDES 2012, 117–122. https://doi.org/10.1145/2457276.2457297

[23] Muke, A., Ugemuge, N. S., &Hajare, H. v. (2017). Use of Advance technology in developing smart villages. www.ijrests.org

[24] Nurchim, I. N. (2018). PemodelanAdopsiTeknologi Digital Guna Mewujudkan Desa Pintar.

[25] OECD. (2017). Key Issues for Digital Transformation in The G20; Report prepared for a joint G20 German Presidency/ OECD conference.

[25] Park, C., & Cha, J. (2019). A Trend on Smart Village and Implementation of Smart Village Platform. International Journal of Advanced Smart Convergence, 8(2), 177–183. https://doi.org/10.7236/IJASC.2019.8.3.177

[26] PusdaingKemendes PDTT. (2022). Petunjuk Teknis Pengembangan Ruang Komunitas Digital Desa.

[27] Rahardjo, M. D. (1986). TransformasiPertanian, Industrialisasi dan KesempatanKerja (2nd ed.). UI Press.

[28] Ranade, P., Londhe, S., & Mishra, A. (2015). Smart Villages Through Information Technology - Need of Emerging India Smart Villages Through. PASJ International Journal of Information Technology (IIJIT), 3(7). http://www.ipasj.org/IIJIT/IIJIT.htm

[29] republika.co.id. (2022, December 15). IDM Status Desa Mandiri 2022 Lampaui Target RPJMN 2024. Https://News.Republika.Co.Id/Berita/Rmxt5p487/Idm-Status-Desa-Mandiri-2022-Lampaui-Target-Rpjmn-2024; Diunduh 25-05-2023; 10;32am.

[30] Salemink, K., Strijker, D., & Bosworth, G. (2017). Rural development in the digital age: A systematic literature review on unequal ICT availability, adoption, and use in rural areas. Journal of Rural Studies, 54, 360–371. https://doi.org/10.1016/j.jrurstud.2015.09.001

[31] Sandelowski, M. (2000). Focus on Research Methods Whatever Happened to Qualitative Description? In Research in Nursing & Health (Vol. 23). John Wiley & Sons.

[32] smartvillagenusantara.id. (2022). Smart Village Nusantara; Mengelola Desa Jadi LebihMudah. SmartVillageNusantara.Id; Diunduh 27-09-2022; Pukul12.35;PM.

[33] Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Qi Dong, J., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. Journal of Business Research, 122, 889–901. https://doi.org/10.1016/j.jbusres.2019.09.022

[34] Wan Mokhtar, W. N. H., Izhar, T. A. T., Zaini, M. K., & Hussin, N. (2022). The Importance of Digital Literacy Skills among Farmers for Sustainable Food Security. International Journal of Academic Research in Progressive Education and Development, 11(1). https://doi.org/10.6007/ijarped/v11-i1/12104

[35] Widaningsih, N., Mulyana, M., & Ali, H. (2021). Application of digital Agricultural Tools in Indonesia: From Creativity towards Rural Community Innovation. https://doi.org/10.33258/birci.v4i4.3512

[36] Yin, R. K. (2002). Case Study Research Design and Method: Vol. Third Edition.

[37] Yustika, A. E., & Baks, R. (2016). Konsep Ekonomi KelembagaanPerdesaan, Pertanian, dan Kedaulatan Pangan: Vol. CetakanKedua. Empat Dua.

[38] Zavratnik, V., Podjed, D., Trilar, J., Hlebec, N., Kos, A., & Duh, E. S. (2020). Sustainable and community-centered development of smart cities and villages. Sustainability (Switzerland), 12(10). https://doi.org/10.3390/SU12103961