TRANSFORMATION OF VILLAGE GOVERNANCE THROUGH DIGITAL DATABASE SYSTEM: PARTICIPATORY ACTION RESEARCH APPROACH IN BATTEMBAT VILLAGE

Ahmad Khomaini Syafeie[1]*, Nurul Azmi[1]
[1]Universitas Islam Negeri Siber SyekhNurjati, Cirebon, Indonesia
*ahmadks@uinssc.ac.id

Abstrak: Penelitian ini bertujuan untuk merancang dan mengimplementasikan Sistem Basis Data Digital (DDS) menggunakan pendekatan Participatory Action Research (PAR) di Desa Battembat, Kecamatan Tengah Tani, Kabupaten Cirebon. DDS berfungsi sebagai alat yang efektif untuk pengambilan keputusan berbasis bukti, meningkatkan efisiensi pengelolaan sumber daya di tingkat desa. Penelitian ini mengadopsi metodologi PAR empat siklus: pengumpulan data awal, pengembangan sistem, uji coba dan evaluasi, dan sistematisasi akhir. Keterlibatan aktif pemangku kepentingan lokal, termasuk pejabat pemerintah dan anggota masyarakat, ditekankan untuk memastikan keberlanjutan sistem. Hasil penelitian menunjukkan bahwa DDS meningkatkan kesadaran masyarakat akan pentingnya data digital, mempercepat proses pengambilan keputusan, dan mendorong peluang kewirausahaan berbasis data. Selain itu, sistem ini meningkatkan transparansi dan akuntabilitas dalam tata kelola desa. Penelitian ini berkontribusi pada literatur tentang sistem informasi pedesaan, menggarisbawahi pentingnya metode partisipatif dalam implementasi teknologi lokal. Temuan penelitian ini menyoroti potensi DDS untuk mengubah tata kelola pedesaan, mendukung pembangunan yang berkelanjutan dan inklusif. DDS memberikan dampak positif terhadap peningkatan partisipasi warga dan akses ekonomi lokal, namun tantangan utama meliputi keterbatasan literasi digital, resistensi perubahan, dan ketersediaan infrastruktur teknologi. Penelitian ini merekomendasikan pelatihan lebih lanjut dan pengembangan kapasitas bagi para pemangku kepentingan untuk mengoptimalkan penggunaan DDS dan memastikan fungsionalitas jangka panjangnya. Secara keseluruhan, studi ini menekankan pentingnya mengintegrasikan inovasi digital dengan pendekatan partisipatif untuk mengatasi tantangan tata kelola di daerah pedesaan.

Kata Kunci: Participatory Action Research (PAR), pemetaan geospasial, sistem basis data digital, tata kelola pedesaan.

Abstract: This study aims to design and implement a Digital Database System (DDS) using a Participatory Action Research (PAR) approach in Battembat Village, Tengah Tani District, Cirebon Regency. The DDS serves as an effective tool for evidence-based decision-making, enhancing resource management efficiency at the village level. The research adopts a four-cycle PAR methodology: initial data collection, system development, trial and evaluation, and final systemization. Active involvement of local stakeholders, including government officials and community members, was emphasized to ensure the system's sustainability. Results demonstrate that DDS improves community awareness of the importance of digital data, accelerates decision-making processes, and fosters data-driven entrepreneurship opportunities. Additionally, the system enhances transparency and accountability in village governance. The study contributes to the literature on rural information systems, underscoring the significance of participatory methods in local technology implementation. The findings highlight the potential of DDS to transform rural governance, supporting sustainable and inclusive development. DDS has a positive impact on increasing citizen participation and local economic access, but major challenges include limited digital literacy, resistance to change, and the availability of technological infrastructure. This research recommends further training and capacity building for stakeholders to optimize DDS usage and ensure long-term functionality. Overall, the study emphasizes the importance of integrating digital innovation with participatory approaches to address governance challenges in rural areas.

Keywords: Participatory Action Research (PAR), geospatial mapping, digital database system, rural governance

Introduction

Effective governance at the village level remains a critical challenge in Indonesia, particularly in regions like Battembat Village, Cirebon Regency. Limited access to accurate and updated data often hinders decision-making, leading to inefficient resource allocation and suboptimal developmental outcomes (Badan Pusat Statistik Kabupaten Cirebon, 2020). Integrating geospatial, social, and sectoral data is necessary to enhance evidence-based policymaking and ensure sustainable development at the grassroots level. Law Number 6 of 2014 concerning Villages in Article 1 Paragraph 6 stated that village governance is defined as village management that includes planning, implementing, and evaluating development activities involving community participation to achieve village independence. This definition emphasizes the sustainability of village development through community involvement as the core of the governance process.

According to Kooiman (2003), governance is the interaction between formal structures and social actors in the management of public policies, which in the context of the village includes managing human, natural, and financial resources. In this framework, the village not only functions as an administrative unit but also as an entity responsible for decision-making oriented towards community needs. UNDP (1997) defines good governance as a process in which power and authority are used to manage resources to meet public needs, with key principles such as participation, transparency, accountability, responsiveness, and effectiveness. In the Indonesian context, Law Number 6 of 2014 concerning Villages emphasizes the importance of village independence through management based on community participation and empowerment of local potential. Goodchild (2007) states that information technology provides great opportunities to improve accuracy, speed, and transparency in data-based decision making. Therefore, technology-based village governance is an important foundation for sustainable village development. Grindle (2004) states that village governance is the ability of local institutions to design, implement, and be accountable for development-oriented public policies.

A Digital Database System (DDS) offers a transformative approach to address these challenges. By consolidating diverse data types into a centralized and structured platform, DDS enables local governments to access accurate, consistent, and real-time information, facilitating better planning and resource management (Goodchild & Janelle, 2010). Beyond its technological benefits, DDS also promotes transparency and accountability, key pillars of good governance (Carver & Fritz, 2008). Meanwhile, according to Laudon and Laudon (2020), digital-based information systems can increase transparency and accountability in resource management, while encouraging community involvement through better data accessibility. Heeks (2002) emphasizes that digital technology can be a strategic tool to improve governance, especially in developing countries, by providing solutions to resource and accessibility limitations. Elmasri and Navathe (2016) stated that a database system is a collection of interconnected data and software to manage the data, thus enabling efficient storage, retrieval, and processing. Connolly and Begg (2015) define a database system as a technology that enables centralized data storage

to manage, control, and provide access to data required by various users. Kroenke and Auer (2014) define a database system as a software system that supports storing and managing structured data to support an organization's information needs.

Experts highlight the benefits of a database system, which include: emphasizing that database systems enable efficient data management through organized data structures and automated processing tools (Elmasri & Navathe, 2016). Connolly and Begg (2015) stated that database systems allow real-time access to data, which supports transparency in financial and operational reporting. According to Kroenke and Auer (2014), database systems are designed with security features such as access control, encryption, and rights management. Elmasri and Navathe (2016) noted that database systems facilitate big data analysis through query capabilities and integration with analytical tools. Connolly and Begg (2015) explain that database systems enable collaboration between users from various departments through centralized data. The definitions and benefits outlined by the experts above reflect the importance of database systems in supporting operational efficiency, transparency, and security. In the village context, implementing a digital database system can overcome various management challenges, such as scattered or difficult-to-access data. In addition, integrating analytical features opens up opportunities for villages to use data in evidence-based development planning.

The application of Participatory Action Research (PAR) is particularly relevant in this context. PAR emphasizes active community involvement in every stage of research and implementation, fostering local ownership and ensuring the system's sustainability. This participatory approach empowers stakeholders and aligns technological solutions with the community's needs and conditions (Reason & Bradbury, 2001). This study focuses on Battembat Village, a semi-rural area facing challenges such as urbanization, environmental risks, and limited infrastructure. By implementing DDS through the PAR framework, this research aims to transform village governance, enhance data literacy, and support inclusive development in the region.

The Flood Disaster Vulnerability Map in Cirebon Regency provides information that Battembat Village, located in Tengah Tani District, Cirebon Regency, is an area that has unique socio-economic and geographical characteristics (Badan Informasi Geospasial, 2022). Based on data from the Central Statistics Agency (CSA) of Cirebon and geospatial data from the Geospatial Information Agency (GIA), Battembat Village shows a significant development pattern in several aspects. First, in terms of population, Battembat Village has experienced a moderate increase in population in recent years, driven by urbanization and an increase in the local economic sector. These data show that infrastructure development is urgently needed with the increasing population, especially regarding educational facilities and entrepreneurship training. Currently, access to educational facilities is still limited, with several primary and secondary schools scattered in several locations.

Regarding land use, geospatial data reveals that most of the village area is used for agriculture, especially rice and horticultural crops. However, a trend of converting agricultural land into residential areas can impact local food security if not appropriately managed. In addition, challenges in flood management also need to be considered, considering that topographic data shows that several points in Battembat Village are in flood-prone areas. This

highlights the need for better drainage infrastructure development and wise spatial management to develop this village sustainably. Thus, government and local stakeholder intervention are needed to balance development and environmental sustainability.

This community service focused on the Digital Database System (DDS), including: 1) Participant Understanding of DDS: This research focuses on how participants, such as village officials, communities, and stakeholders, understand the concept and objectives of DDS. Data were collected through in-depth interviews and surveys to determine the extent of participants' knowledge regarding the functions and uses of DDS; 2) DDS Mentoring: This focus examines the methods used in mentoring, including technical training and coaching for communities and village governments. The mentoring process was evaluated through direct observation and questionnaires to measure effectiveness and challenges; and 3) DDS Results, Impacts, and Benefits: This research evaluates the results of DDS implementation, including social, economic, and village governance impacts. The research was conducted by comparing conditions before and after DDS was implemented and measuring long-term benefits for the community.

This community service aims to evaluate participants' understanding of DDS, identify effective mentoring methods in its implementation, and analyze the results, impacts, and long-term benefits of DDS for the Battembat Village community in improving governance, access to information, and socio-economic welfare. Analysis of Community Service Strategy to achieve the objectives includes: 1) Resource Availability: Evaluation of the availability of human, technological, and financial resources for implementing DDS and mentoring in Battembat Village. Identification of resource needs and management strategies; 2) Stakeholder Participation: Analysis of stakeholders' participation level and involvement in the mentoring process. Identification of factors that influence active participation and strategies to increase it; 3) Institutional Capacity: Assessment of the capacity of local institutions in the management and utilization of DDS. Evaluation of training and mentoring needs to strengthen data management capacity at the village level; 4) Sustainability: Review of factors influencing the sustainability of DDS operations and mentoring. Identification of appropriate sustainability models and strategies to ensure program continuity; and 5) Benefits and Impacts: Analysis of the benefits and impacts of DDS implementation and mentoring on sustainable development in Battembat Village. Evaluation of the achievement of development goals and identifying areas that require improvement (Raharja & Wardhani, 2020; Fina, 2018).
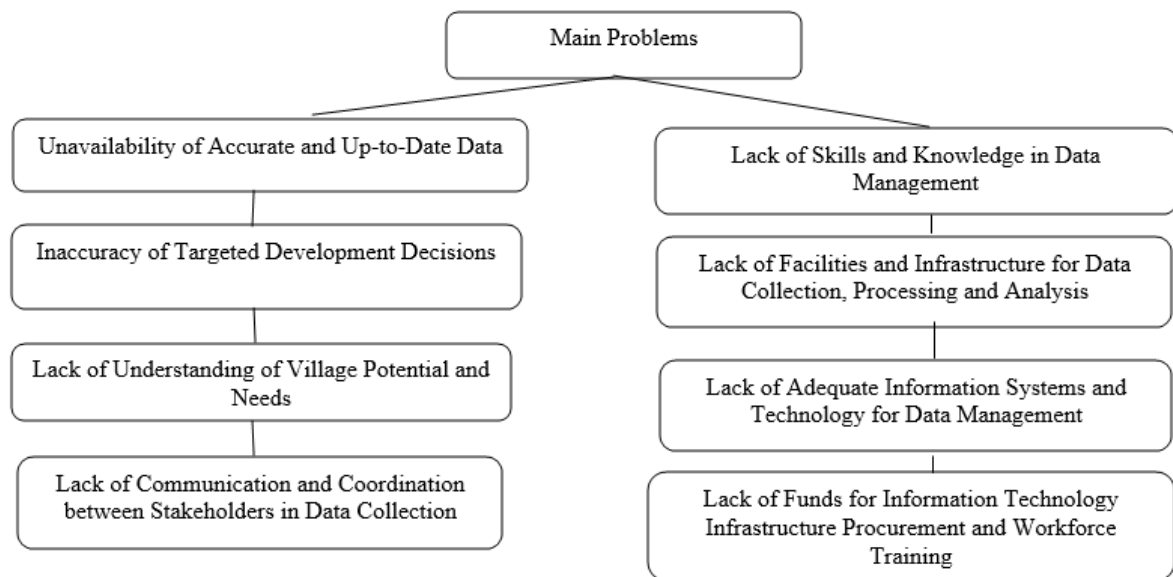
Problem Tree Analysis (Asset Strength Analysis)

Problem Tree Analysis is a tool used to analyze the causal relationships between factors that cause the main problem, its impacts, and its root causes. In the context of geospatial, social, and sectoral data mapping in Battembat Village, this chart provides a systematic overview of the problems faced, including a lack of infrastructure, coordination, and skills, which impact inaccurate village development decisions. A detailed explanation of each element in this problem tree is outlined as follows: a) Main Problem: Unavailability of Accurate and Up-to-Date Data to support development decision-making in Battembat Village. Accurate data is essential to ensure that the planning and implementation of development programs can be carried out effectively

and efficiently. Without adequate data, decisions are often based on assumptions or incomplete information, which has the potential to hinder village progress; b) Impact of the Main Problem: Inaccurate Targeted Development Decisions Inaccurate data results in inaccurate decision-making, so that development programs do not provide maximum benefits to the community. As a result, resources are allocated inefficiently. Without good data, the village government has difficulty understanding the existing potential and needs of the community as a whole. Consequently, village development opportunities that should be maximized are neglected.

Some root problems in Battembat village include: 1) Lack of Adequate Information Systems and Technology for Data Management Information technology is the primary foundation in managing data digitally. The unavailability of a qualified technology system hampers the process of collecting, storing, and analyzing data, so that the resulting data is irrelevant or outdated; 2) Lack of Facilities and Infrastructure for Data Collection, Processing, and Analysis. Physical infrastructure such as hardware, software, and inadequate internet access are major obstacles to data management. This condition slows the process of collecting valid data and increases the risk of errors in analysis; 3) Lack of Funds for the Procurement of Information Technology Infrastructure and Workforce Training. Financial factors play an important role in supporting the development of information systems. Without sufficient funding, it is difficult to provide the latest technology and train the workforce to manage the system; 4) Lack of Skills and Knowledge in Data Management. Village workers lack training and learning results in low-quality data management. Skills such as geospatial mapping, data processing, and statistical analysis are often poorly mastered; and 5) Lack of Communication and Coordination Between Stakeholders in Data Collection. Data collection requires cooperation between various parties, including village governments, communities, and other stakeholders. Lack of communication and coordination results in data collected that is not integrated or even contradictory.

From the root of the problem above, the solutions that can be proposed are: a) Improving Information Technology Infrastructure. Investment in hardware and software, including cloud-based systems, can support better data management. Procurement of modern devices can also increase the efficiency of the data collection and analysis process; b) Provision of Training and Education for Workforce. Training focusing on technical skills, such as using GIS (Geographic Information System) software and data analysis, should be provided to village government staff and local communities; c) Strengthening Inter-stakeholder Coordination. Forming a forum or working group consisting of village government, community organizations, and academics can help ensure the data collected is relevant, accurate, and accessible to all stakeholders; d) Increasing Funding through Partnerships. Establishing partnerships with the private sector, local governments, or non-governmental organizations (NGOs) can help in obtaining sufficient funds to support the procurement of technology and training; and e) Utilization of the Participatory Action Research (PAR) Approach. The PAR approach, which actively involves communities in all stages of research, can increase program ownership and sustainability. This approach also helps to raise public awareness about the importance of digital data. Problem Tree Analysis (Asset Strength Analysis) can be visualized in Figure 1.

Figure 1. Problem Tree Analysis Chart

Objective Analysis (Tree of Hope)/Asset Development Objective Analysis

Analysis of Community Service Strategy to achieve goals includes: 1) Availability of Resources; 2) Stakeholder Participation; 3) Institutional Capacity; 4) Sustainability; and 5) Benefits and Impacts (Raharja & Wardhani, 2020; Fina, 2018). The Tree of Hope analysis is used to describe the ideal vision and the steps needed to achieve the desired development goals. In the context of mapping geospatial, social, and sectoral data in Battembat Village, this chart provides a comprehensive framework for village development aspirations. This tree of hope consists of various branches representing elements of hope, ranging from infrastructure, economy, education, to the community's quality of life. The following is a detailed description of these elements: 1) Main Vision: Improving the Quality of Life of the Community. The peak of this tree of hope is improving the quality of life of the people of Battembat Village. This vision includes various aspects, including economic welfare, access to basic services, and improving the quality of the environment. This vision is the foundation for all development efforts and village policies; 2) Main Branch: Pillars of Hope, including: a) Improving Economic Welfare. Improving economic welfare is one of the main goals of the Tree of Hope.

The proposed strategies include: Diversification of Local Economic Enterprises: Utilizing local potential such as agriculture, tourism, and creative industries to create new sustainable business opportunities, Use of Information and Communication Technology: Supporting marketing and promotion of local products through digital technology, Mentoring and Training: Providing training for small and medium enterprises to increase the economic capacity of the community, and Development of Inter-Village Cooperation: Collaboration between regions to share resources and expand economic networks; b) Ensuring the Fulfillment of Basic Community Needs. Another expectation is to ensure that all communities have access to basic needs, including: Provision of Public Facilities: Infrastructure such as roads, bridges, and adequate transportation, Access to Water Resources: Availability of clean water and well-functioning water treatment facilities,

Improvement of Water Quality and Sanitation: Improving the quality of the environment through better sanitation systems, Increasing Access to Education and Training. Education is a key element to improve community capacity, through: Accessibility of Higher Education: Expanding community opportunities to obtain higher education, Information Technology Skills Training: Providing training in new technologies and sciences to support the digital transformation of villages, Development of Public Service Infrastructure Quality public service infrastructure is the basis for supporting community welfare, including: Provision of Quality Public Services: Opening easier access to health, administration, and social services and Increasing Accessibility: Ensuring that people can access these services without geographical or economic barriers; and c) Supporting Targeted Development Planning. Accurate data is at the heart of supporting effective development planning, through: Provision of Data for Analysis: Geospatial, social, and sectoral data are used to support evidence-based decision-making and Sustainable Planning: Village development that considers long-term impacts on the environment and society.

Strategic Steps to Achieve Expectations: a) Identification of Village Potential and Problems. As an initial step, a comprehensive mapping of the potential and challenges in the village is needed. This mapping includes geospatial, social, economic, and environmental aspects; b) Preparation of Development Policies and Programs. Based on the mapping results, specific policies and targeted programs can be designed to answer community needs and maximize local potential; c) Community Assistance. Direct community involvement in every stage of development is critical to ensure the program's success. A participatory approach can increase community ownership of development results; d) Development of Digital Technology. Villages can utilize digital technology, such as data-based applications, to support various aspects of development, including resource management, product marketing, and access to education and health services; e) Strengthening Multi-stakeholder Cooperation. Cooperation between village governments, the private sector, educational institutions, and non-governmental organizations is needed to support the program's implementation holistically.

The Expected Positive Impacts include: 1) Increased Economic Welfare. By diversifying businesses and strengthening economic capacity, village communities are expected to increase their income and overall welfare; 2) Village Independence. Villages with adequate infrastructure and empowered communities will be more independent in managing resources and facing future challenges; 3) Better Quality of Life. Fulfilling basic needs such as access to clean water, sanitation, education, and health services will improve the community's quality of life; 4) Sustainable Development. By considering environmental and social impacts, development in Battembat Village will be more sustainable and have a positive impact in the long term. Objective Analysis (Asset Development Objective Analysis) can be visualized in Figure 2.
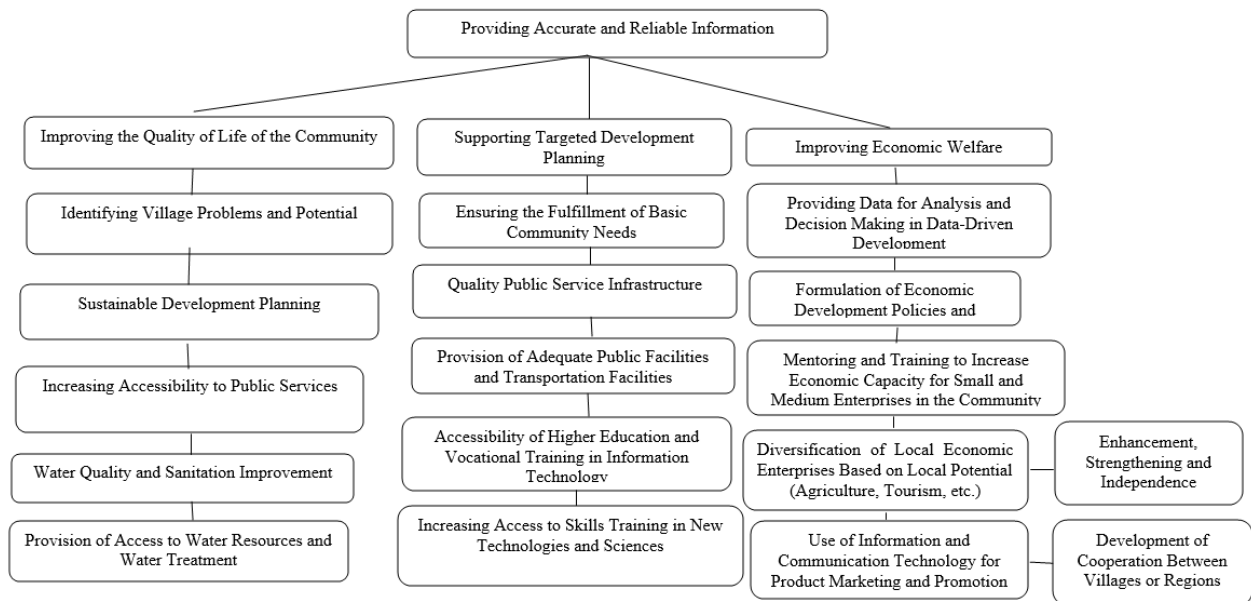
Figure 2. Objective Analysis (Tree of Hope)

Program Strategy Analysis

Program Strategy Analysis is a tool designed to identify, evaluate, and provide strategic solutions to various problems faced in village management and development. In the context of Battembat Village, it can be described as the relationship between existing problems, community expectations, gaps, and the reasons behind these conditions. Table 1 shows the Program Strategy Analysis of this community service.

Table 1. Program Strategy Analysis

No.	Problem	Hope	Gap	Reason
1	Unavailability of Accurate and Up-to-Date Data	Providing Accurate and Up-To-Date Data for Making Targeted Development Decisions	Mismatch between Real Conditions and Targeted Needs	Inaccurate and up-to-date data can result in development decisions that are not on target.
2	Lack of Understanding of Village Potential and Needs	Have a Deep Understanding of Village Potential and Needs to Plan Sustainable Development	Mismatch between Perception and Reality	Lack of understanding of the village's potential and needs can result in off-target planning.
3	Lack of Skills and Knowledge in Data Management	Improving Skills and Knowledge in Data Management for Effective Analysis and Decision Making	Lack of Capacity to Manage Data	Without adequate skills and knowledge, data cannot be managed effectively.
4	Lack of Facilities and Infrastructure for Data Collection, Processing and Analysis	Have adequate facilities and infrastructure for data collection, processing and analysis.	Limited Access to Facilities and Infrastructure	Inadequate facilities and infrastructure can hinder the process of effective data collection, processing and analysis.
5	Lack of Adequate Information Systems and Technology	Have Information Systems and Technology that Support Effective and Efficient Data Management	Limitations of Information Technology Infrastructure	Without adequate information systems and technology, data management will be hampered.
6	Lack of Funds for Technology Infrastructure Procurement and Workforce Training Information	Sufficient Funding for Information Technology Infrastructure Procurement|	Limited Financial Resources and Workforce Training	Funding constraints can hamper investment in information technology infrastructure and necessary workforce training.

Methods

This study employs the Participatory Action Research (PAR) approach, a collaborative methodology that actively involves stakeholders in the research process. PAR is particularly effective in addressing complex community challenges by combining action, reflection, and iterative learning cycles (Reason & Bradbury, 2001). It emphasizes inclusivity, empowering local communities to co-create solutions that align with their unique contexts and needs. The reason for using the Participatory Action Research (PAR) method is a methodological approach that allows active community participation in the research process aimed at achieving a better understanding of the problems faced by the community and creating sustainable social change.

During implementation, several challenges emerged, including limited digital literacy, initial skepticism about technology adoption, and inadequate infrastructure. These difficulties were addressed through continuous community mentoring, flexible training modules adapted to local contexts, and phased deployment of digital tools. Open dialogue sessions and participatory workshops also helped build trust and address concerns. The community responded positively as awareness increased and the benefits of the Digital Database System (DDS) became visible. Users gradually embraced the system, especially as it demonstrated improvements in transparency, decision-making efficiency, and access to resources. This participatory journey fostered ownership and sustainability of the technology-driven governance innovation.

Participants

The subjects of assistance in the Digital Database System (DDS) implementation program in Battembat Village reflect the diversity of characteristics of the actively involved community. The subjects consist of 13 individuals with varying backgrounds in terms of age, education, occupation, and gender. This diversity is an important asset to ensure the program's success by involving individuals from various educational backgrounds, from junior high school to undergraduate level, and professions that include teachers, village officials, private employees, and self-employed individuals. Each subject contributed to the problem identification, planning, implementation, and evaluation stages, making the Participatory Action Research (PAR) approach more inclusive and representative of the needs of the Battembat Village community. Table 2 shows the participants who were assisted.

Table 2. Mentoring Participants

Full name	Gender	Age	Education	Work
Nurhasanah	Female	50	S1	Teacher
Shofi nurhikmah	Female	28	High School	Village officials
Kartika Eka putri	Female	40	Junior High School	Housewife
Qomariyah	Female	27	S1	Private sector employee
Ana Fathanah	Female	49	High School	Housewife
Muhamad kholid	Male	53	S1	Private sector employee
Shofi nurhikmah	Female	28	High School	Private sector employee
Nahrul Anita	Female	22	High School	Village officials
Bayu eka saputra	Male	27	High School	Self-employed

Full name	Gender	Age	Education	Work
Lely Affriyanti	Female	38	High School	Housewife
Akhmad Firdaus H	Male	40	High School	Self-employed
Supriyadi	Male	53	Junior High School	Self-employed
Fikri Ersano	Male	24	High School	Private sector employee

The number of respondents in the Digital Database System (DDS) mentoring program in Battembat Village consisted of 97 families (Family Card/FC) with 279 individual residents. Respondents were grouped based on the contribution of 13 main subjects who acted as surveyors or facilitators. Each surveyor handled several families and individuals according to the area or community group they assisted. For example, Nurhasanah facilitated nine families with 28 individuals, while Shofi Nurhikmah, who contributed in two areas, handled eight families with 24 individuals per area. Other subjects, such as Kartika Eka Putri and Qomariyah, assisted eight families with 22 to 26 individuals. The variation in the number of families and individuals assisted reflects the distribution of community participation in this program. Overall, this approach ensures inclusive representation of various community groups based on age, gender, and level of participation in data collection and DDS implementation. This data is an important basis for needs analysis, program planning, and evaluation of the success of DDS implementation in the village. Table 3 shows the results of the questionnaire survey.

Table 3. Number of Respondents

Facilitators	Number of Respondents	
	Family (FC)	Individual (Citizen)
Nurhasanah	9	28
Shofi nurhikmah	8	24
Kartika Eka putri	8	22
Qomariyah	8	26
Ana Fathanah	8	24
Shofi nurhikmah	8	24
Nahrul Anita	8	24
Bayu eka saputra	8	17
Lely Affriyanti	7	19
Akhmad firdaus hambali	9	24
Supriyadi	8	22
Fikri Ersano	8	25
Total	97	279

Stages of Community Empowerment, Organizing, and Assistance

The community service program was implemented in Battembat Village, Tengah Tani District, Cirebon Regency, West Java Province, from October 2024 to January 2025 with the following stages:

1. Preparation. Identification of Problems and Needs: Conducted through surveys, interviews, or observations to understand the community's specific needs. Formation of the Mentoring Team: The team comprises facilitators, academics, community leaders, and local change agents. Program Plan: Prepared based on the identification results, including objectives, strategies, and resource allocation.

2. Community Involvement. Initial Focus Group Discussion (FGD): Aims to gather input from the community and build consensus on priority issues. Socialization Activities: To introduce the program to the community and educate them about its benefits.

3. Capacity Building. Technical Guidance (TG): Provide technical training using digital systems or specific skills. Use a practical approach to improve participant understanding. Workshop: The community is invited to design a work plan relevant to their needs. Practical simulations are applied to ensure readiness for implementation.

4. Program Implementation. Field Assistance: Facilitators provide technical support and direct supervision during program implementation. Periodic Monitoring: Conducted to measure program progress and identify obstacles in the field.

5. Evaluation. FGD Evaluation: The community and the mentoring team assess the program's success based on the established indicators. Report Preparation: The final report contains the evaluation results, findings, and recommendations for the program's sustainability.

Evaluation

Triangulation is a data validation technique involving multiple data sources, methods, or perspectives to ensure the validity of research results. Patton (1999) explains that triangulation can increase data credibility by minimizing bias that may arise from a single source or method. Member checking is a process in which researchers go back to participants to ensure that interpretations of the data are consistent with their experiences or views. Lincoln & Guba (1985) cite member checking as one of the most reliable ways to increase data validity in qualitative research.

Peer debriefing is a technique in which researchers discuss with colleagues to review findings, methods, and data interpretation. This technique aims to identify bias or weaknesses in the research. Creswell & Miller (2000) emphasize that peer debriefing is an important tool to ensure that researchers remain objective throughout the research process. Braun and Clarke (2006) explain that thematic analysis is a flexible method that allows researchers to explore in-depth data to find relevant meanings. Chambers (1997) emphasized that participatory analysis enables communities to identify and understand their issues and contribute to formulating solutions. Miles and Huberman (1994) explain that comparative analysis compares data from various sources and methods. This technique refers to an approach that emphasizes the importance of "systematic comparison" to identify consistencies and contradictions in the data. Goodchild (2007) stated that geospatial data allows for a better understanding of the spatial distribution of resources and community needs. Riessman (2008) explains that narrative analysis effectively explores the deeper meaning of participants' stories. Creswell (2014) emphasized the importance of statistical analysis in mixed methods research to provide a more objective basis.

The program evaluation technique is carried out through various complementary techniques, such as triangulation, member checking, peer debriefing, audit trail, and contextual validation. This approach ensures that the data collected is valid, reliable, and relevant to the needs of the Battembat Village community. These techniques reflect the main principles of PAR, namely collaboration, inclusivity, and contextual relevance, which support the transformation of

village governance based on digital systems. Data validation is a critical step in research to ensure the accuracy, validity, and reliability of the data obtained. In this study, which uses the Participatory Action Research (PAR) approach, data validation becomes more complex because it involves the active participation of various elements of the Battembat Village community. Validation techniques are designed to ensure that the data collected reflects the real conditions of the village and can be used to support the transformation of governance based on digital systems.

Results and Discussion

The community empowerment program through the development of the Digital Database System (DDS) involves a series of systematically designed action stages. Each stage, starting from the initial Focus Group Discussion (FGD), designing the DDS, Technical Guidance (TG), workshops, to FGD evaluation, has a unique dynamic and contributes directly to creating change at the community level. The following is a detailed description of the dynamics at each stage.

Identifying Needs and Potential

Figure 3. Initial Group Discussion Forum

Researchers immersed themselves in the community to observe governance practices and the use of existing data systems. This method provided contextual insights into daily operations and challenges (Spradley, 1980). To understand their governance and data management perspectives, semi-structured interviews were conducted with key informants, including village officials, community leaders, and residents. This technique enabled gathering nuanced and detailed information (Kvale, 1996). FGDs brought together diverse stakeholders to discuss their expectations, concerns, and suggestions regarding the DDS. This technique fostered collaborative problem-solving and highlighted shared priorities (Krueger & Casey, 2015). Structured surveys were used to gather quantitative data on stakeholder awareness, attitudes, and readiness for digital transformation. The surveys provided a broad overview of community needs and capacities (Creswell, 2014).

The initial FGDs are an important platform for listening to community voices (see Figure 3). At this stage, community leaders, village officials, and citizen groups gather to: Identify Problems: Discussions are directed at uncovering key issues, such as limited data access or low digital literacy. Explore Potential: Communities are invited to identify local resources supporting DDS implementation. Build Consensus: All parties are invited to agree on program objectives and priorities to be achieved. Orientation to Change: Opening up an inclusive dialogue space so

communities feel ownership of the program. Initiating a change in mindset by introducing the importance of digital data in governance. Regarding sustainability, integrating DDS with participatory monitoring created a loop of continuous feedback, where community members actively updated or corrected their own household data. This participatory updating process not only maintained data relevance but also reinforced a sense of ownership among residents.

Designing DDS: Integrating Requirements with Technology

The introduction of DDS has fundamentally improved data management and decision-making processes in Battembat Village (see Figure 4). Local authorities can access accurate, updated, and comprehensive information by integrating geospatial, social, and sectoral data into a centralized platform. These improvements have streamlined resource allocation, enhanced planning accuracy, and reduced delays in addressing community needs (Goodchild & Janelle, 2010). Furthermore, the DDS promotes transparency and accountability by providing stakeholders access to information on village governance activities (Carver & Fritz, 2008).

Figure 4. DDS design

This stage involves collaboration between technology developers, village officials, and academics to: Design the System: Adapt DDS features to local needs, such as population data management, infrastructure, and village potential. Accommodate Input: Design the system based on input from the initial FGD, so the results are relevant to community conditions. Initial Simulation: Test the system prototype to ensure technical feasibility. Orientation to Change: Build awareness of the importance of technology-based solutions. Strengthen the ability of village officials to understand complex digital systems.

Technical Guidance (TG): Improving Technical Capacity

Figure 5. Technical guidance of DDS

TG is a technical training platform to ensure all stakeholders have adequate skills (see Figure 5). Activities include: Intensive Training: Participants are taught how to operate DDS, such as entering data, accessing digital maps, and generating reports. Direct Practice: Simulations of system use are conducted to improve technical understanding. Problem Solving: Participants are given case studies to solve governance problems using DDS. Change Orientation: Transforming technical limitations into capacity-building opportunities and increasing the confidence of village officials and communities in using technology.

Workshop: Designing Implementation Strategy

Figure 6. Workshop

The DDS has demonstrated potential for long-term sustainability due to its design and capacity-building efforts. Workshops and training sessions equipped local stakeholders with the skills to operate and maintain the system independently. Additionally, the participatory approach ensured that the DDS aligns with the community's priorities, increasing its acceptance and usage (Creswell, 2014). The system has also opened pathways for data-driven economic activities, such as identifying entrepreneurial opportunities based on local resources and market demands (Krueger & Casey, 2015).

The workshop aims to integrate technical training with operational planning (see Figure 6). Activities include: Developing a Work Plan: The community and the facilitator design an implementation strategy, including division of tasks and an implementation schedule. Interactive Discussion: Participants discuss potential challenges and seek solutions together. Multistakeholder Collaboration: Residents, village officials, and academics collaborate to ensure the inclusive implementation plan. Change Orientation: Opening opportunities for the community to actively participate in planning and decision-making. Encouraging social transformation by emphasizing collective responsibility.

Forum Group Discussion (FGD) Evaluation: Reflection and Improvement

The evaluation FGD is a reflection forum to assess the program's success and identify areas for improvement. Activities include: Providing Feedback: Participants provide views on the effectiveness of DDS in supporting governance. Measuring Impact: Discussions focus on the

extent to which the program has resulted in changes in community life. Developing Recommendations: The community and the support team formulate improvement steps for the program's sustainability. Orientation to Change: Establishing a culture of continuous evaluation at the community level and increasing community ownership of the program through active involvement in evaluation.

The process of implementing the DDS-based empowerment program in Battembat Village, which includes initial FGD, DDS design, TG, workshops, and evaluation FGDs, shows progressive dynamics and is oriented towards change. Each stage is designed to change Mindsets, from traditional methods to technology-based management. Increase Community Capacity: From minimal digital literacy to more technically skilled. Encourage Independence: From dependence on facilitators to sustainable independent management. With an inclusive and structured approach, this program provides technical solutions and creates profound social transformation in the community.

Active involvement of the community throughout the DDS development process was a critical success factor. The PAR framework facilitated engagement at every stage, from identifying data needs to system implementation. This approach empowered residents to contribute their knowledge and insights, fostering a sense of ownership and responsibility (Reason & Bradbury, 2001). Community members reported increased awareness of the importance of digital data and its applications in governance and development (Spradley, 1980).

Village Potential and Challenges

Despite its success, the DDS implementation faced challenges, including limited technical infrastructure and initial resistance to adopting new technologies. Addressing these barriers required targeted interventions, such as upgrading hardware and conducting regular stakeholder consultations. Continued support from local and regional authorities is necessary to sustain the system's effectiveness and scalability (Carver & Fritz, 2008). Battembat Village has great potential for village governance transformation through education, infrastructure development, and community training. However, to achieve optimal results, the village needs to ensure a balance between these three sectors. Sustainability strategies and increasing digital literacy must be a priority to overcome existing challenges, so that the implementation of the digital database system can run effectively and sustainably. This information can be visualized through the following diagram.

Resource Allocation in SPDD Project
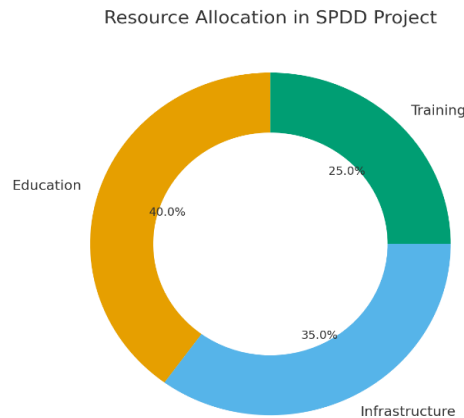
Figure 7. Resource Allocation

Figure 7 shows that the resource allocation in the Battembat Village Digital Database System (DDS) project is divided into three main categories: training (25%), Infrastructure (35%), and Education (40%). Figure 8 shows the impact of the Digital Database System (DDS) on various sectors in Battembat Village, here is an analysis of the potential and challenges based on impact scores in three main sectors: Governance, Economic Impact, and Education.
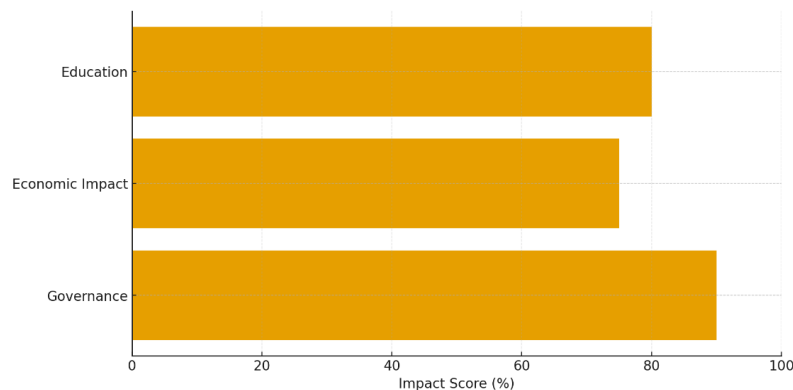
Figure 8. Impact of DDS

Improved Governance (90%). With the most significant impact on the governance sector, Battembat Village has great potential to improve transparency, accountability, and efficiency in village management. The implementation of DDS supports data-based decision making, budget monitoring, and better activity reporting. Potential: The village can be a model for technology-based governance for other villages, improving the image and trust of the community towards the village government. Education Development (80%). Significant impacts on the education sector indicate that DDS has succeeded in improving access to information, education program planning, and resource distribution. Digital technology can also support digital literacy programs in the community. Potential: Improving the quality of education can create a more competent generation ready to face global challenges. Economic Impact Improvement (70%) of DDS improves the local economy through resource optimization, data-driven planning, and identifying economic opportunities. This improvement opens opportunities for developing small businesses, managing tourism potential, or empowering community-based economies. Potential: Villages can create new jobs by integrating technology with local economic activities.
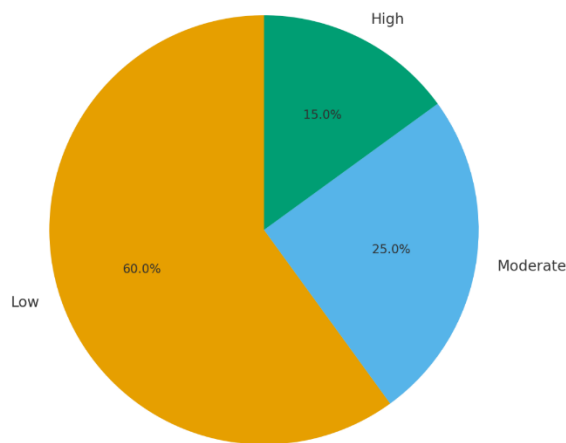
Figure 9. Internet Access Level

The pie chart in Figure 9 shows the internet access level in Battembat Village (60% low, 25% medium, and 15% high). The diagram in Figure 10 shows the expected progress of implementing DDS (Digital Database System) in Battembat Village for 6 months, with a steady increase reaching 100% in the sixth month.
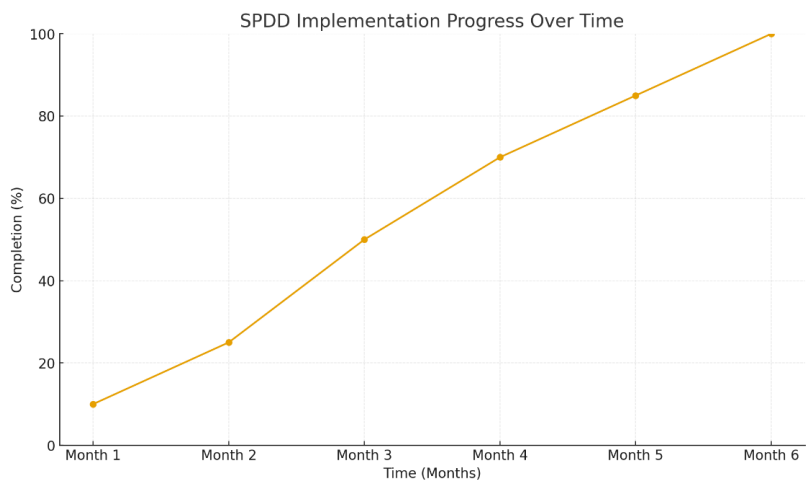

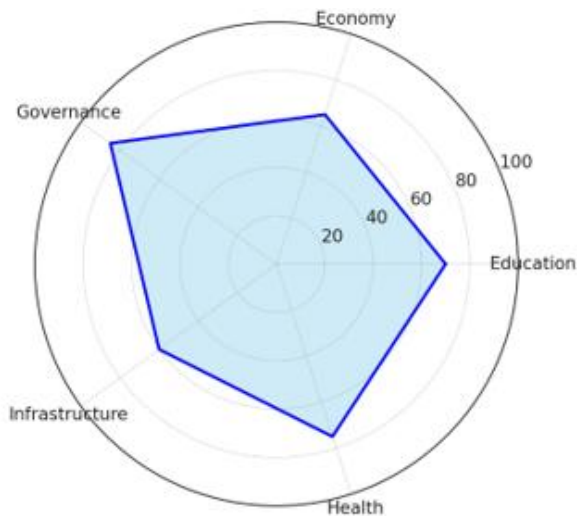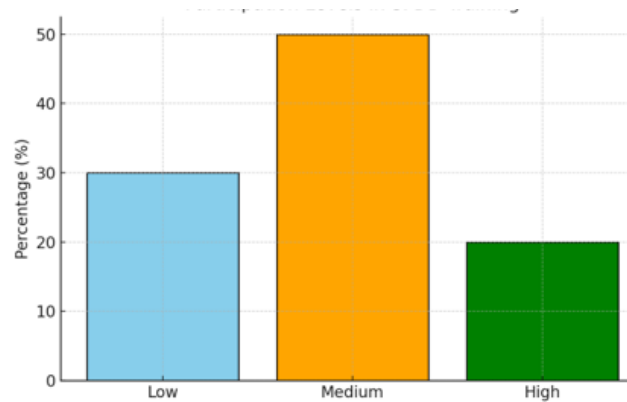
**Figure 10.** DDS Implementation Expectations

Figure 11. Sectoral Strength in DDS

The radar diagram in Figure 11 shows the sectoral strengths in implementing DDS (Digital Database System) in Battembat Village, covering five main sectors: Governance, Economy, Education, Health, and Infrastructure.

Figure 12. DDS Training Participation Level

Figure 12 shows the level of participation in DDS (Digital Database System) training in Battembat Village. The participants were divided into three categories: Low (30%), Medium (50%), and High (20%).
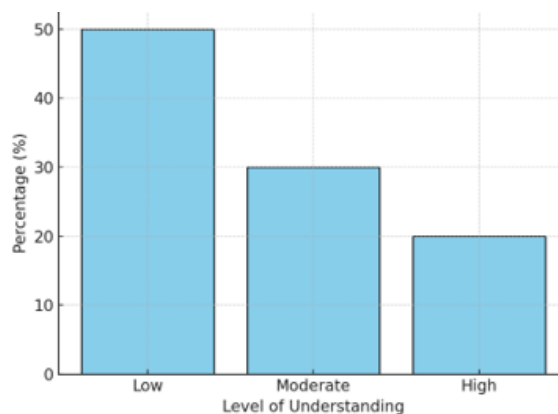
Figure 13. Level of Understanding of DDS Participants

The diagram shows that Battembat Village has great potential to improve community digital literacy through DDS training. However, the main challenge is to increase the involvement of groups with low participation and ensure sustainability for groups with medium participation. With an inclusive strategy and a focus on reducing inequality, the village can strengthen community involvement, which ultimately supports the success of DDS implementation.

Based on Figure 13 and the explanation provided, the low participation rate (50%) in DDS (Digital Database System) training in Battembat Village likely results from several key interrelated factors. Here is a deeper analysis of why certain groups have low participation: Many community members, particularly older adults or those in remote hamlets, may have limited exposure to digital technology. A lack of prior experience with devices such as smartphones, computers, or the internet can create fear or resistance toward participating in DDS-related training. According to the diagram, these individuals fall into the "low" category, indicating a need for more foundational support before engaging with DDS platforms.

Similar studies highlight that low digital engagement in rural communities often stems from limited literacy, socio-cultural constraints, and inadequate outreach. For example, Mtega et al. (2012) found that rural ICT initiatives in Tanzania failed due to a lack of skills and awareness, emphasizing the need for tailored community-based training. The use of DDS as a digital database system in village governance in Battembat aligns with the e-governance transformation phenomenon applied in other contexts (Chen et al., 2024), highlighting the importance of local ICT platforms in strengthening village digital governance. The Participatory Action Research-based approach emphasizes community empowerment, in line with the digital empowerment model in West Javanese villages (Jatnika et al., 2024). Determinants of successful implementation—such as digital literacy and infrastructure—are also found in studies of digital village development in China (Cao et al., 2023), while multi-stakeholder collaboration (government-local-private sector collaboration) is identified as key to digital village development in Karanganyar. Furthermore, digital technology in the agricultural sector presents similar opportunities for developing DDS-based village entrepreneurship (Choruma et al., 2024).

Conclusion

The study results showed that participants' understanding of the Digital Database System (DDS) was initially relatively low, especially among village communities who were not yet familiar with digital technology. In-depth interviews and surveys revealed that village officials understood the function of DDS better than the general public, who still viewed this technology as complicated and irrelevant to daily activities. Through initial socialization and focus group discussions (FGDs), participants' knowledge began to increase, especially after the direct benefits of DDS were explained, such as increased transparency, administrative efficiency, and access to public information. The strategies used included technical guidance, workshops, and simulations of system use, and visually-based educational materials, effectively clarifying the concept and objectives of DDS to various groups.

Based on the results of implementing the Digital Database System (DDS) through the Participatory Action Research (PAR) approach in Battembat Village, several recommendations for follow-up can ensure sustainable changes under expectations. These recommendations focus on strengthening the results achieved, addressing identified challenges, and expanding the program's benefits for the community. To strengthen the impact, future actions should include scheduled follow-up training, user manual development, and a mentorship network among trained villages. Additionally, forming a regional task force to assist neighboring villages in replicating DDS could foster wider adoption and ensure long-term sustainability of the digital governance system.

Acknowledgement

References

Badan Informasi Geospasial. (2022). Peta Administrasi Kabupaten Cirebon. Jakarta: BIG.

Badan Pusat Statistik Kabupaten Cirebon. (2020). *Statistik Kecamatan Tengah Tani 2020*. Cirebon: BPS Kabupaten Cirebon.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77-101.

Carver, S., & Fritz, S. (Eds.). (2008). *Geospatial Methods for Rural Development*. Routledge.

Cao, X., Yan, M., & Wen, J. (2023). Exploring the level and influencing factors of digital village development in China: insights and recommendations. *Sustainability*, *15*(13), 10423.

Chambers, R. (1997). Whose Reality Counts? Putting the First Last. Intermediate Technology Publications

Chen, Y., & Ye, Q. (2024). The impact of digital governance on the health of rural residents: the mediating role of governance efficiency and access to information. *Frontiers in Public Health*, *12*, 1419629. doi:10.3389/fpubh.2024.1419629.

Choruma, D. J., Dirwai, T. L., Mutenje, M. J., Mustafa, M., Chimonyo, V. G. P., Jacobs-Mata, I., & Mabhaudhi, T. (2024). Digitalisation in agriculture: A scoping review of technologies in practice, challenges, and opportunities for smallholder farmers in sub-saharan africa. *Journal of agriculture and food research*, *18*, 101286.

Connolly, T. M., & Begg, C. E. (2015). Database Systems: A Practical Approach to Design, Implementation, and Management (6th ed.). Pearson, hlm. 6, 15, 20.

Creswell, J. W. (2014). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. SAGE Publications.

Creswell, J. W., & Miller, D. L. (2000). Determining validity in qualitative inquiry. Theory Into Practice, 39(3), 124-130.

Elmasri, R., & Navathe, S. B. (2016). Fundamentals of Database Systems (7th ed.). Pearson, hlm. 4, 12, 18.

Fina, A. (2018). Determinants of Sustainability of Village Information System in The Perspective of Social Technology. Jurnal Sistem Informasi Bisnis, 1(2), 77-86.

Goodchild, M. F. (2007). Citizens as Sensors: The World of Volunteered Geography. GeoJournal.

Goodchild, M. F., & Janelle, D. G. (Eds.). (2010). *Spatially Integrated Social Science*. Oxford University Press.

Grindle, M. S. (2004). Good Enough Governance: Poverty Reduction and Reform in Developing Countries. Governance: An International Journal of Policy, Administration, and Institutions, 17(4)

Heeks, R. (2002). Information Systems and Developing Countries: Failure, Success, and Local Improvisations. The Information Society, 18(2)

Jatnika, D. C., Burhanudin, M., Santoso, M. B., & Septiyanti, S. P. (2024). Empowerment Theory and Digital Village: Insights from West Java's Digital Village Programme. *The Journal of Indonesia Sustainable Development Planning*, *5*(3), 227-245.

Kooiman, J. (2003). Governing as Governance. SAGE Publications.

Kroenke, D. M., & Auer, D. (2014). Database Concepts (7th ed.). Pearson, hlm. 3, 21.

Krueger, R. A., & Casey, M. A. (2015). Focus Groups: A Practical Guide for Applied Research. SAGE Publications.

Kvale, S. (1996). InterViews: An Introduction to Qualitative Research Interviewing. SAGE Publications.

Laudon, K. C., & Laudon, J. P. (2020). Management Information Systems: Managing the Digital Firm. Pearson Education

Miles, M. B., & Huberman, A. M. (1994). Qualitative Data Analysis: An Expanded Sourcebook (2nd ed.). Thousand Oaks, CA: Sage Publications.

Mtega, W. P., Dulle, F. W., Malekani, A. W., & Chailla, W. A. (2012). The usage of information and communication technologies in rural areas of Tanzania: A case of Kilosa district. *International Journal of Information and Communication Technology Research*, *2*(2), 117–123.

Patton, M.Q. (1999). Enhancing the Quality and Credibility of Qualitative Analysis. Health Services Research, 34(5 Pt 2), 1189-1208.

Raharja, S. J., & Wardhani, D. P. (2020). The Importance of Stakeholders' Participation in Decision Making Process of Spatial Data Infrastructure (SDI) in Indonesia. In 2020 7th International Conference on Information Technology, Computer and Electrical Engineering (ICITACEE) (pp. 1-6). IEEE.

Reason, P., & Bradbury, H. (Eds.). (2001). *Handbook of Action Research: Participative Inquiry and Practice*. SAGE Publications.

Spradley, J. P. (1980). Participant Observation. Holt, Rinehart and Winston.

UNDP. (1997). Governance for Sustainable Human Development. United Nations Development Programme.