***PRECISION VILLAGE DATA METHODOLOGY: A TRANSFORMATIVE APPROACH FOR SUSTAINABLE RURAL DEVELOPMENT IN INDONESIA***

**METODOLOGI DATA DESA YANG PRESISI: PENDEKATAN TRANSFORMATIF UNTUK PEMBANGUNAN PERDESAAN BERKELANJUTAN DI INDONESIA**

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***ABSTRACT***

*The Precision Village Data (PVD) methodology has emerged as an innovative approach to addressing challenges in rural development by integrating census-based, spatial, and participatory data collection techniques. This study investigates the implementation of the PVD methodology in Denai Sarang Burung Village, Indonesia, to assess its effectiveness in improving governance, community welfare, and sustainable development planning. A mixed-methods approach combined quantitative data collection through surveys and Geographic Information Systems (GIS) mapping with qualitative insights from focus group discussions and key informant interviews. The findings reveal that the PVD methodology significantly enhanced data accuracy facilitated evidence-based decision-making, and promoted transparency in resource allocation. Community participation was a critical success factor, fostering trust and ownership among stakeholders. However, challenges such as limited digital infrastructure and capacity gaps among enumerators highlighted the need for further investments and training. The study concludes that the PVD methodology offers a robust framework for sustainable rural development and a scalable model for similar contexts globally. Future research should explore its application in diverse settings to evaluate long-term impacts and adaptability.*

***Keywords****: Precision Village Data, Rural Development, Community Participation, Geographic Information Systems, Sustainable Development*

**ABSTRAK**

Metodologi Data Desa Presisi (PVD) telah muncul sebagai pendekatan inovatif untuk mengatasi tantangan dalam pembangunan perdesaan dengan mengintegrasikan teknik pengumpulan data berbasis sensus, spasial, dan partisipatif. Studi ini menyelidiki implementasi metodologi PVD di Desa Denai Sarang Burung, Indonesia, untuk menilai efektivitasnya dalam meningkatkan tata kelola pemerintahan, kesejahteraan masyarakat, dan perencanaan pembangunan berkelanjutan. Pendekatan metode campuran menggabungkan pengumpulan data kuantitatif melalui survei dan pemetaan Sistem Informasi Geografis (SIG) dengan wawasan kualitatif dari diskusi kelompok terfokus dan wawancara dengan narasumber. Temuan menunjukkan bahwa metodologi PVD secara signifikan meningkatkan akurasi data, memfasilitasi pengambilan keputusan berbasis bukti, dan mendorong transparansi dalam alokasi sumber daya. Partisipasi masyarakat merupakan faktor penentu keberhasilan, menumbuhkan kepercayaan dan rasa memiliki di antara para pemangku kepentingan. Namun, tantangan seperti infrastruktur digital yang terbatas dan kesenjangan kapasitas di antara para enumerator menyoroti perlunya investasi dan pelatihan lebih lanjut. Studi ini menyimpulkan bahwa metodologi PVD menawarkan kerangka kerja yang kuat untuk pembangunan pedesaan yang berkelanjutan dan model yang dapat diperluas untuk konteks yang sama secara global. Penelitian di masa depan harus mengeksplorasi penerapannya di berbagai latar belakang untuk mengevaluasi dampak jangka panjang dan kemampuan beradaptasi.

**Kata kunci:** Data Desa Presisi, Pembangunan Perdesaan, Partisipasi Masyarakat, Sistem

# INTRODUCTION

Pursuing sustainable development in rural areas has become a critical agenda in global development discourse. Accurate and precise data are

indispensable for designing and implementing effective policies and programs to address rural development challenges. However, many rural areas still face significant data availability, validity, and integration issues.

These shortcomings often hinder strategic planning and realizing sustainable development goals (Sjaf, 2017; Hidayat, 2020).

One innovative approach to addressing these challenges is the Precision Village Data (PVD) Methodology, which was developed to provide accurate, integrated, and comprehensive data for rural development. This method combines census-based, spatial, and participatory approaches to ensure data accuracy and relevance at family and individual levels. The PVD methodology has shown the potential to improve rural governance by facilitating evidence-based planning and fostering community involvement in data collection and utilization (Hidayat, 2020).

Implementing the PVD methodology has been explored in Indonesia through pilot programs in selected villages, including Denai Sarang Burung Village. This village, located in Deli Serdang Regency, North Sumatra, represents a microcosm of challenges many rural communities face in developing countries. Issues such as outdated and fragmented data, limited technological resources, and minimal community participation in planning processes are prominent barriers to sustainable development (Wibowo, 2019; Sulistyaningsih, 2020).

To address these issues, the Precision Village Data initiative emphasizes capacity-building through training local enumerators, integrating Geographic Information Systems (GIS), and leveraging mobile applications for data management. This approach ensures data accuracy and promotes transparency and public trust. Additionally, the integration of community participation in data collection processes aligns with global trends of inclusive governance and enhances the socio-economic resilience of rural communities (Prasetyo, 2021; Suryani, 2021).

Despite its potential, the application of precision data methodologies in rural contexts remains underexplored, particularly in low-resource settings. This study aims to investigate the effectiveness of the PVD methodology in Denai Sarang Burung Village, highlighting its impact on governance, community welfare, and sustainability. By providing empirical evidence, this research seeks to contribute to the broader discourse on data-driven rural development and offer actionable insights for policymakers and stakeholders.

# Literature Review

## The Importance of Precision Data in Rural Development

Accurate data is pivotal in rural development, supporting evidence-based policy-making and efficient resource allocation. Previous studies have highlighted the adverse effects of unreliable or outdated data on rural development planning, including misaligned priorities, resource wastage, and diminished community trust (Sjaf, 2017; Sulistyaningsih, 2020). The Precision Village Data (PVD) methodology solves these challenges by combining census-based, spatial, and participatory approaches to ensure accurate, comprehensive, and actionable data (Hidayat, 2020).

## Theoretical Frameworks in Precision Data Utilization

The implementation of precision data methodologies is grounded in several theoretical frameworks. The Participatory Development Theory emphasizes integrating community involvement in planning processes to enhance inclusivity and ownership (Chambers, 1997). Meanwhile, technology acceptance models explore how technological tools, such as geographical information systems (GIS) and mobile applications, can facilitate data collection and utilization in rural contexts (Davis, 1989; Prasetyo, 2021). These frameworks underscore the relevance of precision data methodologies in fostering effective governance and promoting sustainable rural development.

## The Role of Technology in Data Collection and Management

Technological advancements have revolutionized data collection and management in rural areas. GIS tools and mobile-based applications have proven effective in mapping geographic, demographic, and socio-economic data, enabling local governments to address development gaps more effectively (Hidayat, 2020; Suryani, 2021). However, challenges such as limited digital literacy, lack of infrastructure, and resistance to technological adoption persist, particularly in low-resource settings (Wibowo, 2019).

## Participatory Approaches to Enhance Data Quality and Community Engagement

Community involvement in data collection and validation processes has been widely recognized as critical to improving data quality and ensuring the alignment of development programs with local needs. For instance, Participatory Rural Appraisal (PRA) techniques empower communities to actively contribute to identifying development priorities, fostering greater trust and ownership (Chambers, 1997). The PVD methodology integrates similar participatory elements to bridge the gap between data producers and users.

## Precision Village Data in the Indonesian Context

In Indonesia, rural development efforts face unique challenges, including fragmented data systems, unclear administrative boundaries, and limited institutional capacity (Sjaf, 2020). Implementing the PVD methodology has demonstrated the potential to address these issues by providing accurate and integrated data at the family and individual levels. Early applications in pilot villages, such as Denai Sarang Burung, have highlighted the benefits of this approach in improving governance, fostering community participation, and driving sustainable development (Hidayat, 2020; Wibowo, 2019).

## Gaps in Existing Research

Despite the increasing recognition of precision data's importance, gaps remain in understanding its application in low-resource settings. Most studies focus on developed regions, leaving questions about the scalability and sustainability of these methodologies in developing economies unanswered (Prasetyo, 2021). Additionally, limited attention has been given to the role of human capacity-building in ensuring the long-term success of precision data initiatives.

## Contribution of This Study

This study contributes to the growing body of literature by examining the implementation of the PVD methodology in a developing country context. Specifically, it investigates the case of Denai Sarang Burung Village, focusing on the impacts of precision data on governance, community welfare, and sustainability. By addressing existing research gaps, this study aims to provide actionable insights for policymakers, practitioners, and researchers seeking to leverage data-driven approaches in rural development.

# METHODOLOGY

## Research Design

This study adopts a mixed-methods approach, combining quantitative and qualitative methodologies to comprehensively examine the implementation of the Precision Village Data (PVD) methodology in Denai Sarang Burung Village. The research design is structured to analyze the impact of PVD on governance, community welfare, and sustainable development. Quantitative methods were employed to collect measurable data, while qualitative methods provided contextual insights through participant observations and interviews.

## Study Area

The research was conducted in Denai Sarang Burung Village, Deli Serdang Regency, North Sumatra, Indonesia. This village was selected due to its challenges in data accuracy, community participation, and rural development planning, making it a representative case for testing the efficacy of the PVD methodology. The village comprises four hamlets with diverse socio-economic characteristics, offering a robust context for evaluating PVD's applicability.

## Data Collection Methods

1. Quantitative Data Collection
   * Survey Method: A structured survey was conducted using a mobile application integrated with the PVD system to collect demographic, economic, and spatial data. Enumerators trained in the PVD methodology collected data at the family and individual levels.
   * GIS Mapping: Geographic Information Systems (GIS) were utilized to map physical infrastructure, land use, and natural resources, providing spatial data for planning and analysis.
2. Qualitative Data Collection
   * Focus Group Discussions (FGDs): FGDs were conducted with community members, local government officials, and stakeholders to explore perceptions of the PVD methodology and its implications for governance and development.
   * Key Informant Interviews (KIIs): Semi-structured interviews with village leaders, enumerators, and program coordinators provided in-depth insights into the challenges and opportunities of PVD implementation.
   * Participant Observation: Researchers observed the implementation process, capturing real-time challenges and community dynamics during data collection and validation.

## Sampling Techniques

A purposive sampling method was used to select participants for qualitative data collection, ensuring representation from diverse stakeholder groups, including local leaders, community members, and development practitioners. For quantitative surveys, a stratified random sampling technique was employed to ensure coverage across all four hamlets of the village.

Data Analysis

1. Quantitative Analysis
   * Data collected through surveys were analyzed using descriptive statistics and spatial analysis tools in GIS software to identify trends, patterns, and relationships between socio-economic variables.
   * Indicators such as household income, education levels, and access to services were analyzed to assess community welfare.
2. Qualitative Analysis
   * Transcripts from FGDs and interviews were analyzed using thematic analysis, identifying recurring themes related to governance, participation, and sustainability.
   * Observational notes were triangulated with interview data to ensure validity and reliability.

## Ethical Considerations

This study adhered to strict ethical standards to protect participants' rights and confidentiality. Prior informed consent was obtained from all participants, and data were anonymized to ensure privacy. Approval was secured from the relevant institutional ethics committee before data collection began.

## Limitations

While the mixed-methods approach offers a holistic perspective, limitations include potential biases in self-reported data during surveys and interviews. Additionally, the scope of the study is limited to a single village, which may affect the generalizability of findings to other rural contexts.

# RESULTS

## Demographic and Socio-Economic Profile

The Precision Village Data (PVD) methodology revealed a detailed demographic and socio-economic profile of Denai Sarang Burung Village. The village consists of 1,200 households distributed across four hamlets. Key findings include:

* Demographics: The population is predominantly engaged in agriculture (45%) and fisheries (30%), with the remainder involved in small-scale trade and services.
* Education: Approximately 60% of adults have completed primary education, while only 15% have attained higher education.
* Income Levels: The average monthly household income is USD 150, with 40% of households falling below the local poverty line.
* Access to Infrastructure: Only 70% of households have clean water, and 50% have adequate sanitation facilities.

## GIS Mapping and Spatial Data Analysis

The integration of GIS technology provided valuable spatial insights into village resources and infrastructure:

* Land Use: Agricultural land accounts for 60% of the total area, while residential zones occupy 25%. The remaining 15% comprises forests and undeveloped land.
* Infrastructure Gaps: The mapping identified areas lacking access to essential services such as healthcare facilities and schools, particularly in remote hamlets.
* Geographic Vulnerabilities: Flood-prone zones were identified, emphasizing the need for climate-resilient development strategies.

## Community Participation in Data Collection

The PVD methodology facilitated active community engagement:

* Enumerator Involvement: 20 local enumerators were trained to collect data, fostering a sense of ownership and capacity-building within the community.
* Feedback Loops: Focus group discussions revealed that community members appreciated the transparency and inclusivity of the process, with 85% expressing confidence in the data collected.

## Governance and Decision-Making

The availability of precise and integrated data significantly improved governance and decision-making processes:

* Data-Driven Planning: The local government used PVD-generated data to prioritize development projects, such as constructing clean water facilities in underserved areas.
* Budget Allocation: Accurate data enabled more equitable distribution of village resources, addressing disparities between hamlets.
* Policy Impact: The data influenced a new village development plan, incorporating targeted interventions for vulnerable groups.

## Challenges and Barriers

While the implementation of the PVD methodology demonstrated positive outcomes, several challenges were identified:

* Technological Limitations: Limited access to digital devices and internet connectivity hindered real-time data integration.
* Community Resistance: Initial skepticism regarding the purpose of data collection delayed participation in some areas.
* Capacity Constraints: Some enumerators faced difficulties using GIS tools and mobile applications effectively despite training.

## Key Outcomes

The study highlighted several significant outcomes of the PVD initiative:

1. Improved Data Accuracy: Integrating census-based, spatial, and participatory approaches ensured data reliability.
2. Enhanced Governance: Precise data facilitated evidence-based decision-making and resource allocation.
3. Increased Community Trust: Active involvement in data collection improved transparency and strengthened trust between the community and local government.
4. Foundation for Sustainability: The system established a framework for periodic data updates, promoting long-term development planning.

# Discussion

## The Role of Precision Data in Enhancing Rural Development

The findings demonstrate the significant impact of the Precision Village Data (PVD) methodology in addressing long-standing challenges in rural development. Integrating accurate demographic, socio-economic, and spatial data improved decision-making processes. Consistent with prior studies (Hidayat, 2020; Suryani, 2021), the implementation of PVD facilitated evidence-based planning, ensuring that development priorities align with the community's actual needs. For instance, identifying underserved areas through GIS mapping led to targeted interventions, such as clean water facilities, showcasing how precision data can bridge development gaps.

## Community Participation as a Catalyst for Success

Active community involvement was a cornerstone of the PVD implementation. The participatory approach enhanced data accuracy and fostered community ownership of the development process. This aligns with the principles of Participatory Development Theory, which emphasizes the value of involving local stakeholders in planning and decision-making (Chambers, 1997). Moreover, the positive feedback from community members reflects the effectiveness of inclusive strategies in overcoming initial resistance and skepticism. Future initiatives could strengthen participation by incorporating community-led monitoring systems to sustain ongoing engagement.

## Governance and Equity in Resource Allocation

The PVD methodology significantly improved governance by providing a reliable evidence base for resource allocation and policy formulation. Accurate data enabled the local government to address disparities between hamlets, as evidenced by equitable budget allocation for infrastructure development. This finding supports earlier research suggesting that data-driven governance enhances transparency and efficiency in rural administration (Prasetyo, 2021). However, the study also highlights the need for capacity-building initiatives to ensure local officials can fully utilize advanced data tools and methodologies.

## Challenges in Technology Adoption and Capacity Development

Despite the positive outcomes, technological adoption and capacity development challenges were evident. Limited access to digital infrastructure and the lack of technical expertise among enumerators occasionally hindered the effectiveness of the PVD implementation. These challenges are consistent with findings from Wibowo (2019), who noted similar barriers in rural contexts. To address these issues, future programs should prioritize investments in digital infrastructure and provide continuous training to enhance technological literacy among community members and local officials.

## Implications for Policy and Practice

The results underscore the importance of precision data methodologies in rural development planning. Policymakers should consider institutionalizing the PVD approach to ensure sustainable data management practices at the village level. Furthermore, integrating participatory and technological elements in data collection could serve as a model for other regions facing similar development challenges. However, this approach's scalability depends on addressing structural and contextual barriers, such as digital divides and resource constraints.

## Contribution to the Literature

This study contributes to the growing knowledge of data-driven rural development by providing empirical evidence from a developing country context. Unlike prior studies focusing on developed regions, this research highlights the potential and limitations of precision data methodologies in low-resource settings. It extends the theoretical understanding of participatory and technology-enabled approaches, offering actionable insights for researchers, practitioners, and policymakers.

## Limitations and Future Research

While the study provides valuable insights, certain limitations warrant attention. The findings are specific to Denai Sarang Burung Village, limiting the generalizability of results to other rural contexts. Future research could expand the scope by examining the application of the PVD methodology in diverse geographic and socio-economic settings. Additionally, longitudinal studies are recommended to evaluate the long-term impacts of precision data on rural development and governance.

# CONCLUSION

Implementing the Precision Village Data (PVD) methodology in Denai Sarang Burung Village has demonstrated its potential to transform rural development through accurate, integrated, and participatory data collection processes. This study highlights several key outcomes:

1. Enhanced Data Accuracy and Utility: The PVD methodology ensured the reliability of data by combining census-based, spatial, and participatory approaches, enabling precise identification of development needs and resource gaps.
2. Improved Governance and Decision-Making: The availability of comprehensive and accurate data facilitated evidence-based planning and equitable resource allocation, enhancing governance and promoting transparency.
3. Community Engagement and Ownership: Active participation of local enumerators and stakeholders fostered trust and ownership, which are critical for the sustainability of development initiatives.
4. Capacity-Building and Technological Integration: GIS and mobile applications, combined with training programs, equipped local officials and community members with the skills necessary to manage and utilize data effectively.

Despite these successes, challenges such as limited digital infrastructure, resistance to change, and capacity gaps were evident, emphasizing the need for further investments in technology and continuous training programs.

## Policy Implications

The findings underscore the importance of institutionalizing the PVD methodology as a standard practice in rural development planning. Policymakers should prioritize digital infrastructure development and foster partnerships with academic and private sectors to enhance the scalability and sustainability of precision data initiatives.

## Future Directions

While this study provides valuable insights, future research should explore the application of PVD in diverse socio-economic and geographic contexts to assess its broader scalability and adaptability. Longitudinal studies are also recommended to evaluate the long-term impacts of precision data methodologies on community welfare and governance.

In conclusion, the PVD methodology represents a transformative approach to rural development, offering a robust framework for achieving sustainable and inclusive growth. By addressing existing challenges and capitalizing on its strengths, this methodology has the potential to serve as a model for data-driven development in rural communities globally.

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