**The Role of Village Information System (SID) in Accelerating Rural Development: Empirical Evidence from Kota Kualasimpang Subdistrict, Aceh Tamiang, Indonesia**

**Abstract**

Digital transformation through Village Information Systems (Sistem Informasi Desa, or SID) has emerged as a pivotal strategic policy in recent decades. This study explores the influence of the SID in accelerating rural development by examining the contributions of three supporting factors: human resources, infrastructure, and IT services. The study was carried out in Kota Kualasimpang Subdistrict, Aceh Tamiang, Indonesia, utilising a quantitative research approach. A total of 99 respondents from five villages participated in the study, selected using an accidental sampling method. Data were collected through structured questionnaires and analysed using descriptive statistics, validity and reliability testing, classical assumption testing, and multiple linear regression. The findings indicate that human resources, infrastructure, and IT services each have a statistically significant and positive effect on the acceleration of rural development. Among these, IT services exert the strongest influence, emphasising the importance of technological readiness in village administration. The results underscore the critical role of digital governance infrastructure in promoting development in rural areas, especially in regions with special autonomy like Aceh. This research offers empirical insights into the optimisation of SID implementation and its potential as a strategic tool for sustainable village advancement.

**Keywords:** Aceh Tamiang, Human Resources, Infrastructure, Rural Development, SID

1. **Introduction**

Indonesia continues to face considerable challenges in achieving equitable and sustainable rural development. Key constraints include underdeveloped infrastructure and inadequate human capital, particularly in regions with special autonomy status such as Aceh Tamiang. In response, digital transformation through Village Information Systems (Sistem Informasi Desa, or SID) has emerged as a pivotal strategic policy in recent decades (Kurniawati, 2025; Sihotang, 2023).

Globally, the adoption of information and communication technologies (ICT) has demonstrated a positive impact on rural development. A large-scale quantitative study in China showed that "digital village construction significantly enhances rural revitalisation" by promoting resource aggregation, organisational growth, and market integration (Wang, 2023; Deng, 2024).

The Village Law gives the village authority in managing village and rural development, so development planning must be supported by quality information as a reference. The data produced by SID is managed by villages and can be accessed by villagers and stakeholders in the implementation of rural development (Wahda, 2020; Antlöv et al., 2016).

However, the success of SID implementation is not solely dependent on infrastructure; it also hinges on the competence of local human resources. Research in Indonesia has confirmed that ICT development indices are significantly correlated with regional Human Development Index (HDI) scores, emphasising the importance of digital literacy and human capital in rural ICT governance (Sari, 2024).

Moreover, ICT systems have proven instrumental in enhancing local governance. Effective internal control systems and the application of digital platforms have contributed to improved accountability and performance in village administrations, thereby promoting good governance practices (Boufounou, 2024).

The role of IT services—ranging from training and equipment maintenance to technical assistance—is also critical. Yet empirical studies quantifying the direct impact of IT services on rural development outcomes remain scarce, especially in the Aceh context, where digital adoption is constrained by institutional and infrastructural disparities. (Roza D.F, 2025)

Aceh’s unique sociopolitical structure requires a localised approach to SID implementation. Research on smart village initiatives in Indonesia indicates that ICT strategies must align with the specific cultural and sectoral characteristics of rural areas, including agriculture, tourism, and coastal livelihoods (Sangnak, 2025).

From the perspective of digital governance theory, increasing public participation through SID platforms may foster greater trust in local government institutions. Studies from China have shown that digital governance not only improves health behaviours in rural communities but also builds political trust through enhanced transparency and accessible public information (Tolbert, 2006; Wang J, 2025). However, to achieve citizens’ participation in rural development, the major task is not only resides on the role of the central and local governments, nor solely on the ability of local residents, but also involve other social agencies such as the role of NGO (Non-Government Organizations) and other agencies such as Corporate Social Responsibility (Pamungkas, 2018).

Despite its potential, SID implementation still faces obstacles such as low digital literacy, inadequate infrastructure, and high operational costs. Existing literature highlights that the primary barriers to digital village success often stem from infrastructure deficits and insufficient digital awareness among rural populations(Tahmasebi, 2023).

Research into digital village construction in China further emphasises the importance of embedding such initiatives within broader national innovation systems. Effective SID deployment requires coordinated efforts across national, provincial, district, and village levels to foster an enabling digital ecosystem (Bapennas, 2019).

Against this backdrop, this study aims to empirically assess the extent to which human resources, infrastructure, and IT services influence the acceleration of rural development via SID implementation in Kota Kualasimpang, Aceh Tamiang. By focusing on a region with unique administrative characteristics, this research contributes novel insights to the growing body of literature on digital governance and rural transformation in decentralised and autonomous contexts.

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1. **Methodology**

**2.1 Research Approach and Design**

This study employed a quantitative explanatory research design to assess the impact of supporting factors—human resources, infrastructure, and IT services—on the acceleration of rural development through the implementation of the Village Information System (SID). The aim was to test causal relationships among the variables using empirical data and statistical modelling. A cross-sectional survey was conducted to capture perceptions from respondents at a single point in time, aligning with the goal of understanding current implementation outcomes of SID in rural governance.

**2.2 Population and Sample**

The target population comprised 5,804 heads of households (HHs) across five SID-implementing villages in the Kota Kualasimpang Subdistrict, Aceh Tamiang Regency. The sample size was calculated using Slovin’s formula with a 10% margin of error, resulting in 99 respondents. A proportional stratified sampling method was applied to ensure village-level representation. Within each stratum, accidental (convenience) sampling was used, targeting respondents who had awareness of SID operations or had interacted with SID services. The final distribution included households from Desa Kota Kualasimpang, Desa Kota Lintang, Desa Perdamaian, Desa Sriwijaya, and Desa Bukit Tempurung..

**2.3 Data Collection**

Primary data were gathered using structured self-administered questionnaires consisting of closed-ended items on a five-point Likert scale. The questionnaire was distributed through direct visits to each village. To ensure contextual relevance, items were developed based on literature reviews and aligned with indicators from existing SID performance assessments. Secondary data were obtained from institutional records such as BPS, Bappeda, the Village Office, and academic references, providing context on population demographics, SID infrastructure, and governance.

**2.4 Operational Definitions and Variables**

The study involved **one dependent variable** and **three independent variables**:

* **Dependent Variable (Y)**: *Acceleration of Rural Development* – operationalized through indicators such as improved public services, infrastructure expansion, and community empowerment initiatives.
* **Independent Variables**:
	+ - $X\_{1}$ **– Human Resources**: The readiness, competency, and distribution of SID-related personnel.
		- $x\_{2} $**– Infrastructure**: Availability and condition of physical and digital infrastructure supporting SID operations.
		- $x\_{3}$ **– IT Services**: Quality and availability of digital tools, internet connectivity, and technical support.

All variables were measured using indicators adapted from validated scales in rural development and e-governance literature.

**2.5 Validity and Reliability Testing**

A pilot study involving 30 respondents was conducted to assess instrument quality. Content validity was confirmed via expert review. Construct validity was tested using Pearson correlation coefficients, where all items exceeded the critical r-value of 0.361, confirming validity. Reliability testing using Cronbach’s Alpha yielded values above 0.70 for all variables: Human Resources (0.808), Infrastructure (0.700), IT Services (0.732), and Rural Development (0.808), indicating strong internal consistency.

**2.6 Data Analysis**

Data were analysed using **SPSS version 24**. The analysis involved:

* **Descriptive statistics** to summarise respondent profiles.
* **Assumption tests**, including:
	+ **Normality** (Kolmogorov–Smirnov test)
	+ **Linearity** (ANOVA for deviation from linearity)
	+ **Multicollinearity** (Tolerance and Variance Inflation Factor [VIF])
	+ **Heteroskedasticity** (Scatterplot examination)
* **Inferential analysis** through **multiple linear regression** to assess both individual (t-test) and collective (F-test) effects of independent variables on the dependent variable.
* The regression model used was:

Y=a+β1​$X\_{1}$​+β2​$x\_{2}$​+β3​$x\_{3}$​+ε

1. **Results and Discussion**

**3.1.1 Demographic Profile of Respondents**

A total of 99 respondents from five villages in Kota Kualasimpang participated in this study. The sample was distributed proportionally across Desa Kota Kualasimpang (10 respondents), Desa Kota Lintang (37), Desa Perdamaian (12), Desa Sriwijaya (16), and Desa Bukit Tempurung (24). The age distribution indicated that 48.48% were between 31–40 years, followed by 32.32% aged 20–30, and 19.20% aged 41–50.

Table 1: Respondent Characteristics by Age

|  |  |  |
| --- | --- | --- |
| **Criteria** | **Respondents** | **Percentage (%)** |
| 20–30 years | 32 | 32.32% |
| 31–40 years | 48 | 48.48% |
| 41–50 years | 19 | 19.20% |
| **Total** | **99** | **100%** |

Educational attainment among respondents was relatively high. About 44.44% were high school graduates, 38.38% held undergraduate (bachelor’s) degrees, and 6.07% held a master’s degree. This suggests a generally educated sample, conducive to understanding and engaging with digital platforms such as SID.

Table 2: Respondent Characteristics by Education

|  |  |  |
| --- | --- | --- |
| **Criteria** | **Respondents** | **Percentage (%)** |
| Junior High School (SMP) | 11 | 11.11% |
| Senior High School (SMA) | 44 | 44.44% |
| Undergraduate (S1) | 38 | 38.38% |
| Postgraduate (S2) | 6 | 6.07% |
| **Total** | **99** | **100%** |

Occupationally, respondents were predominantly engaged in the informal sector. Entrepreneurs made up the largest group (41.33%), followed by civil servants (29.33%), traders (18.67%), and contract staff (10.67%).

Table 3: Respondent Characteristics by Occupation

|  |  |  |
| --- | --- | --- |
| **Criteria** | **Respondents** | **Percentage (%)** |
| Civil Servants | 29 | 29.33% |
| Contract Staff | 10 | 10.67% |
| Entrepreneurs | 41 | 41.33% |
| Traders | 19 | 18.67% |
| **Total** | **99** | **100%** |

In terms of income, 37.37% of respondents earned between IDR 2–4 million per month, while 33.33% earned between IDR 4–6 million. A smaller group (10.10%) earned less than IDR 2 million, and 19.20% reported monthly earnings exceeding IDR 6 million.

Table 4: Respondent Characteristics by Income

|  |  |  |
| --- | --- | --- |
| **Criteria** | **Respondents** | **Percentage (%)** |
| < IDR 2,000,000 | 10 | 10.10% |
| IDR 2,000,000 – 4,000,000 | 37 | 37.37% |
| IDR 4,000,000 – 6,000,000 | 33 | 33.33% |
| > IDR 6,000,000 | 19 | 19.20% |
| **Total** | **99** | **100%** |

**3.1.2 Descriptive Statistics of Key Variables**

Descriptive statistics were used to analyse perceptions toward each of the study’s variables. Mean scores were generally favourable:

Human Resources ($X\_{1}$): Mean = 3.89

Infrastructure ($x\_{2}$): Mean = 3.94

IT Services ($x\_{3}$): Mean = 4.12

Rural Development Acceleration (Y): Mean = 4.06.

Table 5: Descriptive Statistics of Research Variables

|  |  |  |  |
| --- | --- | --- | --- |
| **Item Number** | **r-count** | **r-table** | **Remarks** |
| **Human Resources (X1)** |  |  |  |
| Human Resources 1.1 | 0.451 | 0.361 | Valid |
| Human Resources 1.2 | 0.730 | 0.361 | Valid |
| Human Resources 1.3 | 0.559 | 0.361 | Valid |
| Human Resources 1.4 | 0.815 | 0.361 | Valid |
| Human Resources 1.5 | 0.878 | 0.361 | Valid |
| Human Resources 1.6 | 0.850 | 0.361 | Valid |
| **Infrastructure (X2)** |  |  |  |
| Infrastructure 2.1 | 0.592 | 0.361 | Valid |
| Infrastructure 2.2 | 0.726 | 0.361 | Valid |
| Infrastructure 2.3 | 0.688 | 0.361 | Valid |
| Infrastructure 2.4 | 0.432 | 0.361 | Valid |
| Infrastructure 2.5 | 0.632 | 0.361 | Valid |
| Infrastructure 2.6 | 0.715 | 0.361 | Valid |
| **IT Services (X3)** |  |  |  |
| IT Services 3.1 | 0.525 | 0.361 | Valid |
| IT Services 3.2 | 0.676 | 0.361 | Valid |
| IT Services 3.3 | 0.667 | 0.361 | Valid |
| IT Services 3.4 | 0.774 | 0.361 | Valid |
| IT Services 3.5 | 0.718 | 0.361 | Valid |
| IT Services 3.6 | 0.596 | 0.361 | Valid |
| **Rural Development (Y)** |  |  |  |
| Rural Development 1.1 | 0.856 | 0.361 | Valid |
| Rural Development 1.2 | 0.797 | 0.361 | Valid |
| Rural Development 1.3 | 0.754 | 0.361 | Valid |
| Rural Development 1.4 | 0.774 | 0.361 | Valid |
| Rural Development 1.5 | 0.812 | 0.361 | Valid |
| Rural Development 1.6 | 0.625 | 0.361 | Valid |

Source: Processed primary data, 2025

The relatively higher mean for IT Services reflects respondents’ appreciation for digital accessibility, including internet availability, SID-related software, and digital service features. Meanwhile, human resource capacity scored slightly lower, indicating a possible need for targeted training to improve staff competencies and digital literacy in SID management.

**3.1.3 Instrument Validity and Reliability**

The research instrument was validated using the Pearson correlation technique. All item correlation coefficients exceeded the minimum threshold (r > 0.361), confirming construct validity. Reliability was tested using Cronbach’s Alpha, and all constructs surpassed the acceptable limit of 0.70:

* Human Resources ($X\_{1}$): α = 0.808
* Infrastructure ($x\_{2}$): α = 0.700
* IT Services ($x\_{3}$): α = 0.732
* Rural Development Acceleration ($Y$): α = 0.808

Table 6: Validity and Reliability Test Results

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable** | **Cronbach's Alpha** | **Reliability Threshold** | **Remarks** |
| Human Resources (X1) | 0.808 | 0.60 | Reliable |
| Infrastructure (X2) | 0.700 | 0.60 | Reliable |
| IT Services (X3) | 0.732 | 0.60 | Reliable |
| Rural Development Acceleration (Y) | 0.808 | 0.60 | Reliable |

These findings demonstrate that the survey instrument was statistically sound and consistent across different dimensions of the SID evaluation framework.

**3.1.4 Classical Assumption Testing**

Several diagnostic tests were conducted to confirm the appropriateness of the multiple regression model:

* Normality: Kolmogorov–Smirnov test yielded a p-value of 0.181, indicating a normal distribution.
* Linearity: ANOVA tests for deviation from linearity showed p-values > 0.05 for all variables.
* Multicollinearity: Tolerance values were all > 0.9 and VIF < 1.05, indicating no collinearity concerns.

Heteroskedasticity: Residual plots revealed no visible patterns or funneling.



Figure 1: Scatterplot for Heteroskedasticity Check

Table 7: Classical Assumption Testing Summary

|  |  |  |  |
| --- | --- | --- | --- |
| **Assumption** | **Test Method** | **Result** | **Conclusion** |
| **Normality** | Kolmogorov–Smirnov Test | Sig. = 0.181 (> 0.05) | Normally distributed |
| **Linearity** | ANOVA – Deviation from Linearity | Sig. > 0.05 for all variables | Linearity assumed |
| **Multicollinearity** | VIF and Tolerance | VIF < 1.05; Tolerance > 0.9 | No multicollinearity |
| **Heteroskedasticity** | Scatterplot Observation | Random distribution; no funnelling pattern | Homoscedasticity assumed |

This confirms that the dataset met the required assumptions for regression analysis, validating the robustness of the inferential findings.

### **3.1.5** Multiple Regression Analysis

The multiple regression model used was:

$$X\_{1} Y=48.038+0.177x\_{1}+0.246x\_{2}+0.407x\_{3} $$

Where:

* $Y$: Acceleration of rural development
* $x\_{1}$: Human resources
* ​$x\_{2}$: Infrastructure
* ​$x\_{3}$: IT services

**Table 8: Coefficient Estimates from Multiple Regression Analysis**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable** | **Unstandardized Coefficient (B)** | **Standardized Coefficient (Beta)** | **t-value** | **Sig. (p-value)** | **Remarks** |
| Constant | 48.038 | – | – | – | – |
| Human Resources (X1) | 0.177 | 0.240 | 2.580 | 0.011 | Significant |
| Infrastructure (X2) | 0.246 | 0.325 | 3.384 | 0.001 | Significant |
| IT Services (X3) | 0.407 | 0.496 | 5.656 | 0.000 | Significant |

All three independent variables exhibited statistically significant, positive coefficients:

* Human Resources (X1): β = 0.177, p = 0.011
* Infrastructure (X2): β = 0.246, p = 0.001
* IT Services (X3): β = 0.407, p = 0.000

The strongest influence was exerted by IT Services, indicating that SID's effectiveness in promoting rural development hinges significantly on technical readiness and access.

.**3.1.6 Hypothesis Testing**

Using partial t-tests and a simultaneous F-test:

* **H1**: Human resources positively influence rural development (t = 2.580; p = 0.011)
* **H2**: Infrastructure positively influences rural development (t = 3.384; p = 0.001)
* **H3**: IT services positively influence rural development (t = 5.656; p = 0.000)

Simultaneously:

F = 15.997; p < 0.001 — indicating joint significance

**Table 9: Hypothesis Testing Summary (t-test and F-test)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Hypothesis** | **Variable** | **Test Type** | **Test Statistic** | **Sig. (p-value)** | **Conclusion** |
| H1 | Human Resources (X1) | t-test | 2.580 | 0.011 | Supported (Significant) |
| H2 | Infrastructure (X2) | t-test | 3.384 | 0.001 | Supported (Significant) |
| H3 | IT Services (X3) | t-test | 5.656 | 0.000 | Supported (Significant) |
| H4 | X1, X2, X3 → Rural Development (Y) | F-test | 15.997 | 0.000 | Supported (Significant) |

These results affirm all hypotheses and show that the presence of skilled personnel, reliable infrastructure, and robust digital support systems is indispensable to accelerating rural transformation.

**3.2 Discussion**

The findings align with global evidence that digital infrastructure and well-trained human capital are essential for successful e-governance implementation. The strong influence of IT Services supports the argument that digital transformation is not merely technological but strategic, enabling more inclusive, transparent, and efficient local governance (Zhang & Guo, 2024).

In the Aceh context, SID serves as more than a database—it is a governance tool that promotes administrative transparency, citizen participation, and planning efficiency. The significance of human resources affirms the relevance of Stewardship Theory, wherein local authorities act as caretakers of public resources. Meanwhile, infrastructure remains foundational, especially for underserved rural areas that depend on basic connectivity for SID integration.

The collective impact of all variables also suggests a systems-thinking perspective: enhancing one domain without the others would not yield optimal outcomes. A balanced approach that simultaneously builds capacity, infrastructure, and digital services is key to rural development acceleration.

1. **CONCLUSION AND RECOMMENDATIONS**

**4.1 CONCLUSION**

This study provides empirical evidence on the role of Village Information Systems (SID) in accelerating rural development, with a specific focus on the Kota Kualasimpang Subdistrict, Aceh Tamiang. Through the analysis of 99 respondents across five villages, the research identified that human resources, infrastructure, and IT services each contribute significantly and positively to the effectiveness of SID in promoting local development.

Among the three predictors, IT services demonstrated the strongest influence, suggesting that digital platforms, internet access, and technological readiness are critical enablers of successful village governance. This underscores the strategic nature of digitalisation in rural contexts—not merely as a support function, but as a driver of administrative transparency, service efficiency, and community empowerment.

Human resources were also shown to play a significant role, aligning with Stewardship Theory, where village officials are seen as trusted custodians of public resources and data. Meanwhile, infrastructure—though often overlooked—remains foundational, as it enables the operationalisation of digital systems and ensures equitable service delivery across rural areas.

Overall, the findings reinforce that SID is most effective when supported by a synergistic combination of competent personnel, reliable infrastructure, and responsive IT services. These components must be developed in tandem to realise the full potential of digital governance in rural development.

**4.2 RECOMMENDATIONS**

The findings of this study highlight several strategic directions for improving the implementation and effectiveness of the Village Information System (SID) in accelerating rural development. First, it is crucial to enhance the capacity of human resources involved in SID operations. Regular and targeted training programs should be institutionalised to strengthen digital literacy, data management competencies, and system maintenance capabilities among village officials and SID administrators. These efforts would ensure not only the technical operation of the system but also its sustainable integration into local governance routines.

Equally important is the expansion and modernisation of infrastructure to support SID functionality. Many rural areas still lack the necessary technological and physical infrastructure—such as high-speed internet, computers, and uninterrupted electricity supply—hindering the full utilisation of digital platforms. Investment in these areas, particularly in regions with lower connectivity, is essential for closing the digital divide and enabling equitable access to information and services.

The role of IT services also warrants further optimisation. This includes improving the responsiveness of technical support, ensuring user-friendly interface design for SID applications, and conducting regular system audits to detect and resolve performance bottlenecks. Establishing clear feedback mechanisms between users and developers can contribute to more adaptive and community-centred service delivery.

Moreover, fostering active community engagement is vital for enhancing the social legitimacy and utilisation of SID. Awareness campaigns and participatory planning activities can cultivate a sense of ownership among residents, thereby increasing transparency and accountability in local governance processes. SID should not be perceived merely as an administrative tool, but as a participatory platform that bridges citizens and the state.

Lastly, the implementation of SID should be embedded within a coordinated multi-level governance framework. Effective collaboration between village administrations, subdistrict officials, and regional authorities is required to ensure resource integration, policy coherence, and infrastructure interoperability. Such institutional support will help anchor SID within broader rural development agendas and ensure its continued evolution in line with technological and policy advancements.

Ethical Approval And Consent

All participants provided informed verbal consent prior to participation. The study ensured anonymity, confidentiality, and voluntary participation. No personally identifiable information was collected. The research adhered to ethical standards consistent with the Declaration of Helsinki and local academic research protocols. Approval was obtained from the relevant village authorities before data collection commenced.

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