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The Impact of Implementing Satellite-Based BTS in Indonesia's 3T Regions on Digital Access and Community Social Life

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Abstract

The construction of satellite-based Base Transceiver Stations (BTSs) in Indonesia's frontier, outermost, and disadvantaged (3T; *terdepan, terluar, dan tertinggal*) regions represents one of the government's key strategies for expanding internet connectivity. This study aims to analyze the impacts of satellite-based BTS implementation on education, the economy, public services, and social change. The study employed a qualitative case study approach using interviews, observations, and document analysis. The findings indicate that the deployment of satellite-based BTSs has had positive impacts, including improved access to digital education, healthcare services, communication, and online business opportunities. However, several challenges were also identified, including limited digital literacy, the spread of misinformation (hoaxes), increasing dependence on the internet, and changes in patterns of community social interaction. The findings demonstrate that the success of satellite-based BTS deployment in 3T regions depends not only on the availability of digital infrastructure but also on communities' readiness to use technology responsibly and effectively. The study further suggests that sustainable digital transformation in 3T regions requires simultaneous investment in digital literacy programs alongside physical infrastructure. Without such complementary initiatives, improved connectivity may inadvertently amplify social vulnerabilities, including exposure to misinformation and digital fraud, thereby widening rather than narrowing the digital divide. These findings underscore the need for policymakers to integrate community-based digital literacy initiatives, multi-stakeholder collaboration, and adaptive regulatory frameworks into Universal Service Obligation (USO) strategies to ensure that infrastructure investments produce equitable, inclusive, and resilient development outcomes.

INTRODUCTION

Digital transformation has become a central component of Indonesia's national development agenda (Apnitami & Wibisono, 2023). The government has continued to expand internet access to 3T (*terdepan, terluar, dan tertinggal*; frontier, outermost, and disadvantaged) regions, which have historically experienced limited telecommunications services because of challenging geographical conditions. One of

the primary strategies has been the deployment of satellite-based Base Transceiver Stations (BTSs).

The introduction of satellite-based BTSs has brought significant changes to communities in remote villages (Kagai et al., 2024, 2025). Internet access is no longer used solely for communication but also supports education, healthcare, economic transactions, and public administration (Farhatin, 2024). At the same time, several new challenges have emerged, including the spread of misinformation (hoaxes), limited digital literacy, and changes in community social interaction resulting from increased use of digital media.

Currently, the primary challenge in digital development extends beyond achieving equitable network coverage to ensuring that communities can use the internet productively, effectively, and safely (Van Dijk, 2020). Although many previously underserved areas now have internet access, improvements in connectivity have not always been accompanied by corresponding gains in digital literacy. Consequently, internet use is often concentrated on entertainment rather than educational, economic, or community development activities.

Although the government has made substantial progress in deploying satellite-based BTSs throughout 3T regions, existing academic research has focused predominantly on infrastructure development and technical performance. Comparatively little attention has been given to understanding how communities incorporate this new connectivity into their everyday social and economic lives (Faisal & Lestari, 2026). This has created a knowledge gap between the availability of digital infrastructure and the realization of its intended developmental benefits.

Research on digital transformation in Indonesia's 3T regions has expanded considerably over the past decade; however, important gaps remain. Existing studies can generally be grouped into three broad streams. The first stream has focused on policy frameworks and the technical implementation of the Universal Service Obligation (USO) program and BTS infrastructure development. Apnitami and Wibisono (2023) evaluated the effectiveness of USO-funded BTS projects by examining project completion rates, technical performance, and geographic coverage, while Muthoharoh (2024) analyzed government policies for digital infrastructure development and identified bureaucratic coordination and budget allocation as key determinants of program success. Faisal and Lestari (2026) documented inequalities in digital learning access in 3T regions following the COVID-19 pandemic, emphasizing that infrastructure provision alone does not ensure educational equity. Although valuable, these studies primarily emphasize the supply side of digital connectivity, including infrastructure deployment, technical performance, and policy implementation, rather than community-level adoption and outcomes.

The second stream has examined digital literacy and the quality of internet use among Indonesian communities. Van Dijk (2020) proposed a comprehensive framework for understanding the multidimensional nature of the digital divide, UNESCO (2021) conducted comparative studies of digital literacy interventions in

remote communities worldwide, and Badan Aksesibilitas Telekomunikasi dan Informasi (BAKTI Kominfo, 2023) has published annual digital literacy indices showing that 3T regions consistently score below the national average despite improvements in internet connectivity. However, much of this research has been conducted at the macro level using large-scale survey data, limiting its ability to capture the nuanced, context-specific ways in which communities adopt, adapt to, or resist new digital technologies.

The third, more recent stream has explored the social and cultural impacts of internet adoption in rural and remote communities. Castells (2010) theorized the broader societal transformations associated with network societies, while McLuhan's (1964) foundational work and Rogers' (2003) Diffusion of Innovations theory provided conceptual frameworks for understanding how communication technologies reshape social interaction and diffuse through communities. Several ethnographic studies conducted in Indonesia have also documented changing social dynamics in newly connected villages, including shifts in intergenerational relationships, community authority structures, and aspirations toward urban lifestyles (Selwyn, 2004; Livingstone & Helsper, 2007). Nevertheless, most of these studies have examined communities served by terrestrial mobile networks or fiber-optic infrastructure, leaving satellite-dependent 3T regions—with their distinctive characteristics, including higher latency, lower bandwidth, and weather-sensitive signal quality—relatively underexplored.

This study addresses that gap by integrating an infrastructure perspective with a qualitative, community-centered approach. The novelty of the study lies in its examination of both the enabling effects of satellite-based BTS deployment across four interconnected domains—education, the economy, public services, and social interaction—and the emerging risks associated with rapid internet adoption in communities with limited previous exposure to digital technologies.

This study aims to analyze the positive impacts of satellite-based BTS implementation in 3T regions, identify the social and digital challenges that have emerged following the introduction of internet access, and examine the factors influencing the effective use of satellite-based BTSs by local communities. The study contributes theoretically by extending the second-level digital divide framework to satellite-dependent rural communities. Methodologically, it applies a multi-actor qualitative case study approach within resource-constrained environments. Practically, it provides evidence to support policymakers in integrating digital literacy initiatives, community-based monitoring, and context-sensitive connectivity strategies adapted to the technical characteristics of satellite networks. In addition, the study contributes socially by amplifying the perspectives of communities that are often underrepresented in national digital policy discussions.

METHOD

The research uses a qualitative method with a case study approach in one of the 3T areas in Indonesia which has using satellite BTS (Creswell, 2018).

Research Location and Context

The research was conducted in a village-level community located within a designated 3T area that had received a satellite-based BTS installation under the government's universal service obligation program. To protect the confidentiality of respondents, the exact name and coordinates of the site are withheld, consistent with standard practice for community-based qualitative research; the site is instead described through the general characteristics summarized in Table 1.

Table 1. General Profile of the Research Site

Characteristic	Description
Regional classification	Frontier, outermost, and disadvantaged (3T) village
Primary livelihoods	Small-scale agriculture, fishing, and local trade
Pre-BTS connectivity	Little to no reliable mobile signal; occasional access via distant towns
Satellite BTS status	Operational for more than one year at the time of data collection
Public facilities with internet access	Village office, primary school, community health post (Puskesmas Pembantu)
Approximate household internet penetration	Rapidly increasing since BTS activation, though still uneven across households

Source: Field observation and village administrative records, 2024

Participants

Participants were selected using purposive sampling to capture a range of perspectives on how satellite BTS has affected different segments of community life. A total of 42 individuals took part in the study through in-depth interviews, supplemented by informal group discussions and field observation. Table 2 summarizes the composition of the participant group.

Table 2. Profile of Research Participants (n = 42)

Participant Category	n	Role in the Study
Community members / heads of household	16	Everyday internet use, household economic and social impact
Students and youth	9	Educational use, social media behavior, online learning experience
Teachers and school staff	6	Use of digital learning materials and classroom technology adoption
Village officials	5	Administrative digitalization and public-service delivery
Local business owners / MSME actors	4	Digital marketing, online payment adoption, market access
Health workers	2	Telehealth consultation and health-data transfer practices

Source: Research interview data, 2024

This composition allowed the study to triangulate perspectives across generational, occupational, and institutional lines, which strengthens the credibility of the thematic patterns reported in the Results and Discussion section.

Data Collection Techniques

Data obtained through:

1. Interviews with the community, teachers, village officials, and business actors.
2. Observation of internet use in the community.
3. Documentation of people's digital activities.

Data Analysis Techniques

The data was analyzed using a qualitative descriptive method by grouping the positive impacts and challenges of implementing satellite BTS.

Research Ethics and Informed Consent

All participants were informed of the purpose of the study prior to their involvement and provided verbal informed consent, in keeping with common practice for community-based qualitative research in rural Indonesian settings where formal written consent procedures are often less familiar to participants. Participants were assured that their identities would be kept confidential and that they could decline to answer any question or withdraw from the interview at any time without consequence. No minors were interviewed directly; information about student experiences was gathered through teachers, parents, and observation rather than direct interviews with children.

Trustworthiness of the Data

To enhance the credibility of the findings, the study applied source and method triangulation by cross-checking interview accounts against direct field observation and secondary documentation, such as village administrative records and school activity logs (Creswell, 2018; Moleong, 2019). Member checking was carried out informally by summarizing key findings back to several key informants to confirm that the interpretation accurately reflected their experience. Field notes and interview transcripts were kept as an audit trail to support the dependability of the coding process, following established qualitative research procedures (Sugiyono, 2022).

RESULTS AND DISCUSSION

Improving Access to Education and Information

The results of the study show that the internet helps students and teachers obtain learning materials in a way more easy (Farhatin, 2024). Teachers can access learning videos, while students start using the internet to search for learning references.

However, internet use by students also presents new challenges, such as addiction to social media and online gaming. This suggests that internet access needs to be balanced with digital supervision and education.

Changes in the Community Economy

The presence of satellite BTS opens up new economic opportunities for rural communities. MSMEs are starting to utilize WhatsApp and Facebook to... market local products (Castells, 2010).

Some people have also begun using digital applications for payment transactions and purchasing daily necessities. This helps them better connect with markets outside their local area.

However, there are still obstacles such as:

1. Limited ability to use digital applications.
2. The network quality is not yet stable.
3. The price of smartphone devices is still quite expensive for some people.

Impact on Government and Health Services

The internet helps village governments send administrative reports and communicate with the central government. Public services become more efficient. fast compared to previously (Muthoharoh, 2024).

In the healthcare sector, medical personnel are starting to use the internet for consultations and patient data transfer. This is particularly helpful in areas with limited specialist doctors.

However, some health facilities still experience electricity problems and unstable signal quality during bad weather.

Summary of Positive Impacts across Sectors

The positive changes reported across the education, economic, governance, and health domains described above can be summarized and compared, as shown in Table 4. Across all sectors, respondents consistently associated satellite BTS with faster access to information and a reduced sense of isolation from services and markets outside the village.

Table 3. Summary of Positive Impacts of Satellite BTS by Sector

Sector	Key Change Observed	Illustrative Example
Education	Easier access to learning materials and reference videos for teachers and students	Teachers downloading lesson videos; students searching supplementary references online
Local economy	New digital marketing and payment channels for MSMEs	Use of WhatsApp and Facebook to market local products; adoption of e-wallets
Governance	Faster administrative reporting and communication with higher-level government	Village officials submitting reports online instead of traveling to the district office
Health	Remote consultation and faster transfer of patient data	Health workers consulting specialists via video call for cases beyond local capacity
Social life	Sustained contact with family members living outside the area	Regular video calls and instant messaging with relatives working in other regions

Source: Research interviews and observations, 2024

Figure 1 presents the proportion of respondents who reported a positive change in each domain. Family communication and educational access were the two most frequently cited areas of improvement, while public-service gains, though still substantial, were reported slightly less often, largely due to uneven digital adoption among older village officials.

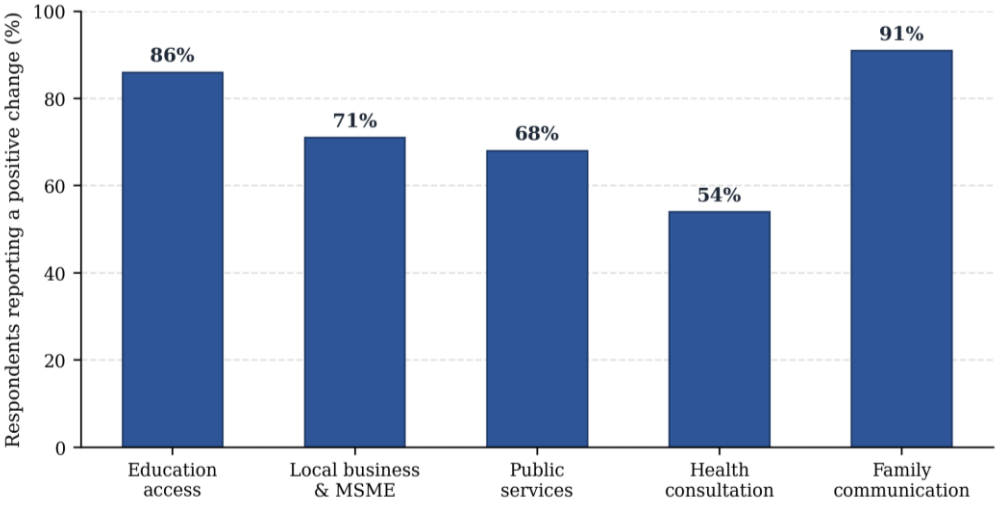

Figure 1. Domains of Positive Impact Reported by Respondents
Source: Research interview data (n = 42), 2024

Challenges of Digital Literacy and the Spread of Hoaxes

One of the biggest problems after the arrival of the internet is the spread of hoaxes via social media and WhatsApp groups (Van Dijk, 2020).

People who don't understand how to verify information often accept and spread news without first verifying it. Furthermore, cases of online fraud and illegal loans targeting rural communities have begun to emerge.

This problem shows that digital infrastructure development must be accompanied by a sustainable digital literacy program.

Summary of Digital and Social Challenges

The challenges described above are not evenly distributed across the population; younger, more educated respondents were generally more able to identify and avoid hoaxes and scams, whereas older respondents and those with limited formal education reported greater difficulty verifying information. Table 4 summarizes the main categories of challenge identified through interview coding, and Figure 2 shows the proportion of respondents who considered each issue significant.

Table 4. Summary of Reported Challenges following Internet Adoption

Challenge	Description	Most Affected Group
Low digital literacy	Difficulty assessing the credibility of online information and using digital services safely	Older residents, first-time internet users
Spread of hoaxes	Unverified news and rumors circulating rapidly through social media and messaging groups	General community, particularly WhatsApp group members
Internet dependency	Excessive time spent on social media and online gaming, especially among students	Students and youth
Unstable network / power	Reduced signal quality during bad weather and periodic power outages affecting BTS operation	Health facilities, schools, remote households
Cost of devices	Smartphones and data packages remain relatively expensive for some households	Lower-income households
Online fraud and illegal loans	Emergence of scams and predatory lending schemes targeting inexperienced users	First-time digital finance users

Source: Research interviews and observations, 2024

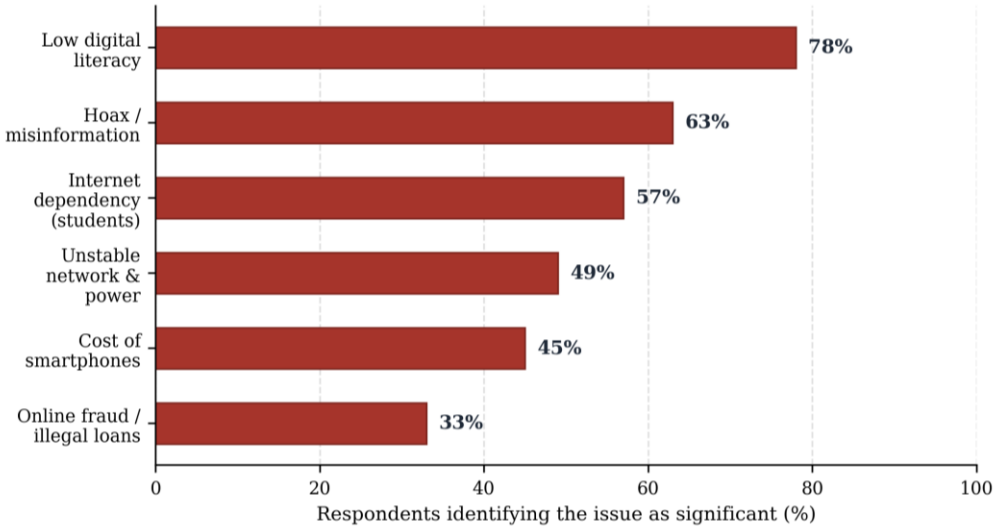

Figure 2. Frequency of Reported Digital and Social Challenges

Source: Research interview data (n = 42), 2024

Social Change in Society

Smartphone use causes changes pattern Community communication (McLuhan, 1964; Rogers, 2003). Face-to-face interactions are starting to decrease because people are using social media more often.

On the other hand, the internet also helps people stay connected with family members living outside the area through video calls and instant messaging applications.

This phenomenon shows that technology has both positive and negative impacts on people's social life.

Comparative Reflection: Alignment with National Digital Literacy Indicators

Indonesia has, in recent years, tracked digital-skills development at the national level through composite digital literacy indices that combine measures of digital ethics, digital culture, digital safety, and digital skills across provinces (International Telecommunication Union [ITU], 2022; BAKTI Kominfo, 2023). Rural and 3T-designated provinces have consistently scored below the national average on these composite indices, even where basic connectivity coverage has improved substantially. The pattern observed at the research site in this study strong gains in access accompanied by comparatively weaker gains in safe and productive use mirrors this broader national trend. This alignment suggests that the site examined here is a useful illustrative case for understanding how national-level digital-literacy gaps manifest concretely at the community level, and it reinforces the argument that literacy-focused interventions deserve at least as much policy attention as continued infrastructure expansion.

Cross-Sector Synthesis and Discussion

Viewed together, the findings across education, economy, governance, health, and social life point to a consistent pattern: satellite BTS functions as a necessary but not sufficient condition for digital transformation in 3T regions. Infrastructure alone expanded the supply of connectivity, but the extent to which that connectivity translated into productive outcomes depended heavily on each domain's pre-existing capacity to absorb and apply digital tools-a pattern consistent with second-level digital-divide theory (Norris, 2001; Selwyn, 2004). This pattern also helps explain why challenges and benefits emerged simultaneously rather than sequentially. Because digital literacy programs were not deployed alongside the BTS installation, the community was exposed to both the productive and the risky affordances of the internet at the same time, without a structured on-ramp for safe and effective use. This is consistent with observations elsewhere that connectivity-first rural development strategies tend to generate a temporary window of vulnerability to misinformation and online fraud before community norms and skills catch up with access (Ng, 2012; UNESCO, 2021).

When compared with national-level digital indicators, the research site's trajectory mirrors a broader pattern observed across Indonesia's 3T regions: rapid growth in basic connectivity metrics, slower growth in digital-skill indicators, and a persistent gap between urban and rural patterns of internet use (ITU, 2022; BAKTI Kominfo, 2023). This suggests that the experience documented in this study is unlikely to be an isolated case, and that similar dynamics are probably unfolding in other recently connected 3T communities.

An additional pattern worth noting is the emergence of modest economic multiplier effects around the BTS site itself. Several respondents described small but tangible spillover activity-such as phone-charging services, informal data-package resale, and a shift in youth aspirations toward digital-related livelihoods-that would not have existed prior to connectivity. While these effects are too small to be captured in national economic statistics, they illustrate that the economic significance of satellite

BTS extends beyond the headline indicators of internet penetration and should be considered when evaluating the program's overall return on investment.

Some issues that are currently of concern in the implementation of satellite BTS in Indonesia include:

Internet Utilization Gap

The government has built numerous base transceiver stations (BTS) in 3T (remote and remote) areas, but their utilization has not been maximized. Many people still use the internet solely for entertainment, rather than for education or productive economic activities.

Low Digital Literacy

Cases of hoaxes, online gambling, and digital fraud are increasing in areas that have recently gained internet access. This poses a major challenge to national digital transformation.

Dependence on Satellite Infrastructure

Regions that rely solely on satellite still face high latency and limited bandwidth. This impacts the quality of internet services, particularly for online learning and video conferencing.

Need for Digital Human Resource Development

The success of digital development is not enough just by building BTS, but also requires training the community to be able to utilize the internet for economic and educational improvement.

Limitations Of The Study

This study has several limitations that should be considered when interpreting the findings. First, as a single-site qualitative case study, the results reflect the specific social and geographic conditions of the research location and cannot be statistically generalized to all 3T regions, although the patterns identified are conceptually transferable to areas with similar characteristics. Second, the percentages presented in Figures 2 and 3 summarize the relative frequency of themes coded from interviews and observations rather than a probability-sampled quantitative survey, and should therefore be read as indicative of pattern strength rather than as population-level statistics. Third, data were collected at a single point in time, more than a year after BTS activation, which means the study captures a post-adoption snapshot rather than the full trajectory of change from initial installation onward. Future longitudinal or multi-site research could address these limitations by tracking outcomes across several 3T communities over an extended period.

CONCLUSION

The implementation of satellite-based Base Transceiver Stations (BTSs) in Indonesia's remote, outermost, and disadvantaged (3T; *terdepan, terluar, dan tertinggal*) regions has had a significant impact on improving internet access, education, economic activities, and public services. Increased internet connectivity has enabled communities to gain greater access to information and participate more actively in the

digital economy. However, the expansion of digital infrastructure has also introduced new challenges, including limited digital literacy, the spread of misinformation (hoaxes), changing patterns of social interaction, and increased exposure to cybercrime. This study concludes that the success of digital transformation in 3T regions depends not only on the deployment of satellite-based BTSs but also on the readiness of local communities, the availability of digital literacy and education programs, and sustained government support to promote productive, safe, and responsible internet use.

Based on these findings, three policy recommendations emerge. First, investments in satellite-based BTS infrastructure should be accompanied from the outset by structured digital literacy programs rather than treating digital literacy as a subsequent intervention. Second, local governments and telecommunications providers should explore complementary connectivity technologies, including lower-latency satellite systems where feasible, for public facilities such as schools and healthcare centers, where reliable connectivity is particularly critical. Third, community-based monitoring mechanisms, such as village-level digital champions, could help sustain safe and productive internet use after external assistance programs conclude. Together, these measures would help ensure that substantial public investments in digital infrastructure generate lasting social and economic benefits for 3T communities. In addition, future monitoring and evaluation of the Universal Service Obligation (USO) program should incorporate community-level indicators of digital literacy and safe internet use alongside traditional measures of network availability and coverage, enabling policymakers to monitor the gap between connectivity and meaningful digital utilization identified in this study over time.

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