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Diffusion of artificial intelligence across Indonesia: Digital disparities, local contexts, and policy implications

Difusi kecerdasan buatan di seluruh Indonesia: Kesenjangan digital, konteks lokal, dan implikasi kebijakan

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Abstract

Digital literacy across the urban–rural divide in Indonesia plays a significant role in the adoption/implementation of AI. This study attempts to investigate the principal factors behind AI introduction within a descriptive qualitative study and collaborative case study design. The current study is qualitative, using semi-structured interviews with 180 informants conducted in 36 communities from eight key islands during the period of October to December 2024. The findings indicate that rural areas lag behind urban areas in terms of infrastructure, digital literacy readiness and perceived technological complexity, whereas urban areas benefit from the vibrant ecosystems, institutional support as well as accumulation of training programs. Any vision for digital transformation should be joined up and include increased infrastructure investment, investment in community based digital literacy programs as well as development of AI applications that are locally relevant and culturally sensitive. These results elaborate on the Diffusion of Innovations Theory as articulated by Rogers, showing how infrastructural and sociocultural contexts interact in the adoption of technology, while also offering new perspectives for policy and practice in contrasting low and middle-income contexts.

Keywords: digital divide; artificial intelligence; technology adoption; digital literacy; inclusive transformation

Abstrak

Literasi digital di seluruh wilayah perkotaan-pedesaan di Indonesia memainkan peran penting dalam adopsi/implementasi AI. Studi ini mencoba menyelidiki faktor-faktor utama di balik pengenalan AI dalam studi kualitatif deskriptif dan desain studi kasus kolaboratif. Studi ini bersifat kualitatif, menggunakan wawancara semi-terstruktur dengan 180 informan yang dilakukan di 36 komunitas dari delapan pulau utama selama periode Oktober hingga Desember 2024. Temuan menunjukkan bahwa wilayah pedesaan tertinggal dibandingkan wilayah perkotaan dalam hal infrastruktur, kesiapan literasi digital, dan persepsi kompleksitas teknologi, sementara wilayah perkotaan diuntungkan oleh ekosistem yang dinamis, dukungan kelembagaan, serta akumulasi program pelatihan. Visi apa pun untuk transformasi digital harus dipadukan dan mencakup peningkatan investasi infrastruktur, investasi dalam program literasi digital berbasis komunitas, serta pengembangan aplikasi AI yang relevan secara lokal dan peka budaya. Hasil ini menguraikan Teori Difusi Inovasi sebagaimana diartikulasikan oleh Rogers, yang menunjukkan bagaimana konteks infrastruktur dan sosiokultural berinteraksi dalam adopsi teknologi, sekaligus menawarkan perspektif baru untuk kebijakan dan praktik dalam konteks berpenghasilan rendah dan menengah yang kontras.

Keywords*: disparitas digital; kecerdasan buatan; adopsi teknologi; literasi digital; transformasi digital*

Introduction

With the advent of the digital transformation age, artificial intelligence (AI) technology has emerged as a leading element that can drive every aspect of life, including economic activity, learning and healthcare (Agarwal et al. 2024, Aldoseri et al. 2024, Da Silva 2024). AI can lead to higher levels of efficiency and productivity (Makridakis 2017, Furman & Seamans 2019, Damioli et al. 2021, Gao & Feng 2023).

However, the use of AI in Indonesia is still overshadowed by the digital divide (Keith 2024). The urban-rural gap covers the discrepancy in AI technology access, as well as its comprehension and application between urban and rural residents (Fu et al. 2024, Ono et al. 2024, Wu & Peng 2024).

Statistics indicate that in 2023, internet penetration will be 77.02% (Utomo & Marianta 2023) but this is unequally distributed. According to the Indonesian Internet Service Providers Association (APJII), urban areas have an access rate up to 95 percent and the rural areas have an access rate that is around 62 percent (Hidayat et al. 2023). This differential creates an initial profile of the digital divide, and it is mirrored in the adoption of AI technology (Robinson et al. 2015). AI is used in a number of areas (AI in telemedicine health services, AI in intelligent transportation systems) (Shen et al. 2021, Fernandes 2022, Ahmed et al. 2023, Katal 2024) but rural communities still encounter restrictions related to the technology infrastructure (Correa & Pavez 2016, Tim et al. 2021, Gómez-Carmona et al. 2023).

The findings from 36 localities spread across the eight major islands of Sumatra, Java, Kalimantan, Sulawesi, Bali, Nusa Tenggara, Maluku, and Papua reveal various levels of AI adoption and digital readiness. For instance, in Jakarta and Bandung, AI technologies have been adopted for smart public administration, traffic management systems, and digital health monitoring. In the meantime, AI is beginning to be used in educational platforms and public service computerization in cities such as Semarang and Tangerang. In rural areas like Tasikmalaya and Toba, AI is largely associated with simple smartphone-based translation apps or weather prediction tools for agriculture, without anyone even knowing they are using AI systems. This usage disparity reveals that the awareness and execution of AI capabilities is not yet uniform.

Other than access, digital literacy is one of the major predictors of the use of AI (Celik 2023). The level of digital literacy in Indonesia as indicated by Digital Literacy Index 2023 is 3.54 out of the maximum result of 5 (five) (Novela et al. 2024). This score is markedly uneven among localities. In cities, they apparently do score better than rural areas who continue to follow tradition. This places a premium on digital literacy to support the broader adoption of AI.

This parity wasn't the case; AI's implementation in the rural developing countryside encountered a lack of corresponding infrastructure and training (Yang & Lou 2024). A study by Ramadhani et al. (2021) and Yanti et al. (2023) discovered that Indonesian rural populations have a suspicious attitude towards new technology because of the low level of technology literacy in the average consciousness (Yanti et al. 2023). Some recent studies such as Omotayo highlight that digital technology, including AI, is beginning to penetrate rural sectors, yet its adoption remains dependent on adequate infrastructure and supportive government policies (Omotayo et al. 2025). However, the successful adoption of technology such as AI still needs a holistic approach including the improvement of the public perception and the establishment of inclusivity in the technology ecosystem (Campion et al. 2022, Pradana et al. 2022).

These findings are consistent with international trends. For instance, Lewis-Smith et al. (2023) in India showed that in rural areas (Ye et al. 2023), the barriers of low digital literacy and a lack of infrastructure (Wejnert 2002) are the sources of low AI technology adoption. Another study by Zhang & Aslan (2021) in China has proven that technology-based learning along with vigorous training can pave the way for AI to be embraced even in peripheral areas (Mustafa et al. 2024). These findings have the power to be a comparison as well as an explanation with regards to what is observed in Indonesia.

Everett Rogers' Diffusion of Innovations Theory's was an appropriate theoretical framework to use to study this phenomenon (Curtis 2020). In this theory, the decision to adopt an innovation (Kurniawan 2024) such as AI is affected by five main factors: relative advantage, compatibility, complexity, triability and observability (Yuen et al. 2021). These five elements differ tremendously along the rural-urban continuum within Indonesia (Pepinsky et al. 2024). The level of relative advantage of AI in terms of efficiency is more likely to be greater within urban areas that already have suitable cost effective AI and ICT infrastructures in place (Guo & Li 2018). The complexity of AI is a significant barrier (Amin et al. 2024) outside of urban areas.

The aim of this paper is to investigate the different determinants of adopting artificial intelligence (AI) based across a range of regions in Indonesia. The key area of investigation addresses the ways that infrastructural access, digital literacy and perceived technological relevance relate to the adoption of AI in particular populations. This research proposes strategic policy suggestions for enabling an inclusive digital transformation where rural residents can benefit from and not be left behind in the national progress of AI-led innovations. As a consensus and due to it being an unresolved issue, the digital divide in AI use needs further theoretical and empirical investigation. This study contributes to the literature as a critical case-based analysis of the phenomenon and the proposed practical implications will be of interest to policymakers and practitioners.

Research Method

This study applied a qualitative design by exploring public perceptions and experiences of artificial intelligence (AI) through a collective case study conducted in several regions and involving a range of Indonesian people. The approach was decided upon due to the vast differences in geography, social conditions and infrastructure across the Indonesian archipelago. As opposed to the sole reliance on a phenomenological filter, employing the case study template here facilitated the comparison and situated interpretation of multiple islands, provinces and village types.

The data was generated by conducting semi-structured interviews with 180 informants in different categories including village bureaucrats, teachers, young people, private entrepreneur and civil servants. Four to six informants based in each city were chosen from each domain, representing dominant local perspectives on the adoption of AI. The field work extended over three months at the end of the year 2024 (October - December), and this allowed us to conduct in-depth interviews, crosscheck the information and observe the local situation. To achieve strong representation, areas were classified into rural versus urban that informed the comparative analysis of AI readiness. Table 1 summarizes all study sites and their classification.

Table 1.
Research location and type of location

Island	Research location & type of location
Sumatra	Biruen (Aceh) (Rural), Toba (North Sumatra) (Rural), Pelalawan (Riau) (Rural), Padang Pariaman (West Sumatra) (Rural), Pesisir Selatan (Rural)
Javanese	Tasikmalaya (West Java) (Rural), Jakarta (Urban), Tangerang (Banten) (Urban), Bandung (Urban), Semarang (Urban)
Kalimantan	Kapuas Hulu (West Kalimantan) (Rural), Hulu Sungai Tengah (South Kalimantan) (Rural), Kutai Kartanegara (East Kalimantan) (Rural)
Sulawesi	Minahasa (North Sulawesi) (Rural), East Bolaang Mongondow (Rural), Boalemo (Gorontalo) (Rural), Pohuwato (Rural)
Bali	Klungkung (Urban)
Nusa Tenggara	Central Lombok (Rural), East Lombok (Rural), West Sumba (Rural)
Maluku	Central Maluku (Rural)
Papua	Jayapura (Rural)

Source: Processed research data

The information was thematically analyzed from an interpretive perspective and was organized in categories that emerged from the repeated occurrences present in the field, linked to Rogers' theory of the Diffusion of Innovations. Themes such as digital access, digital literacy, infrastructure, institutional

support and community perception guided the concepts. These were then mapped to a variety of urban and rural locations to identify the typology of AI adoption gaps, drivers and barriers. This method aims to address both structure (systemic contexts) and agency (local meaning and understanding). It also helped to locate the findings in a picture of understanding involving various levels of why AI uptake is uneven despite the presence of uniform policies and programs.

Results and Discussion

The main finding of this research following the analysis of the 36 sampling sites on eight of the islands in Indonesia is presented in this section. This comparison case study will look at how artificial intelligence (AI) is conceived, interacted with and taken up in distinct regional and social territories, both urban and rural, by using comparative case study research design. Inspired by Roger's Diffusion of Innovations Theory, the content analysis is structured around emergent themes based on semi-structured interviews with 180 respondents.

The conversation should be seen as a representation of the interviewed responses (literally so, as we include some of these) rather than a generic model, helping us to retain sociality and network specificity in the sense of what we propose the shape of the digital divide and the adoption of AI might look like. Each subsection links empirical evidence to the existing literature and theoretical constructs, thus providing concrete application and theoretical elaboration. The ultimate part of this sub-section is devoted to the theoretical contribution of the study, following it with the section's conclusion and policy implications.

Theoretical and literature-based discussion

These empirical findings illustrate that Rogers' Diffusion of Innovations Theory (Rogers 2003) remains applicable in the Indonesian context but with strong local inflections. In urban areas where the digital infrastructure is advanced, the perceived relative advantage of AI is high, particularly in enhancing productivity and service delivery (Rogers 2003, Heeks 2009). As observed in Jakarta and Bandung, AI is smoothly integrated into public services and education, demonstrating clear observability as a key driver of technology diffusion.

In contrast, rural regions such as those in Kalimantan, Maluku, and Nusa Tenggara illustrate how compatibility and trialability become major barriers. In these areas, digital tools often do not align with local customs, workflows, or technological expectations, leading to perceptions of irrelevance (Sein et al. 2019). This gap is not only technological but also institutional and cultural, where the lack of sustained training, local facilitators, and culturally adapted tools continues to hinder adoption (Septiandri et al. 2025), leads to complexity and resistance to adoption (Walsham 2017, Achruh et al. 2024). Drawing on Toyama, we can assert that technology does not scale solutions; it scales intent and capacity (Toyama 2011). In Indonesia's rural zones where institutional capacity is uneven and the policy agenda is centralized, AI struggles to make inroads despite national-level efforts. This reinforces the idea that geographic centrality and institutional trust act as mediators in technology uptake (Septiandri et al. 2025).

The digital divide we're observing here is not just a result of accessibility or infrastructure. It is a product of social meaning, perceived utility, and cultural framing around what AI stands for. These perspectives invite also a recontextualized approach to the diffusion of innovation, as per Sieber et al. (2024), and one that focuses on the symbolic and relational dimensions of digital inclusion in the Global South (Sieber et al. 2024).

The digital divide in urban and rural areas of Indonesia

The digital divide still is one of the biggest hurdles for AI implementation in Indonesia. Even with increasing levels of national focus on speeding up the process of digital transformation, the digital divide between urban and rural is still determining what the use, access, and understanding of technology – including the likes of AI - looks like. Drawing on fieldwork conducted in 36 sites on eight of the main islands, this paper argues that such differences are not only technological but fundamentally geographical, institutional and cultural.

Since the digital infrastructure in the urban areas across the country such as Jakarta, Bandung and Klungkung is quite advanced, AI can be deployed in key sectors such as education, health services and local governance. An informant in Jakarta (Informant NAD, interview, 2024) narrated: "*We have started using Artificial Intelligence (AI) for public service reports in mapping the trends of the complaint. It's a way to prioritize government response more effectively*." A teacher from Bandung (Informant VIK, interview, 2024) also related having this experience: "*Our students have access to language learning and math quizzes with AI supported tools*."

It is different story in the outskirts of Kalimantan, Nusa Tenggara, Maluku and Papua where it is still difficult for people to access the most basic digital connectivity. Two of the pockets that present themselves are the communities lacking internet access, low digital literacy, and no exposure to the institution (schooling) of AI. One such informer from Pesisir Selatan (west Sumatra) stated (Informant SUR, interview, 2024): "*At this place the children are involved in the use of telephone (smartphone) for social media. We haven't heard about AI tools in farming, or in education*."

Such differences emphasize the problem of the relative advantage that an innovation has, if it is seen as better than the one it replaces, according to Rogers. In digitally advanced parts of the world, AI is effectively perceived as convenient and time-saving. But in low-internet-access areas, its worth is reduced or not known, and thus it is not used. There is a big compatibility issue. In spaces where digital tools are already used heavily, AI is simply the next input in a series of practices and habits. In other places like East Sumba or Central Maluku, AI is seen as an entity that does not conform to local practices, work routines, and capacities.

Sprawling geographic balkanization exacerbates these existential fears. For example, residents in Hulu Sungai Tengah (in South Kalimantan) are closer to the provincial capitals but are digitally left behind, due to the mountainous terrain and policy negligence. Jayapura (Papua), which is also classified as urban, tends to have a lack of equitable use and access regarding digital resources. As another informant from Jayapura (Informant MAY, interview, 2024) said: "*We are a city, but we don't receive the same service as Java. Whenever apps work poorly here, the service providers always claim it's the fault of the network*."

To show these regional contrasts, Table 2 provides a picture of the digital readiness of a selection of well-known research settings found in the eight islands of this study.

Table 2.
Regional typology and digital readiness based on field observations

Island	Location	Type	Observed digital readiness	AI usage identified
Java	Jakarta, Bandung, Semarang, Tangerang	Urban	High	Public services, education, retail
Bali	Klungkung	Urban	Medium to High	Administrative, tourism
Sumatra	Pesisir Selatan, Padang Pariaman, Toba	Rural	Low	None
Kalimantan	Kapuas Hulu, Hulu Sungai Tengah	Rural	Very Low	None
Sulawesi	East Bolaang Mongondow, Boalemo	Rural	Low	Minimal awareness only
Nusa Tenggara	East Lombok, East Sumba	Rural	Very Low	Project attempts failed
Maluku	Central Maluku	Rural	Very Low	None
Papua	Jayapura	Rural/Urban	Medium (inconsistent)	Limited use in local government

Source: Processed research data

To put it more simply, the gap in AI use between Indonesia's regions isn't just a matter of the infrastructure. It is instead a question of what technology can and cannot do, and can and cannot fit into. This relates to the social norms, institutional frameworks, and physical infrastructures. A city has the best of both access and alignment but rural areas are left trying to wrestle with the difficulties of the connectivity and compatibility problems. For AI to be a game changer in Indonesian locations, such basic gaps need to be addressed first, through inclusive digital strategies that are sensitive to local readiness, context and demand.

Literacy, learning, and complexity

Digital literacy is not only a technical skill; it is the minimal sociotechnical capacity to access, interpret and make use of technology if it is new, such as Al. The digital literacy level in Indonesia is not balanced, where urban people are more adaptable than rural people. This gap is what is present when we talk about AI diffusion.

The findings in this study suggests that rural end-users cannot even complete elementary digital tasks, meaning that they will discard advanced systems. In East Lombok, for example, a village extension worker remembered (Informant SAM, interview, 2024): "*We also introduced a chatbot to assist farmers in plant pest determination. But they didn't know how to actually open the app. Some thought they needed a password from the government.*" This indicates a state of technological complexity (Rogers 2003) compounded by digital illiteracy. The design and feel of AI applications is difficult for those not used to smartphones, and for those who have never done any formal ICT training. In this sense, AI is not a tool so much as a "mystified machine."

In the meantime, AI has become present in everyday practices in locations like Semarang and Tangerang. A Semarang teacher (Informant AYU, interview, 2024) explained this: "*If Indonesian curriculum can be implemented in full, at the beginning our learning will be good quality. We have AI-based learning apps such Quizziz, Grammarly etc. Students are even experimenting with image generators for art classes.*" It's an example of how exposure (or repetition) leads to recognition and to making something less unusual. Here, AI is no longer an "innovation" but rather de rigueur, a day-to-day practice. This is a textbook case of good normalization.

In Central Maluku or Pohuwato, the availability of AI tools have been introduced through national programs but they are poorly used. As one village leader put it (Informant KUR, interview, 2024):

> "We trained last year, but it was with laptops and internet. One or two people at a time could follow suit, and the rest sat there in bafflement. And there was no one to carry on once the trainer had left." (Informant KUR).

This illustrates a second core DOI concept trialability. Users can also play with AI tools safely without the fear of doing wrong and feeling ashamed by there being a high-literacy proving ground. The lack of support networks and already "*doing it wrong*" mentality in low-literacy settings is what causes the technology to be abandoned before it is properly adopted. There are fears as well, voiced by multiple informants across Kalimantan and Sulawesi, that "*machines might replace jobs*," particularly among older people concerned about their own futures.

This concern is made worse by the low levels of trust in digital information along with inadequate guidance. A religious figure (Informant UST, interview, 2024) in East Bolaang Mongondow stated: *"People here believe in advice from people they trust, not machines. If an app asks them to reorganize how they farm or pray, "they grow suspicious."* This is in line with the semiotic richness of AI, which transcends its technical reality. In close-knit neighborhoods, intelligence is relational (not algorithmic). Digital learning smacks of an impersonal and perhaps inferior alternative, particularly where it contradicts an external body of entitlement or doctrine. A second important discovery is the gender-differentiated aspect of literacy differences. In many villages in West Sumatra and East Nusa Tenggara, women, especially older

women, said they had less confidence in using smartphones, let alone AI. As one informant in West Sumba (Informant ROH, interview, 2024) confessed: *"I call my kids using WhatsApp, but I never use apps. I am afraid to push the wrong button. My husband does all the online stuff."*

Throughout every household, when taken alone or combined with the gendered division of labor, the household dynamics represented in this quotation limit women's exposure to AI and AI skills. Without literacy-increasing strategies that account for gender, there isn't much reason to believe these gaps won't grow. There was also the language barrier. Although most of the AI systems are not limited to any specific language, most of the applications available are presented in English or formal Bahasa Indonesia, and thus are not directed at the local language proficient users of Minangkabau, Bugis, Bima speakers, and other incoming migrants. Failure to communicate can compound perceived complexity and thwart the development of confidence as part of implementing the service.

This is exacerbated by the lack of learning eco-systems in most remote areas. While most city children get a helping hand from friends, YouTube tutorials and tech-savvy teachers, the danger is that the rural students already left behind have none of these, and thus no one to turn to for support when they get stuck. Without learning scaffolds, motivated users find themselves alone in trying. In summary, the AI transfer in Indonesia faces not only infrastructure issues but also profound inequality along the lines of digital literacy, learning support, gendered roles, language, and local epistemology. These complexities are not necessarily something that a technical solution alone can fix. We need a culturally-aware, community-led digital learning solution, which takes into account cultural practices, and incrementally increases adoption potential through low-risk, high-trialability interventions.

Institutional support and local initiatives

Institutions, both formal and informal, are crucial for governing the deployment, use and diffusion of AI in societies. According to Roger's Diffusion of Innovations Theory, innovations diffuse in a "social system," which is the system within which the innovation is diffusing (and) in which change agents or opinion leaders influence the rate and extent of adoption. Here, this relates to the institutional, policy and community approaches for AI adoption and adaptation in Indonesia This research discloses that institutions, policies and communities can have a significant impact as determinant insiders regarding the adoption of AI in Indonesia.

In the cities of Jakarta, Bandung and Klungkung, institutional participation is prominent and structured. In Jakarta, AI adoption has been institutionalized in service delivery through Smart City initiatives. An individual from Jakarta Smart Province (Informant HEN, interview, 2024) said: *"We employ AI to manage traffic flow, tackle citizen complaints and organize public transport schedules. These are strengthened by central government programs and technical support."*

In Klungkung (Bali), the local government is collaborating with a university to trial AI-based rubbish disposal systems. According to an informant:

> "The regency partners with IT students who had created AI models that help to track where the waste is overflowing and when it will be picked up. That makes operations run more efficiently, and it lifts up local talent." (Informant YAS).

These cases highlight that digitally forward-looking municipal governments and cross-sector collaboration might institutionalize the integration of AI, shifting the technology from an ethereal possibility to a concrete necessity. Rural governments, like Hulu Sungai Tengah or east Sumba, barely have the wherewithal let alone regulatory and human capacity to get an AI-based solutions in or to support parts of said solutions. As the village leader of Hulu Sungai Tengah said:

> "We open the forest; we are directly responsible for this. We were told to use a digital reporting system, but had not been trained. ⁋It is sooo slow on the internet, and most staff at the E.P.F. don't even know how to login. We have just gone back to paper." (Informant PAH).

This points to a structural problem top-down digital mandates without sufficiently developed institutional scaffolding just won't work or at least won't stick. Scores of village officials from around Maluku to those on Nusa Tenggara confided that the grievances they were airing were pretty much the same translocal expressions of frustrations when central policies all too often arrived without considering the local reality and capacity development.

Outside the formal world of government, the following spaces including television, local schools, non-governmental organizations and religious communities affect how technology is perceived and put to use. In Minahasa (North Sulawesi), a community-based education center in a church ran an NGO for children through an AI learning tool. One of the program managers (Informant MEL, interview, 2024) said: *"We are educating kids to code educational games with AI. Once the children are comfortable, they teach their parents. It reverses the learning flow."* This is a model that matters and is a fine example of an intergenerational, community-led digital transformation.

But his kind of work is the exception. There aren't enough grassroots efforts in a lot of extremely rural places to keep the rates of experimentation down. This is very similar to the idea of change agents in DOI theory. Where there are champions on the ground as in digitally literate teachers, leaders and youth workers, or NGOs, the curve of diffusion is better. Adoption stagnates in their absence. This was illustrated, for example, in the case of a youth digital facilitator in Central Lombok.

> "When I started training on AI image apps and language tools, kids got excited. But the village head didn't get behind it he disapproved, on the grounds that it was a waste of time. There's only so much you can do without institutional support." (Informant YDF).

Another aspect is policy fragmentation. National AI strategies have emerged but there is little coherence between ministries and central versus local government. The result has been "*project fatigue*" at the community level: a confusion of independent digital initiatives that have emerged only to fizzle out. One informant from East Kalimantan (Informant DWI, interview, 2024) said: "*Every year, new applications emerge, like e-farming, e-village, and e-budgeting. If you don't understand them and learn from users, it's possible, but you won't be able to maintain the system."*

These findings suggest that institutional health, much like infrastructure, contributes to sustainability. Digital transformation is often ad hoc and misguided, and there remains a very real possibility that these initiatives will explode and fail. The extent to which AI can penetrate also depends on how closely an organization's aspirations align with the reality on the ground.

This study also observed that informal social structures, especially those related to religious leaders, traditional elders, and family networks, impact technology acceptance the most. In some villages in Gorontalo and Aceh, people said they asked religious teachers or adat elders for permission or advice when they had to use new tools. This is an iteration of the gatekeeping role in the socio-cultural sense but one that can favor or disfavor the spread of AI depending on how the leadership reacts.

Some promising practices have been undertaken to address this institutional gap. In Toba (North Sumatra), a polytechnic-supported program involving local farmers enabled the use of an AI-based weather forecasting application. Farmers were trained visually and through demonstrations between participants. As one participant in the neighborhood (Informant SIN, interview, 2024) put it: "*At first, we were ignorant about machine learning. But when the machine allowed us to predict rain better than TV, we trusted it. 'Believing is seeing' in the application of a trust-based adoption model*."

These are the drivers and barriers to AI-based adoption as regarded by various organizations, including governments, educational systems, religious institutions, and communities. The issue isn't simply about having books and basic literacy infrastructure in place for the community; it's about what kind

of leadership is needed to make that change happen, who the change agents are, and how to create that support structure. Without institutional support and ongoing development, AI will falter, and its adoption will fail in some areas and be neglected in others.

Perceived relevance and cultural barriers

In addition to access and skills, attitudes toward the relevance and sociocultural fit of AI in Indonesian communities are important when it comes to helping facilitate the adoption of AI. As per the Diffusion of Innovations theory: "*An innovation is more likely to be adopted when it is perceived as compatible with the existing values, past experiences, and needs of potential adopters*." This evidence suggests that in many remote areas, AI is also "*distant*" not in terms of something that is shunned but rather due to the lack of compelling relevance to local issues, practices and ways of knowing.

In Central Maluku, East Kalimantan, and West Sumatra, informants commonly claimed that AI is "*urban technology*," designed for offices or students in large towns. A Toba teacher (Informant YUN, interview, 2024) expressed this as follows: "*These Indigenous schools are based on our own community laws, genealogies and family; the family in connection with the territory. We've heard about AI. But here we are writing about how to get good seeds, steady water and access to markets. Those things are more urgent."* This is a sensible statement about what takes precedence in life. Driven by inadequate infrastructure, economic insecurity, and environmental volatility, AI is itself not readily apparent as a helpful or practical fix.

What's more, a lot of informants have symbolic suspicion, where they think of AI as something to do with Big Brother, a jobless future or faceless, corporate decision-making. An adat elder in East Sumba explained that (Informant GUS, interview, 2024): *"Maybe we are all such clowns. Why does this machine have to tell us that? Will they stop asking us and listen instead to the computer?"* It is a product of cultural resistance that is not as misinformed as we think, responding to a sense that social authority is in decline. In many traditional indigenous and rural communities, knowledge is relational, transmitted from person to person, rather than being an automated logical deduction. So AI raises an ontological question: who makes decisions, not just how are they made?

Gendered assumptions are also at work in terms of how AI is considered relevant. In Boalemo (Gorontalo), the coordinator of a women's group (Informant INA, interview, 2024), said: *"Technology is considered the thing that men use. And when digital farming tools did materialize, it was just the husbands who received training."* This is an example of how static gender frames have excluded women from digital access and knowledge about AI. Coupled with low literacy and mobility, this exclusion only strengthens the notion that 'AI is not for me', particularly for rural women.

Religious framing also matters. In Aceh and areas of West Java, some informants were uncomfortable with voice assistants or AI content. A Bireuen imam said the following (Informant RAZ, interview, 2024): *"The machine actually talks like a human being, and that confuses people. Some of the villagers believe it copies spirits. That needs to be carefully explained."* This mysticism and unnaturalness about AI in cultural terms can result in reluctance or refusal, unless institutionally people are better shielded from an overdetermination of the technology with appropriate contextual social framing.

In other areas of Bandung and Tangerang, AI is perceived as a ubiquitous tool. Students, small business owners, and even online taxi drivers say they rely on AI in their devices for translation, scheduling, or customer responses. This distinction illustrates the subjective nature of relevance as judged by users. AI is accepted when it addresses common concerns: efficiency, education, and convenience. When AI seems abstract or culturally exotic, it is perceived as alienating.

The third trend we noted was the lack of AI interfaces in the local languages, which exacerbates the cultural disconnect. Millions of rural residents, especially the elderly, are already alienated by formal Indonesian interfaces, let alone English-based ones. This language barrier also contributes to the feeling that AI is a

tool "*not made for us*," he said. "*Teachers don't see the district office or the central office, or their payment schedule when they are asked to do better."* (Informant RAN, Interview, 2024). "*We want to get money, but when the government tells us to improve, our assets will be lost. I mean lost in our heritage."* (Informant RAN, interview, 2024) T Alwi said: *We don't know what will happen to our school. Look for short-term negative consequences. If the short-term consequences are very negative, teachers will not comply and transfer their knowledge and skills. If students can ask AI in Manadonese Malay, maybe they will use it more often. But if it can only speak formal Indonesian, they will become nervous or confused."*

These cultural and perceptual factors intersect with a variety of emotional reactions (fear, mistrust, shame, not being smart enough) that collectively also act as soft barriers to adoption. These barriers are softer (social barriers, as opposed to infrastructure barriers) and therefore less visible, but are no less powerful. These barriers determine whether someone will play with, learn, and integrate new devices into their lives. Efforts to popularize AI must go beyond technical education. It is about cultural translation, authentic messaging, and reframing AI as a human-centered and locally relevant technology. Community mediators such as teachers, pastors, imams, or youth leaders can play a significant role in building bridges of perception and bringing AI into local settings where it feels less foreign and more compatible with local value propositions.

In short, the spread of AI in Indonesia is hampered, among other things, not only by the digital and literacy divide but also by cultural distance, symbolic incongruence, and social emptiness. For new technologies to gain widespread acceptance, AI must be interpreted linguistically, socially and morally into a mode appropriate to local conditions. These findings are consistent with recent studies in similar developing countries. Mustafa et al. found that cultural perceptions and local social hierarchies in Pakistan have a substantial impact on AI adoption, with religious framing and generational gaps being key soft barriers (Mustafa et al. 2024). Abdulai et al. conducted a study in Ghana and Nigeria and showed how the perceived relevance of AI in rural areas depends on its integration into everyday activities, such as agriculture and education (Abdulai et al. 2023). In Southeast Asia, as noted by Nguyen et al., the proliferation of AI devices is more acceptable when they are adapted to the local languages and culturally embedded narratives (Nguyen et al. 2023). Our perspective on these findings provides further evidence that successful AI adaptation is not simply about access to technology or expertise but about being embedded in situations, feelings, and symbols. Failure to pay attention to these strata can lead digital inclusion programs to repeat exclusion in new ways.

Social impact and community response

The public discussion on the introduction of artificial intelligence (AI) in Indonesia has led to a variety of social reactions that send mixed messages, which on the one hand shows encouragement for change but also worrying about the issue of disruptive innovation. For the city, it's all about the benefits, including education, health and commerce. For the field, it's all about the potential detriments to access and some kind of vague potential downside to the social good side of AI. Visible impacts and community responses in the study clusters are presented in this section.

The integration of urban AI in cities like Bandung and Jakarta has led to a concrete quality of service wins. A university student in Bandung (Informant DEA, interview, 2024) observed: *"Now we employ AI in our thesis research. It speeds up the process of identifying relevant journals. And a lot of my friends are able to feel less stressed because of this support."* In the same vein, one health worker in Jakarta (Informant RIS, interview, 2024) explained: *"We are using AI-generated diagnostic tools in clinics. Patients feel more confident since the doctor is able to demonstrate the AI-generated analyses."*

These latter cases illustrate the observability dimension of Rogers' theory that when the benefits are observable and evident, the spread of adoption is more pronounced in social networks. But in the countryside, the influence of AI is little or uneven, and people are skeptical or resist. To give an example, as one of farmer in East Lombok said: *"We'd heard of an app that forecasts rain, but it proved not to be available without a signal. People lost faith. It turned out to be just another broken promise."*

Here, the lack of dependability reduces both observability and credibility in future projects. Bad experiences with digital tools confirm people's impression that "technology from out there" is not to be trusted, showing the social aspect of trust. In Toba, North Sumatra, a teacher explained how trust was developed (Informant MIA, interview, 2024): *"We involve in their trust with every approach and it justifies the cost cause it's paying it full in every progress made, and works in our results. What we dream will be amazing in our tomorrow and we will be able reach our target."*

When children began showing their parents that they can use AI apps to help them to solve their homework, more families were curious and open to it. *"If young people weren't showing, they'd never try."* This underscores the importance of peer-to-peer and intergenerational transmission in which the first adopters of new social norms influence others with whom they interact. On the contrary, in Centicl Maluku, they continue to spread rumors. As one elder of the community put it (Informant HAR, interview, 2024): *"Machines cannot understand our traditions. When young people heed their apps instead of their elders, it's decaying our culture."* Such a sentiment positions AI as a cultural threat and not as a cultural tool, suggesting that cultural fit is the greater challenge.

The gendered nature of the social reaction also came out strongly. Women's groups based in Boalemo (Gorontalo) likewise noted that they were left out of digital literacy workshops due to a stereotype where technology is seen as a "*man's job*." (Informant INA, interview, 2024) *"I have a friend who said: 'Fuck it, I will just go home!"* "*They trained the men, but not us. We'd like to know, too, but there was no invitation."* This exclusion continues to sustain inequality and limit the penetration of AI, where one half of the population is intrinsically removed from engagement. Even so, localized adaptive practices are showing potential. In Jayapura, a group of young people set up AI translation tools to enable elders to communicate with migrant traders. One young volunteer (Informant BEN, interview, 2024) described this: *"We also use AI to translate Bahasa into broken language when it's market day. Older folks like it because it enables them to haggle fairly."* This innovative remix is an example of what AI could look like when rethought to serve a tangible community need, increasing relevancy and trust.

Local responses to AI are generally mixed. The media coverage of AI in Indonesia has ranged from high anticipation in digitally savvy regions to skepticism and even hostility in rural and culturally conservative areas. Trust, observability, and social proof all factor into these reactions. AI cannot simply emerge without compelling local success stories (entrepreneurs, champions), and there are a lack of trusted local intermediaries, meaning that AI remains perceived as irrelevant or threatening. Adoption acceptance rapidly increases when it becomes clear that AI can solve local problems on the ground (especially in small, locally sourced, and bottom-up efforts). This is consistent with recent findings elsewhere in the Global South. For example, in a study of rural Ghanaian communities, emphasized the importance of perceived usefulness and trust in intermediaries (local teachers or farmer cooperatives) in technology adoption (Agyekum et al. 2024). Thus, the Indonesian case illustrates the idea that AI is not simply a technical innovation but a deeply social one, and this resonates with experiences across borders and comparable societies.

Strategic solutions and policy implications

This study found that addressing the digital divide and achieving inclusive AI adoption in Indonesia is not based on a single solution but rather requires support from several multi-level, aspect-specific strategies. The national roadmap focuses on infrastructure development but the study findings suggest that adoption also depends on literacy, institutional integration, and cultural acculturation. Strategic measures must consider both technical and social factors.

Infrastructure development

This still requires reliable internet access and digital devices. Connectivity is reportedly unstable, and devices are not widely available in rural areas of Nusa Tenggara, Maluku, and Kalimantan. As one source in Kapuas Hulu revealed:

> "We always hear there are huge potential benefits in AI. If I had an AI lobby, it would have an incredible future," he said. "That's assuming everyone will have good, stable internet. Without that, there are millions of AI apps that cannot get off the ground. Even the government websites don't work here." (informant ANI).

It speaks to DOI dicta about observability if communities can't see the technology in the flesh, resulting in adoption never increasing. In addition, investing in infrastructure in underprivileged provinces is necessary to provide a foundation for the integration of AI.

Community-based digital literacy

Locally adapted digital education is crucial. The results from Semarang and Toba suggest that communities are more open to AI when the mediators are young or teachers. A teacher in Semarang (Informant AYU, interview, 2024) explained: "*Bendesa village are the lower caste towards the bongkahan, because they are bowing. We train students first. Eventually, they teach their parents how to download apps. This is much more impactful than one-shot workshops."* It's all about trialability: the same with learning, it must be low-risk, iterative, and social supported. The policy prescription is to invest in community-based digital mentors who can contextualize AI training, not just short-term, external programs.

Locally relevant AI applications

AI adds value when the tools directly address daily challenges. In Toba, the AI-supported weather forecast earned the trust of the farmers after it proved to be precise. On the other hand, the general e-government apps in Central Maluku could not work due to a loss of pertinence. As one informant from Central Maluku (Informant KUR, interview, 2024) stated: *"We cannot afford digital reporting first. We need something that will help our crops and our income."* Policies need to encourage bottom-up innovation: investing in AI projects that are locally relevant in agriculture, health and commerce, rather than those that use a one-size-fits-all approach.

Institutional collaboration and sustainability

This study found that diffusion is hampered by institutional instability. Many village leaders are also tired of dealing with a series of haphazard government projects. As a young LIN facilitator from East Lombok (Informant LIN, interview, 2024) noted*: "Every year there's a new digital project, then it disappears. People stop believing in it."*

Table 3.
Barriers to AI adoption and recommended strategic solutions

Identified barrier	Strategic solution	DOI element addressed
Poor infrastructure (internet, electricity)	Targeted investment in rural ICT infrastructure	Observability, Trialability
Low digital literacy	Community-based digital training & mentorship	Complexity, Trialability
Low relevance of AI tools	Localized AI applications in agriculture, health, MSMEs	Compatibility, Relative Advantage
Institutional discontinuity	Sustainable multi-stakeholder partnerships	Social System, Change Agents
Cultural resistance / mistrust	Engage local leaders as mediators, integrate local language interfaces	Compatibility, Observability

Source: Processed research data

To achieve sustainability of the initiatives, ongoing training provision, and shared responsibility, multi-stakeholder partnerships between the government, NGOs, universities, and local communities are crucial. To generate these recommendations, an overview of how the identified challenges relate to these strategies is presented in Table 3.

These strategic actions have important policy implications. The race for AI will not be won if AI adoption remains viewed as a technical project that needs to be rolled out. Instead, we must understand it as encompassing inclusive implementation, inclusive training, and sustainable institutional arrangements. Investments in infrastructure tailored to literacy programs and local relevance can make Indonesia's digital transformation more equitable. *"In the absence of such alignment, the digital gap is likely to intensify even further, as rural areas remain at the end of the national technology curve."*

These strategic directions resonate with the findings from comparable studies. Bisheko & Rejikumar 2023) emphasized that rural technology adoption in South Asia depends not only on infrastructure but also on deep community engagement and social intermediaries. Wibowo et al., in their study on Southeast Asian health systems, emphasize that inclusive AI adoption is more likely to succeed when it resonates with local economic priorities and cultural contexts (Wibowo et al. 2025). Moreover, Davison & Joia (2023) found in Latin American contexts that the sustainability of digital programs hinges on multi-stakeholder cooperation rather than short-term pilots. In this light, the strategic solutions outlined in this study reinforce the importance of tailored AI strategies grounded in the social context, local ownership, and sustained institutional presence principles also echoed in the UNDP (2023) recommendations for digital inclusion.

Theoretical implications & novelty

This research effort makes a significant contribution to the field of technology and development (ICT) by demonstrating the relevance of Roger's (2003) Diffusion of Innovations in the local context of Indonesia. The five antecedents of innovation diffusion, including relative advantage, compatibility, complexity, trialability, and observability, remain in play. The five antecedents are "*heavily influenced by Indonesia's vast geographic diversity, infrastructure imbalances, and cultural diversity*" (Heeks 2009). At the metropolitan level, including Jakarta and Bandung, AI is seen as a natural evolution of digital practices with direct implications for education, business, and government. Conversely, in regions such as Maluku, Kalimantan, and East Nusa Tenggara, AI is generally perceived as irrelevant to the local culture and needs, making it less applicable.

In rural areas, complexity and trialability function differently. This is due to low digital literacy and limited access to long-term training, in addition to the perception that AI is complex and threatening (Sein et al. 2019). Even when community members have digital devices, inadequate institutional support and local guidance create fear and isolation. Observability is also driven more by social validation than technical exposure. Low-impact technology showcases about AI are positioned versus high-impact, trusted local figures. Trust from teachers or religious leaders in small communities or villages can open people up to new technologies by using technology demos that exemplify relatable technologies (Walsham 2017).

The novelty of this study lies in its empirical depth and breadth. By investigating 36 localities across eight Indonesian islands, this research extends beyond case-specific or single-site studies. It reveals the uneven and multidimensional patterns of AI adoption across a nation characterized by extreme internal diversity. This broader empirical base allows for the more comprehensive theoretical development of innovation diffusion in emerging economies. It also suggests that Indonesia's digital divide is not only technical or infrastructural, but also cultural and symbolic (Toyama 2011). While access to internet and devices remains a barrier, the deeper issue is whether AI resonates with the local languages, traditions, and systems of trust. This study argues that the successful diffusion of AI requires more than technological availability. It requires alignment with cultural relevance and support structures that foster trust and shared understanding. In doing so, this work refines Rogers' theory by showing that in contexts like Indonesia, innovation must be socially embedded and context-sensitive. This refinement offers valuable insights for future research in technology adoption across diverse and unequal environments, and also provides policy guidance for inclusive digital transformation.

Conclusion

The findings of this study indicate that AI adoption in Indonesia is driven by digital infrastructure and literacy, as well as institutional support and cultural perceptions. These results highlight that the digital divide is not simply a gap between urban and rural areas but can also be divided into two levels: technological and sociocultural. Metropolitan areas with better connections, more robust institutions, and higher digital literacy are also more adept at integrating AI into education, healthcare commerce, and governance. Conversely, rural areas continue to face barriers such as poor infrastructure, low digital literacy, cultural and technological resistance, and the absence of credible intermediaries, which hinder the observability and trialability of AI applications.

Based on Rogers' Diffusion of Innovations Theory, these findings also provide insights into the utilization of relative advantage, compatibility, complexity, trialability, and observability in island communities and across cultures. Specifically, observability is not solely determined by the availability of technology. It relies on the reliability of local advocates, and its substitution is highly dependent on the suitability of AI tools to local demands and practices. This study proposes the concept of a double-layered digital divide between infrastructure and socioculture, emphasizing that policies aimed at achieving digital equality must simultaneously address both physical and symbolic barriers.

This policy has clear implications: an integrated approach is needed, including an investment in an inclusive rural infrastructure, community-based digital literacy development, and the application of AI in locally relevant and linguistically accessible applications. This also requires collaboration with the Nigerian federal government, universities, NGOs, and local leaders to not only introduce AI but also to sustain and build trust in these solutions across communities. This study is not without limitations. For a broader comparison, 36 locations were selected, although due to its qualitative focus, the results are not statistically representative. Few informants had actual personal experience with AI, and their views were captured in anticipation or perception, rather than long-term use. Future research could replicate these findings with a longitudinal mixed-methods design, and add quantitative adoption statistics to the evidence base.

In summary, this study has made both theoretical and managerial contributions to the context of digital transformation in Indonesia. This research contributes to a deeper understanding of the application of diffusion theory in developing communities and has practical implications for reducing the digital divide. With the necessary policies and sustained efforts in place, Indonesia can chart a course toward more inclusive and locally contextualized AI integration, ensuring that the benefits of innovation are more widely distributed across the vast Indonesian archipelago.

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