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The use of information technology in communicating environmental policy in West Sumatra: A PRISMA-based systematic literature review

Eric Kurniawan M[1], Yunia Wardi[2]

[1,2]Universitas Negeri Padang, Sumatera Barat, Indonesia

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ABSTRACT

The advancement of information technology has transformed how governments communicate public policies, including environmental policies. In West Sumatra, environmental policy communication requires not only fast and open communication channels but also approaches aligned with the socio-cultural characteristics of Minangkabau society. This article examines the use of information technology in communicating environmental policy through a Systematic Literature Review (SLR) guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. From an initial corpus of 35 entries, 22 articles were retained for thematic synthesis. The findings show that information technology plays a significant role in expanding the reach of policy communication, enhancing transparency, accelerating government responsiveness, and opening spaces for public participation. However, its effectiveness depends on message quality, communicator credibility, public digital literacy, data openness, inter-agency coordination, and alignment with local values. This article proposes a conceptual model of IT-based environmental policy communication that is participatory, transparent, adaptive, and contextually grounded.

Corresponding Author:

Eric Kurniawan M,
Universitas Negeri Padang,
Jl. Prof. Dr. Hamka, Air Tawar Barat, Kec. Padang Utara, Kota Padang, Sumatera Barat, 25171, Indonesia
Email: erikkurniawansjj@gmail.com

1. INTRODUCTION

Environmental issues have become one of the central challenges of regional development. Local governments need to communicate environmental policies clearly so that the public understands, accepts, and participates in their implementation. Communicating environmental policy cannot rely solely on circular letters, formal meetings, or face-to-face socialisation. Governments must also leverage information technology to reach citizens more widely, quickly, and interactively (Dunan & Mudjiyanto, 2020; Hirsch et al., 2023).

Information technology offers governments the opportunity to disseminate policy information through official websites, social media, public-service applications, geographic information systems, complaint channels, data dashboards, and digital participation platforms (Fishenden & Thompson, 2013; Amirova, 2025). In the context of environmental communication, digital technology can help governments convey information on waste management, forest conservation, pollution control, ecological-disaster mitigation, spatial planning, and education on environmentally responsible behaviour (Quiles-Soler et al., 2023; Krätzig & Warren-Kretzschmar,

2014). West Sumatra possesses distinctive socio-cultural characteristics. Minangkabau society is organised around customary law (adat), deliberation (musyawarah), the authority of ninik mamak, the value of mutual cooperation (gotong royong), and a strong relationship with its living space (Bustamam Ahmad & Zulfidar, 2023; Asmal & Latief, 2023). Consequently, the communication of environmental policy in this region must integrate information technology with locally grounded socio-cultural approaches (Hasibuan & Permana, 2022).

The literature on environmental communication shows that the field has evolved as an interdisciplinary domain that intersects with science communication, public policy, governance, sustainability, and citizen participation (Akerlof et al., 2022; Davis et al., 2018; Carbaugh, 2007). Studies on digital government likewise indicate that technology can strengthen public service delivery, transparency, and civic engagement, but its success depends on institutional capacity and public readiness (David et al., 2023; Fan, 2025; Meijer, 2001).

Despite the rapid expansion of scholarship in these three domains, an important research gap remains in their integration. Studies on information technology in government typically focus on infrastructure, e-services, or digital transformation in general terms (David et al., 2023; Fan, 2025; Amirova, 2025), while environmental communication research tends to address messaging, framing, and persuasion at a conceptual or sectoral level (Akerlof et al., 2022; Davis et al., 2018; Carbaugh, 2007). Research on local wisdom, in turn, often treats culture as a static backdrop rather than as an active component of policy communication (Bustamam Ahmad & Zulfidar, 2023; Asmal & Latief, 2023). Few studies have brought these three strands together to examine how information technology can be embedded in environmental policy communication in a way that is sensitive to the customary, deliberative, and communal values of local communities. This gap is particularly visible in the West Sumatran context, where digital communication strategies have not yet been systematically aligned with Minangkabau social structures, and it forms the central concern of the present review. By addressing this gap, the present study aims to make a specific contribution to the development of environmental policy communication models at the local level. Rather than proposing a generic digital communication framework, it formulates a model that is explicitly anchored in the socio-cultural setting of West Sumatra and that connects information technology, environmental communication, and local wisdom within a single analytical structure. The model is intended to be operationally useful for provincial, district/city, and nagari governments seeking to design communication ecosystems that are participatory, transparent, adaptive, and contextually grounded, and it offers a reference point that other regions with strong customary institutions may adapt to their own circumstances.

Based on this background, this article presents a PRISMA-based SLR to address the following central question: how is information technology used to communicate environmental policy in West Sumatra according to findings from prior literature?.

2. RESEARCH METHOD

Research Design

This study employs the Systematic Literature Review (SLR) method using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach. PRISMA was selected to ensure that the identification, selection, evaluation, and synthesis of literature were conducted in a systematic, transparent, and traceable manner (David et al., 2023). The SLR method was chosen because the study aims to review and synthesise prior research on the use of information technology in communicating environmental policy. This approach enables the researcher to develop a conceptual overview, detect patterns of findings, identify research gaps, and formulate a model of environmental policy communication suited to the context of West Sumatra. The research is qualitative and conceptual in nature, as the analysed data consist of scholarly articles rather than primary numerical data from field respondents.

Research Questions

Four research questions guided this study: (RQ1) How has the body of scholarship on information technology, government communication, and environmental policy communication developed? (RQ2) What forms of information technology are used in communicating environmental policy? (RQ3) What factors influence the effectiveness of IT-based environmental policy communication? (RQ4) What model of IT-based environmental policy communication is appropriate for the West Sumatra context?

PRISMA-Based SLR Protocol

The SLR protocol established the review objective as identifying and synthesising literature on the use of information technology in environmental policy communication, particularly in the context of West Sumatra. The unit of analysis comprised relevant journal articles, scientific proceedings, and academic publications. The literature source was a curated corpus of scholarly articles in RIS format compiled by the authors. The type of analysis applied was thematic synthesis and conceptual mapping, producing thematic findings, research gaps, and a conceptual model of IT-based environmental policy communication.

Data Sources and Literature Identification Strategy

The data source consists of a curated corpus of scholarly articles in RIS format compiled by the authors. Initial identification yielded 35 literature entries. All entries were inspected on the basis of title, abstract, keywords, journal name, publication year, and relevance to the research focus. Because the corpus had been curated in advance, the study did not conduct a new search of academic databases. Nevertheless, the selection process still followed PRISMA principles: identification, screening, eligibility, and inclusion stages. Keyword groups used to cluster articles covered: information technology (digital technology, ICT, AI, big data, digital platform); government communication; environmental communication; public policy; public participation; and local context (West Sumatra, Minangkabau, local wisdom).

The initial corpus of 35 articles was not assembled arbitrarily but on the basis of explicit considerations. First, the corpus was constructed to give balanced coverage of the three analytical pillars of this review: information technology and digital government, environmental and policy communication, and the socio-cultural context of West Sumatra. Articles were drawn purposively so that each pillar was represented by a sufficient number of conceptual and empirical contributions. Second, preference was given to articles published in reputable peer-reviewed journals indexed in international databases, with recent publication years prioritised in order to capture the current state of digital communication practice, while a smaller number of foundational works was retained for theoretical anchoring. Third, the size of the corpus was kept at a level (around three to four dozen entries) that is manageable for thematic synthesis within an SLR while still being large enough to support cross-cluster comparison and the identification of research gaps. Together, these criteria ensured that the 35 entries provided a thematically representative and methodologically defensible starting point for PRISMA-based screening.

Keyword grouping played a central role in safeguarding the accuracy of literature selection. By clustering search terms into the six conceptual groups listed above, articles could be evaluated against well-defined thematic boundaries rather than against a single, undifferentiated topic. This grouping made it possible to detect overlap between domains (for example, articles connecting digital government with environmental communication) and to flag entries that touched only one domain marginally, which in turn supported more consistent inclusion and exclusion decisions. Keyword grouping also reduced the risk of selection bias by forcing each article to be assessed against the same set of conceptual filters, and it facilitated traceability, since each retained article could be linked back to the keyword group or groups under which it was relevant. As a result, the grouping strategy strengthened both the internal coherence of the corpus and the reproducibility of the selection process.

Inclusion and Exclusion Criteria

Inclusion criteria required that each article: (1) addresses information technology, digital government, ICT, big data, AI, social media, websites, or digital platforms; (2) addresses government communication, policy communication, or environmental communication; (3) is relevant to environmental policy issues, public governance, public participation, or information transparency; (4) contributes conceptually or empirically to the Indonesian or West Sumatran context; and (5) contains sufficient bibliographic information. Exclusion criteria removed articles unrelated to IT, communication, public policy, environment, or socio-cultural context; articles too distant from the research focus; duplicates; articles lacking bibliographic data; and articles mentioning environment or technology only in passing.

PRISMA-Based Literature Selection Stages

Identification: 35 articles were compiled as the initial corpus. Screening: one duplicate (Akerlof et al., 2022) was removed, yielding 34 unique articles; 8 further articles were excluded for lack of direct relevance, leaving 26. Eligibility: 4 additional articles were excluded for too-indirect relevance. Included: 22 articles were retained for thematic synthesis, grouped into clusters covering environmental communication, digital government communication, digital governance, public participation, and local socio-cultural context. All 22 included articles are cited in the present manuscript and listed in the References section.

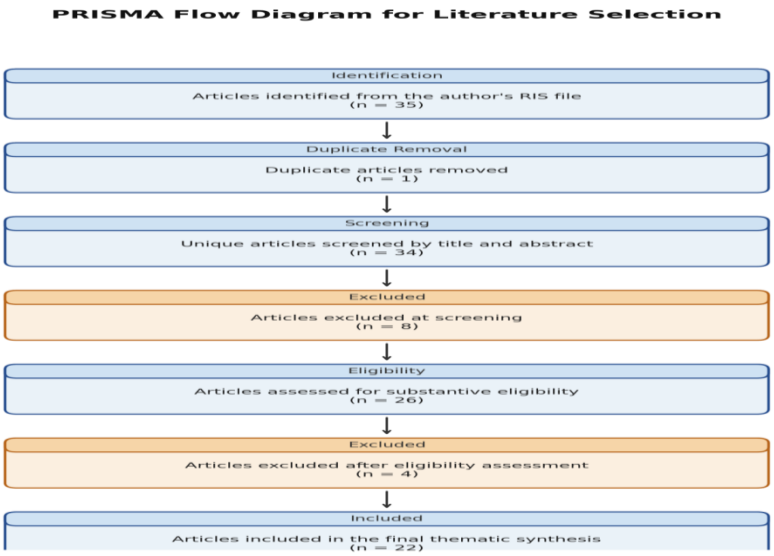

Figure 1. PRISMA flow diagram for literature selection

Data Extraction and Analysis

Data extraction captured: author and year; article title; publication source; focus of study; research method; main findings; relevance to this research; and theme cluster. Data analysis used thematic synthesis, involving: reading and understanding articles; initial coding of key concepts (information technology, government communication, public participation, transparency, digital literacy, local culture); grouping codes into themes; comparing findings across literature; developing a conceptual synthesis; and formulating a conceptual model of IT-based environmental policy communication.

3. RESULTS AND DISCUSSIONS

Characteristics of the Analysed Literature

Based on thematic grouping, the 22 included articles can be classified into five main clusters: (1) Environmental communication, examining relationships between communication, environmental issues, science, and public behaviour (e.g., Akerlof et al., 2022; Carbaugh, 2007; Davis et al., 2018; Jain

et al., 2023; Christis & Wang, 2021); (2) Digital government communication — strategies, digital public relations, and local-authority effectiveness (e.g., Dunan & Mudjiyanto, 2020; Hyland-Wood et al., 2021; Hirsch et al., 2023; Quiles-Soler et al., 2023); (3) Digital governance — AI, big data, open architecture, and public service transformation (e.g., Fan, 2025; Giest, 2017; Fishenden & Thompson, 2013; David et al., 2023; Amirova, 2025; Meijer, 2001); (4) Participation and interactive media — web tools, social media, and channels for public participation (e.g., Krätzig & Warren-Kretzschmar, 2014; Scott et al., 2023; Cuberos et al., 2019); (5) Socio-cultural context — local wisdom, Minangkabau culture, and the Indonesian context (e.g., Bustamam Ahmad & Zulfidar, 2023; Asmal & Latief, 2023; Hasibuan & Permana, 2022). One additional study (de Vries et al., 2015) cuts across clusters by addressing how communicated motives shape public perceptions of environmental policy.

Environmental Communication as an Interdisciplinary Field

Akerlof et al. (2022) demonstrate that environmental communication has developed as an increasingly interdisciplinary field, intersecting environmental science, public policy, business, technology, and public participation. Environmental policy cannot be communicated as purely technical information, it must be conveyed as a social, economic, cultural, and political issue directly connected to citizens' everyday lives (Carbaugh, 2007). In West Sumatra, policy communication must bridge technocratic government language and the social language of communities, using infographics, short-form videos, digital maps, social media, and public Q&A channels. Davis et al. (2018) emphasise the link between environmental communication and science communication, implying that data on air quality, river conditions, landslide risk, or land-cover change become more publicly accessible when packaged visually and disseminated through digital media. Quiles-Soler et al. (2023) further show that organisations communicating environmental policy increasingly rely on official websites and social media as complementary channels, although their integration into a coherent communication ecosystem is often suboptimal, a lesson directly applicable to local governments in West Sumatra.

Information Technology and Government Communication

Government communication in the digital era demands openness, speed, consistency, and interactivity. Dunan and Mudjiyanto (2020) emphasise the importance of public-relations strategies adapted to the Industry 4.0 era; governments must establish two-way communication through digital media. Hirsch et al. (2023) found that digital communication tools can enhance local administrative effectiveness, highly relevant for West Sumatra, where environmental policy involves multiple actors including environmental agencies, nagari governments, civil society organisations, schools, and youth communities. Hyland-Wood et al. (2021) underscore that government communication must be clear, trustworthy, consistent, and responsive, particularly in crisis situations such as floods, landslides, forest fires, and pollution events. Amirova (2025) further argues that citizen-centred public services require not only digital channels but also legal and institutional frameworks that align service delivery with the needs and expectations of citizens, a perspective directly relevant to designing environmental policy communication ecosystems at the provincial and nagari levels.

Local-Government Digitalisation and Technology Adoption

David et al. (2023) show that digital technology adoption by local governments is shaped by institutional strategy, organisational capacity, policy support, technological infrastructure, and human-resource readiness. Local governments must establish content governance, deploy competent operators, maintain public-response systems, and develop evaluation mechanisms, not simply create social-media accounts or an official website. Fan (2025) argues that AI and digital government transformation create opportunities to strengthen decision-making, accelerate public-service delivery, expand transparency, and encourage participation, but must remain attentive to algorithmic fairness, data privacy, accountability, and the digital divide. Fishenden and Thompson (2013) highlight open architecture in digital government: environmental data should be publicly accessible in usable formats rather than held exclusively by governments. Meijer (2001) extends this argument by showing that electronic records management is essential to public accountability: how

ICTs are designed and used can either strengthen or undermine the availability of records on which accountability depends, a concern that becomes acute when environmental policy decisions, permits, and monitoring data are at stake.

a. Implications of AI and Big Data for Environmental Policy Communication

The integration of artificial intelligence and big data into government communication has specific implications for the environmental sector. Operationally, AI-supported analytics enable governments to mine large volumes of complaint data, social-media discussions, sensor readings on air and water quality, and satellite imagery on land-cover change, turning fragmented signals into actionable communication content such as early warnings, location-specific advisories, and targeted public messages (Fan, 2025; Giest, 2017). Big data also makes it possible to segment audiences and adapt environmental messages to particular districts, watersheds, or community groups, which increases the relevance of communication in a province as geographically and culturally diverse as West Sumatra. At the same time, these technologies raise distinctive challenges. Algorithmic decision-making can obscure how environmental risks are prioritised and which communities receive attention first, creating fairness and accountability concerns (Fan, 2025). Heavy reliance on data-driven narratives may also reduce complex socio-ecological issues to quantifiable indicators, sidelining traditional ecological knowledge and the deliberative processes that are central to Minangkabau governance. Furthermore, the use of citizen-generated data — through complaint applications, geotagged reports, or social-media posts — raises questions about consent, privacy, and the secure preservation of records that may later be needed for public accountability (Meijer, 2001). The practical implication is that AI and big data should be treated as decision-support and communication-support tools rather than as substitutes for participatory deliberation, and that their deployment in environmental policy communication must be governed by transparent rules on data use, model explainability, and human oversight.

Digital Media as Channels for Environmental Communication

Krätzig and Warren-Kretzschmar (2014) show that interactive web tools can enhance communication in sustainable environmental planning, enabling citizens to understand policy impacts through maps, simulations, visualisations, and feedback channels. In West Sumatra, this approach can be deployed for spatial planning, watershed conservation, and ecological disaster mitigation. Jain et al. (2023) note that persuasive environmental communicators must possess credibility, relevance, and appeal. Christis and Wang (2021) provide experimental evidence that the style of environmental communication matters as much as its content: a uniform, consistent message style outperforms both under-communication (greenhushing) and over-claiming (greenwashing) in shaping public trust and behavioural intentions. Quiles-Soler et al. (2023) further demonstrate that information disseminated through corporate or institutional websites and social media is most effective when these channels are used in complementary rather than redundant ways. Digital messages on environmental policy should therefore meet five principles: clarity (avoiding excessive technical jargon); credibility (grounded in data and official sources); contextual relevance (aligned with local concerns); interactivity (opening space for questions, responses, complaints); and consistency (delivered continuously, not only in crises).

Information Technology, Public Participation, and Data-Driven Policy

Giest (2017) discusses the use of big data in policymaking: it can accelerate policy analysis but requires attention to data quality, institutional capacity, and the risk of oversimplifying social problems. In environmental policy communication, digital data can help governments identify patterns of public complaints, pollution locations, disaster-prone areas, or community waste behaviour. Cuberos et al. (2019) demonstrate that ICT can mediate public policy, functioning not merely as an information dissemination tool but as a bridge between government and citizens. Scott et al. (2023) show that strategic science communication can shape public discourse among policymakers, reinforcing the case for policy briefs, environmental-data infographics, and concise digital reports. Where the perceived motives behind environmental policy are misread by the public,

however, even well-designed communication can backfire: de Vries et al. (2015) demonstrate that audiences often suspect "greenwashing" when communicators emphasise sustainability motives, suggesting that authorities in West Sumatra should communicate environmental policy in ways that acknowledge multiple motives transparently and avoid the appearance of symbolic rather than substantive commitment.

The Socio-Cultural Context of West Sumatra

West Sumatra exhibits a distinctive Minangkabau socio-cultural structure that must be considered in environmental policy communication. Bustamam Ahmad and Zulfidar (2023) discuss the concepts of merantau (migration), tau jo nan ampek (knowledge of the four), and ninik mamak (matrilineal elders) within Minangkabau culture, underlining the importance of social networks, customary authority, local knowledge, and deliberation-based communication. Asmal and Latief (2023) show that communal family spaces and local wisdom can strengthen social cohesion and environmental resilience in coastal settlements. Hasibuan and Permana (2022) emphasise that development policy must consider socio-cultural character: digital messages must be adapted to local language, customary values, and nagari community communication patterns. Local governments can engage customary leaders, religious figures, youth communities, and local organisations as message amplifiers.

Challenges in the Use of Information Technology

Several challenges emerge from the literature. First, the digital-literacy gap: not all citizens have equal capacity to access and interpret digital information. Second, message quality remains uneven, digital communication is often fast but not necessarily clear, and messages that are overly technical or excessively long reduce effectiveness (Christis & Wang, 2021). Third, public trust is shaped by communicator credibility, consistency of information delivery, and perceived motives behind the policy (de Vries et al., 2015; Hyland-Wood et al., 2021). Fourth, inter-agency coordination is critical: environmental policy involves many institutions, and inconsistent messaging can create public confusion. Fifth, data protection, accountability, and digital ethics matter: the use of complaint applications, location data, or digital monitoring systems must safeguard citizens' privacy and preserve auditable records of public decisions (Meijer, 2001; Fan, 2025). Strategic recommendations include: adopting hybrid communication strategies combining digital media with local social forums; establishing a single cross-agency hub for environmental information (Amirova, 2025); providing complaint channels and digital public consultations; presenting data through infographics and simple dashboards; and engaging ninik mamak, alim ulama, cadiak pandai, bundo kanduang, and nagari youth as message amplifiers.

Research Gaps and Novelty

The SLR results indicate that scholarship on environmental communication, digital government communication, and digital governance is reasonably well developed, but research gaps remain in integrating these three domains within the local context of West Sumatra. Most literature addresses information technology in government generally (e.g., David et al., 2023; Fan, 2025; Amirova, 2025), environmental communication conceptually (e.g., Akerlof et al., 2022; Davis et al., 2018; Carbaugh, 2007), or cultural context separately (e.g., Bustamam Ahmad & Zulfidar, 2023; Asmal & Latief, 2023). Few studies have specifically linked information technology, environmental policy communication, and Minangkabau local wisdom within a single analytical framework. The novelty of this article lies in formulating a conceptual model of IT-based environmental policy communication that takes the socio-cultural structure of West Sumatra into account, emphasising message adaptation, local actors, and citizen participation mechanisms.

Proposed Conceptual Model

Drawing on the SLR results, this article proposes a model of IT-based environmental policy communication for West Sumatra, consisting of five core components:

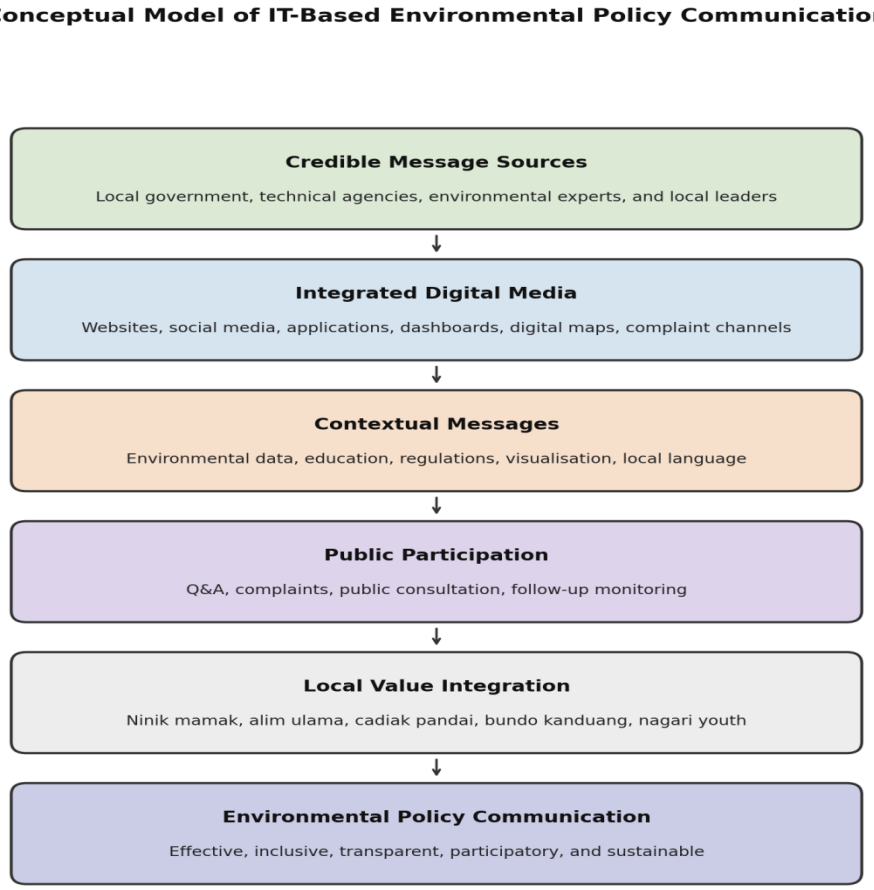

Figure 2. Conceptual Model of IT-Based Environmental Policy Communication in West Sumatra

Credible Message Sources

Local governments must serve as the principal and credible source of information. Environmental agencies, provincial and district/city governments, and nagari governments must convey consistent messages. Credibility can be reinforced through open data, evidence-based explanations, and the involvement of environmental experts (Hyland-Wood et al., 2021; Jain et al., 2023). Communicators should also be transparent about the motives behind environmental policy in order to avoid public suspicion of symbolic or self-serving framing (de Vries et al., 2015), and should ensure that the records underpinning policy decisions remain accessible for public accountability (Meijer, 2001).

Integrated Digital Media

Official websites, social media, complaint applications, WhatsApp channels, digital maps, and environmental dashboards must be linked within a single communication ecosystem. This integration enables citizens to obtain information through the channels they find most accessible (Quiles-Soler et al., 2023; Fishenden & Thompson, 2013; Amirova, 2025).

Contextual and Accessible Messages

Environmental policy messages should use plain language, engaging visualisation, and examples drawn from everyday community life. Governments can combine Bahasa Indonesia and Minangkabau, infographics, short-form videos, and local stories to explain policy. Consistency of

message style across channels, neither under-claiming nor over-claiming, is essential to sustain public trust (Christis & Wang, 2021).

Public Participation

Information technology must open spaces for public participation. Citizens should not merely receive information but should also be able to provide input, report environmental problems, take part in public consultations, and monitor follow-up actions by government (Krätzig & Warren-Kretzschmar, 2014; Cuberos et al., 2019; Scott et al., 2023).

Local Value Integration

Digital communication must be reinforced by local values such as deliberation (musyawarah), mutual cooperation (gotong royong), and the roles of ninik mamak, alim ulama, cadiak pandai, bundo kanduang, and nagari youth, aligning policy communication with the social structures of West Sumatran society (Bustamam Ahmad & Zulfidar, 2023; Asmal & Latief, 2023; Hasibuan & Permana, 2022).

4. CONCLUSION

This PRISMA-based SLR demonstrates that information technology plays a significant role in expanding the reach of environmental policy communication, enhancing transparency, accelerating government responsiveness, and opening spaces for public participation. However, its effectiveness depends on message quality, communicator credibility, public digital literacy, data openness, inter-agency coordination, and the alignment of communication strategies with local values.

In the context of West Sumatra, digital communication of environmental policy needs to integrate official government media, social media, participatory channels, open environmental data, and locally grounded approaches such as deliberation (musyawarah), the role of ninik mamak (traditional leaders), and mutual cooperation (gotong royong). The five-component conceptual model proposed, credible message sources, integrated digital media, contextual and accessible messages, public participation, and local value integration, provides a practical framework that local governments in West Sumatra can use to design effective, participatory, transparent, and contextually grounded IT-based environmental policy communication strategies.

The proposed model carries several practical implications for local governments in West Sumatra and other regions with comparable socio-cultural settings. First, it implies the need to establish a single cross-agency communication hub that consolidates environmental information from the provincial environmental agency, district/city governments, and nagari governments, so that citizens encounter consistent messages across channels and authoritative records remain traceable. Second, it requires investment in digital infrastructure and human-resource capacity, including the training of content operators, data managers, and complaint-handling staff, so that official websites, social media accounts, complaint applications, and environmental dashboards function as a coherent ecosystem rather than as isolated platforms. Third, it calls for standard operating procedures that define message formats, response times, data-sharing protocols, and routines for verifying environmental information before public release, particularly in crisis situations such as floods, landslides, forest fires, and pollution incidents. Fourth, it recommends the formal involvement of customary and community actors — ninik mamak, alim ulama, cadiak pandai, bundo kanduang, and nagari youth — as message amplifiers and as participants in design and evaluation processes, ensuring that communication strategies remain aligned with local values. Fifth, it suggests budgetary and policy support at the provincial level, including allocations for digital literacy programmes, open environmental data initiatives, and regular performance evaluation of communication channels. Taken together, these implications translate the conceptual model into a set of concrete administrative, technical, and participatory actions that local governments can incorporate into their environmental governance practice.

To strengthen and refine the conceptual model proposed in this study, several forms of further research are recommended. Empirical case studies in selected districts and nagari of West Sumatra are needed to test the operational feasibility of the five components and to document how

customary structures interact with digital communication tools in practice. Mixed-method designs combining surveys on digital literacy and trust with in-depth interviews involving customary leaders, environmental officers, and community members would enrich understanding of the contextual factors influencing communication effectiveness. Comparative studies across regions with different socio-cultural configurations — for example, between Minangkabau, Batak, Bugis, and Balinese settings — could clarify which components of the model are generalisable and which need contextual adaptation. Further research could also evaluate the impact of specific digital tools such as complaint applications, environmental dashboards, and AI-supported analytics on public participation and policy outcomes, ideally using quasi-experimental or longitudinal designs. Finally, future studies should examine the ethical, legal, and governance dimensions of citizen-generated data and AI-based decision support in environmental communication, in order to ensure that the model evolves alongside emerging technologies while remaining grounded in local values and democratic accountability.

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