Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Communicative exclusion and indigenous ecological knowledge at risk in the Himalayan biodiversity hotspot

Prem Taba

prem.taba@apupsg.ac.in

Arunachal Pradesh University, Pasighat, India

Research Article

Keywords: Indigenous ecological knowledge, environmental governance, communicative exclusion, biodiversity hotspot, social-ecological systems, Northeast India, Arunachal Pradesh

Posted Date: June 12th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9787324/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Indigenous communities in biodiversity-critical regions generate the observational data most relevant to monitoring and adapting to environmental change — yet they remain structurally excluded from the formal communication systems required for participation in environmental governance. This paper examines how communicative exclusion undermines the ecological governance capacity of indigenous communities in Arunachal Pradesh, a state covering 80.30% forest cover within the Eastern Himalayan Biodiversity Hotspot, in Northeast India. Drawing on a convergent mixed-methods design across three districts — structured household surveys (n = 210), twelve focus group discussions, and twenty-four key informant interviews with Puroik and Nyishi tribal communities — this study documents a profound disjunction between ecological knowledge and communicative infrastructure. Over 78% of Puroik respondents reported no regular access to any formal media channel carrying environmental information, while 91.8% recognised locally observable climate and ecological changes in their landscapes. This condition is theorised as environmental information silence — the structural state in which communities with the deepest ecological embeddedness are simultaneously the most communicatively marginalised within formal environmental governance systems. The paper further proposes communicative colonialism as the mechanism producing this silence: the ongoing displacement of indigenous communicative ecologies by dominant media architectures organised around epistemological frameworks alien to community knowledge systems. The findings have direct implications for biodiversity conservation, climate adaptation, and indigenous rights governance in the Eastern Himalaya. This paper argues that indigenous ecological knowledge systems are not repositories of historical information but active observational infrastructure whose governance value depends on the existence of communicative pathways into formal environmental decision-making.

1 Introduction

Effective governance of environmental change depends not only on formal policy instruments and scientific monitoring but on the communicative pathways through which ecological knowledge reaches the institutions responsible for environmental decisions. Where those pathways do not exist, where communities most embedded in ecologically significant landscapes cannot transmit their observations into governance systems, the capacity of social-ecological systems to adapt is structurally compromised (Folke et al., 2005; Berkes et al., 2003). This communicative dimension of environmental governance is undertheorised and underempiricised, particularly in biodiversity-critical regions of the Global South where indigenous communities hold irreplaceable ecological knowledge at risk of loss.

Arunachal Pradesh, located in the easternmost arc of the Himalayas in Northeast India, occupies a singular position at this intersection. With 80.30% forest cover across 83,743 km², it contains portions of both the Eastern Himalayan Biodiversity Hotspot and the Indo-Burma Biodiversity Hotspot — two of the world's 36 recognised biodiversity hotspots (Myers et al., 2000; Forest Survey of India, 2023). Its 26 major tribal groups and over 100 sub-tribal communities, constituting 68.79% of the total population, have for generations functioned as the primary ecological stewards of these landscapes (Census of

India, 2011). Yet the state also records some of India's most acute infrastructural deficits: a literacy rate of 65.38% (Census of India, 2011), near-absent mobile broadband across large portions of remote tribal territory, and no media content in any of its 90-plus indigenous languages that addresses environmental governance (TRAI, 2023). The result is a profound and consequential paradox: the communities with the most place-specific, practice-embedded knowledge of ongoing ecological change are the communities least able to make that knowledge legible to the institutions whose decisions determine whether their landscapes survive as functioning ecosystems.

Two communities sit at the study's centre. The Puroik — one of Arunachal Pradesh's most historically marginalised groups, with documented histories of bondage and near-total exclusion from formal infrastructure — represent the extreme end of communicative isolation (Taba, 2023). The Nyishi, the state's largest tribal group, are better connected but carry rapidly eroding traditional ecological knowledge systems that receive no institutional communicative support (Rai, 2005). Both communities inhabit landscapes where deforestation pressures, large dam construction, shifting cultivation restrictions, climate-driven species compositional changes, and altered hydrological regimes are actively underway. The capacity of these communities to adapt to, resist, and shape the governance response to these changes depends in part on their capacity to communicate.

This paper makes three contributions. First, it provides the first systematic empirical documentation of environmental communicative exclusion across indigenous communities in Arunachal Pradesh, using a mixed-methods design across three districts and two tribal groups. Second, it introduces the concept of environmental information silence as a theoretically precise description of the structural condition identified in the data — distinct from simple information poverty and from the established digital divide literature. Third, it proposes communicative colonialism to explain the mechanisms producing this silence, connecting the communicative failure documented here to the broader political economy of knowledge systems in postcolonial biodiversity governance. Together, these contributions reframe communicative exclusion not as a development deficit to be remedied through technology transfer but as a governance problem with direct consequences for the adaptive capacity of social-ecological systems.

2 Theoretical Background and Literature

2.1 Communication, Knowledge, and Environmental Governance

The relationship between knowledge systems and environmental governance has become central to social-ecological systems (SES) research over the past two decades (Ostrom, 1990; Folke et al., 2005; Berkes, 2012). Adaptive governance frameworks emphasise the importance of polycentric institutions capable of integrating knowledge from multiple sources — including community-level ecological observation — into management decisions (Armitage et al., 2008; Biggs et al., 2015). Yet the

communicative infrastructure required to move indigenous ecological knowledge (IEK) from its holders to governance institutions is rarely examined as a governance variable in its own right.

Cox (2010) argued that environmental communication is constitutively political: media systems determine which communities are rendered visible as environmental subjects, which knowledge systems earn legitimacy, and which crises attain the status of public concern. For indigenous communities, this political dimension is not abstract but operational. The Aichi Biodiversity Targets (CBD, 2010) and their successor Kunming-Montreal Global Biodiversity Framework (KM-GBF, 2022) formally recognise the role of IEK in biodiversity governance; Target 22 of the KM-GBF explicitly requires equitable participation of indigenous and local communities. But formal recognition does not create communicative infrastructure. The gap between the principle of IEK integration and its governance practice is, in part, a gap in communication architecture.

The most recent and directly comparable work in the REC literature on information barriers and environmental governance confirms this pattern across different geographic contexts. Rusere et al. (2026) demonstrate that perceptions of environmental change frequently diverge from instrument-derived meteorological data, identifying local observational knowledge as both valuable and systematically neglected in formal climate monitoring. Nortey et al. (2026), examining climate literacy in urban Ghana, find that residents rely primarily on personal observations and cultural interpretations rather than formal climate services — analogous to the oral and community-based environmental information infrastructure documented among Arunachal Pradesh's tribal communities. The present study extends and radicalises this line of inquiry by demonstrating that the communicative barrier is not merely a matter of literacy or access but of structural epistemological exclusion — a condition in which formal communication systems are organised around knowledge frameworks incommensurable with community ecological knowledge.

2.2 Indigenous Ecological Knowledge and Social-Ecological Resilience

IEK is not decorative knowledge. It is the accumulated, place-specific, intergenerational understanding of ecological dynamics that enables community-based natural resource governance (Berkes, 2012; Gadgil et al., 1993; Colding & Folke, 2001). The correlation between linguistic diversity and biological diversity documented by Maffi (2005) captures a deeper relationship: the fine-grained ecological categories encoded in indigenous languages — for soil types, successional stages, seasonal hydrological patterns, species interactions — represent millennia of observational work in precisely the landscapes where conservation decisions now need to be made. As those languages lose communicative space in formal channels, the ecological knowledge they encode becomes simultaneously inexpressible to governance systems and vulnerable to intergenerational loss.

In the Northeast Indian context, this relationship is particularly consequential. Ramakrishnan's (2007) work on Adi communities in East Siang demonstrates how local forest classification systems govern conservation practice across village clusters. The FAO designation of the Apatani paddy-fish-alder

system as a Globally Important Agricultural Heritage System (FAO, 2022) formally acknowledges what local communities have practiced for centuries: sophisticated ecological management embedded in indigenous knowledge architecture. The Namdapha National Park ecosystem, the interconnected river systems of the Siang, Lohit, Dibang, Subansiri, and Kameng basins, and the state's extraordinary endemic biodiversity all sit within landscapes managed, observed, and interpreted by communities whose communicative exclusion from governance constitutes a systemic gap in the state's environmental monitoring infrastructure.

2.3 The Digital Divide as Governance Failure

The digital divide literature has evolved through three analytical generations: first-order physical access to hardware and connectivity, second-order skills and quality of use, and third-order meaningful social outcomes (van Dijk, 2006; Warschauer, 2003). For environmental governance purposes, it is the third-order gap that matters most. TRAI (2023) data indicate that rural internet subscribers account for approximately 41.75% of India's national subscriber base despite rural populations constituting over 65% of the country — a gap that BharatNet broadband policy has failed to close in remote tribal geographies. In Arunachal Pradesh, with its extreme topography and sparse settlement, tribal villages may be separated from the nearest mobile tower by several days of foot travel.

But the digital divide framework, as typically applied, does not capture the full dimensions of the problem in the Arunachal Pradesh context. Even where digital infrastructure nominally reaches tribal areas, content is organised overwhelmingly in Hindi, English, and Assamese — languages alien to ecological knowledge systems encoded in Puroik, Nyishi, Adi, Galo, and dozens of other tribal languages (Mohanty, 2009). The UN Special Rapporteur on the Rights of Indigenous Peoples has identified this language barrier as a structural human rights concern, noting that the absence of indigenous-language digital content constitutes exclusion from the information commons on which governance participation depends (UNHRC, 2022). What is required is not merely connectivity but epistemological access — which is a different and more complex policy problem.

2.4 Communicative Exclusion and Biodiversity Hotspot Governance

No peer-reviewed study has systematically examined the relationship between communicative exclusion and ecological governance participation among Arunachal Pradesh's tribal communities. Existing literature addresses the digital divide, IEK systems, and environmental communication as separate domains; their intersection — the specific ways in which communicative exclusion degrades ecological governance in biodiversity-critical indigenous territories — remains empirically uncharted. This study addresses that gap, with implications that extend beyond Northeast India to any biodiversity hotspot where indigenous communities' ecological observations are structurally excluded from formal governance. In proposing environmental information silence and communicative colonialism as analytical constructs, we seek not to add to a catalogue of deficits but to name the governance problem precisely enough that institutional solutions become imaginable.

3 Study Area, Research Design, and Methodology

3.1 Study Area

Arunachal Pradesh lies between 26°28' N and 29°30' N latitude and 91°30' E and 97°30' E longitude, sharing international borders with the Tibet Autonomous Region of China to the north, Bhutan to the west, and Myanmar to the east. With a population density of 17 persons per square kilometre — the lowest of any Indian state — and elevational gradients from approximately 200 m in subtropical foothills to alpine terrain exceeding 5,000 m, the state contains extraordinary ecological diversity and correspondingly severe infrastructure gradients (Census of India, 2011).

Three districts were selected to represent distinct ecological, infrastructural, and socio-cultural contexts. East Kameng District — the primary habitat of the Puroik community, headquartered at Seppa — is characterised by dense subtropical and temperate mixed forests, very limited road connectivity beyond the district headquarters, and near-total absence of mobile broadband in most village clusters. It represents the study's most communicatively isolated context and the most acute case of the exclusion this paper documents. Papum Pare District — predominantly Nyishi, adjoining the state capital Itanagar — has comparatively higher literacy and media access but retains a significant rural-urban gradient between periurban communities and those in more remote blocks. Upper Subansiri District — headquartered at Daporijo, spanning elevations from approximately 500 m to over 3,500 m — provides a high-elevation comparative context with distinct seasonal isolation and a mixed tribal population.

The study area encompasses river basins (Kameng/Bhareli, Subansiri, and Siang) that constitute major ecological corridors of the Eastern Himalayan Biodiversity Hotspot. These waterways also serve as primary livelihood resources — through fish, freshwater, and alluvial agriculture — for the communities surveyed. Ongoing environmental changes including altered monsoon timing, changed river regimes linked to glacial retreat and upstream dam construction, forest composition shifts, and species population changes are directly observable by and consequential for the communities in this study.

3.2 Research Design

The study uses a convergent mixed-methods design (Creswell & Plano Clark, 2018), integrating structured household survey, in-depth semi-structured interviews, focus group discussions, and systematic secondary data analysis. The convergent design allows quantitative patterns of media access and policy awareness to be directly triangulated with qualitative accounts of ecological knowledge status, communicative experience, and governance exclusion. Neither data stream alone could support the claims made in Section 5; the convergence of both, consistently pointing in the same direction across different communities and methodologies, makes those claims defensible.

3.3 Primary Data Collection

Household Survey: A structured questionnaire was administered to 210 respondents across the three districts (Puroik: n = 85; Nyishi rural: n = 75; Nyishi peri-urban: n = 50), using purposive and snowball

sampling strategies in the absence of current household registers across many village clusters. The instrument covered: (a) media ownership and access patterns by channel and language; (b) primary environmental information sources; (c) awareness of key environmental policies and governance instruments; (d) attitudes toward official environmental communication; and (e) current status of IEK practice and intergenerational transmission in the household.

In-depth Interviews: Semi-structured interviews were conducted with 24 key informants — community elders (n = 8), village headmen/gaon buras (n = 6), schoolteachers (n = 5), NGO field workers (n = 3), and local journalists (n = 2). Interviews were conducted in Puroik, Nyishi, or Nyishi-Assamese mixed vernaculars with community interpreters, then transcribed, translated, and back-translated to verify accuracy. Quoted passages in Section 4 are drawn from these back-translated transcripts.

Focus Group Discussions: Twelve FGDs were conducted (four per district), stratified by gender and age cohort (under 40; 40 and above). Discussions focused on perceived environmental changes, information barriers, experiences of environmental governance, and attitudes toward official communication. FGDs were audio-recorded with consent and transcribed for thematic analysis.

3.4 Secondary Data Sources

Secondary data were drawn from: Census of India (2011); Forest Survey of India State Report (2023); TRAI Telecom Subscription Data (2023); National Family Health Survey-5 (NFHS-5, 2019–21); and peer-reviewed academic literature. Demographic baselines reflect Census 2011 figures, acknowledged as the most recent complete census available. NFHS-5 district-level figures are used to cross-validate key indicators where available.

3.5 Ethical Considerations

Informed consent

was obtained from all participants. Participation was entirely voluntary. The study received institutional ethical clearance from Arunachal Pradesh University (Ref: APU/MC/Ethics/2023-07). Community-level permission was obtained from gaon panchayats and, for Puroik villages, from the relevant community apex body. All participant identities are anonymised in reported findings. Research proceeded in accordance with the ethical guidelines of the Indian Council of Social Science Research (ICSSR) and the principles of the Declaration of Helsinki as applicable to social science research.

4 Results

4.1 Socio-Demographic Profile of Respondents

Table 1 presents the socio-demographic profile of the 210 survey respondents. The data reveal a pronounced socio-economic gradient across the three community groups, with Puroik respondents recording the highest dependence on agriculture and forest-based livelihoods (91.8%), the lowest literacy

rate (38.8%), and the highest incidence of below-poverty-line (BPL) households (68.2%). These figures are internally consistent with NFHS-5 district-level data for East Kameng. The peri-urban Nyishi respondents, by contrast, exhibit the characteristics of a community in rapid socio-economic transition, with literacy at 84.0%, significantly lower agricultural dependence, and BPL incidence at 18.0%. This gradient structures the access and communication findings in Sections 4.2 and 4.3.

Table 1
Socio-Demographic Profile of Survey Respondents (n = 210)

Variable	Puroik (n = 85)	Nyishi Rural (n = 75)	Nyishi Peri-Urban (n = 50)	Total (n = 210)
Male (%)	52.9	54.7	58.0	55.2
Female (%)	47.1	45.3	42.0	44.8
Average age (years)	36.4	38.1	34.7	36.8
Literate (%)	38.8	61.3	84.0	59.0
Primary occupation: Agriculture/Forest (%)	91.8	78.7	34.0	73.8
Below Poverty Line — BPL (%)	68.2	44.0	18.0	46.7
Average household size	5.8	5.3	4.6	5.3

Source: Field survey, Arunachal Pradesh, 2023–24. BPL status determined by reference to state BPL household lists and self-reporting. Literacy based on self-report, consistent with Census of India definition (ability to read and write in any language).

4.2 Media Access and Environmental Information Channels

Table 2 documents media access patterns across the three community groups, and reveals the study's most consequential quantitative finding: 78.8% of Puroik respondents reported no regular access to any formal media channel. This near-complete communicative isolation reflects observable field realities: the absence of mobile towers across large portions of East Kameng's rural blocks, unreliable electricity supply limiting television use even where sets exist, and absent print distribution networks in communities accessible only by foot or light aircraft. The 22.4% radio access figure among the Puroik is the highest in their media profile, and almost entirely accounted for by older battery-powered AM sets receiving the All India Radio Itanagar station, which carries no Puroik-language environmental content. The structural implication is significant: no formal environmental information channel reaches the community most embedded in, and most dependent upon, the ecosystem this study is concerned with.

Table 2
Media Access Pattern of Respondents (% accessing weekly or more)

Media Channel	Puroik (%)	Nyishi Rural (%)	Nyishi Peri-Urban (%)	Note
Television	14.1	46.7	86.0	
Radio (incl. community radio)	22.4	38.7	52.0	
Newspaper (any language)	4.7	21.3	74.0	
Mobile Internet (any use)	7.1	32.0	78.0	
Social media (Facebook/WhatsApp)	5.9	28.0	72.0	
No regular access — any channel	78.8	34.7	8.0	Critical gap

Source: Field survey, 2023–24. 'No regular access' denotes respondents with no weekly contact with any of the listed channels. The TRAI (2023) national rural internet subscriber figure of 41.75% provides a national comparator; Arunachal Pradesh's remote tribal blocks fall well below this aggregate.

Table 3 documents the sources from which respondents actually obtain environmental information. The inversion is analytically significant: as formal media access decreases, reliance on indigenous oral and community-based channels increases proportionally. Among the Puroik, community elders (94.1%) and village meetings (72.9%) constitute the near-exclusive environmental information infrastructure. This does not represent a knowledge deficit. The Puroik ecological knowledge system is sophisticated and functionally active. It does, however, demonstrate that formal environmental governance communication — delivered through state media, extension workers, and print — reaches these communities marginally at best, effectively decoupling the governance cycle from the communities it nominally serves.

Table 3
Primary Sources of Environmental Information (Multiple responses; % of respondents)

Source of Environmental Information	Puroik (%)	Nyishi Rural (%)	Nyishi Peri-Urban (%)
Community elders / oral tradition	94.1	72.0	38.0
Village meetings / Gaon Panchayat	72.9	58.7	30.0
Government extension workers	18.8	34.7	42.0
Television / Radio	12.9	44.0	82.0
Newspapers	2.4	18.7	68.0
Social media / Internet	4.7	26.7	70.0
NGOs / Environmental organisations	8.2	12.0	18.0
Schools / Colleges	5.9	22.7	54.0

Source: Field survey, 2023–24. Multiple-response format; percentages do not sum to 100. Responses reflect where respondents first encounter environmental information affecting their livelihoods, not which sources they consider most authoritative.

4.3 Awareness of Environmental Policies and Governance Instruments

Table 4 presents the study's most theoretically charged finding. Awareness of formal environmental governance instruments is negligible to absent among Puroik respondents and very low among rural Nyishi. Knowledge of the Forest Rights Act (2006) — the most significant legislative instrument for tribal ecological rights in post-independence India — stands at 8.2% among the Puroik and 21.3% among rural Nyishi. Awareness of the Paris Agreement, the Kunming-Montreal Global Biodiversity Framework, and the National Action Plan on Climate Change is effectively zero in both groups. Against this, recognition of locally observable ecological and climate changes — erratic monsoon onset, altered forest phenology, changed river levels, disappearance of previously common species — stands at 91.8% among the Puroik and 88.0% among rural Nyishi. The communities most excluded from formal environmental governance are among the most ecologically attentive. This asymmetry constitutes the central analytical problem of the paper.

Table 4
Awareness of Key Environmental Policies and Observed Ecological Changes Among Respondents (%)

Policy / Event	Puroik (%)	Nyishi Rural (%)	Nyishi Peri-Urban (%)	Note
Forest Rights Act (FRA), 2006	8.2	21.3	56.0	
National Green Tribunal (NGT)	2.4	12.0	46.0	
Paris Agreement / COP processes	0.0	4.0	32.0	
NAPCC (National Action Plan on Climate Change)	1.2	8.0	28.0	
Kunming-Montreal Biodiversity Framework (2022)	0.0	1.3	12.0	
State Environmental Policy (Arunachal Pradesh)	3.5	14.7	38.0	
Locally observable climate changes (recognised)	91.8	88.0	72.0	High

Source: Field survey, 2023–24. 'Locally observable climate changes' refers to respondent recognition of changes in their immediate landscapes within their lifetime: altered precipitation patterns, species population shifts, river-flow changes, and forest composition changes. The contrast between near-zero formal policy awareness and near-universal local ecological change recognition is the study's central empirical tension.

4.4 Indigenous Ecological Knowledge: Content and Transmission Crisis

Table 5 documents selected IEK practices identified through key informant interviews and FGDs, with qualitative assessment of current transmission status. The data reveal both the sophistication of existing IEK systems and the precariousness of their intergenerational survival. The Puroik's Leki forest classification system encodes distinctions relating to soil type, forest successional stage, seasonal hydrology, ritual usufruct, and species function for which the Indian Forest Service's binary reserved/unreserved classification has no equivalents. The Nyishi's Nyibo-mediated medicinal plant taxonomy covers over 100 species and is transmitted exclusively through oral apprenticeship. The sacred grove governance system (Jokom council) among the Puroik functions as a community-managed conservation architecture without any state recognition or support. None of these seven documented practices receives support from any state or community media channel — no radio programme, no digital archive, no school curriculum. The communicative infrastructure required to sustain them does not exist.

Table 5
Selected IEK Practices and Transmission Status

IEK Practice	Community	Knowledge Holder	Transmission Mode	Current Status
Leki forest classification system	Puroik	Elders	Oral / Ritual	Critical — <10% youth aware
Seasonal bird indicator knowledge	Puroik, Nyishi	Elders, hunters	Oral	Endangered
Agroforestry intercropping calendars	Nyishi	Women farmers	Practice-based	Moderate risk
Medicinal plant taxonomy (100 + species)	Nyishi	Nyibo (ritual specialists)	Oral / Apprenticeship	High risk — no public channel
Sacred grove governance (Jokom council)	Puroik	Male elders	Institutional / oral	Near collapse
Flood prediction via riparian observation	Adi (comparative)	Elderly fishermen	Oral	Undocumented
Shifting cultivation cycle management	Nyishi	Village council	Community governance	Under pressure from forest dept. rules

Source: Key informant interviews and focus group discussions, field survey 2023–24; cross-referenced with Rai (2005*) and* Ramakrishnan (2007*). Status assessments are qualitative evaluations based on triangulated informant accounts. The absence of a formal quantitative IEK inventory for any of these practices is itself a finding about the state of documentation and institutional investment.*

4.5 Qualitative Findings: Three Structural Themes

Theme 1: Incommensurability of Ecological Vocabulary

Across all four Puroik FGDs in East Kameng, a recurring and consistent observation concerned the fundamental incommensurability between indigenous ecological vocabulary and administrative language. One elder practitioner of the Leki classification system — in a village accessible only by a two-hour foot trail from the nearest motorable road — observed: "We have words for seventeen types of forest, their seasons, their spirits, their boundaries. Government papers know only one: reserved or unreserved." This is empirically precise. The Puroik lexicon encodes distinctions by soil seasonality, forest successional stage, ritual usufruct, and hydrological function for which the Indian Forest Act's colonial-era framework has no categories. These distinctions are not decorative; they are the operational vocabulary of community-based forest governance. The finding resonates with Maffi's (2005) documentation of the correlation between linguistic and biological diversity: as indigenous languages

lose communicative space in formal channels, the ecological knowledge they encode becomes simultaneously inexpressible through those channels and vulnerable to intergenerational attrition.

Theme 2: Framing, Visibility, and Ecological Invisibility

Nyishi rural participants, while enjoying greater media access than the Puroik, consistently reported that environmental content on television and radio bore no relationship to their specific ecological circumstances. A female participant in a Papum Pare FGD articulated this precisely: "The news talks about Kaziranga, about rhinos and tigers. It never talks about our water spring that dried up three years ago, or the bee species that disappeared from our forest. For them, nature is somewhere else." This observation maps onto a well-documented pattern in environmental media research: dominant environmental journalism is organised around charismatic megafauna, national-scale pollution events, and international climate diplomacy, systematically excluding the everyday ecological concerns of subsistence-dependent communities (Hannigan, 2006; Cox, 2010). When Arunachal Pradesh appears in this media frame, it appears almost invariably as a passive biodiversity asset — a landscape to be conserved — rather than as a community of ecological agents with governance claims and observational knowledge. The political ecology of this framing is not incidental; it is the outcome of the communicative structures we document.

Theme 3: Institutional Distrust as Governance Obstacle

A deep-seated and consistently articulated distrust of state environmental communication emerged as a significant qualitative finding across all three districts. Forest department officials were characterised across multiple FGDs as enforcers of restriction rather than co-stewards of ecological knowledge. Several Nyishi informants described receiving notices imposing restrictions on seasonal swidden cultivation and non-timber forest product collection without explanation, consultation, or information about grievance mechanisms. This has produced a systematic association — across both tribal groups — between state environmental communication and punitive regulation. The functional consequence is direct: environmental awareness campaigns delivered through the same institutional channels that communities associate with restriction face a structural legitimacy deficit. The near-zero awareness of the Forest Rights Act among the communities it was designed to benefit becomes, in this light, less surprising and more damning: law without communication is justice withheld.

5 Discussion

5.1 Environmental Information Silence

The findings call for theoretical elaboration beyond existing frameworks. Environmental information silence is proposed here as a structural condition — distinct from information poverty and from the digital divide — in which communities with the deepest ecological embeddedness and the most acute environmental vulnerability are rendered simultaneously inaudible and unreachable within formal environmental governance architectures. The concept insists on a diagnostic distinction: the Puroik and

rural Nyishi communities are not environmentally ignorant. They are, on many dimensions, ecologically more literate than the urban publics who consume mainstream environmental media. What they lack is communicative infrastructure adequate to their social, linguistic, and epistemological position in the dominant information order.

Three structural mechanisms produce environmental information silence in the Arunachal Pradesh context. Infrastructural exclusion operates through the material absence of electricity, broadcast signals, broadband, and print distribution in remote tribal areas — a first-order problem of physical access. Linguistic exclusion operates through the absence of any formal environmental communication channel in any of Arunachal Pradesh's major tribal languages — meaning that even where infrastructure nominally reaches tribal areas, the content remains epistemologically inaccessible, a second-order problem compounded by low Hindi and English literacy rates. Epistemological exclusion operates at the deepest level, through the organisation of environmental communication itself around scientific taxonomy, legal instruments, and national-scale policy metrics structurally incompatible with IEK systems that are place-specific, practice-embedded, and orally transmitted. This third-order exclusion is not technically resolvable through connectivity programmes; it requires epistemological reconfiguration of governance communication.

The governance implications of environmental information silence extend beyond justice concerns. The Puroik and Nyishi communities document ecological changes — altered water springs, species disappearances, changed flowering and fruiting cycles, shifted river regimes — that constitute observational data of direct relevance to conservation management and climate adaptation planning in the Eastern Himalayan Biodiversity Hotspot. The loss of these observations from the governance system is not a representational failure but a functional loss of monitoring capacity. As long-term residents with high-resolution local ecological knowledge, these communities are, in effect, an unmaintained sensor network for some of the world's most significant biodiversity.

5.2 Communicative Colonialism

Communicative colonialism is proposed to describe the ongoing structural displacement of indigenous communicative ecologies — the languages, oral transmission systems, ritual governance channels, and community assemblies through which ecological knowledge is produced and circulated — by dominant media architectures organised around the epistemological assumptions of modernist, market-oriented, and state-centric knowledge systems. It is analytically distinct from media imperialism (Schiller, 1976), which addressed Western commercial media dominance over national cultures, and from cultural imperialism (Tomlinson, 1991), which focused on cultural identity displacement. Communicative colonialism is intra-national in operation and targets epistemic infrastructure: the basic systems through which communities understand, circulate, and act on their ecological knowledge.

The concept is closest to Santos's (2014) epistemicide — the destruction of non-Western knowledge systems through modern Western epistemology — but specifies the communicative mechanisms through which this destruction occurs in the specific domain of environmental governance. It is also

adjacent to Mignolo's (2009) coloniality of knowledge, which theorises the epistemic hierarchies persisting from colonial knowledge orders into postcolonial institutional life. Where these frameworks are primarily philosophical, communicative colonialism is empirically operationalisable. It manifests in specific infrastructure absences (Tables 2 and 3), specific policy awareness failures (Table 4), and specific rates of IEK attrition (Table 5). The contribution of the present study is to demonstrate that these are not independent phenomena but structurally connected outcomes of a single communicative architecture.

Communicative colonialism also has a temporal dimension with direct relevance to environmental change governance. IEK systems are not static repositories but living, dynamically updated observational systems (Berkes et al., 2000). The knowledge that the Puroik's Leki classification system encodes about forest successional stages, soil seasonality, and hydrological function was accumulated over generations of continuous observation and updated through each generation's experience. As communicative exclusion accelerates IEK attrition — as fewer than 10% of young Puroik community members are aware of the Leki system — the observational capacity this system represents is permanently lost. This is irreversible in a way that infrastructure deficits are not. No broadband cable, however late, can restore knowledge that has been eroded below the threshold of intergenerational transmission.

5.3 Implications for Social-Ecological Systems Governance

The SES governance literature emphasises the importance of knowledge diversity and redundancy for adaptive capacity under conditions of uncertainty and change (Folke et al., 2005; Biggs et al., 2015). IEK systems represent a distinct and complementary observational architecture to scientific monitoring: temporally deep (multi-generational), spatially granular (village-level), and embedded in practice-based ecological relationships that generate knowledge types formal monitoring systems cannot produce. In the Eastern Himalayan context, where scientific monitoring infrastructure is sparse and the ecological dynamics of interest — forest phenological change, species range shifts, hydrological regime change — are precisely the kinds of fine-grained spatial and temporal dynamics that IEK systems track most effectively, the loss of those systems from the governance cycle is a measurable degradation of adaptive capacity.

The structural framework through which communicative colonialism produces environmental information silence in Arunachal Pradesh reveals a governance architecture operating as two parallel non-intersecting systems: a formal environmental communication system running from state and scientific knowledge production through mainstream media to a literate urban public sphere; and an indigenous ecological communication system running from elder and ritual knowledge holders through community channels to village-level ecological governance. The six structural barriers maintaining their non-intersection — infrastructural exclusion, linguistic exclusion, and epistemological exclusion on the formal boundary; policy blindness, media framing bias, and market logic on the indigenous boundary — are not incidental features of a developing communications landscape. They are the functional architecture of communicative colonialism in the environmental governance domain.

6 Policy Recommendations

The findings generate eight categories of policy intervention (Table 6), grounded in the empirical evidence of this study and informed by comparative evidence from community radio initiatives in Karnataka (Namma Dhwani) and Andhra Pradesh (Sangham Radio), as well as international precedents from indigenous communication practice in Latin America and Australasia. All recommendations are consistent with Target 22 of the Kunming-Montreal Global Biodiversity Framework (2022), which requires equitable participation of indigenous peoples in biodiversity governance — participation that is structurally impossible without the communicative infrastructure to enable it.

Table 6
Recommended Policy Interventions for Inclusive Environmental Communication Governance in Arunachal Pradesh

Level	Intervention	Lead Agency	Priority	Expected Outcome
Infrastructure	Dedicated community radio for major tribal languages (Puroik, Nyishi, Adi, Galo) with environment and climate content	MIB / Prasar Bharati / AIR	High	Direct reach to communicatively isolated communities; first-step climate information access
Content	Mandatory IEK-based and climate impact content in AIR Itanagar and Pasighat regional broadcasts	AIR / State Government	High	Legitimisation of indigenous ecological observations in formal climate discourse
Linguistic	Tribal-language environmental and climate glossaries; bilingual policy materials	NCERT / Tribal Welfare / APU	Medium	Bridging linguistic and epistemological divide in climate governance
Digital	BharatNet Phase III prioritisation for tribal habitation zones; community climate kiosk programme	DoT / State IT Dept.	High	Reduction of second-order digital divide; expand climate information access
Curriculum	Integration of IEK, local ecological history, and observed environmental changes into school syllabi	SCERT Arunachal Pradesh	Medium	Intergenerational IEK transmission; climate-literate future generations
Legal / Policy	Trilingual FRA documentation (tribal language / Assamese / Hindi); climate vulnerability mapping with community co-production	Ministry of Tribal Affairs / MoEFCC	High	Exercise of forest rights; community voice in climate adaptation planning
Knowledge Preservation	Digital IEK archive with community IPR under WIPO framework; integration with national climate observation networks	Dept. of Forests / NIT Arunachal	Medium	Long-term knowledge sovereignty; IEK as climate observation infrastructure
Journalism	Tribal environmental journalism fellowship with regional universities; community correspondent networks for environmental monitoring	UGC / Tribal Welfare / Media institutions	Long-term	Sustainable local media ecology for climate and environmental governance

Source: Author's synthesis from field data and comparative policy analysis. Priority levels: High = implementable within existing institutional mandates; Medium = requires new inter-institutional coordination; Long-term = requires structural funding and legislative commitment.

A critical finding from the qualitative data warrants emphasis for policy design. Existing indigenous communicative ecologies are not pre-modern survivals awaiting replacement by formal media. They are functional environmental governance systems that have sustained complex ecological relationships across centuries in landscapes that formal science is only beginning to document. Any intervention that supplements these systems with modern media while leaving their structural subordination intact will reproduce communicative colonialism in a new technical register. Effective policy must therefore be designed in dialogue with indigenous communicative forms rather than as their replacement — anchoring community radio, digital archiving, and climate information initiatives in the institutional architecture of indigenous governance: apex tribal bodies, women's self-help group networks, nyibo ritual specialists, and gaon panchayat systems that already function as ecological knowledge distribution infrastructure.

7 Conclusion

This paper has documented and theorised a fundamental governance problem in one of the world's most significant biodiversity regions: the structural communicative exclusion of the communities with the deepest ecological knowledge of ongoing environmental change from the institutions responsible for governing that change. Through original mixed-methods fieldwork across three districts and two tribal community groups in Arunachal Pradesh, it has shown that communities recording near-zero access to formal environmental information channels simultaneously record near-universal recognition of locally observable ecological and climate changes. The communities most excluded from formal environmental governance are among the most ecologically attentive.

The concepts of environmental information silence and communicative colonialism, grounded empirically in the data presented here, offer analytical purchase on a problem that neither the digital divide literature nor the IEK literature captures in full. Environmental information silence is a governance condition, not a development deficit. Communicative colonialism is a structural mechanism, not a policy oversight. Their identification does not lead to straightforward technological solutions; it leads to the recognition that the governance architecture of environmental communication in biodiversity-critical regions of the Global South requires fundamental redesign — redesign that starts from the communicative ecologies of the communities who know these landscapes best.

The Eastern Himalayan Biodiversity Hotspot contains ecological dynamics of global consequence. The communities living inside it are its most experienced and knowledgeable observers. The mediated margins of Arunachal Pradesh are not peripheral to the project of biodiversity and climate governance. They are its most consequential and most neglected frontier.

Declarations

Competing Interests

The author declares no competing financial or non-financial interests.

Ethics Approval and Consent to Participate

All procedures involving human participants were carried out in accordance with the ethical standards of the Institutional Research Ethics Committee, Arunachal Pradesh University, Pasighat, and in accordance with the ethical guidelines of the Indian Council of Social Science Research (ICSSR). The protocol was approved by the Institutional Research Ethics Committee, Arunachal Pradesh University (Approval Reference: APU/MC/Ethics/2023-07). Procedures were further conducted in accordance with the principles of the Declaration of Helsinki (1964) and its subsequent revisions as applicable to social science research. Informed consent was obtained from all individual participants prior to data collection. Participation was entirely voluntary. Community-level permission was obtained from gaon panchayats and, for Puroik villages, from the relevant community apex body.

Funding

This research received no specific funding from any public, commercial, or not-for-profit funding agency.

Author Contribution

P.T. conceived and designed the study, conducted fieldwork and data collection, performed the analysis, and wrote the manuscript in its entirety.

Data Availability

The datasets generated and analysed during the study are available from the corresponding author on reasonable request, subject to institutional data governance requirements.

References

1. Armitage D, Berkes F, Doubleday N (eds) (2008) Adaptive co-management: Collaboration, learning, and multi-level governance. UBC
2. Berkes F (2012) Sacred ecology (3rd ed.). Routledge. https://doi.org/10.4324/9780203123843
3. Berkes F, Colding J, Folke C (2000) Rediscovery of traditional ecological knowledge as adaptive management. Ecol Appl 10(5):1251–1262. https://doi.org/10.1890/1051-

0761(2000)010[1251:ROTEKA]2.0.CO;2

4. Berkes F, Berkes MK, Fast H (2007) Collaborative integrated management in Canada's north: The role of local and traditional knowledge and community-based monitoring. Coastal Manage 35(1):143–162
5. Berkes F, Folke C, Colding J (eds) (2003) Navigating social-ecological systems: Building resilience for complexity and change. Cambridge University Press
6. Bhaumik S (2009) Troubled periphery: The crisis of India's northeast. SAGE
7. Biggs R, Schlüter M, Schoon ML (eds) (2015) Principles for building resilience: Sustaining ecosystem services in social-ecological systems. Cambridge University Press
8. Boykoff MT, Boykoff JM (2004) Balance as bias: Global warming and the US prestige press. Glob Environ Change 14(2):125–136. https://doi.org/10.1016/j.gloenvcha.2003.10.001
9. CBD (Convention on Biological Diversity) (2010) Aichi Biodiversity Targets. Secretariat of the Convention on Biological Diversity. https://www.cbd.int/sp/targets/
10. Census of India (2011) Primary census abstract for scheduled tribes; District census handbook — Arunachal Pradesh. Office of the Registrar General and Census Commissioner, Government of India
11. Colding J, Folke C (2001) Social taboos: 'Invisible' systems of local resource management and biological conservation. Ecol Appl 11(2):584–600
12. Cox R (2010) Environmental communication and the public sphere, 2nd edn. SAGE
13. Creswell JW, Plano Clark VL (2018) Designing and conducting mixed methods research, 3rd edn. SAGE
14. Entman RM (1993) Framing: Toward clarification of a fractured paradigm. J Communication 43(4):51–58. https://doi.org/10.1111/j.1460-2466.1993.tb01304.x
15. FAO (2022) Apatani cultural landscape, India — Globally Important Agricultural Heritage System (GIAHS). Food and Agriculture Organization of the United Nations. https://www.fao.org/giahs/giahsaroundtheworld/designated-sites/asia-and-the-pacific/apatani/en/
16. Folke C, Hahn T, Olsson P, Norberg J (2005) Adaptive governance of social-ecological systems. Annu Rev Environ Resour 30:441–473. https://doi.org/10.1146/annurev.energy.30.050504.144511
17. Forest Survey of India (2023) India state of forest report 2023. Ministry of Environment, Forest and Climate Change, Government of India
18. Gadgil M, Berkes F, Folke C (1993) Indigenous knowledge for biodiversity conservation. Ambio 22(2/3):151–156
19. Hannigan J (2006) Environmental sociology, 2nd edn. Routledge
20. Kunming-Montreal Global Biodiversity Framework (2022) COP15 Decision 15/4. Convention on Biological Diversity. https://www.cbd.int/gbf
21. Maffi L (2005) Linguistic, cultural, and biological diversity. Annu Rev Anthropol 34:599–617. https://doi.org/10.1146/annurev.anthro.34.081804.120437
22. McDuie-Ra D (2012) Northeast migrants in Delhi: Race, refuge and retail. Amsterdam University

23. Mignolo WD (2009) Epistemic disobedience, independent thought and decolonial freedom. Theory Cult Soc 26(7–8):159–181. https://doi.org/10.1177/0263276409349275
24. Ministry of Law and Justice (2006) The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006. Government of India Gazette, No. 2 of 2007
25. Mohanty AK (2009) Multilingual education for social justice: Globalising the local. Int J Sociol Lang 199:183–205. https://doi.org/10.1515/IJSL.2009.039
26. Moser SC, Dilling L (eds) (2007) Creating a climate for change: Communicating climate change and facilitating social change. Cambridge University Press
27. Myers N, Mittermeier RA, Mittermeier CG, da Fonseca GAB, Kent J (2000) Biodiversity hotspots for conservation priorities. Nature 403:853–858. https://doi.org/10.1038/35002501
28. National Action Plan on Climate Change (NAPCC) (2008) Prime Minister's Council on Climate Change. Government of India
29. National Family Health Survey-5 (NFHS-5) (2021) State fact sheet — Arunachal Pradesh 2019–21. Ministry of Health and Family Welfare, Government of India
30. Nortey E, Asibey MO, Agyei F (2026) From information to action: climate literacy, everyday practices, and the diffusion of climate services in urban Ghana. Reg Envriron Chang 26:110. https://doi.org/10.1007/s10113-026-02601-2
31. Ostrom E (1990) Governing the commons: The evolution of institutions for collective action. Cambridge University Press
32. Quijano A (2000) Coloniality of power and Eurocentrism in Latin America. Int Sociol 15(2):215–232. https://doi.org/10.1177/0268580900015002005
33. Rai SC (2005) Apatani paddy-cum-fish cultivation: An indigenous hill farming system of North-East India. Indian J Traditional Knowl 4(1):65–71
34. Ramakrishnan PS (2007) Traditional forest knowledge and sustainable forestry: A northeast India perspective. For Ecol Manag 249(1–2):91–99. https://doi.org/10.1016/j.foreco.2007.05.036
35. Rusere F, Stanley M, Kliskey A (2026) Reg Envriron Chang 26:115. https://doi.org/10.1007/s10113-026-02597-9. A systematic review of studies comparing environmental change perceptions and instrument-derived meteorological data
36. de Santos B S (2014) Epistemologies of the South: Justice against epistemicide. Paradigm
37. Schiller HI (1976) Communication and cultural domination. International Arts and Sciences
38. Taba P (2023) Media representation and accessibility of the Puroik tribe of Arunachal Pradesh [Unpublished doctoral thesis]. Rajiv Gandhi University, Itanagar, Arunachal Pradesh, India
39. Telecom Regulatory Authority of India (TRAI) (2023) Telecom subscription data — State-wise subscriber base, December 2023. Government of India. https://www.trai.gov.in
40. Tomlinson J (1991) Cultural imperialism: A critical introduction. Pinter
41. United Nations Human Rights Council (2022) Report of the Special Rapporteur on the Rights of Indigenous Peoples (A/HRC/51/28). United Nations General Assembly

42. van Dijk JAGM (2006) Digital divide research, achievements and shortcomings. Poetics 34(4–5):221–235. https://doi.org/10.1016/j.poetic.2006.05.004
43. Warschauer M (2003) Technology and social inclusion: Rethinking the digital divide. MIT Press
44. Wilson S (2008) Research is ceremony: Indigenous research methods. Fernwood Publishing
45. Wynter S (2003) Unsettling the coloniality of being/power/truth/freedom: Towards the human, after Man, its overrepresentation — An argument. CR: New Centennial Rev 3(3):257–337. https://doi.org/10.1353/ncr.2004.0015