SAARC JOURNAL OF SOCIAL SCIENCE
Vol. 3, No. 2, 2025, pp. 113-128 • ISSN: 2583-9950

URL: http://www.pbjournals.com/sjss
Publisher of Open Access Journals

Indigenous Knowledge Systems and Artificial Intelligence: Towards Epistemic Justice and Inclusive Innovation

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To Cite this Article

Mayadhar Sethy (2025). Indigenous Knowledge Systems and Artificial Intelligence: towards Epistemic Justic and Inclusive Innovation. *SAARC Journal of Social Science,* 3: 2, pp. 113-128.

Abstract: Indigenous Knowledge Systems (IKS) embody centuries of cumulative experiential wisdom, deeply rooted in ecological, spiritual, and communal contexts. Despite their rich epistemological frameworks, IKS remain systematically marginalized within dominant technological and scientific paradigms. As Artificial Intelligence (AI) becomes integral to global systems of governance, development, and resource allocation, there is a pressing need to critically interrogate its epistemological underpinnings. This paper examines the tensions and possibilities at the intersection of IKS and AI, advocating for a decolonial, participatory, and ethically grounded approach to technological development. Drawing on interdisciplinary literature, Indigenous-led initiatives, and critical AI ethics, it argues for reimagining AI not merely as a technological tool but as a sociotechnical construct shaped by diverse epistemologies. The integration of IKS can enhance AI's capacity for contextual responsiveness, justice, and sustainability.

Keywords: Indigenous Knowledge Systems, Artificial Intelligence, Epistemic Justice, Decoloniality, Data Sovereignty, Participatory AI, Indigenous Epistemologies

1. Introduction

The release of ChatGPT by OpenAI in late 2022 marked a significant moment in the public visibility of Artificial Intelligence (AI). While AI has long been embedded in systems such as predictive policing and credit scoring, large language models (LLMs) like ChatGPT captured public imagination through their capacity to generate coherent and seemingly intelligent language. This excitement, however, is accompanied by critical questions about power, representation, and epistemology,

Received : 17 August 2025 • **Revised :** 28 August 2025 • **Accepted :** 05 September 2025 • **Published :** 26 November 2025

concerns rooted in science and technology studies (STS), media theory, and decolonial scholarship.

Despite their apparent novelty, these technologies emerge within longstanding histories of colonial knowledge production, capitalist accumulation, and technocratic governance. Data-driven systems, including LLMs, are deeply shaped by ideologies of racial capitalism [1]– [3], operating through vast infrastructures of surveillance, extraction, and classification. They do not merely "learn" from data but inherit and reproduce embedded historical inequalities. Central to this reproduction are epistemological hierarchies privileging abstract, quantifiable, and scalable knowledge rooted in Euro-Western Enlightenment rationalism, which valorizes objectivity, generalizability, and linear causality [4], [5].

In contrast, Indigenous Knowledge Systems (IKS) emphasize relationality, land, oral tradition, and accountability [6]– [9]. The exclusion of IKS from mainstream AI development reflects broader patterns of epistemic injustice [10] and digital colonialism [11]. When translated into data science logic, Indigenous knowledges risk reduction to "cultural data," stripped of context, ethics, and cosmologies.

Recent interventions by Indigenous scholars and technologists have sought to resist this epistemic extraction. Frameworks such as the Indigenous Protocol and Artificial Intelligence Position Paper [12] and the CARE Principles for Indigenous Data Governance [13] advocate for centering Indigenous ethics, community control, and collective consent in technology design. These initiatives challenge the framing of AI as a purely technical issue, positioning it instead as a site of cultural politics and sovereignty.

This article draws on critical Indigenous methodologies [14], decolonial theory [15], and platform studies [16], [17] to situate AI as a political and commodified platform. We explore how Indigenous knowledges are excluded, appropriated, or sanitized within AI and consider what it would mean to build AI anchored in relationality, storytelling, and community accountability.

We view this moment as a critical juncture, akin to Foucault's notion of problematization [18], where dominant AI paradigms are contested by alternative technological and epistemic futures. As AI increasingly impacts land use, language preservation, health care, and environmental monitoring, Indigenous communities emerge as agents of technological resistance and resurgence. This article contributes to Indigenous algorithmics efforts to encode values like kinship, reciprocity, and narrative logic into computational systems [12], [19] and broader conversations

about epistemic pluralism, platform power, and sociotechnical imagination. Ultimately, the future of AI depends not on perfecting universal intelligence, but on embracing diverse intelligences and knowledges to foster equitable and sustainable futures.

2. Literature Review

Artificial Intelligence (AI) is often portrayed as the pinnacle of human innovation neutral, objective, and universally applicable. However, beneath these claims lie deep epistemic assumptions rooted in the political and historical lineage of Western scientific rationalism. Critical scholarship from feminist epistemology, Indigenous studies, and decolonial computing has challenged these assumptions by exposing the violence of epistemic exclusion and the risks of algorithmic enclosure [4], [5], [20].

At the margins of this techno-scientific terrain are Indigenous Knowledge Systems (IKS) holistic, place-based, and relational epistemologies that encompass empirical observation alongside cosmology, governance, spirituality, ecological stewardship, and community law [6], [9], [8]. Transmitted through oral tradition, ceremony, and interspecies relationships, IKS emphasize lived experience, affect, and ethical reciprocity [7]. Their foundational principles interdependence, responsibility, and respect for land and kin stand in direct contrast to the abstraction, universality, and scalability valorized by dominant AI paradigms.

This epistemological divergence has material consequences. The imposition of Western data regimes over Indigenous contexts constitutes what scholars' term "algorithmic colonialism" [21], wherein data extraction, surveillance, and algorithmic governance replicate historical logics of resource exploitation without consent. Couldry and Mejias describe this phenomenon as "data colonialism" [11], a process by which life itself is appropriated as raw material for capitalist computation. These critiques echo de la Cadena and Blaser's concept of the "pluriverse," which advocates for recognizing multiple ontologies that challenge the hegemony of Western worldviews [22].

In response, initiatives such as the Indigenous Protocol and Artificial Intelligence Position Paper [12] and the CARE Principles for Indigenous Data Governance [13] offer radical reorientations. Rather than retrofitting Indigenous values into existing digital frameworks, these interventions call for transforming infrastructures by centering Indigenous concepts of collective consent, cultural continuity, and

community-defined benefit. The CARE Principles Collective Benefit, Authority to Control, Responsibility, and Ethics represent a decisive departure from the dominant FAIR data principles (Findable, Accessible, Interoperable, Reusable), which assume open access is a universal good without accounting for histories of data violence and cultural misappropriation [13].

A growing body of literature on Indigenous data sovereignty further deepens this critique. Scholars such as Kukutai and Taylor [23] and Walter and Suina [24] argue that sovereignty extends beyond controlling dataset access to reclaiming the authority to define what constitutes data, who interprets it, and for what purposes. This shift marks a paradigmatic move from representation to self-determination, and from technical design to epistemic governance. For example, Te Mana Raraunga (the Māori Data Sovereignty Network) demonstrates how IKS can function as both resistance and resurgence, asserting *tino rangatiratanga* (self-determination) against digital colonization.

Beyond data governance, an emergent discourse on Indigenous algorithmics seeks to encode Indigenous relationality, temporality, and ethics into computational systems [12], [25]. This raises vital questions: What would it mean to design AI that listens to stories, honors land-based knowledge, and learns through reciprocity rather than extraction? Such approaches not only critique dominant AI modes but reimagine computation as a relational practice, embedded in place, history, and community.

In summary, the literature on IKS and AI highlights a fundamental tension between technocratic universalism and epistemic pluralism. It also offers generative possibilities, envisioning AI not as a colonizing force but as a platform for resurgence, refusal, and world-building. The challenge lies not in superficially integrating IKS into existing AI models but in dismantling the epistemological supremacy of those models altogether.

3. Methodology

This study adopts a qualitative, interpretive research design that is grounded in the principles of critical Indigenous methodologies [26]– [28]. These methodologies are not simply tools for data collection; they are epistemological and ethical frameworks that recognize knowledge as relational, embodied, and contextually situated. As Linda Tuhiwai Smith emphasizes in *Decolonizing Methodologies*, Indigenous research must begin with the political imperative of decolonization and

the resurgence of Indigenous sovereignty not only over land and governance, but over knowledge itself [26].

Our methodological stance is thus informed by three overlapping commitments:

(1) to epistemic justice, which foregrounds the structural exclusion of Indigenous knowledges in AI discourse [29];

(2) to relational accountability, which positions the researcher as responsible to the communities, histories, and land from which knowledge emerges [28]; and

(3) to reflexive critique, which interrogates the norms and values embedded within dominant AI infrastructures [30], [31].

3.1. Data Sources and Selection Criteria

The empirical foundation of this study draws on a multiplicity of qualitative sources, selected for their relevance to both Indigenous knowledge systems and AI development:

- Peer-reviewed academic literature in the fields of Indigenous studies, AI ethics, data sovereignty, and decolonial computing.
- Policy frameworks and guidelines such as the CARE Principles [13], the OCAP framework [32], and national Indigenous data strategies (e.g., Te Mana Raraunga).
- Documented case studies of Indigenous-led or Indigenous-partnered AI and data projects, including language revitalization tools, land surveillance systems, and algorithmic design workshops [12], [33].

This approach privileges texts and initiatives that are authored, led, or critically informed by Indigenous scholars, practitioners, and communities, aligning with calls in the literature to avoid extractive forms of knowledge production [24], [34].

3.2. Analytical Framework

The analysis is framed by a decolonial epistemological perspective [15], which interrogates the colonial foundations of scientific modernity and advocates for the recovery and reinvention of other ways of knowing. This involves a process of epistemic disobedience, refusing the singular authority of Eurocentric rationality and opening space for pluriversal futures [35].

We also draw on insights from Science and Technology Studies (STS), particularly the notion that technologies are never neutral but are shaped by and productive of social orders and power relations [30], [36]. Through this lens, AI systems are understood as sociotechnical assemblages that co-produce knowledge, governance, and subjectivity. The interface between IKS and AI is thus not merely technical, but deeply political—raising questions about who gets to design, to define, and to decide.

To operationalize these frameworks, we employed a critical thematic analysis, identifying key tensions, silences, and possibilities across our data sources. Attention was given to how Indigenous knowledge is framed (or erased), how power is distributed in participatory processes, and how epistemological assumptions are encoded into technical systems.

3.3. Positionality and Ethics

The research process is also informed by reflexive positionality, recognizing that all knowledge is situated [5]. As non-neutral actors within a landscape of ongoing settler colonialism, researchers must be accountable to the communities whose knowledges they engage with. Following the guidance of Indigenous scholars [37], [9], we treat relationality not as metaphor, but as method one that requires humility, consent, and continuous engagement.

Ethical considerations extend beyond institutional review to include community-defined protocols, respect for cultural sovereignty, and commitment to reciprocal benefit. Where possible, this study uplifts Indigenous-authored sources and refrains from speaking over or for Indigenous peoples, instead seeking to amplify and align with their visions for technological sovereignty.

4. Analysis and Discussion

4.1. Epistemological Divergences: Between Relational Worlds and Algorithmic Abstractions

The foundational assumptions of artificial intelligence namely abstraction, objectivity, scalability, and universality are deeply entangled with Euro-Western epistemological traditions rooted in Enlightenment rationalism and positivist science [4], [38]. These traditions valorize quantification, predictability, and decontextualized knowledge, privileging what Haraway calls the "god trick" of disembodied objectivity [5].

By contrast, Indigenous Knowledge Systems articulate a relational ontology and epistemology that centers responsibility, interconnectedness, and embodied wisdom [8], [28], [9]. Knowledge is not a commodity to be extracted or stored in datasets but a living practice interwoven with place, kinship, and the non-human world [39]. This ontological divergence exposes a critical tension: the datafication logic of AI systems reducing the world into discrete, computable units fundamentally contradicts the holistic and contextual nature of IKS. As Ahenakew argues, Indigenous knowledge challenges not only what counts as data but how data should relate to ethics, memory, and futurity [40]. Hence, epistemic misalignment is not merely a technical issue; it is a political and philosophical impasse that requires a profound rethinking of AI's foundational architectures.

4.2. Data Sovereignty and Digital Colonialism: From Extraction to Consent

AI development is inherently data-driven, and the imperatives of "open data" and mass surveillance have fueled what Couldry and Mejias call "data colonialism" [11] a new regime of accumulation where human and ecological life are continuously mined for value. For Indigenous communities, this extraction often mirrors historical patterns of land theft and epistemic erasure, now extended into the digital realm [37], [1].

Indigenous data sovereignty movements, such as those guided by the OCAP® principles [32] and the CARE Principles [13], challenge the dominant narrative that data must be open and universally accessible. These frameworks foreground collective rights, cultural protocols, and the principle of "data for governance, not governance of data" [41]. Such principles offer a counter-epistemology to neoliberal data infrastructures, emphasizing that data is not neutral but relational and accountable.

As Walter and Suina argue, any AI system that engages with Indigenous knowledge without explicit consent and community governance risks becoming an extension of settler colonial control [24]. Without Indigenous-led frameworks, AI risks becoming not a tool of empowerment, but a mechanism of continued dispossession.

4.3. Participatory Design and Indigenous Algorithmics: Reclaiming the Code

The integration of Indigenous perspectives into AI development must move beyond tokenistic consultation toward genuine co-design processes that redistribute power

in technological decision-making [42]. Participatory design, when implemented with depth and accountability, offers pathways for Indigenous communities to shape not just AI's outputs but its very logic, architecture, and value systems [43].

Emerging work in Indigenous algorithmics represents a radical reimagining of computation—one that encodes values of kinship, oral storytelling, reciprocity, and place-based ethics into algorithmic design [12]. Storytelling, a central mode of Indigenous knowledge transmission, can inform narrative-based AI systems that prioritize context, emotion, and memory over abstract deduction. This orientation aligns with the work of Noble and D'Ignazio & Klein, who call for feminist and decolonial data science that values situated knowledge and challenges algorithmic dominance [2], [44].

By embedding Indigenous cosmologies within code, communities assert not only technical agency but epistemic sovereignty, transforming AI from an instrument of surveillance into a medium for resurgence and resistance.

4.4. Applications: Between Revitalization and Resistance

Despite the risks, AI technologies also hold transformative potential when they are developed with consent, accountability, and Indigenous leadership. Across the globe, communities are adapting AI for language revitalization, environmental protection, and land defense, recasting technological tools in the service of Indigenous resurgence [45], [33].

Projects like FirstVoices, which use AI to preserve and teach endangered Indigenous languages, illustrate how digital technologies can be harnessed to sustain cultural continuity. In the Amazon, Indigenous communities are deploying machine learning and satellite analytics to monitor deforestation and document illegal encroachments, transforming AI into a tool of land protection and political advocacy [22], [46].

These initiatives reflect a broader pattern of technological appropriation and re-signification, where communities actively reshape digital tools to reflect their values and cosmologies. As Tuck and Yang caution, however, such engagements must be grounded in sovereign futurity, not subsumed by frameworks that simply seek to "include" Indigenous people within existing systems [34].

5. Case Studies

To move beyond theoretical critiques and towards material interventions, this section examines three illustrative case studies where Indigenous communities and

actors are actively engaging, reshaping, and reclaiming AI and data technologies. These examples reflect not only the challenges of digital colonialism, but also the generative capacity of Indigenous-led technological innovation grounded in sovereignty, relationality, and place.

5.1. Te Mana Raraunga: Māori Data Sovereignty and Algorithmic Ethics

Te Mana Raraunga, the Māori Data Sovereignty Network, represents a powerful articulation of self-determined data governance rooted in *tikanga Māori*, a system of customary values and ethics that frames Māori relationships to land, community, and knowledge [47], [48]. Formed in response to growing concerns about data extraction, misrepresentation, and invisibilization, the collective asserts that data about Māori people, resources, and environments must be governed by Māori, for Māori, according to Māori protocols. By centering *whakapapa* (genealogy), *mana* (authority), and *kaitiakitanga* (guardianship), Te Mana Raraunga challenges the technocratic assumptions of "neutral" data infrastructures. The collective has been instrumental in shaping national digital policy in Aotearoa/New Zealand, including input into AI governance frameworks, the New Zealand Algorithm Charter, and COVID-19 data practices. Crucially, this initiative reframes AI not as a tool to be tamed, but as a space for ontological negotiation, where Māori epistemologies contest and reshape the very terms of technological engagement. Their work exemplifies how epistemic sovereignty and digital ethics are inseparable, and how Indigenous-led governance can shift national debates about algorithmic accountability.

5.2. Indigenous AI Gatherings: Reclaiming Space in Global AI Discourse

In 2019, the Indigenous Protocol and Artificial Intelligence Working Group, in collaboration with international partners, hosted the Indigenous AI Workshop at the NeurIPS conference, an elite site in global AI research. This gathering was groundbreaking not only because it brought Indigenous voices into a field where they are often absent, but because it reframed AI as a cultural and ethical practice, not merely a technical one [49]. Participants engaged in critical dialogue about how storytelling, protocol, and relationality could inform AI design. These conversations culminated in the Indigenous Protocol and Artificial Intelligence Position Paper, a document that sets forth guidelines for building AI in alignment with Indigenous worldviews. Rather than seeking representation within dominant systems, the initiative foregrounds epistemic pluralism and redefines what AI can be when

rooted in Indigenous ontologies. This case demonstrates how spaces of high-level AI discourse can be repurposed as platforms for epistemic justice. It also underscores the importance of gatherings, not only as knowledge exchange, but as ceremony, community-building, and sovereignty in action [49]. In doing so, Indigenous AI workshops illuminate possibilities for protocol-driven AI that is not only responsive to context but spiritually and ethically attuned.

5.3. Amazonian Territories: AI for Land Defense and Environmental Justice

In the face of intensifying ecological violence, Indigenous communities across the Amazon Basin have begun to deploy AI tools, satellite imagery, geospatial mapping, and machine learning to resist illegal deforestation, monitor biodiversity, and assert territorial sovereignty [50], [51]. In partnerships with NGOs and academic institutions, these communities co-develop technologies that are adapted to local knowledge, ecological rhythms, and political struggles. One notable example includes collaborations with the Rainforest Foundation and Global Forest Watch, where machine learning algorithms are trained to detect early signs of forest incursions, enabling rapid response teams to intervene. Yet, unlike technocratic models of conservation, these projects are embedded within Indigenous cosmologies that understand forests as kin, not resource and technology as a means of defending life, not optimizing productivity. These practices exemplify what Simpson (2017) calls "grounded normativity" place-based ethics that emerge from long-standing relationships with land [52]. Rather than being passive recipients of AI, Amazonian Indigenous communities are active agents of environmental data sovereignty, using digital tools as extensions of ancestral governance and resistance to settler-capitalist encroachment.

Synthesis: From Case to Critique

These case studies are not isolated successes but expressions of Indigenous futurity in digital terrains. Together, they show how communities are asserting not only rights over data and technologies but also cosmological frameworks that contest the universalism of Western AI. They challenge the foundational logic of AI systems that prioritize abstraction over relation, efficiency over ethics, and scalability over place. What unites these initiatives is not a rejection of AI per se, but a refusal to engage on extractive, colonial terms. They reveal the possibility of AI otherwise: technologies that are accountable to land, embedded in community, and shaped

by relational ontologies. In a moment when AI is rapidly becoming infrastructural to governance, economy, and ecology, these examples offer a crucial reminder: the most radical innovation may not be in building smarter machines, but in building more just relations among humans, non-humans, and the systems we design.

6. Challenges

While the imperative to integrate Indigenous Knowledge Systems (IKS) into AI development is increasingly recognized, the path forward is marked by formidable challenges not only technical, but structural, ontological, and political.

6.1. Infrastructural and Institutional Asymmetries

One of the most persistent obstacles is the asymmetry in technological infrastructure between Indigenous communities and mainstream AI research institutions. Many communities face systemic underinvestment in digital infrastructure, including access to reliable internet, hardware, and technical training [53]. These material disparities are not neutral; they are a direct consequence of historical dispossession, settler colonial governance, and ongoing racial capitalism [34], [54]. Even when infrastructure is available, institutions that control AI development, universities, corporations, government agencies are often ill-equipped or unwilling to engage with IKS in meaningful ways. Institutional inertia, colonial epistemologies, and extractive funding models limit the scope of Indigenous-led innovation, frequently reducing Indigenous participation to symbolic inclusion or "consultation" rather than shared governance or authorship [26], [37].

6.2. Epistemic Hierarchies and Reductionism

A second critical barrier is epistemic hierarchy: the privileging of Western scientific paradigms as universally valid while positioning IKS as subjective, anecdotal, or non-rational. This epistemic violence manifests in the translation of Indigenous knowledges into formats legible to AI systems, often resulting in reductionism, abstraction, and depoliticization [40]. For instance, when oral traditions are reduced to textual data or spiritual cosmologies are flattened into "belief systems," the relational and ceremonial dimensions of knowledge are lost. Moreover, algorithmic architectures are designed to process information according to logics of efficiency, prediction, and generalization, making it difficult to encode knowledge systems grounded in context, reciprocity, and affect. This tension calls not merely for

technical innovation but for epistemic humility, a willingness to decenter dominant frameworks and reimagine what computation itself could become.

6.3. Toward Hybrid Knowledge Infrastructures and Capacity Building

Despite these challenges, the way forward is not foreclosed. There is growing momentum toward developing hybrid knowledge infrastructures that enable co-presence, rather than co-option, of IKS and computational systems [30], [49]. Such infrastructures must be co-designed with Indigenous communities, grounded in protocols of consent, trust, and collective governance, and attuned to non-Western ontologies of time, land, and knowledge. Equally vital is the investment in Indigenous computing education. Rather than framing coding and AI literacy as neutral "skills," educational reforms must embed Indigenous philosophies, aesthetics, and ethics into computational thinking [39]. Initiatives such as Indigenous AI fellowships, land-based tech education, and tribally governed research centres are essential for cultivating technological sovereignty not simply access, but control.

7. Conclusion

The convergence of Indigenous Knowledge Systems and Artificial Intelligence is a contested terrain, one fraught with histories of extraction and violence, but also ripe with possibility. As AI continues to shape ecological futures, political institutions, and everyday life, the stakes of epistemic exclusion become ever more profound. What is at issue is not simply who uses AI, but whose ways of knowing and being are inscribed into the systems that increasingly govern our world. To move toward ethical and sustainable AI futures, it is imperative to rupture the epistemological monoculture that currently underpins algorithmic technologies. This requires more than technical "fixes" or representational inclusion. It calls for a reorientation of the very foundations of AI: from extraction to reciprocity, from abstraction to relation, from prediction to responsibility.

Integrating IKS into AI is thus not a peripheral concern, but a central ethical and political project. It is a call to reimagine intelligence not as computational supremacy, but as the capacity to live well with others human and more-than-human in reciprocal and just relation. As Indigenous scholars and technologists have long argued, this vision is not utopian; it is grounded in millennia of knowledge, survival, and futurity. In a world increasingly governed by systems that claim objectivity while reproducing inequality, the integration of Indigenous knowledge represents a path

toward epistemic justice, technological decolonization, and planetary survivance. The task ahead is urgent not only to build AI that includes Indigenous voices, but to build AI otherwise.

Acknowledgements

We sincerely thank the anonymous referees for their insightful feedback, which greatly improved this study. We also acknowledge all the scholars and academic works whose ideas have been invaluable to this research.

Funding Information

This study did not receive any external funding.

Disclosure Statement

The authors declare that there are no potential conflicts of interest related to this work.

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