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Integrating Indigenous and Scientific Knowledge: Epistemic Justice, Decolonised Conservation Policy, and Artificial Intelligence

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Abstract

Conservation policy depends on digital technology, global rules, and scientific knowledge. As land degradation increases, conservation efforts are becoming more evidence-based and data-driven. Digital technology boosts technical skills and equips people to manage the environment at a larger scale. However, it reflects Western scientific culture to the neglect of indigenous and local knowledge, especially in the Global South, where most biodiversity hotspots overlap with indigenous lands. This paper examines the problems in the two knowledge systems in environmental governance. The focus is to decolonize conservation. Using epistemic justice, the paper highlights conservation projects and the interplay between colonial power and data-driven, technocratic solutions, often skewed towards data-driven, technocratic solutions over lived, place-based knowledge of indigenous origins. The paper also delved into the role of Artificial Intelligence (AI) in influencing conservation efforts. The research employed qualitative data and a desk study. It drew on political ecology, science and technology studies, indigenous studies, and sustainability research to try to establish a clearer view of what AI integration means for conservation. The results confirm the important role AI plays in environmental monitoring, environmental predictions, and informing decision-making. They reveal AI's tendency to exclude indigenous knowledge. The paper concludes that when combined, indigenous knowledge and AI tools provide the desired outcome. Therefore, co-existence is recommended to enhance knowledge sharing, improve local governance, and ensure indigenous control over data. Also, the combination process, AI has to leverage epistemic justice to ensure real collaboration, and indigenous self-determination and conservation decolonisation. Again, AI governance needs to be built on indigenous data sovereignty, accountability, and shared authority.

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INTRODUCTION

The way we govern the environment is changing quickly. Climate change is getting worse, biodiversity is disappearing at an alarming rate, and land is wearing out almost everywhere. All of these make it very difficult to protect the environment worldwide. Big sustainability plans these days keep pushing for policies grounded in science, continuous data tracking, and digital tools to help us better care for the environment. Even with all these new ideas and technologies, conservation results are all over the place. In fact, they are especially worse in indigenous lands and in the Global South's biodiversity hotspots (Braun & Clarke, 2013). More and more research shows that these problems are not just caused by technical issues or people breaking the rules. Instead, the real fights are about whose values and knowledge should shape conservation (Brockington, 2002). Conservation policies often put one kind of knowledge, usually what is seen as 'natural' or scientific, above others. So, the real question is: Whose view matters? When choices are made, whose priorities are important? The root of all this is a long-standing difference between indigenous and scientific knowledge systems. The 'two cultures' problem is often the term used to describe it. Snow (1959) explains the gap between science and the humanities, and the phrase stuck around in debates about the environment. What it really show is how Western science has kept itself at the top of the knowledge ladder, leaving other ways of knowing or viewing the world behind (Carroll et al., 2020).

OVERVIEW OF AI'S IMPACT ON THE CONSERVATION LANDSCAPE

While all of this is happening, AI is having a significant impact on conservation science. You have machine learning identifying species, AI modelling habitats, satellites tracking land use, and decision-making software helping fill data gaps and run things more smoothly. AI gives conservationists what they want: speed, scale, and accuracy. For instance, machine learning models can identify endangered species with up to 96% accuracy when there is sufficient high-quality data. Also, autonomous systems are already pointing out deforestation in tropical forests (de Sousa Santos, 2018). AI is even helping combine indigenous knowledge with satellite imagery to map marine habitats in Sanikiluaq, Canada. Given how quickly the marine ecosystem is changing, this is considered a significant step. Despite AI's important contributions, many researchers are starting to fight back. One cannot really think of AI as a neutral, political, or free

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tool. Every AI system shows the data it receives, the biases built into its models, and the context in which it operates. If these systems are built without indigenous people being involved, there is a risk of repeating the same old hierarchies that make indigenous knowledge invisible, extractive, or just plain wrong (World Economic Forum, 2025; ITU, 2025). Tsosie (2023:887-898) says it plainly: 'indigenous peoples should be seen as co-creators and stewards of knowledge,' not just as sources of data.

EPISTEMIC JUSTICE AS AN ANALYTICAL FRAMEWORK

A lot of people have been talking about epistemic justice lately, and for good reason. It is a way to demonstrate who gets heard and whose views are neglected when we decide what counts as 'real' knowledge.

The theory examines who is seen as trustworthy, who has power, and who gets to interpret. In other words, who gets to help shape the story in the first place? Some groups keep getting left out or misrepresented. When people talk about epistemic justice in environmental governance, they do not just mean giving marginalised groups a seat at the table for show (Chisom et al., 2024). It is about working together, sharing real power to make decisions, and learning from each other. Fricker (2017) divides it into two major problems. First, testimonial injustice happens when someone's ideas are ignored because of stereotypes or bias related to their identity. Secondly, hermeneutical injustice occurs when a marginalised group lacks the appropriate language or concepts within the mainstream system to comprehend their own experiences. A lot of recent work in conservation shows how indigenous people deal with both: they are not included in decisions, and even when science tries to include them, their stories get distorted or left incomplete. Badruddin (2025) argues that the Global South still struggles with this intellectual dependence. Language barriers, not enough resources, and indigenous knowledge being pushed aside, contribute to this struggle.

RESEARCH QUESTIONS AND OBJECTIVES

This study specifically investigates how historical and institutional frameworks in conservation have contributed to the epistemic exclusion and undervaluation of indigenous knowledge systems. It focuses on the origins of both Indigenous and scientific knowledge in conservation and identifies areas where individuals are excluded or overlooked; secondly, in what ways do current environmental governance policies and institutional practices either reinforce or challenge traditional knowledge hierarchies? It examines conservation policies within institutions and governance frameworks to determine support for or opposition to old knowledge hierarchies; and

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finally, what are the primary ethical risks and opportunities associated with the integration of Artificial Intelligence in conservation, regarding indigenous data sovereignty and decolonised governance? The objective is to reveal the real risks and opportunities of using AI to blend different knowledge systems in a decolonized approach to conservation, with a close eye on protecting indigenous data and control.

THEORETICAL UNDERPINNINGS

Indigenous Knowledge, Conservation, and Power

Since the start of the 2010s, the conservation literature has increasingly recognised the importance of Indigenous and local knowledge in protecting biodiversity, adapting to climate change, and making ecosystems more resilient (FAO, 2020). Indigenous knowledge systems are profoundly embedded in the interactions among people, land, and non-human entities that have persisted through time. Unlike reductionist methodologies, they emphasise the significance of reciprocity, responsibility, and the ethical dimensions of relationships with the natural world (Fricker, 2007). Indigenous peoples are the custodians of approximately 80% of the world's biodiversity, which remains relatively unscathed and resides in regions that frequently coincide with global biodiversity hotspots (Wildlife Conservation Society, 2025). Their traditional ecological knowledge (TEK), also known as indigenous ecological knowledge or Indigenous Knowledge Systems (IKS), is fundamentally the product of an ongoing, intergenerational adaptive management practice that has been meticulously refined (Haupt et al., 2022). Indigenous fire management in Australia, seasonal fishing closures in Pacific Island communities, and rotational agriculture systems in the Amazon exemplify advanced ecological governance rooted in local observation and spiritual, relational epistemologies (IPBES, 2019). Even though this is true, indigenous knowledge is still used in conservation in a biased, utilitarian way. Some consider that eco-initiatives use only certain parts of local knowledge, such as species indicators or seasonal calendars, and ignore the deeper cosmology and systems of governance that these pieces of knowledge derive from (ITU, 2025). This mechanism, also known as knowledge appropriation or epistemic extractivism, is how indigenous communities learn that their knowledge is being used to support dominant institutions without having to change these power structures or give up their rights to make decisions (Kalluri, 2020).

Historical Context: Fortress Conservation and Displacement

"Fortress conservation," a model created during colonial times that viewed environmental protection as something that could only be achieved by removing people from the land

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(Latulippe & Klenk, 2020), is not the only reason indigenous knowledge is not respected. This legacy continued to displace indigenous people by forcibly removing them from their traditional lands, making it illegal for them to use natural resources in the traditional ways, and treating indigenous peoples as opponents of conservation rather than as sources of knowledge and caretakers (Maracle et al., 2025). Even modern conservation projects are based on the same ideas that worked in the past. One example is the global biodiversity targets' goal of expanding protected areas (such as the Kunming-Montreal Framework's '30x30' goal). This still leads to disagreements over who owns the land, who can use its resources, and who has the right to govern it (WCS, 2025). If the conservation doesn't clearly protect indigenous rights and Free, Prior, and Informed Consent (FPIC), it could still take away people's land even while claiming to protect the environment (Mongabay, 2026).

Epistemic Justice and Decolonised Conservation Policy

Epistemic justice serves as a valuable analytical instrument for deconstructing such issues. As previously mentioned, there are two types of injustice: testimonial and hermeneutical, as Fricker (2007) explains. In conservation, the former refers to situations in which holders of indigenous knowledge are seen as merely sharing local stories rather than being acknowledged as experts, leading to a pattern of their discrediting (Nadasdy, 2003). When basic indigenous ideas like concentric ecology (the idea that everything is connected), relational autonomy, or being responsible for more than just human relatives do not have words or ideas that fit in with the dominant policy language, which is mostly about ecosystem services, the economics of nature, or biodiversity compensation (Nelson et al., 2025). An example of this is when indigenous peoples' stories about their connections to salmon or forests, as coming from family and therefore requiring mutual commitments, are almost always 'interpreted' or 'translated' through the scientific lens as 'cultural ecosystem services' or 'non-material benefits,' which removes the spiritual and ontological aspects that give the relationships their meaning (Nyamahono, 2024).

AI in Conservation Governance: Critical Perspectives

Since the middle of the 2010s, the use of AI in conservation has grown very quickly. AI-based tools are widely used and now standard for many applications, such as monitoring wildlife, tracking deforestation, modelling climate risk, and supporting law enforcement (Turnhout et al., 2013). People who support technology say that these kinds of changes make people more productive, more honest, and more likely to grow, especially in data-poor areas of the Global South (Whyte, 2017). Even now, a lot of big questions in AI research still do not have answers. And when algorithms make decisions, it is easy for

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accountability to get lost in the mix. That leaves the people affected by those choices with almost no way to push backers even to figure out why a particular conservation decision was made. The reasons are usually buried in proprietary code or tangled up in neural networks that hardly anyone can interpret. Without strong Indigenous data governance, AI turns into just another tool for extracting indigenous knowledge often without permission, without paying, and with no benefit coming back to the communities themselves.

METHODOLOGY

The research design utilises qualitative desk-based research methodologies grounded in the interpretive frameworks of indigenous studies, political ecology, and science and technology studies (Williamson et al., 2013). Desk-based research is a useful way to examine epistemic and policy debates because it brings together conceptual, empirical, and normative research from a wide range of academic fields and research areas worldwide (Nyamahono, 2024). The analysis investigates the influence of colonial histories and current digital infrastructures and knowledge systems on contemporary conservation practices, emphasising their impact on statistical accuracy and causal relationships.

The review concentrated on peer-reviewed journal articles, academic monographs, and institutional reports disseminated from 2012 to 2025. This time frame includes some important changes: discussions about ‘knowledge co-production’ in conservation (about 2014 to 2017), the emergence of decolonial and epistemic justice viewpoints in environmental research (beginning around 2016 and continuing), and the quick growth of AI in environmental governance since about 2018 (Whyte, 2017). Sources were identified through searches in major academic databases, including Scopus, Web of Science, Google Scholar, and JSTOR.

Table 1: Literature Search Terms by Domain

Domain	Search Terms
Indigenous knowledge	‘Indigenous knowledge,’ ‘Traditional Ecological Knowledge,’ ‘local knowledge,’ ‘community-based conservation’

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Epistemic justice	'Epistemic justice,' 'epistemic injustice,' 'decolonizing conservation,' 'knowledge pluralism'
Artificial Intelligence	'Artificial intelligence,' 'machine learning,' 'Deep learning,' 'digital conservation,' 'AI governance'
Environmental governance	'Environmental governance,' 'conservation policy,' "biodiversity management,' 'co-production'.

RESULTS AND DISCUSSIONS

THE EPISTEMIC DIVIDE IN CONSERVATION POLICY

Findings indicate that conservation policy continues to be grounded in a positivist epistemology that prioritises quantification, standardisation, and scalability as the primary indicators of 'quality' knowledge. Policy frameworks often focus on biophysical indicators, such as species abundance, carbon sequestration, and land cover classification, that can be monitored through satellite data and algorithmic analysis. In contrast, indigenous knowledge systems are inherently relational, place-based, and rooted in the moral and spiritual links between humans and non-humans. These systems operate on fundamentally different epistemological principles:

Table 2: Epistemological Differences in Knowledge Frameworks

Principle	Indigenous Knowledge Framework	Western Scientific Framework

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Accountability	Relational: Derived through mutual obligations with human and non-human kin	Objective: Derived through independent, passive observation and peer-review
Geography	Place, Specific: Knowledge is rooted in specific territories and seasons	Universal: Knowledge seeks to establish generalizable laws and principles
Validation	Intergenerational: Affirmed through centuries of practice and oral tradition	Experimental: Affirmed through replication and statistical Significance

This divide often results in indigenous stakeholders being excluded from the definition of conservation problems and goals. While they may be invited to participate in workshops, their knowledge is frequently 'fragmented' or 'mined' for specific data points—such as the presence of a particular species—while the deeper governance and spiritual contexts are ignored. This process, termed 'epistemic extractivism,' reinforces the dominance of scientific paradigms by treating indigenous knowledge as a resource to be harvested rather than a system to be respected.

Empirical evidence from South Africa highlights this friction. In the Dwesa, Cwebe Nature Reserve, a lack of mutual trust between reserve managers and the local Xhosa community has hindered conservation efforts. Managers often dismiss local ecological observations as 'stories' rather than evidence, while the community views managers as being out of touch with the land's spiritual and customary realities. Despite both parties sharing a goal of protecting marine and forest resources, the exclusion of indigenous knowledge from formal management plans has led to ongoing conflict and decreased conservation effectiveness.

TESTIMONIAL AND HERMENEUTICAL INJUSTICE

The research identified widespread instances of both testimonial and hermeneutical injustice in conservation governance. Testimonial injustice is evident in wildlife monitoring and climate adaptation projects where indigenous observations are treated as 'subjective opinions' that require scientific 'ground truthing' before being considered factual. For

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example, detailed reports from indigenous rangers on changing animal behaviour or weather patterns are often categorised as 'local anecdotal data' rather than expert evidence.

Hermeneutical injustice is equally pervasive, manifesting in the 'translation' of indigenous concepts into Western policy terms. A primary example is the concept of 'kincentric ecology'-the idea that humans are related to all living beings, which is often translated as 'cultural ecosystem services. This translation strips the relationship of its ontological power, treating nature as a provider of 'benefits' to humans rather than a community of relatives with whom humans share mutual responsibilities.

THE ROLE OF ARTIFICIAL INTELLIGENCE IN CONSERVATION

The integration of AI has introduced both transformative potential and significant epistemic risks. Current applications of AI include machine learning for camera trap analysis, deep learning for satellite-based habitat mapping, and predictive modelling for climate risk. These tools have demonstrated high efficiency; machine learning models can identify endangered species with 96% accuracy under optimal conditions.

However, the findings reveal a 'techno-elitist' trend in AI deployment. A survey of AI-driven conservation projects in India identified a significant gap in indigenous participation and in integrating indigenous knowledge.

Table 3: Integration of Local Knowledge in AI Conservation Projects

Level of Indigenous Integration	Percentage of Projects (India, 2018–2024)
No inclusion of Indigenous/Local Knowledge	63%
Minimal consultation with local communities	24%
Collaborative data design and planning	10%
Indigenous, led with AI as a tool	3%

The high percentage of projects that exclude local knowledge (63%) suggests that AI is often deployed as a top-down tool for 'remotely managed' conservation. This creates a risk of 'digital colonialism,' where AI systems analyse indigenous lands based on satellite imagery while the communities living on those lands lose their authority to manage their

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own resources.

Furthermore, many AI models operate as 'black boxes,' with their reasoning buried in proprietary code, leaving communities unable to challenge or understand the algorithmic decisions that affect their livelihoods.

PATHWAYS TOWARD DECOLONISATION

Despite these challenges, the research identified successful models of 'decolonised conservation' that effectively integrate indigenous sovereignty and AI. In Brazil, the Tembé tribe co-manages a project with Rainforest Connection that uses TensorFlow-based acoustic monitoring to detect illegal logging in real time. This project is guided by strong 'Free, Prior, and Informed Consent' (FPIC) protocols, ensuring that the technology serves the tribe's own patrolling priorities. Similarly, in Sanikiluaq, Canada, Inuit communities serve as 'technology co-creators,' using AI to integrate traditional land-use data with satellite imagery for marine habitat mapping.

These cases suggest that AI can mediate knowledge systems effectively when: indigenous communities own and control the data collection and storage; algorithms are transparent and co-designed to reflect community priorities; and technology is used to strengthen indigenous resource claims and customary governance.

Table 4: Global Case Studies of AI and Indigenous Knowledge

Case Study	AI Application	Outcome
Rainforest Connection (Brazil)	Acoustic sensors for chainsaw Detection	Reduced illegal logging; empowered indigenous patrols
Similipal Biosphere (India)	AI drone surveillance for fires/poaching	High efficiency, but limited community involvement
Coral Gardeners (French Polynesia)	Reef OS sensors for coral health	Indigenous, led restoration of heat, resistant corals

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Sanikiluaq (Canada)	AI, based marine habitat mapping	Strengthened resource claims and climate adaptation

The interpretation of these findings suggests that the ‘two cultures’ divide in conservation is not an inherent scientific necessity but a product of historical power dynamics that continue to be mediated through new technological infrastructures. The rapid rise of AI in environmental governance parallels trends observed in the media and information sectors, where algorithmic moderation and content personalization have fundamentally changed the nature of public discourse and regulatory compliance. In conservation, AI acts as a powerful mediator that can either bridge the gap between indigenous and scientific knowledge or entrench existing inequalities.

The findings indicate that AI systems are not neutral; they are embedded in the ‘political ecology’ of conservation. The high rate of exclusion of local knowledge in AI projects (Table 3) illustrates a ‘technocratic drift’ in environmental governance. When AI designs rely exclusively on standardized datasets and satellite imagery, they privilege ‘remote sensing’ over ‘place-based sensing.’ This shift has profound implications for indigenous sovereignty. If an algorithm identifies a specific area as a ‘high, priority conservation landscape’ without understanding the customary land uses or sacred geography of that area, it may recommend policies that lead to the displacement of indigenous peoples, a modern iteration of ‘fortress conservation’.

This dynamic is similar to the challenges faced in AI, driven media regulation, where algorithmic bias can unintentionally perpetuate stereotypes or silence marginalized voices. In the media industry, the lack of transparency in AI moderation systems has led to calls for ‘Fairness, Accountability, and Transparency’ (FAT) principles. In conservation, a similar movement is needed to ensure that AI reasoning is ‘explainable’ and accountable to the communities whose lands are being modeled. The current ‘black box’ nature of many AI tools creates an accountability gap, where decision-making power shifts from local stakeholders to remote programmers and data scientists.

Moving toward a decolonized approach requires the institutionalization of epistemic justice through robust data governance. The research synthesis identifies the CARE (Collective Benefit, Authority to Control, Responsibility, Ethics) Principles for Indigenous Data Governance as a critical framework. These principles emphasize that data about indigenous lands and people must remain under indigenous control and must be used in a way that provides tangible benefits to the community.

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Table 5: The CARE Principles in Environmental AI Governance

CARE Principle	Application in Conservation AI
Collective Benefit	AI models must prioritize community-defined ecological goals
Authority to Control	Communities must have the power to 'opt out' or restrict data access
Responsibility	Tech developers must establish long-term, reciprocal partnerships
Ethics	Algorithms must respect cultural protocols and sacred knowledge

The contrast between the 'FAIR' (Findable, Accessible, Interoperable, Reusable) principles, which are standard in Global North scientific research, and the 'CARE' principles highlights the fundamental tension in conservation data. While scientific bodies often push for 'open data' to improve modelling accuracy, indigenous communities may need 'protected data' to prevent the exploitation of their traditional knowledge or the unauthorised mapping of sacred sites. Reconciling these two approaches is essential for achieving a 'pluralistic' AI governance that respects both scientific innovation and indigenous sovereignty.

Despite the emergence of promising frameworks, empirical evidence reveals significant gaps in their implementation. For instance, while many projects claim to follow 'Free, Prior, and Informed Consent' (FPIC), surveys show that only a small fraction of community members feel they fully understand how their data is being used. This suggests that FPIC is often treated as a 'check box' exercise rather than a process of substantive engagement. Furthermore, the 'intellectual dependence' of Global South institutions on Northern technological infrastructures continues to marginalise indigenous scholarship and practice.

To address these gaps, conservation policy must move beyond simple 'consultation' and toward 'shared authority.' This means institutionalising indigenous laws and protocols within the design and assessment of AI systems. It also requires a shift in how conservation 'success' is measured. Instead of focusing solely on biophysical indicators, success should include metrics of epistemic justice, such as the degree of community control over digital infrastructures and the preservation of cultural, ecological relationships.

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Theoretically, this study contributes to the literature on AI and media by demonstrating that the challenges of algorithmic bias, transparency, and regulation are not limited to the information sector but are deeply embedded in the 'governance of nature'. The 'two cultures' problem in conservation is revealed as a struggle over the 'epistemological basis of information dissemination'—whether ecological truths are determined by algorithms or by lived relationships with the land.

Practically, the research offers a framework for media practitioners, technologists, and policymakers to integrate AI ethically. For industry professionals, adoption must prioritise 'technological prowess alongside ethical practices' to preserve audience and community trust. For policymakers, the findings advocate for a 'practical regulatory framework' that facilitates AI innovation while ensuring transparency and accountability. The integration of indigenous-led AI projects, such as those in Canada and Brazil, provides a blueprint for how technology can be used to strengthen communal autonomy rather than undermine it.

CONCLUSION

This study has investigated the transformative potential and ethical complexities of Artificial Intelligence in environmental conservation through the lens of epistemic justice and decolonial policy. The research demonstrates that the integration of indigenous and scientific knowledge is not merely a technical hurdle but a profound challenge of power, perspective, and planetary ethics. While AI offers unprecedented capabilities for monitoring and predicting ecological changes, its current deployment patterns frequently reinforce a 'two cultures' divide that privileges technocratic data over the place-based, relational wisdom of indigenous communities.

The primary findings indicate that 'epistemic extractivism'-the reduction of indigenous knowledge to fragmented datasets-remains a dominant mode of operation in conservation policy. This is particularly evident in the high percentage of AI-driven projects that exclude local ecological knowledge or fail to establish meaningful consent protocols. However, the study also highlights successful models of indigenous-led conservation and co-designed AI architectures that empower communities to manage their own lands and resources in accordance with their customary laws.

Moving toward a decolonised future requires a fundamental shift in conservation governance. AI must be subordinate to the principles of epistemic justice and Indigenous sovereignty. This necessitates adopting the CARE Principles for Indigenous Data Governance and creating 'explainable AI' systems that are transparent and accountable to local stakeholders. Only when indigenous people are recognised as co-creators and stewards of knowledge-rather than just sources of data can environmental governance

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move beyond the hierarchies of the past toward solutions that are both ecologically sustainable and socially just. Future research should continue to monitor the long-term impacts of indigenous-led AI projects on biodiversity and community well-being. There is also a critical need for comparative studies across different cultural contexts to understand how AI-managed information networks can be designed to resist 'digital colonialism' while fostering global ecological resilience. Ultimately, the future of the planet depends on our ability to weave together diverse ways of knowing, ensuring that the innovations of the digital age are used to honour and protect the relationships that sustain life on Earth.

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