INVITED ADDRESS · UNESCO

Combining AI and Indigenous Knowledge for Climate Action

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UNESCO Co-Chair · Transforming Indigenous Knowledge Research Governance and Repatriation




Carbon Accounting (Monitoring, Reporting, and Verification)
Public Health
Water Resources and Hydrology
Risk Assessment Disaster Management & Relief
Policy, Economics and Social Sciences
Forestry
Climate Science
Power & Energy Systems
Accelerated Materials Science
Agriculture and Food Security
Transportation
Biodiversity & Ecosystems
Buildings & Cities
Oceans & Marine System
Weather
Climate Finance

Artificial Intelligence

A branch of Computer Science engaged in automation of intelligent behaviour.

Lacks definition and comprehensive understanding.
The foundations - sound theoretical and applied principles of the field.
Principles determine the data structures used for knowledge representation.
Algorithms must apply the knowledge and operate on the knowledge.

Intelligent computer programmes are still dealing with the vitality and complexity of human mind.



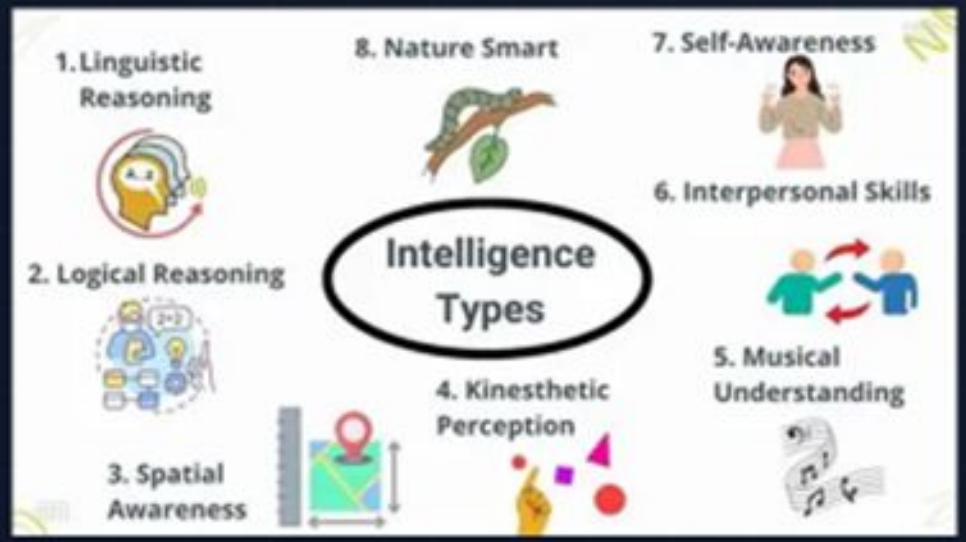
Sectoral AI

Single Faculty vs. Multiple capabilities



Apriori – Ability
Reason – Intuition
Ability – Skill
Learnable – teachable

Computable - Principle of Specification



Lecture Outline



SPEAKER PROFILE

A journey connecting Indigenous knowledge, education and AI

Across India and global forums, her work connects Indigenous communities, education, mathematics, computer science and knowledge governance.



BSc, MSc (Mathematics)

M.Phil, PhD (Computer Science)

JNU (Computer Science and AI + Issues of marginalised sections)

World Indigenous Peoples and Tribes in India

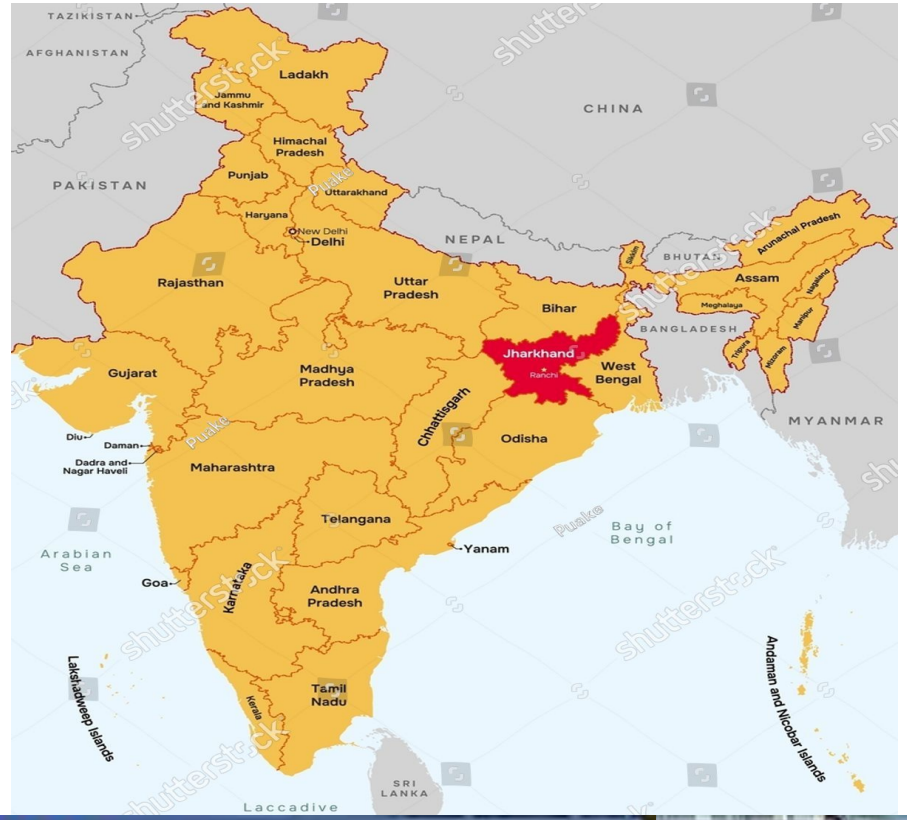
SKMU – MA in Santal Culture Studies

UNESCO Higher Education Conference

Education and tribes in India

World Indigenous Conference on Education

UNESCO Chair in Transforming Indigenous Knowledge Research Governance and Rematriation



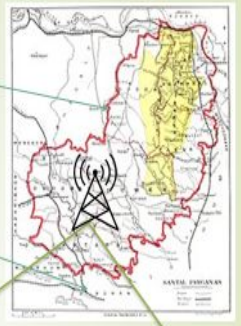






Sido Kanhu Murmu University, Dumka, Jharkhand, INDIA







Where AI Creates Climate Value



OBSERVE

Fuse satellites, sensors and models to detect change, forecast hazards and express uncertainty.



OPTIMIZE

Improve grids, buildings, mobility, irrigation and industry—under physical, social and policy constraints.



DISCOVER

Accelerate climate science, materials and processes while testing physical plausibility.

Climate AI Is Only as Fair as Its Institutions



DATA + CONTEXT

Representative local data, community knowledge and clear limits on reuse.



INFRASTRUCTURE

Accessible compute, connectivity and skills—especially in SIDS and the Global South.



OVERSIGHT

Human responsibility, explanation, appeal, remedy and independent evaluation.

INVITED ADDRESS · <name of the program>

INDIGENOUS (PEOPLES') KNOWLEDGE

Living systems of intelligence,
stewardship & sovereignty



Prof Sonajharia Minz

Indigenous Knowledge

A cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment. Berkes (2018)

The understandings, skills and philosophies developed by societies with long histories of interaction with their natural surroundings. For Indigenous Peoples, local knowledge informs decision-making about fundamental aspects of day-to-day life. (UNESCO 2017)



Quiz Question 1

What percentage of world population do Indigenous People constitute?
What percentage of biodiversity on surface of the earth is preserved by the Indigenous Peoples?

Knowledge of Indigenous Peoples is a living system—not a relic

Not merely a collection facts and knowledge nuggets, but a system. It has evolved over very long interactions - relationships among people, place, more-than-human life, memory, practice and responsibility.

01 **CUMULATIVE**
built through observation across generations

02 **ADAPTIVE**
revised as conditions and relationships change

03 **PLACE-BASED**
specific to landscapes, waters and communities

04 **RELATIONAL**
knowledge carries duties—not only information

05 **GOVERNED**
access, use and transmission follow community norms

Brondízio et al., 2021 · Tengö et al., 2014 · Kimmerer, 2002

Knowledge is inseparable from the authority that sustains it

A working definition

Indigenous knowledge comprises the understandings - axioms, practices - rules, values – governing protocols and institutions Indigenous peoples use for systematic generational transfer, enduring relationships with their territories and communities.

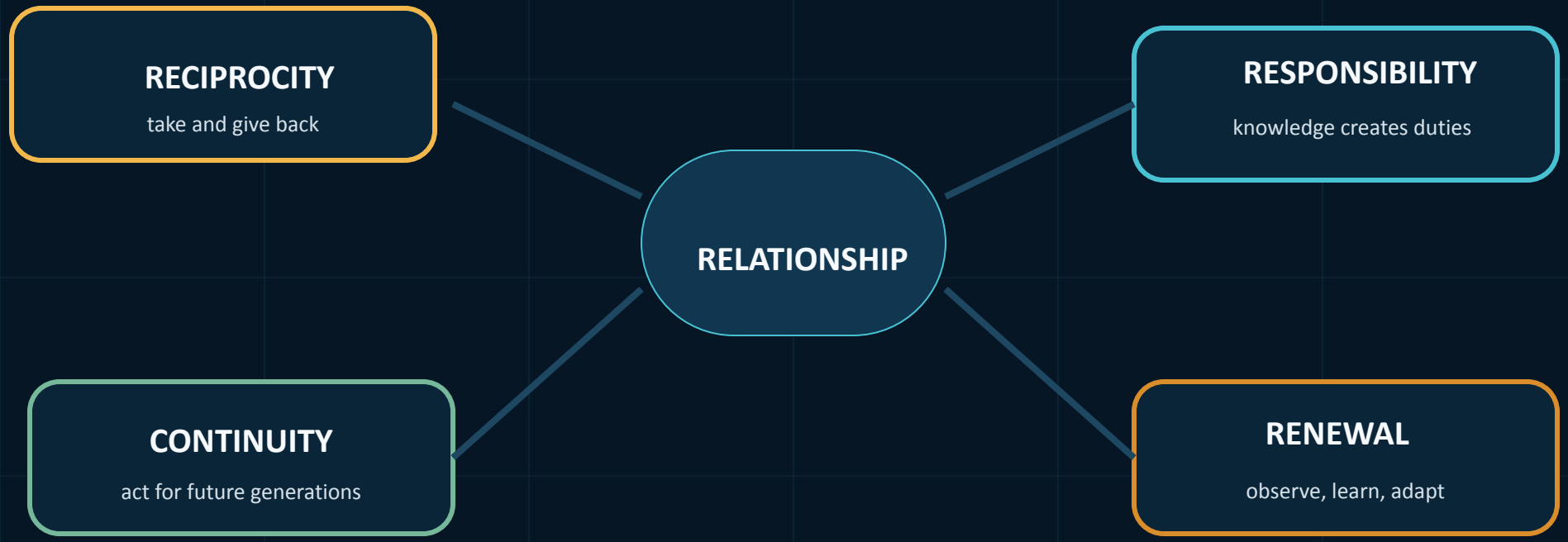
The unit of knowledge is not only the fact. It is the relationship that makes the fact meaningful and accountable.

WHAT IT IS NOT

- a single global worldview
- a static archive of the past
- raw data without context
- a shortcut around consent
- a resource free for external use

Brondízio et al., 2021 · Walter & Suina, 2019

Four obligations hold relational knowledge together



Relationality is not a decorative value. It is a governance logic for deciding what can be known, shared and changed.

Brondízio et al., 2021 · Orlove et al., 2023

Worldviews make responsibility visible

Distinct traditions—not equivalent templates; translations are necessarily partial.

MI'KMAQ

Two-Eyed Seeing

Learn to use the strengths of Indigenous and Western knowledge together—without making one the judge of the other.

MĀORI

Kaitiakitanga

Guardianship and protection grounded in relationships, authority, tikanga and obligations to treasured beings and places.

DINÉ

Hózhó

A philosophy of living in health, harmony and beauty through balanced relations among person, community, land and cosmos.

The lesson is not to copy a term. It is to respect the community, language and governance that give the term life.

Bartlett et al., 2012 · Whittaker et al., 2023 · Kahn-John & Koithan, 2015

Land, language, community and governance form one knowledge architecture

LAND & WATER where observation is accumulated and tested

LANGUAGE where distinctions, relations and memory are encoded

COMMUNITY where knowledge is practiced, interpreted and taught

GOVERNANCE where authority, access and responsibility are decided

REMOVE ONE LAYER

and meaning, legitimacy or continuity can fracture.

Maffi, 2005 · Wilder et al., 2016 · Brondízio et al., 2021

Quiz Question

“Research is a colonial method of knowing.”

Is there scope to Decolonize research in physical science?

Plural evidence is stronger than forced integration



The goal is complementarity—not assimilation.

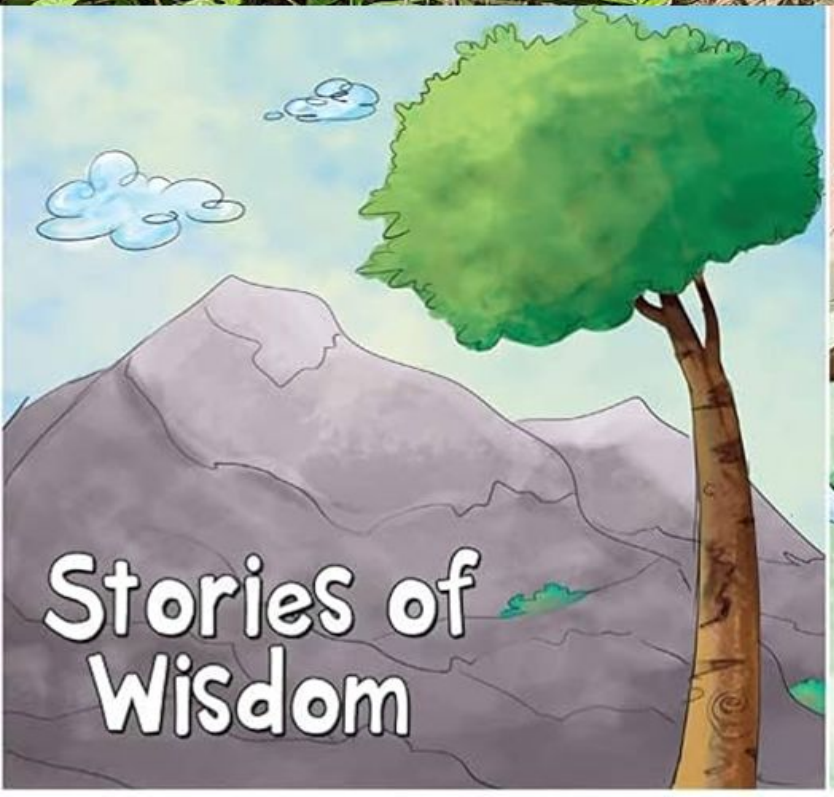
Tengö et al., 2014; 2017 · Mistry & Berardi, 2016

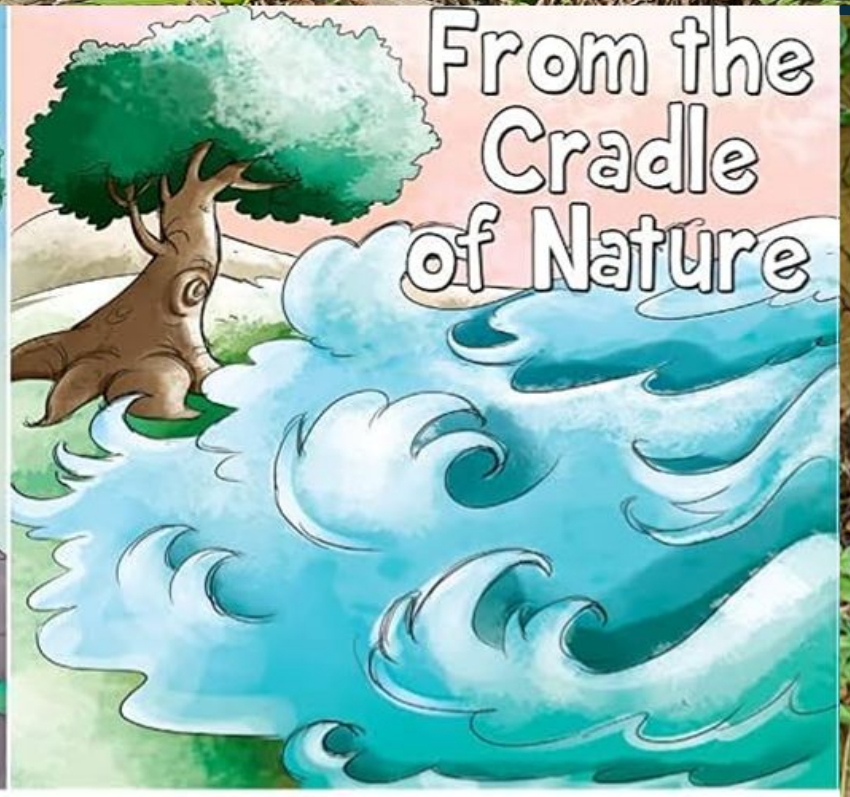
Data, Indigenous Data, Data Sovereignty





Data
Book of Nature
Indigenous Data







The Indigenous World:

Land, Language, Culture, Community

A Living Knowledge System (more than people**)**

- Territories and Landscapes
- Languages
- Oral Traditions
- Food Systems
- Ecological Knowledge
- Governance Systems
- Arts, Design & Cultural Expression
- Community Institutions
- Worldviews and Ways of Knowing

Who decides what counts as Data/Knowledge?

MODERN WORLD

- Universities
- Scientists
- Publications
- Laboratories
- Data
- Experts

INDIGENOUS WORLD

- Land
- Elders
- Oral Traditions
- Landscapes
- Experience
- Communities

Data Sovereignty

The data travels.
The land does not.
The community does not.
The custodians do not.
The worldview does not.

- Who consents?
- Who controls access?
- Who benefits?
- Who can withdraw?

Who governs knowledge after it becomes digital?

Data/Knowledge Sovereignty

- Who defines knowledge?
- Who interprets knowledge?
- Who represents knowledge?
- Who governs future use?

Without knowledge sovereignty:

Communities become subjects of knowledge rather than governors of knowledge.

Quiz Question 2

In research on a language, whose decision matters?

a) Investigators
b) Funders
c) State
d) Speakers of the language

Decolonization changes who defines research—and whom it serves

COLONIZING RESEARCH

research on communities
questions set elsewhere

classification + extraction



DECOLONIZING METHODOLOGY

research by, with and for Indigenous peoples
authority returned

self-determination + benefit

Linda Tuhiwai Smith reframed research as a site of power: Indigenous peoples must shape its questions, methods, interpretation and benefits.

Māori leadership turned decolonization into research infrastructure

Three contributions from Aotearoa New Zealand connect methodology, ethics and data governance.

RESEARCH

Kaupapa Māori

Centres Māori worldviews, questions and leadership. Research should strengthen Māori aspirations and make a positive difference.

ETHICS

Te Ara Tika

Brings tikanga Māori into ethical review through relationships, cultural safety, justice and meaningful benefit.

DATA

Te Mana Raraunga

Treats Māori data as a living taonga and asserts that Māori data should remain under Māori governance.

Aotearoa's contribution is not an exportable template; it shows how Indigenous authority can reshape research, ethics, data and AI.

Smith, 2021 · HRC NZ, 2010 · Te Mana Raraunga, 2016/2018 · Lilley et al., 2024

Open science for inclusive —and open only on legitimate terms

OPEN

publications, data, software and methods
transparent collaboration
societal participation

PROTECT

human rights and privacy
intellectual property
threatened species
sacred and secret Indigenous knowledge

DIALOGUE

recognize diverse knowledge systems
include Indigenous knowledge holders
reduce technology and knowledge divides

The test is not maximum openness; it is equitable access with rights, authority and context intact.

Indigenous lands are globally significant for conservation

≥38M km²

managed or held under tenure rights by Indigenous peoples across 87 countries

>¼

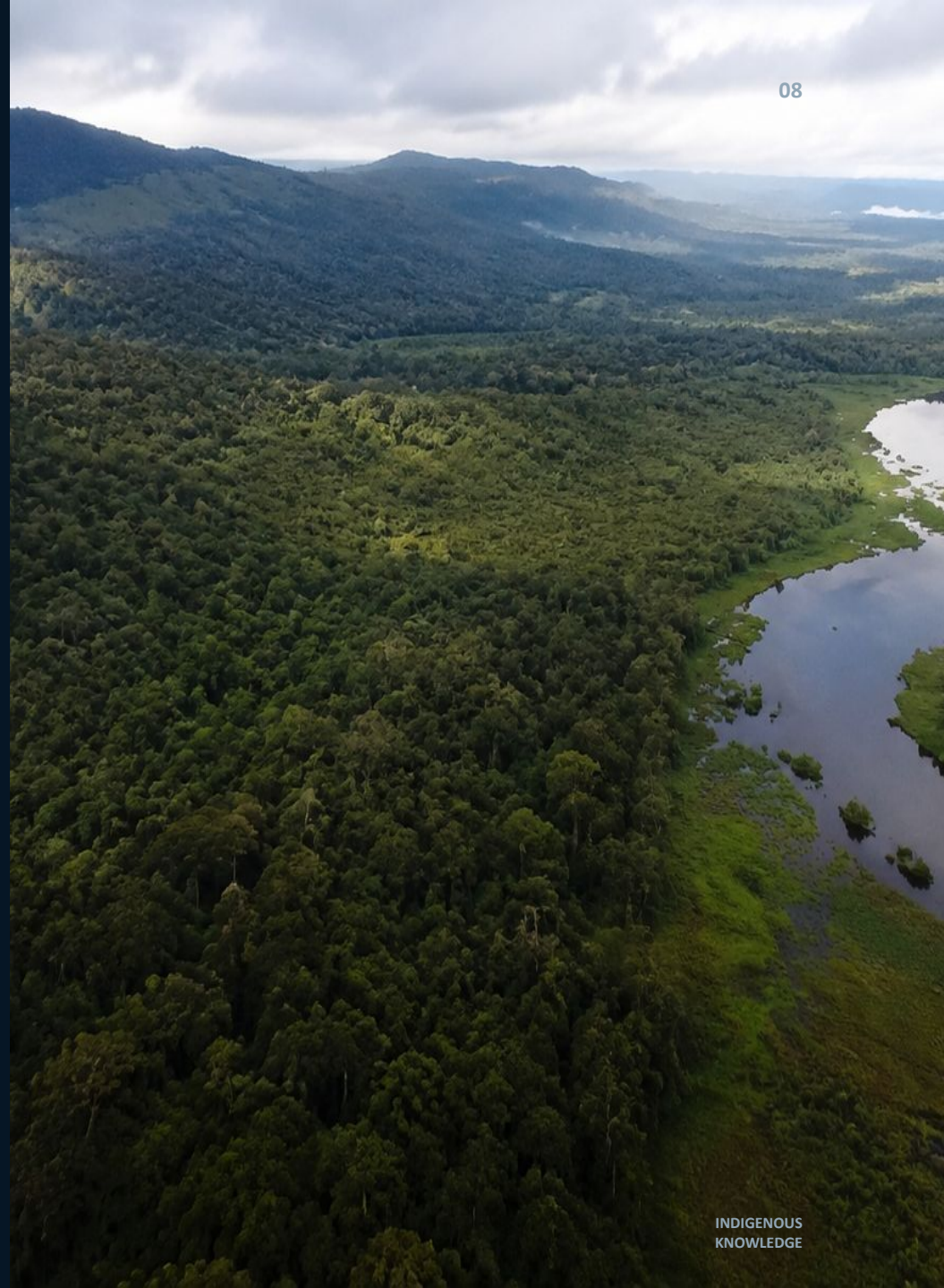
of the world's land surface

≈40%

of protected areas and ecologically intact landscapes overlap these lands

These outcomes depend on rights, institutions and stewardship—not on identity as a substitute for governance.

Garnett et al., 2018 · Schuster et al., 2019 · Fa et al., 2020



INDIGENOUS KNOWLEDGE

Long observation records reveal change at the scale people live

10,660

local observations

2,230

localities

137

countries

≈70%

of localities across 122 countries reported warming or shifts in seasonality and rainfall. Temperature observations were broadly consistent with modelled trends.

Instruments measure variables. Place-based knowledge detects consequences, thresholds and meaning.

Savo et al., 2016, Nature Climate Change

Fire can be a relationship—not only a hazard

A global review of primary studies on Indigenous fire stewardship found:

79%

reported increased biodiversity

63%

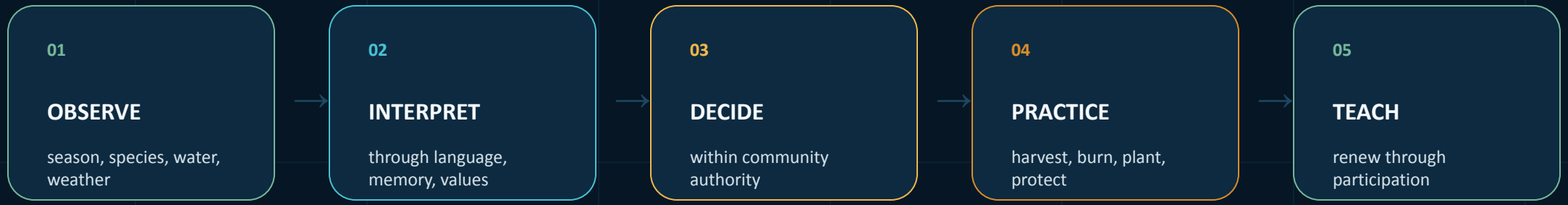
reported increased habitat heterogeneity

Stewardship shapes frequency, season, intensity and purpose. Removing people from fire-adapted landscapes can remove ecological function.

Hoffman et al., 2021, PNAS



Knowledge - a balance of adaptation and resilience, practice – systematic generational transfer



FOOD WATER HEALTH IDENTITY

Resilience comes from the whole cycle—not from extracting the observation at the beginning.

Brondízio et al., 2021 · Kimmerer, 2002

Language is knowledge infrastructure

PLACE

SEASON

SPECIES

KINSHIP

A language does more than label the world.

It carries distinctions, relationships, ethics and ways of noticing/specifying that may have no exact translation in another worldview.

MEMORY

PROTOCOL

RESPONSIBILITY

Language revitalization is therefore also knowledge revitalization.

Bromham et al., 2022 · Wilder et al., 2016 · Maffi, 2005

Extraction breaks the very system it claims to value

KNOWLEDGE IN RELATIONSHIP

land · language · values
practice · authority · consent

meaning + accountability



DECONTEXTUALIZED DATA

isolated facts
reformatted for external systems

utility without responsibility

Review of 81 climate-adaptation studies: the dominant pattern treated Indigenous and local knowledge as data to fill scientific gaps.

Orlove et al., 2023 · Mistry & Berardi, 2016

Two Worlds or worldviews

THE WORLD

- 8.2 Billion People
- US$110T GDP
- 37B Tonnes CO_2 / Year
- ~200 Languages
- SDGs 2030

INDIGENOUS PEOPLES

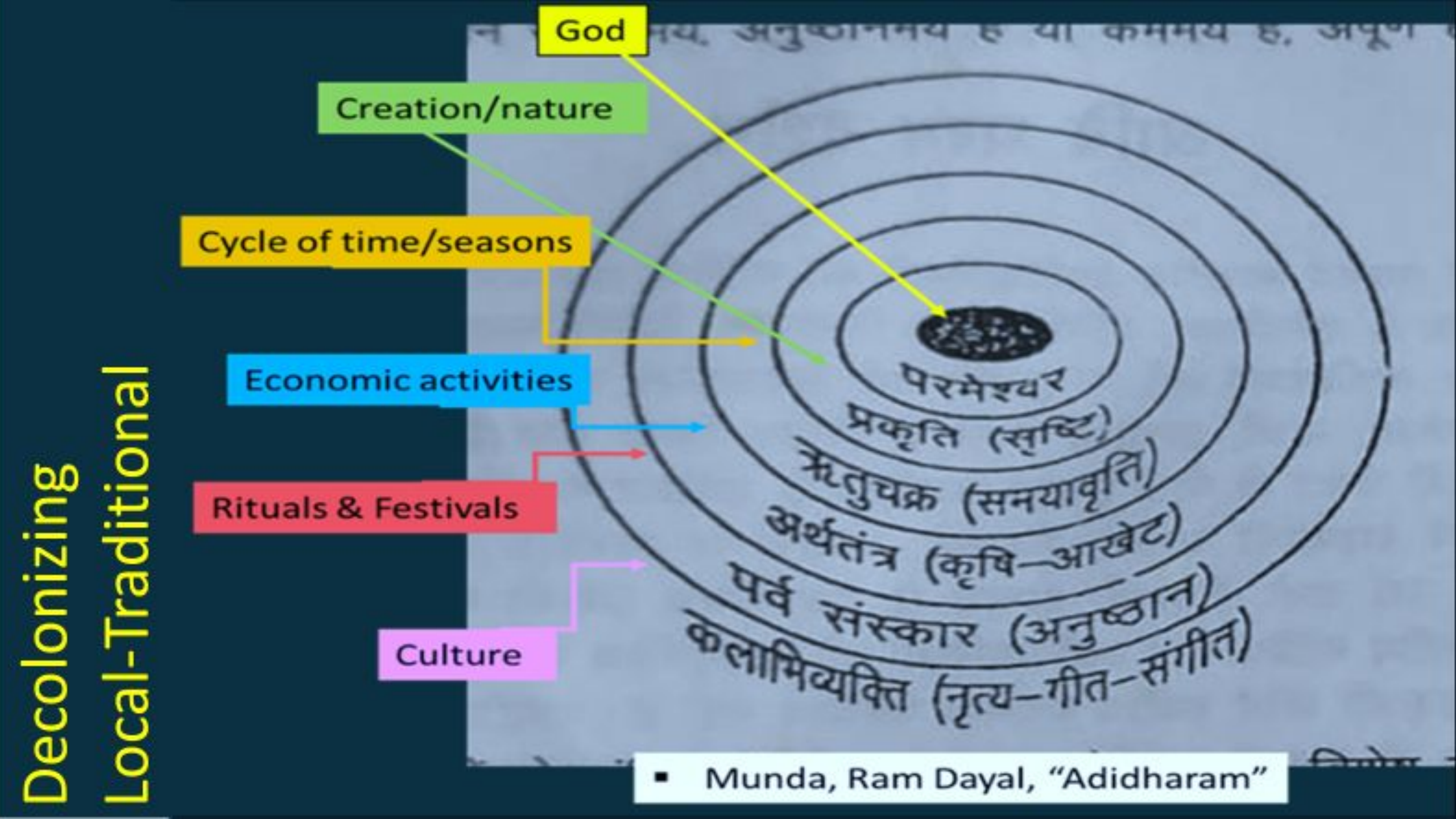
- 476M People (6%)
- ~80% of Global Biodiversity
- Protect Largest Carbon Sinks
- ~7,000 Languages
- UNDRIP (2007)

Difference in understanding or difference in ways of knowing - Epistemology

(Indigenous) Knowledge Governance



Decolonizing
Local-Traditional



- Munda, Ram Dayal, "Adidharam"

From Living Knowledge to Data

- ***What happens when living knowledge becomes data?***
- ***When living knowledge becomes data,***
- ***Who becomes its custodian?***

Is knowledge intangible

Culture is visible

- Songs
- Stories
- Crafts
- Rituals
- Festivals
- Designs

Quiz Question 4

Are facts and objects/samples (as in any research, such as climate change/action) the same? Justify.

Documentation, Translation, Digitization

Lossy translation

- Healing Systems > Ethnobotany
- Governance > Custom
- Weaving > Craft
- Stories > Folklore
- Rituals > Culture

Traditional knowledge is often documented through categories such as folklore, craft, heritage, ethnography and oral literature.

OCAP® makes First Nations authority operational across the data lifecycle

OCAP®

A Canadian First Nations framework—not a generic label for all Indigenous data governance.

O

OWNERSHIP

A Nation collectively owns information about itself as an individual owns personal information.

C

CONTROL

First Nations control research and information-management processes from design to use.

A

ACCESS

First Nations decide who may access their information—and maintain access to data about themselves.

P

POSSESSION

Physical custody is a practical mechanism for protecting and asserting ownership and control.

OCAP® is expressed by each First Nation according to its own worldview, protocols and priorities.

Data about Indigenous peoples must remain answerable to Indigenous authority

CARE moves governance from data alone to people and purpose.

C

COLLECTIVE BENEFIT

Data ecosystems should strengthen community aspirations and equitable outcomes.

A

AUTHORITY TO CONTROL

Indigenous peoples decide how data are collected, governed, accessed and reused.

R

RESPONSIBILITY

Data stewards sustain relationships, capability, attribution and accountability.

E

ETHICS

Uses are assessed for harms, benefits, future implications and community values.

FAIR makes data reusable. CARE asks whether reuse is legitimate.

Carroll et al., 2020; 2021 · Walter & Suina, 2019

AI can extend knowledge—or accelerate extraction

OPPORTUNITY

language learning
environmental monitoring
community decision support
digital return & access

RISK

unauthorized training
loss of provenance
cultural flattening
commercial reuse without benefit

GOVERNANCE TEST

Who defines the problem?
Who controls the data and model?
Who receives benefit?
Who can stop deployment?

Technical capability never substitutes for community mandate.

Bird, 2020 · Png, 2022 · Whittaker et al., 2023

Put community authority before data—and keep it through deployment

01

RELATIONSHIP

community mandate and purpose

→

02

GOVERN

protocols, consent, access & ownership

→

03

CO-DESIGN

questions, methods, metadata & provenance

→

04

CONTROL

models, outputs, audit & security

→

05

RETURN

benefit, capability, renewal & stewardship

RIGHT TO REFUSE · PAUSE · RESTRICT · WITHDRAW

Consent is not a one-time form. It is an ongoing relationship with enforceable stopping conditions.

Carroll et al., 2021 · Bird, 2020 · Whittaker et al., 2023

Move from inclusion to shared authority

01	**Start with rights and relationships**	Engage early; recognize community jurisdiction and the right not to participate.
02	**Fund continuity, not only projects**	Support language, knowledge holders, youth learning and long-term community institutions.
03	**Value evidence without assimilation**	Use multiple-evidence approaches and preserve legitimate divergence.
04	**Share decisions, credit and benefit**	Make authority, attribution, intellectual contribution and benefit explicit.
05	**Measure accountability**	Audit whether commitments survived procurement, publication, deployment and reuse.

Orlove et al., 2023 · Mistry & Berardi, 2016 · Brondízio et al., 2021

Selected highly indexed sources

- **Brondízio et al. (2021)**
  Annual Review of Environment and Resources
- Garnett et al. (2018)
  Nature Sustainability
- Savo et al. (2016)
  Nature Climate Change
- Hoffman et al. (2021)
  Proceedings of the National Academy of Sciences
- Mistry & Berardi (2016)
  Science
- Bromham et al. (2022)
  Nature Ecology & Evolution
- Carroll et al. (2021)
  Scientific Data
- **Tengö et al. (2014)**
  Ambio
- Tengö et al. (2017)
  Current Opinion in Environmental Sustainability
- Orlove et al. (2023)
  Ambio
- Kimmerer (2002)
  BioScience
- Wilder et al. (2016)
  BioScience
- Walter & Suina (2019)
  International Journal of Social Research Methodology
- Bird (2020)
  COLING / ACL Anthology

CLOSING THOUGHT

Knowledge survives when relationships survive.

The future is not built by choosing between knowledge systems.
It is built by learning how to relate without erasing difference.

Respect · Authority · Reciprocity · Continuity

Prof Sonajharia Minz