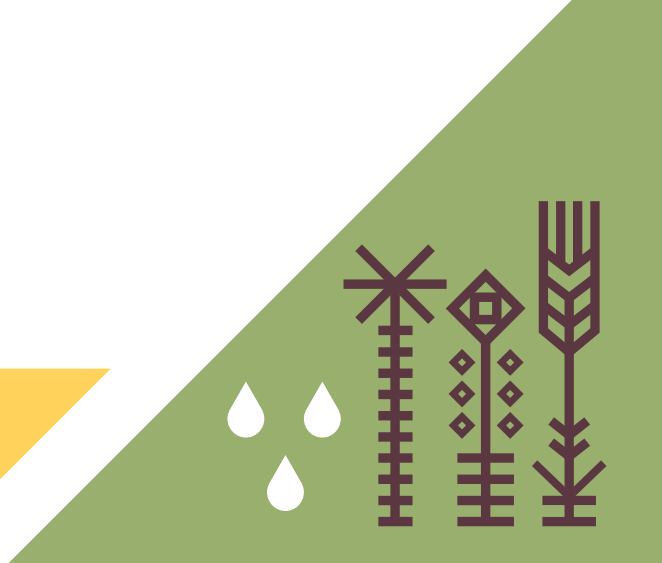
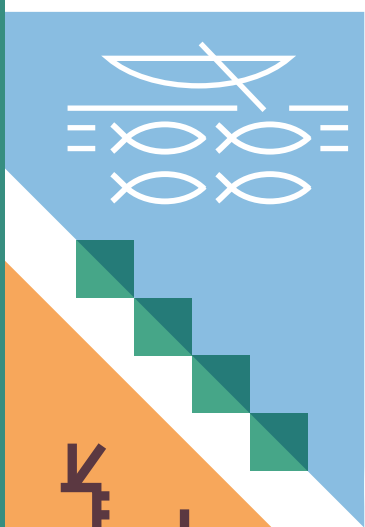




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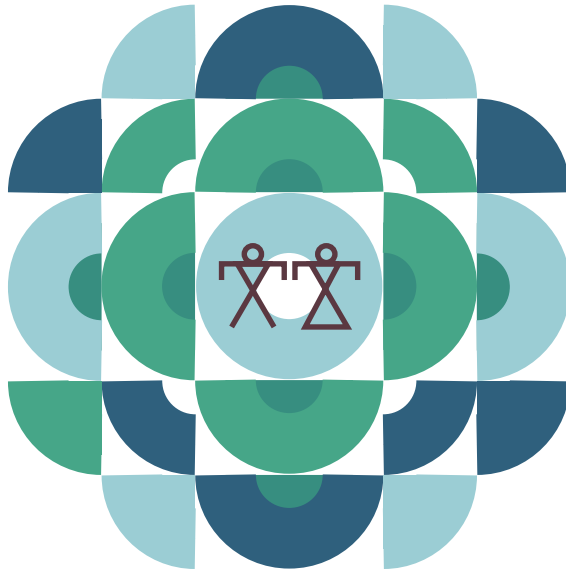
LiNKs

Local and Indigenous
Knowledge Systems



Local Knowledge, Global Goals





This publication is a reflection on indigenous and local knowledge systems, and their interactions with science and policy, today and in the future.

As the world changes increasingly rapidly, we explore the ways that indigenous and local knowledge contributes to understanding, mitigating and adapting to climate change, environmental degradation and biodiversity loss.

UNESCO's Local and Indigenous Knowledge Systems Programme (**LINKS**), established in 2002, is grateful to Denmark, France (ANR, CNRS and MNHN), Japan, Norway, Sweden, IPBES, the Christensen Fund and UNU for their support during the past 15 years.

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SECTION I

Indigenous knowledge today

Strong roots

for the Sustainable Development Goals

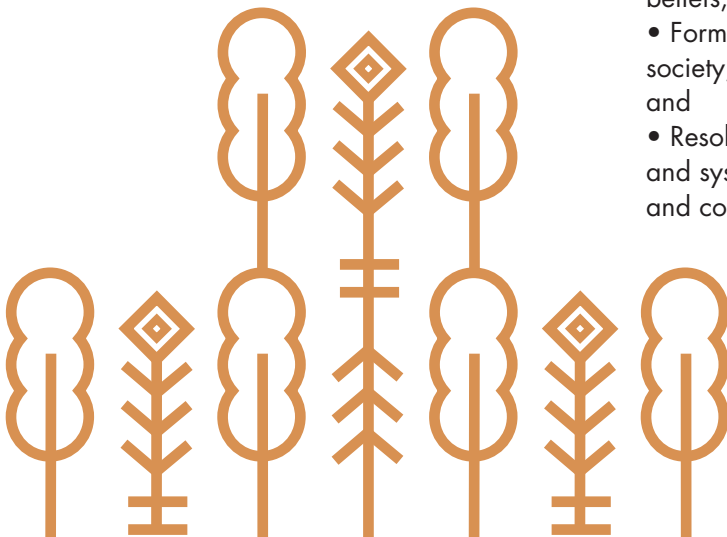
Local and indigenous knowledge refers to the understandings, skills and philosophies developed by societies with long histories of interaction with their natural surroundings. For rural and indigenous peoples, local knowledge informs decision-making about fundamental aspects of day-to-day life. This knowledge is integral to a cultural complex that also encompasses language, systems of classification, resource use practices, social interactions, rituals and spirituality. These unique ways of knowing are important components of the world's cultural diversity, and contribute to the achievement of Agenda 2030 and the Paris Agreement.

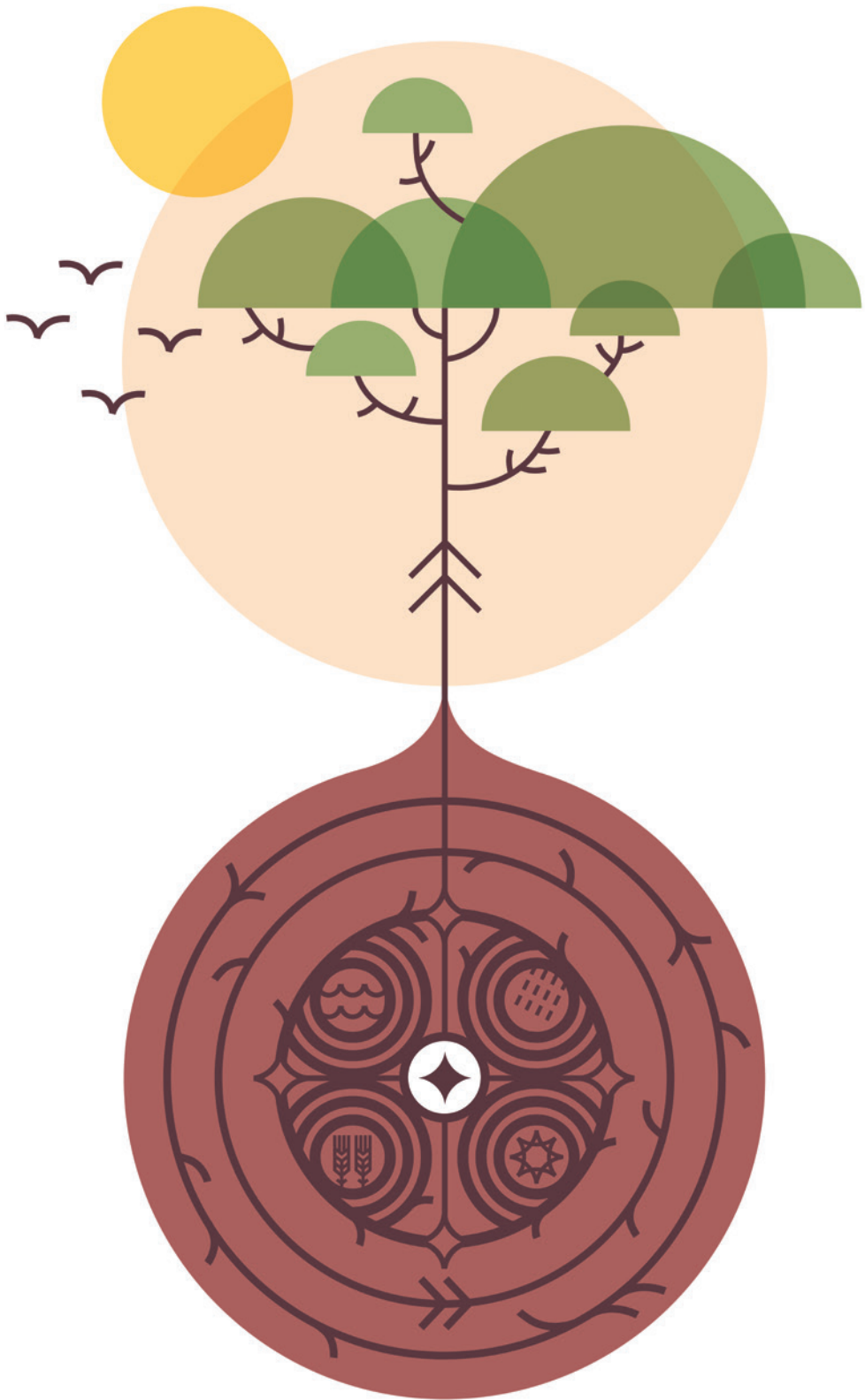
WHO ARE INDIGENOUS PEOPLES?

Indigenous peoples are diverse. A formal definition has not been adopted at the international level. Instead, a number of criteria have been established to identify indigenous peoples.

These include:

- Self-identification as 'indigenous' by individuals and acceptance by the community as one of their members;
- Historical continuity with pre-colonial and/or pre-settler societies;
- Strong links to territories and surrounding natural resources;
- Distinct social, economic or political systems;
- Distinct language, culture and beliefs;
- Form non-dominant groups of society; and
- Resolve to sustain environments and systems as distinctive peoples and communities.





Local and indigenous knowledge

A timeline

1992 >

Agenda 21, the main document of the 1992 Earth Summit in Rio de Janeiro: indigenous peoples have a vital role to play in environmental management and development because of their traditional knowledge and practices.

1993 >

The Convention on Biological Diversity (CBD) enters into force. Article 8j refers to the respect, preservation, and maintenance of knowledge, innovations and practices of indigenous and local peoples.

1999 >

World Conference of Science: 'traditional and local knowledge systems ... make and historically have made a valuable contribution to science and technology... there is a need to preserve, protect, research and promote this cultural heritage and empirical knowledge'.

2012 >

The Future We Want outcome document: traditional knowledge makes an important contribution to the conservation and sustainable use of biodiversity. Indigenous peoples and local communities are often directly dependent on biodiversity and ecosystems and thus are the most immediately affected by their loss and degradation.

2012 >

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is established. Operational principles include: 'recognise and respect the contribution of indigenous and local knowledge to the conservation and sustainable use of biodiversity and ecosystems'.

2014 >

The Fifth Assessment Report of the Intergovernmental Panel on Climate Change: 'indigenous, local, and traditional knowledge systems and practices... are a major resource for adapting to climate change... Integrating this knowledge with existing practices increases the effectiveness of adaptation'.

2000 >

The World Intellectual Property Organization establishes

the Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore to work towards an international instrument that would ensure effective protection of traditional knowledge.

2002 >

UNESCO

launches the Local and Indigenous Knowledge Systems programme (LINKS).

2007 >

UN Declaration on the Rights of Indigenous Peoples (article 31):

indigenous peoples have the right to maintain, control, protect and develop their traditional knowledge.

2015 >

Addis Ababa Action Agenda of the Third International Conference on Financing for Development:

traditional knowledge supports social well-being and sustainable livelihoods. Indigenous peoples have the right to maintain, control, protect and develop their cultural heritage and traditional knowledge.

2015 >

Article 7.5 of the Paris Agreement acknowledges that

adaptation action should 'be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous peoples and local knowledge systems'.

2016

The Scientific Advisory Board of the UN Secretary General

releases a policy brief on the links between indigenous and local knowledge and sustainable development.



Revitalising

knowledge across generations

Education programmes are important for human development, but they may also compromise the transmission of indigenous knowledge.

With formal education, children learn passively in classroom settings, rather than engaging in hands-on learning on the land. Teachers replace parents and elders as the holders of knowledge and figures of authority. National languages are the medium of instruction instead of vernacular languages. Formal education may therefore contribute

to the erosion of cultural diversity and social cohesion, and heighten the alienation and disorientation of indigenous youth.

There is an urgent need to enhance the intergenerational transmission of indigenous knowledge, alongside and within formal education. Efforts are being made to bring indigenous language and knowledge into school curricula, as well as to move learning back into the community, thus reaffirming the status of elder men and women as knowledge holders.



ON THE KUUJUAQ RIVER, Arctic Quebec, Canada, a young Inuk boy learns to skin and butcher a caribou by carefully observing his father's methodical sequence of actions. Learning by experience is often crucial for the transmission of indigenous knowledge.



LINKS SUPPORTED MAYANGNA COMMUNITIES in the BOSAWAS Biosphere Reserve, Nicaragua, to bring their indigenous language and knowledge of biodiversity into classrooms. These Mayangna curriculum materials reinforced the meaningfulness and relevance of school for Mayangna youth and built community self-esteem.



THE INDIGENOUS PEOPLES of the Pacific developed a vast body of knowledge about the ocean and wayfaring. They navigated the ocean guided by stars, winds, waves and the behavior of birds, fish and whales. LINKS developed The Canoe Is the People learners' resource pack, a website and curriculum in English and Maori, to build awareness and pride among Pacific youth about this unique intellectual heritage.

Safeguarding

Indigenous knowledge has often been exploited for profit without consultation with communities. Many communities are calling for the protection of their knowledge from inappropriate use, emphasising the need for free, prior and informed consent and benefit sharing.

Existing intellectual property regimes are ill-adapted to indigenous knowledge. More appropriate methods are being developed, such as *sui generis* systems based upon customary law.

Even within a community, access to knowledge may differ. Some types of knowledge, especially those considered sacred, may be restricted to certain individuals and families who fulfil particular roles in the community (e.g. shamans or midwives). There is also knowledge that the community may want to keep for themselves (e.g. locations of sacred groves and preferred harvesting areas). It is important to understand the different types of knowledge, and both the individual's and community's right to control access.



INUIT MARK ROUTES and sites with piles of stones called inukshuk, which often have a human-like form. This image has been commercially exploited, and as a result many Inuit want the inukshuk to be recognised as their collective intellectual property. Existing legal frameworks make this difficult.



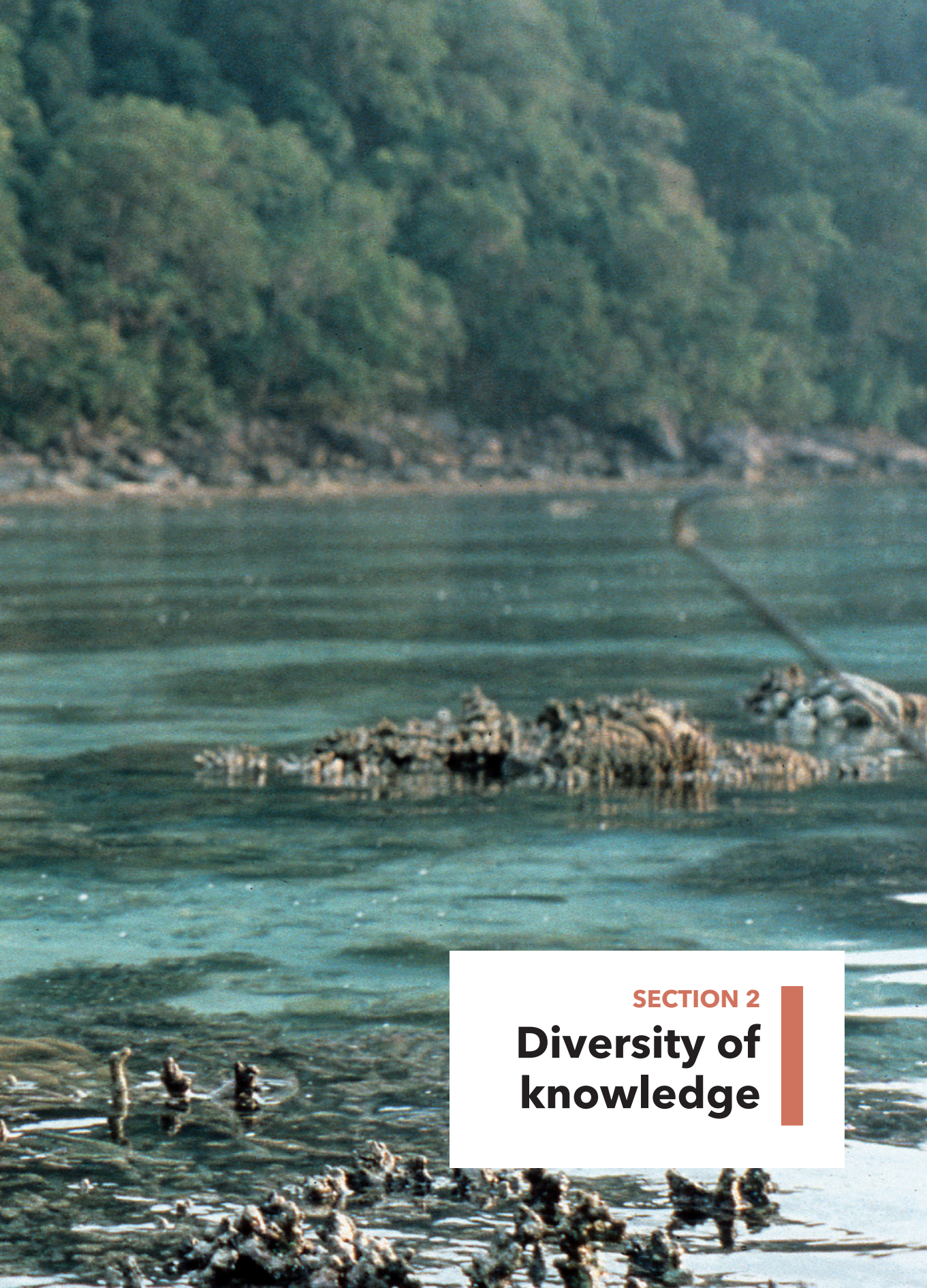
SACRED Q'IPIS (textile bundles) guide leaders of the Coroma people of the Bolivian Altiplano in managing their relations with nature, including the prevention of crop failure and natural disasters. Through the UNESCO Cultural Property Convention, stolen bundles were returned to the communities.



IN 2008 A BIDAYUH-KROKONG village in Sarawak, Malaysia held *Gawae Pinganga*, an almost-forgotten ritual, to ask the *Pinyanga* (spirit guardians) for a dry season so that burning of the land could be performed. Such sacred knowledge is held by the 'sighted ones' of the community and is guarded closely.







SECTION 2

Diversity of knowledge



From

words to worldviews

Indigenous peoples' languages constitute the vast majority of the world's linguistic diversity.

Languages are a reflection of a people's worldview. The things that a society chooses to name reveal the nature of its engagement with the world around it. Elaborate vocabularies are constructed around topics of particular ecological, economic and socio-cultural importance.

The multitude of terms for snow and ice developed by Inuit, Sami and other

Arctic peoples is a classic example. Their elaborate and highly-specialised lexicons (terms) and taxonomies (ways to classify) constitute high-resolution conceptual frameworks for observing the environment and noting subtle transitions and trends.

Today's rapid erosion of linguistic diversity is doubly devastating. The disappearance of a language is accompanied by the loss of a unique system of knowing and comprehending the natural world.



INUIT IN CANADA

possess over 100 terms for sea ice and associated phenomenon, illustrating the refinement and subtlety with which they perceive and interact with their local ice environment. Many terms are bundled with crucial information about hazardous conditions and potential dangers.



BAHIMA PASTORALISTS

in Uganda call the season of heavy rains *nyakatumura* – 'rain that removes food from one's mouth' because evening rain interferes with the milking of cattle. Scattered rains during a long dry period are *ibunzya Bahima* – 'rain that makes Bahima wander, following the rains'.



A YANOMAMĪ BOY

in Upper Orinoco, Venezuela, looks for honey. Yanomami have names for 50 types of bees that provide honey for food or medicine. They have terms for different types of hives (at the top or base of trees, inside tree trunks or fallen logs) each requiring different gathering techniques.





Gender & knowledge

Complementary ways of knowing

Although men and women share knowledge, they also hold distinct knowledge sets relating to differing and complementary roles in society and in food harvesting and production. Women have their own areas of expertise and their own modes of knowledge transmission. Their knowledge is vital for sustaining community livelihoods, values and well-being.

Differences between women and men, for example with respect to resource access and decision-making, can create patterns of gender-specific vulnerability in the face of social, environmental or climate change. Gender-specific vulnerabilities and knowledge need to be considered in adaptation planning.



MAASAI WOMEN IN AFRICA compose songs and sing them to their cows while they milk. When, in spite of the songs, the cows produce less and less milk, the women know that pasture quality is diminishing and that it is time to move the herds to a new location.



FISHING PROVIDES the main source of protein for the Mayangna of the BOSAWAS Biosphere Reserve in Nicaragua. Women do much of the fishing in summer, primarily using handheld lines and fishhooks. Men fish primarily in winter, using other techniques, such as bow and arrow or mask and spear fishing.



AN INUIT WOMAN TAKES part in a seal hunt on the Kuujjuaq River, Ungava Bay, Canada. Seal hunting is almost exclusively a male activity for Inuit. Women assume the important role of processing meat and skins, and making sealskin clothing. Consequently, they have detailed knowledge about seal health.

Dynamism

of 'traditional' knowledge

Local and indigenous knowledge is frequently represented as a fixed body of wisdom that is passed down intact from generation to generation. Terms such as 'tradition' and 'heritage' evoke constancy, immutability and inflexibility. In reality, local knowledge has always been reassessed, renewed and expanded. Each generation reinterprets the knowledge of their forebears to confront the emerging challenges and opportunities of a changing world.

The adoption of modern technologies by indigenous peoples is often misinterpreted as the abandonment of their distinct values and ways of life. In reality, the capacity to incorporate new tools and skills has always been fundamental to the dynamism of indigenous cultures. Indeed, it is by blending new ways with old that many indigenous communities are able to uphold their unique lifestyles and worldviews.



A FISHERMAN THROWS a nylon cast net in the sandy shallows in Vanuatu. Resource depletion is often wrongly attributed to technological change. Entry into a market economy may be the more decisive factor, encouraging individuals to forsake community values and sustainability for individual profit.



INUIT IN ARCTIC CANADA were quick to adopt modern technologies to strengthen their hunting, fishing and trapping way of life. Motorised transport allowed them to regain access to distant hunting territories that were abandoned when Inuit settled into permanent villages in the 1960s.



MEN FROM MAROVO Lagoon, Solomon Islands, prepare to return home from fishing on the barrier reef. Their canoe is carved from a huge *golothi* tree, and is powered by a community-owned outboard motor. Such motors support subsistence fishing activities and are now ubiquitous in the Western Solomons.





Adaptive knowledge

for variability and change

The knowledge of indigenous peoples is not a static body of 'traditional' information. Indigenous peoples have always been confronted with environmental variability, unpredictability and change. Their knowledge is thus a dynamic system that is collectively and continuously re-visited, re-shaped and shared across a web of social actors. It maintains its adaptive capacity and vitality.

In this sense, indigenous knowledge bears a resemblance to science. Science defines itself by the scientific method and not as a fixed body of data, as this would inevitably become outdated. While acknowledging the wisdom of their elders, indigenous knowledge holders emphasise the central role of their own learnings and experiences. In this manner, successive generations adapt and transform their understandings in the face of environmental variability and change.



THAILAND'S MOKEN people gained international attention when they predicted and escaped the tsunami waves that swept away their villages in 2004. Knowledge of the *laboon*, or 'seventh wave', had been passed down for thousands of years. This knowledge gave them enough time to evacuate to high land.



ACROSS THE ARCTIC, Inuit storytelling is a critical dimension of cultural adaptation to climate change. Stories help link environmental changes in the past to what Inuit are experiencing today, allowing them to maintain connections to animals and their lands and helping with adaptation strategies.



CANADIAN FIRST NATIONS have been observing impacts from industrial development for many decades. Impacts include increasingly large packs of wolves using pipeline cut lines and forestry roads to hunt moose and caribou. Aided by these 'highways' through the forest, the packs can devastate ungulate herds.





SECTION 3

**Knowledge for
sustainability**

Community-based assessments

of global climate changes

Observation and interpretation of meteorological phenomena have guided the activities of local communities for millennia. Planting and harvesting, transhumance or herd migration, and the timing and locations of hunting, fishing or gathering are dependent on detailed understandings of weather and climate.

Indigenous knowledge contributes to climate science by offering observations and interpretations at a much finer spatial scale

and with considerable temporal depth. They also highlight elements of significance to local livelihoods that are not considered by scientists. The Intergovernmental Panel on Climate Change (IPCC) in the Summary for Policymakers of its Fifth Assessment Report (2014) concluded that: 'indigenous, local, and traditional knowledge systems and practices, including indigenous peoples' holistic view of community and environment, are a major resource for adapting to climate change'.



IN CANADA'S BOREAL forests, indigenous hunters report that parasitic ticks are flourishing due to warm winters. This is having increasingly negative impacts on moose populations. Moose become weaker due to tick infestations, and more vulnerable to other pressures including habitat loss and predation.



MONGOLIAN PASTORALISTS report degradation of pastures since 1999 due to changes in rain quality and distribution. They observe an increase in *torgnii hee boroo* or 'silk embroidery rains' which create patches of green pasture dotted across an arid landscape (like silk embroidery on a coat). Scientific data, which measure annual means over large territories, show no significant change for the same area and period.



DAGU, dubbed the 'internet of the Afar', is a traditional information exchange network among Afar pastoralists in Ethiopia. Individuals who cross paths are obliged socially to openly share information on what they have seen on their travels: condition of pastures, abundance of water, extent of rainfall, numbers of livestock. It is a holistic indigenous climate observing system.





Vulnerability and resilience

in a world of change

Indigenous peoples and marginalised populations are particularly exposed and sensitive to climate change impacts due to their resource-based livelihoods and homelands in marginal environments. Small population size, isolation, and the absence of recognised rights over resources contribute to their vulnerability to economic, social and environmental impacts that are exacerbated by climate change.

Despite their high exposure and sensitivity, indigenous peoples and local communities are actively responding to climate change,

showing great resourcefulness. Adaptation is rooted in local knowledge, social systems, and cultural values and attitudes. Strategies include maintaining genetic and species diversity in crops and herds, mobility, diversified use of landscapes, and livelihoods based on use of multiple resources. Traditional systems of governance and social networks reinforce the ability to respond collectively to change and build resilience.



IN INDONESIAN BORNEO, a typical Dayak village makes use of natural forest, managed forests, rotating swidden/fallow and permanent fields. This multiple land-use system, with a mix of personal and communal ownership, is a livelihood strategy, a biodiversity conservatory and a source of resilience in the face of climate change.



IN BOLIVIA, the maintenance of diverse traditional crop varieties reduces risks from climate variability and pests. At the heart of their resilience are the age-old 'paths of seeds', whereby grains and plants are transported and exchanged among neighbouring communities and across altitudinal gradients.



IN THE NICARAGUAN CARIBBEAN, increase in the strength and frequency of storms has resulted in loss of forest areas and coastal flooding. Indigenous peoples have responded in part by revitalising traditional social arrangements and practices, including increased reliance on traditional foods and medicines under the reinforced leadership of community elders.

Monitoring

biodiversity loss

Indigenous peoples are often well positioned to observe and understand local ecosystems. Many live in areas that have high biodiversity values. Their ways of life and knowledge systems depend on close interactions with nature, and observations of the animals and plants on which they rely. As knowledge is garnered throughout a lifetime, and enhanced by oral history passed down through generations, indigenous peoples often also have knowledge of changes in biodiversity over many decades or even centuries.

As many indigenous peoples live in remote areas, they are often better placed than scientists to provide detailed information on local biodiversity. By working with many communities over a wide area, a picture of biodiversity trends over whole regions can be achieved. The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) recognises the importance of including indigenous and local knowledge in its assessments of biodiversity.



CALLED AKPIK by Inuit and *luopmanat* by Sami, the cloudberry (*Rubus chamaemorus*) is highly-prized by indigenous peoples throughout the Arctic. The Arctic Climate Impact Assessment (ACIA, 2005) included indigenous knowledge about declines in cloudberry, as well as changes in volume and diversity of grasses and shrubs. At the time, ACIA was a frontrunner in incorporating indigenous knowledge alongside science.



BIODIVERSITY ASSESSMENTS require inputs from both science and indigenous knowledge, as acknowledged today by the new Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). IPBES is also working to establish a mechanism to enhance the participation of indigenous and local knowledge holders.



A LOCAL KNOWLEDGE assessment of changes in biodiversity over a 50-year period was carried out within the *iqoliqoli* (fishing grounds) of Vanua Navakavu in the Fiji Islands. Local vernacular names for over 1,000 species were recorded and the recovery status of almost 900 species was assessed.





Co-managing

species and spaces

Indigenous homelands and territories harbour the greater part of the world's biodiversity.

Local communities manage natural resources through their own customary institutions and in some cases, enhance biodiversity by transforming landscapes.

Today it is increasingly recognised that the conservation of threatened species or protected areas requires the development of partnerships with indigenous peoples and local communities. State-indigenous

co-management regimes benefit from in-depth indigenous knowledge about natural resources that complements scientific understandings. When indigenous peoples are full partners in the development and implementation of management plans, they become crucial actors in research, monitoring and awareness-raising.



IN THAILAND, the Karen people worked hard to prove that their system of rotational farming in forests is sustainable and supports biodiversity. Large tracts of forest that were destroyed by commercial logging have now been regenerated by the Karen, supporting both their livelihoods and biodiversity.

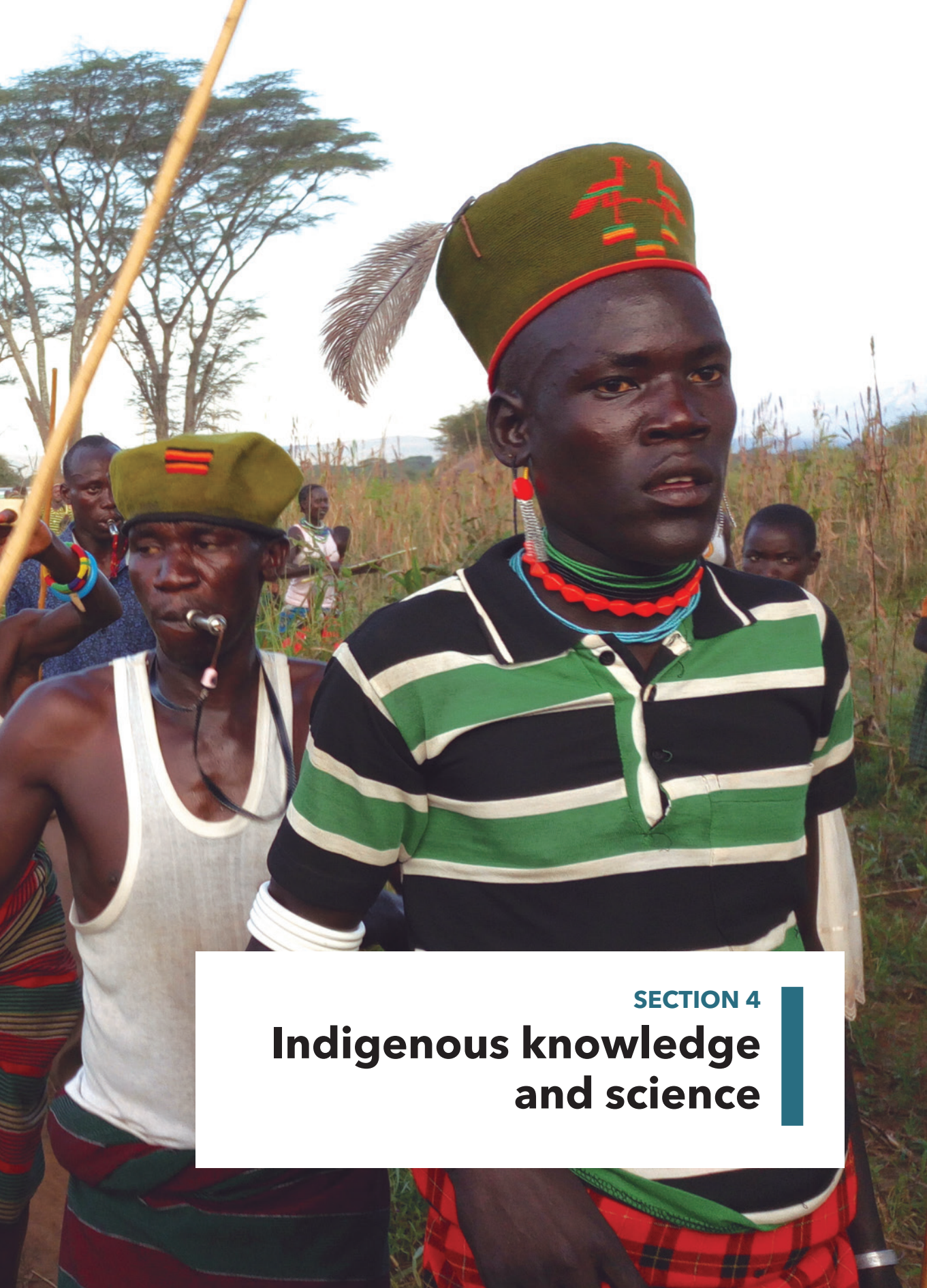


VICUÑA RECOVERED from 10,000 animals to over 400,000 in 45 years, partly through community-based management. Communities harvest vicuña fibre through catch and release systems that follow the Inca chaku tradition, where large numbers of community members herd vicuñas by holding colourful flags.



TSÁ TUÉ BIOSPHERE RESERVE in Canada is home to the Sahtuto'ine. It is the first (and only) biosphere reserve in Canada to be created at the request of its indigenous population. The Sahtuto'ine are leading the development of the area's management plan, in cooperation with a range of agencies and organizations.





SECTION 4

**Indigenous knowledge
and science**

Overcoming

opposing worldviews

Western conservation philosophies separate humans from nature. This has led to the widely-held notion that people must be excluded if environments are to be preserved. In indigenous worldviews, however, such a division is unacceptable as ecosystems and social systems are intertwined. Landscapes are rendered meaningless if the interdependent relationship between social systems and ecosystems is severed, as they shape and sustain each other.

Furthermore, Western science traces its origins to an opposition of the rational and the spiritual. Indigenous thought, however, makes no such distinction, nor does it value the rational above the spiritual. Instead, they flow together and intermingle. For this reason, efforts to extract indigenous knowledge from its cultural and spiritual foundations often result in its misinterpretation, misrepresentation and fragmentation.



THE EXCLUSION of indigenous peoples from many of Africa's national parks disrupted socio-ecological systems that co-evolved over centuries. The notion that people need to be excluded in order for nature to be conserved is rooted in the Western ideology of 'wilderness'. Biologists still adhere to the wilderness ideal despite its religious origins.



A TABU LEAF indicator at Lamén Bay, north Epi, Vanuatu, signifies that an area is closed to fishing due to the death of a clan member. Across the Pacific, a wide range of cultural practices are instrumental in regulating renewable resource use and access, integrating social and environmental cues.



FOR INUIT, hunting is part of their spiritual relationship with animals, marked by ceremony and respect. If hunting stops, this severs the relationship and the animals will be offended and disappear. This contrasts with western ideas that banning hunting will lead to increases in animal numbers.





Towards

transdisciplinary understandings

Western science separates knowledge into many disciplines and most scientists are highly specialised in narrow domains. This reductionist approach, whereby scientists know more about less, is science's greatest strength and its major weakness. While science makes advances within specific domains, complex interdisciplinary problems remain a perpetual challenge.

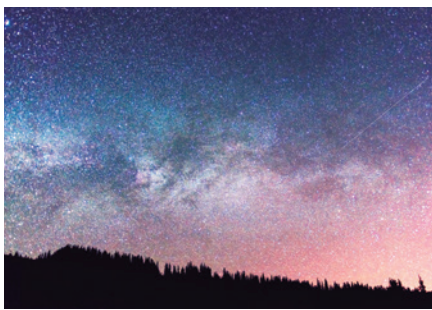
Indigenous knowledge holders, however, have no such barriers. They possess expertise that extends across bio-physical and social domains. Herders are

knowledgeable about the welfare of their livestock, the soils that make good pasture, the rains that trigger growth, and prices in the marketplace.

So when scientific and indigenous knowledge experts come together to address complex problems such as biodiversity loss or climate change adaptation, scientists from several disciplines in the natural and social sciences need to be at the table.



NOMADIC FULANI pastoralists in the Sahel region of Chad observe and interpret a web of interlinked changes in winds, clouds, temperature and flowering plants to predict the timing and location of rains. This helps them to plan when and where to move with their herds, and even when to slaughter for market.



FOR CENTURIES, indigenous Andean farmers have successfully forecasted the nature of the forthcoming rainy season by observing the Pleiades star cluster. An anthropologist, meteorologist and climatologist worked together to understand that the farmers base their forecast on the appearance of the Pleiades, which varies in accordance with the degree of cloud in the troposphere. This marker of El Niño conditions affects rain over the Andes several months later.



TONGAN FARMERS use their own traditional calendar to decide when to plant and harvest. Today, weather phenomena have shifted in relation to the traditional calendar, so they have had to adapt their planning and activities. This detailed knowledge of local-level change and adaptation is invaluable for understanding climate change impacts and policy responses.

Synergies

between scientific & indigenous knowledge

Scientists often attempt to validate indigenous and local knowledge, as a prerequisite for accepting it. The frequently encountered desire to 'integrate' indigenous knowledge into science also presupposes that this knowledge should be analysed and validated using western scientific criteria and methods.

Yet scientific and indigenous knowledge each have their own culture-specific systems of logic. Ignoring science's own cultural

roots and assuming it can pass judgement over others hinders collaboration that could occur with indigenous knowledge systems.

Other modalities of working with indigenous knowledge may be more appropriate and effective, including the co-production of knowledge, which recognises that both knowledge forms are legitimate within their contexts.



ABORIGINAL PEOPLES

in Australia use fire to create landscape mosaics that conserve and enhance biodiversity. Today traditional 'firestick management' has been adopted as the primary tool for managing protected areas, such as the Uluru-Kata Tjuta and Kakadu World Heritage Sites, and for reducing greenhouse gas emissions in return for carbon credits.



FOR ANDEAN INDIGENOUS

peoples, the arrival of rains, the success of the harvest, and the well-being of society are intimately connected to human respect for both the material and spiritual dimensions of the world. In their view, climate change results from a lack of appropriate respect for the spiritual forces that influence weather and climate. It is therefore necessary to re-establish a respectful relationship through rituals. Acknowledging such indigenous worldviews is a prerequisite for collaboration with scientists.



IN 2017, SCIENTISTS

discovered a 'new' rodent in the Solomon Islands – a giant rat. This was not news, however, for the indigenous people of Marovo Lagoon. They had already documented their knowledge about *vika*, as they call it, several times, including in the LINKS publication 'Reef and Rainforest', where they noted its large size and diet of coconuts. Science has moved from skepticism to agreement.





Co-producing knowledge

There is great potential for indigenous and local knowledge to contribute further to global challenges of climate change, environmental degradation and biodiversity loss in order to achieve goals such as sustainability and resilience.

The vastness and complexity of today's challenges require the mobilisation of the best available knowledge for decision-making. Indigenous knowledge holders and scientists contribute different understandings.

By virtue of their differences in temporal and spatial scale, qualitative vs. quantitative nature, or holistic vs. specialised character, they are largely complementary.

Where indigenous knowledge and science can work together to address a jointly defined problem, each bringing their own expertise to the table, their co-produced knowledge may lead to novel solutions. For this to happen, building dialogues that ensure mutual respect is crucial.



TROUBLED by the destructive impact of commercial logging on reindeer pastures, Sami herders in northern Sweden have engaged with forestry scientists to initiate unprecedented research. Pooling their distinct sets of knowledge and experience, herders and scientists are working to identify the conditions required for optimal restoration of lichen pastures.



IN UGANDA, the Karamojong hold *akiriket*, a sacred assembly attended by adult men and women. Here, elders share information, pass on knowledge, and collectively plan use of pastures. Crucial climate observations and understandings can be gained by respecting this revered institution and working with its membership.



IN SIBERIA, Nenets reindeer herders have collaborated with NASA to study rain-on-snow events. These events can lock winter pastures under ice, and entire reindeer herds may be threatened with starvation as they are unable to dig through ice layers. NASA provided satellite imagery, while herders provided observations of weather and pasture conditions and their impacts on the herds.



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