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Co-production between Indigenous Knowledge and Science: Introducing a Decolonized Approach

MARIE ROUÉ AND DOUGLAS NAKASHIMA

Times are bleak for planet Earth. The contours of the challenges facing human society are more and more sharply defined: global climate change, unprecedented biodiversity loss, deepening poverty and growing inequalities. We have entered the era of the Anthropocene. Our society's capacity to transform the environment in which we live has become a threat to our own existence. This new global outlook contrasts sharply with the twentieth-century myth of human progress orchestrated by advances in science and technology. Our heavy hand on the planet now confronts humans with a future full of unknowns.

This threat to human well-being is further aggravated by climate injustice. Societies transformed by scientific and technological 'progress' are consuming by far the greatest proportion of the earth's resources and are responsible for the vast majority of greenhouse gas emissions. Yet, they rarely bear the brunt of negative repercussions. Among those suffering the most are Indigenous peoples and rural communities who continue to rely on natural environments that are increasingly under threat. Pacific islanders are combatting rising sea levels that exacerbate coastal erosion and decimate food crops as a result of saltwater intrusion. The lives and livelihoods of circumpolar Arctic peoples are threatened by regional warming at rates twice the global average. Herders and small-scale farmers are facing increasingly frequent and extreme drought and flooding throughout the African Sahel.

Nevertheless, Indigenous and rural communities around the world are not passive victims of global change. They are demonstrating an astounding capacity to innovate and adapt. This resilience is rooted in in-depth intergenerational knowledge and know-how about the natural milieu and its variability, as well as social systems and community values that ensure solidarity and the sharing of lessons learned.

As our impacts on the planet move us into uncharted waters, scientists have had to take a step back from their habitual 'expert' stance. As science is no longer able to offer certitudes about the future state of the earth, opportunities have been

created to recognize the observations and understandings that other knowledge systems bring to the decision-making table. This fracturing of science's hegemony over 'truth' has facilitated the formation of collaborative partnerships across knowledge systems that enhance our understanding of a world in rapid transformation. One such partnership, the decolonized knowledge co-production between Indigenous knowledge holders and scientists (DKC), is the subject of this book.

In this introductory chapter, we outline our proposal. Our usage of the term 'co-production' differs from much of the contemporary scientific literature, which focuses on co-production within Western society, either across scientific disciplines or among scientists, citizens and policymakers (Meadow et al., 2015; Lemos et al., 2018; Miller and Wyborn, 2018; Adelle et al., 2020). Our endeavour explicitly reaches beyond Western society to co-produce knowledge at the interface of science and Indigenous knowledge systems. Knowledge co-production is not, however, just another way to refer to traditional or Indigenous knowledge. Instead, we propose Indigenous–scientific knowledge co-production as an emerging practice that has as yet rarely been attained in full, a challenging goal towards which future collaborations between Indigenous knowledge holders and scientists should aspire.

This chapter is organized into four sections, with the first three relating to the origins of our concept of co-production, its theoretical foundations and essential constituent parts, followed by a fourth section that offers an overview of the book. Descriptions of each section follow:

1 *Origins: Ethnoscience and Indigenous Knowledge of the Environment*

Our conception of co-production between Indigenous knowledge holders and scientists has emerged from several decades of earlier work within ethnoscience and on Indigenous knowledge of the environment. In recent years, however, Indigenous knowledge has become a victim of its own success. The multiplication of calls to include Indigenous knowledge in programmes, projects and research has led to the widespread adoption of the term, but often with little effort to ensure meaningful content. Out of concern that this trend might undermine the legitimacy of Indigenous knowledge, we have formulated the more ambitious project of DKC that is presented here.

2 *Co-production: Founding Concepts and Ethical Frameworks*

Elinor Ostrom, a political economist, was the first to coin the term 'co-production', which was subsequently taken up in science and technology studies. We discuss how these earlier usages inform our own, while also recognizing important insights from reflexive anthropology, radical feminism and research decolonization.

3 A Methodology and Ethic for Decolonized Knowledge Co-production (DKC)

We outline the conditions under which this ambitious undertaking might meet with success today, including the need for a problem-oriented approach with focused outcomes; long-term engagement and intellectual rigour to overcome differences in ontologies and epistemologies; and a decolonization of the quest for knowledge so as to address asymmetries of power and achieve equity.

4 About This Volume

We conclude with a brief overview of the organization of this book and the papers presented in the following chapters.

Origins: Ethnoscience and Indigenous Knowledge of the Environment

The concept of Indigenous-scientific knowledge co-production builds upon several decades of work on Indigenous, traditional or local knowledge of the environment. For some researchers, the initial approach to Indigenous knowledge has been through the domain of ethnoscience (Conklin, 1954; Sturtevant, 1964). For others, work on 'traditional ecological knowledge' (TEK) emerged in the political context of Indigenous claims to land and resource rights (Freeman, 1976). Despite their distinct origins, these paths have interconnected in subsequent decades and have been mutually reinforcing, creating conditions for the emergence of knowledge co-production.

Ethnoscience: Indigenous Knowledge of 'Natural' Environments

Ethnoscience or the 'new ethnography' – ethnobotany, ethnozoology and ethnoecology – emerged and prospered as a field of research from the 1950s to the early 2000s. Harold Conklin (1954) was a trailblazer, documenting the vast botanical knowledge of the Hanunoo, swidden farmers of the Philippines. In a completely different milieu and culture, Richard Nelson (1969) also provided an early and decisive contribution on Alaskan Iñupiat (Eskimo) knowledge of the physical environment, particularly that of Arctic sea ice. Their pioneering research unveiled the meticulous quality, remarkable amplitude and systematic nature of Indigenous knowledge of the natural milieu, including its transmission from one generation to the next and its parallels and contrasts with Western science. In the 1960s, Levi-Strauss (1962) offered a first overview of research into Indigenous knowledge systems in his seminal book, *The Savage Mind*.

Preparing the way for the cognitive sciences, ethnoscientists focused research on Indigenous systems of denomination and classification of natural phenomena – plants, animals, colours, celestial bodies, etc. – setting in place an ambitious

interdisciplinarity involving ethnology, linguistics and natural sciences (Sturtevant, 1964; Berlin et al., 1966; Ellen, 1983, 2006; Toledo, 1992; Friedberg, 1999). Indeed, researchers strove to juxtapose the in-depth knowledge of each culture – the syntax and semantics of Indigenous terms, the signifiers and the signified, social relations, practices and ontologies – with scientific understandings of the plants, animals or other elements under scrutiny. Researchers from many disciplines, including anthropologists, ecologists and geographers, conducted research under various labels: ethnobotany, ethnozoology, ethnobiology, ethnecology, and more recently, historical ecology (Balée, 2002) and ethnoclimatology (Orlove et al., 2002).

Indigenous Land Claims and the Emergence of TEK and Co-management

Ethnoscience refuted notions prevailing from colonial times about the ‘cognitive limitations’ of ‘primitive’ peoples and swept aside colonial ethnobotany with its narrow focus on economically useful plants. However, its focus was on similarities and differences in human cognition rather than on human rights. In contrast, the driving force behind the recognition of Indigenous knowledge of the environment in northern North America was the politics of Indigenous peoples’ rights to land and resources. Starting in the late 1960s in Alaska, United States and the 1970s in Canada, legal recognition of Indigenous rights over traditional territories that had not yet been extinguished by earlier treaties (Burger, 1977) opened an era of negotiations between governments and Indigenous peoples. These negotiations addressed not only the delimitation of Indigenous lands (Freeman, 1976) but also aboriginal rights to the harvesting and management of natural resources (Berkes, 1982, 1999). It is in this context that research on traditional ecological knowledge (TEK) emerged, attesting to the extensive and detailed environmental knowledge underlying Indigenous resource use (Freeman and Carbyn, 1988; Berkes, 1999; Nakashima and Roué, 2002; Huntington, 2011) and Indigenous self-management regimes (Feit, 1973).

These land claim processes led to the establishment of wildlife co-management regimes with Indigenous peoples seated alongside government representatives to share knowledge, priorities and practices (Pinkerton, 1989; JBNQA, 1998). The term ‘co-production of knowledge’ made its first appearance as part of an effort to include the knowledge of the Dene peoples and biologists in modelling caribou availability in north-western Canada and Alaska.

We strive towards the co-production of knowledge with communities ... not to meld cultural perspectives, but in an attempt to improve communication among parties and resolve common problems.

Kofinas and Braund, 1998: 3

This association of co-management with knowledge co-production is made explicit in Armitage et al. (2011), who demonstrate how the institutional arrangements of co-management may be conducive to the successful co-production of knowledge (Nakashima et al., 2012). The authors interpret co-production as a social learning process among a wide circle of organizations and individuals, both Indigenous and government. The close ties between co-production and co-management are also the subject of a recent special issue of the journal *Arctic Science*, the editors of which emphasize that ‘the meaningful inclusion of Inuit and their knowledge systems is both implicit and explicit in wildlife co-management’ (Johnson et al., 2020: 124).

Arctic and subarctic North America have been at the forefront of these developments as a result of political pressures to settle Indigenous land claims in the face of oil and gas, hydropower and mineral exploitation. However, recognition of Indigenous knowledge and resource management is not by any means restricted to these regions. Research among peoples of the Pacific Islands reveals their exceptional knowledge of the marine environment and the wealth of traditional institutions that manage resource access and conserve marine ecosystems in finite island environments (Johannes, 1978, 1981; Ruddle and Johannes, 1984). Similar ground-breaking work has been conducted in Africa (Scoones and Thompson, 1994; Warren et al., 1995), Asia and Latin America (Sillitoe, 2007).

Indigenous Knowledge: Growing Recognition and the Quagmire of Political Correctness

This growing local and national recognition of the value of knowledge from Indigenous cultures and environments across the globe has contributed to its emergence at the international level as an essential component of humanity’s response to planetary environmental crises. The United Nations Convention on Biological Diversity (CBD) provided a decisive push in 1992 with its recognition of the importance of ‘traditional knowledge, innovations, and practices’ under its Article 8(j). In subsequent years, Indigenous knowledge came to be an established feature of an ever-expanding web of research programmes, development initiatives and institutional arrangements. Prominent recognition was provided by scientific expert bodies such as the Intergovernmental Panel on Climate Change (IPCC) (beginning with its Third Assessment Report in 2001) and the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES) since its initial session in 2013 (Nakashima et al., 2018).

This expansion of Indigenous knowledge into a multitude of arenas at national and international levels held much promise for Indigenous peoples. It opened the possibility that their knowledge, insights and priorities would be considered,

alongside science, in a wide range of environmental decision-making processes. However, it also triggered a proliferation of superficial and opportunistic allusions to the concept.

Numerous programmes and projects have tacked on Indigenous knowledge components in order to tick the box of stakeholder involvement that many donors require. Nevertheless, without the necessary expertise or sufficient motivation to genuinely engage with local communities, these responses steeped in political correctness do little good and considerable harm. Instrumentalized in this manner, Indigenous knowledge is sapped of its meaning and, in some instances, the term has become little more than a buzzword.

This widespread recognition has nonetheless enabled the emergence of a new phase of knowledge collaboration. Indigenous peoples and scientists are joining forces in decolonized partnerships to grapple with the complex challenges posed by global change. We designate these emerging collaborations across knowledge systems as *decolonized knowledge co-production between Indigenous knowledge holders and scientists (DKC)*.

Co-production: Founding Concepts and Ethical Frameworks

Earlier applications of the term are briefly presented here to better understand how they inform our concept of co-production between Indigenous knowledge and science.

Ostrom's Co-production of Public Services: From Observation to Aspiration

Elinor and Vincent Ostrom, a political economist and a political scientist, respectively, coined the term 'co-production' in the context of their work on polycentric public services. Examining the delivery of security by local and centralized police departments in and around the city of Indianapolis, United States (Ostrom and Whitaker, 1973), Ostrom et al. (1978) concluded that citizens should be recognized as 'co-producers with police' of public security as they play an essential role in the delivery of outcomes including the success of investigations, number of arrests and rates of criminality (Ostrom et al., 1978: 383). The authors themselves point out that co-production is 'a rather novel and important aspect of our approach' (Ostrom et al., 1978: 389). Indeed, the concept features prominently in subsequent work with additional examples such as the co-production of education by teachers and students, and of health by doctors and patients. In a paper that spells out the methods of institutional analysis, Ostrom (1985) describes the conditions leading to co-production,

... when the outcomes of a process cannot be produced without the active cooperation of several different owners of input resources, the outcomes are subject to co-production.

Ostrom, 1985: 13

Whereas co-production is initially presented as a social phenomenon deduced from field observations, it subsequently emerges as a central tenet of Ostrom's vision of 'the Good Society' (Ostrom, 1993). She rails against the increasingly pervasive notion of one-way, top-down governance where governments are responsible for service delivery and citizens are confined to the passive role of consumers or clients.

The term "client" is used more and more frequently to refer to those who should be viewed as the essential co-producers of their own education, safety, health and communities. A client is the name for a passive role. Being a co-producer makes one an active partner.

Ostrom, 1993: 8

For Ostrom, co-production is an essential building block for democratic societies. It is an integral part of two-way governance processes involving citizens who, as co-producers, 'take responsibility for as much as possible of what happens around them' (Ostrom, 1993: 8). She expressed her fear that this active role is increasingly threatened by the growing hegemony of centralized government.

Rabeharisoa and Callon (2004) describe one such co-production process where patients and their families engage medical scientists in a mutual apprenticeship (Epstein, 1995, 1998) to advance medical knowledge about rare and orphan diseases. This 'new relationship between science and society, between those who produce knowledge and those who are supposed to benefit' from it (Rabeharisoa and Callon, 2002: 71) is driven by patient associations such as the French Association of Myopathies that defend the right to 'self-help' and lobby for taking into account the experiences of the patients themselves. Embracing this concept of knowledge co-production, one such collective of patients, doctors, S&T experts and artists have named themselves 'The Institute of Knowledge Co-production on the Huntington Disease Dingdingdong' (Rivière, 2013).

Co-production of Science and Society: Insights from Science and Technology Studies

Co-production, as conceived by Ostrom, focuses on the delivery of public services by governments and citizens. Philosophers and epistemologists in science and technology studies (STS), however, have considered the particular case of science: its co-production as an integral part of society and its assertions about 'truth' and 'reality'.

Physician and biologist Ludwick Fleck is the first to have argued that scientific concepts and theories are culturally conditioned. His iconoclastic book ‘Genesis and Development of a Scientific Fact’ published in 1935, continues to fluster scientists and their claims to ‘truth’ (Fleck, 1979). He demonstrates that ‘facts’ are constructed by groups of scientists who, as ‘thought collectives’ with specific ‘thought-styles’, create and adhere to norms, conceptions and practices that differ from those of other scientists in the same discipline. Scientific ‘facts’ produced by one thought collective are incommensurable with those of another, thus unveiling the relative nature of ‘truth’.

Thomas Kuhn (1962) takes issue with the positivist epistemology of Karl Popper, for whom science is cumulative and progresses in linear fashion. He postulates, instead, that science is cyclic. Following a period of ‘normal (cumulative) science’, a crisis is encountered that engenders a ‘gestaltswitch’ or *paradigm shift*, after which a new period of ‘normal’ science is set in motion until the next paradigmatic crisis. This change in paradigms is so profound that the science existing before the crisis is, to a large extent, incommensurable with the science that follows. It is a shift from one way of viewing the world to another.

Fleck reveals the extent to which scientific ‘facts’ are socially constructed by specific groups of scientists, while Kuhn demonstrates that scientific ‘truths’ shift historically from one period to the next. This ‘social construction of scientific facts’ is further analysed by Bruno Latour (1990), who for the first time outlined a ‘theory of the co-production of science and its social context’ in his review of ‘Leviathan and the Air Pump’, Shapin and Schaller’s book on the seventeenth-century debate about the air pump. For Latour, science is but one of several ‘modes of existence’ that co-exist among the ‘moderns’ of contemporary Western society, each incommensurable with the other because each ‘possess(es) its own conditions of truth and falsity’ (Latour, 2013: 177). In view of this incommensurability, Latour postulates the need for a system of ‘diplomacy’ that allows proponents to interact without being judged by the regime of ‘veridiction’ (truth and falsity) of the other (Latour, 2013).

Sheila Jasanoff reflects further on the term co-production in an essay on the sociology of scientific knowledge that reaffirms that science is ‘a dynamic and integral part of society – a social construct’ (Jasanoff 1996: 409).

Scientific knowledge, in particular, is not a transcendent mirror of reality. It both embeds and is embedded in social practices, identities, norms, conventions, discourses, instruments and institutions – in short, in all the building blocks of what we term the social.

Jasanoff, 2004: 2–3

By re-situating science within society, rather than as an imagined extra-societal undertaking, Jasanoff debunks the binary oppositions that Western science has

long used to extol its own virtues as objective and rational, while disparaging other knowledge systems as value-laden and rooted in superstition.

Co-production can therefore be seen as a critique of the realist ideology that permanently separates the domains of nature, facts, objectivity, rationality and policy from those of culture, value, subjectivity, emotion and politics.

Jasanoff, 2004: 2–3

However, rather than acknowledging that science is co-produced with society, it is much more tempting for scientists to perpetuate these culturally constructed oppositions of nature versus culture or facts versus values. For Isabelle Stengers, the renowned science philosopher, science professors are complicit even today in promulgating this cognitive hierarchy among their students.

I have learned from my teaching experience that most students enrolled in the so-called ‘hard’ sciences are determined to forget their courses (in epistemology of science) once exams are over. . . . Although obliged to put up with these courses that they consider ‘chatty’, they do not view them as a crucial part of their curriculum, an attitude seconded by many of their ‘true’ professors with a smirk, complicit smile or wise advice about not allowing oneself to ‘be dispersed’.

Stengers, 2013: 16–17 (author’s translation)

Recognizing that science is inextricably linked to society is a crucial first step towards its decolonization, and is essential for achieving, as we will discuss subsequently, a decolonized co-production of science and Indigenous knowledge.

From Postcolonialism to Decolonization

Other writings lay foundations for the emergence of knowledge co-production by revolting against the scientist’s reification of their ‘research objects’. Indigenous intellectuals have triggered a decolonization of research ethics, initially among the social sciences and, more recently, among parts of the biological sciences. At the time the American Indian Movement was coming into being, Vine Deloria, an Indigenous intellectual, accused anthropologists of reducing Indigenous peoples to being mere ‘objects for observation’ (Deloria, 1997). In a book entitled ‘Custer Died for Your Sins: An Indian Manifesto’, which gained considerable renown, he asks: ‘Why should we continue to be the private zoos for anthropologists?’ (Deloria 1970: 99). As aptly summarized by Biolsi and Zimmerman:

Deloria represented the anthropologist as an urban, overly intellectualized, insufficiently humanized academic who descends on Indian country every summer to confirm and reproduce essentially self-confirming, self-referential and self-reproducing closed systems

of arcane “pure knowledge” – systems with little, if any, empirical relationship to, or practical value for, real Indian people.

Biolsi and Zimmerman, 1997: 2

Similarly, Edward Saïd (1978), in his book *Orientalism*, denounces Western discourses about the Middle East as justifications for their colonial enterprises. By demonstrating how the ‘Other’ is invented by the Western world in order to fulfil their own needs, he becomes the leader of a new movement: post-colonialism.

In the decade that followed, reflexive anthropology, semiotic anthropology and post-structuralism dedicated themselves to redefining objectivity in relation to knowledge and the subject/object relationship. Feminists in particular criticize the reifying stance of science, proposing in its place a situated and embodied knowledge (Haraway, 1988: 583). They advocate a ‘positioned rationality’ and lambast scientists who, by presenting themselves as the holders of a universal objectivity, place themselves in a position of cultural hegemony, forgetting to analyse their own worldviews: ‘There is no way to be simultaneously in all, or wholly in any, of the privileged (i.e. subjugated) positions structured by gender, race, nation, and class’ (Haraway, 1988).

Reflexive anthropology, founded by Rabinow (1983) and Clifford and Marcus (1986), abandons the position of scientists as subjects who study objects, proposing in its stead a dialogue inspired by the notion of dialogism invented by Bakhtin in the domain of literature,

Reflexive anthropology sees the resultant production as a dialogue between anthropologist and informant so-called: the observer/observed relationship can no longer be assimilated to that between subject and object. The object(ive) is a joint production. Many voices, multiple texts, plural authorship.

Strathern, 1987: 264, note 38

Following in the footsteps of Edward Saïd, Linda Tuhiwai Smith published *Decolonizing Methodologies: Research and Indigenous Peoples* in 1999. She argues that collaborations with non-Indigenous scientists are difficult to envisage as ‘there is no difference (. . .) between “real” or scientific research and other visits by inquisitive and acquisitive strangers’ (Tuhiwai Smith, 1999: 3). Her critique, which targeted extractive research and an anthropology that reified the people studied, has created an opportunity to establish a new relationship.

Whose research is it? Who owns it? (. . .) Who will benefit from it? Who has designed its questions and framed its scope?

Tuhiwai Smith, 1999:10

The questions she poses and the requirements she defines could be understood as a programmatic forerunner to what we propose as a decolonized co-production between Indigenous and scientific knowledge systems.

A Methodology and Ethic for Decolonized Knowledge Co-production between Indigenous Knowledge Holders and Scientists (DKC)

As we have seen in the previous section, the term co-production is polysemic. In the first instance, it is *descriptive* as it describes a process inherent to a given society. It might also be termed *intrinsic co-production* in reference to it being an essential or fundamental component of, for example, public services (Ostrom et al., 1978) or science (Jasanoff, 1996). But the term may also be *prescriptive*, when co-production is put forward as an aspiration or norm, such as for democratic societies (Ostrom, 1993) or to advance knowledge about rare or emerging diseases (Rabeharisoa and Callon, 2002). Furthermore, Meadow et al. (2015) underline the need for a *deliberate co-production* between scientists and decision-makers that is explicitly planned and executed in an iterative and reflexive manner. Our proposal goes one step further in that it concerns a deliberate co-production, not between groups within the same society, but between scientists from diverse disciplines and traditional knowledge experts from Indigenous societies.

This cross-cultural co-production is recent in origin as its emergence is predicated on scientists engaging in a reflexive analysis of Western science and their own scientific practice, and a progression from descriptive co-production to one that is prescriptive and then deliberate. Therefore, rather than addressing knowledge co-production 'in general', this book focuses on co-production between two specific groups, Indigenous knowledge holders and scientists, in response to environmental risks and uncertainties unleashed by global change, including anthropogenic perturbation of climate and life systems. At the advent of the Anthropocene, these are as yet uncharted waters. Neither science nor Indigenous knowledge can provide answers for challenges that are only beginning to emerge. Yet these knowledge systems are largely complementary: science focuses on large-scale, even global phenomena and trends, with an appetite for quantification and the universal; while Indigenous systems are rooted in intimate, qualitative understandings of the inner workings of local systems. In the face of uncertainty, observations, understandings and interpretations from both systems may be usefully shared and jointly debated to co-produce new knowledge that may lead to effective responses.

Articulating two knowledge systems, however, is not just a matter of inventing a new method and a strategy for its global application. Knowledge is intimately connected with power (Pohl et al., 2010), and in our contemporary societies, a severe power asymmetry persists between science and Indigenous knowledge. Even though Indigenous peoples across the globe have hunted, fished, gathered, herded or farmed their homelands on land and sea for millennia, their environmental knowledge has long been ignored, if not disdained.

State-management systems with science-based policies of quotas, closed seasons, protected areas and maximum yields have profoundly transformed that which we call 'nature' in Western cultures. The opposition of nature with culture is a unique trait of our naturalist ontology (Descola, 2005). Such a dualism does not exist for Indigenous peoples for whom human and non-human persons are part of the same continuum. The imposition of Western rules and regulations on Indigenous homelands (often misrepresented as 'nature' or 'wilderness') threatens their cultures, ways of life, and their very existence. Without addressing these asymmetries of power and differences in ontologies, efforts to build dialogue between Indigenous knowledge and science run the risk of merely reinforcing this deeply rooted colonial heritage.

DKC is ambitious, but it is not by any means a *merging* of *entire* knowledge systems. Knowledge systems are rooted in unique cosmologies and epistemologies, as well as their own social dynamics and ways of life. They cannot be blended whole scale. The goal that we envisage for knowledge co-production is more modest. Its aim is not to merge, but rather to seek out correspondences, dissonances and complementarities between two distinct but intersecting views on jointly defined and clearly circumscribed problems. Such a process, freed of the inequities instilled by our colonial past, may lead to a collaborative generation of new knowledge and novel approaches to help resolve the complex socio-ecological challenges facing humanity today.

Although encouraging advances have been made during recent decades, decolonized knowledge co-production between Indigenous knowledge and science remains an ambitious undertaking that few, if any, can claim to have fully achieved. Some of the essential requirements to progress towards this goal are as follows:

Prerequisites

A Long-Standing Dialogue

DKC can only emerge from a long-term exchange between Indigenous and scientific experts that is measured in years, if not in decades. In sharp contrast, Rapid Rural Appraisal (RRA) and other participatory processes use rapidity as the measure of their efficacy and the inevitable consequence is superficiality (Richards, 1995).

An In Situ Approach Anchored in Local Knowledge of Indigenous Homelands

DKC occurs *in situ*, within the home territories of the knowledgeable Indigenous experts who partner with field scientists. It is built around their in-depth local knowledge and relevant sciences.

A Problem-Oriented and Engaged Approach

DKC is a circumscribed undertaking that focuses on a mutually agreed problem faced by Indigenous communities. By focusing dialogue and debate on matters essential to the defined problem, conditions conducive to successful co-production between Indigenous knowledge and science are created.

An Intentional and Applied Undertaking with Theoretical Implications

By fostering innovative methodologies and the generation of new knowledge, DKC is an applied undertaking that may also have important theoretical implications, for both Indigenous knowledge holders and scientists.

Broad Interdisciplinarity and Transdisciplinarity

DKC requires much more than a multidisciplinary approach, which merely juxtaposes scientific disciplines without resolving the fundamental problem posed by their different temporal and spatial scales. To consider complex issues such as the local impacts of global phenomena, a broad interdisciplinary approach is needed that not only engages different disciplines in a shared undertaking in order to address a jointly defined problem but also bridges the domains of the bio-physical and social sciences. Even more challenging is the establishment of dialogue that extends beyond science to encompass both scientific and Indigenous knowledge, often referred to as transdisciplinarity.

*Key Actors**A Community of Practice*

In DKC, each project requires the constitution of a community of practice that works to bridge the divide between knowledge systems and communities with their distinct cultures, languages, methods and worldviews. Strict respect for equity between knowledges and an absence of hierarchy in social interactions are essential requirements for an effective dialogue that remains attentive to ontological and semantic conflicts which may offer critical insights. Finally, personal ties established over time as the work progresses create a climate of mutual confidence that ensures the success of the endeavour.

Indigenous Experts

DKC requires the involvement of individuals recognized by their communities as experts in the targeted domain, whether their recognized expertise is thematic, spatial (knowledge about particular places), or temporal (generations with

knowledge from different periods). Both expert women and men are involved for their gender-based knowledge.

Scientific Experts

In DKC, to establish and maintain productive dialogue with Indigenous experts, scientists must be knowledgeable about the bio-physical issue at hand, whether it might relate to climate conditions, ice dynamics or ecological change. Social science expertise in Indigenous languages and ethnoscientific methods is also fundamental in order to decipher semantic conflicts and steer clear of ontological and epistemological pitfalls, along with transdisciplinary expertise between science and other knowledge systems. The most important requirements, however, are of a completely different order: reflexivity, humility and a passion for knowledge that renounces the hegemony of science are essential prerequisites for establishing a constructive dialogue across cultural boundaries.

Mediators

DKC requires capable and experienced mediators, both Indigenous and scientific, to bridge the divide between knowledge systems. Their key role is to serve as translators, not in the linguistic sense, but rather in the ontological sense of finding common ground in relation to meanings. This critical function generally requires long experience of collaborative interactions with persons from both knowledge systems.

Ethics and Relationships

Decolonization

DKC at the interface of scientific and Indigenous knowledge systems requires new partnerships rooted in an epistemic decolonization that is gaining momentum. Indigenous rights are formally recognized by the 2007 UN Declaration on the Rights of Indigenous Peoples. Indigenous knowledge holders have gained broad international recognition, building on the platform provided by the Convention on Biological Diversity and its Article 8(j), further reinforced by the Nagoya Protocol on Access and Benefit-Sharing. A new generation of Indigenous leaders has emerged that is at home in two worlds, combining their training in Western institutions with knowledge from their communities. Among interdisciplinary scientists specializing in Indigenous knowledge, some have moved beyond merely documenting and valuing this intellectual heritage to partnering with and for Indigenous peoples.

Equity between Knowledge Systems

DKC requires the dismantling of hierarchical relations between science and Indigenous knowledge systems. While in citizen science, scientists alone fix research questions, establish methods, analyse data and draw conclusions, co-production requires a level playing field and equitable partnership from day one. There is no place for the ‘validation’ of one knowledge system by the other (Roué and Nakashima, 2018) or for an extractivist approach where one system selects knowledge of value and rejects the rest.

Mutual Trust and Benefits

In DKC, trust between Indigenous and scientific partners is born from long experience of joint work that builds the confidence of all parties in a shared capacity to willingly and successfully navigate between distinct languages, classification systems and ontologies: basic requirements for an effective and respectful dialogue. Equally important is the identification of mutual benefits that are clearly defined and agreed from the beginning with shared responsibility for their fullest realization.

From FPIC to Co-authorship

Free Prior and Informed Consent (FPIC) is a right included as Article 10 of the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) of 2007. Not only must Indigenous peoples be consulted prior to any project, but they are also free to withdraw their consent at any point in time. DKC, however, goes well beyond FPIC for project initiation. Indigenous experts are fully engaged and responsible partners alongside scientists throughout the process from the project’s earliest stages to its completion. This shared responsibility extends to project outputs, including transparent co-authorship of reports and publications by the Indigenous experts and scientists jointly involved in this equitable enterprise.

About This Volume

This book responds to the need to move beyond reaffirming and documenting the importance of Indigenous peoples’ knowledge. It proposes decolonized knowledge co-production between Indigenous knowledge holders and scientists (DKC) as a goal to work towards and presents case studies that illustrate some of the different efforts underway. It is organized in three major parts:

- Part I From Practice to Principles: Methods and Challenges for DKC
- Part II Indigenous Perspectives on Environmental Change
- Part III Global Change and Indigenous Responses

Part I From Practice to Principles: Methods and Challenges for Decolonized Knowledge Co-production (DKC)

This first part focuses on research and projects in the Arctic and Subarctic regions that have been on the frontlines of climate change due to the accelerated rate of circumpolar warming (Krupnik and Jolly, 2002). Political processes relating to Indigenous land and resource rights have stimulated several decades of joint work by circumpolar Indigenous peoples and researchers on Indigenous knowledge systems and regimes of co-management. With legal recognition of Indigenous knowledge in northern Canada and Alaska, and ambitious international collaborations such as during the International Polar Year 2007–2008 (Krupnik et al., 2011), long-term partnerships between Indigenous peoples and scientists have been forged over recent decades that offer a unique opportunity for reflexive analyses of DKC (Roturier et al., Chapter 7).

Authors emphasize the importance of a step-by-step and feedback-driven process – learning by doing. The opportunity for co-production emerged as the project advanced, even though it may not have been envisaged from the beginning: ‘As trust was built and relationships were created among the participants, people began to realize that more was possible,’ (Huntington et al., Chapter 2). Similarly, a broad interdisciplinarity, extending from the physical to the ecological sciences (Druckenmiller, Chapter 4), and also embracing history and the social sciences (Eicken et al., Chapter 3; Krupnik, Chapter 5), is not achieved a priori but rather assembled step-by-step as required by the complexity of the problem to be resolved.

In DKC, long-term relationships based on collaborative ‘learning by doing’ create fertile ground for serendipity: discovery emanating from the unexpected. This phenomenon, associated with many scientific ‘inventions’, is often mistakenly represented as ‘chance’. But as Louis Pasteur so famously declared, ‘Chance only favours prepared minds’. In dialogues between knowledge systems, semantic ‘anomalies’ emerge where concepts once believed to be synonymous are in fact discovered to differ (Roué et al., Chapter 6).

Part II Indigenous Perspectives on Environmental Change

Part II highlights Indigenous voices. The texts presented here are based on interviews conducted by M. Roué during UNFCCC COP 21 and 22, or as part of the BRISK project. Their shared message in very different settings is about monitoring change and responding with resilience. Conscious that loss of knowledge leads to a loss of identity, they strive to pass on to younger generations traditional knowledge and ways of life as a foundation for adapting to an era of

global change. In contrast to popular images of Indigenous peoples resisting modernity, they are open to technical innovations, adapting them to fit their needs and maintain their modes of existence. They continually reinvent tradition to keep it alive, whether for wayfaring in the Pacific (Fuluna, Chapter 9), herding reindeer in Sapmi (Bongo, Chapter 10) or raising livestock in the Sahel (Dicko, Chapter 11).

For those who believe that Indigenous rights are upheld at the international level, the account by Oumarou (Chapter 8) illustrates how difficult it is for Indigenous voices to be heard in UN arenas where only governments have the right to speak. Capable of defending Indigenous rights in the international arena with enormous determination and great talent, while also working on the ground with members of her herding community, the experience of this young Indigenous woman is exemplary. It resonates with that of Indigenous peoples around the globe who rise to challenges that are at once global and local.

Part III Global Change and Indigenous Responses

The third part of the book illustrates the enormity of the challenges facing knowledge co-production in a world where climate change impacts are further aggravated by global change. While some Indigenous efforts to adapt may meet with success (Steward, Chapter 14; Fernandes-Llamares and Cabeza, Chapter 15), skewed power relations may complicate final outcomes. Their efforts may end up appropriated and monetized by government, as in the Himalayas (Salick, Chapter 12) or compromised by industrial development, as in the case of Nenets reindeer herders who co-exist with the largest natural gas complex in the Arctic (Forbes, Chapter 13). These cases remind us of how illusory it is to believe that simple technical fixes would suffice to counter climate risks, when in fact Indigenous peoples worldwide are facing complex challenges of global change, failed governance and new forms of coloniality (Burman, Chapter 16). In this rapidly changing world, a decolonized co-production that unites the forces of Indigenous knowledge with that of science may provide Indigenous peoples with much-needed additional leverage.

Acknowledgements

Sincere thanks to Igor Krupnik for his valuable comments that helped us shape this chapter. We are also grateful for the financial support provided by the Agence Nationale de la Recherche (ANR-France) for the programme Bridging Indigenous and Scientific Knowledge (BRISK) and the programme Future Arctic Ecosystems (FATE) in the framework of the Belmont Forum.

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