# Transnational Interactions and Integrations of Indigenous Knowledge Systems and Western Science: A Cross-Case Synthesis of Informed and Consented Educational and Policy Interventions on Biodiversity Conservation and Genetic Resource Management

By

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**Abstract**

This dissertation examines how Indigenous Knowledge (IK) and Traditional Knowledge (TK) systems interact with Western Scientific Knowledge (WSK) in contemporary efforts to reintroduce traditional agroecosystems and build transnational collaborations among Indigenous Peoples and Local Communities (IPLCs). I focus on the role of education, broadly defined, in establishing political and practical conditions that foster equitable integration of knowledge systems in accordance with international treaties and binding agreements around biodiversity conservation and sustainable development. The context for this work is the rapidly evolving policy discourse of Indigenous Peoples' territorial, human, environmental and intellectual property rights, and the set of principles that are emerging from this discourse. Central among these is the principle of Free, Prior, and Informed Consent (FPIC). The case studies presented herein trace how transactional models of education and scientific research replicate and reproduce the harms of colonialism, and identify promising alternatives in the form of educational, agroecological, and resource-exchange practices that emphasize Indigenous Peoples' governance over natural and genetic resource management. In particular, I describe the emergence of international coalition-based resistance by IPLCS to intensive cultivation, agrochemical practices, and the control of seed genomes by the western/neoliberal intellectual property system. Restoring Indigenous management of key genetic resources for health, nutrition, and ecosystem management emerges as the central theme across the dissertation.

The dissertation strengthens the case for the *biocultural* governance capacity of IPLCs and for transnational IPLC networks as strategic partners in the pursuit of global sustainable development goals. At the same time, it highlights the legal, policy, and ethical obligations of mainstream educational and research institutions to obey the principles of FPIC in all collaborations with Indigenous Peoples as part of their commitment to national and international

sustainable development goals. The higher education sector is undeniably complicit in the neocolonial project of integration and Indigenous erasure, as well as global systems of intensive cultivation and intellectual property that threaten the success of all sustainable development projects. Yet higher education can also claim a powerful and constructive new role by creating programmatic spaces that facilitate FPIC-based institutional relationships with IPLCs, supporting transnational indigenous networks, and advance equitable principles for consensually integrating the methods and findings of diverse knowledge systems.

## Introduction

Early in my studies at UW-Madison, I spent six years working on a large science education project for Indigenous and non-Indigenous learning communities in Northeast Wisconsin. Our goal was to develop a place-based platform for effective interactions among Indigenous Knowledge Systems (IKS), Traditional Knowledge (TK), and Western Knowledge Systems (WKS). The project leaders anticipated that integrating the Traditional Ecological Knowledge (TEK) framework into science education would result in a range of technical and methodological problems. For example, forms of validation might not be mutually compatible, or sensitive cultural representations of knowledge might be marginalized as overly subjective or emotional, or, the potential of TEK to offer conceptual approaches beyond land tenure practices could be dismissed outright. Ultimately, however, the project became entangled in a much wider range of questions that involved epistemological, cultural, historical, policy, and political issues, as well as the very conceptualization of education as a tool for particular notions of social development.

As an international Indigenous scholar with personal, professional, and academic experience with Indigeneity in diverse contexts across the American continent and beyond, many of these issues stood out for me. Even so, it still took at least seven years of practice and participant-observation, as well as extensive discussions with multiple participants among different projects, including this dissertation research, to most fully understand how unproductive the typical approaches to relationships between IKS/TEK and WKS have been. They will remain thus until and unless non-Indigenous scholars and practitioners consider the complexities of Indigeneity, as not only relevant but also crucial to reflect equitable, mutually

beneficial, and productive integrations of these frameworks within collaborations and partnerships.

For example, when I worked as digital media specialist on science curriculum design with the UW-Madison POSOH Project and the Department of Biochemistry, I noticed how the Menominee knowledge system was isolated, as a unit of study, in order that it could be more easily adapted into western standardized science curriculums for high schools in Northeast Wisconsin. When this project began in 2011, there were only four fluent Menominee language speakers alive; all were at risk of dying due to extreme age and, with them, a key mechanism within Menominee culture that contained critical information about its epistemological and material systems. Their language had always been an inextricable part of their cultural knowledge system as a whole and, though it was in danger of being lost, it still has the potential to be recovered by tribal members. As I worked with the College of Menominee Nation over the course of 6 years, I began to see the importance of reinitiating external interactions with other Indigenous Knowledge Systems, as a kind of parallel process to their own recovery of internal and local sources of knowledge on the verge of being lost.

As I learned more and more about issues importance to Indigenous Peoples from around the world, it became clearer to me that the recovery of components of cultural and material knowledge would, of necessity, involve the inner-cultural and linguistic processes of Indigenous Peoples that otherwise remain exogenous to western science epistemologies, ontologies, and methodologies. More importantly, I began to see how much of the Menominee's experience, in terms of the contingencies they worked within and the challenges they faced, were indeed common to a global experience of Indigeneity among other such peoples, and have also been deeply connected to policy developments in international law, since the early 1990's.

Research, as informed by postcolonial studies, critical educational research, and sustainable development, among other related disciplines, has demonstrated that IKS are critical not only to achieving sustainability but also to the survival and thriving of Indigenous Peoples and Local Communities (IPLCs) overall, as many of their knowledge systems are approached in research, industry, and policy in oppressive and extractive ways. "Local Communities" refers to disenfranchised and displaced Indigenous communities who in the absence of recognized governance are represented by external mediating institutions, such as regional organizations and NGOs or through the International Peasant Movement or Via Campesina. These Local Communities are nevertheless intertwined with the global Indigenous representation. In this dissertation, I refer to Indigenous Peoples as constitutionally recognized Indigenous Peoples, and Local Communities as non-recognized Indigenous Peoples who may be on the path to recognition. Because the frameworks of the Convention of Biological Diversity and the climate change agreements make reference to Indigenous Peoples and Local Communities together, I do so as well in light of the specific perspective of biodiversity conservation. Moreover, the concept of Indigenous Knowledge (IK) is associated with Indigenous governance structures, while TK is associated with Local Communities as a product of the relationships between Local Communities and external organizations. TK also refer to a set of practices that have been extracted and adapted into sustainable development discourse and action. The dissertation uses the framework of IK/TK to refer to Indigenous Peoples and Local Communities with a common history around Indigeneity and their coalescing representation in international law.

The latest mechanism to protect IKS/TK and IPLCs' rights emerged in international law and policy through the United Nations Permanent Forum on Indigenous Issues (UNPFII) which has met annually since 2002. This group represents a global consensus for the self-determination

of world Indigenous Peoples. In addition, the United Nations Declaration of the Rights of Indigenous Peoples (UNDRIP) was ratified on September 13, 2007 by a majority of 144 states in favor, 4 votes against (Australia, Canada, New Zealand and the United States) and 11 abstentions (Azerbaijan, Bangladesh, Bhutan, Burundi, Colombia, Georgia, Kenya, Nigeria, Russian Federation, Samoa, and Ukraine).[1] Years later, the four countries that voted against UNDRIP have reversed their position and now support the UN Declaration. Today the Declaration is the most comprehensive international instrument on the rights of Indigenous Peoples. It establishes a universal framework of minimum standards for the survival, dignity, and well-being of the Indigenous Peoples of the world, and it elaborates on existing human rights standards and fundamental freedoms as they apply to the specific situations of Indigenous Peoples.

Central to my dissertation is the relevance of the Free, Prior, and Informed Consent (FPIC) mechanism which comes out of the global Indigenous movements I have briefly discussed above. FPIC requires equal exchange among IPLCs governance and knowledge systems. IKS rely on the capacity of IPLCs to exercise their governance systems with autonomy, self-determination, and/or sovereignty according to their national legislations. IPLCs governance systems must also be strengthened in order for FPIC to be a fair and legal mechanism that ensures productive interactions and integrations around critical issues of loss of biodiversity, climate change, and environmental disaster mitigation. In my field research and data analysis, I found the consistent argument that WKS are intertwined with political systems that oppose the

[1] Resolution adopted by the General Assembly on 13 September 2007 *[without reference to a Main Committee (A/61/L.67 and Add.1)]* 61/295. United Nations Declaration on the Rights of Indigenous Peoples. *The General Assembly, Taking note* of the recommendation of the Human Rights Council contained in its resolution 1/2 of 29 June 2006, by which the Council adopted the text of the United Nations Declaration on the Rights of Indigenous Peoples.

strengthening of IKS and self-determined Indigenous governance over their own territories and natural resources.

This dissertation project seeks to deconstruct postcolonial relations and policies related to biodiversity conservation in order to understand the struggles for Indigenous revitalization at national and local levels, as well as the important contributions that IPLCs and IK/TK systems offer at a very critical time for humanity. My work honors my experiences with Indigenous Peoples, responding to the lessons I learned from diverse Indigenous communities, and ultimately aligns with existing research and policy with attention to the restoration of governance and knowledge systems.

The conceptualization and completion of this dissertation was in a very real sense the continuation of years of work on participatory interactions between IKS/TKS and WKS in the context of science and environmental education interventions around bioenergy, prairie restoration, and lake and river conservation in American Indian Reservations across US. I intend to highlight the inclusion of Indigenous and Traditional Knowledge as a legal as well as epistemological matter in the conservation of genetic resources and in intellectual property systems related to the access, use of, and benefit from the use of genetic resources. My research is also unavoidably and (I believe) fruitfully informed by my identity and reflections as a Peruvian American Indigenous scholar with more than two decades of life and work experience with Indigenous communities in Peruvian Andes and Amazonia, and with a decade working with American Indian, Alaskan, and Pacific Islands Peoples, as well as with international scholars from Indigenous Peoples' communities around the world.

**Understanding the Problem**

After many years of research, I encountered evidence that one of the core problems of science education projects—along with many other research initiatives that strive to facilitate exchange between WKS and IKS—is rooted in the attempts to isolate and adapt the knowledge of Indigenous Peoples. These groups are engaged in profound and ongoing cultural and historical change related to the rescue of their inner-cultural funds of knowledge and in the restoration of their land-based governance systems. Central to their struggle is the process of revitalizing knowledge systems based on the surviving pieces held by different but historically connected Indigenous institutions and communities. This revitalization process has been activated all across the world to differing degrees depending on the conditions and status of Indigenous societies and the capacity of their governance systems to control the dialogue with the external world and the use and transferability of their knowledge and cultural resources.

Dodson (2003) defines governance as processes, structures, and institutions (formal and informal) through which a group, community, or society makes decisions, distributes and exercises authority and power, determines strategic goals, organizes corporate, group, and individual behavior, develops rules, and assigns responsibility (Dodson et al., 2003). In the US, the Harvard Project on American Indian Economic Development conducted systematic research into the relationship between American Indian governance, sovereignty, and sustainable economic development.[2]

Without a doubt, the revitalization of IK/TK systems requires a different perspective on education, one that connects with transnational Indigenous contexts and realities that are largely unacknowledged by mainstream public educational systems—systems that respond to the

[2] See Begay, Cornell & Kalt 1998; Cornell 1993, 2002; Cornell and Gil-Swedberg 1995, Cornell & Kalt 1992, 1995; Jorgensen 2000; Kalt 1996.

demands of corporate capital and the neoliberal job market by deploying compulsory standardized curricula. The revitalization of IKS also depends upon the development of new political and legal mechanisms to govern the interaction of IKS and WKS under the overarching framework of FPIC, whether those interactions take place in the context of industry, academic research, or education.

This dissertation contributes to ongoing scholarly and political discussions about contemporary transnational challenges to the relationships between Indigenous Peoples and nation-states, particularly the tensions resulting from the fragmentation (through colonization, genocide, and ongoing political oppression) of IKS and political identities. These discussions have intensified in recent years, owing in part to the increasing emphasis on the biocultural research methods and sustainable development frameworks that are perceived to be vital for global biodiversity conservation and in response to climate change.

Informing my research is unawareness of the fact that the interactions between science and public education are not helping to improve the situation of Indigenous Peoples on multiple fronts. Decades of interactions between different research and practice platforms such as Indigenous Knowledge (IK), Indigenous Ecological Knowledge (IEK), TEK, and TK, still divide scientists, policy, and learning communities to the point of open confusion. Since some of these confusing or outdated terms still exist on many official documents, agreements, validations, and reports, the meanings of the relationship between diverse IKS and WSK has not fundamentally changed beyond technical and methodological stances. Therefore, since the creation of these terms, they have not contributed to improving the quality of education, life, self-governance, and sustainability for Indigenous Peoples in their own territories. As Steg et al. (2009) observes, changes in people's quality of life constitute an important component of the more general notion

of sustainable development. Prior to this research and during my international research in Indigenous contexts, I perceived the sense of uncertainty and frustration in the voices of Indigenous delegations in law forums and I listened the numerous reports of rights violations from Indigenous Peoples representatives at the UNPFII who denounced the worsening of the relations between IPLCs, nation states and societal institutions.

The attention to the role of Indigenous Peoples in biodiversity conservation has included new questions about their capacity for natural resource management governance, the status of genetic materials under their care and management, and the relationships between genetic science, human rights, and governance of world Indigenous communities. As more stakeholders are convinced that sustainable development requires productive interaction between IKS and WSK, Bohensky et al. (2011) argues that an understanding of the similarities and differences between IKS and WSK as well as the benefits and challenges of integrating these different knowledge systems, is considered to be a prerequisite to knowledge integration.[3]

The legal protection of TK raises difficult questions at the intersection of innovation policy and knowledge governance, with important implications for the universality of Indigenous Peoples' rights. A significant source of tension in ongoing discussions internationally has been the difficulty of "delineating entitlement interests in traditional knowledge consistent with prevailing doctrinal limits to intellectual property (IP) rights, such as the public domain" (Long, 2005 p. 1). Long also argues that favoring a multilateral framework recognizing minimum

[3] In Bolensky (2011): See also, Moller, H., F. Berkes, P. O. Lyver, and M. Kislalioglu. 2004. "Combining science and traditional ecological knowledge: monitoring populations for co-management." *Ecology and Society* 9(3): 2. [online] URL: http://www.ecologyandsociety.org/vol9/iss3/art2/. Davis, M. 2006. "Bridging the gap or crossing a bridge? Indigenous knowledge and the language of law and policy." *In* W. V. Reid, F. Berkes, T. J. Wilbanks, and D. Capistrano, editors. *Bridging scales and knowledge systems: concepts and applications in ecosystem assessment.* Island Press, pp. 145-163.

standards for the protection of TK is inconsistent with the underlying logic of the global intellectual property system:

> "It also portends deep fractures in the emerging regime complex for the global governance of Indigenous knowledge assets. Certainly, narrow rights in traditional knowledge appear facially consistent with a liberal view of the public domain. But the binary tenor of the current public domain discourse in the context of traditional knowledge …risks obscuring distributional and justice issues of great significance to Indigenous communities" (Long, 2005, p. 9, 10).

One aspiration for the integration of IK/TK frameworks is "to manage complex systems through practices that bear many similarities to Western adaptive management systems, and many of these traditional practices are founded on important social mechanisms" (Bohensky, 2011 p. 4). Also, IK/TK is thought to converge with Western science disciplines, like community ecology, by emphasizing connectedness and relatedness between human and nonhuman components of ecological systems which forms the basis for Indigenous concepts of nature, politics, and ethics, through an interdisciplinary approach. We might conclude that IK/TK needs to be specifically reaffirmed as a pertinent tool in ecologically oriented research, practice, and projects, as "place-based and fundamentally 'space-based,' focusing on spatial relationships in nature" (Bohensky et al., 2011).

Horsthemke's (2004) critique of science recalls that the integration between IKS and science is not expected to be a celebratory event as western rationality and knowledge supports the subjugation of nature and "the pursuit of nuclear energy, wholesale deforestation and destruction of flora and fauna, factory farming of nonhuman animals for human consumption, vivisection and genetic engineering [which] are deplorable and–indeed–irrational" (p. 33).

The development of Indigenous science education programs remains vital in order to provide the foundation for successes in cross-cultural classrooms (Quigley, 2009) and balance the forces that sustain and take education outside classrooms into spaces that influence policy and research protocols. However, there is a confusion about the origins, relations, and accountability of different platforms and methods (both internal and external to IPLCs) such as Traditional Ecological Knowledge (TEK), Indigenous Ecological Knowledge (IEK), Indigenous Knowledge Systems (IKS), Traditional Knowledge (TK) and other possible variations. Internally, Indigenous research centers and research bodies who sustain dialogues with Indigenous tribal or local agrarian organization governance structures to develop a space to renew the agreements about these denominations and frameworks have not cleared the confusion of these terms. However, each term expresses a different set of agreements towards the ends and uses of the research, the beneficiaries of the data and the complementary applications, the use of intellectual rights for the dissemination and distribution of the results, possible patent and commercial registrations with private or state funding, etc. These agreements respond to specific processes and commitments between research and corporate communities with different purposes.

The dissertation will use alternatively the term Indigenous Knowledge to refer about bodies of knowledge from recognized Indigenous Peoples under a cultural proprietary relationship. Also, will refer to Traditional Knowledge as relevant to Local Communities who may or not be Indigenous. However, in the perspective of biodiversity conservation, this dissertation will use alternatively the combined framework of IK/TK to refer to Indigenous Peoples and Local Communities (IPLCs) as they are explicitly included in the Convention of Biological Diversity as non-state actors and potential stakeholders.

Previous experiences in science and educational research around IK/TK that were decisive for this dissertation indicated that qualified researchers and academic authorities are not only unaware of the differences between these frameworks (and what these differences imply for different levels of "integration" with science) but there was little interest from some researchers and academic authorities to acknowledge these implications for the decision-making accountability (Dodson, 2003). I believe an initiative led by the Indigenous research community rather than initiated by a research university, is essential to clearing up these meanings to the mainstream community. This clarification process is vital to understand IK/TK systems as products of Indigenous governance systems with diverse identities that apply differently to diverse challenges around science research and industry development.

Therefore, one associated proposition is the cross-boundary development of Indigenous research studies programs that offer accreditation to policy makers, teachers, attorneys, and engineers to prepare them to manage diverse knowledge systems and apply their capacity to manage each framework productively. But this expanded decision-making accountability requires acknowledging a paradigmatic shift contesting the predominance of western science as the ultimate body of knowledge in environmental and natural resources management paradigms and work in partnership with Indigenous governance systems.

It is increasingly clear that interactions between IKS and WSK can only be equitable when the research and knowledge exchange mechanisms recognize the centrality of governance structures associated with diverse epistemic and material systems. Dodson (et al., 2004) also notes that governance is not the same as government. Rather "governance" focuses our attention on a much wider range of stakeholders and their relationships and networks, including individuals, government, the private sector, and non-government organizations.

> "While 'self-government' means having jurisdiction and a mandated control over the members of a group, its land and resources, 'governance' is about having the structures, processes and institutional capacity in place to be able to exercise that jurisdiction through sound decision-making, representation and accountability" (Dodson et al., 2003 p. 8).

The recognition of these different levels of accountability (methodological, philosophical, policy-based, research protocols, governance, legislative, land concession, intellectual property authorities, etc.) is vital to clarify the forms of the integration of knowledge systems in respect to the particular capacities and terms of interaction with different actors and stakeholder who interpret Indigeneity and IK/TK from different perspectives. IKS are living and dynamic but also weakened and fragmented by centuries of colonization, displacement, repression, and genocide. Re-vitalization of IKS requires re-connection of fragmented knowledge networks that are often described as separate in settler colonial knowledge and governance contexts but not meaningfully separate in the present. The re-vitalization and re-connection of IKS therefore requires education, both within non-Indigenous and Indigenous learning, research, and policy communities. This educational process enables and is enabled by FPIC-based legal and policy arrangements that should constitute a requirement for interaction with and acknowledgement of Indigenous governance systems.

Fortunately, a new legal and policy language is emerging from the very dynamic and fast-changing international law and policy regimes that govern sustainable development. In sustainability law and policy circles, much of the last decade has been devoted to methodological and practical strategies for integrating IKS and WSK. In particular, the framework of FPIC has emerged as a critical tool for governing interactions between IKS/TK and WKS, as well as the

governance groups that are associated with those knowledge systems. FPIC requires the establishment of a consultation process with an Indigenous Population prior to development projects or the use of resources within Indigenous Peoples' territory. Under FPIC, the restoration of Indigenous Peoples' epistemological and material systems constitutes a pre-requisite for informed interactions with WSK. A crucial obstacle to development of new, FPIC-based frameworks for equitable interaction between IKS and WSK is the historical fragmentation and "balkanization" of Indigenous epistemological and material relations.

This dissertation has shifted its focus away from merely inquiring into the effective integration of knowledge systems. Instead, I have moved toward questioning attempts to merge disconnected pieces of IKS—which are in the process of rediscovery, reconnection, and restoration at the transnational level—with the large body of western science. One hypothesis of this dissertation is that blind attempts at technical integrations constitute possible forms of discrimination and segregation, and they perpetuate the fragmentation and isolation of the historical epistemic and material foundation of Indigenous Peoples. This argument is supported by scholarship that describes how Western Science interventions in Indigenous research and education are highly problematic. These arguments foreground that the restoration and reconnection of Indigenous methodologies need to be prioritized and developed in order to establish a prior informed and consented interaction. As Bohensky (2011) argues:

> The practice of knowledge integration continues to present a number of challenges. Some of these are undoubtedly due to the tensions posed by competing, or even unclear objectives of integration processes. Scientific research, natural resource management, conservation, development, self-determination, and advocacy for Indigenous rights have all been legitimate drivers of efforts to integrate knowledge. In some cases, however,

> knowledge integration has merely become a fashionable trend in natural resource management. (Bohensky et al., 2011 p. 2)

At the same time, there is a recognition of "the value of local knowledge to science assessments, as a source of fine-grained, detailed information about local ecosystem services in areas where little formal knowledge exists" (Fabricius et al. 2006, p.5). However, one of the observed shortcomings of local knowledge is "its inability to evolve quickly enough to accommodate change in social-ecological systems, and its tendency to lack relevance outside local context" (Bohensky et al., 2011 p5). Bohensky (et al. 2000) argues that while IK systems gathered through empirical, experimental, and systematic methods, "western science, by contrast, may be seen as narrow and naïve in the way it considers and defines questions" (Bohensky et al, 2011 p. 5). This is consistent with critiques to issues of compartmentalization and suppression of social considerations in natural and biological science research. This critique is also part of the reasons why IK/TK cannot rely primarily on western science methods for their revitalization, as their reconnection takes place with complementary epistemic bodies that honor the interrelations between humans and non-humans and nature.

One of the primary domains where such revitalization and re-connection occur is in the exchange of agroecological knowledge and practices resulting from Indigenous Peoples' responses to environmental challenges caused by inequity in the implementation of global treaties that regulate the access, management, and benefit from natural resources. The restoration and revitalization of IK/TK systems also connects to biodiversity conservation as a component of sustainable development. The biodiversity framework presents correlations between biodiversity loss to issues of health, nutrition, community development, economic development, and gender equity, as the "loss of biodiversity is likely to disproportionately impact on the health and well-

being of the poorest" (Daw et al., 2011)[4]. The visibility of the contributions from local communities to agrobiodiversity and food security is of vital importance as is the need to mainstream actions leading to food security following the United Nations Declaration on the Rights of Indigenous Peoples' implementation to the fulfillment of the 2030 Agenda for Sustainable Development.

In Chapter 1, I discuss the major theoretical tensions that define my work, focusing in particular on four issues: the transnational nature of Indigeneity, the relationship between IKS and WSK, the need to reconceptualize Indigenous education in terms of revitalization and reconnection rather than assimilation, and the law and policy systems that have historically governed agroecological exchange. I argue that these important conceptual foundations are vital to understanding the specificity of my approach, as well as to reorient the inquiry into the visibility of material and epistemological governance structures behind knowledge systems. Finally, I conclude this chapter by introducing the research questions that guided my research.

In Chapter 2, I describe my methodological commitments as well as the specific methods used in the course of two linked case studies. This chapter argues for the pertinence of a case study research framework as relevant to a transnational approach to diverse contexts and interconnected issues. It also briefly discusses the relationship between the two case studies and summarizes my analysis thereof.

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[4] See also Millennium Ecosystem Assessment 2005, and also Dallimer et al. 2012

In Chapters 3 and 4, I describe the central findings of the first and second case studies, respectively. First, in Chapter 3, I discuss my evolving understandings about the role of education with regard to the issues related to the research question; the seminar case study as example of a curricular intervention in two higher education contexts; the particularities of community-based education in IK/TK revitalization and agroecological exchange; and the importance of turning the attention to the decolonization of western institutions of research and education as the most productive development frameworks.

Then in Chapter 4, I outline my understandings of the complex and layered policy regimes that shape the constitutional rights of Indigenous Peoples; the issues presented by intensive agriculture, colonialism, and the contextual policies of Indigeneity. Also, the chapter explores issues around the extractive use of IK/TK in broader contexts; the corresponding mobilization of IK/TK both within and against intellectual property regimes, and at the light of the active role of Indigenous networks, governance, and resistance. Finally, it examines the multifaceted role of universities in the processes of knowledge exchange, as well as knowledge integrations and methodologies.

In Chapter 5, I summarize what I determine to be the most important cross-cutting topics for future discussion in the context of science and environmental research, including the limitations of this research project, while also outlining some important next steps for future research and practice.

## Chapter 1: Literature Review

This chapter summarizes and analyzes scholarship on the intersections between Indigenous Peoples and environmental and science education, ecology and preservation, IKS/TK, agroecology, critical geography, environmental sociology, political economy, and other interrelated fields. The works I discuss represent the latest international debate from comparative and transnational perspectives. I also discuss sources that address structural inequality, decolonization theory, Indigenous research methods, critical educational research, culturally relevant education, cultural assimilation, as well as sociocultural and political boundaries movements. This chapter is divided into: an explanation and description of key theoretical foundations of Indigeneity, as well as related concepts and relations; the legislative history and development of Indigenous education policy in the US as a concrete reference to a national, political, and institutional recognition of sovereignty; a transnational approach to different developmental discourses around IK/TK; the understanding of IK/TK within the biodiversity conservation specific framework; the introduction of key references to knowledge integration frameworks around IK/TK and WSK; and the reference to successful experiences around science curriculum design that incorporate IK.

The perspective that drives this compilation and analysis intentionally avoids any methodological fragmentation of Indigenous Knowledge. Furthermore, I trace the intersection of sustainable agriculture, sustainability education, and Indigenous education developed by and with Indigenous Peoples, which could all be considered "boundary objects." This term describes a practice of studying different perspectives about Indigenous Peoples while recognizing the importance of "connect[ing] and mobiliz[ing] across social and cultural practices to avoid fragmentation" (Hermans, et al., 2010). The defragmentation and reconnection of knowledge

systems are key to processes involving epistemic and material systems from diverse bodies of knowledge that are vital for the survival of World Indigenous Peoples.

I follow Hoppers' (2002) approach regarding a transnational inquiry concerning "the movement of peoples, ideas, technologies and institutions across national boundaries," to question how Indigenous Peoples' spaces, institutions, traditions, genetic resources, biodiversity, identity, and borders are under constant threat and how they change over time. Addressing the transnational contemporary history of Indigenous Peoples could potentially highlight and explain the relation between Indigenous Peoples and nation-states around issues and efforts of sustainability and development in general, and in terms of its "cross-national influences" (Hoppers, 2002). My fieldwork allowed me to survey, collect, and compare wide data from exemplary cases of Indigenous education along three strategic regions across the global south: The large American continent (i.e., Amazon Basin and Andes, Mesoamerica, Caribbean, and North America,) Asia, and Africa. The decision to address such a wide geographical scope responds to a critical need for connecting work around science education activities and inner-cultural educational programs of and/or from Indigenous Peoples that incorporate environmental, economic, and cultural considerations across different disciplines. At the same time, the breadth of my project matches the widely accepted definition of sustainability.

**Theoretical Foundations: Indigeneity, Concepts, and Relations**

This section establishes the importance of the concept of Indigeneity and its evolving significance in international law, as well as the interdisciplinary nature of these developments as they involve multiple agencies and experts working under different relationships. The United Nations Department of Economic and Social Affairs chapter on Indigenous Peoples references one of the most cited definitions for what constitutes an Indigenous People, from the work of Jose R.

Martinez Cobo, the former Special Rapporteur of the Sub-Commission on Prevention of Discrimination and Protection of Minorities, in his famous "Study on the Problem of Discrimination against Indigenous Populations" (1981). It offered a working definition of "Indigenous communities, peoples and nations" that has been used since 1991 by the International Labor Organization Article 169 global treaty since it entered in force, as well as by the Convention of Biological Diversity global treaty. In this first definition, Cobo (et, al., 1986) presented a number of basic ideas that provide the intellectual framework for the right of Indigenous Peoples themselves to define what and who is Indigenous. The working definition reads as follows:

> "Indigenous communities, peoples and nations are those which, having a historical continuity with pre-invasion and pre-colonial societies that developed on their territories, consider themselves distinct from other sectors of the societies now prevailing on those territories, or parts of them. They form at present non-dominant sectors of society and are determined to preserve, develop and transmit to future generations their ancestral territories, and their ethnic identity, as the basis of their continued existence as peoples, in accordance with their own cultural patterns, social institutions, and legal system.
> This historical continuity may consist of the continuation, for an extended period reaching into the present of one or more of the following factors:
>
> a. Occupation of ancestral lands, or at least of part of them;
> b. Common ancestry with the original occupants of these lands;
> c. Culture in general, or in specific manifestations (such as religion, living under a tribal system, membership of an indigenous community, dress, means of livelihood, lifestyle, etc.);
> d. Language (whether used as the only language, as mother-tongue, as the habitual means of communication at home or in the family, or as the main, preferred, habitual, general or normal language);
> e. Residence on certain parts of the country, or in certain regions of the world.
> f. Other relevant factors. On an individual basis, an indigenous person is one who belongs to these indigenous populations through self- identification as indigenous (group consciousness) and is recognized and accepted by these populations as one of its members (acceptance by the group). This preserves for these communities the sovereign right and power to decide who belongs to them, without external interference." (Cobo, 1986)[5]

[5] See Secretariat of the Permanent Forum on Indigenous Issues 2004 for discussion and relevant working definitions. Also updated in Chief, Karletta, et al., 2015, p.2-3

Indigeneity, from a complementary perspective, is defined as "socio-spatial processes and practices whereby First Peoples and places are determined as distinct (ontologically, epistemologically, culturally, etc.) to dominant (Western European) universals" (Radcliffe, 2015). An approach to Indigeneity that questions and reviews these transnational, epistemological, and ontological tensions and encounters becomes critical to unveil community-state contradictions (Boelens, 2010), as well as different forms of inter-legal development of Indigenous community resource systems ownership (Boelens, 2010; Hoekema, 2010) in different parts of the world.

A wider mapping of Indigeneity; one that connects with sustainable development; is needed in order to formally and most accurately document Indigenous Peoples's efforts to reconstruct and restore their knowledge systems. Moreover, whether through development, education, economics, or technology, Indigenous Peoples negotiate forms of coexistence with non-Indigenous societies and nation-states. The resulting relationships are products of reformulations of education and science research. Meanwhile, some conceptualizations of Indigeneity lack of knowledge or understanding of transnational Indigenous organizations as "transnational advocacy networks" of "relevant actors working internationally under a common discourse… and dense exchanges of information and services" (Keck & Sikkink, 1998).

The concept of Indigeneity also refers to the cultural identity politics of the First Peoples who inhabit a geographical location, island, or a nation (Kenfield, 2016). Therefore, "historicizing and respatializing subjects through the lens of indigeneity implies to identify and theorize the relational, historically- and geographically- contingent positionality of what is (known to be) Indigenous" (Radcliffe, 2015). Kerstetter (2012) argues that differences of positionality exist in researchers' knowledge and values based on their socialization within

different ethnic, racial, and cultural communities. These categories are mediated by individuals' status characteristics (e.g., gender, class, religion, and age).

Global Indigeneity emerges also from these discussions in international law and policy, demanding a recontextualization of science in relation to capital, technological, and environmental transformations, globally. Conversations about the political struggles and tensions with Indigenous societies and nation-states across the world also impact global conceptualizations of Indigeneity. This debate about political struggles and tensions takes place beyond localized forms of the Indian Native/ Western polarity (Derrida, 1993) and requires incorporating multidisciplinary methodological approaches to decolonization, questioning "systemic relationships from notions of culturalism, cultural relativism, comparative cultural history, cross-cultural comparison, and comparative analysis" (Schriewer, 2006) in order to properly address the diversity of Indigenous Peoples and knowledge systems that is the foundation of the concept of Indigeneity.

In discussing global understandings of Indigeneity, it is also necessary to understand the concept and process of globalization—a concept typically linked to capital, technological, and environmental transformations, which also represents a mix of political processes of "economic transgression of national boundaries, heightened capital mobility, shifts from manufacturing to business and financial services, control of economic activity from distance, and hierarchical organization of economic activity" (Rizvi, 2007). These processes involve "command and movement of international capital" serving "transnational corporate and financial elites," while designing a series of structurally unequal relations under "a new economic rationality" (Rizvi, 2007). Globalization has also been recognized as a reorganization of the global structure and local sociocultural forms of penetration "intrinsically dependent of 'hyperdevelopment' and

'commodification' of societies, for the creation of a postmodern consumer culture" (Buell, 1998). From these stances, we see how the concept of Indigeneity and the (re)definitions of Indigenous Peoples in terms of their political identities correspond to the reformulations of global capitalism across the world, and in direct response to its negative impacts.

Brosius (2006) summarizes the outcomes of the remarkable proliferation in the 1980's and 1990's of Indigenous movements worldwide that led to the realization of IK as very connected to this struggle:

> "Indigenous peoples across the globe forged unprecedented solidarity premised on widely shared histories of oppression and dispossession. Much of the momentum for this movement was built around opposition to the presence of extractive industries on indigenous lands, and the indigenous movement forged powerful alliances with, among others, the global rainforest movement. Somewhat later, as "indigenous knowledge" began to appear on international agendas, the issues of bioprospecting and intellectual property rights became central concerns around which indigenous activists organized". (Brosius et al., 1993 p.3)

This shift in methodological positionality highlighted the rebuilding and restoration of material Indigenous relations around ontological struggles (Radcliffe, 2015; Byrd 2011) over land and territory as a priority. The notion of Indigenous Knowledge challenges ontological generalizations or compartmentalization across and amongst cultures as "problematic and inaccurate" (Smith, 1999), proposing a critical geography of Indigeneity and a reorientation of Indigenous geographies" (Radcliffe, 2015). Examples of these critical geographies include renewed attention to "human-centered visions of development in health, preserving and conserving biodiversity, in human rights, and in the alleviation of poverty" (Hoppers, 2002). This renewed attention to Indigenous critical geographies include the support of Indigenous economies and the exchange of technological knowledge and education around agriculture, fishing, forest resource management, atmospheric and climatological knowledge, as well as soil and water management techniques (Hoppers, 2002).

The notion of IKS differs from TK to redefine not only paradigms around final technical and transferrable products in many fields of application, but also to refer to present practices of knowledge production, implementation and dissemination, with technology, skills, worldviews, perceptions, as well as theoretical and factual understandings (Horsthemke, 2004) from constitutionally recognized Indigenous Peoples around the globe participating in social, economic and philosophical unique educational, legal and governance systems (Hopper, 2002). This definition of IKS is "historically enmeshed in genealogies of colonial rule and counterinsurgency" (Radcliffe, 2015), revealing a map of a "critical geography of Indigeneity" and a "reorientation of Indigenous geographies" (Radcliffe, 2015). At the same time, these Indigenous genealogies and geographies situated away from the Western realm connect to larger historical processes of restoration and rebuilding of material biological diversity and relations around land (Radcliffe, 2015; Byrd 2011). In most of the cases, their emergence does not arise from the integration, recombination, reinterpretation, or validation by Western Knowledge Systems (WKS), Science or Modern Western Science (MWS).

The definitions of Indigenous Knowledge and Indigeneity also require identifying positions and frames of reference from which often scholars and writers present their data, interpretations, analyses, and instruction. The lack of recognition and identification of these biases, assumptions, perspectives, and points of view have frequently victimized people of color such as African Americans and American Indians (Banks, 1993). Schmidt (2013) argues that a growing integration of Native people into the overarching narrative of colonial America from ethno- and colonial historians was also part of how European settlers conceived their integration into the mainstream of colonial American history. Settlers left Indigenous Peoples outside of history in their process of developing their own social constructs and official history.

However, the persistence of "exceptionalism narratives" from early American history (Schmidt, 2013) until the present have not deterred contemporary Indigenous narratives from continuing to actively emerge in academic and political discourse. These narratives have emerged alongside global Indigenous Peoples and organizations at local and regional levels as part of efforts "to cope with globalized markets and industrialized production, accelerate deforestation and further marginalize vulnerable people and ecosystems" (Borras, McMichael, & Scoones, 2010).

A historization of the notion of Indigeneity in national and international laws however remains in question as "complexities associated with ethnic identities, indigeneity, politics, and nation-states and national borders in various parts of Asia" (Baird, 2016) plays a consistent role in other world regions. In the context of South-East Asian, Baird (2016) argues that the concept of "Indigenous" itself is subject to dismissal by many governments who assume "a relative lack of European settler colonization in the continent." This argument known as the "salt-water theory" or the "Asian controversy" and arrogates to nation-states the authority to define "who is Indigenous and who is not" in the region.

Dissenting voices from critical geography such as Elson (2004), in an article titled "Reinventing a Region: Southeast Asia and the Colonial Experience," contradict the common argument that since European colonization did not play a significant role in South East Asia, ancestral Native societies in these vast territories are unable to reclaim Indigenous identities, and therefore special status and protection in national and international laws. Elson (2004) argues instead that "in its mature and developed form European colonialism had (indeed) serious implications for the sense of region within Southeast Asia," affecting "the landscape of Southeast Asia and the lives and livelihoods of its peoples" having "regularized, fenced and atomized the

region in an entirely new and foreign ways" impacting "any substantial and inherent shared identity of characteristics or destiny" (Elson, 2004). This particular example is relevant to illustrate issues with the conditions of production, import, and labor dependency that became indispensable to the processes of modernization and wealth systems and inherent to the viability of nation-states.[4]

The endorsement of many countries of the UN Declaration of the Rights of Indigenous Peoples (UNDRIP) in 2007 has introduced changes to this situation, such as a number of governments in Asia recognizing the existence of Indigenous Peoples in their own countries. These countries include the Philippines, Nepal, Cambodia, Japan, and the Republic of China (Taiwan). "In other countries in Asia, where governments continue to deny the relevance of the concept of indigeneity, various movements in support of the concept of indigenous peoples have emerged and expanded in recent years. This includes the establishment of new civil society organizations in support of indigenous peoples at local, national, and regional levels" (Baird, 2016). In a similar case, the Sami Peoples in the heart of the Scandinavian countries experienced a long history of discrimination, oppression, and land displacement by the Swedish, Finnish, and Norwegian governments (O'Dowd, 2015). They finally saw relative improvements in their language protection and their fishing and hunting rights with limited autonomy in their territories

[4] "The prevalence of discrimination against upland minorities in Thailand, and the lack of legal mechanisms to address pervasive and long-standing discrimination problems, has led to some efforts to increase rights and recognition, spearheaded in northern Thailand by NGOs. These have included contributing to 'shadow reports' to the United Nations and other international groupings, in which racial discrimination in Thailand has been highlighted. Moreover, the roles of NGOs in pushing for the rights of historically upland minorities have gradually increased in recent years, as has the position of allied academic bodies, such as the Center for Ethnic Studies and Development (CESD) at Chiang Mai University. This has especially been the case since the Tribal Research Institute, a government body created in 1965 to address ' problems' related to upland ethnic minorities, was dissolved in 2002 without a proper hand-over of its work to another government agency. NGOs in northern Thailand and allied academics have especially pushed for increased rights related to land and forest management, as well as cultural rights, including the right to be at least partially educated in their own languages." (Baird, 2016, p.4)

only after joining the international Indigenous movement at the European Union and United Nations forums.

In a very distant context but very related to the protection of Indigenous languages, Dean (2015) illustrates that the case of formal "modern" Indigenous education in the Peruvian Amazon is "intimately related to state-driven introductions of Occidental concepts of 'progressive' development, eventually anchored to incorporation into global markets (Dean, 2015, p.429)." However, the Peruvian Amazonia regions are currently joining regional efforts across the continental basin and across 5 countries, contextualizing inter-cultural education, and especially Indigenous identity politics, in very distinctive ways.

As Dean states that over the past generation, debates over the performance, and meanings of Indigeneities have been common themes surfacing in the socio-political lives of contemporary Indigenous Peoples in lowland South America from a context of "complex relations between land rights and Indigenous activism (Dean, 2015):

> "Many peoples living in Peruvian Amazonia have had their livelihoods jeopardized due to on-going socio-economic challenges, ecocide and decades of political violence. Like highland Andean communities, indigenous societies … of the Huallaga Valley have been dramatically impacted by nearly two generations of civil war… accompanied by significant transformation in their patterns of human migration, internal displacement, and a neoliberal economy that has favored the privatization of natural resources, including petroleum exploration, and vast palm-oil production plantations and facilities (p.433) … Indeed, the contemporary nature of Amazonian ethnolinguistic diversity underscores the fluid, dialectic relationship among ethnic identity, language, genetics, geography and the astonishing disruptions associated with colonial and postcolonial encounters." (Dean, et al., p. 438)

Shizha (2007) also argues that "the exclusion of indigenous knowledge systems including Indigenous languages in schooling in Africa has been viewed as a form of "cognitive imperialism" (Battiste & Henderson, 2000, p. 12) and "therefore, the recovery and restoration of Indigenous identities, knowledge, and experiences is strongly linked to the revitalization of

indigenous languages" (McKinley, 2005). As language revitalization led to the need of knowledge systems revitalization, Brosius (2006) addressed the four distinct historically situated approaches in which the study of Indigenous Knowledge must be understood: descriptive historical particularism, cultural ecology, cognitive anthropology, and human ecology. Brush (1993) concludes the following about these four approaches:

> "Each of these presupposes a different set of starting assumptions regarding the nature of indigenous knowledge, and the purposes and epistemological bases for studying it. Central to the latter two approaches in particular has been a concern with the structural or systemic nature of indigenous knowledge (Ibid:658) and its utilitarian or adaptive significance (Ibid:659). Nonetheless, when we speak of indigenous or local knowledge, what we generally mean is environmental knowledge. (Brush, 1993, p.658)

One example of Indigenous societies engaged in expanding this process into global partnership (Harris & Wasilewski, 2004) is the initiative of the Advancement of Maori Opportunity (AMO) and Americans for Indian Opportunity at the 47th International Society of System Sciences. These organizations proposed a partnership that would include an inner-cultural global project—the Advancement of Global Indigeneity (AGI)—that would "reach out to other Indigenous groups who may be in different places and spaces" developing a practical strategy and a focused action plan for reaching out and working with Indigenous communities worldwide" (Harris & Wasilewski; 2004). These progressions of interconnection within the international Indigenous movement across academic and political networks are moving towards the restoration of a transnational body of knowledge that represents diverse epistemologies, experiences, methods, and goals of Indigenous Peoples. The movement is also connected to land-based forms of autonomy, self-determination, and/or sovereignty. Brosius (2006) considers these

forms of academic and political actions "mediated by transnational discourses of indigeneity," at the times when "the rights of indigenous peoples have become a global concern, indigenous advocates have increasingly found common ground outside national borders." Brosius (2006) asserts that such groups "are increasingly brought into transnational advocacy networks."

Across this complex panorama, the calls for the restoration of Indigenous Knowledge and Indigeneity also allude to the formulation of a new system of relations between Indigenous and non-Indigenous peoples. The concerns over Indigenous control should not be seen as subversive forms of social relations that result in confrontations with non-native communities, but as processes of restoration, mutual and equal acknowledgement and facilitation of transitional forms of social justice that must constitute moral and ethical political imperatives in favor of the survivors of colonization. "For its advocates, this would not be the socio-geographic separation of old, wherein indigenous peoples were robbed of an ability to pursue their definition of the good life. Rather, it would be a qualified form of place autarchy in which Indigenous Peoples achieve meaningful control over both the kind and the degree of interaction with non-indigenous peoples is needed… Indigenous localisms are being pursued, in part, through universal human rights discourses in which non-indigenous peoples have secured rights to territories that might be infringed if proprietorial resource control by native groups is ever seriously achieved" (Castree, 2004, p.158).

One important consideration in this shift is the normative and social character of scientific inquiry. Knowledge production processes resulting from the relations between Indigenous and Western science require new commitments from education and critical pedagogies to develop a systemic bridge of "epistemic plurality" around Indigeneity. Such efforts would incorporate the diversity of cultural and ideological perspectives from Indigenous

societies around the world to influence changes in the conduct of scientific research (Longino, 2002). Hackman (2012) addresses how inclusive and equitable sciences might honor new ways of producing knowledge across disciplines by acknowledging the challenges of such integration when certain disciplines dominate the epistemological and financial terrain. This dominance results in the muting of different research traditions and cultures, methods, and cultural languages. This perspective also suggests that interdisciplinarity is a fundamental and relevant tool for transformativity, as a feature of the new social science research.

Indigenous research, as a transformative project, is needed as an active pursuit of social and institutional change that makes space for IK and that has a critical view of power relations and inequality (Pihama, 2001). One indispensable component of this "epistemic plurality" is the effort towards Indigenous languages preservation in the consideration of "the imbalance that prevails among global and national dominant languages and the thousands of Indigenous languages that are threatened with extinction (Jacob, 2009). Jacob (2009) describes the destruction of Indigenous knowledge and traditions as linguistic and cultural genocide, including language death, language extinction, and linguicide.

Hoppers (2002) argues that a conceptual and methodological framework for the integration of IKS starts with an opposition to the commodification of such knowledge and from the need for innovation in the intellectual property regime itself (Hoppers, 2002). Whereas Brayboy (2005) states that Indigenous education must be understood, researched, analyzed, and developed in ways that take into account the sovereign status and self-determination goals of Indigenous communities. This principle is applied in my analysis as a proposition and a framework for an international Indigenous education for sustainability that embeds land, cultural, and political rights across all interventions that remain at the center of Indigenous struggles

across differential geographies (Castree, 2004). This section fits the overarching thesis by presenting conceptual and policy roadmaps that are key to understanding Indigeneity in different global contexts. One especially important reference is the legislative history in countries that are part of the current British colonial axis that recognizes their self-determination and sovereignty as constitutional rights; radically different from contexts in which Indigeneity is otherwise denied or even outlawed.

**Indigenous Education Policy and Legislative History in the US**

This section discussed the US government's very specific and long legal history of national educational reforms related to Indigenous Peoples (Castagno & Brayboy, 2008). In the twentieth century, legislative literature such as the 1969 report from the U.S. Senate titled *Indian Education: A National Tragedy—A National Challenge* is significant. This report evolved into the *Special Subcommittee on Indian Education* by institutionalizing a deficit approach to the "Indian problem". However, the *Havighurst Report of 1970* also offered data on the academic performance of Indigenous youth and the lack of curriculum that supported tribal languages and cultures in schools (Fuchs & Havighurst, 1973; Havighurst, 1970). It is striking that these educational reforms took place shortly after the federal government implemented the Indian Termination Act that eliminated federally recognized status of more than 100 tribes from the 1940's -1960's. This Act removed the trust land status of more than 2 million acres, opening them for sale to non-Indian settlers. At the same time, the Indian Relocation Act of 1956 was enacted to promote Indigenous displacement to urban areas, where Indigenous peoples supplied the lowest paid positions in the workforce. This created divisions and conflicted identities between individuals, communities, and families who lived either on reservations or in urban areas where they completely assimilated to the workforce and public education. The Termination

Act was a permanent threat to tribal sovereignty in the US and was not formally abandoned until 1988, only 29 years ago.

During this period, and in the middle of intense Indigenous activism in academic and political circles, the US *Indian Education Act of 1972* promoted the first opportunities and funding for creating tribal culture and language programs for schools and support for increasing the number of Native educators. Later, the *Indian Self-Determination and Education Assistance Act of 1975* became the most important federal educational policy. It facilitated the development of schools and educational programs under tribal control (Demmert & Towner, 2003).

However, the pervasive focus of federal Indian policy on the deficiency of American Indian learning communities' points to the post-reformation theory of Jacques Derrida (1993). Derrida argued that violence that is enabled by and connected to exclusion affects educational philosophy as well as theoretical and narrative structures. Exclusion establishes political confrontations between educational research and research instruments in relation to Indigenous education. The question becomes: "how can we be both pragmatic and scientific at the same time?" (Derrida, 1993). Complementary approaches, such as the "structural inequality theory" (Ridgeway, 2001; Ladson-Billings, 1995), articulate notions of "conflict theory," "cultural ecology," and "social inequality in societal arrangements" that apply to the case of Indigenous populations. The Culturally Responsive Schooling (CRS) that became crucial for US American Indian Peoples and Indigenous youth, demanded that "issues of Indigenous education must be understood, researched, analyzed, and developed in ways that take into account the sovereign status and self-determination goals" (Castagno & Brayboy, 2008; Brayboy, 2005).

Champagne (2009) argues that "interdisciplinary and multicultural approaches have inherently assimilationist or mainstream goals, methods, and interests, and therefore are not

unbiased interpreters of the Indigenous experience." Approaches such as multi-cultural, postcolonial, postmodern, racial critical theory, gender, transcultural, and sexuality approaches not centering on Indigenous communities and issues can only present portions of an Indigenous perspective or discipline (Champagne, 2009)[5]. The shifts required in natural science and environmental research present the same challenge whey they incorporate IKS and cannot be based on technical direct solutions, since they involve further processes of decolonizing theory, methodology, and critical practice.

Huffman (2010) cites three complementary perspectives in the US related to the distinctive field of Indigenous Education:

> 1. The Interactionalist Theory was designed to "understand the nature of higher education attrition, prominently found in American Indian education literature." This theory explores "how different person-environment interactions lead to varying levels of academic and social integration that are believed to contribute to the decision to persist or departure from college."
> 2. The Transculturation Theory is a micro level theoretical perspective specifically designed to explain how Indigenous students encounter, engage and ultimately persist in mainstream education without losing their tribal and native identity.
> 3. The Decolonization Theory addresses the need to "create a unique scholarly discourse and research methodological approaches customized to Native peoples, providing a consistent questioning to Native subjugation in all possible forms." (Huffman, 2010)

An important bridge between Multicultural and Indigenous Education takes place in experiences such as the application of CRS as a strategy to improve the education and increase the academic achievement of American Indian and Alaskan Native (AI/AN) students in US schools (Castagno, Brayboy, 2008). This framework is advocated by many tribal communities and Indigenous educators and leaders grounded in Indigenous languages and cultures and regarded as "a fundamental prerequisite for the development of culturally-healthy students and

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[5] Permanent Forum on Indigenous Issues (United Nations), & United Nations. Statistical Division. (2009). *State of the world's indigenous peoples* (Vol. 9). United Nations Publications.

communities associated with that place, and thus is an essential ingredient for identifying the appropriate qualities and practices associated with culturally-responsive educators, curriculum, and schools" (Alaska Native Knowledge Network, 1998; Castagno & Brayboy, 2008).

The debate around the nature of diversity and the role of education in pluralistic societies—especially in urban areas—connects multicultural education and Indigenous education. One site of common ground is the nature of knowledge and the divergent political and social interests in defending "the dominance of Western civilization in the school and university curriculum" (Banks et al., 1993). Some are concerned that western history, literature, and culture would be endangered. Advocates for multicultural education have called out the ways these foundational regimes marginalize the experiences of people of color and women (Banks, et al., 1993). Multicultural education also intersects with Indigenous education when it strives to eliminate negative factors that marginalize Indigenous science from science teaching and when it acknowledges how Indigenous communities (Brayboy, 2005) are under siege by policies of high-stakes accountability and standardization (Lomawaima & McCarty, 2006).

The CRS framework for US American Indian Peoples along with learning communities and "communities of practice" emerge from these debates. CRS goals include increasing the academic achievement of American Indian and Alaska Native (AI/AN) students in US schools. However, this educational approach requires a shift in teaching methods, curricular materials, teacher dispositions, and school–community relations. These set of relations are in many cases entrenched in the legal history between American Indian Nations and Tribes and the federal government since "The Merriam Report" of 1928. This report called "for more Indigenous teachers, early childhood programs, and the incorporation of tribal languages and cultures in schools" (Demmert & Towner, 2003, p. 2). The report changed all ideas and educational policies

in the history of Indigenous education since the era of the Indian Boarding Schools. It sought to incorporate culturally based education as a necessary component of school culture, ostensibly to ensure that "Native American students were to succeed academically as students and play a meaningful role as citizens" (Demmert & Towner, 2003, p. 2). Although the Meriam Report was a clear call for change, little actually occurred until more than 30 years later (Castagno, Mckinley & Brayboy, 2008).

The experience of US Native Nations in their path of recognition constitutes an important reference toward understanding of global interpretations of Indigeneity and the unequal legislative approaches and contexts that IPLCs face across the world. Understanding these differences is key to my thesis about the critical visibility of Indigenous Peoples' inherent governance structures in the current process of restoration in international law, as well as their relation with science research and education related to sustainable development in Indigenous contexts.

**Global Developmental Discourse around IK/TK**

At the international level, since 1992, the Agenda 21—a non-binding, action plan of the United Nations with regard to sustainable development, introduced at the Earth Summit—has called for governmental affirmation of the rights of Indigenous Peoples "by legislation if necessary, to use their experience and understanding of sustainable development to play a part in education and training" (Agenda 21). Agencies such as the World Health Organization (WHO), the United Nations Environmental Program (UNEP), the United Nations Development Program (UNDP), and the United Nations Educational, Scientific and Cultural Organization (UNESCO) are evolving in their roles of implementing mandates around diversity, IK/TK, and the rights of Indigenous peoples world-wide. Transnational Indigenous networks have advanced new forms of

political representation in order to bring to the public issues and applications of sovereignty, self-determination, and autonomy in international law.

Research universities represent important strategic partners across the planet in the implementation of United Nations Declaration of the Rights of Indigenous Peoples UNDRIP. The participation of academic researchers constituted a critical layer in the implementation of Indigenous Peoples' legal protections. These researchers played a vital role in aligning and articulating frameworks for inter-legal applications in Indigenous contexts and provided scientific evidence supported by research universities.

The adoption and application of local forms of Traditional Ecological Knowledge (TEK) in international development projects were initiated in early 1990s (Houde, 2007) and promoted through place-based programs and research and developmental projects. These programs and projects represented a concerted response to previously "centralized, bureaucratic resource management systems" which were criticized for "leading to ecological collapses" in many parts of the world and failing to "improve people's lives at local and global scale" (Agrawal,1995). TEK was in practice disconnected from the participation of Indigenous Peoples and their increased forms of autonomy and self-determination. It also became a form of reification of particular localized applications of place-based funds of knowledge in rural contexts, valued only for their potential functionality within local science research projects. Within the last decade, TEK has been regarded in development discourses as a particular reinvention of a modern inclusive and tolerant science, and as a scientific method and framework to "study" and "assist" rural Indigenous communities around the world.

Galison's manual of history of science (1997) establishes the relationships between material objects, instruments, and industry and western standards of right reasoning and methods

of argumentation. Galison recognized that intense multidisciplinary debates about validation and the nature of perception flood the history of European philosophy forging paradigmatic representations of "science into conceptual schemes (p.18): "As it is in the case of relativism, "these conceptual schemes create knowledge blocks— a symbiotic, self-reinforcing amalgam of theory, experiment, observation and instrument—each one isolated from an incommensurable forerunner and successor system" (p.18). The golden age of science coincides with the simultaneous advancement of international policies of assimilation and displacement of Indigenous Peoples and with constitutional education reforms coinciding with the Relocation and Termination Acts in US, Australia, New Zealand and Canada.

Western research methods have been consistently and methodically separated and isolated as particular forms of knowledge. Parallel to the formation of western research methods is the colonial reorganization of the world which categorizes Indigenous cultures as research units, muting any references to their articulation and interactions with each other and negating Indigenous transnational networks. This omission, presented as natural and inherent to the quality of knowledge production and dissemination in western-modeled institutions leaves traditional forms of knowledge from displaced Indigenous societies fragmented at the point of divorce from dominant scientific paradigms (Redclift, 1992).

In this regard, new language introduced at the Earth Summit in 1992 recognized the important role of multiple Traditional Knowledge Systems (TKS) in educational agendas related to climate change research and in local and community adaptation and vulnerability assessments.[6] In practice, the adoption of TK was presented as nation-states' incorporation of Indigenous Peoples into national agendas on poverty reduction and development, deepening the

[6] Agenda 21. "UN Documents Cooperation Circles," Earth Summit 1992.

dependence on centralized forms of regional and local government and management.[7] From this turning point, TEK evolved as a particular invention of a modern "inclusive" science, and separated and isolated fragments of particular forms of knowledge and cultures as units of study within western epistemics.

This "inclusive" process many times failed to promote the understanding of customary laws and the national and international legal history and relations between Indigenous populations and mainstream society. This process also failed to address the concern of how individual tribes and knowledge holders could develop and secure control of the process of sharing TK. The convenient isolation of surviving cultures and governance systems and the muting of any references to Indigenous transnational networks has been presented as a necessary methodological objective in order to narrow of an object of study.

The challenge for modern scientists and traditional practitioners is to bridge the gap between different methodologies, knowledge exchange, verification and validation and, eventually, applications. This requires the capacity of IK practitioners to redesign the methods of documentation in their own terms and promote a collaborative review of the rationale and criteria for managing the resources and technical assistance from the scientific community and international organizations (Sibisi, 2015). Scientific validation methods remain a critical challenge and a roadblock in the case of IK practitioners of traditional health when they are expected to provide documented evidence (Sibisi, 2015):

> Health regulations and research protocols require that treatments in medicine or processes in other disciplines are clearly described and subjected to critical

[7] The International Labor Organization's (ILO) Convention 169 on Indigenous and Tribal Peoples in Independent Countries, ratified in 1989 by almost all countries in the Americas region, has provisions against attempts of separatism from Indigenous communities. The convention, while broadly outlining policies on land, self-determination, labor, education, health, conflict and employment, at the same time aligns with the UN, World Bank, and Inter-American Bank on policies and support to projects towards Indigenous peoples from international financial assistance and developmental perspectives. (Tomei & Swepson, 1996)

> analysis and that they reproduce replicable results. They are expected to provide documented evidence of the efficacy of their claims in academic journals. However, much of indigenous knowledge is rooted in oral traditions and is not systematically documented in written form (with some notable exceptions of traditional medicine from India and China). Indigenous knowledge is largely held in the custody of the elders in a community and usually not shared across communities. As a growing number of local languages are disappearing so may a vast body of knowledge and culture. Hence, the challenge for modern scientists and traditional practitioners is to bridge the gap between their worlds of different methodologies, knowledge exchange, verification and validation and, eventually, applications. (Sibisi, 2015)

One example of this challenge was the shift in the incorporation of traditional health practices in Africa where medical sciences validate herbal treatments of HIV/AIDS-related opportunistic infections. These efforts have transformed African Traditional Medicine and the scientific validation methods for the discovery of new pharmaceutical active ingredients. This model facilitated the establishment of community-based agro-processing businesses for the production of medicinal and aromatic crops. Experts from the World Intellectual Property Organization at the UNPFII 2016 and 2017 suggested in their reports that Medical Patent Pools are the promising option in the case of medicinal plants in HIV treatment, despite that at present they only provide a temporary certification under a bureaucratic renewal process. Regarding the need of a permanent certification, Maheshwari (2011) addresses in the article "Patenting Indian Medicinal Plants and Products," the need to:

> "…document the Indigenous knowledge related to Indian herbs and plants and their medicinal and other uses and convert it into easily navigable computerized data base for easy access and to secure patenting rights; to discourage other countries for patenting Indian heritage." Considering that many of the countries with high Indigenous population are "shelters of biodiversity and rely economically on their ability to export Indigenous products and processes, they see the rising importance of protecting their traditional knowledge from unjustifiable foreign patenting" (Maheshwari, 2011).

**IK/TK in the Biodiversity Conservation Framework**

Significant changes in the relation between IKS and WKS have been a critical part of the evolving relations between transnational Indigeneity in international law since the late 1950s. One reason is that people recognized that universal human rights provisions were not enough to protect ethnic minorities and Indigenous Peoples from persecution, assimilation, and genocide (Mauro & Hardison, 2000). TK, as a framework, emerged in the 1990s with the global agenda introduced at the Convention on Biological Diversity (CBD). Some scholars go so far as to consider TK a political and legal invention aligned with a wave of western intellectual property laws across the world along with the upcoming digital era (Sunder, 2007).

In 1993, the Convention on Biological Diversity (CBD) recognized the "close and traditional dependence of indigenous and local communities . . . on biological resources, and the desirability of sharing in the benefits derived from the use of traditional knowledge, innovations and practices" (Mauro & Hardison, 2000).[5] It's worth noting that the introduction of TK in biodiversity conservation discourse was not introduced or authored by Indigenous Peoples, and its ratification process was part of an international obligation by the CBD parties (Hardison, 2005). More than two decades later, issues of "misappropriation of knowledge and resources" related to TK projects became considered not only offensive "but dangerous to Indigenous spiritual, cultural and physical health and well-being" (Hardison, 2005).

These issues of misappropriation of Indigenous knowledge and resources are also very related to the development of the Intellectual Property (IP) system to protect European monarchies and subsidiaries, as the Virginia Company and the Plymouth Company as join-stock

[5] Preamble of the Convention on Biological Diversity (CBD). National obligations toward Indigenous and local communities occur in Articles 8 (In-situ Conservation), 10 (Sustainable Use of Components of Biodiversity), 17 (Exchange of Information), and 18 (Technical and Scientific Cooperation) (UNEP 1992).

companies chartered by British King James in early 1600s to secure the colonial appropriation and the economic control in their colonies[6]. Intellectual property has been historicized as European monarchies' tool designed to control the regulation and conduct of various industries, exercise control over what items could be imported, marketed and produced, as well as the manner in which new devices and procedures could be introduced to the stream of commerce. Since early 1990s a whole new set of laws and regulations were permeating other areas of Intellectual Property (IP), creating a new IP system in charge of granting exclusive rights for the privatization of genetic resources and all pertinent digital records. In response, many contemporary American Indian tribes in US have expressed concern for the "push towards sharing or commodification without securing their ability to control the flow of their knowledge or access to their resources."

While IK was recognized by scientists, practitioners, and policymakers and was evolving as a subject of national and international law (Anaya, 2004), Intellectual Property laws still see TK (not IK in mid 1990's), as "the opposite of property" (Boyle, 2003). IK is still seen as the "raw material of innovation, ancient, static, and natural" rather "than intellectual property or modern, dynamic, scientific, (and) cultural inventions" (Sunder, 2007). Natural resources of Indigenous Peoples are addressed by "cultural environmentalists" as areas of "development through intellectual property" (Sunder, 2007), placing "patenting of organisms and products identified and produced by Indigenous peoples" (Smith, 1999) at the core of a global contention.

Scholars agree that pressuring the existing intellectual property and trade-related regimes to accommodate the knowledge and resources of Indigenous and local communities is one way

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[6] Cain, T. (2001). John Donne and the Ideology of Colonization. *English Literary Renaissance*, *31*(3), 440-476. Mrozowski, S. A. (1999). Colonization and the commodification of nature. *International journal of historical archaeology*, *3*(3), 153-166.

of appealing to the international legislative history between nation-states and Indigenous Peoples on the regulation, control, and access to markets for biodiversity and biogenetic resources (Hardison et al., 2011)[7]. An important precedent is the Nagoya Protocol, which was initiated on October 12, 2014 after the ratification of the *Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity.* As an international agreement, it was aimed at sharing the benefits arising from the utilization of genetic resources to enable more fair and equitable ways of enhancing "legal certainty and transparency on procedures for access and benefit-sharing, and for monitoring the utilization of genetic resources along the value chain, including an internationally recognized certificate of compliance." However, despite these milestones in international law, clear lines of trust between scientific authorities and Indigenous governments have been drawn in regard to the protection of ancestral germplasm:

> Tribes are…concerned that studies of their knowledge can reveal sacred and sensitive knowledge, that it can forcefully put their knowledge into the public domain, that it can expose them to economic exploitation without permission or compensation, it can expose them direct competition for culturally vital resources, and it can detract from issues of tribal trust resources and tribal regulatory authority. Because of this, secrecy and non-disclosure is one of the few options for tribes wishing to protect their traditional knowledge, which stifles the ability to carry on the conversations and exchange of knowledge needed to effectuate the use of traditional knowledge in natural resource planning and management. (Hardison, 2005)[8]

The Florence Declaration at the Convention of Biological Diversity in 2014 for instance, links biological diversity to cultural diversity. This connection enabled Indigenous

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[7] Indigenous Perspectives Volume VIII, Number 1 A Journal of Tebtebba Foundation Working on Biodiversity & Traditional Knowledge Protection Published by Tebtebba Foundation (International Centre for Policy Research and Education) with support from Evangelischer Entwicklüngsdienst (EED) Baguio City, Philippines

[8] Preston Hardison, participates in the Convention on Biological Diversity (CBD) since 1996 serving on the Informal Advisory Committee to the Clearinghouse Mechanism (CHM) for the Indigenous Biodiversity Information Network (IBIN) Access and Benefit Sharing (ABS). He also represents the Tulalip Tribes at the World Intellectual Property Organization (WIPO).

representatives at the COP21 (Conference of the Parties) Paris Summit in 2015 to introduce new language about biocultural resources. Experts in biological diversity at UNPFII 2016 and 2017 which focused on the protection of biological diversity and TK from Indigenous Peoples, discussed new considerations linking genetic inequality to social inequality, public and global health inequality, and lower biodiversity and economic disparities. New research studies in biodiversity and cultural diversity are exploring links to biological diversity, health, resiliency and change, and ecosystems and environmental stability. Other links e between material culture and political relations and the implications for cultural services and ecosystem services are driven by cultural factors.

More research is necessary to understand how western science can accommodate IK in the fields of law, environmental science, conservation biology, agroecology, and especially intellectual property laws in order to address Indigenous property rights over genetic resources and these resources role in the legal and political claims to sovereignty, self-determination, and autonomy. Problems remain related to the efficacy of nation-states to implement supranational recommendations (from UNPFII, WIPO, FAO, CBD, and UNESCO) regarding Indigenous genetic resources. Considering that community protocols and legal forest protection frameworks are not enough, the need to secure Indigenous protection and control over the facilitation, agreement, and exchange of ancestral germplasm is crucial as is the role that education plays at multiple levels in these contexts. As Sibisi (2004) envisions in his article, “Local Pathways to Global Development” which focused on Africa:

> “For this to happen, the science and research communities (and their associated industries) need to develop strategic partnerships between scientists and IK practitioners. This calls for an open mind and the willingness on both sides to learn from each other.

> Scientists need to understand and accept the context specificity of IK, and IK practitioners need to understand and accept that knowledge sharing, and critique are essential prerequisites for the maintenance and development of any knowledge." (Sibisi, 2004, p.35)

Key agencies as the World Health Organization (WHO), the United Nations Environmental Program (UNEP), the United Nations Development Program(UNDP), and the United Nations Educational, Scientific and Cultural Organization (UNESCO) have produced cutting-edge conventions or mandates of various kinds on issues of diversity, IK/TK, and the rights of Indigenous Peoples world-wide in the last two decades (Hoppers, 2002). In 2007, the UNPFII adopted the Universal Declaration on the Rights of Indigenous Peoples (UNDRIP) in response to active pressure from global Indigenous networks and organizations during the "First International Decade of the World Indigenous Peoples" in 1994, proclaiming a historic body of collective rights and human rights of Indigenous Peoples and individuals, while setting the stage for the continuous development of international standards and national legislation to protect and promote Indigenous Peoples' human rights.

Previously, in 1995, the General Assembly identified a number of specific objectives, including the development of activities by specialized agencies of the UN system and other inter-governmental and national agencies that benefit Indigenous Peoples. These activities included the implementation of educational interventions for Indigenous and non-Indigenous societies with regard to the cultures, languages, rights and aspirations of Indigenous Peoples, which led to a more specific language on the promotion and protection of the rights of Indigenous Peoples. A second period called the "Second International Decade" in 2005, included a broad range of issues, such as collective and individual rights, self-determination, globalization, colonization,

and a process of education in the General Assembly, seeking improvements "to strengthen international co-operation to solve the problems faced by indigenous people in such areas as human rights, the environment, development, education and health."[9]

UNPFII identified educational access and biological diversity as key strategic elements in the recognition and protection of Indigenous status, a key solution to endemic global poverty and marginalization of Indigenous Peoples across the world, and as vital steps towards culturally appropriate forms of sustainable development. Within that spectrum, the strategic importance of the preservation, protection, repatriation, and exchange of cultural and genetic resources, and the legal tools that guarantee Indigenous nations and communities' control and respect of data governance are considered of utmost importance in the relation with existing intellectual property and trade-related regimes to accommodate and include the knowledge and resources of Indigenous and local communities (Hardison, 2006, 2005, 2009, 2011).[10]

In parallel, among researchers in the fields of conservation biology and agroecology, new voices have coalesced around the idea of repatriation of seeds, restoration of biological diversity, and protection of genetic resources as a strategic intersection and consolidation of Indigenous rights. In 2016 and 2017 the UNPFII identified issues of educational access and biological diversity as key strategic elements in the recognition and protection of Indigenous political and social status. Among the most important recommendations to nation-states, mainstreaming biological diversity represents the key solution to endemic global poverty and marginalization of Indigenous Peoples across the world, and constitutes a vital step towards culturally appropriate

[9] Agenda 21 "UN Documents Cooperation Circles" - Earth Summit 1992
[10] Indigenous Perspectives Volume VIII, Number 1 A Journal of Tebtebba Foundation Working on Biodiversity & Traditional Knowledge Protection Published by Tebtebba Foundation (Indigenous Peoples' International Centre for Policy Research and Education) with support from Evangelischer Entwicklüngsdienst (EED) Baguio City, Philippines

forms of sustainability for millions of world Indigenous communities. A critical component of this new biodiversity framework is the legal control, monitoring capabilities, and respect of genetic diversity data collection and governance.

This governance includes processes and byproducts from genetic resources associated and invested with TK. It seeks to secure the ability to set global certifications of germplasm domesticated by Indigenous cultures and to prevent the modification and patent of ancestral food, medicinal, and crop wild relative (CWR) genetic resources by any private entity. CWRs are considered the wild "cousins" of cultivated crops and can be crossed with the crop species to which they are related to develop new varieties. According to the literature presented by Global Crop Diversity Trust in their references per adapting agriculture to climate change, they have great value at different levels,

> "Crop wild relatives possess many valuable traits that are fairly easily identifiable, such as resistance to pests and diseases, salinity tolerance, and drought tolerance. However, scientists have also discovered valuable genetic diversity in crop wild relatives that is not only hidden, but also somewhat unexpected. For example, genes for higher yield have been found in *Oryza rufipogon*, even though this wild rice species has low grain yield. Crossing *O. rufipogon* with cultivated rice has produced hybrids with higher yields than the original cultivated variety (Thalapati et al., 2012)."

Plant genetic resources and IK/TK are inextricably associated with strategic life forms and entire ecosystems. For example, there is a direct relationship between the domestication of the Melipona Bees in Mayan culture in Quintana Roo, Mexico. The bees depend on the life of a forestland maintained ancestrally by culturally distinctive societies that preserved them in the middle of vast challenges. This biocultural interrelation between genetic resources and cultural practices and technologies requires that the existing intellectual property and trade-related regimes accommodate the knowledge and resources of Indigenous and local communities

(Dutfield, et al., 2004; Hardison, 2011)[11] in order to unleash a wealth of biological research that incorporates Indigenous laws, cultural and economic networks, organizations, and languages in national and international legislations.

Mainstreaming biodiversity conservation is increasingly recognized as the restoration of the biocultural interrelation between IPLCs as holders of two-thirds of the world's biodiversity[12]. As IPLCs manage a significant amount of crop genetic diversity with limited formal recognition and use of their resources for future food security and global environmental balance, the call for the development of community genetic resource management systems is connected to a larger Plant Genetic Resources for Food and Agriculture (PGRFA) landmark[13] representing a historical shift. The development of diverse Indigenous community genetic resource management systems is related to expanding community gene banks and food and medicinal germplasm repositories. This expansion would include CWR, animals, insects and microbes, fish sperm and eggs, livestock breeds, pollinators, and soil microbes. The call for support community gene banks and food and medicinal germplasm repositories builds also from two central international reports on Indigenous Community Gene Banks: the 2014, Community seed banks Junior Farmer Field and Life School Facilitator's guide, FAO, YUNGA; and the 2015 Community Seed Banks, Biodiversity International. Additionally, it is important to propose specific policy and operational guidelines aligned with international agreements

[11] Indigenous Perspectives Volume VIII, Number 1 A Journal of Tebtebba Foundation Working on Biodiversity & Traditional Knowledge Protection Published by Tebtebba Foundation (Indigenous Peoples' International Centre for Policy Research and Education) with support from Evangelischer Entwicklüngsdienst (EED) Baguio City, Philippines.
[12] World Resources Institute - https://www.wri.org/blog/2015/11/landmark-protecting-indigenous-and-community-lands-making-them-visible
[13] FAO 2010 The Second Report of the State of the World's Plant Genetic Resources for Food and Agriculture, Rome.

and commitments towards the recognition of IPLCs as global strategic partners in the Sustainable Global Development Goals (SDGs) post 2020.

New indicators and data sources that emphasize placed-based community genetic resource management systems that support biodiversity conservation on the ground have been developed to connect global health, nutrition, disasters prevention, climate change, and community resilience strategies in rural and protected areas.

**Knowledge Integrations Frameworks around IK/TK and WSK**

In the last two decades, there have been multiple applications and integrations of IK and WSK in environmental research around the world. There have also been many instances of IKs integration in science research and sustainable development. However, as I alluded to earlier in this chapter, the "technical" combinations or integrations of IKS and WKS are highly problematic. Not only there are significant epistemological, theoretical, and methodological differences between both systems, but additionally the global situation of Indigenous Peoples has worsened in the areas of environmental health, global health, natural resource threats, political confrontation, and others. At this stage, it would be inaccurate to state that processes of academic or institutional cooperation that result from the combination of IK with WSK legitimately ensure the improved conditions and well-being of global Indigenous populations. Agrawal (1995) summarizes about the difference between IK and WSK and the context where it commonly takes place:

> "Indigenous knowledge is concerned primarily with those activities that are intimately connected with the daily livelihoods of people rather than with abstract ideas and philosophies. Thus, most writers on indigenous knowledge suggest that local populations possess highly detailed and richly complex information about agriculture, agro-forestry, pest management, soil fertilization, multiple cropping patterns, health care, food preparation and so forth. Western knowledge, in contrast, is divorced from the daily livelihoods of people and aims at a more analytical and abstract representation of the

> world. Western science builds general explanations that are one step removed from concrete realities and which result in insights that can be used for problem-solving in many different contexts." (Agrawal, p.15)

Brosius (2006) discusses also the concern brought about by the Millennium Ecosystem Assessment which sought "to link scales of analysis integrating local/indigenous knowledge into global scientific assessment (p.1)." The Assessment recognized that knowledge integration is more complicated and needs more expansive conceptions that do more than bridge epistemologies in order to bring legitimate contributions to the world:

> In our efforts to bridge scales and epistemologies, we stand at a critical crossroad. For today we are confronted with two apparently contrary trends in the domain of environmental governance. On the one hand, we have witnessed a trend toward the valorization of indigenous/local forms of knowledge and the mobilization of indigenous peoples. The present conference, the outputs of the World Parks Congress, and the CBD/COP7 are three manifestations of this trend. On the other hand, in the last five years or so we have witnessed a decisive move by major conservation organizations toward cartographically enabled regional land-use planning approaches under the rubric of ecoregional conservation. Along with this, we have witnessed the emergence of the field of "conservation finance" (Bayon, et al 2000, Conservation Finance Alliance 2002, WWF 2001), and the proliferation of social science-based metrics and models designed to monitor and manage social and political processes in conservation (Brosius & Russell 2003). These three are linked discursively, strategically, and institutionally in a broader process of consolidation, and together they are reshaping the way conservation is conceptualized, planned and administered. The comprehensive visions being promoted, and the proprietary databases being produced in the emerging complementarities of spatial planning, investment, and social metrics have the potential to reshape the contours of the relationship between humanity and nature for generations to come." (p.4)

One observation to the expansion of IK stems from the idea that the available theory is still focused on questions of power and tends to focus on clarifying the boundaries between the epistemological and the political. On the other side, scientific interests in IK are focused overwhelmingly on environmental knowledge and ignore other domains of knowledge, even though IK is actively developing forms of transnational Indigenous biodiversity conservation (Brosius, 2006).

Hackman et al. (2012), in their article "Transformative Cornerstones of Social Science Research for Global Change," addresses the need for inclusive and equitable sciences to honor new ways of producing knowledge across disciplines by acknowledging the challenges of such integration when certain disciplines dominate the epistemological and financial terrain, as well as the institutional power and dominance in muting research traditions and cultures, methods, and languages:

> "…interdisciplinarity is a fundamental and relevant tool for transformation and is a feature of a new social science research that promotes consistent sets of questions that honor contextual complexities, as well as "cultural epistemologies and correlating forms of capacity building at individual and systemic level" (Hackman, 2012, p.127).[14]

This bridge between knowledge systems at individual and systemic level conceptual and methodological framework for the integration of IKS starts with an opposition to the commodification of knowledge and the need for innovation in the intellectual property regime itself (Mashkelar, 2000; Hoppers, 2002). This is particularly critical when many tribal organizations and populations are now more than ever concerned about their cultural and physical survival. Brayboy (2005) states in the article "Toward a Tribal Critical Race Theory in Education" that the unique status of tribal nations as political entities within the United States,—which we can expand to the Indigenous Peoples aspirations across the world—means that issues of Indigenous education must be understood, researched, analyzed, and developed in ways that take into account the sovereign status and self-determination goals of Indigenous communities, citing President George W. Bush's Executive Order of April 30, 2004. However, previously

[14] Hackmann, H., & Clair, A. S. Transformative Cornerstones of Social Science Research for Global Change (Paris: The International Social Science Council, 2012); or I. Scoones, M. Leach and P. Newell, eds. *The Politics of Green Transformations: Pathways to Sustainability*.

Brayboy (2003) recognized that for scholars of Indigenous education, the connections between Culturally Responsive Schooling (CRS), sovereignty and self-determination are not explicit, and that Indigenous Education still fails to "explicate the unique political status of American Indian Tribes (p .2)":

> "The United States has a unique legal relationship with Indian tribes and a special relationship with Alaskan Native entities as provided in the Constitution of the United States, treaties, and federal statutes. This Administration is committed to continuing to work with these federally recognized tribal governments on a government-to-government basis and supports tribal sovereignty and self-determination. (p. 433)

One significant advancement in the methodological interaction between IKS and WKS in the U.S. is the combination of place-based education (PBE) and environmental education (EE) in schools. PBE serves to revitalize mostly rural communities These methods help students to explore the geography, ecology, sociology, and politics of their communities, while at the same time becoming equipped with decision-making tools to make environmental choices (Howley, et al., 2011). However, in Latin America the challenges for education and professional development are focused on closing the gender-gap in Indigenous societies (Wotherspoon, 2015) in nations like Paraguay, Honduras, and Guatemala, "where levels of educational attainment for indigenous females are well below the low primary school completion rates of their male counterparts, compared to cases like Canada, Australia or New Zealand where indigenous women are more likely than indigenous men to have postsecondary credentials" (Wotherspoon, 2015; Champagne 2009).

Improving education in Indigenous communities is being done in various regions of the world. IK has evolved in formal and informal educational and environmental contexts "into a

science and technology of its own, with African farmers and communities performing as scientists and innovators, observing, drawing conclusions, and taking action (Sibisi, 2015).” In Burkina Faso, meteorologists and farmers are working together now to forecast weather and in so doing to serve farming communities and villages in the region. Additionally, in new schools in Botswana, students are taught to develop critical skills in order to articulate their claims to Indigenous rights and to effectively advocate for themselves (Sibisi, 2015). In the Caribbean region, Stewart (2013) describes the application of postcolonial theoretical perspectives in specific island-state systems in Jamaica. There, scholars address the need to re-position Indigenous knowledge in schools, colleges, and universities by applying the concept of cultural continuity. Levinson (2005) cites the efforts from the Purhépecha Indians of west-central Mexico who encourage their younger generations to pursue advanced degrees in order to return to their community and serve its development. Levinson (2005) also refers to the case of South American schools attempting to “overturn the historic dominance of Spanish over indigenous speakers” to fulfill “a mission of providing bilingual education for a pluralist nation” (Levinson, 2005).

Back in the US, Kimmerer (2002) argues that Indigenous languages encode significant information concerning species interactions. She cites Nabhan (2002) to suggest “that biological information embedded in indigenous languages may be valuable in conservation biology.” Native organizations are advancing integrated curriculum and pedagogies to serve their own distinctive educational needs. Wotherspoon (2015) suggests in the article “Formal and Informal Indigenous Education” that limited discussion and validation of IKS have also meant that “few educators and students are aware of the dynamic, multifaceted nature of indigenous knowledge, including distinctions between more formal and informal learning processes and surface and

deep knowledge, and knowledge-related protocols" (p.88). Wotherspoon (2015) also argues that "the ways in which learning, knowledge and power relations intersect with one another carry several important implications for indigenous populations and how they come to be positioned within core fields within contemporary societies (p.88)."

The mandatory imposition of Spanish as the dominant national language through officially sponsored literacy programs in X locations has estranged some Indigenous Peoples from their traditional means of socialization, modes of cultural expression, ingenuity, and human creativity. Post-industrial, models of pedagogy (emphasizing individual rather than collective achievement), and the commoditization of education are antithetical to traditional Indigenous notions of sharing of information (Dean 2004). Not only have we seen Indigenous students learning skills and discursive formations (Foucault 1972) that have not been appropriate for their particular socioeconomic and historical situation, but they have all too often been taught to be embarrassed of their own cultural and linguistic heritages. Not surprisingly, "typical" students in pluricultural Peruvian Amazonia are instructed about the "noble" Andean Inca, the "glorious" Spanish Empire, and Republican hagiography, but are taught very little about Amazonian Indigenous histories, mythopoetics, or narrative epics and songs undergirding their own societies' distinctive cultural identities (Dean, 2015).

Exemplary cases of educational research around Indigenous cultural practices have taken place in New Zealand (Macfarlane & Glynn 2008). These studies have focused on "knowledge and pedagogies of other Indigenous Peoples to improve education theory and practice in other nations" by which distinctive cultural relations weave together different strands of knowledge bases, relationships, and practices (Macfarlane & Glynn 2008).

In Africa, IK/TK has had a relative success addressing the impacts of Indigenous education for environmental conservation and climate change mitigation impact, on setting the stage for sustainable environmental management, combining traditional practices around biodiversity and biotechnology practices, and assisting in ecological protection and poverty reduction in rural communities (Shizha, 2007). These transformations take place in Mozambique, as discussed in the next chapters, among important tensions between nation states, tribal customary governance and "the dominant juridico-economic ideology of governance in an African postcolony… marked by the profound effects of the neoliberal restructuring of the state… [showing] the progress and pitfalls of democratization in the broader African context (Obarrio, 2014, p.232)". In these contexts, the return of customary governance from Indigenous African societies emerges as part of the impact and resistance to intensive agriculture projects and national land concessions, which promoted that entire communities relocate and adapt to new landscapes and limited natural resources.

This has presented new areas in which science education has contributed to environmental conservation and mitigation based on the notion of restoration. Studies from Zimbabwe and Namibia have for instance described the use of kraal, or manure, in homestead rotation and selection of Indigenous crops to maintain soil fertility (Verlinden, et al., 2006). In Mali and Zimbabwe, examples of Indigenous education related to the support and development strategies from Indigenous Peoples point to the conservation of the Jatropha Curcas plant "grown as an alternative renewable energy source (Easton, 2004). The growth of this plant contributes to environmental conservation (Shizha, 2007). Other instances of the relationship between IK and climate change within and outside the western hemisphere are addressed by Whyte (2016). For instance, the United League of Indigenous Nations climate change initiatives work to protect

culturally significant species from alterations such as sea level rise and glacier retreat, and the Asian Indigenous Women's Network that work to protect the subsistence traditions of Indigenous communities living in forests (p.4). Whyte (2016) also cites the cases of Indigenous Peoples in Alaska who are engaged in political actions against industries that contribute to climate change and force communities to permanently relocate.

In Peruvian Amazonia, new educational research about the impact of intercultural bilingual experiences for the primary socialization of Indigenous children is also being conducted from the perspective of restoration of Indigenous cultures and local notions of sustainability. The existence of Indigenous teacher training initiatives, such as the Iquitos based AIDESEP's Bilingual Teachers training program (Dean, 2015), is an example of one of Peruvian Amazonia's most innovative intercultural pedagogical and curricular frameworks oriented to non-western epistemic pedagogies. This program strives to be mindful of the relationships between apprenticeship, culture, and TK. In the case of AIDESEP's program, this control over the process enable learners to provide feedback for on-going curricular and pedagogical modifications without the pressure of the standard curriculum. This teaches students to actively value, enrich, and engage in the educational processes that occur both in their classroom and within Indigenous community settings (Dean, 2015).

**Science Curriculum Design Incorporating IK/TK**

Wide-ranging research projects address the formal and informal educational settings and interventions in which IKS are present, both within and outside of Indigenous educations systems that function as alternatives to Western education. These projects seek to promote culturally responsive, culturally competent, and/or culturally appropriate pedagogies and

practices in public education. These practices are specifically applied to science and environmental education informed by IKS at various scales.

Two kinds of educational paradigms constitute the frameworks in which Indigenous Peoples are confronted with what the most comprehensive international governance policy foundations identified as political, economic, and social consequences of colonization. The first of these is urban education, which opens up issues of displacement, removal, involuntary migration, and relocation of Indigenous Peoples to urban and industrial areas in many countries as a colonial method. Public education is part of the assimilation of urban Indigenous students into new forms of multicultural and multilingual education and is part of the impact of standardized curriculums and pedagogies to assimilate culturally diverse urban populations into western epistemologies and economic power relations created by industrialization. Urban education relates to urban Indigenous communities situated in a differential socioeconomic relation to dominant European American communities.

The second paradigm is rural education, which raises issues of colonization in rural regions and forced European resettlement and urbanization. There are several elements that contribute to making formal education problematic for Indigenous students in rural contexts. When education does not connect to any of the issues that Indigenous Peoples actual communities are discussing or demanding in local, national and international arenas, it becomes problematic. And when education does not incorporate Indigenous-defined topics, historical and present struggles, or connections with other Indigenous societies or when it does not address the development of these issues in international law, it becomes problematic for Indigenous territorial and cultural governance in the territories and lands they live and protect. At the same time, a form of education for communities who decided to retain their self-determined existence

as nations and tribal communities and that does not contribute to the acknowledgement of and the attention to issues of self-determination, autonomy, and self-determination, represents a challenge to contemporary Indigenous societies in rural contexts. It often follows that problems of science education in rural local schools that struggle with the standardized curriculums and textbook regime reproduce discrimination and segregation, by which mainstream educational research and higher education programs continue operating colonial paradigms by disconnecting Indigenous Peoples from their wider transnational funds of knowledge.

The problems in formal education for Indigenous students are further compounded in science education. Western Science tends to assist Indigenous education programs by lending data validation methods, instruments and technology, data collection and data processing methods. But instead, IK/TK need to be incorporated from autonomous, self-determined, and sovereign frameworks from Indigenous Peoples, institutions, and organizations through informed institutional partnerships.

This includes culturally responsive and culturally relevant curriculums and pedagogies that develop local and authentic forms of Indigenous Education within these communities. The place of higher education alongside these issues is manifest in different areas: K-12 and higher education; public and Indigenous education; rural public education and rural Indigenous education; and urban Indigenous education/urban public multicultural education for American Indian/Alaskan Native/Pacific Islanders. Each one exhibits different and complementary sets of relations:

Rural education is also related to material and cultural dispossession, loss of languages and traditional customs, physical displacement from ancestral homelands, loss of biological diversity and genetic resources, and to issues of self-determination and autonomy expressed in

self-governing bodies, educational boards, Indigenous /Tribal /Aboriginal /Community schools and colleges, or a territorial/land base.


In this context, Community Based Participatory Research (CBPR) constitutes an important framework in response to these shifts in the control of the interactions and the management protocols within western educational institutions. It seeks to address equitable relations between Indigenous community and academic institutions involving the budget allocation between the partners. This includes the provision of equitable salaries to Indigenous partners and project staff as a keyway to facilitate a true partnership and to increase the level of respect on both sides. Trained community partners are also involved in data collection, management, analysis, and interpretation. The involvement by community members in the dissemination of the findings is another important area; successful inclusive authorship on

manuscripts is key and is expected to become the norm [15]. CBPR projects require established partnerships between the community and academic institutions prior to the submission of a grant proposal (Ferreira & Gendron, 2011). This process is sometimes subject to different democratic processes and consultation with all tribal community members. It also includes parallel deliberation with appropriate boards about an initiative that concerns an Indigenous community, making the approval process of IRBs at the level of the Indigenous group itself and academic or governmental institutions, requiring sometimes a window of 12 months or longer (Ferreira & Gendron, 2005).

Outside of the US, but in a country with similar colonial experiences with Anglo-European settlers, Australian governmental programs for Indigenous education are being re-designed with the overarching public objective of social justice from a central governmental perspective. Australia based its educational reform on "the achievement of equality of education outcomes for Indigenous people" (Corrigan & Mellor, 2004). This shift represented a major vertical overhaul of the official governmental policy in the 21st century towards Australian Indigenous Peoples. This change was enacted by the Commonwealth ministers, who stated that cultural inclusiveness was "the remedy for Indigenous education disadvantage, and that the practice of "schools culturally excluding of Indigenous culture contributed to Indigenous students' disadvantage (p.10)." This case reveals how governmental policies recognized the diversity amongst Indigenous Australians and the need for differentiated curriculum and pedagogies.

However, this emphasis on equality in Australia is being challenged through programs such as Indigenous Education Strategic Initiatives Program (IESIP) and Indigenous Education

[15] See, (Burhansstipanov, Christopher, & Schumacher, 2005); (Cashman, Adeky, Allen et al., 2008); (Christopher et al. 2008); and (Ferreira & Gendron, 2011)

Direct Assistance (IEDA) programs, which prioritize the exclusive role of vocational education and training (VET) institutions. Under this framework, Corrigan & Mellor (2004) propose a complete set of technical recommendations with the idea of a more culturally inclusive schooling based on institutional assistance in all educational transitions, and under the perspective of education as preparation for secure employment. It is important to note that the vocational perspective of this educational reform and the official documents do not make any reference to issues of Indigenous educational self-determination and the collaborative curriculum design processes previously discussed. The emphasis on the vocational and assimilationist discourses appeal to discourses of "mitigation" and deficiency which is consistent with issues of the displacement of "second-generation immigrants" to urban centers in Australia, which was similar during the 1970's with the American Indian Relocation Act in the US which promised to secure employment and housing.

The article titled "Indigenous Education in Comparative Perspective: Global Opportunities for Reimagining Schools" (Cottrell, 2010), provides an overview of Australian, Canadian, and American policies. It concluded that Australia had "the worst Indigenous educational outcomes of any comparable Western settler society." Citing Fitzgerald's (2006) research about Indigenous women and educational leadership in cases about Indigenous female school administrators in Canada, Australia, and New Zealand, Cottrell (2010) acknowledges the "emerging global desire in postcolonial societies to devise ways that traditional Indigenous beliefs and values might inform models of school leadership and governance." In this direction, the article "Indigenous Higher Education" (Champagne, 2009) reflects on the assumption that "students will be competitive, self-reliant, and ready to learn how to master extensive knowledge that will prepare them for successful and productive careers within national economic, political,

scientific, and cultural institutions." This is an assumption that is not significant to the life of many Indigenous individuals and communities and is potentially a reason why Indigenous students do not thrive in public schools and public colleges and universities (Champagne et al., 2010).

Through this review, education is highlighted as a critical particular arena to honor the evolving political terms of the relationship between Indigenous Peoples, nation-states, and mainstream institutions. Rather than incorporating and assimilating Indigenous Knowledge in a fragmentary way, formal and informal education must support the re-appropriation of the means of knowledge production by Indigenous cultural and governance systems. Although this process may manifest in local, place-based contexts, it ultimately relies on the revitalization of IKS through the transnational connections between various Indigenous governance systems.

**Implications of Free, Prior, and Informed Consent in Education and Science Research**

As sustainability gets rebranded as part of the nation-state development discourse, in terms of facilitating economic development in the middle of unequal political relations, the framework for conservation and restoration in Indigenous contexts remains inextricable from questions about sovereignty, autonomy, and self-determined governance that are ratified international treaties, laws, and policies. The notion of self-determined development requires the protection of peoples' sociocultural expressions, values, and traditions (Kalafatic, 2019). Thinking along these lines, the new set of *Biocultural* Indicators of Indigenous Peoples' food and agroecological systems (Hendriks, 2019), is defined by their right of access to and use of traditional lands and territories, their change in consumption and preparation of traditional foods and medicines and their associated ceremonial uses, and by the use of languages associated with traditional food systems (see also Woodley et al., 2006). The central claim in this dissertation

asserts that applying and respecting indicators such as these at *all* stages of a development project (conceptualization, implementation, evaluation and assessment) is essential in order to improve IPLCs' food security (Kalafatic, 2019).

Principles for respectful and effective engagement with Indigenous Peoples around food security frameworks must involve understanding and addressing the unequal power relations between WSK and empirical traditions within IK/TK systems, making explicit whose value system(s) and cultural standard(s) will guide the decision-making processes. According to Morin's "Insights from Science and Technology Studies" (et al., 2017 p.1), knowledge management can positively contribute to complex governance issues, particularly on ex-situ and in-situ conservation of agrobiodiversity, in pursuit of food security and in self-determined development (Smith, 2013; Pimbert, 2017).

These principles ultimately require the enforcement of the international Free, Prior and Informed Consent (FPIC) standards to insure "meaningful consultation," as established by ILO169 and UNDRIP. For this to lead to the explicit and un-coerced consent of IPLCs requires also the thorough review of culturally appropriate information, well in advance of any legislative/administrative decisions, projects, or other measures likely to affect their lands, territories, resources, and/or livelihoods. The right of self-determination underlies how policy decision-making should incorporate the participation of IPs' traditional/customary authorities based on local cultural protocols. This emphasizes the value of FPIC as a pragmatic principle that presents the necessary conditions for sustainability as well as conflict resolution mechanisms in any engagement with IPLCs.

In this mediational role, diverse "boundary organizations" become key to the creation of shared knowledge across regimes and reduce the risk of tensions among them (Morin, et al.,

2017)". This notion matches the concept of "boundary objects" as well, highlighted through the two studies addressed by this dissertation (focused on education, biological science, global health, nutrition, law, environmental research). This term describes a tie between different perspectives, recognizing the importance to "connect and mobilize across social and cultural practices to avoid fragmentation" (Hermans & Hermans-Konopka, 2010). The notion of the defragmentation and reconnection of knowledge systems has also been a consistent theme applied to epistemic and material resources within diverse bodies of knowledge that are vital for the survival of the world's Indigenous Peoples. A consistent reference to this epistemic and material reconnection is the widespread implementation of language revitalization programs that many Indigenous Peoples refer to as processes through which to regain the memory, specific instructions, and meaning-making dynamics embedded into thousands of such languages and cultural practices.

Managing these frameworks requires also the development of "cross-boundary capacities" to oversee the complex knowledge integrations and applications that follow up with international law and policy mandates and recommendations. It was through these processes, for instance, that FPIC as a boundary policy became applicable to multiple fields, adopted by the International Fund for Agricultural Development's policy with Indigenous Peoples, ratified by UN-FAO formal guidelines for all field operations, the Convention on Biological Diversity–Akwé: Kon Guidelines, as well as by the UN Development Group Guidelines for country-level planning and programming (Kalafatic, 2019).

The development of functioning FPIC processes indeed requires cross-boundary capacity from nation-states, organizations, and institutions dealing with topics such as policy analysis, data management, cultural protocols, communication styles, research expertise, and collaboration

platforms, among others, to engage with IPLCs at the transnational level. Under the umbrella of FPIC, such protocols are specific to each community implementation process, both derived from and in support of their governance systems and rights (Kalafatic, 2019). The understanding of FPIC goals and processes is a productive stage toward understanding the issues within the international legal and policy regimes that govern sustainable development which, in turn, define and constrain the exchange of land tenure practices and resources of Indigenous Peoples.

## Chapter 2: Methods

This chapter presents my methodological approaches to the two research questions articulated in the previous chapter.

1. What are the roles of education (eg. educational systems, curricula, pedagogies) in transnational IPLCs processes of reintroduction of traditional agroecosystems of crop and CWR germplasm?

2. How do the international legal and policy regimes that govern sustainable development define and constrain biodiversity conservation and the exchange of agroecological practices and resources, and what ideas about IK/TK and WSK explicitly and implicitly guide these legal and policy regimes? What new systems and mechanisms are evolving and what additional changes are needed to enable fair and sustainable forms of exchange?

I address these questions using two separate but linked case studies (Yin, 2018), both of which took place in the context of evolving law and policy regimes and conversations about what the ownership, use, study, exchange, and trade of genetic resource mean from the perspectives of IK/TK in agroecology and biodiversity conservation, and what those frameworks mean in different contexts. There are different reasons why this methodological option is proposed as the appropriate one: each of the two case studies is not limited to a single case or context but rather each develops around multiple cases and contexts that share similar questions about concrete, and practical (context-dependent) knowledges; there is no interest in a model generalization of the findings but rather on a model of collective process of knowledge accumulation in given fields within research and policy communities; moreover, the analysis is not limited to research activities alone; the two cases have the potential of generalized importance serving “to elucidate the nature of agents’ knowledgeability, and thereby their

reasons for action, across a wide range of action-contexts (Flyvbjerg, 2006, p.7).” The two case studies examine how frameworks explicitly and implicitly operate and interact with the real-world contexts of Indigenous Peoples and Local Communities (IPLCs), citing international law related to IPLCs as a point of reference and focusing on agroecological research and biodiversity conservation as critical spaces of interaction between knowledge systems.

My overarching methodological approach is a mixed methods inquiry that includes critical research for the problematization of knowledge systems, critical social research to locate social phenomena in their specific historical contexts and social structures, as well as critical Indigenous research methods to contextualize these issues from the perspective of Indigeneity and Indigenous positionality, through a case study research designed to integrate information from multiple sources of evidence while retaining a wider and real-world perspective (Yin, 2018). The case study approach is well-suited for contexts in which there are many more variables than data points, such as real-world interventions that connect different international sources of agroecological materials, practices, and knowledge.

Case studies are intended to be explanatory as well as descriptive; in this dissertation, they allow me to perform a transboundary pattern-matching analysis of how and why certain processes take place within the fields of sustainable agriculture, agrobiodiversity, sustainability education, global health, and nutrition from diverse Indigenous cultural, historical and political perspectives. I am not primarily concerned with comparing the value of different knowledge systems, but when my analysis requires me to discuss the contrasting approaches of IKS and WKS, I maintain a relativist approach by including in-depth descriptions and applications of IKS and WKS, highlighting the different standards of reasoning and procedures of justification that are products of differing conventions and frameworks of assessment.

Critical Indigenous Research is the development of critical theory or critical social research applied to Indigenous contexts. Bohman (1999) states that critical theory or more generally critical social inquiry "generally aim[s] at constructing social theories that link explanation and criticism and thus have both normative and explanatory features" from a "commitment to methodological and theoretical pluralism." A very useful definition of critical social science is that it constitutes "precisely the analysis of the basic terms and norms of cooperation" (Bohman, 1999, p.5). This approach serves my inquiry into diverse forms of integration, interaction, and adaptation of IKS/TK and WSK and governance systems. Specifically, the Critical Indigenous Research Methodologies (CIRM) perspective is defined by Brayboy et al (2012) as "an emancipatory project that forefronts the self-determination and inherent sovereignty of Indigenous Peoples … rooted in relationships and … driven explicitly by community interests. Given this orientation, the challenge is for scholars and institutions that prepare researcher-scholars to move away from such limited definitions of what kinds of knowledge systems and research processes can be labeled scientific and to consider the ways in which Indigenous Peoples and methodologies inform and frame scientific scholarly inquiry" (p. 456)."

My focus and methodological choices were shaped by my own experiences in different educational settings, interventions, and interactions with diverse national and international IPLCs' learning, policy and research communities. These choices seek to respond to the most critical processes these groups face and the mismatch between the processes that public education proposes, as well as the lack of spaces in which the focus on IPLCs processes can be sustained. In this regard, my commitment to critical Indigenous research required an additional review and partial departure from the premises of multicultural education. Multicultural

education differs from Indigenous education because of its assimilationist goals and because of its assumptions about diasporic ethnic relations and issues of race and gender which do not necessarily apply or have different cultural references in the context of Indigenous Peoples. My argument is that different lenses are needed for IKS which in turn determine different methodological approaches and different governance accountability in the context of Indigeneity.

Indigenous learning communities and researchers, as well as their knowledge systems, must be understood, incorporated and not separated from their cultural contexts. I apply this approach to the case of Indigenous education rather than a branch of multicultural education. The general concept applied here questions issues surrounding the learning and development processes, as well as the design of productive learning environments and experiences within Indigenous learning communities at different levels. My experience around IK/TK has previously explored the mediational means, such as cultural artifacts, tools, signs, and symbols (including language) to rethink how living Indigenous cultures mediate their relation to the contemporary social world (Pacheco et l., 2009, p.61).

As mentioned in the introduction, this dissertation grew out of my six years of research working with different projects on the interaction of Traditional Knowledge with science and environmental education. I worked with UW-Madison's Department of Biochemistry and the Global Health Field Course (organized and run by faculty and staff from the Department of Life Sciences Communication) and as a Project Assistant within the UW-Law School and the Indigenous Law Center under Professor Richard Monette during the summers of 2017 to 2020. I also worked with legal scholar Dan Cornelius from the Oneida nation on food sovereignty issues, particularly on the research and drafting of Indigenous cooperative codes for tribal, intertribal and international Indigenous commons. We were in dialogue with Indigenous tribal leaders in

the state and the nation through my collaboration as co-organizer of the UW-Madison Indigenous Law Conference (2018) which was dedicated to biodiversity and Indigenous genetic resources, including the Rights of Nature legal adoption by Wisconsin Tribes. This project continues today in hopes of developing a legal framework for an Indigenous commons and market in support of a culture-based economic development. All of these projects were conducted in dialogue with members of learning communities from Native American tribes residing in the state of Wisconsin and in close interaction with other tribal nations and communities across the country.

These experiences helped me understand different pedagogical approaches, formats, and digital tools for both informal and formal education, and how those different approaches work within the particular conditions of tribal communities that limit participation in learning through technology. While information technologies can sometimes broaden access to informal learning activities, digital divides limit the distribution of opportunities for some communities and groups. Many Indigenous people live in conditions that limit technology access, such as remote rural regions that do not yet have high speed internet connections or inner-city areas where up-to-date technologies are not high priorities, are not affordable, and are not conducive to participation in computer-based learning activities that require substantial downloading of data (Wotherspoon, et al., 2015).

My field observations during these two projects drew my attention to the complex interactions between educational and environmental researchers at different stages of curriculum design and development, or during what we referred to as the validation processes, supporting and assisting tribal educators and researchers to reinterpret notions of science, sustainability, health, and social and economic development with the expectation that these would be

incorporated into their own future policies and programs. My own boundary-crossing role involved listening to what tribal governments and tribal organizations saw as beneficial in the research or collaborative work and to what cultural visions and perspectives our researcher-led initiatives needed to align with in order to follow the path of critical Indigenous research and Indigenous education.

In my position as a boundary crosser, I needed to be informed about the differences between typical multicultural education and Indigenous education, and the contemporary theoretical and methodological research about the combination, integration, and exchange between IKS and science and environmental education. Through this reflective process, I came to the conclusion that Indigenous and multicultural education, as well mainstream public and private education, should incorporate understandings of the legal definition of Indigenous Peoples from international law, recognizing them as "the assembly of those who have witnessed, been excluded from, and have survived modernity and imperialism" (Smith, 2005), maintaining a unique socio-political relationship to nation-states and mainstream institutions.

The recognition of the unique status of Indigenous Peoples should be central to any educational or research framework that aims to serve the reaffirmation of decolonizing science and enabling transformative knowledge systems to contribute to the most important issues of our time. As part of this, it is also critically important to understand that IKS, as a body of knowledge and practices, requires an institutional structure under international Indigenous governance that facilitates transfer and exchange between Indigenous learning communities based on common epistemologies, interests, and relations.

The dissertation develops two case studies. The first case study addresses a formal educational intervention in higher education:  a curriculum unit around Indigenous issues from

different perspectives, something that was and is still nonexistent within the UW-Madison campus-wide curriculum. I studied the viability and significance of this educational setting as well as the institutional support for the initiative. The focus of this case study was the Seminar on Global Indigeneity and Sustainability offered in Fall 2016 and Spring 2017. It was the first pilot learning community application of a formal programmatic device, a course at both a Tribal College (College of Menominee Nation) and at a historically white research university (University of Wisconsin-Madison's Nelson Institute for Environmental Studies). The seminar project was under my design and facilitation and included leading a delegation to the 2017 and 2018 United Nations Permanent Forum on Indigenous Issues UNDRIP with 3 members assigned by the Menominee Nation.

For this study, I collected data from with 5 participants of the seminar at the College of Menominee Nation in Fall 2016. Four of these interviewees were Indigenous students with affiliations with one of the local Tribes in Wisconsin, such as Oneida, Menominee and Stockbridge Munsee Band of Mohicans. My second set of data comes from 2-page weekly written posts by students in the UW-Madison seminar in Spring 2017. These documents were posted to the online course site at Learn@UW. The third source of data was a group of semi-structured interviews with 7 University of Wisconsin-Madison faculty, program directors, and post-doctoral researchers who participated as presenters of the Seminar on Global Indigeneity and Sustainability in both Fall 2016 and Spring 2017.

During the seminar of Fall 2016 and Spring 2017, I started my attendance participant-observation at the United Nations Permanent Forum on Indigenous issues that has been continued to present, the United Nations High-Level Political Forum on Sustainable Development 2019, the UN Convention on Biological Diversity CBD-Conference of the Parties

COP14 at Egypt in Nov-Dec 2018, and participating on diverse committees and workgroups at UN-International Union for Conservation of Nature (IUCN), Commissions on Ecosystem Management (CEM), Environmental, Economic and Social Policy (CEESP), Species Survival Commission, and Seed Conservation Specialist Group, for 2017-2020.

Finally, I formally interviewed 6 key international researchers and informally at least 30 members of diverse communities of practice, policy makers and researchers from different countries such as: Mozambique in July 2018 International Potato Center Maputo; North India, Dehradun-Navdanya Trust-Earth University Course Agroecology August 2018, and Himalayas with Shakti Adivasi communities in Ladakh; South India, Kerala, at MS Swaminathan Biodiversity Research Center March 2019;  Nepal, Kathmandu and Bhaktapur, September 2018; Egypt ,Cairo and Sharm El Sheik November-December 2018; Colombia, Cali, Cauca, Nasa and Mizak Resguardos, July 2019; Peru, Lima Protected Areas Conference November 2019, and Cuzco Center of Origin for Biodiversity and Agriculture December 2019; and Mexico, Yucatan Peninsula in July 2019 with Mayan and Campesino Ejidos in August 2019, and Tulum and Hopelchen with Mayan Seed Keepers in February-March 2020. This process included attending the Latin American Studies Association Conference in Boston in May 2019, the International Conference on Protected Areas for Latin America and Caribbean in November 2019 in Peru, returning invited to an expert panel to a workshop at the Centers of Origin for Biodiversity and Agriculture organized by the Peruvian Environment Ministry.

During field research conducted in different countries I developed a role as participant-observer. Yin (2018) describes participant observation as “not merely a passive observer” (p.123), in which the researcher may assume a variety of roles within a fieldwork situation and may actually participate in the actions being studies (Yin, et al., 2018 p. 123). Participant-

observation techniques have been used in studies of different cultural and social groups. This methodology has been very appropriate to this dissertation to interact with advanced policy and research communities with many years of field experience, and with culturally distinctive circles on interactions that involve particular protocols for actions that need to be taken to be part of the experience or discussion with Indigenous elders, and in context with null possibilities to ask formal questions. The main difficulty has been my own ability to gain access to different event and groups that otherwise would be inaccessible through a formal study and difficult to collect evidence other than through participant-observation. The second difficulty has been to be recognized as an insider of all the events and groups that I actively observed and interacted with in order to produce an accurate portrayal of the complex research phenomenon, and to produce a greater variety of situations for the purposes of collecting data (Yin, 2018 p.124).

From those perspectives, my research offers insight into how policy priorities and perceptions about Indigeneity were changing in science education and science research as well in the sustainable development discourse and policy, and how the significance of transnational processes of the reintroduction of traditional agroecosystems of crop and CWR germplasm became essential for IPLCs', connecting internal actions around food security, nutrition and health, to a larger framework of biodiversity conservation that is based on the strategic role of world Indigenous Peoples in biodiversity governance.

The second case study after the first seminar case study ended in July 2017, was developed from insights I gained from the first study. I built this study from the premise of the seminar to look for traces of practices and educational processes in Indigenous contexts involving different knowledge systems in which Indigeneity is applied in different legal and policy regimes that govern sustainable development paradigms in different countries. The study

was conducted at different international sites so as to show examples of the constraints in the exchange of agroecological practices and resources as well as to offer insights into the evolving systems and mechanisms needed to enable fair and sustainable forms of exchange.

I had previously conducted associated research on food sovereignty issues in the US by visiting Tribal communities and attending food sovereignty summits and events in the Midwest from 2010-2016. Other events related specifically to food projects took place in July of 2018, visiting the International Potato Center in Mozambique and traveling to agricultural stations from Maputo to the districts of Umbeluzi, Gaza, Chókwe, Chibuto, Manica, and Sussundenga, and in contact with local family and community farmers. This trip was a direct contact with Dr. Maria Andrade, who won the 2016 World Food Prize. On this trip, I discussed different topics related to my research through informal meetings with diverse experts from the Ministry of Agriculture on Biodiversity, on ethnobotany, and biofortification.

Another experience related to agriculture took place in August 2018, at the Vidyapeeth Research Center of the Navdanya Project Trust in Dehradun, North India. There, I attended the Earth University seminar in Ladakh, Indian Himalayas as part of a homestay experience with a Shakti Adivasi Village living with seed and traditional agriculture keepers who practiced an ancestral Buddhism. Also, as part of this trip I formally interviewed Dr. Vandana Shiva director of the Navdanya Trust, and Dr. Biju Kumar Head of the Department of Acquatic Biology and Fisheries from the University of Kerala, and the staff from the Navdanya Organic Farm and Seed Bank in Dehradun. These research trips included participant observation of a program scheduled by the Navdanya in India. There I conducted informal interviews and dialogued with members of different traditional and learning communities, in order to understand their cultural contexts and ideas, approaches to and ideas about sustainability.

This field research trip also included a visit to Kathmandu, Nepal in early September of 2018. This trip was facilitated and through a contact of mine, a delegate of UNPFII who provided the logistical support of Nepal Indigenous Television to visit the sacred city of Bhaktapur, or Khwopa, in the eastern corner of the Kathmandu Valley in Nepal. There I visited special seed banks in ancestral temples that survived intact the devastating 2017 earthquake, and formally interviewed Dr. Dev Kumar Sunuwar, law professor and Nepalese delegate at UNPFII.

I later returned to India in March of 2019 to attend the Wayanad National Seed Fest and Seminar in Kerala, South India and to present at a panel of Indigenous Knowledge and Biodiversity for Natural Disasters Prevention at the MS Ramaiah Medical Research Center in Bengaluru. In Wayanad, Kerala, I traveled through Adivasi villages for one week after the seminar, staying at the MS Swaminathan Biodiversity Research Center. This period allowed an immersive experience informally interviewing and discussing local issues with agronomists and farmers inside and outside the center in different Adivasi communities.

The second case study includes also my role as participant-observer at UNPFII from 2016-2019 in New York at UN Headquarters, and as a result of this participation to be invited as Indigenous delegate to the UN Convention of Biological Diversity COP14 in November 2018, representing the Peruvian Amazonian Shipibo Conibo Xetebo Council of nations. As delegate, I became part of the International Indigenous Forum for Biodiversity that ran parallel to COP14. In this capacity, I participated in the collective review of policy recommendations to national delegations on Indigenous matters. At the same time, I sustained my participant observer role pertinent to this dissertation research as Indigenous delegate of the UN High Level Political Forum on Sustainable Development HLPF 2019 that led me to participate in UN Environment Program UNEP on IUCN Commissions such as Ecosystem Management (CEM), Environmental,

Economic and Social Policy (CEESP), Species Survival and Seed Conservation Specialist Groups, for 2017-2020.

In these capacities, I actively dedicated at least three years pursuing dialogues and conversations with experts in many related topics to Indigenous issues all associated with and contributing to my dissertation research. This process included reviewing a great amount of policy, academic, and organizational literature linked to a myriad of research topics related to Indigenous Peoples.

In June 2019, I continued my fieldwork by visiting the Nasa and Mizak Peoples in the Cauca region, South Colombia. There I visited the Guambia and Silvia Villages and Indigenous Resguardos (Reservations), participating in meetings and interviewing community members, Indigenous governors, farmers and teachers in order to understand their specific and general challenges as Indigenous Peoples. I also sustained my participant observer role during my travels through the Yucatan Peninsula during the month of August 2019. I traveled with the Director of UW-Madison's Latin American, Caribbean and Iberian Studies (LACIS) program, documenting Indigenous agricultural issues. Specifically, I worked with Mayan and other local farming and forest preservation communities and Ejidos (Cooperatives) across the Quintana Roo state. Though some of this work was for a different project, I utilized spaces inside and outside of the formal work to conduct dialogues and discussions towards my understandings of the topics of this dissertation.

Finally, my participant observer role was completed during my attendance to the International congress of Protected Areas for Latin American and Caribbean in Lima, Peru in October 2019. There I presented on the principles and management of Community Seed Banks from my experiences in India, and later returned to Peru in November of 2018 to attend the

International Seminar Centers of Origin for Biodiversity and Agriculture in Cusco, Peru as member of the panel, discussing issues and exchanging information and solutions related to biodiversity conservation in Indigenous contexts, with a workgroup of experts from different countries.

**Methods for Study 1 - Research Question 1**

The first case study is a teaching-practice case (Yin, 2018) focused on two iterations of a seminar that I co-facilitated during the academic year 2016-2017. This seminar, which was funded by the Title VI National Resource Centers from the Department of Education and the Institute of Regional and International Studies (IRIS), focused on emerging interactions between IKS and Western Science in the context of agroecological practices and the restoration and protection of genetic resources. It was grounded in an extensive review of principles, theories, and recent debates around shifts in sustainable development and scientific research methodologies, as well as the development of corresponding international law. The first iteration of the seminar occurred in the Fall 2016, consisting of fourteen classroom-based presentations that were offered at the College of Menominee Nation, having a non-formally enrolled but revolving audience of an average number of 30 students from the Menominee Nation, adjacent Oneida, and Mohican Tribes as well as persons from local communities attending all weekly sessions during the semester.

The seminar also included thirty presenters, consisting of faculty and researchers from different nationalities and cultural backgrounds. The second iteration of the seminar occurred during the Spring of 2017, and consisted of fifteen classroom sessions at which a recurrent group of 25 presenters from universities and local Indigenous tribal organizations in the continental US, Hawaii, New Zealand, Australia, Africa, Asia and Latin America shared theories and examples

with 19 formally enrolled undergraduate and graduate students at the University of Wisconsin-Madison Nelson Institute for Environmental Studies, plus an additional number of revolving online participants from US Tribes through our online live sharing platform.

The objective of the seminar was to promote ways for faculty, students, and community members affiliated with the College of Menominee Nation and adjacent tribal and rural communities to become part of an international exchange regarding sustainability and action research. The seminar invited key international researchers, practitioners, and academics throughout the semester to discuss a variety of topics related to Sustainability, Indigeneity and Sustainable Development from an Indigenous comparative and transnational scope. The seminar project reflected my conviction that an international collaborative umbrella network for research, education, and outreach can partner with academic programs with area studies centers in different continents.

The seminar facilitated a series of presentations and discussions with the participation of international experts, educators, and researchers who were already advancing this dialogue and discourse in academic and professional networks. The content of the seminar series was concurrent with the six components of the sustainability framework adopted by the Menominee Model of Sustainable Development, consisting of six cross-cutting and inter-related components: Land and Sovereignty, Environment, Institutions, Technology, as well as Economics and Human Behavior/Perception (Dockry, et al., 2016).

The seminar followed the standard set by the North and South American Indigenous Technical Exchange for Sustainability that studies the similarities between environmental and natural resource management systems on Indigenous lands and territories, as well as the relationships between state and federal governments across the great American continent. This

exchange was conceived among educational and tribal institutions on curriculums and policies around sustainable resource management, sustainable development, and global health across the three hemispheres. At the same time, partnership with local tribes to research models of sustainable agriculture, sustainable energy, global health, and sustainable development from an Indigenous comparative and transnational perspective was also key.

These two iterations of the seminar serve as rich examples of the implementation of educational interventions that span Indigenous and non-Indigenous learning communities in a higher education context. Both presenters and participants came from diverse cultural, disciplinary, and national backgrounds. The methodological challenge in this case study overall was to reconcile my facilitator and participant-observer role across two semester-long interventions and within the institutional framework of two host academic programs—the School of Education and the Nelson Institute for Environmental Studies—both of which saw the seminar as an attempt to link diverse learners, researchers, and educators around the restoration and protection of genetic resources in Indigenous contexts.

To provide a rich account of the seminar, I combined notes from my own participant-observer role as the co-organizer of the seminar with semi-structured interviews of all presenters and academic participants. The interviews, which were audio-recorded for later transcription and analysis, focused on how presenters and students responded to the seminar's pedagogical stances and design, and what reflections, perceptions, and commitments the educational experience promoted. They also explored the participants' views about the interaction between knowledge systems and possible forms of action around Indigenous Knowledge at the local and transnational level. Each interview lasted about 40 minutes to an hour.

All conducted interviews followed the same interview protocol for interviewers to observe variations and commonalities among the participants' stances. The type of interview was semi-structured around a set of 14 questions conducted between June 2017 to March 2019, after the last seminar was concluded. The data collection methods included audio-recordings with presenters and participants, notes from the participant-observer role about the case study sessions of 2016 and 2017, and analysis of pertinent theory and methodology related to the two research questions addressed by this study. This study received a Human Subjects IRB Protocol (#2017-0171) approved by the University of Wisconsin-Madison's IRB Office.

**Methods for Study 2 - Research Question 2**

The second case study is primarily focused on material systems, research frameworks, and policy development related to the interaction of IKS and WSK in the exchange of agroecological practices and resources. This case study gathered data from a set of transnational initiatives, each of which highlights a particular attempt to build connections through coordinated action across multiple IKS research and practice contexts. This part of the dissertation, which is intended to highlight the developing international legal and policy regimes that govern sustainable development, discusses projects with different understandings of and attention to what constitute beneficial relationships between IK/TK and WSK. Each resulted in different degrees of change in the political and legal acknowledgement of Indigenous governance and frameworks of autonomy, self-determination, and sovereignty.

Except for one initiative which focused exclusively on the policy dimension of connection and coordination action, the initiatives examined in this case study included agricultural research projects around ethnobotany, horticulture, agroecology, sustainability, and science education. All were connected, in some degree, to language and culture preservation in

Indigenous schools, programs, and informal education contexts. All drew on and responded in different ways to the ideas of sustainability or sustainable development. The five projects were:

- Intertribal Food Cooperative Initiatives and Food Sovereignty Networks (United States)
- Orange Flesh Sweet Potato breeding and biofortification for Agricultural Development and Nutrition for Aboriginal and Traditional Communities (Mozambique; this project was the recipient of the 2016 World Food Prize)
- Navdanya Network: Community Seed Banks and Traditional Crops Restoration (India)
- Latin American Indigenous Peoples and Local Farming Communities from Peru (Cusco), Colombia (Cali-Cauca) and Mexico (Yucatan Peninsula, Mayan Seed Keepers)
- United Nations Convention of Biological Diversity COP14 (Egypt, November 2018), Representative of the International Indigenous Forum for Biodiversity (IIFB).

As in the first cast study, this case study combined data from multiple sources. Here, I combined direct participant observation in the field with data from semi-structured interviews, institutional and project report documents, as well as archival files. This process was carried out over multiple years, from 2015 through 2019 in US and international sites. As part of my research with each initiative, I conducted semi-structured interviews and used "passive interviews" in spaces where any open recording or note taking were not allowed, and in which cultural and respectful interactions and ethical relationships were key for observation and participation.

Each initiative was chosen based on contacts and referrals made by academic colleagues and faculty, as well as by learning through engaging the relevant literature and participating in academic and policy events. The seminar initiative was the result of the completion of the science education project with the UW-Madison Department of Biochemistry (POSOH Project,) and also my interest in the expanded interaction among diverse Indigenous knowledge systems that could assist US Native tribes in recomposing their lost knowledge. The pilot seminar was included in the proposals to the U.S. Department of Education Title VI from the National Resource Centers from the University of Wisconsin – Madison, for the cycle 2014-2018. It was

supported by Dr. Alberto Vargas (LACIS), Dr. Michael Cullinane (Southeast Asian Studies), and Chris Caldwell, director of the Sustainable Development Institute of the College of the Menominee Nation. The main idea was to test an educational intervention in a rural school that included the internationalization of the curriculum. The contact with such a large number of presenters was made possible through my work relationships and contacts developed while having worked on Indigenous issues on campus since 2009. Many of these had already been already acquaintances in academia, to whom I had reached out in advance. I made office visits to these faculty members in order to discuss my academic interests, relative to their own interest in the same topics, in order to recruit them to participate in the seminar. Its first iteration represented a culmination of the shared personal interests among all presenters, as well as their personal commitment to making this information and perspective available to and part of the university experience. The second iteration affirmed our shared belief in the central idea proposed by the seminar: a unique and innovative approach to interrelated fields of study, around the same culturally distinctive populations in different geographical contexts.

Dr. Sumudu Atapattu from the UW-Law School suggested I connect with the Navdanya network and Dr. Vandana Shiva in particular, because she was invited to the US campus in 2017 as a visiting scholar. I used Dr. Atappatu's reference and recommendation to register at the Earth University seminar and obtained research travel support to North India, Dehradun in August 2018. During this trip, I interviewed Dr. Vandana Shiva, Dr. Biju Kumar, Chair of the Science Department of University of Kerala, and also the Manager of the Navdanya Organic Farm in Dehradun, India about the relationship between IKS and traditional farming practices as well as about the protection of Indigenous seeds and the role of community seed banks in North India.

The initiative to visit the Orange Flesh Sweet Potato site was a result of the recommendation of Dr. Irwin Goldman with whom I have been in conversation with since 2016 regarding his participation in our seminar as presenter. This trip also came out of conversations with Dr. Jack Kloppenburg regarding my inquiries into possible Indigenous Seeds Commons that can use the site's Open-Source mechanisms. My own experience is with Indigenous contexts in Peru, and my own positionality provided a strong drive to study the implications of knowledge and especially governance systems in germplasm conservation, intellectual property, and science paradigms for other Indigenous societies in the Global South, which includes US Native Nations. Dr. Goldman was already coordinating a project to support the restoration of a few ancestral varieties of corn and tobacco for the Ho-Chunk and Oneida Nations of Wisconsin. His recommendation to visit Mozambique was about an international case of biofortification of OFSP in a complex sociopolitical context of a post-colonial state, which was significant because it served the nutritional needs of poor Indigenous and traditional communities. This program has been expanded into 5 more countries. The CIP Mozambique office and Dr. Andrade offered logistical support for me to visit OFSP, cassava and amaranth agricultural sites, and villages outside Maputo from July 10-26 of 2018.

My attendance at the UNPFII since 2016 made possible my contact with multiple Indigenous delegations. There I learned from direct sources the situation of world Indigenous Peoples; I listened for 5 days to interventions from delegates who summarized their most important issues and needs. During the second week at UNPFII, I attended a variety of meetings and presentations with international organizations. Because of the accreditation as observer from UW-Madison, I was able to attend many events and establish direct dialogue with multiple delegates and experts. I met Dr. Dev Kumar from Nepal in 2017 and we coordinated the visit to

Kathmandu to visit Indigenous community seed banks in the first days of September 2018. Dr. Kumar's organization, Indigenous Television Network of Nepal, provided the logistical support to visit the city of Bhaktapur and several agricultural villages outside of Kathmandu along with two temples with seed repositories. The visit was also scheduled to include the important national Gai Jatra Festival in the capitol Kathmandu which would have attested to the powerful cultural and religious diversity in Nepal because of the attendance of important Indigenous and religious leaders and delegations.

My attendance at the COP14 in Egypt was a result of my involvement in UNPFII. Secondarily, and my nationality as Peruvian was important as I served on an Amazonian Peoples Council (Shipibo, Conibo, Xetebo) as part of an international delegation. During this trip I met Dr. Balakrishna Pisupati, Chair of the Forum for Law, Development, Environment and Governance (FLEDGE) based in India. Dr. Pisupati, is a prominent member of the UN and IUCN community and is the former Chair of UNEP 2015 and former Director of a biodiversity policy and research program at the UN University in Japan. Dr. Pisupati offered me an international honorary fellowship and sponsored my trip to South India and the Wayanad National Seed Fest and Seminar in Kerala, India and my stay at the MS Swaminathan Biodiversity Research Center in Wayanad. During this trip it was possible to conduct informal meetings with Indigenous conservationist leaders (Mr. Cheruyaval Raman, India's national ancestral paddy rice protector), agricultural researchers, Indigenous community leaders, and seed keepers. I also presented, along with Dr. Pisupati, at the seminar about Biodiversity Conservation and Natural Disasters Prevention at the Ramaiah Medical Research Center and at the Shrasti University at the TK and Architectural Design seminar in Bangalore, India. Throughout, I

continued to take on a participant observer role, and have consolidated my understanding of the IPLCs Global South networking around multiple projects and initiatives.

The initiative to visit the Indigenous Peoples from Colombia in September 2019 was a result of my participation in the UNPFII as well as the support of Rafael La Torre from Cornell University who studies the introduction of sustainable crops and biodiversity conservation projects in support of health and nutrition strategies in Indigenous Resguardos in Colombia. Dr. La Torre facilitated the contact with the Indigenous Nasa Government in Corinto (60 km from Cali at 4,000maltitude), who at the same time coordinated a meeting with several Nasa Indigenous governors around the issues their communities face and the need of support research and action projects oriented to the protection of their land and environmental rights. In Corinto, I was able to conduct an informal dialogue around topics related to Indigeneity with members of the Nasa government. The Nasa Indigenous government of Corinto subsequently coordinated, through internal channels, my visit to the Mizak Nation in Guambia (145 km from Cali at 2620m altitude) escorted by members of the Nasa nation from Corinto. At Mizak nation, the Indigenous representative guided us to visit an elementary and a high school, the ceremonial and traditional medicine center, the community agricultural sites, the community and family trout farms, and allowed informal interviews with the tribal authority who escorted me and with members of the community in different capacities and activities. All these interviews contributed to my understanding of Indigenous issues in Colombia from different angles and contributed to my reflections on the significance of the two research questions directly in the field.

My role as a participant observed developed gradually during extensive field research in different countries. My relationship as member of forums on Indigenous issues provided the basics for a trusting relationship that gave me a limited access to the richness, complexity, and

conflict that characterized participants of these forums' thoughts, feelings, and activities, coming in representation of peoples from the four corners of the earth. On the other hand, it was my researcher identity that offered me direct access to legal experts that work with IPLCs in international forums and expert workgroups around multiple areas of international policy change.

I collected data from interviews after the seminar completion in May 2017, and the process continued until December 2019. The weekly posts we collected from January through Maybi, 2017. Additional data in various forms was collected during field research conducted between 2015 to March 2020. There were three types of data that I collected: contextual/relational, formal, and document based. Some of these data constituted relational and background information around the educational processes and roles of education and schools in the communities that I visited. It was very important for me to inquire into whether there were other forms of education in the communities that were alternative to formal schooling. I also inquired into their views on sustainability from environmental, economic, and cultural considerations and how they related to the development and understanding of Indigeneity. I asked questions about the agricultural base and its match with health and nutrition issues in the communities, about seed sovereignty or dependency on external seed markets, and their reflections on and positionality regarding the processes of the reintroduction of traditional agroecosystems of crop and CWR. I also commonly asked about the social and economic challenges of Indigenous Peoples and the status of their relationship with nation-states, as well as policy and legal issues regarding land tenure, educational and health services access, and community decision making power and governance forms and affiliations. The level of information was extensive, and it constitutes a very promising field of study for combining social and natural science.

The second type of interviews were formal and semi-structured that comprised of around 14 questions with students, faculty, and researchers. When this data was collected, I initially hoped to obtain different responses to the same questions. From these responses I would later on reflect on the common trends and significant relationship to issues of education and international legal and policy regimes that frame different relationships with IK/TK. I believe these trends can provide important insight into the changes needed to enable sustainable forms of exchange between these knowledge systems.

**Data Collection Process**

The data collection process was built on academic relations and networking that led from one source to another which allowed me to extend my research network. The data shows recurrent mentions of the complex relations that have been established through a theoretical review. The interviews were also connected semi-formally so as to allow me to adjust some questions in order to bring information from other interviewees to look for agreement, confirmation, or consistency. The contacts made with my subjects during my fieldwork strove for relational, contextual, and background information. I made the decision to interview someone based on their availability and level of articulation of the subject matter. Other considerations were their role or capacity with my context or with the organization or community I inquired about. Overall, I conducted around 50 interviews with different subjects during the process of fieldwork.

For the formal interviews, the criteria of selection of the consulted faculty and researchers as subjects was based on the following: their expertise or representation within a significant organization or educational institution; their authority on topics related to the two research questions; and the references from faculty researchers and members of my committee about

them. I observed their confidence in the topics and in their transnational approach along with their comfort level when addressing a diverse case analysis related to Indigeneity, IK/TK, and education as well as policy development and tensions around biodiversity conservation. I observed also if they needed assistance in understanding the issues underneath the research questions and the significance of the research. It was important for me to observe if they considered the research valuable and significant, and if they had ideas that could contribute to the solutions to the problems expressed in this research process and in the research questions. One important guide for me was to see their references to education, agriculture, community and capacity building, policy making, theory and practice development, outside of the framework of schooling and public education. In other words, it was important for me to see how they viewed education as a process and not necessarily as a product in all contexts. The formal data collection process included the following interviews in five groups:

1. 5 participants of the seminar conducted in Fall 2016 at the College of Menominee Nation.
2. A collection of written posts containing reactions and reflections from 19 participants of the Seminar in Global Indigeneity and Sustainability in Spring 2017. These posts were shared through the online course site, Learn@UW, every week.
3. Interviews with 2 participants of the seminar conducted in Spring 2017 at the University of Wisconsin-Madison Nelson Institute
4. Interviews with 7 University of Wisconsin-Madison faculty and researchers who participated as presenters in the Seminar in Global Indigeneity and Sustainability in both semesters Fall 2016 and Spring 2017.
5. Interviews with 6 key international researchers from India, Nepal, and Mozambique who were focal points during the field research conducted in several countries.

**Data Collection Chart**

| SOURCE TYPE | MODALITY | NUMBER |
|---|---|---|
| General Subjects Informal – Contextual / Relational | Passive casual interviews<br>Topics: Alternative education, Social and cultural issues, Views about sustainability, environmental, economic and cultural reflections. | ~ 50 |
| Students participants in the seminar in Spring 2017 at the University of Wisconsin-Madison Nelson Institute. | Online written posts<br>One-page reflections | ~ 240 |
| Students participants in the seminar in Fall 2016 at the College of Menominee Nation. | Formal interviews consisting of 14 questions | 5 |
| Student participants in the seminar conducted in Spring 2017 at the University of Wisconsin-Madison Nelson Institute | Formal interviews consisting of 14 questions | 2 |
| Key international researchers from India, Nepal and Mozambique, | Formal interviews consisting of 14 questions | 6 |
| UN inter agencies, NGOs, academic publications, project reports, UN convention and mandates, project reports, etc. | Document-based | ~ 50 documents |

The common themes that I included in all interviews were related first to the overall social and political conditions in the country I visited. I asked questions regarding their challenges and achievements as country as well as the situation of Indigenous Peoples. I asked about what worked and what did not in relationships between the state and Indigenous Peoples, the existence of non-recognized Indigenous Peoples, and the historical processes that these populations (Indigenous and non-identified or recognized Indigenous Local Communities) have encountered in their relations with a national identity. I asked general questions about the educational institutions (preferably the existence of Indigenous education programs) and the existence of food systems programs tied to the internal community agricultural systems that satisfies internal consumption. I also generally inquired about the accessibility and affordability of health systems and well-being programs in Indigenous communities as it is a strong indicator of different pressure and tensions.

My background questions connected the source or the information to the current situations Indigenous Peoples faced in that region, which I would then relate to what I learned of world Indigenous Peoples during my fieldwork at the UN and policy forums. From that commonality I looked for information about the particular governance status of the Indigenous Peoples self-determination, autonomy, or sovereignty status and attempted to inquire into whether current governance structures correlated to the situation around sustainable agriculture, germplasm availability, and the efforts to reintroduce organic seeds into their crops and IK/TK practices and methods. In this regard, India was too vast a context with too many sources and ramifications; therefore, it became critical to reflect on the need to reframe my interests in the pursuit of information related to my two research questions.

The first case study drew upon diverse examples from around the world but occurred in one location, while the second case study followed central research themes across multiple locations around the world. The first case study had an explicitly educational goal, using various pedagogical strategies to foster sustained interaction and discussion among the seminar's participants and presenters. In the seminar, the successes and challenges of different projects around the world were used to provoke dialog about how and when it is possible for interactions between IKS and WSK to be ethical and mutually beneficial, and what such interactions might look like and do.

In the second case study, although all of the different projects that I examined involved education, education was often in the background for the study participants. In other words, these projects were not explicitly defined in terms of education as products and artifacts for classrooms and schools, but as educational processes around biodiversity and conservation. Within each project, education and learning were integral to the creation of new systems and mechanisms that are evolving to enable fair and sustainable forms of exchange between IKS and WKS in the context of the developing international legal and policy regimes that govern sustainable development. By drawing attention to the distinctive features of each initiative, as well as the patterns, categorizations, assertions that cut across the various projects, the second case study provides a powerful counterpoint to the extended reflective curriculum and pedagogy exercise portrayed in the first case study.

The general strategy for both studies was to conduct an analysis of all available data from interviews, student posts, and general document-based information in order to respond to the two research questions. Thus, I aimed to establish direct correlations between the two case studies with the generic goal of contributing to expanding theories that avoid the classic extrapolation of

probabilities or the particularization of singular cases of IK/TK in relation to their interaction with science. Nonetheless, the goal of the analysis was to develop generalizations based on multiple case studies that test the theoretical propositions related to the significance of the restoration of world Indigenous Peoples' epistemological and material systems that contribute to explaining the multiple instances in which informed and consented interactions and policy making platforms with WSK are used as variable instrumental validation, technical integration, or adaptation frameworks.

At the same time, the analysis focuses on two complementary approaches. The first analyzes specific educational processes and dynamics that take place within educational and governance and policy institutions within an educational framework that conveys specific action research and produces collaborative alliances around knowledge systems between culturally distinctive learning communities. The second approach seeks evidence of "critical links" between communities of practice and policy regimes that show the interactions and intersections of agroecological practices in the sustainable development discourse in relation to the impacts in biodiversity conservation. Specifically, the case of the protection and restoration of Indigenous genetic resources is a strategic platform for the confluence of rights, legal regimes, research, and governance with multiple applications.

The data analysis highlights consistent occurrences and specific cases, or policy frameworks and theoretical foundations, connected to the restoration and protection of genetic resource systems, and contrasted with relevant theory. This central topic is the most relevant space to test how different theories or questions more thoroughly explain the different forms of interaction between these divergent knowledge and policy systems within diverse disciplines and/or fronts of action around sustainable development. Each code addresses diverse patterns of

similarities and differences, correspondence and causation regarding the relations within knowledge systems, as well as in relation to divergent knowledge systems.

Each interview was transcribed and added to a collection of texts that also included roughly 240 one-page student posts, documentary evidence, and field notes from each case study site. The formal data collection in the form of interviews was processed by applying an emergent coding analysis (MAXQDA software), supported at UW-Madison and serving as a resource for this work. The data processing was based on interviews transcripts (18 total) that had been organized in relevant sections under different codes. I created different codes assigned to a summative, salient, essence-capturing, and/or evocative attribute of a portion of language-based data. These coded portions consisted of passages of text that represented and captured a datum's primary content and essence (Saldana, 2015). Other document-based data consisted of participant observation field notes, open-ended responses, and international institutional and organizational project reports and publications that are relevant to the issues this dissertation addresses. These assigned codes constitute researcher-generated constructs with attributed and interpreted that are intended to translate the data through categorizations, assertions, or proposition developments, as well as diverse theory building that result from establishing "critical links" between diverse datum meanings (Saldana, 2015). Each code has been defined at the beginning of the Findings chapter.

This collection of texts was then analyzed using the qualitative data analysis software MaxQDA. The goal of this process was to contrast the data with all relevant information and theory related to the two research questions. The proposed codes are organized around analysis of the academic discipline, ontological orientations, theoretical and conceptual frameworks (Saldana, 2015), contrasted with inductive data and pertinent literary sources to determine a set

of categories that are revised against the research questions, including different approaches addressed by this research. The analysis also seeks for patterns of consistent occurrences that can reveal unity around conditions and contexts as well as a multiplicity of elements that make visible and more comprehensible evidence and descriptions of rules, roles and relationships around these concrete instances of meaning (Saldana, 2015).

Each code has been particularly defined as a "propositional statement" (Saldana, 2015) of an emergent category in order to describe a set of relations, academic disciplines, ontological and epistemological orientations, as well as theoretical and conceptual frameworks that are proposed to attribute data significance to the two main question for this research. These categories are not discreetly bound but often times overlap. Each code constitutes a category in a hierarchical coding scheme (Saldana, 2015) that will be analyzed to reach outcome propositions that prove and match the main propositions of this dissertation.

In my analysis of data from the first case study, I cross-analyzed participants' statements and understandings about exchange processes and the conditions for dialogue between universities, international Indigenous academic programs, sustainable development projects and Indigenous networks. I also tracked the changes in their academic stances and perceptions that took place over the course of the seminar.

In the analysis of the second case study, I questioned how the sustainable development paradigms applied in international research in different regions of the world represent different approaches and stages in the implementation of international law related to Indigenous Peoples. Moreover, I assessed how they reflect different stages in cultural and environmental science research that are very pertinent to this research, as it involves deeper levels of interaction and collaboration between IK/TK and WSK at multiple levels.

For both case studies, my analysis consistently interweaves data and observations gleaned from my participant observer role. In doing so, I attempt to disclose my inherent biases as well as the ethical and methodological dilemmas associated with entering the field of culturally distinctive societies, as well as the forms of positioning and disclosure within their cultural protocols, and the processes of shared relationships and disengagement with the subjects and fields of study at the conclusion of the data collection process.

The inductive approach taken by this dissertation is concerned with the generation of theory emerging from the data, giving special attention to testing propositions that should, based on the theory being examined, apply to the cases that are sampled in the design and implementation of educational intervention cases. I start with the proposition that education is a central arena in which diverse knowledge systems connect through strategic intersections of governance and political rights, interrelated applications, and agency-based adaptations. In this process, the relevance of the Free, Prior and Informed Consent policy and mechanism for all the issues that affect Indigenous Peoples, emerged as central to the relations not only with Indigenous Peoples in real time, but central to the productive integration goals between IK/TK and WSK knowledge systems. FPIC needs to be more central in future research. My analytic induction approach within this dissertation focuses particular attention on the interactions between IKS and WSK in which the governance systems associated with these epistemic and material systems are placed at the center of research paradigms and methods, inextricably linking the interactions among knowledge systems to policy regimes that govern nation states, Indigenous Peoples, and sustainable development.

The second case study research is primarily focused on material systems, research frameworks and policy development from thriving communities that present examples of

relevant complex problems and responses on how Indigenous Knowledge and Traditional Knowledge along with WSK interact around the exchange of agroecological practices and resources in the context of the developing international legal and policy regimes that govern sustainable development. This section also focuses on projects that benefited from equitable relations between IKS and WS, resulting on different levels of changes in the acknowledgement of Indigenous governance and frameworks of autonomy, self-determination and sovereignty. This second study explores how IKS agroecological practices and resources as well as research protocols from Indigenous Peoples, would interact productively with research bodies and industry sponsorship, from the positionality of Indigenous Peoples as strategic partners for global sustainable development. This second study also discusses patterns of action and consistencies of human affairs (Saldana, 2015) around documented cases that faculty, researchers, practitioners specifically cite in the data. It is important to note how the transnational approach in this study is intended to highlight consistencies across institutional and policy frameworks in different parts of the world that intersect personal and expertise-based perceptions, values, differences, and variations (Saldana, 2015) among specific communities of practice and learning.

The conceptual frameworks that inform my methodological approach are global Indigeneity, human and environmental rights, as well as international law related to Indigenous Peoples. The fieldwork and data collection pay attention to different conceptual schemes in which Indigenous sustainability education and diverse knowledge systems intersect with science research and global development policy. The dissertation is also interested in the conceptual and methodological foundations for the integration of IPLCS's IK/TK systems at different levels. I reference conceptualizations of sovereignty, autonomy, and self-determination as related to governance in different contexts around the world.

Finally, another relevant framework used here relates to critiques of western science as the epistemological and methodological expansion of global corporate capitalism and its impacts on Indigenous Peoples territories and cultures. This is connected to sustainability, sustainable development, biodiversity conservation, climate change, and in the attention to the different roles and accountability of different knowledge systems in educational processes. These conceptual frameworks take in consideration general agreements of the Convention of Biological Diversity, the UNDRIP, ILO 169, the Sustainable Development Goals post 2015 towards 2030, and international conventions and previsions related to Indigenous Peoples. Lastly, the dissertation analysis follows a discursive and conceptual approach rather than ethnographic analysis of the statements provided in a collection of formal data.

# Chapter 3: Findings on Research Question 1

## Methods, Summary, and Organization

This chapter focuses on the following research question: What are the roles of education (eg. educational systems, curricula, pedagogies) in the transnational IPLCs processes of reintroduction of traditional agroecosystems of crop and CWR germplasm? My approach to this research question is guided by a broad understanding of education that encompasses a wide range of cultural interaction, including but not limited to formal schooling. In this view, education is an essential part of, for example, healing historical trauma and reestablishing culture revitalization programs.

In the specific context of reintroducing traditional agroecosystems, educational projects often involve the interaction of IK/TK and WSK systems – typically because of a history of extractive/economic interest of WSK in traditional crop and crop wild CWR germplasm obtained from Indigenous Peoples, leading to the appropriation of resources and associated knowledge systems. The interaction between knowledge systems does not occur on equal footing; indeed, IPLCs are often forced to engage with WSK. To the extent that education requires the interaction of IK/TK and WSK, it has a deeply ambivalent impact on IPLCs, embodying both liberatory potential and oppressive systemic realities. I take as the starting point for my work that there can be no equitable integration of knowledge systems unless the interaction between them is conducted in accordance with international treaties and legal binding agreements, as for example the International Labor Organization (Article 169), the Convention of Biological Diversity (Article 8(j)-Traditional Knowledge, Innovations and Practices), and the UN Declaration of the Rights of Indigenous Peoples as central comprehensive instruments for the recognition, protection and promotion of these rights. Under the principles outlined in these agreements, the

restoration of IK/TK systems is intrinsically connected to the recognition of Indigenous Peoples and Local Communities (IPLC), with clear implications for the role that science and environmental research institutions have at local and global level.

To answer this research questions, I drew on the following data sources:

- A collection of 117 written online weekly posts containing reactions and reflections from 19 participants of the Seminar Global Indigeneity and Sustainability in Spring 2017 at the University of Wisconsin-Madison Nelson Institute for Environmental Studies, shared through the course online site at Learn@UW in the form of weekly posts through the entire semester.
- Interviews with 5 participants in the seminar that was conducted in Fall 2016 at the College of Menominee Nation.
- Interviews with 7 University of Wisconsin-Madison faculty and researchers who participated as presenters for the Seminar on Global Indigeneity and Sustainability in both semesters Fall 2016 and Spring 2017.
- Interviews with 7 prominent international researchers from India, Nepal and Mozambique who were focal points for international field research conducted in 2018 and 2019.
    - Dr. Vandana Shiva, Director of the Navdanya Network, India
    - Dr. Biju Kumar, Director of Marine and Aquatic Sciences, University of Kerala, India
    - Dr. Maria Andrade, Director of the International Potato Center, Mozambique
    - Milagre Nuvunga, Director of the MICAIA Fund, Maputo, Mozambique
    - Bija Vidyapeeth Agroecology Center Manager Navdanya Project.
    - Dr. Dev Kumar, Indigenous International Law Professor, University of Nepal.
    - Prof. Tim Frandy, Northwestern University, Ashland, Wisconsin, USA
    - Field visit to Nasa and Mizak Reservations in Cauca region, Cali, Colombia in July 2019.

My analysis focused on the relationship between education and Indigenous Peoples' governance and self-determination, with particular concern for educational activities that facilitate equitable interactions between knowledge systems. As my analysis proceeded, I became acutely aware of the distinct roles that education plays for different stakeholders. In one direction, education can play an important role within and across IK/TK systems by contributing to the consolidation of transnational knowledge and policy networks. Without such consolidation and re-composition, further integrations with WSK inevitably take the form of de-contextualized extraction and appropriation of knowledge fragments that perpetuate misrepresentations and essentializations of Indigenous Peoples, while facilitating the violation of intellectual and cultural property rights. In the other direction, educational projects can play an important role within and across WSK institutions by transforming the frameworks that these institutions adopt in interaction with IPLCs and with IK/TK systems to avoid reiterating historical patterns of oppression and marginalization. The emergence of this cross-cutting theme in my analysis allowed me to refine my attention to the roles of education within specific contexts and for specific audiences at research, practice, and policy development level.

**My Evolving Understanding of the Role of Education**

This research project began as a broader inquiry into how to decolonize Western education, and gradually acquired a more specific focus on the larger global efforts among Indigenous Peoples and Local Communities (IPLCs) to restore their own cultural and political governance mechanisms. I also compared these scenarios to those found in the existing literature, in terms of the theoretical foundations of Indigeneity therewith, as well as the concepts and relations around their economic and political marginalization, under both colonial and

neocolonial regimes. As my involvement in global policy deepened, I began to follow the emerging principles and evolving policy discourse of land rights and intellectual property rights, paying close attention to international law forums and transnational networks that center Indigeneity.

The intellectual journal that led to this point is grounded in my consistent observations of compulsory, assimilatory, and alienating forms of government-implemented public education in a range of contexts, including among Indigenous Peoples. My early professional experiences around the conceptualization and applicability of gender perspectives and IEC (information, education and communication) strategies around Women and protected populations including Indigenous Peoples, from 1988 to 1999 in Peru, had led me to an appointment as a UNDP consultant on Human Development and Women Rights for the Peruvian government. At this point, I began to pay close attention to Indigenous issues as they arose in policy and development contexts. My initial direct engagement with these issues took place within such interdisciplinary fields as social and economic development, education, human rights, gender, and public health, as related specifically to international cooperation.

Once in the US, my understanding of and interest in issues related to Indigeneity continued to evolve and took on a central role in my graduate education at UW-Madison from 2008 to the present. For seven years I played various roles in service-learning projects, such as in Environmental Justice at New Orleans (Department of Biophysics), and with tribal and multicultural communities of practice with the POSOH Project (Department of Biochemistry), and the Tribal Youth Media and Global Health Field course with the Life Sciences Communication Department of the College of Agricultural and Life Sciences. The POSOH Project particularly focused on the development of 7$^{th}$, 8$^{th}$ and 9$^{th}$ grade science curricula that

integrated what those projects referred to as the "traditional knowledge" of Indigenous tribal communities in Northeast Wisconsin (Menominee, Oneida and Stockbridge Munsee Band of Mohicans) with material from the standardized science curriculum. The resulting materials were then used in 57 schools in the region that were part of the Cooperative Educational Service Agencies (CESA) regions 8 and 9. Through this project, I documented the stances of many educators and members of diverse communities of practice, conducting interviews with key Indigenous and non-Indigenous participants from 2012-2015. The POSOH project consistently encountered tensions around validating acceptable meanings and meaning-making practices from Indigenous students inner-cultural knowledge (Bang, et al., 2013). It was also overwhelmed by entrenched "knowledge-power relations, historically structured inequalities, and assumed assimilation into particular knowledge paradigms [that] silence or marginalize" Indigenous students, placing them in "untenable epistemological positions" (Bang, et al., 2013) that work against engagement in meaningful science learning.

Later, during the completion phase of this dissertation, I held a teaching appointment at University of Wisconsin-Platteville that deepened my knowledge of American Indian history and complemented my field experience. For three years, I taught a contemporary history course called "The Native American Experience." This experience showed me the great need for more accurate accounts of history, from a decolonized positionality, in U.S. secondary and higher education, in order for students to be able to see U.S. history through the eyes and experiences of its First Nations. My students had not previously been exposed to the level of information provided in this course about, for example, the ruthlessness of colonization or its use of violence, the well documented schemes and legal maneuvers it exerted toward both land acquisition, and the intermediation of European settlement.

Since my earliest involvement as part of a U.S. university system, from 2005 onward, I observed that the notion of Indigenous governance was perceived by a dominant sector of the UW-Madison academic community as problematic. It is, I assert, misunderstood by many who perceive the assertion of governance rights by tribal communities as a kind of retrograde form of self-marginalization that involves retracting from the western idea of progress and economic development. Those who hold this misconception see Indigenous governance as an obstacle to emerging scientific research. Throughout my educational formation at UW-Madison, I personally observed the imposition of western epistemologies on Indigenous communities that have suffered violence, historical trauma and marginalization.

During my graduate education, my reflections about Indigenous Peoples' exercise of their fundamental right of self-determination became linked to the restoration of Indigenous material and epistemic systems. I consulted new research about large ecosystems that were severely damaged in the absence of IK/TK systems, such as dams and hydroelectric plants as well as large intensive agriculture and extractive operations, revealing the need of taking into account both those IK/TK systems and the Indigenous governance systems that facilitated them. Similarly, the reintroduction of traditional agroecosystems of crop and CWR, as part of IPLC's biocultural relations and knowledge diversity, are regarded by many sources I consulted as critical pathways to the restoration of land rights and customary practices for Indigenous Peoples.

Looking for answers, I followed the lead of Indigenous Peoples' communities of practice, many of which were focused on insuring the implementation of United Nations Universal Declaration of the Rights of Indigenous Peoples (UNDRIP) at multiple levels. As discussed in the preceding chapters, this became a key component of my dissertation research. In my participant-observer role, I followed Indigenous networks that actively engage with

corresponding and relevant UN agency networks. In the process of consulting and interviewing science and policy experts within the UN interagency system, I learned that the issue of protecting Indigenous genetic resources connects to a global problem: an overall loss of biodiversity, which will have multiple devastating consequences for the entire planet in the immediate future. I also began to see this biodiversity loss, and the climate change problems happening concurrently, as inextricably connected to the forced removal and displacement of Indigenous Peoples and Local Communities from their territories, as they therefore become disconnected from their critical roles in conserving the globe's vast genetic resources.

Biodiversity loss and the consequences of climate change also impeded Indigenous Peoples' assertion of land and territorial rights by making them increasingly dependent on external markets and vulnerable to incompatible land uses—as in the case of mining and oil concessions imposed on their territories. In agriculture and agroindustry, this challenge has legal implications for intellectual property issues around domesticated germplasm, with its associated traditional knowledge, as well as for the potential dismissal of Indigenous stakeholder rights with regard to national genetic resources and their associated traditional knowledge, potentially in violation of policies intended to guarantee the regulated access and benefit sharing of genetic resources, as consistently affirmed by the Nagoya Protocol as a treaty-level, legally binding agreement.

My experiences within American higher education, as well as my interactions with Indigenous communities of practice in the USA, Mozambique, India, Jamaica, Colombia, Peru, Egypt, Mexico, and Nepal, have led me to believe that many critical stakeholders, Indigenous and non-Indigenous, are not adequately prepared to develop and implement alternatives to the practices that are causing human and ecological misery at a global scale—alternatives that

require global governance structures to recognize the framework of the rights of Indigenous Peoples, adopting and ratifying the constitutional protections and amendments that are clearly outlined at UNDRIP and ILO 169.

This points to a great need for education (broadly defined) and the institutions that support it. Educational institutions and research organizations must reformulate their knowledge integration frameworks to support equitable relationships with Indigenous Peoples. To accomplish this, they must also reform themselves: internal educational interventions are also needed, to engage faculty researchers and educational administrators as the main target audience of educational decolonization strategies.

**The Seminar: Curricular Intervention in One Higher Education Context**

The seminar "Global Indigeneity and Sustainability," which is the primary focus of this section, represented my conscious attempt to respond to the need for educational transformation within and around institutions of higher education; it also offered a site of inquiry for my own research into the potential roles of education in addressing the linked challenges of knowledge integration and indigenous governance. I designed it, in part, to respond to the problems I observed as a graduate student and during my work with the POSOH Project, in regard to the existing literature and prevailing practice around Indigenous education policy and legislative history in the US, further expanded to incorporate the contrasting analysis of issues around global developmental discourses around IK/TK. As a participant-observer during the years 2014-2016, I witnessed and took part in complex interactions between diverse epistemologies at different stages of curriculum design and development. These occurred during different validation processes around epistemological differences, supporting and assisting tribal educators to reinterpret notions of science, sustainability, and health, as well as social and economic development, with the

expectation that these would be incorporated into their tribe's own future policies and programs. The tribal governments, tribal educators, and tribal organizations that participated all voiced specific ideas about what would comprise the most beneficial type and scope of collaborative work and also what cultural perspectives within a critical Indigenous research path ought to be followed. Unsurprisingly, not all of those ideas could be realized in the context of the POSOH project.

"Global Indigeneity and Sustainability" was developed as the pilot experience for a formal programmatic initiative that explored Indigeneity with a transnational approach. It spanned two very different educational institutions with very different underlying educational frameworks and used an interdisciplinary format that the developers (including me) saw as an ideal platform for promoting dialogues across technical, technological, and biological research frameworks on one hand, and social and political fields of inquiry related to Indigenous Peoples on the other. We agreed at the outset that this kind of integration was necessary in order to reshape educational institutions into places that are more welcoming of and oriented toward Indigenous students.

The first iteration of the course, in Fall 2016, involved working directly with administrators, educators, and learners (including high school students) at the College of Menominee Nation. The second iteration of the course, in Spring 2017, took place at the University of Wisconsin-Madison Nelson Institute for Environmental Studies, and included both Indigenous and non-Indigenous participants among the students and presenters.[16] Both seminar

[16] Some activities connected to the seminar extended beyond the meetings at CMN and UW-Madison. In particular, the seminar included a week field approach leading a Menominee delegation to New York for the 2016 and 2017 to the United Nations Permanent Forum on Indigenous Issues (UNPFII). The Menominee intervention at UNPFII focused on the denouncement of the Back 40 Ore Mining Project, located next to and posing an environmental threat to the Wolf River and, in turn, the last remaining 235,000 acres of Menominee ancestral homelands. As a result of the seminar, and since that first delegation in 2016, I continued serving as a cross-cultural and cross-academic boundary link over the years connecting the Menominee delegation at UNPFII in 2018 and 2019 to other Indigenous

semesters increased the awareness of international Indigenous issues in two different contextual spaces as it was later expressed by participants and scholarly communities from both institutions, linked to how science education and scientific research was understood by different visions ad experiences. The seminar also filled a gap[17] in the teaching and research being done within the field of international Indigenous studies, at such an influential research university as UW-Madison. The value that students placed on this sort of educational experience aligned with previous arguments in favor of combining technical and socio-political perspectives on interdisciplinarity "lead to fundamental changes in the ways biodiversity is conceptualized, assessed, and managed" from education and research to the field and state policy (Bannister et al., 2006, p. 24).

Through this seminar, participants often drew connections between the exploitative and oppressive history of education for Indigenous People, as well as about the practice of science researchers coming into Native American/American Indian/Alaskan and Pacific Islander communities to gather data for their own benefit. For example, student participants expressed concerns that, in the absence of an explicit deconstruction of colonial methods and a deliberate focus on Indigenous knowledge within it, western-oriented public education remains a focus of suspicion:

> "Another issue that goes along with trying to incorporate indigeneity into schools is the lack of respect [in such institutions] for Indigenous knowledge. When compared to [western science's definition of] scientific evidence, TEK tends to be viewed as primitive or less concrete. When taught in school, I think indigenous beliefs are often [presented]

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delegations from all over the world, while I also connected through panels and discussions with experts on issues about the protection of genetic resources and issues of Indigenous representation in biodiversity conservation towards this dissertation. In these capacities, I was invited to become part of the UN Indigenous Media Caucus, for which I reviewed a study of Indigenous community radio worldwide in 2019, along with experts from Nepal, Mexico, Canada, Africa, Peru, Nicaragua, Colombia, and United States, to develop a set of global guidelines that would align with UNDRIP provisions.

[17] UW-Madison had hosted only one prior such experience, the Indigeneity in Southeast Asia Conference in 2013, developed by Dr. Ian Baird, and a Wisconsin Native Nations Summit organized by the Nelson Institute in 2015.

> as outdated or historical, rather than alive and current. That creates an issue for Indigenous students then, who feel their culture is undervalued by westernization. (EH, Weekly entry, February 2017)

Students also demonstrated a growing awareness of the way that western education can have corrosive impacts at the community scale. In the words of one non-Indigenous student

> "These peasants have a lack of trust for foreign technology, assistance, and knowledge. Improving their livelihoods can be a double-edged sword. If they invest in their children's education, they may send their community into a downward spiral. Sending away the young and educated to escape is essentially giving up on their community. Peasant farmers can migrate to bigger cities but then they risk even more loss of their culture." (KF, Weekly entry, April 2017)

An Indigenous student and seminar attendee from a local Midwest tribal community added further nuance to this theme, reflecting on how much distrust Indigenous peoples associated with schooling and science: "Many times the only schools available are public schools, which do not help to preserve cultural values and language [and] lead to children losing their cultural values. These people cannot trust their government to provide useful knowledge to help them better provide for their families (K.S., Weekly post, April 2017)."

For all students in the seminar, juxtaposing conversations about educational systems and research systems in the same seminar provided numerous opportunities for students to build their awareness of the interconnectedness of formal education and research, and to see how education is connected to the impact of western science research from its neocolonial, ethnocentric, instrumental and industry-based body of knowledge.

Students who participated in the seminar made references to associated Indigenous language revitalization[15] as fundamental to educational frameworks relevant to Indigenous Peoples' restoration processes. Several suggested that local speakers of Native languages should translate relevant content from Indigenous practitioners, scientists, and educators from other parts of the world, and provide references in their own local languages, to support the development of placed-based science, environmental, and health curriculums that speak to experiences common among world's Indigenous Peoples. Students and presenters also emphasized the importance of including values, cultural views, issues, and a commitment towards land rights as parts of IK/TK in the campus curriculum.

Although non-indigenous students developed their understandings of the oppressive nature of western educational and scientific systems, my data consistently show that Indigenous participants demonstrate greater self-awareness of cultural, social, and economic pressures of being Indigenous and about Indigeneity than mainstream counterparts, and of the challenges these pose for their communities. This came through in the way an Indigenous Menominee scholar who participated in the 2017 seminar expressed the paradox of participation in western education and western science, which both oppresses and (in some cases) can provide the leverage to counter oppression:

> There's an aversion to [being the subjects of science] research, an aversion to [western] science, because of things that have happened here…to my people. I think [those directing the shift in decolonizing education have] got to be Indigenous Peoples… But it

[15] The emphasis on language revitalization was also common among members of different learning communities I consulted through my field research process in different countries.

> takes Indigenous Peoples getting their education [in order to] understanding those systems and to make them work within their contexts. (J.G. Interview, November 2017)

Indigenous participants were openly critical of science research and argued for new models to be built upon core principles of environmental stewardship and consent processes. Another Indigenous participant drew attention to the role of self-determination and consent mechanisms in knowledge exchange, saying

> "It is important to ensure mutual agreements about disclosure and respect to groups who want certain information to be protected… To create mutual benefits, there needs to be trust and consent between everyone involved… [The research] needs to be done in ways that give local people the power to help themselves, rather than simply coming in and implementing modern, westernized ways of thought. (E.H. Weekly entry, April 2017)

My relation to the Indigenous participants in the seminar, as both a facilitator and participant-observer, encouraged sharing among everyone of a deeper, more reflexive awareness of the historically oppressive impact of education for communities like their own. From this dialogue, it became evident that among Indigenous Peoples' learning communities there was not only a greater awareness than non-Indigenous learners and researchers of their rights, but also about the history of exploitation that has threatened such rights. Students attending the semester of the seminar course offered at the College of Menominee nation in the Fall 2016, particularly participant Indigenous students from Menominee, Oneida and Stockbridge Munsee Band of Mohicans local tribal communities from Wisconsin, had a nuanced understanding of the power relations, institutions, and historical contexts.

It is important to note, however, that the Indigenous participants in both editions of the seminar were not all from or based in Wisconsin. In addition to students and participants from

the First Nations of Wisconsin, the seminar included scholars from Hawai'i, Aotearoa/ New Zealand, Peru, Sápmi (from Norway and Finland), Laos, and American Indian Tribal Nations. Participating students found the intersection of Indigenous perspectives useful.

> "Thematically, the most important areas, for my research and interests, were those that focused on Indigeneity and seeds. However, I think I learned something from every presentation, even those with further distance from my research interests. I think discussing Indigenous issues at all levels–local, national, and international–is the way to go" (M.D., Weekly Post, April 2017).

Faculty members involved in the seminar were also quick to praise the global nature of the seminar and its breadth of Indigenous perspectives. Paul Robbins, Dean of the UW-Madison Nelson Institute for Environmental Studies, argued that

> "We need more curriculum in this area… Historically what we called south/south relationships, where there is just an enormously rich set of knowledge and practices. I don't see why that wouldn't inform sustainability efforts here. Although, we don't see it on campus, what would that look like?" (P. Robbins, Interview, December 2017).

The breadth of Indigenous perspectives present in the seminar did not, however, satisfy the strong desire of some participants for local Indigenous Peoples' representation. Many of the sessions held at the College of the Menominee Nation were attended by non-Native school administrators, teachers, and members of the community in general; they often either did not feature Indigenous presenters, or, even those that may have been Indigenous were not identified as members of a particular tribe or nation. A Menominee participant expressed particular disappointment that even though this seminar was held at their own College of Menominee Nation (CMN), it did not feature more Indigenous presenters, or gather more Indigenous students

from not just their nation but from among *all* tribes in the state, with specific acknowledgement by and for each of these communities. The same student worried that the people present did not understand the local context or the perspectives of the Indigenous people present, and argued for rooting the learning experience in *place* to provide a vital reference for local culture and governance referencing their treaty-based territorial and land rights:

> "I value the idea of group modeling, to identify relationships within tribal communities and building from strengths, from language, and culture, and the environment. I think, from the Western point of view, there are a few people who are seeing that that's an asset and that's where change is going to happen in Indigenous communities is by recognizing and valuing indigenous systems and indigenous knowledge to help those communities grow" (J.G., Interview, November 2017).

Far from being an isolated concern, this participant's argument connected back to a recurring theme of the seminar: what types of education would most effectively and comprehensively promote the rights of Indigenous Peoples? As I suggested earlier, I noticed a deeper, more reflexive awareness of challenges related to education and western science among students from local Tribal Nations' communities (Menominee, Oneida and Stockbridge Munsee Band of Mohicans) with access to strong, community-based learning opportunities. This contributes to my conviction that community-based education built around the restoration of IK/TK and cultural reservoirs of knowledge provides crucial support for Indigenous self-determination and is essential to the development of Indigenous academic and political representation in the world. In the next section, I draw on my field work in different sites around the world to illustrate this type of education, and to examine the roles that education can play in IPLC's community-based settings.

**Community-Based Education in IK/TK Revitalization and Agroecological Exchange**

This section expands, from the field, the existing literature about applications of IK/TK in the biodiversity conservation specific framework. As described in the methods chapter, my international data collection entailed participant-observation in a wide range of contexts, each leading to the next, in ways that were not initially anticipated when I started the dissertation. My participant-observer role in various committees and expert groups within major global forums (UNPFII, HLPF, CBD,) and in multiple academic and policy events was interwoven with fieldwork visits to exemplary agroecological case studies connected to IPLCs in Asia, Africa, Latin America, and the Caribbean. In each context, I interviewed key sources about their first-hand experiences and observations related to IK/TK, agroecological practices, knowledge exchange, and Indigenous capacity and agency towards autonomy and self-determined governance.[18]

In the field, these themes often blended together, and apparently abstract topics were often anchored in the present by immediate and practical work. For example, during a visit to a relatively wealthy rural Shakti Adivasi homestead outside of Ladakh (in the Indian Himalayas), I discussed biodiversity conservation and local community land governance with the father of the household that hosted my visiting group[16]. This middle-aged farmer, who also served in the Indian Army and was on family break, asked for my help at dawn to remove stone blocks from

[18] Because I was interested in the policy and governance regimes that contextualized each project, my interviews often touched on the implementation of UNDRIP, nation-state binding agreements, and policies in education and science that addressed Indigeneity and IK/TK. When relevant, I asked about the implementation of ABS policies and FPIC mechanisms as they relate directly to the recognition of land rights, and as deriving from a political identity based in the recognition of IPLCs as non-state stakeholders and counterparts to nation states within national policies about biodiversity conservation. Most of the discussion of policy and governance regimes that resulted from these interviews appears in the following chapter.

[16] I made this visit in as part of my participant-observation in a workshop run by the Navdanya project, which I discuss in more detail below.

his fields irrigation lines to allow water to flow down the hill to other farms after an unusual night of full rain. While we talked about the implications of his way of life, we were literally opening the flows of water across the field that would irrigate other crops down the valley. He shared that his community only sent 20% of their agricultural production to market, with the remainder directed to different purposes, including individual family seasonal sustenance, a community food bank, a produce diversification exchange, small community seed banks, religious events and offerings. Observing this scenario on a prosperous autonomous agricultural field in the Himalayas showed me the stark difference between the dominant western concept of material and economic growth and investment, and the more interdependent traditional ways of life that these communities embody under constant environmental threats.

In all of my cases, the availability of seeds and the restoration of traditional crops was vital for IPLCs. Yet in nearly every agroecological project focused on seed preservation and seed exchange, education was a recurring theme. The importance of education, and the inextricability of IK/TK revitalization and Indigenous sovereignty, are neatly encapsulated in the words of Dr. Vandana Shiva, who said

> *What I spread are seeds of knowledge. And what I spread are seeds of seed satyagraha [seed sovereignty]*. And I think an organized force of Indigenous people needs to do what we did…We wrote the international biodiversity convention, [and] the international treaty on genetic resources… to regulate the corporations who were taking whatever they wanted. Now we must regulate the blockages, and work on what is the future, and what are the freedoms, and what is the accountability, and what is safe and what's not safe. (VS, Interview, South India, August 2018, my emphasis)

Dr. Shiva is one of the founders of the Navdanya project, a large informal and community-based educational network that has supported and allied with important Adivasi and so-called Scheduled Tribe causes in India, as well as in other parts of the world, connecting with many other affiliated organizations. A central aspect of Navdanya's work is promoting the protection of organic seeds and their secured distribution to Indigenous communities in different parts of India and Africa, precisely to counter the negative impact of the intensive agricultural prioritization of exclusively commercial varieties with a focus on maximum earning from either industrialization or genetic modification.

Navdanya's network and itinerant seminars play a multidimensional role in supporting local biodiversity education as well as engaging international researchers (like me) who are looking for evidence of exemplary cases with Indigenous beneficiary communities on education for biodiversity conservation, seed sovereignty and development of local organic certification standards that support local Indigenous biodiversity governance. The Bija Vidyapeeth campus, in Derahdun, in the North Indian state of Uttarkhand, has hosted international researchers for many years, highlighting the value of knowledge exchange in the network's action. My experience there in August 2018 provided a powerful illustration of the potential to develop significant opportunities for educational exchange and mutual learning, beyond the classic hands-on agricultural technical training, while also focusing on restoring the relations and meanings of IPLCs knowledge around natural resource management and seeds preservation within larger perspectives of ecosystems conservation at transnational level.

I traveled to Northern India in August 2018 to attend an international course on Indigenous agroecology in Indigenous contexts. This course was offered in the context of Navdanya's efforts to promote community seed banks. On this first trip to India, I traveled with

the Navdanya Network and Dr. Vandana Shiva from New Delhi to Ladakh, in Indian Himalayas, for a week-long stay at an Indigenous Shakti Village outside of Ladakh. One feature of this Shakti Adivasi community was that it had its own boarding school, where elementary and middle school students resided on weekdays, in order to focus on an education that was not only culturally embedded, but also combined with national standards and field duties. I interviewed the father of our homestay family in Ladakh; a soldier who received one week of break every month while serving at India's border with China. Although he himself was deeply involved in communitarian networks and traditional agroecological practices, he expressed hope that his two daughters would learn about technology and at least two different languages, in order to insure their survival in an uncertain world. Ladakh is threatened, for example, by the likelihood of a future water shortage and also by the melting of the Himalaya glaciers, currently in process.

I was reminded of this conversation in 2019, when I visited two community-based schools in Cauca, Colombia within the Mizak Indigenous Peoples' reservation, known as the Resguardo de Silvia. There, students wear traditional Mizak attire, speak the Mizak language, and also use computers in classes about agroecology, all the while sustaining many traditional customs and community visions of stewardship over their pristine lands. Through such novel juxtapositions of Indigenous and non-Indigenous epistemic and cultural practices, I witnessed these communities encouraging their youth not to abandon their lands.

Later that year, I participated in an expert group convening[19] of the Centers of Origin for Biodiversity and Agriculture, in Cusco, Peru, in 2019 where I attended to present my research about community seed banks in India. The conclusion of this group, after listening to direct

[19] I was invited to join this panel following my earlier participation in the community seed banks initiative launch at the Congress for Protected Areas of Latin American and Caribbean, as an international fellow of the Forum for Law, Environment, Development, and Governance [FLEDGE.]

reports from national agencies, international researchers and local farmers, was that the majority of agrobiodiversity in the world, as found in both major and minor crops, remains in the fields of traditional farmers. However, the effort to focus conservation on farms run by traditional farmers was proving that the youth was massively abandoning farming, and that no such conservation projects could succeed without educational work that sustains cultural practices and connections in the younger generation. The group concluded that

> "This abandonment of traditional farming suggests that agrobiodiversity conservation will only be successful if this trend can be reversed. We suggest that the focus of such conservation should move from the genetic resources to the human resources, since without the people who create and maintain it there will be no agrobiodiversity to conserve." (Centers of Origin for Biodiversity and Agriculture expert group conclusions in Cusco, Peru in December 2019)

My experiences in classrooms with Indigenous and non-Indigenous communities, as well as in the field visiting direct Indigenous communities and inquiring about the unique social and cultural spaces it takes places, led me to reflect on the value of combining technical and socio-political perspectives to "lead to fundamental changes in the ways biodiversity is conceptualized, assessed and managed," from education and research to field and state policy (Bannister, 2006, p. 24). It seemed clear that the preservation of Indigenous traditional knowledge and territorial integrity was not incompatible with the appropriation and incorporation of western technology and western science to support a self-determined form of engagement. Yet the awareness of Indigenous learners deserves particular attention, as do the types of education and research that further the boundary-crossing abilities of this emerging learning community, toward productive

fronts in scientific research, insofar as such research benefits the interests and rights of Indigenous Peoples.

The community-based education of Indigenous scholars and boundary-crossers is an important focus of the MS Swaminathan Biodiversity Research Center in Wayanad, Kerala (South India). I visited the Biodiversity Research center in March of 2019 to attend their National Seed Fest and Seminar, which included ceremonial events of Adivasi tribes outside of Wayanad related to seeds restoration during a two-day community vigil. In the same week, I spent an entire day with Mr. Cheruyaval Raman, distinguished by Indian government with the honorific title of National Seeds Protector, to interview and observe his work in his farm[20] and small forest. Mr. Raman receives scholars who study IK/TK conservation directly in his fields and travels the world to offer presentations. His work connected to the work of the MS Swaminathan Biodiversity Research Center puts education and learning at the center, using recurring workshops and events such as the festival, as central spaces to interact with these communities. The staff also use an internship model to foster the development of local scholars who reside in the center and return to their villages on weekends.

Research centers and networks like the ones I visited in India have counterpart and partners elsewhere in the world. In 2018, I visited the International Potato Center in Maputo, Mozambique, home to an agricultural project that is increasingly focused on the role and impact of education in community settings. The International Potato Center was born as the result of partnerships between NGOs and research organizations with autonomous Indigenous ancestral potato breeding communities from Peruvian Andes, specifically Cusco, where my father's family

[20] He has insisted on living in a traditional farm building with traditional adobe architecture in an area where many properties have otherwise been modernized with new homes resulting from investments of family members working abroad; a phenomenon that transformed the traditional lower-income dominant rural landscape of South India.

is from. Dr. Maria Andrade's work at the Center on the biofortification of orange flesh sweet potato tuber, a Peruvian ancestral crop, for nutrition and Vitamin A deficiency in Africa was honored by the World Food Prize in 2016. The center has expanded significantly since then, and now operates in 14 countries,[21] each with different notions of Indigenous and local traditional forms of self-determination and land resource allocation. The project also developed associated crops, such as cassava and amaranth, as complementary plant communities that might attend other community health and nutritional needs. Andrade described the process to determine the model to best serve their intended adult beneficiary population:

> "In the Niassa district, we got into a community where one NGO is [working] with literacy [and] they became our partners. So sweet potato enters in a program as entry point, to teach growing, and they translate all this information, make it very simple; translate them into [the] local language. And as you do that, you reach millions, millions of communities with the message on how to grow. So, it is an education system, but the main point is how to grow a sweet potato, how to process it, how to diversify it, how can you improve the diet of your children. It is not conventional, but they are learning how to write around sweet potatoes and all that." (Maria Andrade, CIP, Interview, July 2018).

Yet Dr. Andrade also confirmed, later in the interview, that there are hard limits to educational interventions that focuses only on the top-down dissemination and replication of nutrition programs. Recent projects have focused on increasing awareness among researchers, educators, and community organizers about cultural, ethnic, legal, epistemic, and ethical dimensions that impinge upon biological research. In Dr. Andrade's words,

> "We created what we call the community of practices. We have an online program where we have people that are interested in seed, others that are interested in monitoring and

[21] Efforts have expanded farmer access to quality planting material and improved farming practices, as well as creating demand through the development of new sweet potato products, vastly expanding both their production and their consumption in Uganda, Kenya, Ethiopia, Tanzania, Mozambique and Ghana, China, Georgia, the Philippines, Vietnam, Papua New Guinea and others.

> evaluation, other community that are interested in seed processing, other into marketing. So, in this program, people discuss several aspects, because you are right. Scientists like me who is a breeder, we think like if you release a variety, that you are there, you finished" (Maria Andrade, CIP Mozambique, Interview, July 2018).

In saying this, Dr. Andrade reveals her awareness of the limited knowledge of social issues associated with community-centered Indigenous land rights among educators and researchers from the global south, as well as those based in the global north. During my time in the field with agricultural researchers at CIP, I observed both their awareness of and their hesitation to discuss traditional cultural governance mechanisms in what the Mozambican Constitution recognizes as "traditional" communities. Turbulent years of political violence in the 1980s displaced many communities from their places of origin to far distant locations. In many cases, those that we visited outside of the Maputo district, had been relocated just three years prior or were part of pending national land reforms still in process. I explored this policy context, and its implications, in greater detail in the next chapter.

Yet there was clearly a growing awareness of the need to work differently with IPLCs. A notable international participant of the Maputo study, the director of an international NGO based in Mozambique that works with so-called traditional communities, reflected on the potential of adult education to support the capacity of these peoples by the reaffirmation of the diversity of their knowledge systems, that in turn connect common local processes, principles, and dynamics. In her words, "It's a recognition of different knowledge systems that we can all respect, if we know about them and recognize and give them equal standing" (Milagre Nuvunga, MICAIA Foundation, Mozambique, Interview, July 2018). Obviously, this perspective complicates the expansive international ambitions of the International Potato Center, which must contend with

the distinctiveness and diversity among traditional and ecological knowledge systems in Africa, which correlates to the continent's diversity of hundreds of languages, dialects, as well as ethnic and cultural markers.

Despite the challenges inherent in building respectful and equitable partnerships, those most focused on the empowerment of IPLCs frequently acknowledge the importance of mutually informative collaborations that involve both science and IK/TK. For example, one key participant of my international fieldwork inquiry was Dr. Biju Kumar, Head of the Department of Aquatic Biology and Fisheries at the University of Kerala. Consulted on the importance of educating both Indigenous and social science (academic) communities, he emphasized the need to especially inform IPLCs about the differences between genetic improvement and genetic modification, in order to ensure informed interactions between Indigenous communities and science research institutions around more achievable and equitable management of genetic resources:

> "In third world countries like India and Peru, where we have lot of genetic resources, the government and the scientists, should give priority to improving the quality of [currently available] genetic resources, rather than going for genetic manipulation. These resources may play a very critical role on multiple levels. For example, in the era of climate change, some of them are climate smart, and some may be high in nutritional content. Each crop has their own value, as far as the ecosystem is concerned, and an existence value as well, ultimately." (B. Kumar, Interview, August 2017).

One of the participants in the "Global Indigeneity and Sustainability" seminar offered a clear example of productive and respectful collaboration. Alfonso del Rio, a Peruvian-American scientist from UW-Madison Department of Horticulture, described a 2018 collaboration between scientists and campesino farmers organized by the International Potato Center in Cuzco, Peru. Dr. del Rio referred that in this collaboration, the invited scientists, affiliated with the International Potato Center, the University of Wisconsin-Madison and other research

organizations, initially disagreed with some of the technical procedures that Andean farmers have otherwise been using successfully for millennia. The campesino farmers, accordingly, declined offers of assistance on such aspects, choosing to instead reaffirm their traditional knowledge and clear mastery of the agricultural practices in sustaining around 3,000 varieties of potatoes with multiple nutritional properties, all developed and sustained under different cultural and technical paradigms of highly diverse agriculture (del Rio et al., 2018; Gomez, et al., 2016; Palta et al., 2017).

The communities from the Andean highlands described in Dr. del Rio's research did encounter a critical *new* challenge, though—one for which their robust agroecological practices offered no immediate solution. Climate change had not only begun to extinguish potato species that had previously grown at the highest elevations, it was also bringing new pests and fungi to varieties grown in warmer areas, in the valleys. The Indigenous community of Colquepata, Paucartambo, Cuzco, expressed need for help with this new situation they had never confronted before. The use of western science in this aspect of the dialogue was part of a self-determined and collective agreement made between the community and those scientists that had demonstrated their prior understanding of and respect for Indigenous Peoples' intellectual rights under law and custom in Peru. Dr. del Rio's team introduced a solution to protect their crops against plagues and soil degradation, based on the application of sodium sulfate powder—an already commonly found adobe sealant material used in Andean traditional architecture. The community had no idea prior to their participation in this collaboration that such an affordable material could be used in this way. The results were successful beyond expectation and, with pests thereby eradicated without the use of pesticides, the community's agricultural production tripled.

In this case, three aspects grounded the consensual nature of the exchange of knowledge. First, it was presented in the terms that the Indigenous community needed, in order to be understood. Second, it demonstrated respect for their refusal to influence or change certain culture-based practices. Third, their need for educational interactions and integrations among the communities of practice, based on a mutuality of critical responsibility, was fulfilled.

**Returning Attention to Western Institutions of Research and Education**

This section expands the premises of existing literature about knowledge integration frameworks around IK/TK and WSK, in order to inquire further, in the field and from a transnational perspective, how tailoring education with the input of, and to meet the needs of, distinctive IPLC groups, challenges the limits of participatory processes that push boundaries of current disciplines, professions, or organizations. This becomes increasingly complicated by the institutional goals of these disciplines, professions, or organizations having been designed around, or heavily influenced by, principles of capital accumulation, private property and the rejection of communal property-ownership and the land-based autonomy of surviving colonized communities. Up to this point, I have used the idea of community-based education primarily to draw attention to projects rooted in and intended for IPLC audiences. Yet as my experience with the "Global Indigeneity and Sustainability" seminar suggests, there is a powerful need for education that addresses the shortcomings of western/non-indigenous research and education communities.

The seminar I designed and conducted specifically addressed also intellectual property law as one key to asserting Indigenous governance in access and benefit sharing of genetic resources, and in terms of how each impact the reaffirmation of associated land and economic rights for IPLCs. Although the notion of Indigenous biocultural governance is embedded in

cultural epistemologies common to IK/TKs, as well as critical to agroecology and biodiversity conservation strategies, it is rarely addressed in research and educational projects focused on these subjects. My main concern, in terms of my reflection about educational and methodological issues, was that the customary separation among fields of inquiry, as highlighted by existing literature and previous experiences around science curriculum design incorporating IK, contributes to biological scientists' lack of awareness about how their work may impact or is impacted by Indigenous rights of the type and scope outlined by UNDRIP. Therefore such rights are not even being considered, with regard to the kind of technological transformations that impose unilateral economic challenges on IPLCs.

Paul Robbins, dean of the UW-Madison Nelson Institute for Environmental Studies reflected on the challenges to implement decolonized frameworks at research universities founded on the preeminence of western colonial settlement as connected to science and economic development:

> I'm not sure everybody is equally well-trained in those areas to be effective. That's part of the problem, it seems like theory and method in this area ... If a student came to me and said, "Where can I arm myself with kind of knowledge, I'm not sure I'd have an easy answer for them… It's not that the theories and methodologies aren't out there, or they're being articulated, it's not that the instruments and the legal pieces, like the IRBs, don't exist. It's that I'm not sure we're, as educators, we're making… [decolonizing science research] a universal goal. I think everybody on this campus should be trained in at least some competency at this level, on this kind of thing, but that's a lot to ask." (P. Robbins, Interview, Madison, December 2017)

Yet the sort of theories and methodologies that Dr. Robbins mentions are, in fact, formally required by international treaties addressing the rights of Indigenous peoples. The shift by western educational systems to incorporate Indigenous Peoples rights to self-determination, as ratified by international law and policy, requires the engagement of interdisciplinary perspectives. This interdisciplinarity challenging the classical methodological and theoretical

fragmentation of Indigeneity as individual disconnected units of study into an interconnected global epistemic and material reality. This repositioning defines actions towards the assertion of Indigenous governance as part of the process of advancing forms of political self-determination. This policy context, and its influence on IPLC and higher education actors, is the focus of the next chapter.

## Chapter 4: Findings on Research Question 2

This chapter focuses on the following research question: How do the international legal and policy regimes that govern sustainable development define and constrain the exchange of agroecological practices and resources, and what ideas about IK/TK and WSK explicitly and implicitly guide these legal and policy regimes? What new systems and mechanisms are evolving and what additional changes are needed to enable fair and sustainable forms of exchange?

My approach to this research question is guided by the formulation of Indigenous Peoples' collective rights articulated in international treaty and policy documents, and the different applications and contexts in which they play a role. This notion of interrelated collective rights was ratified in the United Nations Declaration on the Rights of Indigenous Peoples in 2007 and was later applied to subsequent international binding agreements.

First, as in the previous chapter, I assert the relevance of *self-determination* to biological and environmental science research conducted by research universities, organizations, and corporations, as an important field of interaction that almost inevitably involves the strategic issues of intellectual property and bioethics, as well as in the capacity of Indigenous Peoples to implement or monitor prior and informed consent protocols for the access and benefit-sharing of the use of genetic resources (ABS) with associated IK/TK. Second, I am interested in the relevance of Indigenous Peoples and Local Communities' *governance* as the appropriate counterpart for consented interactions between research and development towards the SDGs. Third, I examine the intersections between food security and food sovereignty in light of IPLCs *territorial and land rights*, as well as their decision-making and research capacity in sustainable development. Fourth, the right of self-determination extends to education, and to the necessary

methodological integrations of diverse knowledge systems. One critical context in which this bundle of rights is being implemented is the emerging network of South-South connections that serve as a source of evolving models, systems, mechanisms and commons of fair and sustainable exchange among IPLCs, based in the mutual recognition of their cultural and political identities as members of diverse nations and societies in current processes of governance restoration.

As in the previous chapter, the restoration of IPLCs self-determination and biocultural land rights was a central theme guiding my inquiry into the international legal and policy regimes that govern sustainable development, and how those regimes support IPLCs' exchange of agroecological practices and genetic resources. Two additional themes from the previous chapter carried over into this analysis and are further developed here: the role of research universities in the deployment of productive methodological frameworks for knowledge integration with equitable outcomes, and the importance of the new policy framework of biocultural land rights for science research and sustainable development. This framework is being used by transnational indigenous networks to negotiate equitable relations between IK/TK and WSK with far-reaching consequences for international legal and policy regimes related to Indigenous peoples. It also has concrete implications for research, development, and educational practices at the local level.

However, in order to establish the significance of the implications of equitable relations between IK/TK and WSK it is of vital importance to reference the economic dimensions and impacts of the access and use of plant genetic resources with associated IK/TK, often presented as cases of breaching of cultural and ethical protocols in an equitable relation or partnership. I consider it vital to reference the latest research about Protecting Traditional Knowledge, Lessons

from Global Studies (Wright, 2020)[22] that presents evidence of the global economic benefits of medicinal plants with associated IK/TK:

> "While Indigenous and local communities do not view traditional knowledge solely as a commodity to be traded,[23] traditional knowledge is also of significant economic value. Approximately 80 per cent of the world's population relies on traditional medicine for their primary health care needs.[24] Furthermore, where plants are used in prescription medicines, it is estimated that approximately 75 per cent of those plants were originally used in traditional medicine.[25] Traditional medicine may, therefore, represent a significant resource for companies engaged in pharmaceutical or agricultural research and development and may be used to drive cost savings...[26] The value of the world market for medicinal products derived from leads associated with traditional knowledge is estimated at approximately USD 43 billion.[27] It is further estimated that benefits of approximately USD 5.4 billion would flow to Indigenous and local communities around the world if multinational corporations paid royalties for traditional knowledge used in food, agriculture and pharmaceuticals.[28]

Interview participants repeatedly described how evolving biocultural indicators[29] connected to Indigenous collective rights enable new mechanisms of fair and sustainable exchange that: (1) inform emerging protocols and frameworks for scientific research and development, and (2) place new demands on the crafting of policy to account for the coupling of environmental and Indigenous rights concerning land tenure, political participation, access and benefits sharing of cultural and genetic resources, sociocultural rights and epistemic identities

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[22] Wright, E. (2020). *Protecting Traditional Knowledge: Lessons from Global Case Studies*. Edward Elgar Publishing.
[23] Statement by the International Indigenous Forum on Biodiversity cited on Conference of the Parties to the Convention on Biological Diversity, *Report of the Seventh Meeting of the Conference of the Parties to the Convention on Biological Diversity*, UN Doc UNEP/CBD/COP/7/21 (13 April 2004) [585]-[588].
[24] Katrina Brown, 'Medicinal Plants, indigenous medicine and conservation of biodiversity in Ghana' in Timothy M. Swanson (ed), Intellectual Property Rights and Biodiversity Conservation: An Interdisciplinary Analysis of the Values of Medicinal Plants (Cambridge University Press, 19950 201.
[25] Jack Kloppenburg Jr, No Hunting! Biodiversity, Indigenous Rights and Poaching (1991) 15(3) Cultural Survival Quarterly 14.
[26] Shiva, V. (2016). *Biopiracy: The plunder of nature and knowledge*. North Atlantic Books. P. 11-16
[27] Posey, D. A., & Plenderleith, K. (2002). Commodification of the sacred through intellectual property rights. *Journal of Ethnopharmacology*, *83*(1–2), 3–12. https://doi.org/10.1016/S0378-8741(02)00189-7
[28] United Nations Development Program and Rural Advancement Foundation International, Conserving Indigenous Knowledge: Integrating two systems of innovation (Rural Advancement Foundation International, 1994) 17.
[29] Deroy, B. C., Darimont, C. T., & Service, C. N. (2019). Biocultural indicators to support locally led environmental management and monitoring. *Ecology and Society*, *24*(4). https://doi.org/10.5751/ES-11120-240421

and validity in constant process of negotiation.[30] Ongoing efforts to enact these biocultural dimensions into Indigenous rights illustrate the dynamic roles of particular policies in shaping and constraining the reference to biocultural relationships in global policy and science research frameworks as well as in sustainable development policy.

One additional important theme arose in my analysis that my data do not fully address: the emergence of South-to-South Indigenous international cooperation and commons as a concrete decolonization framework. This theme, which I take up in the discussion and conclusions, will be a critical focus for my future work around implementations of IPLCs community genetic resource management systems, and to the attention to the corresponding educational processes and interventions around them.

## Understanding the Complex and Layered Policy Regimes that Shape the Rights of Indigenous Peoples

My understanding of the political significance of Indigeneity and its real-world implications for IPLCs has been profoundly shaped by comparing existing literature around the theoretical foundations of Indigeneity, its concepts, and relationships to my personal experience of how it (as a popularly asserted and understood concept) has unfolded in Peru. The International Peasant Movement, or Via Campesina, originated in Indigenous movements mobilized around the displacement of farming communities. In Peru, the term campesino (an old Spanish term for peasants) provided a localized political grounding to the movement and was then carried forward in popular discourses and in the 1969 Agrarian Reform enacted by the

[30] Biocultural indicators are broadly contained in six emergent criteria that reflect core components of Indigenous environmental management (EM) that also mobilized WSK paradigms. These are: Cultural Saliency (social or cultural practices; Supportive of place-based relationships (around self-determination); Inclusive (connected to other species, services, values or relationships); Sensitive to Impacts (on ecological processes); Perceptible (through quantitative or qualitative approaches); and Linked to Human Well-being (food security, cultural identity, economic activity) (Deroy et al., 2019).

Military Government (coup d'état) under President Juan Velasco. Its explicit function was to end the aristocratic/feudal system of landholding that had been used to subjugate the country's Indigenous Peoples (those comprising distinct nations and communities) since that system's establishment by the Spanish Viceroy Francisco de Toledo in 1569. This imposed colonial tribute system had long served to suppress Indigenous governance structures and cultural identities. Ironically, however, the same system also embedded the recognition of Indigenous Peoples, as well as a (vestigial) form of Indigenous governance, in Peruvian law. This lingering acknowledgement of Indigenous communities had been preserved until 1851 as part of the Spanish colony and then, even after Peru's independence, was ratified by the constitution of 1920. In the 1970s and 1980s, however, following the Agrarian Reform of 1969, Andean Indigenous Peoples became rebranded as "campesinos," which thus prevented Indigeneity from re-emerging as a *political* identity in Peru—even as a new global awareness began to emerge about the human rights violations of Indigenous Peoples. Corresponding to this, intense pressure from Indigenous delegations to the United Nations began to change the ways in which Indigenous Peoples would henceforth be represented in international laws and treaties.

I was born before this process of national agrarian reform started, in 1963. I, along with my mother and older brother, had been brought from the Port of Callao by my father, a military engineer, to live at a military camp in the Amazon, in Chachapoyas, Peru. It was there where I witnessed firsthand the role of nation-state displacement of Indigenous Peoples, and the evolution of postcolonial extractive industry in Indigenous territories.

As an undergraduate at the University of Lima, I learned from first-hand research how the denomination "campesino" and the social movement associated with it had been a double-edged sword in international policy discourse, distorting the perspective from which Peruvian

Indigenous Peoples confronted large extractive and intensive economic interests. During the ‘80s and ‘90s, I witnessed this confrontation as a press correspondent and investigative report producer. On one hand, I could see how the (relatively) new denomination of “campesino” recognized the relative autonomy of Andean agricultural societies, creating a cooperative agrarian economic identity alternative to the one that was emerging in the UN around human rights and more importantly, land rights. On the other hand, I also saw how it removed their constitutionally recognized Indigenous governance systems. Twenty-seven years after my birth, I returned to Chachapoyas and saw the chaotic growth of urban settlements positioned to facilitate the extraction of large amounts of raw material, produce, timber, oil, gas, and plant genetic resources with hundreds of trucks leaving the area per day on their way to the coast and the shipping ports.

Thirty additional years after my return to Chachapoyas, I sat at UNPFII and COP14 as one of the few Peruvian observers and Indigenous representatives. My attendance at these UN meetings closed a significant personal circle, but it also revealed with harsh clarity the absence of Peruvian Indigenous delegations to UN policy forums—a critical weakness in the negotiation of binding agreements that the state ratifies in treaties. None of the representatives of the ancestral Andean nations were present. Only one Peruvian Amazonian Council of Indigenous Nations (Shipibo-Conibo-Xetebo) has sustained their presence thanks to the support of the Amazon Watch organization. The Peruvian delegation chairs for state representatives were always empty during my 4 years of participation as UNPFII. What I have observed instead is a trend toward NGO intermediation with and on behalf of campesino communities.

The proliferation of NGOs in many countries of the global third world has been pointed to as one of the causes of a delayed emergence of Indigenous self-governance and subsequent

displacement as stakeholders in regional and local negotiations related to rural development, agriculture and forestry.[31] In the context of India, Dr. Biju Kumar reflect on the positive and negative presence of NGOs in Indigenous communities,

> "The problem is that we have a large number of NGOs who have genuine interest, and those who are looking at the exploitation side also. So today, when the community members are strengthened, and the new leaders emerge from the communities, the genuine NGOs are good, in taking the momentum forward." (B. Kumar, Interview, Dehradun, North India, August 2018)

Yet the ancestral Andean nations and their governance systems have not vanished. Instead, the rebranding of these communities as campesinos (simple peasants with commercial identities as agrarian cooperative societies) instead of Indigenous Andean nations removes their rights as stakeholders in the governance of the vast and vastly diverse genetic resources that they preserve with no recognition. In 2019, I met Dr. Marcela Torres Wong, a noted Peruvian author and researcher, at the 37th annual International Congress of the Latin American Studies Association in Boston. Her work complemented my personal and experiential knowledge of the political significance of indigeneity for Andean peoples and provided new insight into through the implications of the term campesino and its role in dissociating the peoples so labeled from their Indigenous roots and rights. This disassociation is rarely recognized as problematic—an obstacle to campesino communities advocating for FPIC implementation, particularly on mining

[31] Indigenous communities were involved in some of the early voluntary certification programs in Bolivia; however, these communities had to rely on outside expertise and funding for management, because they lacked the educational capacity to train their members in forest management. While the professional foresters and NGOs hired by the indigenous communities agreed that sustainable forest management was the goal, understandings of sustainability differed between these managers and indigenous communities." Michael Dockry, 2012 Doctoral Dissertation, UW-Madison.

projects and extractive operations. Campesino-defined communities lack the legal weight and recognition necessary to both negotiate a binding agreement with the state and to appeal to internationally recognized rights frameworks subscribed to by Peru. This semantic disenfranchisement from international legal protections means that neither FPIC nor ABS mechanisms can be effectively implemented. Campesino-defined communities are often forced to participate in FPIC mechanisms that are initiated and managed by extractive corporations, rather than the communities themselves. Torres Wong's research shows that most cases of corporate-controlled FPIC processes result in the approval of extractive operations that contradict the historical stances of campesino communities as well as an increase in environmental policy violations and potentially irreversible environmental and social damages. In her own words,

> "I am skeptical of state and company-led prior consultations. As of today, it is naive to believe that through a procedure that can always be manipulated, we can overcome centuries of injustice, inequality and violence against indigenous populations. Participation needs to be preceded by aggressive redistribution of economic resources towards indigenous territories and these resources should not be conditioned to indigenous peoples having to give up their lands." (M. Torres Wong, Interview, November 2020).

I begin with this example because it has shaped my own perspective and because it encapsulates the complex politics of Indigeneity, and the ways in which local histories of colonialism interact with the emerging international policy discourse of Indigenous rights. In the sections that follow, examples from Colombia, Peru, India, Nepal, and Mozambique will repeatedly illustrate the complex interaction between local, regional, and national history/policy

on one hand and international policy regimes on the other. Although my primary focus is on the international legal and policy regimes, the meaning and practical impact of these international laws and policies on IPLCs is inevitably shaped by their unique historical and political context.

**Intensive Agriculture, Colonialism, and the Contextual Politics of Indigeneity**

Food security is an integral part of sustainable development—it is, for instance, the central component of the UN's second sustainable development goal. Yet the food security approach preferred by international and national sustainable development agencies strongly favors a form of intensive cultivation that perpetuates postcolonial land tenure relations by focusing on commercial cropping systems under an agrochemical regime. This section compares issues presented by the existing literature, about global developmental discourses around IK and in the biodiversity conservation framework, with concrete experiences in transnational contexts, starting with Southeast Africa and South Asia.

Dr. Milagre Nuvunga, director of the MICAIA Foundation in Maputo, Mozambique, works with traditional communities across Mozambique. She expresses the significance of food security in contexts that present consistencies with IPLCs across the global south,

> "We talk a lot about food security today and when we talk about food security in Mozambique for instance, we have gone through so many these stages where we have been unfortunate enough to, we have had too many wars, and a lot of migration and with that loss of traditional knowledge, but also we have had in Mozambique I think a number of centuries through which specific companies took over large chunks of land to produce very few commodities that were important for the international market. And so that was done in detriment to local food security systems that hadn't been developed for many, many, many years. (M. Nuvunga, Interview, Maputo, Mozambique, July, 2018)

Intensive cultivation and agrochemical practices are promoted at the expense of agroecological practices guided by IK/TK. They are typically accompanied by the displacement of IPLCs from their historical territory, and almost invariably disrupt IK/TK systems for environmental

management. All of this is especially true for the many Indigenous Peoples that are considered Local Communities with no recognized governance mechanisms and are therefore outside of the protection of ILO Convention Article 169. In this category there are campesino communities and organizations under cooperative structures, NGOs and civil as well as commercial entities. In the following paragraphs, I introduce the historical and political contexts of Indigeneity in three geographic regions where I collected data: South America (Peru and Colombia), Southeast Africa (Mozambique), and South Asia (India and Nepal). My reflection on international Indigeneity builds also from research experience among Indigenous Tribal communities in the state of Wisconsin, United States, discussed in the first research question.

My first reference is the context of the three-border Amazon region connecting Colombia, Brazil, and Peru—a region that is at the same time a protected area and a biodiversity hotspot. I learned from an interview source, Dr. Olga Lucia Chaparro, researcher from the National University of Colombia-Amazonas branch and from the city of Leticia, about the impact of shifting food systems on Amazonian Indigenous Peoples In this regional case, local and national governments subsidize food processing and importation as alleged poverty reduction measures. Yet these subsidies have accelerated combinations with extreme poverty, social violence, and governmental corruption, dramatically increasing public health issues among settlers in urban areas.[32] The misunderstanding of the roles of Indigenous Peoples on stewarding these lands is also adding more tensions in the region. In her own words,

[32] Colmenares, R., Palacio Castañeda, G. A., Alimonda, H., Puyana Mutis, A. M., Franky Calvo, C. E., Mahecha Rubio, D., ... & Vargas Gutiérrez, L. A. (2009). *Ecología política en la amazonia: las profusas y difusas redes de la gobernanza*. / Political ecology in the Amazon: the profuse and diffuse networks of governance. (Chapter 16 "Distribución, Acceso y Uso de las Tierras en el Departamento del Amazonas: Una Visión Desde la Experiencia Institucional - Olga Lucía Chaparro Africano). Universidad Nacional de Colombia sede Amazonia.

> "Some public policies and government programs such as conditional subsidies, are generating the migration of indigenous people and settlers to the cities, to access money through banks, which leads to major food transformations, leaving their lands and the production of food to consume what they can buy with the subsidy processed foods that lead to public health problems." (O. Chaparro, Interview, November 2020)

In this perspective, Chaparro seeks to articulate three approaches as scales of realization of the Right to Food and Indigenous governance: Food sovereignty (land tenure), territoriality and construction and defense; Autonomy, supported by local agri-food circuits; and Food security, about land management for local consumption.[33] Land distribution in Amazonas, the biggest department of Colombia, Indigenous Peoples are nominally the owners of more than 80% of the total extension of more than 9 million acres of Indigenous Reservations (Resguardos), without being the majority of the population and without any support of the Colombian state. In Amazonian Peru, the rampant loss of biodiversity corresponds with an exponential increase of environmental damages stemming from the appropriation of the region's genetic resources (fish, plants, foods, meat, oil, timber, etc.) by external corporations, vividly illustrating the connection between the erosion of biocultural indicators and severe deterioration of the social conditions for IPLCs as a whole. More state recognition to the roles and responsibilities of Indigenous and non-Indigenous communities to sustainability governance is critical.

In Mozambique, waves of disruption to Indigenous governance and agroecological practices paved the way for state-sponsored development projects that emphasize the intensive cultivation of biofuels. Throughout colonial history, people were moved from their original land

[33] Chaparro, O.L. 2010. Distribución, Acceso y uso de las tierras en el departamento del Amazonas. En: Ecología política de la Amazonia: las profusas y difusas redes de la gobernanza, de Germán Palacio Castañeda (Ed.). Bogotá: ILSA, Ecofondo, Universidad Nacional de Colombia, Sede Amazonia, 541 pp.

to other places to work on national projects such as road building or to big plantations for agricultural labor. Gradually, these ethnic groups lost connection with the communities they came from and lost critical IK/TK systems that were key for natural resource management on other contexts. Following the end of the colonial period, in the period from 1975-1990, the socialist state attempted to suppress the land-based Indigenous identity and tribal organization of the country's peoples. State actors associated Indigenous identity and governance with "tribalism," which they interpreted as an obstacle to both social progress and the modern concept of citizenship. In an interview with Dr. Milagre Nuvunga, she recalled that there was a strong movement to unite Mozambicans after independence, to do away with this tribal identity and, in doing so, to create a national identity. And so many Mozambican families and individuals of today were either brought into Maputo or assigned to other provinces across Mozambique: "As they learned to call those places homes and learned to call those communities their own communities. That was the dream of the independence, the dream of a united Mozambique trying to reduce all connections with tribes that could probably in time create conflicts, create division" (MN, Interview, Maputo, Mozambique, July 2018).

Tribal communities were relocated across the country, even though many of them continued their tribal structures and community governance systems, and therefore retained an internal denomination of "traditional" communities or communities with a traditional governance council (Obarrio, 2014). Many, however, adopted the new village and town structures imposed by the state. In this context, Dr. Nuvunga referred to Indigenous governance in Mozambique in very general terms as "a system and platform for peoples with rights and knowledge." To this day, the Mozambican government does not recognize Indigenous Peoples and their corresponding territories as otherwise identified in international law—only as so-called "Local"

or “Native Traditional Communities” whose governance systems do not count as valid counterpart to the ABS obligations from the Mozambican government. Therefore, the fulfillment of international law, in terms of country obligations, is still both an uncharted territory as well as an active concern for Mozambican authorities.

During a group discussion where I was invited to participate at a meeting with different experts at the Ministry of Agriculture facilitated by Dr. Maria Andrade, director of the International Potato Center-Mozambique, and Dr. Nuvunga, the group discussed the implications for upholding the position of international treaties contained in the CBD Nagoya Protocol to protect the country traditional or customary knowledge systems, medicinal plant resources and treatments. Dr. Andrade pointed out that many local communities who had been displaced from their ancestral homelands were still in the process of being relocated to new government designated settlements, a process which, in many cases, started only three years prior to my visit in July 2018. Following decades, the long history of disruption to their IK/TK-guided agroecological systems, these communities are attempting to re-learn how to plant, maintain crops and diversity, and use plant derivatives incorporated into their nutrition and health. They are also under great pressure from the government of Mozambique, which prioritize the intensive cultivation of biofuel crops—a staple of some sustainable development frameworks. The long-term consequences of this emphasis on intensive cultivation for food security are difficult to overstate. In Dr. Nuvunga’s words,

> [W]hat it means today is that those crops that we got used to, and they're being produced in industrial scales like maze and others, they are today very vulnerable to changes in climate and other processes, other climatic processes… When we talk for instance to local communities, we know that they have knowledge of many plants within the ecosystem they could rely on to survive, but they don't share that knowledge anymore. They're even ashamed of sharing that knowledge because they think because of the stigma that has been created because you have to eat rice, you have to eat maze, you have to eat this or that. (M. Nuvunga, Interview, Maputo, Mozambique July 2018).

The political history and contexts of Indigeneity in India are more complex, and my research only brought me into contact with a few specific instances. While interviewing Dr. Vandana Shiva, world known Indigenous leader and founder of the Navdanya Trust, I learned about India's enactment of a self-governance law for the Adivasi Peoples in the 1990s. This law was intended to give Adivasi Peoples the highest authority over their land, forests, resources, and development approaches, and was drafted in a manner such that it is not to be overruled, even by the nation's president and prime minister. In subsequent years, however, paramilitary forces acting on behalf of corporate interests have violated these laws, crushing Adivasi's constitutional rights to self-determination and instead actively attempted to reverse the political gains that Adivasi and Scheduled Tribes had reached.

Despite the limited practical protection that the self-governance laws provided the Adivasi Peoples in their national context, their clear legal designation still offered them a platform for challenging the extractive exploitation of traditional crops and associated IK/TK practices. Dr. Shiva was a leader in the mobilization of IPLCs along the Uttarakhand Valley when a Texas company's attempt to patent a type of Basmati Rice triggered anti-globalization protests in the 1990's.[33] The native variety of Basmati Rice that grows in the Uttarakhand Valley along with another 750 rice varieties, is part of the local communities' cultural and historical heritage. This significance was also associated with tragic events in the region in opposition to the extractive use on this crop with associated IK/TK. In the words of Dr. Shiva:

> Because of the super extraction of trends from land, today the rents being extracted from seed and knowledge, which is why more than 300,000 Indian farmers have committed suicide. Because a corrupt criminal company called Monsanto took a patent in America.

[33] India-U.S. Fight on Basmati Rice Is Mostly Settled. By Saritha Rai. Aug. 25, 2001. Section C, Page 1. New York Times. Aug. 25, 2001, Section C, Page 1 of the National edition with the headline: India-U.S. Fight on Basmati Rice Is Mostly Settled.

> Even though in our laws, we do not allow patents of seed. Because I worked with our government and our parliament to ensure that our indigenous ethics of us being part of the earth family recognizes that we do not invent a plant. We do not invent an animal. They are relationships. They're our relations. You don't invent your relationships. You live with respect in your relationships. You have reverence, you have protection. You don't say, "My invention." A mother doesn't say to a baby, "My invention." An IVF doctor might say that, but never a mother. Because you have an understanding, deep understanding of the creation, the forces of creation, the continuity of creation. (V. Shiva, Interview, Dehradun, India, August 2018)

Dr. Paul Robbins, Dean of the UW-Madison Nelson Institute for Environmental Studies, also connects this movement for the rights of Adivasi Peoples in India to the UN Declaration of the Rights of Indigenous Peoples,

> The Indigenous communities in India are Adivasi, there are some scheduled tribes and scheduled casts there that have special kinds of historically specific knowledge herding by diversity… The rights of Adivasi in India are superseded constantly by state, mining interest, whatever else. Being able to call upon this as part of your strategy for resisting occupation is really useful, but it can't stand on its own, so there are limits to it as well, I guess. I think it's also really important …because it dovetails with the convention on biodiversity in a complicated way, in terms of honoring. (P. Robbins, Interview, December 2018)

In 2015, tribal Adivasi governments built on this mobilization by joining in solidarity with Indigenous nations in the United States against the patenting of a distinct variety of Manoomin (Wild Rice) cultivated in the Great Lakes region. This example foreshadows the establishment of transnational networks for Indigenous political action, which I will discuss in greater detail below.

**Extractive Use of IK/TK in a Broader Context**

The case of Basmati rice is also emblematic of a broader pattern of extractive use that characterizes the historical and contemporary relationship of scientific research to IK/TK. This extractive relationship was previously addressed from the discussed literature, about the regulation of

IK/TK within the biodiversity conservation framework. Across her various publications, Dr. Vandana Shiva has described how predatory capitalism appropriates entire Indigenous forms of agricultural production around the world, imposing patents to traditional seeds, forcing concessions and displacement of large Indigenous populations, and then benefiting from the trends of agribusiness stocks from these appropriated lands based on the economic projected and assumed development of agricultural production set to take place in the future, and with secured long-term effects thereafter. In critical geography this process has been analyzed as part of land-grabbing strategies in support of agrobusiness.[34]

In Vandana Shiva's account, this refers to India's agricultural transformation that turned India from one of the most prosperous countries, "which used to be 25% of the world economy, into an impoverished, starving country were 2 million people died in the great Bengal famine." This important reference about the illegitimate appropriation and commodification of Indigenous lands and genetic resources is a critical evidence of conflicts with the existing legal and policy regimes that also govern scientific research continue to treat IK/TK as a resource to be extracted and integrated into agroecological practices without the participation of Indigenous governance systems and IK/TK practitioners, and in direct contradiction of international laws related to the Indigenous rights.

Control over these seeds, and the agroecological practices connected with their cultivation, is deeply connected to both food security and food sovereignty—matters of survival for Indigenous Peoples. Prof. Biju Kumar, the organizing Secretary of the International Biodiversity Congress and head of Aquatic and Biology research department at Kerala University, argues that cultural practices outside of the agroecological realm are often given prominence in public and political debates,

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[34] Hendlin, Y. H. (2019). Environmental justice as a (potentially) hegemonic concept: a historical look at competing interests between the MST and indigenous people in Brazil. *Local Environment*, *24*(2), 113-128.

> "But the genetic resources have more commercial potential, but it is not realized by the communities as well as by the government, in some cases. So genetic resources may be the future of the globe. Especially when you think in terms of food security and nutrition security. Because unless and until you conserve the genetic resources locally, the local food security, which is addressed in the CBD and international platforms, including UN Sustainable Development Goals, cannot be achieved." (B. Kumar, Interview, August 2018).

Despite their global importance, it is the *commercial* value of traditional seeds and agroecological practices rooted in TK/IK that has dominated and distorted their use by non-Indigenous entities. As B. Kumar describes the situation,

> "…we see the entire perspective of the CBD agreement in terms of commercial angle only. And if you look at commercial angle only, then always the priority will go to the genetic sources with commercial value. But at the same time, if you are really interested in a long-term sustainability of agriculture and then the genetic resources, particularly the seed resources, available locally, they play very, very critical role. Especially in maintaining the food security at the *local* level." (B. Kumar, Interview, August 2017, my emphasis)

Some of the most important aspects of the associated IK/TK, regarding genetic resources encountered from direct references in the field research, regard the importance of CWR in traditional corn growing and breeding among Oneida and Haudenosaunee tribes, which I have previously documented in two educational documentaries; one about the Tsyunhekhwa Organic Farm at the Oneida Reservation in Northeast Wisconsin, and the other focused on the Oneida Corn Growers Association and the "Braiding the Sacred" Network coalition, both of which

involved  Haudenosaunee affiliated tribes and intertribal members from all over the country. Particularly, during my work at the POSOH Project, I documented the practice of the Oneida Nation, around Three Sisters Gardens, to grow traditional pole beans and squash alongside corn. Later, during a process of interviewing Haudenosaunee farmers, I learned that the premise of the Three Sisters Garden had then been extended to incorporate a wider range of plant communities with many relatives, through a vision of restoring Indigenous epistemologies in different roles and functions, both above and underground, in which the restoration of CWR connected interrelated functions between the plants and the multiplicity of living organisms around them.

About the importance of the CWRs, I learned a new dimension to this via my former experience in Peru, from Prof. Eve Emshwiller, on oca and other Andean tuber crops with high nutritional properties, and their multidimensional significance beyond their mere commercial value, as members of plant communities centered around the potato as a natural fertilizer, nitrogen fixing source, and repository of immense cultural value. CWRs are also representative of the longterm investment in IK/TK systems, during the experimentation and domestication of strategic crops that have historically been commodified as world food staples by corporative colonization, leaving plant relatives such as oca in a  devalued, non-commercial, crop limbo. This threatens its continuation as a key food plant for the Indigenous farming communities as well as for the ecosystems it is part of.

Other examples of the referencing of CWR along with food crops were observed in in the Cauca region of Colombia, in July of 2019, where the Mizak people are choosing to resist the assertion of the ancestral practice of the diversification of plant communities, now under constant threat of agricultural intensification, soil contamination, and pressure from agrochemical corporations and local governments. I found an associated reference to plant communities, as

opposed to intensive monocrop agriculture, in Mozambique, which considers the incorporation of amaranth and cassava along or proximal to OFSP crops.

The current emergence of global interest in the commercial plant varieties that can be extracted from their local context and used in intensive cultivation regimes contributes to the oppressive post-colonial circumstances described in the previous section. Scientific institutions have often abetted and even accelerated this process, particularly through "genetic manipulation exercises, which is going on as part of GMO and other activities across the world" (B. Kumar, Interview, August 2017) and through the international system of intellectual property, which I discuss below.

**The Mobilization of IK/TK both within and against Intellectual Property Regimes**

The exchange of agroecological practices and resources, including the application of IK/TK in conservation and restoration contexts, requires rigorous implementation and possible enforcement of governance protocols in terms of engagement in biodiversity conservation strategies that emphasize the respect of Indigenous Peoples sovereignty, autonomy, and self-determination applicable to their legislative context in that relationship. I address different examples in the mobilization around IK/TK in Nepal and Mozambique that are consistent with international binding agreements related to rights involved in the use of IK/TK

During my visit to Nepal, I interviewed Dr. Dev Kumar, Professor of Indigenous Peoples Customary and Constitutional Law, and also International Indigenous Law, at the University of Nepal in Kathmandu. Recognizing IPLCs as "the knowledge holders," in D. Kumar's words, requires validating the knowledge they possess. However, despite these challenges, as Dr. Kumar pointed out while visiting an ancestral seed repository in an old Buddhist temple in the city of

Bhaktapur, traditional resources and knowledge continue being preserved even in very precarious conditions:

> "Today, we talk about globalizations and modernizations, or more the means of technology has displaced their [local] knowledges. Still, in Nepal and in in many Indigenous Peoples, they still practice the traditional Indigenous [seed] storing system itself. (Prof. D. Kumar, Kathmandu, Nepal, September 2018).

Crucially important to this process of legal and economic resistance from IPLCs in different fronts, is the knowledge of the seeds and their cultivation, as well as the seeds themselves, that are preserved by Indigenous communities. In D. Kumar's words,

> "When we talk about the genetic resources, as I said at the beginning, Indigenous Peoples are the knowledge holders. They are the guardians of that knowledge. Even UN itself has recognized, very much, that indigenous peoples are the holders, or local people are the holders of [those] resources, technologies, or genetic resources. One of the rights that they have given to the local communities or local indigenous peoples [is] to be consulted. To be consulted whenever their knowledge is extracted. But today, what has happened is, multinational companies, they have gone to the local areas and they have extracted their knowledges without their consent. And that has become a conflict, as such. Indigenous peoples who hold the knowledge, their knowledge had been taken away." (D. Kumar, Interview, Kathmandu, Nepal, September 2018)

I argue that the recognition of "knowledge holders" needs a clarification of different terms associated with it in Indigenous contexts. The most common, as noted earlier in the existing literature presented in this dissertation, are: TEK, IEK, IKS, TK. These are not all equivalent or exchangeable among one another, either in their conceptual nuances or in their legal and policy interpretations. Some have been operationalized in the context of particular research or policy processes with no concurrent interest in or acknowledgement of Indigenous governance rights. For example, large international agricultural projects from the International Potato Center in 15 countries in Latin America, Asia and Africa, and the Consultative Group on

International Agricultural Research (CGIAR) consortium of research centers that work with plant genetic resources extracted from Indigenous communities.[35] Others were embedded in policy documents based on the commitments and preferences of particular communities, as in the case of issues of incorporating IK/TK in environmental impact assessment in several Indigenous communities in Canada,[36] in which TEK was used as a particular framework for this purpose, as part of a larger framework of IK. An example of this confusion is addressed in an Executive Summary about Canadian Federal and Provincial environmental impact assessments. It is important to see in this example, how TEK and IK were used in this report to denote TEK as part of IK and relevant to a specific purpose,

> "Despite the general policy requirement for the consideration of TEK in the federal environmental assessment process and the provisions for Indigenous knowledge in provincial, territory and land claim assessments, there exists an overall lack of clarity, consistency and an absence of guidance about what TEK consists of and how it should be implemented."

The context-specific uses of these different terms mean that none can be easily eliminated, and all must be used with caution. One fairly broad generalization can be made, however. According to multiple interviews and dialogues with Indigenous and non-Indigenous

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[35] "As of the date of agreement of this Framework, the following 15 research organizations are recognized as CGIAR Research Centers: Africa Rice, Bioversity International, Center for International Forestry Research (CIFOR), International Center for Agricultural Research in the Dry Areas (ICARDA), International Center for Tropical Agriculture (CIAT), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), International Food Policy Research Institute (IFPRI), International Institute Tropical Agriculture (IITA), International Livestock Research Institute (ILRI), International Maize and Wheat Improvement Center (CIMMYT), International Potato Center (CIP), International Rice Research Institute (IRRI), International Water Management Institute (IWMI), World Agroforestry Centre (ICRAF) and WorldFish. – Framework approved by the CGIAR System's Funders and Centers on 17 June 2016 and was last amended on 18 July 2019 to reflect a decision of the System Council (SC/M8/DP8) to approve up to five temporary additional Funder voting seats on the System Council (Article 3.1; Annex B).

[36] "The guidelines once more did not require IK in the process and the timeframe was even shorter than that proposed in the BHP assessment preventing the proper collection and consideration of Indigenous knowledge (CARC, 1998). The guidelines also neglected the long-term commitments by the proponent in relation to TK collection, documentation and use in project design, modification, management and monitoring." - Gibson, B. (2003). Traditional ecological knowledge and environmental impact assessment. University of Waterloo. Environment Resource Studies Home. http://uwaterloo. ca/environment-resource-studies/sites/ca. environment-resourcestudies/files/uploads/files/Burnaby_TEK% 26Asmt. pdf (Page consultée le 4 février 2014).

experts in global forums, the term “Traditional Knowledge” used in policymaking and developmental projects since the 80’s and 90’s was used to deliberately present Indigenous Peoples as retrogrades opposed to modernity. Vandana Shiva, a scientist with a background on mathematics and science philosophy from the University of Ontario with extensive international experience on Indigenous issues, discusses these views from a reverse perspective, on how IK/TK practitioners see WSK limitations:

> “So, we have a short 200 years of a reductionist, mechanistic, scientific paradigm, which took it on itself to say, "This is science, and the rest is not." Which was wrong…And in fact, reductionist knowledge is not a system, because it doesn't hang together. It is fragments…The disconnectedness of mechanistic knowledge and reductionist science, which is what the colonizers knowledge was, which is a fossil fuel knowledge, [is the problem] because as the rise of the fossil fuels took place, mechanistic science grew. (V. Shiva, Dehradun, India, August 2018)

These deliberate attempts to dismiss IK/TK as legitimate bodies of knowledge made it easier to deny Indigenous Peoples legitimate governance authority in regulation and law enforcement concerning matters such as intellectual property and biopiracy with major economic implications as addressed in the opening of this chapter. In the view of the experts and leaders I spoke with, the idea of “Traditional Knowledge” was part of the developmental framework that, as its priority, affirms the rights of nation-states over all genetic resources, including with associated TK, within their national jurisdictions. The term Indigenous Knowledge (IK), in contrast, offers since its inception the precise legal framework needed to reaffirm Indigenous Peoples self-determination and sovereignty under international law—which, in turn, can be used to press for constitutional reaffirmations by national legislation, especially as applied to rights over genetic resources, for example.

However, there are also positive movements in the direction of supporting the reestablishing customary governance in Mozambique based first on the recognition of IKS,

recognized as “traditional” in the absence of a national policy towards the recognition of Indigeneity. This dynamic movement towards equitable frameworks is brought by Dr. Nuvunga as part of the articulation of national and customary political, economic and cultural identities,

> But we're still Mozambicans. We're still local. We could all be called indigenous of Mozambique, but in those places, …particularly in rural areas, you can still find the core of traditional knowledge that we can work with and that we can build from to be able to sustain processes, and knowledge, and practices that once worked well for those communities. What we're doing today is to see how those processes can be supported by science. I think it's interesting that we are having this conversation here at a research center because we do work in partnership with CIP [International Potato Center] in recognition of the knowledge that exists here and how this can support all the processes that we're working on with rural communities. (M. Nuvunga, Maputo, Mozambique, July 2018)

My research in Mozambique offered interesting examples of the practical challenges associated with asserting and mobilizing Indigenous Knowledge, both at the local scale and beyond. Dr. Milagre Nuvunga has worked both within and outside of the Mozambican government to develop and document IK/TK practices related to genetic resource management. In her own words, Dr. Nuvunga’s work emphasizes forms of documentation “that give [IPLCs] recognition as the holders of that knowledge” and use that recognition to “help these communities to grow, and just point out to these avenues, be them legal or financial or others” (M. Nuvunga, Interview, July 2018). Her projects use a characteristic co-learning process in which her foundation brings additional knowledge about national and international contexts and relates them to the government assertions from international treaties that can help to defend these communities’ rights, as knowledge holders. The co-learning model promotes equitable relations with central and local governments at policy level, including other holders around legal and financial resources for traditional communities with customary governance. This could be referred as a productive NGO practice to promote community governance.

Recognition of these important national and international contexts is a starting point for communities who retained their customary structure to be able to invest in themselves, navigate relations with governments at policy level, and interact with stakeholders and knowledge holders on legal and financial resources. This model of cooperation also presents the possibility for more equitable relations, as its end purpose points out how a community's resources govern their decision-making in this relationship. During my visit to Mozambique, Dr. Nuvunga illustrated how this co-learning process work in the practice while guiding me through an understanding of policies and norms that are creating opportunity at the ground level:

> There are a number [of policy frameworks] like the ABS, or Intellectual Property Rights, and others, that apply. For instance, we are working with baobab. We produce baobab powder. As long as this is just a powder which is a food that everybody eats, that's fine. As long as the terms of trade are right, then that's okay. We try to guarantee that by making sure that the producers in a particular value chain know as much as possible. We bring that knowledge to the producers so that they know that what they're doing here is contributing to all these processes. They can decide if this is where they want to be, or they want to work towards placing themselves in different places in that value chain. That can only come with the knowledge of what that value chain is nationally and internationally. (M. Nuvunga, Interview, July 2018)

While Dr. Nuvunga and colleagues work to build capacity among IPLCs to navigate national and international policy regimes, other scientist and academic activists are pressing to reform a critical piece of those regimes: intellectual property systems. Members of the India-based Navdanya Network focus on finding ways to shift Intellectual Property systems to accommodate and include Indigenous knowledge, biocultural indicators, and customary laws, along with many other legal protections and provisions. They also seek to advance an Indigenous commons system as a new platform for economic exchange, developed under self-determined economic-related laws among Indigenous Peoples, out of market competition and under rules other than those typically geared toward western and corporate economic growth. Dr.

Vandana Shiva, who leads many of these efforts, reminds us how connected the shift in Indigenous economic development is to the protection of their genetic resources. In her interpretation, "…biodiversity and knowledge have become the big capital, and intellectual property has become the big property… [But] not in one battle have the corporations won against people and knowledge" (V. Shiva, Interview, Dehradun, India, August 2018). Such battles are increasingly internationalized, as illustrated by the transnational cooperation between Adivasi growers of Basmati rice and Ojibwe cultivators of Manoomin wild rice in the U.S. Great Lakes region.

**Indigenous Networks, Governance, and Resistance**

This section expands upon the existing literature about knowledge integration frameworks around IK/TK and WSK, to highlight shifts in the consideration of governance as a central mechanism of participation. My research in India provided compelling illustrations of the coalition-based resistance of IPLCs to intensive cultivation, agrochemical practices, and global intellectual property regimes. During our 2019 interview, Dr. Shiva referred to this resistance as "the Global Seed Satyagraha." This frame neatly captures the colonial roots of the struggle, as well as the power imbalances inherent in IPLC's resistance to legal frameworks that are designed to disempower them. Satyagraha means for the force of truth, but it also describes the force of civil disobedience via direct action. It is deeply connected to the Indian national struggles for independence. When Ghandi returned from South Africa in 1917, he called for the "Indigo Satyagraha." In the "Salt Satyagraha," 45,000 Indians were shot dead for the simple act of producing salt outside of the British control of salt production, as enshrined by its 'Salt Law' of 1930. As Dr. Shiva walked with me around their thriving community seed bank at the Bija Vydiapeeth campus, she tied the contemporary struggle of Indigenous Peoples around the world

against the imposition of genetically modified seeds on their lands, and the agrochemical regime of intensive cultivation, to these and other historic campaigns launched against land grabbing and the oppressive agricultural policies of the British.

In these contexts, community seedbanks face an enormous loss of original, ancestral organic seeds in favor of national and private ex-situ germplasm repositories. Dr. B. Kumar explained that there was a coalition assembled to study these issues, which included "non-governmental organizations, community seed banks, and specialized governmental research organizations such as the National Plant Genetic Resources Institute and ICAR, Indian Council of Agriculture Research" (B. Kumar, Interview, Dehradun, India, August 2018). I visited the world highest national seed bank in a cryptopreservation facility in Indian Himalayas with the Navdanya project in a fieldtrip to Pangong Tso Lake, the highest in the world, during a travel to the city of Ladakh in August 2018. However, Dr. B. Kumar also pointed out that although Indian state governments and universities maintain cryopreservation facilities, key researchers in the field recognized the need to go beyond "cryopreservation facilities that focus on the static preservation of seeds, to also emphasize seed-based conservation systems that preserve not only a greater diversity thereof, but also the key and relevant IK/TK for future generations." (B. Kumar, Interview, Dehradun, India, August 2018).

This statement was extremely relevant in my field research in Kerala in March of 2019 as visiting scholar of the MS Swaminathan Biodiversity Research Center, during the National Seed Fest and Workshop in Wayanad that showcased community seed keepers from Adivasi communities. During my one-week visit, I also visited Mr. Cheruyaval Raman, formally recognized as India's National Rice Seed Protector in Wayanad, as well as local Adivasi and Scheduled Tribe communities in Wayanad region to see more examples of community

interpretations to ex-situ and in-situ germplasm conservation within Adivasi communities alternative national central seed banks.

These new local forms of conservation represent a major historical shift that needs to be understood and supported. B. Kumar explains its significance,

> If you see the onslaught of the globalization process and the Green Revolution which took place in India, which took away the diversity of seeds and the concentration came to fewer variety of seeds, and then these people and the seeds were forgotten. And then the real value of the seed was forgotten. And at the same time, now when we think about the climate change and the varying scenarios, environmental impacts, now we realize that these seeds are very important, particularly in a highly diverse ecosystem and highly diverse country like India, where the seeds which evolved in the local area, they play a very critical role in maintaining, not only food security but, also the nutritional security of the Indigenous communities. And that is the reason why now there is a revitalization, regarding the thinking about the seeds and conservation of seeds, with the community participation. (B. Kumar, Interview, August 2017).

As a vivid test of this theory, the MS Swaminathan Biodiversity Research Center in Wayanad has been working with a pool of researchers and students to restore a high biodiversity agro-ecosystem in the wake of the 2017 cyclone in Kerala—a natural disaster that devastated intensive agriculture operations and threatened the food and nutritional security of Adivasi Peoples in valleys and forestlands. This process, highlighted by local farmers at the National Seed Fest and Workshop, involves both opposing the restoration of intensive and commercially oriented agriculture that previously dominated the region, and wrestling for the control of seeds associated with IK/TK practices related to health, nutrition, and ecosystem management.

In Northern India, coalition-building also characterizes the work of the Navdanya Network in their field education programs at the Biodiversity Conservation Farm in Dehradun. The campus, called Bija Vidyapeeth, was created to oppose intensive cultivation and land grabbing but also to promote gender equality and community building, to restore biodiversity among Adivasi and local communities. Drona Chetri, the coordinator of courses at Navdanya,

explained that networks of Indigenous women are a prominent force for change and participation in that region.

Attending the National Seed Fest and Seminar in South India allowed me also to observe firsthand how dialogues run by IPLCs contributed to the crafting of a shared vision at a regional scale among Indigenous and Local farmers and organizations. In addition, attending an educational program at Navdanya in Norther India, allowed me to observe exemplary programs through which local groups and Indigenous communities can secure institutional affiliations, allowing them to create and manage small community seed banks at shared low cost, and also with regard to variable to non-use of technology or modern infrastructure, open to alternative energy sources. Navdanya also offers two certification bodies through which to provide alternative germplasm organic certification. The network first develops relationships with farmers from different parts of India and around the world, promoting a productive collaboration framework model that integrates IK/TK and WSK bodies with a clear positionality about the restoration of local governance among Adivasi, Scheduled Tribes and Scheduled Cast which are the formal classification of Indigeneity in India. These cases present a roadmap for other Indigenous and Local Communities in South Asia and Africa, as well as informing other contexts of Indigeneity in the Americas in the affirmation of their biodiversity governance and self-determination.

**The Multi-Faceted Role of Universities in Knowledge Exchange**

A careful read of the preceding sections shows that many universities and university-based researchers around the world are deeply involved in many efforts to promote the sovereignty and food security of IPLCs and support the development of IK/TK-based agroecological alternatives to intensive cultivation and agrochemical practices. Research

universities are well-positioned to support governance and policy exchange partnerships between themselves and Indigenous governance systems. Yet research universities are also deeply connected to the system of intensive cultivation, and often replicate colonial and post-colonial patterns of oppression in their relationships with IPLCs, not least by approaching IK/TK with the same extractive attitude that characterizes international development and commercial agriculture.

Paul Robbins, dean of the UW-Madison Nelson Institute of Environmental Studies, cites previous cases in which technical and instrumental approaches damaged possible fair integrations between IK/TK and WSK in health projects in South Africa. In his own words,

> Well, it can't get any worse. I mean, in South Africa when they try to integrate indigenous health knowledge it's in the most grossly instrumental way that does not challenge the paradigm at all. They just bring in one of these community health peoples, whatever you call them, and they use that person just to drive and direct community traffic into the hospital, so that they can do the real health work. This was at the height at the HIV crisis, so it was very cynical, very instrumental. (P. Robbins, Interview, Wisconsin, December 2017).

To play a constructive role in the reinvigoration of Indigenous knowledge systems and support equitable knowledge exchange between IK/TK and WSK, research universities must clarify their positionality and affirm it as being in support of frameworks that recognize the governance role of IPLCs, as a key aspect of their capacity to contribute to global sustainable development. These partnerships can then include the creation and curation of programmatic spaces, institutional relationships, and the collaborative development of research projects and practices that result from the implementation of FPIC processes that integrate equitable principles and methodologies.

In 2018, I interviewed Prof. Tim Frandy, current faculty at Western Kentucky University and former faculty at Northland College in Ashland, WI about the observed and potential value

of academic exchange around IK/TK. Frandy thought that such exchanges could be transformative, but pointed to the need for partnerships that respond to each local circumstance:

> That exchange is really valuable. It helps us work across cultural lines… I don't think that there's like one specific pan-indigenous model that we can use for all of our work, but I think we can use the work to draw ... It's not like replicable model plug and play stuff, but we can use that work to draw inspiration from and to learn how to adapt it to our own communities. Linda Tuhiwai Smith's Maori models are not going to work for my own Sámi American community, but I can use that to understand how I could create a model for my own cultural context. (T. Frandy, Interview, Wisconsin, December 2018).

As Professor Frandy's experience reminds us, models of knowledge exchange that are developed in one context are not neatly transferrable to another, but they are relevant *as models*. Ian Baird, a Professor of Geography at the University of Wisconsin-Madison and expert on Southeast Asia, identifies some of the principles underlying equitable models of knowledge exchange across contexts. According to Baird, knowledge exchange projects that attempt to bring IK/TK together with WSK must emphasize

> Research by indigenous peoples themselves or in collaboration with other researchers who are supporting them. But giving them a key role in kind of determining the course of the research and making sure that they are controlling the data. They are controlling the results and they have a clear understanding about what they are doing. And they have also clear communication with their communities about what they're doing, and everybody is in agreement and has access to that information and is controlling that information. (I. Baird, Interview. Madison WI, January 2018)

These principles are shared with the FPIC framework that set the terms of engagement and interaction on issues or operations that may affect IPLCs cultural, political and economic rights. Even though this framework has been primarily applied to preventing the negative impact of extractive operations  in Indigenous territories and protected areas (oil, gas, mining, fishing, plant genetic resources, etc.), I argue that the interaction of IPLCs and research universities and schools also require the implementation of formal FPIC mechanisms underlined by international policy (ILO Art. 169; CBD), UNDRIP), as research universities have a role on perpetuating

negative instrumental and technical scientific approaches in many countries that in many cases go against the rights of IPLCs at different levels.

It would be a mistake to think about the role of universities entirely in terms of what is instrumental in their research. As it builds from the existing literature and practice about science curriculum design incorporating IKS, it argues that universities have many other potential roles to play in the pursuit of equitable knowledge exchange. For example, they may act as strategic partners in the implementation of UNDRIP, helping to advance the principles and practices of that convention through their impact on policies that impact the lives of IPLCs within international standards of sustainability. Dr. Paul Robbins, Dean of the University of Wisconsin-Madison Nelson Institute for Environmental Studies, offered one example of how this might play out through existing U.S. policy exchanges with American Indian Nations and Tribes, where tribal organizations could work in partnership with research universities to assert their legal rights:

> [By applying the] Clean Water Act in sovereign tribal nations with land, [they] actually could be treated as states under the Clean Water Act, but very few tribes know how to do that. The best way to get that out is through larger scale tribal organization, and that's got to be true at the global level. There is certain kind of 'how-tos' in terms of law, in terms of, again, the sharing of certain kinds of technical knowledge. That's obviously where a lot of momentum has been gained in the last 10 or 15 years. People are much better organized, communities, they're not as isolated. I definitely think that is true. (P. Robbins, Interview, December 2017).

There is also much that Universities can do through their educational programs to also benefit Indigenous Peoples and include them as stakeholders in science education and science research. One such role is the education and capacity-building of professionals from IPLC groups. Bicultural professionals might play a critical role in establishing fruitful and equitable partnerships for knowledge exchange, and the inclusion of IPLCs in decision making roles at different authority levels has transformative potential, particularly when those people have

expertise in both WSK and IK/TK systems. Dr. Milagre Nuvunga captured the power in the potential of this coalition in a story of an interesting work experience she'd had with a traditional healer in Mozambique who had also studied at university to become a medical doctor. There had been, she explained, many processes that he'd been taught at his school that did not resonate with him. Later on, having become established as a traditional healer trained in the western medical traditional as well, this man became a national resource, joining the government medical force in developing successful treatments in Mozambique for the HIV crisis:

> He bought [a] forest to teach traditional healers…then, he spent six years moving. Spending one year at a time with different traditional healers, learning other systems, the parallel system…So, he went back to university and did botany… Because they knew him and they respected his intelligence and knowledge, he was able to create Memorandums of Understanding (MOUs) with [the universities and traditional healers]. (M. Nuvunga, Interview, Maputo, July 2018)

Nuvunga discussed a key difference in traditional healing, as practitioners do not perform surgical procedures,

> On certain illnesses that could not be treated by western medicine, this practitioner places patients either close to the sea or in certain mountains and certain fires that he knew the energy fields were such that could help, in a month to six, to bring the balance back and restore the person to sanity, what we understand as sanity. He had that understanding." (M. Nuvunga, Interview, August 2018).

I had the same information interviewing traditional healers in Silvia, Cauca region, 130 km. outside of Cali, Colombia, at the Mizak Resguardo (reservation) in July 2019, where traditional healers described how they treat their worst patients, in some cases taking them to the highest mountains (Paramos) to expose them to natural elements as fog, and natural forces as heat and wind, to establish complex culturally-embedded contacts with spiritual entities in hazy areas, through a process called re-harmonization. Other treatments combine traditional medicine provided for community members at the ceremonial house (Casa Payan), that include offering basic registered medicinal products for basic family health grounded on the local natural

pharmacopeia. One of the main concerns of the two elder traditional healers in that remote center located in Colombia's highlands was the continuation of a new lineage of practitioners, as only one young community member who silently remained away from our group, was in an apprentice path.

These two examples make clear how preparing powerful intermediaries between knowledge systems is not simply a matter of providing scholar and technical training for Indigenous communities or offer more higher education opportunities for them. Instead, it is about WSK bodies supporting tertiary capacities to elevate the roles of communities of practice in the implementation of biodiversity conservation actions in IPLCs territories and communities.

In the example referred by Nuvunga, taking advantage of the complementarities between WSK and IK/TK required a network of people and bonds of trust that this healer established over time in Mozambique. These networks require creative participation from the organizations involved:

> For instance, because I knew that the person didn't have the means to be able to produce good standard, his products, his medicine did not have international standards, even though they cured many diseases, he could not place this in any formal shop. Through this program, I had managed to connect an international institute to him so that they could work together on first describing what were the active ingredients in his different portions. (M. Nuvunga, Interview, August 2018)

Another important niche derives from the role of Universities in accreditation and licensure. Policy makers, teachers, attorneys, and engineers, among others, all pass-through Universities programs that might prepare them to manage diverse knowledge systems productively. Policy and development professionals might, for instance, be offered coursework and experiences focused on understanding key UN documents and other international treaty frameworks related to the rights of Indigenous Peoples, and the role of indigeneity in regional and national development programs. Food and nutrition professionals also have decisive roles on

linking sustainable agriculture to specific nutritional goals based on geographical and gender characteristics, to promote IPLCs' self-reliance and community genetic resources management (organic germplasm, natural pesticides and fertilizers, pollinators) free from external intermediation and free from the external agrochemical regime.

I personally witnessed two additional contrasting contexts on this matter: one case in India, Wayanad, during a workshop conducted by the Ministry of Agriculture, in which external Indian agronomists explained and distributed among Adivasi community members, traditional plants that existed in the area and were displaced by semi-intensive agriculture, worsening the impact of the 2017 cyclone and the quality of the soil. I was taken to this outdoor workshop by the MS Swaminathan Biodiversity Research Center in Wayanad, Kerala in March of 2019, after the Wayanad National Seed Fest and Seminar. During the workshop the agronomists from the Ministry of Agriculture distributed also natural chemicals in the form of gel, inside of special plastic bags that Adivasi community members agreed to grow as friendly bacteria and use it as natural fertilizer and pesticide.

If Universities are to fill this role effectively, though, they undergo a paradigmatic shift regarding their historical emphasis on western science as the ultimate body of knowledge. At its most basic level, this requires respect for IK/TK knowledge systems: "For me, that's a level of awareness and education, that if we could get there, it's a recognition of different knowledge systems that we can all respect if we know about them and recognize and give them equal standing". (M. Nuvunga, Interview, August 2018)

Dr. B. Kumar, from the University of Kerala, India, offered one version of how the distinct strengths of different knowledge systems might be perceived as complementary by WSK and IK/TK experts:

> Western science basically, it is all framed in the typical scientific procedure. Which of course is again the explanation of the Western scientists only. This is the way to do science. You need to have a hypothesis and to prove it, and to get the machine around. But the Indigenous system is based on the ground realities and their experience and which of course is still science-based, *but it may not be hypothesis-based*. And so, the Indigenous knowledge is time tested in many of the cases. (B. Kumar, Interview, August 2018).

This is a common challenge for traditional medicine programs and practitioners who in many cases have struggled to obtain certification licenses for medicinal plants, or recognition of therapies and treatments due the irrelevance of documentation and methodological rigor demanded by WSK. I attended policy presentations from the World Intellectual Property Organization (WIPO) at UNPFII in the last three years since 2016 and discussed possible resources and mechanisms for IPLCs in general to protect their medicinal plants and organic germplasm with WIPO representatives and COP14 delegates from many nations and organizations. But the difficulty remains in the adoption from countries and corporations of a perspective that affirm Indigenous rights as a foundational boundary for sustainable development. B. Kumar raises also the concern over conflicts of interest in this relation,

> For example, there are many medicinal seed varieties, which may cure many of the diseases and strengthen your nutritional ability to increase your immunity. At the same time, if you ask me the question, "what alkaloid is involved in this kind of curing of the disease?" You may not have an answer. But at the same time, it is time tested and you have no side effects… then it is actually the job of the scientists to find out what exactly is the mechanism involved in this kind of process. But it is not the duty of the Indigenous communities. (B. Kumar, Interview, August 2018)

My observation of several campus projects within the last 7 years indicates that many Universities, as well as most science researchers and research administrators involved, have little interest in acknowledging the implications of IK/TK systems for use, decision-making, and accountability in relation to asserting Indigenous Peoples' rights and agency in projects that might affect them. When they are interested, they often have little awareness of the differences

among the frameworks (TEK, IEK, IKS, TK), including what differences each implies with regard to different levels of IK/TK "integration" with western science (Dodson, 2003). Dr. Tim Frandy acknowledges this confusion requires a shift on science to insert biological research in critical dialogues with social sciences and IK/TK,

> What needs to be done to clarify these relations? Well, I think we have to completely reform how we understand thinking about science. And we have to understand it's ethnoscience and think we have to expose science to the same critical dialogue about race, and racism, and ethnocentrism, and sexism, and colonial logics and entrenchment that basically every other discipline in the academy's already had to go through. (T. Frandy, Interview, Wisconsin, December 2018).

My argument is that those critical dialogues that Frandy proposes are indeed FPIC mechanisms that are critical to be adopted for education and research. It is unproductive and unequitable to subtract education and science research from prior consent processes for programs, activities and services that might affect Indigenous Peoples rights, territories and resources. For Alan Turnquist, who coordinated an international agroecology exchange program and was presenter at the Seminar case study, the context-based use of different applications of IKS is vital to understand the accountability they involve for market and legal relations, as we discussed highly profitable café and cacao Indigenous farms. In his words,

> I also think the context, in which they are being kind of applied matters, because I've seen instances, where outside forces, market forces, can really impact the viability of utilizing indigenous practices. We can just say knowledge systems or traditional ecological knowledge. So, it could be a market force, it could be environmental change that is sort of imposed on a community. And, so, not that that necessarily... let's just say devalues… Indigenous knowledge. But, to some degree if Indigenous or traditional ecological knowledge systems are built up over time to apply in an area, and their dynamics outside that impacted in a different way, they can make it very challenging I think to continue. So, to clarify these relationships, I think... it depends on the situation. There are so many things that are imposed… [as] imposing a knowledge system or another kind of contextual element, like a market system… It's not obvious if you don't come to the understanding of all of these different perspectives and contexts in which they operate. (A. Turnquist, UW-Madison Agroecology Exchange Program Coordinator. Interview, Madison, November 2017)

About resolving the differences of context-based use of different applications of IKS towards different levels of integration with western science, Dr. Ian Baird, Professor at UW-Madison Department, argued that decolonizing methodologies, or the modalities of action research, participatory action research, and grounded-level and grassroots work is a condition for this integration. He addressed the vital importance of mutual respect among different knowledge systems: “And if that doesn't happen, I think that's a very serious problem. So, I'd say that's a very important issue and the one that is maybe the foundation of anything like this. If you don't have that it's not going to be valuable. In fact, it could be very destructive.” (I. Baird, Interview. Madison WI, January 2018)

My observations indicate that participatory leadership from the relevant Indigenous research community is essential to such initiatives, in order to clear up the implications of these platforms for the mainstream academic community. They must also learn new processes and practices for partnership with Indigenous governance systems. However, some universities, especially those specifically research focused, do not offer content about Indigenous governance in their curricula and research projects beyond the typical characterizations as peasant communities and organizations, etc., and therefore have yet to meaningfully address the significance of such governance systems for western science assumptions about accountability and validation. Paul Robbins, Dean of UW-Madison’s Nelson Institute for Environmental Studies, acknowledges the lack of institutional recognition and will to include the Native Tribes in the general university governance as stakeholders:

> There are also many Indigenous governance systems that already utilize a formal research review process through tribal governments and tribal colleges… It’s not that the theories and methodologies aren’t out there, or they're being articulated, it’s not that the

> instruments and the legal pieces, like the IRBs, don't exist. It's that I'm not sure we're, as educators, we're making that a universal goal. I think everybody on this campus should be trained in at least some competency at this level, on this kind of thing, but that's a lot to ask. (P. Robbins, Interview, December 2017)

One of the students of the seminar "Global Indigeneity and Sustainability" that I analyzed in the previous chapter stated the problem succinctly: "Modern governance, by and large, still doesn't do a good job of including, encouraging and supporting the voices less heard. In fact, there is a consistent attitude–direct and subtle, conscious and subconscious–that does just the opposite" (M.T.P., Weekly Post, February 2017).

Ultimately, there is a pervasive need for universities and for researchers grounded in WSK to learn about the tribal and customary governance perspectives and be able to discuss and respond to such issues the (mis)alignment of data governance and intellectual property rights from the perspectives of Indigenous Peoples institutions and WSK research institutions. These improvements could be implemented under the umbrella of an FPIC mechanism invoked in each research or educational intervention (as well as in development, extractive, and investment projects). There are, as Robbins notes, IRBs at Indigenous-centered academic and research institutions and programs. Yet integrating FPIC into data management and the IRB process is, in some sense, accepting the existing institutional infrastructure of non-Indigenous-lead research and development. Alternative approaches to mainstream research and development, such as creative commons and open-source types of licensing, may be more representative of both Indigenous ownership and the responsibility for the management of genetic resources that have been associated with IK/TK.

# Conclusions

## Contributions to research

The dissertation makes several distinct contributions to research and theory surrounding the participation of Indigenous Peoples in meeting global sustainable development goals. First, I argue that education, broadly defined, is a critical prerequisite to such participation. Then, by looking across educational settings, I clarify the type and scope of educational opportunities needed to that would enable and empower IPLCs to restore their own genetic resources in the context of the complex relations between genetic resource management, land rights, and self-determination. In particular, I show how educational opportunities must both be built around ideas of autonomy and self-determination and built capacity for authentic implementation of Free, Prior, and Informed Consent processes and multiple levels of social organization. Existing frameworks for the adaptation and integration of IK/TK with WSK have too often circumvented the principles of self-determination and prior consent. Decolonizing educational interaction between knowledge systems means redefining and refocusing them to recognize the centrality of governance. The reaffirmation of IK/TK as inextricable from Indigenous Peoples' inherent territorial, cultural, and economic rights is essential to IPLCs informed and consented participation as strategic partners in the fulfillment of the global sustainable development goals (SDG,) post-2020.

Up to this point, the discourse and practice of biodiversity conservation have not explicitly recognized the importance of non-state actors' governance in the implementation of key mandates and treaties, especially per the Nagoya Protocol. The framework presented in this dissertation positions governance as central to the political and juridical identity of Indigenous Peoples, clarifying the actions that nation-states and institutions need to take to support their

political identities, which must, in turn, be integrated into public education and scientific research with communities, farmers, rural, poor, peasants, activists, organizations or villagers associations, so as to restore their (prior to colonization) strategic role in biodiversity conservation.

Some of the most pressing questions for future research are: How does the incorporation of IPLCs governance transform methodological protocols, and therefore redefine and redirect scientific research priorities toward the conservation of natural resources? How does educational decolonization interact with, and potentially break, the disciplinary and sectoral silos in work with the world's IPLCs, while contributing to the role that education must play in terms of biodiversity conservation as an urgent global action?

The findings for the first research question demonstrate the need for a multidimensional role for education (broadly defined) and science research in the support of Indigenous Peoples rights, and in the respectful interaction and potential integrations of their knowledge systems and western science. The knowledge integration frameworks from educational institutions and research organizations must be reformulated to support equitable relationships with Indigenous Peoples. To accomplish this, they must also reform and transform themselves. For example: internal educational interventions are needed, to engage faculty researchers and administrators as the main target audience of decolonization strategies. At the same time, Indigenous learners deserve particular attention, as do education and research initiatives that will further the boundary-crossing abilities of this emerging learning community, as well as to contribute to productive fronts in aligned scientific research that benefits the interests and respects the rights of Indigenous Peoples.

Connections among international Indigenous scholars have unique value, but indigenous networks must also connect to western universities, so that they may understand IPLC communities from newly non-extractive lenses, in which IPLCs are addressed as subjects and not objects. These connections have the potential to transform, at a regional level, how IPLCs inform and engage with universities and other research organizations. Research universities can also play important roles by mediating interaction between IPLCs and local and regional governments, to change the conditions of exchange and those under which education and action for sustainability take place within distinctive cultural communities.

At the same time, the first study notes that community-based education, built around the restoration of IK/TK and cultural reservoirs of knowledge, provides crucial support for Indigenous self-determination and is essential to the development of Indigenous academic and political representation in the world. Finally, my findings highlighted the consensual nature of the exchange of knowledge systems and practices, in terms of responding to Indigenous Peoples self-determined interests, the eradication of forms of influence or change to certain culture-based practices, and the need for educational interactions and integrations among the communities of practice, based on a mutuality of critical responsibility.

The need of reorienting education to prioritize different institutional goals suggests that critical changes in western educational systems to incorporate Indigenous Peoples' rights, as ratified by international law and policy, require the engagement of interdisciplinary perspectives that challenge the prevailing methodological and theoretical fragmentation of Indigeneity, transforming it instead into one that makes visible IPs' interconnected global epistemic and material realities. This repositioning defines actions taken toward the assertion of Indigenous governance as part of the application of the principle of self-determination, as recognized by

educational and research bodies in relation to intellectual property rights for IK/TK, and those rights asserted per international law and policy. Incorporating references to international law is necessary due to the pervasive structure of national laws, largely established during colonial epochs, that required international mobilization from IPLC actors and voices.

The second study expands this debate, addressing the need to increase in understanding of the complex politics of Indigeneity, and the ways in which local histories of colonialization interact with the current emerging international policy discourses on Indigenous rights in international contexts. This complexity is expressed around issues of, for one example, postcolonial land tenure relations on commercial cropping systems under the pressure of agrochemical regimes and also, for another example, around the negation of local governments about Indigenous Peoples' economic and environmental roles in environmental conservation, which can indeed have a global impact.

This dissertation calls attention to the existing threats to Indigenous lands and genetic resources by existing postcolonial legal and policy regimes, supported and related to instrumental natural and biological research. Offered by the most important research universities in the world and disassociated from any social and environmental considerations, scientific research continues to treat IK/TK as though a resource to be extracted and integrated into agroecological practices. It all-too often continues without implementing of prior consent mechanisms and without the direct participation of Indigenous governance systems and IK/TK practitioners, many times dismissing international laws, policies and recommendations related to Indigenous Peoples' rights such as ILO Article 169 and the CBD among many others that are part of the UN global governance system around sustainable development, health, education and environmental protections. In this respect, I argue for the need to clarify a number of terms

associated with these practices. The most common, as noted earlier in this dissertation, are: TEK, IEK, IKS, TK. These are not all equivalent or exchangeable among one another, either in their conceptual nuances or their legal and policy interpretations. Some have been operationalized in the context of particular research or policy processes with no concurrent interest in or acknowledgement of Indigenous governance rights or self-determination.

Additionally, diverse expert sources in policy analysis and in the field pointed out that the global interest in commercial plant varieties—those that can be extracted from their local context and used in intensive cultivation regimes—contributes to pervasive oppressive post-colonial systemic structures that impact the lives of IPLCs today. Scientific institutions have often abetted and even accelerated this process, particularly through genetic manipulation exercises that challenge the Convention of Biological Diversity and related binding agreements that protect Indigenous Peoples' rights over genetic resources with associated IK/TK.

In this regard, the advancement of the Indigenous commons system represents a new platform for economic exchange—developed under self-determined economic-related exchanges among Indigenous Peoples, outside of the parameters of market competition and under rules other than those typically geared toward western style corporate economic growth—emerges as a late aspiration of the world's Indigenous Peoples, whose governance systems are now conferring among one another. These platforms that materialized from a coalition-based resistance of IPLCs in response to intensive cultivation, agrochemical practices, and global intellectual property regimes, coincide with their regaining control of seeds associated with IK/TK practices and the shifting of its research and applications to health, nutrition, and ecosystem management. This cross-case synthesis of informed and consented educational and policy interventions present a

roadmap for informing other contexts of Indigeneity in the affirmation of their biodiversity governance and self-determination.

**Applied Lessons for Mainstream Educational Institutions**

Complementary to these processes, research universities must clarify their positionality and affirm educational decolonization in support of frameworks that recognize the role of governance for IPLCs as a key aspect of their capacity to contribute to global sustainable development. They must also identify locally and regionally salient practices that embody the principles of equitable knowledge exchange. I argue that the interaction of IPLCs with research universities and institutions should also require the implementation of formal FPIC mechanisms underlined by international policy (ILO Art. 169; CBD), UNDRIP), as they have played a role historically in the perpetuation of negative instrumental and technical scientific approaches in many countries; including those that, in many cases and at different levels, go against the rights of IPLCs.

Education and capacity-building for professionals from IPLC groups is critical. Bicultural professionals, too, might play a critical role in establishing fruitful and equitable partnerships for knowledge exchange, while the inclusion of IPLCs in decision making roles, at different authority levels, has transformative potential—particularly when such individuals have expertise in both WSK and IK/TK systems. Policy makers, teachers, attorneys, and engineers, among others, all pass-through university programs that might prepare them to expertly and productively manage diverse knowledge systems. Such policy and development professionals might also, for instance, be offered coursework and experiences focused on understanding key UN documents and other international treaty frameworks related to both the rights of Indigenous Peoples and the role of indigeneity in regional and national development programs. Food and

nutrition professionals play particularly decisive roles in linking sustainable agriculture to specific nutritional goals based on geographical and gender characteristics, to promote IPLCs' self-reliance as well as their community's genetic resource management (organic germplasm, natural pesticides and fertilizers, pollinators) free from external intermediation and free from the external agrochemical regime.

There is a pervasive need for both universities and researchers grounded in WSK to learn about the tribal and customary governance perspectives of the communities in or with which they work, as well as to promote both fair discussions about and informed responses to such issues as data governance and intellectual property rights, from the perspectives of US tribal nations and WSK research institutions, especially in complex biological and genetic research on resources associated with IK/TK. One of the implications of our seminar case study was that the Menominee nation had altogether changed their paradigm around local funds of knowledge to focus more about agriculture. They have thus become transnationally engaged with Indigenous Peoples elsewhere around the globe, with whom the students and presenters from the seminar connected as a result of this intervention.

Finally, the study concludes that alternative approaches to mainstream research and development, such as creative commons and open-source types of licensing, may be more representative and also affirming of both Indigenous ownership and the responsibility for the management of genetic resources that have been associated with IK/TK.

**Implications of Educational Decolonization**

In broader terms, the institutional actions that mainstream education takes towards decolonization processes, with the participation of Indigenous Peoples and communities, can be summarized as follows:

Full implementation of UNDRIP is essential for effective integrations of Indigenous Peoples, their knowledge systems, and their resources as strategic partners to achieve the global sustainable development goals (SDGs). In this regard, effective and equitable interactions between IKS/TK and WSK are linked to land-based political rights and self-determination laws that determine the scope of relationships between science research and development projects. Protocols for science research and intercultural, inter-institutional, and inter-governmental engagement need to be constantly and explicitly updated with the direct participation of Indigenous Peoples via prior consent mechanisms, according to international law. This consent process takes place through the integration of Indigenous Peoples and Local Communities, as well as their knowledge systems and genetic resources, as strategic actors to provide solutions for critical global issues across the world.

The processes of reintroducing traditional agroecosystems of crop and CWR germplasm represent strategic fronts for the reaffirmation of a bundle of rights that are fundamental for the world's Indigenous Peoples. Mainstream education needs to support the exchange of agroecological practices and resources among Indigenous Peoples by providing transformative roles that create capacity to reorient legal and policy environments in order to benefit IPLC sustainable development. It is important to create specific education and research spaces on Indigenous issues that target high and mid-level national governance systems, research and policy institutions, regional and local organizations, as well as community-based organizations that work with Indigenous Peoples around the world.

Incorporating the universal implementation of FPIC mechanisms and processes that ensure equitable relations between IPLCs and research bodies, governments, and corporations, preserves the best interests of IPLCs and must be part of diversified scientific training that

promote knowledge integration processes for mainstream transnational IK/TK systems, highlighting Indigenous Peoples' political and economic sustainability paradigms as part of a pluralized education. The participation of Indigenous Peoples and Local Communities in such decision-making and co-governance needs to be supported and encouraged as necessary to achieve balance. It cannot be left to WSK and western epistemic and material governance to manage.

In terms of science education, decolonizing and diversifying science curricula can be implemented through specific projects requiring knowledge integration processes for transnational IK/TK systems, and in interdisciplinary and transnational disciplines that serve national and international learning audiences. The internationalization of Indigenous education is not only an important step in decolonizing education overall, but also an informed action that empowers Indigenous Peoples and diverse knowledge systems to fully engage in their own research—research that may provide solutions to some of the most important issues of our time.

**Discussion**

These final sections clarify some final stances that surfaced after the conclusions. In these, I summarize my particular observations of what is possible to do, in both the present conditions and beyond them, what conclusions need to be further explored and developed, as well as what will follow from this work in my personal research trajectory. They also point to limitations that need to be considered, and also the effects of my findings that suggest and predict future research and practice. At the same time, these final remarks answer questions posed in the introduction and by those central research questions that were not directly addressed by the data and needed to be crossed with key decisive references, to finally close the conceptual

and methodological circle that this dissertation envisioned. These final stances are related to: FPIC and self-determination; governance in future research; transnationality and Indigeneity; Indigenous education for governance and self-determination; and the emerging South-South international cooperation in decolonization processes in multiple areas of sustainable development. They conclude with suggestions about implications for future research in South Asia and Africa, and about their implications for the incorporation of Indigenous bio-culturalism in future research.

These implications addressed herein are the result of a meaningful process of consultation among a diverse member-pool of national and international science research communities in different capacities, and from different cultural, historical, and personal trajectories. The first sources consulted were graduate and undergraduate students who sought specific approaches to questions they brought with them from their particular disciplines and found perspectives they had not seen in any previous educational experience. The second sources included faculty researchers who expressed a particular positionality about issues that involved science research and Indigeneity, and who had reflected about the consequences these issues have for education and society, and therefore the importance to take urgent action. However, this inquiry sought to transcend the mere reflection about the role of education, given that schools clearly have limited capacity to foster continuity to commitments that protect and respect the rights of Indigenous Peoples.

At the same time, a context comprised solely of the US notably limited the scope of my reflections related to any fundamental issues that involved Indigenous Peoples, because my own positionality not only followed the different faces of Indigeneity across transcontinental contexts, it also allowed me to access resources and meanings linked to both my Andean ancestry and my

personal trajectory as an Indigenous scholar. This allowed me to develop unique and deeper relationships with key faculty from international universities and researchers working in different capacities in Mozambique, Nepal, India, Mexico, Peru, Colombia, and United States. Their comparable stances around the same questions revealed a profound and shared concern for urgent actions needed to achieve meaningful changes in the loss of global biodiversity, through collaborative frameworks among those Indigenous Peoples and Local Communities who manage vast genetic diversity on the ground, and research universities with science research projects all around the world.

**Contributions from the University of Wisconsin Native Nations Taskforce and Workgroup**

The University of Wisconsin-Madison and its Strategic Workgroup have been influential in pressuring science research bodies to incorporate community-based and participatory research mindfulness and social justice-oriented pedagogies interactions in the relation with all 11 American Indian Tribes in the State of Wisconsin. The challenge of this relationship is that it requires the establishment of relationships with Indigenous Peoples as collaborators, rather surpassing their governance systems to extract knowledge from their communities. Many participants of the study welcome a new era of nominal "consultation" among the state, federal governments, and tribes, and would like precepts such as those encapsulated in the statements from the UW Native Nations Strategic Workgroup, about "partnering, shared knowledge, and shared cultural production," to govern the relationship between the UW and those Native nations and tribes whose territories are within state boundaries.

However, since the beginning of my own involvement with campus projects, and while engaging in international field research and the crafting of this dissertation, new developments in this relationship, between the Native nations and the (non-Indigenous) peoples and institutions of

the state, have taken place—against these hopeful statements. Not only do racism and discrimination continue in towns and villages settlement adjacent to Indian reservations, but now also, new mining threats have arisen against both the Menominee Nation and residents of Northeast Wisconsin overall. The threat of oil spills from precarious pipelines that cross Ojibwe reservations, among others, in Northern Wisconsin is palpable, and therefore adds to the already significant and negative current impacts of the massive soil contamination occurring due the use of pesticides and fertilizers. This context highlights and confirms the complexity of the panorama of governance issues at the center of the movement to reclaim the balance that Indigenous nations have lost, after having previously sustained it for millennia.

Participants of the study, some of whom are members of local tribes in the State of Wisconsin and/or have some kind of relationship to UW-Madison, envisioned future economic landscapes, while calling against the exploitation of economic crises or natural disasters to justify any highly intensified "rescue" regime of harsh austerity, privatization, as well as de-regulatory and pro-corporate policies, along with issues of economic threats to Indigenous communities' basic sustainability, poverty, lack of access to markets, as well as the lack of infrastructure and assistance accessible to peasant or Indigenous farmers that would empower them to activate their own organizations and traditional knowledge systems.

As I concluded work on this dissertation, Indigenous Peoples nationwide were experiencing severe health impacts due to the global pandemic, which revealed significant disparities and the high vulnerability of rural and poor Indigenous communities, consistent with the reports about other IPLCs around the world who have continued to be marginalized and displaced throughout the COVID-19 era.

In the US, the future viability of sustaining and recomposing Indigenous tribal communities is also directly related to governance issues, due to the imposed blood quantum policy's impact in the surviving colonized Tribal Nations. Participants of the study referred to the fact that, by federal policy, any official tribal member needs to be at least 1/4 descendant and confirmed by tribal and Bureau of Indian Affairs (BIA) records. Some tribes, however, accept those with 1/8 descendance thereof, and there is an active discussion to review these policies—specifically the requirement of speaking one's native language in order to register as tribal member. Issues of governance, economic development and the emergence of Indigenous market commons will continue pressuring the future policy development to accommodate stronger Indigenous societies under different legislations. The support of research universities to this process may be decisive in making changes to federal and state policies in the US.

The emergence of a new wave of Indigenous research centers in many universities, around the country and the world, present very positive and vibrant platforms of interaction. This dissertation takes a stance about the need for these important initiatives to be extended to Indigenous communities with differing political identities, as the goal of this work is to open new doors, rather than point to what has been done already. Regardless of universities' role in recruitment, retention, and ultimately assimilation of minority Indigenous communities into mainstream western cultures and job markets, this dissertation finds invaluable opportunities for U.S. based Indigenous learning and research communities to exchange and engage in mutual learning, connected to national and international Indigenous communities with whom they share common epistemic and material relations.

In this role, in my opinion, the UW Native Nations Taskforce and Workgroup could serve the interests of self-determined and surviving societies, challenging neo-colonization beyond

local contexts and promoting a wider consideration of Indigeneity through the experiences of interactions and integrations among Indigenous Peoples and knowledge systems. The role of legal and policy expertise, to transcend local contexts of application, can constitute a powerhouse for all the Great Lakes and Midwest tribal nations, connecting them to counterpart Indigenous societies and projects that involve knowledge systems integration. This dissertation concludes by emphasizing the strategic importance of biodiversity conservation frameworks as an ideal that any programmatic effort in support of this very needed initiative should follow.

**Policy Mechanisms to Support the Revitalization of IK/TK Systems**

Universities are essential to providing spaces for distinctive cultural learning and research communities to interact and integrate solutions to critical problems that may or not involve interacting with or integrating WSK, under distinctive paradigms for economic growth and sustainable development. This also may or may not involve inscribing IPLCs into market added value-chains or promoting any associated economically dependent relationships outside IPLC communities, or their epistemic and material relations.

Research universities have a critical responsibility to acknowledge the historical colonial nature of education systems in settler-colonial countries in perpetuating the oppression and isolation of Indigenous Peoples, thus also maintaining the paradigm of cultural disenfranchisement and assimilation as a condition of participation. At the same time, curriculum and research policy actors in and around research universities have responsibilities, in terms of the implementation of UNDRIPs principles as well as technical and practice recommendations throughout programmatic research initiatives that include direct participation of IPLCs in their policy design. Meanwhile, academic networks that promote and support the implementation of UNDRIP in academic research programs and curricula can serve transnational Indigenous

research and policy communities to certify legal and diverse knowledge expert bodies in project evaluation and FPIC implementation, as well as to provide certified technical assistance and policy analysis to research bodies, governments, and corporations. This is with regard to their obligations and responsibilities with IPLCs in sensitive topics such as bioethics, genetic research, seed open sources, biomedical research, as well as agricultural and botanical research on crops and WCR.

In broader terms, related to the support of research universities for global and regional policy making, the recognition and support of Indigenous Peoples' participation in all UN conventions and mandates that are related to them requires elevating UNDRIP as a formal framework of interaction, ensuring the shared participation of Indigenous Peoples and Local Communities in the highest forms of decision-making and co-governance. The restoration of key biocultural rights, natural and genetic resources, as well as the integration of diverse knowledge systems from Indigenous nations and societies across the world, presents a most important opportunity to affirm the meaningful participation in sustainable development of IPLCs.

**Governance in Future Transnational Research**

This dissertation has taken a decisive stance regarding the centrality of governance, as a connecting theme across myriad lines of inquiry. Governance must be seen, in education, not as Indigenous Peoples trying to gain a space in the US, to thrive in the western world, but rather to restore their own worlds. Culturally Relevant Pedagogies (CRP) work differently for Indigenous Peoples with regard to the ultimate goal of education as a mean of assimilation and to the nature of diasporic relations that, for IPs, are different than that imposed on (voluntary or involuntary) immigrant communities in the U.S. and the similar Anglo settler-colonial contexts such as Canada, Australia, and New Zealand. Historically, the participatory processes used by settler-

colonial institutions in their work with Indigenous Peoples have been designed with the interests of those institutions interests in mind. In these processes, the FPIC mechanism has typically not been observed beyond designated listening sessions. Because of the fragmentations imposed by distinct fields of inquiry and knowledge specializations, educational decolonization requires breaking the silos - interdisciplinary and holistic - with regard to working with IPLCs. Finally, the topic of land rights needs to be reviewed and revisited, in terms of the fulfillment of treaty-binding agreements that institutions and society have entered into with the survivors of colonization. Such rights are understood to comprise a people's legitimate right to territorial spaces and a respect for their integrity, to live self-determined existence as peoples. Therefore, educational decolonization needs to address such issues, perceptions, and claims thereof, promoting their discussion among *all* students in mainstream educational settings.

My analysis thereof offers specific attention to applications related to the restoration and reintroduction of biocultural diversity in Indigenous contexts—including key references to IK/TK perspectives on the inter-relationships between human and non-human communities. Prior to this dissertation, my inquiry process was informed by direct interaction with Indigenous knowledge practitioners and others also trained in western science. From these dialogues and learning experience, restoring Indigenous governance has been a key proposition for this research; one that has crossed all data and theoretical stances from the sources consulted therein. From these experts, and the intensity of participating in many policy forums, at national and international levels, the theme of governance revealed its strategic importance around the topics of seed redistribution and seed conservation rights in recognition of Indigenous self-determination policies and principles, towards the consolidation of a global Indigenous

commons for sustainable development and a sustainable marketplace under different paradigms of economic development and science research positionality within the South-South axis.

Experts I consulted frequently, from multiple organizations, shared their thoughts about issues rules and policies regarding intellectual property, trade and investment, as well as marketing, that displace farmers' power to influence how, where, and by whom key germplasm (including organic varieties) for major food staples were accessed, and for what purposes. Not surprisingly, resistance to existing seed laws in countries that are considered in terms of biodiversity conservation "megadiverse", such as Peru, India, Colombia, and Mozambique, where this dissertation research took place, has taken many forms.

The FPIC propositions first emerged as a recurrent theme in this research, as national constitutional laws have shaped the local conditions for IPLCs political participation and incorporation. Some of these came about in direct response to the hegemonic imposition and pervasiveness of western influence (Jacob et al., 2015) so it needs to be incorporated into education diverse "Indigenous ways of knowing, learning, instructing, teaching, and training" as "potentially beneficial for students, teachers, and other societal members in a culturally sensitive manner beyond the standard Western curriculum and learning experiences (Abu-Saad & Champagne 2006, p.11)". Indigenous groups could become key players in establishing new modes of convergence, as well as offering new forms of self-governance in which the introduction of Indigenous models of cooperation and sharing that define and constrain the nature of international cooperation itself (Jacob et al., 2015).

The classification of particular groups of peoples as Indigenous or non-Indigenous emerges, too, as a compelling theme with many class-based implications. Dr. Peter Swift, (2015) whom I interviewed in this dissertation, describes the complex social and political networks that

both facilitate *and* resist land grabs in Southeast Asia, showing how people are influenced— in terms of funding and throughout the discourse—from peasant movements on one side to Indigenous movements in the other. Swift (2015) emphasizes the importance of transnational networks and organizations in asserting sovereignty and establishing structures for negotiation around land and genetic resources. He cites several powerful examples, such as the Indigenous Peoples Movement for Self Determination and Liberation, which started in the Philippines and became a global network of Indigenous organizations focused on learning about developing policy language in regard to self-determination and territory, including FPIC and how to make local law and policy consistent with UNDRIP. He also mentioned the Expert Mechanism on the Rights of Indigenous Peoples (EMRIP,) which gathers Indigenous delegates annually in Geneva, Switzerland, as a form of sustained space for discussion. The Human Rights Council Expert Mechanism on the Rights of Indigenous Peoples Tenth session, which took place on 10-14 July 2017, stated that "United Nations should, in accordance with the Declaration, establish a permanent mechanism or system for consultations with Indigenous Peoples' governance bodies, including Indigenous parliaments, assemblies, councils or other bodies representing the Indigenous Peoples concerned, to ensure effective participation at all levels of the United Nations (see A/HRC/18/42, annex, para. 36)."

Other transnational organizations have a more ambivalent relationship to indigeneity, derived from different histories of incorporation and disenfranchisement. The International Peasant Movement (or Via Campesina) originated in Indigenous movements and in displaced farming communities in Brasil in the 70's and expanded through Latin America, Asia and Africa in previously colonized countries. The distortion of the language around the concept of campesino previously used in Spain to denominate peasants, as sued by those Indigenous

communities from its disassociation from a political identity derived from local or regional usage of this term by colonial fragmentation, has not been properly recognized in ways that honor the political identity of Indigenous nations and peoples as survivors of colonization along the entire continent.

My field research affirmed that as not all agrarianism is Indigenous, not all campesinos have either relate to the cultural, historical, and political history of Indigenous Peoples as recognized by national constitutions or in accordance to ILO Article 169, CBD and UNDRIP, among other international policy definitions Ultimately, the lumping together of Indigenous Peoples *and* Local Communities (such as with those classed as "campesinos") in the Convention on Biological Diversity represents an external imposition, not a self-determined convergence. This does not mean that the grouping is without value. The policy tools designed to address the needs of so-called Local Communities are relevant to, and have informed, the development of transnational Indigenous networks. Additionally, the most significant peasant organizations and Indigenous Peoples networks have defined their battle fronts in similar ways. According to Claeys (2015):

> La Via Campesina (LVC) developed in the early 1990s as peasant and small-scale farmers from Central America, North and South America, Europe, and elsewhere sought to articulate a common response to the neoliberal onslaught that had devastated their lives. Since then, the movement has opposed 'global depeasantization' and the emerging 'corporate food regime'. It has developed a 'food sovereignty' model to counterpose the dominant 'market economy' paradigm and has managed to build a common agenda across the North–South divide.

Still, the formation and identification of Indigenous and campesino/peasant political movements differ at many levels—for example, with regard to the issue of food sovereignty. Since 1996, La Via Campesina has defined this as "the right of each nation to maintain and develop its own capacity to produce its basic foods respecting cultural and

productive diversity" (Vía Campesina, 1996). The World Trade Organization (WTO) became one of the main targets of LVC's activities, and opposition to the WTO has fueled the movement. The focus of food sovereignty, in this context, was oriented to end, dump, and revamp international trade rules, and ensure tariff protection for agricultural products (Via Campesina, 1999)[37]. The analysis is complementary aspects related to Indigenous and Campesino communities has been a challenge to reconcile different definitions associated to them. By understanding these two terms in their accurate political stances, made me for instance, absolutely aware of the vulnerability of consultation-based and treaty-based governance mechanisms and revealed, once again, the complexity and relevance of Indigenous governance as the central issue.

Across these two studies, faculty researchers, chairs, and deans of international science research departments, post-doctoral researchers, administrators, and scientists, agreed that while IK/TK systems are needed in many research fronts, the absence of appropriate programmatic infrastructure that supports equitable relations between different knowledge systems as IK/TK with the equitable participation of Indigenous Peoples reinforces the systemic colonial presence in research universities. Thus, a potentially pivotal role of IK/TK, with respect to these issues of global importance, relies on the creation of policies ensuring mutual agreements about disclosure and respect of Indigenous Peoples' knowledge and rights. These mutual agreements, in turn, rely on the understanding of the larger IPLCs vulnerability as a long-term phenomenon that expands in relation to conditions of poverty, political disempowerment, and economic oppression (Maldonado et al., 2013).

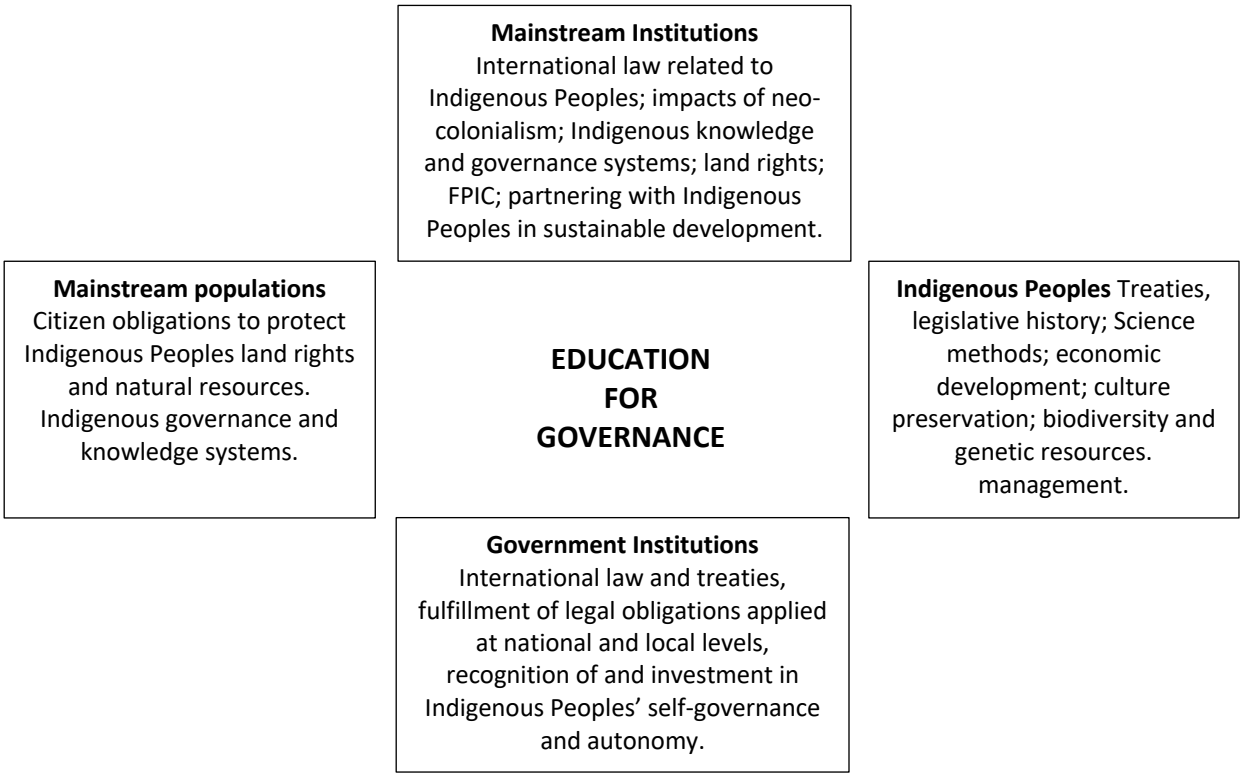
[37] Via Campesina. (1999, December 3). Seattle declaration: Take WTO out of agriculture. Retrieved from www.viacampesina.org

**Indigenous Education: Governance and Self-Determination**

Multiple participants, from among those in the US consulted on this dissertation, discussed the need for improved research governance regarding collaboration with international Indigenous/Native/Aboriginal and Traditional communities' studies departments, and specially with research institutions run by Indigenous communities. They also pointed to the need for researchers grounded in WSK to learn about tribal governance perspectives, and to discuss the (mis)alignment of data governance and intellectual property rights—from the perspectives of US-based tribes and WSK research institutions. Such improvements could be implemented under the umbrella of FPIC mechanisms invoked in each research or educational intervention (as well as in development, extractive, and investment projects). Integrating FPIC into data management and the IRB process is, in some sense however, an accepting of existing institutional infrastructure of non-Indigenous research and development.

By articulating the multiple needs and audiences for a given form of education, participants pointed to similar challenges faced by Indigenous Peoples around the world, including with regard to land rights, water rights, language revitalization, affirming cultural traditions and values, and self-governance systems, as contained in the implications of Article 8j and Related Provisions Working Group of the Convention on Biodiversity (Tebtebba, 2008). Along similar lines, the rights of IPLCs to control access to their traditional knowledge, and to benefit from its use by third parties, are at the center of the discussions taking place under the 8j Working Group of the CBD and the World Intellectual Property Organization's (WIPO) Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore (Morin, 2017).

Participants also shared their interest in alternatives to mainstream approaches to research and development, such as creative commons and open-source licensing that would represent Indigenous ownership and responsibility for the management of genetic resources associated with IK/TK. In keeping with the focus of this dissertation, they recognized the importance of education in order to transform the relationship between WSK and IT/TK. It was useful to organize these different ideas into a multi-directional framework that can identify the particular needs of different constituencies/audiences for education:




Recognition for the ties between governance and knowledge systems would guarantee these communities the ability to not only invest in themselves, but also to be partners in global frameworks of sustainable development. It is possible for central government institutions and civil organizations to provide legitimate legal and financial assistance. But there is an accompanying need to develop and secure a bundle of rights, including those pertaining to

material and nonmaterial values, bundled into "traditional resource rights" (Posey et al., 1996), and identities reserved specifically for constitutionally recognized Indigenous Peoples in many countries.

**Emerging South-South International Cooperation**

An emerging theme that needs more attention, which the data for this dissertation does not support fully (as it was not addressed as a central theme or inquiry line,) is the rise of South-South cooperation networks that have been used, in the last decade, as new forms of economic cooperation. These include trade, investment, development assistance, and other financial flows. The South–South cooperation (SSC) model among countries of Latin America, Asia, and Africa "has been a key organizing concept and a set of practices in pursuit of these historical changes through a vision of mutual benefit and solidarity among the disadvantaged of the world system.

This alternative concept is an innovative source of research and policy that needs to be understood as one an among numerous emerging platforms from the world's Indigenous Peoples and Local Communities governance systems themselves, not created by development agencies. They represent concrete forms of the decolonization of science research in the field. Central to these South-South cooperation networks is the challenge of Indigenous-centered community-based research to the revitalization and conservation of seeds, especially traditional varieties thereof. The publication "The Future of Food: Seeds of Resilience" (Global Alliance for the Future of Food 2016) notes that: "Seed diversity is being eroded and community-based seed systems, representing tremendous complexity, are under threat. Farmers do not have adequate representation within the international governance systems that regulate seeds. Communities are feeling the negative impacts of the increasing privatization of seeds. The

current intellectual property regime restricts traditional and local seed saving practices… to contribute to protecting and enhancing agricultural biodiversity... (G. Alliance, 2016 p.4)."

The idea of South-South cooperation (SSC) and networks has been engaged in the last decade as a reference, at the level of economic cooperation including trade, investment, development assistance and other financial flows. This model, among countries of Latin America, Asia, and Africa, etc., offers "a key organizing concept and a set of practices in pursuit of these historical changes through a vision of mutual benefit and solidarity among the disadvantaged of the world system. It conveys the hope that development may be achieved by the poor themselves through their mutual assistance to one another, and the whole world order transformed to reflect their mutual interests vis-à- vis the dominant global North (Gray, 2016 p.557)". The alternative concept of South-South exchange processes needs to be understood as an emerging platform for the governance systems among the world's Indigenous Peoples and Local Communities.

As societies become more and more dependent on high-yielding crops, intellectual property issues and policies that govern the race for patents have become prominent among IPLC movements across the globe. During my interview with Dr. Vandana Shiva (which took place in North India, after I visited the country's National Plant Genetic Resources Institute and the highest Seed Bank in the Indian Himalayas along with a delegation from the Navdanya Network, she recalled periods of cyclic change in the recognition of Indigenous rights:

> "I have watched the time where indigenous people had been forgotten. I have watched the time in the '90s, where, in India we wrote a self-governance law, which said Indigenous peoples[1] have the highest authority to decide what they'll do with their land,

[1] India's official terms for Indigenous Peoples is Adivasi and Scheduled Tribes.

> their forest, their resources, their development. Even the president of India cannot overrule their decisions… I have watched how paramilitary forces have been sent to crush Indigenous peoples exercising their constitutional right to self-determination. I have watched in the last few years how Indigenous defenders of the earth are the ones most frequently being killed, because we have an economy of greed whose appetite is insatiable (V. Shiva, Interview, August 2018)."

For IPLCs trapped in a food commodity centered regime, the contradictions of the food security paradigm, and the sociocultural complications that neocolonialism have presented, create vicious unhealthy cycles—just when IK/TK systems, thanks to the advance of Indigenous Peoples and IPLCs rights, remain at their best value in the present global environmental catastrophe. The importance of claiming an identity as knowledge holders and owners of specific knowledge(s) needs to be referred to in these contexts as key for insuring local capacity in food security, and as a precursor to food sovereignty as a new level of IPLCs governance and natural resource management capacity.

**Implications for Future Research**

In the proactive perspective, sustainable agroecological systems of germplasm conservation will remain tied to land rights and the development of international inter-tribal economic commons, as paired with a platform for education that enables knowledge systems exchange and integration. These processes around self-determined governance should not be seen as "concessions" from nation states, but rather, as the innovative and equitable integration of social dimensions in biological science research. One concrete form of action, pointed by many sources of this study, is the reform of Intellectual Property systems in order to accommodate and include Indigenous knowledge, biocultural indicators, customary laws, and

Indigenous commons into new platforms for economic development, as developed under self-determined economic laws, outside of western capitalist market competition, and under rules outside of the western corporate economic growth paradigm.

At the same time, biological and genetic research around bioethics is urgently needed, in the context of legal protections for medical and genetic information. It is especially important to restore critical safeguards for the collection of human genetic information from Indigenous Peoples and incorporate the existing accessions and databases into ABS compliance, as legal and science policy fronts. In parallel, the issues around the appropriation of plant and human genetic information from derived associated traditional knowledge constitutes a new and formidable research field that needs urgent attention, given how the access and manipulation of genetic Digital Sequence Information (DSI) that allows the use of genetic sequence codes derived from actual plant genetic resources, remains out of reach for ABS national and international policies expanding into uncharted territories due to emerging technologies such as artificial intelligence (AI). My participation in the IIFB delegation at COP-14 was precisely an appointment to participate with the group that developed the global position of Indigenous Peoples with regard to new DSI technologies, calling for the need of further regulation under the previsions established by the Nagoya Protocol.

The official report from the Ad Hoc Technical Expert Group on Digital Sequence Information on Genetic Resources of the Convention on Biological Diversity CBD, 2018 (UNEP, Laird et al., 2018) noted that the word ‘information’ has generated perhaps the greatest discussion, with significant differences in opinion on whether the subject of discussions is information or data, and whether genetic resources— defined within the CBD as “genetic material of actual or potential value” (genetic material means any material of plant, animal,

microbial or other origin containing functional units of heredity)—would include digital sequence information. Possible routes of action suggested by participants of the study suggested selective uses for education and research, under specific certification and licensing, in order to develop international bodies that participate in legal and biological policy research.

It is important to ensure that the perspective of agrobiodiversity is recognized in this dialogue as an expansion from the agroecology framework, given that it introduces the dialogue over governance systems sustained at CBD in conjunction with multiple law and policy platforms. This interrelation, in fact, confirmed my propositions about the importance of genetic resources and their intersection with international policy, food security, nutrition security, and research. The call for dismantling the criteria for the commercial valuation of germplasm as conservation unit, is based on the global CBD treaty establishing that local ecosystems cannot be impacted by the prioritization of genetic resources with commercial value.

This requires a different paradigmatic relation in a direction that biological and agricultural science can relate around these principles. It would involve shifting the very concept of economic growth to incorporate the perspective of biodiversity conservation, as both an actual limit to economic growth and as a fair alternative to western market competition. This shift needs to enforce the perspective of genetic improvement, rather than modification—i.e., improving the quality of genetic resources rather than manipulating them. Finally, research frameworks that introduce these key social considerations into biological and economic research need to also address the epistemic distances between agroecological and biodiversity conservation frameworks, and how they relate differently to the notion of private property and capital accumulation.

I agree also with Ens (et al., 2015) seeing "the potential contribution of Indigenous knowledge to contemporary ecosystem science and management …[as] irrefutable; the complex challenge we face worldwide, is how to integrate the knowledge, preferred management methods and inclusion of Indigenous and non-Indigenous peoples to reach local to international biological and cultural conservation objectives. This contribution represents an ultimate innovation in biological and environmental research and practice paradigms towards critical global needs in biodiversity conservation and constitutes a final call for an ethical transformation of the knowledge integration policies, decolonizing science and environmental research and education. Part of my participant-observation role has been to attend meetings and science briefs at the highest level of policy analysis within closed meetings at UNPFII and CBD where science reports from the most prominent scientists are warning about upcoming environmental catastrophes. This changes the whole perspective of our action and commitment.

One characteristic of the systems and mechanisms which needed to clarify changes in the visibility of governance relations is the acknowledgement of different jurisdictions and accountability of each knowledge systems (IK, TK, TEK, IEK, etc.) and their specific policy platforms and commitments reaffirming the need for decolonized interdisciplinary spaces that reaffirm knowledge plurality. In all cases, the incorporation of prior consent mechanisms towards a full FPIC process implementation would determine accountability frameworks and commitments for every project that might affect the rights and resources of IPLCs.

I deeply reflected upon the propositions of this study as this dissertation unfolded, having revealed the need to resolve contradictions at the level of implementation of the rights of Indigenous Peoples, through key research institutions' programmatic actions, connecting cases from communities who are making important differences today. Two lessons emerged from this,

following this notion of societies with "complex governance" (Morin et al., 2017): the need to promote inter-institutional learning as well as social learning processes, so as to "positively contribute to regime complex governance, favoring the constant adaptation of institutions to their changing social and institutional environment (Morin, et al, 2017 p. 3)." These principles are not mere ethical standpoints but calls for urgent action, as the latest science reports offered at the Convention of Biological Diversity and related forums on climate change have already discussed a point of no return from environmental impacts that may possibly transform all socioeconomic structures in more drastic and unexpected ways.

**Implications for World Indigenous Peoples**

Finally, it is my hope that Indigenous Peoples take away from this work three main considerations that have emerged from my consistent observations in and of Indigenous societies around the world:

1. The process of decolonization can only be guaranteed by the implementation of FPIC mechanisms, which in turn must be sustained as platforms for interaction and integration with the western world. The defense of the Nagoya Protocol and subsequent associated legal binding agreements depends on the defense of FPIC as an UNDRIP-mandated and universal mechanism. In this regard, the creation and emergence of diverse global Indigenous academic and legal representation is vital for the defense of a bundle of rights that IPLCs have been negotiating for generations.

2. The development of a global Indigenous commons around education, commerce, and economic development of Indigenous Peoples needs to proceed in parallel with the consolidation of intellectual proprietary rights over Indigenous knowledge funds as they are applicable to multiple disciplines.

3. The exercise of territorial and land rights can be advanced as a common objective in global decolonization efforts around the world. Local Indigenous societies must join those international law and policy bodies to counter corporate hegemonic control over strategic resources. It is my aspiration that Indigenous Peoples move towards the consolidation of genetic resources management systems that help to secure their rights over land and genetic resources, the expansion of environmental standards protection, as well as to secure food sovereignty through the implementation of organic seed banks that break their dependence from seed corporations, while contributing to biodiversity conservation at a global scale. It is vital for the survival of Indigenous Peoples to continue pressing for constitutional reforms within their own legislative contexts, in order to regain their identities as First Nations with all the power and security that entails.

4. It is vital, finally, that Indigenous Peoples establish strategic alliances with research universities to secure the competent knowledge of their proprietary rights, and insure the establishment of data records through relevant public data bases under limited registration, in which IK/TK frameworks applied to interdisciplinary research activities are legally recognized by external funding organizations for research and learning, external markets, research bodies, and extractive corporations. One example of the critical engagement of these alliances is their assistance in the implementation of genetic resource management systems. This will be the next step in the advancement of strategies for food security and food sovereignty to assist Indigenous Peoples' control over the dialogue, traffic, and utilization of their cultural and genetic resources.

## Appendix X

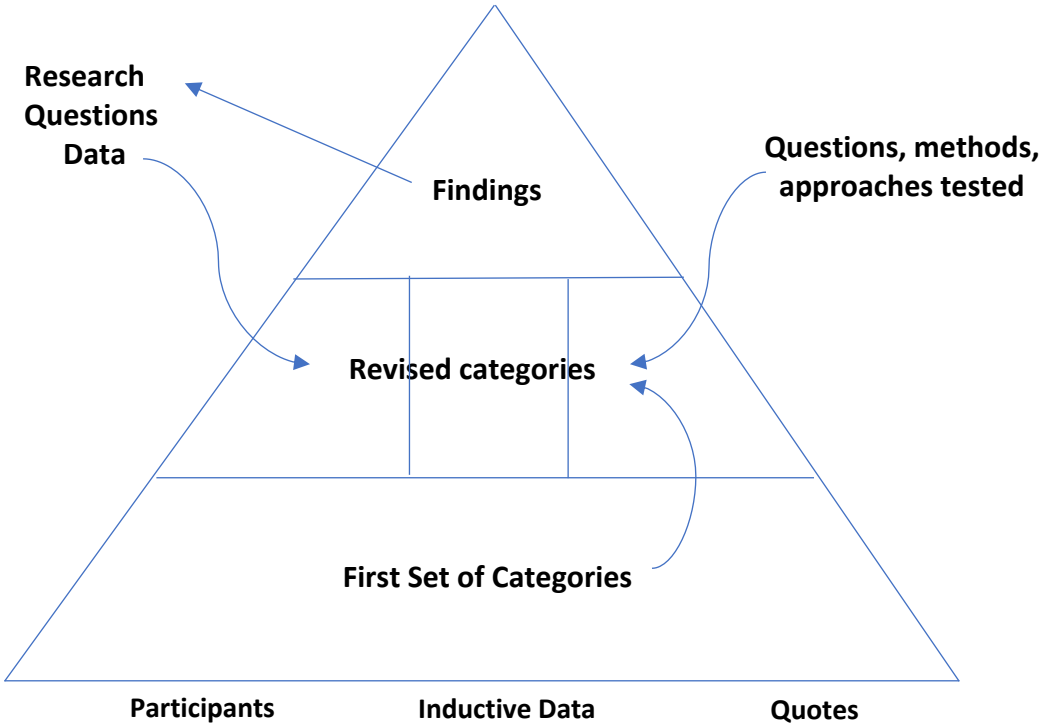
**Guide for Emergent Coding Analysis**

| Research Questions | Data Source | Analysis Strategy |
|---|---|---|
| What are the roles of education (eg. educational systems, curricula, pedagogies) in the transnational IPLCs processes of reintroduction of traditional agroecosystems of crop and CWR germplasm? | - Seminar (all data)<br>- Background experiences (POSOH, etc.)<br>- Quotes or speaks of role of education<br>- Reintroduction of agroecosystems. | Emergent coding focused on WHO, WHAT and HOW:<br><br>Different groups who participate benefit from the educational intervention,<br><br>AND the challenges and productive tools and practices with respect for each topics and subjects. |
| How do IK/TK and WSK interact around the exchange of agroecological practices and resources in the context of the developing international legal and policy regimes that Analysis Strategies | - International Interviews and Documents<br>- Documents, laws, declarations, experiences at COP14, and in the field.<br>- Indigenous Peoples and Local Communities and Western Scientific Knowledge researchers | A) Identify legal and policy conditions that constrain and guide the interaction of IK/ TK with WSK.<br><br>B) Examples of interaction of IK/ TK with WSK and ask how they are guided and constrained as well as resist legal and policy frameworks. |

**STAGE 1: Seminar Interviews**

| | |
|---|---|
| Instances of talk in which people discuss the goals, roles and outcomes of Education | • Background<br>• Positionality<br>• What are the implicit theories for interaction of WSK and IKS/TK?<br>• What sort of Education? |
| Emergent coding of instances of talk about interaction of IKS & WSK. Sub code: Methods | What outcomes do people expect from shifts in frameworks? How do people talk about the influence of policy contexts? |
| Emergent coding of instances of talk about frameworks | *Triangulation in qualitative inquiry involving gathering and analyzing multiple perspectives, using diverse sources of data, and during analysis, using alternative frameworks*. |

**Inquiry Model**



**Emergent Coding: Codes Constructed Definitions**

**1. Agriculture.** The notion of agriculture as a field and discipline in western science contrasts with the epistemological foundations of agriculture in Indigenous Knowledge systems. These differences are in the concepts and relations of property, ownership, hierarchical relations, clan affiliations, cultural distinctive practices and beliefs, as well as historical interrelations between these societies with the natural environments and the representations of those relations. These relations are still present in cultures that have survived a recent short period of 300-400 years of violent changes. In this period and before contact, the epistemological foundation of agriculture across multiple worlds that became in clash has substantial differences.

**2. Knowledge System.** Aside of the definitions offered earlier, **t**he dissertation departed from the constant reference to IK/TK together to avoid particular essentializations of these terms, and with the purpose of expanding the relationship between knowledge production processes. The reference moves also into an expanded notion of Knowledge Systems that include certain national circumstances in which local applications of western science can participate on productive dialogues around the strategic topic of biodiversity conservation. There are four subcodes included under this key code that are related to different foundations, practices and applications of Knowledge Systems: *Indigenous Knowledge Systems (IKS), Traditional Knowledge, Western Science, Epistemic.* From these, only the notion of epistemic needs to be clarified as the reference to cultural ways of knowing and meaning making of the world and nature relations from particular perspectives that are also linked to environmental and cultural-historical conditions.

**3. Exchange.** The idea of exchange is related to the opportunities for diverse knowledge systems that were disenfranchised and marginalized by western science epistemological,

methodological and economic control, to restore their epistemic and material connections and systems. These connections are not just present expressions of historical common histories of oppression and colonization, but restoration of actual material and epistemic trade connections between Indigenous societies long before contact. These exchanges are in general related for the purposes of this analysis and dissertation, to seed management, natural resource management, forest management, water resource technologies, agricultural diversification, natural genetic cross-breeding research, soil management, plant communities, as well as marine ecosystems and terrestrial ecosystems interconnection and management, among others equally relevant. All of them contained under different sets of relations as the sub-codes: ***Intersection, Practices, Research, and Reintroduction*.**

The idea of exchange is also related in this dissertation to bidirectional processes that ensure free, prior and informed consent processes between the research institutions and the Indigenous communities that are part of the initiatives to share protected knowledge, resources as genetic material, food and medicinal plant knowledge, and organisms and species that are part of an ecosystem. The arenas in which the exchange take place are educational research, science research, ceremonial in Indigenous contexts, community-based, international law forums and conferences, etc.

The subcode International is referred to the level of nation-states and conglomerate of national contexts. The notion of international is not related to a theoretical or methodological approach to comparative or transnational approaches. Finally, under exchange, the definition of the subcode Transnational applies to all what constitutes a system of relations beyond the sociopolitical and economic framework that would include an international scope. This more than a scope is a framework and set of multiple relations associated with the addition of

sociocultural and biocultural, plus the set of governance of the visible and invisible, the recognized and the non-recognized constituents from distant geographical locations.

**4. Framework.** The notion of framework as a central code implies principles, guidelines, practices, and a set of theoretical foundations and methodological approaches about applications, practices and analysis perspectives. All these components constitute the notion of framework for the purposes of this dissertation. This code contains seven subcodes that reflect different pertinent frameworks that are applicable to the scopes of the two studies: *Health, Sustainable Development, Traditional, Global, Sustainability, International, and Transnational*. From them, the framework of sustainability under all purposes in this dissertation is linked to the notion of sustainable development as international formal policy, defined as the attainment of the solution or set of proactive policy and concrete educational (service-learning programs) guidelines that incorporate ecological, cultural and economic considerations, among other relevant definitions. The framework of sustainability relates to the critical role of education at the level of multiple forums and interventions towards different constituency that run in parallel to multiple policy platforms with Indigenous Peoples formal representation.

**5. Governance.** Under the code of Governance there are associated notions referred to governance systems framed either by constitutional as well as customary law. It includes governance systems from recognized Indigenous Peoples by their national constitutions as dependent nations, or communities under autonomous laws or law administration systems, and where either sovereignty, autonomy and or self-determination frameworks are active. Governance also implies a different jurisdiction and authority in internal resources (environmental, genetic, cultural knowledge, intellectual property, innovations, trade secret,

decision making processes, educational systems, all based on cultural distinctiveness, and/or legal based local and relative national jurisdiction, as dependent of a nation-state.

Within this code we have subdivided into 5 sub-codes: *Legal and Policy; Self-Determination; Autonomy; Sovereignty; and Agroecosystems*. The subcode Legal and Policy is more related to Question 2 as it refers to the specific realm of international and national laws related to Indigenous Peoples such as the United Nations Declaration of the Rights of Indigenous Peoples (UNDRIP), and the Article 169 of the International Labor Organization, both ratified by all countries as legal binding agreements. Complementary, the legal and policy reference is related to national constitutional laws, as well as Customary Laws, defined as *standards of community* that have been long-established in a given local socio-geographical, biocultural, and cultural-historical contexts. However, the term can also apply to areas of international law where certain standards have been nearly universal in their acceptance as correct bases of action, such as laws against piracy or slavery. In many, though not all instances, customary laws will have supportive court rulings as case law that has evolved over time to give additional weight to their rule as law, and also to demonstrate the trajectory of evolution in the interpretation of such law by relevant courts.

The subcode Self-Determination represents one of the stages of the political advancement of sets of legal protections for Indigenous Peoples. Along with Soverignty and Autonomy, it represents a different result of the relation with the particular constitutional identity of a nation-state. Self-determination implies a relative increase in autonomy (decision-making level) to the development of institutions with a governance structure that even does not have sovereignty as any power to supersede the regional and local governments, have the voice in the design of policies and activities embedded in the cultural identity and vision of the local community. The

principle of self-determination has multiple application in all social and economic human activites as an inherent right of a local community to govern in their best interest and decision-making authority. In the specific context of Indigenous Peoples, self-determination implies a historical and political weight in the relation with the nation-state's local institutions, as the legal history between a particular Indigenous Peoples and a nation-state constitution. Education, legal, cultural, scientific, health, environmental, and political self-determination, is an aspiration from Indigenous Peoples of the world to restore their forms of governance.

The subcode Autonomy refers to a voice and decision-making authority in local and community governances' structure with no internal government institutions and non-recognition of different governance than the local and regional centralized dependent national governance. In these cases, autonomy is a dynamic in-movement social project that updates and recreates itself in individual basis and under different national legislations. Finally, the notion of Agroecosystems is based on agriculture as main activity. In this case connect with forests, watersheds and basins, as wider geographical markers and divisions that are contained into ecosystems that in which the agricultural base of these communities is inscribed.

Agroecosystems have at the same time different governance systems. One example subject is swidden agriculture,[17] also known as shifting cultivation, which refers to a technique of rotational farming from Indigenous Peoples living under Customary Law (not constitutionally recognized) in which land is cleared for cultivation (normally by fire) and then left to regenerate after a few years. Many members of these agrarian families practice a form of harvesting food across "food forests," that were managed by distinctive traditional practices re threatened by

[17] Swidden agriculture, also known as shifting cultivation, refers to a technique of rotational farming in which land is cleared for cultivation (normally by fire) and then left to regenerate after a few years.

national land grabbing or land concessions in Indigenous territories. Non recognized called 'Ethnic' groups are displaced from their territories and reassimilated as workforce in agricultural concessions in many parts of Asia and Africa at large scale. Usually national and corporate concessions tend to break any form of local traditional governance on privatized lands.

**6. Educational.** The code Educational is related to all theoretical, methodological and practical applications to formal and informal teaching and learning frameworks. Curriculum and Instruction are more related to formal education. While the notions of pedagogies crosses over informal and formal educational interventions. It represents also a moving dynamic state that had different values and connotations. Assimilation as a colonial policy was a project that was executed along with ethnic and cultural cleansing. It was imposed as part of a colonial education and was imposed as a value and adopted translated version of dominant constructed frameworks. In other processes, internalized assimilation was sold and eventually seen by Indigenous survivors as a positive form of incorporation into first, emerging national identities, and second as ethnic and social incorporation in urban multicultural spaces. The idea of the international seminar on Question 1 is an exemplary case of the inclusion of this highly important topic at one of the top 25 research universities in the world, with significant investment on genetic and biological research on genetic resources associated with Indigenous Peoples and their territories. Examples of institutions that carried assimilation goals were churches, boarding schools, religious affiliated schools, technical schools, vocational schools, etc. The references to educational levels also relate to degrees in formal education either Public or private and is more related to post-secondary education level: Bachelor, Masters and PhD. In general, when the dissertation refers to education in broader terms, it would imply not only formal and informal processes, but the learning experience itself, within and outside of schools, implying a much

wider content outside of the academic realm. In the learning experience of culturally distinctive cultures, education is not necessarily carried by institutions, but rather but a complex system of relations and practices of diverse nature. For the purpose of this dissertation, we must refer to education in more narrow terms: both as a process that carries the intention of transmitting knowledge from culturally distinctive peoples, and towards the understanding of environmental, natural and biological knowledge, relations and processes that are critical to sustainability.
A reference about the orientation of the knowledge production and practice towards the primary benefit of Indigenous Peoples is a key premise of this dissertation. The question remains open about when practitioners, researchers and learners want to position themselves as the assistance purveyors, breaking the community inner cultural governance systems and relations of the communities who they try to assist: What form of assistance is possible or relevant to the need to empower Indigenous governance systems to develop their own capacity? Does that capacity mean necessarily breaking with the methodological and institutional (funded research for example) ties with science?

The subcode Information is proposed in the context of the IEC (Information, Education and Communication) framework used on Public Health research, and as development framework and tool, the reference to Information is about a multidirectional transmission of objective and subjective content of diverse kind between different parties. The associated subcode of Curriculum is referred to a structured configuration of a formal educational unit, which contains a perspective of the learning experience, detailing the goals of the instruction, course, seminar or workshop; and structuring the flow of topics and perspectives according to learning objectives aligned with the larger framework to which this learning experience is designed to be implemented. In critical educational research, curriculums are also carriers of ideologies, or

ideological interpretations of society, as well as economic and cultural relations, representatives of the dominant culture and political system in power.

The notion of the subcode Pedagogies can be understood as the different instructional approaches and perspectives used to not only transmit information, but to connect in a transformative way the learner and the learning experience itself. Pedagogical approaches vary in the consideration of the sociohistorical and sociopolitical and economic situation of the learners and the learning environment, either schools or community-based organizations. These approaches vary also by the level of institutional commitments from standardized education to private charter vocational curriculums, and from community-based, place-based, and alternative education at urban and rural level.

**7. Indigenous Peoples.** This code and major reference relate to the general discussion around INDIGENEITY. The dissertation formally adheres to the international definition of Indigenous Peoples from UNDRIP, and the demographic estimates of Indigenous Peoples across the world with caution. Particularly on the demographic estimate, the fact of urban migration, intermingling societies, assimilation, and blood quantum levels, play a role on the relative validity of the estimate of Indigenous peoples. In many cases the strategic essentialization of this estimate agrees on a viable number for global resource management and coverage based on what nation states report. This code also relates to the notion of Indigenous communities under different treatment by national and international laws that recognizes their governance systems. Indigenous communities represent also another source of demographic estimation in terms of decolonizing the analysis of Indigenous populations across the world. Two associated subcodes are Reconnection and Decolonization, to allude processes that are complementary to each other, or part of the contextual political and cultural-historical nature of Indigenous peoples.

**Sub Codes**

I conducted 7 main rounds of coding that included 27 sub-codes that were selectively used to relate the topics from the interviews to important issues that the two research questions address. These codes and sub codes are:

1. Agriculture
    - 1.1. Germplasm
    - 1.2. Biodiversity
2. Knowledge System
    - 2.1. Indigenous Knowledge
    - 2.2. Traditional Knowledge
    - 2.3. Western Science
    - 2.4. Epistemic
3. Exchange
    - 3.1. Intersection
    - 3.2. Practices
    - 3.3. Research
    - 3.4. Reintroduction
4. Framework
    - 4.1. Health
    - 4.2. Sustainable Development
    - 4.3. Traditional
    - 4.4. Global
    - 4.5. Sustainability
    - 4.6. International
    - 4.7. Transnational
5. Governance
    - 5.1. Legal and Policy
    - 5.2. Self-determination
    - 5.3. Autonomy
    - 5.4. Sovereignty
    - 5.5. Agroecosystems

6. Educational
    - 6.1. Assimilation
    - 6.2. Higher Education
    - 6.3. Education
    - 6.4. Information
    - 6.5. Curriculum
    - 6.6. Pedagogies
7. Indigenous Peoples
    - 7.1. Indigenous Communities
    - 7.2. Reconnection
    - 7.3. Decolonization

**Question 1:**

Each sub code is related to each of the 7 main codes:

| **1 Agriculture** | **2 Knowledge** | **3 Exchange** | **4 Framework** | **5 Governance** | **6 Educational** | **7 Indigenous** |
|---|---|---|---|---|---|---|
| Epistemic | Biodiversity | Intersection | Health | Autonomy | Assimilation | Communities |
| TK | | research | SD | Legal and policy | Higher Ed | Reconnection |
| IK | | | sustainability | agroecosystems | Education | Decolonization |
| WS | | | transnational | | Information | |
| | | | | | Curriculum | |
| | | | | | Pedagogies | |

**Question 2:**

| **1** | **2** | **3** | **4** | **5** | **6** | **7** |
|---|---|---|---|---|---|---|
| Epistemic | Germplasm | Practices | Health | Legal and Policy | Education | Indigenous Communities |
| TK/IK | Biodiversity | reintroduction | Sustainable Development | Self-determination | Curriculum | Reconnection |
| | | | Traditional | autonomy | | |
| | | | global | sovereignty | | |
| | | | sustainability | agroecosystems | | |
| | | | international | | | |
| | | | transnational | | | |

**Data Collection**

| | |
|---|---|
| Document groups: 4 | PDF documents: 13 |
| Text documents: 202 | Table documents: 0 |
| Image documents: 0 | Codes: 45 |
| Coded segments: 2291 | Code sets: 0 |
| Document memos: 3 | Memos: 297 |
| Code memos: 26 | In-document memos: 268 |
| Document Variables: 0 | Code Variables: 0 |
| Document sets: 1 | Internals links: 0 |

**Interview Groups**

- 19 Participant Students – Nelson Institute (Spring 2017). Data: 182 Entries from Weekly Reflection posts.
- 5 Participant Students from both the Seminar at CMN and at UW-Madison. Data: Semi-structured interviews.
- 6 International Researchers. Data: Semi-structured interviews
- 7 Presenters both national and international from UW-Madison.

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