Article

Shifting the Framework of Canadian Water Governance through Indigenous Research Methods: Acknowledging the Past with an Eye on the Future

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Abstract: First Nations communities in Canada are disproportionately affected by poor water quality. As one example, many communities have been living under boil water advisories for decades, but government interventions to date have had limited impact. This paper examines the importance of using Indigenous research methodologies to address current water issues affecting First Nations. The work is part of larger project applying decolonizing methodologies to Indigenous water governance. Because Indigenous epistemologies are a central component of Indigenous research methods, our analysis begins with presenting a theoretical framework for understanding Indigenous water relations. We then consider three cases of innovative Indigenous research initiatives that demonstrate how water research and policy initiatives can adopt a more Indigenous-centered approach in practice. Cases include (1) an Indigenous Community-Based Health Research Lab that follows a two-eyed seeing philosophy (Saskatchewan); (2) water policy research that uses collective knowledge sharing frameworks to facilitate respectful, non-extractive conversations among Elders and traditional knowledge holders (Ontario); and (3) a long-term community-based research initiative on decolonizing water that is practicing reciprocal learning methodologies (British Columbia, Alberta). By establishing new water governance frameworks informed by Indigenous research methods, the authors hope to promote innovative, adaptable solutions, rooted in Indigenous epistemologies.

Keywords: Indigenous research methods; water governance; Indigenous knowledge systems; Indigenous water relations; community-based research; reciprocal learning; environmental justice; boil water advisories; First Nations; Canada

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1. Cree Creation Story

After the Creator had made all the animals and had made the first peoples, he said to Wisakedjak, "Take good care of my people, and teach them how to live. Show them all the bad roots, all the roots that will hurt them and kill them. Do not let the people or the animals quarrel with each other." But Wisakedjak did not obey the Creator. He let the creatures do whatever they wished to do. Soon they were quarreling and fighting and shedding much blood.

The Creator, greatly displeased, warned Wisakedjak, "if you do not keep the ground clean, I will take everything away from you, and you will be miserable." But Wisakedjak did not believe the Creator and did not obey. Becoming more and more careless, and disobedient, he tricked the animals and

the people and made them angry with each other. They quarreled and fought so much that the earth became red with blood.

The Creator made all things again. He commanded the rivers to take the salt water back to the sea. Then he created mankind, the animals of today, and the trees. He took from Wisakedjak all power over people and animals and left him only with the power to flatter and to deceive [1] (p. 227).

We include this creation story highlighting the experiences of the trickster Wisakedjak in order to illustrate how stories provide an important source of knowledge [2]. Acknowledging that there is no universal creation story, we have chosen this Cree story as one example of Indigenous knowledge that suggests the importance of sustainable environmental governance of land and water. This version was taken from the First Nation Environmental Assessment Toolkit by the Chiefs of Ontario. Indigenous author John Borrows explains the significance of Indigenous storytelling by stating, "one cannot understand First Nations law unless there is an appreciation of how each story correlates with other stories" [3] (p. 455). He states an important source of Indigenous legal traditions flows from stories, teachings and experiences. Thus, placing stories at the forefront of our work is part of a broader effort to center our research around Indigenous knowledge and research methodologies.

2. Introduction

Water governance challenges are typically framed as technology, infrastructure, or funding problems, but deeper analysis often reveals that inequitable resource distribution, sociopolitical and governance challenges are the more fundamental issues [4,5]. The First Nations water crisis in Canada is a case in point [6]. Many First Nations communities are living with multi-year boil water advisories, inadequate water treatment facilities, and little to no policy commitments to address local source water contamination [7–9]. While most Canadian citizens have access to safe drinking water, many First Nations communities are forced to treat water sources, or are altogether lacking clean water access. Although non-Indigenous rural communities are also impacted [10], studies have demonstrated that First Nations in Canada are disproportionately affected by poor water quality.

Despite increased attention to this issue, government interventions have been hard pressed to address First Nations community concerns [11–13]. Scholars have pointed to the highly fragmented nature of Canada's water governance institutions as part of the problem [7,14,15]. In many cases, federal or provincial governance bodies have delegated water management responsibility to communities, based on the premise that local communities are well positioned to understand and address local water management challenges. Yet in this case, devolution of management authority has occurred as an unfunded mandate, since many local communities lack the financial and technical resources, as well as the governance capacity required to fully provide community water needs [7,8,15–17].

In addition to causing severe public health issues, the lack of clean water for Indigenous communities also eliminates the spiritual connections and cultural uses of water that are equally essential to many First Nations. Departing from a worldview that treats water as a resource or commodity, many Indigenous peoples maintain a spiritual relationship with the land and water, and in many cases, water is understood to be an animate being. Indigenous water relations have been described in multiple contexts, which alternately emphasize interdependency, reciprocity, respectful conduct, and the aliveness of water [18–24]. Loss of clean water threatens the ability of First Nations to maintain their relationships with the land, animals, plants and water as an important component of cultural identity [24–27].

This paper examines a gap in our understanding of how Indigenous research methodologies can be applied to Indigenous water governance problems. Our work applies decolonizing research approaches to water governance, and requires critical applications of Indigenous research methodologies based on Indigenous knowledge [28,29]. In *Decolonizing Methodologies*, Linda Tuhiwai Smith describes the process of "decolonizing" as a process which includes an in depth understanding of imperial and colonial impacts on Indigenous peoples. To *decolonize*, one must "draw upon the notion of authenticity" drawn from enduring practices of Indigenous self-determination, which persist despite ongoing colonial legacies [28] (p. 25).

This work is unfolding in the context of a Canada-based partnership on Sustainable Water Governance and Indigenous Law, an eight-year, community-based research initiative that aims to create prototypes (both technical and governance in scope), which support Indigenous-led water monitoring programs rooted in Indigenous legal traditions (www.decolonizingwater.ca). The authors of this paper have connected through the partnership's Indigenous Research Methods Working Group (IRMWG), and are seeking to understand and develop innovative methods for collaborative research on Indigenous water governance.

Our working group members are both Indigenous and non-Indigenous scholars and practitioners who are following the philosophy of "two-eyed seeing" as an approach to linking innovative Indigenous research methodologies and western approaches [30,31]. We see our work as acknowledging the past with an eye on the future in order to address current water governance challenges. To be clear, our approach is not calling for an integration of knowledge systems—an approach that has been widely criticized, since Indigenous knowledges do not currently carry the same weight as western scientific knowledge in conventional water/environmental governance regimes. We are also not intending to limit the types of interacting knowledge systems to a binary of Western and Indigenous knowledge [15,32,33]. Rather, we recognize that there are multiple knowledge systems being co-produced within an uneven political context affecting water relations.

For the purposes of this paper, we use the term Indigenous knowledge systems in a broad sense to mean knowledge created and/or mobilized by Indigenous peoples that may include traditional knowledge and scientific knowledge frameworks [34,35]. We also use the term traditional knowledge to discuss longstanding knowledges, practices, and beliefs, developed from experience gained over the centuries and adapted to the local culture and environment, which are handed down through the generations. This includes traditional ecological knowledge regarding the relationship of living beings (including humans) with one another and with their environment, as well as traditional social knowledge [36,37]. Following the United Nations' International Covenant on Civil and Political Rights, we refer to Indigenous self-determination as the right of Indigenous peoples to "freely determine their political status and freely pursue their economic, social and cultural development" [38]. We acknowledge the diversity of Indigenous knowledge systems, which differ within and among communities, across regions, languages and cultures.

Following a discussion of Indigenous research methodologies and the multitude of issues that First Nations face when accessing clean water, our analysis begins by presenting a theoretical framework for understanding Indigenous water relations, an essential starting point for water policy interventions and our broader decolonizing water project. We then present three case studies that demonstrate how Indigenous research methodologies are being critically applied to current water governance challenges in Canada. These findings are intended to speak to a wide range of water governance issues concerning First Nations communities in Canada, including climate change, water allocation, and industrial impacts on water sources, among others.

Our case analyses trace a set of pathways connecting concepts to practice. These cases include (1) an Indigenous Community-Based Health Research Lab, based on the philosophy of two-eyed seeing (Saskatchewan); (2) water policy research that uses knowledge sharing frameworks to facilitate knowledge sharing conversations between Elders and traditional knowledge holders (Ontario); and (3) a long-term community-based research initiative founded on the principles of reciprocal learning and decolonizing methodologies (British Columbia, Alberta).

3. Case Background: Decolonizing Water

3.1. Indigenous Research Methodologies

Indigenous research methodologies have emerged in recent decades in response to colonial research paradigms that have continued to subjugate Indigenous peoples and their lands [28,29]. Indigenous research approaches, paradigms, and methods put "tribal methodologies" at the center of

the research project [29]. Such approaches are based on Indigenous ways of knowing [39,40]. Building on other emancipatory research methods, such as community-based participatory research, feminist research methods, and others, Indigenous research acknowledges the "power politics of knowledge and the research practices that produce it" [41] (p. 50).

There are as many approaches to Indigenous research as there are Indigenous nations. In this paper, we focus on community-based Indigenous research as a way to prioritize community concerns and ways of knowing. We discuss some of the guiding principles for Indigenous research established in literature below.

As a first step, Indigenous research requires building reciprocal and respectful community-based research relationships. The research relationship is intended to establish trust, and to ensure that the research agenda produces mutual benefits for both the community and researcher. By engaging with, rather than conducting research on, communities, researchers hope to enhance the capacity of their research partners in a spirit of reciprocal learning. This often means offering training opportunities for communities and their youth, and assisting with key challenges faced by the community. Scholars also suggest that working with a network of researchers can facilitate benefit sharing with communities, and help to ensure that knowledge obtained through research studies is effectively disseminated [3,28,42].

Because the vast majority of research is currently defined through a western science-based lens, Indigenous perspectives often become occasional add-ons or afterthoughts. Therefore, Indigenous knowledge and worldviews must increasingly become a starting point for new research efforts. Indigenous research is formulated based on Indigenous worldviews, knowledges and experiences. It also responds to particular Indigenous needs and inquiries. As Cree scholar Margaret Kovach writes:

> Indigenous methods do not flow from western philosophies, they flow from tribal epistemologies. If tribal knowledges are not referenced as legitimate knowledge systems guiding Indigenous methods and protocols within the research process, there is a congruency problem. Furthermore, by not recognizing Indigenous inquiry for what it is—a distinctive methodology—the political and practical quagmire will persist. [29] (p. 37)

Some Indigenous health researchers follow principles of two-eyed seeing, which means to learn from one eye with the strengths of Indigenous knowledges and ways of knowing, and from the other eye with the strengths of western knowledges and ways of knowing [28,43,44]. This approach recognizes that Indigenous ways of knowing have been undermined for centuries and must be central to the inquiry, yet it does not reject western scientific knowledge. Following these protocols and principles within the context of trust-based relationships requires sustained commitment to effective, reciprocal dialogue and to building relationships that acknowledge the complicated and ambivalent history of colonial research [14,28,29,39,45,46].

In addition, Indigenous research methodologies seek "to make positive differences in the condition or lives of people" [28] (p. 130) and understand that "research exists within a system of power" [28] (p. 226). In Linda Tuhiwai Smith's *Decolonizing Methodologies* (2012), she writes that Indigenous researchers need to take their culture into consideration. She also advocates for Indigenous researchers to "think critically and address structural relations of power and build cultural values and systems and contribute research back to communities that is transformative" [28] (p. 214). She stresses the importance of Indigenous communities "talking up to" or "talking back to" power [28]. These ideals are important for non-Indigenous researchers to consider in order to understand what First Nations communities are looking for in research partnerships.

Finally, Indigenous communities are developing their own ethical guidelines and protocols to protect their communities and knowledge systems. These guidelines build on four core values of Indigenous Community-Based Research (often referred to as the "four R's"): respect, responsibility, reciprocity, and relevance [47]. In the Canadian context, the National Aboriginal Health Organization (NAHO) has developed the OCAP (Ownership-Control-Access-Possession) principles, which provide a practical roadmap for implementing the 4Rs. The OCAP principles convey that ownership of data

rests with communities. To retain control over their knowledge, communities have prescribed protocols for data access and possession. These protocols must be negotiated between First Nations communities and researchers [48]. As encouraged by Smith (2012), this approach directly challenges existing power relation structures, emphasizes principles of self-determination, and opens up communication between parties.

We recognize that even thoughtfully enacted policy change impacts can require a decade or more before quantifiable results are observed [49]. Our case analysis identifies key shifts in process mechanisms within relevant water policy and research forms that are critical for initiating and supporting positive, lasting changes for First Nations water governance. These process shifts, which include shifts in resource allocation, institutional arrangements, and dominant belief systems, among others, are necessary precursors for desired watershed outcomes, which effectively address First Nation community needs and interests [49,50].

3.2. First Nations Water Crisis

The First Nations water crisis is a serious and ongoing problem, which illustrates the fundamental changes required in Canadian water governance models. A 2016 report by Human Rights Watch stated that 134 water systems in 85 First Nation communities across Canada were currently under boil water advisories. Some First Nations communities have suffered under boil water advisories for decades without resolution. These advisories are "indicative of the broader systemic crisis that leaves many First Nations persons facing daily challenges just to access safe water for drinking and hygiene" [8] (p. 4).

The complex and fragmented nature of the current governance structure has created gaps in the provision and regulation of freshwater to Indigenous communities, with negative impacts on both human and environmental health [51]. While provincial governments regulate water quality for off-reserve communities, there are no comparable regulations in place for water quality on First Nations reserves [6,17,52]. The responsibility for providing and maintaining clean water sources is often shared between Aboriginal Affairs and Northern Development Canada, Health Canada, Environment Canada and First Nations community leadership, which creates numerous challenges with accountability [7,53,54].

Ontario First Nations communities are at the forefront of this water crisis, and their experiences illustrate the geographical and situational diversity of water quality issues that can be observed throughout Canada [6]. Poor water quality, caused by both natural and manmade contaminants, creates unique challenges for remediation efforts and water treatment strategies [55]. In many instances, water treatment infrastructure is absent or inadequate, and monitoring programs are limited or non-existent. Human health concerns mean that community members cannot drink water from the tap, wash properly, and/or are at an increased risk of harmful bacterial infections [8]. Thus, First Nations community members that choose to remain in their community must endure substandard living conditions, and seek expensive alternative sources of water for consumption.

The federal government has attempted to address the First Nations water crisis primarily by increasing funding for treatment facility and infrastructure improvement [53,55]. In March 2016, Canada's Prime Minister announced yet another investment of $4.6 billion over five years to improve infrastructure in First Nations communities. Unfortunately, the measures have been largely unsuccessful, and poor water quality remains pervasive in many communities. This is, in part, because infrastructure inadequacies constitute only one piece of a multi-dimensional problem whose origins can be traced back through colonial history [52]. Without a concrete regulatory framework in place to govern water quality for First Nations, and insufficient decision-making power allocated to community leaders, spending more money will continually fall short of improving water quality [6].

Canadian social and legal experts acknowledge the urgent need for a paradigm shift in water governance to more effectively address the multitude of water-related problems in First Nations communities [56,57]. Attempted interventions to date have historically ignored Indigenous values and methods for assessing and addressing water quality in their territories. Thus, among the multiple

proposals for improving policy intervention, one recommendation is to use Indigenous-focused research methods to evaluate water quality. Additional recommendations involve increasing capacity within First Nations communities to independently test for quality and contamination, and establishing a legal and administrative framework based on First Nations water rights [7,52,57]. Such measures would help construct an Indigenous-led framework of water governance to establish satisfactory quality guidelines and maintain these improvements over multiple generations.

Succeeding with this paradigm shift, however, requires overcoming a long history of colonial and extractive research on Indigenous communities, which has largely excluded First Nations and their concerns from research agendas and allowed industry to dominate the research and regulation process.

4. Discussion and Analysis

4.1. Indigenous Research Contributions: Understanding Indigenous Water Relations

As our first contribution towards addressing First Nations water governance challenges, we present a theoretical framework for understanding Indigenous water relations. In doing so, we propose reconfiguring our understanding of human-water relations based on Indigenous knowledge systems, with a focus on Indigenous epistemologies of water. We draw from our own research, existing literature, and Indigenous legal traditions to establish how Indigenous knowledge can help shift current water governance approaches. We see this as a positive intervention in the status quo approach to doing research on water governance issues.

This is a crucial shift in approach given that Indigenous knowledge is typically marginalized by dominant society [58–62]. As evidenced by the Indigenous water security challenges described in this paper, Indigenous peoples continue to experience ongoing colonial legacies, which create the adverse social, political, and environmental conditions making Indigenous communities more vulnerable to health problems, and other issues. Even in more inclusive research contexts, Indigenous knowledge is often used in a techno-bureaucratic manner to provide an empiric measurement for policy makers, without considering broader context or the diversity of Indigenous knowledge systems [63]. These challenges are exacerbated by the current system of laws, sciences, and policies that exclude Indigenous perspectives, knowledges, and worldviews, and choose to privilege western science as the final authority [7,59].

In "Aboriginal Women, Water and Health", Kim Andersen (2010) discusses the different ways in which water affects the spiritual, physical and mental health of Indigenous people. In this article, Andersen interviews eleven First Nations, Inuit and Métis grandmothers who illustrate how water is needed for Indigenous spiritual and physical health because it is needed to wash, it is needed to drink, and in Indigenous cultures it is also used to send people back into the spirit world. The grandmothers also stressed the cultural significance of water being present in childbearing and discussed the many ways in which water can "heal" [63]. These spiritual and physical needs are what guide Indigenous peoples in protecting and respecting water through ceremony, song and prayer. Deborah McGregor describes this Indigenous connection to water as:

> The ethic of responsibility to water reflects the notion that water is understood as a living force which must be protected and nurtured; it is not a commodity to be bought and sold. Water, according to First Nations peoples, has cleansing and purifying powers. It is the giver of life with which babies are born. It is imperative in our traditions to keep the water clean so it can continue to fulfill its purpose. [15] (p. 501)

McGregor and Andersen describe Indigenous women as the protectors of water for the benefit of generations to come. Based on the reflections of the grandmothers interviewed, Andersen writes that "women have a distinct spiritual connection to water because of their ability to carry the waters of new life" [64] (p. 36). Additionally, earth is also a woman, and is referred to as a mother, with water being described as her life blood [64,65]. Furthermore, it is not just lakes and oceans that require protection,

respect and reverence, but also the rivers, streams, and creeks which carry water to and from the oceans and lakes [64].

Indigenous cultures and knowledges also stress the significance of water in all creation, including the creation of life itself [62,65]. In "Traditional Knowledge and Water Governance," Deborah McGregor (2014) explains the Indigenous connection to the Creator, which in turn defines their connection to all creation extending to the earth, the plants, the animals, and all people on earth including our ancestors and those yet-to-be-born generations [15]. It is these relationships with each other, with creation, and with the Creator that gives rise to "natural law" [3,66].

In the report *Anishinaabe Nibi Inaakonigewin*, Aimée Craft (2013) discusses what Anishinaabe (the different spellings of this word reflect the diversity of Indigenous cultures throughout Canada, and some of the different spelling systems used in Indigenous languages) water law means to the Anishinaabe people:

> Laws govern interactions between beings. In Anishinaabe law, we expand our understanding of "beings" to include life forms such as animals, plants, rocks, in other words anything that has a spirit. Spirits are considered to be beings with whom we interact. Anishinaabe law considers the interactions between and within these beings and understands them to be governed by spiritual, natural and customary laws. Sacred law is the law that is handed down to us by the spirit. Natural law is dictated by what we observe in nature and that "behaviour" which we model ourselves by. [66] (p. 44)

Craft (2013) further explains that the "Anishinaabe way of life is centered on relationships, and responsibilities are associated with each of those relationships. These relationships give rise to rights, obligations and responsibilities. Rights, obligations and responsibilities are exercised both individually and collectively by the Anishinaabe [66] (p. 8)." The responsibility and accountability that Indigenous peoples have to water is the reason why Indigenous peoples require their own jurisdiction over water in their communities, and why they should be included in water policy decisions with other governments [8,15,66].

This further illustrates why it is necessary to shift how dominant water governance frameworks typically view knowledge and resources, McGregor discusses how many Canadians understand water "as a resource, a commodity to be bought and sold" and how this has threatened Indigenous worldviews. McGregor stipulates that the adaptability of Indigenous knowledge systems makes them ideal to "meet new challenges" and ensure "proper conduct" in respect to water relations [15] (p. 494). She describes how Anishinaabek knowledge guides an understanding of our responsibility to all beings in Creation through stories, which remind us "that our relationships are not centered exclusively on people, but are shared among all our relations". Through our interactions with Creation, the natural world and the environment, we learn about these relationships and responsibilities [15] (p. 495). Indigenous legal scholar John Borrows also asserts that Indigenous knowledge can provide valuable information, knowledge and insight on water quality, fish habitats and spawning, animal migrations, and "social and cultural effects of situating new villages"—a concept Borrows calls "(re)placing knowledge" [3] (p. 437). Borrows points out that new designs for Indigenous co-governance of water would benefit greatly from collaborative research and studies in the areas of law, Indigenous studies, political science, environmental studies and geography:

> The rich stories, ceremonies, and traditions within First Nations . . . contain the law in First Nations communities as they represent the accumulated wisdom and experience of First Nations conflict resolution. Some of these narratives pre-date the common law, have enjoyed their effectiveness for millennia, and have yet to be overruled or extinguished out of existence. These laws relative to environmental protection are strong and contain legal principles that could be integrated into US and Canadian institutions. [3] (p. 454)

Indigenous author Vine Deloria echoes the importance of Indigenous connections and relationships to the "land", a term he uses to encompass the bodies of water that make up the broader

landscape. Deloria adds that land is a significant part of Indigenous peoples' identities. Deloria describes Indigenous views of land as "the most vital part of man's existence . . . It supports them, [and] tells them where they live" [25] (p. 175). He also discusses the common Indigenous practice of placing the land at the center of their universe. This practice functions to ensure that Indigenous peoples have "a home to go to", helps to secure their identity, and enables them to live off the land without being disconnected from it [25].

Deloria also emphasizes the importance of acknowledging, learning from, and using Indigenous law and knowledge systems so that all people can benefit from Indigenous knowledges. Broad transmission of Indigenous knowledge to non-Indigenous communities has occurred since colonial periods, with the loss of Indigenous languages increasingly necessitating the writing and recording of traditional knowledge [15,66]. At the same time, it is important to acknowledge the challenges with sharing Indigenous knowledges. Due to the disempowered status and outstanding land rights issues that many communities face, Indigenous peoples are often wary about sharing their vast repositories of knowledge. In addition, not all knowledge is appropriate for sharing with all people. Indigenous communities often face difficulties around sharing traditional knowledge without giving away sensitive information—a practical reality that researchers and government officials should be aware of [67].

Finally, Indigenous water relations are often based on the concept of reciprocity, which includes the maintenance of respectful relations between human and non-human entities. Just as water sustains human life, humans hold an inherent caretaking responsibility for the waters they depend on for their survival. By focusing our attention on reciprocal relationships and away from commodities, Indigenous perspectives can help challenge dominant assumptions regarding water governance [3] and create a better understanding of how human and non-human entities (including water) are co-constituted in the context of the particular Indigenous lands and cultures.

4.2. Indigenous Research Contributions: Indigenous Water Governance Case Analysis

Our second contribution to Indigenous research methodologies involves directly engaging First Nations communities in research to address current Indigenous water governance and health challenges. Taking a case study approach, we describe three innovations in Indigenous research methodologies that have facilitated respectful collaborations with First Nations communities to address water governance issues and related problems. These cases draw from our own experiences with Indigenous research initiatives across Canada to effectively illustrate an Indigenous-centered approach.

4.2.1. Redesigning the Research Lab: "Two-Eyed Seeing"

As a first innovation, First Nations community leaders are reinventing the research lab based on Indigenous research methodologies. One such example is the Indigenous Community-Based Health Research Lab, located at the First Nations University of Canada in Saskatchewan, run by Dr. Carrie Bourassa, and funded by the Canadian Foundation for Innovation. This laboratory uses Indigenous methodologies to support research with several Indigenous communities on and off-reserve, in rural, remote, and urban contexts.

The Indigenous Community-Based Health Research Lab (recently re-named in ceremony by lab Elder Betty McKenna as Morning Star Lodge) includes a community lab, which provides a safe space for Indigenous community partners to engage in various Indigenous community-based research projects, as well as a lab for training undergraduate and graduate students. Examples of alternative research practices used include applying Indigenous methodologies to code data; preparing tobacco bundles under the guidance of a research team Elder; reviewing and editing video footage; and learning about "body mapping". Body mapping is literally the process of creating body maps through a variety of techniques that can include painting, photography, drawing, or a combination of artistic techniques that represent an individual's aspect of their life, body, and the world and environment in which they live. Essentially, it is a form of storytelling done through symbols that the individual or participants

can share. In an Indigenous context, an Elder or Knowledge Keeper facilitates and assists with the process to help participants share their individual stories. This technique is often seen as having therapeutic value [68].

The lab practices the philosophy of two-eyed seeing and reciprocal learning, discussed above, which draws from the strengths of both Indigenous and western knowledges and ways of knowing [28,43,44]. One example of the successful interplay between knowledge systems is the Indigenous Storytelling methodology, often referred to as the conversational method on Indigenous Research Methodology (IRM), that is used by Dr. Margaret Kovach [69]. This approach can be seen as a way of gathering knowledge in the oral storytelling tradition within IRM [69]. As one example in the lab, data is collected from participants using storytelling methodology. The group then works in the student training lab to employ NVivo qualitative analysis software for the initial data coding. Afterward, the entire research team uses the community lab for second and third level coding, where the group uses Indigenous methods to collectively analyze the data, an approach that is referred to as the Collective Consensual Data Analytic Procedure (CCDAP) [70].

The lab space emphasizes critical mentorship of emerging health researchers. The lab group practices a mentorship model that is based on respect, responsibility, reciprocity and relevance, as core values of Indigenous research [47]. The student training lab fosters a team environment for undergraduate, graduate and postdoctoral trainees, supervised by Dr. Bourassa and her academic group. Elders are actively involved in guiding every research project, and are always available to the student trainees. Mentorship in the lab happens not only between academic supervisor/student, but also between students, as well as between Elders and students, community members and students, and especially between community members and academics. Academic team members often remark how much they learn from the Elders and community members in this setting.

One of the most important outcomes from this work is the facilitation of mentorship—not only amongst and between student and community trainees, but also amongst and between student/community trainees and research team members. Research teams may include academic leads, Elders/Knowledge Keepers, community leads/co-leads, physicians, nurses, clinicians, policy makers, and this is what makes our approach so powerful. We have heard many testimonials from students and our diverse team members explaining how much they have learned through this reciprocal learning process. It is a process that opens up new avenues for individuals to explore and develop new methodologies, new epistemologies, and new ways of thinking and collaborating. Recently, the Canadian Foundation for Innovation recognized this important work by naming one of our students and our lab as part of the #IAmInnovation Campaign. By developing an innovative research process, team members create new pathways for research applications, including new approaches to solving water governance problems.

4.2.2. Indigenous Research and International Water Policy: Knowledge Sharing Frameworks

Our second case follows Indigenous research methods that have helped to include traditional knowledge in complex water governance negotiations. This work discusses a series of agreements involving the Chiefs of Ontario, and a series of policy agreements on Great Lakes water quality occurring at multiple scales. Such approaches are particularly important for supporting decolonizing efforts, particularly water co-governance frameworks that enable First Nations communities to take on a meaningful decision-making role alongside state agencies. In this case, Indigenous research methodologies played a key role in facilitating the recognition and inclusion of Indigenous knowledge in dominant water policies. This was accomplished, in part, by building a shared knowledge base across multiple First Nations communities through a respectful, collaborative, and non-extractive research framework.

After fifteen years of advocacy to change policy direction in relation to the Great Lakes, in 2001, the Chiefs of Ontario directly engaged in policy research with Elders, Traditional knowledge (TK) holders/practitioners and keepers to influence water policy and governance. By developing a

"knowledge sharing framework" [71], the Chiefs worked to affect policy at the international (Great Lakes Water Quality Agreement), national (Canada-Ontario Agreement respecting the Great Lakes Water Quality Agreement), and provincial (Great Lakes Strategy and Great Lakes Protection Act) levels. The knowledge sharing framework approach facilitates more innovative and culturally appropriate modes of working with Indigenous peoples and their knowledge, in addition to mobilizing Indigenous knowledges for broader aims and aspirations.

A knowledge sharing framework is a research approach [71] that brings knowledge holders together to share their expertise, experiences and knowledge through an open process. TK holders/Elders share knowledge with each other, rather than have knowledge extracted from them on an individual basis (e.g., through interviews). Knowledge sharing was achieved through a series of gatherings that occurred over a number of years [72]. In the collective knowledge sharing process, ceremony and Indigenous language formed an essential aspect of the gatherings, along with the observation of traditional protocols. This approach is similar to the Anishinaabek water law research methodology employed by Aimée Craft, which uses a "faculty of Elders" approach [15].

TK holders/Elders shared with each other to build upon their experiences and expertise. Both men and women were invited to participate, in part to account for gender differences. Knowledge related to taking care of water, water laws, water governance, and traditional knowledge was shared at these gatherings and recorded. Through advocacy involving the Chiefs of Ontario (a political coordinating and advocacy organization representing 133 First Nations in Ontario), the Chiefs of Ontario gained empirical evidence (throughout these gatherings over 100 Elders/TK holders participated) to support the inclusion of First Nations peoples and TK in broader policy and governance frameworks.

In 2008, the gatherings culminated in the Water Declaration of the Anishinaabek, Mushkegowuk and Onkwehonwe, which forms the basis of the First Nations policy direction [72]. The Water Declaration has influenced provincial policy and finds expression in the Great Lakes Strategy. The emphasis on traditional knowledge (TK) and continued advocacy also resulted in the recognition of TK in the Great Lakes Protection Act, 2015. The Great Lakes Protection Act includes provisions for Indigenous involvement in water governance through the creation of the Great Lakes Guardian Council. In this way, research based on Indigenous methodologies has facilitated the recognition of TK in the Great Lakes Water Quality Agreement between Canada and United States (2012).

Knowledge sharing gatherings are ongoing as TK continues to shape water governance in Ontario [15], and more recent approaches focus on youth engagement. TK holders/Elders have stated that they wish to share their knowledge with youth, so that TK can be utilized at the community level as well as broader policy and governance levels. In 2015, the Chiefs of Ontario coordinated an Elder/youth gathering in Sault. St. Marie, which they called the "Following in the footsteps of our Ancestors Elders and Youth Water Gathering". The purpose of the gathering was to enable the sharing of traditional knowledge related to protecting the waters, particularly the Great Lakes. The gathering offered First Nations youth the opportunity to connect with Elders, share knowledge, and begin to build their capacity as leaders.

The Chiefs of Ontario's advocacy for the inclusion of TK in Great Lakes governance has resulted in the explicit recognition of traditional knowledge in the Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health (COA), 2014. The Agreement contains an Annex devoted to engagement with First Nations. For example, Annex 13 includes the explicit goal to "Enhance understanding and appreciation for the Great Lakes by considering traditional knowledge", and "envisions a result of creating opportunities to collaborate with First Nations on traditional knowledge". This commitment led to a TEK/youth gathering held in 2015 (see http://www.chiefs-of-ontario.org/node/398 for a video of the gathering). It has also led to the funding of pilot projects to demonstrate how TEK can apply to addressing Great Lakes environmental challenges. More recently, the Government of Canada announced via the 2017 budget the establishment of the Great Lakes Protection Initiative (GLPI), which in turn supports the Great Lakes Indigenous Fund (GLIF). The GLIF supports Indigenous community-based projects to protect the Great Lakes.

4.2.3. Research Methods for Decolonizing Water: Reciprocal Learning

Our third case considers the authors' current work as members of the Sustainable Water Governance and Indigenous Law partnership project. The decolonizing water partnership currently includes 44 interdisciplinary research collaborators, with funding support that extends from 2016 to 2023. One of the project goals is to help create and support a framework for reciprocal learning as a key strategy for operationalizing Indigenous research methods within academic and policy networks, and as an important step towards decolonizing water in practice.

Part of our role within the Indigenous Research Methods Working Group is to provide the foundation for ethical research for the working group as a diverse team of individuals coming from both Indigenous and non-Indigenous backgrounds, and from the biophysical and social sciences. Our group's expertise includes Indigenous community health, environmental toxicology, transboundary water governance, Indigenous resource management, and Indigenous law. Some of us have in-depth experience with conducting Indigenous research, while others are new to this work. We view the decision to establish a formalized governance body on Indigenous research methods as an important step towards developing a more Indigenous-centered research and policy agenda for water governance.

A starting place for understanding how we apply reciprocal learning lies with the core values of Indigenous community-based research: respect, responsibility, reciprocity and relevance [47]. To work in the spirit of reciprocal learning means engaging in partnership with communities [73]. This requires shifting from the "postcolonial stance of expert-subject" to collaborative inquiry, engaging in "open dialogue around hidden nature of power and inequities", and building capacity among community and academic partners [42].

We approach reciprocal learning through an action research framework. The partnership's work aims to address current water policy issues of the highest concern for First Nations communities, which include First Nations boil water advisories, proposed construction of the Site C mega dam, the increasing development and transport of oil and gas within Indigenous territories, and other community concerns. Thus, the reciprocal learning approach can be used as a means of "building inter- and intra-tribal solidarity and political coalition" [74] (p. 241) [75] (p. 159).

The reciprocal learning framework also provides a useful methodology for carrying out the philosophy of two-eyed seeing. This mode of research emphasizes a two-way process, where knowledge flows back and forth between learning partners to support equitable exchange between Indigenous Elders, traditional knowledge holders, grandmothers and grandfathers on the one hand, and academic researchers on the other. Reciprocal learning is therefore a non-hierarchical process, which emphasizes the reflexive, relational and holistic nature of knowledge production.

While the goals set out by other emancipatory research approaches like community-based or Indigenous research may include reciprocal learning, we see a distinction with reciprocal learning, which requires that both communities and academics learn something new through the research process in a deep, intentional, and useful way.

The decolonizing water partnership is currently developing its policy on reciprocal learning. Part of the approach includes offering training for communities and their youth, especially following Indigenous pedagogies that emphasize learning from the land. Partnership members are also working to ensure the research is in conversation with Indigenous water advocates, so that research is both informing and informed by community organizing. Another part of the work involves extending beyond academic publications to express decolonizing water concepts and findings through more broadly accessible formats and forums, e.g., through art exhibits, Indigenous radio, film, social media, and the Indigenous youth movement.

Research partners are also "setting up strategic directions" for the work so that First Nations can self-determine their own needs and priorities, and define how research should proceed [28]. This requires following First Nations OCAP (Ownership, Control, Access and Possession) protocols. These efforts involve working out terms for information sharing that both protect cultural knowledge,

and ensure that information is "available and useful long into the future" [46]. The extended time frame for the project provides a hopeful opportunity to conduct the careful relationship building that needs to occur for the partnership to succeed, following the principle, "Go slow, do it right".

As this is the first stage of a long-term research project, it is still too early to share results on community engagement through reciprocal learning. However, the partnership group has taken a reciprocal learning approach to its meetings. This has helped build stronger connections and collaborations in our interdisciplinary team. The approach has also enabled project participants to include guidance from Indigenous Elders, as well as to better engage with learning from the water and land itself as part of the work.

4.2.4. Case Study Synthesis: Reciprocal Relations, Reciprocal Learning

Whether we are working in the research lab, the field, or at the negotiating table, all of these cases speak to the importance of learning from Indigenous research methodologies to practice more respectful, reciprocal relations with the earth, and with its waters. This work requires engaging in deep social learning that attends to the underlying values and worldviews that inform our water relations and policies [76,77]. As demonstrated by our cases, two-eyed seeing brings important insights into how we build a research team that includes multiple generations, coming from academic and non-academic backgrounds, in order to improve First Nations community health. Knowledge sharing frameworks that facilitate conversations between Elders and traditional knowledge holders across multiple First Nations communities create new possibilities for multi-cultural and multi-national water policies. Reciprocal learning frameworks set a high expectation for equitable exchange and learning to occur at a deep level for both Indigenous community members and academic researchers.

These cases provide a basis for our recommendations of best practices in Indigenous research, which can inform long-term water policy solutions (see Table 1). Because Indigenous knowledge has developed based on a different set of relationships with the natural environment, Indigenous perspectives can help to challenge our assumptions regarding water governance [3]. At the same time, western science offers additional knowledge and tools to support First Nations community goals. As discussed earlier, we view our work in the context of reciprocal learning, respectfully learning from each other to provide mutual benefits, and to appreciate the interconnections between humans and the natural world [3].

Our case study research also demonstrates that the practice of reciprocal learning can take many forms. Sometimes it means using research principles that enhance the capacity of community research partners, in the spirit of reciprocity. Sometimes it applies to personal interactions, such as learning about who you are and where you come from (Phare, 2009). Reciprocal learning is also intended to create the space for (re)placing knowledge [3] by bringing First Nations ideas and knowledge into community design. For example, First Nations' experiences can anticipate the impacts that specific external activities will have on the environment, as well as suggest specialized techniques that may ensure that undesired impacts will not occur.

We continue to learn and develop our understanding of reciprocal learning, as we apply these principles within our Indigenous Methodologies Working Group. As a small community of Indigenous and non-Indigenous researchers committed to interdisciplinary research, the authors strive to situate ourselves and our experiences in the work that we have done, both individually and together as a team [28,68], and to learn deeply from one another. As we work together, it is our goal to share this knowledge and its effectiveness toward achieving positive solutions for water issues with multi-generational benefits for, by, and with Indigenous communities.

Table 1. Recommendations for engaging in Indigenous research.

Recommendations for Engaging in Indigenous Research
• Learn directly from Indigenous communities.
• Actively engage with Indigenous epistemologies through research questions, concepts, and practice.
• Follow OCAP (Ownership-Control–Access-Possession) research principles.
• Seek advice from community Elders and advisors, in addition to elected leaders.
• Involve youth in research and other project activities.
• Incorporate trainings that increase community capacity for research to be conducted within and at the direction of the community.
• Involve community and academic research partners in a collaborative and participatory process to balance goals for research and community benefit/action.
• Train and hire Indigenous peoples, especially youth scientists to carry out field work and assessment experiments.
• Ensure equal power sharing in research decision-making processes, with open engagement, full disclosure, and the community members acting as full partners.
• Acknowledge that all Indigenous communities and peoples are different (although some commonalities exist) so that research approaches can be customized accordingly.
• Practice the "two-eyed seeing" philosophy and recognize that two-eyed seeing can encompass more than just "western" and "Indigenous" knowledges.
• Apply a reciprocal learning approach, which means ensuring that both Indigenous community members and academic researchers learn from one another at a deep level through the research process.
• Acknowledge and account for the effects of colonization when considering potential solutions and recommendations.
• Restructure research laboratories based on Indigenous research philosophies and methodologies (e.g., lab methods practiced by Dr. Carrie Bourassa).
• Support efforts to include diverse Indigenous knowledges into existing law, environmental policy, and western science by enabling communities to "talk back to power" in a culturally appropriate manner.

5. Conclusions

This paper has demonstrated the importance of using Indigenous Research Methods to address current water problems affecting First Nations. We have shown how Indigenous epistemologies of water relations bring a distinct perspective about how we frame and analyze water problems. Through our case analyses, we have provided a detailed account of current innovations with Indigenous research. By doing so, this work begins to operationalize what it means to apply decolonizing methodologies to water research and policy formation. We have argued that by establishing a more effective water governance framework, which applies Indigenous concepts of reciprocal relations to critical water policy issues, we can strengthen water quality outcomes for First Nations communities in Canada. In other words, by using Indigenous research methodologies to reconfigure existing water governance frameworks, the authors seek to encourage innovative, adaptable solutions, rooted in Indigenous epistemologies, which can better provide clean water and ensure cultural survival to Indigenous communities for the long-term.

We need to make this shift because the dominant approach to water governance has not addressed the water problems being faced by Indigenous communities, as exemplified by the First Nations water crisis in Canada. Involving First Nations communities in research that respects their worldviews, ontologies, epistemologies and knowledges is part of the solution. This work requires both changing our approach to scientific research, and identifying practical pathways for using Indigenous research methods to inform water policy. Through our analysis and case studies, we have demonstrated that community concerns, priorities, and ways of knowing need to be at the forefront of Indigenous community based research to ensure that policy outcomes meet the needs of communities.

This work also involves rethinking laws, regulatory rules and institutional structures with Indigenous experiences and epistemologies in mind. For example, given the spiritual relationships that Indigenous peoples have with water, protecting water at the source should be considered alongside

mitigation efforts, such as water treatment. Given the diversity of Indigenous peoples, policy processes that support Indigenous self-determination must engage with a broad spectrum of First Nations communities. This work requires investing in capacity building and technical support. With these very real challenges in mind, this paper is intended to provide a starting point to encourage applying decolonizing methodologies to water, both in research and policy formation.

We anticipate that it will be some time before we are able to see the impact of such a shift in methodologies on water quality, and in many cases, a direct causal link will be impossible to establish. Still, we assert that the way that people take up different knowledge systems has everything to do with power and knowledge hierarchies. It is by shifting the research relationship and centering our inquiry on traditional knowledge that we expect to gain a different outcome: the ability to build the relationships we need to collaborate across cultures, borders and even species to improve our water relations, including our ability to take responsibility for protecting our water sources.

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