

Review

Pipeline Spills and Indigenous Energy Justice

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Abstract: The Canadian provinces of Alberta and Saskatchewan transport their energy resources by pipeline to the eastern and western seaboard, and south into the United States. The used pipeline infrastructure reshapes the landscape and affects sustainability of the environment, traditional Indigenous livelihoods, and drinking water, particularly when spills and leaks occur. This scoping review is focused on Indigenous sustainability issues in relation to surrounding pipeline spills/leaks, impacts on drinking water and Indigenous communities in Western Canada. We found that Indigenous communities are particularly vulnerable to pipeline leaks, and have limited capacity to mitigate them. Strategic decisions need to be made about the management of pipeline leaks. For building Indigenous energy justice, the findings of this paper suggest that Indigenous-led databases, programs to monitor and assess impacts, report leaks, and funding of community-based participatory action research are required.

Keywords: energy; Indigenous drinking water; Indigenous; pipeline spills; scoping review; sustainability

1. Introduction

The Western Canadian provinces of Alberta and Saskatchewan significantly rely on oil pipelines' revenue, dependent on the transport of their energy resources by pipeline to the eastern and western seaboard, and south into the United States. Pipeline infrastructure reshapes the landscape and impacts sustainability of the environment, traditional Indigenous livelihoods, and drinking water, when spills and leaks occur. The purpose of this paper is to provide Indigenous communities, particularly those communities of northern Alberta and Saskatchewan, with new tools that can help them make strategic choices about pipeline leak management to enhance their energy justice to pipeline leaks.

Indigenous knowledge has important lineages in energy sustainability, as it includes culturally distinctive ways of knowing specific to societies, with long histories of interaction with their natural surroundings. For Indigenous people, the term sustainability is part of their everyday life, which connects spiritually and relationally; acting sustainably means giving, not taking the Earth's natural resources and is defined by an ethic of making decisions in respect of Earth's resources that will not hamper the access to these resources for the next seven generations [1]. Indigenous knowledge includes traditional ways of knowing and doing in sustainably managing very complex ecosystems [2]. In the dramatic transition of energy and water management regimes over the last few decades, Indigenous knowledge has received little recognition, and Indigenous histories and perspectives are rarely valued as significant data to the sustainable contemporary management of water and energy resources [3].

For understanding the concept of sustainability in energy and drinking water access for Indigenous people, this paper reports on a scoping review of critical issues in sustainability, particularly energy pipelines and their impact on Indigenous peoples' drinking water access. For instance, how is the concept of Indigenous sustainability and Indigenous energy justice affected through colonial

energy management policy and practices? This paper reports on a scoping review of energy issues surrounding pipeline spills/leaks, and impacts on drinking water and Indigenous communities in Western Canada. This paper first suggests that the researchers need to explore past leak impacts on Indigenous communities' water, agriculture, and challenges in current risk management processes and regulations; and secondly, provide recommendations to build sustainability in Indigenous energy practice from and within Indigenous people and their perspectives.

2. Scoping Methodological Framework of Study

Our scoping review in this paper was used according to our keywords listed in Table 1. Drawing from a scoping method logical framework, this paper focused on Indigenous sustainability through Indigenous energy and water [4,5]. A scoping method logical framework is “a form of knowledge synthesis that addresses an exploratory research question aimed at mapping key concepts, types of evidence, and gaps in research related to a defined area or field by systematically searching, selecting, and synthesizing existing knowledge” [6]. In this paper, we used the scoping method logical framework with a comprehensive assessment of the literature. The present scoping review was guided by keywords listed in Table 1. The goal was to evaluate the extent to which Indigenous sustainability issues have been considered in these studies, and to discuss their conclusion. Thematic key words were reviewed from the online databases prior to search. The authors searched for intersections of the issues of pipeline spills/leaks and Indigenous conceptualizations of sustainability. Search databases were used with a wide range of disciplines, which included Web of Science (multidisciplinary, 2008–present) and Google Scholar. Thematic keywords used for searching are included in Table 1.

Table 1. Keywords used for literature search.

#1	Pipeline Spills/Leaks	Pipeline Spills, OR Leaks OR Pipeline Breaks OR Pipeline
#2	Indigenous Energy	Indigenous Meanings of Energy OR Energy Management OR Indigenous Energy
#3	Drinking water Crisis	Drinking water quality OR water crisis OR drinkable water protection OR safe water OR water OR sustainable water supply OR fresh water OR water OR water supply
#4	Indigenous Communities	Indigenous people OR Indigenous OR Unban Indigenous OR Reserve Indigenous OR Aboriginal OR Native(s) OR Indigenous people OR First Nations OR Métis OR Inuit Or Inuk
#5	Environmental Impacts	Environmental Impacts OR Environmental Harms OR Environmental Injustice
#6	Health Impacts	Spiritual health wellness OR well-being OR mental health OR social health
#7	Challenges	Challenges in solution OR Barriers
#8	Canada	Canada OR Indigenous areas in North America
#1 #5 AND #1 AND #4		

3. Overview Findings from Selected Studies

We found a total of 220 articles from our overall search with 46 from the bibliographic searching process (i.e., according to the key words, authors' names, the titles of the works), and 174 from grey literature. 35 articles matched with our thematic keywords, title, and abstract (i.e., Table 1: Keywords #1, 2, 3, and 4); however, 21 studies did not meet the second-level required criteria, leaving a total of 19 articles matching for the final scoping review. Focusing on our search findings, we divided our result sections into five subsections including: first, thematic analysis and study findings; second, lack of Indigenous engagement in energy management and pipelines; third, impact of pipelines on Indigenous drinking water quality; fourth, pipeline spills/leaks and impacts; and finally, recommendations.

4. Thematic Analysis from Study Findings

The findings of reviewed articles were grouped under the following key themes:

- (a) Challenges in Indigenous Engagement concerning Energy and Pipelines;
- (b) Impact of Pipelines on Indigenous Drinking Water Quality;
- (c) Pipeline Spills/Leaks and Impacts on Indigenous people.

Our scoping review focused on a systematic approach to find Indigenous sustainability-related information on Indigenous environmental issues associated with pipelines spills in Indigenous communities in Canada and North America. Our review found 19 closely relevant articles from the initial pool of 220 articles. The focusing points in this review were the literature on pipeline spills, impacts of drinking water, and agriculture, and health in Indigenous communities in Canada. None of the articles in the sample used a decolonizing approach on pipeline leaks and energy management, or an approach that would privilege Indigenous knowledge and perspectives surrounding sustainability. During our scoping review, we also focused on researchers who emphasised the Indigenous communities' knowledge and values, the Calls for Action from the Truth and Reconciliation Commission, and Indigenous governments. The thematic analysis and study findings are summarized below.

4.1. Lack of Indigenous Engagement in Energy Management and Pipelines

Most of the government and companies' reports and assessments, as well as other reports by non-profit organizations, discussed governmental regulation and policy guidelines in Indigenous sustainability issues. Only three articles from the 19 articles critically discussed that there was insufficient focus on pipeline spills in Indigenous communities and impacts on Indigenous communities [7,8]. A recent report on Saskatchewan Indigenous communities shows that pipeline spills and their impact on Indigenous drinking water and agriculture are high in Indigenous communities compared to the national average, and more than 50% of Indigenous communities in reserve areas in Canada are at "high risk". Two studies by Auston, and Wilke and Freeman [9,10] discuss that pipeline spills have more severe impact on rural Indigenous communities' drinking water, agriculture, and traditional cultural practice with land than the other non-Indigenous communities do in urban areas.

Another five articles discussed that governments' lack of interest in Indigenous engagement as being a significant challenge for sustainable energy management [7–11]. Two studies [9,10] argue that because of the lack of Indigenous communities' involvement in energy management, many Indigenous communities have suffered a number of negative impacts on their drinking water, health and surrounding environment. For instance, the Treaty 6 territory situated in Western Canada is one of the vulnerable parts of Canada including its Indigenous communities. According to the Assembly of First Nations, there are 81 long-term drinking water advisories (DWA) affecting more than 50 Indigenous communities across the country. As of August 6, 2018, there were 42 short-term DWAs in place, and there are more than 15,000 Indigenous people under Drinking Water Advisories in Saskatchewan [12].

Recent federal government activities have also become a major challenge for reducing pipeline leak impacts on many Indigenous communities [13]. A recent report of Canadian government initiatives for Indigenous energy management concludes that as of May 30, 2018, the current government in Canada confirmed it paid \$4.5 billion to buy the Kinder Morgan pipeline; but there are many Indigenous communities currently living with high drinking water advisories [13]. There were 124 DWAs at the beginning of May 2018, and now the number has spiked to 174 advisories in the last couple of weeks. While in December 2017, the Parliamentary Budget Officer estimated the cost of ending boil water advisories by 2020 to be \$3.2 billion, the Kinder Morgan pipeline crosses 1355 waterways, putting communities' drinking water at risk. For instance, the Coldwater Indian Band, along with several other Indigenous nations, launched a legal challenge because the pipeline cuts right through the nation's drinking water source. This study also claims that instead of allocating adequate funding to ensure clean water for First Nations and upholding the human right to water and sanitation, the Trudeau

government is committing \$4.5 billion to bail out Kinder Morgan and ram through a pipeline project that puts the drinking water of Indigenous nations and municipalities at risk. This study also argues that the \$4.5 billion Prime Minister Trudeau committed to bailing out Kinder Morgan could increase Indigenous communities' capabilities to end boil water advisories in First Nations.

No single article discussed Indigenous knowledge or perspectives in energy management and Indigenous decision-making opportunities in pipeline leaks management. However, there are two articles that show Indigenous engagement in energy and pipeline leaks management have been significantly missing historically [7,14]. Only two articles [3,15] strongly suggested including Indigenous communities and their traditional practices in sustainable energy management.

4.2. Impact of Pipelines on Indigenous Drinking Water Quality

Seven articles discuss that pipeline leaks, DWA, and poor water quality are prominent in Indigenous communities. This is important for sustainability, given the impacts of pipeline spills/leaks on Indigenous people described below. These seven articles were coded regardless of the reason for source water deterioration, and included advisories issued due to the oil spill on the North Saskatchewan River [14–24]. If a groundwater source was believed to be under the direct impact of surface water, but there was insufficient treatment to deal with the direct influence of surface water, poor source water was coded and the article included. Silt being drawn into the treatment system by wells and changing the source water to a non-regulated water source was coded as poor source water.

Pipeline development and its impacts on Indigenous communities is also a concerning factor for other parts of Canada. According to a recent report by Health Canada and British Columbia's First Nations Health Authority, up to one-in-four people may not have clean drinking water on First Nations reserves [23]. This report argues that DWAs in Indigenous communities should not be a way of life in a country with an abundant water source. However, a lack of infrastructure, political will, and public solidarity causes such problems. This report also shows that on top of long-standing DWAs, the Trudeau government has actually approved a series of development projects that threaten important First Nations waterways such as Kinder Morgan's Trans Mountain Expansion project and Enbridge's Line 3 tar sands pipelines replacement project.

Another three articles reported how pipeline leaks and their contamination of drinking water concerns specific pathogens in pipeline spills/leaks including serious health impacts from water [8,24–27]. Qualitative measures of impacts of pipeline spills/leaks in Indigenous drinking water were assessed in five other articles [19,21–24]. Two articles related to health risks from impacted drinking water [14,28]. In general, two of these suggested that there is a high risk in drinking water in Indigenous communities; however, they also suggested risks in drinking water differed according to province, water source, and other social and physical indicators [28].

4.3. Pipeline Spills/Leaks and Impacts

Six articles (three specifically from qualitative articles, the other three based from mixed methods articles) from 35 articles discussed pipeline spills/leaks [14–20]. For instance, the Wingrove (2012) study shows that there have been at least 10 pipeline leaks since 2011 in Alberta. Wingrove gave an example from the biggest pipeline spill (i.e., Plains Midstream pipeline spill near Little Buffalo) that leaked more than 4.5 million liters in April 2011, and another larger spill in December 2017 (i.e., from a Pengrowth Energy Corp. pipeline near Judy Creek, Alberta) where 1.9 million liters spilled. There were 12 major spills reported from 2008 to 2018 (Table 2), particularly in Saskatchewan and Alberta. Most of these oil spills are connected with either Indigenous surface water or their traditional food source, including Indigenous hunting and gathering.

Table 2. Major pipeline spills in between 2008–2017 in Canada, particularly in Saskatchewan and Alberta [14–20].

Major Pipeline Leaks 2008–2017	Amount (by L)
July 2016 into the North Saskatchewan River.	250,000 L
June 2016 into northwestern Alberta.	380,000 L
July 2015 into near Fort McMurray, Alberta.	5 million L
March 2015 into Northeast of Peace River, Alberta.	2.7 million L
November 2014 into Red Earth Creek in northern Alberta.	60,000 L
April 2014 into northwest of Slave Lake, Alberta.	70,000 L
July 2013 into Cold Lake Air Weapons Range, Alberta.	1.5 million L
May 2013 into Zama City, region of northern Alberta.	15 million L
June 2012 into Red Deer River in central Alberta.	461,000 L
May 2012 into near the Alberta–Northwest Territories boundary.	3.5 million L
April 2011 into northern Alberta aboriginal community of Little Buffalo.	4.5 million L
April 2007 into Glenavon, Saskatchewan.	990,000 L

Two articles from 19 articles suggest that pipeline spills threaten ecosystems both ways (i.e., *during spills* and *spill cleanup*) [22–25]. For instance, the Todd (2017) study shows how spills can threaten the ecosystem in two ways: *during spills*, dangerous toxins mixed with surface which transferred to agricultural land, water, and wetland that contaminated whole ecosystems including human, animals, birds, and plants; *during cleanup*, physical cleanup (e.g., cleaning oil from surface) can have direct impacts of normal soil and water quality. Todd showed in how oil spills can damage native habitat and significantly reduce native species and foster invasive species. However, this study also suggests more research for making more concrete decisions on how spill removal from the surface can reduce habitat damage, and to understand the threats to native species and wildlife.

Five articles show that pipeline spills not only impact on Indigenous people’s drinking water, but also have negative impacts on non-human species (such as birds and wildlife habitat including their food, water, shelter, and nesting areas) [8,26,27]. For instance, the Austen (2013) study shows that pipeline spills increase various environmental toxins in water, particularly aromatic hydrocarbons, and PAHs. According to Austen’s study, environmental toxins from pipeline spills (polycyclic aromatic hydrocarbons, or PAHs) can dissolve in water quickly and can kill non-human species including fish and other aquatic creatures. A number of studies [8,26–31] show that the non-human species, particularly fish and aquatic creatures, which live in the water for most or all of its lifetime, are more vulnerable to oil spills than other wildlife. The fish and aquatic creatures typically break down quickly and disappear. Other chemicals can have longer impact in the water and can make serious ongoing health effects for aquatic species that may appear after longer times, including after many months and years. Another study [14] suggests that environmental toxins (i.e., oil toxicity and its contaminants, or pollutants, and the oil itself) became less significant in human-centric politics.

Pipeline spills have serious health outcomes interrelated with fear and poor drinking water in many Indigenous communities. For instance, an article [9] specifically discussed the weakness of governments and profit-oriented organization-led research by saying that environmental toxins from the pipeline spills have been poorly tracked, including carcinogens, gene mutagens, and endocrine disruptors. This study also suggests: (1) that the environmental toxins from the pipeline spills are directly connected with human cancer-causing compounds; (2) the official reports also found various toxins from spills at dangerous levels in waterways and deep-water; (3) the relationship between pipeline oil leaks and health impacts are highly significant. Further, a recent study by Wilke and Freeman [10] concluded that it is important to understand the relationship between pipeline oil leaks and air quality, as oil

spills or leaks can have significant impact on air quality. The air quality has an indirect connection with human chronic respiratory illnesses. Using data from a large electronic medical record representing more than 400,000 in primary care, Wilke and Freeman's study suggests that 5935 patients are suffering with asthma. This study also claims that the connection between pipeline oil leaks and human health risks are high because of drinking water infections.

5. Discussion and Recommendations

Our scoping review suggests there is a significant need for more academic and community-based research with Indigenous communities to understand sustainability issues from and within Indigenous perspectives. Indigenous knowledge needs to be understood through their participation and decision-making in energy management and drinking water pipeline leaks management and in identifying solutions. For understanding sustainability surrounding Indigenous energy and water, this review also suggests for the researcher's critical focus to be on barriers and challenges in Indigenous communities (i.e., sufficient research funding to the community, Indigenous-led research, protecting drinking water, and their health). Although the number of related studies was very small in this scoping review, the studies reported reflect a wider range of research designs and findings by the Indigenous community. sustainability. For instance, while some research is emerging, there is very limited research on Indigenous communities' perspectives and Indigenous knowledge on current pipeline development, and drinking water management. For understanding sustainability issues, this study suggests focusing on the redesign of research, and research within and from Indigenous community participants and academic researchers. The lack of cultural understanding among government and NGO researchers is also another significant challenge in Indigenous sustainability research [9–15] as well as improvement in increasing Indigenous communities' active participation. Studies also recommend greater sample sizes from the community perspectives so that both academics and communities can better understand challenges from multiple perspectives. There is a need for Indigenous worldviews, Indigenous methodology, Indigenous research frameworks, from and within Indigenous community-based participatory research, that also can lead to community-based effective solutions. More research is also needed to understand government and non-governmental initiatives and their impact on Indigenous communities' involvement in their energy management and sustainability [31–48].

For understanding sustainability issues, it is recommended that the significant gaps in the evidence of drinking water consequences related to pipeline leaks in Canadian Indigenous communities be addressed [31–37]. There are no systematic studies that focus on Indigenous rights, including access to drinking water and surrounding the health of women and minors in Indigenous communities.

To move forward in better understanding sustainability through potential protection of Indigenous drinking water, their health, and their environment from pipeline spills in Canada, we make the following recommendations for understanding sustainability issues based on the scoping review:

Community-Based Participatory Action Research (CBPAR). Studies suggested that Indigenous-led CBPAR can provide a better understanding from and within community perspectives on the oil spills, affecting assessment and protecting their drinking water and environment. Although there are significant needs for bridging among academic researchers, policy makers, community leaders, Indigenous Elders, Knowledge Keepers, government and companies; studies specifically suggested for centering Indigenous perspectives for building sustainability within and from Indigenous communities.

Develop an Indigenous-Led Database. Studies argued that Indigenous communities, in most cases, do not have access to government and companies' research information. Therefore, they do not know the impacts on their water, health, and environment. According to studies, the Indigenous-led database cannot only improve information access, but also can be helpful for government and companies to take meaningful, timely action from and within community people. Indigenous Elders, Knowledge Keepers, and leaders can guide to develop Indigenous-led databases.

Indigenous Perspectives. For building sustainability in Indigenous communities, Indigenous perspectives are critical. Studies suggested developing Indigenous perspectives on concepts (i.e., energy, energy management, safe drinking water, and health risk) through Indigenous Elders and Knowledge Keepers' guidelines.

Funding. Funding is one of the critical issues for building sustainability in oil spills management. Most communities suffer for lack of funding during and after oil spills. Therefore, studies strongly suggested federal and provincial governments, research agencies, and companies create a special call for Indigenous CBPAR research, interdisciplinary research, actions-based solutions, and maintain a workforce during and after any oil spills. Ongoing pre-oil spills funding is also needed for educating the community.

Develop Indigenous-Led Programs. Indigenous-led programs from and within Indigenous communities are significant for building sustainability for Indigenous communities. These programs are to monitor impacts and assessments, and report the pipeline leaks and drinking water outcomes to implement strategies for finding effective solutions in removing barriers and challenges to safe drinking water, Indigenous health, and their environment.

Sustainability in energy justice requires responsible energy development in Indigenous communities. This scoping review paper suggests that when energy is developed in Indigenous communities, there is a need to consider Indigenous peoples' interests regarding the opportunities and impacts of energy development. Our study found that energy development without Indigenous community engagement has been creating not only serious negative impacts on the environment, but also creating significant barriers for Indigenous everyday practices, including impacts on Indigenous water, agricultural land, traditional hunting and gathering practices, and ceremonies. Therefore, in reviewing recent research on Indigenous communities, this study suggests that following the above recommendations are significant for building energy sustainability in Indigenous land. To achieve this, we strive for relationships that are based on transparency, mutual respect and trust.

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