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Article

Addressing the Environmental, Community, and Health Impacts of Resource Development: Challenges across Scales, Sectors, and Sites

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Abstract: Work that addresses the cumulative impacts of resource extraction on environment, community, and health is necessarily large in scope. This paper presents experiences from initiating research at this intersection and explores implications for the ambitious, integrative agenda of planetary health. The purpose is to outline origins, design features, and preliminary insights from our intersectoral and international project, based in Canada and titled the "Environment, Community, Health Observatory" (ECHO) Network. With a clear emphasis on rural, remote, and Indigenous communities, environments, and health, the ECHO Network is designed to answer the question: How can an Environment, Community, Health Observatory Network support the integrative tools and processes required to improve understanding and response to the cumulative health impacts of resource development? The Network is informed by four regional cases across Canada where we employ a framework and an approach grounded in observation, "taking notice for action", and collective learning. Sharing insights from the foundational phase of this five-year project, we reflect on the hidden and obvious challenges of working across scales, sectors, and sites, and the overlap of generative and uncomfortable entanglements associated with health and resource development. Yet, although intersectoral work addressing the cumulative impacts of resource extraction presents uncertainty and unresolved tensions, ultimately we argue that it is worth staying with the trouble.

1. Introduction

The health impacts of resource extraction and development exemplify complex issues that stretch across jurisdictional, ecological, disciplinary, and sectoral boundaries [1,2]. Indeed, the health dynamics of resource development and extractive industries can be equally framed as global, national, regional, or more proximal experiences, and underscore the formidable task of designing research and policy that meaningfully addresses the scope of personal, public, population, and planetary health. The interrelated pathways that influence health pose both challenges and opportunities when considering the encompassing aspirations and integrative challenges of planetary health [3–5]. Responding to complex pathways of health impacts also demands awareness of how drivers of change influence health across multiple levels, demanding attention to the interplay of local and global dynamics [6,7].

This paper responds to these challenges with a focus on addressing intersecting environmental, community, and health implications of resource development in Canada, both within and beyond national boundaries. Within its developmental context, the Canadian economy has been tightly coupled with resource development and extraction [8] ranging from mining, oil and gas, forestry, fisheries, agriculture, and aquaculture to renewable energy developments and nature-based tourism activities. Attention to the risks and benefits of resource development in Canada is active and ongoing, with a growing focus on impacts that accumulate across space and time [9], along with increasing questions about cumulative determinants of health impacts, especially in rural, remote and Indigenous communities in resource-rich regions [10–13]. We use the term Indigenous to refer to Indigenous peoples in Canada and also in other parts of the world, consistent with the United Nations Declaration of Indigenous Peoples (United Nations, 2008). Depending on the context, the term Aboriginal is used specifically in the Canadian context to refer inclusively to First Nations, Métis, and Inuit peoples of Canada, and the term First Nation(s) to denote specific First Nations within Canada.

Informed by gaps in understanding regarding resource extraction and health [1], and demand for more attention to intersectoral features of "Environments and Health" in the Canadian context [14,15],

our team developed "The ECHO Network" (an abbreviation of the Environment, Community, Health Observatory Network). The focus, as described in founding documents, is on "strengthening intersectoral capacity to understand and respond to the health impacts of resource development" [16]. As a five-year research program, funded by a Canadian Institutes of Health Research "Environment and Health Signature Initiative" Team Grant [14], the ECHO Network offers insights regarding the demands and relevance of boundary-crossing research attuned to planetary health challenges, where "ecosystems, people, and health meet" [17].

The ECHO Network is framed around a guiding question: "How can an Environment, Community, Health Observatory Network support the integrative tools and processes required to improve understanding and response to the cumulative health impacts of resource development, with specific emphasis on rural, remote, and Indigenous communities and environments?" Informed by the diversity of resource extraction and development contexts, this question led to a research design focused on four Canadian regional cases. Each case reflects a commitment to learning and exchange within the local context, as well as across and among the ECHO Network as a whole, including emerging regional cases in other parts of Canada and in the Oceania region (particularly Australia and New Zealand).

Noting that health and resource development dynamics are evident from the local through to the planetary, this paper seeks to: (i) Examine how the design and approach of the ECHO Network is addressing the cumulative environmental, community, and health impacts of resource extraction; and (ii) explore the successes and challenges that are informing future phases of work. In doing so, we highlight lessons learned about collaborative, cross-jurisdictional approaches to the interplay of health, natural resource extraction, and place-based complexities. First, we outline the background to the research, noting converging conceptual and practical influences that provided the foundations for the ECHO Network. Next, we present the design of the Network, briefly examining key features of our research framework, and its implications for nested, interrelated, and emergent research processes. We then move into a discussion of some of the insights arising from the early phases of the project. We view the early insights from the ECHO Network as having a range of implications for related research, especially when focused on complex issues that demand both integrative research and intersectoral action to improve health [18]. Our discussion highlights implications for research that crosses both scales and boundaries and seeks to better address the converging health, ecological, and social issues influencing health in the Anthropocene [5,19,20].

2. Background and Context

Key factors that have provided the foundation for the ECHO Network are briefly introduced in this section. The intention is not to offer a detailed literature review, but rather to highlight important conceptual and convergent influences and interactions among both pragmatic and aspirational imperatives. The background can be framed as a combination of conceptual 'push' factors arising from attention to cumulative thinking applied to resource development and applied "pull" factors arising from Canadian challenges. The background and context also help to frame the ECHO Network as an emergent response to complex challenges—a multi-faceted, collaborative aspiration toward what Escobar describes as "healing the web of life" [19]. Critical reflections on the limitations of designing research that aspires to such complex challenges are discussed in the final section of the paper.

2.1. Cumulative Thinking, Resource Development, and Health

The combined environment, community, and health impacts of resource development remain poorly understood due to their scope, scale, and systemic nature [21]. This is consistent with the long-standing tendency to address interrelated health, ecological, and social concerns in isolation [18]. Recurring calls to bridge and work across traditional disciplinary territories, sectoral mandates, and jurisdictional boundaries are a common response to the 'wicked' features of health and resource development, with their associated interrelationships, dependences, and overlapping organizational mandates. Extending from foundational work by Churchman in 1967 and Rittel and Weber in 1974,

"wicked problems" describe issues which are not typically amenable to a simple cure or complete resolution, and that tend not to be solved by 'taming' manageable sub-problems [18,22,23].

One response to these dilemmas in the context of resource development has been the development and application of a conceptual framework that focuses on cumulative impacts, as detailed by Gillingham et al. [21] in relation to the "cumulative environmental, community, and health impacts of multiple natural resource developments". A central conceptual foundation of this work is cumulative thinking [24,25] described as:

> " . . . a commitment to conceptualizing the full range of spatial and temporal scales as well as impacts that occur as a result of human-caused changes to coupled social–ecological systems. A cumulative thinking perspective demands recognition that impacts are not just environmental, they are not just large development projects, and they are not all easily identified and quantified. Furthermore, past experience tells us to expect interactions" [24], p. 222.

Cumulative impacts arise when multiple forms of resource development occur simultaneously on the same land base. The co-existence of these developments can then interact with both pre-existing effects, and the longer-term impacts of historical decisions and past land uses [21,26]. We experience cumulative impacts on a daily basis, and they leave lasting legacies for people, communities, and ecosystems.

Gillingham et al. [21] describe the ways in which cumulative thinking creates an "integration imperative" in the context of resource development, warranting approaches that are more attentive to the relationships among ecological, community, and health impacts. This orientation is consistent with an array of international efforts emphasising the many ways social and ecological factors influence health, cumulatively, over time and space [27]. Recognition of the ways that the health of other species (plants, animals, wildlife, ecosystems) have far-reaching implications for human health include the international attention to 'One Health" [28], "Wetlands and Health" [29], and "Parks and Health" [30,31]. Ongoing attention to ecohealth—or ecosystems approaches to health—are characterized by systems approaches that promote the health of people, animals, and ecosystems in the context of social and ecological interactions [5,32–38]. These efforts are supported by an expanding range of integrative approaches that underscore the relevance of cumulative impacts on health across time and space, such as the Lancet Commission on Planetary Health [39] and the 2015 "State of Knowledge report on Biodiversity and Health" co-produced by World Health Organization [40]. Cumulative thinking applied to the health impacts of resource development also recognizes that ecosystems and biodiversity are not only sources of hazardous exposures, but also make positive contributions to health relating to our relationship to the land, livelihoods, lifestyles, culture, and identity [29,37,41].

The precedents above, combined with the complex dynamics of resource development, have drawn attention to the "cumulative determinants of health impact" [13], linking cumulative thinking with "upstream" factors, including the social and ecological determinants of health [2,42]. Figure 1 depicts the potential for resource development activities to interact as upstream drivers of change in a region of concern, leading to an array of proposed or actual changes in the landscape.
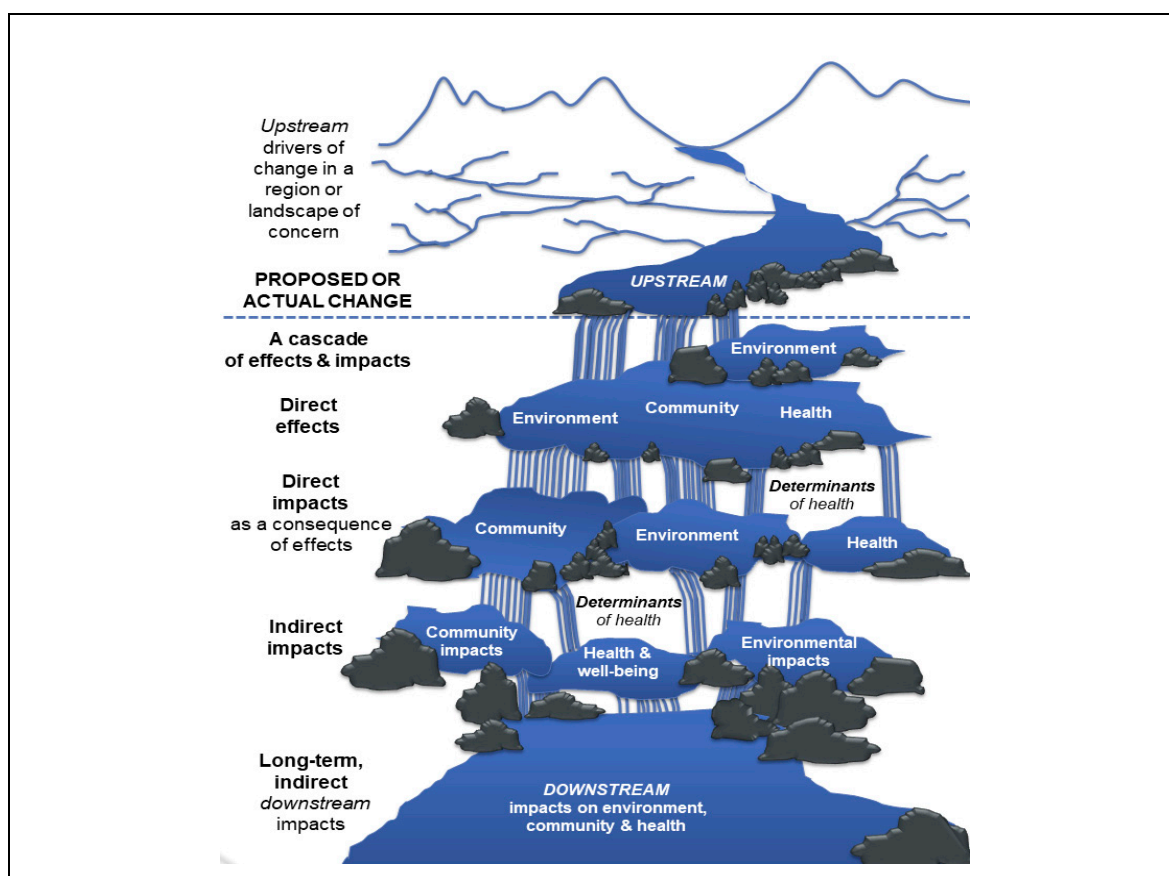
Figure 1. Resource development and the cascade of effects and impacts. Upstream drivers of change lead to a cascade of effects and (environmental, community, and health) impacts. Reprinted with permission from Springer. Source: Parkes 2016 [13] Figure 5.1.

The cascade depicted in Figure 1 highlights relationships among short-, medium-, and long-term effects and impacts, with implications for community, environment, and the social and environmental determinants of health [13]. Although the feedback and flows depicted in the cascade are mostly one-way, multiple other feedbacks exist over time and space, whereby downstream impacts and flows (among health, community, environmental factors), can be seen to cycle back to impact upstream drivers of change.

The range and scope of possible 'upstream' drivers of change that trigger this cascade are extensive. Climate change can be seen to overlay and compound most drivers of landscape change [43]. Halseth et al. note that some natural resource management decisions, such as the allocation of mineral rights or land leases, set in motion a series of pre-determined activities that lead towards a particular type of development debate and trajectory [9]. Across sectors, there are also some noteworthy overlaps and disconnects among "upstream"-related metaphors. The oil and gas industry, for example, is described in relation to "upstream industry" which finds and produces crude oil and gas, "midstream industry" which processes, stores, markets, and transports oil and gas commodities, and "downstream industry" including oil refineries, petrochemical plants, and distribution chains [44], making an interesting contrast to public health references to upstream determinants of health.

The flows depicted in the cascade (Figure 1) prompt consideration of interactions among impacts on environments and communities via ecological injustices and social inequities. Ecological injustice can manifest through, for example, upstream assessment policies that lead to direct impacts on habitats and specific species [45,46]. Yet, accounting for environment and ecology can compound social and cultural tensions, as suggested by critiques of ecological justice narratives in relation to

Indigenous ontologies [47–49]. The interactions in Figure 1 also suggest potential for cascades of interacting inequities where, for example, the same upstream industry could impact on the mental health and wellbeing of those witnessing changes to their communities and environments [50–54], on the livelihoods of workers or families of workers [11,55,56], and other nuances of lived experience within impacted communities [10,50,57].

The cascade also has planetary implications across scales and generations. Cumulative impacts from multiple resource developments within the same landscape are also driven by global processes spanning climate change, corporate power dynamics, urbanization, and other megatrends, with an array of overlapping environmental, community, and health consequences [2,11,27,58,59]. Attention to temporal and spatial dimensions of impacts draws attention to both short-term acute crises and longer-term health implications of global ecological change [60]. Noting that the impacts of resource development manifest across the life span and generations raises questions about intergenerational equity. These considerations are especially pressing for those whose jurisdictional mandate is to protect and promote health and wellbeing over the long-term and across multiple generations [10,61] and demands attention to the complexity of interactions, outcomes, and intersectoral effort over time and space [32].

2.2. Canadian Responses to Planetary Dilemmas: Assessments, Observatories, Intersectoral Prevention

In addition to the "push" of cumulative thinking applied to health and resource development, a range of contextual "pull" factors influenced the timing, opportunities, and motivations to engage in this project. The emphasis in this section is on several converging influences in the Canadian context, that have not only contributed to the "wicked", cross-jurisdictional nature of the resource development and health issues, but that have also demanded research responses that are emblematic of the challenges of crossing knowledge boundaries to address complex issues [62,63].

Calls for attention to cumulative impacts in Canada are consistent with a range of critiques of the Canadian environmental assessment (EA) process [24,58,64]. This includes urgent calls for increased and more robust inclusion of Indigenous decision making in impact assessment processes [12,65–67], and ongoing critiques of the ability of formal health impact assessment to express an integrated understanding of social and ecological determinants of health [68–70]. These concerns also align with critiques of cumulative effects assessments as a component of environmental impact assessment [58,59,64,71] through to overt concerns about the failure of the EA process to address the intrinsic value of other species [45]. Indeed, critiques of addressing the cumulative dynamics within EA underscore limits of Canadian federal and provincial legislation [24]. They also exemplify the scope of the challenge when seeking to fully grasp the inter-jurisdictional complexity and local-to-global scope of these issues. Cumulative thinking confronts us, not only with the difficulties of engaging with local dynamics and lived experiences [57,72] but also the far-reaching impacts of the Canadian extractive industries beyond Canadian borders, raising important questions about the political ecologies of health [73] and the commercial and corporate power dynamics involved [7].

The "policy failures" exemplified by Canadian EA are not unexpected when dealing with wicked problems [18,22], and can be usefully seen in relation to disconnected but complementary calls for more integrative responses to overlapping health, social, and ecological concerns. Nationally-focused examples include the Canadian Nature Survey [74] and the Canadian Public Health Association's paper on Ecological Determinants of Health [60]. The demand to connect across mandates and sectors is reinforced by overt calls from Canadian Provinces to more effectively link ecological and social determinants of health in the context of resource development, as exemplified by the report by the Office of the Chief Medical Officer of Health in New Brunswick in relation to the health impacts of Shale Gas [10]. At the level of regional health authorities, new efforts can be seen to listen and respond to a range of social, ecological, and health concerns, exemplified by efforts in northern BC by Northern Health and First Nations Health Authority [75,76].

Public health observatories have been proposed as one way to better integrate and respond to complex, interacting issues, as a means to "address the challenges of understanding the multiple factors

that influence health, and the dispersed and uncoordinated nature of data" [77] and by networking relevant experts, data, and information to support decision-making and public health practice [78]. The ongoing proposal and emergence of public health observatories in Canada, across national, provincial, and regional contexts reflects the ongoing appeal of this idea (see for example: [79–81]). Yet, classic public health observatories face two notable challenges when addressing the cumulative impacts of resource development. First, current monitoring, evaluation, and analytical tools tend to deal with environmental, community, and health concerns in isolation, and are poorly equipped to integrate data and information, creating missed opportunities to "see" in an integrative way, or to benefit from the full range of knowledge and experience relevant to the cumulative impacts of resource development [10,11,13]. A second dilemma is the need for increased capacity for intersectoral actions and responses, which requires working and learning together both "vertically" (through levels of socioecological or political systems) and "horizontally" (across the same levels of a system) including across species boundaries [18,82–85].

Alongside these developments, between 2012 and 2015 the Canadian Institutes for Health Research identified concerns about Canada's attention to environmental and health issues, and the funding allocated to address them, noting:

> "Trends demonstrate that Canada ranks low amongst peer countries on the environment and risks falling further behind. The 2013 Conference Board of Canada Report Card on the Environment showed that Canada ranked 15th (among 17 peer countries) on fourteen indicators including air quality; water quality and quantity; biodiversity and conservation; climate change and natural resource management". [15]

In partial response to these concerns, a time-bounded Environments and Health "Signature Initiative" was launched [15]. Intersectoral prevention research was identified as a core research component with the goal to "advance our understanding of how to prevent and mitigate environmental threats and promote healthful environments within Canada and globally" [15]. All research components were also oriented toward three "nexus areas" of agrifoods (food production, food security, food safety, nutrition, and the microbiome), resource development (production and/or extraction of natural resources), and urban form (design of communities and cities). The subsequent call to fund nine intersectoral prevention research teams [14] has fueled terminological, methodological, and practical debate about the nature of intersectoral prevention research. The program's funding criteria underscored the ambitious nature of this work by requiring team grants to be co-led by researchers and 'knowledge-users', to involve knowledge-users outside of the health sector, and to be both cross-jurisdictional and interdisciplinary.

The ECHO Network is a response to these overlapping conceptual and contextual circumstance, and will be introduced in the section below. Importantly, while many of the features of the issues described above could be considered "Canadian", the ECHO Network also needs to be seen as nested within its planetary context—tightly connected to, and informed by, specific nuances of global, national, regional, and local activities, which will be introduced further in the next section. Despite the obvious relevance of cumulative impacts of resource development internationally, and ECHO research partnerships in Oceania, it is important to note that the heart of the project lies in regional cases within Canada (discussed below). This highlights fundamental tensions within the planetary health context—although the ECHO Network is nested in a global context, our lens is one rooted in a country with a relatively well-established legal and regulatory regime, albeit with limitations and particularities of the contemporary Canadian settler colonial context. In other words, the approach and framework of the ECHO Network described below, are both deeply rooted in a particular, developed settler colonial context. Noting that the ECHO Network does not seek to be applicable across the political world, we also recognize the important differences and nuances that may arise from countries with entirely different legal and regulatory circumstances, legacies of colonialism within very different governance systems, and regionally specific capacity and resource issues that may differ across lower-, middle-, and high-income countries. These differences and nuances resonate with Escobar's notion of

"healing the web of life", where he suggests that health, like ecology, is fundamental to pursuing the goal of "a better, *and different*, world" [19] p.3.

3. Approach: Influences on Research Design, the ECHO Framework, and Governance

The multiple factors introduced have identified two imperatives that have shaped the evolution of the ECHO Network. First is the cross-jurisdictional demand for more integrative tools and processes to detect, take notice of, analyze, and respond to the health impacts of resource development [10,13,86]. Second is the need to understand and respond to the cumulative impacts of resource development in ways that recognize combined environmental, community, and health impacts resulting from past, present, and future resource development across time and space [11,21,27].

Our aim in this section is to introduce the approach the ECHO Network has developed to respond to these imperatives. At its core, the ECHO Network was designed to foster learning and mentoring of a new cadre of researchers, practitioners, and community members, who are equipped to engage with interdisciplinary and intersectoral implications of the cumulative impacts of resource development, including working within and outside of the health sector. The Network adapts the public health observatory concept, where the "observers" are primarily Network members, and the emphasis is on *integrative* approaches that address health, environment, and community considerations together.

Introducing this approach requires orienting our overall methodological responses to the nature and challenge of 'intersectoral prevention research', to the ECHO framework that is an ongoing point of reference for our research design and collective efforts, and to the regional cases and governance considerations the Network has been informed by and oriented to during its establishment phase.

3.1. Methodological Influences and Intersectoral Prevention Research

The calls for intersectoral prevention described in the previous section demand engagement across sectors, jurisdictions, and types of knowledge [18,87]. These boundary-crossing engagements warrant explicit attention to horizontal and vertical dynamics [84,85,88], and to the conceptual and methodological innovation required to foster "transdisciplinary imagination" [89].

The ECHO Network also adopts an overtly cross-jurisdictional approach, recognizing differences across regions and jurisdictions where resource development decisions play out. The specific issues, needs, and activities with each of the four regional cases are a reflection of a demand to better understand and respond to the nuanced, place-based effects and impacts, depicted and described below. Our approach to involving researchers and knowledge-users or research partners within each regional case is informed by research attention to knowledge-generation and action [90], and integrated knowledge translation (iKT) research [91,92]. iKT is oriented toward involving knowledge users as equal partners throughout the research process, creating a dynamic, reciprocal interaction between knowledge generation and use through all stages of research, and expanding understandings of the classic "push" and "pull" of knowledge translation [93].

In response to the challenge of working together in a team that crosses sectors, disciplines, and jurisdictions, the ECHO Network draws on research and methods that are explicitly oriented to learning together [94,95]. This reflects influences from collective learning, decision-making, and action as applied to wicked problems [23,96]; the dynamics of social, situated, and collaborative learning when addressing complex environmental, health, and social issues [84,97–100]; and the value of an explicit learning-orientation in networks seeking to understand complex issues [94,95,101–103].

In addition to the broad framings of iKT research and learning together, the design of the ECHO Network required a team with a range of methodological experience. Four notable methodological influences are highlighted here, reflecting the orientation and past work of team members and the requirements of navigating the complexity of this challenging topic area.

First, the ECHO team benefits from extensive team experience in participatory, multi-sector, and community-based approaches to knowledge generation and exchange [72,82,84,95,97,104–108], along with a clear recognition of the cautions and limitations associated with naïve approaches to such

work [109,110]. The orientation to regional cases with specific research partners in each region is also consistent with transdisciplinary approaches to engaging with community concerns and practice-based knowledge [62,85,111]. A related response has been to adopt a purposefully asset-based approach that values the precedents and multiple knowledge cultures within the team and different regions [96,112] and which provide the foundation for much of the learning and exchange within the ECHO Network.

A second, related influence in the ECHO research design is the commitment towards a research culture and ethic of respect, relevance, reciprocity, and responsibility [113] in relation to the knowledge, actions, and priorities of research partner organizations, communities, and collaborators. This commitment is consistent with philosophical orientations within the research team [114] informed by experience with, and ongoing aspirations to decolonizing, critical, and Indigenous research methodologies [113,115,116]. While this is not an Indigenous-led project, this is a network where Indigenous team members are research-leads and research partners, who work alongside team members who range from being longstanding allies and collaborators in decolonizing approaches, through to those with minimal experience working with Indigenous peoples. Respecting variations across a regional, decentralized project, the ECHO Network recognizes the value of, and learning derived from, efforts to become an "Indigenous-informed" collaboration and network. This challenges all team members and regional cases to be actively informed by, learn from, and engage with Indigenous and settler histories, dynamics, and contemporary processes that are unfolding in the lands and territories they work in, not only in Canada, but also in in the Oceania region, especially in Australia and New Zealand.

Third, consistent with principles of ecosystem approaches to health [34,35,95], social and gender equity considerations are an important feature of our research, noting the need to consider inequities and disparities across different population groups, not least the complex sex, gender, and life-course dynamics relevant to understanding the health impacts of resource development for all [61,117–122]. Bringing an ecological approach to the center, that includes a substantive equity focus, informed by social and ecological justice, as well as Indigenous ontologies and epistemologies is most certainly an ambitious undertaking, central to the challenge of linking environmental, community, and health concerns in Canada (and elsewhere), and which demands a reflexive and intentional approach which is not always easy, as discussed below. The fact that social equity, ecological justice, and Indigenous approaches manifest and are prioritized differently across the cases and teams within the Network, creates both tensions and opportunities for meaningful integration, as discussed below.

A final methodological influence on the research design is the incorporation of developmental evaluation as integral to the research design from the outset [123], leveraging ongoing evaluative thinking "to guide adaptation to emergent and dynamic realities in complex environments" [123] p. 1. Developmental evaluation is especially suited to supporting the development of innovative, adaptive, learning-oriented, and utilization-focused results in dynamic environments [103,123]. Recognizing developmental evaluation as an internal team function integrated into the process of gathering and interpreting data, framing issues, surfacing and testing model developments [123], this orientation has been influential throughout the design and evaluation of the ECHO framework.
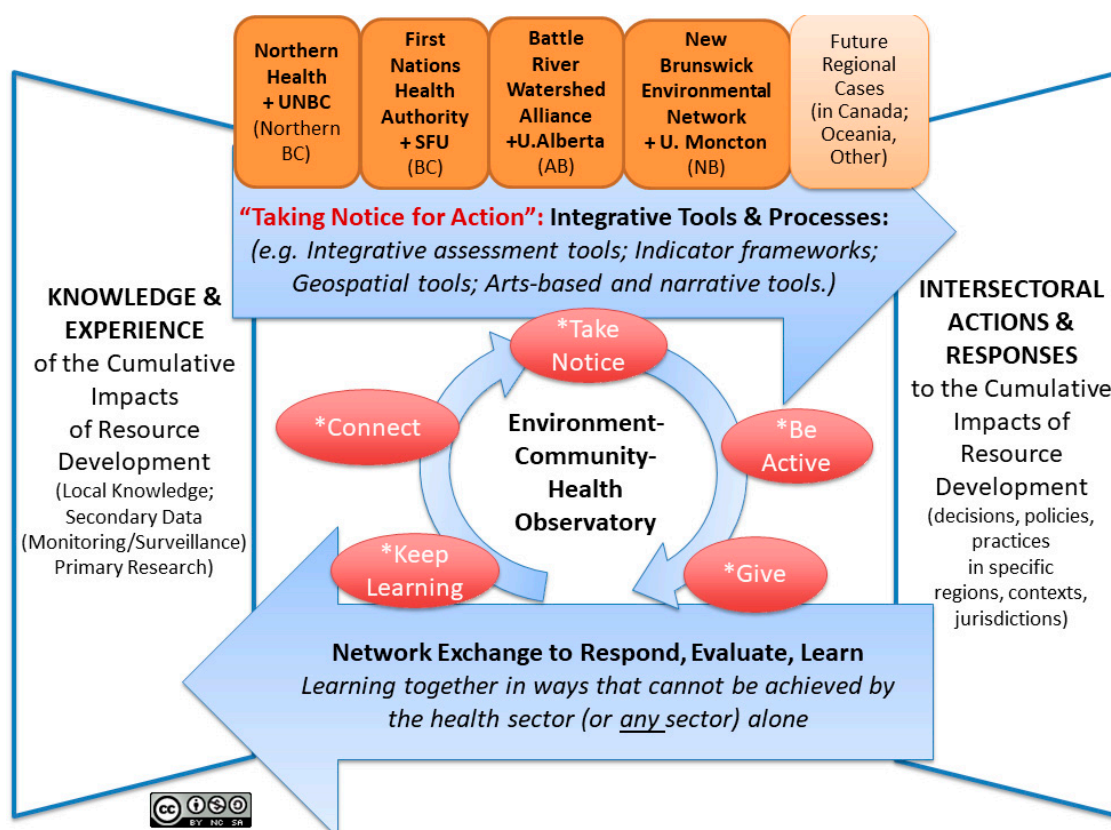
3.2. The ECHO Network Framework

The overall guiding research question for the ECHO Network (Section 1) was informed by the concepts, context, and methodological orientations above. The ECHO Network is also designed to meet two main objectives:

1. To make evidence-based recommendations on the form and function of a cross-jurisdictional ECHO, consisting of a suite of tools and processes designed to improve integrative understanding of and responses to the cumulative impacts of resource development and health.
2. To inform, enable, empower, and evaluate intersectoral strategies to address the cumulative determinants of health impacts arising from resource development by targeting actions and responses that cannot be achieved by the health sector alone.

Although addressing all aspects of these objectives is beyond the scope of this paper, we focus here on introducing the ECHO Network Framework (Figure 2). Informing a Network that seeks to understand *and* respond to the multiple determinants of cumulative health impacts, the Framework underscores the combined attention to both *content* (environment, community, health) and *process* (observatory and network) that are embedded into the project name [124] and the Network design.

The emphasis on both knowledge and application is reflected in our research hypothesis—that public health observatory approaches can be adapted to support the combination of information integration, capacity-strengthening, cross-jurisdictional relationships, information flow, and engaged decision-making needed to enable intersectoral actions that address the health impacts of resource development. Figure 2 depicts the reciprocal dynamic between knowledge about cumulative impacts of resource development, with intersectoral actions to respond to these issues. This knowledge-to-action orientation creates a sense of flow and continuum: to consolidate a suite of integrative tools and processes (top arrow); to apply these integrative approaches to inform intersectoral actions in different contexts (especially in regional cases); to exchange, reflect, and learn from this application across the Network (bottom arrow); and to inform new knowledge and discovery.

Figure 2. ECHO Network Framework: Integrative approaches to connecting knowledge and action to address the cumulative impacts of resource development. *Adapted from "Five Ways to Wellbeing" [125,126] Abbreviations: AB: Alberta; BC: British Columbia; SFU: Simon Fraser University; NB: New Brunswick; U. Alberta: University of Alberta; U. Moncton: Université de Moncton; UNBC = University of Northern British Columbia. Published under the conditions of Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0). https://creativecommons.org/licenses/by-nc-sa/4.0/.

The interrelationships in Figure 2 are connected with a central cycle of interaction focused on enhancing wellbeing: *take notice, be active, give, keep learning*, and *connect* [125]. These five actions were identified through an assessment of evidence around actions to improve wellbeing by the New

Economics Foundation in the United Kingdom [126]. Although focused on individuals, our ECHO team found these five actions to be a highly relevant point of reference throughout our research design phase, and as guides to the implementation of the complex regional, jurisdictional, sectoral, and disciplinary dynamics and actions of our emerging ECHO Network.

A key component of the ECHO Framework (and research design) is the focus on regional cases, depicted at the top of the framework and which are introduced in the following section (see also Box 1). The orientation to specific regions and experiences reflects the methodological orientations introduced above. The four types of integrative tools and processes identified in the framework (integrative assessment tools, indicator frameworks, geospatial tools, and arts-based and narrative approaches) were informed directly by regional demands and interests, as well as team expertise and experience in response to the challenges of cumulative impacts, described in Section 2 (see, for example, [1,75,76,127]).The Environment, Community, Health Observatory responds to calls for better approaches to connect and analyze diverse, complex data sources (spanning local knowledge, secondary data, and primary research), recognizing that existing data have been found to be incomplete, inaccurate, and sporadic, existing across multiple jurisdictional scales with varying degrees of granularity. The Framework emphasis on integrative approaches that explicitly link environment, community, and health reflects efforts to recognize health as a product of our interactions with the world around us and to fuel actions informed by these integrated perspectives. This orientation has influenced collaborations in each region, and the Network as a whole, fostering cyclic attention to both content and process [124]. Working with, learning from, and exchanging about these experiences has created multiple, iterative opportunities for early lessons and insights, discussed in Section 4.

3.3. Foundations for Learning and Exchange: Regional Cases and ECHO Network Governance

The ECHO Network is anchored in, and designed in relation to, regional cases in jurisdictions actively grappling with the health impacts of resource extraction and development (Box 1). In each regional case, the partner organizations have projects underway that involve trialing, refining, or adapting specific tools and processes to address intersectoral issues. These organizations and partners have also identified decision-support needs or issues that demand a better integration of environment, community, and health impacts, and an intersectoral response that stretches beyond isolated jurisdictional mandates and capacities. The four regions provide varying contexts to test the research hypothesis, as well as regional hubs of activity that will contribute to, and benefit from the networked knowledge, integrative tools, processes, and learning orientation of the ECHO Network.

Box 1. Four Canadian Regional Cases in the Environment, Community, Health Observatory Network.

The New Brunswick Environmental Network (New Brunswick), in partnership with the Université de Moncton. The *New Brunswick Environmental Network (NBEN)* [i] Regional Case is informed by a multi-year collaboration centered on work with the NB Children's Environmental Health Collaborative (NBCEHC), an established network of organizations and agencies across the province working to prevent children's exposure to environmental hazards that affect health and to promote children's access to healthy environments. Partnering with the ECHO Network creates opportunities for the NBEN to profile resource development, associated community and ecosystem changes including changes to watershed health, and implications for children's health issues. Another feature of the NB Regional case, developed in collaboration with researchers from Université de Moncton, is the analysis of the benefits and challenges of arts-based tools in the emergence of actions and possible solutions to complex problems related to the impacts of natural resource development. The research in the NB case also seeks to address health equity issues, to foster accountable and inclusive governance, and to encourage attention to the cumulative impacts of natural resources exploitation within public policy. Located in the only officially bilingual province in Canada, the NB case offers a microcosm of the importance of actively accommodating French and English in the project.

Battle River Watershed Alliance (Alberta) in partnership with the University of Alberta. The *Battle River Watershed Alliance (BRWA)* [ii] Regional Case is informed by a history of established research collaborations in rural and remote communities, led by the Alberta Centre for Sustainable Rural Communities at the University of Alberta. The research team has a long-standing orientation to the importance of watersheds as integrative, ecologically-coherent, intersectoral context for understanding complex driving forces of change across land, water, community, and health concerns. The BRWA is a non-profit organization working in the areas of watershed management, education, and stewardship in Alberta. They seek to frame watershed health discussions in relation to environmental, social, and economic factors. To that end, the BRWA is working to develop an integrated watershed health indicator framework that reflects the interrelationships among land and water management, socioeconomic factors, and health, in the context of resource development. This work will enhance efforts to share more integrative information on watershed health with residents, stakeholders, and decision-makers in the region.

First Nations Health Authority (British Columbia), in partnership with Simon Fraser University (SFU). The *First Nations Health Authority (FNHA)* [iii] Regional Case builds on significant developments in health governance and service delivery in British Columbia (BC). FNHA works with First Nations in BC and in coordination with federal, provincial, regional, and non-governmental partners to improve health and wellness outcomes for First Nations. Together with SFU researchers, FNHA has been working on (1) implementing the Local Environmental Observer (LEO) Network, a citizen science geospatial tool and network, in partnership with the Alaska Native Tribal Health Consortium, to document and respond to environmental changes identified by First Nations communities in BC; and (2) the mapping of ecological disturbance to assist communities to visualize the degree or extent to which anthropogenic forces have changed First Nations lands and territories. These tools help to gather traditional and scientific knowledge which add layers of insight into the complex story of connections between land, water, health, and wellness, and will contribute to various initiatives at FNHA, including the joint Provincial Health Officer and FNHA Chief Medical Officer's First Nations Population Health and Wellness Agenda. These data have stimulated great conversations around resource development and are seen as a valuable tool to inform dialogues on land and resource management in a range of communities and at a variety of geographical locales and scales.

Northern Health Authority (British Columbia) in partnership with the University of Northern British Columbia. The *Northern British Columbia* (BC) Regional Case is geographically focused in the northern two-thirds of BC, within the service area of both the Northern Health Authority and the University of Northern British Columbia (UNBC). Local economies in northern BC have historically been characterized by an array of resource extraction, processing, and related infrastructure development and transport activities which include oil and gas, forestry, mining, agriculture, fisheries, hydroelectric, and renewable energy projects. Community and environmental health and wellbeing have been directly impacted by resource development in complex ways. Within this context, the Northern Health Office of Health and Resource Development[iv] and UNBC Cumulative Impacts Research Consortium[v] endeavour to work across multiple sectors, jurisdictions, and communities to better understand and address the social and environmental determinants of health in northern BC.

Notes:

(i) New Brunswick Environmental Network https://www.nben.ca/en/; (ii) Battle River Watershed Alliance https://www.battleriverwatershed.ca/; (iii) First Nations Health Authority http://www.fnha.ca/; (iv)Northern Health Office of Health and Resource Development https://www.northernhealth.ca/services/programs/office-health-and-resource-development; (v) UNBC Cumulative Impacts Research Consortium https://www.unbc.ca/cumulative-impacts.

In addition to the Regional cases, several different scales of operation support the implementation of the ECHO Network Framework. These include two complementary groups attending to overall

research and learning across the Network: (1) Team Learning and Impact has a primary focus on the overall meta-learning of the project as a whole; (2) the Research Design Working Group is attentive to the overall research design challenges, including study design and research ethics relating to meta-learning. The Research Design Working Group examines a range of specific projects arising in relation to regional cases, and maintains a sense of the whole as specific research projects arise within the generative research dynamic created across the Network. Another operational feature of the Network, designed to support different research projects across and among regional cases is the development of cross-cutting "Teams" (Team Communications, Team Equity, Team Learning and Impact, Team Watersheds, Trainee and "Capacity Strengthening" Team, Geospatial ECHO (GECHO) Team, and an emerging Youth Engagement Team). Each team includes members from across the Learning Community, ideally involving multiple regional cases, roles (researchers, partners), career stages, and orientations.

The importance of the nested interactions across ECHO teams, regional cases, and the emerging Network are depicted in Figure 3. The four regional cases in Canada (Box 1) influence and are influenced by the different teams described above, and these reciprocal interactions are also influencing emerging cases in other parts of Canada and Oceania. The interconnections among the different components (e.g., observatory teams, regional cases, emerging cases) increase options to implement the ECHO Framework (Figure 1), with implications within and beyond the Network.
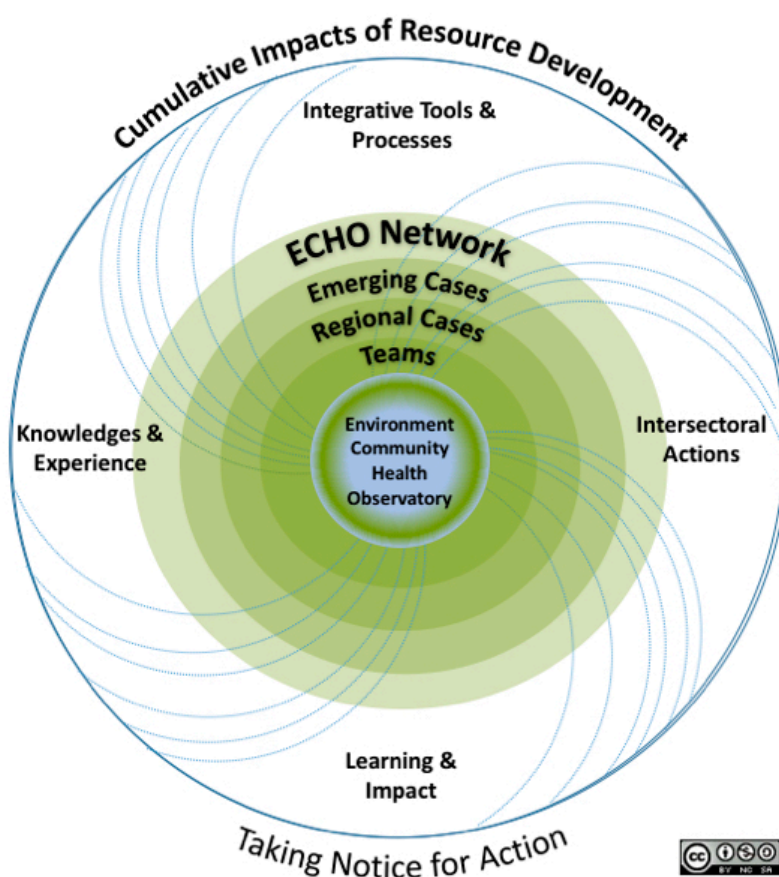
Figure 3. A nested, emerging Environment, Community, Health Observatory Network. The observatory teams and regional cases are linked through multiple pathways creating reciprocal interactions internal and external to the Network, expressed and implemented through integrative tools and processes, intersectoral actions, learning and impact, and knowledges and experience. Published under the conditions of Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0). https://creativecommons.org/licenses/by-nc-sa/4.0/.

Figure 3 also depicts important dynamics relating to the need for both interactions internal and external to the emerging Network. An evolving contribution to our learning community and overall governance is an External Advisory Group that provides targeted advice to the Network, consisting of ongoing members and *ad hoc* members on specific topics identified by the Steering Committee as warranting external advice and guidance. A Research Manager and Project Assistant support all committees and most working groups and manage the administration of the grant, research ethics, funding transfer agreements, and other functions as needed to enable the collaboration among the 10 institutions formally involved in the project. Team Learning and Impact, supported by the Research Manager, other researchers, and partners, has a multi-faceted role facilitating and documenting the meta-learning across the Network over the course of the project, as well as working with observatory teams and cases to profile Network lessons internally and externally.

An imperative arising from these cross-scale features of the ECHO Network team and structure was to ensure that the research is supported by—and consistent with—research ethics considerations that pay attention to the 'whole' of overall ECHO Network learning as well as the "parts" of specific regional cases, teams, and projects. In keeping with the integrated knowledge to action approach and other methodological considerations outlined in Section 2.1, the overall research processes have been enabled by the initiation of an intentional ECHO "Learning Community" that requests that those involved with the ECHO Network sign a global consent form. Requesting Network members to consent to be part of the learning community formalizes recognition that learning and evaluation will be taking place across the ECHO Network activities (including Network meetings, events, and workshops), as well as entrance and exit activities, and that members may also receive further invitations to participate in specific, but optional, research activities such as targeted surveys, interviews, art-based and narrative techniques (e.g., Photovoice), and/or other emerging approaches. This overall research ethics framing is complemented by the active support of specific research ethics processes within each regional case, or for identified specific projects, which are handled by the respective project leads, and which are shared with the Research Design Working group, for feedback and input.

We have outlined the primary elements and purpose of this research including the governance structure. Yet, the implementation of such a large project, with multiple regional cases, partners, and cross-cutting teams, with the meta-goal of addressing the impacts of resource extraction on environment, community, and health, has not been without its challenges. We open up discussion in this final section of the paper, to begin to address some of the underlying tensions within the actual performance of the ECHO Network and its implications for planetary health research.

4. Discussion: Emerging Insights from Working across Scales, Sectors, and Sites

The foundational phase of the ECHO Network research design has generated a range of insights—and challenges—that have arisen from working across the scales, sectors, and sites the ECHO Network interacts with. Intentionally establishing an ECHO Network learning community (described above) has provided the basis to identify and share emerging insights arising from conversations, exchange, and learning activities among members of the ECHO Network. Importantly, these preliminary insights are not resolved, but serve as important, ongoing points of reference for further work and attention across and within our team as the Network evolves.

Our aim in this section is to share and respond to specific examples of how our work is being mobilized—drawing on preliminary insights emerging from our experience, and theoretical points of inquiry, that warrant further attention as we continue to learn from our efforts to implement the ECHO Network framework (Figure 1) and the complex dynamics emerging within and beyond our emerging Network (Figure 2). We do this in the following three subsections that examine (i) scale, (ii) the hidden and the obvious, (iii) and "staying with the trouble" [128].

4.1. Working with Scale

Decisions that lead to local impacts of natural resource use are a reflection of interacting global, national, regional, and local "scalar" factors [9,32,129]. Despite weaknesses of scale as a heuristic category and the potential of "flattening" crucial power dynamics [130,131], scale is of use in thinking through tensions and similarities across jurisdictions, which necessarily have both temporal and spatial elements. Scale is invoked to understand ecosystems and social systems, nature, and society, and can be defined broadly as "a temporal, quantitative, or analytical dimension (e.g., small to large, or short-term to long-term) used to measure and study a phenomenon" ([37], p. 53). While recognizing the relevance of both spatial and temporal scale to cumulative thinking [9,32], in this discussion we focus especially on the spatial scale considerations within the ECHO Network.

Attention to scale is especially relevant given the context outlined concerning cumulative thinking, encompassing issues ranging from global and planetary, from international and national politics down to the micro and bodily level [132]. We see this conversation around scale as an "opening up" and lens to approach some of the tensions that have been experienced while working across scale, insofar as there are intersecting actors, research partners, and jurisdictions at play with different political positionalities among other crucial differences.

Understanding scalar and differential levels of influence is difficult, but offers a useful point of reference when seeking to understanding intersecting and cumulative environment, community, and health issues in any particular location and landscape. This includes paying particular attention to questions of human scale and the embodied elements of the impacts of resource development, that are spatially experienced very differently depending on multiple factors, including social, cultural, and economic considerations [2,53]. The dynamics of global, national, provincial, and Indigenous resource governance matters here, particularly in light of the power and scale of transnational corporate entities and the ways that global financial decision making plays out regionally, on the ground [2,7–9]. Of note are the ways in which global economies of resource extraction and large scale infrastructure projects are also 'messy'.

The intersection of the political economy of resource development and colonialism means the embodied experiences of resource development play out differently across not just local but also global scales [133]. Beyond the suggestion that the local scale becomes 'messy' or complicated by the power of multinational corporations, we also recognize the mess of both international and national conditions driving economic decision-making.

The Canadian context is contoured not only by settler colonial histories, but also by the settler colonial present. In this context, court cases are pushing at the limited boundaries of Indigenous rights and title and human rights law, as seen through the Tŝilhqot'in title case and Canada's adoption of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) [134]. But regulatory and policy conditions within the settler colonial present necessarily mean that the playing field is uneven, with corporate law having an advantage within the confines of federal and provincial legal traditions that govern resource extraction and development. This power dynamic may be an obvious one, but has far-reaching implications including for the topics and contexts ECHO Team members are engaging and working within. In Canada, tensions arising from power dynamics embedded in Canada's settler colonial condition fuels ongoing pressure to meaningfully implement the UNDRIP and to consider the implications, struggles, and "spectacles" [135] associated with responding to the "Calls to Action" of Canada's Truth and Reconciliation Commission.

Colonial histories of extraction have, of course, been analyzed across many other international geographies, with deep historical power asymmetries resulting from scalar violence, including impacts on rural, remote, and, particularly, Indigenous populations and multiple local/global resistance efforts [133,136]. Interactions across regional cases have also underscored the need to recognize the social and health disparities in other contexts, including those experienced by small rural Francophone communities living in minority contexts [137], which are especially important considerations in the

context of the New Brunswick regional case [138]. Within these contexts, the challenging question of 'who needs to do what differently' demands complex consideration.

Experiences within the ECHO Network also underscore recognition that levels within any particular scale (including those depicted in Figure 3) are neither "natural" nor uncontested (consider, for example, global regions, nationstates, local areas, and the colonial boundaries that define settler jurisdictional categories). One response to this is to emphasize the flows and interaction within levels, between levels, and across different scales [129]. The implications of this are far-reaching, raising the challenging questions of: Which nation, region or local area, or temporal scale should we be attentive to in relation to resource development and health? And how does this differ across regional cases and for the Network as a whole? Asking these questions, ECHO Network team members have been challenged by the recognition that our "gaze" (within our different roles) is both scalar and political.

Scalar dynamics also feature in and are experienced in different ways across and among the different observatory teams and cases depicted in Figure 3. While all team members are challenged to consider the entangled and confronting dynamics of (in)equity that underpin considerations of resource extraction and health, "Team Equity" is helping to identify paths for collective conversations about these issues within regional cases as well as at the level of the Network as a whole. As with equity and diversity work more broadly, this also results in crucial conversations and workloads that are experienced in differential circumstances, that are not just scalar but also necessarily uneven. "Team Watersheds" is sharing tools and processes that shed light on cumulative dynamics of resource dynamics at the watershed scale, exploring ecologically coherent units of analysis within which to address interrelated social and ecological determinants of health [6,139]. In keeping with the nested dynamics depicted in Figure 3, ECHO Network individuals, teams, and the learning community as a whole are grappling with the political, social, and economic dimensions of scale that impact on the health of humans and ecosystems, and are also confronted with the limitations and opportunities of how to influence change within their own as well as partner organizations to address these issues.

4.2. The Hidden and the Obvious

"The hidden and the obvious", refers to two combined dynamics identified as warranting ongoing attention within the Network's research agenda. First is a continuation of issues associated with scale—ways in which issues become hidden when they cross past–present–future considerations, and/or are overlooked by those working at different scales (e.g., global economic dynamics impinging on lived experiences in multiple contexts). A related aspect of the hidden and the obvious are the ways that critical issues, such as the dispossession of Indigenous lands [12,50,51], and the global corporate forces acting on resource development projects and practices [1,2,7], pervade topics and issues within and throughout the Network yet do not always form the center of conversations. Critical considerations around race, sex, gender, class, and ecological difference, for example, can often remain hidden, silenced, or left unspoken. Also of note is what gets hidden, or overlooked, in planetary health conversations that emerged, primarily, from the domain of the environmental and health sciences. Embedded in these disciplinary spaces are issues of power, political economy, and political ecologies of knowledge [140]. Noticing the intersections between social relations of power, political economy, and related sexed, gendered, and racializing processes opens up not always easy but absolutely necessary ways of building health and wellbeing across environments, communities and health.

As the Network unfolds in 'conversation' with the ECHO framework (Figure 2), it has become important to underscore that frameworks have strengths and limitations as heuristics, including features that are more obvious and, also, hidden. Frameworks do not depict reality, but are beneficial to fuel discussion and recognition of constraints [141]. The "knowledge to action" framing is proving to be useful. Team members are regularly oriented to the recognition that this is a research project not only focused on generating knowledge, but also how to foster action in different contexts. We also continue to ask, in keeping with our major methods of inquiry and with reference to "five ways to

wellbeing" (Figure 2, and Reference [126]), how the Network is working together to take notice, remain active, give, keep learning, and connect.

We are challenged to meaningfully put an intersectional framework at the center of a network so large in scope, scale, and sector. Thus, the Network is also grappling with *how* we do research that is attentive to both intersectoral action [87,142] and intersectionality [143]. Despite the textual similarities between intersectoral and intersectional action, the different ontological, theoretical, and practical implications of these two words warrant particular attention, when considering issues relating to resource development and health. These considerations may be informed by political ecologies that work at the intersection of territory, difference and context [140,142–145]. A subgroup of the Network is currently working on a project that examines if and how intersectionality and intersectorality can be meaningfully put into conversation. This offers timely contributions to planetary health, given the ways that both intersecting terrains (intersectional theory and intersectoral action) have such relevance to the challenges facing planetary health. For similar reasons, these meta-problems and challenges are not ones the ECHO Network seeks to answer; rather, we are gaining direct experience of the importance of surfacing these issues and finding ways to address them.

It is not surprising, then, that Network members have acknowledged, and have experienced differently, that thorny sociopolitical issues do not fit neatly into a diagram or framework such as depicted in Figures 1–3. Working within networks as large and intersectoral as ECHO, in tandem with an orientation to research for social and ecological justice, has created notable tensions, conceptually and practically; this has presented the team with new and ongoing questions, such as: How do we work with the constraints and tensions that arise when attempting to meaningfully engage with a social *and* ecological justice framework that explicitly engages the wellbeing of humans and other species? What are the implications for this, given the challenge of bringing people together across sectors and jurisdictions with the recognition of dynamics that center around differences in gender, sexuality, power, ecology, race, politics, and accountability? How do we account for deep sociopolitical distributions of power, place, and ecology in light of the global political economy of resource development? These questions have placed emphasis on the 'hidden and the obvious' as metaphorical thinking, and are impetus to expand the opportunities for learning and impact within the ECHO Network in ways familiar to those working within feminist political ecology frameworks [143–145].

As noted above, social inequities and ecological injustices can be understood and explained through cascades and upstream and downstream impacts, particularly relating to policy (in)adequacies. Another metaphorical example was that of 'cream and butter', whereby one team member described valuable lessons from each regional case floating to the top of their regional case experiences, and another team member suggested that the aim of ECHO is to value all the different lessons ("cream") and then work with the regional cases to churn this cream into delicious butter which we can spread/share with others!

Indeed, a variety of metaphors have been proposed in an attempt to communicate the meta-evaluative features of the project, reflecting a consistent need to value meta-learning as a key type of learning across, and informed by, the regional cases. An understanding of ecological scale and challenges of "cumulative thinking" are central to this meta-level learning, and continue to pose challenges conceptually and methodologically. Another interesting element of metaphors is the ways in which different metaphors may, and may not, work across sectoral boundaries, knowledge cultures, and languages (including, for example English, French, and Indigenous languages across Canada, and internationally). In the case of Francophone colleagues in New Brunswick, metaphors have been noted as important cultural mechanisms to explain their experiences. Working across languages goes beyond simple translation, to reveal specific elements about language by which particular concepts, traditions, and meanings mediate a certain relationship to the world.

The metaphoric languages and terms emerging within the Network offer a glimpse at ways in which our Network is developing a style of communication and interaction that reflects the emergent and reflective demands of the project. Part of this metaphorical thinking is linked with recognizing the ways in which we can challenge ourselves, individually and collectively, to "stay

with the trouble" [128], in ways that reflect the inevitable emergent, complex, and evocative issues associated with the cumulative environment, community, and health impacts of resource development.

4.3. "Staying with the Trouble"

The idea of how we "scribe", and take notice of diverse ECHO experiences, is another way in which the Network attempts to uncover the hidden. An example of this is the specific commitment to bring an intentional arts-based and narrative component to the project. This is not just as a potential tool and process within regional cases, but a central aspect of the ECHO learning community. Arts-based and narrative project components have intentionally surfaced and reinforced a range of team and individual experiences around environment, community, and health in their context, and shed light on how resource extraction is visually embodied across scales [72]. These efforts can be seen as part of an expanding call for active and critical engagement with humanities perspectives as ways to expand beyond environment and health research approaches dominated by biophysical and biomedical sciences [57,146,147]. The idea of staying with the trouble also resonates with recent, important conversations around relationality in public health, as discussed by Escobar in relation to a pluriversal approach that is "*weaving effectively the web of life*" within an ecological conception of health and equity" [19], p. 4.

The ECHO Network is actively learning about what it means to "stay with the trouble" as we strive towards bringing a social and ecological justice lens to the fore, recognizing that conversations that cut across issues of health and (in)equity will be an ongoing challenge in the emerging area of planetary health—as they are across the terrain of public health and personal health [19]. This gap is particularly apparent when addressing issues that traverse health, ecosystems, and society [18]. The cross-scale work of the ECHO Network has underscored the need to embrace the (productive) tensions, including messy, emotional, socio-political spaces, that arise when teams as large and complex as the ECHO Network seek to engage outside sociopolitical, disciplinary, and sectoral comfort zones [17,18]. Such tensions are both timely and relevant for consideration by those engaging with the complexity and reciprocity embedded in the emerging concept of planetary health.

5. Concluding Thoughts

This introduction to the ECHO Network has sought to present both the need for an Environment, Community, Health Observatory and the Network that supports this need. Our aim has also been to explore key lessons and challenges from the early phases of the project. The central problematique of the ECHO Network remains "meta", in keeping with the fact that our question (how an ECHO Network can support the integrative tools and processes required to improve understanding and response to the cumulative health impacts of resource development?) is both cross-cutting and sizeable. This question was informed by the Network's shared understanding of the need for increased emphasis on these concerns in rural, remote, and Indigenous communities. Preliminary insights from our foundational work have highlighted that, alongside the consideration of a governance structure and rigorous operational framework, important emergent dynamics for the ECHO Network include increasing awareness of gaps, missing voices, and awareness of both hidden and emerging conversations and voices both inside and outside the team. Attending to these considerations is relevant internally within the ECHO Network team, and also for interactions with external partners in regional cases and across the Network. As the Network continues to emerge, different observatory teams and cases will be challenged to design and implement integrative approaches that "take notice for action" in ways that prevent harm to communities and the ecosystems they depend on, and which recognize reciprocities among the health of humans and other species.

It is also important to note that the conversations and discussions raised in this paper reflect a beginning, as opposed to an end, to the work of the ECHO Network. There are strands of power, scale, and jurisdiction that we have opened up that will continue to serve as ongoing touchstones as we continue to develop as a Network, over the duration of this project and beyond. Rather than

seeing this paper as a closed discussion with a clear hypothesis, thesis, and conclusion, our intent has been to create an opening for ongoing and future research that addresses environment, community, and health concerns, especially in the emerging field of planetary health. Noting that planetary health has much to offer in terms of expanding on integrative conversations that push the boundaries of traditional research approaches, our intention has been to highlight some of the gaps in a project that spans from the planetary to the local. Discussions around hidden, obvious, and challenging equity issues, only briefly touched upon here, are too often seen as peripheral to the center of inquiry within public health and policy, and warrant ongoing attention. Although our discussion of these issues has not formed the center of this piece, in that we have focused our efforts on outlining the methodological approach and overall project design, our aim has been to raise important questions that are intended to provoke, formulate, and influence future responses, both within the ECHO Network, and also within the ambitious terrains of planetary health.

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