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Pacific connections for health, ecosystems and society: new approaches to the land-water-health nexus

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Abstract: Renewed effort to understand the social-ecological context of health is drawing attention to the dynamics of land and water resources and their combined influence on the determinants of health. A new area of research, education and policy is emerging that focuses on the land-water-health nexus: this orientation is applicable from small wetlands through to large-scale watersheds or river basins, and draws attention to the benefits of combined land and water governance, as well as the interrelated implications for health, ecological and societal concerns. Informed by research precedents, imperatives and collaborations emerging in Canada and parts of Oceania, this review profiles three integrative, applied approaches that are bringing attention to the importance the land-water-health nexus within the Pacific Basin: wetlands and watersheds as intersectoral settings to address land-water-health dynamics; tools to integrate health, ecological and societal dynamics at the land-water-health nexus; and indigenous leadership that is linking health and well-being with land and water governance. Emphasis is given to key characteristics of a new generation of inquiry and action at the land-water-health nexus, as well as capacity-building, practice and policy opportunities to address converging environmental, social and health objectives linked to the management and governance of land and water resources.

Keywords: determinants of health; indigenous; Pacific; watersheds; wetlands.

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Introduction

The need for greater understanding of how ecosystem change influences both environmental and social determinants of health continues to demand international attention from global to national and local scale (1, 2). A core feature of progress in this area has been a shift from simple representations of ecosystem and health linkages as cause-effect relationships associated with specific hazards, to a more nuanced and systems-based orientation to diverse pathways by which ecosystem services and social-ecological systems can influence health and well-being directly and indirectly (3–5). These connections and interrelationships are exemplified by the dynamics of land and water resources and their combined influence on health, ecological and social issues.

The demand for combined attention to land and water resources in relation to the social-ecological context of health draws on three important research insights made over the last decade. First, the health implications of water resources management cannot be understood in isolation from land-use, and vice versa. These interrelationships call for combined attention to the land-water-health nexus, applicable at different scales, ranging from small wetlands through to large-scale watersheds (6, 7). Wetlands are defined by Ramsar as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at lowtide does not exceed 6 m" (8). Watersheds (also known as catchments and river basins) are spatially bounded biogeophysical units including their associated social actors and institutions (9) and can be viewed as "functionally distinct hydrologic units in which the water cycle is a key driver of ecosystem processes [and which] come reasonably close to what might be considered an idealized ecosystem" (10, p. 319). Second, understanding land-water-health dynamics requires attention to negative and positive influences on health and well-being, whereby the condition of wetlands or watersheds can determine exposure to health hazards (chemical and microbial contaminants), while

at the same time providing health benefits ranging from the core human requirements of food and water, through to lifestyle, livelihoods and the health benefits of biodiversity, equitable water access, and stewardship (6, 7, 11). Third, attention to land-water-health issues demands a shift in attention from government to governance (7, 12). Understanding governance as "a process whereby societies or organizations make their important decisions, determine whom they involve in the process and how they render account" (13, p. 1) enables attention to be placed on the range of factors, roles, responsibilities and intersectoral challenges associated with governing land and water resources, and the implications of watershed governance for the determinants of health.

Attention to the land-water-health nexus is considered especially important in an era of dramatic increases in the rate and scale of social-ecological change, compounded by intensifying resource extraction and development internationally, and the overlay of climate change (1, 4, 14, 15). These changes compound and exacerbate the complex health and well-being issues associated with the governance of land and water resources, ranging from safety and security of drinking water sources, to capacity to sustain livelihoods, food security, economies, lifestyle and cultural values, especially in resource-dependent and climate-impacted communities (4, 7, 16–20). Such issues have implications not only for populations living in rapidly urbanizing societies, but also for rural, remote and indigenous communities that remain especially sensitive to changes in social-ecological systems which, in combination, can disrupt social determinants of health, create environmental hazards, and disturb critical relationships among culture, identity and well-being (21, 22).

In response to these issues, a new area of research, education and policy is emerging that focuses on the interrelated health, ecological and societal consequences of a combined focus on land and water governance. Informed by research precedents, imperatives and collaborations emerging across Canada and parts of the Oceania region (Oceania: A general name applied to the isles of the Pacific Ocean, including Polynesia, Melanesia, Micronesia, Australasia and sometimes the Malaysian Islands) (23), this brief review profiles three integrative, applied approaches that are bringing new attention to the importance the land-water-health nexus within the Pacific Basin:

1. Wetlands and watersheds as intersectoral settings to address land-water-health dynamics;
2. Tools to integrate health, ecological and societal dynamics at the land-water-health nexus;
3. Indigenous leadership: linking health and well-being with land and water governance.

Innovations at the land-water-health nexus

A combined focus on interrelated land, water and health issues demands not only new knowledge generation about these issues but also increased attention to the actions required to address the social-ecological influences on the determinants of health. Innovative responses to these demands are emerging from a variety of research and policy contexts, including explicit attention to the 'knowledge to action' dynamics of ecosystem approaches to health, and the complex societal challenges identified as 'wicked problems' at the interface of health, ecological and societal concerns (24–27).

In the Pacific region, opportunities to exchange knowledge about land-water-health issues, as well as actions to address these issues, are challenged by the jurisdictional, demographic, cultural and ecological diversity of the region (28, 29). Even so, the types of innovations profiled here are notable for their generic relevance and potential for application in a range of contexts spanning the small island states of the South Pacific to the continental-coastal dynamics of Australia and Canada.

Wetlands and watersheds: intersectoral settings to address land-water-health dynamics

The need for attention to the role of the public health sector in responding to complex intersectoral challenges is growing, especially in response to the combined ecological and social impacts of climate change and resource development on health and well-being (16, 19, 20). Calls for a new generation of intersectoral action are arising in contexts from global to local, ranging from a recognition of planetary and global impacts (1) through to national calls for new types of intersectoral action to address the combined health implications of social and environmental change (2, 30). Within countries, the importance of public health engagement with land and water governance processes is being highlighted in contexts ranging from the public implications of oil and gas exploration (16, 17, 19), through to increased interactions among health units and watershed-based jurisdictions (31) and growing interest in the cumulative (health, social, environmental) impacts of resource development (20, 32, 33). Health units and authorities are finding themselves challenged by the recognition that changes to land and water resources will provide the context for population health in

the short, medium and long-term. Addressing 'upstream' determinants of health demands explicit attention be paid to the driving forces of social and ecological change (7, 20). Along with growing recognition that 'upstream is a place', are demands for 'integrated settings approaches' focused on social-ecological contexts for health (34–36).

Against this backdrop, watersheds and wetlands are increasingly being recognized as settings for health, helping to contextualize important features and characteristics of the land-water-health nexus across a range of scales and contexts (6, 7, 34). Both wetlands and watersheds are usefully understood as social-ecological settings, which also demonstrate the characteristics of coupled natural–human systems (10, 37). Wetlands and watersheds therefore offer a place-based construct within which to understand and manage driving forces of change in particular social-ecological systems, the interactions between social systems, ecosystems and health, and to identify specific actions to improve social and ecological determinants of health within these settings. As expressions of the land-water-health nexus, wetlands and watersheds are being found to be internationally relevant, but especially pertinent in the context of changing climate and associated impacts on land and water resources in the interrelated continental, island and terrestrial-marine systems across the Pacific region (18, 38, 39).

A heuristic framework for depicting and examining these intersectoral dynamics is presented in Figure 1. This framework, is adapted from previous versions of the prism framework (7, 40), to highlight the fact that these intersectoral relationships could be understood in the context of any social-ecological system. In this example, wetlands and watersheds are proposed as place-based settings within which to examine the intersectoral dynamics of the land-water-health nexus.

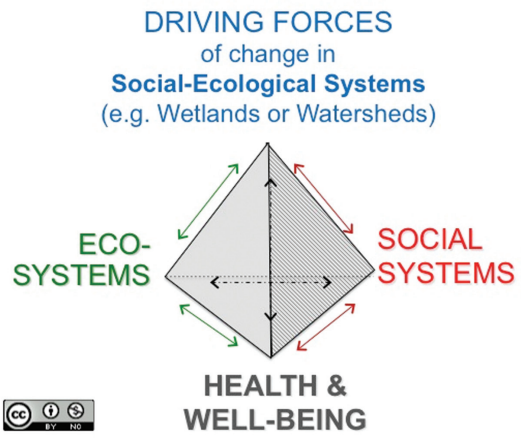

Figure 1: The prism framework for health and sustainability adapted to the land-water-health nexus.
The framework offers a heuristic for application in any social-ecological system. In this example, wetlands and watersheds are presented as a place-based setting within which to examine the intersectoral dynamics of the land-water-health nexus. Adapted from Parkes et al. (7, 20). "The Prism Framework for Health and Sustainability adapted to the Land-Water-Health Nexus" by Margot W. Parkes is licensed under a Creative Commons Attribution-Non-Commercial 4.0 International License.

Tools to integrate health, ecological and societal dynamics at the land-water-health nexus

Tightly coupled social-ecological change and associated shifts in the landscape of the determinants of health highlight the need for the public health community to move from a focus on why the social-ecological context for health is important, to identify how the health sector can work with others to develop research, practices and policies appropriate to the intersectoral challenges at the land-water-health nexus. Better understanding of the boundary-crossing, complex intersectoral challenges of land and water governance, has been associated with the need for new types of tools and practices that can benefit from multiple forms of 'knowledge' (local, community, disciplinary, organizational, indigenous and holistic) and multiple types of 'actions' (ranging from specific research, education and practices to policies, legislations and socio-political change). One response to this need has been ongoing attention to participatory, multi-stakeholder, transdisciplinary approaches to knowledge generation and exchange, especially within the emerging field of ecosystem approaches to health (5, 41), and which are benefitting from development of related approaches in the context of watershed in catchment management, across Canada and Australasia (42–44).

Another effort to respond to the complexities of the land-water-health nexus is arising through the revision, development and refinement of existing decision-support tools. Rapid development in geospatial technologies has seen considerable shift from traditional (largely biophysically oriented) Geographic Information Systems (GIS), through to participatory, and expert-informed GIS tools that explicitly seek to understand the complex social-ecological values and priorities operating at the land-water-health nexus (45, 46). A related development has been the design of geospatial watershed 'portal' tools capable of integrating diverse forms of spatially related data, documents, audio-visual material across health, social and ecological realms within watersheds (47).

Indigenous leadership: linking health and well-being with land and water governance

A notable area of development in decision-support tools relevant to the land-water-health nexus has been innovations and targeted efforts to develop integrative tools that value and prioritize indigenous perspectives on these relationships (44, 48–50). Indeed, integrative indigenous perspectives and research leadership has been providing a range of opportunities for integration of health, ecological and social concerns, with particular relevance to the land-water-health nexus (22, 39, 51). Many integrative approaches to understanding indigenous health explicitly identify land, water and environmental stewardship as interrelated determinants of indigenous well-being and "web of being" (22, 52–56). Given the legacies of unethical research and disproportionate health burdens impacting indigenous peoples internationally, using culturally appropriate practices to promote health and prevent disease at the land-water-health nexus will be imperative (57). Lessons and insights from across Canada and Oceania echo wider issues and priorities for indigenous peoples internationally.

Responding adequately to the diverse land-water-health context in the Pacific region will require a shift in perspective from "including" indigenous knowledge, to focusing on interrelated processes of indigenous leadership, knowledge generation and action to address the health, ecological and socio-cultural dynamics of land and water governance experienced by indigenous peoples. In addition to developments in existing decision-support tools, an array of new approaches to learning and exchange are being developed, including Digital Story-telling and related narrative approaches that reflect well-documented connections among language, cultural strength, histories of orality and connectivity between land and community as drivers of indigenous peoples' health and well-being (57–59). A new generation of effort in the Oceania region is prioritizing both Indigenous perspectives and an explicit focus on the land-water-health nexus (39). One indication of this was the inaugural Oceania Ecohealth Symposium titled "Linking Peoples, Landscapes, Health and Well-being" (December 2013) convened at the University of Melbourne which explicitly profiled precedents of indigenous leadership from Australia, New Zealand and the South Pacific. This event highlighted the level of interest in fostering indigenous-oriented collaborations that profile leadership and practices relating to land, water and health, including the potential co-design of comparative international research. These developments are directly informed by collaborations among indigenous and non-indigenous researchers and practitioners in Canada and Oceania, and offer fertile prospects for research and learning across the Pacific Basin.

Conclusions

This brief review presents innovations and developments focused on different aspects of the land-water-health nexus, drawing particularly from experience and precedents in Canada and parts of Oceania. These efforts form part of a growing body of work that links health, ecosystems and society across scales, spanning biodiversity and health (11), wetlands and health (6, 60), watersheds and health (7, 34) and planetary health (1). Emphasis has been given to new areas of inquiry and action with potential for research collaborations and comparative case-studies across the diverse Pacific region, as well as capacity-building, practice and policy opportunities to address converging environmental, social and health objectives arising in relation to the management and governance of land and water resources.

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